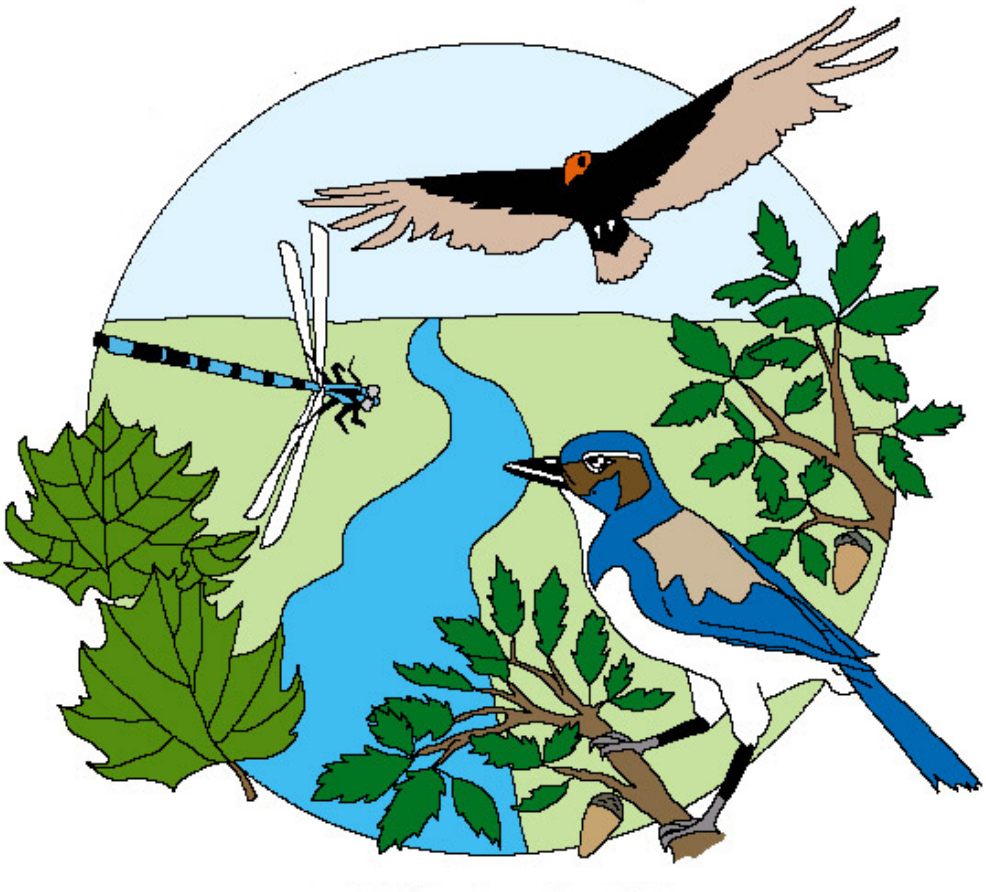
Mission Creek

A Model of Urban Stream Restoration

by
Joyce R. Blueford, Ph.D.
Math Science Nucleus



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with contributions
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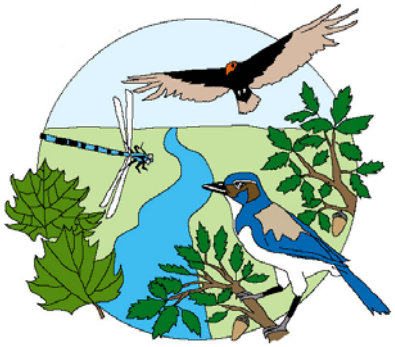
Erdmann Rogge, M.S.hydrologist
Leonora Ellis, M.S., biologist
Victoria Huang



Advisory

Joy Chien, Ph.D. Math/Science Nucleus
Sandy Ferreira, City of Fremont
Katie York, Math/Science Nucleus

Photographs
Victoria Huang, Joyce R. Blueford,
Sandy Ferreira, ClipArt.com

Drawings
Doris Raia, Elaine Wang, Vicky Eggert, April Yang, Joyce Blueford

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Mary Dean, provided aerial photographs from the 1950's through 1970's. She also helped me understand what Mission Creek looked like without homes.

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Victoria Huang assisted in the data gathering for this project. As a student from Mission San Jose High School she helped take photographs, collect chemical and biological data. She also helped in organizing high school students who have volunteered their time and effort to the project.

Dedicated to the students of the
Mission San Jose High School
Green Club(2002-2004)

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Preface

When a city becomes urbanized, the web of underground infrastructures becomes hidden to the community. City planners and engineers devise ways to connect people with drinking water, sewage, electricity, and telecommunications. In order for people to access their homes, they create a maze of roads composed of cement and asphalt. The roads were created for transportation in modern society, but with modernization sometimes we forget to incorporate nature into our urban landscape.

The roads and buildings prevent rain from soaking into the ground. The ground water trapped in aquifers provides one third of Fremont's drinking water. Our city and county planners developed ways in which you quickly remove the rainwater through flood control channels. The water or "runoff" goes directly into the San Francisco Bay. As we better understand our ecosystem and hydrology of the flow of water, we realize that the flood control channels can be multifunctional. Not only can they prevent flooding, but they also can be part of the ecosystem, providing habitat and food for urban critters.

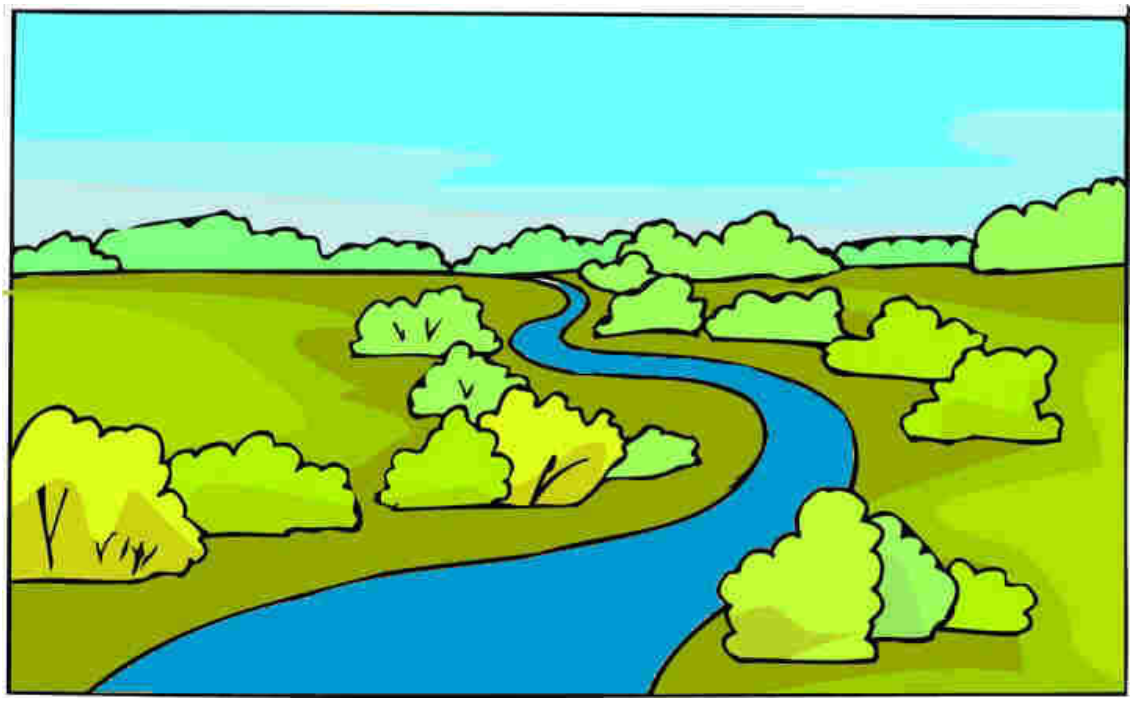
Restoration of a creek allows an ecosystem to develop along the stream corridor. The goal of any project is to allow the flora and fauna to live together with the nearby human population. Mission Creek Restoration involved a substantial amount of intervention to repair the neglect over the last 150 years in this stream corridor.

Restoring an impacted area requires an understanding of the creek's dynamic role in the overall ecosystem. The elements needed include a lateral, longitudinal, and vertical investigation of the stream. This information can then help predict a creek's future. This involves the expertise of hydrologists, biologists, geologists, and engineers to explore their individual specialty and come to a consensus on how the creek is flowing and how to repair it.

The Mission Creek Restoration Project took one portion of the stream corridor and successfully brought it back to its original splendor. This book looks at the entire Mission Creek Watershed, but concentrates on the restored segment between Palm Ave and Driscoll Road.

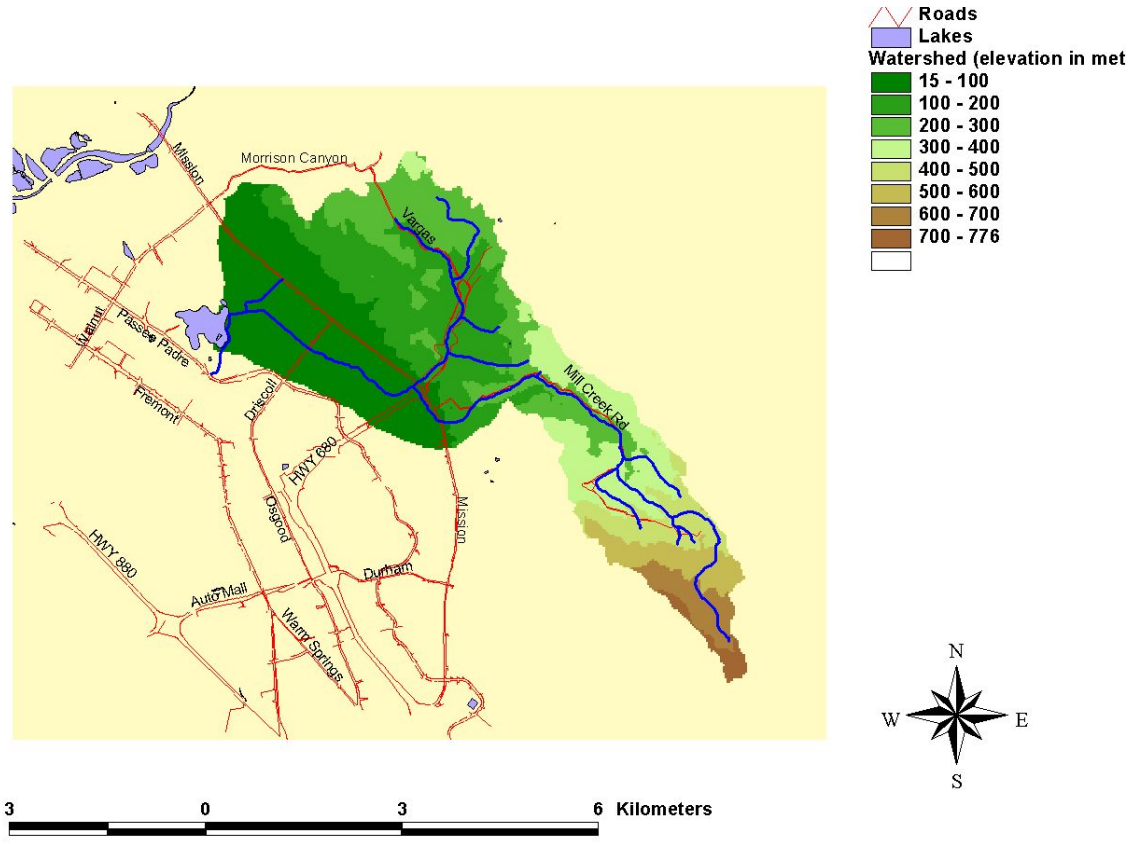
Chapter 1.

BACKGROUND INFORMATION



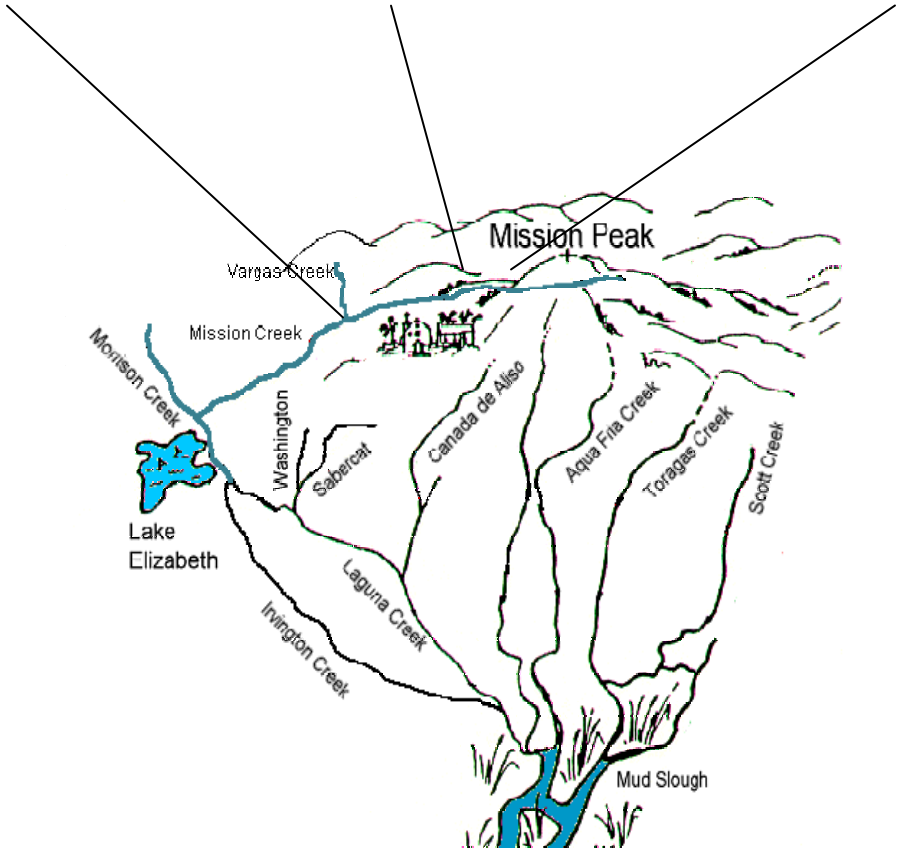
Introduction

Mission Creek Watershed is the upper portion of the larger Laguna Creek Watershed located in Fremont. The entire Laguna Creek Watershed drains into the southeastern end of the San Francisco Bay at Mud Slough. Mission Creek flows from the hills and then meanders toward Lake Elizabeth, where it branches into Laguna Creek and Irvington Creek.



Mission Creek Watershed showing elevation and tributaries.

A spring is located on the north slope of Mount Allison (810 m), which is considered its headwaters. It flows north and northwest, parallel to the Mill Creek Fault. It flows adjacent to Mill Creek Rd toward Mission Blvd where it is dissected by the Mission Fault. It flows behind Mission San Jose High School, Chadbourne Elementary, and Hopkins Junior High on its way to Lake Elizabeth. At Lake Elizabeth it is diverted to the south and feeds into Laguna and Irvington Creeks, which flows into Mud Slough and then into San Francisco Bay. Mission Creek has a total stretch of approximately 12.8 km. There are 5 tributaries in the upper reaches, including Vargas Creek which flows into Mission Creek close to the intersection of Highway 680 and Mission Blvd.



Mission Creek Watershed in blue, within the Laguna Creek Watershed that flows toward the San Francisco Bay.

History

The region that is now known as the Mission area in Fremont, was a majestic site for early visitors. During sunrise, golden rays would outline a silhouette of a grand peak, slowly revealing itself in the eastern horizon. The burly live oaks, slender cottonwood, and contorted sycamore trees outlined the meandering creeks that started part way up the flanks of the mountain. Fragrances from the California buckeye and bay laurel trees mixed with the potpourri of wildflowers, made early visitors think they were in paradise.

Sketch of mill near Mission San Jose

Water in this area originated from bubbling springs, that mystically appeared from groundwater. Water would ooze out along contorted layers of sandstone that peeked through the soil. The water flowed from the Mission area and slowly made its way toward what is now called the San Francisco Bay.

This sight was witnessed during the Pleistocene, by mammoths, mastodons, sabercats, camels, and sloths that roamed the savannah type flatlands closer to the bay. All these organisms used the waters that flowed through this area. The landscape changed through time. The hills became taller with each new shake from an earthquake, which constantly changed the course of the creeks.

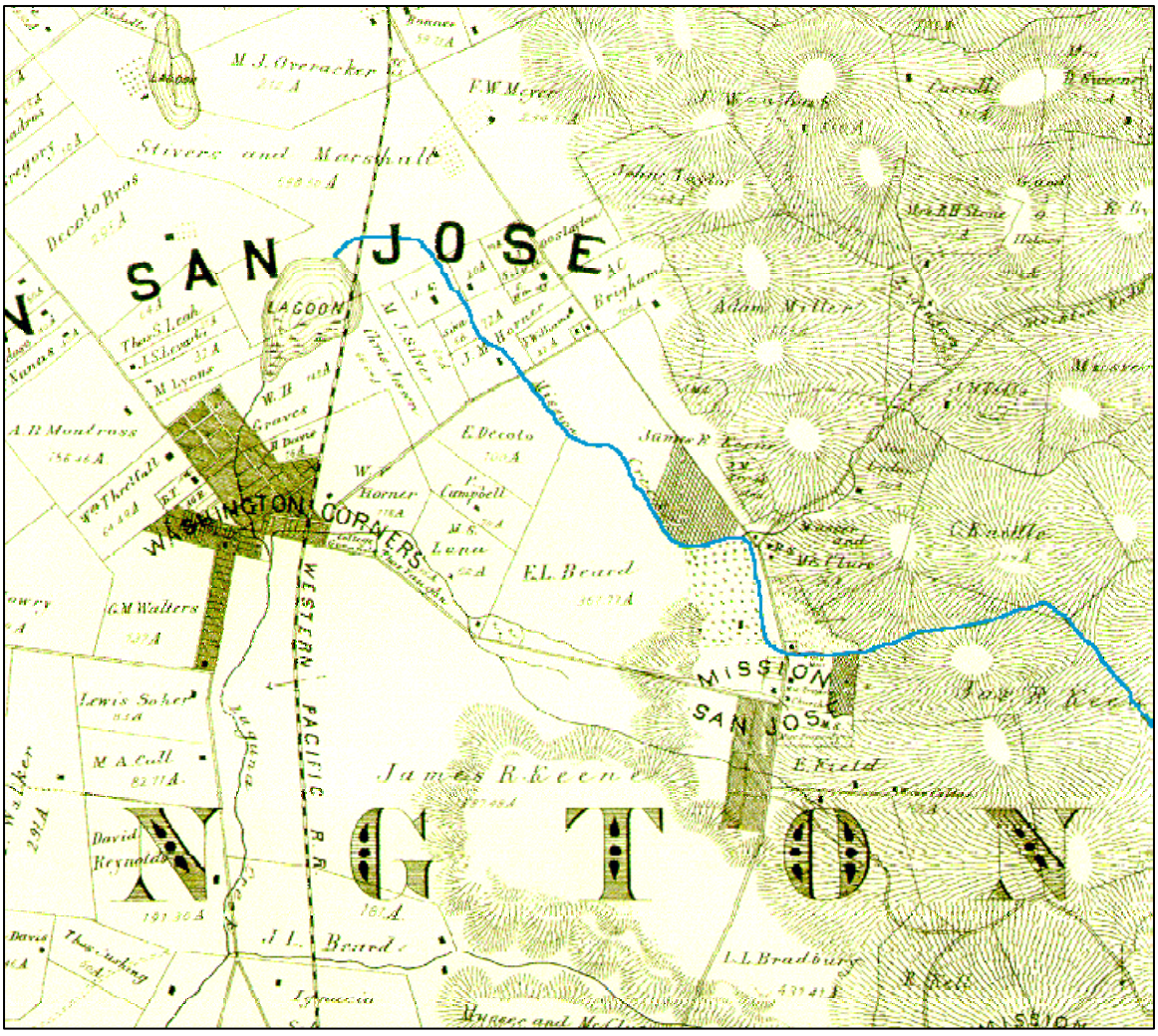
The larger animals became extinct, probably due to climatic change. Slowly new visitors to the area, like the Ohlone Indians, saw a perfect area to live. There was a constant source of water and a place to hunt, as animals came to drink along the creeks.

Sloth that lived in the Fremont area.

A survey party of soldiers along with Father Antonio Danti in 1795, were looking for a place to operate a new mission. They recommended this golden area with the fertile land and free flowing streams that could support crops and cattle.

In 1797, Father Fermin de Lasuen founded Mission San Jose. They

quickly diverted water from three creeks to serve their new living and working quarters. The Ohlone Indians were recruited to create a reservoir above the mission, and started an extensive system of clay pipes to water the crops and serve the Mission San Jose. A large flour mill was erected across the main creek in the early 1800's. A large fountain in the Mission's plaza was erected for bathing and washing.



Mission Creek is shown to enter Stivers Lagoon in a 1878 map.

The creeks would never again flow freely along the flanks of Mission Peak, as humans diverted the water for their use as the area prospered. The Mission San Jose Water Company sold water in 1878 to customers of the growing cities to the north (Oakland and San Francisco). Juan Gallegos and his prosperous Palmdale Winery would use the waters to nourish miles of grape crops for decades.

However the extensive use of water, which was stored in the pores of the sandstones below the Mission area, could not supply the creeks forever. Every season the water flows diminished. The creeks, which flowed year round from

the underground springs, were now dependant on humans to store water in small reservoirs to keep the streams alive. The remnant of this glorious wet past is now preserved as Mission Creek. This creek feeds into Laguna Creek that begins around the present-day Lake Elizabeth and flows toward the bay. Hence this region is part of the Laguna Creek watershed within the City of Fremont.

In the 1960's as this area became the City of Fremont and Alameda County became responsible for "flood control," these creeks became part of a system to again serve the people. Lake Elizabeth was created from what was then referred to as "Stivers Lagoon."

In the late 1990's a group of agencies decided to restore a portion of Mission Creek between Palm Ave and Driscoll Road. The restoration was completed in 2003, and only time will tell if it is successful.

Area photograph of Palm Ave, near Mission San Jose High School portion of creek (1956)

Geology of Mission Area

Mission Creek dissects 5 geologic units including the Briones Formation (Miocene), the Tice Shale (Miocene), the chert and siliceous shale member of the Claremont Formation (Miocene), older alluvial fan deposits (Pleistocene), and flood basin deposits (Holocene). A “formation” is a geologic term that includes rocks that were deposited under similar conditions over a large area. Erosion occurs predominantly in the hills where the Briones Formation, Claremont Formation, and the Tice shale are exposed, but erosion also occurs in the older alluvial fan deposits. Sedimentation occurs further down the creek in the flood plain deposits and in Lake Elizabeth.

Mission Creek is located within the area covered by the Niles and La Costa 7.5-Minutes Quadrangles, which are maps produced by the U.S. Geological Survey. Thomas Dibblee completed the first preliminary geologic maps in 1980. Graymer, et al (1994), in his preliminary geologic map of the Niles 7.5 Minutes Quadrangle did not assign a name to the Cretaceous sediments, but correlated the Miocene sediments with those found further north in the Berkeley area and assigned them the unit and formation names common in the Berkeley Hills. The aerial extent of the geologic units in Graymer’s map differs little from Dibblee’s in the Mission Creek area. His descriptions of the map units are more detailed and show some differences to Dibblee’s. The interpretation of the structure in the area is also interpreted differently. While Dibblee recognizes a syncline (Niles Syncline) and an anticline in the Cretaceous and Miocene sandstone units, Graymer sees them as faults, the Sheridan Creek fault and the Dresser Fault/Mill Creek Fault respectively. Dibblee interprets the layers of Miocene sandstones between Mission fault and the anticline northeast of Mission Fault as being overturned and dipping northeast. Graymer sees these layers as just dipping to the northeast between Mission Fault and Mill Creek Fault. Below is a summary of the units of Graymer, et al (1994). The codes can help you find them on the simplified geologic map in this book.

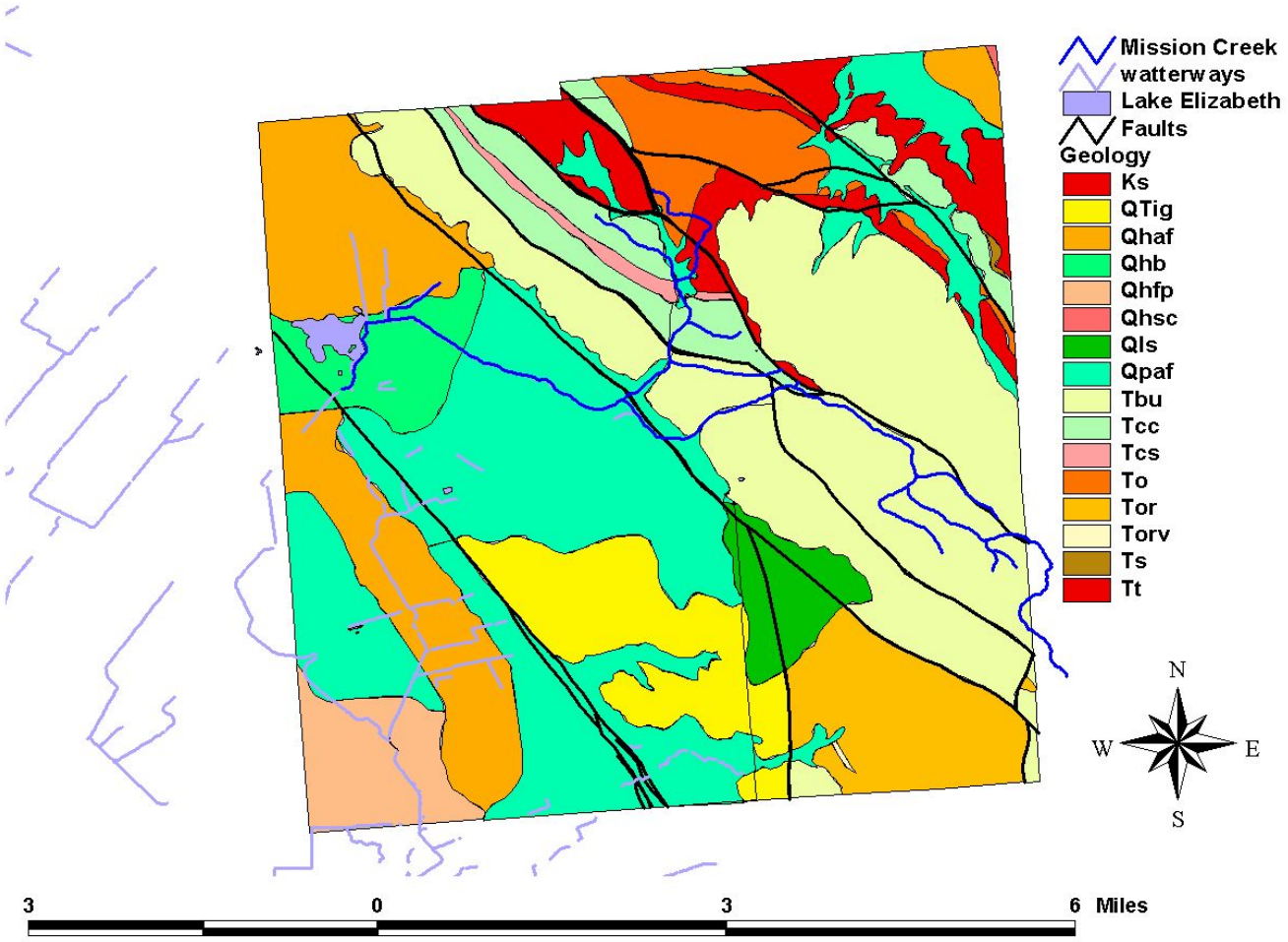
UNNAMED (Holocene) (QTig, Qhaf, Qhb, Qhf, Qhsc, Qls)
Organic-rich clay to very fine silty-clay deposits occupying the lowest topographic position either between the Holocene levee deposits or Holocene flood plain deposits.

UNNAMED (Pleistocene) (Qpaf)
Tan to reddish brown, dense, gravel to clay sands or clayey gravel that grades upward to sandy clay.

BRIONES FORMATION (late Miocene) (Tbu)
The basal part of this formation consists of distinctly bedded, gray to white fine-grained sandstone and siltstone. Bedding is parallel and cross-beds are not evident. Sandstone beds are as thin as 5 to 10 cm with 2 to 10 cm thick shaly interbeds. These are interbedded with massive fine-grained sandstone beds as

much as 5 meters thick. The middle part of the formation (shell beds) consists of indistinctly-bedded, white, fine to coarse-grained sandstone, conglomeratic sandstone, and massive, shell-hash conglomerate. Shell-hash conglomerate is made up of marine mollusk shells in a white calcareous sandstone matrix. Pebble and cobble conglomerate beds are present in a few places. Conglomeratic clasts include black chert, red chert, quartzite, andesite, argillite, siltstone, basalt, felsic tuff, and vein quartz. The shell beds and conglomerates are hard and resistant and form prominent ledges, ridges and peaks such as Mission Peak. The upper portion of the formation consists of distinctly indistinctly-bedded, massive to cross-bedded, fine to coarse-grained light colored sandstone. Sand grains are predominantly quartz and feldspar.

CLAREMONT FORMATION (middle to late Miocene) (Tcc, Tcs)
Chert occurs as distinct, massive, gray beds as much as 10 cm thick with thin (about 1 to 2 mm) shale partings. Chert forms about 30 % of the member in the Niles quadrangle. Siliceous shale is dark brown to gray, finely laminated, with grains ranging from clay to silt size.



Simplified geologic map of Mission Creek Watershed

OURSAN SANDSTONE (To)
Distinctly to indistinctly - bedded black mudstone, and foraminifera - bearing, brown to tan siltstone and fine -grained sandstone. In places these rocks have a large amount of secondary calcite. The Oursan is distinguished from the Briones and Claremont Formations by its darker color, finer grain size, and presence of Foraminifera in siltstone, sandstone and dolomite. In this area it is 300 to 1000 meters thick.

ORINDA FORMATION (Tor,Torv)
Distinctly to indistinctly bedded pebble to boulder conglomerate, conglomeratic sandstone, and coarse to medium - grained lithic sandstone. At least 1500 meters thick in this area, although the base and top are not exposed in continuous space. It is easily distinguished from other conglomerates in the area by the red and green color.

SOBRANTE FORMATION (Ts)
White, fine to medium grained quartz sandstone. Occurs in discontinuous outcrops below the base of the Claremont Formation in the eastern part of the quadrangle, nowhere more than 120 meters thick, in fault contact with underlying Cretaceous rocks.

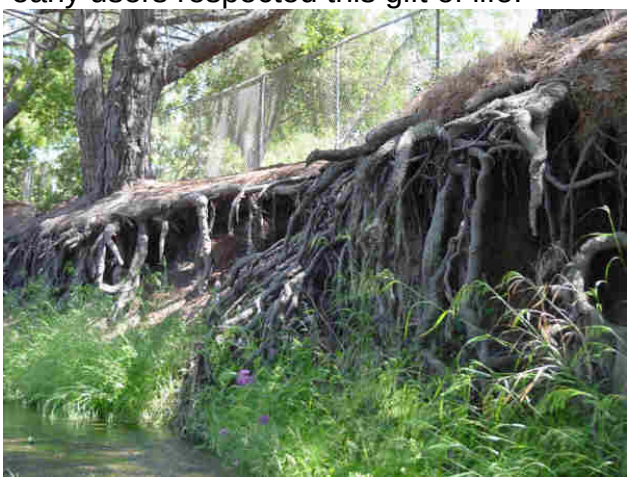
TICE SHALE (middle Miocene) (Tt)
Distinctly bedded, dark brown, gray and tan, siltstone, mudstone and siliceous shale. Tice shale weathers in place to a reddish brown color, and in places contains abundant fish scales. The shale also contains numerous lenses of massive, tan dolomite, as much as 2 m in length that weathers to a characteristic bright orange color. Many of the dolomite lenses contain Foraminifera that are evident on weathered surfaces of the rock. Tice shale has a maximum thickness of 290 m in this area. Tice shale is similar to shale in the Claremont Formation in the Niles Quadrangle, but lacks the chert beds characteristic of the Claremont.

UNNAMED (Cretaceous)
Distinctly bedded gray to white, well lithified, massive to cross bedded, micaceous, coarse to fine grained sandstone, siltstone and shale. Sandstone varies from granitic (quartz, feldspar, and biotite grains) to lithic wacke (grains of mica, clay, quartz, feldspar and lithic fragments). Sandstone and shale beds are interfingering and range from several cm to several meters thick. In some places the shale contains small (10 cm) to large (1-2 m) limestone concretions. Poorly preserved foraminifera are present in many shale outcrops, and plant debris is common. Sandstone tends to form outcrops on the ridges and uplands, and prominent resistant outcrops in canyons, whereas the shale interbeds are largely visible only in canyons.

Stream Restoration

Until the 1960's the Mission Creek Watershed was used for agricultural and livestock businesses. The proximity to a water supply, fertile land, and warm climate made this an ideal place for early settlers. The Ohlone Indians used this area to live because of these very reasons. They even built a small dam near the Mission San Jose area. This dam was later enlarged by the missionaries, who added a mill to grind flour and corn.

Early pioneers in the wine and nursery business also used Mission Creek as the radiating point for their businesses. As long as the water flowed their businesses were successful. The earlier generation of creek users understood the importance of a clean and flowing creek. They were limited on the full understanding of the dynamics, but the early users respected this gift of life.



Undercutting of large trees along Mission Creek.

However, developers saw this area as a haven from city life and started to build homes. They brought with them asphalt and concrete as they constructed roads and the infrastructure to support humans in the area. When you have natural ground cover about 50% is saved in the ground water. However, the ground can absorb only about 15% when you develop a city's infrastructure. Impervious surfaces can cause up to 55% run off of water. Poor engineering of the surrounding buildings caused damage to the creek. Erosion caused by rapid water flow caused undercutting of the large trees that lined the bank. The creek's dynamics became unstable and flooding in certain stretches and fallen trees started to become a problem in the watershed in the 1990's.

When a creek needs to be "restored" there is an implied understanding that there has been damage done to that area. Restoration does not always mean that it will look like an area before human intervention, but that it will be engineered so humans and other organisms can coexist. Even without humans, nature is constantly evolving. In today's urban landscape it is difficult to remove all exotic or non-native vegetation. Seeds from local landscaped gardens will somehow find their way along a creek.

The restoration of Mission Creek is attempting to create a stable channel bed and bank system while creating a meandering pattern that prevents erosion. In

order to accomplish restoration there are many different ways to engineer improvements.

Erosion on Mission Creek had been so intense that the Union Sanitary Sewage District's pipeline was dangerously close to the stream. In order to prevent breakage the sewage line was moved and enlarged.

The channel was terraced to allow water to meander more effectively and not to scour certain areas. This involved major earth movements and the use of bioengineering to reduce the velocity of the water in this area. Coir logs or cylindrical structures of coconut husk fibers were used as a protection of creek bends and slopes. Live red willow stakes, which are native to this area, are inserted in the coir logs. They grow by rooting directly from the stake and the roots will bind the banks to decrease erosion. Straw wattles or tubes of rice straw are used along steeper bank slopes for erosion and stormwater runoff control. The placement of rootwads (root structures of previous trees that were cut) helps stabilize stream banks from erosion. Rip-rap or large boulders are also placed in key areas to help direct water flow.

In areas were eucalyptus trees were removed; a flood plain terrace was created. Revegetation of the area will create bank stabilization as well as allowing habitat enhancement to increase wildlife in the area.

Only time will tell how successful the restoration will be, and a new chapter will have to be written.

BEFORE AND AFTER RESTORATION

Walking from Palm Ave there was a 10 foot water fall shown in the 2003 picture, which has now been filled. The water flow has been slowed, which decreases erosion.

Palm Ave Culvert, 2003

Palm Ave Culvert, 2004

About 60 Eucalyptus trees were removed in an incised portion of the creek. The area has been terraced and revegetated to slow down the water flow.

Mission Creek Drive, 2003

Mission Creek Drive, 2004

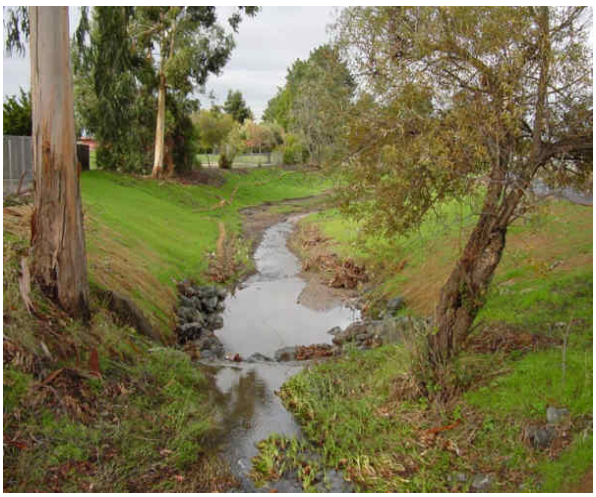
Old concrete structures where replaced with rip-rap and vegetation. The old Covington Bridge was replaced with a higher bridge to prevent damage during high flows.

Covington South, 2003

Covington South, 2004

Pools and riffles were created downstream from the Covington Bridge to increase habitat value and to slow water flow.

Covington North, 2003



Covington North, 2004

The stream was diverted away from the bank near Chadbourne Elementary School and the area was terraced to help decrease flow. Students can now access the area through their playground.

Chadbourne, 2003

Chadbourne, 2004

Near the Hopkins soccer field, the trail was moved about 20 feet toward the field. This allowed room to meander Mission Creek to reduce the erosion of the banks. The walnut and red willow trees are used to help keep the creek within its new channel.

Hopkins field, 2003

Hopkins field, 2004

The stream channel was moved and widened to prevent undercutting of the creek along the fence of nearby homes.

Hopkins, 2003

Hopkins, 2004

Monitoring Mission Creek

Restoration of our waterways is not a short-term or easy process. Successful restoration requires the cooperation of many groups including city and county officials as well as local citizens over a long term.

Stream corridor restoration can be expensive. Streams are dependant on nature to heal past practices, but nature is not always predictable. Monitoring during and after the restoration is a way to help detect problems before they become unmanageable. Monitoring usually involves looking at the biological, geological, hydrological, chemical and physical components of the creek.

The biological observation of the stream is probably the most rewarding to a non-scientist. It involves learning the vegetation and organisms that live along the creek. It is a life-long skill to observe and appreciate what nature brings to our doorstep. Understanding the biological component helps to determine if restoration was successful or not.

This next section is a compilation of the biological data along the entire reach of Mission Creek. It includes the different organisms that live in and along the creek. This is a record of what was observed over a year's time, with emphasis on the urban portion of Mission Creek. It is not a complete list.

Biological assessment of an area is a long and tedious process. This base survey just reflects the diversity, not abundance or specific location within the creek. If a stream corridor has an abundance of larger animals, that infers an ecosystem which is supporting itself. The food web has an internal structure that supports the different layers of the food pyramid. The following chapters document the major plants, vertebrates, and microorganisms.

There are some groups like land arthropods, annelids, and other small land invertebrates that are missing from this survey. We tried to concentrate on aquatic and near aquatic area. Although they are all important, they are not as helpful on monitoring successful restoration over a long period of time.

The plant section includes aquatic plants, trees, shrubs, other flower plants, and grasses. The vertebrate

section includes birds, mammals, amphibians, and reptiles. Birds donate the section because they reflect the top of the food chain. The more birds documented the richer the food web supporting those animals.

Aquatic microorganisms are emphasized because they reflect most accurately the health of the water in which it lives. It can provide clues on the chemical balance of the creek.

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Chapter 2.

Plants

Plants in a stream corridor can be diverse and abundant. The water from the stream provides excellent conditions for both land and aquatic plants. In the stream you would find aquatic plants that are adapted to being surrounded by water. The zone adjacent to the stream, known as the riparian zone, can sustain land plants whose roots can tap the moist soil from the stream. Along Mission Creek there are very old trees, some oaks may

be 300 years old. In the restored area, plants were chosen that represent Fremont when the Ohlone Indians roamed this area.

PLANTS

AQUATIC PLANTS

Brassicaceae (Mustard Family)
Watercress (*Rorippa nasturtium-aquaticum*)

Cyperaceae (Sedge Family)
Tule (*Scirpus acutus* var*. occidentalis)*
Flat sedge (*Cyperus eragrostis*)

Equisetaceae (Horsetail Family)
Common horsetail (*Equisetum arvense*)

TREES

Aceraceae (Maple Family)
Box elder (*Acer negundo)*

Caprifoliaceae (Honeysuckle Family)
Blue elderberry (*Sambucus mexicana)*

Fabaceae (Pea Family)
Mimosa *(Albizia lophantha)*
Western redbud *(Cercis occidentalis)*

Fagaceae (Oak Family)
Coast live oak (*Quercus argrifolia*)

Hippocastanaceae (Chestnut Family)
California buckeye (*Aesculus californica*)

Juglandaceae (Walnut Family)
California Black Walnut (*Juglans califonica*)
English (Persian) Walnut (*Juglans regia*)

Lauraceae (laurel Family)
California Bay Laurel (*Umbellularia californica)*

Moraceae (Mulberry Family)
Edible fig (*Ficus carica*)

Myrtaceae (Myrtle Family)
Blue gum (*Eucalyptus globules*)

Oleaceae (Olive Family)
Oregon ash (*Fraxinus latifolia*)

Pinaceae (Pine Family)
Monterey pine (*Pinus radiata*)

Platanaceae (Sycamore Family)
Western sycamore (*Platanus racemosa*)

Salicaceae (Willow and Poplar Family)
Fremont Cottonwood (*Populus fremontii*)
Red Willow (*Salix laevigata*)
Arroyo Willow (*Salix lasiolepis*)

Taxodiaceae (Bald Cypress Family)
Redwood (*Sequoia sempevirens*)

SHRUBS AND OTHER FLOWERING PLANTS

Apiaceae (Parsley Family)
Fennel (*Foenicultum vulgare*)
Poison hemlock (*Conium maculatum*)

Apocynaceae (Perwinkle Family)
Big leaf Perwinkle (Vinca major)

Araceae (Arum Family)
Jack-in-Pulpit (*Arisaema triphyllum*)

Araliaceae (Ginseng Family)
Algerian ivy (*Hedera canariensis*)

Asteraceae (Sunflower Family)
Yarrow (*Achillea millefolia*)
Italian thistle (*Carduus pycnocephalus*)
Prickly lettuce (*Lactuca serriola*)
Common sow thistle (*Sonchus oleraceous*)
Coyote brush **(***Baccharis pilularis)*
Mugwort (*Artemisia douglasiana)*

Caprifoliaceae (Honeysuckle Family)
Snowberry (*Symphoricarpos rivularia*)

Fabaceae (Pea family)
Clover (*Trifolium sp.)*

Garryaceae (Silk Tassel Family)
Coast Silk-tassel (*Garrya elliptica)*

Grossulariaceae (Gooseberry Family)
Fushia flowering currant (*Ribes speciosum)*

Rosaceae (Rose Family)
Himalayan blackberry (Rubus discolor)
California blackberry (Rubus ursinus)
California rose (Rosa californica)
Toyon (*Heteromoles arbutifolia)*

Rhamnaceae (Buckthorn Family)
Italian buckthorn (*Rhamnus alaternus)*
Coffee berry (*Rhamnus californica*)
Blue blossom (*Ceanothus thyrsiflorus*)

Scrophulariaceae (Figwort Family)
Sticky monkey flower (*Diplacus aurantiacus*)

Tropaeolaceae (Nasturtium Family)
Nasturtium (*Tropaeolum majus*)

Urticaceae (Nettle Family)
Big Leafed Periwinkle (*Urtica diocica*)

GRASSES

Poaceae (Grass Family)
Wild oat (*Avena fatua*)
Meadow barley (*Hordeum brachyantherum*)
Italian ryegrass (*Lolium multiflorum)*
Rabbitfoot grass (*Polypogon monspeliensis)*

AQUATIC PLANTS

Brassicaceae (Mustard Family)

Watercress
Rorippa nasturtium-aquaticum
NATIVE

Watercress has deeply divided leaves that lie along the surface of the water bordering slow-moving creeks. Its showy white flowers grow above the water. Both the leaves and flowers have a strong peppery flavor and are used in salads, soups, and sandwiches. It was valued by early Californians as a rare source of winter vitamins. Watercress should not be collected from the wild unless the water in which it grows is free from pollutants and uncontaminated by cattle and sheep.

Cyperaceae (Sedge Family)

Hardstem Bulrush, Native Tule
Scirpus acutus var*. occidentalis*
NATIVE

The flowers occur in dense spikelets borne at the top of the stem. The Ohlone Indians bound bundles of tules together to make boats that were used in hunting and fishing along San Francisco Bay. Air chambers in the hollow stems kept the boats afloat. Long cylindrical stems from 1.5 to 2.4 meters tall. Leaves have slender, v-shaped blades. Flowers are arranged as spikelets and resemble orange brown scales. Reproduction is usually from underground stems.

Flat Sedge
Cyperus eragrostis
NATIVE

Flat sedges range in height from .4 – 1 meter, and tolerates pH between 5 and 9. It is sometimes referred to as umbrella sedge. It is found close to the water's edge because it prefers wet soil. This perennial has greenish-yellow flowers that are clustered in spikelets borne on round heads. The stems are slightly triangular in cross sections. It is an invasive native weed. Flat sedge grows at the edges of ponds and slow-moving creeks.

Equisetaceae (Horsetail Family)

Horsetail
Equisetum arvense
NATIVE

Horsetails are ancient, primitive plants that have survived nearly unchanged for three hundred million years. They grow in swampy and moist areas. They have jointed, ribbed, bright green stems topped by small dark cones that produce tiny spores instead of seeds. Horsetails are sometimes called scouring rushes because they take up silica, which forms hardened branches which was useful to early inhabits to clean cooking pots.

TREES

Aceraceae (Maple Family)

Box Elder
Acer negundo
NATIVE

The box elder's leaves are coarsely serrated along margins in a somewhat lobed variable shape. They are green above and paler green below and are arranged opposite to each other. The yellowish green flowers appear after the leaves come out in spring. Flowers are small, yellow, born in long racemes. The double winged fruits, resembling helicopter blades, are called samaras.

Caprifoliaceae (Honeysuckle Family)

Blue Elderberry
Sambucus mexicana
NATIVE

Blue elderberry prefers canyon bottoms where water is available in summer, but also grows on dry hillsides. Elderberries often start as multi-trunked shrubs that mature into small trees. The deciduous leaves are compound. The blue berries are eaten by wildlife and were dried for later use by the Ohlones. Early Californians made jam and wine from the berries. The creamy flat-topped flower clusters can be dipped in pancake batter and fried. Elderberry stems have a soft white central pith that can be removed, leaving a hollow tube that serves as a flute, clapper, or gambling stick.

Fabaceae (Pea Family)

Mimosa, Silk tree
Albizia julibrissin
NON NATVE

A semi-evergreen 6 meter tree with leaves that are deep green. The leaves are twice pinnately divided.

The young leaves have the capability to display thigmonasty (touch-induced movement). In the sensitive plant, the leaves respond to being touched, shaken, heated or rapidly cooled. Native to Asia.

Western Redbud
Cercis occidentalis
NATIVE

Flower is very showy, light to dark pink in color, 1.3 cm long, appearing in clusters in March to May before the leaves. Bark is dark in color, smooth, later scaly with faint ridges. Fruits are flattened, dry, brown, pea-like pods, 5 to 10 cm long. The flat, elliptical, brown seeds are 0.64 cm long. Maturing in July to August.

Fagaceae (Oak or Beech Family)

Coast Live Oak
Quercus agrifolia
NATIVE

Coast live oak is a tall tree with smooth gray bark. The 2.5 to 7.6 cm long oval, evergreen leaves are stiff and leathery and often do not lie flat. They are shiny dark green on the top surface and dull pale-green below, with rusty fuzz in the angles formed by the midrib and the side veins and scattered sharp spines along the edges. The acorn matures in the first year. The slender, pointed nut is 2.5 to 3.8 cm long.

The Mission area has many old oaks that are over 100 years old some may be as old as 300 years old. Early pictures of the area show many oaks lined the Mission Creek.

Hippocastanaceae (Chestnut Family)

California Buckeye
Aesculus California
NATIVE

Compound leaf with 5 leaflets. Flowers bloom in a long, terminal cluster, which produces a leathery capsule with 1-3 large brown shiny seeds each with a pale scar (a buck's eye). Seeds are poisonous to humans.

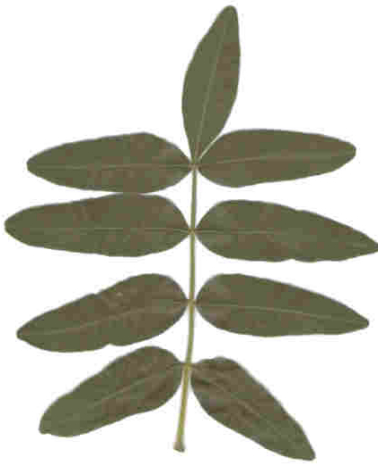
Juglandaceae (Walnut Family)

Northern California Black Walnut
Juglans californica
NATIVE

Northern California black walnut is a small tree, often branching from near the ground. The bark is dark brown with deep ridges. The pith is dark brown. The deciduous compound leaves are 23 to 38 cm long with 11 to 19 slender leaflets. There are soft hairs on the main veins on the underside of the leaf. The smooth nut has shallow grooves, is flattened at the ends, and is much smaller and thicker than the English walnut. It is often found around old Indian encampments in Central California. It is used as a stock upon which commercially grown English walnut is grafted because its roots are better adapted to local soil conditions and may hybridize with this species.

English (Persian) Walnut
Juglans regia
NON NATIVE

English walnut is native to southeastern Europe, the Himalayas, and China. It is a large tree with smooth gray bark. The deciduous leaves are 20 to 41 cm long and have 7 to 9 broad leaflets. The end leaflet is larger than the others. The thin-shelled nut is divided into two halves. English walnut is often grafted onto California black walnut rootstock so that it will grow better in local soils.



Lauraceae (Laurel Family)

California Bay Laurel
Umbellularia californica
NATIVE

This evergreen bay tree has simple leathery lance-shaped leaves. When crushed, the pungent leaves smell like bay rum. Bay leaves are used to season stews and sauces, and are placed on pantry shelves to discourage insect pests. Clusters of small fragrant yellow flowers appear in December. The fruit resembles a small avocado and turns purplish when mature. The heavy, fine-grained laurel wood and burls are used to make plates, bowls, novelties and furniture and are often sold as pepperwood or myrtle.

Moraceae (Mulberry Family)

Edible fig
Ficus carica
NON NATIVE

Forms a shrub or low spreading deciduous tree. Lives in mild winters with hot dry summers. Originally from Asia. It has large (5-15 cm), simple leaves with 5 but sometimes 3 or 4 lobes. Bark is smooth, silvery gray.

Myrtaceae (Myrtle Family)

Blue Gum Eucalyptus
Eucalyptus globulus
NON NATIVE

Blue gum is a very tall tree that has been planted throughout California. It was introduced from Australia and Tasmania in the late 1800s as a fast-growing lumber crop; however, the wood twists as it dries, making it unsuitable for working. Its roots are very efficient at finding water at the expense of more desirable native species. Eucalyptus oil is used in cough and cold medications. The peeling outer bark ignites readily and firebrands can be carried a great distance by updrafts produced by fires.

Oleaceae (Olive Family)

Oregon ash
Fraxinus latifolia
NATIVE

Tree is dioecious with small greenish flowers that appear with leaves. Fruits are elliptical samaras that ripen in late summer. Leaf is compound with 5-9 ovate leaflets. Bark is thin, smooth and gray green when young. Drought resistant but can tolerate flooding. Found in riparian habitats.

Pinaceae (Pine Family)

Monterey pine
Pinus radiata
NATIVE (central coastal California)

Trees are rapid growers and can grow to 15-30 meters. Bark is gray to red-brown with deep "V" furrows. Needles are long in bunches and deep yellow-green.

Platanaceae (Sycamore Family)

Western Sycamore
Platanus racemosa
NATIVE

Western sycamore grows along creek beds. It is a large deciduous tree with heavy twisted branches. Its "jigsaw puzzle" bark is smooth and ashy-white with greenish-gray and tan patches. The broad leaves are light green above and paler and rusty-hairy below. The fruits are contained in bristly "button-balls" borne in clusters on the flower stalk.

Salicaceae (Willow and Poplar Family)

Fremont Cottonwood
Populus fremontii
NATIVE

Cottonwoods are common trees found in local creeks within Alameda County. The deciduous leaves are spade-shaped and become golden in fall. Wind blowing through the trees sounds like running water. Male and female flowers are borne on separate trees. The female tree has cottony seeds that are dispersed by the wind that bloom between March and April. This tree is well known for its ability to grow quickly with heights up to 35 meters.

Red Willow
Salix laevigata
NATIVE

Red willow is a medium-sized deciduous tree that always grows near water. The bark of mature trees is dark and rough; young twigs may be red to yellow-brown. The narrow leaves are green and shiny above, whitish below, and usually widest below the middle. Male and female flowers are borne on separate plants and appear soon after the leaves in early spring. The tiny seed produced by the female catkin has a cottony "fluff" and may be carried a great distance by the wind. Because all willows root easily and grow quickly, they have potential for holding soil on steep slopes. The flexible willow shoots were used by the Ohlone Indians to make baskets and huts. Willow bark contains salicin, which our bodies convert to salicylic acid, the active pain-relieving ingredient in aspirin.

Arroyo Willow
Salix lasiolepis
NATIVE

Arroyo willow is a small tree or branching shrub. It grows along perennial or summer-dry creeks, or in arroyos. The bark of the mature tree is deep gray. Twigs are yellowish to brownish. The narrow leaves are dark green and smooth above and hairy to smooth beneath, with margins that are sometimes toothed and slightly rolled under. The leaves are usually wider above the middle. Pliable willow twigs were used by the Ohlones for making baskets and constructing temporary huts. Willow bark is a source of salicylic acid, the active ingredient in aspirin, and was used to relieve pain.

Taxodiaceae (Bald Cypress Family)

Coast Redwood
Sequoia sempevirens
NATIVE (Coastal California)

This majestic tree ranges from 60-110 meters tall. Trunks are usually enlarged with swelling or burls at the base. Cones are small, about 12-35 mm long and reddish brown.

SHRUBS AND OTHER FLOWERING PLANTS

Family Apiaceae (parsley)

Fennel
Foeniculum vulgare
NON NATIVE

A perennial herbaceous plant with umbels of tiny yellow flowers with dark green thin leaves. Introduced from Eurasia. Dried fennel fruits are used as a spice. Leaves and stalks can be eaten like a vegetable. Has a sweet, aromatic taste similar to licorice or anise.

Poison Hemlock
Conium maculatum
NON NATIVE

Poison Hemlock is a perennial herb, 1-2 meters tall. The stems are smooth and hollow with a characteristic red mottling. Leaves are compound, lacy, and alternate. The small white flowers are borne in compound umbels at the top of the stalk. The taproot is small and white with a disagreeable smell. All plant parts are poisonous. The seeds contain the most poison, a piperidine alkaloid. Socrates is reputed to have been killed by being forced to drink the juice of this plant.

Apocynaceae (Perwinkle Family)

Big leaf Perwinkle
Vinca major
NON NATIVE

Herbaceous, evergreen with oval, glossy, green leaves in an opposite arrangement. The plant spreads on the ground and forms dense masses. Flowers are purple to white and have 5 parts.

Araceae (Arum Family)

Jack-in-the pulpit
Arisaema triphyllum
NON NATIVE

Perennial, herbaceous plant about 65 cm in height. The plant has basal leaves only. Each leaf is divided into 3 equal parts. Flowers are green with purple-brown stripes. Fruit is a cluster of bright shiny, red berries. Found in moist, shaded areas. Native to eastern United States. Indians used for medicinal purposes from snakebites to arthritis. However, no part of the plant should be eaten.

Araliaceae (Ginseng Family)

Algerian ivy
Hedera canariensis
NON NATIVE

A fast growing ground cover that likes shade. It is fast growing and invasive. Leaves are alternate and simple. Leaves are lobed with variegated green color. It is an evergreen.

Asteraceae (Sunflower Family)

Yarrow
Achillea millefolia
NATIVE

Herbaceous perennial that produces one to several stems. Leaves are found toward the bottom of the stems. The compound leaves are fern-like with leaflets that are bipinnate. The flower heads have a flattened dome shape with approximately 10-20 yellowish-white ray flowers with 5 petals. They are drought tolerant.

Mugwort
Artemisia douglasiana
NATIVE

Mugwort is a meter tall perennial, with a distinctive odor that is found along the stream banks. It blooms from June to October . Leaves are long and grayish green in color. The common name of “mugwort” comes from a European species used as a condiment (seasoning). The name is derived from the old English name for plant “wort” and a container “mug.” The European herb may have been used as a flavoring in a beverage consumed from a mug.

Coyote Brush
Baccharis pilularis
NATIVE

Coyote brush is an evergreen shrub that grows up to 4 meters in this area. Male and female flowers are borne on separate plants in late fall. The yellow pollen of the male flower smells like shaving soap. Early Californians, because of its abundant silky-haired seeds, called coyote brush "fuzzy-wuzzy". Coyote brush is an important pioneer species in the process of plant succession. It is usually the first shrub to appear in a grassy field after vegetation has been removed by cultivation or fire.

Caprifoliaceae (Honeysuckle Family)

Snowberry
Symphoricarpos rivularis
NATIVE

A deciduous shrub 1-3 meters high and spreads by suckers. Produces a small pink bell shaped, 5 petalled flower that are hairy inside. Berries mature in autumn and are white and globe shaped.

Fabaceae (Pea Family)

Clover
Trifolium sp.
NON NATIVE

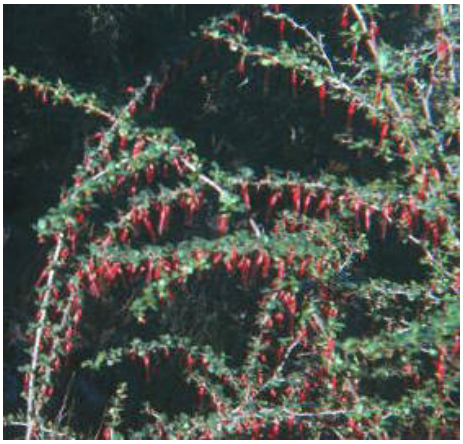
Perennial, legume, stems erect, leaves of basal rosette. Leaves are palmately compound with 3 leaflets. Flowers are 10-15 mm long, rosy purple to creamy white. Peduncle and calyx are hairy. Can grow on wet or dry meadows and be used as feed for cattle.

Garryaceae (Silk Tassel Family)

Coast Silk-tassel
Garrya elliptica
NATIVE

Evergreen shrubs or small trees. Leaves are leathery with wavy edges. They are arranged in opposite pairs and are dark shiny green above; gray below with dense, microscopic hairs. Male and female catkins are borne on separate plants. The male catkin is long with slender chains of "bells."

Grossulariaceae (Gooseberry Family)



Fushia Flowering Currant
Ribes speciosum
NATIVE

In late winter this plant is covered with drooping clusters of pink flowers. Fruit maturation following pollination brings berries that the birds enjoy. It is found in many habitats from the North Coast and Outer North Coast Ranges to the Outer South Coast

Rhamnaceae (Buckthorn Family)

Coffee Berry
Rhamnus californica
NATIVE

Low lying, medium to large evergreen shrub, found in the Coast Ranges. Coffee berry bears black fruits that gives the name of coffee berry to most species. Clusters of berries are green, ripening to orange-red and finally black. The young leaves are lighter green and mature to dark green. Edges curl under during dry summers to conserve moisture. Flowers are white with a star shape, emerging from green buds in clusters.

Italian Buckthorn
Rhamnus alaternus
NON NATIVE

This evergreen shrub has an irregular upright form with a dense canopy. Medium height about 5-7 meters with a spread of about 5 meters. Leaves are dark green, serrated, glossy, and oval about 5 cm in length. It is valued as a tough, low-maintenance street tree. Appropriate beneath overhead wires. Disease and pest resistant and attracts birds.

Blue Blossum
Ceanothus thyrsiflorus
NATIVE

Shrubs or small trees, with white to blue flowers that are small but showy. The terminal inflorescence varies with each species The leaves are evergreen, alternating, and are oval in shape. There are 43 species native to California from the coast to the Sierras.

Rosaceae (Rose Family)

Toyon
Heteromoles arbutifolia
NATIVE

Large evergreen shrub or small tree, 1.8-3 meters tall. It has brilliant red berries in the winter. Leaves are dark green, serrated. Flat cluster of small white flowers. Drought tolerant plant.

California Blackberry
Rubus ursinus
NATIVE

California blackberry is a low-growing arching shrub that roots where stems touch the ground. The stems are covered with weak prickles. Its leaves are divided into 3 slender, spiny leaflets that are green on both surfaces. White to pink flowers are followed by small berries that are ripe when deep, dull black.

Himalayan Blackberry
Rubus discolor
NON-NATIVE

Himalayan blackberry is an Asian species that has been cultivated for its large berries. The stems bear large, stout spines. Its leaves are divided into 5 large leaflets that are silvery on the underside. It spreads rapidly in riparian areas and crowds out more desirable native vegetation.

Scrophulariaceae (Figwort Family)

Sticky monkey flower
Diplacus aurantiacus
NATIVE

Size is about 40 cm, erect sub-shrub. Sometimes it has a sprawling growth. It has a deep orange flower that blooms in early summer. Leaves are 2-8 cm, dark green and resinous above. Occurs in foothills and coastal ranges north of Santa Barbara County. Drought resistant.

Tropaeolaceeae (Nasturtium Family)

Nasturtium
Tropaeolum majus
NON NATIVE

Plants form a low bush or trailing form 8-12 inches tall. Leaves are light green and round while the bright flowers range from red, orange, and yellow.

Urticaceae (Nettle Family)

Stinging Nettle
Urtica diocica
NATIVE

Humans that brush near a stinging nettle may get tiny hollow hairs from the leaves that release formic acid which irritates the skin and causes white itchy spots to appear. The plant grows as a large main stem. The leaves are in opposite pairs and the flowers concentrate in clusters from the leaf axils. The flowers do not have petals; male flowers have a 4-lobed calyx and 4 stamens and the female flowers are either 4-lobed or 2-lobed and have a pistil that produces a single seed.

GRASSES

Poaceae (Oat Family)

Wild Oats
Avena fatua
Non native

Most wild oats germinate and emerge in early to mid-spring. Cool, moist conditions promote maximum emergence, so crops that are seeded early are usually the most heavily infested. Fall or early spring applications of nitrogen fertilizer stimulate germination. Growth of roots and shoot of wild oats is slow for the first two weeks, but increases quickly from then on. Most wild oats tiller within a month of emergence.

Meadow barley
Hordeum brachyantherum
NATIVE

Herbaceous perennial is native to lower elevations in western California where it is a component of most grasslands. Blades are about 11 cm long and 4 mm wide with long and short hairs on both sides. Leaves are alternate.

Italian Ryegrass
Lolium multiflorum
NON NATIVE

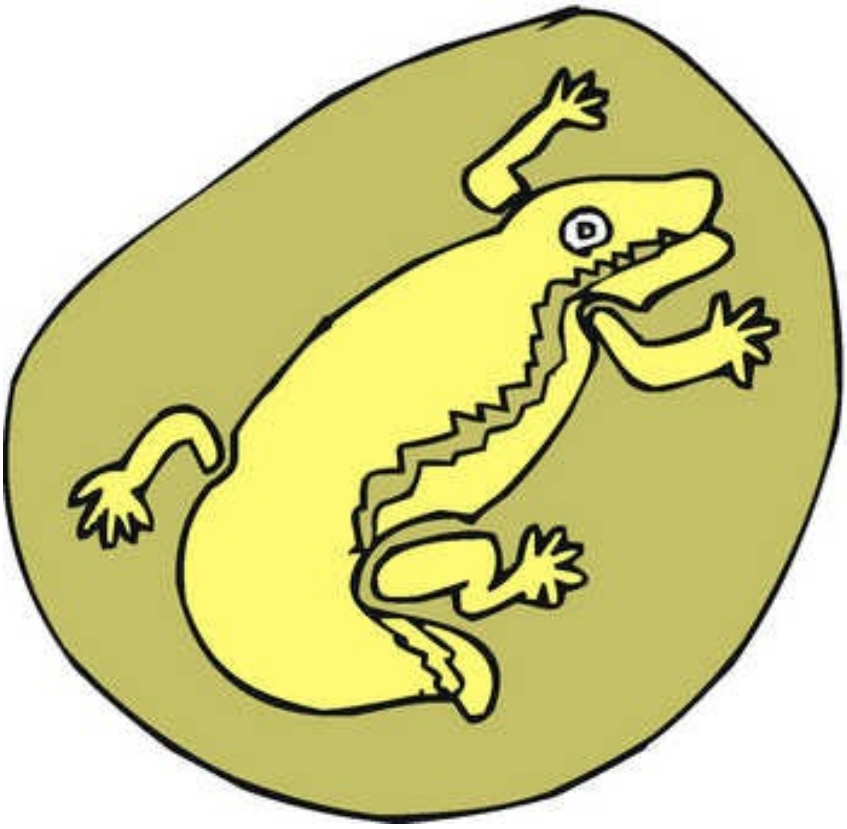
Italian ryegrass is an annual grass that has been introduced from Europe and is cultivated as a meadow, pasture, or lawn grass. Its flowers are borne on short spikelets that alternate on the stem. The seed has a short, thin awn (hair). It is a considered to be a facultative wetland indicator species because it occurs in wetlands as often as it occurs in uplands.

Rabbit foot Grass
Polypogon monspeliensis
NON NATIVE

Rabbit foot is a low-growing annual grass that is native to Europe. It has become naturalized in California and is commonly found growing on wet or moist soils. The dense flowering head has long silky hairs and resembles a rabbit's foot.

Chapter 3.

Vertebrates



BIRDS

Birds that live along Mission Creek are diverse and abundant. Birds of Prey are the most abundant along the foothills where they search for rodents who live in the grasslands. Hundreds of Turkey Vultures can be seen soaring on the wind currents. Songbirds jump from tree to tree and provide background music as you walk along Mission Creek. Water Birds are not as abundant because the creek does not provide enough pools for food or shelter, but they occasionally stop by as they fly from Lake Elizabeth, Tyson Lagoon, Quarry Lakes, and the San Francisco Bay.

Class Aves

Order Falconiformes (vultures, ospreys, hawks, falcons)

Family Falconidae
American Kestrel (*Falco sparverius)*
Family Cathartidae
Turkey Vulture (*Cathartes aura)*
Family Accipitridae
Cooper's Hawk (*Accipiter cooperii)*
Red Shouldered Hawk (*Buteo lineatus)*

Order Strigiformes (owls)
Family Strigidae
Great Horned Owl (*Bubo virginianus)*

Order Passeriformes (songbirds)

Family Corvidae
American Crow (*Corvus brachyrhynchos)*
Steller's Jay (*Cyanocitta stelleri)*
Western Scrub-Jay (*Aphelocoma californica)*
Family Turdidae (thrushes)
American Robin (*Turdus migratorius)*
Hermit Thrush (*Catharus guttatus)*
Varied Thrush (*Ixoreus naevius)*
Family Tyrannidae (tyrant flycatchers)
Black Phoebe *(Sayornis nigricans)*
Family Emberizidae
California Towhee (*Pipilo crissalis)*
Dark-eyed Junco (*Junco hyemalis)*
Song Sparrow *(Melospiza melodia)*
Golden-crowned sparrow (*Zonotrichia atricapilla*)
White-crowned Sparrow (*Zonotrichia leucophrys)*
Family Icteridae
Brewer's Blackbird *(Euphagus cyanocephalus)*
Family Aegithalidae
Bushtit *(Psaltriparus minimus)*
Family Paridae
Chestnut-backed Chickadee *(Poecile rufescens)*
Family Sturnidae
European Starling (*Sturnus vulgaris*)
Family Fringillidae
House finch (*Carpodacus mexicanus*)

Family Parulidae
Wilson's Warbler (*Wilsonia pusilla*)
Yellow rumped warbler (*Dendroica coronata*)
Family Regulidae
Ruby-crowned kinglet (*Rugulus calendula*)
Family Mimidae
Northern Mockingbird (*Mimus polyglottos*)

Order Piciformes (woodpeckers)
Family Picidae
Nuttail's Woodpecker (*Picoides nuttalli*)
Northern Flicker (*Colaptes auratus)*

Order Apodiformes (hummingbirds)
Family Trochilidae
Anna's Hummingbird (*Calypte anna)*

Order Columbiformes (doves, pigeons)
Family Columbidae
Mourning Dove (*Zenaida macroura*)

Order Anseriformes (ducks, geese)
Family Anatidae
Green heron (*Butorides virescens*)

BIRDS OF PREY

Order Falconiformes (vultures, ospreys, hawks, falcons)

Family Falconidae
American Kestrel
Falco sparverius

The American kestrel is the smallest and most common of our falcons. It has a russet back and tail, and two black stripes on a white face. The male has blue-gray wings. Kestrels feed on insects, small reptiles and mammals and hover over their prey before plunging to seize them in their talons. They were formerly called sparrow hawks because they may feed on small birds in winter. Their call is a shrill, loud *killy killy killy.*

Family Cathartidae
Turkey Vulture
Cathartes aura

Turkey vultures are large eagle-like birds, with 2-toned blackish wings and small red naked heads. They have a longish, hooked bill with short, thick legs. "Kettles" of vultures are often seen soaring in wide circles with their wings held in a "V" position (dihedral). They ride thermals of rising air and seldom flap their wings as they soar in the sky. Vultures feed on the flesh of dead animals (carrion) including that of small mammals, birds, reptiles, amphibians, and fish.

Family Accipitridae
Cooper's Hawk
Accipiter cooperii

A medium sized bird with a long, lean body. A swift flyer with a hooked beak. This hawk is noted as a predator of other birds, as well as also mammals. The female is about 42-50 cm and the male is slightly smaller. In flight the Cooper's hawk exhibits a long barred tail and short, rounded wings.

Family Accipitridae
Red Shouldered Hawk
Buteo lineatus

This predator eats small mammals, reptiles, amphibians, and small birds. It is a large broad-winged hawk with a relatively long tail. The female is larger than the male. A brown head and reddish upper wings are characteristic of this species. The tail is dark brown with white bands. It has sharp eyesight with excellent depth perception. Females lay 3-4 whitish eyes with brown blotches.

Order Strigiformes (owls)

Family Strigidae
Great Horned Owl
Bubo virginianus

Distinct catlike ears and eyes with a feathered tuft on head that resembles a horn. Upper body is brown with gray brown mottling. Average length is about 64 cm with a 1.4-meter wingspan. Considered a ferocious predator hunting on small mammals, birds, and crayfish. It regurgitates the unwanted parts of its prey. Uses abandon nest of hawks or crows.

PERCHING BIRDS, SONGBIRDS

Order Passeriformes (flycatchers, swallows, jays, chickadees, nutcrackers, thrushes, wrens, starlings, warblers, sparrows, finches)

Family Corvidae
American Crow
Corvus brachyrhynchos

Large black bird that is slightly iridescent blue and purple about 45 cm long with a 90 cm wingspan. Tail is fan shaped and slightly rounded. Nest is coarsely but well made with sticks, twigs and grass. They have 4-7 blue green to greenish white mottled and speckled eggs that are about 41 mm in length. This omnivore eats grains, seeds, insects, frogs and human scraps. It gives a *caw-caw* or *caa-caa* sound.

Family Corvidae
Steller's Jay
Cyanocitta stelleri

A jay with black crest with deep blue belly with black breast. It has a length of 30-34 cm and a wingspan of 45-48 cm. It has a thick, pointed bill. Its song *is chook-chook chook* or *shack-shack-shack*. This omnivore eats nuts, seeds and acorns, and some invertebrates. It also eats the eggs of other birds. It is monogamous with clutches of 2-6 eggs in cup shaped nests.

Family Corvidae
Western Scrub-Jay
Aphelocoma californica

The crestless scrub jay has a blue head, wings and tail, a brownish back, white throat, and a necklace of short streaks across the breast. Its rough rasping *shreek* often announces the presence of an intruder into its habitat. It has an oak woodland habitat. It lays 3-6 reddish or green spotted eggs in a twiggy bowl located in a bush or low tree.

Family Turdidae (thrushes)
American Robin
Turdus migratorius

Considered a large thrush 23-28 cm in length. It is brown above, reddish on the breast, especially in males. Throats are white, streaked with black. They are omnivores eating fruits, earthworms, and insects. They are an effective pest control. Cup shaped nests with mud on the inside. They lay 3-5 blue green eggs that are incubated by the female for about 14 days. Robins are migratory, shifting south during the autumn.

Family Turdidae
Hermit Thrush
Catharus guttatus

Average length is 17 cm with a wingspan of 29 cm. This bird has a distinct white eye ring, indistinct whitish bar over the lores, darkly spotted breast and sides of throat. Reddish coloration on tail. Omnivores-eats insects, small invertebrates and fruits. Female lays 3-6 eggs that are pale blue to blue-green with brow flecks.

Family Turdidae
Varied Thrush
Ixoreus naevius

The varied thrush is 19-26 cm long. The male is slate blue on its back and nape, with an orange face. The female is dull with brownish-olive coloration. It is an omnivore eating fruits, berries, acorns and arthropods.

Family Tyrannidae (tyrant flycatchers)
Black Phoebe
Sayornis nigricans

The black phoebe is a solitary flycatcher that feeds almost entirely on flying insects. It perches in the open near water, wagging and spreading its tail. It makes short flights to catch insects, and returns to its perch. The top of its body, including the breast, is black; the belly is white. Its 4-syllable song is a thin, rising *pee-wee*, followed by a descending *pee-wee*. Its calls include a loud *tsee* and a sharper *tsip.* It lays 3-6 white eggs in a cup nest of mud and grass built beneath an overhanging cliff or eave.

Family Emberizidae
California Towhee
Pipilo crissalis

The California towhee is dull brown above, paler below, and has a dark buff colored streaked throat. It has a long tail with rusty orange under tail coverts. This common bird hops while feeding on the ground near dense shrubbery. Its call is a metallic *chink*. The cup nest is built in a bush or tree and contains 3-4 spotted eggs.

Family Emberizidae
Dark-eyed Junco
Junco hyemalis

Gray sparrow with white outer tail feathers and white breast. It breeds in brushy areas. It is an omnivore that eats seeds, insects and some fruits. Has a pink conical bill. The female is somewhat browner

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Family Emberizidae
Song Sparrow
Melospiza melodia

The song sparrow is brown with a heavy streaked breast and a central dark "stickpin." Its legs and feet are pinkish. It pumps its long, rounded tail in flight. It inhabits dense streamside thickets and moist wood margins. Its song is a series of variable musical and buzzy notes: *sweet, sweet, sweet*. Its call note is a hollow *chimp*. It lays 3-5 spotted eggs in a grass cup on the ground or in a bush.

Family Emberizidae
Golden-crowned Sparrow
Zonotrichia atricapilla

Medium sized bird with a long tail and a yellow crown. Feeds on seeds, nuts, and insects. It has a dark conical bill. Its face and under parts are gray. Wings are brownish.

Family Emberizidae
White-crowned Sparrow
Zonotrichia leucophrys

Distinctive black stripe that extends along the crown of head and behind eyes. It outlines white feathers on top of its head. Its breast is light gray with dark brown flight feathers. Mainly eats seeds, grass, buds and fruit.

Family Icteridae
Brewer's Blackbird
Euphagus cyanocephalus

The Brewer's blackbird male has a black body that in certain light can reflect purple on the head and green on the body. The eye of the male is white. The female is a brown gray color and has brown eyes. These birds generally occur in pairs even when with a flock. They feed on insects, seeds, and fruits found in the surrounding area.

Family Aegithalidae
Bushtit
Psaltriparus minimus

High thin, fussing notes and constant twittering and fluttering in the trees announce the arrival of a flock of insect-eating bushtits. They are gray above with brownish cheeks, whitish below, and have a long tail and short bill. Approximately 11 cm in length. Feeds on aphids, spiders, and other insect as well as seeds and fruits. The nest is a long woven sock hung from a branch that usually contains 5-7 white eggs. Eggs incubate in 12 days and young fledge in 14-15 days. Common in California.

Family Paridae
Chestnut-backed Chickadee
Poecile rufescens

The chestnut-backed chickadee has a brown cap, white cheeks, and a black bib. It is about 13 cm with a small body and long tail. It is an omnivore eating seeds, spiders, caterpillars and many other insects. It feeds high in trees, sometimes hanging upside down. Its call is a hoarse, rapid *tseek-a-dee-dee*. It lays 5-7 dotted eggs in a cavity of a tree or stump. It is a social bird traveling in flocks with creepers, woodpeckers, and kinglets.

Family Sturnidae
European Starling
Sturnus vulgaris

The starling is about 22 cm in length with iridescent green glossy feathers covering the back, nape and breast. Its legs are a reddish brown. It has a black bill, except during mating season it is yellow. They are omnivores eating seeds, insects, and fruits. Eggs are glossy light blue and white. They have three clutches per year.

Family Fringillidae
House Finch
Carpodacus mexicanus

Small bird about 14 cm in length. Male is rosy pink on throat and rump, while female is gray-streaked brown. They eat seeds from thistle and dandelion as well as fruit such as cherries. Nest is made of grass as a shallow cup. A clutch is 3-6 bluish or greenish white eggs.

Family Parulidae
Wilson's Warbler
Wilsonia pusilla

Similar to yellow rumped warbler but has a distinctive black cap. The back is yellow green with yellow front and cheeks. Mainly an insectivore that eats mostly adult larval invertebrates, but will eat berries. Small slender bill. Female lays about 4-6 eggs.

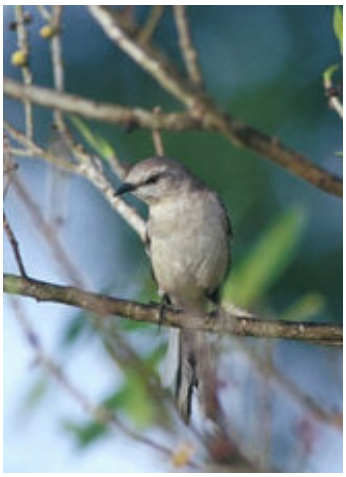
Family Parulidae
Yellow-rumped Warbler
Dendroica coronata

A warbler with a yellow rump with yellow patches on its sides. During mating the male and female have yellow crown patches and white tail feathers. They are omnivores eating insects, berries and other fruits. Their nest is a neat cup made of twigs, bark strips, and is lined with feathers and grass. They have 4-5 cream colored eggs with brown spots.

Family Regulidae
Ruby-crowned kinglet
Rugulus calendula

The ruby-crowned kinglet is a tiny, plump, active, nervous bird. It flicks its wings rapidly while singing a high, thin *tsee*, or scolding *je-dit je-dit*. It is grayish-olive above, with two white wing bars. The male flashes its red crown patch when upset.

Family Mimidae
Northern Mockingbird
Mimus polyglottos

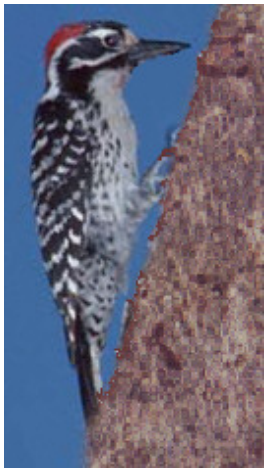


Long tail with gray feathers above and paler gray to white below with white wing bars. This perching bird has a gray back and pale underside. It has white wing patches that are noticeable during flight. The long tail has white outer feathers. Its song is a mixture of imitated songs and calls that may continue into the night hours. Commonly found in thickets and shrubs along creek margins. About 30 cm long.

WOODPECKERS

Order Piciformes (Woodpeckers)

Family Picidae
Nuttall's Woodpecker
Picoides nuttallii



Black with white stripes on face. Male has a red crown. About 18-19 cm in length. They excavate a nest in oak or cottonwood and female lays about 3-6 white eggs. Their voice is a rolling call, *prreep*, or sharp *pit-it*.

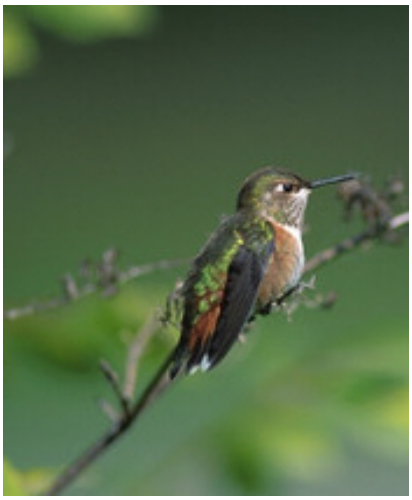
Family Picidae
Northern Flicker
Colaptes auratus

Brown above with dark spots and bars with a black patch on its upper breast. Face is gray with a red bar near the base of its peak. It has a white rump that is visible during flight. It has a loud repeated *wik-wik-wik* or *flicker-flicker-flicker.*

HUMMINGBIRDS

Order Apodiformes (hummingbirds, swifts)

Family Trochilidae
Anna's Hummingbird
Calypte anna



This hummingbird is the largest California hummingbird and is the only one commonly found here during midwinter. It is dark green above and gray below. Males have a brilliant red crown and red-spotted throat. Females often have a few red throat feathers and a white-tipped tail. Its song, delivered from a perch, is a series of squeaking, rasping notes; its call is a sharp *chick*. It lays 2 white eggs in a tiny lichen-covered cup fastened to a branch of a tree or shrub.

DOVES

Order Columbiformes (Doves, pigeons)

Family Columbidae
Mourning Dove
Zenaida macroura

This common dove is gray-brown with a black spot on its cheeks. It has a slim body, small head, pinkish feet, and a long pointed tail. The wings produce a whistling sound as the dove takes flight and the white tips of the outer tail feathers are visible. Small flocks are often found feeding on the ground or perched on wires or tree branches. Its flight is swift and direct without coasting. Its call is a series of mournful coos. It lays 2 white eggs in nests in trees, shrubs, or on the ground.

WATER BIRDS

Order Anseriformes (ducks, geese)

Family Anatidae
Mallard
Anas platyrhynchos

Mallards have a violet or blue wing patch (speculum) bordered with white. The bill is light greenish-yellow in the male and yellow blotched with black in the female. The hen (female) is mottled brown with a light line above the eye. In breeding, the drake (male) has a plumage of a bright green head, white color, reddish-brown chest, gray sides, and black all around the base of the tail.

Order Ciconiiformes (herons, egrets)

Family Ardeidae
Green Heron
Butorides virescens

Adult green herons are about the size of a crow (40 cm high) with a stocky build and legs that are relatively short. They fly with their long beaks and legs extended. Adult green herons have distinctive bluish-green and reddish-brown coloration with gray under parts and a dark bill. They forage along wooded shores from perches on snags or trees close above the water. They build stick nests in the upper dense tops of tall trees. They usually lay 2-4 eggs. Carnivores feeding on fish and invertebrates with some rodents, lizards, frogs, tadpoles, and snakes.

mammals

Throughout the Mission Creek Watershed you can find many urban animals that use the creek for water. Wild mammals have changed throughout the history of Mission Creek, but many of the smaller mammals like shrews, voles, moles, and gophers were around before settlers came to this area.

Class Mammalia

Order Carnivora

Family Procyonidae
Procryon lotor (raccoon)

Order Marsupialia

Family Didelphidae
Didelphis virginiana (opossum)

Order Rodentia (Rodents)

Family Geomytidae
Thomomys bottae (gopher)
Family Sciuridae (squirrels)
Otospermophilus beecheyi (California ground squirrel)
Sciurus griseus (western gray squirrel)
Sciurus niger (fox squirrel)

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Order Carnivora

Family Procyonidae
Raccoon
Procyon lotor
NATIVE

The raccoon has a black mask over its eyes and a bushy tail with 4-10 black rings. Ears are large and rounded with prominent whiskers. Fur is gray, brown, reddish with lots of black tipped hairs. The nose is black. Its forepaws resemble slender human hands with 5 toes. The raccoon is omnivorous and feeds on crayfish in the creek as well as blackberries. Raccoons are primarily nocturnal, active dusk to dawn. During the day they find protected areas and are hard to find. Their forepaws are very dexterous and can open doors, latches and garbage cans.

Order Marsupialia

Family Didelphidae
Opossum
Didelphis virginiana
NATIVE

A marsupial with long, stiff guard hairs on the dorsal side. Opossum is approximately 60-100 cm long. Wooly fur on its belly side. It has a sharp muzzle with 50 teeth. The tail is long, round, without hair. Ears are large and rounded and without hair. They are omnivores feeding on mainly small mammals, insects, worms, small reptiles, fish, crayfish, and eggs. The female's pouch has 9-17 nipples to feed its young. Babies must crawl 5 cm to get to its mothers pouch after only 13 days gestation.

Order Rodentia

Family Geomytidae
Gopher
Thomomys bottae

Long claws on the forefeet and heavy shoulder muscles make gophers superb diggers. They carry food in fur-lined pouches on either side of their mouth. A furry membrane behind the incisors keeps dirt out of the mouth while the gopher is digging. The earth mounds that are pushed out during the gophers' search for food have a distinct earthen plug at the center or the side. Gophers plow the land and bring tons of soil to the surface each year, stimulating plants to grow larger and healthier. Pocket gophers are solitary except during the breeding season and usually expel intruders from their burrow system. However, abandoned gopher burrows often provide essential refuge for a variety of other animals. Gophers are prey for hawks, owls, fox, cats and snakes.

Family Sciuridae
California ground squirrel
Otospermophilus beecheyi
NATIVE

The tail of the ground squirrel is shorter and less bushy than the tree squirrels. As its name implies, it likes to remain on the ground, but is also a good climber. It stores great amounts of food in its burrow. It stays closes to their burrows and sits up on their haunches to see over the area. It is noted for sounding an alarm on top of its burrow to warn other squirrels. Its alarm is a loud chirp at regular intervals.

Family Sciuridae
Western Gray squirrel
Sciurus griseus
NATIVE

Silver gray with white undersides. Long bushy tail. Lives for 7 to 8 years. Mainly eats seeds, but known to eat berries, fungus, bark, sap, and insects. Lives in hollow trees or nests. Similar footprints as the fox squirrel. It is an excellent climber but spends as much time foraging on the ground. As most squirrels, it uses its tail to help balance as it travels on tree limbs.

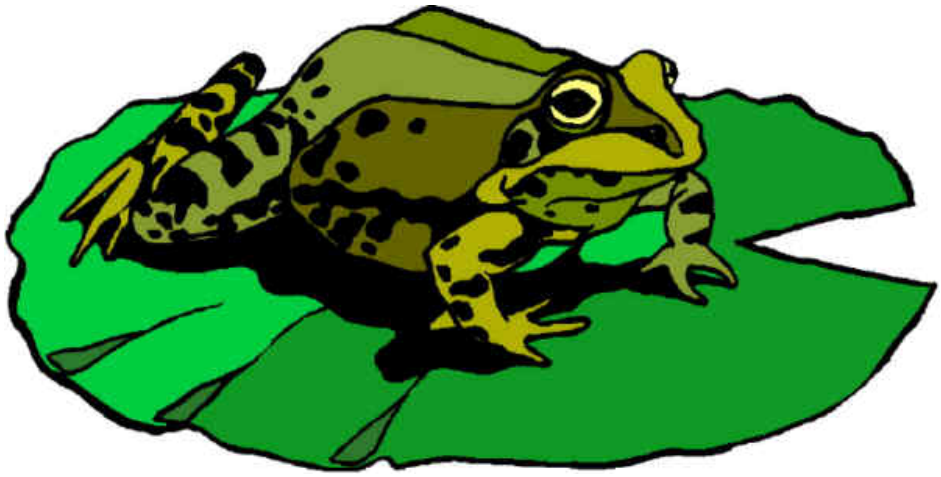
Family Sciuridae
Eastern Fox Squirrel
Sciurus niger
NON NATIVE

This squirrel is a medium-sized tree squirrel, rusty to reddish gray across back. It has 3 main color phases including rusty, gray and black. It is the largest of the North American tree squirrels. It weighs 1.6-2.4 pounds and eats acorns, walnuts, and other types of seeds. Its foreprint has 4 toes while the hindprint has 5 toes. This squirrel is diurnal, but not as agile in the trees as the western gray squirrel. Their lifespan is 6-10 years.

Reptiles

and

Amphibians



The habitat for reptiles and amphibians along the Mission Creek Stream Corridor has been disturbed by humans over the last 200 years. Today this area is not as desirable a habitat for reptiles and amphibians. Hopefully as the Mission Creek provides a more native riparian vegetation the reptiles and amphibians will return.

Class Amphibian

Order Anura

Family Hylidae

Pseudacris regilla (Pacific Chorus Frog, Pacific Tree Frog)

Class Reptile

Order Squamata

Family Phrynosomatidae

Sceloporus occidentalis (Blue Belly Lizard)

Amphibian

Order Anura
Family Hylidae

Pacific Chorus Frog, Pacific Tree Frog
Pseudacris regilla
NATIVE

The adult is small (2-5 cm), with a rounded snout, large eyes for its body, with dark bands from the back of its eyes to the front. Prominent toe pads with limited webbing. The dorsal color and pattern is highly variable from light to dark green. The males have a round vocal sac that can balloon to be three times its size. A group of calling males is known as a chorus.

Reptile

Order Squamata
Family Phrynosomatidae

Blue Belly Lizard
Sceloporus occidentalis
NATIVE

Dark brown to black pattern on the dorsal scales are keeled and pointed. Blue spots on back and large on the throat with blue ventral batches. The under surfaces of their rear legs are orange or yellow. Females are not as colored as males. Juveniles lack ventral patches.

Chapter 4.

microorganisms

The water's of Mission Creek are alive with many different microscopic and macroscopic organisms. This micro world is full of small plants, protozoa, bacteria, and animals. These critters provide the food source for larger organisms. They can also tell us whether the environment is healthy. The microorganims have different roles. Some are authotrophic or can make their own food from the Sun. Some are heterotropic or ingest food including plants and other organisms. Some live their entire live in the water (holoplankton) and others only have their larval stages in the water (meroplankton).

Holoplankton

Plantae

Phylum Bacillariophyta
- **Class Baccillariophyceae (diatoms)**
  - **Order Pennales**
    - *Surrirella* sp.
    - *Tabellaria* sp
    - *Navicula* sp.
    - *Gyrosigma* sp.

Phylum Chlorophyta
- **Class Chlorophyceae**
  - **Order Zygnemales**
    - *Closterium* sp.
    - *Mougeotia* sp.
  - **Order Chlorococcales**
    - *Pediastrum* sp.

Protozoa
- **Phylum Ciliophora**
  - **Order Humenostomatida**
    - Family Paramedidae
      - *Paramecium* sp.
      - *Urocentrum* sp.
  - **Order Hypotrichida**
    - Family Euplotidae
      - *Euplotes* sp.
  - **Order Peritrichida**
    - Family Vorticellidae
      - *Vorticella* sp.
  - **Order Gymnostomatida**
    - Family Colepidae
      - *Coleps* sp.
  - **Order Endogenida**
    - Family Tokophryidae
      - *Tokophyra* sp.
- **Phylum Actinopoda**
  - Class Heliozoa
- **Phylum Rhizopoda**
  - Family Amoebidae

Animalia

Phylum Rotifer

Squatinella sp.
Philodina sp.
Euchlanis sp.

Phylum Gastrotricha

Phylum Nematoda

Phylum Platehelminthes

Planaria

Phylum Annelida

Class Oligochaeta

Pristina sp.
Chaetogaster sp

Phylum Arthropoda

Class Crustacea

Subclass Branchiopoda

Cladocera (water fleas)

Macrothrix sp.

Subclass Ostrocoda

Cypris sp.

Subclass Copepoda

Cyclops sp.

Meroplankton

Phylum Arthropoda

Order Diptera
Family Chironomidae
Family Dixidae
Dixa sp.
Family Culicidae
Culicinae
Anopheles larva (mosquito larva)
Chaoborinae (Phantom midges)

Order Ephemeroptera (mayflies)

Order Megaloptera
Family Sialidae (alderflies)
Neochauliodes bowringi

Order Odonata
Zygoptera (damselflies)
Argia agrioides (California dancer)

Order Coleoptera
Family Gyrinidae (Whirligig beetles)

Order Hemiptera
Family Corixidae (water boatman)
Corixa sp.
Family Gerridae (Water Strider)
Gerris gibbiffer

HOLOPLANKTON

Holoplankton spend their entire lives as part of the plankton. It includes any organisms whether authotrophic or heterotropic, that is controlled by the water movement in which they reside. However, some components are capable of slight movement.

The authotropic representatives include diatoms and green algae. Heterotropic representatives would include protozoa and small animals like rotifers and gastrotriches. Some arthropods can also live their entire life in the water column including water fleas, ostrocods and copepods. Also Included in this section are organisms that live in the water column as plankton, but can live in the benthic (bottom) environment.

Note: Consult "Quick Identification of Fresh Water Microorganisms" for approximate sizes of organisms shown in this section."

PLANTAE

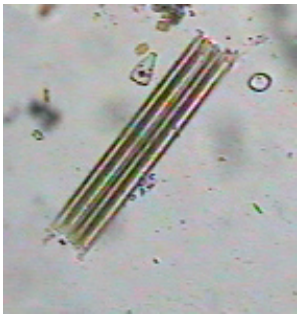
Phylum Bacillariophyta (Diatoms)

Unicellular organisms are the primary source of food for zooplankton. Most diatoms are plankton that lack flagella (except the male gametes). Frustules (shells or valves) are overlapping like a "pill" box and are made of opaline silica. They are identified by the frustule by its pores, depressions, striae, costa, raphe, and ornamentations. They possess raphe, which is a slit on the apical valve. Striae are holes (punta/areolae) mainly along the edges. Costae are thickened ribs. They are fresh or marine and contain chlorophyll a and c. They are autotrophic with mainly asexual reproduction. There is over 37,000 species.

Class Bacillariophyceae
Order Pennales
Surirella sp.

Frustules are biraphid and symmetrical to the apical axis. Shape is elliptical to broadly linear in outline. Some species are spirally twisted. The raphe are elevated along the margin of the valves. Striae fine to unresolved.

Class Bacillariophyceae
Order Pennales
Tabellaria sp.



These pennate diatoms usually attach themselved to form large sig-zag chains. They rarely form straight colonies. The ends and central portions of one individual valve are inflated. Striae are fine and costa are absent.

Class Bacillariophyceae
Order Pennales
Navicula sp.

The pennate diatoms exhibit a gliding movement, changing motion without any apparent reason. Striae are perpendicular to the central raphe, which has a characteristic larger area in the center.

Class Bacillariophyceae
Order Pennales
Gyrosigma sp.

The overall shape of the frustule is moderately sigmoid and lanceolate. It gradually tapers to obtusely rounded ends. The axial (top) area and the raphe are sigmoid as well. The proximal ends of the raphe curve in opposite directions and the central area is longitudinally elliptical. The transverse and longitudinal striae are distinct and the transverse striae are slightly radiate. The longitudinal striae curve outward to the sides of the central area

Phylum Chlorophyta (green algae)

The Chlorophyta are very diverse aquatic plants with over 8000 species ranging from fresh to marine conditions. However, about 90% are fresh water. They contain chlorophyll a and b. They store starch as a food reserve inside plastids. The classification is confusing and not agreed upon by researchers. Most green algae have firm cell walls. Some contain flagella while other have calcified shells.

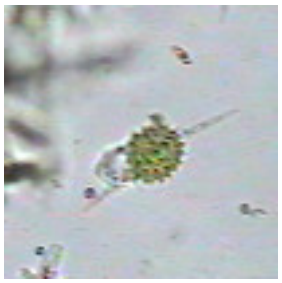
Class Chlorophyceae
Order Zygnematales
Closterium sp.

Pair of cells whose cytoplasm are joined by an isthmus at the location of a single shared nucleus. Pyrenoids run parallel to the cell's long axis. Lunate or acuate curved.

Class Chlorophyceae
Order Zygnematales
Mougeotia sp.

Mougeotia species are unbranched filamentous green algae. They are cylindrical, with band-, plate- or star-shape chloroplasts. A single chloroplast fills the length of the cell. This chloroplast resembles a twisted ribbon. The chloroplast may be seen lying flat (horizontal) when seen through the microscope. The chloroplast may be twisted and can be seen as a narrow strip up the middle of the cell. Cell walls are parallel. Grows rapidly to produce a type of pond "scum."

Class Chlorophyceae
Order Chlorococcales
Pediastrum sp.



A colonial algae widely found in freshwater. Multinucleate cells are geometrically arranged in flat, circular plates. Protruding pointed projections can be seen on the surface.

PROTOZOA

Phylum Ciliophora

Ciliates are fresh and marine microbes, covered with cilia. Cilia are short whip-like extensions embedded in the outer cell. Cilia aid in movement during feeding. A variety of organelles plus two kinds of nuclei can be found internally. Ciliophora are heterotrophs feeding on bacteria and other small organic particles. Usually reproduce asexually but also exchange DNA through a process of conjugation.

Phylum Ciliophora
Order Hymenostomatida
Family Parameciidae
Paramecium sp.

Paramecium have a stiff outer covering in a slipper shape. It swims using its short cilia that encapsulated the entire outer surface. It has an external oral grove that leads to a mouth pre. It also has an anal pore. Moves forward in a corkscrew manner, but can reverse directions.
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Phylum Ciliophora
Order Hymenostromatida
Family Urocentridae
Urocentrum sp.

Cylindrical, short body with cilia as distinct girdles with a distinct tuft at the rear. An oval shaped Ciliophora with a constriction in the middle. Swims rapidly on its tail in an irregular spiral motion. 50-80 microns.

Phylum Ciliophora
Order Hypotrichida
Family Euplotidae
Euplotes sp.

This cilicate has complex ciliary structures in the cell's surface. Cell shape is ovoid with tuffs of cilia joined together to act as an organelle.

Phylum Ciliophora
Order Peritrichida
Family Vorticellidae
Vorticella sp.

The genus *Vorticella* has a bell shaped body with a circle of cilia around the oral opening. A slender, contractile stem helps this group to attach to a substrate (sessile) or to other members of the same species. It forms a colony of many individuals.

Phylum Ciliophora
Order Gymnostomatida
Family Colepidae
Coleps sp.

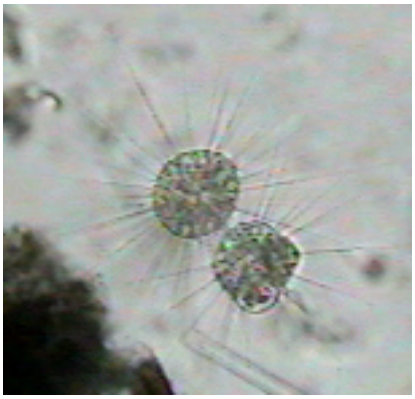
Barrel-shaped body with regularly arranged calcareous plates. Cilia surrounds anterior end with smaller projects near its posterior end. A rapid swimmer and voracious feeder. Eats detritus or dying small organisms.

Phylum Ciliophora
Order Endogenida
Family Tokophryidae
Tokophyra sp.

Protozoa that possesses hollow, sticky tentacles (instead of cilia) to capture prey. Resides on water plants and other organisms.

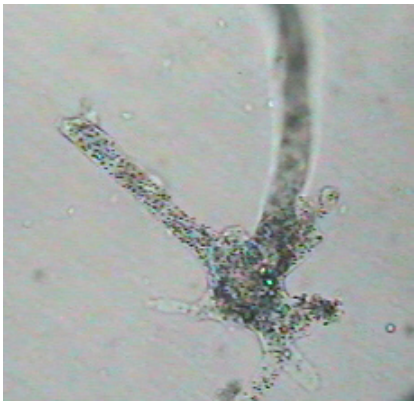
Some groups are difficult to speciate so the following descriptions represent larger groups of protozoa

Phylum Actinopoda
Class Heliozoa



Freshwater species with a symmetrical globular form. Possesses radiating axopodia that contains cytoplasm. The axopodia contract bringing bacteria and other nutrients into a food vacuole where it is digested.

Phylum Rhizopoda
Family Amoebidae (naked amoeba)



Amoebas are noted for its slow, free-form motion using pseudopods. The cell wall moves as the cytoplasm shifts within the cell . It captures its food by engulfing its prey with this motion. Specimens found were naked (without a shell) and polypodial (many pseudopods at one time).

ANIMALIA

Phylum Rotifer

Rotifers are named for the cilia at the crow of their heads. They are bilaterally symmetrical and covered with an external layer of chitin called a lorica. Rotifers lack a circulatory system and respire through the surface of their body. Most are free swimming individuals although some create colonies that can be seen rotating rapidly like a spinning ball. They feed on bacteria, protists, other rotifers and small animals, and suspended organic matter. Rotifers are a major source of food for other animals in freshwater environments.

Phylum Rotifer
Squatinella sp.

Squatinella has a transparent shield over the head region. Their eyes have lenses. The shield covers the cilia which is on the depressed side and has two pronounced appendages toward posterior end.

Phylum Rotifer
Philodina sp.

A large rotifer that is transparent with easily observed internal organs. Cilia form a rotating wheel organ on the head. The cilia stroke back and forth at very high speed creating a whirlpool that draws food to its mouth. This genera is commonly used in toxicity studies.

Phylum Rotifer
Euchlanis sp.

The lorica is transparent and encases most of the rotifer. It feeds on small microorganisms and debris. It uses its 2 rear appendages to move itself around.

Phylum Gastrotricha

Gastrotrichs are wormlike animals with lobed heads that are bilaterally symmetrical. The have adhesive tubes mainly near its posterior that help it cling to surfaces. Their bodies are not segmented and are flat. Their head lobe has small bristles on an oral hood.

Phylum Nematoda (roundworms)

Nematodes are cylindrical and slender with rounded ends, which attributes to this group being referred to as roundworms. They lack segmentation and cilia. Nematodes can be found in most habitats including soil, sand, salt flats, ocean, hot springs, and fresh water. There are also parasitic forms.

Phylum Platyhelminthes (flatworms)

These flatworms are ribbon-shaped and are adapted to many habitats including land, marine, and fresh water. They are noted for their extensive regeneration. They are not as complex as the annelids. They have an opening into the gut that acts as food in and waste out portal.

Phylum Platyhelminthes
Planaria

Planaria are easily recognized because their head region has two eyes that appear "cross-eyed." They are free living and eat decaying meat. They have a simple nervous system. Their excretory system consists of specialized "flame cells," that remove waste.

Phylum Annelida

Annelids have external segments that correspond with repeated digestive and reproductive organs. They live on land, in ocean and fresh water. Fresh water annelids include leeches and bristle worms. Most annelids are predators or scavengers. Swimming annelids actively feed on fish eggs and insect larvae.

Phylum Annelida
Oligochaeta
Pristina sp.

A segmented worm with characteristic hair setae in bundles along its dorsal side. Prostomum rounded to form proboscis at the anterior end.

Phylum Annelida
Oligochaeta
Chaetogaster sp.

Chaetogaster eats small crustaceans and insect larvae. The prostomium (mouth area) is well developed, pointed in shape with long sensory hairs. The dorsal side does not have setae (hairs), but can be found on the ventral side.

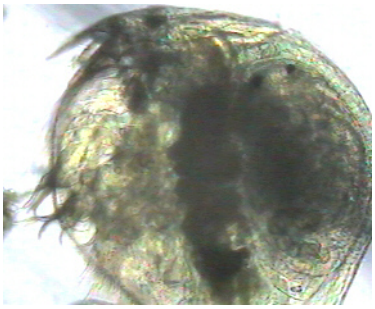
Phylum Annelida
Oligochaeta
Family Tubificidae (aquatic worms)

Aquatic worms are close relatives to the earthworm except they are smaller and live in shallow, fresh water. They feed on detritus, bacteria, and algae in the water. They use the same undulating motion that is common movement for earthworms.

Phylum Arthropoda

Arthropods compose the largest group of organisms on Earth. They are characterized by having an external skeleton with jointed limbs. They include both marine and fresh water groups. Some arthropods are total aquatic while others may only live in the water in their larval or nymph stages.

Crustacean
Subclass Branchiopoda
Cladocera (water fleas)
Macrothrix sp.



Water fleas have large antennae which they use for locomotion. They have large dual compound eyes above the antennae. Five-six feet are used to filter food (small algae) before it goes through its digestive system. You can also observe its very small heart.

Crustacean
Subclass Ostrocoda
Cypris sp.

Ostracods have characteristic two symmetrical shells that cover its body. The shrimp like critter lives inside. The shell is composed of calcium carbonate.

Crustacean
Subclass Copepoda
Cyclops sp.

Copepods do not have a shell but are slender and segmented. Cyclops is a common fresh water copepod that has one single eye spot. Females carry two sacs on their tail.

MEROPLANKTON

Meroplankton refers to organisms that live only part of their life in the plankton. Usually meroplankton has a complete or incomplete metamorphism. The early stages are usually planktonic and then they emerge either as a land or flying critter. Eggs of fish or other animals are included in this group. Other organisms include their larval or nymph stages. Some groups, like the dragonflies can spend up to 2 years as plankton and then emerge only to live on land for a few months.

Note: Consult "Quick Identification of Fresh Water Microorganisms" for approximate sizes of organisms shown in this section."

ARTHROPODA

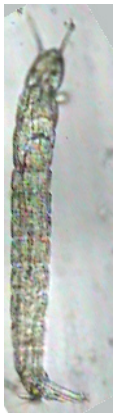
INSECTA

Order Diptera

This order includes many members that are in their larval and pupa stages and adapted to fresh water. The transition from larval and pupa may have very different forms. The larval stages may last several weeks or up to two years depending on species, temperature, and food availability. The skin usually molts 3 times. Adults are never truly aquatic. All aquatic representatives are legless although there may be pseudopods on the thorax or abdomen. Diptera include the common mosquito, midges, gnats, crane fly, and the common fly.

Order Diptera
Family Chironomidae

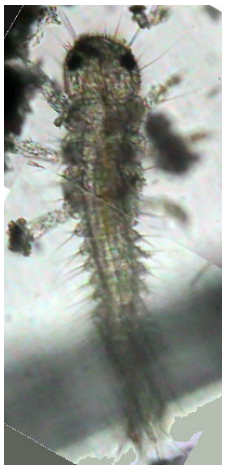
This group is referred to as non-biting midges because the adult mandibles are poorly developed. Larval chironomid species can help track ecological conditions. This group can tolerate polluted water. However, low numbers if found within a diverse population can indicate non-polluted conditions.



Order Diptera
Family Dixidae
Dixa sp.

Adult dixa midges are small insects that swarm around a pond or stream at dusk. Females deposit eggs in shallow water. The larvae have distinct thoracic segments and is U-shaped at rest. The pupa stage (photograph) is not truly aquatic, as they attach themselves just above the water.

Order Diptera
Family Culicidae (Culicinae)
Mosquito (Anopheles larva)



Culicidae larvae are easily distinguished because their thoracic segments are fused and thicker than the rest of the body. They mainly feed on algae, protozoa, and organic debris by using their bristles. The larvae lie quietly on the surface and have a characteristic wiggling motion.

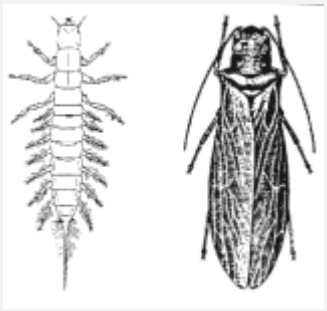
Order Diptera
Family Culicidae (Chaoborinae)
Phantom midges

Similar to mosquito but the adults do not bite. The larva are called phantom because they are transparent. They have jerky, lashing movements of the body. The larva is predatory and catches small crustacean and other larvae with their antennae.

Order Ephemeroptera
Mayflies

Small to medium terrestrial insect with incomplete metamorphism. Its wings are delicate and held together at rest. The have large compound eyes with a reduced mouth because the adult does not eat, as it lives for a few hours to a week. The nymphs however are herbivores and browse on the substrate. The nymphs have three occasionally two distinct cerci (tails). Cerci may be fuzzy or thread-like. Nymphs are climbers, bottom crawlers, or burrowers.

Order Megaloptera
Family Sialidae (alderflies)
Neochauliodes bowringi



Adults are 10-70 mm with two pairs of wings held over their body at rest. Head has a long slender antennae and biting mouth parts. The larva has a single tail filament with distinct hairs. Segments of abdomen have 6 to 8 filaments on each side. Not tolerant to pollution.

Order Odonata
Zygoptera (damselflies)
Argia agrioides (California dancer)`

Nymphs are elongated with three paddle-like tails. Two large eyes on top of head. Nymphs are carnivorous, feeding on other aquatic invertebrates.

Order Coleoptera
Family Gyrinidae (Whirligig beetles)

Beetles are black, shiny, oval and ventrally depressed. Adapted for rapid locomotion with its middle and back legs which are flattened and paddle-like. Frequently fly but unable to take off from the surface, but can dive. Larva and pupa stage tends to be in the mud and not in the water column.

Order Hemiptera
Family Corixidae (Water boatman)
Corixa sp.

Water boatman* are totally aquatic. Nymphs develop through 5 growth stages or instars. Like all aquatic bugs they lack gills, so they need to breathe at the surface. Most eat algae while some eat mosquito larva and other small aquatic organisms.

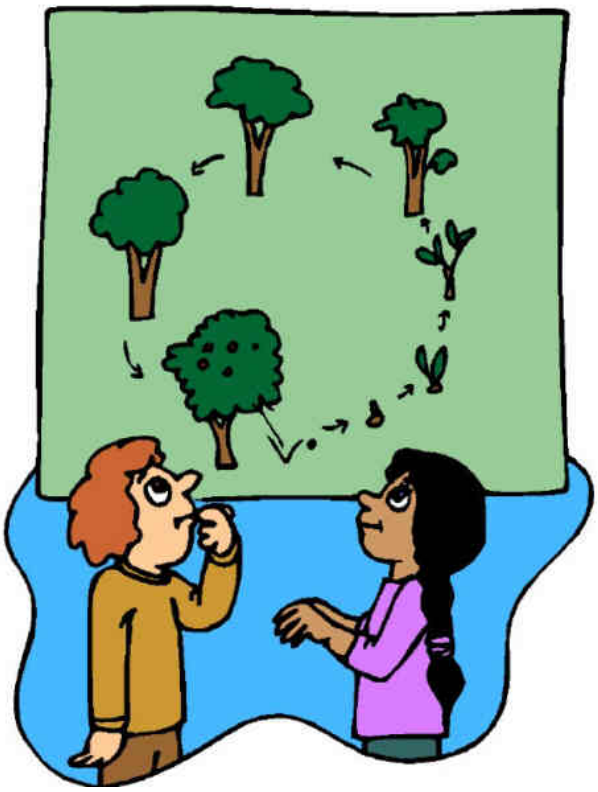
* Boatman are strong swimmers as adults. So technically not planktonic. We include them in the meroplankton section for that reason.

Order Hemiptera
Family Gerridae (Water Strider)
Gerris gibbiffer

The adult lives around water. Belly is covered with hair. Short front legs are used to catch prey while back legs are used to steer and move. They are predators and scavengers. They eat other small insects that fall in water or eat larvae. Striders stay on top of water because of surface tension.

Chapter 5.

LESSON PLANS



Mission Creek can provide children with an outdoor experience to illustrate many environmental concepts. It can give students an appreciation of their surrounding, and as they walk along the creek to school it will enforce the learning. If they walk with their parents or friends, children will repeat what they learned. This section provides some ideas and lesson plans for different grade levels.

Mission Creek Self Guided Tour

between Palm Ave and Driscoll Road

The Mission Creek Restoration Project is an opportunity to look at the dynamics of a creek. As you walk down the trail you can envision how Fremont looked when early settlers came to this area. The plants provided food for many of the inhabitants of the region, while the critters in the creek provided food for larger animal. As humans, we need to appreciate and understand how streams work and why it is important to keep our waterways clean and flowing.

Recommended Grades: Primary to Secondary

Subjects: Physical Education, Social Studies, Science, Art

Background:

Fremont has been slowing metamorphosing from an agricultural area to suburban to urban center. Some of the children living in Fremont are unfamiliar with ecological principals or the joys of natural environments. Past generations of children used the creeks as their playground, now many children don't even realize we have creeks in Fremont.

The Mission Creek Trail between Palm Ave and Driscoll can act as a vehicle that can enforce many cross curriculum principles.

Activities:

Primary:

Science: Mission Creek has abundant insects, worms, and many creepy crawlies. All grades can visit the area and see critters and plants. Just to visit and see the difference between spring and winter is information that will stay with a child forever. Students can love science if they realize that observing and record information in a place like Mission Creek is science.

Literature: Students can learn many terms just by observing a creek. Students can find words that help them describe what they see. Math terms also help them descript especially geometry. For example, how many leaves are on a branch and how are they arranged. This helps build students descriptive language.

Social Studies: Mission Creek was a valuable waterway not only for the Ohlone Indians but the early setters. It provided the needed water that was essential to live.

Physical Education: Walking and appreciating nature can be a lifelong hobby. It is an excellent way to keep healthy.

Secondary:

Science: Mission Creek is an outdoor lab to collect data. Students can use the area to observe water flow patterns as well as changing of wind patterns. The microorganisms that live in the creek acts as a real look at nature under the microscope, not just a store purchased slide.

***Literature*:** Students can use the creek to learn how to use nature as a metaphor to life. Many words that we use to describe our road through live can be used as a comparison to nature. For example, a trouble youth meanders his life from one decision to another.

***Physical Education*:** Students can use the trail to run or just to walk along. Students should also be aware that when they make short cuts through the vegetation, they might be disrupting a habitat.

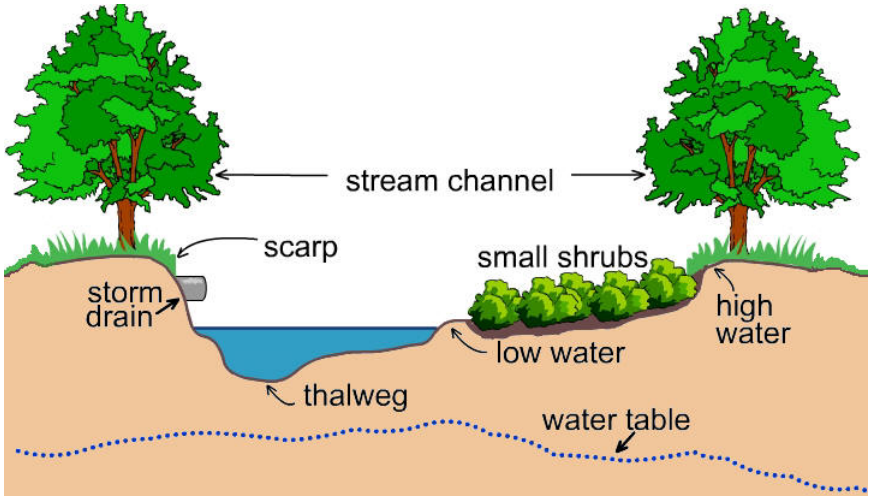
The guided tour information below takes you from Palm Ave toward Driscoll Road, the area restored in 2003.

Mission Creek Watershed

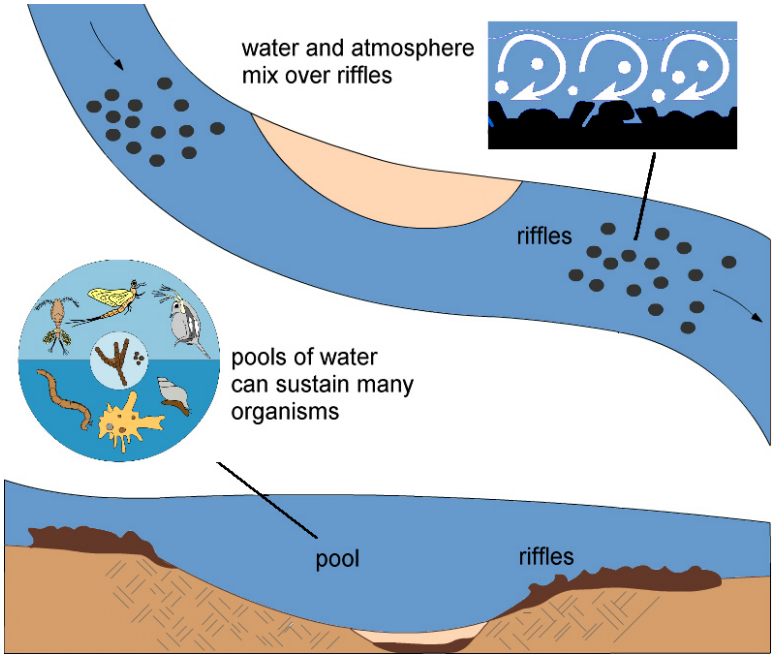
Water starts flowing from springs at Mt. Alison, near Mission Peak. The creek flows along Mill Creek Road and passes by the Mission San Jose. Vargas Creek joins Mission Creek under the 680 Freeway. It continues to flow downhill toward Lake Elizabeth where it is joined by Morrison Creek. Mission Creek continues to flow alongside Lake Elizabeth, bringing nutrients and water to Stivers Lagoon. Mission Creek divides under Paseo Padre into Laguna Creek and Irvington Creek.

Elements of Mission Creek Stream Corridor

Many forces create Mission Creek's stream channel over time. The abundance of water (surface or ground), type of rock, soil composition, biological growth, and tectonic forces are all at work. Creekside vegetation is referred to as the "riparian zone." It helps protect the stream channel while providing habitat for organisms who use the creek.

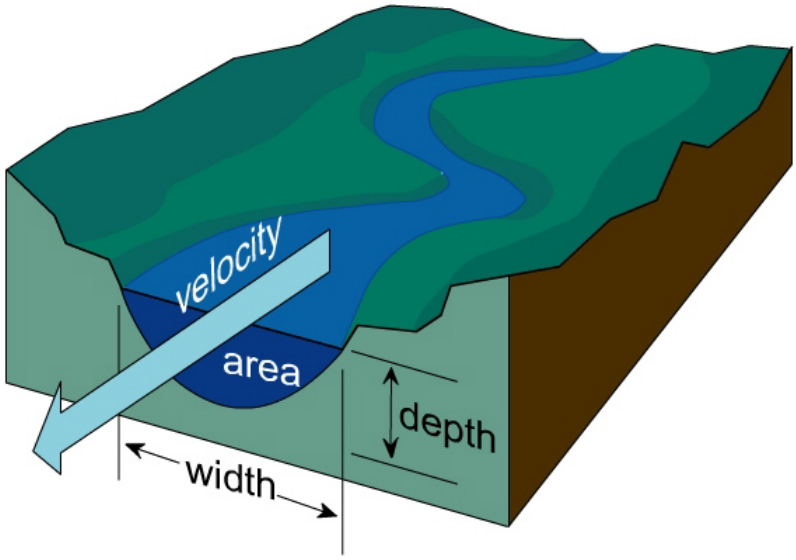


Pools and Riffles



A stream can be a challenge for organisms that live in water. Flowing water can move mud, sand, and gravel. The faster the water flows the larger the particles it can move. As the water slows, particles will settle out and be deposited. High velocity can scour areas that create pools, which support plankton (floating organisms), and larger animals like frogs and fish. Riffles, or areas of gravel help provide dissolved oxygen as the water mixes with the atmosphere. Organisms require dissolved oxygen to live.

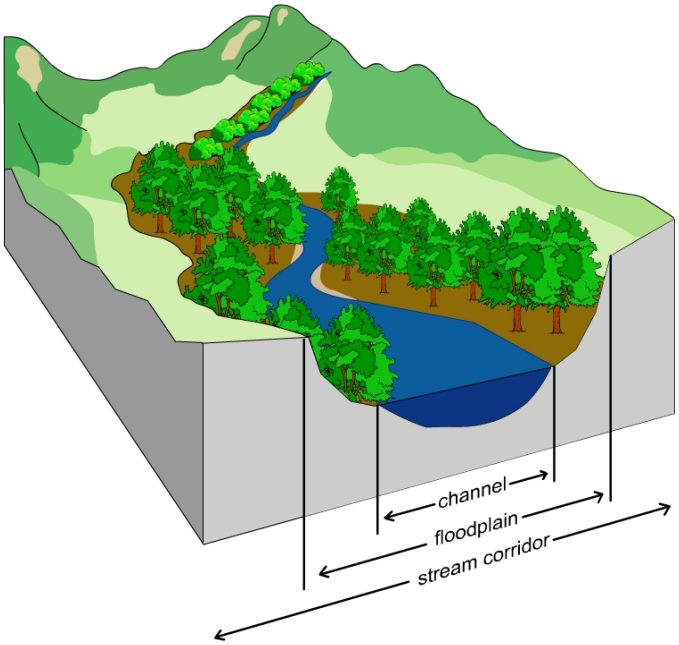
Erosion, A Natural Part of Creek Evolution



A stream channel is created and maintained by its energy flow. The erosion in Mission Creek is the result of topography, rock type, soil cover, climate, ground water, and vegetation. Erosion of the stream bed increases when velocity of the flow increases. Soil and rock particles are detached when energy is highest. In low energy areas particles will be deposited. A stream is always changing.

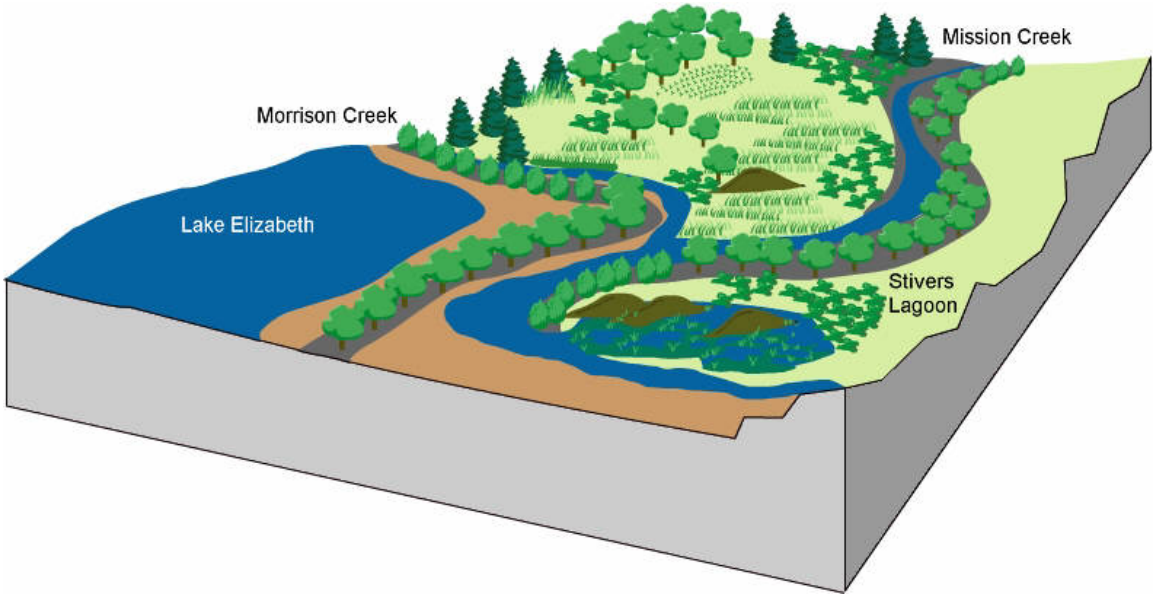
Tree Canopy Provides Healthy Conditions

Trees create many habitats for different organisms throughout the stream corridor. Shade protects aquatic organisms by helping to lower the water temperature during the summer In the winter the canopy provides protection from the effect of storms. Tree roots assist in reducing erosion within the floodplain.



Biological Bonanza Downstream

Dissolved nutrients from the upper reaches of Mission Creek, flow downstream until it finds a topographically level area. Mission Creek and its tributary, Morrison Creek feed into Stivers Lagoon alongside Lake Elizabeth. Stivers Lagoon is a fresh water marsh, providing habitat for local flora and fauna.



TOPOGRAPHY AND GEOGRAPHY

These lesson plans have students observe different portions of topographic maps and try to determine the flow of Mission Creek and all its tributaries. Topographic maps show a 3 dimensional world in 2 dimensions by using contour lines, or equal lines of elevation.

A **watershed** or **drainage basin** refers to a system controlled by topography that defines how water will flow. You refer to a watershed by the largest body of water that the creeks, rivers or streams feed into. For example, all creeks that flow in the San Francisco Bay are part of the San Francisco Watershed. However, there are many smaller watersheds within this area depending on flow patterns. The Mission Creek Watershed would represent all tributaries that flow into Mission Creek. When Mission Creek divides at Paseo Padre is the end of the Mission Creek Watershed.

A watershed has an orderly flow pattern. The pattern is **dendritic** or branching, as it flows from the headwaters to a larger body of water. When one stream flows into a larger stream or river they are called **tributaries**. The smallest channels in a watershed with no tributaries are called first order streams. A second order stream is when two first order streams join. If you look at the stream order diagram, you can see the creation of a fifth order stream channel. Fifth to sixth order streams are usually larger rivers, while first and second order are often small, steep, or intermittent.

Defining the Mission Creek Watershed

Recommended Grades: Secondary

OBJECTIVES

- Define a watershed.
- Trace and locate places on topographic maps.

MATERIALS

- Copies of 2 sections from Niles Quadrangle and one from LaCosta Quadrangle Topographic Map
- Student Sheet "Defining the Mission Creek Watershed"

BACKGROUND

What is a watershed? Almost all the area of a watershed is land, not water. By definition a watershed is the land area from which water, sediment, and dissolved material drain to a common watercourse or body of water. Did you know that you live on a watershed? We are fortunate living in Fremont to be able to access and study the Laguna Creek watershed, which is actually part of the larger Coyote Watershed, which includes southern Fremont and parts of Santa Clara County (delineated by U.S. Geological Survey). When studying watersheds, it is important to understand all of the factors which effect the watershed system. Factors include climate, physical features, soil, geology and vegetative cover.

In this unit, students will study and trace the path of Mission Creek and locate other places on a section of the Niles and LaCosta Quadrangles from the U.S. Geological Survey.

PROCEDURE

Students should use the sections copied from U.S. Geological Survey 7.5 minute quadrangles and answer the questions on the worksheet. If students are unfamiliar with the symbols used on the map, please refer to our lesson online on "Map Reading" and "Maps as a Tool." You can find them by using the following url: http://msnucleus.org/membership/html/jh/earth/index.html

ANSWERS:

2.a. type of rocks; b. velocity of water; c. vegetation; d. topography

6. A benchmark is a measured elevation

9. The contours are “pointing” in a different direction

10. flow of water through a human made channel

12. holds water, but geological a sag pond caused by faults

13. 2517 ft

16. east

19. The friction of the fault causes heated water, hence warm springs

Defining the Mission Creek Watershed

QUESTIONS

1. Describe a watershed in your own words

2. Give two examples of how factors can affect a watershed along its course.

3.On each map put an arrow that points to North.

La Costa Quadrangle Section A.

4. In the southwest corner find Mt. Allison and label it. (hint: 2286')

5. Draw the trace of the Mission Creek headwater. Remember this continues onto the Niles Quadrangle.

6. Circle Bench Mark (BM) 533. What is a benchmark?

7. Circle the area of Haynes Gulch. What is a gulch and how do you know from the topography that this is a Gulch? (Hint: look at the contour lines.)

8. Draw a line on the trace of high power lines. (Hint: find the word "tower."

9. Circle Leyden Creek. Is the water flowing in the same direction as Mission Creek or the opposite direction? How do you know?

10. Trace the line of the "Aqueduct." What is an aqueduct?

Niles Quadrangle Section B.

11. Trace Mission Creek (hint: parallels Mill Creek Road in some places) to St. Joseph's School, near Mission Blvd.

12. Circle Mission Reservoir. What is this feature?

13. Circle Mission Peak? What is the altitude of Mission Peak?

14. Trace Aqua Caliente Creek. Is it flowing into Mission Creek? How do you know?

15. Trace the electricity lines. This power comes from generators near Yosemite. These lines help move the electricity to the city.

16. Is Mission Creek east or west of Mission Peak?

17. Circle Benchmark 192.

18. Trace the line of line that shows the city limits of Fremont.

19. Circle Warm Springs. Trace Aqua Caliente Creek. This area has warm water. Why?

Niles Quadrangle Section C.

20. Circle Stivers Lagoon and Lake Elizabeth.

21. Trace Mission Creek to Stivers Lagoon. Near Stivers it splits into 2 Creeks, Irvington and Laguna Creek. Trace the split into the two creeks.

22. Trace Vargas Creek. Where does it meet Mission Creek?

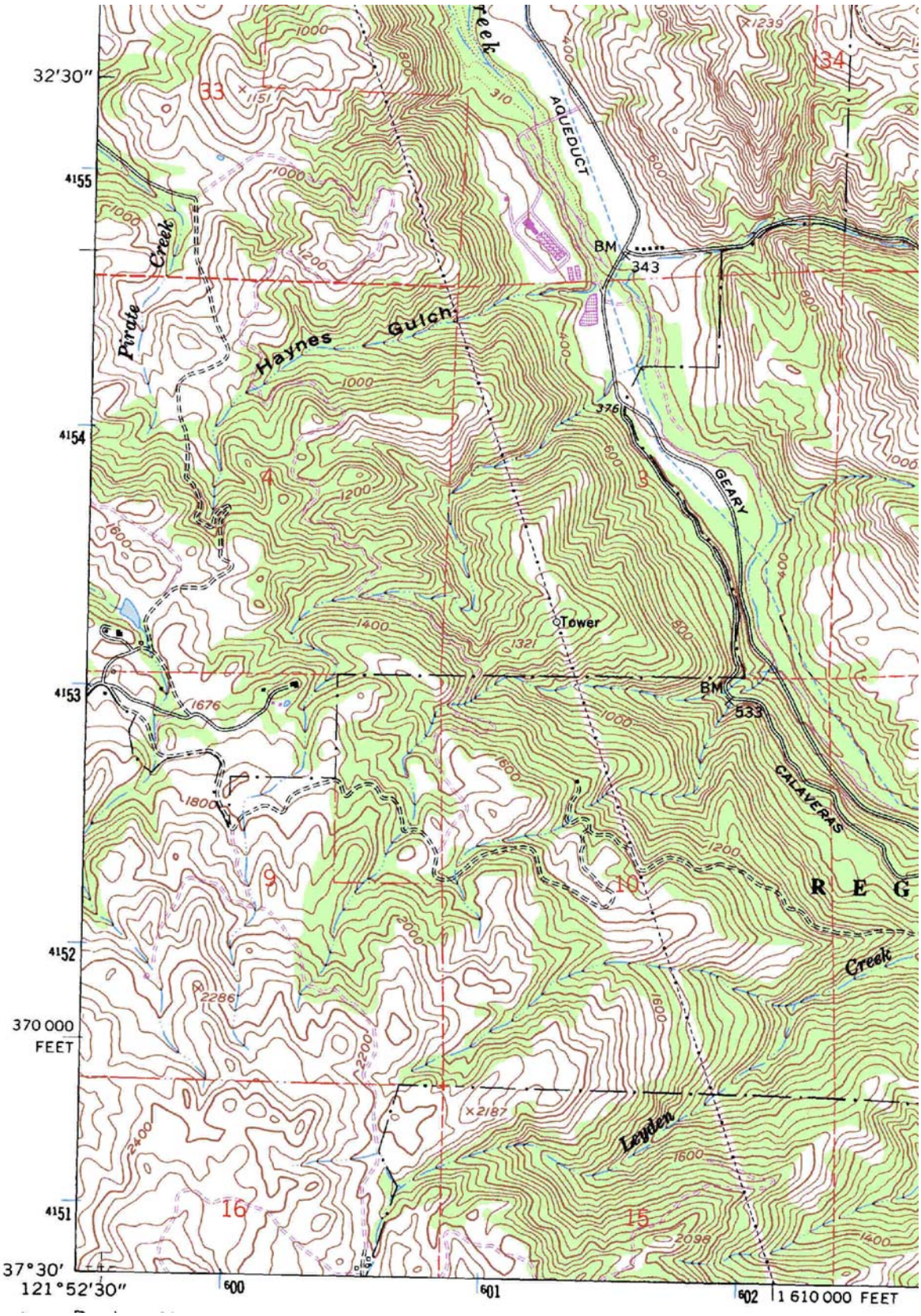
23. Circle Hopkins Junior High, Chadbourne Elementary, and Mission San Jose High School.

24. Gomes Elementary School is not written on the map but if you continue Mission Creek toward Lake Elizabeth you will see a large open area. Label that Gomes Elementary School.

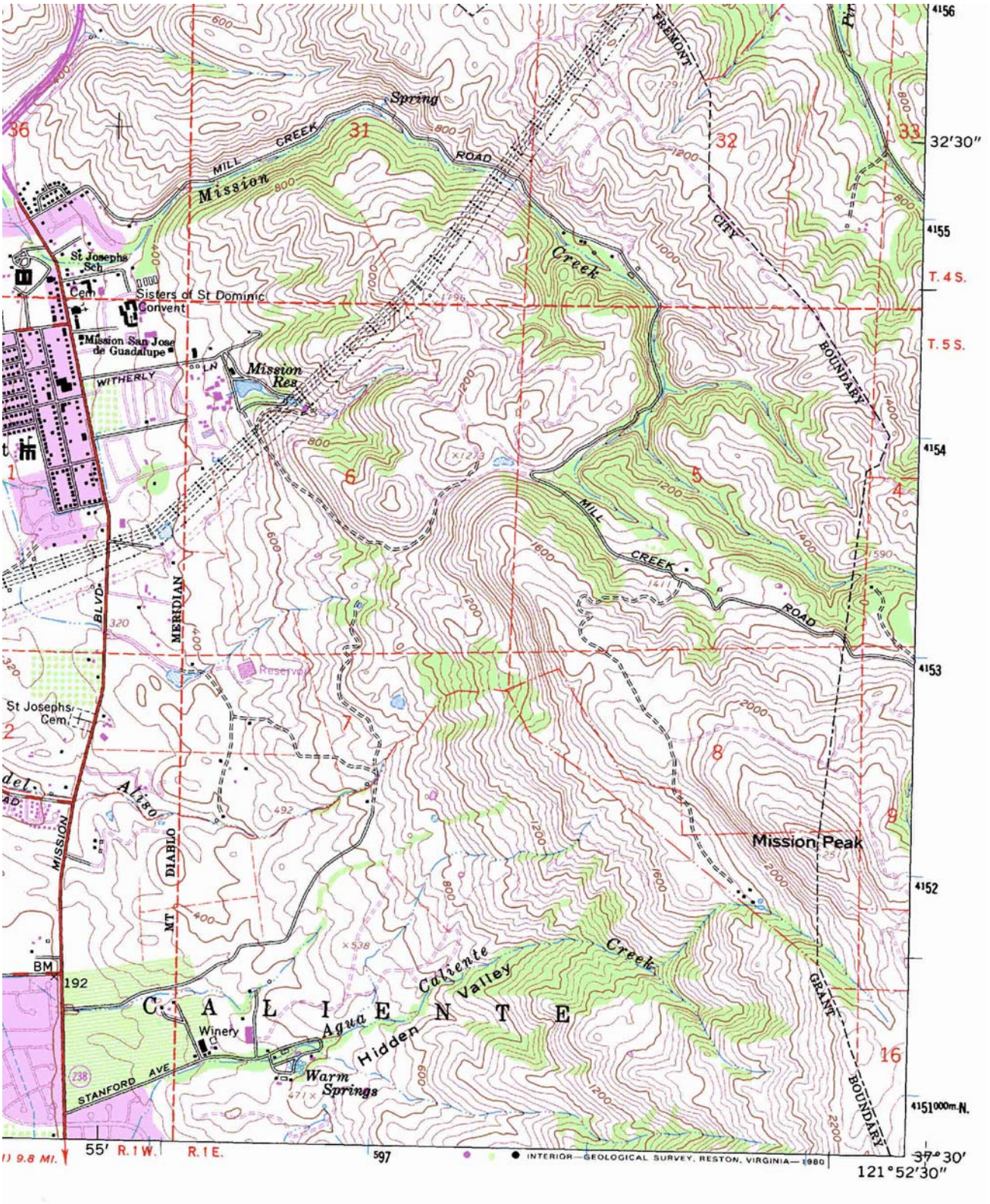
24. Circle the Irvington Pumping Station. Trace a line of the double dashed lines. This is the trace of Hetch Hetchy water line that brings water from Yosemite area to San Francisco. Fremont uses some of this water in their drinking supply.

25. Circle Benchmark 70 and 93.

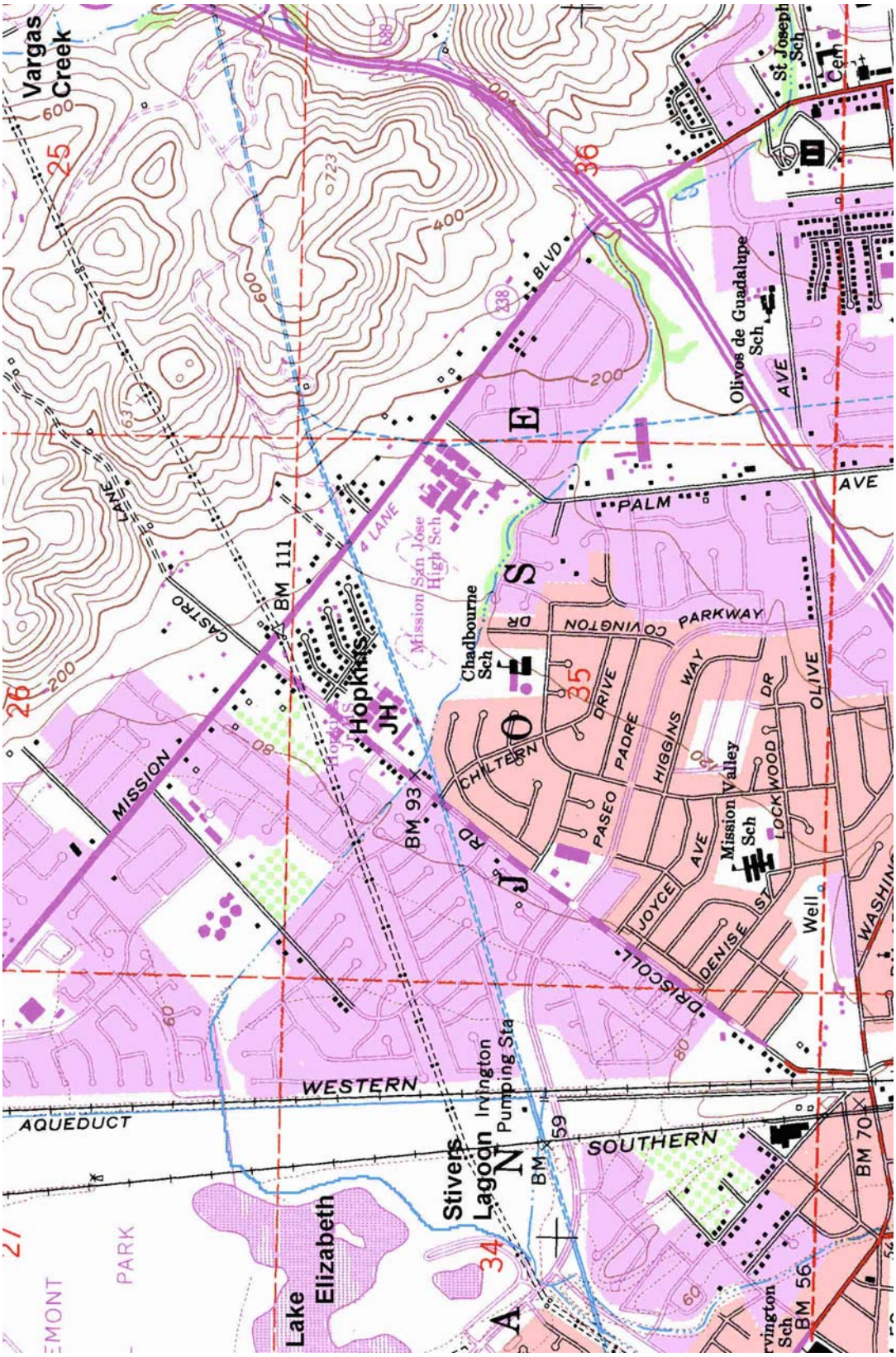
26. Trace the high voltage electricity lines (hint: double dashed lines with dots).



La Costa Quadrangle Section A (north is on top)



Niles Quadrangle Section B (north is on top)



Niles Quadrangle Section C (north is to left)

ORGANISMS OF MISSION CREEK

The vegetation in watersheds affects the quality of the water. Grasses, shrubs, and trees make up the majority of plant cover. As they fall and decompose, they add the organic components to the soil. Trees are the protectors of the watershed. The tree litter protects the soil's surface as the roots of the tree protect the soil from erosion. Trees also provide a canopy that keeps the water cool so organisms don't die of thermal pollution. The **canopy** can also reduce the force of the rain and the velocity of wind in a watershed.

Plant cover is important to a watershed to prevent the erosion of valuable soil as water rushes downstream. Plant cover also provides food and protection for many small organisms.

The green zone along a stream ecosystem is called a **riparian** area and has several unique properties. Riparian zones have the capacity to buffer rivers and other waters from runoff from agricultural, urban, or other areas. Healthy riparian zones can absorb sediments, chemical nutrients, and other substances contained in runoff.

Riparian areas provide all the components needed for a wildlife habitat including food, water, and cover. Diversity of organisms living in these wetland areas is very high. A riparian habitat includes three areas depending on the influence of water. The aquatic area refers to the area that is the stream channel or pond. The organisms that live in this area must be adapted to a wet lifestyle.

These following lesson plans can help your identify and learn about the diversity of organisms along Mission Creek.

Aquatic Life

Recommended Grade: Primary

Background Information:

1./Mosquito pupa – All mosquitoes go through different life stages before they become the flying and biting insects that most students are familiar. They start as eggs in water and hatch as mosquito larva. They molt their exoskeletons and change into the pupa stage. This stage is a resting, non-feeding part of their life. When development is complete they transform into a flying mosquito. It takes a mosquito from 10-14 days to go from egg to flying insect depending on species and water temperature.

2. Copepod - Copepods are diverse aquatic crustaceans that are founds in habitats ranging from fresh to salty conditions. Free living copepods feed on bacteria, diatoms, an other unicellular organisms. Eggs are carried in cluster in one or a pair of air sac attached to the base of the female abdomen. They have characteristic antennae from the head region.

3. Phantom midge – This is a stage prior to its transformation into a non-biting midge fly. The phantom midge is transparent with large mouth parts and eyes. Sometimes they are referred to as "ghost worm." They filter water with their mouthparts to get food. The midges eat cladocera, copepods, and other small aquatic animals. Phantom midges are eaten by water spiders.

4. Cladocera – "Water flea" is the common name for fresh water Cladocera, a large group of fresh water Crustacea. They have a transparent carapace (shell) that covers its shrimp-like body. This group helps to determine the health of a lake as different species are used in toxicity studies.

5. Worm (leech) - Leeches belong to the invertebrate annelid (worm) group. It is flattened lengthwise and has a sucker-feeding apparatus at each end. They feed on decaying animals and plant debris. An abundance of leeches in water usually indicate very poor water quality.

Procedure: This coloring exercise helps students focus on major components of plankton. We suggest to go over the different groups prior to having students color or look under the microscope.

Aquatic Life

Identify the following by making a color legend

Mosquito pupa

☐

Phantom midge

☐

Copepod

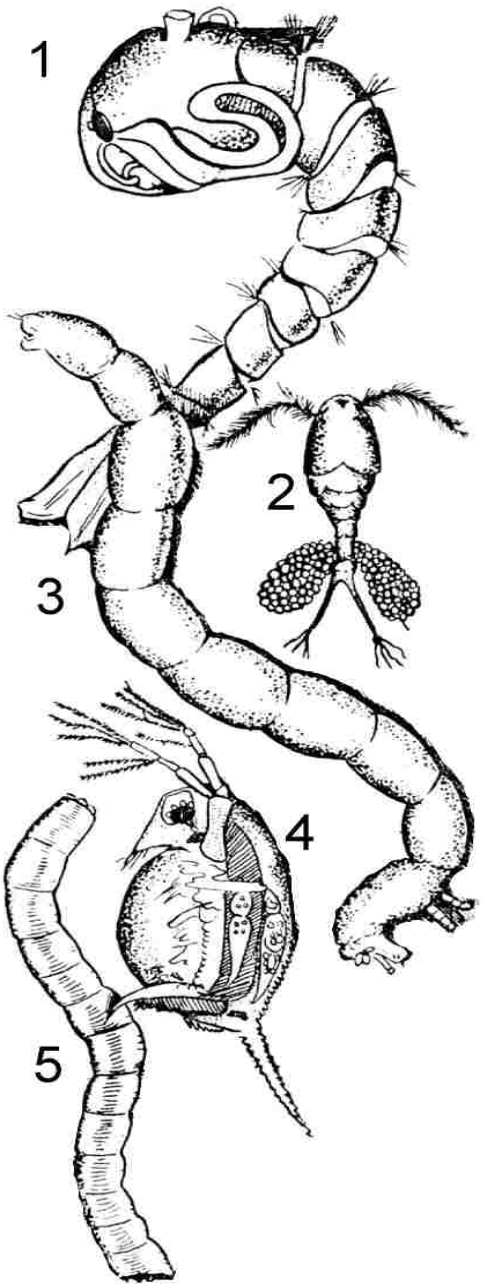
☐

Cladocera

☐

Worm (leech)

☐



Bioassessment Techniques

Recommended Grade: Secondary

Background

The diversity, abundance, and condition of fish, insects, algae, plants, and other organisms are used to determine the health of specific bodies of water. Studying these factors is called biological assessment.

Bioassessment is an effective but qualitative way at looking at the health of water. Aquatic plants and animals constantly exposed to the effects of changing environmental conditions including biological, physical, geologic, and chemical conditions. It is a valuable tool to monitor and how to interpret what is found to decide how to control the health of the waterways.

Procedure

Students need to learn to identify the organisms first. Included in this lesson is a guide to identification of fresh water microorganisms. It is intended to be an quick way to try and get students motivated to identify the organisms. You can collect samples using a net or a jar. Make sure you include plant material, since most of the organisms would be feeding on decaying material.

Depending on the type of microscopes you have will depend on the detail of these lessons.

On the sheet that says “Mission Creek Stream Study,” have the students record what they see.

Mission Creek Stream Study

use “Guide to Identification of Fresh Water Microorganisms”

Date:_____ Site Number _____

Investigators _____

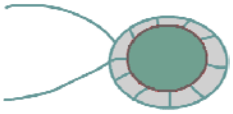
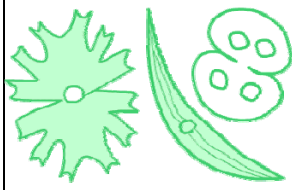
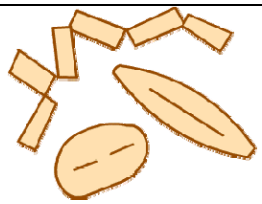
Weather conditions _____

SENSITIVE	SOMEWHAT SENSITIVE	TOLERANT
❑ Caddisfly larva	❑ Riffle beetle larva	❑ Aquatic worms
❑ Dobsonfly larva	❑ Cranefly larva	❑ Blackfly larva
❑ Mayfly larva	❑ Dragonfly larva	❑ Leeches
❑ Stonefly larva	❑ Alderflies	❑ Midge larva
❑ Water penny	❑ Clams	❑ Lunged snails
❑ Gilled Snails	❑ Whirligig	
❑ Riffle beetle adult	❑ Damselfly	
❑ Planarian		

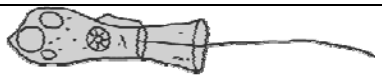
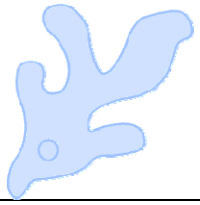
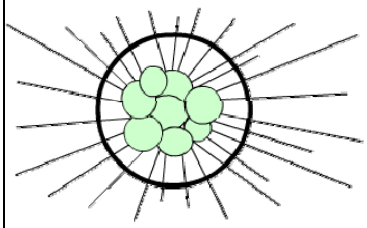
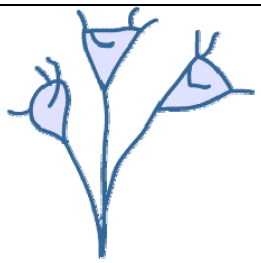
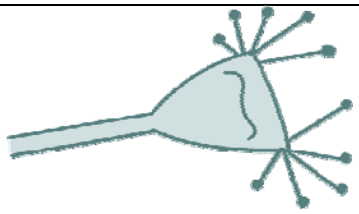
Describe or draw what you see in your samples.

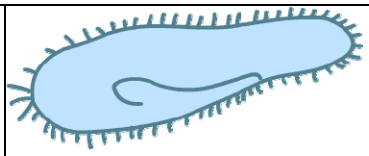
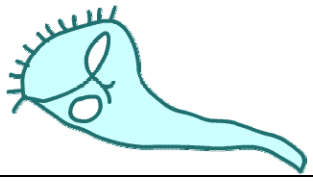
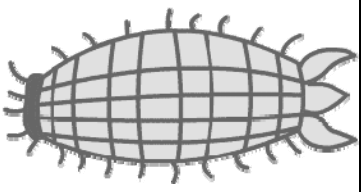
Guide to Identification of Fresh Water Microorganisms

Microscopic autotrophic organisms (i.e. algae)

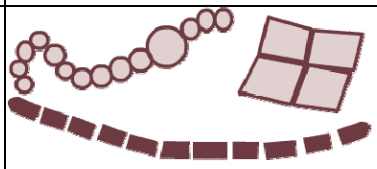
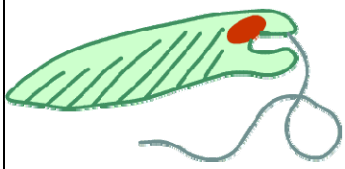
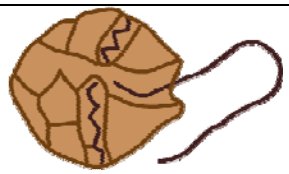
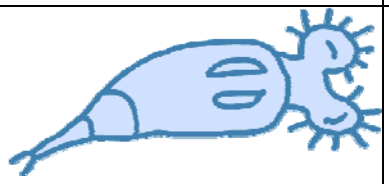
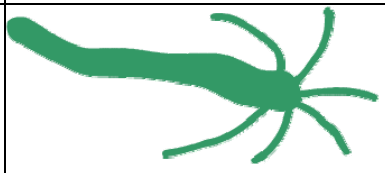
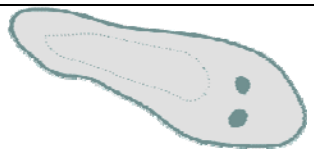
Name	Picture	Characteristic	Taxonomy
Green algae (with flagella, small) <.05 mm		1. flagella 2. small 3. solitary 4. rapid movement	Phylum Chlorophyceae i.e. *Chlamyolomonas* sp.
Green algae (with flagella) .5-2mm		1. spherical 2. colonial 3. with two flagella	Phylum Chlorophyceae i.e. *Volvox* sp.
Green algae (no flagella) <.5 mm		1. spherical to conical 2. not attached to surface 3. no movement	Phylum Chlorophyceae i.e. *Pediastrum* sp.
Filamentous green algae <.1 mm – cms		1. non branching 2. chains of cells with chloroplast 3. no flagella	Phylum Gamophyceae i.e. *Zygnema* sp. *Spirogyra* sp.
Desmids <.5 mm		1. green 2. no flagella 3. mainly solitary, some colonial 4. various shapes 5. two semi-cell, mirror image	Phylum Gamophyceae I.e. *Desmidium* sp *Closterium* sp.
Diatoms <.5 mm		1. one cell 2. slow gliding motion 3. solitary or colonial 4. cell wall (frustules) made of silica	Phylum Bacillariophyceae i.e. Pennales, Centric

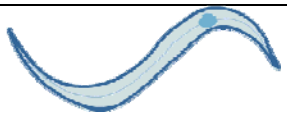
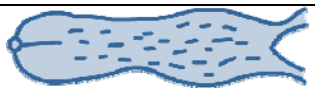
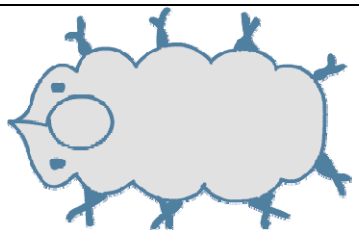
Protozoa – heterotrophic only

Name	Picture	Characteristic	Taxonomy
Flagellates <.5mm		1. one or more flagella 2. colonial or free living 3. with or without lorica	Zoomastigophora i.e choanoflagellates
Amoeba .02 –5 mm		1. pseudopodia 2. slow movement 3. engulfs food	Sacrodina Order Amoebina i.e. *Amoeba proteus*
Shelled Amoeba .1-.4 mm		1. amoeba with a shell, usually sand grains 2. pseudopodia 3. slow movement	Sacrodina Order Testacea i.e *Arcella* sp.
Heliozoans .01-1 mm		1. spherical 2. radiating hair like pseudopods 3. no movement	Sacrodina Order Heliozoea
Ciliates – Peritrich < .25 mm		1. cylindrical or bell shaped bodies 2. undulating cilia 3. some stalked 4. often colonial 5. attached to different substrate	Ciliophora Order Peritrichida i.e. *Vorticella* sp.
Ciliates – Suctoria <.7 mm		1. no cilia, sticky tentacles 2. some attached to other organisms (i.e. *Suctoria*)	Ciliophora Order Eridogenida i.e. *Tokophyra* sp.

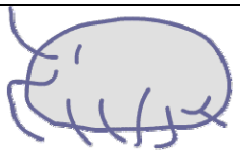
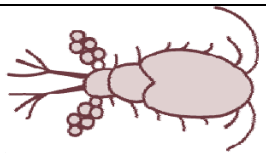
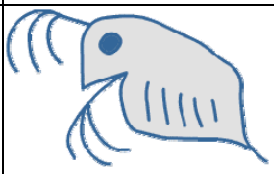
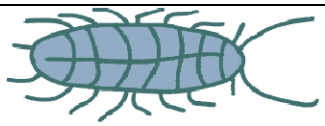
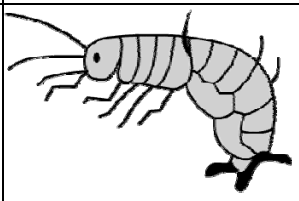
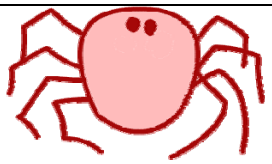
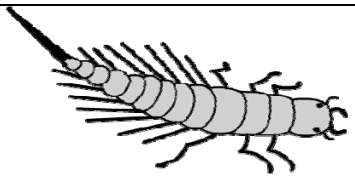
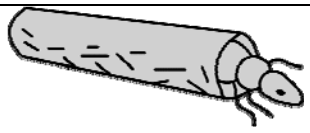
Ciliates Paramecium .01 – 4mm		1. mostly free living forms 2. cell of fixed shape 3. movement by contraction and use of cilia 4. fixed mouth and anal pore	Ciliophora Order Oliogohymenophorea i.e. *Paramecium* sp
Ciliates Stentor .01 – 4 mm		1. large body 2. contractile 3. cilia on mouth end	Ciliophora Orer Heterotrichea i.e. *Stentor* sp.
Ciliates Coleps .01-4mm		1. barrel-shaped 2. spinous projection at posterior end 3. cytosome apical	Ciliophora Order Prostomatea i.e. *Coleps* sp.

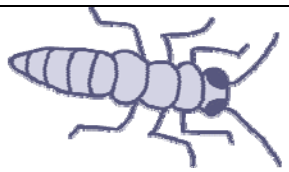
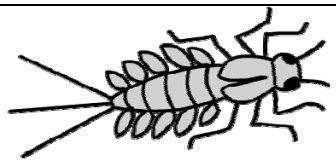
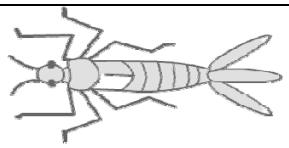
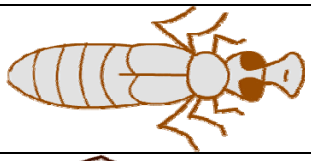
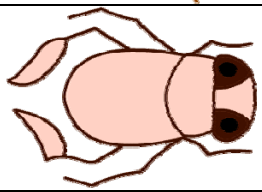
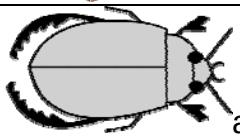
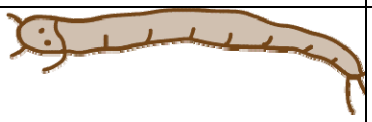
Other fresh water plankton (Animalia, Monera, etc)

Name	Picture	Characteristic	Taxonomy
Blue-green algae (cyanobacteria)		1. blue green color 2. gliding movement 3. prokaryote	Kingdom Monera i.e. *Annabella* sp.
Euglenoids <.4mm		1. sometimes green 2. flagellate 3. red eye spot	Phylum Euglenida i.e. *Euglena* sp.
Dinoflagellates <.4mm		1. free swimming 2. tough armor 3. flagellate 4. autotrophic, heterotrophic	Phylum Dinoflagellate
Rotifers .4mm - 2 cm		1. corona with cilia 2. hairy appendages 3. transparent with lorica 4. free swimming or attached 5. organs, compressed body	Phylum Rotifer Class Bdelloided Class Monogononta
Hydra 2 cm		1. green brown or colorless 2. body and tentacles contract and stretch 3. primitive organs	Phylum Cnidaria i.e. *Hydra* sp.
Flatworms 1-15+ mm		1. flattened 2. eye spots 3. move in gliding motion	Phylum Platyhelminthes Class Turbellaria I.e. *Planaria* sp.

Roundworms .2-10 mm		1. moves in rapid "s" form 2. round body 3. bilateral 4. anterior, posterior openings	Phylum Nematodes
Oligochaetes 1.5 mm - >2 cm		1. segmented 2. worm motion 3. hair bundles (setae)	Phylum Annelida Class Oligochaeta
Leeches > 1 cm		1. predatory or parasitic 2. terminal suckers 3. hermaphroditic	Phylum Annelida Class Hirudinea
Gastrotricha .1-1.5mm		1. mainly benthic 2. head bristles 3. eat algae, bacteria, protozoa	Phylum Gastrotricha Order Chaetonotida
Tardigrades Little water bears < 1 mm		1. head and 4 trunk segments 2. 4 pair legs 3. eyes 4. herbivores	Phylum Tardigrada

Arthropods - segmented, exoskeletons

Name	Picture	Characteristic	Taxonomy
Ostracods <2mm		1. bean-like shell 2. filter feeders 3. bivalve carapace	Class Crustacea Order Ostracoda i.e. *Cypris* sp.
Copepods .5-3mm		1. long antennae 2. tiny eyespot 3. holoplankton	Class Crustacea Order Copepoda
Water fleas .3-10mm		1. antennae 2. large compound eye 3. holoplankton	Class Crustacea Order Cladocera i.e. *Daphnia* sp
Isopods 5-20mm		1. flattened 2. 7 pairs legs 3. scavengers	Class Crustacea Order Isopoda
Amphipods 5-25mm		1. curved 2. compressed body 3. humped back 4. scavengers	Class Crustacea Order Amphipoda
Water mites .5-5mm		1. 8 legs 2. round body 3. larvae (parasitic) 4. nymph looks like adult	Class Arachnida Order Acarina
Alderfly nymph 5-25mm		1. one tail 2. long filaments along the abdomen 3. meroplankton	Class Insecta Order Megaloptera Family Sialidae
Caddisfly larva 3-40mm		1. cylindrical case for protection 2. distinct case but different materials	Class Insecta Order Trichoptera

Stonefly nymph <15 mm		1. two jointed tails (cerci) 2. carnivorous 3. indicates clean water	Class Insecta Order Plecoptera
Mayfly nymph <15mm		1. three jointed tails0 2. leaf-like gills on sides	Class Insecta Order Ephemeroptera
Damselfly Nymph <15mm		1. three leaf like tail appendages (gills) 2. extendable jaws	Class Insecta Order Odonata Zygoptera
Dragonfly nymph <15mm		1. robust 2. no tail appendages 3. extendable jaws	Class Insecta Order Odonata Anisoptera
Water boatman nymph.and adult 10-15mm		1. no jaws 2. tube-like beak 3. nymphs don't have wings	Class Insecta Order Hemiptera Family Corixidae
Water beetle <45mm	 adult	1. strong jaws 2. tough shield 3. fierce predator	Class Insecta Order Coleoptera Family Elmidae
	 nymph	1. strong jaws 2. long segmented body 3. short legs	
Mosquito larva 1-20 mm		1. long slender body 2. moves in undulating s curves	Class Insecta Order Diptera

Drawings redrawn from http://www.microscopy-uk.org.uk/pond/index.html

ANIMALS OF MISSION CREEK

Drawings by Vicky Eggert, Ranger

Recommended Grades: primary

Headbands

- Turkey Vulture
- Scrub Jay

Have the students color and cut out. Extend the sides with paper so it will fit around the child's head.

The **Turkey Vulture** has a red orange head without feathers. The beak is yellowish and the feathers are brown.

The **Scrub Jay** is mainly blue with white bands and black-brown beak.

Red shouldered hawk Glider

1. Copy to heavy stock paper.
2. Color the glider.
3. Cut out
4. Assemble. Slide the wings through the slit in the middle of the body so your hawk can fly. Attach the tail to the body at the slits. You just cut and you will be done.

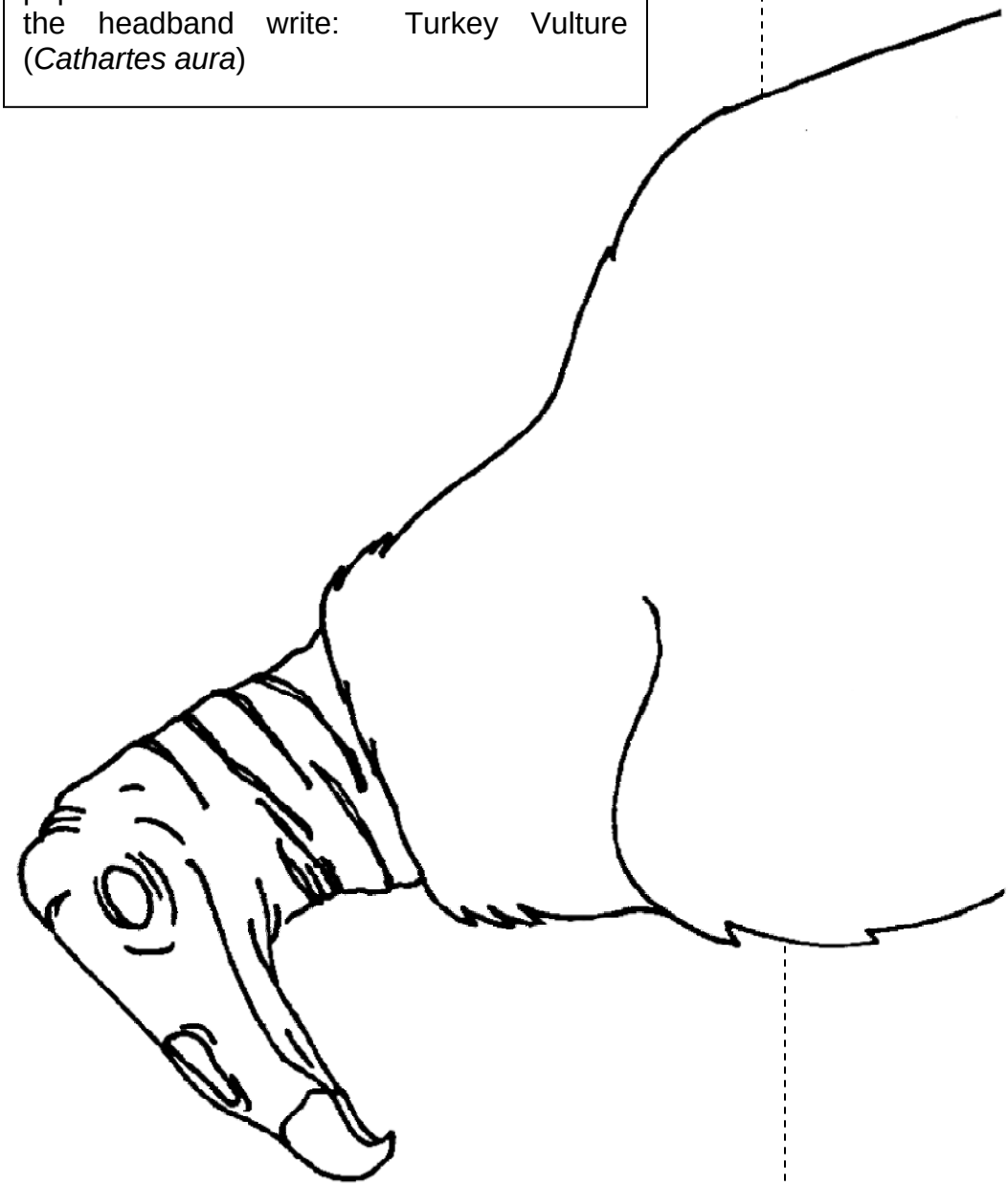
The reddish shoulder patches that give this hawk its name are not easily visible, except at close range. Under parts are pale rust with horizontal barring. From below, this hawk shows translucent "window" patches at the base of the primaries, and narrow white bands on a dark tail. Immature hawks are brown above, clear pale chest, and vertically streaked brown breast and belly.

Dragonfly Arm Band

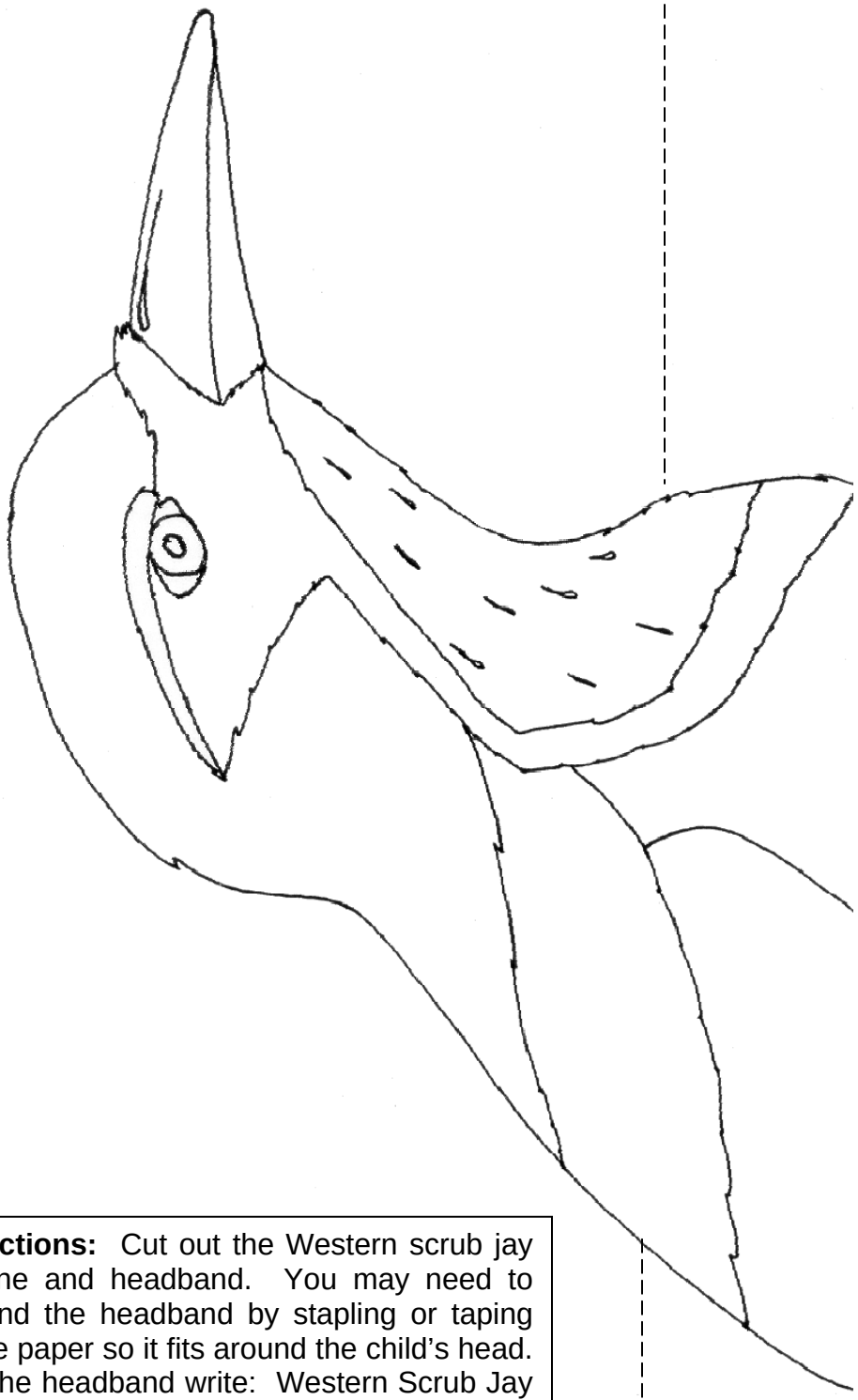
The students can imagine that a dragonfly landed on their arm. They know it is a dragonfly because its winds are outreached when it perches. A damselfly would have its winds in a closed position.

Headband for a turkey vulture

Directions: Cut out turkey vulture outline and headband. You may need to extend the headband by stapling or taping more paper so it fits around the child's head. On the headband write: Turkey Vulture (*Cathartes aura*)

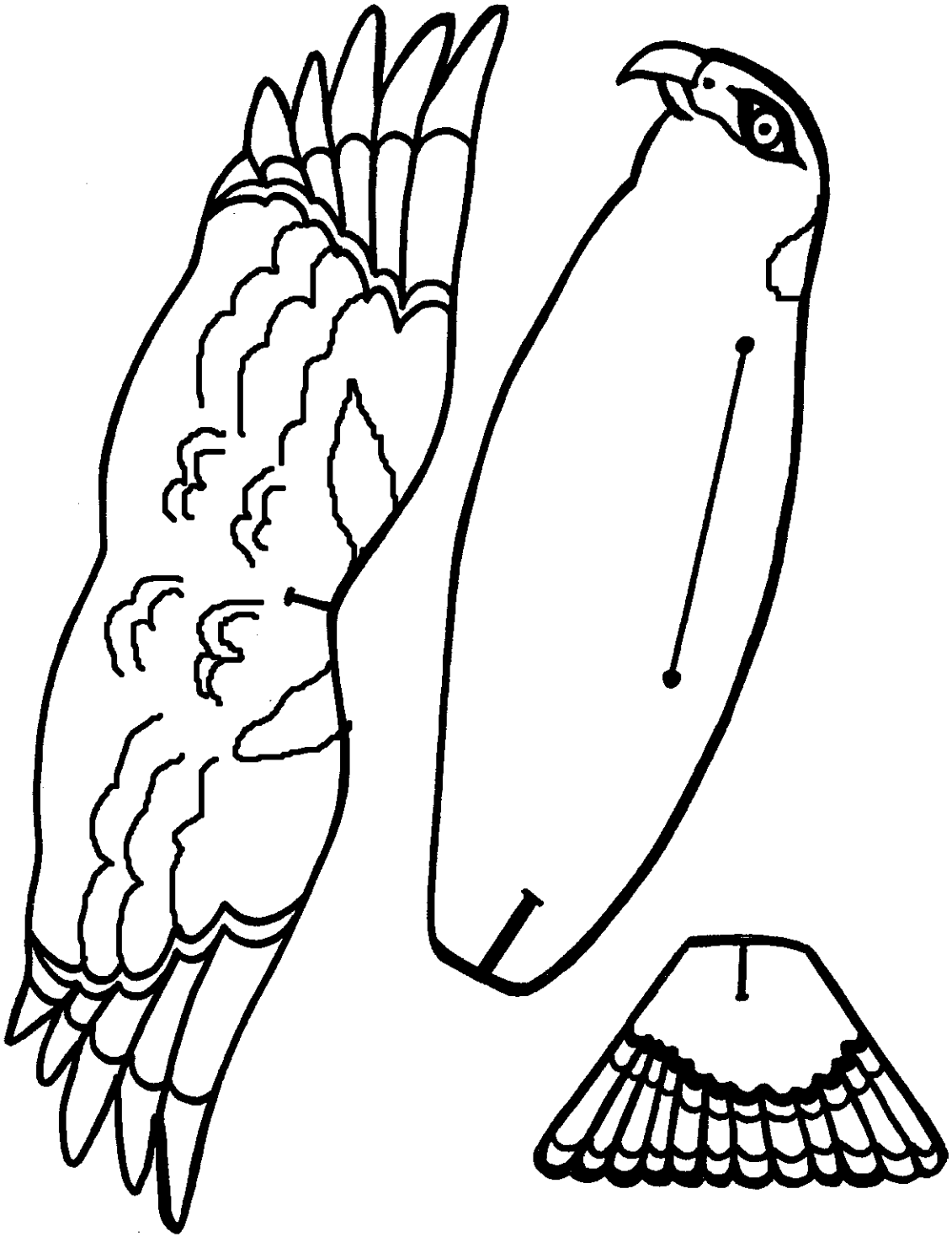


Western Scrub Jay



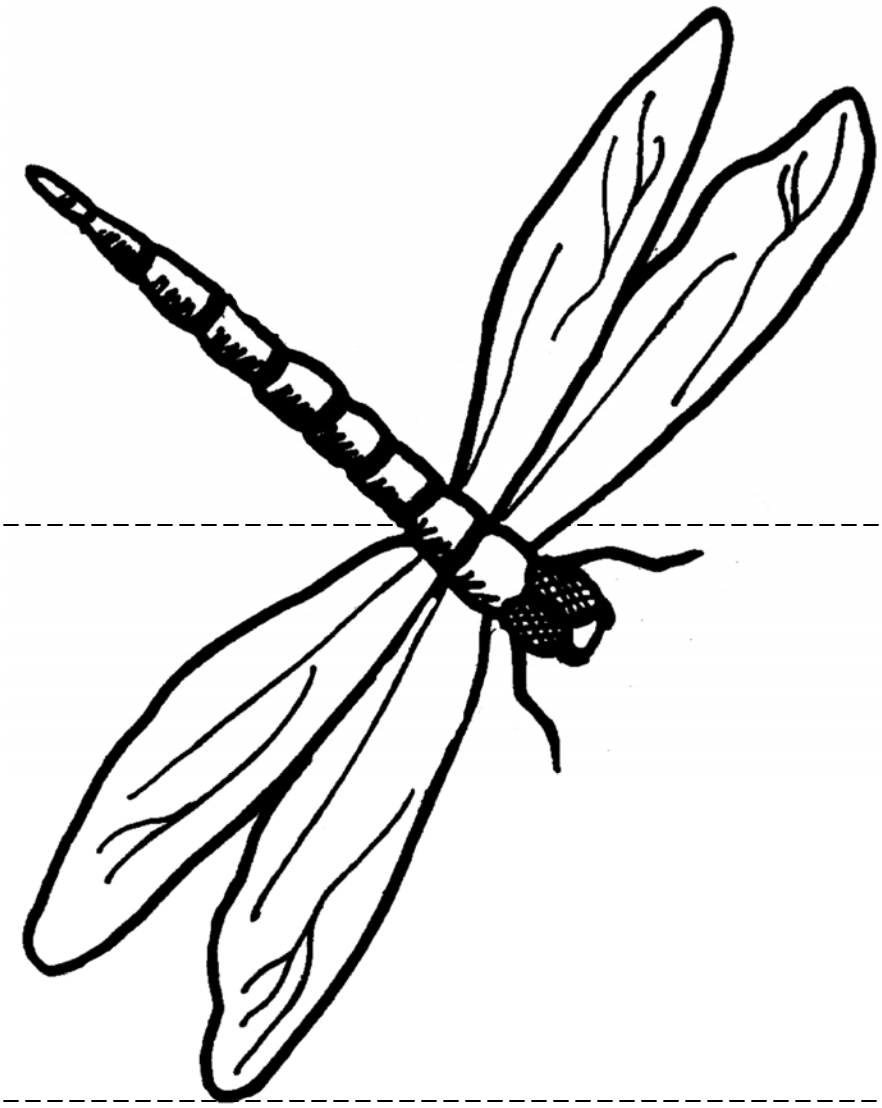
Directions: Cut out the Western scrub jay outline and headband. You may need to extend the headband by stapling or taping more paper so it fits around the child's head. On the headband write: Western Scrub Jay (*Aphelocoma californi*a)

Red Shouldered Hawk



Dragonfly Armband

Dragonfly and damselflies belong to the Order Odonata. You can tell the difference when they perch. The Dragonfly will have its wings open and the damselfly will have its wings closed when they are at rest



Directions: Cut out the dragonfly outline and headband. You may need to extend the headband by stapling or taping more paper so it fits around the child's head. On the headband write: Dragonfly

Restoration Principles

RECOMMENDED GRADES: primary

Two students from Mission San Jose High School wrote this story. It is about a young frog, Pacifica, who learns about the terrible conditions of Mission Creek before the creek was restored. This book is available on the internet as an "Electronic Storybook" (http://msnucleus.org/membership/index.html). Below is a written copy of the text. You may want to use the book as an introduction of restoration and how important it is to think of the water flow through a city and the affect it has on the smaller creatures of a stream.

The following are possible vocabulary words that may need more explanation for students to fully understand the story.

Coir logs - Roll of coconut fiber, often used in bioengineering systems to provide erosion control along a stream bank, also helps to support the establishment of new vegetation, especially willow stakes

Erosion - Removal of soil particles by wind and water

Eucalyptus tree - A tall tree, whose outside bark peels and native to Australia. Arrived in California in the 1800's as a quick growing tree. It produces chemicals that do not allow many native wildflowers and grasses to live in the undergrowth.

Lagoon - A body of water that is not moving

Meander - When a creek moves into a "s" pattern, reflecting a slow down of water velocity.

Pacifica Frog – The name of the character in "Through a Frog's Eye" referring to the Pacific Chorus or Tree Frog (*Pseuacris regilla*) which is found in Mission Creek

Restoration - Bringing an area back to a specific time (before humans lived in an area; before the ice age, etc)

Rip-rap - A layer, facing, or protective mound of stones, randomly placed to prevent erosion or scour at a structure or embankment; also the stone so used

Straw wattles - Temporary large, woven mat made of straw, that is placed over a steep bank and to hold back erosion and to act as a surface for seeding quick growing wildflowers and grasses.

Sycamore tree - Grows along creek beds and has a characteristic greenish-gray smooth bark. Native sycamores have large tree lobed leaves.

Tule - This aquatic plant with long, green reeds. Tules go dormant during the winter and grow rapidly during the spring and summer. Native to California wetland areas.

Turkey vulture - A large bird with a characteristic red-orange, naked, small head. The bird is a scavenger that feeds on the meat of dead animals.

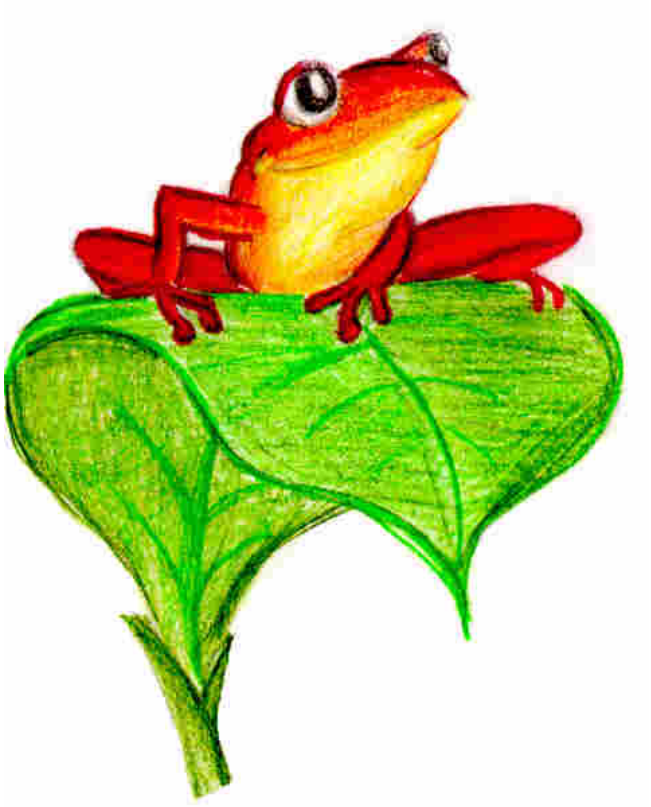
Webbed feet - An adaptation by birds, amphibians, and reptiles that usually use the water for swimming. Helps capture water to help propel more efficiently.

Through a Frog's Eyes

by April Yang and Frances Kwong

It was a lazy summer afternoon. The air was hot and stuffy. Little **Pacifica Frog** went to visit her grandmother at Mission Creek. Grammy lived in the most lush and greenest plants under a tangled **sycamore** tree. Frogs prefer the refreshing water under the sycamore trees to the spicy, stagnant pool around the **eucalyptus** trees.

Knock, knock,“ Is anybody home?" croaked Little Pacifica. "Coming, coming!" Grammy said hoarsely. She unfastened a piece of grass that held the door closed on her **tule** house. Little Pacifica hopped in happily. Pacifica lives downstream with her family in a nearby **lagoon**, but during the summer it gets real hot.



Pacifica, I missed you so much!" exclaimed Grammy. She proceeded to give Pacifica a sticky froggy kiss and handed her a chilled FrogAde. "You only visit me because it’s nice and wet here with all these oaks and sycamores giving us shade," teased Grammy. "Not true," said Little Pacifica, "I’m here because you promised to tell me the story of Mission Creek, remember?"

"That’s right!" Grammy exclaimed. "For as long as I can remember, I have lived in Mission Creek. Back in the old days, I used to live in a newspaper stand. It was stuck in the mud, but it was the only shady place so I made a home out of it. Back then, the creek was in terrible shape. The creek banks were eroded so us creek critters always had a difficult time getting around. During the floods, we'd always have to scramble out of the creek because debris would hit us."

"That's scary. You could have been killed," said Little Pacifica. "You're right," Grammy continued on, " There were so many eucalyptus trees that wildflowers and green bushes couldn't grow. Without these, life was hard for us frogs, reptiles, insects, and birds. My friend, Bitsy Bee was so upset that there were no flowers to make honey, she left with a long hmmmm. Many creatures left."

Moving cut logs and replacing with large boulders.

"That is sad Grammy." Little Pacifica interrupted, "No friends to play with." "The pre-restoration days were lonely." sighed Grammy, " I remember a time when I couldn't hear any birds singing. The only birds around were the **turkey vultures** and they don't sing. The turkey vultures loved the high trees, and they would soar on the wind. They just look for dead animals to feast on. So it was just a few of us miserable frogs, croaking the blues."

Pacifica was taking a big gulp of the FrogAde when Grammy suddenly yelled, "Do you know why the creek was in such bad condition?" Grammy's voice had been so loud that she scared the FrogAde right out of Pacifica's hand. It hit her sticky **webbed feet** with a big splash.

Mission Creek with coir logs to the right to protect erosion of the bank.

Grammy angrily croaked on, "Many suns ago, there appeared some colorful giants. They built homes and grew orchards. They didn't think about the creek critters and what we needed to survive. Many creek critters left for wetter areas."

"Is that so?" Little Pacifica was surprised by the story. Grammy went on, "The giants' selfish use of the water and paving of the ground with concrete and asphalt caused erosion. It narrowed the creek channels in some places and caused deep gullies. The erosion caused the water to become murky and choked with silt. I don't know how I survived all those years in that newspaper stand."

"The giants finally got the hint that our creek needed some help. They called it "**restoration**" and asked us to leave for a little while. I gladly packed my bags and hopped away for a few months. Some of those resourceful giants were able to get money to fix our creek and help us creek critters."

"When I returned, the creek gently **meandered** instead of flowing right through, so the water went slower and we could actually cross the creek. They put **coir logs**, **straw wattles**, and large boulders called **rip-rap** in special places to control the **erosion**, sediment, and storm run off."

They removed many of the eucalyptus trees, but left some behind for the turkey vultures, so they'd still have homes. Now the vultures have a better view of us, so you'd better watch out when you are out there playing."

"Thank you for warning me, Grammy," Little Pacifica nervously croaked. "Life is still hard," Grammy went on, "Now all of the creek critters can share in our beautiful creek. We can enjoy the new trees that are like the ones that were here long before the giants came."

Pacifica was so proud of Grammy. Her Grammy was the only frog she knew that had seen the effects of the restoration firsthand. Pacifica decided to spend the summer with Grammy, so she could learn all about the trees, shrubs and other creek critters. Best of all, it was always nice and cool in Mission Creek.

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