Ogier Ponds Feasibility Study

Feasibility of Removing Surface Hydraulic Connection Between Coyote Creek and Ogier Ponds, Santa Clara County, California

March, 2018

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Executive Summary

Background

The Ogier Ponds are comprised of six-perennial to semi-perennial instream ponds (i.e., former quarry pits) located along Coyote Creek in southern San Jose approximately 2 miles downstream of Anderson Reservoir, within Coyote Valley. The site consists of approximately 591 acres of land and water owned and managed by Santa Clara County Department of Parks and Recreation (SCC Parks). The site contains recreation infrastructure including multi-use pedestrian, bicycle and equestrian trails and a radio-controlled model airplane field.

Mining of construction aggregate materials (i.e., soil, gravels) occurred at the site under the name of Polak Quarry from 1958 to 1993. The land was privately owned until May 1973 when Santa Clara County acquired the property containing the Ogier Ponds from Mr. Polak by eminent domain. The quarry continued to operate at the site under the County permits until 1993 when the quarry became idle. At the end of quarry operations, approximately 3.4 million cubic yards of alluvial material was mined leaving 145 acres of gravel pits ranging up to 35 feet deep. The mining pits were not originally within the Coyote Creek channel, but high creek flows when Anderson dam spilled in 1997 removed a section of the earthen berm separating Coyote Creek from Pond 1. As a result, Coyote Creek currently flows into Pond 1 and through inter-pond connections through Ponds 2 ,3, and 4. Since the cessation of mining at the property, SCC Parks has managed the property for recreational uses.

County Parks' Coyote Creek Parkway Integrated Natural Resource Management Master Plan, adopted by the Board of Supervisors in 2007, has a natural resource objective to evaluate the potential for constructing a channel with a connected floodplain through the Ogier Ponds site in cooperation with the District. To address the potential changes to the Ogier Ponds site, the District and County Parks found it to be mutually beneficial to coordinate efforts to guide planning efforts for this feasibility study while integrating their respective missions of recreation, flood management, and water supply. The District and County Parks entered into a partnership agreement on May 1, 2016 to conduct the feasibility study, but neither entity is obligated to implement the findings of the feasibility study.

Objectives and Approach

The overall purpose of the Feasibility Study is to determine if separating the Ogier Ponds from Coyote Creek is technically, legally, and economically feasible and if feasible, if performing a detailed planning study in conformance with District Standards is warranted. The detailed study objectives are as follows:

- Investigate the feasibility of removing artificial surface hydraulic connections between Coyote Creek and Ogier Ponds,
- Analyze potential enhancements to aquatic and riparian habitat,
- Evaluate preservation and enhancement of recreational opportunities,
- Evaluate the potential for managed groundwater recharge on site, and
- Evaluate the potential for flood attenuation on site.

To evaluate the District's interest in the property, analysis was conducted for stream stewardship (i.e., ecology), managed aquifer recharge and flood attenuation. As the landowner and manager of Ogier Ponds, SCC Parks' primary objective was to preserve the pond-based recreation, if the hydrologic condition was altered by separating the creek from the ponds. To determine the potential range of implementation costs for a creek-pond separation project to be applied to the District interest, staff has identified a pre-1997 channel restoration concept that would separate the creek and ponds and improve aquatic habitat at the lowest cost. Staff also identified a floodplain restoration concept that would create a connected floodplain. These concepts are very preliminary and should not be considered project alternatives. This study includes assumptions associated with conceptual designs to allow preliminary estimation of implementation costs. Should the District and the County decided to move the project to planning, a planning level study would identify and analyze a range of project alternatives in much greater detail. These two concepts are described below:

Pre-1997 Channel Restoration Concept: This concept is the smallest amount of construction and land disturbance that would remove the existing hydraulic connection of the creek to and return creek flows to the pre-1997 channel located west of the ponds. This concept would facilitate fish migration through the Ogier Ponds site in the pre-1997 channel. The eastern side of the pre-1997 channel would be built up with a berm to contain flows up to approximately 4,000 cubic feet per second (cfs) within the channel. Additionally, the area where the creek currently flows out of the ponds at pond 4 would be built up to complete the pre-1997 channel. This concept assumes no other improvements. Approximately 2 acres of the existing 145 acres of on-site ponds would be permanently removed for berm construction but water dependent recreation would be maintained on the remaining ponds.

Floodplain Restoration Concept: To preliminarily estimate the upper implementation cost, consideration was given to construction of a new creek channel and connected floodplain which could promote Sycamore Alluvial Woodland (SAW) regeneration. This concept would be consistent with the vision for the site contained in the Coyote Parkway Integrated Natural Resources Master Plan (INRMP) prepared by County Parks. Floodplain reconnection would restore interactions between the stream and its floodplain by increasing the frequency of overbank flows, resulting in a regaining of hydrologic and ecological function. The connected floodplain would be bounded by setback levees or berms to protect adjoining properties from flood hazards. The 500-foot floodplain width chosen for this concept is intended to recreate the maximum historical floodplain size. Restoration of the historic ecology would be constrained by the modifications to creek flows due to ongoing operation of upstream dams, which results in reduced peak flows and increased dry season flows in the creek compared top pre-dam conditions. The surface area of the existing ponds would decrease from the current 145 acres to 60 acres to create the connected floodplain and setback berms, significantly reducing the available area for water-dependent recreation but not eliminating it.

Ecology

Fish and wildlife resources were separated for the ecological evaluation and an analysis of impacts to these resources were considered for the pre-1997 channel restoration and the floodplain restoration concepts. Wildlife resources essentially would remain the same as existing conditions for the pre-1997 channel restoration concept however, for the floodplain restoration concept up to 60% of the existing ponds would be permanently removed to create a connected floodplain. Coyote Creek would be restored to approximate historical (e.g., 1930s) alignment through the central portion of the Ogier Ponds complex, and it would no longer have a surface connection to the ponds. Restoration of a meandering multi-stem Coyote Creek and connected floodplain would result in considerable benefits to creek-associated habitats and species. However, there is a tradeoff ecologically in that the conversion of ponds to an active floodplain will reduce quality and quantity of pond habitat and associated pond species.

For native fish resources, Removal of the ponds from the stream will have a substantial ecological benefit as the ponds cause increased creek water temperatures and harbor predatory fish; both effects are detrimental to salmonid populations and impeded fish passage. Under the pre-1997 channel restoration concept substantial ecological improvements are anticipated and those benefits increase with creation of the connected floodplain as envisioned in the floodplain restoration concept.

Managed Aquifer Recharge

The deep aquifer under the site supplies groundwater to the Santa Clara sub basin, which is a major source of water supply. Managed recharge of the deep aquifer is conducted by the District and is necessary to prevent overdraft. Measurements of water levels in shallow monitoring wells, the ponds, and Coyote Creek at the site showed direct hydraulic connection between shallow groundwater and the ponds, and much less connection to the deep aquifer. As a result, surface water spread at the ground surface on the site would flow predominantly to the shallow aquifer and ponds instead of the deep aquifer, substantially reducing recharge effectiveness. Based on the results of the analysis, the Ogier Ponds site is not suitable for managed groundwater recharge.

Flood Attenuation

The location of Ogier Ponds is such that they are only able to store water that spills from Anderson Dam since all the large tributaries are downstream of the ponds, thus limiting its benefits to attenuate flood flows. The results of the analysis indicate Ogier Ponds could potentially store about 1,000 acre-feet of water, which would flood protection benefits for the 10-year event at William Street and the mobile home area at Berryessa, and incremental benefits for the 25-year event at the William Street and Berryessa areas.

However, these potential benefits would only be realized during large storm events focused around Anderson Dam and the watershed upstream of the dam. If the storm is focused downstream of Ogier Ponds, water detained at the site would provide not protect the downstream urban areas from flooding caused by the tributaries.

Recreation

A key element of the feasibility study is the viability of ponds for recreation if the ponds were removed from the surface water connection. The results of the analysis indicate that the creek does not need to flow through the ponds to provide water to the ponds due to the direct hydraulic connection between shallow groundwater and the ponds; only extended periods of little or no flow (20 months or more) would result in the ponds going dry. While the volume of water in the ponds would be sufficient to support onsite recreation after the creek-ponds surface connection is removed, water quality in the ponds would be negatively affected. To utilize the ponds in a closed hydrologic system, measures may be required to maintain an acceptable water quality standard for water-based recreation.

Implementation Costs

For this feasibility study, the design for remedial action to meet project objectives is conceptual, and, therefore, the cost estimate is an order of magnitude and not a detailed estimate of direct/indirect costs of capital construction related to a preferred alternative.

The pre-1997 channel restoration concept is intended to represent the lowest costs for implementation that would meet the desired objective to remove creek-pond connection and improve fish passage. The range of costs reflects the range of ecology benefits that could be achieved. The range of cost estimates include planning, design, permitting, real estate and construction, but does not include mitigation costs, maintenance costs or replacement of damaged roadways. Given the minimal benefits for flood attenuation, these estimates do not include costs to design and construct a structure to divert high flows of Coyote Creek into ponds for flood attenuation.

There are challenges associated with the creek/lake separation which could increase costs substantially and therefore need to be considered. Permitting and mitigation costs could be significant as the site supports multiple listed species. Consideration needs to be given to the level of design for creek/lake separation as the pre-1997 channel restoration would reconnect with the ponds when Anderson Dam spills, approximately every 15 years. This may not be acceptable to resource agencies and therefore the pre-1997 channel restoration may not be permittable. To achieve the project objective of a long-term creek-pond separation, raising and/or armoring of degraded portions of the berm on site would be required at elected locations throughout the berm's 6,000 ft length. A detailed geotechnical and hydraulic evaluation would be needed to determine the length of berm needing repair and is beyond the scope of this feasibility study. And lastly, the SCVWD does not currently have land rights at the site. Therefore, the range of costs estimated in this feasibility study start at $12 million for the pre-1997 channel restoration concept and up to $52 million for the floodplain restoration concept.

Conclusion

The results of this analysis indicate that removal of the surface hydraulic connection between Coyote Creek and Ogier Ponds is technically feasible and, in doing so, will likely support water-based recreation as identified in the County's Integrated Plan for Coyote Creek Parkway. The site is not viable for managed aquifer recharge, and minimal flood protection benefits would be achieved if the site were used for flood attenuation. There is a substantial ecological benefit from separating the creek from the ponds, which will increase if the floodplain restoration concept is implemented over the pre-1997 channel restoration concept. Should the District's Board of Directors and the County Board of Supervisors approve the study to move to planning, the estimated costs for implementation are between $12 and $52 million. These costs represent a broad range and substantial flexibility is present to design a project within that range.

If the district moves this initiative into planning phase, the following key issues and challenges would need to be addressed:

- The amount of County resources, including both county staff effort and financial support, that would be available to support project planning and implementation;
- What level of hydraulic separation (i.e. recurrence interval of creek-ponds reconnection) represents an optimal balance between implementation cost and ecological benefits;
- Whether the County will allow the district to obtain a property interest to construct and maintain newly constructed berms;
- The degree to which the existing berm between the pre-1997 channel and the ponds meets district engineering standards and what amount of berm replacement and/or reconstruction would be necessary.
- The legal implications of restoring full creek flows to portions of the pre-1997 channel which are privately owned.

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1. Introduction

1.1. Study Background and Scope

The Ogier Ponds are artificial ponds located along Coyote Creek in southern San Jose about 2 miles downstream of Anderson Reservoir (Figure 1). The Santa Clara Valley Water District (District) entered into a Memorandum of Agreement (MOA) with the Santa Clara County Department of Parks and Recreation (SCC Parks) on March 1, 2016 to evaluate the feasibility of removing the existing surface water connection between the Ogier Ponds and the main stem of Coyote Creek. County Parks' Coyote Creek Parkway Integrated Natural Resource Management Master Plan, adopted by the Board of Supervisors in 2007, has a natural resource objective to evaluate the potential for constructing a channel with a floodplain through the Ogier Ponds in cooperation with the District. To address the potential changes to the Ogier Ponds site, the District and County Parks found it to be mutually beneficial to coordinate efforts to guide planning efforts for this feasibility study while integrating their respective missions of recreation, stream stewardship, flood management, and water supply.

Because SCC is the landowner for almost all the site, SCC and the District entered into the MOA to facilitate the feasibility study. In the MOA, the District commits to performing topographic surveys and hydrologic assessments, developing a site water budget, assessing water quality, and analyzing wildlife and fisheries. SCC committed to providing site access, relevant documents and data from county files; conducting environmental planning for the feasibility study including compliance with the California Environmental Quality Act; and coordinating stakeholder outreach. SCC and the District agreed to study the feasibility of creek-pond separation, but neither party is obligated to implement the findings of the study (County of Santa Clara and Santa Clara Valley Water District, 2016).

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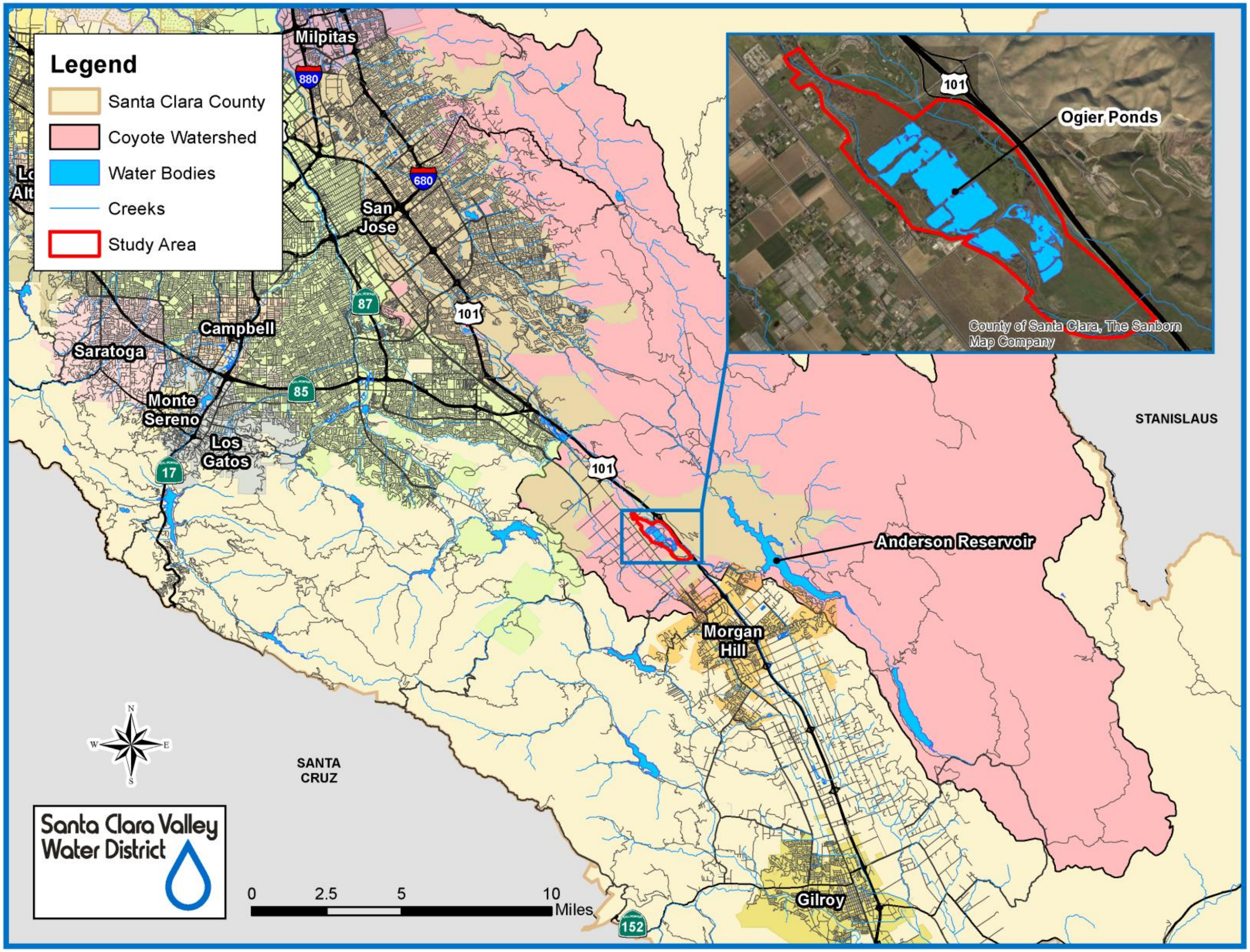

Figure 1: Regional Map

1.2. Study Objectives & Approach

The project team examined the feasibility of removing the existing surface connection between Coyote Creek and the artificial ponds at the site. Artificial river impoundments can have profound ecological effects by changing the river's natural flow and sediment dynamics. The National Marine Fisheries Service (NMFS), an agency of the National Oceanic and Atmospheric Administration tasked with protecting marine and anadromous fisheries, designated the Central California Coast (CCC) distinct population segment of steelhead trout as a threatened species under the Endangered Species Act (ESA). Coyote Creek is within Santa Clara Hydrologic Unit 2205 and the reaches of the creek between Anderson Reservoir and San Francisco Bay are classified as critical habitat for CCC steelhead (NMFS, 2005). The ponds are considered a thermal barrier to passage for anadromous fish which inhabit Coyote Creek by NMFS (Wheeland, 2002). Solar warming of the pond water increases stream water temperatures; and the lake-like environment favors alien fish over the native stream adapted forms, creating inhospitable conditions for the ESA listed steelhead. In recognition of the fish passage barrier caused by the ponds, the District Board of Directors directed staff to study the feasibility of removing the existing surface hydraulic connection between Coyote Creek and the Ogier Ponds. The study is also considering the potential effects of hydraulic separation on recreational opportunities, infrastructure, and wildlife habitat, as well as the opportunities to use the site for flood attenuation and/or managed groundwater recharge.

The overall purpose of this Feasibility Study is to determine if separating the Ogier Ponds from Coyote Creek is technically, legally, and economically feasible and if feasible, if performing a detailed planning study in conformance with District Standards is warranted. The study objectives are:

- Investigate the feasibility of removing the existing surface hydraulic connection between Coyote Creek and Ogier Ponds,
- Analyze potential enhancements to aquatic and riparian habitat,
- Evaluate preservation of recreational opportunities,
- Evaluate the potential for managed groundwater recharge on site, and
- Evaluate the potential for flood attenuation on site.

To estimate the potential range of implementation costs for creek-pond separation, the project team identified a simple creek/lake separation concept (Pre-1997 Channel Restoration) that would separate the creek and ponds at minimal cost, with minimal ecological enhancement (i.e., fish barrier removed). The team also identified a larger and more complex environmental enhancement concept that could achieve greater ecological enhancement (Floodplain Restoration). These two concepts are described below:

Pre-1997 Channel Restoration Concept (Figure 2): This concept would restore the previous berm between the creek and ponds with minimal earthwork and ground disturbance, redirecting the creek flow to the pre-1997 channel located west of the ponds. This concept would facilitate fish migration in the pre-1997 channel after it is re-watered and upstream and downstream of the Ogier Ponds site.

The existing berm on the eastern side of the remnant channel would be built up with a berm to keep flows up to approximately 4,000 cfs contained within the channel. Over the past 60 years, Anderson Dam spilled 11 times, and of those 11 times, four spills were greater than 4,000 cfs, placing an interval of channel-pond connectivity at approximately every 15 years which would enter the ponds through an engineered weir that could require hardscaping over the berm. The eastern berm would have a height of 8 feet, a minimum channel bottom width of 40 feet, and a channel-side side slope of 3H:1V. The berm will be built up along pond 1 where the washed-out berm was located pre-1997. Additionally, the area where the creek currently outflows out of the ponds at pond 4 would be built up to complete the remnant channel. No improvements would be made to the western bank or ponds. Approximately 2 acres of the existing 145 acres of on-site ponds would be permanently removed because of the berm construction but water dependent recreation would be maintained. The ponds would retain water in 19 years out of 20 due to groundwater seepage.

Floodplain Restoration Concept (Figure 3): To frame the upper cost estimate, consideration was given to restoration of a connected floodplain for Sycamore Alluvial Woodland (SAW) regeneration. In California, this habitat is rare largely because of changes to flow and sediment dynamics from damming rivers and the removal of floodplains from the influence of periodic flooding (Keeler-Wolf et al. 1996). While substantial technical challenges arising from the modified creek hydrology would need to be overcome to implement this concept, this was the historically prominent habitat type. Specifically, reservoir operations result in reduced frequency of large wet season flows and increased dry season low flows compared to pre-reservoir conditions. These hydrologic modifications would constrain the ecology of the on-site floodplain and would need to be addressed during planning and design. The connected floodplain example would reconfigure the ponds to create a free-flowing channel which would be allowed to laterally migrate and inundate a 500-foot-wide floodplain. The historical ecology describes the field surveys conducted during the 1850sof the Coyote Valley which documented a broad, active channel ranging from three to eight chains wide (198-528 feet) (Grossinger et. al., 2006). The 500-foot floodplain width chosen for the floodplain restoration concept was intended to represent the maximum historical value for creek restoration. To maximize ecological value for Coyote Creek and associated floodplain the alignment should avoid to the extent practicable the existing riparian and wetland features. However, even with avoidance the floodplain restoration concept would likely reduce habitat for pond-dwelling reptiles, amphibians, birds, and odonates to create the floodplain dimensions. Additionally, reduction in pond size due to the increase in floodplain would impact existing use of ponds by waterbirds and other marsh species. Berms would be constructed to protect areas outside the channel and floodplain from flood hazards. The floodplain would be vegetated with California sycamore (*Platanus racemosa*) trees and associated savannah species to emulate the historically prominent and rare SAW habitat type. The surface area of the existing ponds would decrease from the current 145 acres to 60 acres to create the connected floodplain and berms, significantly reducing the available area for water-dependent recreation but not eliminating it.

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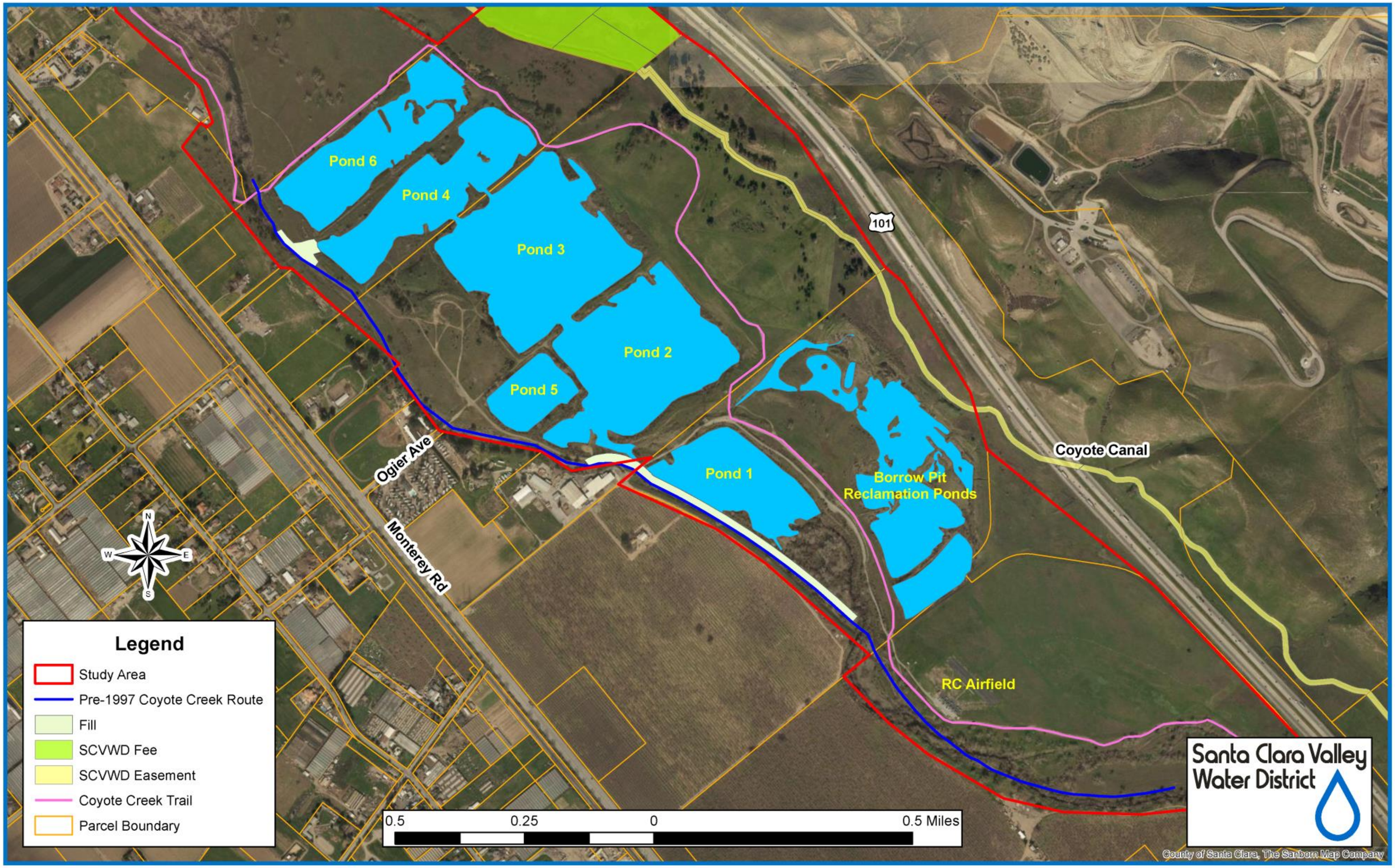

Figure 2: Pre-1997 Channel Restoration Concept

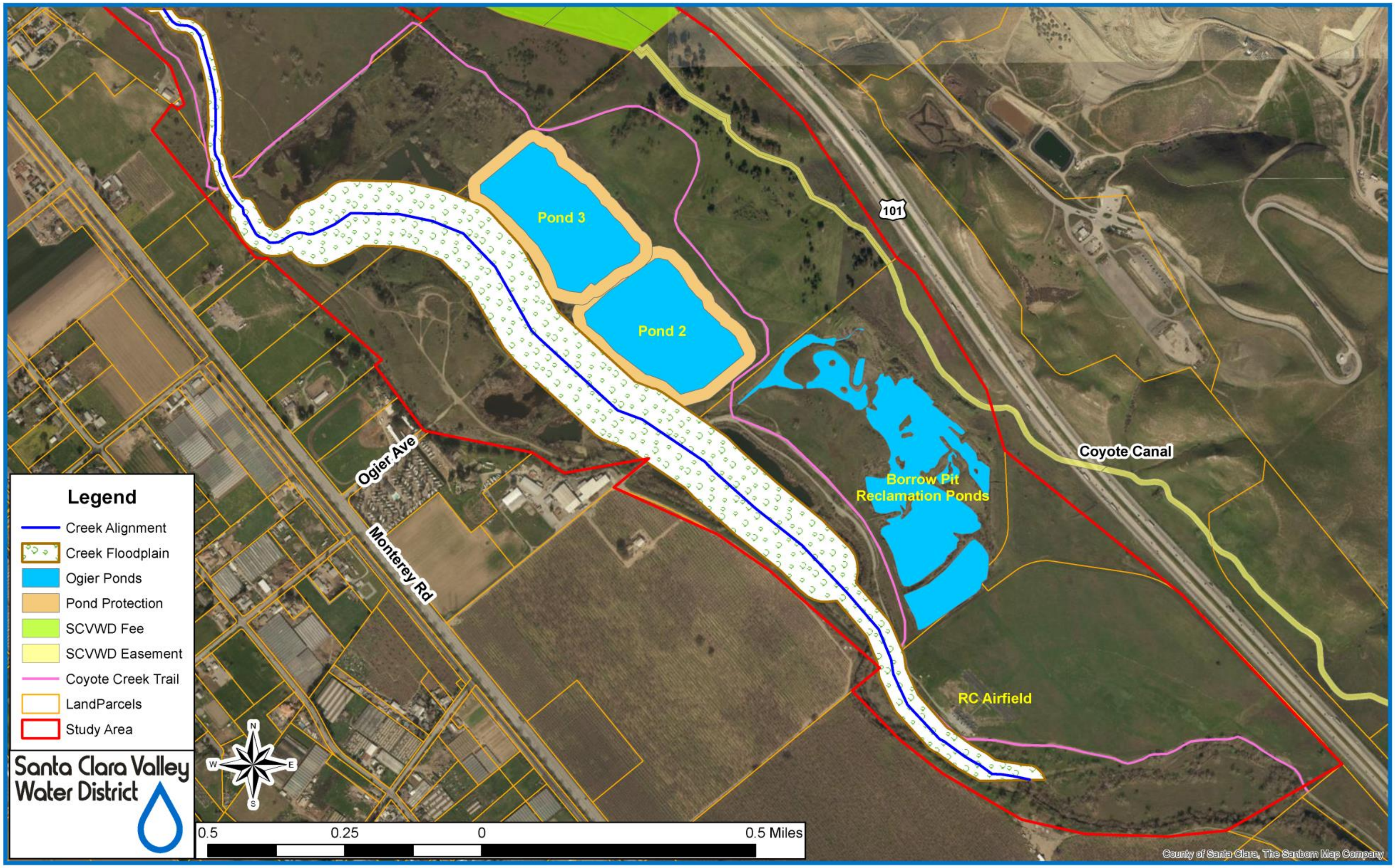

Figure 3: Floodplain Restoration Concept

2. Site Location and Past and Current Uses

2.1. Site Location and Ownership

The Ogier Ponds site is located within the Coyote Creek watershed which is the largest watershed in Santa Clara County, encompassing approximately 350 square miles. The eastern and southern portions of the watershed drain the western face of the Diablo Mountain Range where the creek originates at an elevation of about 3,650 feet above mean sea level. These upland areas are largely undeveloped. The northern and western portions of the watershed are comprised of the Santa Clara County valley floor. Much of the valley floor is urbanized with patches of undeveloped parks and open agricultural lands. Coyote Creek has 29 tributaries, and flows northwest through the valley, approximately 42 miles from its headwaters to south San Francisco Bay.

The site, located approximately two river miles downstream from Anderson Reservoir, consists of approximately 591 acres of land and water located in the Coyote Valley of central Santa Clara County (SCC). The Coyote Valley, including the site is at the southern portion of the Santa Clara groundwater sub basin. The site is composed of seven adjoining parcels (Table 1) which vary in elevation from about 300 to 360 feet above mean sea level (U.S. Geological Survey, 2012). SCC owns six parcels with a combined area of 573 acres, representing 97% of the site area. The remaining 18-acre parcel is owned by the District.

The site consists primarily of open space with six perennial to semi-perennial ponds and former borrow pits that typically contain water. SCC Parks manages the site, which contains recreation infrastructure, including a multi-use pedestrian, bicycle, and equestrian trail, access roads and parking areas, and a radio-controlled model airplane field.

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Table 1: Land Ownership at the Site

Assessor's Parcel Number (APN)	Area (ac)	Owner	Description/Features
725-08-001	68.39	SCC	North of Pond 6
725-06-008	77.32	SCC	Ponds 4 and 6
725-05-002	180.23	SCC	Ponds 2, 3, and 5
725-04-003	110.18	SCC	Pond 1, pits
725-03-003	118.82	SCC	RC Plane airfield
725-05-001	17.48	SCC	Between Ponds 2 and 3 and Hwy 101
725-06-001	18.04	District	Between Ponds 4 and 6 and Hwy 101
Total Area	**590.46**		

Coyote Creek flows into Pond 1 at the upstream portion of the site and then flows northward across the site and through Ponds 2, 3, and 4 before flowing off site (Figure 4). Ponds 5 and 6 and the borrow pits do not have a surface hydraulic connection to the creek but are sustained by shallow groundwater which results from creek water infiltrating into the ground through the bed of Coyote Creek. Table 2 provides the water surface area of each pond.

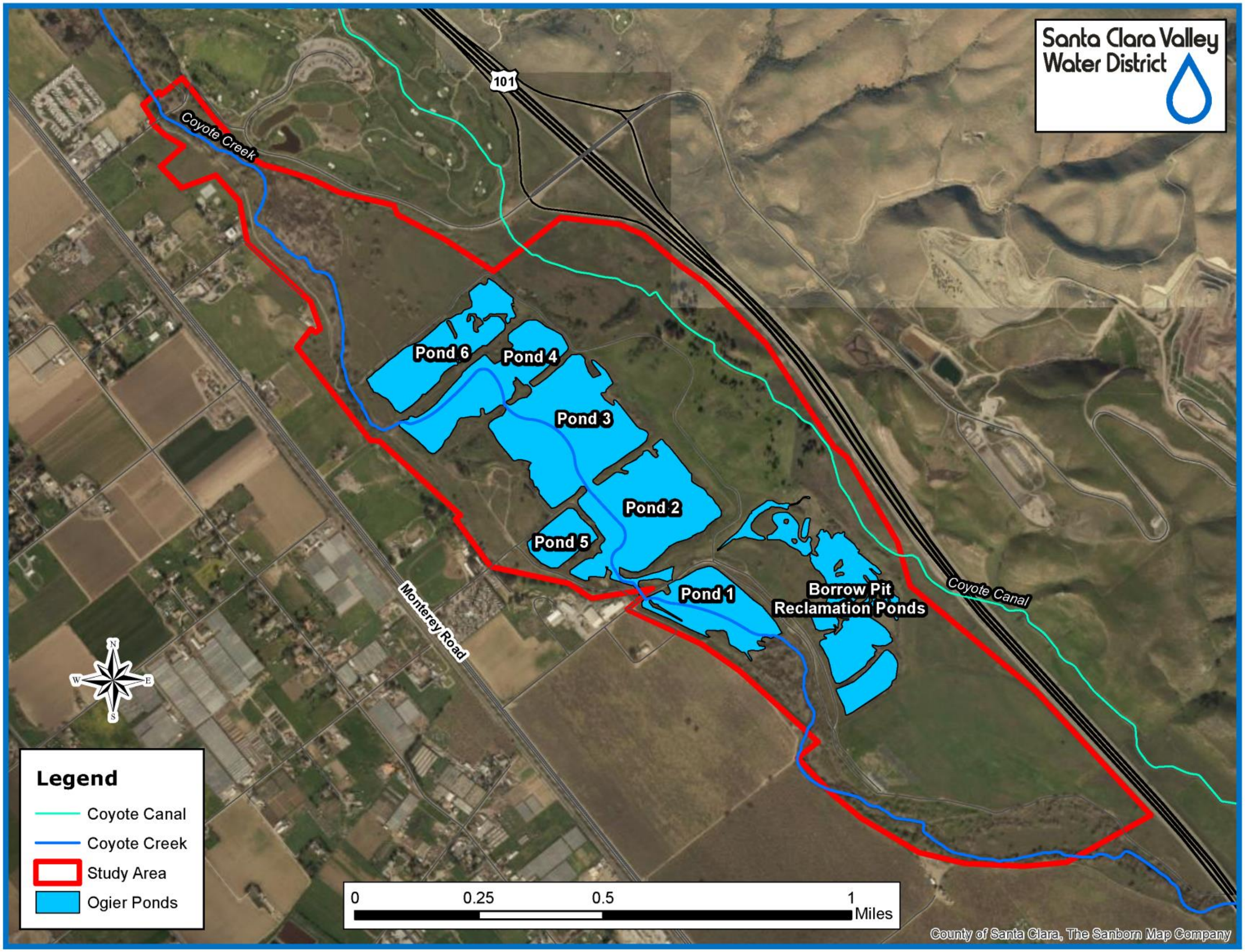

Figure 4: Map of creek, canal, and pond configuration in study area

Table 2: Ponds Water Surface Area and Elevation in April 2017

Pond	Water Elevation (feet above mean sea level)	Water Surface Area (Acres)
1	312	14.9
2	306	29.9
3	304	30.9
4	304	15.7
5	306	5.7
6	304	18.8
Borrow Pits	304	27.8
Total Water Surface Area		**144.9**

2.2. Past Site Use

The Coyote Valley floor was formed by the deposition of alluvial sediments spreading downward from the canyons of the Diablo Range and fluvial sediments transported across the valley floor by stream action. The stream reaches within the vicinity of Ogier Ponds were shallow and braided with multithread channel characteristics. The stream corridor was generally wide with unvegetated gravel bars, but interspersed with shorter, narrow reaches (SFEI, 2006) (Figure 5).

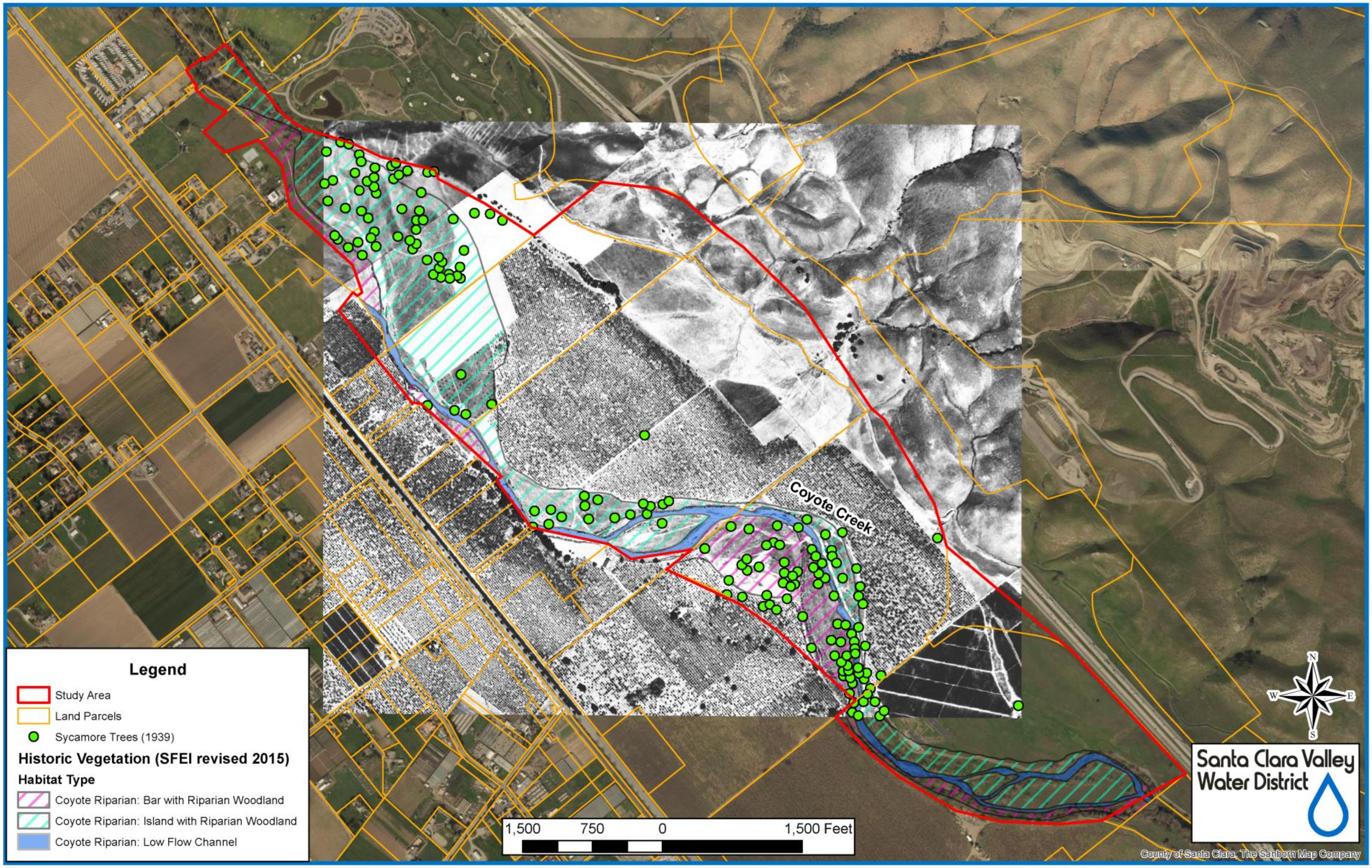

Figure 5: Historical aerial imagery (1939) depicting the generally wide, unvegetated gravel bars.

The scale of this figure is approximate and should be used for visual representation only.

Due to its abundant alluvial deposits and sparse vegetation, the site became a perfect candidate for aggregate mining. To support the state's substantial economic growth and development, mining of construction aggregate (i.e., soil, gravels) occurred at the site under Polak Quarry from 1958 to 1993. In addition, portions of the site were used for agriculture before and during mining operations. In 1954, Santa Clara County granted a use permit to Frank J. Polak for a sand and gravel quarry located west of Monterey Highway Road near Miramonte Avenue. The permit required that Coyote Creek remain in its natural channel and that excavation to a depth below the river bed could occur only if a 150-ft wide berm be built between the creek and excavation areas. The requirement to keep the Coyote Creek alignment unchanged was based on recommendations the county received from California Department of Fish and Game (CDFG, currently California Department of Fish and Wildlife) and Santa Clara Valley Water Conservation District (County of Santa Clara Planning Commission, 1958).

Santa Clara County acquired about 195 acres of the property containing the Ogier Ponds from Mr. Polak by eminent domain in May 1973. The primary purposes for acquiring the property was for recreational use as part of the Coyote Creek Park. However, upon purchase, the County also assumed responsibility for a pre-existing lease for a sand and gravel quarry operated by Polak Quarry located on the property (Stamos, 1978). Under the lease terms, Graniterock Co. operated the quarry and paid royalties to the County based on amount of sand and gravel produced at the quarry (County of Santa Clara, California, 1983).

In 1983, SCC Planning modified Granite Rock's use permit for the Polak Quarry to allow Phase 2 mining at the property. The Architectural and Site Approval included in the modified use permit contained the following requirement: "a berm 150-ft. wide and 15 ft. above grade is to be provided between the excavation area and Coyote Creek." Granite Rock constructed an earthen berm between the excavation pits (currently ponds) and the creek, but the constructed berm was narrower and shorter than required by the modified use permit. The berm has eroded since it was first constructed over 30 years ago and it currently ranges from 50 to 100 ft in width and 6 to 8 ft in height. The berm eroded during high creek flows in 1984 and 1997, resulting in the current hydraulic connection of the creek and ponds.

In 1989, the County and Graniterock agreed on a five-year renewal of the use permits needed to operate the quarry. The permits required Graniterock to implement a phased reclamation plan at the quarry site. As mining operations ceased in each portion of the quarry, Graniterock would stabilize the ground surface, revegetate the formerly mined area, remove mining structures, and install signage, fencing, a recreational trail, a 20-ft wide drive from property entrance to radio-controlled airplane field, and a retriever club training site.

By 1993, mining activity had ceased, and the county considered the quarry to be "idle". In 1994, the SCC Parks informed Graniterock that some of the reclamation work was behind schedule (SCC Parks, 1994). In either February 1995 or 1996, Coyote Creek eroded the east levee, which resulted in considerable entrainment of water and growth of emergent vegetation in the quarry pits. Due to the changed site conditions, County Planning recommended that the reclamation plan for Phase II of the quarry, located east of the creek, be revised (County of Santa Clara Parks and Recreation Department, 1999).

Graniterock revised the reclamation plan in 2001 to remove creation of wetlands and include protection and preservation of existing wetlands created at the flooded quarry excavations. In addition, the ground surface would be recontoured to eliminate over steepened slopes and 3.1 acres of native trees and shrubs would be planted on the property. The plantings were intended to restore several habitat types, including willow riparian woodland, riparian scrub, valley oak woodland, sycamore alluvial woodland, and grassland. The revised reclamation resulted in fill of 0.25 acres of wetlands and 0.95 acres of other waters of the U.S. (Biotic Resources Group, 2001). Due to the impacts to waters of the U.S. and state the reclamation plan required permits from the U.S. Army Corps of Engineers (USACE), San Francisco Bay Regional Water Quality Control Board (RWQCB), and California Department of Fish and Wildlife (CDFW).

In 2001, CDFW issued a streambed alteration agreement approving the revised reclamation plan. In 2003, Graniterock obtained approval of the revised reclamation plan from USACE under Nationwide Permit #27 – Wetland and riparian restoration and creation Activities, 401 Water Quality Certification from RWQCB, a Biological Opinion from U.S. Fish & Wildlife Service, and a streambed alteration agreement from CDFG (USACE, 2003; USFWS, 2003; RWQCB, 2003; CDFG, 2003). The revised reclamation plan and permits included 5 years of maintenance and monitoring and success criteria for plantings (Biotic Resources Group, 2001).

Graniterock implemented the reclamation plan in 2003 and began monitoring in 2004. Year 3 monitoring was performed in 2006. The Year 3 monitoring results showed that the vegetation success criteria had been met and found no new rilling and no increase in size of old rills. The monitoring report noted a wood-boring beetle infestation affecting willows, but no practical treatment for the infestation was identified. Graniterock left portions of the irrigation system in place for future county use. Year 4 and 5 monitoring confirmed that reclamation success criteria had been met (Rana Creek Habitat Restoration, 2008). On behalf of Santa Clara County, PMC inspected the site in November 20, 2008 and found that reclamation was essentially complete and met Surface Mining and Reclamation Act requirements. The only concerns noted by PWC were the need to coordinate with the county regarding continued irrigation of plantings and control of invasive yellow star thistle (PMC, 2009). In May 2009, at the request of Santa Clara County, the state Office of Mine Reclamation determined that reclamation of the Polak Quarry was complete and released the reclamation bond posted by Graniterock (Koehler, 2009).

2.3. Current Site Use

Since the cessation of mining at the property, SCC Parks has managed the property for recreational uses. In 2007, the county prepared the Coyote Parkway Integrated Natural Resources Management Plan and Master Plan which covers the 15-mile long Coyote Parkway, including the site. The Parkway includes the portion of the site owned by SCC and extends upstream and downstream of the site. The parcel at the site owned by the District is undeveloped apart from the Coyote Canal, a defunct canal that formerly conveyed water diverted from Coyote Creek upstream of the site around the site to the east and back to Coyote Creek downstream of the site (Section 3.1).

The Integrated Plan calls for expansion of recreational infrastructure throughout the park, including the Ogier Ponds area, in a manner that protects the riparian habitat and biological resources of the Coyote Creek corridor. Additional details are provided in Section 5.3, Recreation, below.

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3. Issues

3.1. Ecology

3.1.1. Historical Ecology

Understanding the historical landscape of a river helps us understand how human alteration can affect the geomorphic and subsequent ecological setting present at Ogier Ponds today. A historical ecology report was commissioned by the District in 2006 which depicts the historical landscape of Coyote Valley (Figure 6). The historical ecology report describes the Coyote Valley as follows:

> *"Coyote Valley is shaped by the cone of alluvial sediment spreading downward from the canyon mouth, at the present-day site of Anderson Dam. Currently, Coyote Creek flows to the north, but in previous ages it has flowed south to Monterey Bay. The subtle watershed divide here, crossed in the vicinity of Morgan Hill, is formed purely by the alluvial topography.*
>
> *A vast valley oak savanna occupied much of Coyote Valley, with small and large 'oak openings'. Coyote Creek maintained a 'wide, gravelly bed' that excluded agriculture from a broad zone. Steep creeks approached the creek from the hills immediately east of the channel, likely contributing to a high sediment load. On the west side of the Valley, the streams, including Fisher Creek, were discontinuous. In this reach, Coyote Creek presently exhibits some of its most un-modified morphology and riparian habitat. Examples of sycamore alluvial woodland and open riparian scrub can be found upstream and downstream of Ogier Ponds, representing significant residual habitats.*
>
> *There is some evidence indicating that Coyote Creek's banks were quite dynamic in this reach, as the main channel moved within the broader channel area.* "(Grossinger et al, 2006).

In rivers the physical structure (i.e., habitat) is defined largely by physical processes, especially the movement of water and sediment within the channel and between the channel and floodplain (Cole, 1994). A high to moderate sediment supply and episodic flooding are the physical processes integral in maintaining this gravel dominated, braided, shallow sparsely vegetated stream corridor described in the historical ecology. Gravel recruitment to the alluvial plain occurred as Coyote Creek emerged from the canyons and the eastern tributaries of Coyote Creek and upstream sources from the Canyons.

Before the modifications of the 19th and 20th centuries, the lands along Coyote Creek supported a remarkably diverse mosaic of habitats. Native grasslands and the celebrated valley oak savannas occupied the well-drained alluvial fans and natural levees along Coyote Creek. These areas (in yellow and orange on the map) became the most productive agricultural lands, primarily fruit orchards.

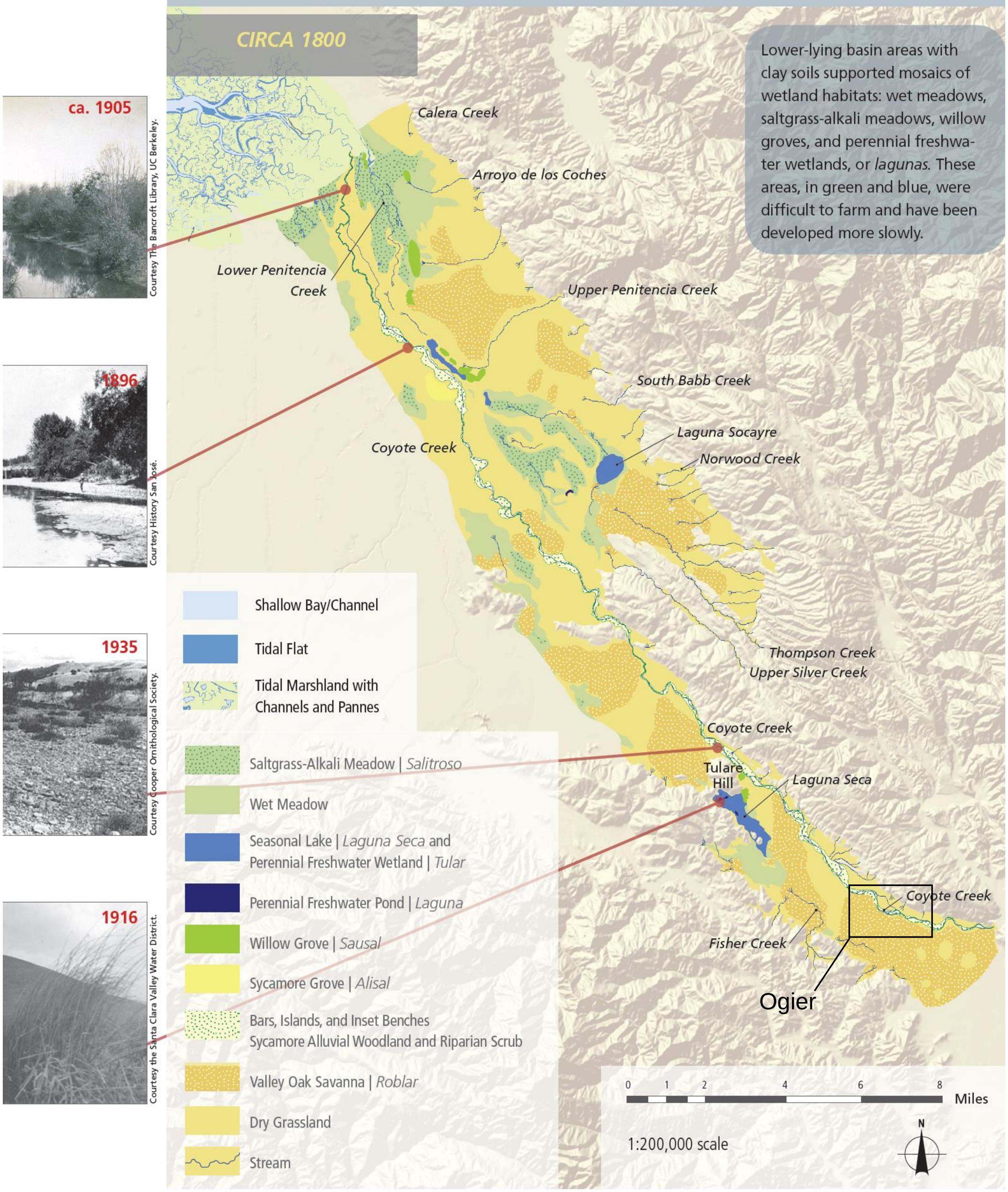

Figure 6: Historical habitats in Coyote Valley. Study area outlined in black.

3.1.2. Current Ecological Condition

The hydrology of Coyote Creek as it flows through the site is controlled by two upstream reservoirs, Coyote Reservoir (capacity of 23,600 acre-feet) and Anderson Reservoir (capacity of 90,373 acre-feet). Coyote Reservoir's tributary watershed is approximately 120 square miles and is drained by the east and middle forks of Coyote Creek, which join near Soda Spring Canyon to form Coyote Creek. Downstream of Coyote Reservoir lays Anderson Reservoir. Anderson Reservoir's tributary watershed has tributaries not shared with Coyote Reservoir: Shingle, Las Animas and San Felipe Creeks. Coyote Creek receives water from neighboring drainage basins, and water discharged or spilled from Anderson Reservoir.

Construction of Coyote (1936) and Anderson (1950) Reservoirs altered the magnitude and frequency of overbank flows on Coyote Creek. Dam operations resulted in a decrease in size of the largest flow events on the creek. The largest documented flow on record for Coyote Creek, 25,000 cfs, downstream of Coyote Valley at Edenvale stream gauge, occurred in 1911 before the construction of the reservoirs. After construction of Coyote and Anderson Reservoirs, the largest flow on record occurred February 21st, 2017 and was approximately 7,300 cfs. In addition, releases from the reservoir increased dry season base flows in the creek compared to pre-reservoir dry season flows.

In addition to reducing peak flows of Coyote Creek, the Anderson and Coyote reservoirs trap sediment and large woody debris which would otherwise be transported downstream and deposited in the Coyote Creek channel and its floodplain. Due to the reduction in creek sediment load downstream of the dams, instream point bars and riffles have been eroded and are not reforming due to the dearth of sediment. Based on historical aerial photos, Coyote Creek has also been laterally confined by adjacent land uses and sediment supplied by tributaries and alluvial fans to the east of the creek has been cutoff due the construction of California Highway 101 and the Coyote Canal (Figure 7). The overall result has been to modify Coyote Creek from a multi-thread channel with numerous bars and islands to a single stem stream (Figure 8).

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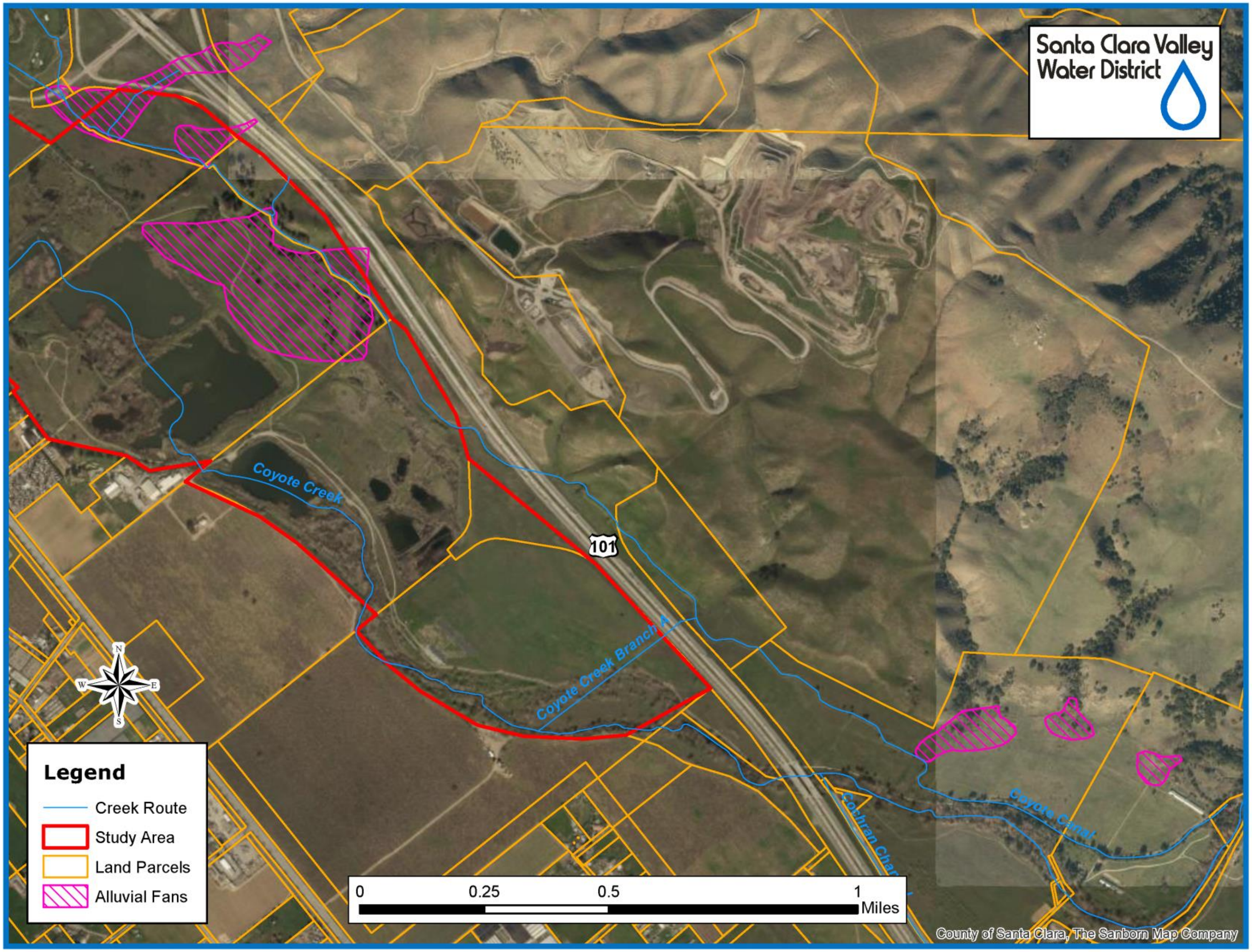

Figure 7: Local alluvial fan deposition from Diablo Range tributaries. *Approximate location and size of alluvial fans extracted from historical aerial photographs collected for Grossinger et., al., 2006.

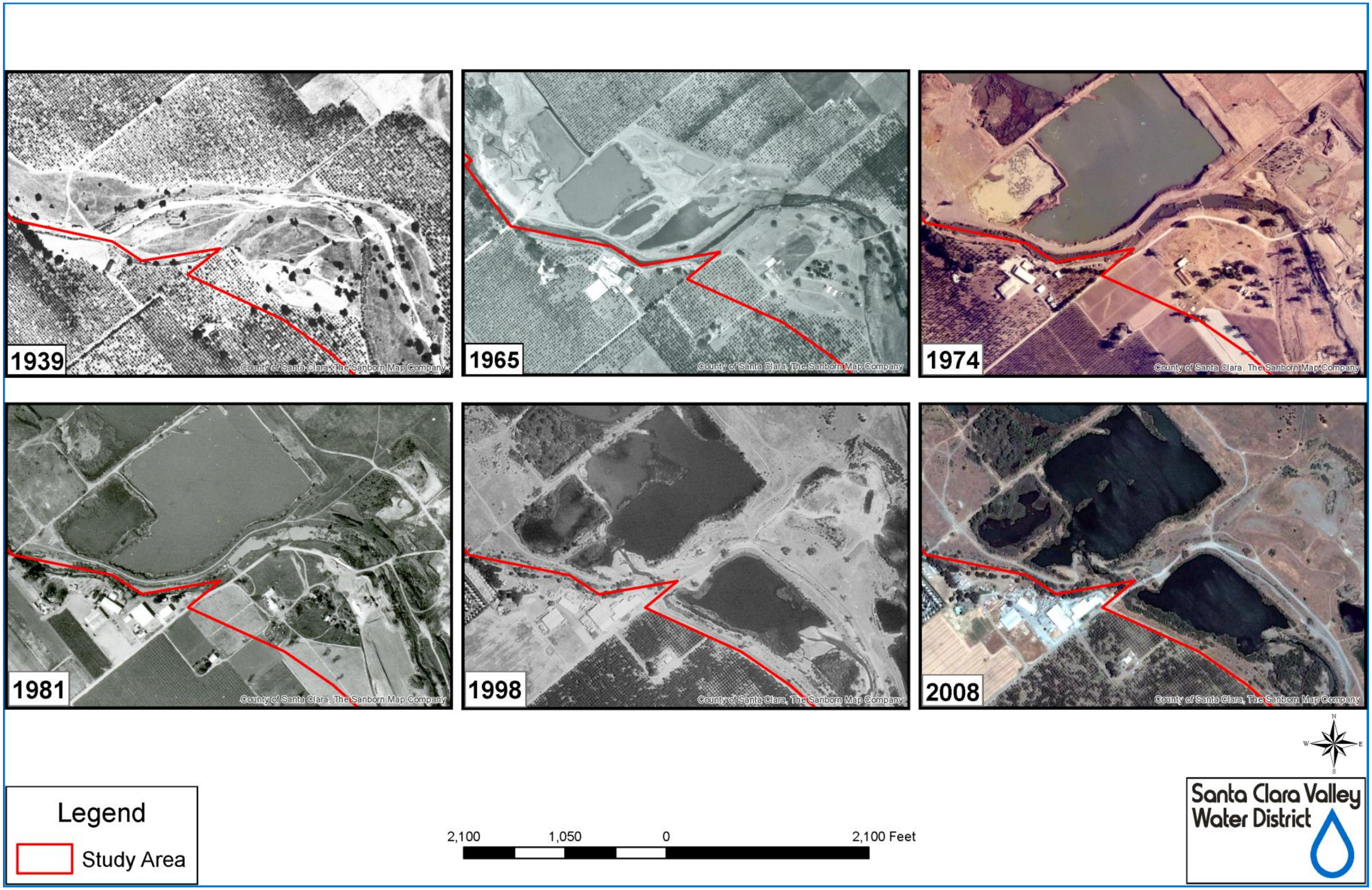

Figure 8: Changes in channel and floodplain morphology over time due to upstream reservoirs and changes in adjacent land use.

Adjacent quarrying and filling of land for agriculture have also affected channel and floodplain morphology. Riffle-pool sequences have been replaced by long mid-channel pool habitats. Additionally, along some sections of the creek the sparsely vegetated corridor which was maintained by flood scour has been converted to a denser cottonwood, willow riparian forest. The increase in riparian trees resulted in increased shading of the creek water. While this increase in riparian complexity facilitates increased diversity in avian and other wildlife, the dense shading also limits algae production, which requires sunlight, within the creek channel. Dense shading at portions of the creek channel likely decreases primary biological productivity and can be detrimental to native fish. It should be noted that the amount of light in a stream also affects fish behavior. Steelhead are drift feeding fish and light is essential to their survival (Moyle, 2002).

Damming of creeks alters water temperature regimes in downstream reaches. Anderson Dam has a multiport outlet which draws water from three different elevations within the reservoir to provide operational flexibility; however, it can elevate water temperatures if water is drawn from the warmer mid-level or top outlets for release into Coyote Creek. Water drawn from the lowest portal is cooler but has lower dissolved oxygen levels, higher turbidity, and contain hydrogen sulfide. Additionally, relatively warm imported water from the CVP pipeline augments the surface flow downstream of Anderson Reservoir. In addition to temperature effects, water from the Central Valley differs in water chemistry (i.e., dissolved inorganic ions, dissolved organic compounds, etc.) from natural creek water.

In addition to the changes in sediment, chemistry and hydrological regimes, the site was actively mined for gravel for thirty-five years. Based on historical aerial imagery and current lidar data, it is estimated that 2,100-acre feet (3.4 million cubic yards) of alluvial sand and gravel was excavated from the Site. This mining left about 145 acres of pits ranging up to 35 ft in depth that collect storm runoff and groundwater seepage and have become permanent or semi-permanent ponds. The mining pits were not originally within the Coyote Creek channel, but high creek flows when Anderson dam spilled in 1997 removed a section of the earthen berm separating Coyote Creek from Pond 1. As a result, Coyote Creek currently flows into Pond 1 and through inter-pond connections through Ponds 2 ,3, and 4.

3.1.3. Fish

The valley floor of the Coyote Creek watershed has been extensively modified over the last one hundred years due to agricultural and urban development. As a result, the fish communities that were adapted to the environmental conditions in Coyote Creek have also changed.

Coyote Creek is included in the Sacramento-San Joaquin ichthyological province, which historically was the center for fish speciation in California. The province is composed of seven sub provinces and, based on fish assemblage, Coyote Creek is within the Monterey Bay sub province (Moyle, 2002). During the middle to late Pleistocene epoch (about 1.3 million to 12,000 year ago), San Francisco Bay was a freshwater system connected to the Sacramento-San Joaquin Rivers that flowed into the Pacific Ocean at Monterey Bay. During this time, freshwater fish dispersed from the Sacramento-San Joaquin basin and colonized Coyote Creek (Branner, 1907).

In 1904, J.O. Snyder, Assistant Professor of Zoology at Stanford University, documented thirteen species of fish in eleven tributaries of the San Francisco Bay. Coyote Creek was the only creek he sampled that contained the full assemblage of all thirteen species (Table 3).

Table 3: Latin and common names of native fish species documented by Snyder for Coyote Creek (1904)

Entosphenus tridentatus	Pacific lamprey
Catostomus occidentalis	Sacramento sucker
Orthodon microlepidotus	Sacramento blackfish
Lavinia exilicauda	Hitch
Pogonichthys macrolepidotus	Sacramento splittail
Ptychocheilus grandis	Sacramento pikeminnow
Leucicorus crassicauda	Thicktailed chub
Rutilus symmetricus	California roach
Agosia nubile carringtoni	Sacramento speckled dace
*Salmo irideus**	Rainbow trout
Gasterostues cataphractus	Threespine stickleback
Hysterocarpus traski	Tule perch
Cottus asper	Prickly sculpin

*In 1989, morphological and genetic studies indicated that trout of the Pacific basin were genetically closer to Pacific salmon (*Oncorhynchus* species) than to the Atlantic salmon (*Salmo salar*) of the Atlantic basin. In 1989, taxonomic authorities moved the rainbow and other Pacific basin trout into the genus *Oncorhynchus.* Rainbow trout/steelhead below impassable barriers are listed under the ESA as threatened.

During these initial collections, Snyder did not record the presence of Sacramento perch (*Archoplites interruptus*) or Western brook lamprey (*Lampetra richardsoni*). A researcher for the University of Michigan, Carl L. Hubbs, documented the presence of both of these species during his study in Coyote Creek in May of 1922 (Hubbs, 1925). W. Follett with the California Academy of Sciences also found Sacramento perch in the watershed in 1932. Riffle sculpin (*Cottus gulosus*) were not recorded in Coyote Creek until 1953 by Terrence J. Merkel of the University of California Berkley.). Staghorn sculpins (*Leptocottus armatus*) are not included in the historical record however they are known to occur in lower Coyote Creek (not within the study area) and other streams tributary to the San Francisco Bay (David Salsbery, SCVWD, pers. comm., 2006) (Moyle, 2002).

The sixteen native fish species documented in the Coyote basin give the creek the distinction of having the greatest diversity of fish species in the South San Francisco Bay (HRG, 1995). This distinct assemblage of fish in Santa Clara Valley persisted until the turn of the 20th century and was the result of the mosaic of habitats available prior to extensive modifications to the hydrology and geomorphology of the creek.

Current distribution of fish in Coyote Creek and Ogier Ponds have been affected by the modifications to the watershed coinciding with the local extirpation and extinction of native fauna and the introduction of non-native species (CDFG, 1976; HRG, 1995). Thicktailed chub and Sacramento splittail were first and last reported in Coyote Creek by Snyder in 1904 (CDFG, 1976). Thicktailed chub are extinct with the last recorded specimen being caught in the Sacramento River near Rio Vista in 1957 (Moyle, 2002). It is possible that Sacramento splittail were already declining when Snyder recorded their presence in 1904.

The last recorded occurrence for Sacramento perch in Coyote Creek was 1959. Tule perch and western brook lamprey were last recorded in the Coyote basin by Hubbs in 1922 (CDFG, 1976; Leidy, 1984). A single tule perch was found on the mainstem of Coyote Creek in 1999 and again at Ogier Ponds in 2002 (SCVURPPP, 2001). As a result of the reported specimens the District fisheries staff undertook a an electrofishing survey at ponds 1-3 which confirmed different year classes of tule perch in the ponds. The tule perch may have been locally extirpated after 1922 and reintroduced back to Coyote Creek during pipeline water transfers from the Central Valley. Alternatively, it is also possible that the numbers were so depressed in years subsequent to the first observation that other researchers did not observe the presence of the fish.

Table 4 lists non-native introduced fish that have been observed in coyote Creek. Not all of these introduced fish species are present at the Ogier Ponds. The most prevalent fish species by numbers and biomass identified during the electrofishing survey were the introduced largemouth bass (*Micropterus salmoides*) and spotted bass (*Micropterus punctulatus*), found in each of the three ponds. Other alien fish species identified included sunfishes, black crappie (*Pomoxis nigromaculatus*) and bluegill (*Lepomis macrochirus*). Additional fish found during the survey include a native minnow, Sacramento blackfish (*Orthodon microlepidotus*), which was found partitioned in a backwater portion of pond 2, and the Sacramento sucker (*Catostomus occidentalis*) found only in pond 1.

The last recorded observation of speckled dace in Coyote Creek occurred in 1977 (HRG, 1995). Speckled dace have limited distributions in some watersheds which can make them prone to local extirpation (Moyle, 2002). Riffle sculpin and pikeminnow have not been observed below the reservoirs on the valley floor for many years however they still persist upstream of the reservoirs and in tributaries of less disturbed habitats (Leidy, 2007). Sacramento blackfish, Pacific lamprey, California roach, hitch, rainbow trout, prickly sculpin, Sacramento sucker and the threespine stickleback still exist on the mainstem of the valley floor. Degraded habitat and the presence of introduced fauna has reduced the quality and quantity of habitat for these native fish.

Of the fish currently and historically present in Coyote Creek, the steelhead trout *(Oncorhynchus mykiss)* is the only fish listed under the Endangered Species Act (ESA) as “threatened” and as previously noted, Coyote Creek is critical habitat for this species (NMFS, 2005). The NMFS has cited that these abandoned and flooded quarry pits in Coyote Creek “create numerous problems for steelhead including the loss of spawning and rearing habitat, thermal warming, increased opportunities for predatory fish and birds, increased bank erosion, and changes in the channel morphology which adversely affect steelhead habitat “ (NMFS, 2002). Suffice to say, any stream restoration efforts for this site should be focused on steelhead conservation and improvement of critical habitat. Therefore, a brief description of rainbow trout/steelhead life history attributes which have been taken into consideration for this feasibility study is included here.

The life history patterns of California rainbow trout are both flexible and variable as they have evolved in an episodic climate (Moyle, 2002). A major gap currently limiting the management and recovery of steelhead in California is the scarcity of information on the structure and life history of wild populations and the relationship between resident and anadromous life history forms (Lindley et al. 2007). The complex life history patterns of steelhead, including variable freshwater and ocean residence periods, multiple age classes of returning adults, and potential for multiple life history forms contribute to the difficulties in studying and managing wild steelhead rainbow trout populations. The two basic patterns for rainbow trout are “migratory (i.e., steelhead) or resident life history patterns but both types often exist in the same population. However, dominance of one pattern or the other is often a defining trait for a population (Moyle, 2002). Coyote Creek does support a population of “winter” steelhead and multiple year classes of rainbow trout have been identified above the Ogier Ponds although it is unclear what the status of the population is (Moore, M. et al., 2008; Leister, M & Smith, J. 2016).

Steelhead migrate from the ocean into Coyote Creek when winter rains provide enough cold water for both migration and spawning but a lack of information about the population structure means relying on the published literature for life history attributes. Steelhead typically enter freshwater as mostly three and four year old’s and spawn during late spring (February to April). The eggs hatch after about a month in the gravels and the fish rears in freshwater until it reaches a size of approximately 4 inches before it begins its physiological transformation into a smolt. The smolt will migrate downstream during spring and summer to forage and can rear as long as two years or more in larger mainstem rivers and estuaries foraging and gaining weight(Moyle et. al., 2016). The onstream impoundments create a suite of issues for steelhead trout (i.e., degrades rearing and spawning habitat) as the NMFS has cited but the most direct effect of the Ogier Ponds on steelhead is blocked passage of migrants. These impoundments affect fish behavior and physiology in the migration corridor by altering water temperature, dissolved gas concentrations, and other physiochemical conditions both upstream and downstream from the ponds. Temperature alteration is of particular concern because temperature plays a central role in regulating fish physiology, behavior, and survival (Moyle, 2002).

Some of the fish and amphibian species that are more strongly associated with lentic habitats, particularly non-native centrarchid fishes (e.g. largemouth bass and the non-native), are voracious predators of native fish, reptiles, amphibians, and invertebrates. These predators are abundant in the Ogier Ponds, and prey on native species within the ponds. They also compete with native fish for food and habitat. Due to the surface hydraulic connection, these predatory species can more easily disperse from the ponds to the creek, thus increasing predator populations in Coyote Creek as well.

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Table 4: Latin and common names of introduced fish species documented by SCVWD in Coyote Creek, 1995-2007)

Acanthogobius flavimanus	Yellowfin gobi
Ameiurus melas	Black bullhead
Ameiurus melas	Brown bullhead
Carassius auratus	Goldfish
Cyprinus carpio	Common carp
Dorosoma petenense	Threadfin shad
Gambusia affinis	Mosquitofish
Ictalurus punctatus	Channel catfish
Lepomis cyanellas	Green sunfish
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Lepomis microlophus	Redear sunfish
Lucania parva	Rainwater killifish
Menidia beryllina	Inland silverside
Micropterus salmoides	Largemouth bass
Morone saxitalis	Striped bass
Notemigonus crysoleucus	Golden shiner
Percina macrolepida	Bigscale logperch
Pimephales promelas	Fathead minnow
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie
*Oncorhynchus tshawytscha**	Chinook salmon
*Thaleichthys pacificus**	Eulachon

*Species native to California but not historically present in Santa Clara County.

3.1.4. Birds

More than 200 bird species have been recorded in Coyote Valley (DeAnza College (undated)). Of those species, more than 170 have been recorded at the Ogier Ponds. This high bird diversity results primarily from the abundance of water at the Ogier Ponds and the diversity of habitats. Water supports a variety of riparian, wetland, and aquatic habitats that vary in dominant plant species composition, habitat structure, and water depth. These habitats complement the upland grassland, scrub, and oak woodland habitats that dominate the higher, drier areas to produce a habitat mosaic whose diversity is matched in few other areas of Santa Clara County.

For the purposes of this analysis, bird use is described by habitat (focusing on riparian, wetland, and aquatic habitats) and seasonality (because of the variability in bird communities by season). Riparian habitats at the Ogier Ponds are particularly valuable to birds. Two main types of riparian forest and scrub communities occur here – sycamore alluvial woodland and cottonwood-willow riparian forest, woodland, and scrub. Sycamore alluvial woodland present along Coyote Creek just upstream from the Ogier Ponds complex (roughly between the model airplane park and Highway 101) is dominated by scattered, mature western sycamores with an understory of various willows (*Salix* spp.), mulefat (*Baccharis saliciolia*), and other small trees and shrubs. Cottonwood-willow riparian forest, woodland, and scrub occurs in some locations along Coyote Creek, around the edges of the ponds, and on islands within Ponds 2 and 3. This community is dominated by species of willows, Fremont cottonwood, mulefat, and other predominantly native tree and shrub species. Owing to the previous use of these ponds as borrow pits, mature riparian vegetation is limited to areas along Coyote Creek and one large patch in the north-central portion of the Ogier Ponds complex that were evidently undisturbed during the gravel borrow operations. However, dense riparian vegetation is present in a number of areas at the perimeters of ponds and along portions of Coyote Creek that flow into and through the pond complex.

Riparian habitat supports high diversity and abundance of birds due to the high volume of vegetation, which provides ample substrate for perching, foraging, and nesting; high foliage height diversity, which reflects the presence of numerous vertical strata (e.g., ground cover, understory, midstory, and canopy), each of which may support particular species of birds; and abundance of invertebrate prey. This riparian habitat is particularly important to perching birds. Birds such as the chestnut-backed chickadee (*Poecile rufescens*), oak titmouse (*Baeolophus inornatus*), Nuttall's woodpecker (*Picoides nuttallii*), downy woodpecker (*Picoides pubescens*), ash-throated flycatcher (*Myiarchus cinerascens*), western bluebird (*Sialia mexicana*), and tree swallow (*Tachycineta bicolor*) nest in tree cavities, particularly in sycamores and mature cottonwoods and willows. The bushtit (*Psaltriparus minimus*), Bullock's oriole (*Icterus bullockii*), yellow warbler (*Setophaga petechia*, a California species of special concern), Pacific-slope flycatcher (*Empidonax difficilis*), warbling vireo (*Vireo gilvus*), American goldfinch (*Spinus tristis*), lesser goldfinch (*Spinus psaltria*), and others nest in midstory and canopy of riparian trees, while the Bewick's wren (*Thryomanes bewickii*), song sparrow (*Melospiza melodia*), common yellowthroat (*Geothlypis trichas*), California thrasher (*Toxostoma redivivum*), California towhee (*Melozone crissalis*), and spotted towhee (*Pipilo maculatus*) nest in understory vegetation, scrub, and ground cover. Larger birds, including the red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), white-tailed kite (*Elanus leucurus*), and green heron (*Butorides virescens*) nest in small numbers in larger riparian trees at the Ogier Ponds as well. Small numbers of wood ducks (*Aix sponsa*) and common mergansers (*Mergus merganser*) nest in larger tree cavities, while Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), and gadwalls (*Anas strepera*) nest in weedy vegetation or riparian undergrowth; these waterfowl then take their young to water within the ponds or Coyote Creek after hatching.

Riparian habitat supports migrant and wintering birds as well. A variety of insectivorous birds such as flycatchers, warblers, and vireos use this habitat during spring and fall migration. Fruits of Mexican elderberry (*Sambucus mexicana*) and seeds of a variety of plants are also eaten by migrants and wintering songbirds, including golden-crowned sparrows (*Zonotrichia atricapilla*), white-crowned sparrows (*Zonotrichia leucophrys*), Lincoln's sparrows (*Melospiza lincolnii*), and fox sparrows (*Passerella iliaca*). Dense riparian habitat also provides roosting sites and cover for a variety of songbirds.

Emergent wetlands classified as coastal and valley freshwater marsh occur as fairly narrow bands around the margins of ponds, and around islands in two of the larger ponds, as well as in more extensive stands in shallower portions of some ponds. These wetlands, which are dominated by California bulrush, rushes (*Juncus* spp.), sedges (*Cyperus* spp.), and cattails, occur primarily (and are best represented) in perennially ponded areas, where they form dense, tall stands. Freshwater marsh habitat at the Ogier Ponds provides nesting substrate for American coots (*Fulica americana*), common gallinules (*Gallinula galeata*), pied-billed grebes (*Podilymbus podiceps*), ruddy ducks (*Oxyura jamaicensis*), green herons, marsh wrens (*Cistothorus palustris*), song sparrows, and red-winged blackbirds (*Agelaius phoeniceus*). Colonies of the tricolored blackbird (*Agelaius tricolor*) nested at the Ogier Ponds in the 1990s; though this California species of special concern and candidate for endangered listing has not nested here in recent years, potentially suitable nesting habitat is still present in ponds with extensive emergent vegetation. American bittern, a scarce breeder in Santa Clara County nests in emergent vegetation at the Ogier Ponds, although that species occurs primarily as a migrant and winter visitor. The sora (*Porzana carolina*) and Virginia rail (*Rallus limicola*) forage in freshwater marshes during migration and in winter as well. Wetland vegetation provides roosting sites and cover for large numbers of red-winged blackbirds and sparrows during the nonbreeding season and provides foraging perches for large waders such as black-crowned night-herons (*Nycticorax nycticorax*).

Aquatic habitats at the Ogier Ponds include the open-water areas (i.e., areas without dense emergent vegetation) within the ponds and Coyote Creek, including areas that are either perennially or seasonally inundated. Submerged aquatic vegetation is present in some areas. The ponds are relatively steep-sided and deep, and they thus contain very limited shallow-water habitat.

Aquatic habitats are used little by birds for nesting due to the absence of suitable nesting substrate. Pied-billed grebes can build floating nests anchored to submerged vegetation, and shorebirds such as the killdeer (*Charadrius vociferus*), black-necked stilts (*Himantopus mexicanus*) and sandpipers (*Actitis macularius*) nest on bare ground, gravel, or sparsely vegetated areas around ponds. However, aquatic habitats at the Ogier Ponds support fairly large numbers and high diversity of foraging waterbirds. Most of the waterbirds that nest in riparian or wetland vegetation around the ponds and along Coyote Creek forage in these open waters as well. Wood ducks, mallards, and common mergansers may forage both in the ponds and within portions of the creek itself, but most waterbird species are associated primarily with the ponds. Numbers of these species are augmented during migration and winter, and hundreds of waterfowl that do not breed at the ponds, including the northern shoveler (*Anas clypeata*), canvasback (*Aythya valisineria*), lesser scaup (*Aythya affinis*), greater scaup (*Aythya marila*), ring-necked duck (*Aythya collaris*), and bufflehead (*Bucephala albeola*), forage at these ponds during migration and winter, eating aquatic vegetation and bivalves such as the non-native Asian clam (*Corbicula flaminea*). Perennial water (or at least, a high water table) is necessary for the maintenance of bivalve abundance to support the diving ducks. The presence of fish in perennial ponds attracts piscivorous species, including several species of grebes, common mergansers, green herons, great egrets (*Ardea alba*), great blue herons (*Ardea herodias*), snowy egrets (*Egretta thula*), black-crowned night-herons, double-crested cormorants (*Phalacrocorax auritus*), Caspian terns (*Hydroprogne caspia*), Forster's terns (*Sterna forsteri*), ospreys (*Pandion haliaetus*), and belted kingfishers (*Megaceryle alcyon*). Muddy edges and shallow water, particularly in seasonal aquatic habitats, provide foraging habitat for shorebirds such as least sandpipers (*Calidris minutilla*), western sandpipers (*Calidris mauri*), and greater yellowlegs (*Tringa melanoleuca*) during spring and fall migration.

Ducks, coots, and geese use the larger ponds as roosting sites due to the protection they provide from terrestrial predators. In addition, 10 species of gulls roost and bathe on the ponds between bouts of foraging at the Kirby Canyon Landfill to the east. With the exception of relatively small numbers (a few hundred) of California gulls (*Larus californicus*) that use the landfill and Ogier Ponds during summer, the majority of gull use occurs from October to April, when up to 5-10,000 gulls may use the ponds on days when the landfill is open. Aside from gulls, most waterbirds are present in relatively low densities. In contrast, bird density within the much more limited wetland and riparian habitats surrounding the ponds tends to be higher.

With respect to bird use by season, a number of the birds that use the Ogier Ponds are permanent residents, occurring there year-round. Their numbers may be augmented during migration and winter with individuals from other breeding populations that use the Ogier Ponds as migration or wintering habitat. Permanent residents rely on the Ogier Ponds for all their breeding, foraging, roosting, and winter survival needs. As a result, those permanent residents that require habitat that is supported by perennial water, such as birds that nest or raise their young in wetland or aquatic habitats, rely on that perennial water during summer and fall (i.e., when seasonal wetlands may not contain water).

A few additional species are present at the Ogier Ponds year-round but use the ponds only for foraging. For example, double-crested cormorants, great egrets, Caspian terns, Forster's terns, and California gulls nest in other South Bay locations but commute to the Ogier Ponds (or, in the case of the California gulls, the nearby landfill) for foraging.

During spring and fall, a variety of migratory birds moving through the region use the Ogier Ponds as migratory stopover habitat. Such birds may remain at the Ogier Ponds for days to weeks, feeding and building up fat reserves to fuel the next migratory flight. A variety of neotropical migrant songbirds that winter in tropical areas and breed north of Santa Clara County occur at the Ogier Ponds, primarily using woody riparian habitat for foraging and roosting. Such migrants include warblers, vireos, flycatchers, buntings, grosbeaks, and tanagers. Although individuals of some of these species may breed at the Ogier Ponds as well, these groups occur primarily as transient migrants. A high groundwater table, which may be associated with perennial water, in turn supports riparian vegetation that provides foraging habitat for these birds.

Other birds use the Ogier Ponds only during migration, with some occurring in winter as well, but they do not breed in the region. These are typically short-distance migrants (as opposed to Neotropical migrants) that breed to the north of the region. They include passerines such as golden-crowned, white-crowned, Lincoln's, and fox sparrows, ruby-crowned kinglets (*Regulus calendula*), and yellow-rumped warblers (*Setophaga coronata*); shorebirds that migrate through Coyote Valley, such as least and western sandpipers and lesser yellowlegs; and a number of waterfowl species.

The following paragraphs discuss the value of the Ogier Ponds to bird populations and communities on three scales: Coyote Valley (i.e., from Morgan Hill to the urban areas of southern San Jose); the larger Santa Clara Valley (i.e., from the San Benito County line north through San Jose, Milpitas, Santa Clara, Sunnyvale, and Mountain View, but not including San Francisco Bay); and the greater South Bay area, including the southern San Francisco Bay, Santa Clara County, and portions of adjacent counties.

On the scale of Coyote Valley, the Ogier Ponds complex represents the most valuable habitat area in terms of the number of bird species supported. The Ogier Ponds area supports most of the species that occur in those other Coyote Valley habitats, and supports higher diversity overall due to the mosaic of different habitats and the presence of more extensive open water than is present in Coyote Creek or at the smaller ponds. Most grebes and diving ducks, as well as gulls, terns, cormorants, shorebirds, and ospreys, make little use of Coyote Creek or smaller ponds in Coyote Valley, and the densities and abundance of other waterbird species (e.g., dabbling ducks, coots, and gallinules) are substantially higher within the Ogier Ponds than along Coyote Creek or at smaller ponds. The combination of high-quality habitat for numerous waterbirds, riparian birds, and upland-associated birds in such a limited area makes the Ogier Ponds area very important to bird diversity at the scale of Coyote Valley.

As the scale of analysis expands to include the larger Santa Clara Valley and adjacent foothills, the contribution of the Ogier Ponds to regional bird diversity decreases somewhat. For example, reservoirs such as Anderson, Coyote, Calero, and others, as well as Lake Cunningham The Ogier Ponds do not support any unique bird species or assemblages that are not found elsewhere in the Santa Clara Valley. However, the Ogier Ponds represent one of the most important locations within the Santa Clara Valley due to the high numbers of species supported in such a limited area and because the Ogier Ponds support several species that are fairly scarce in the Santa Clara Valley as a whole. For example, the marsh-associated species that these ponds support, such as common gallinule, marsh wren, and American bittern, occur very sparingly in other locations within the Santa Clara Valley. They occur more commonly in marshes around the edge of San Francisco Bay, but these species are scarce and very local in Santa Clara County away from the Bay.

As the scale of assessment expands even further to San Francisco Bay and adjacent portions of Santa Cruz and San Benito Counties, the contribution of the Ogier Ponds to bird diversity decreases further. The waterbird species supported by the Ogier Ponds can be found around San Francisco Bay, in extensive wetlands around San Felipe Lake in northern San Benito County, or in ponds and lagoons in Santa Cruz County in much greater numbers than are supported by the more limited habitats at the Ogier Ponds. Similarly, riparian-associated landbird species occur in a variety of riparian habitats in the greater South Bay.

The Ogier Ponds facilitates dispersal of waterbirds within the region. Some species, such as double-crested cormorants, gulls, Forster's terns, and Caspian terns, make daily flights between bayside breeding or roosting areas and inland foraging areas. Such species are frequently seen flying inland toward Coyote Valley and other inland locations in the morning and flying toward San Francisco Bay in late afternoon. On numerous occasions, birds have been seen to stop at the Ogier Ponds to forage or bathe before continuing farther inland or continuing toward the bay. During winter, thousands of gulls make morning flights from the bay inland to forage at landfills or other areas. In the afternoon, these birds move northwest through Santa Clara Valley back to the bay.

3.1.5. Odonates

Most observations of insects at the Ogier Ponds have focused primarily on odonates (e.g. dragon flies and damsel flies). Odonates require aquatic habitat for some portion of their life cycle. Most adult activity occurs March through October, though various species may only be active for a subset of this period. During this flight season, adults feed, mate, and lay eggs. In some species, oviposition occurs directly in water, with females hovering over the water and dipping the tips of their abdomens into the water to drop eggs. Other species lay eggs by inserting them into vegetation.

Some odonates occur primarily in and around lentic waterbodies that are not subject to substantial flow, whereas others are more closely associated with flowing water in creeks and rivers. Thus, high odonate diversity depends on the availability of a diverse array of waterbody types (including both ponds and flowing streams) and a diversity of hydroperiods (including both seasonal and perennial waterbodies). The Ogier Ponds area supports high odonate diversity. At least 32 species, or 62% of the 52 species known to have occurred in Santa Clara County (Biggs, unpublished data), have been recorded at the Ogier Ponds. These include 13 species of damselflies and 19 species of dragonflies. Of the 32 species of odonates that have been recorded at the Ogier Ponds, most are species that occur solely or primarily in areas with perennial water. Only two of the species that have been recorded here are more often associated with seasonal waterbodies.

No other locations in Coyote Valley are likely to support diversity as high as at the Ogier Ponds. The presence of flowing water over the gravel and cobble substrate of Coyote Creek and extensive ponds with diverse wetland and riparian vegetation is likely responsible for the high number of odonate species observed at the Ogier Ponds. On a broader scale (e.g., in the larger Santa Clara Valley), odonate diversity is likely as high as at the Ogier Ponds at some reservoirs that support extensive wetlands and are fed by streams with gravel and cobble substrates (perhaps Coyote Reservoir) and in areas where percolation ponds are present near such streams, such as the Los Capitancillos Ponds along Guadalupe Creek and the Oka Ponds along Los Gatos Creek. However, there are likely few locations in the Santa Clara Valley, or even in the greater South Bay, where as many as 32 odonate species can be found within such a limited area.

3.1.6. Amphibians

The predominant native amphibians occurring at the Ogier Ponds are the Sierra chorus frog (*Hyliola sierrae*) and western toad (*Anaxyrus boreas*). Both species lay eggs in shallow portions of ponds and slow-flowing portions of streams. Sierra chorus frogs lay eggs in winter and spring and require about two to three months for larval metamorphosis after eggs are laid. Western toads breed from January to late spring or early summer; it takes about three months after egg laying for larval metamorphosis to occur. As a result, neither species can breed successfully in highly ephemeral waterbodies, although both species are capable of breeding successfully in seasonal waterbodies that pond from around January or February through April or later.

At the Ogier Ponds, the Sierra chorus frog occurs widely, though in most areas, it is not abundant. Mature western toads also occur throughout the pond complex, though in recent years, breeding has been scarce, possibly due to drought conditions.

Both the Sierra chorus frog and western toad are relatively widespread in the Santa Clara Valley, and they are even more abundant in extensive natural areas with ponds in the adjacent foothills of the Santa Cruz Mountains and throughout the Diablo Range. As a result, the numbers of these species supported by the Ogier Ponds do not represent a substantial proportion of the regional population. However, the Ogier Ponds may serve a function in connecting populations of these species on either side of Coyote Valley. Although individuals are unlikely to disperse from one side of the valley to the other (owing to their small size relative to the width of the valley), aquatic “stepping stones” within the valley provide locations for these species to breed, and dispersal among the stepping stones may allow for genetic exchange that link populations in the mountain ranges on either side of the valley. The Ogier Ponds, along with other ponds and creeks (e.g., Coyote Creek and Fisher Creek) on the Coyote Valley floor, may fill this role.

Two special-status amphibians have potential to occur at the Ogier Ponds - the California red-legged frog (*Rana draytonii*), which is listed as threatened under the Federal Endangered Species Act (FESA), and the California tiger salamander (*Ambystoma californiense*), which is listed as threatened under both the FESA and the California Endangered Species Act (CESA). California red-legged frogs are known to breed in ponds at the Kirby Canyon Landfill just across Highway 101 from the Ogier Ponds, and adult and larval California red-legged frogs were reported at an unspecified location at the Ogier Ponds in 2002 (CNDDB 2016). Due to the abundance of bullfrogs and fish in the ponds, the Ogier Ponds are unlikely to support a viable California red-legged frog population.

California tiger salamanders are not known to occur at the Ogier Ponds, though they have been recorded to the north near the Coyote Creek Golf Course. At the perennial Ogier Ponds, California tiger salamander breeding is unlikely due to the abundance of predatory fish, which would preclude successful breeding by this species (Barry and Shaffer 1994, Shaffer and Trenham 2005).

The non-native bullfrog is likely the most abundant amphibian at the Ogier Ponds. Bullfrogs require perennial water to complete their life cycle because larvae typically overwinter before metamorphosing; the perennial ponds at the Ogier Ponds (as well as associated reaches of Coyote Creek) support this breeding pattern and thus support numerous bullfrogs. Bullfrog adults prey on juvenile toads and chorus frogs, though bufotoxins in juvenile toads may make them unpalatable as prey. Bullfrogs may be a predation problem even in seasonal waterbodies because adults easily travel between seasonal and perennial ponds, and larvae from bullfrog eggs laid in seasonal waterbodies may compete with chorus frog or toad larvae for food, even if those bullfrog larvae do not survive to metamorphosis due to seasonal hydrology. Due to their abundance and predatory nature, bullfrogs limit the abundance of native amphibians at the Ogier Ponds.

3.1.7. Reptiles

Western pond turtles (*Actinemys pallida*) have been observed in small numbers at the Ogier Ponds. Western pond turtles occur in both larger, deeper ponds with extensive open water and in smaller, shallower, marshier ponds. Suitable basking habitat is present on the rocky banks of some ponds, though downed woody debris, mats of tules, and floating or partially submerged aquatic vegetation provide suitable basking habitat as well. This species nests in upland areas. It is unknown whether these ponds support a successfully reproducing population or whether the continued presence of western pond turtles at the Ogier Ponds results from immigration from other areas and/or the long-lived nature of the adults at this site.

Although the western pond turtle is scarce, and considered a California species of special concern, it is distributed fairly widely in Santa Clara County. As a result, the relatively low numbers of individuals present at the Ogier Ponds do not represent a regionally significant proportion of the population. The Ogier Ponds may provide a “stepping stone” facilitating dispersal of the species as discussed for amphibians above, but this species is expected to disperse readily along Coyote Creek and Fisher Creek in the Coyote Valley area, and the provision of habitat for western pond turtles at the Ogier Ponds is likely not critical to the persistence of the species in the Coyote Valley or the species’ ability to disperse through the valley, as long as some aquatic habitat connectivity along Coyote Creek is present.

3.1.8. Ecological Consequences

Restoration of Coyote Creek to its pre-1997 channel will restore the pre-1997 form and function (e.g., sediment transport, water chemistry, and lotic communities) of the channel. Construction of berms to separate the creek and ponds would require removal of existing mature riparian vegetation, but would affect only a small portion of the riparian habitat at the area. The abundance of stream-related odonates would increase. The abundance of riparian-associated birds, reptiles, and amphibians would not be expected to substantially change. Because the creek would be against the western edge of the Ogier Ponds site, there is potential for adjacent residential, industrial, and agricultural uses to result in pollution, disturbance by people, noise, and pets, and introduction of non-native vegetation into the restored creek channel. Also, channel armoring would likely be required to prevent future breaches of the creek bank to protect land uses to the west and the ponds to the east. Both the creek and the ponds would continue to support predatory fish and bullfrogs. However, the ponds provide a more suitable “nursery” for those non-native predators, and removing the surface connection would prevent non-native predatory fish from the ponds from entering Coyote Creek. Adult and juvenile bullfrogs could still move overland between the ponds and the creek, but bullfrog abundance in the creek may decrease once it is no longer directly connected to the ponds. As a result, creek biota may experience somewhat lower risk of predation by non-native fish and bullfrogs than they currently do.

Under the pre-1997 channel restoration concept, pond acreage would be reduced by about 2 acres due to construction of the eastern creek berm, leaving about 142.5 acres of pond. Given the extent of open-water habitat in the ponds and the relatively low densities of birds using the open-water habitats, this pond loss would not substantially reduce the abundance of any pond-related animals or reduce diversity. The loss of wetland and riparian habitat along the edges of these three ponds would have a greater adverse ecological impact.

Under the floodplain restoration concept, up to 60% of the existing ponds would be permanently removed to create a connected floodplain. As a result, conversion of ponds to an active floodplain will reduce quality and quantity of pond habitat and associated pond species. Although this concept would require removal of existing vegetation from large areas of riparian habitat, the restored creek channel/floodplain would be much broader as it flowed through the pond complex. If the project were to move to planning, project alternatives to maximize the ecological value and minimize impacts to existing wetland and riparian vegetation would need to be evaluated. The size of the connected floodplain would be constrained by the modified hydrology of the creek, therefore while 500 feet is used for analysis here that would have to be further evaluated. Additional analysis would be needed to determine the optimal creek and floodplain size. Coyote Creek would no longer have a surface water connection to the ponds. Restoration of a meandering multi-stem Coyote Creek and connected floodplain would result in considerable benefits to creek-associated habitats and species. This concept would result in an increase in the abundance of stream-related odonates, and the increase in riparian habitat would result in an increase in the abundance of riparian-associated birds in the Ogier Ponds area as well. No substantial change in amphibian abundance associated with the creek would result from this concept, but the broad nature of the connected floodplain would provide opportunities to install basking structures for western pond turtles along the creek. The creek would be allowed to meander within the broader floodplain, thus allowing for the natural processes of erosion and deposition that results in the formation of bars on which cottonwoods, sycamores, and willows can naturally regenerate and the development of more natural riffle and pool complexes, resulting in greater aquatic habitat diversity. Restoration of sycamore alluvial woodland may be feasible within the broad floodplain through the re-creation of substrate and hydrologic conditions conducive to sycamore recruitment and survival. However, the artificial hydrology of Coyote Creek at the site would constrain the development of geomorphic channel and floodplain. Specifically, Coyote and Anderson reservoir operations result in an unnatural hydrograph, causing reduced frequency and magnitude of high flow events in the rainy season and unnaturally persistent base flows during the dry season. Thus, stream restoration does not imply restoring the natural creek geomorphology and hydrology to pre-dam conditions. However, just as rivers have been incrementally modified, they can be incrementally restored, with resulting improvements to many physical and biological processes. Therefore, the site represents a rare opportunity to restore sycamore alluvial woodlands, which would provide habitat for numerous bird and invertebrate species and would increase animal diversity and abundance in the Ogier Ponds area.

Under both concepts, the only physical modifications of existing ponds will consist of grading or filling to create the banks and berms along Coyote Creek that will separate the creek from the ponds and/or connected floodplain. The depth of water in the ponds would vary if they are separated from creek water, but the ponds would remain filled with water throughout the year in almost all years. During extended periods of below average precipitation and creek flow, the ponds could dry up and become seasonal. However, that would be expected to occur only one year out of every 20 years on average.

In addition to the physical modification of ponds due to construction of the eastern bank of the creek, hydrological and chemical changes to the ponds are expected to occur as well. Without a surface connection to Coyote Creek, the ponds are expected to continue to hold water as a result of the high groundwater table and, to a lesser extent, runoff from winter rain (Todd Groundwater 2017a). Removal of a surface connection between Coyote Creek and the ponds would eliminate flow within and through the ponds, thus resulting in less flushing of pollutants and lower oxygenation of the ponds. These problems may adversely affect fish, aquatic invertebrates, and the species that prey on them. All of the ponds would still perennially retain water in 95% of years. However, the depth of water may fluctuate more in the ponds than under current conditions. However, because all perennial ponds are expected to remain perennial (Todd Groundwater 2017b) no substantial impacts of drawdown on aquatic or riparian vegetation or animals associated with the ponds are expected to result from thefloodplain restoration concept . Because the creek would be realigned to the central portion of the Ogier Ponds complex, the potential for disturbance, pollution, and introduction of non-native vegetation from the residential and agricultural land uses to the west would be lower than under the pre-1997 channel restoration concept.

3.2. Surface Water Quality

Single measurements of water quality are highly variable due to temperature, season, stream discharge and recent watershed activities (Bain et. al., 1999). Therefore, to ascertain what long term effects the ponds have on water chemistry, two data sets are presented here.

A summary of temperature data collected from 6 stations above and below the ponds for water years 2002, 2005, 2008, 2009, 2010, 2011, and 2012 were graphed and analyzed (Kruskal-Wallis ranked sum test) applied (Figures 10-16). Water temperature strongly influences the composition of aquatic communities and fish physiological functions (i.e., growth and reproduction) are regulated by temperature (Moyle, 2002). The basic premise of this summary exercise was to determine if there is statistical significance to the change in water temperature downstream of the ponds and is that difference seasonally pronounced due to the artificial ponds.

In addition to the summary of the multi-year temperature data set, the District collected continuous water quality measurements for five surface water quality parameters. The District deployed unattended water quality monitoring sondes (YSI 6600 Sondes®) at five locations during the winter of 2015, from December 7th to December 17th (Figures 17, 19-21). The objective of the continuous monitoring from December 7th – 17th, 2015, was to examine basic water quality parameters (e.g. temperature, turbidity, conductivity, chlorophyll, and pH) in order to assess the impacts and environmental stressors surrounding the pond’s presence on the fluvial system.

Trophic status is a useful means of classifying lakes/ponds and describing lake/pond processes in terms of the productivity of the system. Eutrophication, the progress of a lake or pond goes toward a eutrophic condition, is often discussed in terms of lake/pond history. An obvious and problematic symptom of eutrophication is rapid growth and accumulations of phytoplankton, leading to discoloration of affected waters. Consequently, a body of water's trophic index may sometimes be used to make a rough estimate of its biological condition (Cole, 1994). Biological productivity among the ponds will vary owing to the different morphological characteristics of each of the six ponds (i.e., size, shape, degree of mixing). Chlorophyll data were collected as a surface water parameter as the concentration of chlorophyll *a* present in the water is directly related to the quantity of algae living in the water. The intent was to qualitatively evaluate productivity in relation to the lotic system.

One basic assumption is that these artificial instream impoundments are themselves deleterious to the native fish in Coyote Creek. Therefore, the data analysis for fish was conducted differently than for other wildlife. The floodplain gravel mining occurred at the site during the same time frame as did the other widespread hydrologic and sediment changes (i.e., reservoir construction) within the watershed. Beyond recognizing these anthropogenic changes occurred, discerning which impact had a greater or different type of biological response would be difficult to do at this time. Therefore, for purposes of describing what impact the ponds have on native fish in Coyote Creek, water quality differences above and below the ponds were used as a parameter for evaluation of the lentic environment on the lotic system since the chemical and material composition of water influences the species composition and abundance of fish (Moyle, 2002).

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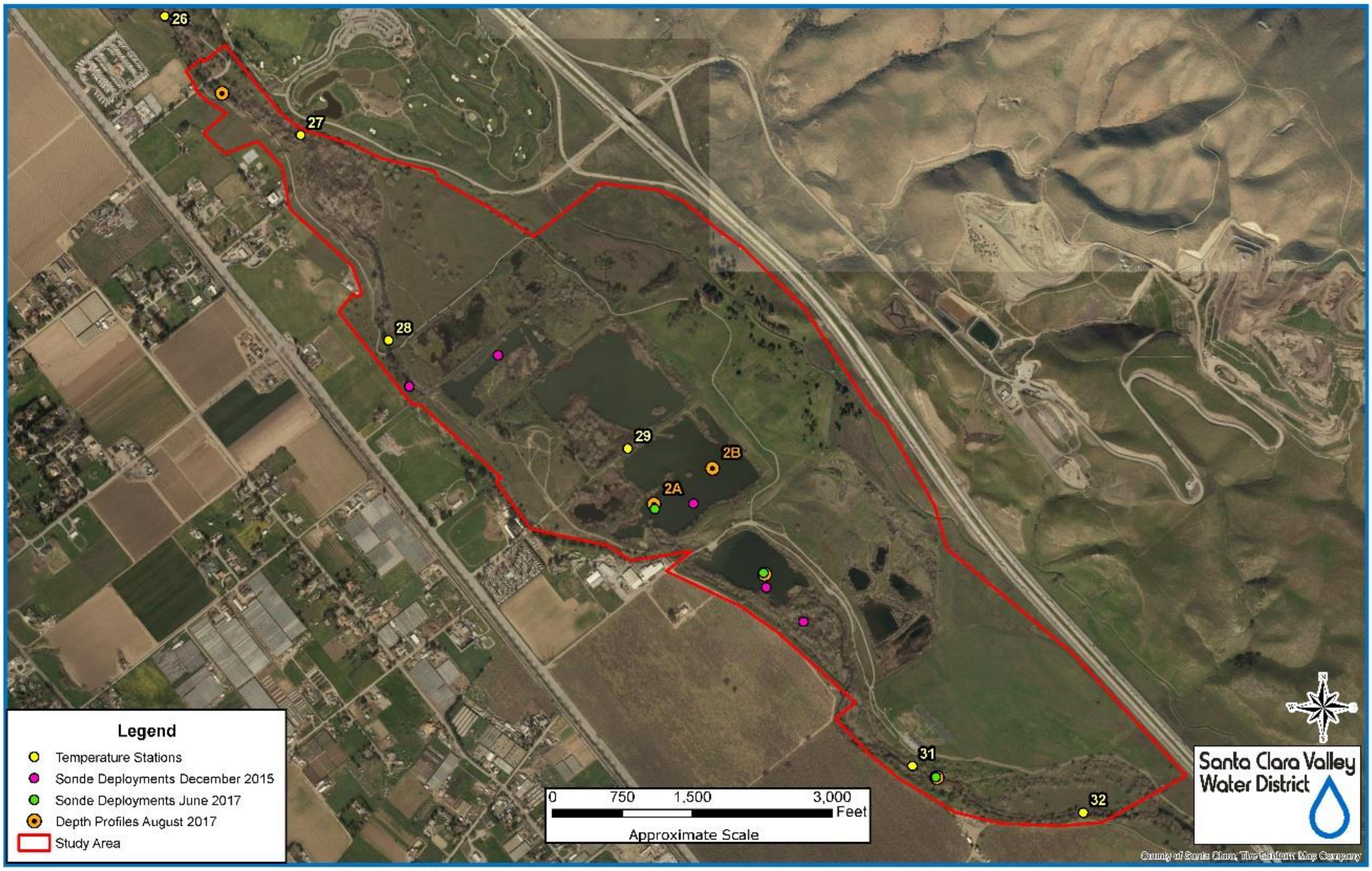


Figure 9. Locations of the six temperature monitoring stations and five multi-parameter sampling points

Temperature

Temperature data were extracted from the District's environmental database for use in this analysis. Multiple years of continuous temperature data were extracted from six established temperature stations (Figure 9). Data are presented from Station #31 (upstream of the Ogier Ponds), Station #29 (within the ponds), and Station #28 (downstream of the ponds) (Figures 10-16). Temperature data is also presented for imported water discharged to Coyote Creek at Gage 5082, about two miles upstream from Pond 1. Temperature data from years between 2002 and 2012 with complete data over the course of the water year were analyzed, while data from years with only partial-year data were not considered in the analysis due to their incomplete nature.

The Kruskal–Wallis test was chosen for statistical analysis as the data has one nominal variable, one ranked variable, and is not normally distributed. It tests whether the mean ranks are the same in all the groups and in the case of Ogier Ponds, the "groups" are defined as ambient water temperature above the ponds versus ambient water temperature below the ponds. The null hypothesis of the Kruskal–Wallis test is that the mean ranks (i.e., ranked variables are expressed as positions) of the groups are the same with the p-value>0.10 as no evidence against the null hypotheses versus a p-value <0.001 as very strong evidence against the null hypothesis. This promulgated the question: are the mean ranks of the ambient water temperatures above the ponds significantly different then downstream ambient water temperatures in summer and winter months? Water temperatures downstream of the ponds are elevated by as much as 7.5 °C in summer (See 2005, 2008) while wintertime differences are smaller (i.e., 1-3 °C).

The results of a Kruskal–Wallis test were significant (H=485.38; df=1; p-value <2.2e-16); the water temperatures upstream of the ponds are significantly different than downstream of the ponds. Some representative years of temperature data above, within and below the ponds were graphed and it appears the ponds alter ambient downstream water temperatures more so in the summer months.

Since Santa Clara County is characterized as a Mediterranean climate with hot, dry summers and warm, wet winter, this analysis spilt the data between two distinct seasons, winter (September-April) and summer (March-August) for comparison. While temperature differences were incrementally smaller in winter, the result of the Kruskal-Wallis test were significant (H=3203.7; df=1; p-value<2.2e-16); the ambient water temperatures downstream of the ponds in winter are significantly different than upstream ambient water temperatures. While the test did demonstrate significance in winter upstream the data demonstrates this does not always imply warming of downstream waters as discussed further in the subsequent section.

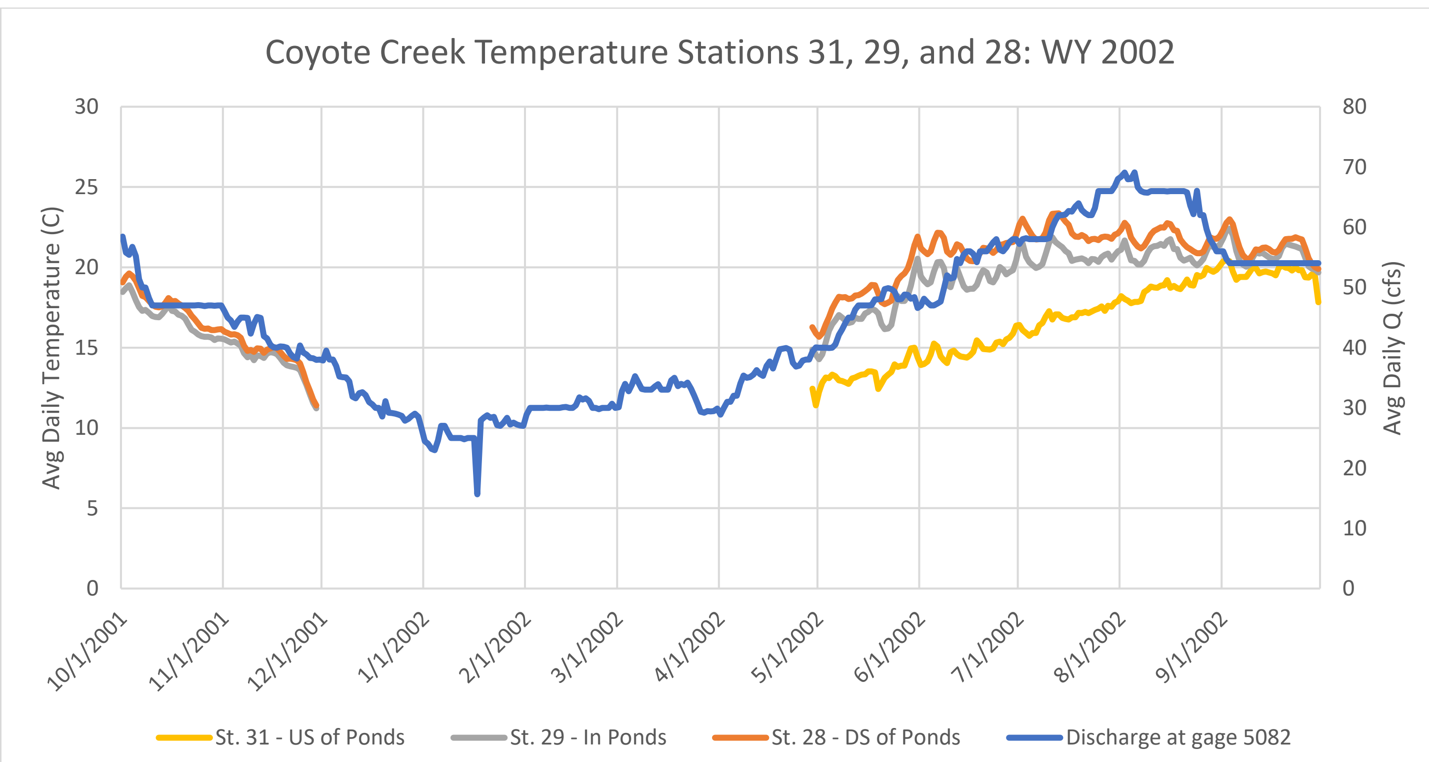


Figure 10: Water temperature above, below and within Ogier Ponds depicted with discharge data for water year 2002, Coyote Creek.

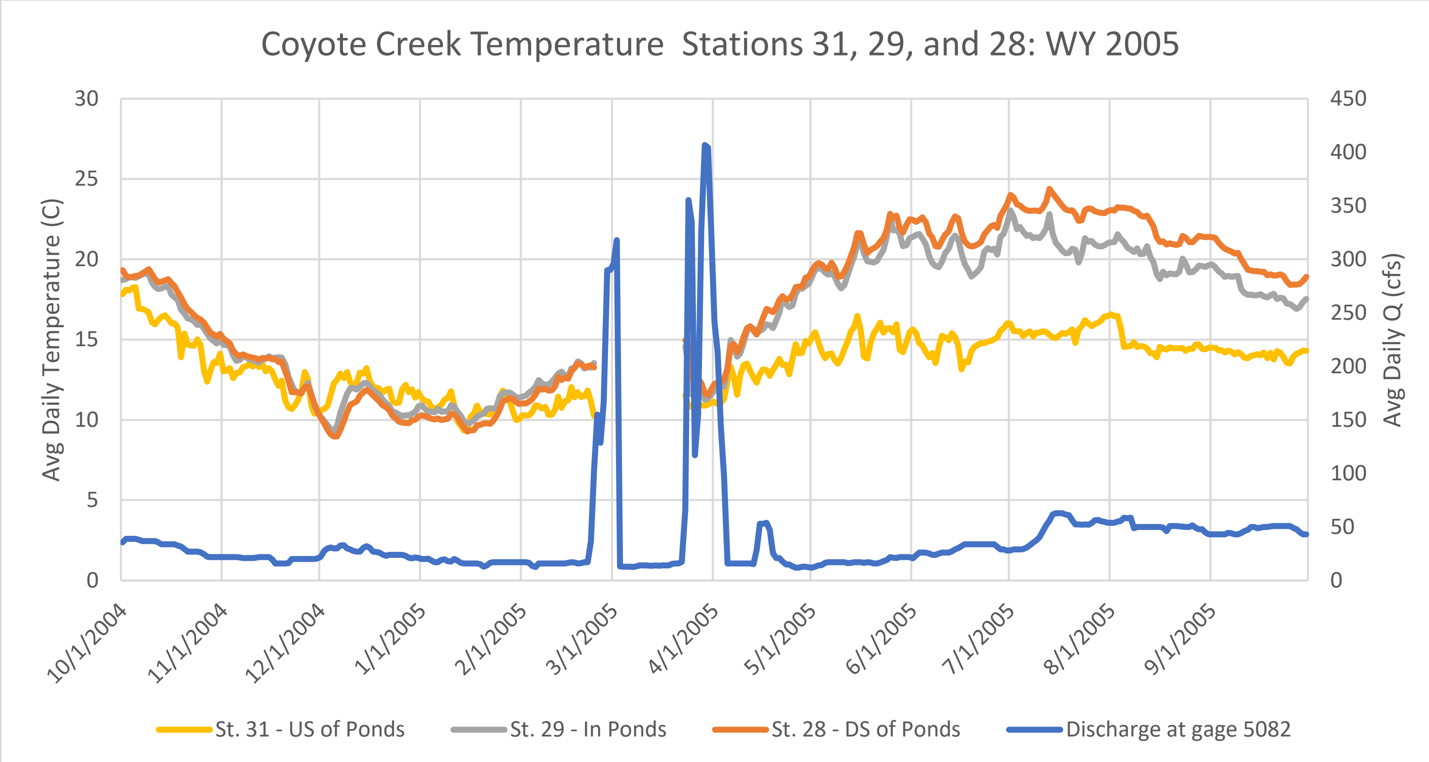


Figure 11: Water temperature above, below and within Ogier Ponds depicted with discharge data for water year 2005, Coyote Creek.

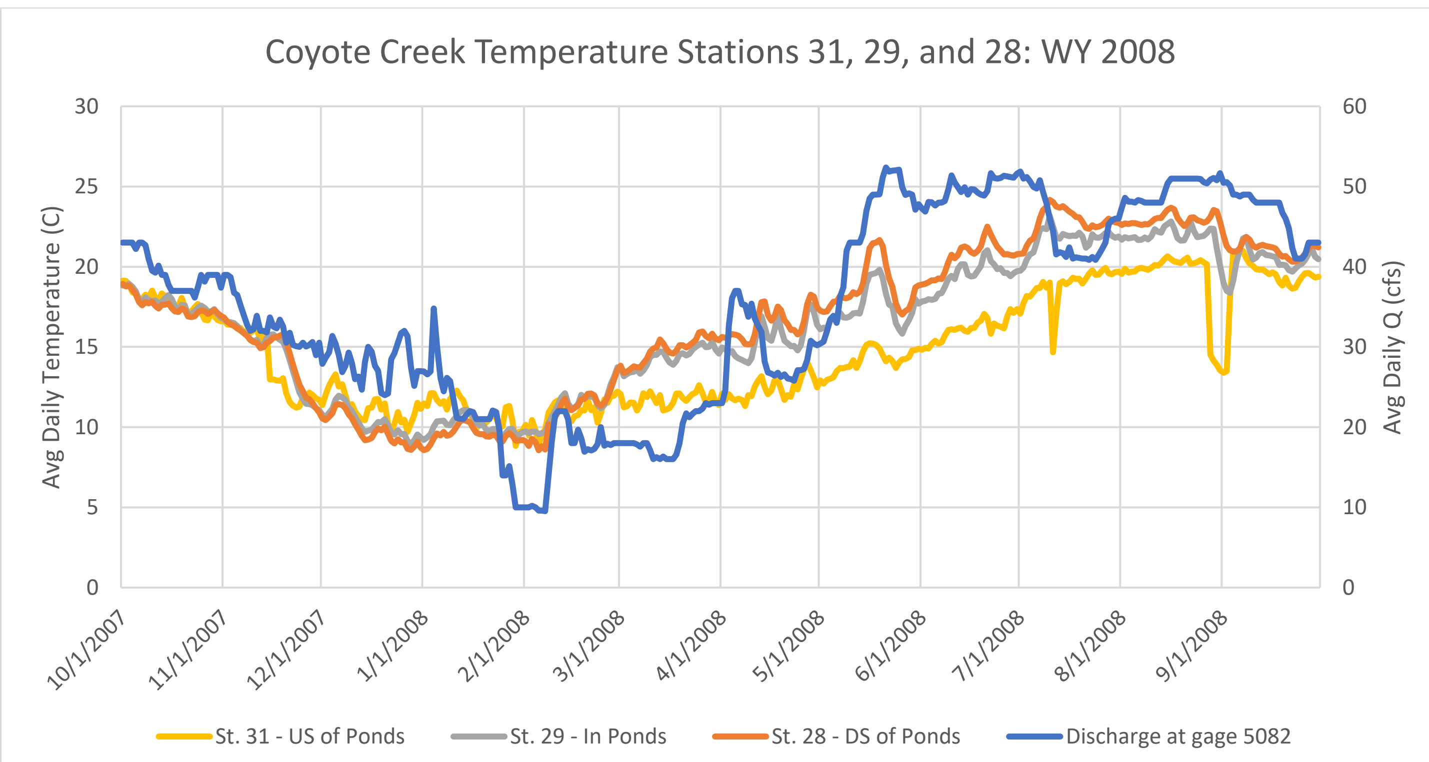


Figure 12: Water temperature above, below and within Ogier Ponds depicted with discharge data for water year 2008, Coyote Creek.

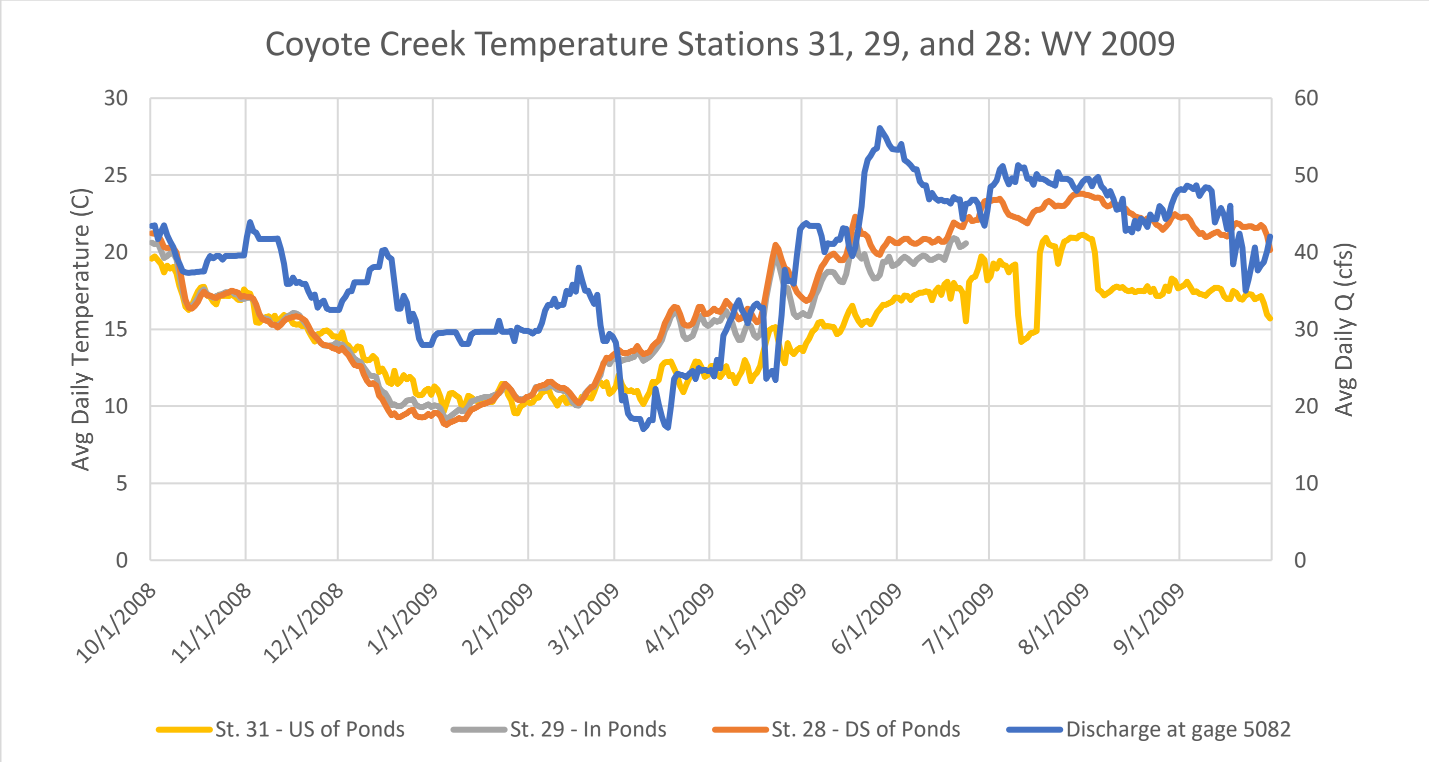


Figure 13: Water temperature above, below and within Ogier Ponds depicted with discharge data for water year 2009, Coyote Creek.

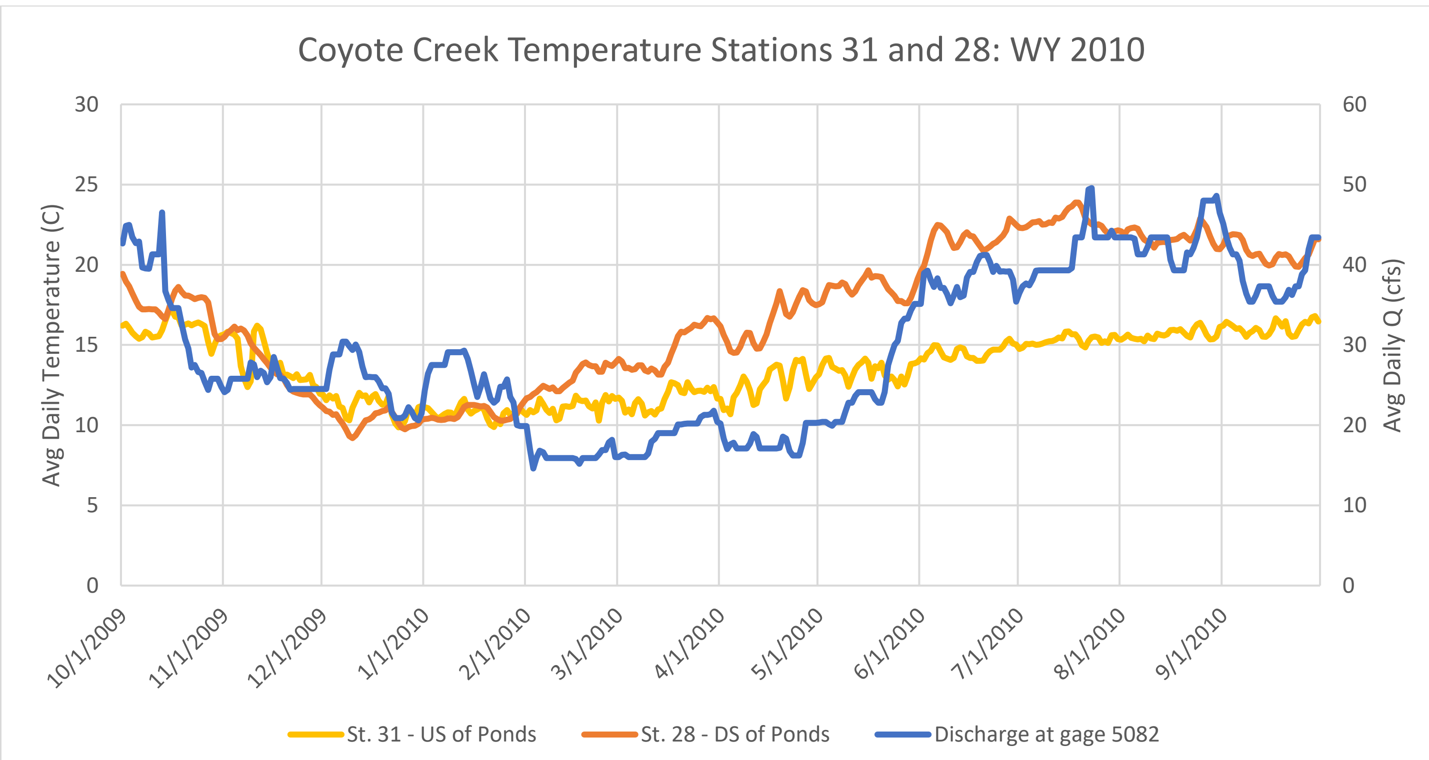


Figure 14: Water temperature above, below and within Ogier Ponds depicted with discharge data for water year 2010, Coyote Creek.

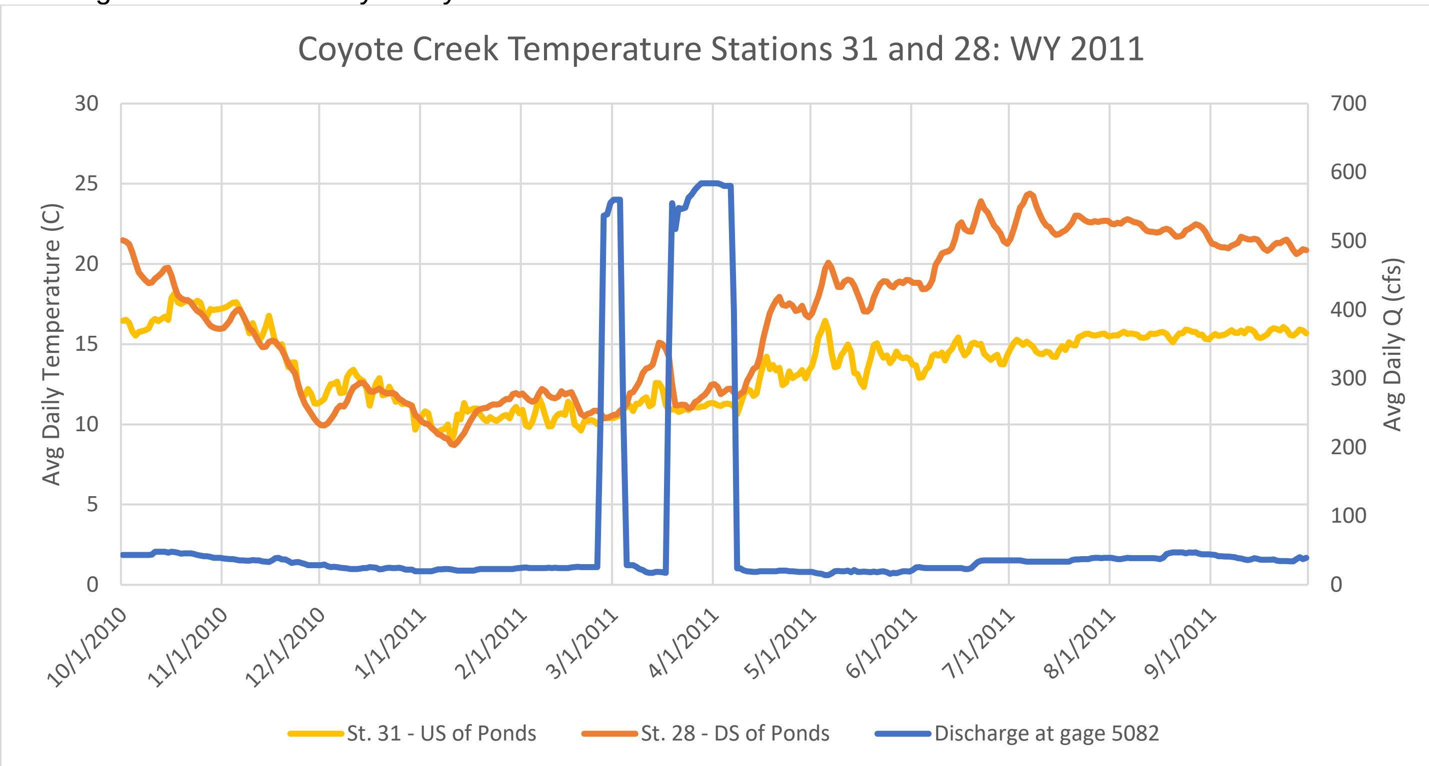


Figure 15: Water temperature above, below and within Ogier Ponds depicted with discharge data for water year 2011, Coyote Creek.

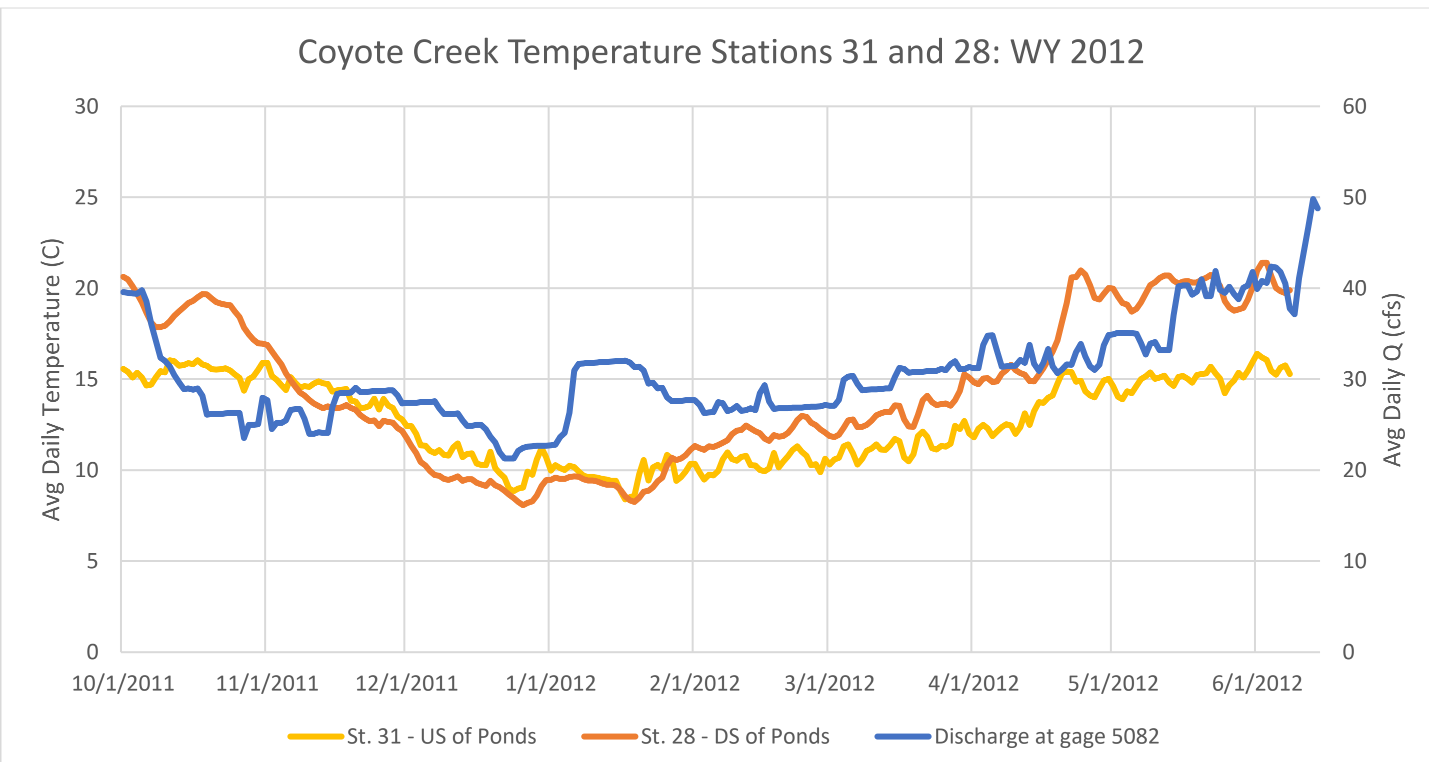


Figure 16: Water temperature above, below and within Ogier Ponds depicted with discharge data for water year 2012, Coyote Creek.

Continuous Surface Water Quality Monitoring Results

December 8th -December 17th, 2015 deployment

Surface water quality measurements for temperature, pH, specific conductivity, turbidity, and chlorophyll were collected simultaneously with the YSI 6600 data sonde (Figures 17, 19-21, respectively). The 5 sondes were deployed and left unattended on December 8th, 2015 where they collected continuous hourly measurements of the aforementioned parameters until retrieval on December 17th, 2015. The sondes were deployed in a metal security cage designed to perch the equipment about one foot above the surface of the stream or pond to avoid fouling of sensors from bottom sediments.

During December 2015, water temperature was cooler upstream of the ponds and warmer downstream of the ponds (Figure 17). This prompted more detailed review of the historical temperature records as summer time differences in water temperature lead to warmer downstream waters. This condition did occur on multiple years of records examined (2005, 2008, 2009, 2010) and always in winter. For graphical representation Figure 18 depicts this trend of cooler downstream temperatures and on 11/6/2011 the water temperatures above and below the ponds were approximately the same. However, by 11/14/2011 water temperatures upstream of the pond were 1.29 °C warmer than downstream of the ponds. This cooler downstream condition persisted until 1/23/2012. The results of the statistical analysis indicated a significant difference in temperature in winter above and below the ponds, however the difference may not always be warmer downstream waters.

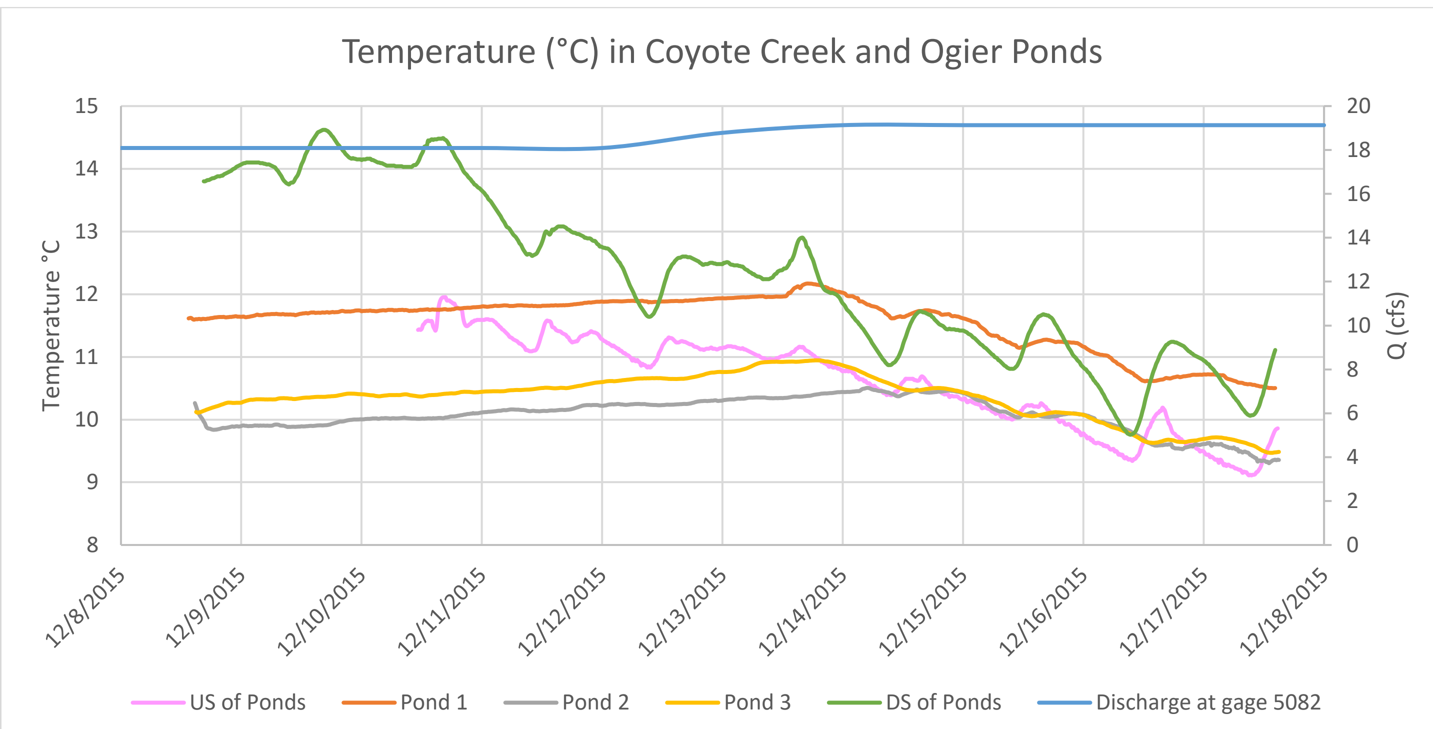


Figure 17: Temperature data collected above and within the ponds with continuous surface water quality sondes (YSI 6600) from 12/8/15 to 12/17/15.

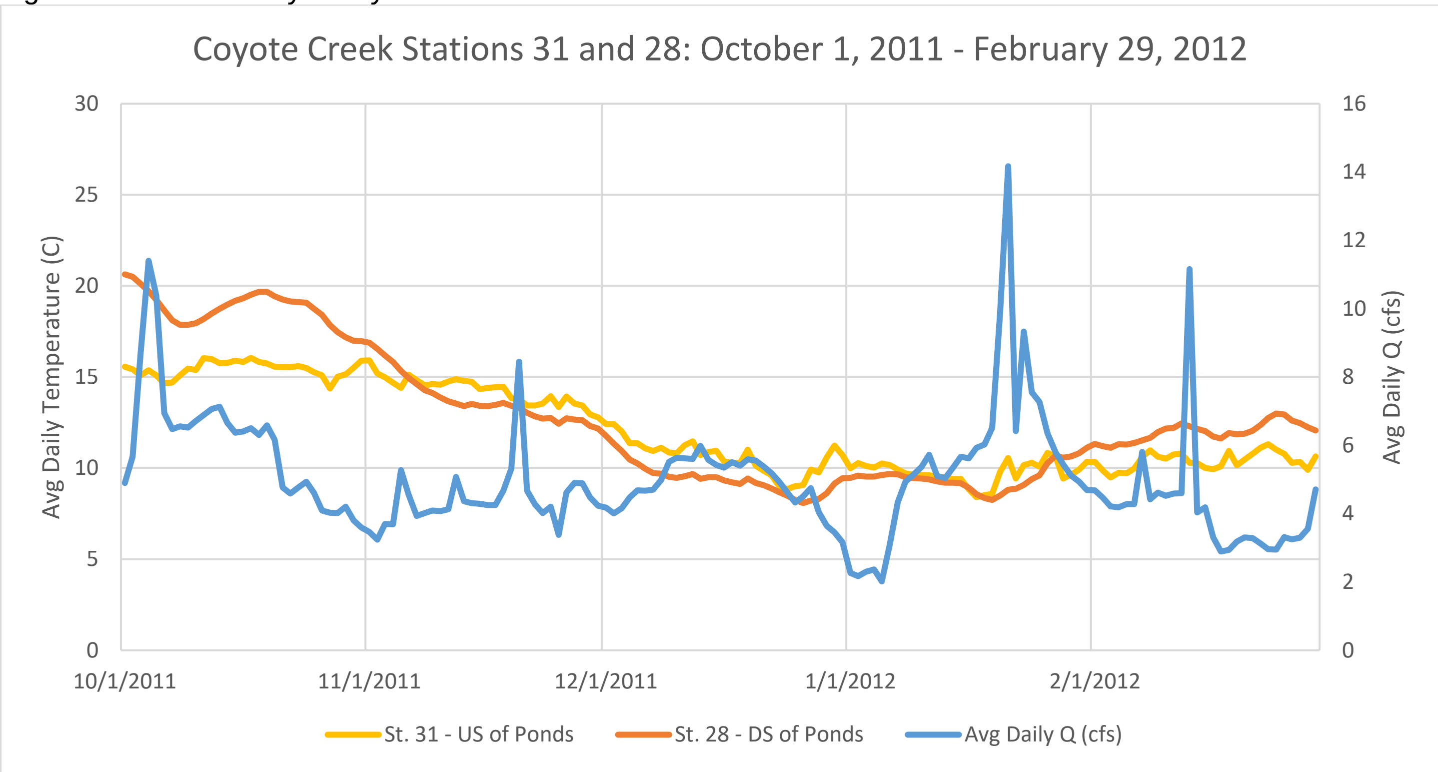


Figure 18: Longer-term water temperatures above and below Ogier Ponds from 10/1/2011 to 2/29/2012

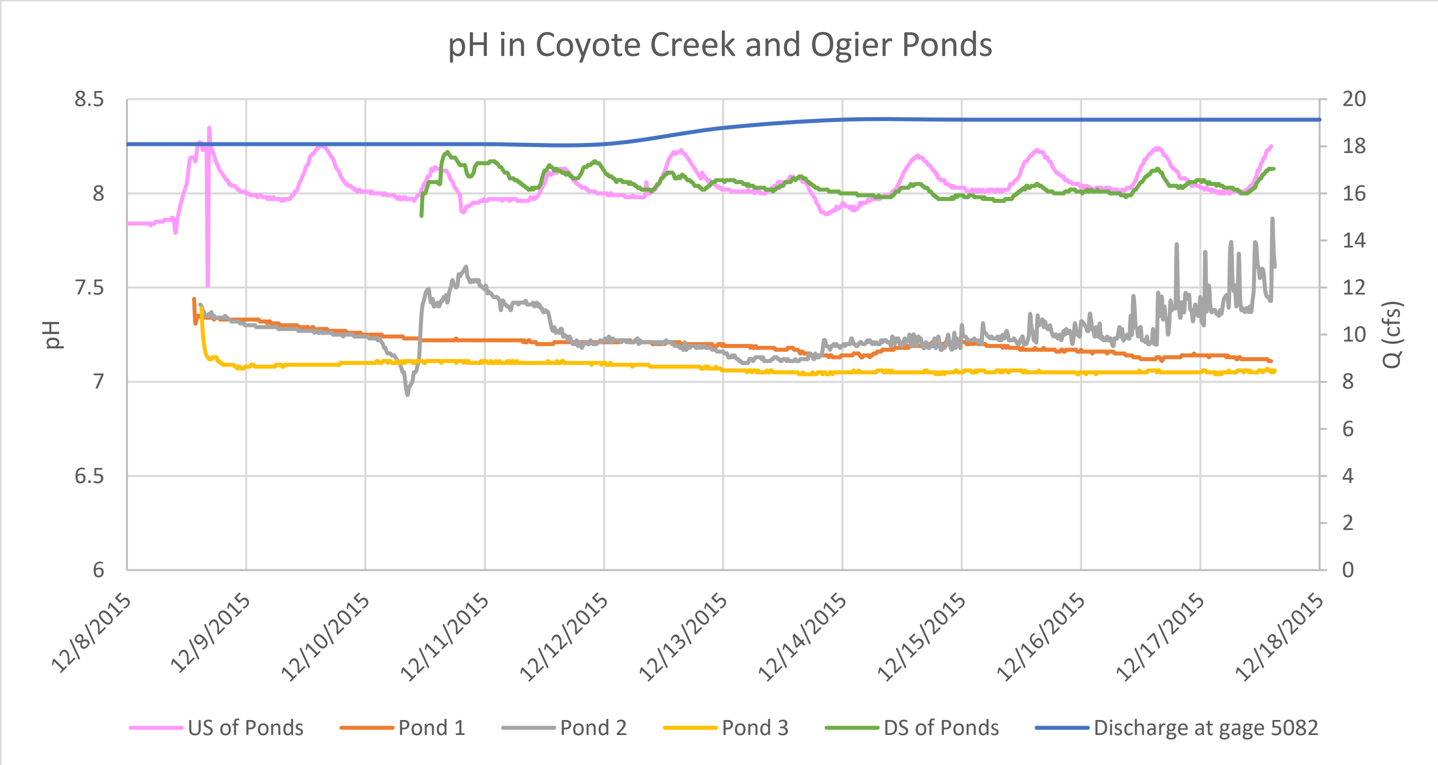


Figure 19: pH at Ogier Ponds from 12/8/2015 to 12/17/2015

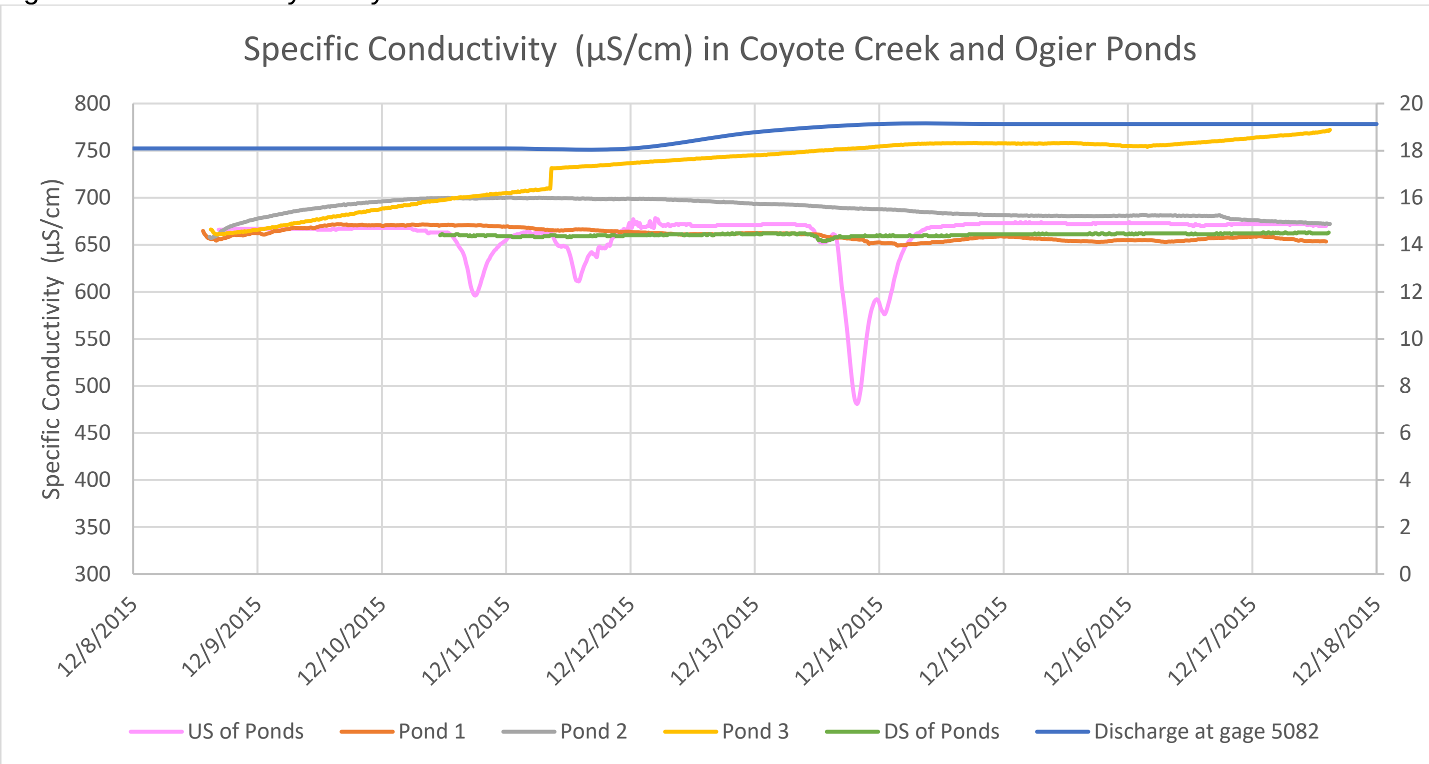


Figure 20: Values reported for specific conductivity at Ogier Ponds from 12/8-17/2015

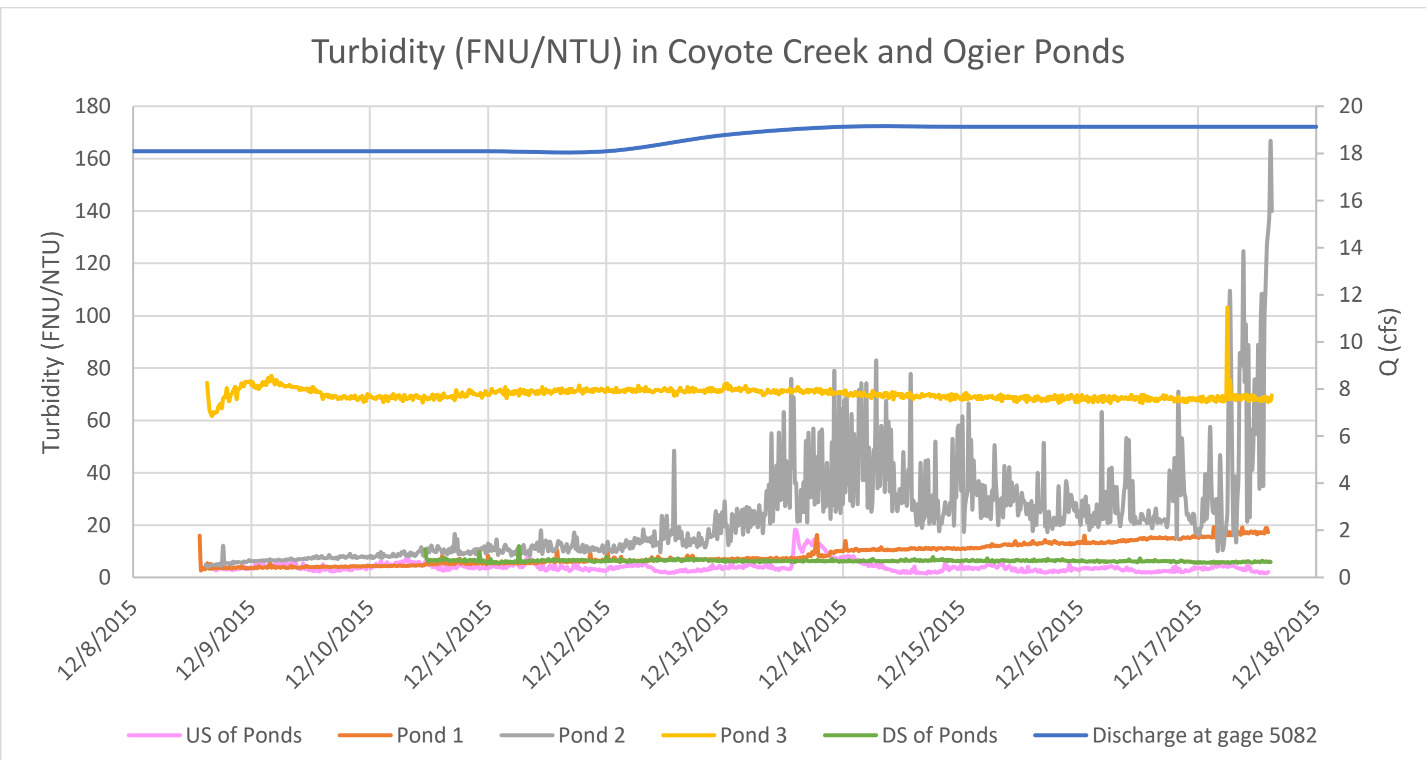


Figure 21: Values reported for turbidity (NTU) at Ogier Ponds for 12/8-17/2015

Specific conductance, pH, and turbidity of creek water was measured upstream and downstream of the ponds. These parameters were also measured for imported water discharged to the creek at Gage 5082 located about two miles upstream of Pond 1. Each parameter showed variation in the lotic system downstream from the ambient water entering the ponds as these variables differ with different habitat types. The pH of water determines the solubility and biological availability of constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.) (Cole, 1994). Shifts in pH were noted during December from ambient values upstream with pH being higher at times downstream and oscillating at a similar pattern as upstream values (Figure 19). All three ponds in which pH was recorded were lower than the stream values. This is likely the result of where the meter was placed in the water column within the ponds. The pond meters were enclosed in a metal cage approximately one foot off of the pond bottoms. As a result the pond meters were likely below the thermocline where increased CO_2 levels from decomposition of organic matter and respiration would reduce pH. While ideal pH levels for fish are 7-8 (fish blood has a pH of 7.4), most fish can adapt to the pH level of their environment (6.0-9.0) as long as there are no dramatic fluctuations. A dramatic fluctuation is considered a shift in pH of 1.4 (up or down) and fluctuations of that magnitude were not measured (Moyle & Chec, 2000).

Specific conductance varied but the maximum difference occurred 12/13/2015 in which upstream values were 73 µS/cm greater than downstream values. Ponds 2 and 3 had the highest reported specific conductance. The US EPA specifies the following descriptions to interpret TDS values in water quality databases nationwide.

Table 5: Total Dissolved Solids EPA Guidelines

Description	**TDS (mg/l)**
Low concentration	<100
Medium concentration	100-500
High concentration	500-1000
Very high concentration	>1,000

Because the relationship of TDS and specific conductance is linear, TDS can be estimated as 0.65 times specific conductance (Bain et. al., 1999). Converting the values for specific conductance upstream of Ogier Ponds to TDS there is a range of 312.7 - 440.7 mg/L and for downstream 425.1-430.9 mg/L. Using the EPA guidelines, the upstream and downstream values are within the medium concentration range for TDS even though range is higher at the downstream end.

Turbidity was generally higher downstream with a maximum difference of 10.5 NTUs, which is not a substantial difference. Turbidity in Pond 1 is lower than Ponds 2 and 3 as it is where Coyote Creek enters the lentic system. The fluctuations noted in Pond for turbidity was the result of placement of the meter at the inflow point to pond 2.

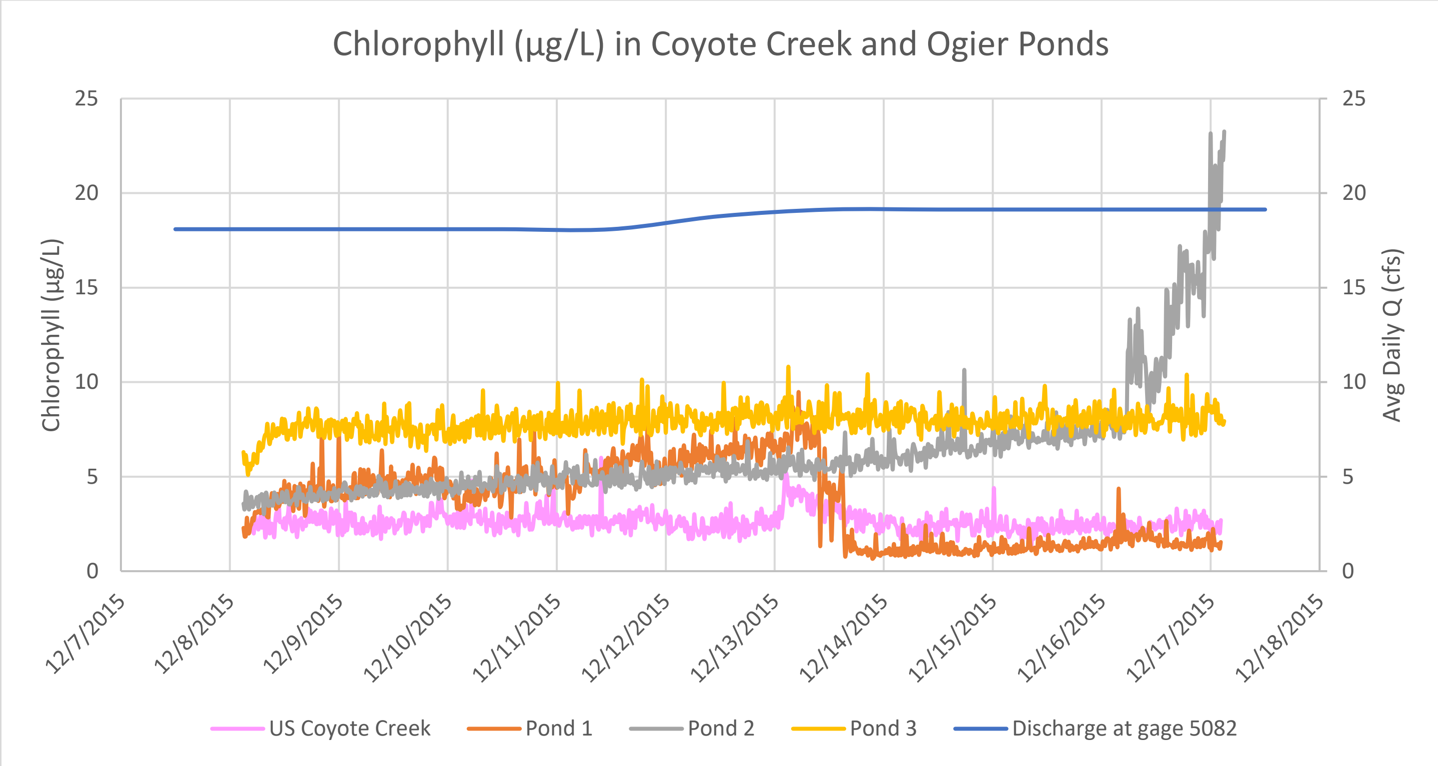


Figure 22: Chlorophyll a collected at Ogier Ponds upstream and within three ponds from 12/8/2015-12/17/2015.

Unfortunately, the downstream sonde had a malfunction at the chlorophyll probe and results were discarded. However, the results do demonstrate a clear difference in algal production between the lotic and lentic systems. Ponds 2 and 3 have much higher values for chlorophyll than the ambient upstream values. Pond 1, which is smaller and receives flow from Coyote Creek, had a higher chlorophyll levels until December 13, 2015 where the algal production fell below ambient upstream values. This coincides with a decrease in specific conductance upstream (Figure 20).

Temperature and Oxygen Profiles

Temperature and dissolved oxygen profiles were conducted at three locations within Ponds 1 (14.9 acres) and 2 (29.9 acres) (Figures 23-25). The objective of the work was to determine the annual circulation patterns and evidence of eutrophication if these ponds stratify and turnover like the reservoirs in Santa Clara County which can be classified as warm monomictic systems. Warm monomictic lakes typically lack an ice cover and circulate in winter although direct stratification in early summer puts an end to complete circulation until the thermocline disappears in fall (Cole, 1994). Anderson and Coyote Reservoirs both stratify and turn over in the fall.

Factors that affect dissolved oxygen in the pond environment are photosynthetic activity, wind mixing and wave action, decomposition of organic byproducts, and temperature stratification (Cole, 1994). Pond 1 did show temperature stratification as a thermocline develops, however the dissolved oxygen pattern is indicative of groundwater inflow as the oxygen levels rise in the hypolimnion. The results of the Managed Aquifer Recharge (MAR) investigation, conducted as part of this feasibility analysis, confirms groundwater inflow to the ponds. Pond 2, profiles 2a and 2b show a similar pattern in both temperature and dissolved oxygen as that of Pond 1, again indicating groundwater inflow.

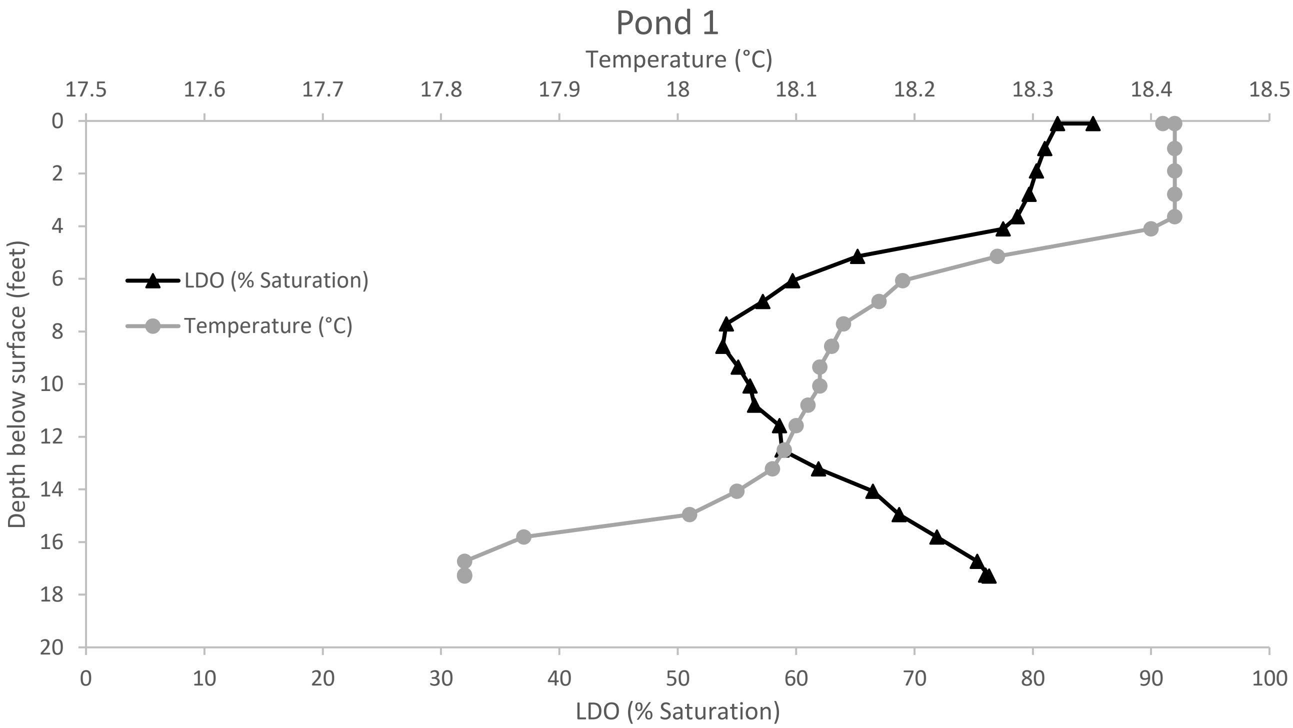
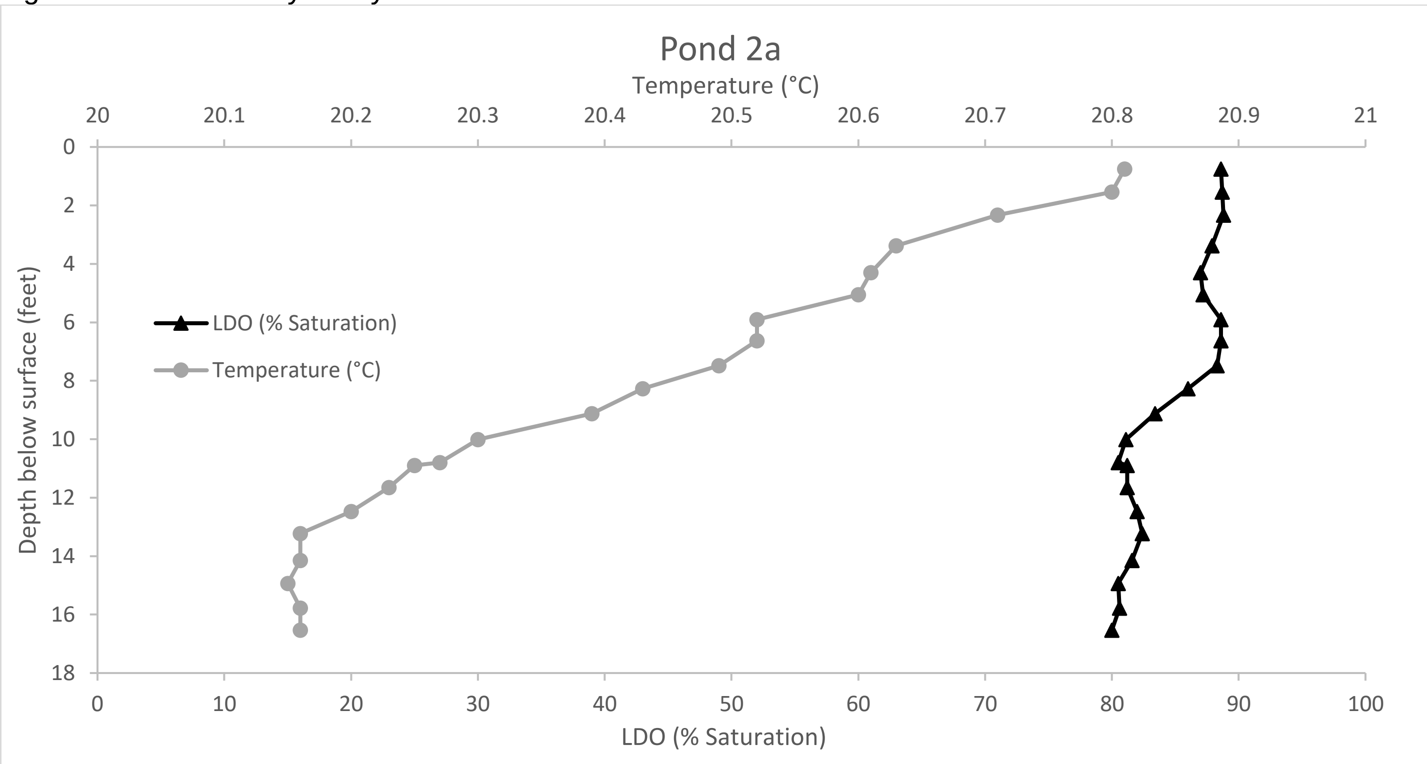
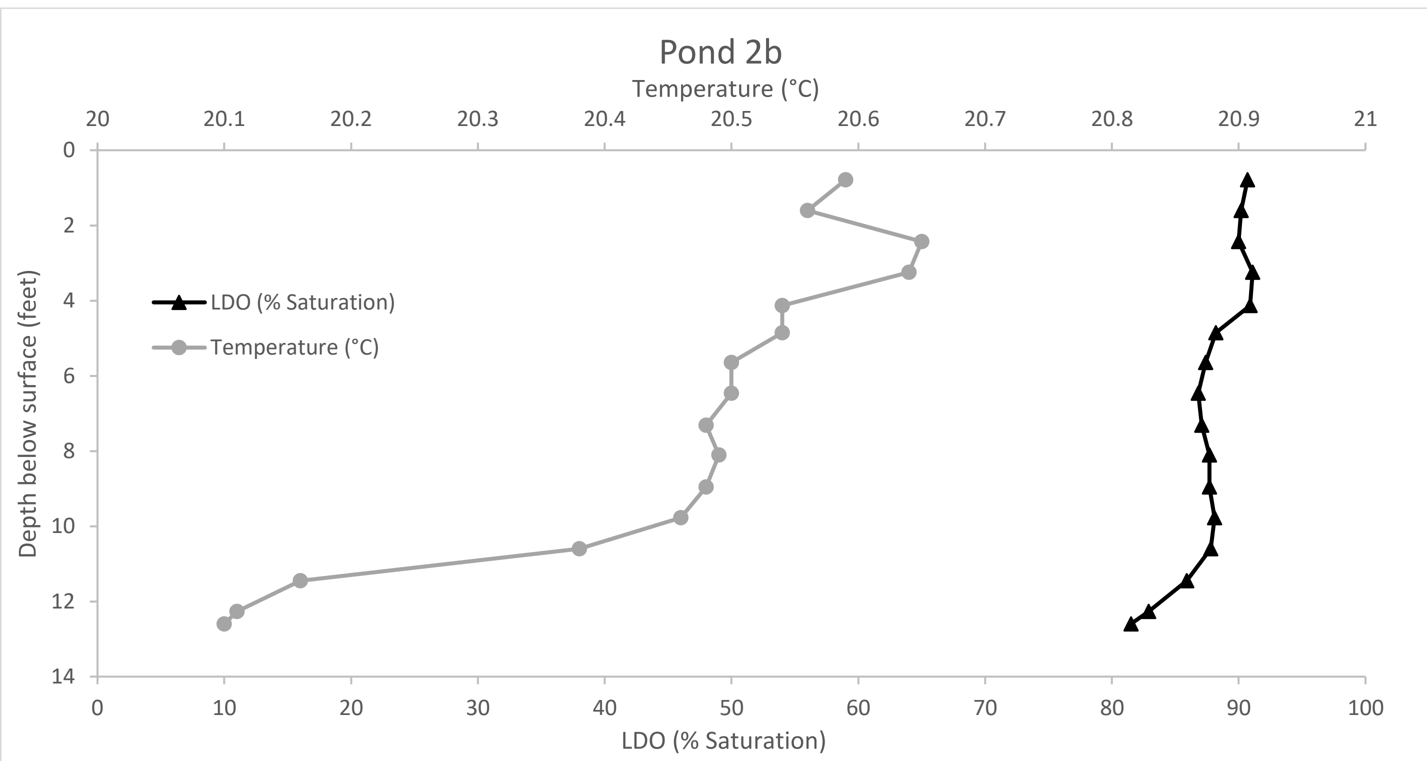


Figure 23: Temperature and dissolved oxygen profile for Pond 1. Measurements were taken August 16, 2017.





Figures 24 & 25: Temperature and dissolved oxygen profiles for two locations in Pond 2. Measurements were taken August 16, 2017.

Water Temperature Effects

The temperature affects to the lotic system from the large instream impoundments significantly alters the downstream aquatic habitat. Water temperature has direct and indirect effects on nearly all aspects of stream ecology as metabolic rates of most stream organisms are controlled by temperature. Temperature also influences the rate of photosynthesis by algae and aquatic plants, as water temperature rises, the rate of photosynthesis increases providing there are adequate amounts of nutrients. Larger bodies of water have larger heat storage capacity and deep ponds mix very slowly compared to streams (Cole, 1996) and when the stream flows through the impoundments the result is an altered water temperature regime. Water temperatures in summer increased by as much as 7.5°C in downstream reaches and while winter increases were generally not as great (i.e., 1-3°C) the effect is still significant. A previously noted, winter temperature differences are at times reversed in which cooler water is found upstream of the ponds and warmer water below.

The warming effect of the creek downstream of the ponds in summer is exacerbated by the warm inflow from reservoir and imported water releases from the Anderson Force Main, which discharges to Coyote Creek at the Coyote Pump Station located upstream of the ponds (see Figure 28). Several years of temperature data were evaluated above and below the discharge point of imported water to better understand the inflow temperature to the ponds. The temperature effects of the imported water will vary depending on the volumes and release times of the water into the stream, but the example chosen here for illustrative purposes is 2009 as there were minimal imported water deliveries in 2010 and 2011. Imported water volumes during the winter of 2008 - 2009 discharged into Coyote Creek ranged from approximately 5 to 25 cfs. As shown in Figure 13, water temperatures at station 40210-41 (upstream of the discharge point) and 40210-47 (downstream of discharge point and upstream of ponds) showed little fluctuation in winter months. As the volume of imported water increased to 35 to 55 cfs at the end of April 2009, the difference in temperatures upstream and downstream of the discharge point also increased. Water temperatures downstream remained higher than upstream temperatures by 1 – 8 degrees C. During the second week of July 2009 the imported water delivery stopped and the temperatures at station 40210-47 decreased to match the temperature at station 40210-41. Temperature effects of the imported water will vary depending on allocation of water from the imported source and time of year water is released to the stream.

The warming of the water above ambient temperatures affects water chemistry in a manner that can be adverse for fish. Temperature influences oxygen solubility, nutrient availability and the decomposing rate of organic matter (Cole, 1994). Water quality parameters such as pH and specific conductance are indicative of biological productivity and vulnerability to change. As was demonstrated at Ogier Ponds downstream of ponds, changes in pH and specific conductance occurred as a result of the stream flowing through the ponds (Figures 19 & 20). Additionally, turbidity generally increased ~2-9 NTUs downstream of the ponds during the monitoring period (Figure 21). It is important to note here, particulate matter causing increased turbidity parameter can include sediment (i.e., clay, silt, fine organic and inorganic matter) but also can include algae and other microscopic organisms. It is likely that organic matter contributes to increased turbidity downstream of the ponds.

Pond 5 2017 Bloom

During a field visit to the site on July 20, 2017, District staff noted bloom-like condition at Pond 5 (Figure 26) that warranted further evaluation. This condition prompted a laboratory analysis for cyanobacteria, a profile in the ponds for temperature and dissolved oxygen and a visual survey of the remaining ponds (Figure 27). A grab sample was collected the subsequent day from the pond for laboratory analysis which included an algal identification profile, algal toxicity, fluorescence and phycocyanin analyses to determine the origin of the substance. Laboratory analysis was performed at the District's water quality lab for the grab sample collected from Pond 5 on July 20th, 2017. An algal identification profile, algal toxicity, fluorescence and phycocyanin analyses were conducted on this sample (Table 6). The laboratory analysis confirmed this was not a toxic bloom of cyanobacteria however, the cell counts were high in the collected sample.

Figure 26: Photograph of dense mat of floating substance of Pond 5 at Ogier Ponds site, July 20, 2017.

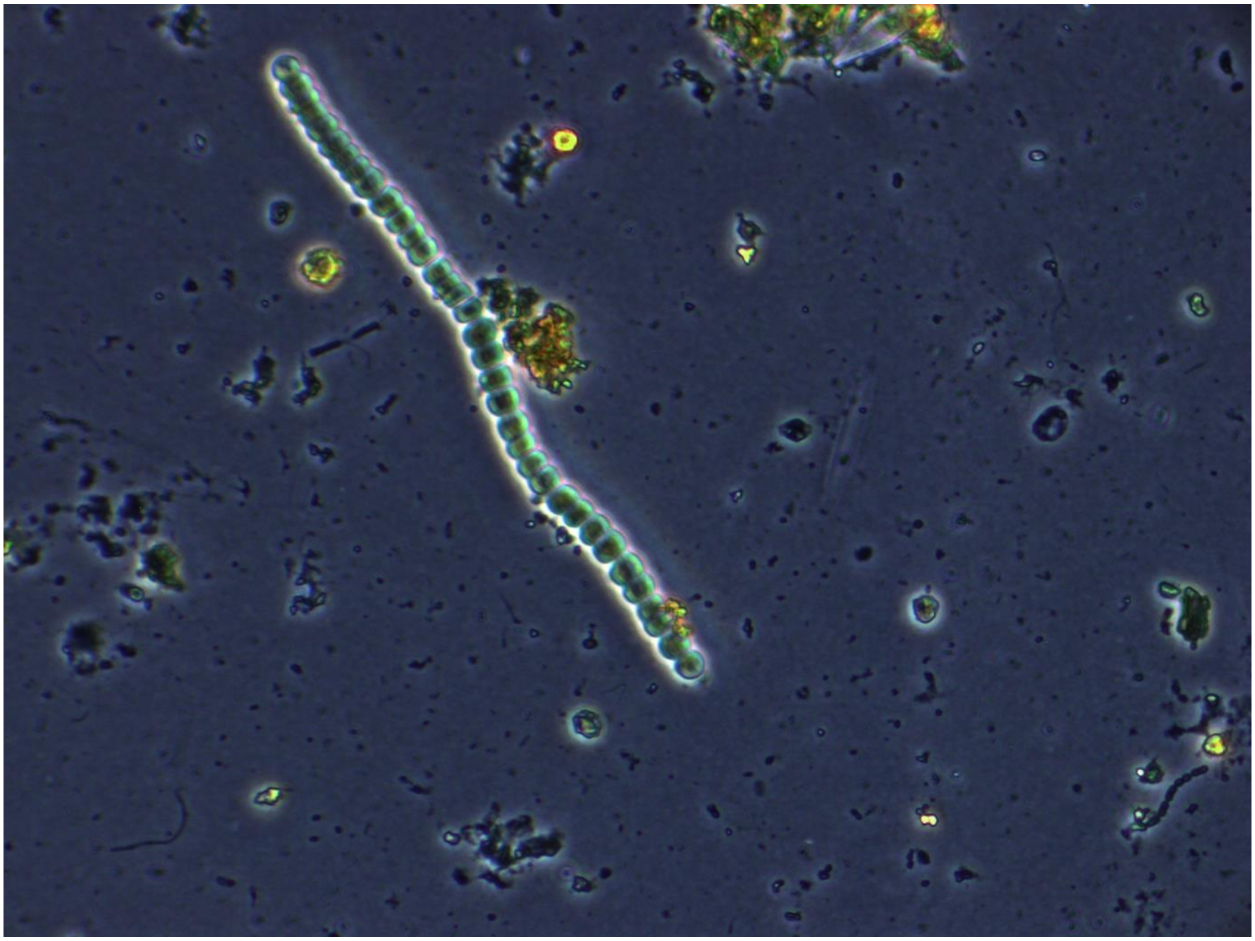


Figure 27: Microscope magnification (40x) of *Azolla filiculoides* collected from water sample Pond 5, Ogier Ponds.

Table 6: Algae Test Results

Blue Green Algae Concentration	
Type	Blue Greens Cells/mL
Nostocales (order)	240,000
Pseudanabaena sp.	45,000
Oscillatoria sp.	9,000
Dolichospermum sp.	1,300
Total	**295,300**

Fluorescence	
Type	Concentration (ppb)
Fluor (rhod-eq)	9,838

Algal Toxicity	
Toxin	Concentration (ppb)
Microcystins	<1
Anatoxin	<0.4
Cylindrospermopsin	<0.5

Phycocyanin Concentration	
Type	Concentration (ppb)
Phycocyanin	199

The results of the analysis indicate that *Azolla filiculoid*es which is a California native water fern is the plant covering the surface of Pond 5 (Calfora, 2017) and not an algal bloom as was presumed. *A. filiculoides* settles in ponds, ditches, reservoirs, and channels of slow moving rivers and through its symbiotic association with *Anabaena azollae*, the floating plant is able to grow in nitrogen-deficient waters (Sah, R., 1988). *Azolla filiculoides* is able to undergo rapid vegetative reproduction throughout the year by the elongation and fragmentation of the small fronds. Under optimal conditions for plant growth the plants can double in area every 4 to 5 days. At Pond 5, the 5.7 surface acres were completely covered in the span of 12 days. An ocular survey of the remaining pond perimeters commenced following this analysis to determine if *A. filiculoides* was present and to what degree the ponds were impacted. *A. filiculoides* was found in ubiquitous habitats (i.e., sun and shade, flowing and stagnant water) in all of the water bodies, including Coyote Creek proper, surveyed within the study area, except for Pond 6. The plant was prolific in the littoral zones of Ponds 2 and 3, exhibiting approximately 90% and 75% cover in ponds 2 and 3 respectively. While the plant was abundant in many areas, there was much aquatic habitat with slow moving water with no *A. filiculoides* present indicating nutrient limitations for optimal plant growth.

While blue green algae was not the suspected agent for the bloom condition observed in Pond 5, the cell count was very high albeit toxicity was low. Microcystins and cylindrospermopsin are toxins produced by cyanobacteria (i.e., blue-green algae) and can be harmful to the health of humans and wildlife. Contact in waters with high levels of cyanaobacteria can result in potentially harmful exposure to these toxins. In 2016, the U.S. Environmental Protection agency proposed draft guidelines for the levels of these toxins that could be harmful and recommended that states use these levels to manage swimming and other water-contact recreational activities. The EPA guidelines for water-contact recreation are 4 micrograms per liter (µg/l, equivalent to 4 parts per billion or ppb) for microcystins and 8 µg/l (equivalent to 8 ppb) for cylindrospermopsin (U.S. EPA, 2016). The laboratory test results from Pond 5 found microcystins and cylindrospermopsin at levels of <1 ppb and <0.5 ppb, respectively Thus the measured levels of these toxins in Pond 5 are below the EPA draft guideline levels for water-contact recreation, and are not harmful to persons or wildlife who contact pond water.

Water Quality Consequences of Pond-creek Separation

The limnology of Ogier Ponds differs from that of a natural lake in that there is unusual density currents flowing into the lentic environment affecting the physiochemical composition of both the stream and ponds. Unlike ponds, recycling of nutrients in a stream does not occur in the same place within the stream as the nutrients are utilized and displaced downstream. For natural ponds as the input of water, nutrients, sediment and plants accumulate over time, it affects the nutrient recycling within the pond (Cole, 1994). Because each of the ponds were created at a different time scale and the creek did not immediately route though the ponds it is safe to presume nutrient levels in each of the ponds is in a different mesotrophic state (i.e., moderate nutrient levels).

The creek flowing through four of the larger ponds interrupts the natural succession of the ponds towards eutrophication. While streams typically have a low nutrient content in undeveloped watersheds, the addition of nutrient via runoff or sediments can elevate amounts of algae. The last water quality parameter collected during the December 2015 monitoring for surface water quality was Chlorophyll *a* which is the photosynthetic pigment that causes the green color in algae and plants.

The concentration of chlorophyll *a* present in the water is directly related to the amount of algae living in the water (Bain et. al., al.1999) therefore, chlorophyll *a* concentrations can be used to estimate the trophic status of the lake (Cole, 1996). The results of the Ogier Ponds chlorophyll analysis indicated that the ponds have substantially higher quantities of chlorophyll than the creek water entering the ponds. The exception to this was Pond 1 on December 13, 2015 in which chlorophyll levels fell below the ambient upstream lotic values (Figure 22). It is unclear what promulgated the reduction in algal levels in Pond 1, but it may be related to the upstream decrease in specific conductance.

As previously described, a water fern infestation of *A. filiuloides* occurred at Pond 5. While this plant is native to California, artificial conditions which lead to infestations can be deleterious to aquatic organisms. Algal blooms reduce light levels below the dense mats of floating vegetation and can cause die off of water plants and algae in the water column while also reducing dissolved oxygen levels. The laboratory analysis confirmed bluegreen algae was not the suspected bloom agent in this case, the algae identification profile identified a high cell count in Pond 5. Considering that there are approximately 144 surface acres of pond where cyanobacteria may be present it is worth noting here. Although many species of freshwater algae proliferate in eutrophic waters, they do not accumulate to form dense surface scums (i.e., blooms) of extremely high cell density, as do some cyanobacteria. The chemical and physical factors needed for a bloom to produce a toxin are not fully understood. However, known requirements include elevated nutrients (i.e., nitrogen and phosphorus) a pH between 6 and 9, and elevated water temperatures (Chorus & Bartram, 1999). The ponds dramatically warm the surface waters at Ogier making conditions more conducive to blooms.

In summary, the ponds combine lotic and lentic habitat to the detriment of the stream dwelling native fish. The historical gravel mining and large scale hydrologic changes (i.e., upstream reservoir construction) altered the physical and chemical habitats of the braided, wide, ephemeral channel of the valley floor. As a result of these changes to the watershed, the habitat available for fish has also changed. The heterogeneous value of the pool-riffle reaches, commonly associated with alluvial valleys of low to moderate gradients, are now irregularly spaced and infrequent. As a result of this channel simplification, long mid-channel pools comprise the majority of valley floor habitats. Detailed habitat typing conducted for 6.1 mile stretch of Coyote Creek on the valley floor found that mid-channel pools comprised 77.4 % of the total habitat available for fish with runs (15.1%) being the second most abundant habitat type and riffles comprising 1.1% (Entrix, 2006). The creek routing through the ponds further degraded habitat conditions for fish in Coyote Creek. The narrowing of the stream channel and vegetation encroachment as a result of hydrologic changes are exacerbated by the instream impoundments of Ogier Ponds. The ponds significantly warm ambient water temperatures in summer and changes ambient conditions in winter, alter water chemistry, and like all artificial reservoirs in California, favor lake adapted alien fish over native stream dwelling fish (Moyle, 2002). As a result of the creek flowing through the ponds, any deleterious event (i.e., algal bloom) within the ponds will also affect the downstream waters of Coyote Creek.

Separating the Ogier Ponds from Coyote Creek would result in beneficial effects on water quality of the creek. Because the ponds would no longer heat water and discharge the heated water to the creek, the existing elevated temperature of creek water downstream of the ponds would return to baseline temperatures, similar to the temperatures occurring upstream of the ponds. Although baseline water temperatures would continue to be affected by the input of relatively warm water the creek from Anderson Reservoir and imported water from the Coyote pump station, the amount of temperature elevation would be less than existing condition. The reduction in creek water temperatures would be generally be beneficial to native aquatic wildlife, especially steelhead who thrive only in relatively cool water. Under the current condition, pond water is often too warm for steelhead which discourages steelhead from swimming into or through the ponds. The proposed separation would mitigate that situation allowing steelhead to pass the ponds and access upstream habitat within Coyote Creek.

In contrast to the benefits to creek water quality, the separation would likely adversely affect water quality of the ponds. Groundwater seeping into the ponds is relatively low in dissolved oxygen compared to the creek water. Additionally, the stagnant condition of the ponds without creek throughflow would tend to exacerbate the relatively low dissolved oxygen levels. The ponds would also be susceptible to algae and/or *Azolla* blooms due to the stagnant nature of the water. Once disconnected, devices or equipment may be required to circulate pond water to meet state standards. Without some type of management to keep water quality viable for recreation the remaining ponds would be subject to eutrophication.

3.3. Water Supply and Water Rights

3.3.1. Water Supply Infrastructure and Operations

The District operates its water supply system according to conjunctive use, which involves the coordinated use of surface water and groundwater supplies. District water supply operations require a complex network of distribution, storage, and treatment facilities. Many of these facilities were constructed to meet the water supply needs of the valley as the valley's population rapidly grew.

The District has appropriative water rights which allow the collection and storage of storm runoff at the Anderson and Coyote reservoirs, which has a significant effect on flows on Coyote Creek downstream of the two reservoirs. Downstream flows in coyote Creek are currently controlled in large part by reservoir operations, which have reduced the maximum rainy season flow rates in the creek and increased flows during the dry season. In addition, water from outside the Santa Clara Valley is purchased from the State Water Project (SWP) and Central Valley Projects (CVP) and used to supplement local water and recharge groundwater aquifers. Current and future facilities in the upper Coyote Creek (i.e., upstream of Ford Road) water supply system include Coyote and Anderson Reservoirs, the abandoned and non-operational Coyote Canal, the Cross Valley Pipeline, Santa Clara Conduit, Coyote Pump Station, Metcalf Ponds, inactive Ford Road Ponds, and inactive instream spreader dams, and the Coyote Percolation pond and Diversion Dam (Figure 28).

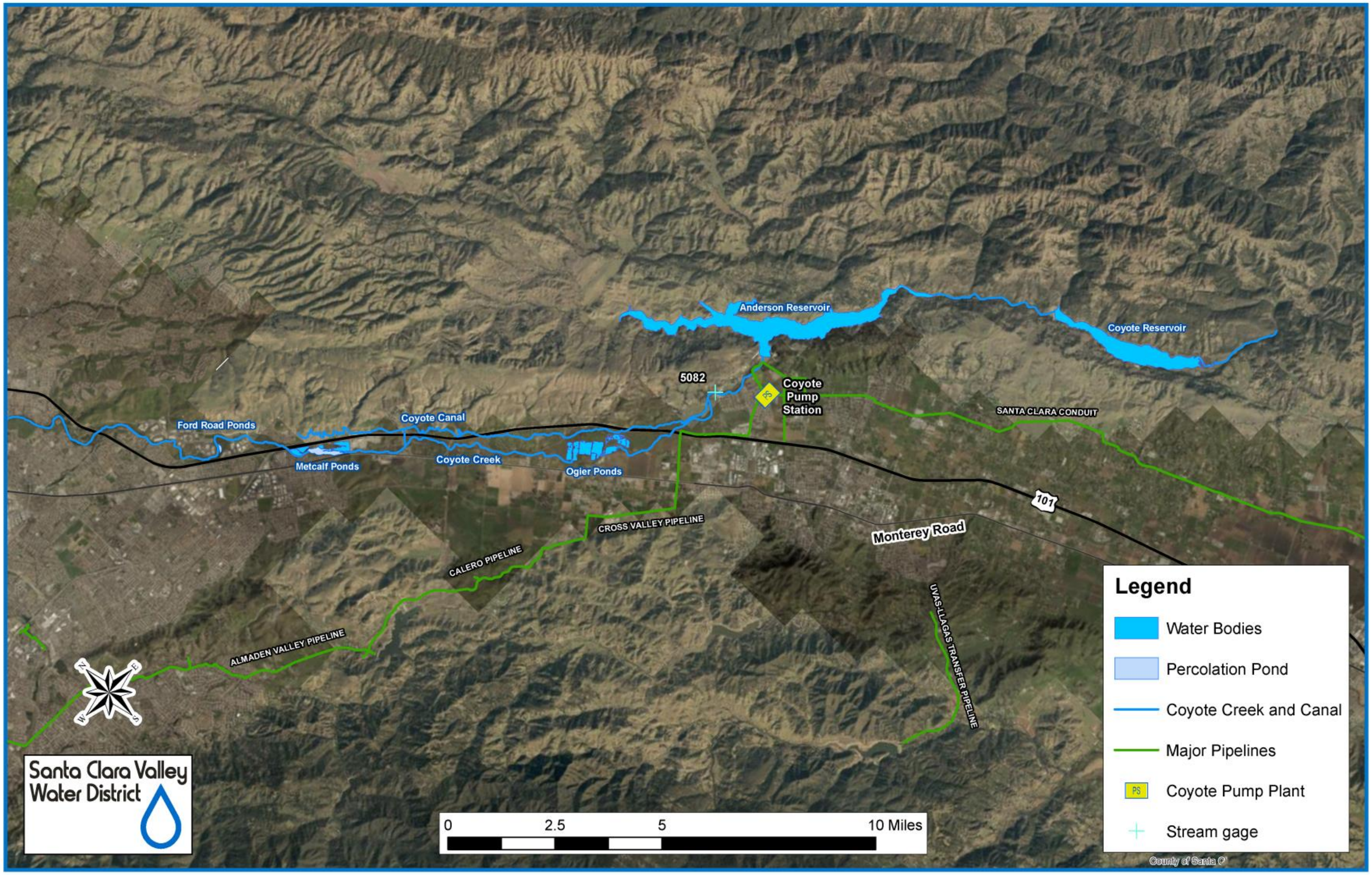


Figure 28: Hydrologic setting of Ogier Ponds

With the completion of railway lines and the formation of grower's associations in Santa Clara Valley, agriculture became big business in the early portion of the 20th century. This caused increased pumping of groundwater for irrigation use, resulting in overdraft and dropping groundwater levels. As typical of the Mediterranean climate found in California, the hot dry summers and the mild wet winters also brought drought and seasonal flooding on the valley floor which was an intolerable economic risk to the local business community. In 1921, the County Board of Supervisors and the San Jose Chamber of Commerce funded a comprehensive water conservation plan (Tibbetts and Kieffer Report) which recommended for the formation of a water district to build a series of six dams.

The Santa Clara Valley Water Conservation District began managing water resources for Santa Clara County in 1929 as the result of passage of the Water Conservation Act (Jones) Act (1929) by the California Legislature. The goals of the original district were to appropriate, acquire, and conserve water and water rights for any useful purpose: to preserve, store, spread and percolate water for such purposes; and to acquire or construct dams, dam sites, reservoirs and reservoir sites.

When the District planned to percolate water through the Coyote Valley in the 1930s farmers protested the action citing that they would be flooded. To overcome those objections, the District built the 7.6 mile long Coyote Canal in 1935 so that the District-controlled portion of Coyote Creek flows could be routed around the Coyote Valley (including the Ogier Ponds site) to avoid flooding the local farms (California History Center & Foundation, 2005). The Coyote canal is located east of the site. It is no longer in use, is not maintained, and has physically deteriorated with numerous breeches in the banks.

During the same year that construction of the Coyote Canal was completed, construction started at the upstream Coyote Dam and was completed on December 3, 1936. The reservoir was constructed with a storage capacity of 23,244 acre-feet and a drainage area of 119 square miles. The Santa Clara Valley continued to grow and with this new growth came increased demand for water. By 1948, the increase in population resulted in the need for a new water supply reservoir. The plans for Anderson Reservoir were submitted to the District board in April 1949, and the new dam and reservoir were constructed in autumn 1950. At the time of completion, Leroy Anderson Dam was the highest embankment dam in northern California with a maximum height of about 240 feet as measured from streambed to the dam crest. The reservoir has a capacity of 90,373 acre-feet at a spillway crest elevation of 625 feet and a drainage area of 193 square miles (SCVWD, 2005).

In the early 1950's several northern towns began to draw water from San Francisco's Hetch Hetchy system. A countywide water consortium, the Santa Clara County Water Commission, was formed to implement water importation in the County and recommend a distribution system. The commission recommended that the County Board of Supervisors contract with the SWP for import of water through the South Bay Aqueduct (SBA) and that use of Hetch Hetchy water by towns in the northern part of the Count continue. By June 1, 1965 the construction of the SBA and Central Pipeline were completed and the first delivery of imported water occurred in July 1965.

In 1967, a third source of imported water for Santa Clara County was identified with the authorization of the San Felipe Division of the federal Central Valley Project (CVP). The first CVP water deliveries in 1987. CVP water is discharged to Coyote Creek about 2.7 miles upstream of the Ogier Ponds. The SCVWD's SWP and CVP contracts call for annual delivery to the District of up to for 100,000 AF and 152,000 AF of water per calendar year, respectively.

However, actual deliveries to the District depend on statewide hydrologic conditions, environmental restrictions, and other limitations, and can be far less.

Prior to 1968, surface water supply operations in Santa Clara County were conducted to maximize groundwater recharge and minimize waste of water. Therefore, water was released to keep streams wetted only in the recharge portion of the basin. For Coyote Creek, downstream of Coyote and Anderson Dams, this meant maximizing instream flows to approximately the Edenvale stream gauge (Station 5058), located about 6 miles downstream of the Ogier Ponds.

In 1996, Guadalupe-Coyote Resource District filed a complaint against the District. This complaint alleged that the District was not meeting instream flow needs for anadromous fisheries. In 1997, in response to the complaint, the District and Department of Fish and Game convened the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) to better understand and address local threats to anadromous fish populations. To improve aquatic habitat, more water than could infiltrate to the aquifer was released to streams. In 1997, the District initiated additional efforts to ensure minimum instream flows were met and to improve fish passage. Low-flow instream alarms were installed; minimum flow rates were established and additional flows provided for specific locations; and dam operations were changed in Coyote Creek to facilitate fish passage from November to April.

Starting in 1998, the District began implementing capital improvement projects to remove instream barriers and install fish passage facilities at water diversions in the Coyote Creek watershed. On Coyote Creek, fish ladders were installed downstream of the Ogier Ponds at Coyote Percolation Dam (about 4.3 miles downstream of the Ogier Ponds) and Coyote Canal. The District also discontinued the use of spreader dams at the Ford Road Facility (about 6.5 miles downstream of the Ogier Ponds) in the late 1990s to improve fish passage conditions on Coyote Creek.

Operation of the ageing Coyote Canal ceased in 1999 as flooding the orchards in Coyote Valley was no longer a significant concern and costs to maintain the canal were increasing. After operation of the Coyote Canal ended, all water intended for groundwater recharge flowed through Coyote Creek and the Ogier Ponds to the downstream Coyote Percolation Pond. Water is released from Coyote and Anderson reservoirs to Coyote Creek for groundwater recharge in conformance with reservoir operations rules. Water is released from the two reservoirs or the following purposes:

- To manage the volume of water in the reservoir for water supply purposes
- To supply raw water to water treatment plants
- To enhance in-channel recharge
- To supply water for off-channel recharge

The amount of stored surface water released from reservoirs is adjusted as seasonal conditions change. Stored water is usually released in the summer and fall so that by November 1 the reservoir has available storage capacity to capture runoff during the rainy season. Although surface water is also released during the winter to recharge groundwater aquifers, the primary goal for this period is to capture as much storm runoff as possible to fill the reservoirs by May 1, consistent with water rights.

During a dry winter, the SCVWD may reduce reservoir releases to conserve stored water. The District currently has an existing Lake and Streambed Alteration Agreement (SAA) with the California Department of Fish and Wildlife permitting the operation of the Coyote Percolation Dam on Coyote Creek. The SAA specifies flow, water quality and monitoring requirements. Under the SAA, instream flow requirements within Coyote Creek may be negotiated under low storage or limited water supply conditions to reduce the risk of dry back conditions in stream or to sustain the downstream extent of flow in the creek.

When rainfall runoff exceeds the holding capacity of the reservoirs, water flows over the spillways to Coyote Creek. This condition occurred in February 2017 when water spilled from Anderson Reservoir to Coyote Creek. Although District reservoirs were built as water supply facilities, operating rules for Anderson and Coyote Reservoirs have been established to reduce the potential for downstream flooding. The combined Anderson and Coyote Reservoir flood risk reduction rule curve, based on historical hydrology, recognizes that if the reservoirs fill early in the year, releases may be made with a high probability of collecting sufficient water to fill the reservoirs by the end of the rainy season.

Coyote and Anderson Reservoirs currently operate as a system under Division of Safety of Dams (DSOD) Interim Storage Restrictions (ISR). Coyote Reservoir has a permanent DSOD storage restriction of 758.0 feet elevation (NGVD 1929) and Anderson Reservoir has an Interim DSOD Storage Restriction(ISR) of 589.5 feet elevation (NGVD 1929) which were issued in 2017. The storage restrictions place an operation capacity restriction on both reservoirs due to the proximity of the dams to the Coyote Creek and Calaveras seismic fault systems. Until the seismic retrofit is complete for Anderson, this ISR is in effect and normal reservoir operations have been adjusted to account for the reduced reservoir storage capacity. Under normal reservoir operations, most stored water is released during the dry season to percolate into the underground aquifers and to supply raw water to water treatment plants. By contrast, ISRs result in an increased emphasis on wet season releases, reducing the amount of water available for dry season releases.

In addition to Anderson and Coyote reservoirs providing water for groundwater recharge, these reservoirs also provide emergency water in case imported water supplies are not available and to provide annual carryover storage as a hedge against a dry year. Anderson Reservoir is also connected to the county's water conveyance system, making water available to the treatment plants for delivery to the potable water distribution system. Imported water is delivered to Anderson Reservoir in conjunction with the local runoff to optimize utilization of supplies. Imported water from the CVP is released to Coyote Creek at the Coyote Pump Plant downstream of Anderson Dam.

3.3.2. Groundwater Conditions

The Coyote Valley represents the southern extent of the Santa Clara Groundwater Sub basin (Basin 2-9.02 as defined by the California Department of Water Resources), which covers about 300 square miles from northern Morgan Hill to the county’s northern boundary. Due to different hydrogeologic, land use, and water supply management characteristics, the District further subdivides the Santa Clara Sub basin into two groundwater management areas: the Santa Clara Plain and the Coyote Valley.

The Coyote Valley is approximately 7 miles long and up to 2.5 miles wide, covering a surface area of 17 square miles. The boundary with the Llagas Sub basin is the Coyote Creek alluvial fan in the Morgan Hill area, which forms a topographic and hydrologic divide between groundwater and surface water flowing to the San Francisco Bay and water flowing to the Monterey Bay.

The Coyote Valley represents the southern extension of the Santa Clara Valley, a linear, northwest-trending intermountain structural trough (Iwamura, 1995). The valley was formed by uplift of metasedimentary and ultramafic basement rocks to the northeast and southwest, coupled with downward forcing of the valley floor which increased towards the Coyote Valley Fault along the northeastern valley margin (McCloskey and Finnemore, 1995).

The Coyote Valley is generally unconfined with no significant laterally-extensive clay layer separating the shallow and the deep aquifer systems. Aquifer sediments are highly to moderately permeable in the southern and central portions of the valley less permeable in the northwest valley where silt and clay materials are more prevalent. The aquifer sediments are bounded to the east and west by the impermeable bedrock of the Diablo Range and the Santa Cruz Mountains, respectively.

The Coyote Valley is filled with alluvial fan, fluvial, and Santa Clara Formation sediments (McCloskey and Finnemore, 1995). The alluvial sediments overlying the Santa Clara Formation vary in thickness from a few feet or less along the west side of the valley to more than 400 feet along the east side. The sediments are mainly composed of a thick alluvial sand and gravel with interbedded thin and discontinuous silts and clays. The Santa Clara Formation underlying the surface alluvial and fluvial sediments is composed of semi-consolidated alluvial sediments and ranges in thickness from tens of feet to 400 feet (McCloskey and Finnemore, 1995).

Groundwater is relatively shallow under much of Coyote Valley, with seasonal high groundwater often within ten feet of the land surface. Figure 19 represents the generalized depth to first water map based on water table data collected from fuel leak sites and monitoring wells. Figure 30 does not depict the water table depth at any particular point in time, but shows the minimum depth to shallow measured through 2003. Depth to groundwater and groundwater elevation varies by location but in general, minimum depths to groundwater range from 0 to 10 feet below ground surface in the northern part of the valley and 20 to 50 feet below ground surface in the southern portion. There are some locations in the Coyote Valley where the groundwater elevation is above the ground surface.

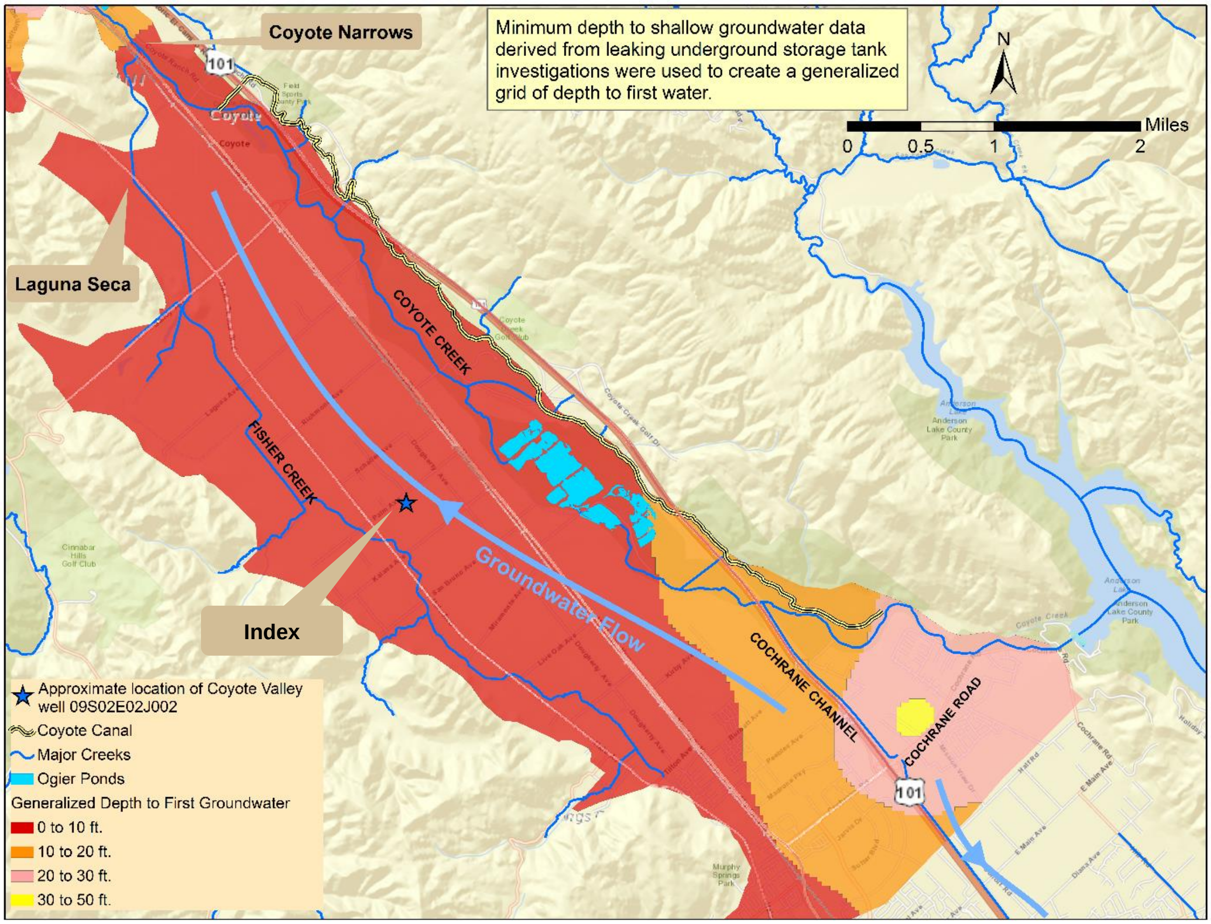


Figure 29: Generalized depth to first groundwater and groundwater flow direction.

Figure 30 shows the minimum groundwater elevation measured at the regional index well in the Coyote Valley, located about 1 mile west of the Ogier Ponds. Groundwater elevation patterns in the valley respond to changes in hydrology, managed recharge operation and well pumping. For example, Figure 30 shows the effects of the recent multi-year drought in lowering water levels, but also the recovery to pre-drought levels due to reduced groundwater pumping, increased managed recharge, and significant precipitation in the winter of 2017.

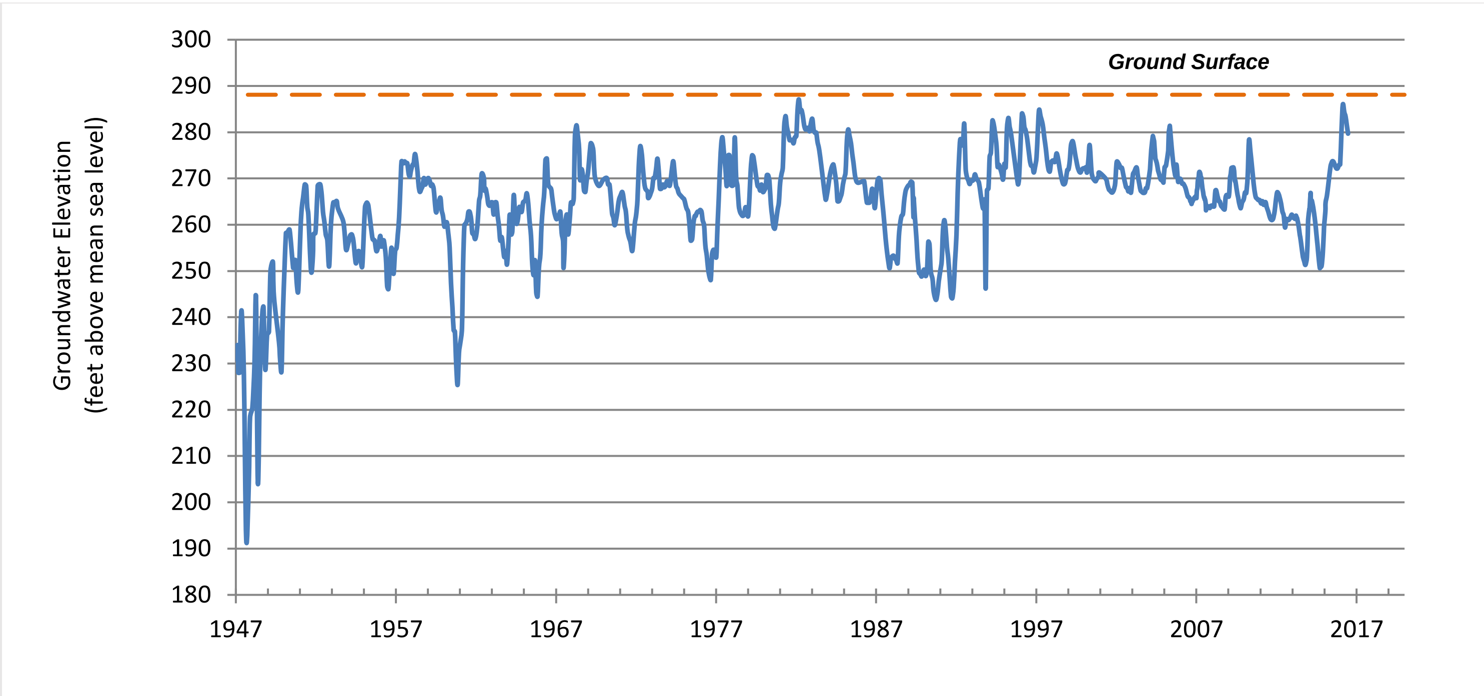


Figure 30: Groundwater elevation trends at Coyote Valley well 09S02E02J002

Both surface water and groundwater generally flow to the northwest (Figure 29). At some locations, local groundwater moves toward areas of intense pumping instead of following the overall Coyote Valley flow direction, such as at the southeastern and northern parts of the Coyote Valley where groundwater production wells are located.

3.3.3. Groundwater Pumping and Managed Recharge

Groundwater is the sole source of drinking water in the Coyote Valley, where over 500 water supply wells pump about 12,000 acre-feet of groundwater each year. Because natural groundwater recharge from rainfall and other sources is far less than what is pumped, the District conducts managed recharge. The District releases local and imported surface water from Anderson Reservoir and the Santa Clara Conduit/Cross Valley Pipeline to Coyote Creek for in-stream groundwater recharge. The District's managed recharge through instream percolation is the principal source of recharge for the Coyote Valley, providing about 12,000 acre-feet annually (i.e., 80% of all groundwater recharge) and the majority of water for groundwater production.

3.3.4. Groundwater Quality

The Coyote Valley generally produces water of good quality for municipal, irrigation, and domestic supply. The typical water type is dominated by calcium-magnesium and bicarbonate. Groundwater in the Coyote Valley is vulnerable to contamination due to very permeable soils and little separation between the land surface and groundwater. Because the area is predominantly rural, there have been relatively few areas impacted by commercial and industrial pollution. Due to historical and ongoing sources like fertilizers and septic systems, elevated nitrate levels have been observed at some wells (SCVWD, 2016).

3.3.5. Water Rights

The State of California asserts ownership of all water within the state. Water users are granted usufructuary rights, which do not convey ownership of the water, but rather allow use of the water. The right to use water is conditioned upon using the water for beneficial and reasonable purposes. There is no right to wasteful or harmful use of water (State Water Resources Control Board [SWRCB], 2017B). SWRCB is authorized to issue licenses allowing appropriation of surface water for beneficial uses. SWRCB has issued four permits to SCVWD to appropriate water from Coyote Creek. All of these permits allow SCVWD to remove water from the creek for specified use; the water must be used within SCVWD's service area in Santa Clara County. Table 7 provides details of those permits.

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Table 7: SCVWD Permits to Appropriate Water from Coyote Creek

Application No.	Permit No.	License No.	Diversion Volume (acre-feet/year)	Diversion Period	Diversion Point	Permitted Water Use
7140	5061	7211	24,560	10/1 to 7/1	Coyote Reservoir Dam	Irrigation, Domestic, Minor industrial, Incidental recreation
8388	5062	2210	5,000	4/1 to 12/15	Coyote Percolating Pond	Irrigation, Domestic
13016	8498	7212	71,100*	12/1 to 5/1	Anderson Reservoir Powerplant	Domestic, Industrial, Recreation, and Incidental power
21128	14709	10607	10,180*	10/1 to 7/1	Anderson Reservoir Dam	Domestic, Industrial, Recreation, and Incidental power

* Licenses 7212 and 10607 limit combined diversions to a maximum of 43,370 acre-feet/year

In addition to the water appropriation licenses issued to SCVWD, SWRCB issued licenses to appropriate water from Coyote Creek and its tributaries to several other private parties. Licenses 7490, 7793, 8485, and 10273 permit those external parties to divert 18 to 150 acre-feet per year (AFY) of water from San Felipe and Kelly Cabin creeks, which are tributaries to Coyote Creek. The total amount of water that can be diverted is 278 AFY. from diversion points located upstream of Coyote Reservoir (SWRCB, 2017A). SWRCB declared Coyote Creek a fully appropriated stream in 1991. This determination applies from the headwaters of the creek upstream of Coyote Reservoir downstream to San Francisco Bay. As a result, no additional appropriations of creek water are expected in the future (SWRCB, Division of Water Rights, 1991).

Santa Clara County is the landowner at the site. The County's landholdings include the channel of Coyote Creek and adjacent lands, which gives the county the right to use water from the creek. The use must occur on the parcels which abut the creek. Additionally, long-term storage of riparian water obtained from the creek is not allowed and water from the creek may not be impounded for 30 days or more. As is true of all water used in California, water obtained via riparian rights can only be used for beneficial and reasonable purposes, and waste is not allowed. The County does not have appropriative rights to water of Coyote Creek.

The proposed creek-pond separation would not affect the existing riparian water rights held by the county or the existing appropriative rights held by the District. No increase in water consumption would result and no new or modified water rights would be needed to implement the creek-pond separation

3.4. Potential for Managed Groundwater Recharge

This section summarizes the results of site-specific data collection, field studies, and analyses documented in the groundwater report (Appendix A). The groundwater report analyzes the feasibility of using surface spreading at the Site to recharge the deep aquifer, which provides water to the groundwater wells in the local area.

Managed aquifer recharge through surface spreading of water requires permeable soils and a thick unsaturated zone (i.e., storage capacity) to facilitate water infiltration and percolation to the aquifer. Aquifers recharged by surface spreading facilities (i.e., infiltration basins) must be unconfined and have sufficient transmissivity to allow lateral flow of the water away from the infiltration sites to prevent excessive groundwater mounding, which reduces the available storage capacity. Measurements of water levels in shallow monitoring wells, the ponds, and Coyote Creek in spring 2017 showed a continuous water surface across the groundwater-surface water interface and direct hydraulic communication between shallow groundwater and the ponds (Figures 31 - 34). As a result, surface water spread on Site for recharge purposes would flow predominantly to the ponds instead of the deep aquifer, substantially reducing recharge effectiveness.

The Site is not suitable for managed groundwater recharge due to limited storage capacity in the vadose zone. Based on review of historical aerial photographs, shallow groundwater and limited storage capacity are not limited to the winter of 2016/2017, an unusually wet year when the field program was conducted; these conditions persist in normal and below normal rainfall years as well. Thus, the lack of vadose zone storage capacity, is a permanent condition at the site and renders the site unsuitable for managed groundwater recharge.

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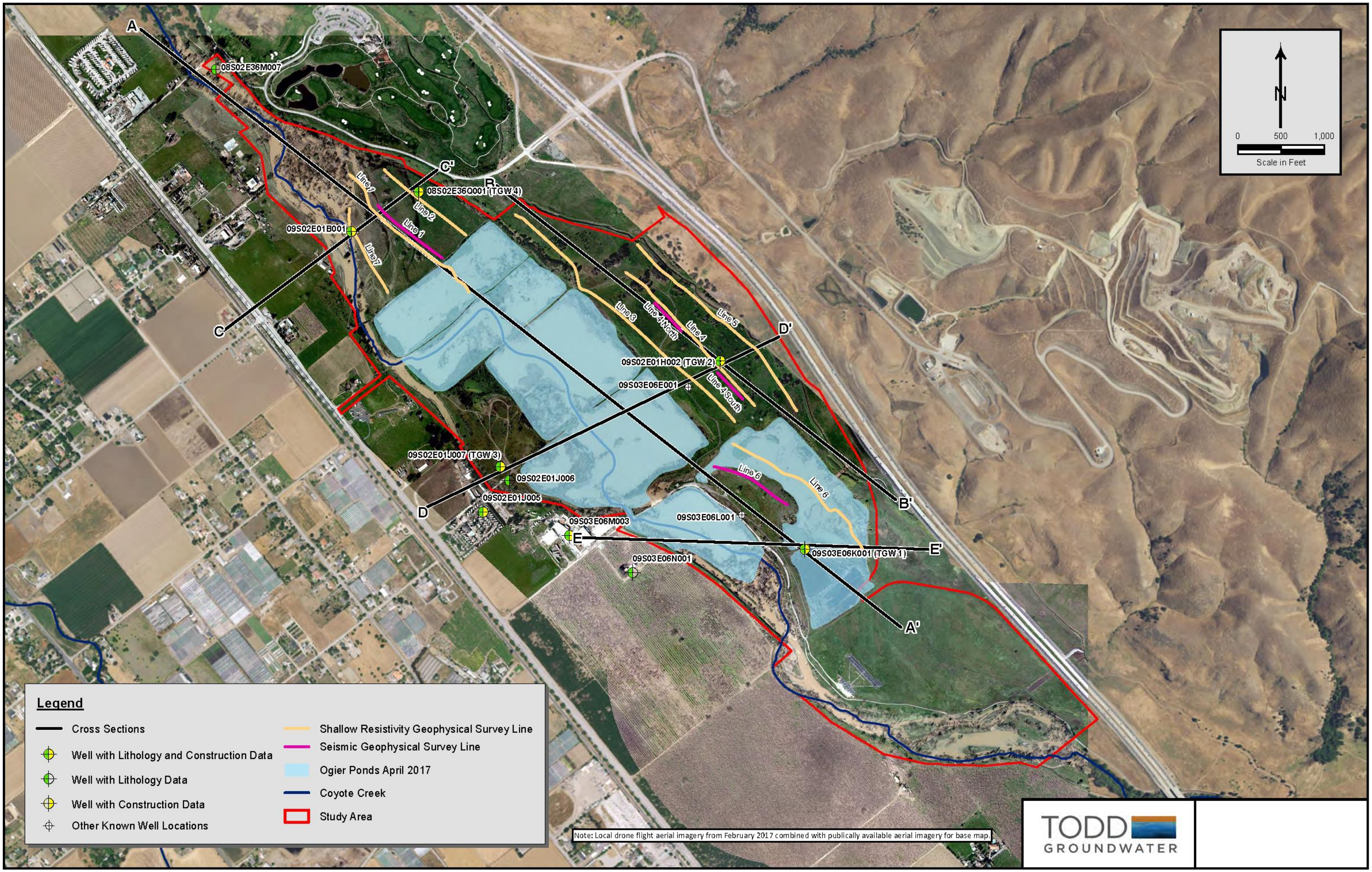

Figure 31: Cross Section Locations

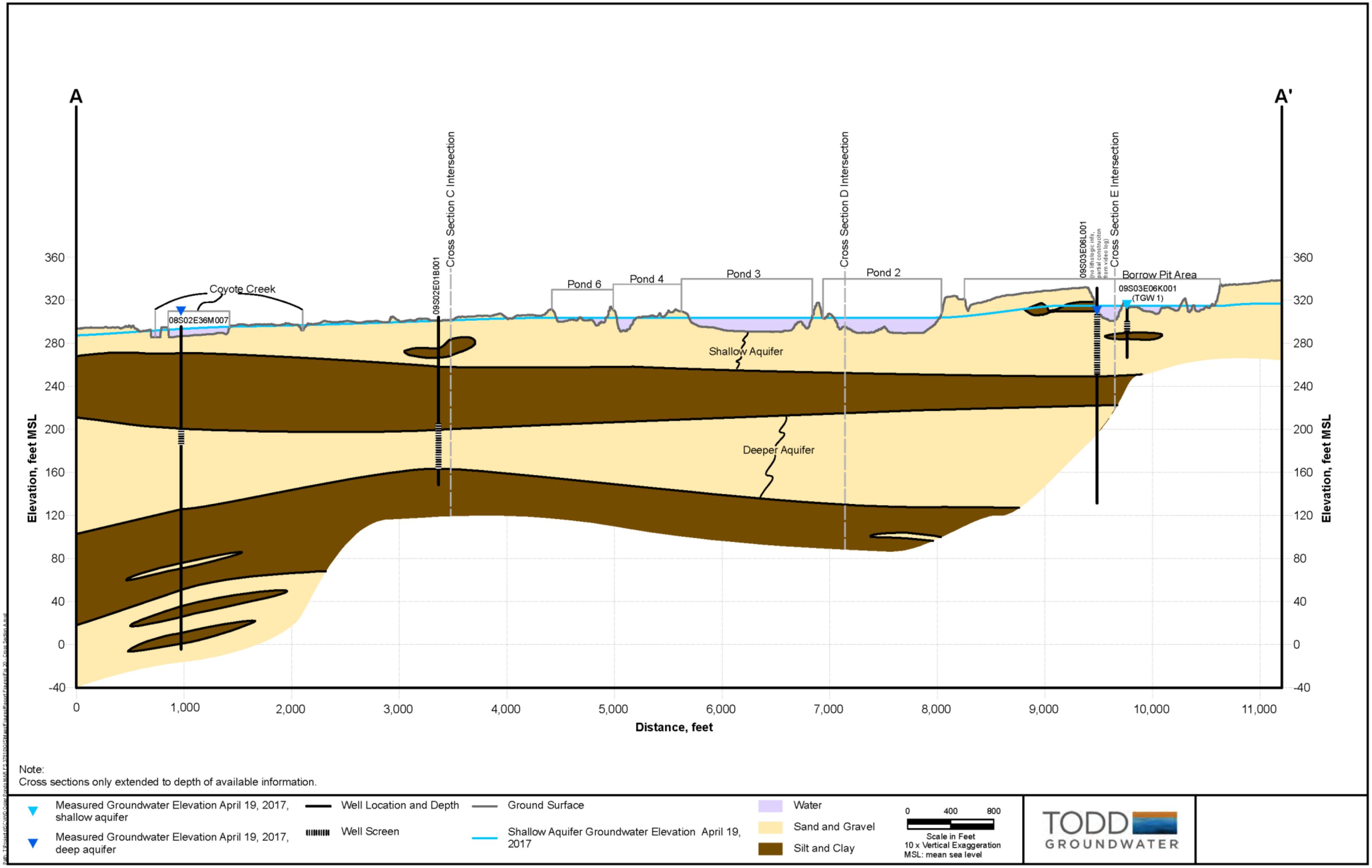

Figure 32: Cross Section A to A'

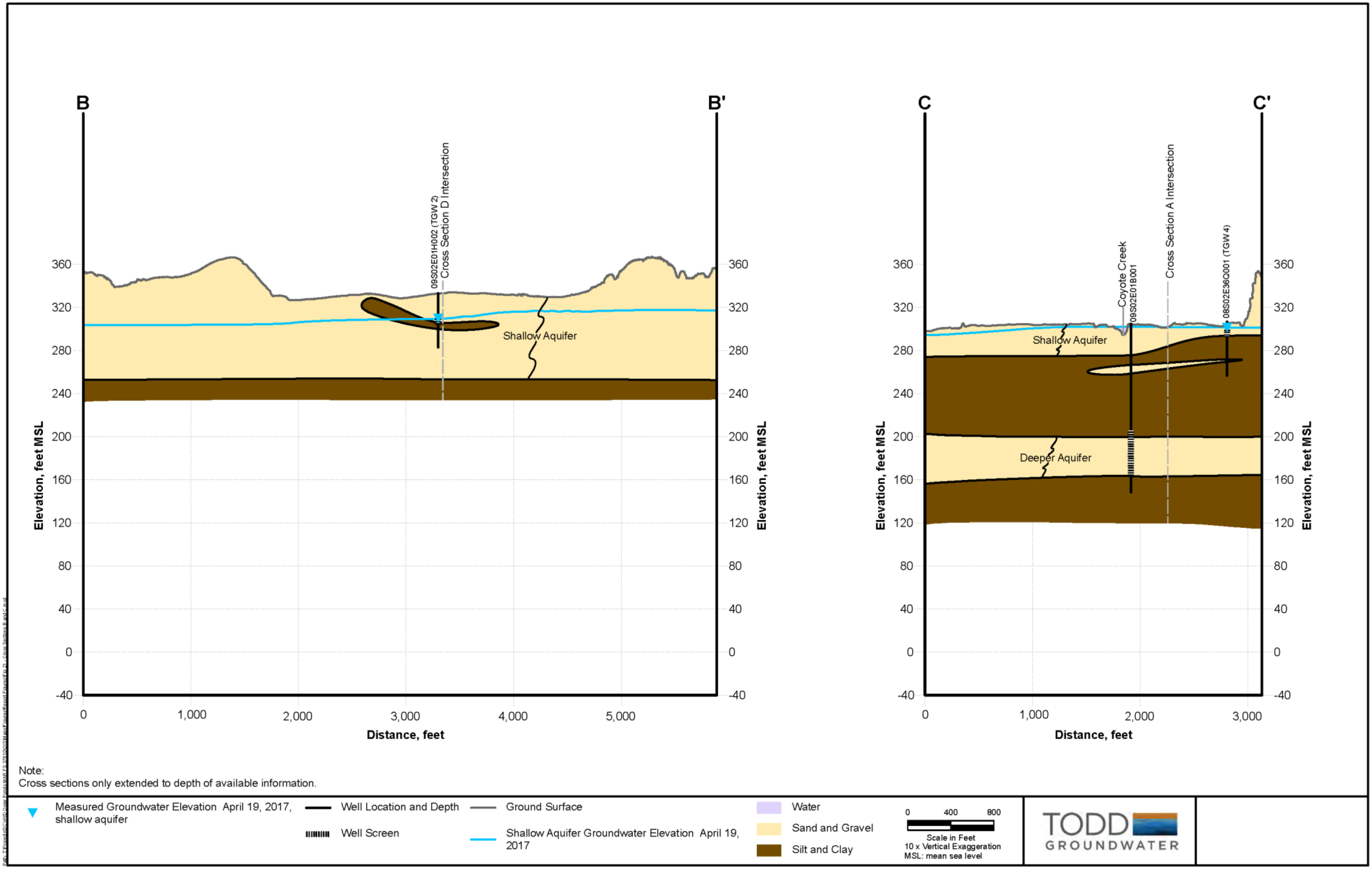

Figure 33: Cross Sections B to B' and C to C'

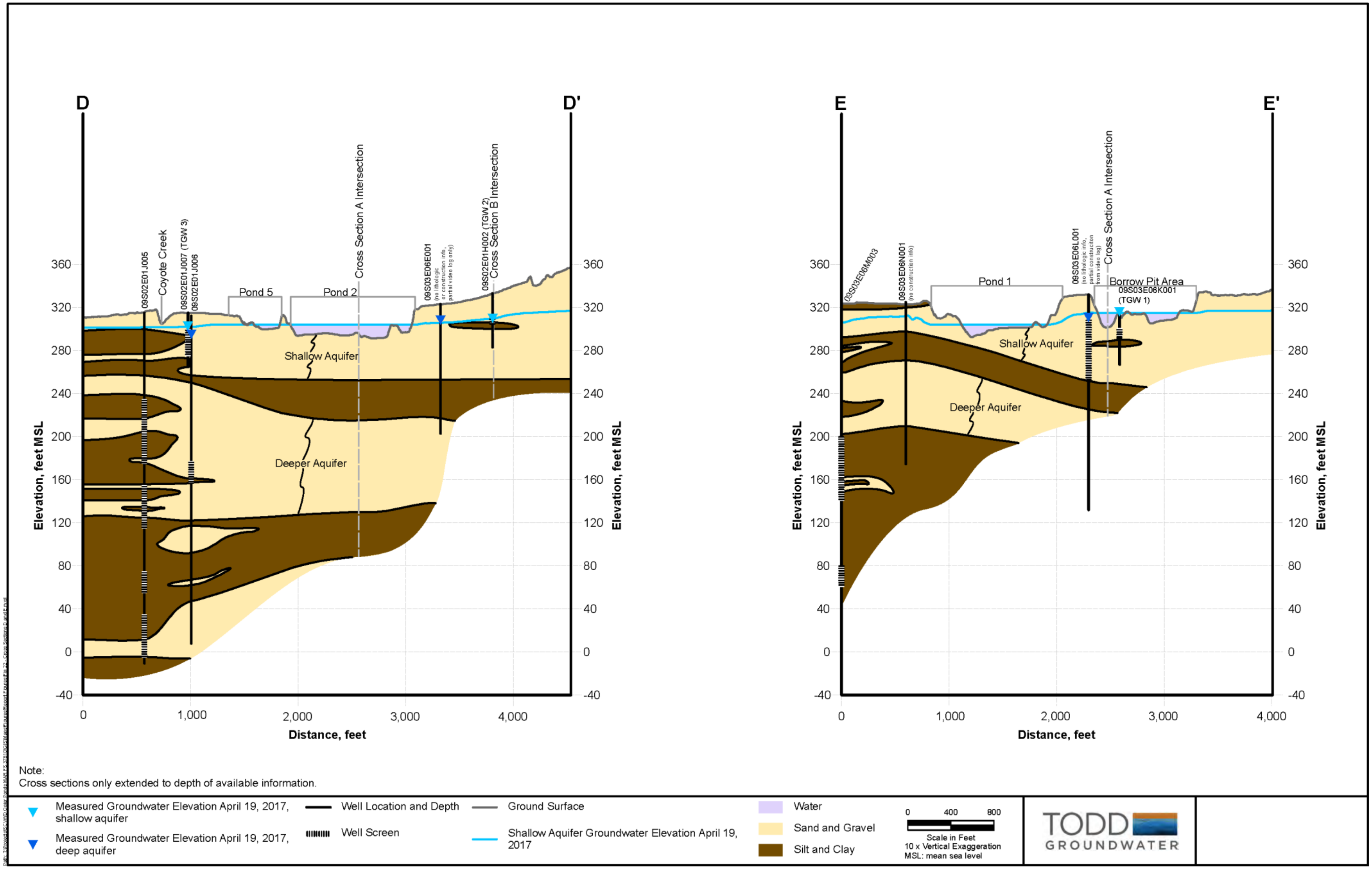

Figure 34: Cross Sections D to D' and E to E'

3.5. Potential for Flood Attenuation

3.5.1. Background, Methodology and Analysis

Coyote Creek drains the largest watershed in Santa Clara County including much of the eastern foothills, the city of Milpitas, and parts of the cities of San Jose and Morgan Hill. Through the latter half of the twentieth century, flooding on Coyote Creek occurred, on average, every four years. Prior to the construction of Coyote and Anderson reservoirs, flooding occurred even more frequently, with flood events in 1903, 1906, 1909, 1911, 1917, 1922, 1923, 1926, 1927, 1930, and 1931. The construction of Coyote and Anderson reservoirs in 1936 and 1950, respectively, reduced, but did not eliminate flooding in the Coyote Creek watershed. Flooding continued to occur, most significantly in 1982, 1983, 1995, 1997, and 2017.

The Coyote Creek Flood Protection Project was authorized for preconstruction planning, engineering, and design by the Federal Water Resources Development Act of 1986.

The Lower Coyote Creek Flood Protection Project completed construction in 1996. The project included berms, parallel overflow channel, and environmental mitigation from San Francisco Bay to Montague Expressway. In 1997, a series of storms generated record runoff in the Coyote Creek watershed. Coyote Creek overtopped its banks and flooded several locations in San Jose and Morgan Hill, damaging homes, and businesses, and closing a portion of Highway 101. In downtown San Jose, several homes were inundated with more than six feet of water, while a mobile home park and businesses adjacent to the Union Pacific Railroad tracks were flooded. As a result of the 1997 flood, the District initiated a new Coyote Creek Watershed Study in 1999, currently called themed- Coyote Creek Flood Protection Project (Planning Study Phase). The study area was located within the central portion of the Coyote watershed, and extends approximately 7 miles between Montague Expressway and Tully Road, all in the city of San Jose. The mid-Coyote study area is about 12 miles downstream from the Ogier Ponds site.

This section evaluates the potential of the Ogier Ponds site, located within the upper Coyote Creek watershed, to temporarily store floodwater based on the capacity of the existing ponds and thereby provide flood protection to the downstream mid-Coyote Creek area, located along coyote Creek about 12 to 19 miles downstream of the Ogier Ponds. The study does not evaluate providing flood protection to the Ogier Ponds site.

Approach and Methodology

The study area for the flood attenuation analysis is approximately 350 acres, including the surface area of the ponds and vicinity (Figure 35). Because the ponds are located downstream of Anderson Reservoir and upstream of all the large tributaries of Coyote Creek, the site has the potential to attenuate flow in Coyote Creek and reduce downstream flood hazards only from dam spills. The analysis herein is based on the following assumptions and approach:

- Six flood mapping scenarios were simulated to determine flood risks. Analyses to fully evaluate flood attenuation benefits would require consideration of many more scenarios, including many different sets of storms at more frequent increments.
- The design and operation of flood attenuation would require detention of Coyote Creek water at the utmost peak of the outflow from Anderson Reservoir. Detention of water before the peak would reduce available storage capacity while providing no floor attenuation benefits.
- The study assumes an idealized volume and flood wave pulse. Actual storms have varying patterns and shapes, which can significantly vary the flood-attenuation performance of the ponds.
- Physical infrastructure would be needed to divert up to 1,000 acre-feet of flow from Coyote Creek and temporarily store it at the ponds which would include additional resources to operate.
- Storage capacity based on the capacity of the existing ponds, not on creation of new ponds or enlarging existing ponds.
- The models do not include the recent short-term temporary floodwall and berm construction at Rock Springs.

In its current configuration, the ponds have a dry volume capacity of approximately 2,000 acre-feet. Volumes were calculated using LIDAR bathymetry survey data collected in December 2016 and Autodesk AutoCAD Civil3D surface tools. Volumes were calculated based on top of bank elevations. However, due to the high groundwater table in the area, the storage capacity of the ponds during wet years (when the ponds would be needed for flood attenuation) would be approximately 1,000 acre-feet. This volume was calculated using the April 2017 groundwater and surface water elevations contained in the Todd Groundwater (2017a) report, when groundwater levels were high because of the previous wet winter season. Therefore, 1,000 acre-feet is assumed to be the maximum available storage for flood attenuation.

The water detention volumes required to provide flood protection were calculated based on how much water would need to be removed from the design hydrograph to achieve a target peak flow at two downstream index locations (Figure 36) subject to flood hazards. These two locations were identified for analysis due to their locations relative to significant tributaries of Coyote Creek.

- *Rock Springs / William Street*: This index location includes the Rock Springs neighborhood and the William Street area by Selma Olinder Park. It is upstream of the Lower Silver Creek confluence with Coyote Creek, but downstream of Upper Silver and Fisher Creeks' confluences with Coyote Creek.
- *Berryessa Road*: This index location occurs downstream of US-101 on Coyote Creek, and includes Mobile Home Parks and along Watson Park. It is downstream of where Upper Penitencia Creek and Lower Silver Creek discharge to Coyote Creek.

Since Coyote Creek is impounded by Anderson Dam upstream of the index locations, flooding at the two index locations can occur either from dam spills or from direct runoff into the creek and tributaries. The analysis will look at singular design storm events for the 10% and 1% recurrence events. These design hydrographs were extracted from the Coyote Hydrology Study. Figure 37 shows four hydrographs:

- The 1%, 24-hr Storm for Rock Springs / William (No Dam Spill)
- The 1%, 72-hr Storm for Rock Springs / William (Dam Spill)
- The 1%, 24-hr Storm for Berryessa Road (No Dam Spill)
- The 1%, 72-hr Storm for Berryessa Road (Dam Spill)

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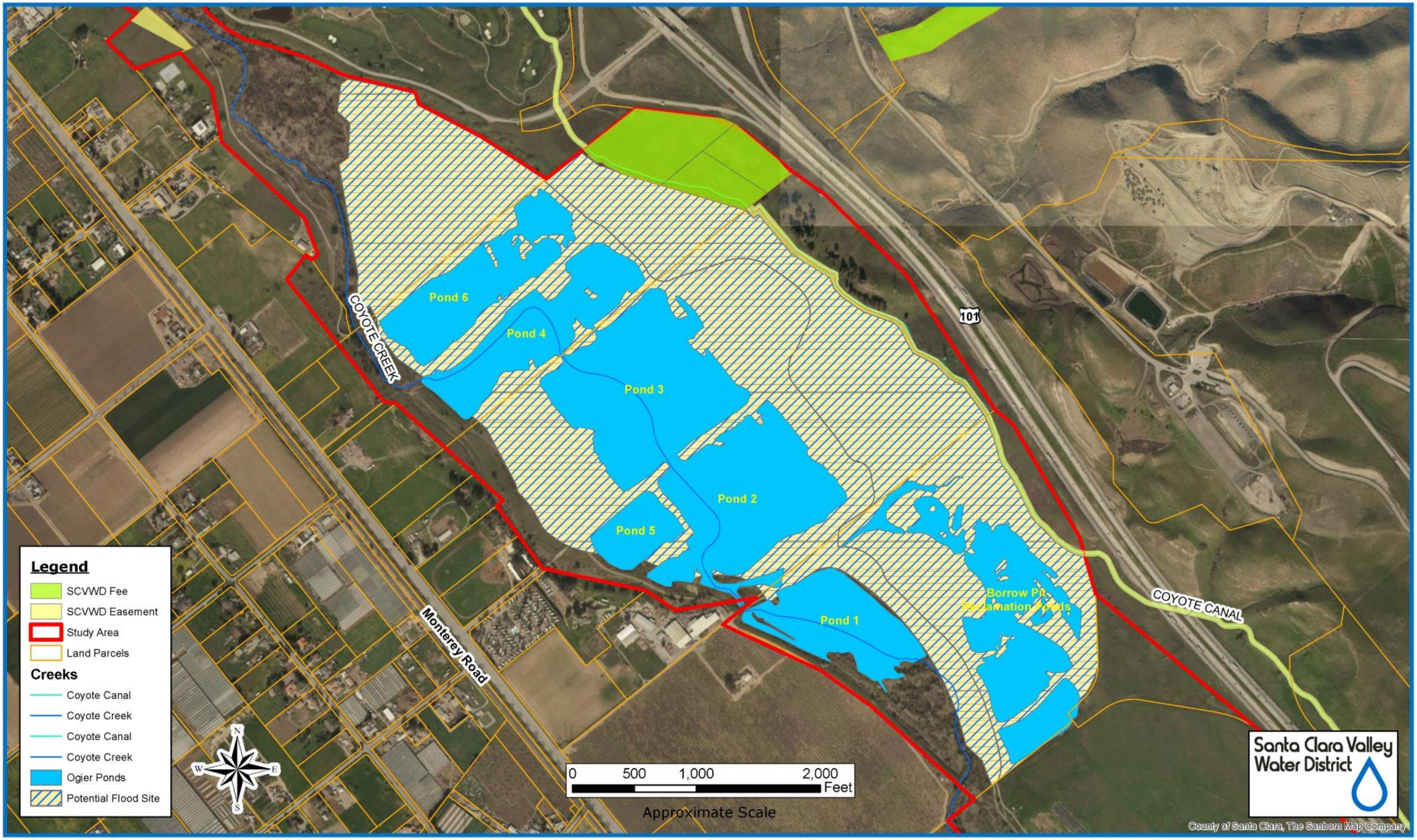

Figure 35: Potential flood site map of Ogier Ponds

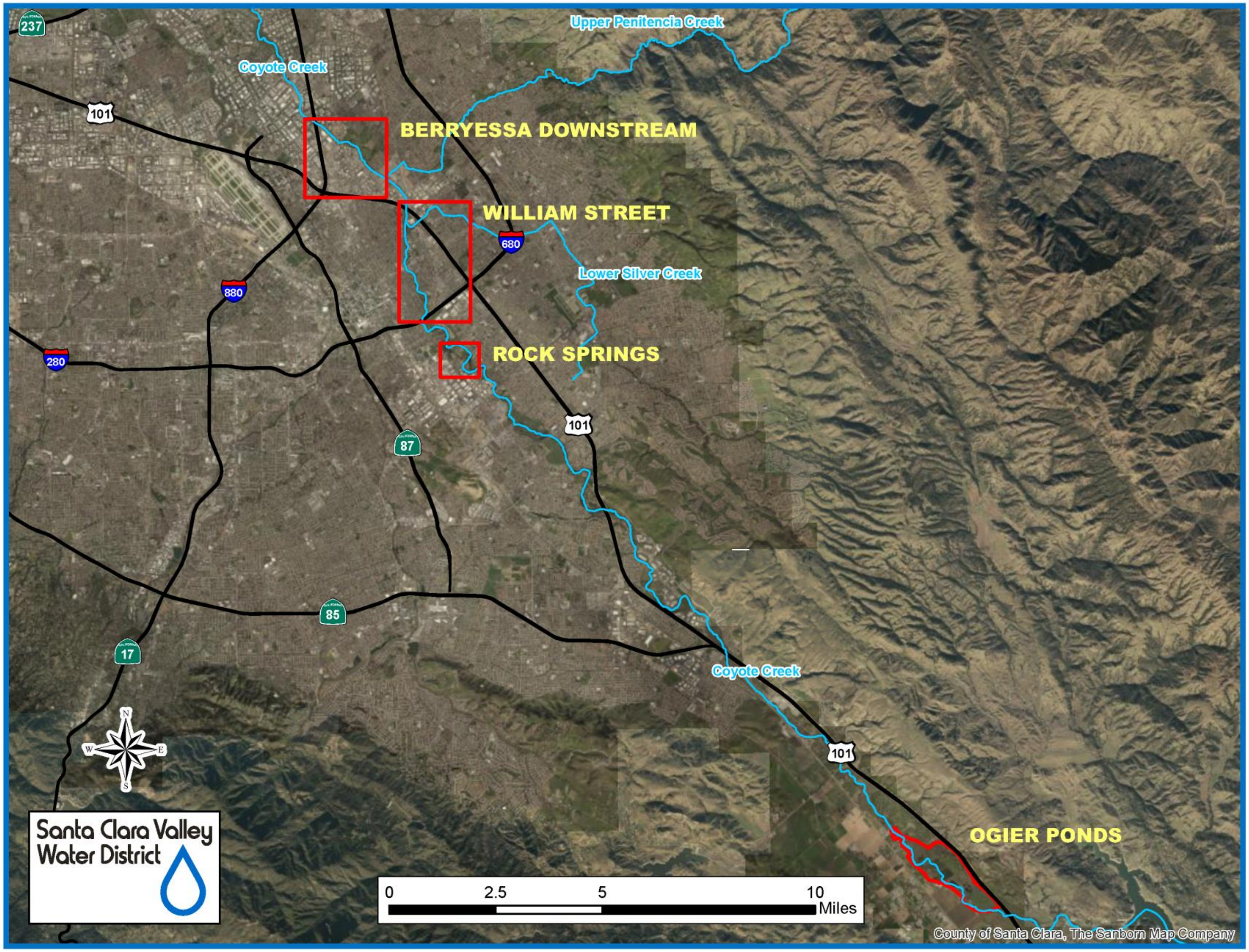

Figure 36: Map highlighting index locations of flood analyses

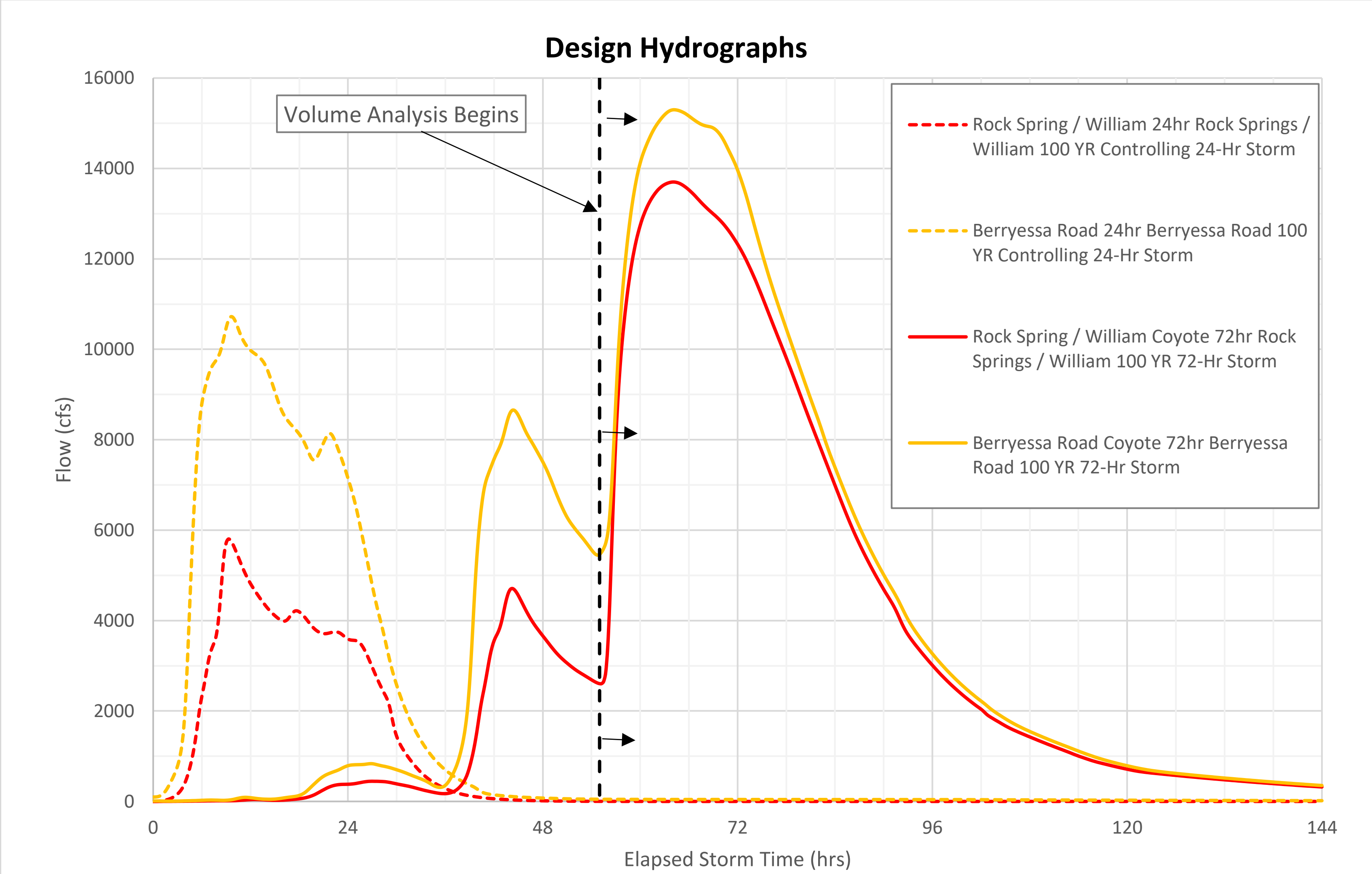

Figure 37: Design hydrographs

The 24-hr storm simulates a large storm that is centered on the tributaries of Coyote Creek (Lower Silver, Upper Penitencia) with no spill from Anderson Dam. These 24-hr storms simulate the 1% peak flows for the tributaries. The 72-hr storm simulates a large storm centered over Anderson Dam and includes dam spills, simulating the 1% flow for Coyote Creek.

The location of Ogier Ponds are such that they are only able to store water that spills from Anderson Dam since all the large tributaries are downstream of the ponds. Therefore, the peak flows at the two index locations from the 24-hr storm represents the first bottom flow threshold for flood reduction benefit, and is shown by the dashed hydrographs in Figure 37. The flow corresponding to the bottom threshold represents water from tributaries that would flood the index locations, even if Ogier Ponds had infinite storage.

To analyze the potential impact of storing water from Anderson spills at the Ogier Ponds, the 72-hr storm is used. In Figure 37, there is a smaller first peak before the larger second peak. This first peak corresponds to the local runoff from tributaries, while the second peak reflects the spill from the dam. This first peak, like the 24-hr storm, cannot be attenuated by the ponds and acts as the second bottom threshold for flood reduction benefits. The larger flow between the 24-hr storm and the first peak in the 72-hr storm dictates the final bottom threshold.

Dam spill flow that can be attenuated by the ponds is shown by the larger, second peak. The current storage analysis focuses on the time between the beginning of the second peak, which is designated by the dashed vertical black line in Figure 37, to the end of the storm. Any flow before this time was not considered in the analysis.

Since the hydrology study did not include 2% and 4% frequency storms, the 2% and 4% hydrographs were interpolated from the 1% and 10% hydrographs by normalizing the 1% and 10% to their high flows, and using the following logarithmic interpolation equations:

$$25YR = (100YR - 10YR) * \log\left(\frac{25}{10}\right) + 10YR$$

$$50YR = (100YR - 10YR) * \log\left(\frac{50}{10}\right) + 10YR$$

The peaks for the 2% and 4% were derived from USGS Bulletin 17B methods, and the rest of the design hydrographs were calculated using the normalized interpolation, multiplied by the peaks. The hydrographs are shown in Figure 38 and Figure 39 which represent the hydrographs after Anderson Dam spills.

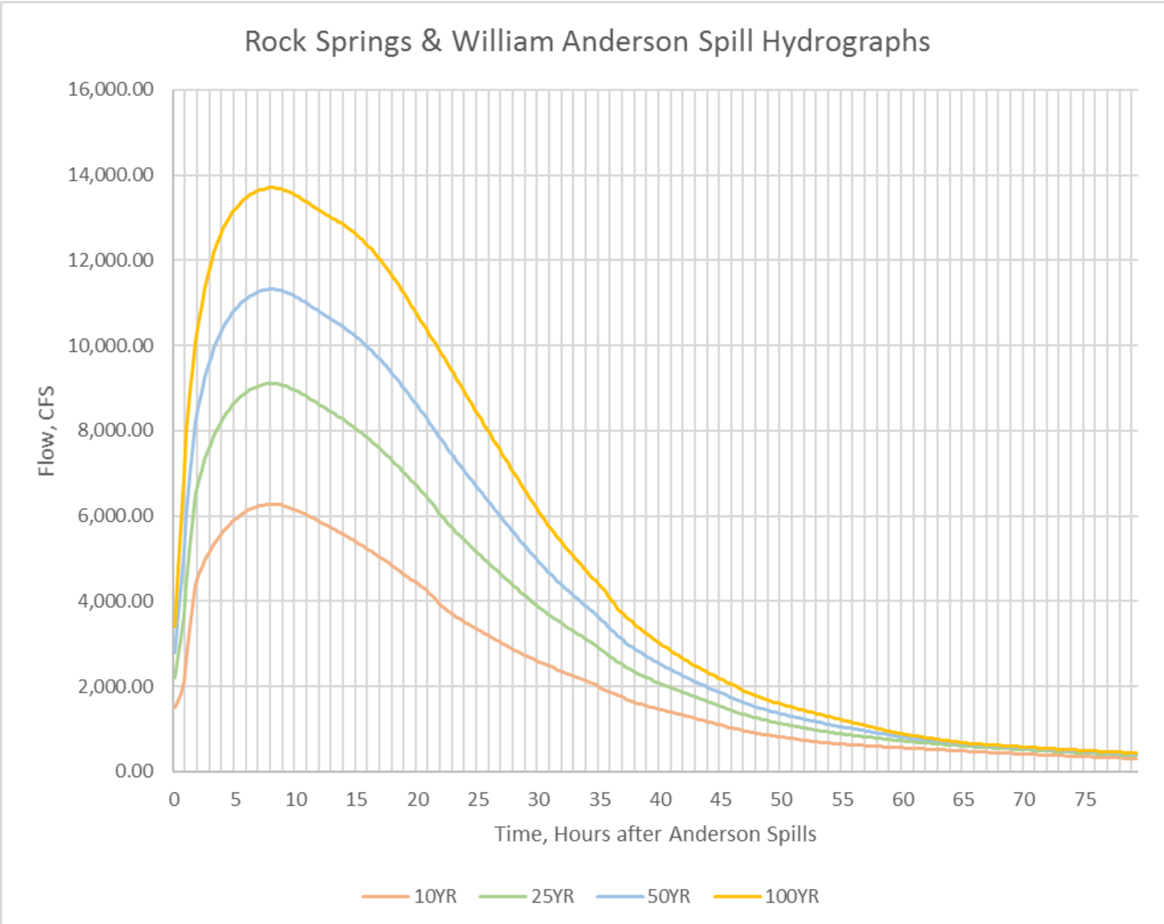

Figure 38: Rock Springs and William Anderson Spill Hydrographs

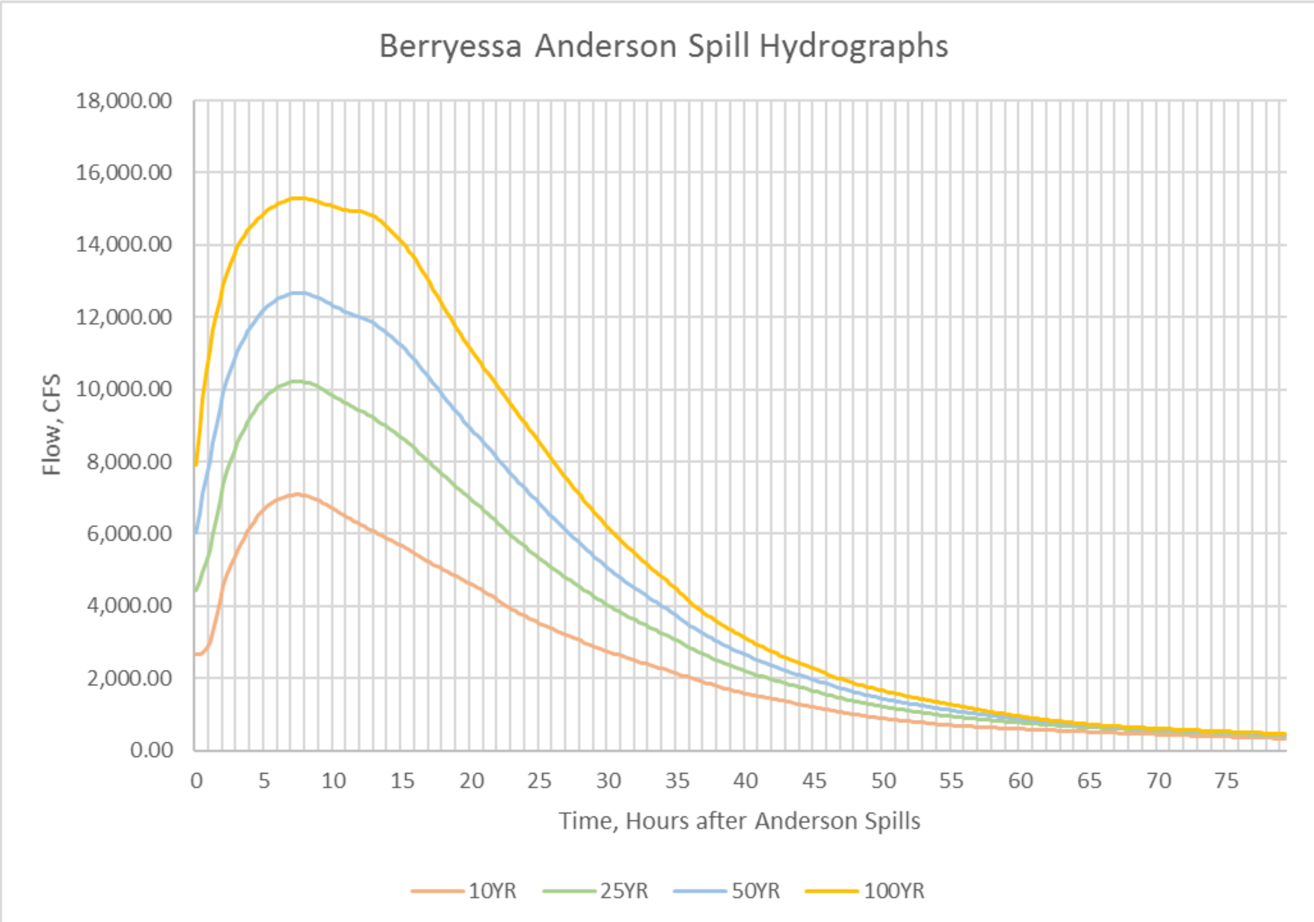

Figure 39: Berryessa Anderson Spill Hydrographs

2-D flood models for Coyote Creek were used to determine floodplain impacts at the index locations assuming storage of creek flow at the Ogier Ponds. Flows were simulated from 4,000 cfs to 14,000 cfs in increments of 2,000 cfs. The model extended from Hellyer Park to San Francisco Bay. The models were simulated using United States Army Corps of Engineers HEC-RAS software. The models do not include the short-term temporary floodwall and berm construction at Rock Springs.

Different required storage volumes to reduce flow to a certain level in the 10-year, 25-year, 50-year, and 100-year events are in Tables 8 and 9. Note that the analysis is only valid for the flow coming from Anderson Dam. The 10-year, 25-year, 50-year, and 100-year return periods are shown to give an incremental range.

	Table 8 – Required Storage (acre-ft) for Flow Thresholds							
	Rock Springs / William				Berryessa Road			
Threshold Q	10YEAR	25YEAR	50YEAR	100YEAR	10YEAR	25YEAR	50YEAR	100YEAR
15,000	0	0	0	0	0	0	0	80
14,000	0	0	0	0	0	0	0	870
13,000	0	0	0	310	0	0	0	2,000
12,000	0	0	0	1,260	0	0	250	3,310
11,000	0	0	90	2,550	0	0	1,100	4,810
10,000	0	0	850	4,080	0	40	2,270	6,500
9,000	0	20	2,060	5,830	0	620	3,660	8,370
8,000	0	670	3,570	7,780	0	1,640	5,300	10,420
7,000	0	1,860	5,330	9,930	10	2,990	7,170	12,670
6,000	90	3,410	7,340	12,280	520	4,630	9,350	15,120
5,000	950	5,260	9,600	14,850	1,570	6,640	12,180	17,880
4,000	2,410	7,440	12,160	17,690	3,100	9,450	15,630	20,930
3,000	4,290	10,020	15,060	20,820	5,430	12,970	19,430	24,270
2,000	6,760	13,320	18,950	24,440	8,850	16,950	23,660	28,040
1,000	10,640	17,930	23,810	28,810	13,110	21,660	28,610	32,530
Bottom Flow Threshold	3,000	4,000	5,000	5,500	5,000	7,500	9,000	10,000

Table 9 shows the approximate reduction in flows at each index location that would result if 1,000 acre-feet of creek flow was detained at the Ogier Ponds.

Table 9 - Peak Flows 1000 AC-FT Storage				
	Return Period	Exist Peak Flow, CFS	Flows with Ogier Storage, CFS	Peak Flow Reduction, CFS
Rock Springs & William	10YEAR	6,280	4,960	1,320
	25YEAR	9,110	7,690	1,420
	50YEAR	11,320	9,860	1,460
	100YEAR	13,700	12,240	1,460
Berryessa Road	10YEAR	7,080	5,490	1,590
	25YEAR	10,220	8,590	1,630
	50YEAR	12,670	11,100	1,570
	100YEAR	15,300	13,880	1,420

Figures 40 to 42 are maps showing the resulting extent and depth of overbank flows at the Rock Springs, Williams Street, and Berryessa and Downstream Index Areas.

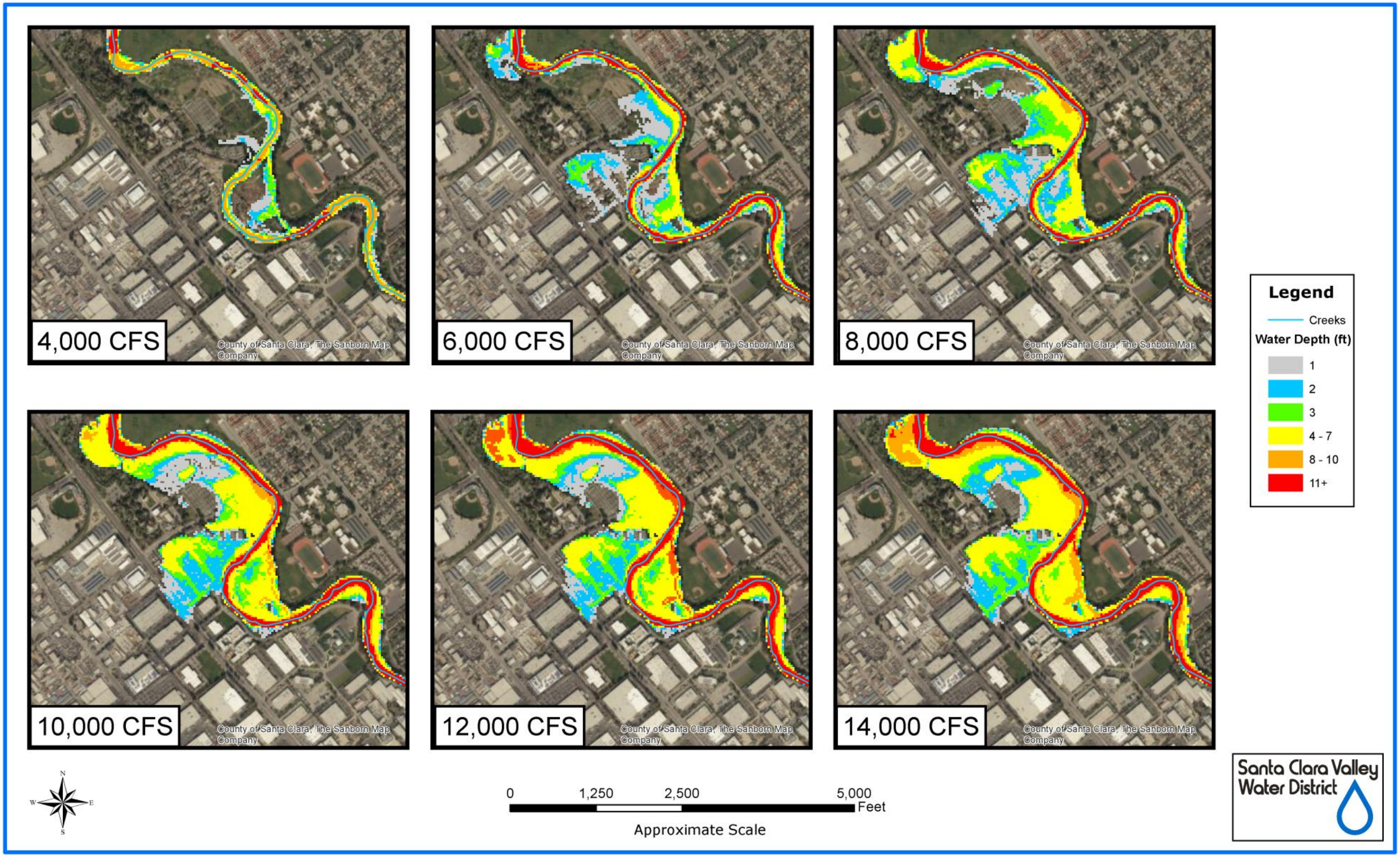

Figure 40: Rock Springs flood map (Pre-Rock Springs flood wall and berm project)

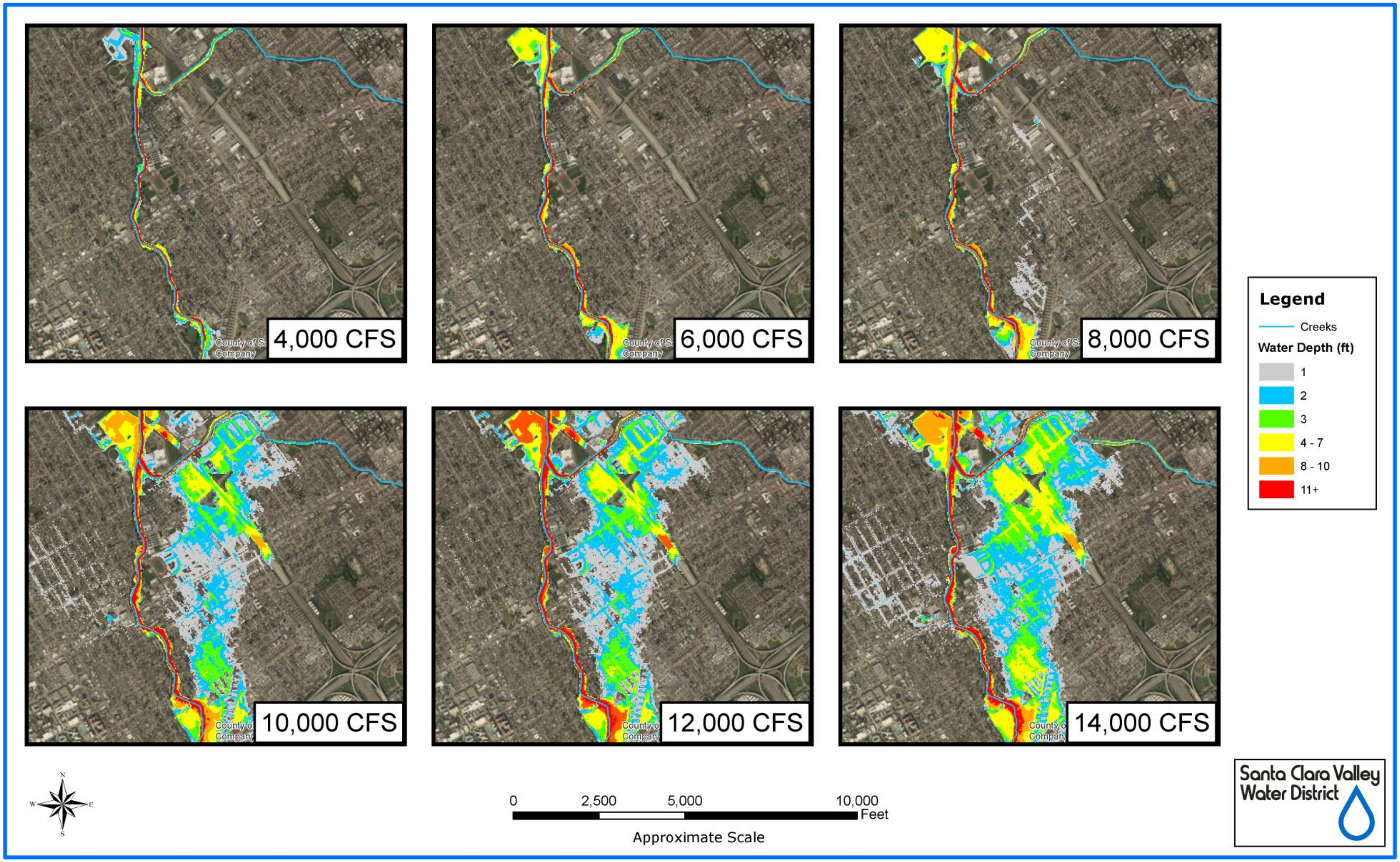

Figure 41: William Street flood map

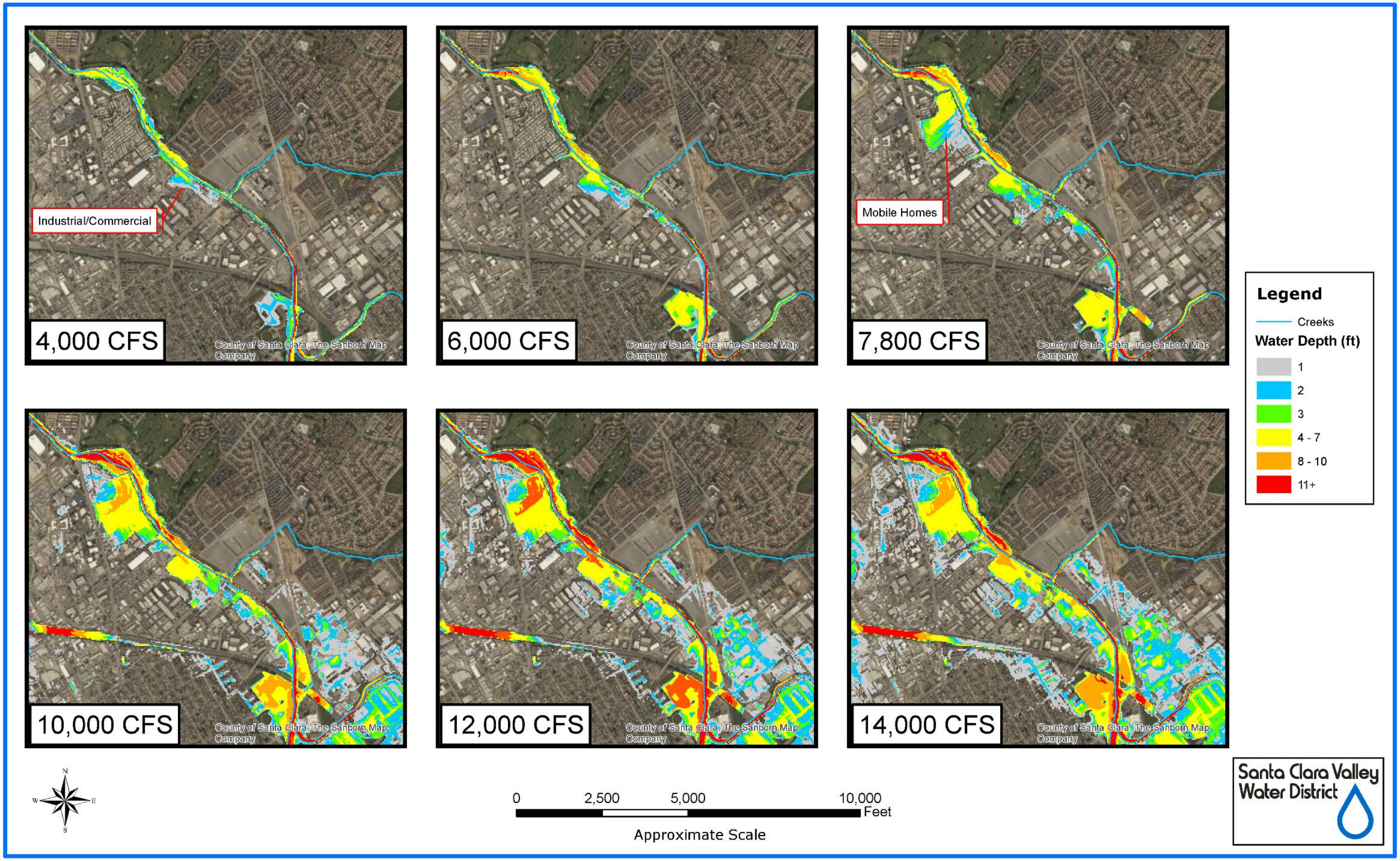

Figure 42: Berryessa Road flood map

3.5.2. Results

The flood model finds that the index locations begin to flood at the flow ranges shown in Table 10:

Table 10	
Index Location	**Flow Range, CFS**
Rock Springs[1]	7,300
William	6,000 – 7,800
Berryessa, Mobile Homes	6,000 – 7,800
Berryessa, Commercial/ Industrial	≤ 4,000

For the Rock Springs area, the models and calculations show that if Ogier Ponds temporarily store 1,000 acre-feet of flow diverted from the creek:

- The flows for the 10-year event is 6,280 cfs which is below 7,300 cfs flood stage. No change in flood risk would result.
- The flows for the 25-year event would decrease from 9,110 cfs to 7,690 cfs which does not prevent flooding, but reduces the area of inundation by approximately 10 acres (39 acres to 29 acres), decreases the maximum water depth by 1 foot (6 feet to 5 feet), and decreases the average water depth by 0.3 feet (2.5 feet to 2.2 feet).
- The flows for the 50-year event would decrease from 11,320 cfs to 9,860 cfs which results in negligible changes in flood risk. (1 acre decrease in inundation)
- The flows for the 100-year event would decrease from 13,700 cfs to 12,240 cfs which would decrease the average depth by 0.3 feet (2.8 feet to 2.5 feet).

[1] The Ogier Ponds Feasibility Study was conducted simultaneously with the District installation of a floodwall and berm construction at Rock Springs, and this analysis considered the changes from the projects. The floodwall and berm at Rock Springs is designed to accommodate 7,300 cfs flow without overtopping of the creek banks.

Table 11 – Rock Springs						
Approx. Recurrence Event	Approx. Recurrence Event w/ Ogier Storage	Flows, CFS	APNS affected	Area Affected, Acres	Maximum Depth, FT	Average Depth, FT
	10YR	4K	0	0	0	0
10YR		6K	0	0	0	0
	25YR	7.8K	78	29	5	2.2
25YR	50YR	10K	79	39	6	2.5
50YR	100YR	12K	79	40	6	2.5
100YR		14K	79	41	7	2.8

Notes:

1. Recurrence events with and without Ogier Ponds storage are approximate. Refer to Table 9 for changes in flows.

For the William Street area, the models and calculations show that if Ogier Ponds temporarily store 1,000 acre-feet of flow diverted from the creek:

- The flows for the 10-year event would decrease from 6,280 cfs to 4,960c cfs which puts the flow below the flood flow range (6,000 cfs—7,800 cfs) which would prevent flooding.
- The flows for the 25-year event would decrease from 9,110 cfs to 7,690 cfs which does not prevent flooding. However, it would reduce the area of inundation significantly by approximately 325 acres (348 acres to 23 acres), decreases the maximum water depth by 6 feet (8 feet to 2 feet), and decreases the average water depth by 1 feet (2.1 feet to 1.1 feet).
- The flows for the 50-year event would decrease from 11,320 cfs to 9,860 cfs which reduces the area of inundation by approximately 45 acres (395 acres to 348 acres), decreases the maximum depth of water by 2 feet (10 feet to 8 feet), and decreases the average depth of water by 0.4 feet (2.5 feet to 2.1 feet).
- The flows for the 100-year event would decrease from 13,700 cfs to 12,240 cfs which would reduce the area of inundation by approximately 65 acres (462 acres to 395 acres), decreases the maximum depth of water by 1 feet (11 feet to 10 feet), and decreases the average depth of water by 0.2 feet (2.7 feet to 2.5 feet).

Table 12 – William						
Approx. Recurrence Event	Approx. Recurrence Event w/ Ogier Storage	Flows, CFS	APNS affected	Area Affected, Acres	Maximum Depth, FT	Average Depth, FT
	10YR	4K	0	0	0	0
10YR		6K	0	0	0	0
	25YR	7.8K	297	23	2	1.1
25YR	50YR	10K	922	348	8	2.1
50YR	100YR	12K	1016	395	10	2.5
100YR		14K	1239	462	11	2.7

Notes:
1. Recurrence events with and without Ogier Ponds storage are approximate. Refer to Table 9 for changes in flows.

For the areas around Berryessa which is downstream of Upper Penitencia Creek, the models and calculations show that if Ogier Ponds temporarily store 1,000 acre-feet of flow diverted from the creek:

- The flows for the 10-year event would decrease from 7,080 cfs to 5,490 cfs which would prevent flooding for the mobile home area, but would not prevent flooding for the commercial/industrial area. For the commercial area, area of inundation would decrease by 15 acres (35 acres to 20 acres), maximum water depth would decrease by 1 foot (7 feet to 6 feet), and average water depth would decrease by 0.5 feet (2.8 feet to 2.3 feet).
- The flows for the 25-year event would decrease from 10,220 cfs to 8,590 cfs which would not prevent flooding for the mobile home area. For the mobile home area, homes affected would decrease by 151 homes (529 homes to 380 home), area of inundation would decrease by 24 acres (59 acres to 35 acres), maximum water depth would decrease by 3 feet (9 feet to 6 feet), and the average water depth would decrease by 0.8 feet (3.3 feet to 2.5 feet). For the commercial area, area of inundation would decrease by 9 acres (44 acres to 35 acres), maximum water depth would decrease by 2 feet (9 feet to 7 feet), and average water depth would decrease by 0.2 feet (3 feet to 2.8 feet).
- The flows for the 50-year event would decrease from 12,670 cfs to 11,100 cfs. For the mobile home area, homes affected would decrease by 5 homes (534 homes to 529 home), and area of inundation would decrease by 3 acres (62 acres to 59 acres). For the commercial area, area of inundation would decrease by 11 acres (55 acres to 44 acres).
- The flows for the 100-year event would decrease from 15,300 cfs to 13,880 cfs. Unfortunately, the six flood mapping scenarios completed under this study did not capture the changes for the 100-year event.

Table 13 – Berryessa (Mobile Homes)						
Approx. Recurrence Event	Approx. Recurrence Event w/ Ogier Storage	Flows, CFS	Homes Affected (2)	Area Affected, Acres	Maximum Depth, FT	Average Depth, FT
		4K	0	0	0	0
	10YR	6K	0	0	0	0
10YR	25YR	7.8K	380	35	6	2.5
25YR	50YR	10K	529	59	9	3.3
50YR		12K	534	62	9	3.3
100YR	100YR	14K	544	64	10	3.4

Notes:
1. Recurrence events with and without Ogier Ponds storage are approximate. Refer to Table 9 for changes in flows.
2. Homes were used instead because 4 parcels encompass all the mobile homes.

Table 14 – Berryessa (Commercial/Industrial)						
Approx. Recurrence Event	Approx. Recurrence Event w/ Ogier Storage	Flows, CFS	APNS affected	Area Affected, Acres	Maximum Depth, FT	Average Depth, FT
		4K	9	12	5	1.9
	10YR	6K	12	20	6	2.3
10YR	25YR	7.8K	22	35	7	2.8
25YR	50YR	10K	25	44	9	3
50YR		12K	36	55	9	3
100YR	100YR	14K	48	64	10	3.2

Notes:
1. Recurrence events with and without Ogier Ponds storage are approximate. Refer to Table 9 for changes in flows.

3.5.3. Flood Attenuation Conclusion

Table 15 – Summary

Return Period	Rock Springs	Williams	Berryessa (Mobile Homes)	Berryessa (Commercial/Industrial)
10-Year	No change[1]	Prevents flooding	Prevents flooding	Reduces area flooded (from 35 acres to 20 acres) and average flood water depth from (2.8 to 2.3 feet)
25-Year	Reduces area flooded (from 39 to 29 ac) and average flood water depths (from 2.5 to 2.2 ft)	Significantly reduces areas flooded (from 348 acres to 23 ac). Reduces average flood water depth (from 2.1 to 1.1 ft)	Reduces area flooded (from 529 to 380 mobile homes) and average flood water depth (from 3.3 to 2.5 ft)	Reduces area flooded(from 44 to 35 ac) and average flood water depth (from 3.0 to 2.8 ft)
50-Year	Minor reduction in areas flooded[2]	Reduces area flooded (from 395 to 348 ac) and average flood water depth (from 2.5 to 2.1 ft)	Minor reduction in areas flooded[2]	Reduces area flooded (55 acres to 44 acres)
100-Year	Reduces flood water depths	Reduces area flooded (462 acres to 395 acres) and average flood water depths (from 2.7 to 2.5 ft)	Slight reduction in areas flood risk	Slight reduction in flood risk

Notes:
1. With the recent construction of the floodwall and berm at Rock Springs, no change in flood risk would occur during the 10-year event since the recent construction would pass flows up to 7,300 cfs.
2. Less than 5%.

From the models and analyses and under the assumptions and limitations of the study, Ogier Ponds could potentially yield flood protection benefits for the 10-year event at William Street and the mobile home area at Berryessa, and incremental benefits for the 25-year event at the William Street and Berryessa areas. With the recent construction of the temporary floodwall and berm at Rock Springs which is expected to be completed in the winter of 2017, there would be no benefit to Rock Springs during the 10-year event if Ogier Ponds attenuate flows during the 10-year event.

Note, the estimated reductions in flood risk would be achieved during a 72-hour storm focused on the watershed upstream of Anderson Dam and Reservoir which caused water to spill over the dam. A total of 1,000 acre-feet of water would be diverted from the peak flow of Coyote Creek and temporarily detained at Ogier Ponds. Due to the relatively upstream location of Ogier Ponds within the Coyote Creek watershed, no attenuation of flood risks would be achieved during a large storm focused downstream of Ogier Ponds. Storage at Ogier Ponds heavily relies on the groundwater levels at the time attenuation is needed. When Anderson Dam spills, the likelihood of the area being saturated is high which could substantially reduce the amount of flood water detention potential at Ogier Ponds. Overall, using the Ogier Ponds site by itself to reduce downstream flood risks has significant limitations because it would only reduce flood risks when storms are focused at or upstream of Anderson Dam.

To expand the analysis of the potential flood attenuation opportunities within the Upper Coyote Creek Watershed, it would be useful to study the effects of flood attenuation considering other District facilities along Coyote Creek parkway chain, including the Ogier Ponds and Metcalf Ponds[2]. By analyzing the entire Coyote Creek Parkway for potential flood attenuation benefits, the District would increase the range of options for detaining flood water beyond the limited capabilities present at just the Ogier Ponds site.

Pre-1997 channel restoration Concept

Under the pre-1997 channel restoration concept, Ogier Ponds would be separated from Coyote Creek and creek flow would be routed to the pre-1997 channel on the western side of the study area. Since the creek channel would be physically separated from the ponds, the ponds could be designed and engineered to detain water diverted from the creek at high flows. This would require construction, operation, and maintenance of permanent infrastructure to divert creek flow into the ponds during the peak outflow from Anderson Reservoir.

Floodplain Restoration Concept

Ogier Ponds would be separated from Coyote Creek, and flow through a connected floodplain, eliminating most of the surface area of the ponds. Like the pre-1997 channel restoration concept, the remaining ponds could be designed and engineered to detain water from the creek at high flows, but since the floodplain would take up more of the site, reducing the pond area by 58% to 60 acres, potential storage capacity at Ogier Ponds would significantly decrease. The floodplain restoration concept would be less effective at mitigating downstream flood risks than the pre-1997 channel restoration concept.

3.6. Pond sustainability

If Ogier Ponds are managed for habitat and recreation in the future, important questions arise as the long-term sustainability of the ponds. Would realigning Coyote Creek to flow around rather than through the ponds cause the ponds to dry up and would water would have to be added to the ponds to sustain them. to answers these questions, historical aerial photographs were analyzed and the ponds water balance was quantified.

3.6.1. Review of Historical Aerial Photography

Historical aerial photographs were compiled and reviewed and compared to approximate creek flows passing the site in order to assess the relationship between creek flow and water in the ponds. The approximate Coyote Creek flows passing the Site consist of the Gage 5082 flows minus the water diverted to the Coyote Canal. This is likely a slight overestimate of flows

[2] Metcalf Ponds consist of Coyote Percolation Pond, Parkway Pond, Pond 10a, Pond 10b, and Pond 10c.

passing the Site, since a small amount creek flow likely percolates to groundwater between Gage 5082 and the Site.

Figure 45 depicts a series of aerial photographs of the Site. Creek flow at Gage 5082 less Coyote Canal flow is also shown on Figure 45. Note that most of the time between 1996 and early 2017 flows have ranged between 10 and 100 cfs. Prior to 1996, flows were more variable.

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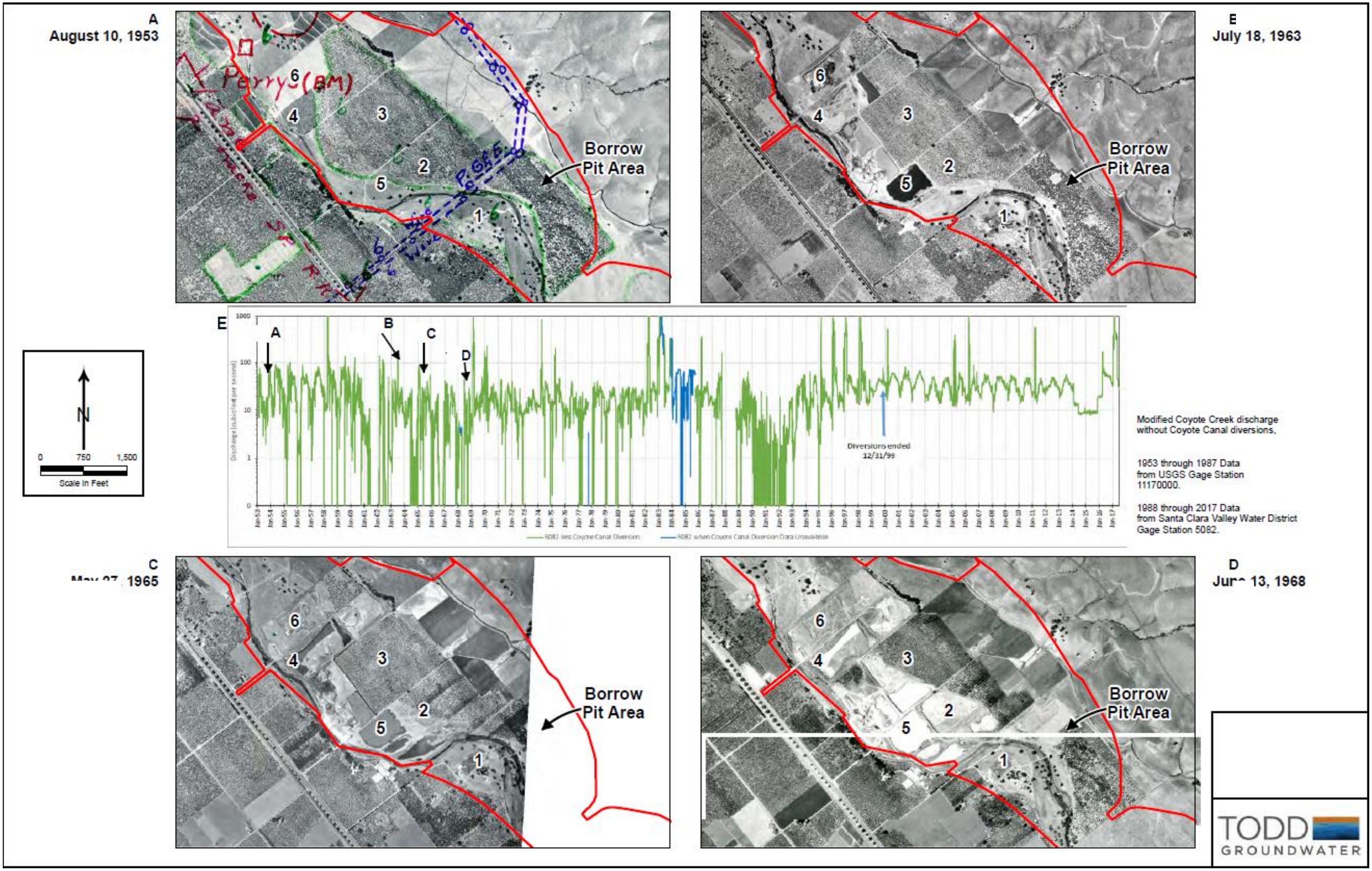

Figure 43: Aerial photographs of the Site from 1953 to 1968 with Coyote Creek flows at District gage 5082 less Coyote Canal diversions.

Figure 44A is a photograph from August 10, 1953 showing the primary land use at the site was agriculture. Since quarry activities had not yet begun, the ponds are not present. Water is visible in the creek and in Coyote Canal. Flow past the Site was 5 cfs on this date. Figure 44B is a photograph from July 18, 1963. Flow past the Site on this day was 15 cfs and there is water visible in the creek and Coyote Canal. By this date, mining operations are apparent close to the creek with agriculture on the northeast side of the Site. It appears that the creek southeast of the Pond 2 area (not yet excavated) has been rerouted to the southeast (when compared with Figure 44A) to accommodate mining operations. Most notable is the appearance of water in Ponds 4 and 5 and southwest of the future Pond 3. Figure 44C is a photograph from May 27, 1965. Flow past the Site on this day was 96 cfs and water is visible in the creek and Coyote Canal. More mining excavations are visible adjacent to the creek with continuing agriculture on the northeast side of the Site. There is water in Ponds 4 and 5, southwest of the future Pond 3 and southeast of Pond 5, which is currently part of Pond 2. Figure 44D is a photograph from June 13, 1968. Flow past the Site on this day was zero and had been zero since May 1, 1968. The data indicate that all Gage 5082 flows were diverted into the Coyote Canal for about a month and a half. Water is visible in the creek and portions of the Coyote Canal. More excavations are visible adjacent to the creek. There is water visible in Ponds 2, 3, 4 and 5, southwest of the future Pond 3. The photograph indicates that the ponds retained water despite an approximately 1.5-month period with no creek flow.

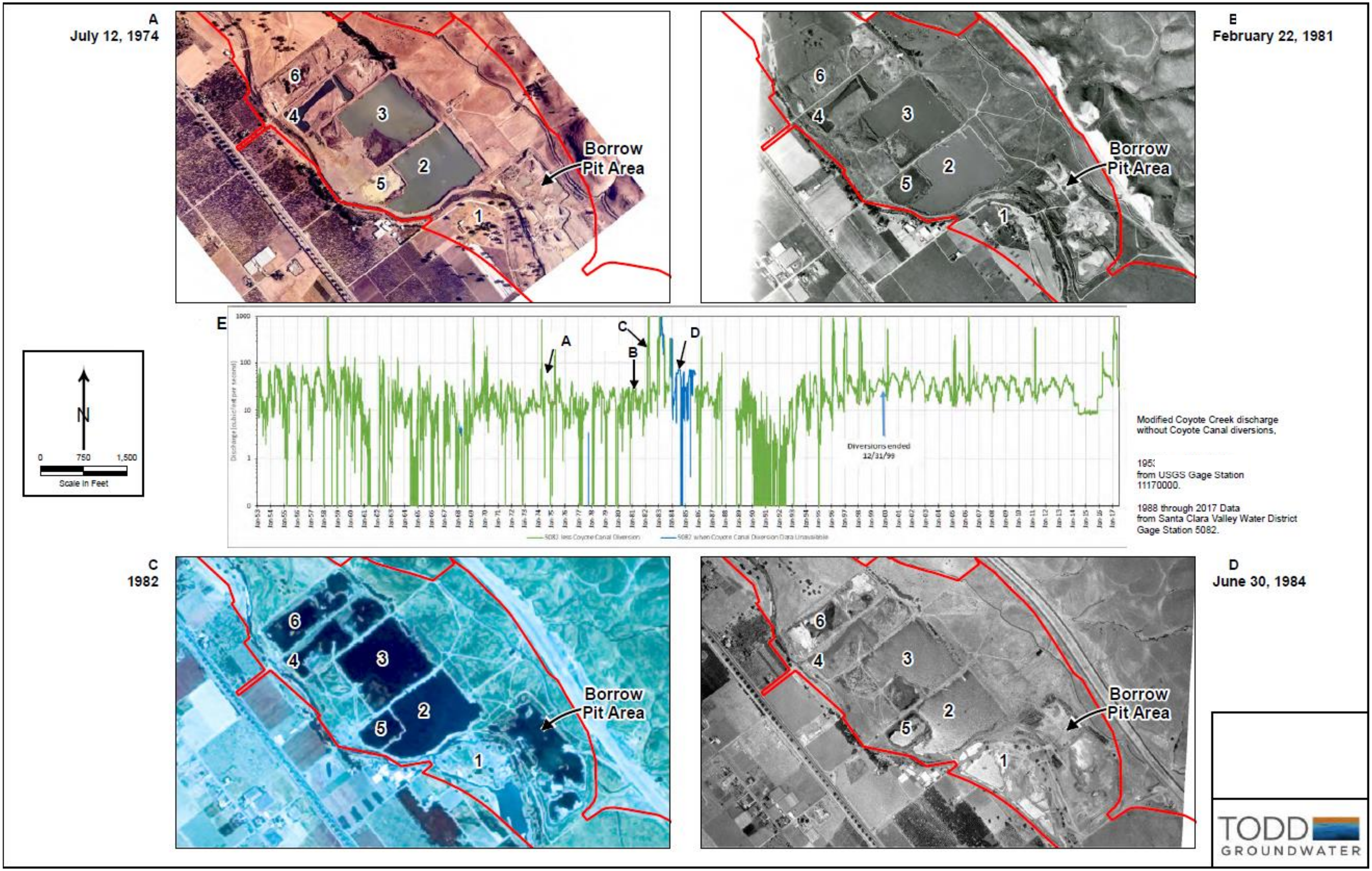

Figure 44: Aerial photographs of the Site from 1974 to 1984 with Coyote Creek flows at District gage 5082 less Coyote Canal diversions.

Figure 45A shows the site in July 12, 1974. Flow past the Site on this day was 39 cfs and there is water visible in the creek and Coyote Canal. Ponds 2, 3, and 4 and the borrow pits contain water and Pond 1 does not appear to have been excavated yet. Figure 45B shows the site in February 22, 1981. Flow past the Site on this day was 26 cfs and there is water visible in the creek and Coyote Canal. This is one of the few winter photographs available. Most are taken in the summer, when cloud cover is rare in California. This was a dryer than normal year with precipitation of 13.3 inches in Coyote Valley. Nonetheless, flow past the Site is typically higher in the winter months as Coyote Canal diversions typically took place in the summer months. The creek continues to flow outside the ponds and Ponds 2, 3, 4 and 5 contain water. Figure 45C shows the site on an unknown month and day in 1982. The winter of 1981/1982 was unusually wet with rainfall of 32.6 inches. Flow past the Site varied between 3 and 3,179 cfs. The creek continues to flow outside the ponds and there is water in the creek and canal. The creek appears to have overtopped its banks in several areas with flooding in the southern Pond 1 area. Ponds 2, 3, 4 and 6 and the borrow pit area contain more water than in previous photographs. Figure 45D shows the Site on June 30, 1984. The winter of 1983/84 had slightly below normal rainfall of 15.5 inches. Flow past the Site on this day was 73 cfs and there is water visible in the creek and Coyote Canal. Most notably, Coyote Creek has rerouted to the south of the Pond 1 area, flows under Barnhart Ave. and continues to flow through Ponds 2, 3, and 4, exiting Pond 4 through the same path as it currently does. The exit channel from Pond 4 appears to have been first eroded at this time. The route through the ponds is the current flow path, and it remains unchanged in all subsequent photographs. While the levee breach that resulted in the creek flowing into the pond has been reported as occurring in January 1997 (District, 2016), the aerial photography indicates that a creek-pond hydraulic connection occurred at least temporarily in 1984, and became permanent in 1997.

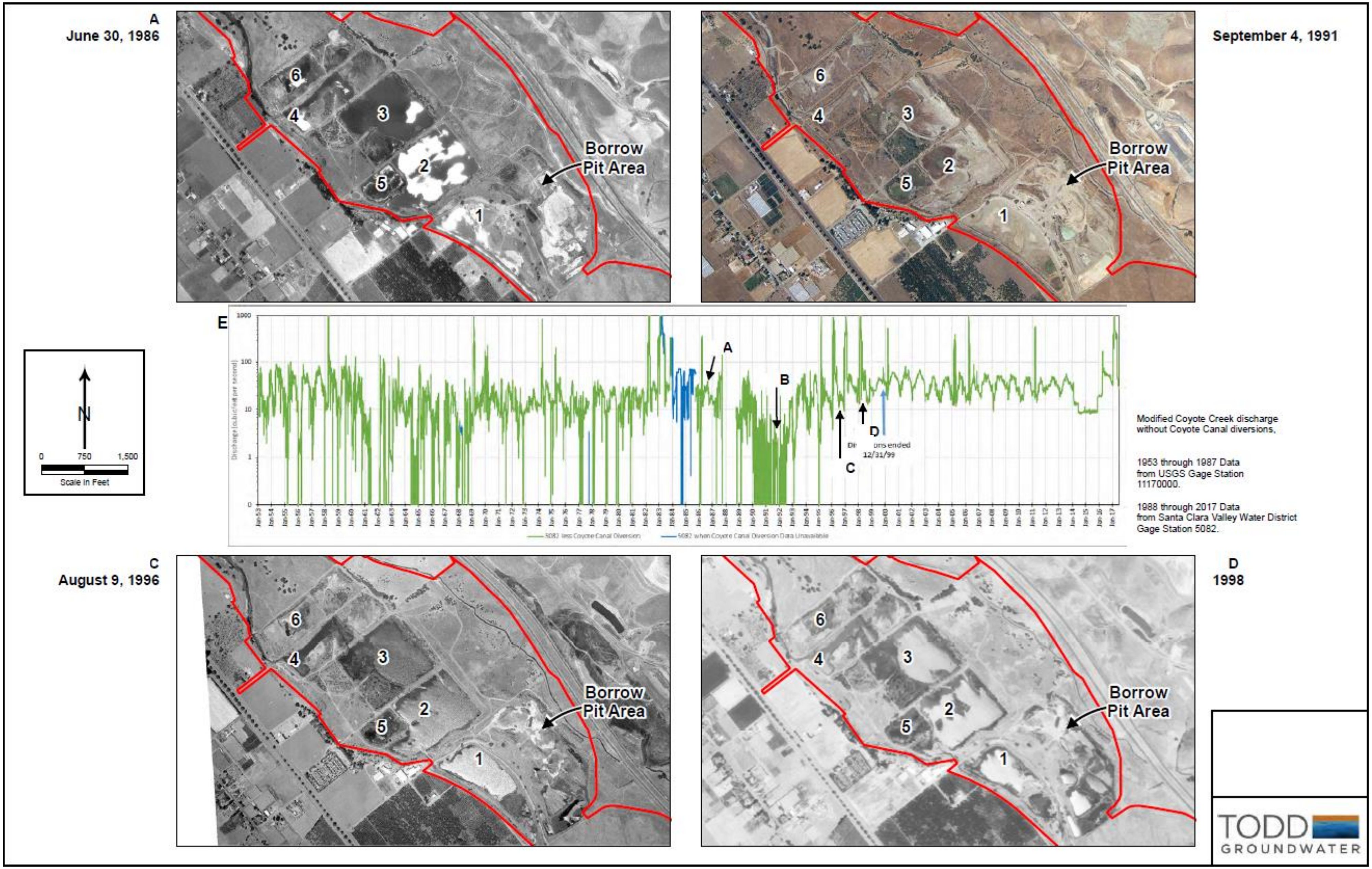

Figure 45: Aerial photographs of the Site from 1986 to 1998 with Coyote Creek flows at District gage 5082 less Coyote Canal diversions.

Figure 46A shows the Site in June 30, 1986. Flow past the Site on this day was 30 cfs and there is water visible in the creek and Coyote Canal. Ponds 1, 2, 3, 4, 5, and 6 and the borrow pits all contain water. Figure 46B shows the Site on September 9, 1991. Flows past the Site were at 3 cfs. There was an extended period of unusually low to no flow recorded from January 1990 through June 1992 as shown on the discharge plot. The aerial photo in the figure shows the creek and all the ponds are dry except for a small area in the borrow pit area. Additional review of this aerial photo beyond the boundaries of the figure indicated that there is no observable flow in Coyote Creek all the way upstream to Gage 5082. There is flow in Coyote Canal and most flows at Gage 5082 were diverted into the canal over this extended drought period. 1990 was the worst of four consecutive drought years in California. Rainfall in water year 1990/91 was below normal at 12 inches. This photograph indicates that the ponds can go dry even with the creek routed through the ponds if the creek is dry for an extended period of time. Figure 46C shows the Site on August 9, 1996. Flow at Gage 5082 on this day was 68 cfs. There is water in Ponds 1, 2, 3, 4, 5, and 6 and the borrow pit area. Figure 46D shows the Site on an unknown month and day in 1998 showing similar conditions to Figure 46A.

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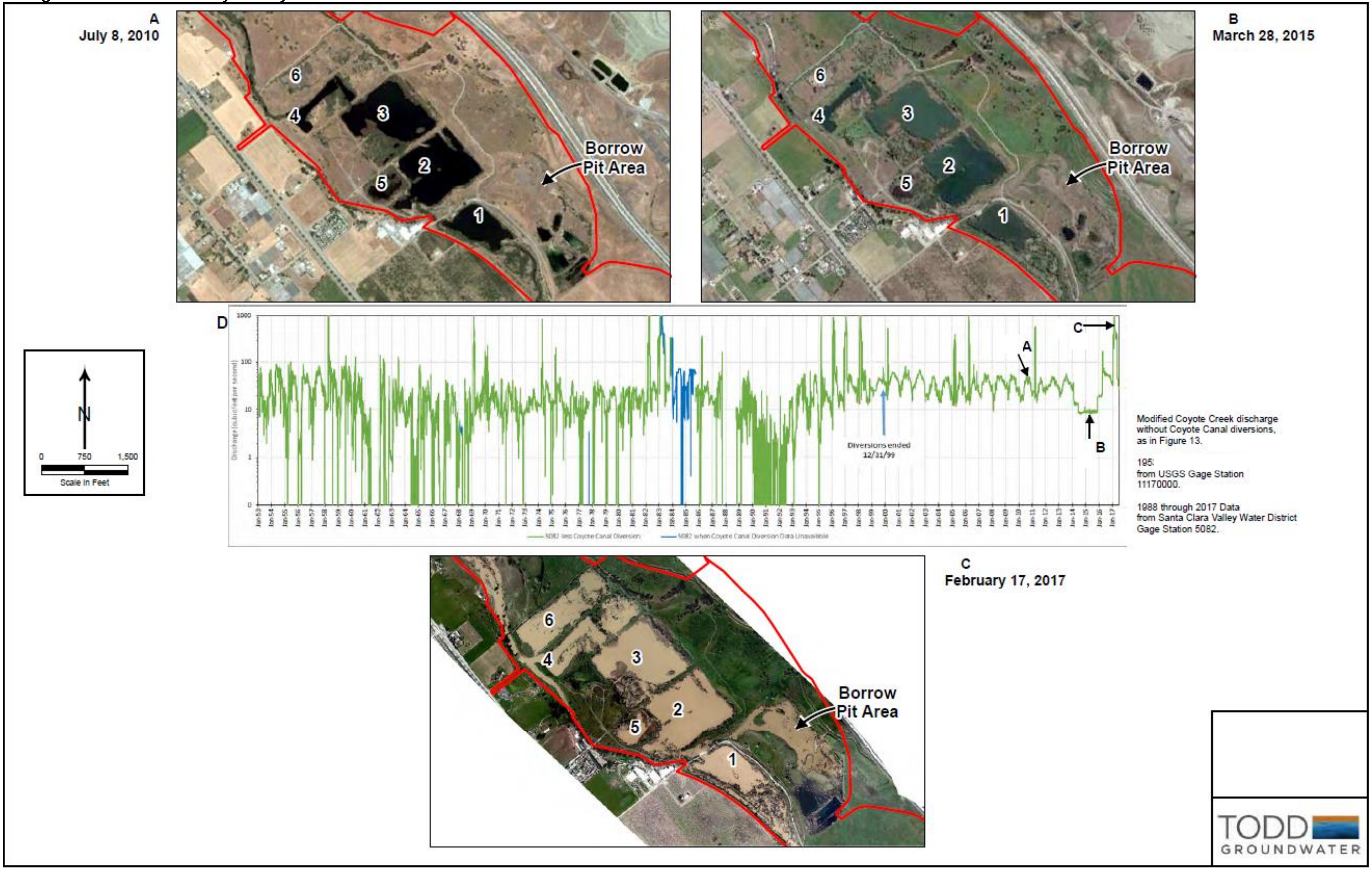

Figure 46: Aerial photographs of the Site from 2012 to 2017 with Coyote Creek flows at District gage 5082 less Coyote Canal diversions.

Figure 47A shows the Site on July 8, 2010. Flow past the Site on this day was 22 cfs and there is water visible in the creek but no water visible in the Coyote Canal, consistent with discontinued use of the canal in October 1999. Water is visible in Ponds 1 through 5. Figure 47B shows the Site on March 28, 2015. Flow at Gage 5082 on this day was 8.6 cfs and this image is during an extended period of low flows in Coyote Creek from August 2014 through November 2015, when flows were below 10 cfs. The creek is mostly dry with only isolated ponded areas. Water year 2014/15 saw below normal precipitation of 13.1 inches in Coyote Valley. Notably, while creek flows were below 10 cfs for 8 months prior to this aerial photograph, there is still water in Ponds 1 through 5 and the borrow pits. Figure 47C shows the drone flight photographs taken on February 17, 2017. Flow at Gage 5082 on this day was 430 cfs and flows over 6,000 cfs were recorded in February 2017. The winter of 2016/17 saw record rainfall in California and the extent of the wetted pond and pit area is similar to that observed in 1982 (Figure 47C). Rainfall in water year 2016/17 through June was 27 inches, 10 inches above normal.

It is concluded that Ponds 1 through 5 and the borrow pit area contain water in almost all years. Pond 6 is dry in most years and only contains water in unusually wet years. Pond 6 is relatively shallower (10 to 15 feet deep) compared with Ponds 1, 2, 3, and 4 (20 to 35 feet deep) and only contains water when groundwater levels are relatively higher or the berm between Pond 4 and 6 is breached, which is believed to be why Pond 6 water is murky in the 2017 image. The connection between groundwater and the borrow pit area is also apparent on all of the images. Coyote Creek does not flow through the borrow pit area, yet that area contains some water on most images, indicating communication with shallow groundwater. The topography of the borrow pit area is hummocky and the deeper ponds contain water in almost all images since they were excavated.

Visual comparison of these images shows the extent of water in the ponds and borrow pit area in wet and dry years is similar before and after the initial levee breach sometime between 1982 and June 1984. Water in the ponds results from creek flow recharging the shallow groundwater system, which is the primary source of water to the ponds, rather than precipitation or storm runoff. This is illustrated in Figure 48, which demonstrates the extent of turbid surface water in the ponds.

Figure 47: Aerial image of Ogier Ponds demonstrating the influence of turbid surface water on ponds in-line with Coyote Creek.

During periods of turbid creek flows, Ponds 1, 2, 3, and 4 contain some surface water evidenced by the murky water color, while Ponds 5 and 6 and the borrow pit area appear to contain clearer less turbid water indicative of groundwater inflow (Figure 48). Accordingly, the creek does not need to flow through the ponds to provide water to the ponds. The visual review of aerial photographs compared with creek flow past the Site indicates that creek flows can drop to about 9 cfs for extended periods of time (i.e., more than a year), without impacting water levels in the ponds significantly. However, extended periods (20 months or more) of little to no flow in the creek result in the ponds going dry. The recent pattern of creek flows from about 1999 to present show relatively consistent flows between 10 and 100 cfs. In addition, since October 1999, no flows have been diverted to the Coyote Canal. This presumably results in larger and more consistent flows past the Site than prior to October 1999 when the canal was active. The conclusion from the review of aerial photography is that Coyote Creek flows can be rerouted around the ponds and the ponds will continue to have similar levels of water as when the creek flows through the ponds. If there are extended periods of time with no flow in Coyote Creek, the ponds will dry up, whether the creek flows through or outside the ponds.

3.6.2. Pond Water Balance

Water balances were performed for three different pond/creek configurations: existing conditions, Pre-1997 channel restoration concept, and floodplain restoration concept. Figure 4 shows the existing condition with the creek running through the Ponds 1, 2, 3 and 4. Figure 2 shows the pre-1997 channel restoration concept with Coyote Creek routed around the ponds in its historical alignment prior to the levee breach. For this concept, the existing pond configuration remains mostly the same with a small reduction in the size of Ponds 1, 2 and 3. Figure 3 shows the floodplain restoration concept , which would eliminate most ponds while retaining portions of Ponds 2 and 3 and the borrow pit area.

The ponds are hydraulically coupled to the shallow aquifer, and the water balance of the ponds is therefore linked to the water balance of the shallow aquifer. Figure 48A shows the conceptual diagram of flows entering and leaving the ponds under existing conditions, with the creek flowing through the ponds. Figures 48B-48D show the water balances created for the existing condition and two concepts.

The creek is presently the primary source of inflow to the ponds, but groundwater also seeps into the ponds. At the pond surface, there are inflows and outflows of rainfall and evaporation. Finally, there is also downward leakage from the shallow aquifer to a deep aquifer of regional extent. The diagram also indicates the “control volumes” for the pond water balance and shallow aquifer water balance. Arrows entering or leaving those regions represent inflows and outflows that were quantified to develop the water balance.

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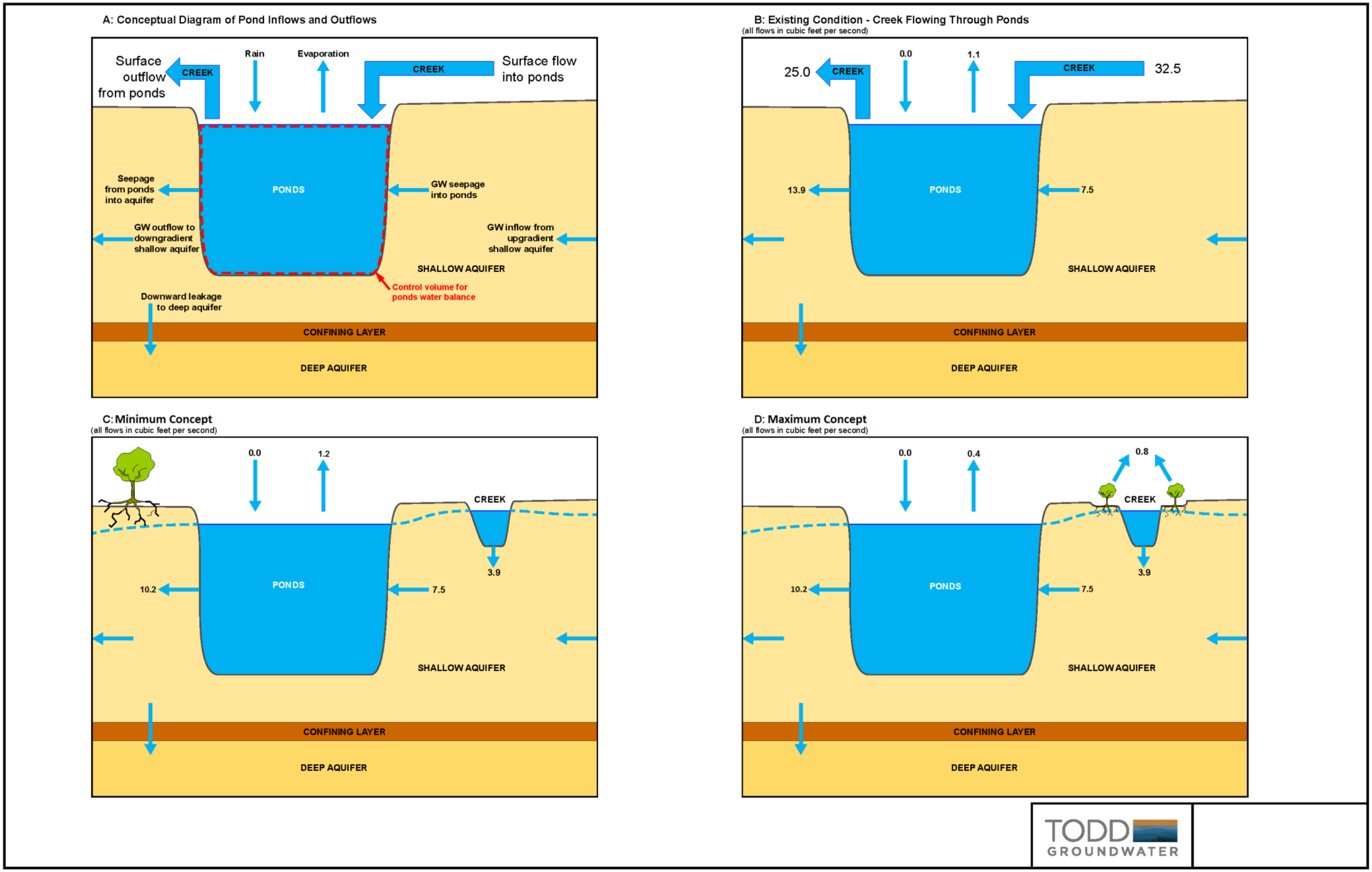

Figure 48: Schematic diagrams of surface water-groundwater exchange under existing conditions (B), and floodplain restoration t and Pre-1997 channel restoration concepts (C, D)

3.6.3. Pond Water Balance Under Existing Condition

A water balance for the ponds was prepared for dry-season (summer) conditions in a year of typical climatic conditions and typical flows in Coyote Creek through the pond reach. For this analysis, streamflow entering the pond reach was assumed to equal the flows measured at Gage 5082. One diversion historically occurred between the gage and the ponds. Prior to 1999 water was diverted from Coyote Creek into Coyote Canal, but diversions were discontinued in 1999 and are not expected to resume.

Quantitative estimates of each pond inflow and outflow in cubic feet per-second are listed in Table 16 and added as labels to the flow diagram in Figure 49B. Data, assumptions and calculations supporting each flow estimate are described below.

Table 16: Ogier Ponds Typical Summer Water Balance Under Existing Conditions

Flow	Summer Rate (cfs)
Inflows	
Rainfall on ponds	0.0
Stream inflow	32.5
GW inflow from shallow aquifer	7.5
Total	40.0
Outflows	
Evaporation from ponds	1.1
Stream outflow	25.0
Pond seepage into shallow aquifer	13.9
Total	40.0

cfs - cubic feet per second GW - groundwater

Values are for dry season in average year.

Rainfall and Evaporation

Rain rarely falls during the dry season and is assumed to be zero in the water balance. Evaporation from the ponds was calculated as the product of pond surface area (104 acres for Ponds 1 through 5) and an evaporation rate equal to reference evapotranspiration (ET). Coyote Valley is in climate zone 8 as delineated by the California Irrigation Management Information System (http://wwwcimis.water.ca.gov/App_Themes/images/etozonemap.jpg). Maximum monthly reference ET in summer is 7.44 inches in zone 8. Reference ET is typically about 80% of pan evaporation, and lake evaporation is also typically about 80% of pan evaporation (Viessman and others, 1979; Shuttleworth, 1993). Accordingly, reference ET is a reasonable estimate of the pond evaporation rate, which is a very small component of the water balance. Evaporation from 104 acres at a rate of 7.44 inches per month is equivalent to a flow of 1.1 cfs, or 2.8 percent of total pond outflow.

Surface Inflow and Outflow

Since about 1999, releases down Coyote Creek from Anderson Reservoir and imported water diversion have consistently been 30-50 cfs during summer, averaging about 40 cfs. During periods of more variable flow prior to 1999, it was observed that an estimated release of 15 cfs would percolate entirely between the Coyote Canal diversion point and the golf course downstream of the ponds (CH2M HILL, 2000). This is about the same total loss rate indicated by recent Site stream gage data. The total flow loss along the reach corresponds to an average percolation rate of 2.8 cfs per mile. The ponds are located in the lower half of the reach between the canal and golf course, and a comparison of gaged flows at the beginning, middle and end of the reach indicates that percolation rates along the upper half are about the same as along the lower half.[3] Thus, about 7.5 cfs of stream percolation was assumed to occur upstream of the ponds and 7.5 cfs was assumed to occur along the pond reach. Thus, average surface outflow from the ponds was estimated to be 40 cfs minus 15 cfs, or 25 cfs.

Groundwater-Creek-Pond Water Exchange

Ogier Ponds were created by excavation into a highly permeable sand and gravel aquifer about 50 feet thick. The ponds are part of the groundwater flow system in the shallow aquifer. If Coyote Creek were re-routed around the ponds, the ponds would persist as water table lakes with surface elevations equal to the adjacent groundwater surface elevation. Under existing conditions, creek flow through the ponds dominates the pond water balance.

3.6.4. Pond Water Balance under Pre-1997 Channel Restoration Concept

Prior to 1984, Coyote Creek flowed through a channel that went around (southwest) rather than through the ponds. Returning the creek flow to its former channel a would alter some of the flows in the water balance, as itemized in Table 17 and shown diagrammatically in Figure 49C. Some of the flows would remain unchanged from the existing condition. These include shallow groundwater inflow to the pond reach, rainfall on the ponds and evaporation from the ponds as the pond surface area would remain roughly the same as under existing conditions).

Percolation from Coyote Creek into the shallow aquifer would be limited to the percolation capacity of the new creek channel. Assuming a percolation capacity of 2.8 cfs per mile (similar to the upstream reach), percolation along the 7,400 feet of new channel would be approximately 3.9 cfs. As under existing conditions, shallow aquifer groundwater would seep into the ponds. As before, percolation from the ponds back into the shallow aquifer was calculated as total creek percolation losses minus pond evaporation. In this concept, inflows to the ponds would be 11.4 cfs and percolation from the ponds into the shallow aquifer would be 10.2 cfs.

Under this concept, groundwater seepagein to the ponds is still 10 times greater than pond evaporation, so the ponds would not dry up. In other words, stream flow, channel percolation capacity and aquifer permeability are sufficiently large to maintain the elevation of the shallow water table, which includes the pond surfaces at nearly the same elevation as under existing conditions. Furthermore, the frequency and magnitude of flow and pond water-level fluctuations would not be any greater than under existing conditions because they depend primarily on upstream reservoir releases and imported water input.

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[3] Daily flows during September 2016 through June 2017 were compared for the Gage 5082, the temporary gage upstream of Ogier Ponds (5123) and the temporary gage downstream of the ponds (5124).

Table 17: Ogier Ponds Water Balance Under Pre-1997 Channel Restoration Concept

Flow	Summer Rate (cfs)
Inflows	
Rainfall on ponds	0
Stream inflow	0
GW inflow from upgradient shallow aquifer	7.5
GW inflow from creek seepage in ponds reach	3.9
Total	11.4
Outflows	
Evaporation from ponds	1.2
Stream outflow	0.0
Pond seepage into shallow aquifer	10.2
Total	11.4

cfs - cubic feet per second GW - groundwater
Values are for dry season in average year.

These water balances demonstrate that the entire pond-aquifer system is sustained by creek flow through or past the Site. Pond levels and surface areas are not strongly affected by whether the creek flows through or around the ponds, but rather by the amount of water flowing in the creek. Pond dry-up would only commence if stream flow dropped for a sustained period below the threshold at which recharge no longer kept up with evaporation and downward leakage. The historical aerial photography analysis indicated that the ponds begin to dry up if flows remain below a threshold somewhere between 0 and 9 cfs for a prolonged period. The September 9, 1991 aerial photograph (after 20 months of little or no flow in the creek) shows the ponds were dry. The March 28, 2015 aerial photograph shows water in the ponds (similar to average creek flow conditions) after more than a year of flows at about 9 cfs. Thus, continuous creek flows of 9 cfs appear sufficient to sustain water in the ponds and creek flows at or near zero for 20 months result in the ponds drying up. The minimum flows and duration of flow needed to sustain water in the ponds lies between these two conditions.

The occurrence of low flows and potential pond dry-up depends on Anderson Reservoir operations, local runoff and imported water discharges to Coyote Creek. The District has developed an operations model of its entire water-supply system that simulates monthly operations over a 94-year period corresponding to hydrologic conditions during 1922 through 2015. In the baseline scenario for 2040 conditions, Coyote Creek flows (consisting of reservoir releases and imported water releases) are90 less than 8 cfs 5.6% of the time. Those months occurred as nine separate sequences of 3 to 11 low-flow months during droughts (in 1931 through 1934, 1950, 1977, 1989 through 1991, and 2014 through 2015). Aerial photographs indicate that the 1989 through 1991 drought resulted in the ponds going dry. During this period flows discharge from Anderson Reservoir were preferentially diverted to the Coyote Canal and the creek near the Site was dry almost continually. The March 28, 2015 aerial photograph, after Coyote Canal flows were stopped, shows that the 2014/2015 drought did not result in the ponds going dry.

3.6.5. Ponds Water Balance with Floodplain Restoration Concept

Under the floodplain restoration concept, Coyote Creek would be realigned to remove the surface hydraulic connection with the ponds and a floodplain would be created along the new creek alignment. The surface area of the ponds would be reduced by about 58%,. In terms of water balance, the primary difference from the pre-1997 channel restoration concept would be a change in evapotranspiration losses. The total surface area of the ponds would be smaller: about 60 acres instead of 145 acres. The decrease in open-water surface area would be offset by an increase in riparian vegetation canopy area. Given the shallow depth to the water table, phreatophytes would almost certainly become established at new creek floodplain, where the depth to the water table would be less than under existing conditions. The floodplain area would be about 80 acres. Conservatively assuming that all of the phreatophyte transpiration in summer is supplied by groundwater (as opposed to residual soil moisture from rains during the preceding winter), and that the vegetation transpiration rate equals the pond evaporation rate on a per-acre basis, evapotranspiration during July would average approximately 1.2 cfs. This roughly equals the loss under existing conditions. The estimated ponds water balance for the floodplain restoration concept is shown in Figure 49D and Table 18.

Table 18: Ogier Ponds Water Balance Under Floodplain Restoration Concept

Flow	Summer **Rate (cfs)**
Inflows	
Rainfall on ponds	0
Stream inflow	0
GW inflow from upgradient shallow aquifer	7.5
GW inflow from creek seepage in ponds	3.9
Total	11.4
Outflows	
Evaporation from ponds and evapotranspiration from riparian vegetation	1.2
Stream outflow	0.0
Pond seepage into shallow aquifer	10.2
Total	11.4

cfs - cubic feet per second GW - groundwater
Values are for dry season in average year.

Another possible minor change in the ponds water balance under the floodplain restoration concept would be a slight decrease in groundwater flow through the ponds because of reduced overall pond width relative to the width of the shallow aquifer. This decrease would likely be small, however, because groundwater flow would still tend to converge toward and into the ponds as a path of less resistance than flowing around or beneath the ponds. This effect is difficult to quantify without hydraulic modeling. Because it is probably small, the groundwater inflow and outflow values for floodplain restoration concept were also used for the floodplain restoration concept water balance.

3.7. Recreation

3.7.1. Recreational Setting

The County of Santa Clara, Parks and Recreation Department manages the 15-mile long Coyote Creek Parkway (Figure 7). The Parkway extends from the base of Anderson Dam at Anderson Lake County Park to Hellyer County Park, and includes the site. The Parkway was established in the 1960s when the City of San Jose and County of Santa Clara began acquiring lands adjacent to Coyote Creek for use as parkland. The purpose of the Coyote Creek Parkway was approved by the City and County in the “Coyote River Policy Statement” in 1969, where “the continuity of riding, hiking, and bicycle trails through the park would be assured, park design would be coordinated with the [Santa Clara Valley Water District], and that all outdoor recreation would be compatible with the natural resources of the area.”

Recreation in Coyote Creek Parkway is planned and managed through the Coyote Creek Parkway Integrated Natural Resource Management Plan and Master Plan (Integrated Plan). The Integrated Plan was developed in 2007 to identify current conditions and future recreation for the approximately 15 miles of riparian corridor. The purpose of a joint Natural Resources Management Plan and Master Plan is to guide management and development for public use while maintaining and improving riparian habitat for wildlife. The Integrated Plan details how Parks and Recreation Department will manage the Coyote Creek Parkway over a 10- to 20-year timeframe to meet the goals and objectives identified in the Integrated Plan.

The Integrated Plan’s vision for the Coyote Creek Parkway focuses on recreation within riparian habitat. The following vision was incorporated into all recreation and natural resources aspects of the Integrated Plan”

> *“The Coyote Creek Parkway is an outstanding example of a regionally significant riparian habitat. It is significant in its physical scope, natural beauty, diversity of species, and extent to which the corridor has been preserved in public ownership. It offers unique recreation and interpretation opportunities for all park visitors. Resource conservation and stewardship values will guide management and development to assure the sustenance of a quality riparian wildlife corridor both now and in the future.”*

3.7.2. Integrated Plan Guidelines

Separating the existing surface hydraulic connection between Ogier Ponds and Coyote Creek could result in adverse effects to existing and planned recreational uses. The following conditions would have to be fulfilled to avoid adverse effects to recreational uses:

- Allow continued recreation use by the public and permitted users;
- Be consistent with the policies and guidelines contained in the Integrated Plan; and
- Accommodate all current licensees and permit holders at the Ogier Ponds site or another site within the Coyote Creek Parkway.

The County Parks and Recreation Department is partially funded by the Park Charter Fund, which was created in 1972 to fund the operation of County Parks for recreation and the preservation of parklands. The Park Charter Fund was renewed in June 2016, with an overwhelming approval by 78% of county voters. The most recent iteration of the Park Charter Fund allocated $0.015 per $100 of assessed property values to the County Parks Department for the next 15 years, with at least 10% for land acquisition, 10% for infrastructure development, and the remainder for operation and maintenance of the County's park system. The Park Charter Fund requires that funding be used towards recreation and parklands, and continued public recreation use of the Ogier Ponds is required by the Park Charter Fund.

The Integrated Plan's fundamental guidelines for the Coyote Creek Parkway are the basis for the goals and objectives and the implementation of the Integrated Plan. Any changes to the physical condition of the Ogier Ponds site must be consistent with the following guidelines of the Integrated Plan.

Natural Resources Management (NRM) Guideline #1: In cooperation with a variety of partner agencies and interest groups:

- The Parkway's creek, groundwater, and biological resources shall be managed and enhanced to encourage native bio-diversity, preserve resources, and protect habitats.
- Coyote Creek and its natural floodplain should be restored, to the greatest extent practical, to allow for stable hydro-geomorphic processes beneficial to the preservation of a sustainable riparian habitat corridor.
- Sufficient buffer areas between adjacent land uses and the riparian habitat corridor shall be provided to protect and preserve the Vision of the Parkway.
- Functioning habitat corridors that connect the Parkway with the surrounding hills and open spaces should be identified, established, and maintained.
- Collaboration efforts should occur to obtain adequate protection and funding for the initiation and long-term administration of natural resource management programs in the Parkway.

Natural Resources Management Guideline #2: A continuous, multi-tiered, riparian wildlife corridor along Coyote Creek shall be established through the Parkway. The corridor would provide nesting, rearing, and foraging areas for wildlife species that depend upon or use the creek, including threatened or endangered species.

Natural Resources Management Guideline #3: The natural resources of Coyote Creek should be enhanced through active stewardship programs and adaptive management strategies based upon the most current and reliable scientific information.

Natural Resources Management Guideline #4: Adjacent lands that would benefit a stable stream hydrology, serve as a buffer between differing land uses, offer unique parkland opportunities, or enhance the existing park should be identified for potential future acquisition and inclusion within it.

Public Recreation Guideline #1: Using the County Park's Parkland Classification System, a framework of parkland classes shall be established for the Parkway that guides recreational development and use in the park.

Public Recreation Guideline #2: A continuous, multi-use trail system should be retained along the Parkway.

Public Recreation Guideline #3: Existing recreational opportunities in the Parkway should be retained where feasible and balanced with resource conservation efforts. Emphasis should be placed upon day-use activities, with defined access points. Water-oriented outdoor recreation opportunities may be considered.

Public Recreation Guideline #4: The Parkway shall provide an interconnected system of recreational facilities, and interpretive opportunities of regional significance that are directly related to or benefit from, the natural, cultural, or historic resources of the Parkway and will foster education and research about the ecology of the Coyote Creek riparian wildlife corridor and the need to steward the creek's natural resources.

Public Recreation Guideline #5: Cooperation shall be encouraged with partner agencies, non-profit organizations, and recreation interest groups to provide outdoor recreation, education and interpretation uses and facilities to meet the goals of the County Park system and, where possible, the mutual goals of these agencies and organizations.

3.7.3. Existing Recreation Uses

County Parks has always promoted of a variety of recreational uses within the Coyote Parkway. To facilitate this, County Parks issues licenses or permits that allow specific users to use County Parks lands and facilities for their events and activities. These uses vary from single day events to long-term leases with daily use. County Parks has a strong interest in supporting these uses at the Ogier Ponds site because many of these uses have special requirements that limit the availability of alternative areas. Any physical changes to the Ogier Ponds site must accommodate current uses or ensure that current uses are relocated to a convenient location within the Coyote Creek Parkway. These existing uses include:

- Santa Clara Valley County Model Aircraft Skypark
- Rescue dog training
- Dog obedience training
- Running races
- Scientific data collection
- Bird watching

The Integrated Plan identified actions for the Ogier Ponds, Perry's Hill Recreation Area (Figure 50), and Santa Clara County Model Aircraft Skypark, all of which could be affected by removing the existing surface hydraulic connection between Coyote Creek and the Ogier Ponds.

- Ogier Ponds
    - Priority Program Actions
        - Continue use in existing designated area (current permits include field sports and water training for retrievers).
    - Future Program Actions
        - Evaluate need to restrict annual period of use based on resource conditions.
        - Redefine use permit area upon completion of Coyote Creek Parkway Nature Center and related interpretive trails (identified in Perry's Hill Recreation Area).
- Perry's Hill Recreation Area
    - Priority Program Actions
        - Develop new access road from Golf Course Drive to the Model Aircraft Skypark with parking bays.
        - Realign Coyote Creek Trail to avoid crossing the new entry.
        - Remove existing access road from Monterey Highway to the Model Aircraft Skypark, including low-flow crossing of Coyote Creek; renovate as component of Riparian Habitat Corridor.
        - Develop associated access improvements to include:
            - Staging area for 40 cars near the entrance
            - Water and restrooms (portable)
            - Picnic area
            - Trail connector from the staging area to the Coyote Creek Trail
            - Set aside area up to 20 acres in which the Silicon Valley Disc Golf Club may construct an 18-hole disc golf course and related hiking trail
            - Construct 18-hole disc golf course and related hiking trail
            - Construct Coyote Creek Parkway Nature Center.
            - Develop interpretive trail loop to / through ponds and creek.
            - Identify an approximate 5-acre overflow parking area for special events at the Santa Clara County Model Aircraft Skypark.
    - Future Program Actions
        - Develop additional access/use facilities as needed to include:
            - Entry kiosk
            - Equestrian staging
            - Restrooms
            - Family and group picnic areas
            - Water and restrooms
            - Overlook points
            - Outdoor classrooms and water access points along interpretive trail
            - Canoe / kayak access to Ogier Ponds and storage facility (use limited to interpretive / educational programs)
        - Relocate Officer Gene Simpson Dog Training Area.
        - Multi-purpose active recreation uses as demand demonstrates.

        - Regional swimming facility.
- Santa Clara County Model Aircraft Skypark (Skypark)
    - Priority Program Actions
        - Continue to use existing designated area (permit).
        - Develop restrooms.
    - Future Program Actions
        - Develop public picnic and observation area.
        - Plant riparian shade trees around parking and use area.
        - Initiate native grassland management program in airfield area

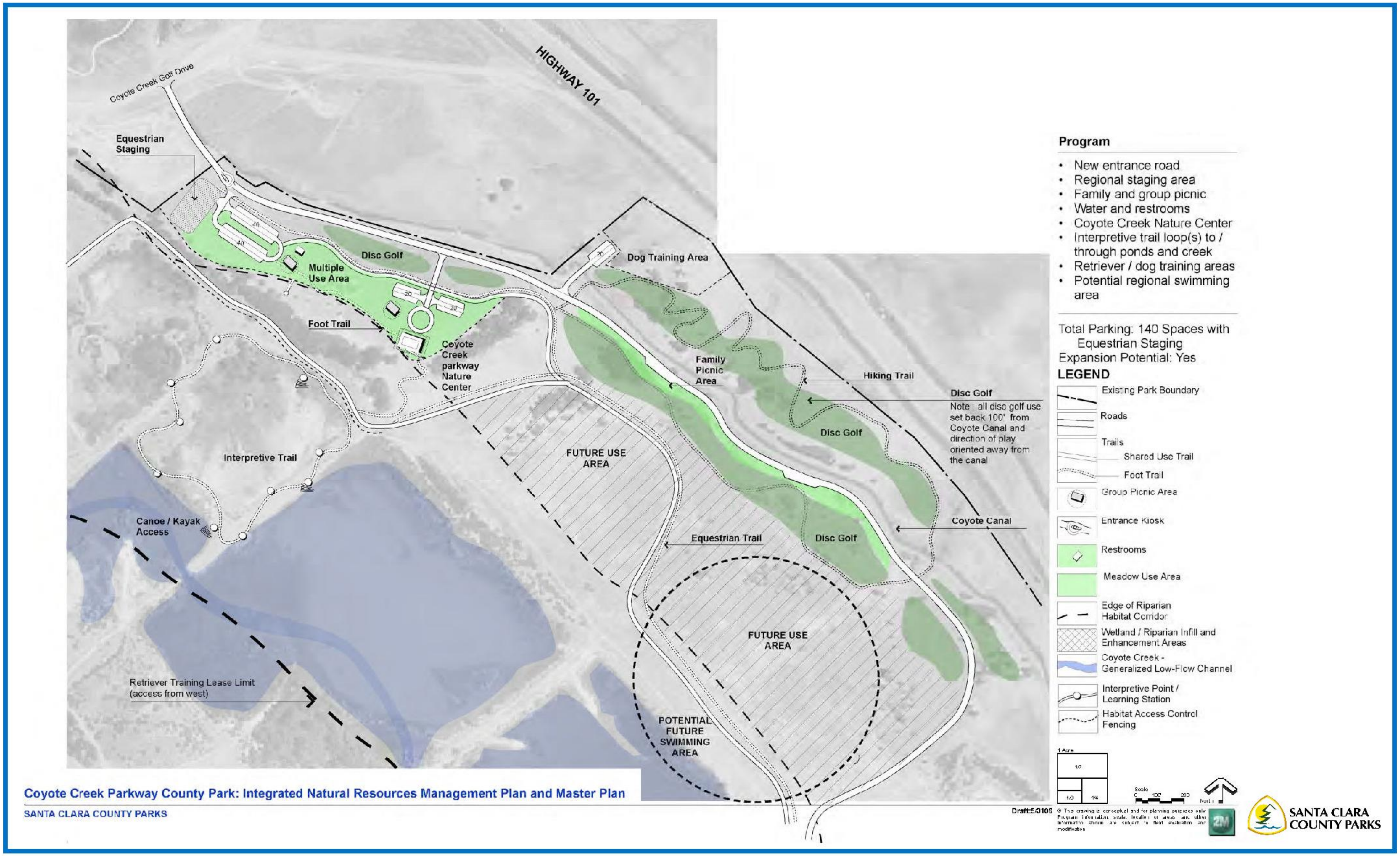

Figure 49: SCC Parks Plan for Perry's Hill Recreation Area

3.7.4. Analysis of Concepts

3.7.4.1. Existing Conditions

Given the thorough planning process that was undertaken for the Integrated Plan, the analysis of opportunities and constraints associated with recreation for each concept for Ogier Ponds is based on the compatibility with the Integrated Plan. Under existing conditions Coyote Creek flow through Ponds 1 through 4. No constraints would result to existing or planned recreational activities at the site. However, Integrated Plan Natural Resource Guidelines 1, 2, and 3 would not be fulfilled.

3.7.4.2. Potential Effects to Recreation from Pre-1997 Channel Restoration Concept

Under the pre-1997 channel restoration concept, the creek flow would be returned to its pre-1997 channel along the western edge of the site and surface hydraulic connections to the ponds would be removed. The layout of the ponds would be mostly with the same as current conditions, although pond surface area would decrease by about 2 acres (1.4%) from 145 acres to 143 acres.

<u>Ogier Ponds</u>

As part of the pre-1997 channel restoration concept, the ponds would be mostly unchanged, and would continue to accommodate current permittees and recreational activities. The reduction in surface area of the ponds would have negligible effect and the site, which would continue to provide habitat for wildlife and opportunities for bird watching.

Although the Ogier Ponds and Coyote Creek would be separated, most of the ponds would continue to hold water. The abundance of groundwater feeding the ponds would eliminate the need for water diversions from Coyote Creek. Coyote Creek is a fully appropriated stream, and SCC Parks lacks a defined water right that could be utilized to divert water to the ponds.

Separating the ponds from Coyote Creek would create an opportunity to create a fishing pond. The closed system would allow the ponds to be stocked with non-native fish, providing a recreation opportunity that was historically available in the Coyote Creek Parkway, but has been recently absent.

This concept could support an aquatic recreation area where water contact recreation could occur. One of the uses could be non-motorized boating in the ponds. The introduction and spread of invasive species throughout the Coyote Creek system is a significant concern with regard to in-stream recreation on the creek. With the ponds hydraulically separated from Coyote Creek, the incoming non-motorized boats would not be able to easily move between the creek and ponds, reducing the potential for introduction of invasive aquatic species. Also, a future swimming area could be established in the ponds as identified in the Integrated Plan and could be safer than current conditions due to the removal of the stream current.

While most of the ponds would contain water fed by shallow groundwater, seasonal variations in pond water levels could occur depending upon precipitation and flow in Coyote Creek. Changes in pond water level would occur very slowly and would be imperceptible on a day to day basis. Modification of one or more bank sections of the ponds would also likely be required to provide access for people, pets, and watercraft as the current steep-sided pond banks render access to the water difficult and inconvenient. The modification could be designed to be functional at various pond levels, thus accommodating seasonal and yearly changes in water levels.

Water quality in the pond could be adversely affected by a lack of circulation after the creek connection is removed. The lack of surface of water inputs and water turnover could result in lower dissolved oxygen levels, higher water temperature, and nutrient-fed algal growth. These water quality concerns would need to be addressed during project design and operation to create a suitable public use area. To allow water-contact recreation, water quality concerns could be addressed by augmenting pond water quality using equipment (e.g. aerators, pond skimmers) or chemical additives.

Perry's Hill Recreation Area

The pre-1997 channel restoration Concept would be consistent with the planned Perry's Hill recreation area improvements included the Integrated Plan. All proposed infrastructure and recreation amenities identified in the Integrated Plan would remain future opportunities, but the removal of the ponds-creek surface hydraulic connection would not prevent development of the recreation area.

Santa Clara Valley Model Aircraft Skypark

There would be no changes to the existing infrastructure or Santa Clara Valley Model Aircraft Skypark under the pre-1997 channel restoration Concept 1. S. Changes to the layout of the Ogier Ponds would not obstruct the alignment of the planned access road connecting the new staging area at Perry's Hill to the Skypark, which is described in the Integrated Plan.

The Integrated Plan includes a staging area with restroom facilities for the Skypark. The expansion of the berms and stream channel could encroach on the buildable space around the Skypark although the shallow groundwater in the area could prohibit the use of a septic system.

3.8.4.3. Analysis of Potential Effects to Recreation from Floodplain Restoration Concept

Under the floodplain restoration concept , creek would be routed into a new channel through the County property and surface hydraulic connections to the ponds would be removed. The creek would be connected to an enlarged floodplain and would be allowed to migrate laterally across the widened, roughly 500-ft wide floodplain. Berms would be constructed to separate the creek from the remaining ponds, and to provide flood protection to the County recreational infrastructure and nearby properties. To accommodate the substantial floodplain increase, the surface area of the ponds would reduce by about 85 acres (58%), leaving about 60 acres of ponds.

Ogier Ponds

This concept would modify the pond configurations and reduce their combined surface area, but would continue to accommodate current permittees and activities. The ponds also would continue to provide habitat for wildlife and opportunities for bird watching, which may be enhanced by the new habitat created at the connected floodplain.

Although the Ogier Ponds and Coyote Creek would be separated, most of the ponds would continue to hold water because of groundwater seepage. The water levels in the reconfigured ponds would fluctuate gradually on a seasonal or yearly basis in response to precipitation and amount of flow in Coyote Creek. The ponds would be expected to contain water unless there is a prolonged period of extremely low streamflow (less than 9 cfs for 20 plus months). Based on the water budget analysis, the ponds would continue to be a source for aquatic recreation.

Separating the ponds from Coyote Creek could create new recreational opportunities that were not possible with surface water connectivity. One opportunity would be a fishing pond. The closed system would allow the ponds to be stocked with fish, providing a recreation opportunity that was historically available in the Coyote Creek Parkway. The elimination of creek pond surface water connectivity would not allow non-native fish species to enter the realigned creek system.

The separation of the ponds also could provide an aquatic recreation area where water contact could be permitted. One of the uses could be non-motorized boating in the ponds. The introduction and spread of aquatic invasive species, particularly quagga and zebra mussels, throughout the Coyote Creek system is a significant concern with allowing the public to recreate on the creek. With the ponds separated from Coyote Creek, the incoming non-motorized boats could be inspected and would not be able to freely move between the creek and ponds. Also, a future swimming area identified in the Integrated Plan could be provided conditions would be safer due to the removal of the stream current.

For the ecology of the park, the Environmental Enhancement Concept would further NRM Guidelines 1, 2, and 3 by restoring the natural floodplain of Coyote Creek, reconnecting the creek and floodplain, and creating a multi-tiered wildlife corridor and restored habitat at the creek corridor.

While many of the ponds would contain water due to shallow groundwater and hydraulic connection in the Ogier Ponds areas, the water level would gradually fluctuate on a seasonal and annual basis.

Water quality concerns may arise in the ponds as a lack of circulation and water turnover can result in low oxygen levels, high water temperature, and nutrient-fed algal growth. from runoff. These water quality concerns would need to be addressed during project design and operation to create a suitable public use area. To allow water based recreation, water quality concerns could be addressed by augmenting pond water quality using equipment (e.g. aerators, pond skimmers) or chemical additives.

The fluctuation in ponds levels combined with a 58% decrease in surface area would result in a reduced water area for existing permit holders or for future aquatic recreation. The current permit holders using the ponds are rescue and obedience dog training. If water surface area or depth is not adequate, then the permit holders would need to be accommodated in another location on Coyote Creek Parkway. Also, if a fishing pond or aquatic recreation area were created, the amount of water necessary to support those uses would not be guaranteed.

<u>Perry's Hill Recreation Area</u>

The site conditions for the Perry's Hill Recreation would be similar to the conditions of the Integrated Plan. The creation of a floodplain would alter the layout of the ponds, with some ponds becoming smaller and other ponds removed entirely. All proposed infrastructure and recreation amenities identified in the Integrated Plan, however, would remain future opportunities because land adjacent to the Perry's Hill Recreation Area would remain mostly unchanged.

Santa Clara Valley Model Aircraft Skypark

The Environmental Enhancement concept would widen the channel and floodplain where it passes by the Skypark, but would not require relocation of existing infrastructure or recreational amenities at the Skypark. Sufficient land would be available to construct a new access road and re-aligned trail between the Perry's Hill recreation Area and the Skypark, as called for in the Integrated Plan.

The Integrated Plan includes a staging area with restroom facilities for the Skypark. Under the Environmental Enhancement Concept berms could be built to confine Coyote Creek to the new channel at the center of the Ogier Ponds site. The expansion of the berms, and creation of a floodplain could encroach on the buildable space around the Skypark. The planned restroom at the Skypark could be impacted if the septic field cannot be located far enough away from the creek or if site conditions are unsuitable.

The current access to the Skypark is from Barnhardt Road. While future access may come from the Perry's Hill Recreation Area, A vehicle crossing of the Coyote Creek channel and floodplain would be needed to keep using Barnhardt Road for Skypark access from Monterey Highway. This would require a significant investment.

3.8. Implementation Costs

To determine the potential range of implementation costs for a creek-pond separation project, the project team estimated the potential costs of project planning, permitting, design, construction, and real estate acquisition. Implementation costs were estimated for two concepts that span the range of potential pond-creek separation approaches.

These two concepts represent extremes in the potential range of environmental restoration/enhancement activities on site and are included in this study for cost analysis purposes. They are not intended to represent project alternatives, which would be developed during project planning phase should the SCVWD Board agree to move into planning phase. Concepts that involve some level of environmental enhancement between the pre-1997 channel restoration and floodplain restoration concepts are also possible, and would result in implementation costs within the range bracketed by the two concepts. At this feasibility stage, concept design is not detailed and therefore the cost estimates included herein are preliminary and should not be considered a not a detailed estimate of implementation costs.

Pre-1997 Channel Restoration Concept

This concept would separate the creek and ponds with minimum disturbance to the existing site conditions and hydrology, resulting in at minimal cost. Coyote Creek would be routed back to its pre-1997 channel through construction of earthen berms between the pre-1997 channel and the entrance to Pond 1 and the exit from Pond 4 (see Figure 3). The eastern berm would have a height of 8 feet, a minimum channel bottom width of 40 feet, and a channel-side side slope of 3H:1V. The berm at Pond 1 would be hardened with rock/concrete bank protection to prevent the berm from re-eroding and reconnecting the creek and Pond 1, as occurred in 1997. The pre-1997 channel would have capacity to convey flows of 4,000 cubic feet per second (cfs) without overtopping the banks. The 4,000 cfs flow is equivalent to a 15-year recurrence interval.

One important point worth noting because of the implications for cost is the condition of the exiting berm, constructed by quarry operator to separate the ponds and creek. The failed section of berm, which eroded during high creek flows in 1984 and 1997, is about 100 ft in length, representing only a small portion (1.6% by length) of the 6,000 ft on-site berm. While it is feasible to restore the failed 100-ft portion of levee and redirect the creek into the pre-1997 channel; this would expose the remaining 98.4% of the berm length to flows of Coyote Creek. Given the berm's inadequate size and generally poor condition, there is substantial potential for other portions of the berm to fail when exposed to creek flows, which would result in re-connection of the creek and ponds. To achieve the project objective of a long-term creek-pond separation, raising and/or armoring of degraded portions of the berm would be required at elected locations throughout the berm's 6,000 ft length. A detailed geotechnical and hydraulic evaluation would be needed to determine the length of berm needing repair and is beyond the scope of this feasibility study. The cost estimate for the pre-1997 channel restoration concept in Appendix C includes construction contingency and bank stabilization costs to cover these repairs. If future studies show that extensive berm repair is needed, repair costs could significantly increase.

Approximately 2 acres of the existing 145 acres of on-site ponds would be permanently removed because of the berm construction but water dependent recreation would be maintained. Groundwater seepage would supply water to the ponds, maintaining perennial water in the ponds during 19 years out of 20. Implementation costs for this concept are estimated at approximately $12 million. This concept would provide benefits for fish passage, however, the ponds and the creek would reconnect when Anderson dam spills, approximately every 15 years. While there is ecological value associated with these costs as it would restore Coyote Creek and allow for fish passage through the site, entrainment of adult/juvenile steelhead into the ponds would result when flows in Coyote Creek reach the 15-year level reach 15-year flow. The periodic hydraulic re-connection of the creek and ponds (every 15 years on average) would allow predatory fish living in the pond to enter the creek and could result of stranding of native fish (e.g. steelhead in the ponds) after flood water recede.

These concerns could render the pre-1997 restoration concept unacceptable to resource agencies, in particular the NMFS. Thereby the minimal concept cost is a starting point for cost consideration but the assumptions made here in feasibility should be re-evaluated early in planning should the SCVWD board approve a planning process as it could increase implementation costs to greater than $12 million. The $12 million cost does not include funds for off-site mitigation to compensate for short-term and long-term impacts to habitat as it appears that on-site mitigation is and would obviate the need for costly off-site mitigation.

Floodplain Restoration Concept

The team also identified a larger and more complex Floodplain Restoration Concept which would include a new enhanced Coyote Creek channel with connected floodplain. This concept would reconfigure the ponds to create an enhanced Coyote Creek channel flowing through the site, with a connected roughly 500-ft wide floodplain (Figure 4). This concept is similar to ecological restoration and enhancement identified in the County INRMP for the Coyote Parkway. The creek would be allowed to migrate across the floodplain in a natural manner and berms would be constructed at the boundaries of the floodplain to protect external lands and development from flood hazards. Floodplain reconnection restores the interactions between the stream and its floodplain by increasing the frequency of overbank flows, resulting in a regaining of hydrologic and ecological function. Floodplain reconnection is not feasible using the remnant pre-1997 channel because it is located on the far western boundary of the property and partially on adjoining privately owned properties. Thus, a newly constructed creek channel would be needed to replace the pre-1997 channel. The floodplain would support riparian habitat including potentially sycamore alluvial woodland, a rare and decreasing habitat in California. Groundwater seepage would supply water to the ponds, maintaining perennial water in the ponds during 19 years out of 20. To frame the upper cost estimate, consideration was given to restoration of a connected floodplain for Sycamore Alluvial Woodland (SAW) regeneration. The floodplain would be vegetated with California sycamore trees and associated savannah species in an effort to emulate the historically prominent and rare SAW habitat type. The surface area of the existing ponds would decrease from the current 145 acres to 60 acres to create the connected floodplain and berms, significantly reducing post construction water dependent recreation but not eliminating it. The Implementation costs for this example are estimated at $52 million. The $52 million cost does not include funds for off-site mitigation to compensate for short-term and long-term impacts to habitat as it appears that on-site mitigation is and would obviate the need for costly off-site mitigation.

Currently, neither the District nor County Parks have funding allocated for design and construction to separate the creek and ponds. Given the magnitude of implementation costs, multiple funding sources may be required to supplement funding from either organization. The project, with its objective to improve steelhead passage conditions, would likely be eligible for grant funding. Should project planning move forward with the floodplain restoration concept, County Parks would consider allowing the riparian corridor and floodplain to be used as compensatory mitigation for other district or county projects under specific conditions. County Parks, however, would not support permanent dedication of the property that would restrict future park planning options. It is important that the County retain flexibility to plan and develop park and recreational amenities in perpetuity, as the needs of the public may change over time. Consistent with current County Parks management of riparian corridors, staff supports the project’s purpose. These lands were purchased using Park Charter funds, and, therefore, any compensatory mitigation would need to be compatible with current or planned recreation for the site and retain the County’s flexibility for ensuring the park purpose continues to be served as park and recreational trends and needs for amenities may change over time. The final decision regarding use of the ponds-creek separation for compensatory mitigation, as well as any conditions imposed on the property, would be subject to Board of Supervisor approval.

Issues to be Addressed by the Planning Study

If the district moves this initiative into planning phase, the following key issues and challenges would need to be addressed:

- The amount of County resources, including both county staff effort and financial support, that would be available to support project planning and implementation;
- What level of hydraulic separation (i.e. recurrence interval of creek-ponds reconnection) represents an optimal balance between implementation cost and ecological benefits;
- Whether the County will allow the district to obtain a property interest to construct and maintain newly constructed berms;
- The degree to which the existing berm between the pre-1997 channel and the ponds meets district engineering standards and what amount of berm replacement and/or reconstruction would be necessary.
- The legal implications of restoring full creek flows to portions of the pre-1997 channel which are privately owned.

4. Comparison of Concepts

The Ogier Ponds site is primarily owned by the SCC Parks and dedicated to recreation uses compatible with ecological restoration. As the land owner and manager, SCC Parks has a substantial interest in any changes to the physical and hydrologic conditions at the site. SCC Parks approval and cooperation will be required to remove the surface hydraulic connection between the Ogier Ponds and Coyote Creek. In the MOA with SCC Parks, the District committed to completion of the feasibility study but neither the District nor SCC Parks is obligated to implement the findings of this study. In order for the District's Board to determine if the concept should be moved into planning phase, District staff has prepared concepts outlining the District's interests in the proposed pond-creek separation.

The site is not hydrologically or geologically suited for managed groundwater recharge. Minimal flood protection benefits to areas along Coyote Creek downstream of the Site could be achieved through temporary detention of peak creek flows on site (i.e., flood attenuation). Flood protection benefits would accrue during 10-year and 25-year events at the William Street and Berryessa areas.

Substantial improvement to the ecological conditions in Coyote Creek could be achieved by separating the creek and ponds. Ecological benefits would include improved steelhead passage and restoration and enhancement of riparian habitat and habitat for stream-related species.

Table 19 summarizes the consequences of each concept for each issue area addressed in this report.

Table 19: Overall Findings and Comparison of Concepts

Issue Area	Overall Findings	Pre-1997 Channel Restoration Concept Details	Floodplain Restoration Concept Details
Ecology	- Removes thermal barrier for anadromous fish (i.e. steelhead) - Increases habitat for stream dwelling reptiles, amphibians, birds, and odonates - Reduces habitat for pond-dwelling reptiles, amphibians, birds, and odonates	- Removes about 8 acres of riparian vegetation, consisting 50/50 of grassland and woodland - Reduces pond surface area by 2 acres (1.5%)	- Replaces existing riparian woodland and grassland with geomorphic channel and connected floodplain - Supports re-establishment of sycamore alluvial woodland - Reduces pond surface area by 85 acres (58%)
Surface Water Quality	- Creek water temperatures decrease by 1.5° to 7.5° C, benefitting salmonids - Remaining ponds become stagnant and subject to eutrophication	- Infrastructure may be needed to maintain pond water quality suitable for water-contact recreation	
Water Supply and Water Rights	- Site is not suited for managed groundwater recharge	- Ponds will contain year-round water 19 years out of 20 due to groundwater seepage - Diversion of water from creek not needed to sustain ponds - No change needed to existing District water rights	

Flood Protection (site vicinity) and Attenuation (mid-Coyote)	- Site can provide up to 1,000 acre-feet of flood water storage - Minimal reduction in mid-Coyote flood risks can be achieved but only with extensive infrastructure and active management of flows - Passive overflow weir will not reduce flood risks at Mid-Coyote	- Diversion to pre-1997 channel could increase flood risks (compared to existing or pre-1997 condition) to county and private property in Coyote Valley	- Setback berms would provide 100-year flood protection to local area
Recreation	- Generally consistent with County Master Plan - Does not preclude existing and planned recreation uses - Remaining ponds can be stocked with fish to support recreational fishing - Reduced water quality in ponds may limit water-contact recreation	- Partially implements Coyote Parkway Integrated Natural Resources Master Plan (INRMP)	- Fully implements Coyote Parkway INRMP by creating geomorphic channel and connected floodplain
Implementation Cost	$12 to 52 million	$12 million	$52 million

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Appendices

A. Groundwater Report
B. Ecological Report
C. Planning, Design, Permitting and Implementation Cost Spreadsheets

Pre-1997 Restoration Concept Estimated Cost				
Item No.	Description of Item	Approx. Quantity / Unit	Unit Price	Total
A	**PLANNING**			**$630,000**
A1	Labor	3,000 / HRS	$210	$630,000
B	**PERMITTING**			**$ 2,517,000**
B1	Labor	1,000 / HRS	$210	$210,000
B2	CDFW Section 1600	Lump sum	$5,000	$5,000
B3	RWQCB 401/WDR	Lump sum	$120,000	$120,000
B4	Valley Habitat Plan	Lump sum	$2,182,000	$2,182,000
C	**DESIGN**			**$ 490,185**
C1	Cost	10% Construction, not including mgmt. and contingency	$4,901,850	$490,185
D	**CONSTRUCTION**			**$7,613,425**
D1	Mobilization / Demobilization	Lump Sum / Lump Sum	$280,000	$280,000
D2	Clearing & Grubbing	7 / acre	$9,300	$65,100
D3	Channel Excavation	4,500 / CUBIC YARDS	$32	$144,000
D4	Imported Fill	45,000 / CUBIC YARDS	$32	$1,440,000
D5	Control of Water	Lump Sum / Lump Sum	$700,000	$700,000
D6	Channel Access Road	2,750 / LINEAR FOOT	$25	$68,750
D7	Erosion Control Blankets	16,000 / SQUARE YARD	$3	$48,000
D8	Concrete	1,500 / CY	$500	$750,000
D8	Rock Slope Protection	7,800 / TONS	$60	$468,000
D9	Site Planting Preparation	7 / ACRE	$6,000	$42,000
D10	Plants	7	$10,000	$70,000

Pre-1997 Restoration Concept Estimated Cost				
Item No.	**Description of Item**	**Approx. Quantity** **Unit**	**Unit Price**	**Total**
		ACRE		
D11	Irrigation System	7 ACRE	$20,000	$140,000
D13	Planting and Establishment Maintenance	7 ACRE	$50,000	$350,000
D10	Compliance with NPDES General permit	Lump Sum Lump Sum	$200,000	$200,000
D11	Wildlife Protection	Lump Sum Lump Sum	$100,000	$100,000
D12	Temporary Fencing	6,000 LINEAR FOOT	$6	$36,000
D13	Construction Contingency	25% Construction cost	$4,901,850	$1,225,463
D14	Engineering Support	4,159 hrs	$210	$873,382
D15	Construction Management	10% Construction cost	$6,127,313	$612,731
E	**REAL ESTATE**			**$1,088,000**
E1	Permanent Easement Acquisition*	15 ACRES	$61,200	$918,000
E2	Temporary Construction Easement Acquisition	25 ACRES	$6,800	$170,000
	TOTAL ALL COSTS			**$12,338,610**

If it is determined that the pre-1997 Channel restoration concept is not a covered activity for VHP purposes, incidental take permits may be required from U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and California Department of Fish and Wildlife (CDFW) to implement the concept. In addition, the District and/or County would need to obtain a 404 dredge/fill permit and 401 water quality certification from the U.S. Army corps of Engineers (USACE) and San Francisco Bay Regional Water Quality Control Board (RWQCB), respectively, to implement the concept. Obtaining regulatory permits necessary to implement the pre-1997 concept would require considerable effort and time. The permitting process would be expected to take one to three years.

Floodplain Restoration Concept Estimated Cost				
Item No.	**Description of Item**	**Approx. Quantity / Unit**	**Unit Price**	**Total**
A	**PLANNING**			**$630,000**
A1	Labor	3,000 HRS	$210	$630,000
B	**PERMITTING**			**$965,000**
B1	Labor	4,000 HRS	$210	$840,000
B2	CDFW Section 1600	Lump sum	$5,000	$5,000
B3	RWQCB 401/WDR	Lump sum	$120,000	$120,000
C	**DESIGN**			**$4,194,951**
C1	Cost	10% Construction, not including mgmt. and contingency	$41,949,509	$4,194,951
D	**CONSTRUCTION**			**$46,144,460**
D1	Mobilization / Demobilization	Lump Sum	$1,850,000	$1,850,000
D2	Clearing & Grubbing	50 acre	$9,300	$465,000
D3	Channel Excavation	100,000 CUBIC YARDS	$32	$3,200,000
D4	Imported Fill	700,000 CUBIC YARDS	$32	$22,400,000
D5	Control of Water	Lump Sum Lump Sum	$1,400,000	$1,400,000

Floodplain Restoration Concept Estimated Cost				
D6	Channel Access Road	12,600 LINEAR FOOT	$25	$315,000
D7	Erosion Control Blankets	140,000 SQUARE YARD	$3	$420,000
D8	Rock Slope Protection	10,000 TONS	$60	$600,000
D9	Site Planting Preparation	60 ACRE	$6,000	$360,000
D10	Plants	30,000 EACH	$10	$300,000
D11	Irrigation	Lump Sum Lump Sum	$350,000	$350,000
D12	Irrigation System Operations and Maintenance	36 MONTH	$5,000	$180,000
D13	Planting & Establishment	36 MONTH	$10,000	$360,000
D14	Compliance with NPDES General permit	Lump Sum Lump Sum	$200,000	$200,000
D15	Wildlife Protection	Lump Sum Lump Sum	$150,000	$150,000
D16	Temporary Fencing	13,000 LINEAR FOOT	$6	$78,000
D20	Contingency	25%	Construction cost	$8,157,000
D17	Engineering Support	5,545 hrs	$210	$1,164,509
D19	Construction Management	10%	Construction cost	$4,194,951
E	**REAL ESTATE**			**$10,132,000**
E1	Permanent Easement Acquisition*	160 ACRES	$61,200	$9,792,000
E2	Temporary Construction Easement Acquisition	50 ACRES	$6,800	$340,000
	TOTAL All COSTS			**$51,934,411**

The floodplain restoration concept would involve the creation of a large amount of high-quality riparian habitat on the connected floodplain, including potential sycamore alluvial woodland, a rare and ecologically valuable Habitat that decreased in area dramatically over the past few decades. This concept was not included as a covered activity in the VHP and is not likely to be considered a covered activity receiving incidental take permits for the range of species covered by VHP. Incidental take permits would be needed from the USFWS, CDFW, and NMFS. The District and/or County would also need to obtain a 404 dredge/fill permit and 401 water quality certification from the USACE and RWQCB, respectively, to implement the floodplain restoration concept . However, the floodplain restoration concept would be an ecologically beneficial project with the prime objective of restoring and enhancing aquatic and riparian habitat and could be designed to be self-mitigating, avoiding the need for off-site mitigation. Obtaining regulatory permits necessary to implement the maximum concept would require considerable effort and time. The permitting process would be expected to take two to five years.