Coyote Creek Watershed Reassessment 2020:

10-Year Reassessment of the Ecological Condition of Streams Applying the California Rapid Assessment Method

SANTA CLARA COUNTY

Technical Report prepared for the Santa Clara Valley Water District (Valley Water)
Safe, Clean Water and Natural Flood Protection Program,
Priority D, Project D5: Ecological Data Collection and Analysis

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Valleywater.org/d5-ecological-data-collection-and-analysis or https://www.sfei.org/projects/santa-clara-valley-water-districts-watershed-condition-assessments

1. Executive Summary

This report describes the amount and distribution of aquatic resources in the Coyote Creek watershed, Santa Clara County, California, and presents the first reassessment of stream ecosystem conditions using the California Rapid Assessment Method[1] (CRAM). Field work was conducted in 2020, following the baseline watershed assessment in 2010 (EOA Inc. and San Francisco Estuary Institute (SFEI), 2011). The reassessment was conducted for the Santa Clara Valley Water District (Valley Water) Safe, Clean Water and Natural Flood Protection Program[2], Priority D, Project D5. Field data and survey results (cumulative distribution function estimates or CDFs) of overall stream ecological condition were uploaded to a statewide database, publicly accessible on EcoAtlas (www.ecoatlas.org). Over the past decade, Project D5 completed six watershed wide ambient stream condition surveys, including nearly 500 CRAM stream condition assessments, across the five major watersheds within Santa Clara County.

Table E.1 Miles of streams in the Coyote Creek watershed and its PAIs (Hills and Valley) based on BAARI v2.1

Stream Type	*Hills*	*Valley*	*Total miles*
Fluvial Natural	2,178	588	2,766
Fluvial Unnatural	3	62	65
Tidal Natural	0	2	2
Tidal Unnatural	0	2	2
Subsurface Drainage	1	27	28
Total miles	2,182	681	2,863
Percent of watershed	76	24	100

The Coyote Creek watershed covers the center of Santa Clara County. At approximately 350 square miles, it is the second largest of Valley Water's five watersheds after the upper Pajaro River (Uvas, Llagas, and Pacheco Creeks). The Coyote Creek watershed is a critical surface and groundwater supply, covering a large area with a variety of habitats and land uses, and supporting a substantial diversity of wildlife, fisheries, and flora. It is an essential wildlife corridor between the Pacific Ocean, Santa Cruz Mountains and Diablo Range to the Central Valley. The watershed receives a low amount of annual rainfall with average annual precipitation varying from about 15 inches in the valley to about 25 inches in the headwaters (Valley Water and SFEI, 2020). Coyote Creek floods periodically. There are two large reservoirs in the watershed, Anderson and Coyote, together covering more than 1,500 acres. Based on the Bay Area Aquatic Resources Inventory (BAARI v2.1), the Coyote Creek watershed has approximately 2,863 miles of streams (Table E.1) in eight Strahler stream orders (Strahler 1952, 1957) with first order headwater streams

[1] www.cramwetlands.org

[2] https://www.valleywater.org/safe-clean-water-and-natural-flood-protection-program

comprising over half the miles, located mostly in the upper watershed or Hills primary area of interest (PAI, watershed area above 1,000 feet elevation).

More than 60 percent (%) of the stream network (1,766 miles) are on protected lands and conservation easements, the majority of which are located in the upper watershed and southern portions of the valley (California Protected Areas Database, CPAD, 2020). A large portion of the Coyote Creek mainstem channel, between Anderson Dam and South San Francisco Bay, is either owned by Valley Water or on protected lands owned by other agencies, such as the Santa Clara County Parks and Recreation Department and City of San Jose.

Valley Water owns about 4% (105 miles) with easement access to another 1% (32 miles) of streams in the watershed, located mostly along channels in the urban and residential areas within the valley. This limits the effect Valley Water has on the overall channel network through its programs, projects and management. Because of this limitation, Valley Water must continue to collaborate with other agencies, organizations and land owners to improve stream conditions at the watershed scale.

Table E.2 Acres of non-riverine wetlands in the Coyote Creek watershed and its PAIs (Hills and Valley) based on BAARI v2.1

Wetland Type	***Hills***	***Valley***	***Total acres***
Depressional (pond)	194	385	579
Lacustrine (reservoir/lake)	75	1,847	1,922
Slope wetland	44	19	63
Playa	0	60	60
Total acres	313	2,311	2,624

Table E.2 summarizes acres of non-riverine wetlands in the Coyote Creek watershed and its two PAIs (Hills and Valley). Tidal wetlands in the Baylands were not included in the D5 watershed assessments. Lacustrine systems (reservoirs/lake) comprise the largest total acreage, including Anderson and Coyote Reservoirs, Cherry Flat Reservoir, Metcalf Ponds, and Lake Cunningham. Depressional wetlands comprise the next largest acreage and include numerous small stock ponds in the watershed, Ogier Ponds, golf course ponds, ponds that are amenities (e.g., housing developments, parks), and water treatment ponds.

Early agricultural practices to ditch and drain wetlands, and modern-day urban and residential development has fundamentally changed aquatic resources in the watershed with impervious surfaces and increased drainage causing loss of many groundwater supported wetland areas, and reducing the overall residence time of precipitation that falls in the watershed. Increased hydrologic connectivity between channels in the foothills and valley has a number of important consequences. For example, unnatural connectivity caused significant changes in the form and function of channels throughout their watersheds. Ditching the alluvial fans lowered base elevations of channels in the foothills, causing them to deepen relative to their original banks. This increased heights of channel banks, destabilizing them, resulting in increased erosion with sedimentation downstream (Grossinger *et al.,* 2006). Ditching also decreased the frequency of overbank flooding and groundwater recharge, and increased the amount of drawdown of the water table near the channels.

Similar to 2010, streams in the Coyote Creek watershed as a whole were in fair to good condition in 2020, as measured by the probability based ambient survey employing CRAM. This is a tale of two parts of the watershed; Hills or headwater streams in good condition, and Valley streams in fair condition. For the entire watershed, the 2020 reassessment found about half of the streams in good condition (51% with 95% confidence range of 42-60%), 41% (32-51%) in fair condition, and 8% (4-11%) in poor condition (Figure E.1). Valley streams (below 1,000 feet elevation) were in fair condition overall with 22% (12-31%), 58% (45-70%), and 20% (11-30%) in good, fair, and poor condition, respectively. Hills region streams were in good condition at 68% (55-81%), 32% (19-45%), and 0% in good, fair, and poor condition, respectively. Differences between survey periods and ecological condition classes were not statistically significant based on *spsurvey's change analysis* test.

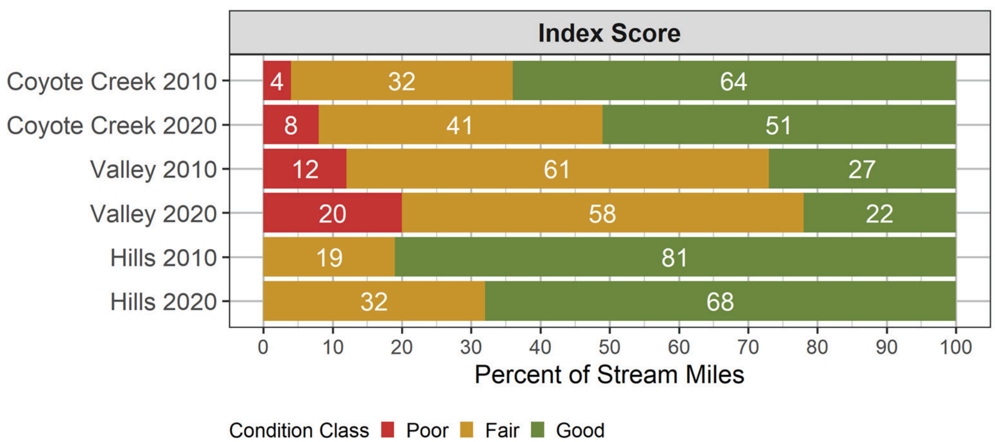

Figure E.1. Percent of stream miles in poor, fair, and good ecological condition throughout the Coyote Creek watershed, Hills and Valley PAIs in 2010 and 2020

Although there appears to be a slight decline in conditions in Figure E.1 above and the leftward shifts in CDF curves in Figure E.2, no statistically significant change occurred in the overall ecological condition of streams between 2010 and 2020 based on the CRAM Index Score CDF estimates (evaluated with a second *spsurvey* statistical test: a Wald-F test). While stream ecological conditions were statistically similar at fair to good from 2010 to 2020, a trend toward declining conditions by the next reassessment in 2030 to 2035 is not desired. Efforts to increase stream ecological conditions are needed, especially in the Valley.

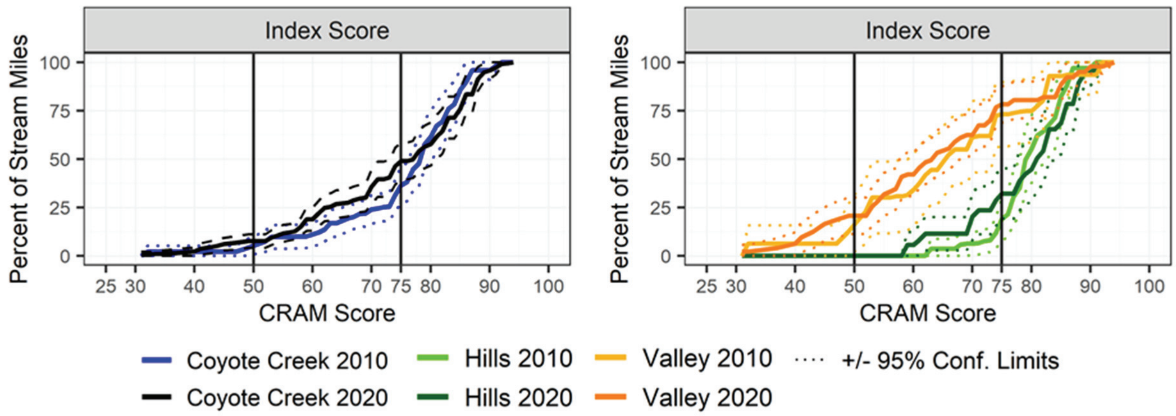

Figure E.2. CDF estimates comparing CRAM Index Scores for the 2010 and 2020 Coyote Creek watershed ambient stream condition surveys for the whole watershed (left) and Hills and Valley PAIs (right). No statistically detectable change between survey periods.

At the CRAM Attribute level, there was a small, but statistically significant declining condition in the Biotic Structure (leftward shift on the Figure E.3 CDF) between 2010 and 2020 at the watershed scale, and within the Hills PAI. The underlying cause(s) of these slight shifts to lower ecological conditions between survey periods is interesting. Flattening CDF curves and shifts towards the left could (in part) be due to several years of drought since 2010, or partly due to a change in survey design, where more AAs were assessed within the Valley, improving the accuracy of its condition assessment. A total of 78 AAs were assessed in 2020, including 52 revisit AAs of the 77 total done in 2010 (Hills: 32 AAs in 2020 and 47 in 2010, Valley: 46 in 2020 and 30 in 2010).

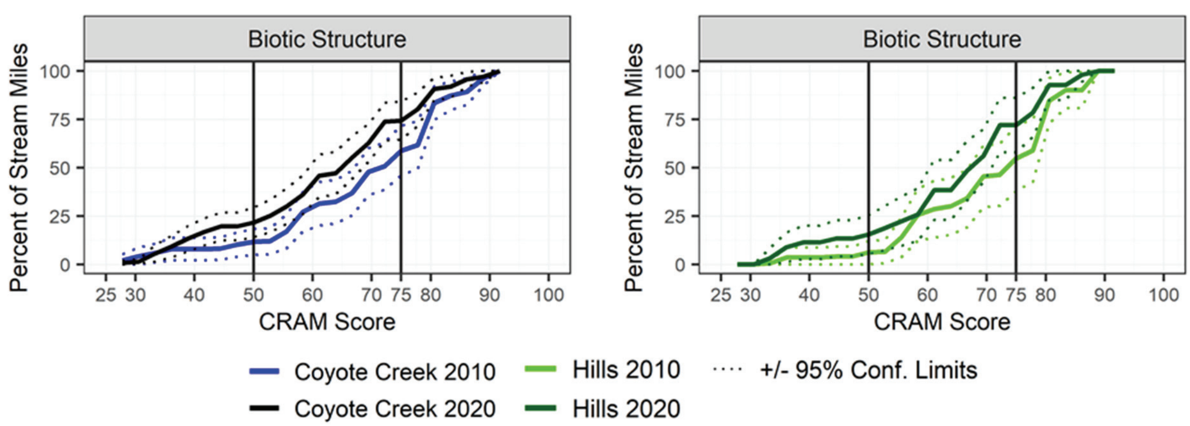

Figure E.3. CDF estimates comparing CRAM Biotic Structure Scores for the 2010 and 2020 Coyote Creek watershed ambient stream condition surveys for the whole watershed (left) and Hills and Valley PAIs (right). There was a statistically detectable change between survey periods.

Based on the 2020 ambient survey CRAM Stressor Checklist, the three most commonly observed stressors having a significant negative impact on overall stream conditions within the

Coyote Creek watershed include: urban residential land use, transportation corridors, and non-point source discharges (urban runoff, farm drainage). Other stressors that continue to be observed and to a lesser degree have significant negative impacts on stream conditions include; trash and refuse, vegetation management, lack of treatment of invasive plants adjacent to AA or buffer, mowing, grazing, and excessive herbivory (within AA). Many of these urban stressors are ubiquitous and intrinsic to highly developed areas, and difficult to eliminate. Therefore, it is expected that stressors such as transportation corridors, urban residential land use, and non-point source discharges are common in urban areas. Nonetheless, many stressor impacts respond to management efforts, and can be mitigated through the presence of riparian buffers, and changes in-stream and riparian management.

This watershed reassessment offers metrics, methods, and recommendations to strive toward ecological uplift or improving stream ecological conditions, and achieve the One Water Plan's objective to maintain healthy watersheds. The Coyote Creek Native Ecosystem Enhancement Tool (CCNEET) identifies enhancement opportunities to improve conditions in the Coyote Creek mainstem, as its D5 Stream Corridor Priority Plan.

CRAM, with its detailed Metric-level descriptions and scoring of observable ecological characteristics as poor to good condition, provides direct prescriptive information to assist Valley Water in identifying specific actions for improving stream conditions. Recommendations include:

- Stream restoration/enhancement projects that improve the condition of adjacent riparian habitats by enhancing cover of native vegetation and reducing the amount of disturbance (human and soil) will improve the quality and function of buffer areas.
- Channel stability is an issue in select locations and can be improved by large-scale efforts to stabilize incising reaches, or reduce sediment supplies to aggrading reaches.
- When designing flood projects and larger maintenance activities, include more channel complexity by installing habitat features (e.g. riffles and pools, large woody debris, cobbles and boulders, vegetated islands, bars), variable topography in the immediate floodplain, shade and other habitat cover within the channel and floodplain to support fisheries and other wildlife (see Figure E.4).
- Channel physical processes could be adjusted for the vegetation communities to naturally regenerate and thrive.
- Reaches with low Biotic Structure scores should be evaluated to see if additional vegetation can be planted, invasives removed, trees encouraged, or maintenance modified so reaches can become more vegetatively complex.
- Educating landowners, who have large areas of invasive plant species or manage stream and riparian area vegetation for simplicity could improve reaches that are not

Valley Water owned, increasing stream condition on their property and lessening impacts on adjacent stream reaches.

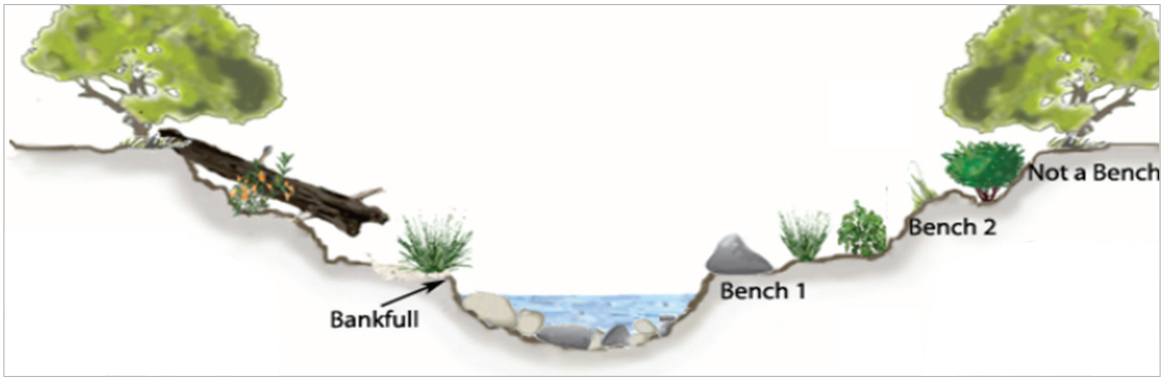

Figure E.4. Example channel cross-section showing high stream ecological conditions (CRAM Riverine field book, CWMW 2013b)

Other specific examples for improving stream ecosystem conditions within the Coyote Creek watershed are provided in this reassessment. Projects and major activities should be entered on EcoAtlas' Project Tracker, which along with CCNEET can be used to map and track the actions, such that they can be planned together, and aligned to improve natural resources management.

List of Abbreviations

AA	Assessment Area
ABAG	Association of Bay Area Governments
BAARI	Bay Area Aquatic Resources Inventory
BMP	Best Management Practices
CAL FIRE	California Department of Forestry and Fire Protection
CARI	California Aquatic Resources Inventory
CCED	California Conservation Easement Database
CCWG	Central Coast Wetlands Group
CDF	Cumulative Distribution Function estimate
CFS	Cubic Feet Per Second
CLs	Confidence Limits
CPAD	California Protected Areas Database
CRAM	California Rapid Assessment Method for wetlands
CWMW	California Wetland Monitoring Workgroup
CWQMC	California Water Quality Monitoring Council
DEM	Digital Elevation Model
EMAF	Environmental Monitoring and Assessment Framework
ESI	Ecological Service Index
FSD	Fluvial Subsurface Drainage
GIS	Geographic Information System
GRTS	Generalized Random Tessellation Stratified
HCP	Habitat Conservation Plan
HUC	Hydrologic Unit Code
IPCC	International Panel on Climate Change
KPI	Key Performance Indicator
LID	Low Impact Development
LOS	Level of Service
NHD	National Hydrography Database
NWI	National Wetlands Inventory
PAI	Valley Water’s Primary Area of Interest
PSA	Perennial Stream Assessment
RipZET	Riparian Zone Estimation Tool
SFEI	San Francisco Estuary Institute
SMP	Valley Water’s Stream Maintenance Program
SWAMP	Surface Water Ambient Monitoring Program

List of Abbreviations (continued)

USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USGS	United States Geological Survey
Valley Water	Santa Clara Valley Water District
VHP	Santa Clara Valley Habitat Plan
WRAMP	Wetland and Riparian Area Monitoring Plan

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2. Introduction

The Coyote Creek watershed in the center of Santa Clara County, California encompasses about 350 square miles (mi^2 Santa Clara Valley Water District (Valley Water) GIS, 2016), flowing from the Diablo Range (a.k.a., Hamilton Range) to South San Francisco Bay through the cities of Morgan Hill, San Jose, and Milpitas (see Figure 1). There are more than 2,860 miles of streams in eight different Strahler stream orders. The highest elevation is Mount Sizer (elevation 3,216 feet) in Henry W. Coe State Park and lowest elevation is sea-level in the tidal estuary of South San Francisco Bay. As the second largest of Valley Water's five watersheds after the upper Pajaro River (Uvas, Llagas, and Pacheco Creeks: Valley Water does not include Alameda Creek's watershed), the Coyote Creek watershed receives the lowest amount of average annual rainfall due to the rainshadow effect caused by the Santa Cruz Mountains to the west. Average annual precipitation varies between about 15 inches in the valley to about 25 inches in the headwaters (Valley Water and SFEI, 2020). Coyote Creek floods periodically with large events occurring in 1852, 1862, 1911 (largest flow recorded at approximately 25,000 cubic feet per second (cfs)), 1917, 1932, 1958, 1969, 1982, 1983, 1997, 1998, and 2017.

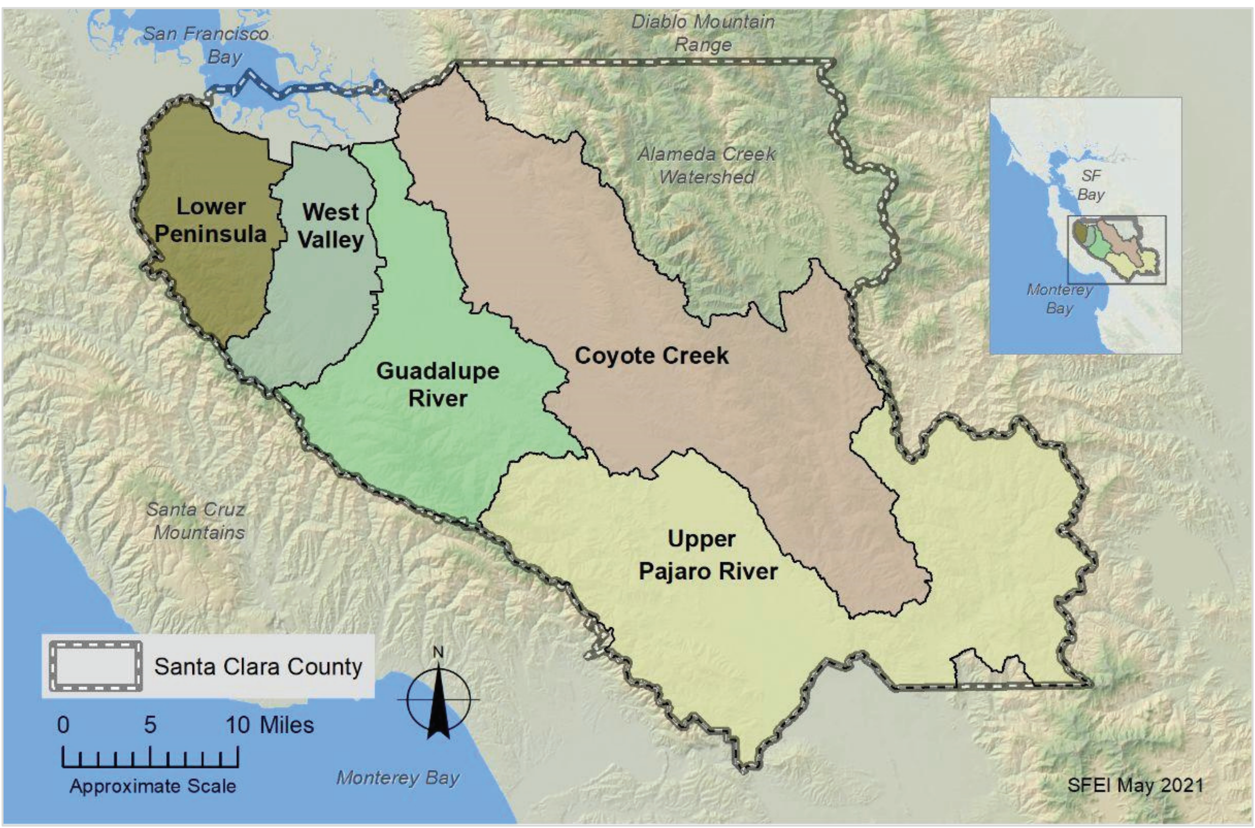

Figure 1. Map of Santa Clara County's five major watersheds. Alameda Creek drains north to Alameda County and is not part of Valley Water's district.

There are 2 large reservoirs in the watershed: Anderson Lake or Reservoir impounded by Anderson Dam (constructed in 1950 with a total storage capacity of just over 89,000 acre-feet) and Coyote Lake or Reservoir impounded by Coyote Dam (constructed in 1936 with a total storage capacity of just over 23,200 acre-feet). A third, but smaller Cherry Flat Reservoir impounded by Cherry Flat Dam (not owned or operated by Valley Water) is located within the Upper Penitencia sub-watershed. Lake Cunningham, owned by the City of San Jose, is another large waterbody. The Coyote Creek watershed is a critical surface and groundwater supply, covers a large and diverse area with a variety of landforms supporting a substantial diversity of wildlife, fisheries, and flora: And, is an essential wildlife corridor between the Pacific Ocean, Santa Cruz Mountains and Diablo Range to the Central Valley. This 2020 reassessment presents the amount of aquatic resources based on San Francisco Bay regional databases and the ecological condition of streams in the Coyote Creek watershed measured by the California Rapid Assessment Method (CRAM), following the baseline pilot watershed assessment in 2010.

2.1. Project D5 and One Water Plan

The Santa Clara Valley Water District (Valley Water) is a California Special District water resources agency in Santa Clara County providing safe, clean water for a healthy life, environment and economy, flood protection, and stewardship of streams on behalf of the county's residents. Valley Water shares most of its boundary with Santa Clara County, serving 15 cities within a 1,300 square mile area. The Alameda Creek watershed is not part of Valley Water's district. In 2012 and 2020, Santa Clara County voters approved the Safe, Clean Water and Natural Flood Protection Program. This Coyote Creek watershed reassessment was done for its Priority D, Project D5. The project continues to build and update watershed data to track stream ecosystem conditions, helping Valley Water and other county agencies and organizations make informed watershed, asset management and natural resource decisions. The new and updated information will be used to develop or modernize integrated watershed plans (such as watershed profiles, One Water Plan and Stream Corridor Priority Plans) that identify potential projects, support grant applications, environmental analyses and permits, and are shared with land use agencies, environmental groups, and the public to make efficient and coordinated environmental decisions throughout the county. These data and plans help integrate and enhance Valley Water's programs, projects, maintenance and stewardship actions through standardized, repeatable and defensible measurements that guide, organize and integrate information on stream and habitat conditions. Valley Water is developing a 50-year vision for an integrated, countywide One Water Plan that reflects the changing context of water management and environmental stewardship in the 21st century.

The One Water Plan has established a framework for developing watershed goals and measurable objectives that address Valley Water's three mission components of water supply, flood protection, and environmental stewardship. The planning framework is organized into three tiers (see side bar): a countywide planning framework (Tier-1), watershed plans (Tier-2), and detailed subwatershed or creek-specific plans (Tier-3). Within One Water's environmental stewardship objective *D (to protect, enhance, and sustain natural ecosystems*) is the Priority D5 Project that collects and analyzes ecological data, providing an empirical scientific basis to support the development of One Water's stream stewardship goals and to monitor progress towards those goals at watershed and subwatershed scales (One Water Tiers 2 & 3).

> One Water's Tiered Planning Framework
>
> Tier -1 One Water Plan Countywide Framework
>
> The Framework establishes guidance for subsequent Tier-2 watershed plans. This guidance includes a vision, goals, and measurable objectives for One Water. While this level is developed to be considered at a countywide scale, it is primarily applied at a watershed scale where most actions will be taken. The Framework's three goals (reliable water supply, improved flood protection, and healthy and resilient ecosystems) mesh well with Valley Water's three mission components of water supply, flood protection and environmental stewardship; while the five objectives (A. protect and maintain water supplies; B. protect and improve surface and ground water quality; C. reduce flood risk; D. protect, enhance and sustain natural ecosystems; and E. mitigate and adapt to climate change) match up with Valley Water governance policies and day to day work on water supply, water quality, flood protection, environmental stewardship and climate change. For each objective, specific metrics have been developed to track conditions of watershed health.
>
> Tier -2 One Water Watershed Plans
>
> Watershed plans will be developed under One Water for the five major watershed areas in Santa Clara County, including Coyote Watershed, Guadalupe Watershed, Pajaro Watershed (within Santa Clara County), West Valley Watersheds, and Lower Peninsula Watersheds (within Santa Clara County). The first watershed plan under development is the Coyote Creek Watershed Plan.
>
> Watershed plans apply the framework's measurable objectives with metrics and targets to determine what condition a watershed may be in and what actions may be taken to see improvements. Under Objective D, Protect, Enhance and Sustain Natural Ecosystems, several CRAM metrics associated with the Safe, Clean Water Project D5 will be utilized to support assessment and tracking of stream conditions.
>
> Tier-3 Detailed Watershed, Subwatershed or Creek-specific Plans
>
> Detailed plans may be developed to support watershed plans, where additional information or partnerships are required to determine what types of enhancements or improvements are needed to bolster watershed health. Examples of these detailed plans include stream corridor priority plans (e.g., Stevens Creek, Coyote Creek Native Ecosystem Enhancement Tool (CCNEET)) and case studies (e.g., Upper Penitencia, which is Safe, Clean Water Project E4, Coyote Valley). The Safe, Clean Water Project D5 provides funding and support for these tier 3 level plans.
>
> For more information please see One Water's website: https://www.valleywater.org/project-updates/one-water-plan

2.2. Project D5 History, Watershed Approach, and Status

In 2010, when developing the foundational roots of One Water and Project D5, Valley Water consultants, EOA Inc. and San Francisco Estuary Institute (SFEI), piloted a watershed approach to environmental monitoring and assessment in the Coyote Creek watershed to characterize the amount, distribution, and condition of aquatic resources (EOA and SFEI 2011). Then known as the Environmental Monitoring and Assessment Program (EMAP) with its Framework (EMAF), Valley Water employed a watershed approach guided by the newly endorsed *Tenets of the State Wetland and Riparian Monitoring Program* (WRAMP) of the California Water Quality Monitoring Council (CWMW 2010). The WRAMP recommended the United States Environmental Protection Agency (USEPA) 3-level wetland monitoring and assessment framework to establish baseline conditions, support state and federal wetland protection policies, resource planning, and performance tracking. It also recommended standardized data collection and online access to data.

Valley Water adopted and implemented the 3-level monitoring and assessment framework, and utilizes the statewide CRAM data management and access tools (see side bar) to support regional resource management and restoration planning within Santa Clara County, and to help Valley Water track the performance of projects, maintenance activities, and on-the-ground stewardship actions; including protecting and restoring healthy riparian areas, floodplains, managing invasive plants, improving fish passage and spawning habitat, and stabilizing stream channels.

Standardized Data Collection and Public Access to Information

Project D5 utilizes public web-services, including EcoAtlas and CRAM data management and aquatic resource tools implementing the CWMW's WRAMP framework recommending standardized data collection, and online access to data. EcoAtlas is an interactive map-based data visualization tool that makes wetland monitoring data available to the public, resource managers, and scientists. The data can be viewed online, downloaded, and summarized within the Landscape Profile Tool. The map interface includes many ecological data layers to choose from including: the California Aquatic Resources Inventory (CARI), historical habitats (in some areas), CALVEG, hydric soils, protected areas, and other kinds of geospatial data. EcoAtlas includes a Project Tracker (a restoration and mitigation project information and tracking tool used for planning, implementing, and monitoring wetland projects), and is the online access point for CRAM data, the California Stream Condition Index (CSCI), and selected water quality data from the California Environmental Data Exchange Network (CEDEN).

The D5 Project's watershed assessment data and results are available in the Landscape Profile Tool (by watershed and subwatershed) and can be viewed and downloaded as a PDF summary. Users can select any of the five major watersheds and generate a landscape profile of the amount, distribution, and diversity of aquatic resources within the user defined area along with the CRAM stream condition scores and probability based ambient stream condition survey results. These ecological data access and summary tools are intended to support a watershed approach to mitigation and restoration planning and resource management and a regional scale.

2.2.1. 3-LEVEL FRAMEWORK

Different kinds of environmental monitoring data are necessary to address core environmental management questions that support long-term wetland resource performance tracking. The D5 Project has adopted the EPA's 3-level framework, which provides a logical and economical structure for organizing and implementing a large regional or statewide wetlands monitoring program. Level 1 data consist of tables, imagery, or maps to determine the distribution, abundance, and diversity of aquatic resources. These data may be collected by remote sensing or ground surveys, but they can always be represented by dots, polygons, or lines in a geographical information system (GIS). The California Aquatic Resource Inventory (CARI v0.3, SFEI, 2017), Bay Area Aquatic Resources Inventory (BAARI v2.1, SFEI ASC, 2017), and Valley Water's "Creeks" GIS-layer are examples of Level-1 data. Level-2 data consist of cost-effective, rapid field assessments of condition based on semi-quantitative, visible indicators that do not require the collection or processing of materials from the field, but are field measures. Rapid methods provide numerical scores of condition. The California Rapid Assessment Method (CRAM) is a standardized, statewide Level-2 method to assess the overall condition of streams and wetlands (CWMW, 2013a). Level-3 data are 'intensive site assessments' providing detailed information on how well the stream or wetland is functioning, or to address specific regulatory monitoring requirements. Quantitative flow measures, water quality testing, hydrogeomorphic assessments, and number of species observed per unit area are examples of Level-3 data.

Upon county voter approval of the Safe, Clean Water and Natural Flood Protection Program in 2012, Valley Water evolved EMAP into Project D5. It was tasked to create a comprehensive watershed database that tracks stream ecosystem conditions helping Valley Water, other County agencies and organizations make informed watershed and asset management decisions. This new information integrates and enhances Valley Water's stewardship actions through a standardized, repeatable and defensible approach that guides, organizes and integrates information on stream conditions. This ecological monitoring and assessment is conducted on an ongoing basis and is shared with land use agencies, environmental resource groups, and the public to support efficient restoration decisions throughout the county. The 2012 key performance indicators (KPIs) were:

1. Establish new or track existing ecological levels of service for streams in five watersheds.
2. Reassess streams in five watersheds to determine if ecological levels of service are maintained or improved.

Project D5 completed baseline surveys that characterize the ecological levels of service in 5 major watersheds within Santa Clara County under Valley Water's purview. Its KPIs under the 2012 Program were to establish new, reassess, and track stream ecological conditions (also known as ecological levels of service) for streams in five watersheds, and determine if ecological conditions are maintained or improved. Baseline surveys and individual watershed assessments were completed between 2010 and 2018. Individual watershed assessment reports completed between 2010 and 2018, and a combined Synthesis Report: *Santa Clara County Five Watersheds Assessment: A synthesis of Ecological Data Collection and Analysis conducted by Valley Water* (termed the Five Watershed Synthesis Report in this report) (Lowe *et al.*, 2020) are available on Valley Water's Project D5 and SFEI's websites. Project D5's first KPI in the 2020 Program is to reassess and track stream ecological conditions and habitats in each of the County's five watersheds every 15 years.

The D5 practical approach to watershed health was foundational to the One Water Plan and is consistent with watershed management principles being considered by the California Ocean Protection Council. Methods and results of watershed assessments by the D5 Project essentially implement the watershed approach of the new California State Water Resources

Control Board's Dredge and Fill Procedures, and can help fulfill its watershed profile requirement. Project D5 results for Coyote Creek in particular provided much of the technical basis for the management actions and opportunity areas identified in the Coyote Creek Native Ecosystem Enhancement Tool (CCNEET) (https://neet.ecoatlas.org), which is a detailed planning tool stemming from the One Water Plan, and a Stream Corridor Priority Plan under the Safe, Clean Water and Natural Flood Protection Program that aims to inform and facilitate restoration and enhancement on Coyote Creek by multiple entities and various property types using a watershed approach.

The watershed-scale of Valley Water's aquatic resource assessments and nature of the data collected are consistent with, and help implement the USEPA and United States Army Corps of Engineers (USACE) preferred watershed approach for aquatic resource management, tracking, and protection under the Clean Water Act. The USACE South Pacific Division issued guidance in 2015 applying CRAM for impact assessment and mitigation for both the San Francisco and Sacramento Districts, covering Santa Clara County. Valley Water is the local sponsor for several flood risk reduction projects with the USACE.

Project D5's goal is to track stream ecosystem conditions within five watersheds of Santa Clara County (excluding Alameda Creek) and is beginning its second generation of watershed assessments: The first reassessment of watershed conditions after 10 to 15 years, building data for assessing trends in stream condition over time. These watershed assessments could be augmented with additional mapping and monitoring to help plan, assess, and report the efforts by Valley Water to improve watershed stewardship in the context of climate change and population growth.

3. Coyote Creek Watershed Reassessment 2020

In November 2020, Santa Clara County voters approved a renewed Safe, Clean Water and Natural Flood Protection Program, including Project D5. The Coyote Creek watershed reassessment bridges the 2012 and 2020 Programs. The renewed Project D5 continues to build and update watershed data to track stream ecosystem conditions, helping Valley Water and other county agencies and organizations make informed watershed, asset management and natural resource decisions. The new and updated information will be used to develop or modernize integrated watershed plans (such as watershed profiles, One Water Plan, and Stream Corridor Priority Plans) that identify potential projects, support grant applications, environmental analyses and permits, and are shared with land use agencies, environmental groups, and the public to make efficient and coordinated environmental decisions throughout the county. These data and plans help integrate and enhance Valley Water's programs, projects, maintenance and stewardship actions through standardized, repeatable and defensible measurements that guide, organize and integrate information on stream and habitat conditions. Measuring changes in ecological conditions through time allows Valley Water, resource agencies, land managers and the public to understand and respond to climate change effects, and evolving creek and habitat conditions. For the 2020 renewed Program, the D5 KPI is:

1. Reassess and track stream ecological conditions and habitats in each of the county's five (5) watersheds every 15 years.

Embarking on the first reassessment of ecological condition of streams in the five watersheds, Project D5 completed the CRAM field reassessment in the Coyote Creek watershed in the summer of 2020. The purpose of these large watershed wide (and Valley Water's Primary Area of Interest (PAI)-scale) assessments is to characterize and track the overall ecological condition of the streams with a known level of confidence, and to allow Valley Water projects to compare project-specific CRAM surveys against conditions at the watershed or PAI scales. These probability based ambient surveys employing CRAM can inform mitigation planning and design and evaluate impacts and mitigation performance over time. An approach and methods to using the watershed approach in project analysis and design is provided in the Five Watershed Synthesis Report with examples (Lowe *et al.* 2020). The D5 ambient survey results can also be overlaid to compare the relative proportions of streams in good, fair, and poor condition among watersheds, or surveys from other regions, or even the statewide stream condition assessment (Collins et . al 2006).

There were no new Level-1 geospatial datasets that extend throughout the Coyote Creek Watershed that could serve to assess change in the amount or distribution of streams and wetlands in the past 10 years. However, this report includes the full suite of watershed monitoring parameters linked to D5's core management questions described in the next section. The geospatial analyses summarize the amount, distribution, and diversity of aquatic resources in the Coyote Creek watershed, including estimates of functional stream riparian extents based on the Riparian Zone Estimation Tool (RipZET, SFEI 2015) developed and reported in the Five Watershed Synthesis Report (Lowe *et al.* 2020). The CRAM Level-2 stream condition reassessment characterizes the overall ecological conditions of streams in 2020 and compares them to the 2010 baseline survey.

4. Management Questions and Monitoring Parameters

The Valley Water Project D5's 3-level monitoring and assessment framework, data collection and analysis efforts are linked to the needs of water resource decision-makers through management questions (or core ecological concerns) that the data should address. Management questions can be general and overarching, or very specific. They can evolve over time based on monitoring findings and management needs. *The purpose is to link watershed monitoring and assessment to trackable management questions that support an adaptive management strategy to protect aquatic resources and their beneficial uses.*

The D5 watershed assessment reports address the following core management questions, which are organized around the first 2 levels of the 3-level monitoring and assessment framework described above.

Level 1: Geospatial, landscape-based, resource management questions regarding extent, distribution, and ownership:

1. What is the amount, distribution, and diversity of aquatic resources in the watershed and its PAIs?
    a. How many miles of streams exist (including natural and unnatural stream lengths, if possible to identify within the GIS dataset)?
    b. What is the extent and distribution of non-riverine wetlands?
    c. What is the extent and distribution of stream-associated riparian areas?
2. How do the modern-day aquatic resources compare to historical extents within the low-lying, valley floor areas for which there is historical habitat GIS data?
3. Other landscape-level questions about streams and stream ownership:
    a. What amount and proportion of the streams are Valley Water-owned or have management easements (designated as Valley Water fee title and easement GIS data)?
    b. What proportion of the streams are protected areas based on the California Protected Areas and Easement Databases (CPAD and CCED: https://www.calands.org/) and other information sources?

Level 2: Rapid assessment-based resource management questions regarding the ecological condition of streams evaluated for the watershed as a whole and individual PAIs using CRAM:

1. What are the overall stream ecosystem conditions based on CRAM (Ecological Levels of Service under the 2012 Safe, Clean Water and Natural Flood Protection Program) and have they been maintained or improved?
2. What are the likely ecological stressors influencing stream conditions?

To address these questions Project D5 currently employs six Level-1 and Level-2 monitoring parameters: five Level-1 plus one Level-2 parameters (Table 1). Parameters A-D have been assessed for the Coyote Creek watershed using the best available digital maps of surface waters and riparian areas. The BAARI (v2.1, SFEI ASC, 2017) was employed to determine the values for Parameters A-D. Values for Parameter E used CALVEG (2014), digital elevation models (DEM), and RipZET. Parameter F was evaluated by conducting probabilistic ambient field surveys of stream condition using CRAM.

Table 1. Monitoring parameters to evaluate the amount, diversity, and condition of streams, riparian and wetland habitats for Project D5

	Parameters	Framework Level	Data or Method
A	Stream abundance (miles of stream channels)	1	Bay Area Aquatic Resources Inventory (BAARI) or Valley Water's "Creeks" GIS-layers
B	Stream distribution (miles of stream channel by stream order)	1	
C	Non-stream wetland diversity	1	
D	Non-stream wetland abundance by type	1	
E	Stream riparian abundance (miles of streams by functional riparian width class)	1	CALVEG, DEM & RipZET
F	Proportion of streams by condition class	2	CRAM ambient stream condition surveys for the whole watershed

The D5 Project's 2020 Coyote Creek watershed reassessment ambient stream condition survey design reconfigured the original 2010 baseline survey's PAIs that were comprised of the whole watershed and Upper Penitencia sub-watershed (EOA and SFEI, 2011). The 2020 survey also includes the whole watershed and two new PAIs (Figure 2) defined by the 1,000-foot elevation contour: the upper headwaters region titled Hills and the lower Valley region (below 1,000 feet). The 1,000-foot elevation demarcates the upper limit of Valley Water's Stream Maintenance Program (SMP[3]) within Santa Clara County. The Hills and Valley are generally consistent with the One Water Plan, where the Valley region (in this report) comprises One Water's Upper Valley and Lower Valley together (Table 2).

These updated PAIs are consistent with the Headwaters, Foothills, and Lowland Valley regions in Project D5's Five Watershed Synthesis Report (Lowe *et al.*, 2020) for the Coyote Creek watershed. The Valley PAI is composed of both the Foothills and Lowland Valley extents, while the Hills is the same as the Headwaters region in that report (see Table 2).

The Hills and Valley PAIs do not divide the watershed based on differing land use, vegetation communities, or landscape ecologies, but rather demarcate the area below which Valley Water is most active in their stream management and maintenance activities. As the part of the

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[3] Valley Water's SMP works to improve the environment, reduce the risk of flooding and keep communities safe. The SMP actively manages streams below the 1,000-foot elevation contour and within the Baylands throughout the County.

watershed where Valley Water works most for reservoir operations and SMP, streams and land below 1,000 feet mark an important monitoring and assessment boundary for tracking status and trends of stream conditions in a long-term monitoring program.

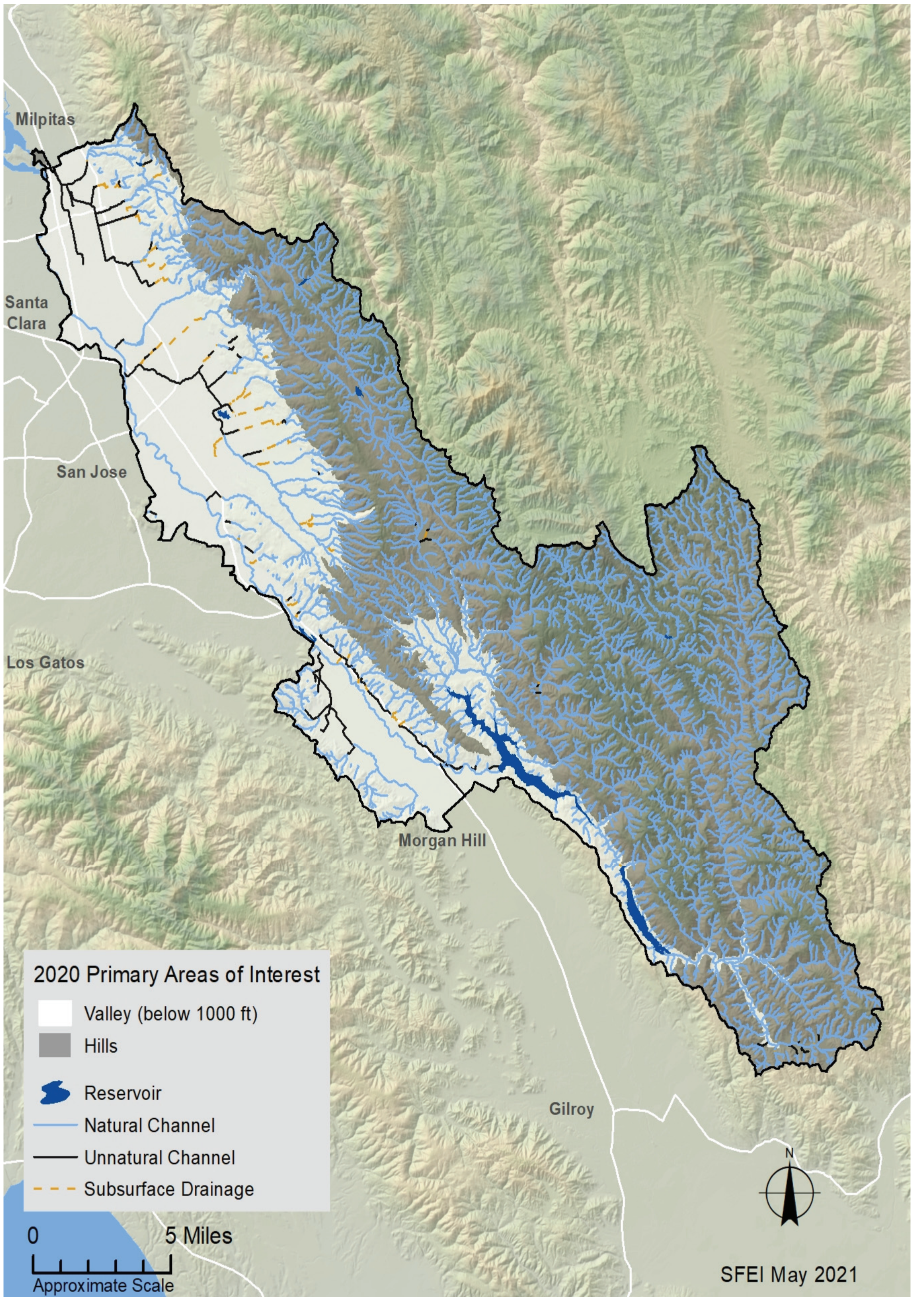

Figure 2. Map of the 2020 Coyote Creek Watershed Reassessment primary areas of interest (PAIs): Hills and Valley.

Table 2. Project D5 PAIs relative to the One Water Plan

D5 Coyote Reassessment	D5 Synthesis Report	One Water	Habitats
Hills	Headwaters	Hills	Open space, forest, chaparral, scrub, grassland, rangeland (>1,000 feet elevation)
Valley	Foothills	Upper Valley Floor	Rural, grassland, woodland, wildlife friendly agriculture (<1,000 feet elevation)
	Lowland Valley	Lower Valley Floor	Urban or intensive agriculture, limited riparian and parkland (<1,000 feet elevation)
na	na	Baylands	South San Francisco Bay tidal wetlands, intertidal creeks and sloughs

5. Coyote Creek Watershed Setting

As mentioned, the Coyote Creek watershed encompasses about 350 mi^2 (Valley Water GIS, 2016), though other sources report 320-325 mi^2, and is the second largest watershed within the 5 major watersheds in Santa Clara County, behind the upper Pajaro River. It covers about 34 percent of the total 5-watershed extent and includes 35 percent of the stream resources (not counting 1st order streams).

The mountains and foothills of the Diablo or Hamilton Range form the eastern topographic boundary of the watershed from Mount Sizer (elevation 3,216 feet) to the tidal estuary of South San Francisco Bay. The upper portion of the watershed, or Hills, is underlain by complexly faulted and folded Franciscan Formation rocks and Great Valley Complex sedimentary rocks including mélange, sandstones, and siltstones. The lower portion of the watershed in the Santa Clara Valley is underlain by a thick package of Quaternary alluvial deposits. The northwest-southeast trending active Calaveras fault system separates the mountainous portion of the watershed to the east from the valley to the west.

Average annual precipitation varies between about 15 inches in the valley to about 25 inches in the headwaters (Valley Water and SFEI, 2020). This relatively lower amount of precipitation is reflected in the amount of runoff produced by the watershed and vegetation communities found within the watershed.

The Coyote Creek watershed has a total of about 2,863 miles of streams in 8 different Strahler stream orders (Strahler 1952, 1957) that drain to South San Francisco Bay (based on BAARI v2.1). Approximately 76% of the natural stream network is in the Hills region. And, approximately 88% of the total channel network length in the entire watershed consists of the lowest three stream orders (Strahler stream orders 1, 2, and 3). Valley Water has fee title or easement on only 5% of the total stream miles in the watershed, but manages the 2 large reservoirs in the watershed: Anderson Lake impounded by Anderson Dam and upstream Coyote Lake impounded by Coyote Dam. Cherry Flat Reservoir and Lake Cunningham are not owned or operated by Valley Water. The operations of Anderson Dam are the primary control of the volume and timing of flows in the mainstem Coyote Creek. Due to infrastructure limitations, the reservoir and dam can only release a limited amount of water during large winter storms. When the reservoir fills, unregulated volumes of water flow over the spillway and can cause flooding in reaches of the Coyote Creek mainstem. The 2017 flood in San Jose was such an event.

As mentioned above and shown in Figure 2 and Table 2, the 2020 Coyote Creek reassessment survey divides the watershed into two PAIs (the Hills and Valley regions). The boundary between the regions *identifies the area below which Valley Water's Stream Maintenance Program is most active in their stream management and maintenance activities*. The boundary splits the *ecologically-based foothills region* in two: placing part of the foothills into the Hills and part into the Valley PAIs. The foothills are characterized by rolling hills, annual grasslands and coastal oak woodland vegetation communities.

5.1. Hills Region

The Coyote Creek Hills region consists of hills and mountains that are largely natural and represent about two-thirds of the Coyote Creek watershed. Large portions are publicly-owned and protected park land. Parks include Henry W. Coe State Park, Joseph D. Grant County Park, Anderson Lake County Park, Coyote Lake Harvey Bear Ranch County Park, and Alum Rock City Park, all located on the eastern side of the watershed. Other protected areas include the Blue Oak Ranch Reserve held by the University of California Regents, Canada de los Osos held by the California Department of Fish and Wildlife, and a number of open-space preserves held by the Santa Clara Valley Open Space Authority (OSA). Other land is privately-held large ranches that are utilized for grazing and resource protection. The steep and hilly topography, distance to urban centers, and to a certain extent land use planning have helped stave off development in this region, which has kept the Hills (landscape and hydrology) relatively natural with minimal human alteration, with the exception of past introductions of non-native grasses and forbes for grazing, a number of small on-channel cattle stock ponds, and livestock fencing.

The Hills region of the Coyote Creek watershed (above 1,000 feet) includes steep mountainous slopes and headwater streams within the Diablo Range portion of the watershed. It supports a variety of vegetation types and communities based upon location within the watershed, aspect, and elevation. These communities are dominated by annual grassland, oak and pine woodland with smaller areas of montane hardwood, chaparral, Blue Oak/Foothill Pine and Valley Foothill Riparian. Serpentine areas with their special status species are an important feature of the upper-watershed and the Hills PAI, but they also exist as unique features within the Valley PAI such as at Tulare Hill. The underlying bedrock of the Hills PAI tends to produce coarse-grained sediment that is characterized by sand, gravel, cobble and boulder streambed sediments in this region. The majority of the headwaters have relatively good stream buffers and little to no modified hydrology due to the protected lands and lack of development. The hillslopes are steep, which causes the smaller-order channels to be narrow, steep and incised, with low complexity overall. The higher-order channels (e.g., 4th, 5th, 6th and 7th order channels) in the headwaters tend to be located in the valley bottoms between the ridges and are relatively wide, shallow and low gradient, especially compared to the lower-order channels, yet still tend to have relatively low complexity.

The low annual average precipitation affects many aspects of stream condition. First, large volumes of runoff are not created from the hillslopes, and thus the streams in the Hills typically are not subject to large, regular floods. Stream power during flood events can create topographic complexity and reset in-channel morphological features, such as pools and bars. Second, the vegetation that is supported tends to be smaller, less dense, and with less variety in number of species and patterns of interspersion. And third, because the majority of the channels are ephemeral or intermittent, they do not support in-channel vegetation throughout the dry summer and fall months, decreasing the overall vegetative complexity. These three factors all affect stream condition and contribute to the relative simplicity of the streams in the Hills. The entire Hills region in the southern portion of the Coyote Creek watershed drains to Anderson Lake, the County's largest reservoir, which is built on the trace of the Calaveras Fault that roughly forms a transition zone between the uplands of the Hills and the Valley PAIs. Anderson Dam actively manages and controls the timing and amount of water delivered downstream, while the dam effectively cuts off the delivery of coarse-grained sediment downstream. Coyote Creek, Upper Penitencia Creek, and Arroyo Aguague Creeks have Federally Threatened steelhead (*Oncorhynchus mykiss*), thus Anderson Dam has regulatory flow requirements to sustain steelhead on Coyote Creek.

5.2. Valley Region

The Santa Clara Valley floor, Coyote Valley (upstream of Metcalf Ponds), and the lower elevations of the foothills comprise the Valley PAI. It is the lowest portion of the watershed, not counting the tidal Baylands, and drains northward into South San Francisco Bay. In contrast to the Hills region, the Valley has been largely altered with dense urban areas including portions of the cities of San Jose, Milpitas, and Morgan Hill. Some reaches along the Coyote Creek mainstem have homeless populations that contribute to ecological disturbance of riparian vegetation and trash in the creek corridor. The Coyote Valley in the southern portion, upstream from San Jose (and upstream of Metcalf Pond) consists of agricultural lands and rural residential land uses including small businesses, a golf course, and grazing pastures. Portions of the Coyote Valley are owned and managed by the Santa Clara County Parks and Recreation District, and are largely operated for recreational uses. Also within the Coyote Valley are the Ogier Ponds, which were created during previous gravel mining operations, but became flow-through ponds when the mainstem Coyote Creek breached the pond berms during the floods of 1997/1998.

Vegetation in the Valley is dominated by a mix of annual grassland and coastal oak woodland with small areas of Valley Foothill Riparian and Valley oak woodlands vegetation communities. Much of the channel network has a corridor of woody riparian vegetation. Riparian habitat widths tend to be wider along the mainstem channel as compared to the tributary channels. Historically, the Coyote Valley supported sycamore alluvial woodland, a mix of large sycamores and grassland, supported by the dynamic stream corridor and coarse alluvial sediments. Smaller areas of remnant sycamore alluvial woodland remain, however the lack of channel disturbance due to controlled releases of flow from Anderson Dam has reduced its ability to regenerate and persist.

The foothills below 1,000 feet typically are more gentle and grade down to the very gently-sloping Coyote Valley and Santa Clara Valley floor, which causes the stream gradients to be more gentle than in the Hills region. The channel network in the Valley consists of 4 types of channels. First, a number of small, relatively unmodified channels exist along the steeper hillslopes below the 1000-foot contour. Second, a handful of larger tributaries that have larger watershed areas (e.g., Upper Penitencia Creek, Fisher Creek) still maintain some/much of their natural characteristics. Third, a number of heavily engineered or modified, or historically constructed smaller tributaries exist, providing efficient drainage for areas of the watershed that historically may not have had a defined stream channel. And finally, the Coyote Creek mainstem, an 8th order channel that maintains some of its historical characteristics (e.g., location, width, outer channel banks, inset surfaces), but has been modified by controlled hydrology from Anderson Dam, urban hydrology from the cities and their storm drains, historic incision, and management actions for flood control. Although these 4 types of channels all exist within the Valley, they have very different characteristics, complexity, flow regimes, management, and thus have different conditions.

The mainstem of Coyote Creek, downstream of Anderson Dam and within the Valley, has a wide variety of character as it flows northward (down-valley) towards South San Francisco Bay. Immediately downstream of Anderson Dam, the channel is typically perennial due to releases from Anderson Dam with a relatively wide riparian area, that is a losing reach (surface water in the stream recharges the shallow groundwater). Downstream in the Coyote Valley, the creek is wide and somewhat braided. It is also a losing reach, can dry-up, and has a less continuous and more sparse woody riparian corridor. These reaches flow across coarse cobble, gravel, and sandy sediments that were delivered to the valley floor before the construction of

Anderson Dam. Within the City of San Jose, the creek becomes perennial and is incised. It is narrow and deep with steep banks, a number of long and slow velocity pools, and is characterized as having relatively low channel complexity. Moving further downstream, the riparian corridor becomes very narrow along the Coyote Creek mainstem channel, and is composed of a large number of non-native plant species. However, unlike other creeks in Santa Clara County, the channel maintains a natural stream bed and banks, and is not hardened. Channel incision is significant, largely due to increased urbanization and connected tributaries that increase runoff volume and stream power. The mainstem channel banks in this reach are fine-grained and cohesive, allowing steep banks to persist. Inset channel surfaces remain, but are only flooded during very large floods. In response to historical mainstem incision, many of the smaller tributaries also experienced incision and, to protect the urban landscape, now have hardened channel reaches (constructed with concrete, sakrete, or gabions) and include drop structures and weirs. Many channels in the lowest reaches of the watershed were historically straightened or re-aligned to improve flood control.

5.3. Flow Regime

The flow regime of Coyote Creek has changed significantly from the early 1900s to the present (Figure 3). Historically, the annual hydrograph reflected precipitation patterns with large peaks in discharge due to large storm events during the wet season, and very low flows often including zero discharge occurring during the dry season. The frequent small and intermediate floods (e.g., discharges in the 1,000 to 5,000 cfs range that occurred every 1-3 years), and the common, but less frequent large floods (e.g., discharges greater than 5,000 cfs that occurred approximately every 5 years) transported sediment, caused frequent channel modifications (small areas of erosion and deposition), and created a dynamic channel corridor that supported complex terrestrial and aquatic habitats. These habitats include sycamore alluvial woodland in the coarse, braided reaches of Coyote Valley that required frequent channel disturbance to maintain and regenerate the habitat; broad, inset floodplain surfaces in the lower reach that provided opportunity for flood flows to slow and infiltrate; and complex interactions between the mainstem, its natural levee deposits, and the tributary channels forming a variety of moisture gradients and localized habitat types on the valley floor along the lower mainstem Coyote Creek reaches (Grossinger *et al.*, 2006).

Today, Anderson Dam is managed and operated for water supply and flood management, and along with Coyote Dam just upstream are the largest controls of flow volume, timing, temperature and sediment transport to the lower watershed (Valley Water and SFEI, 2020). The dam (constructed in 1950) detains natural flows and entirely cuts off the supply of coarse sediment to the lower watershed that is contributed from the upper watershed. Historical hydrologic changes in peak flow downstream of the dam can be seen in a time-series plot of peak flow events measured at the United States Geological Survey (USGS) and Valley Water stream gauges at Coyote Creek at Madrone between 1906-2018 (Figure 3 and Table 3). In addition to the stream gauge at Madrone, many other stream gauges that exist across the county can be used to assess hydrologic change through time. To track hydrologic conditions throughout the Santa Clara Valley to ensure reliable water supplies, flood risk reduction, environmental stewardship, provide information useful to One Water and other management activities, Valley Water operates and maintains a network of measuring stations, a number of which are within the Coyote Creek watershed. These stations collect data on precipitation, reservoir levels, groundwater, stream flow and stage (see https://alertold.valleywater.org/ and for groundwater https://gis.valleywater.org/groundwaterelevations/map.php).

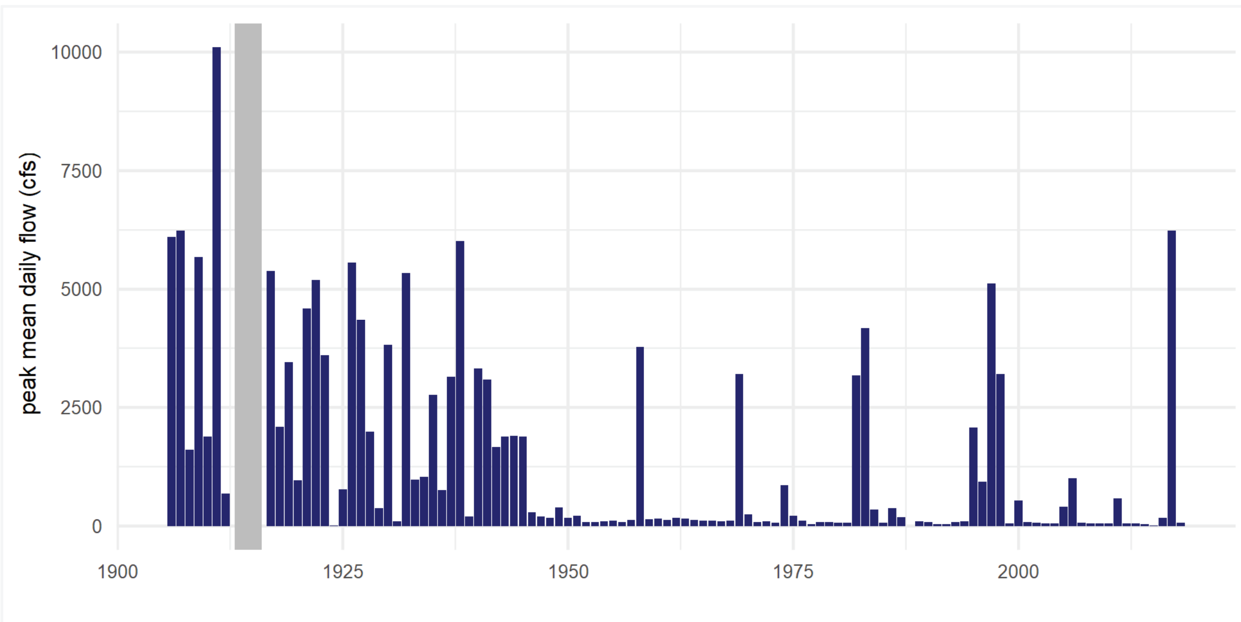

Figure 3. Annual peak mean daily discharge (cfs) as measured at the USGS gauge Coyote Creek at Madrone (USGS 11170000 supplemented with SCVWD gauge data, water years 1906-1912, 1917-2018) (Valley Water and SFEI, 2020).

Table 3. Present day peak flow (cfs) and recurrence frequency (percent and year (yr)) for Coyote Creek at the Madrone gauging station (USGS gauge station 11170000, and Valley Water Alert station 5082 (Alert ID 1498)) (Xu and Chan, 2018)

Coyote Creek downstream of Madrone gauge	***43% 2.33 yr***	***20% 5 yr***	***10% 10 yr***	***4% 25 yr***	***2% 50 yr***	***1% 100 yr***	***0.5% 200 yr***	***0.2% 500 yr***
	1,840	3,660	5,480	8,050	10,090	12,280	14,280	17,280

Anderson Dam changed downstream stream conditions in the following 3 ways:

First, the intra- and inter-annual variability of flood flows within the lower watershed was significantly reduced after the dam was built in 1950 (Valley Water and SFEI, 2020; Figure 3). Intermediate and large floods that historically occurred approximately every 3-10 years are now detained by the dam, preventing regular flooding in the downstream reaches. As mentioned, notable floods on Coyote Creek in modern times before the Coyote Reservoir was constructed occurred in 1852, 1862, 1911, 1917, and 1932. However, large floods still infrequently occur when the reservoirs have filled to capacity, and Anderson Dam releases water uncontrollably via the spillway (reservoir spilling) to protect the integrity of the structure. Since Anderson Dam was built, infrequent floods occurred in 1958, 1969, 1982-83, 1997-98, and most recently in 2017. These events are catalysts for some of the most significant ecological changes and the cause of major impacts upon the downstream reaches, including breaching of the levee between the mainstem Coyote Creek and Ogier Ponds, and flooding of roads, homes, and businesses. These large floods have caused significant property and infrastructure damage in the urban reaches, requiring continued collaboration and investment by Valley Water hand-in-hand with local city and County agencies to both protect Coyote Creek as well as the surrounding community. For example, the Coyote Creek Flood Protection Project will construct site-specific solutions to reduce the risk of flooding to communities from Montague Expressway to Tully Road up to the level of the February 2017 flood, which was the highest flood event observed since Anderson Dam was constructed in 1950, an approximate 20-year event.

Second, the dam prevents intermediate floods from occurring in the mainstem channel due to detention of upper watershed flows. Intermediate-sized floods have enough energy to rework the channel, but not enough energy to cause significant damage. It is these intermediate floods that provide beneficial channel and riparian area habitat disturbance by causing low-level erosion, redistribution of sediment within the channel, and reworking the channel habitat elements (e.g., bars, pools, riffles). Additionally, sediment is not being transported to provide habitat elements within downstream reaches due to both the trapping of sediment behind the dam, and lack of these intermediate floods to transport that sediment. This disruption to the hydrograph is contributing to the narrow and more static, simple channel corridor through the Coyote Valley.

Third, dam operations have disrupted the intra-annual dry and wet season flow patterns. Figure 4 illustrates the mean daily flow rates for the pre-Anderson Dam period (prior to 1950) and the post-Anderson Dam period (after 1950) at the Coyote Creek Madrone USGS stream gauge station (USGS 11170000, Alert station 5082). Historically, the reaches in the Coyote Valley were intermittent, and regularly completely dried during the summer and fall months (dry season). Presently, Anderson Dam releases water during these months for groundwater infiltration to occur in the Coyote Valley reach and to support in-channel aquatic habitat, specifically fisheries. These releases result in perennial and elevated flows during the dry season. However, in the winter and early spring months (wet season), dam operations have reduced daily flows as compared to historically, due to detention of flows from the upper watershed.

Anderson Dam and its operations have significantly changed the hydrograph below it in Coyote Creek, as illustrated by these primary effects. The present day hydrograph has smaller variability in the total range of discharge, removal of low and intermediate flood peaks, retention of only the largest flood peaks, and replacement of regular zero discharge summer/fall days with elevated unnatural mainstem flows during the dry season months. Valley Water manages Anderson Dam releases following its water rights licenses, Federal Energy Regulatory Commission (FERC) and California Department of Water Resources, Division of Safety of Dams (DSOD) dam safety standards, environmental permits, laws and regulations. Valley Water must balance providing an adequate water supply, maintaining sustainable groundwater levels, flood protection, and environmental flows. In the coming decade, the Anderson Dam Seismic Retrofit Project (ADSRP or Safe, Clean Water Project C1), and the Fish and Aquatic Habitat Collaboration Effort (FAHCE) will influence future operations of Anderson Dam and Coyote Creek flows through the valley.

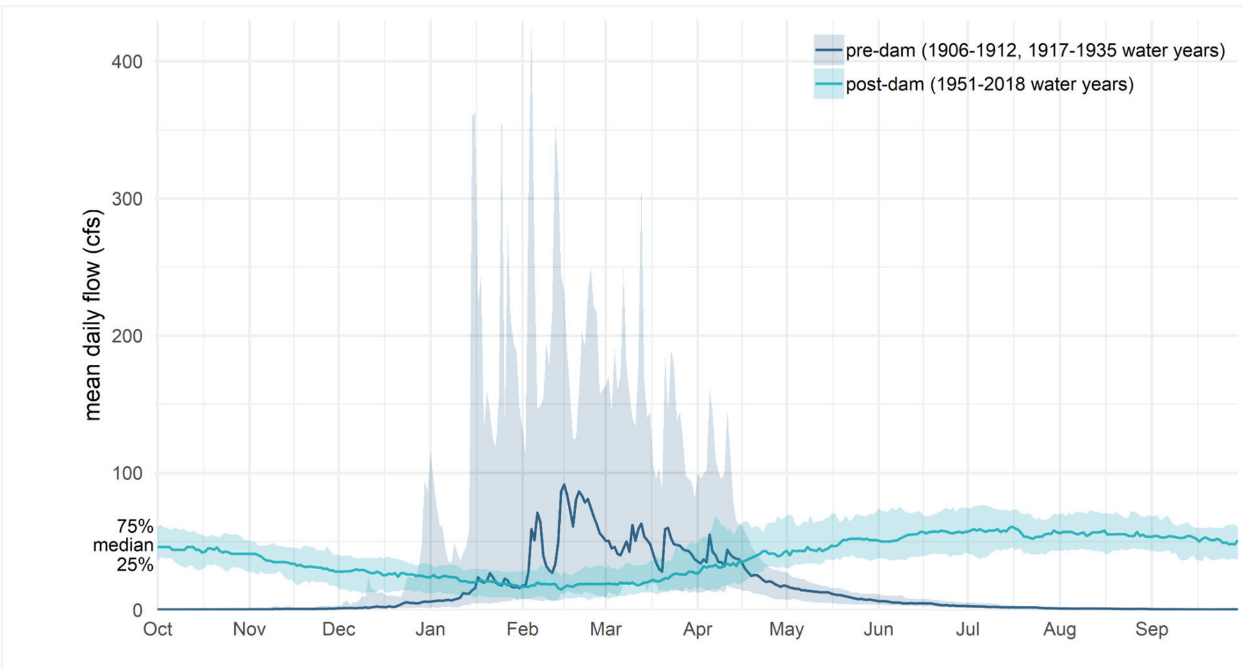

Figure 4. Mean daily flow for the Coyote Creek at Madrone gauge location (USGS 11170000) showing the median daily flow (solid line) and 25th and 75th percentiles (shaded area) for the pre- Anderson Dam time period (grey) and post-Anderson Dam time period (light blue) (Valley Water and SFEI, 2020).

In addition to the hydrologic changes caused by Anderson Dam, the effects of urbanization of the Santa Clara Valley also affects the present day hydrograph. Total length of the drainage network has increased due to changes that have occurred in urban and agricultural landscapes in the watershed. The connection of tributaries to the mainstem, construction of new, artificial channels and ditches, and extensive storm drain networks in the cities all result in greater and faster delivery of stormwater to the Coyote Creek mainstem. This, combined with the elevated runoff contributed from impervious surfaces within the cities result in a large "urban peak" in the hydrograph that occurs quickly following precipitation events. Notably, these urban peaks in the hydrograph have less discharge than the historical intermediate floods, and typically do not cause significant/measurable change in channel morphology. However, runoff from urban areas may elevate water temperatures, and carry significant contaminant loads, including metals, nutrients, pesticides, microplastics, and trash, which negatively affect the water quality of Coyote Creek, as well as its receiving waterbody, the South San Francisco Bay.

5.4. Wildfire History

Reporting the history of wildfire in the Coyote watershed was sparked by the increased intensity and frequency of drought from 2010 to 2020, climate change, and wildfires burning an unprecedented nearly 4.4 million acres in California in 2020, including substantial areas of the upper Coyote Creek watershed. Wildfires in the Bay Area have unfortunately become more commonplace with the Mediterranean climate providing moisture for fuels to grow in the winter and creating hot and dry conditions in the summer, increasing wildland-urban interface, current and future climate change. Fire can be regenerative for a landscape, by clearing low-growing shrubs and debris, regenerating grasses, herbs and shrubs, killing pests such as bark beetles and triggering seed germination for native species such as manzanita and chamise. But, fire can also be destructive. Large areas of high intensity burn can have negative ecological effects by destroying habitat either long-term or permanently, or by encouraging reestablishment by invasive vegetative species. Geomorphically, negative effects of fire include increased runoff from a watershed during the following wet season, excess sediment delivered to creeks and other receiving water bodies, and formation of landslides or debris flows in burned areas. Increased nutrient loads from burned areas can impact water quality. Socially, wildfires destroy houses, structures and infrastructure, and even cause loss of life. Controlling fire through suppression, cutting fire roads, clearing firebreaks, mowing, and replanting post-fire with unsuitable vegetation alters the landscape. Due to its Mediterranean climate, fires in the Bay Area often occur during the dry summer and fall months, and are often driven by the dry Diablo winds, which are east winds that quickly remove moisture from vegetation in the watersheds.

Fire risk in the region has been increasing largely due to climate change that is altering the timing and amount of annual precipitation, increasing summer/fall temperatures, and altering wind patterns that affect evapotranspiration, each intensifying the periods of drought. Other risk factors include increased residential activities along the wildland-urban interface that has increased wildfire risks to those communities. And, changes in the amount and diversity of vegetation communities in the watersheds, partly as a result of fire suppression and other land management practices, has increased the amount of available fuel to burn.

Prior to human habitation of the Bay Area, lightning was the primary ignition source of fire. Using data from the past 75 years, Keeley (2005) has shown that lightning-caused fire in the East Bay (specifically the hills in Contra Costa, Alameda and Santa Clara Counties) occurs at a much lower incidence than the Sierra Nevada or other areas of the state. Between 1945 and 2002, Santa Clara County had an average of 5.3 lightning-caused fires per 247,000 acres (100,000 ha) each decade, as compared to 200-300 fires per 247,000 acres (100,000 ha) each decade for locations in the Sierra Nevada (Keeley, 2005).

With the arrival of Native Americans in the early Holocene, the primary cause of fires shifted to anthropogenically ignited fire. Native Americans used fire as an effective landscape-scale management technique. Fires during this time period were used by the tribes to control the distribution of chaparral, maintain grassland cover and forage for wildlife, control pathogens, improve access to acorns, aid in hunting rabbits and other small game (Stanford *et al.*, 2013). This purposeful management of the land and burning at relatively high frequencies likely modified the plant succession, and shaped the vegetation communities that were encountered by the early European settlers (Stanford *et al.*, 2011).

The use of fire as a part of landscape management decreased with the arrival of European missionaries and settlers in the 19th century. Reduced area of burns, in addition to the increase in grazing (sheep and cattle), especially in the East Bay, began a shift in the vegetation community from shrubland and woodland with small areas of grasslands to larger areas of grasslands (Keeley, 2005).

By the end of the 19th and first half of the 20th centuries, as population and development pushed into the foothills and headwaters of the watersheds, the wildfire regime shifted to largely accidental human-caused fires. Practices such as smoking and arson, as well as cars and machinery caused many of the fires. In the second half of the 20th century, the practice of fire suppression along with establishment of large protected lands and park lands (and the cessation of grazing) allowed the vegetation communities to shift towards larger areas of shrublands that reduced the amount of grasslands (Keeley, 2005). Fire suppression practices have resulted in a reduction in total area that has burned and an increase of available fuels in the foothills and upper watersheds, increasing the risk for high intensity fires.

An analysis by Keeley (2005) using California Department of Forestry and Fire Protection (CAL FIRE) records from 1931-2002 characterized the annual fire frequency for Santa Clara County. For the period 1930 to 1950, the annual number of fires per 247,000 acres (100,000 ha) were typically between 15 and 40. However, the number of fires increased after 1950 to 30 to 80 fires per 247,000 acres (100,000 ha). The total area burned annually decreased from 1930 to 1950 and then (with the exception of a few individual years), the total area burned annually has been fairly constant at less than 2,471 ac/247,000 ha (1,000 ha/100,000 ha) since 1950.

Keeley's analysis shows the effect of fire suppression practices since the 1950s; despite the increase in the number of fires, the total area burned has remained relatively low.

Large fires still occur despite, or perhaps as a result of past, fire suppression practices. CAL FIRE, along with the US Forest Service, Bureau of Land Management, and National Parks Service jointly developed the Fire and Resource Assessment Program (FRAP; https://frap.fire.ca.gov/frap-projects/fire-perimeters/) that compiles the perimeters of individual fires annually, and makes the data publicly available in GIS. While some areas of the state have older records (back to 1898), the record for Santa Clara County covers the period from 1950 to 2019. Fires must be 10 acres or larger to be recorded in this database, however CAL FIRE records only include brush fires that are 30 acres or larger, and grassland fires that are 300 acres or larger. As a result, this is an incomplete record of regional wildfires in terms of cataloging every fire that has occurred. Nonetheless, FRAP data represents the best publically available digital dataset for analysis. FRAP documented 24 fires in the Coyote Creek watershed between 1950 and 2019 (Figure 5 and Table 4).

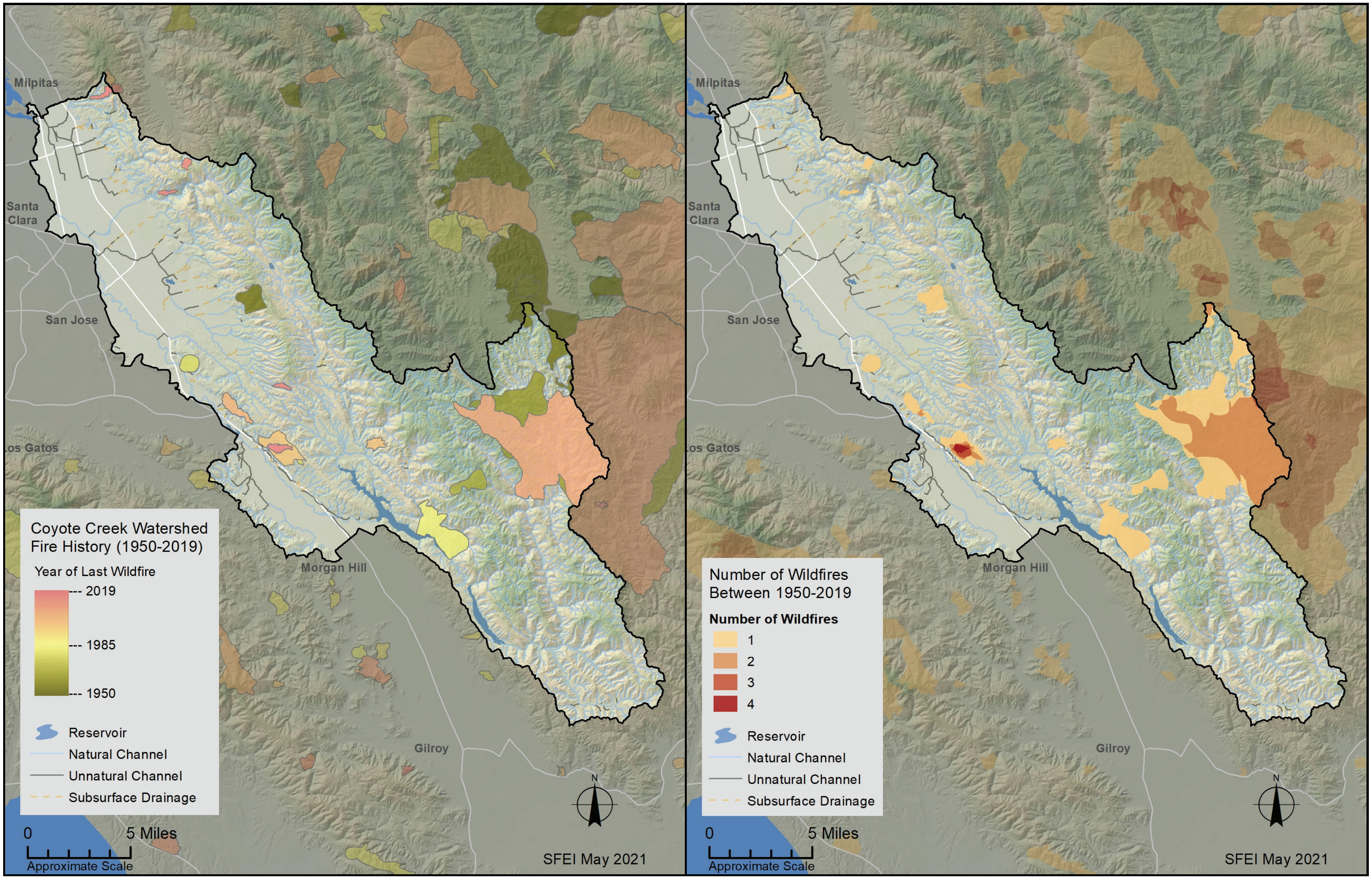

Figure 5. Left: map showing the most recent footprint of wildfires (>10 acres) that have occurred in and around the Coyote Creek watershed between 1950 and 2019 as documented by the Fire and Resource Assessment Program (FRAP, 2021). This map corresponds to the fires listed in Table 4. Right: map using the same data, but showing the number of times a specific area has been burned.

Table 4. List of fires that occurred within the Coyote Creek watershed between 1950 and 2019 mapped by the Fire and Resource Assessment Program (FRAP, 2021) (https://frap.fire.ca.gov/frap-projects/fire-perimeters/) and acres within the watershed that were burned.

Year	Fire Name	Acres Burned		Year	Fire Name	Acres Burned
1951	Isabel Valley Ranch	802		1997	Shea	50
1952	Saunders	7,219		1999	Malech	1,200
1952	Shanti Ashrama	5,458		2000	UTC	255
1955	Venable	336		2002	PG&E	141
1961	Bollinger Ridge	32,866		2004	Silver	479
1966	Star	713		2007	Lick	47,748
1979	Sheriff	429		2011	Ranch	14
1979	Ford Rd.	422		2016	Sierra	124
1981	Pistol Range	306		2017	Felipe	103
1985	Finley	2,057		2017	Lariat	102
1989	PG & E #2	584		2018	Country	321
1989	Squirrel	146		2019	Malech	208

About half of the fires in the watershed occurred in unique areas and did not overlap with areas that were previously burned. However, the other half of the fires occurred in areas that have burned multiple times. These areas include hillslopes just east of Highway 101 at approximately Bailey Avenue, hillslopes on the northeast side of Highway 101 and Metcalf Road, a small area in Isabel Valley, an area south of Highway 130 in the northeast portion of the watershed, and within Henry W. Coe State Park. The area at Bailey Avenue burned four times; 1979, 1981, 1999 and 2019, the Metcalf Road area burned in 1997 and 2004, Isabel Valley area burned in 1951 and 2011, the area south of Highway 130 burned in 1952 and 1955, while the area in Henry W. Coe State Park burned three times; 1952, 1961 and 2007. The FRAP dataset does not provide additional information about fire severity and therefore, we do not know how these fires may have affected the ecological conditions in the burned areas.

At the time of publication, the FRAP dataset did not include the 2020 fire season, which was particularly devastating for so many areas in the state, including the Coyote Creek watershed. The Santa Clara Unit (SCU) Lightning Complex fire started on August 18, 2020 and was active for 44 days, burning a total of 396,624 acres in Santa Clara, Alameda, Contra Costa, San Joaquin, Stanislaus, and Merced Counties. The fire was the third largest fire in California's modern history. The fire damaged or destroyed 250 structures, a number which could have been much higher if the fire had occurred closer to the urban interface. Despite the very large size of the fire complex, only about 28,000 acres within the Coyote Creek watershed were burned by the fire with a majority of that acreage not too severely burned (Figure 6) based on post-fire field assessments by Valley Water (Mallen *et al.*, 2020 unpublished data) that indicated that the soil burn severity was low or very low over most of the burned areas (Table 5), suggesting that impacts to stream habitats might be relatively minor or short duration. In addition, the fire was located in areas within Henry W. Coe State Park that previously burned in 1952, 1961 and 2007.

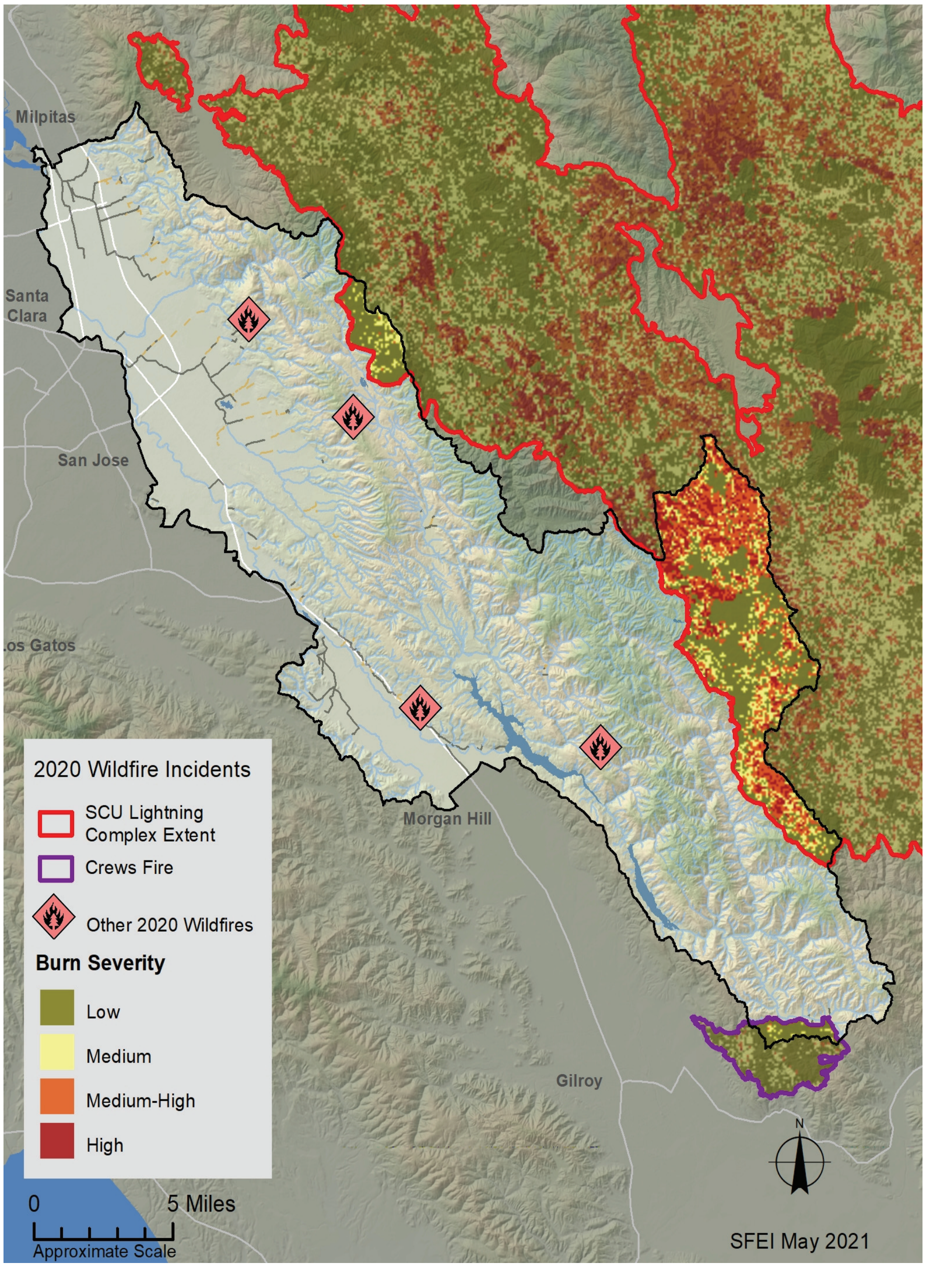

Figure 6. Map of the 2020 wildfire incidents. The SCU Lightning Complex fire perimeter is shown in red and the Crews fire perimeter is shown in purple with information on the burn severity shown for both (CAL FIRE, 2020). As of publication, official fire perimeters for the other 2020 wildfires have not been published; these fires include the Alum fire (31 acres), Silver fire (19 acres), Coyote fire (143 acres) and Park fire (343 acres).

Table 5. Acres of Coyote Creek watershed within the August 2020 SCU Lightning Complex Fire perimeter (CAL FIRE, 2020).

Soil burn severity	*Approximate acreage*
Very low/unburned	9,945
Low	15,169
Moderate	2,852
High	2

Project D5's 2020 Coyote Creek watershed ambient stream condition reassessment survey was fortunate and able to assess 9 AAs in July/August that were in the fire perimeter before the SCU Lightning Complex fire started: COY-005, COY-017, COY-023, COY-025, COY-033, COY-049, COY-065, COY-073, and COY-081. Fieldwork that occurred at Rancho Canada de Pala, a small Valley Water preserve in the Upper Penitencia sub-watershed, after the fire confirmed that fire effects on the soil substrate and vegetation in this location was predominantly very low to low in severity with pockets of moderate severity burn (Mallen *et al.*, 2020 unpublished data). In addition, the very southern portion of the watershed was affected by a different fire, the Crews fire (Figure 6), which burned a single CRAM AA (COY-041) that was assessed in 2010, but not in 2020 due to lack of landowner permission.

5.5. Valley Water Projects

Valley Water has conducted flood control, restoration, and mitigation projects in the Coyote Creek watershed before and from 2010 to 2020. The 2010 Coyote Creek Pilot Study (EOA and SFEI, 2011) listed projects in its appendix. These projects are intended to address flooding hazards, protect water supplies, and/or improve stream ecosystem conditions at reach scales. The larger projects from 2010 to 2020 include:

- Lower Silver Creek - Approximately 4.6 miles in length from the confluence with Coyote Creek to Lake Cunningham: Enhancements included increased wetland, riparian, and shaded riverine aquatic (SRA) habitat.
- Lower Berryessa and Calera Creeks (E3) - Approximately 1.7 miles through Milpitas from the Lower Penitencia Creek confluence and 2.1 miles of Calera and Tularcitos Creeks. Phase 1 to Abel Street completed in 2016 and Phase 2 to Calaveras Boulevard completed in 2020. Construction along Calera Creek begins in 2021. More wetland than expected grew back in the constructed project reaches, especially in the downstream end.
- Upper Berryessa Creek - Approximately 2 miles in length from Calaveras Boulevard to I-680 with the USACE; temporary impacts, and increased wetland habitat as of 2020.

- SMP bank repair, minor maintenance, and vegetation management are mostly temporary and localized impacts mitigated within the watershed. Thompson Creek requires larger and periodic maintenance work; alternating banks in different years. Vegetation management to remove invasive and non-native plants, especially giant reed (*Arundo donax*) is actively done on Valley Water property and easement under SMP's Invasive Plant Management Program (IPMP): Completing or in the process of removing approximately 18 acres of invasive vegetation from 2014 to 2020. The Safe, Clean Water Project D2 is also involved on a smaller scale in this effort in partnership with the City of San Jose. Giant reed removal was also part of the first SMP starting in 2000. Valley Water purchased and manages open space for SMP mitigation in the upper Coyote Creek watershed.
- The Lake Cunningham and Coyote Creek Flood Protection projects were off-channel activities with little to no sizable impacts to wetlands or riparian habitats, but in the buffer zones. The Coyote Creek Flood Protection Project (E1) covering approximately 9 miles of Coyote Creek was in the planning and stakeholder engagement phase in 2020.

Despite the number of stream restoration, enhancement or flood management projects that occurred in the 10 years between survey periods, the amount of stream resources affected was relatively small (just over 10 miles per above) compared to the scale of the watershed survey (more than 2,860 miles of streams).

The D5 Project's watershed based ambient stream condition assessments are not designed to track localized change in condition, but intended to characterize and track the overall ecological conditions of streams in a watershed and landscape context. The ambient survey results are intended to be used to evaluate and track these kinds of restoration and mitigation projects within a watershed context. Therefore, individual projects should utilize CRAM within the project footprint to capture improvements in conditions directly related to the project, and compare those improvements with the watershed-scale ambient condition.

6. Methods

No new Level-1 geospatial data of vegetation or aquatic resources in the Coyote Creek watershed were available at the time of reporting to compare the 2010 Coyote Creek Pilot Study (EOA and SFEI, 2011) and 2020 reassessment survey (see data sources below). The geospatial data presented in this report include the same sources as the Five Watershed Synthesis Report (Lowe *et al.*, 2020) and focus specifically on the Coyote Creek watershed.

The Level-2 CRAM stream condition reassessment employed the same probability-based Generalized Random Tessellation Stratified (GRTS) sample draw sites (also called CRAM assessment areas or AAs in this report) developed for the 2010 Pilot Study with a new updated survey design that focused on characterizing the overall ecological condition of streams across the *whole Coyote Creek watershed* and its PAIs (*Hills* and *Valley)*. The 2010 ambient assessment also covered the whole Coyote Creek watershed and Upper Penitencia Creek as a PAI.

A separate memo, Safe, Clean Water And Natural Flood Protection Program: Priority D, Project D5: Coyote Creek Watershed Ambient Stream Condition Survey Design and Sample Draw Original 2010 Survey and 2020 Reassessment Strategy (Lowe *et al.*, 2020b), describes specific technical information about the original 2010 Pilot Study GRTS survey design and sample draw that was the basis for the 2020 reassessment strategy. It is briefly summarized in the Level-2 Methods section below.

6.1. Level-1: Landscape Analysis of Streams and Wetlands based on Geospatial Data

6.1.1. D5 WATERSHED EXTENTS

The Coyote Creek Watershed Reassessment survey employed the same watershed extent previously described in the Five Watershed Synthesis Report (Lowe *et al.* 2020). For each baseline watershed assessment completed by Project D5 since 2010, the project team reviewed and modified Valley Water's 'SCVWD Major Watersheds' GIS-layer (2011)[4] dataset. Valley Water engineers have periodically examined and updated watershed and subwatershed boundaries to consider storm drain connections, and other drainage changes over the past decade. In general, the D5 team modified the boundaries to: 1) clip to the Santa Clara County boundary to ensure stream channels that followed the County boundary were included within the watershed extent; and 2) remove the majority of the tidal baylands and tidal streams as defined by BAARI's stream layer.

6.1.2. BAY AREA AQUATIC RESOURCES INVENTORY (BAARI)

BAARI (v.2.1, SFEI ASC, 2017) GIS data were used in the Level-1 analyses. The aquatic features within the Coyote Creek Watershed were not substantially changed between the BAARI version used in 2010 vs. version 2.1. BAARI is an intensification of streams (linear features) and wetland areas (polygonal features) compared to the National Hydrography Dataset (NHD), National Wetlands Inventory (NWI), and Valley Water's "Creeks" geospatial datasets. BAARI was initially completed by SFEI in 2010 and used high-resolution (1m) remotely sensed imagery from the National Agriculture Imagery Program (NAIP 2005 and 2009) and a variety of ancillary data sources, including USGS topographic maps, municipal storm drain layers, DEM-derived

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[4] Publication Date: 09/01/2011 (internal draft)

hillshade, Google Earth, and the National Hydrography Dataset (NHD). Subsurface stormdrain data incorporated into BAARI were from the Creek and Watershed Map collection published by the Oakland Museum[5]. Data for that map collection was collected by William Lettis and Associates (WLA).

Channels were attributed with Strahler stream orders (Strahler 1952, 1957), which were helpful in developing the sample frame (or basemap) for the CRAM stream survey design and sample draw in 2010 because 1st order channels are not assessed in CRAM based watershed surveys (explained further in the next section). BAARI data were used to characterize the amount, distribution and diversity of streams and wetlands in the watershed as reported in the Five Watershed Synthesis Report (Lowe *et al.*, 2020), EcoAtlas Landscape Profile tool, map figures and summary tables presented in this report.

6.1.3. RIPZET

To estimate functional riverine riparian extents, Project D5 employs the Riparian Zone Estimation Tool v2.0 (RipZET, SFEI, 2015). RipZET was officially developed after 2010 and is not the same as its preceding RAMT tool employed by the initial Coyote Creek Pilot Study (EOA and SFEI, 2011). RipZET[6] employs geospatial vegetation, aquatic resource, and elevation data within a GIS and Excel platform to estimate functional riparian habitat extents based on topographic slope, and the density and height of mapped vegetation. RipZET has three main components: core code, modules, and output. The core code prepares the input GIS layers used by the Hillslope and Vegetation Processes modules, which are run separately for a specific geographic area defined by the user. Each module generates a GIS dataset that represents riparian habitat extent based on their respective modelled riparian functions. Project D5 uses two of RipZET's modules to estimate functional riparian width:

1. Hillslope – Estimates functional riparian width in steep headwater channels based on adjacent hillslope gradient. Targeted functions include large woody debris input and coarse sediment input.
2. Vegetation – Estimates functional riparian width in all channel types based on adjacent hillslope gradient and mature vegetation height. Targeted functions include bank stability, channel shading, and run-off filtration

The maximum riparian habitat extent from both modules is summarized according to the concept of "functional riparian width", which are ecological functions a riparian area can provide depending on its structure, including topographic slope, density and height of

[5] http://explore.museumca.org/creeks/crkmap.html

[6] https://www.sfei.org/projects/ripzet#sthash.esD6yiAf.dpbs

vegetation, plant species composition, and soil type. Some key riparian functions include wildlife support, runoff filtration, input of leaf litter and large woody debris (allochthonous inputs), shading, flood hazard reduction, groundwater recharge, and bank stabilization (Collins *et al.* 2006). For any given structure, the levels of specific functions within a riparian area depend on its width and length. Wider and longer riparian areas tend to support higher levels, and a greater number of riparian functions than shorter and narrower areas (Wenger 1999). The concept of functional riparian width is central to the riparian definition recommended by the National Research Council (NRC 2002) and integral to many riparian design and management guidelines (e.g., Johnson and Buffler 2008).

RipZET GIS outputs are not regarded as riparian maps per se because they do not depict actual boundaries based on field observations. Instead, they represent modelled areas, where riparian functions are likely to be supported based on hillslope and vegetation processes. The module outputs can be overlaid to estimate the maximum riparian extent for all riparian functions represented by both modules.

6.1.4. HISTORICAL ECOLOGY

Similar to the 2010 Coyote Creek Pilot Study (EOA and SFEI 2011), GIS data from the Coyote Creek Historical Ecology Study (Grossinger *et al.,* 2006) was used to compare historical and modern stream miles within the historically mapped valley floor extent. The historical stream network was reconstructed in a GIS for the valley floor based on interpretation of historical records including maps, land grants, and court documents. Some validation from historical aerial photography was also conducted. The historical ecology GIS maps represent a time period just prior to European settlement.

6.1.5. OWNERSHIP

Valley Water-owned and easement GIS data were provided to SFEI and accessed in June 2021. In addition protected lands, and conservation easements (based on CPAD and CCED GIS datasets, version December 2020) were used to characterize the amount and distribution of streams owned by Valley Water and that are protected within the Coyote Creek watershed.

In summary, the following GIS datasets were used in the Level-1 assessments. These data were developed by SFEI, provided by Valley Water, or are publically available online as referenced below:

- Bay Area Aquatic Resources Inventory (BAARI *streams* & *wetlands* layers v.2.1): BAARI mapping methods (SFEI 2011) and GIS data available at: https://www.sfei.org/baari
- Santa Clara County line GIS layer (Valley Water 2007)
- Valley Water's Stream Maintenance Program (SMP) 1,000-foot elevation boundary. The SMP boundary is based on 2006 LiDAR contour datasets (Valley Water 2006)

- Valley Water-owned and easement lands from Valley Water's fee title and easement GIS layers (2009 [Unpublished and updated on an ongoing basis]). The data were accessed in June 2021.
- California Protected Areas Database (CPAD, GreenInfo Network December 2020)
- California Conservation Easement Database (CCED, GreenInfo Network December 2020)
- Santa Clara County Historical GIS Data. SFEI, 2008-2015. "Santa Clara Valley Historical Ecology GIS Data version 2". Data are available to download[7]. The final Historical Ecology study report was completed by SFEI in 2010 and is available online[8] (Grossinger *et al.* 2006): *Historical Vegetation and Drainage Patterns of Western Santa Clara Valley: A technical memorandum describing landscape ecology in Lower Peninsula, West Valley, and Guadalupe Watershed Management Areas*.
- The United States Department of Agriculture (USDA) Forest Service CALVEG (Zone 6 - Central Coast) data was used by RipZET to assign tree heights to estimate stream riparian extents using the Vegetation Processes module.
- USGS National Elevation Dataset (10-meter digital elevation model or DEM). Available at: https://lta.cr.usgs.gov/products_overview/
- US and Canada Major Roads dataset, Tele Atlas North America (ESRI 2010)

6.2. Level-2: Rapid Assessment of Stream Condition Methods

6.2.1. CRAM

CRAM is a standardized, statewide Level-2 method to assess the overall condition of streams and wetlands. CRAM provides numerical scores to estimate the overall potential of a wetland and its adjacent riparian area to provide levels of the ecological services expected of the area given its type, condition, and environmental setting. CRAM scores are based on visible indicators of physical and biological form and structure relative to statewide reference conditions. Project D5 applies the CRAM Riverine module to assess streams in the watershed (for field methods, see: https://www.cramwetlands.org/documents#field+books+and+sops).

[7] http://www.sfei.org/content/santa-clara-valley-historical-ecology-gis-data

[8] https://www.sfei.org/coyotecreek

6.2.2. GRTS SURVEY DESIGNS (2010 AND 2020)

The watershed-wide stream condition assessment based on CRAM employed a statistically random survey design and sample draw to characterize the overall ecological condition of streams in the Coyote Creek watershed in Santa Clara County with a known level of confidence. The Coyote Creek Watershed sample draw was completed in 2010 and employed the USEPA's GRTS survey design and analysis methods and the *spsurvey* package in R (Diaz-Ramos *et al.* 1995, Stevens and Olsen, 2004, Kincaid and Olsen, 2020). The survey targeted Strahler stream orders 2 and higher as represented in the BAARI streams GIS dataset. CRAM sites (or AAs) were randomly allocated across the stream network (or sample frame) and assigned a 'sample weight' using a stratified survey design to disproportionately allocate sites within the Upper Penitencia subwatershed and the rest of the Coyote Creek watershed as a whole, and by stream orders.

Stratification can improve the efficiency of a GRTS survey design while maintaining its unbiased nature. By increasing the proportion of AAs in areas of particular interest (i.e., specific PAIs or higher stream orders in the Valley), one can improve the confidence levels around the means in those areas, while preserving the ability to evaluate overall condition of streams in the whole watershed. The 2010 and 2020 Coyote Creek watershed assessments allocated CRAM AAs differently across different PAIs and by Strahler stream order (Figure 7):

- The original 2010 baseline survey design targeted 76 CRAM AAs including an intensification of 30 AAs within the Upper Penitencia subwatershed in order to develop a separate cumulative distribution function (CDF) estimate of streams in that PAI as compared to the watershed as a whole. CRAM field assessments were conducted with CRAM Riverine Module v5.0.2 (Collins *et al.*, 2008).
- The 2020 reassessment survey design team elected to focus more resources in the Valley (below the SMP 1,000-foot elevation boundary) and not separately reassess the Upper Penitencia Creek watershed because the large restoration effort planned has not yet been implemented. The 2020 survey targeted 77 AAs including 30 AAs in the Hills region and 47 AAs within the Valley. In addition, the design maximized the number of revisit sites to improve statistical comparisons between survey periods. CRAM field assessments were conducted with CRAM Riverine Module v6.1 (CWMW, 2013b).

Figure 7 shows the distribution of targeted CRAM AAs based on the 2010 and 2020 stream condition survey designs including within their respective PAIs.

Logistical planning and implementation of the CRAM stream condition field assessments involved evaluating each target AA to make sure it was accessible and that field teams had permission from landowners to conduct the site assessments. Oversample sites replaced target sites that were dropped because they were inaccessible or not able to be assessed for any reason.

In 2020, Valley Water and its consultants initially targeted 77 GRTS AAs in the Coyote Creek watershed and evaluated 139 candidate AAs for access. Of the evaluated AAs, 53 were dropped and replaced with oversample AAs, 8 were non-target sites[9] (totaling 61 dropped

[9] Dropped (or rejected) AAs were not assessed because of the following reasons: permission to enter was denied, site was inaccessible (e.g., steep terrain, excessive distance from road, or inundated with impenetrable noxious vegetation [e.g., blackberries, poison oak]), or the site turned out to be non-target meaning that the location either in a reservoir, culvert, or other non-riverine habitat did not fit the definition of a viable CRAM Riverine assessment site.

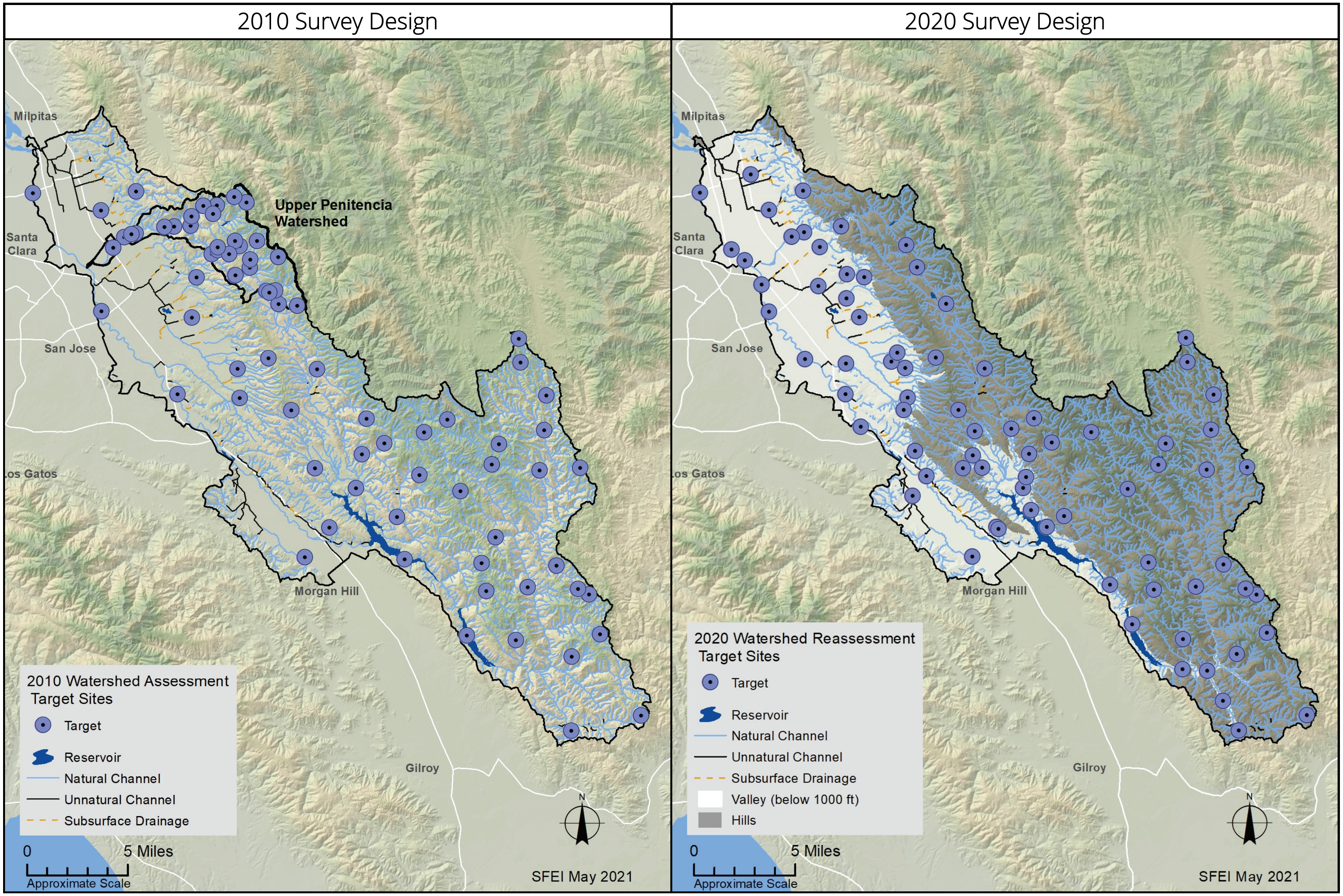

Figure 7. Distribution of Coyote Creek watershed target sites 2010 (n=76) and 2020 (n=77) ambient stream condition GRTS survey designs

AAs). In the end, field teams successfully assessed (or completed) 78 AAs, of which 52 were revisit sites from the 2010 ambient survey. Revisit sites were used in the GRTS *spsurvey* change analysis to evaluate change in overall stream conditions between survey periods. Table 6 summarizes the final number of AAs that were targeted, successfully assessed, and evaluated but dropped within the Hills, Valley, and watershed as a whole for the 2010 and 2020 stream condition surveys employing CRAM.

Table 6. Summary evaluated CRAM AAs including the number that were initially targeted, dropped, and successfully assessed for the 2010 and 2020 Coyote Creek watershed stream condition surveys.

Primary Area of Interest (PAI)	2010				2020			
	Evaluated AAs	Targeted AAs	Dropped AAs	Assessed AAs	Evaluated AAs	Targeted AAs	Dropped AAs	Assessed AAs (revisited)
Hills	81	52	34	47	63	30	31	32 (29)
Valley	40	24	10	30	76	47	30	46 (23)
Total (whole watershed)	121	76	44	77	139	77	61	78 (52)

Figure 8 shows final distribution of successfully assessed versus dropped AAs for the 2010 and 2020 stream condition surveys employing CRAM. The AAs were spread geographically throughout the watershed, Hills and Valley region. There was a noticeable gap in the center of the watershed: Hills and Valley north of Anderson Reservoir (Las Animas Creek and Packwood Creek watersheds) were not sampled in 2010 or 2020 due to issues including landowners denying entry, or target AAs not reasonably accessible. The 2020 Coyote Creek stream condition reassessment was fortunate because CRAM field teams had successfully assessed most of the planned AAs in the Hills region of Henry W. Coe State Park by early August before the SCU Lightning Complex wildfire started on August 18th. Many of these sites were not actually burned in the fire, but if they had not yet been assessed, field teams would not have been able to access the sites after the fire started. Ultimately, 4 targeted sites located outside of the State Park in the fire zone were not sampled in 2020 because landowners had not yet granted permission to access their properties before the fire started, and were too concerned for safety after the wildfire was controlled. The final distribution of successfully assessed AAs was largely unimpacted by the 2020 wildfires in the region (see the wildfire section above). The next watershed reassessment scheduled for 2030-2035 may yield additional data on the effects of wildfire on stream conditions.

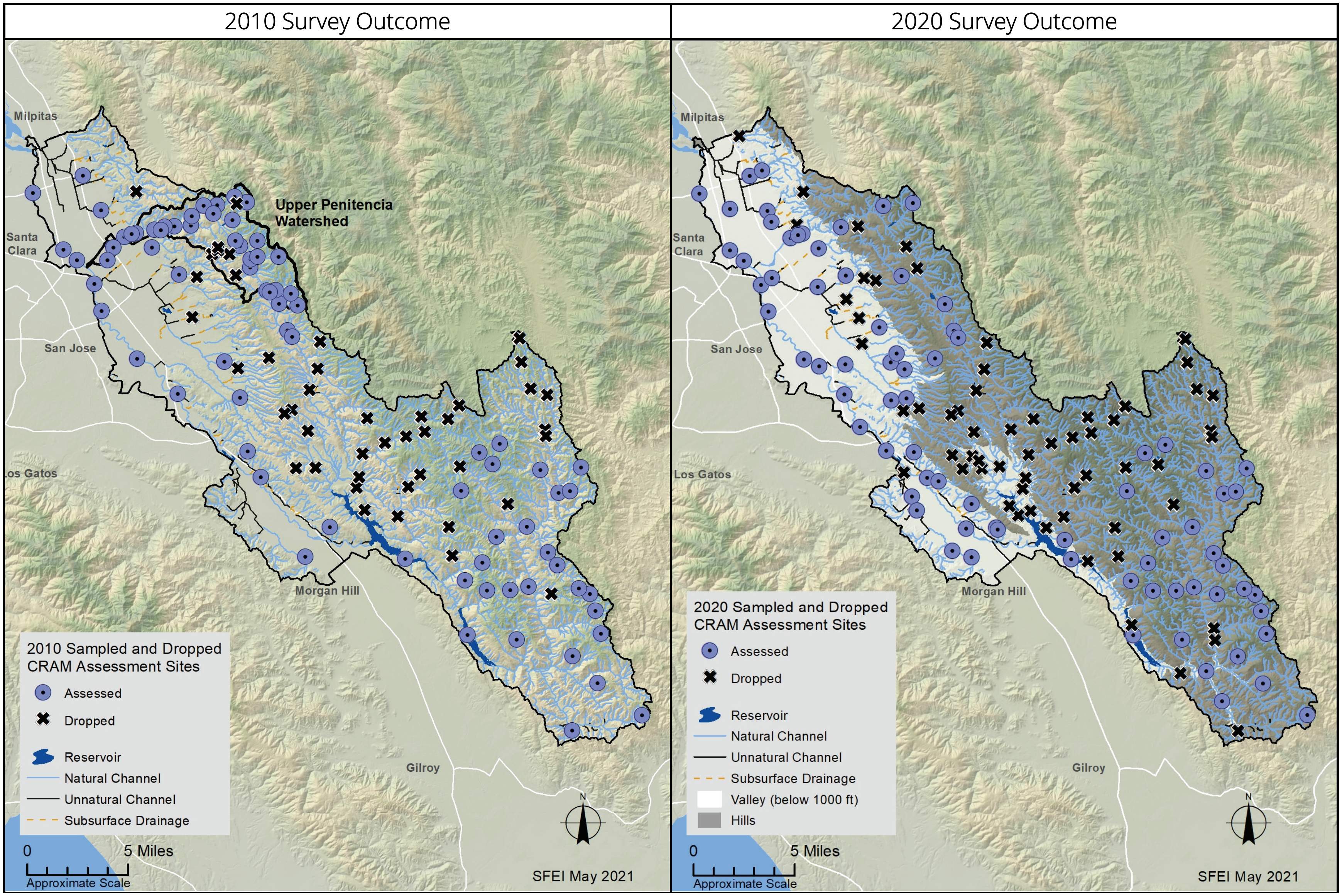

Figure 8. Coyote Creek watershed field assessment outcomes of the 2010 (n=77) and 2020 (n=78) ambient stream condition surveys showing successfully assessed CRAM sites and dropped sites

By applying GRTS and a statistically representative number of sample sites (AAs), Project D5 assumes inaccessible areas are sufficiently similar to accessible areas within the watershed and therefore, stream condition estimates in this and its other ambient surveys are representative of the whole watershed. The assumption that areas not sampled are similar to areas sampled is common for ambient surveys. More specifically, it is assumed that: 1) CRAM AAs are dropped due to random or unforeseen circumstances (e.g., physically inaccessible, permission to enter is denied by the property owner, site is not actually located on a stream that can be assessed using CRAM (culvert, reservoir), site does not meet the CRAM Riverine requirements); and 2) replacement AAs drawn from the oversample list maintain the spatial balance of assessments across the watershed (i.e., surficial stream network). To assure the second assumption holds, oversample AAs were selected in sequential order. However (in practice), the final distribution of assessed AAs often results in some areas being underrepresented. Sizable geographic gaps can occur when large landowners deny access.

For more specific information about the 2010 baseline survey and results, please refer to the EOA and SFEI (2011) technical report. For more information about the 2020 reassessment strategy please refer to the *2010 Survey and 2020 Reassessment Strategy* (Lowe *et al.*, 2020b), which also includes additional technical information about the original 2010 survey design and sample draw.

6.2.3. GRTS SURVEY DATA ANALYSIS EMPLOYING CRAM

When analyzed, CRAM stream condition field results from a GRTS design estimate the proportion of stream resources (miles of stream) that are likely to have a particular ecological condition score with a known level of confidence across the surveyed area (i.e., watershed as a whole and each PAI). Analyzed results are reported as CDFs that are either tabular or visual plots (described below).

The CRAM field assessments were conducted by trained CRAM Practitioners from ICF (including two CRAM Trainers), who completed 78 AAs between July and October 2020. CRAM scores were recorded on field sheets and entered into the online CRAM data management system (eCRAM[10]). Through the eCRAM data entry forms, CRAM assessment scores were verified for accuracy in data entry and completeness, and became publicly accessible online through EcoAtlas[11] (see Appendix F for more information about the EcoAtlas tools and how Project D5 is using them). The 2010 and 2020 CRAM data for both Coyote Creek watershed

[10] http://www.cramwetlands.org/

[11] Project Name = 'SCVWD Coyote Creek Watershed Stream Condition Assessment 2020'. (Note: CRAM assessments where the landowner requested results be kept private are not visible on EcoAtlas, however, results are calculated into EcoAtlas summary measures.)

surveys can be downloaded directly from EcoAtlas, and are also listed in Appendix A along with their associated site codes.

Two field intercalibration exercises were completed for the 2020 CRAM field season to document and compare consistency among the CRAM field Practitioners. Intercalibration exercises, for large surveys that employ multiple field teams, help evaluate and document inter-team variation. They also provide opportunities for additional CRAM training to help align Practitioners in field methods for scoring Metrics and reduce Practitioner-introduced variation, which is unavoidable in large surveys where many field teams are involved in data collection. The results of the CRAM intercalibration exercises were summarized and submitted to Valley Water in a separate memorandum.

6.2.4. CRAM ASSESSMENT - DATA QUALITY ASSURANCE REVIEW

The Coyote Creek reassessment was the first time a baseline watershed-scale stream condition survey employed both a GRTS design and CRAM. Beyond simply using CRAM scores to understand how individual AAs change over time, this was an opportunity to carefully compare revisit-site scores, evaluate CRAM field methodology evolution, and how consistently CRAM Practitioners applied the field observation methodology. Project D5's CRAM lead practitioner (Sarah Pearce, who also completed many of the 2010 assessments, thus was uniquely qualified for quality control and assurance) compared individual CRAM Metric Scores for the 52 revisit sites assessed in 2010 (Riverine Module version 5.0.2) and 2020 (Riverine Module version 6.1). The review indicated some systematic differences in scores between the 2 time periods, which triggered a more thorough evaluation of all the Metrics for all AAs assessed in both survey periods. Two types of inconsistencies were observed:1) methodological changes between CRAM Module versions; and 2) Practitioner error in either measurement or interpretation.

First, some methodological updates occurred in the Riverine Module between versions 5.0.2 and 6.1. The statewide CRAM Level-2 Committee in charge of Module updates carefully considers any changes in scoring methods to make sure that older CRAM scores can be crosswalked to an updated version, so that scores can be compared over time. Project D5 was able to rely upon the Level-2 Committee's documentation to crosswalk 5.0.2 scores to Version 6.1 (CWMW, 2013c). Specific metrics where minor changes in scoring or interpretation occurred include Stream Corridor Continuity, Percent of AA with Buffer, Buffer Condition, Structural Patch Richness, Topographic Complexity, Number of Plant Layers, Horizontal Interspersion, and Vertical Biotic Structure.

The project team was very judicious in their review and conservative in making updates, choosing to trust the data and decisions of the field teams. Where appropriate, the project team updated the 2010 (Version 5.0.2) scores, so they were consistent with Version 6.1 to standardize between survey periods. Updates were made only for Metrics that had clear and obvious differences due to the methodological changes and were well-documented (e.g., sketches and notes, or field photographs). Instances where decisions of the 2010 field team were not clearly documented (e.g., sketches of Horizontal Interspersion) were not changed. Using these criteria, 71 individual Metric scores from the 2010 survey were updated based on methodological changes in CRAM versions (6.6% of the total Metric scores).

Second, some scores reflected Practitioner error; either in measurement, interpretation, or data entry between the field datasheets and eCRAM. The project team reviewed results from both surveys by carefully inspecting field datasheets and field photographs at sites where a suspected metric error was identified. In some cases, conversations with the original field Practitioners about particular scores, and rationale for their initial decisions were discussed in order to arrive at a final score. In other cases, the project's lead CRAM Practitioners discussed the scores and made a final decision. Again, the project team was very careful and conservative; only updating scores where an obvious error was made, and that had clear supporting documentation (e.g., sketches, field photographs, discussion with Practitioners). This resulted in updates to an additional 23 Metric scores from the 2010 survey, and 28 Metric scores from the 2020 survey.

The updated 2010 Coyote Creek CRAM Scores were run through the GRTS survey analysis process to update the CDF estimates and compare them with the 2020 reassessment survey to evaluate change over time. As a result, the 2010 CDFs and estimates of the proportion of stream miles in good, fair, and poor condition previously reported by Project D5, in the Five Watershed Synthesis Report (Lowe *et al.*, 2020), will not match the updated 2010 condition summaries in this report. While the differences were not significantly different, the Project Team believed it was appropriate to take the time to review and update the 2010 CRAM assessment scores to make sure they were consistent with the Riverine Module version 6.1 employed in 2020.

6.2.5. CRAM DATA ANALYSES FOR GRTS SURVEYS

Analysis of the Coyote Creek watershed CRAM data evaluated Index and Attribute scores, applying the Metric scores and their updates noted above. Sample weights were adjusted employing the original 2010 sample draw weights to account for new survey design and replacement sites. Statistical analyses were conducted with the *spsurvey* statistical library[12] (Kincaid and Olsen 2020) and R programming language (version 4.0.4), which is a software environment for statistical computing and graphics specific for GRTS survey designs. The basic *spsurvey* analysis outputs consisted of CDF estimates, plots, and percentile tables of CRAM Index and Attribute scores. To compare differences in CDF estimates between regions, and

[12] https://cran.r-project.org/web/packages/spsurvey/index.html

over time, *spsurvey* includes 2 statistical tests: 1) Wald and Rao-Scott statistical test or Wald F test (Kincaid 2020, Gitzen *et al.*, 2012); and 2) *change analysis* test:

- The Wald and Rao-Scott statistical test (or Wald F test) is a function in the GRTS *spsurvey* data analysis package. It is used to identify significant differences between the CDF estimates and was run to evaluate if the 2010 baseline and the 2020 reassessment surveys were statistically different for the whole watershed and its PAIs (Hills and Valley).
- The *change analysis* test can be applied to both the categorical (e.g. good, fair, poor condition class data) and continuous (e.g. the mean CDF estimate) variables. *spsurvey's change analysis* function takes into account any paired revisit sites in effectively a paired t-test. The 2020 Coyote Creek reassessment survey included 52 revisit sites.

An ambient survey CDF enables a user to characterize and compare the percent of the resource (in this case – stream miles within a watershed or PAI) that has a specific CRAM condition score (or less) with a known level of confidence. Figure 9 presents *example* CDF estimates for a watershed stream condition survey employing CRAM. The solid black and blue lines indicate the estimated percentage of stream miles in the watershed (y-axis) that have specific CRAM Index or Attribute Scores (x-axis) or less - because the estimates are cumulative. The dashed and dotted lines indicate the upper and lower 95% confidence limits around the CDF estimates. Reading the horizontal and vertical arrows for the black CDF example, one would say that 50% of the streams in the watershed have a CRAM Score of 77 or lower. Interpreting the red confidence intervals in the example CDF, one would say (with 95% confidence) that half of the streams in the watershed have a CRAM Score estimated to be between 73 and 80. Confidence intervals are generally wider when there is a lot of variation in condition within a surveyed area or when only a few sites (AAs) represent a large proportion of the surveyed area.

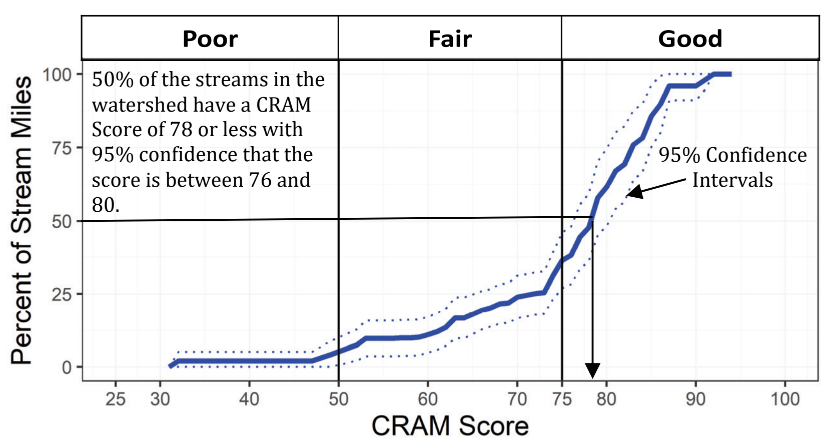

Figure 9. Example CDF estimate curve for a watershed-based stream condition assessment employing CRAM.

A CDF curve that is shifted toward the right (towards higher CRAM Scores on the x-axis) reflects relatively better ecological conditions and conversely a curve that is shifted to the left reflects relatively poorer ecological conditions (lower CRAM Scores). A convex downward curve (one that starts with a steep slope upward that decreases - not shown in Figure 9) would indicate a higher proportion of stream miles with low CRAM condition scores, compared to a convex upward curve (one that starts with a gradual upward slope that increases - as shown in Figure 9) indicates a higher proportion of stream miles with high condition scores. In this example, over 60 percent of the streams in the watershed are in good ecological condition.

CRAM employs 3 standard ecological health classes (also called condition classes) to characterize streams that are in 1) poor, 2) fair, or 3) good condition (CRAM Technical Bulletin CWMW, 2019), defined as tertiles of the maximum range of possible CRAM Index or Attribute scores. Poor condition scores range from 25 to 50, fair condition from 51 to 75, and good condition scores range from 76 to 100. These 'health classes' can be represented in bar charts and CDF plots as a way to bin the CRAM scores to facilitate reporting, comparison, and evaluation.

7. Results

Valley Water Project D5's Coyote Creek watershed 2020 reassessment results are presented below to address the management questions. Results are grouped into 2 sections addressing: 1) Level-1 landscape questions about the distribution and abundance of aquatic resources in the watershed; and 2) Level-2 questions on the status and estimated change in overall conditions of streams in the watershed based on the GRTS survey design, 2010 and 2020 CRAM field survey results.

7.1. Level-1 Distribution and Abundance of Aquatic Resources

Figure 10 shows the distribution of streams and wetlands (together, aquatic resources) in the Coyote Creek watershed from BAARI v2.1 (SFEI ASC, 2017). It includes the linear stream network (surficial natural and unnatural channels, and connecting subsurface drainage features) and polygonal wetlands (lacustrine (reservoirs, Lake Cunningham, Metcalf percolation ponds), depressional wetlands (ponds), playas, and slope wetlands. Tidal wetlands that connect the watershed to San Francisco Bay are not included in this assessment and therefore, this map does not characterize the tidal wetland extents within the adjacent Baylands.

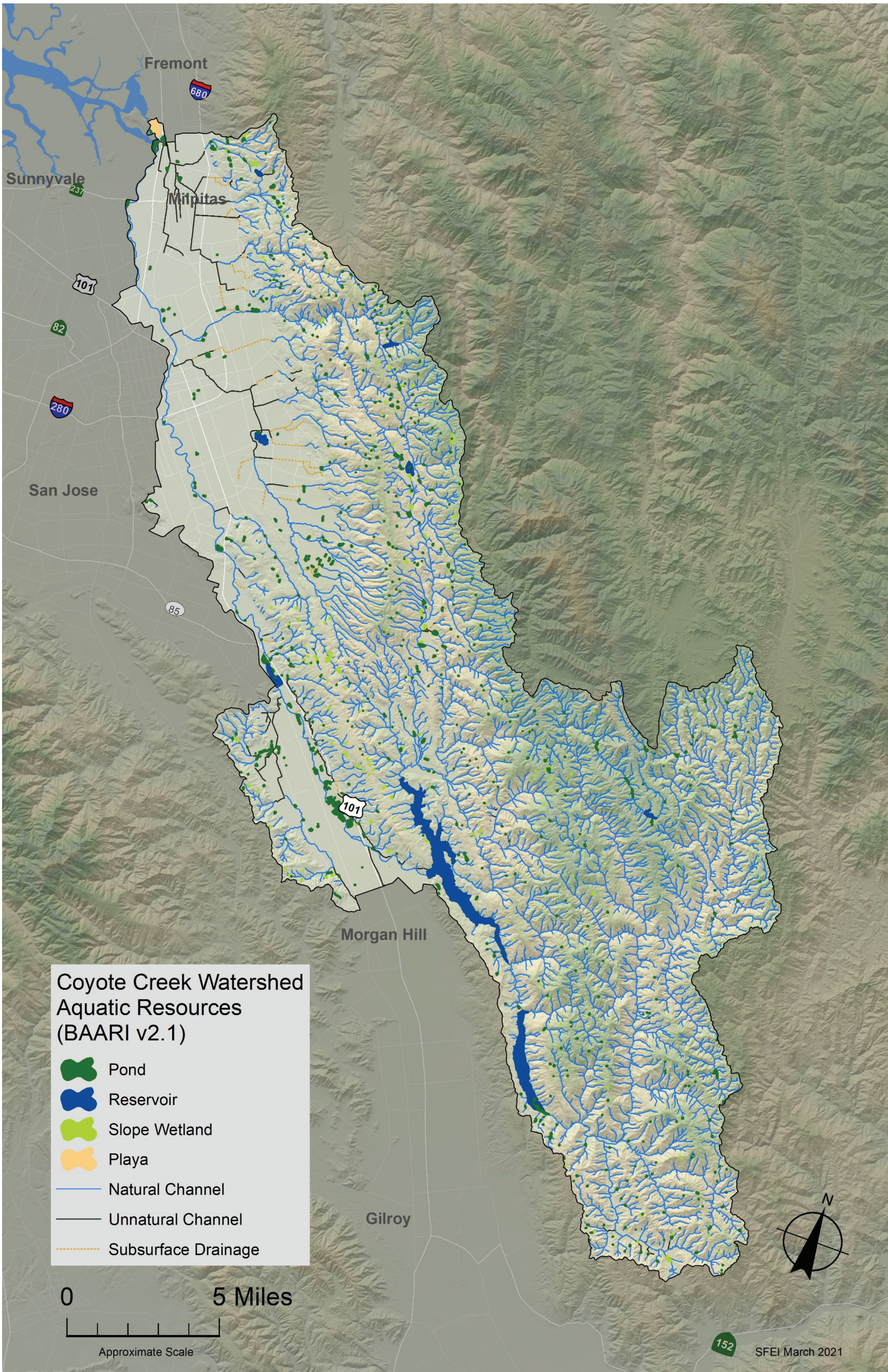

Figure 10. Distribution of aquatic resources including streams and wetlands in the Coyote Creek watershed mapped from BAARI v2.1. Note that wetland polygons and stream lines are exaggerated in size to increase visibility.

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The following Level-1 management questions were addressed based on these spatial data.

7.1.1. HOW MANY MILES OF STREAMS ARE THERE IN THE COYOTE CREEK WATERSHED AND ITS PAIS?

The Coyote Creek watershed encompasses about 350 square miles (224,228 acres, 90,742 hectares) and includes about 2,863 miles[13] (4,608 kilometers) of fluvial streams, tidal channels and subsurface drainage channels based on BAARI v2.1 (Strahler stream orders 1 through 8). First order streams comprise about 1,615 miles (over half of the total miles) and mostly located in the headwaters of the upper watershed. Table 7 summarizes the miles of streams in the Coyote Creek watershed and its PAIs by stream network type as defined in BAARI v2.1.

Table 7. Miles of streams in the Coyote Creek watershed and its PAIs (Hills and Valley) by stream type based on BAARI v2.1 (SFEI ASC, 2017)[10]

Stream Type	Hills	Valley	Total
Fluvial Natural	2,178	588	2,766 (97%)
Fluvial Unnatural	3	62	65 (2%)
Tidal Natural*	0	2	2
Tidal Unnatural*	0	2	2
Subsurface Drainage**	1	27	28 (1%)
Total miles	2,182	681	2,863
Percent of watershed	76	24	100

* Lists only the miles of tidal channels within the Coyote Creek watershed extent defined by Project D5. It is not representative of the amount of natural or artificial tidal channels within the Baylands. Note that the natural and unnatural stream types are not consistent with modified and unmodified channels defined by SMP.

** The subsurface drainage reported in BAARI are largely the culverted streams that support the watershed stream network as defined in BAARI[14].

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[13] The total channel network length of 2,863 miles is higher than the 2,818 miles reported in the Five Watershed Synthesis Report (Lowe *et al.*, 2020) because it includes all channels mapped in BAARI v2.1: Fluvial Natural = fluvial channels; Fluvial Unnatural = ditches and engineered channels; Subsurface Drainage; Tidal Natural = tidal channels; Tidal Unnatural = tidal ditches; tidal engineered channels, plus a segment of ~1.4 miles of Cochran Channel (not part of BAARI stream network) paralleling Highway 101 from the drainage divide with Llagas Creek until it joins Coyote Creek at the farthest upstream crossing of Highway 101. The total 2,863 miles is also higher than the 2,830 miles reported in the 2010 assessment (EOA and SFEI, 2011) by 33 miles. These differences were difficult to trace and could be a result of updates to the Guadalupe Coyote Creek watershed boundary during the development of the Guadalupe River Watershed survey design in 2012 or possible updates to BAARI since 2010. In addition, the Synthesis Report reported 1,593 miles of 1st order channels, choosing not to include fluvial ditches, engineered channels, subsurface drainages, and tidal channels (which are reported in this total) because these tend to occur in the Valley, and are not functionally equivalent to the 1st order channels in the Hills, which comprise the vast majority of the total stream length. By including all portions of the channel network, the total length of 1st order channels in this report is 1,615 miles, 22 miles more than the Synthesis Report. The 2010 report had 1,613 miles of 1st order channels, only two miles less than this report.

[14] Specifically BARRI defines fluvial subsurface drainage features as: "unnatural, below-ground channels in urban landscapes. Their locations can be indicated in ancillary datasets, including the USGS Digital Raster Graphic and local storm drain datasets. When the location of subsurface drainage is not obvious, 3rd order (or higher) channels are

The stream network within Coyote Creek watershed mapped in BAARI consists of natural and unnatural channels, and subsurface drainage that largely connects the upper watershed to the main channels within the urban valley floor (Figure 10). Natural fluvial channels meander and have variable width due to natural formative processes. These channels may have slight human modifications to them and they may be tidal. Unnatural, modified channels include any extensions to straighten or reroute the natural stream network. These features are visibly unnatural in aerial imagery (e.g., straight, sharp-angle turns, and non-sinuous, visible artificial substrate, and have little to no established woody vegetation). They can include flood control channels, as well as canals contributing to watershed drainage. The Coyote Creek watershed as a whole consists of about 97% natural channels.

7.1.2. HOW MANY ACRES OF NON-RIVERINE WETLANDS ARE THERE WITHIN THE WATERSHED AND ITS PAIS?

Table 8 summarizes the acres of non-riverine wetlands in the Coyote Creek watershed and its PAIs. Wetland types include depressional wetlands, lacustrine unnatural (reservoirs, Lake Cunningham, Metcalf percolation ponds), slope wetlands, and playas. The tidal wetlands in the adjacent Baylands area are not included in the study area.

Lacustrine systems (reservoirs/lake) comprise the largest total acreage, including Anderson and Coyote reservoirs, Cherry Flat Reservoir, Metcalf Ponds, and Lake Cunningham. Depressional wetlands comprise the next largest acreage and include numerous small stock ponds in the watershed, as well as Ogier Ponds, golf course ponds, ponds that are amenities (e.g., in housing developments and parks), and water treatment ponds[15]. Slope wetlands primarily occur in the foothills and headwaters, representing locations where shallow groundwater in the root zone supports wetland plants and have unidirectional flow, or emerge at the surface as a seep or spring. Slope wetlands in the Coyote Creek watershed are primarily seeps, springs, or wet meadows. And, the only sizable playa wetland is a large shallow and saline type of depressional wetland, located at the far northern end of the watershed (near the confluence of Coyote Creek with South San Francisco Bay), and separated from the creek by a

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extended beneath roads, buildings, playgrounds, or other man-made, non-agricultural land covers as seen on the NAIP imagery to connect with the downstream channel network."

[15] Wetland acres based on BAARI v2.1 do not match acres in the 2010 report (EOA and SFEI, 2011), especially for depressional wetland areas. Review of a draft summary table from the original 2010 BAARI GIS dataset indicated that the amount of depressional open water unnatural (DOWU) and depressional vegetated unnatural (DVU) wetland sub-types were more than two and a half times larger than current BAARI suggests. The reason for this discrepancy is unknown, but suspect a mapping error that was likely fixed in subsequent BAARI versions, thus does not represent actual loss of wetland acres within the Coyote Creek watershed. In addition, playa wetlands were added to BAARI after the 2010 report (based on review of the draft summary table from that time).

levee. Lake Cunningham was a playa or alkaline meadow, and saline soils with salt-tolerant wetland vegetation still exist in the park around its perimeter. Note that BAARI is a San Francisco Bay regional aquatic inventory and not based on jurisdictional wetland delineations at watershed, creek, reach, or site scales. BAARI includes more aquatic resources than the NWI, NHD, and Valley Water information sources.

Table 8. Total acres of non-riverine wetlands in the Coyote Creek watershed and its PAIs by wetland type based on BAARI wetlands v.2.1 (SFEI ASC, 2017)

PAI	*Depressional (pond)*	*Lacustrine (reservoir/lake)*	*Slope wetland*	*Playa*	*Total area*
Hills	194	75	44	0	313
Valley	385	1,847	19	60	2,311
Total area	579	1,922	63	60	2,624

7.1.3. WHAT IS THE EXTENT AND DISTRIBUTION OF THE STREAM-ASSOCIATED RIPARIAN AREAS?

Riparian areas adjoin waterways and water bodies, including wetlands (Brinson *et al.*, 2002), and they vary in function or value (i.e., ecological services or benefits riparian habitat provides) primarily depending on their width, such as wildlife support, runoff filtration, input of leaf litter and large woody debris, shading, flood hazard reduction, groundwater recharge, and bank stabilization (Collins *et al.*, 2006). Wider areas tend to provide higher levels of more functions. RipZET outputs estimated riparian habitat extents as GIS shapefiles. Table 9 lists the estimated miles[16] of stream riparian habitat in the Coyote Creek watershed by functional riparian width class (Collins *et al.*, 2006).

Riparian width classes reflect natural demarcations in the lateral extent of major riparian functions. A riparian function is assigned to a width class, if the class is likely to support a high level of the function. The estimated stream miles and acres of riparian area listed in Table 9 are based on the output from the RipZET vegetation module. Figures 11.A and B chart the miles and acres of riparian habitat by riparian functional width class for vegetation and hillslope processes that are shown in Figure 12.

[16] Note: Stream lengths associated with each riparian width class were calculated for the left and right banks separately. Therefore, the estimated riparian stream miles are the sum of both banks divided by 2. Total miles in Table 9 will not sum to the total stream network length (flow-line down the thalweg of channels), partly because the shape of the stream network is slightly altered by buffering the GIS-based thalweg flow-line to estimated left and right stream banks, and partly because subsurface drainage features are not included in the estimate of riparian extents.

Table 9. Estimated miles of streams with adjacent riparian areas, acres of riparian habitat, and ecological services provided for each of the 5 in the Coyote Creek watershed

Riparian Width Class (m)	*Miles (Km)*	*Acres (Ha)*	*% Total Length*	*Shading*	*Bank Stabilization*	*Allochthonous Input*	*Runoff Filtration*	*Flood Dissipation*	*Groundwater Recharge*	*Wildlife Support*
0 - 10	372 (598)	483 (195)	31							
10 - 30	415 (668)	7,809 (3,160)	35							
30 - 50	359 (578)	11,486 (4,648)	30							
50 - 100	38 (61)	1,886 (763)	3							
>100	9 (14)	927 (375)	1							

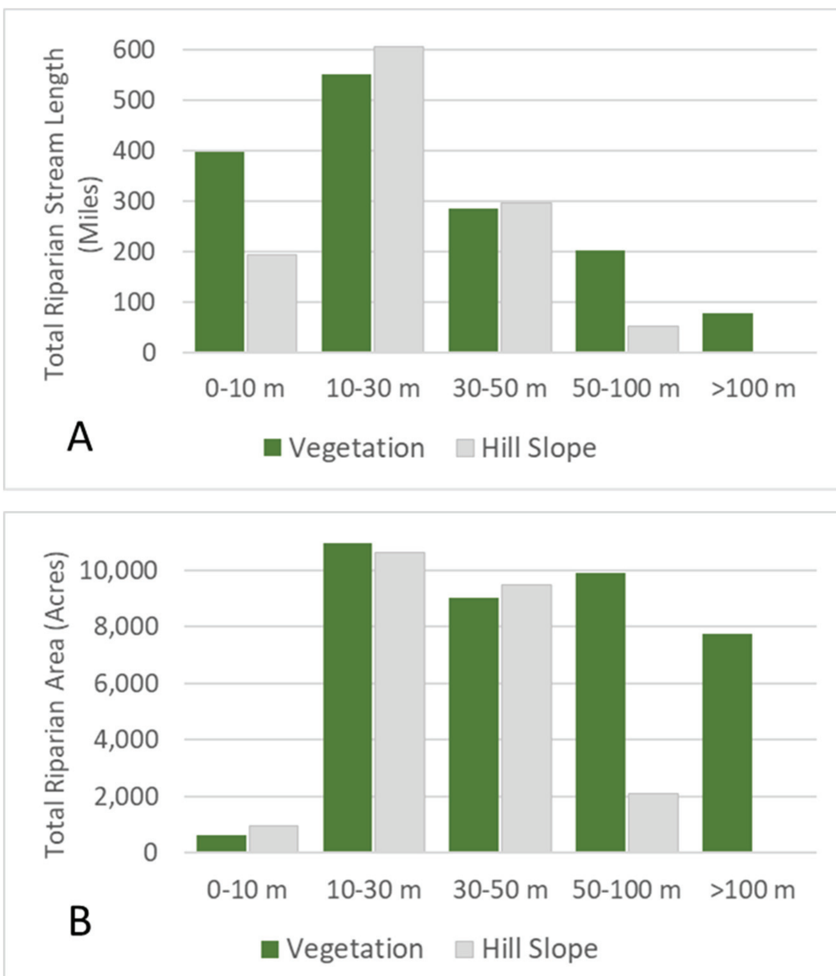

Figure 11. Estimated miles of surficial streams (A) and acres of riparian area (B) by riparian functional width classes (m = meters).

Figure 12 is a map of the RipZET vegetation and hillslope module outputs, which overlays the extent of vegetation processes (green) on top of the riparian hillslope processes (brown). In general, hillslope riparian functions do not extend as far as vegetative riparian functions, except when the hillside is very steep, as can be seen in the inset example areas (A and B).

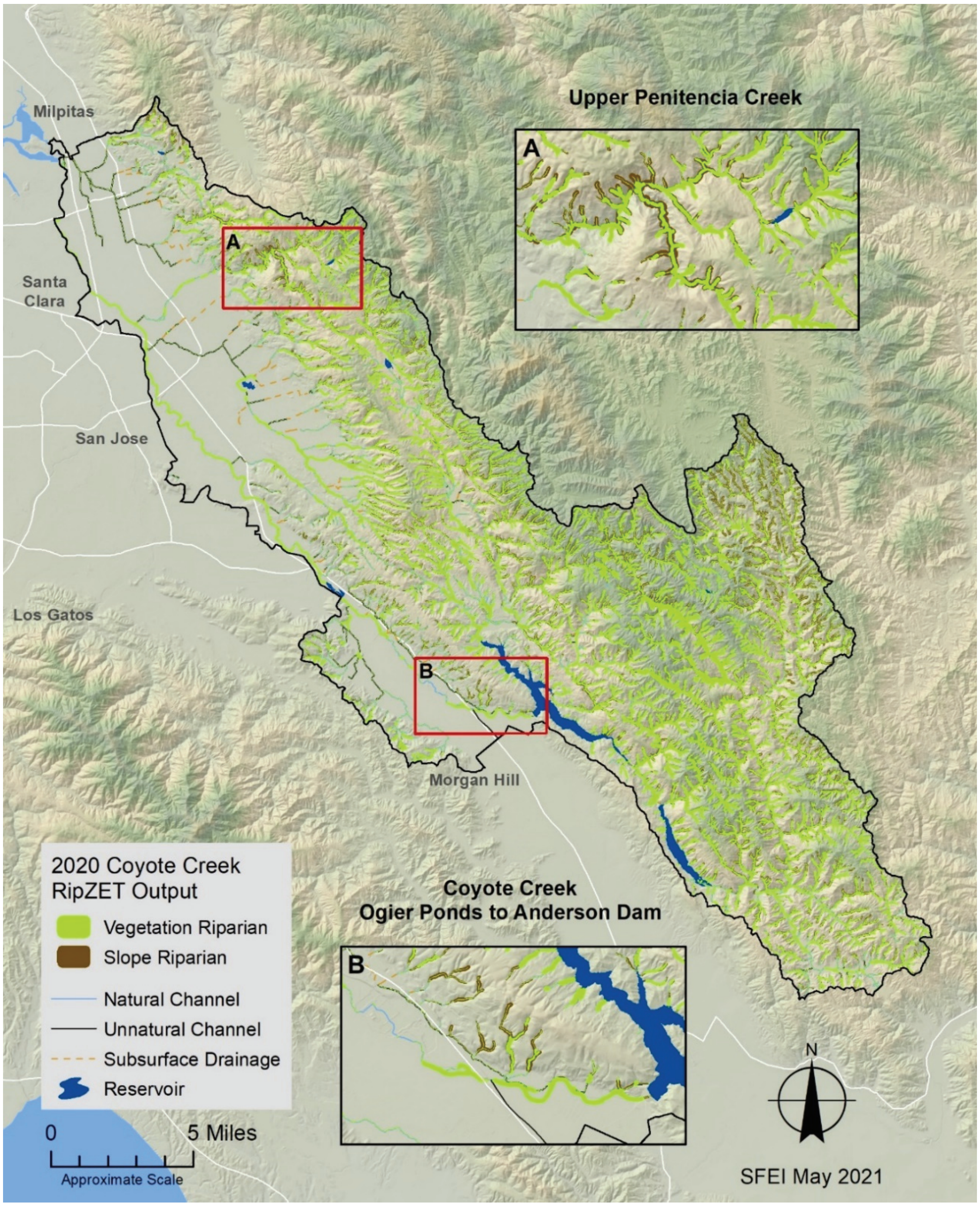

Figure 12. Map of RipZET output for the Coyote Creek watershed, which estimates the extent of riparian vegetative and hillslope processes along surficial streams in the watershed. The inset maps (A and B) show how hillslope and vegetation processes overlap each other.

7.1.4. HOW DO THE MODERN-DAY AQUATIC RESOURCES COMPARE TO HISTORICAL EXTENTS WITHIN THE LOW-LYING, VALLEY FLOOR AREA FOR WHICH THERE IS HISTORICAL ECOLOGY INFORMATION?

Historically, the Coyote Creek watershed had many more ponds (depressional wetlands), willow sausals, wet meadows and slope wetlands, which acted to dissipate and store floodwaters, and supported resident and migratory wildlife (Lowe *et al.*, 2020). However, Coyote Creek has largely maintained its course and character since the late 18th century before European contact: Exiting the headwaters through the canyon mouth near present-day Morgan Hill, and flowing north down the Santa Clara Valley to south San Francisco Bay. However, historically much of the length of Coyote Creek in the valley was dry at the surface for most of the year (Grossinger *et al.*, 2006). Figure 13 shows the historical (circa 1850) and modern aquatic resources in the Coyote Creek watershed within the valley for which there are overlapping historical ecology data from the Coyote Creek Historical Ecology Study (Grossinger *et al.*, 2006) and BAARI v.2.1 (SFEI ASC, 2017).

Reaches in Coyote Valley were shallow and had a braided, multi-thread morphology, interspersed with shorter, narrow reaches. This area supported valley oak savannah and sycamore alluvial woodland. Further downstream, the creek was broad and entrenched with steep (but stable) outer banks and inset benches, typically entrenched 10 to 20 feet below the valley surface (Grossinger *et al.*, 2006). The entire channel network width (including channel, bars, inset benches) were typically 500 to 1,500 feet wide. In the lowest reaches, before Coyote Creek became tidal, the creek was shallow, sinuous and meandering, intercepting near-surface groundwater, and having the character of a slow-moving, perennial lowland stream (Grossinger *et al.*, 2006). Coyote Creek had a natural levee that followed the creek's route and contributed to the formation of areas of wet bottomlands between the levee and toes of the tributary alluvial fans to the east. Coyote Creek was one of the few Bay Area streams to maintain a defined channel across the valley floor and directly join a tidal slough (Grossinger *et al.*, 2006). The tributary streams in the watershed were narrow and much thinner than the corridor of mature riparian trees along their channel. These tributaries were mostly disconnected and distributary, spreading out on the alluvial fan before reaching Coyote Creek. The alluvial fans and permeable valley soils allowed stormwater runoff and flood waters in the valley to recharge the local shallow aquifers (Grossinger *et al.*, 2006). This recharge of shallow groundwater supported wetlands (e.g., wet meadows, willow groves, seasonal ponds) further downslope. Historic riparian associated with the channels and wetlands was heterogeneous, including densely vegetated forest, open savannah/woodland, riparian scrub, large unvegetated gravel bars , and overall was much wider than present-day riparian widths (Grossinger *et al.*, 2006).

During early development of the valley, many of these distributary channels had a straight-line ditch constructed, so they were extended to Coyote Creek or the Bay. In addition, a number of

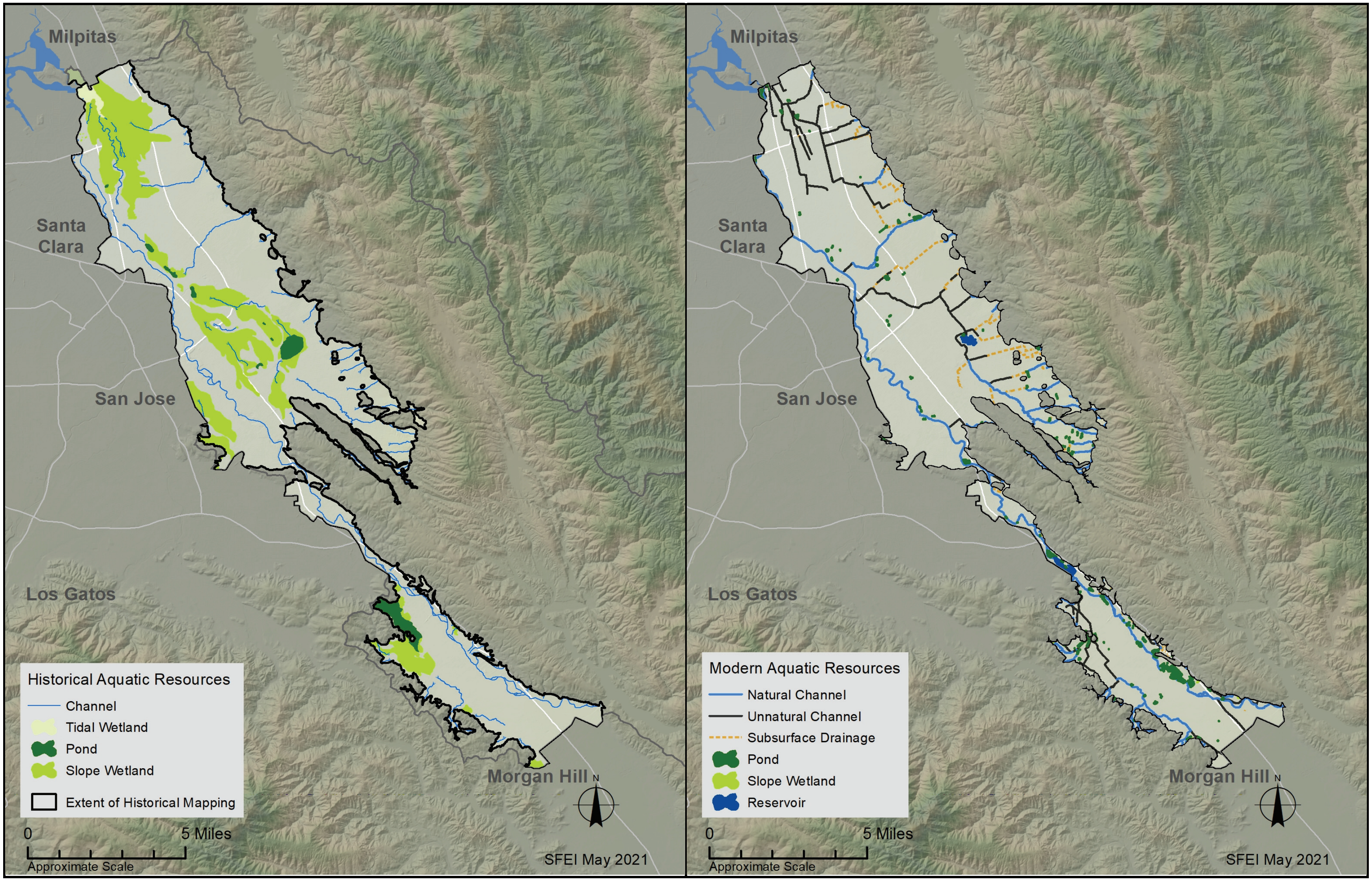

Figure 13. Maps of historical (circa 1850) and modern aquatic resources in the Coyote Creek watershed valley floor, where there are overlapping historical ecology spatial data from the Coyote Creek Historical Ecology Study (Grossinger *et al.*, 2006) and BAARI v.2.1 (SFEI ASC, 2017)

tributaries (Lower Penitencia, Arroyo de los Coches, Lower Berryessa, Lower Norwood creeks) were replaced with artificial and straightened creek channels. The creation of new, artificial drainage channels has significantly increased the total channel network length, especially for the lowland valley floor area. This sped the delivery of runoff to the Coyote Creek mainstem, increased delivery of sediment, and decreased recharge of shallow groundwater. The present day watershed also now includes an extensive storm drain system, further increasing the length of the channel network and delivery of runoff to the mainstem. These changes to the channel network have caused changes to the form and function of channels and caused incision, which has progressed upstream into the Hills (Lowe *et al.*, 2020).

Early agricultural practices to ditch and drain wetlands, and modern-day urban and residential development has fundamentally changed aquatic resources in the watershed with impervious surfaces and increased drainage causing loss of many groundwater supported wetland areas, and reducing overall residence time of precipitation that falls in the watershed. Increased hydrologic connectivity between channels in the foothills and valley has a number of important consequences. For example, unnatural connectivity caused significant changes in the form and function of channels throughout their watersheds. Ditching the alluvial fans lowered base elevations of channels in the foothills, causing them to deepen relative to their original banks. This increased heights of channel banks, destabilizing them, resulting in increased erosion with sedimentation downstream (Grossinger *et al.*, 2006). Ditching also decreased the frequency of overbank flooding and groundwater recharge, and increased the amount of drawdown of the water table near the channels.

The 20th century pumping of groundwater caused widespread subsidence in the Santa Clara Valley, which also affected streams and wetlands in the watershed. Figure 14 compares the amount of natural stream miles that existed historically (circa 1850) to current, modern-day streams in the valley floor, as depicted in Figure13 (above).

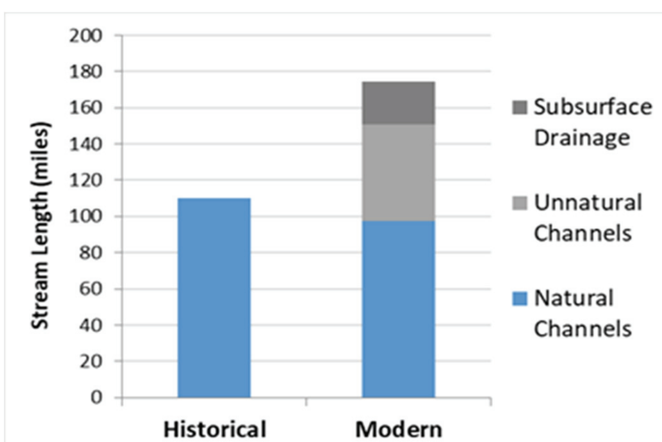

Figure 14. Comparison of the amount of historical and modern streams by stream type for the Coyote Creek watershed valley floor, as depicted in the maps in Figure 13

7.1.5. OTHER LANDSCAPE BASED LEVEL-1 QUESTIONS ABOUT STREAM OWNERSHIP AND ENVIRONMENTAL PROTECTION

- What amount and proportion of the streams are Valley Water-owned or managed through easements (based on Valley Water's fee title and easement GIS layers, data accessed June 2021)?
- What amount and proportion of the streams are in protected areas or conservation easements (based on CPAD and CCED)?

Figure 15 shows a map of Valley Water-owned and easement lands (Valley Water's fee title and easement GIS datasets, accessed in June 2021), protected lands and conservation easements (based on CPAD and CCED GIS datasets, version December 2020) within the Coyote Creek watershed.

Valley Water owns about 105 miles (about 4%) and easement access to another 32 miles (or about 1%) of the streams in the watershed (includes both the surficial and subsurface drainage network), located mostly along channels in the urban and residential areas within the Valley (Figure 15 and Table 10). Most of the streams that Valley Water owns are located within protected areas documented by CPAD and about half of Valley Water owned streams allow open public access (about 51 miles). The remaining owned stream reaches have no (or restricted) public access.

More than 60% of the stream network (about 1,766 miles) are on protected lands and conservation easements, the majority of which are located in the high elevation headwaters and southern portions of the valley. A large portion of the Coyote Creek mainstem channel, between Anderson Dam and south San Francisco Bay, is either owned by Valley Water or on protected lands owned by other agencies, such as Santa Clara County Parks and Recreation Department and City of San Jose. Valley Water also has management easements to access some channel reaches for stream maintenance and flood control purposes.

Table 10. Amount and proportion (parentheses) of streams within the Coyote Creek watershed and its two PAIs that are Valley Water-owned or easements, protected land, or conservation easements (based on CPAD and CCED, respectively)

Primary Area of Interest (PAI)	***Total Stream Miles***	***Valley Water Owned***	***Valley Water Easement***	***Within Protected Lands***	***Within Conservation Easements***
Valley	681	84 (12)	29 (4)	261 (38)	26 (4)
Hills	2,182	21 (1)	3 (0.1)	1,055 (48)	424 (19)
Total Watershed	2,863	105 (4)	32 (1)	1,316 (46)	450 (16)

Note: numbers will not sum to total stream miles as they are not mutually exclusive, but presented side-by-side for comparison.

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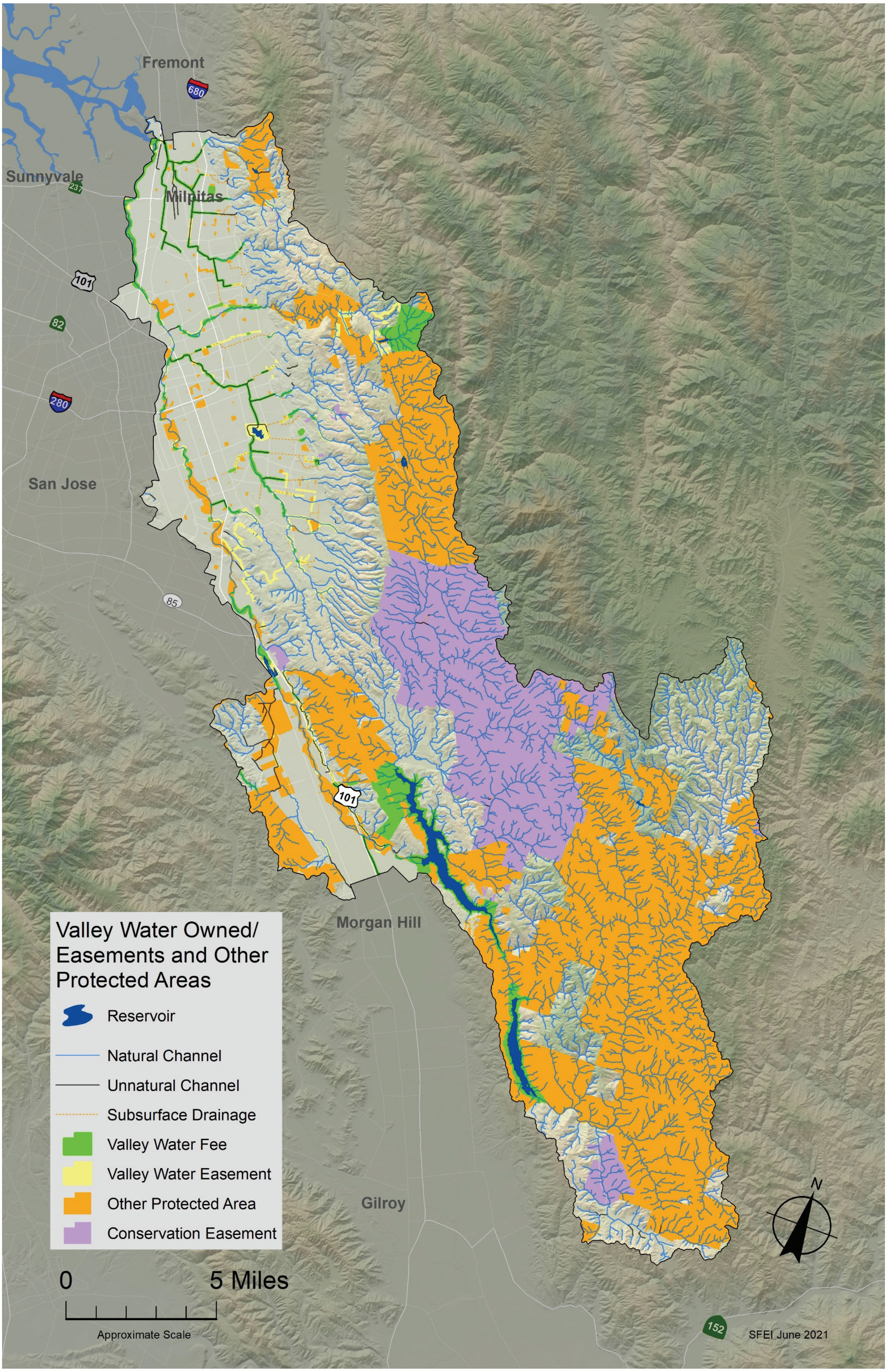

Figure 15. Map of Valley Water owned and easement lands, other protected areas, and conservation easements based on Valley Water's fee title and easements GIS datasets (accessed June 2021), CPAD and CCED (December 2020) data, and more recently acquired protected lands from the Open Space Authority within the Coyote Valley. The underlying map shows BAARI v2.1 streams and wetlands (SFEI ASC, 2017).

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7.2. Level-2 Rapid Assessment of Stream Ecosystem Condition

Valley Water's Project D5 ambient watershed surveys employed standardized monitoring methods to track the ecological condition of streams and their immediately adjacent riparian areas within the Coyote Creek watershed in 2010 and 2020. This section:

- characterizes the 2020 overall ecological condition of the streams in the whole Coyote Creek watershed, and its two PAIs (Hills and Valley);
- compares 2020 conditions to the baseline 2010 stream condition survey; and
- identifies ecological stressors that were observed in the field, and might be impacting stream health.

The GRTS and CRAM survey results are presented in 3 graphical formats with summary tables:

1. Bar charts show the proportions of streams in good, fair, and poor condition employing CRAM's standard ecological condition classes (or health classes as described in the Methods section) based on the GRTS survey analysis CDFs.
2. Maps show the spatial distribution of the CRAM stream condition Index and Attribute Scores color-coded for their ecological condition class of good, fair, and poor.
3. CDF plots, with 95% upper and lower confidence levels, are presented to show the most detailed, visual output of the GRTS survey analysis. CRAM Index and component Attribute Score CDF curves are overlaid to support a visual comparison of the relative amounts of stream resources by CRAM condition scores.

The GRTS *spsurvey* analyses outputs from R, include CDF estimate tables, statistical Wald F test results, and *change analysis* tables. A subset of those outputs are presented in Appendices B, C, and D.

7.2.1. WHAT IS THE OVERALL ECOLOGICAL CONDITION OF STREAMS IN THE COYOTE CREEK WATERSHED WITHIN SANTA CLARA COUNTY?

7.2.1.1. CRAM Index Score Assessments

Streams in the Coyote Creek watershed as a whole were in fair to good ecological condition based on CRAM Index Scores, and have not changed significantly since 2010. Not surprisingly in 2010 and 2020, streams throughout the Valley were collectively in fair ecological condition, while Hills streams were in good condition. Figure 16 shows the relative percent of stream miles in good, fair, or poor ecological condition from CRAM Index Scores for the whole watershed, as well as its two PAIs (Valley and Hills regions) in 2010 and 2020. Table 11 lists the relative proportion of stream resources in good, fair, and poor condition with the lower and upper 95% confidence limits (CLs) in parentheses to show the amount of overlap between condition classes. For example at the watershed scale, between 54-73% of streams were in good condition in 2010, and 42-60% were in good condition in 2020. This drop of 12-13% suggested a decline in condition and while indicative, the difference and range of overlap was within statistical and methodological error to conclude stream ecological conditions are relatively the same. Overlapping ranges intuitively indicated that the difference between the two survey periods may not be significant and *spsurvey's* statistical Wald F and *change analysis* tests confirmed this at the Index Score level for the whole watershed and PAI scales (see Appendices C and D). However, the difference is on the edge of the 95% CLs, and interestingly can be partly traced to the CRAM Attributes of Physical and Biotic Structures.

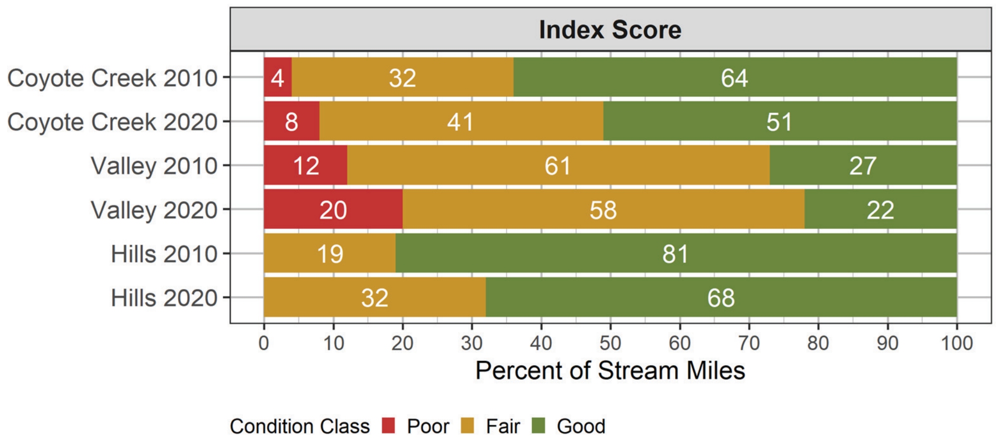

Figure 16. Percent of stream miles in poor, fair, and good ecological condition throughout the Coyote Creek watershed, Hills and Valley PAIs in 2010 and 2020.

Table 11. Percent of stream miles in poor, fair, and good condition* throughout the Coyote Creek watershed, Hills and Valley PAIs in 2010 and 2020 based on the CRAM Index Score CDFs. Values shown in parentheses are the lower and upper 95% CLs.

PAI (Survey Year)	*Poor*	*Fair*	*Good*	*Number of AAs (n)*
Coyote Creek Watershed (2010)	4 (0-9)	32 (22-42)	64 (54-73)	77
Coyote Creek Watershed (2020)	8 (4-11)	41 (32-51)	51 (42-60)	78
Valley (2010)	12 (0-27)	61 (41-80)	27 (10-43)	30
Valley (2020)	20 (11-30)	58 (45-70)	22 (12-31)	46
Hills (2010)	(0-0)	19 (8-30)	81 (70-92)	47
Hills (2020)	(0-0)	32 (19-45)	68 (55-81)	32

* Stream ecological condition classes correspond to the following CRAM Index Score ranges: Poor 25-50, Fair 51-75, and Good 76-100.

Declines in stream ecological condition from 2010 to 2020 were noticeable in the Hills and Valley CRAM regions. However, decadal differences were within statistical ranges and therefore there were no statistically measured declines in condition in the watershed as a whole or within the PAIs. The narrower confidence ranges by condition class in the Valley comparing

2010 to 2020 (Table 11) were potentially due (in part) to the updated survey design that allocated more AAs into this ecologically variable region (30 AAs in 2010 and 46 AAs in 2020). The larger sample size increased the statistical power to characterize overall condition of streams in the Valley PAI. Human land use and activities had greater effects on the landscape in the developed Valley compared to the open space Hills. While stream conditions were statistically similar at fair to good from 2010 to 2020, a trend toward declining conditions by the next reassessment in 2030 to 2035 is not desired. Efforts to increase stream ecological conditions are needed.

Regional differences in the proportions of streams in good, fair, and poor conditions between the Valley and Hills PAIs were clearly discernible at the CRAM Index Score level in both 2010 and 2020 (see Figure 16 and Table 11). Combining the two periods, more than half of Valley streams were in fair condition (~60%) compared to about 20-30% in the Hills. Good conditions were almost inverse at roughly 25% of Valley streams compared to 70-80% in the Hills. Approximately 10-20% of Valley streams were in poor condition with none found in the Hills. As mentioned in general, Hill streams were in good condition, while Valley streams were in fair condition. This highlights the diversity of the Coyote Creek watershed, sitting on the edge of fair to good stream ecological conditions overall.

The CDF estimate plots in Figure 17 visually show detailed survey results for the CRAM Index Score CDFs with 95% CLs for the 2010 and 2020 surveys at the watershed scale (Figure 17.A) and its two PAIs (Figure 17.B). As explained in the Methods section, the x-axis represents estimated ecological condition (CRAM Index Score range is 25-100) versus the y-axis, which indicates the proportion of stream resources (% of stream miles) within the area of interest: the watershed as a whole or its component PAIs. The 2010 baseline and 2020 reassessment stream condition surveys and their 95% CLs largely overlapped along the full range of CRAM Scores at both the watershed (Figure 17.A) and the PAI (Figure 17.B) scales, confirming that there was no significant change in the overall condition of streams over the 10 years (see Wald F test results in Appendix C). The curves visually compare the relative conditions of streams between the PAIs (Hills and Valley), as well as between survey periods within each PAI. Fair to good stream ecological conditions watershed wide is represented by 50% of stream miles crossing CRAM Index Scores around 75. The Valley curve is left of the Hills in Figure 17.B, representing better stream ecological conditions in the Hills. Streams in the Hills were in good condition and Valley streams in fair condition with 50% of stream miles having CRAM Index Scores around 80 and 65, respectively.

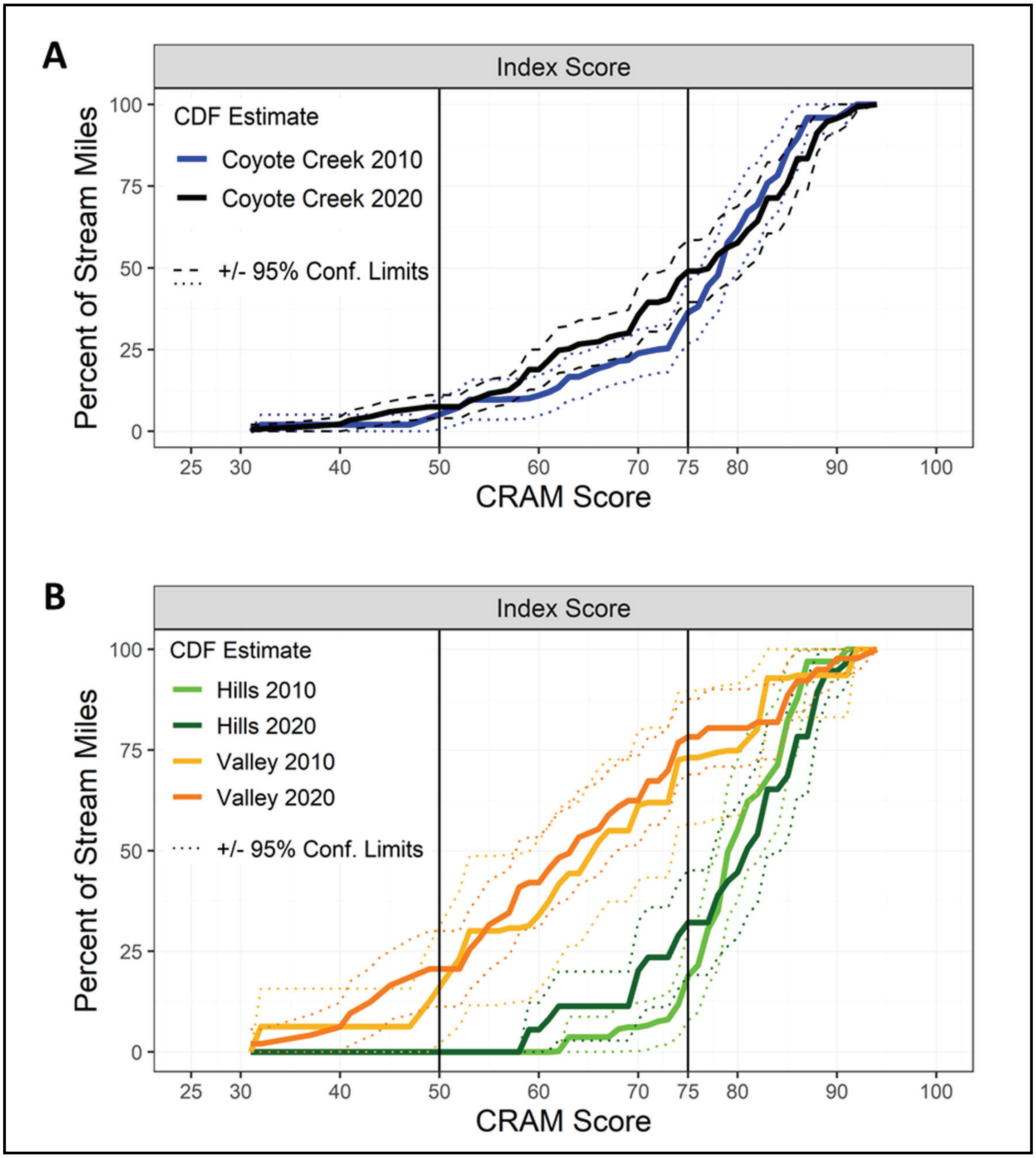

Figure 17. CDF estimates comparing CRAM Index Scores for the 2010 and 2020 Coyote Creek watershed ambient stream condition surveys for the whole watershed (A) and its two PAIs (B, Hills and Valley)

Figures 18 and 19 show final spatial distributions of the 2010 and 2020 AAs across the Coyote Creek watershed and their respective PAIs, color-coded by CRAM's ecological health classes of good, fair, and poor, as well as their CRAM Index Scores. Note the absence of poor condition AAs in the Hills, but also good condition AAs in the Valley.

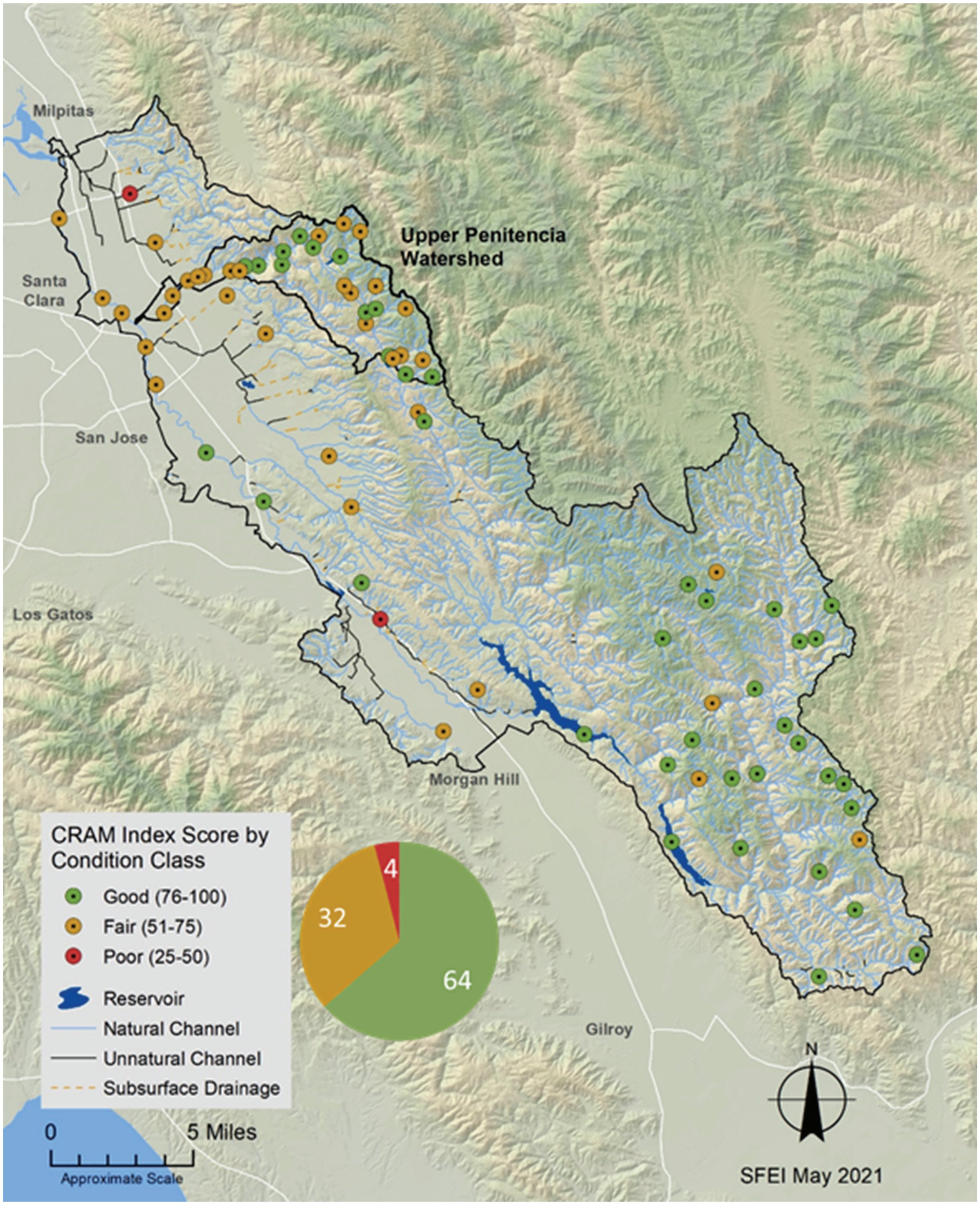

Figure 18. Coyote Creek watershed and Upper Penitencia Creek subwatershed PAI 2010 stream condition survey sites (AAs) color-coded by poor, fair, and good ecological condition (CRAM Index Scores ≤50, 51-75,>75, respectively). Pie chart depicts the estimated proportion of stream miles (% of stream miles) in each health class for the whole watershed, as also shown in the bar charts in Figure 16.

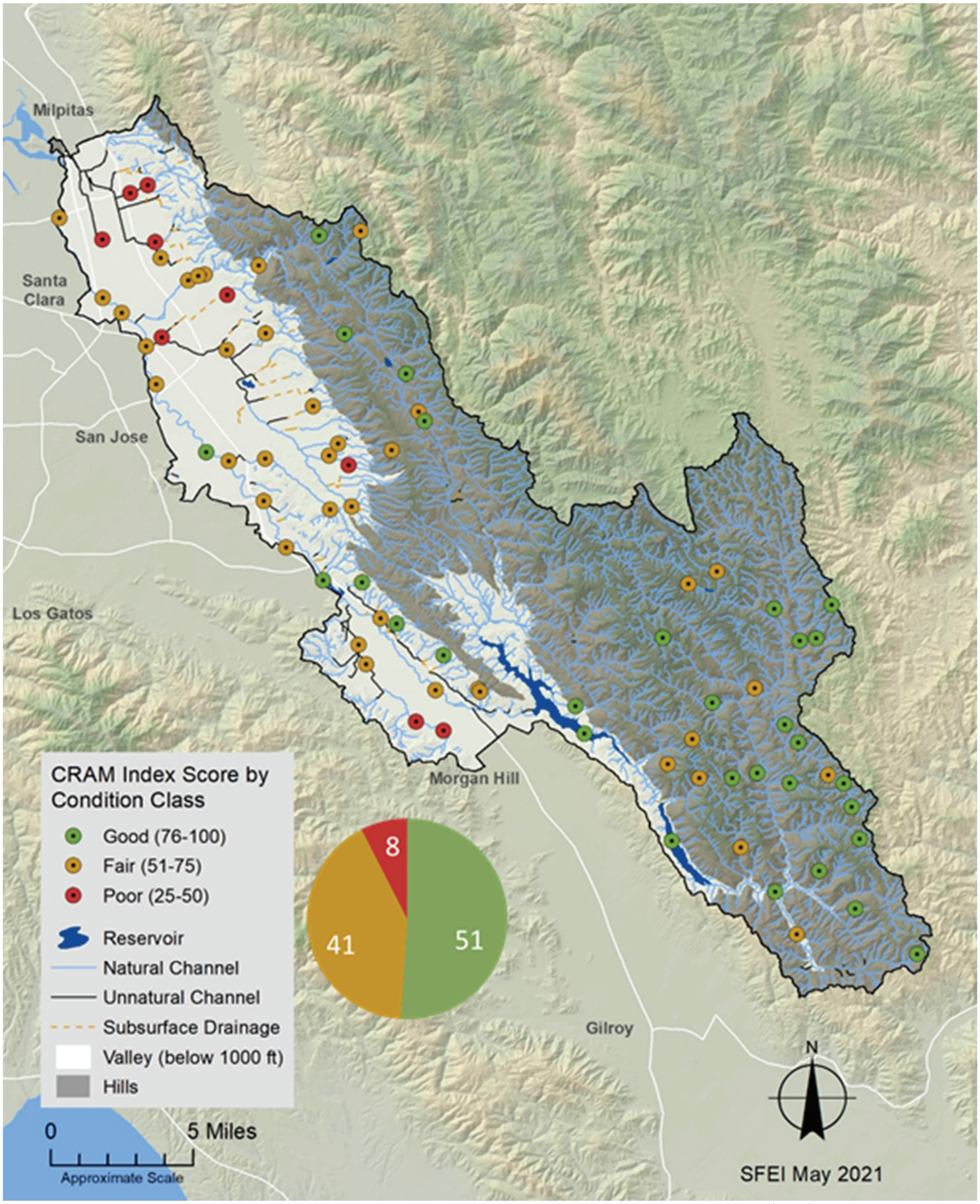

Figure 19. Coyote Creek watershed, Hills and Valley PAIs 2020 stream condition survey sites (AAs) color-coded by poor, fair, and good ecological condition (CRAM Index Scores ≤50, 51-75,>75, respectively). Pie chart depicts the estimated proportion of stream miles (% of stream miles) in each health class for the whole watershed, as also shown in the bar charts in Figure 16.

The patterns of overall stream condition based on the CRAM Index Score CDF figures and table above were largely driven by watershed-scale landscape characteristics, and more specifically characteristics within each PAI. The *Watershed Setting* and *Level-1 Distribution and Abundance of Aquatic Resources* sections (above) help interpret the CRAM ambient survey CDF results with regard to environmental setting, historical and current management of the channel network, and stressors on the stream network. The 2020 bar charts and CDF plots at the watershed scale show over half of the streams were in good condition. More than 90% were in good and fair conditions combined (Figures 16, 17.A, Table 11). This was expected, given 97% of the stream network in the Coyote Creek watershed is largely natural (see Table 7, above) with the majority of the streams (76% of the total stream length) located in the Hills. These results indicate the majority of the streams in the watershed as a whole have not been subject to significant anthropogenic change and the ambient survey condition assessment largely represents natural channel form and function across the watershed.

Looking separately at the Hills PAI, the region is largely undeveloped, and includes protected park lands, managed open space, and grazing lands with few anthropogenic stressors. The channels have had minimal anthropogenic impacts with the exception of the construction of a number of on-channel livestock ponds. The region is characterized by steep topography with geologic and tectonic drivers, which means a large portion of the streams, especially low-order (upper watershed) channels are steep, incised, narrow, and do not have floodplain areas. Floodplains normally increase overall channel complexity and result in relatively higher CRAM condition scores. In addition, low average annual precipitation creates relatively dry conditions compared to statewide norms, which drives the vegetation communities (tending to be shorter in height and less complex than wetter watersheds), and reduces the amount of flow available to regularly reshape channel morphology. Both of these factors contribute to relative channel simplicity, which has a lower overall ecological condition as measured by CRAM. The bar charts and CDFs for the HIlls PAI (Figures 16 and 17.B, respectively) show that the entire stream length is either in good or fair condition for both survey periods. These good and fair condition results reflect the natural character of this area: Largely undisturbed channel network, but morphologically and vegetatively simplistic channels due to the steep topography, and low precipitation.

In comparison, the Valley PAI supports a wide variety of land uses including urban, light industrial, and agriculture, and has a longer history of anthropogenic impacts to the channel network. This PAI includes a variety of channel types (e.g., mainstem and tributaries, natural and unnatural), including a significant length of constructed channel that did not exist historically. The history of channel modification, incision, and management for drainage, flood risks and channel stability, along with more recent modified and managed flow regimes means that most streams within the Valley do not represent natural channel form and function. Each of these impacts typically cause channel simplification, which is reflected in lower condition scores. Impacts from the surrounding urban environment, including reduced channel corridor space, invasive vegetation species, stormwater impacts on the hydrograph, and unhoused populations living in the channel also affect channel form and function. The bar charts and CDF for this PAI shows only 22% of the stream miles in the Valley PAI are in good condition with 58% in fair condition and 20% in poor condition. Compared to the Hills CDF, the Valley CDF is shifted to the left and statistically separate, indicating worse overall condition (Figure 17.B). In addition, the Valley CDF curve is a straighter, relatively consistent slope upward, reflecting a wide range of ecological conditions across the PAI from poor to very good conditions (Index Scores ranged between 31 and 94). Figure 20 shows photographic examples of the full range of CRAM condition scores in the Valley PAI.

Figure 20. Examples of different stream reaches within the Valley PAI of the Coyote Creek watershed show a range of ecological conditions (from poor to very good) based on CRAM. Upper left: COY-085 (2020 Index Score = 31) Upper right: COY-090 (2020 Index Score = 55) Lower left: UP-186 (2020 Index Score = 73) Lower right: COY-026 (2020 Index Score = 94)

Inspecting the shapes of the CRAM Index Score CDFs in Figure 17 and the left-right shift of the curves, there is an interesting flattening and shift to the left for all the 2020 CDFs compared to

2010. In the poor and fair condition range (CRAM scores between 25 and 75), the curves are shifted to the left indicating slightly lower condition compared to the 2010 survey. Although not statistically significant, the underlying cause/s of the shifts to lower conditions between survey periods is interesting. This flattening and shift to the left could (in part) be due to the many years of drought that occurred since 2010. This is hypothesized because the Biotic Structure CDFs are statistically different at the watershed scale and within the Hills PAI, and because the Hydrology CDFs within the Valley were also statistically different between survey periods, as described in the Attribute section below and Appendix C. Or, perhaps the leftward shift to lower condition scores was partly due to the change in survey design between survey periods (see Methods section) and spatial distribution of AAs within the Valley (see Figures 18 and 19). The 2020 survey sampled a larger number of AAs across the Valley, compared to 2010, and was able to better characterize stream conditions in that region (as evidenced by the tighter confidence ranges in Figure 17.B and Table11).

7.2.1.2. Attribute Level Assessments

The CRAM Index Score is composed of four Attributes: Buffer and Landscape Context, Hydrology, Physical Structure, and Biotic Structure. Reviewing Attribute and Metric level CRAM scores further characterizes underlying aspects of stream form and function embedded within the overall assessment of stream conditions. It can also investigate which specific aspects of stream conditions differ among survey periods or PAIs. In this section, Attribute level differences in stream condition are explored within the Coyote Creek watershed as whole and its PAI, as well as among survey periods. The following figures and tables present side-by-side Attribute level comparisons of the:

- Amount and distribution of stream resources in good, fair, and poor condition based on the 2010[17] and 2020 Coyote Creek watershed ambient stream surveys at both the watershed scale and within its two PAIs (Figure 21 and Table 12).
- Ambient survey CDF curves overlaid to compare spatial and temporal differences in Attribute level conditions of stream resources in the Coyote Creek watershed as a whole and its two PAIs (Figure 22).
- Spatial distribution of the 2010 and 2020 ambient survey sites by CRAM Attribute Score, color-coded by CRAM's standard ecological health classes of good, fair, and poor (Figures 23 and 24).

[17] As mentioned in the methods section, the 2010 CRAM Metric scores were carefully reviewed and updated to be comparable to the 2020 CRAM assessments (employing the version 6.1 Riverine module). Therefore, CDF estimates and proportion of streams in good, fair, and poor condition will be different from previous reports.

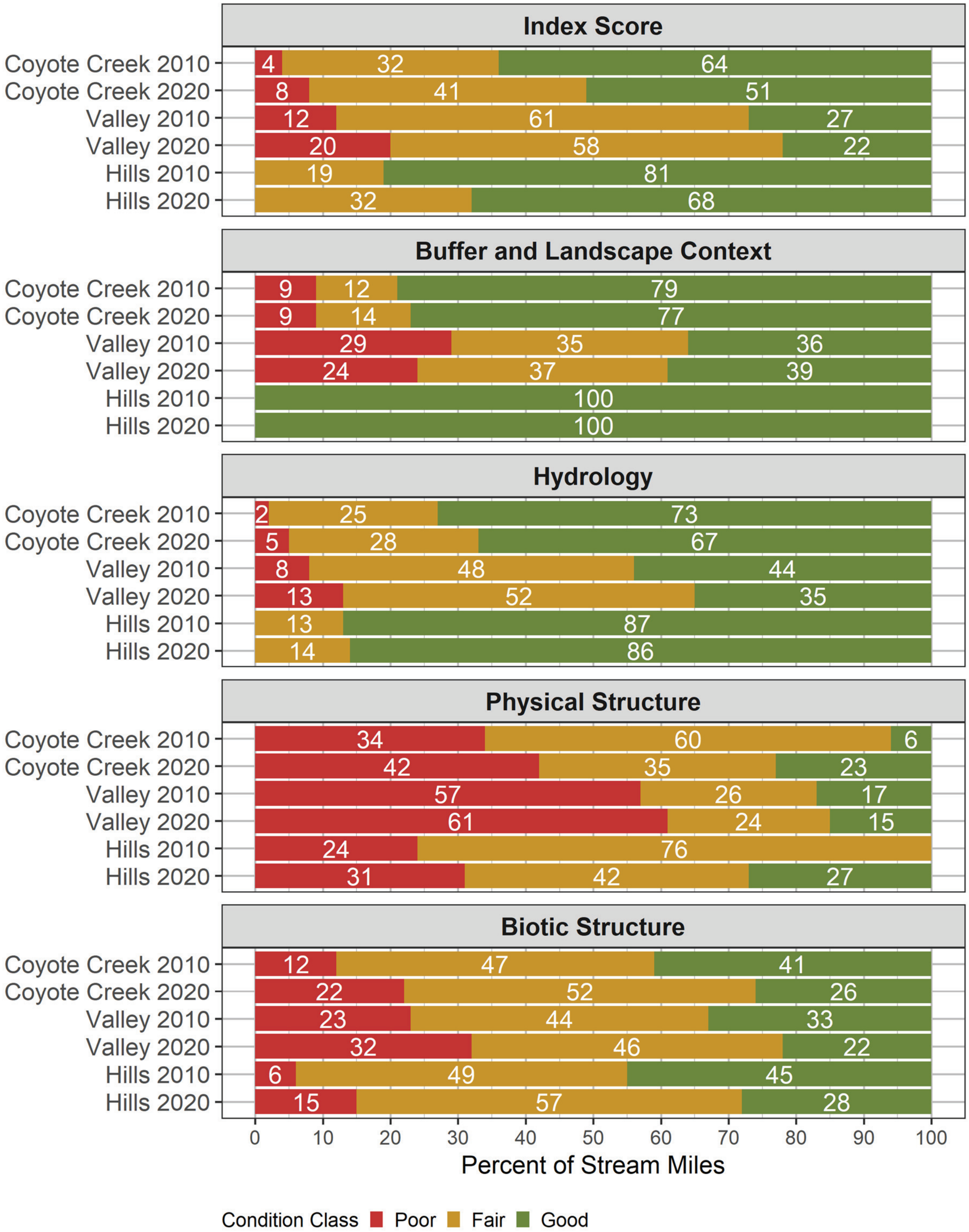

Figure 21. Percent of stream miles in poor, fair, and good ecological condition for the Coyote Creek watershed as a whole (A) and its two PAIs (B) for the 2010 and 2020 ambient surveys based on CDF estimates of the 4 CRAM Attributes. Ecological Condition Classes are based on 3 CRAM equal-interval health classes of Poor 25-50, Fair 51-75, and Good 76-100. Differences between survey periods at this categorical level are not statistically significant (see Appendix D).

Table 12. CDF estimates of the percent of stream miles in poor, fair, and good condition* for the Coyote Creek watershed as a whole, Hills and Valley PAIs from 2010 and 2020 ambient surveys based on CRAM Attribute Scores. Values in parentheses are the lower and upper 95% CLs.

CRAM Attribute	PAI (Survey Year)	Poor	Fair	Good	Number of AAs (n)
Buffer and Landscape Context	Coyote Creek (2010)	9 (4-15)	12 (6-17)	79 (73-86)	77
	Coyote Creek (2020)	9 (5-12)	14 (9-19)	77 (73-82)	78
	Valley (2010)	29 (12-46)	35 (17-53)	36 (18-53)	30
	Valley (2020)	24 (14-33)	37 (25-50)	39 (28-49)	46
	Hills (2010)	(0-0)	(0-0)	100 (100-100)	47
	Hills (2020)	(0-0)	(0-0)	100 (100-100)	32
Hydrology	Coyote Creek (2010)	2 (0-6)	25 (16-33)	73 (64-82)	77
	Coyote Creek (2020)	5 (1-8)	28 (22-35)	67 (60-74)	78
	Valley (2010)	8 (0-17)	48 (28-69)	44 (24-64)	30
	Valley (2020)	13 (4-22)	52 (40-65)	35 (23-46)	46
	Hills (2010)	(0-0)	13 (5-22)	87 (78-95)	47
	Hills (2020)	(0-0)	14 (6-22)	86 (78-94)	32
Physical Structure	Coyote Creek (2010)	34 (25-44)	60 (51-69)	6 (1-10)	77
	Coyote Creek (2020)	42 (32-52)	35 (24-46)	23 (12-33)	78
	Valley (2010)	57 (37-77)	26 (10-42)	17 (1-32)	30
	Valley (2020)	61 (50-72)	24 (13-35)	15 (6-24)	46
	Hills (2010)	24 (14-35)	76 (65-86)	0 (0-1)	47
	Hills (2020)	31 (17-46)	42 (25-58)	27 (11-42)	32
Biotic Structure	Coyote Creek (2010)	12 (5-18)	47 (34-60)	41 (28-54)	77
	Coyote Creek (2020)	22 (14-29)	52 (42-63)	26 (16-36)	78
	Valley (2010)	23 (6-40)	44 (24-64)	33 (15-50)	30
	Valley (2020)	32 (21-44)	46 (33-58)	22 (12-31)	46
	Hills (2010)	6 (0-12)	49 (32-65)	45 (28-62)	47
	Hills (2020)	15 (5-26)	57 (42-71)	28 (14-42)	32

* Stream ecological condition classes correspond to the following CRAM Index Score ranges: Poor 25-50, Fair 51-75, and Good 76-100.

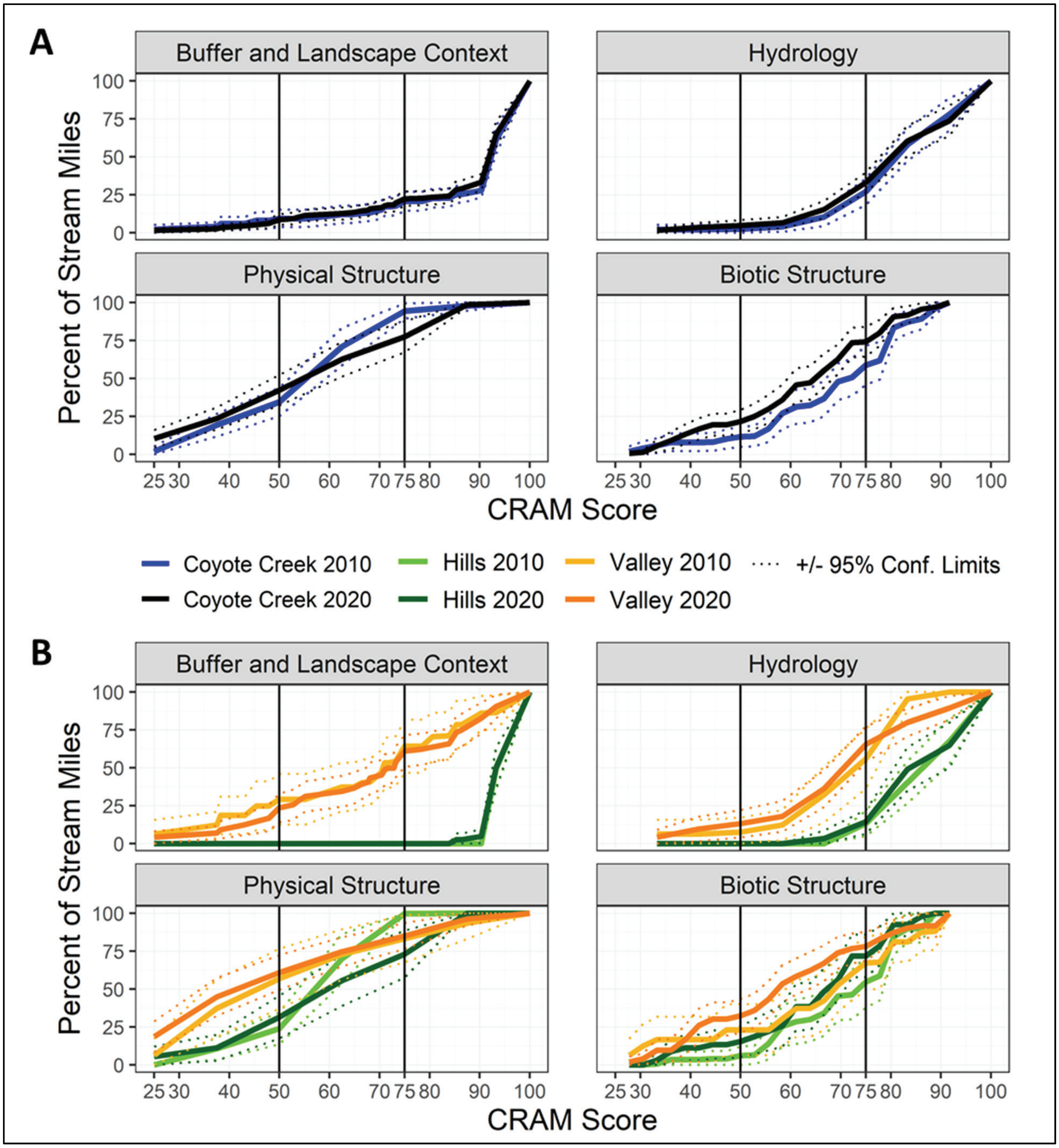

Figure 22. CDF estimates comparing CRAM Attribute Scores for the 2010 and 2020 Coyote Creek watershed ambient stream condition surveys for the whole watershed (A) and its two PAIs (B), Valley and Hills. Curves visually compare the relative conditions of streams within each PAI and between survey periods.

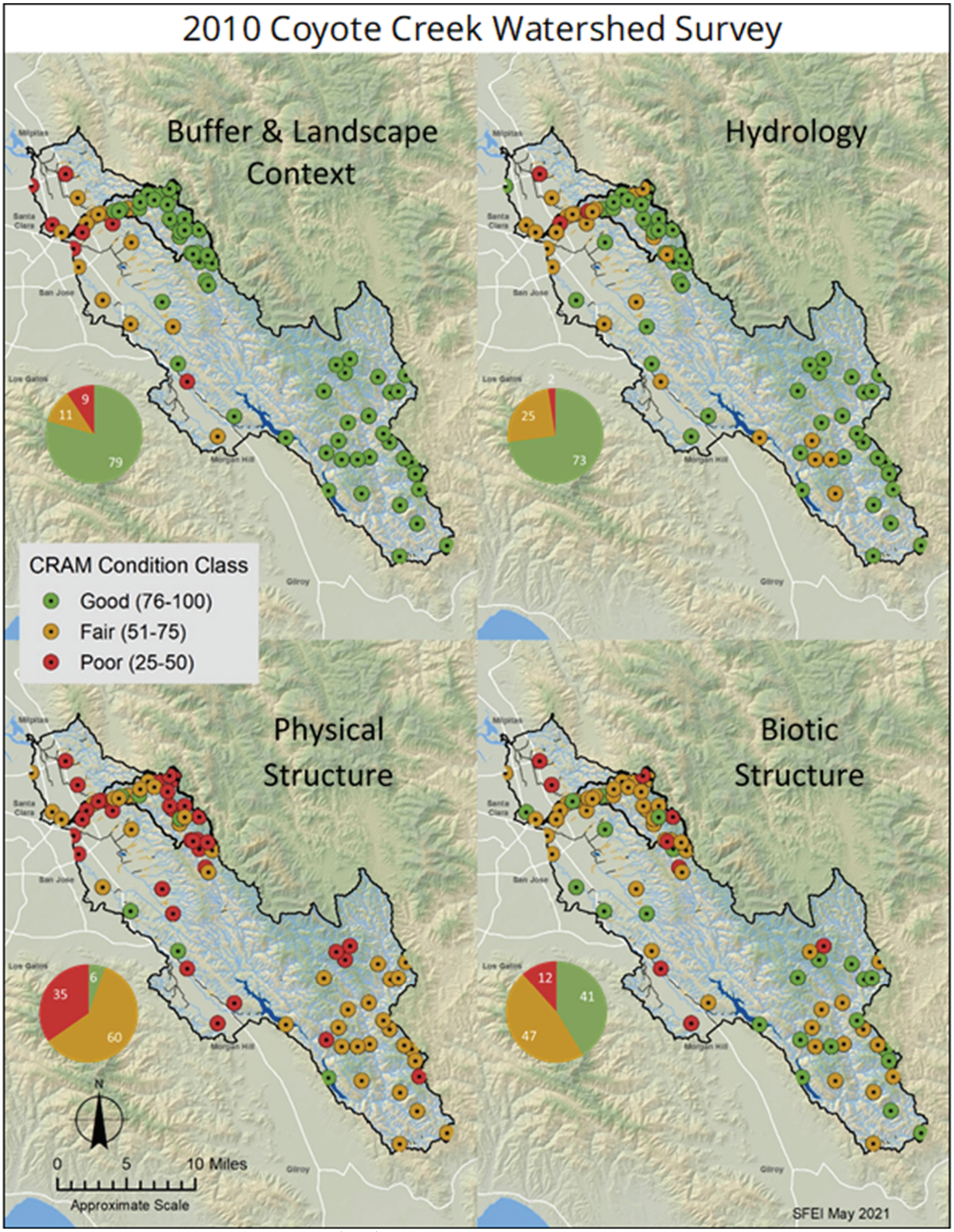

Figure 23. Stream condition survey sites (AAs) in 2010 for the Coyote Creek watershed and its Upper Penitencia Creek subwatershed PAI color-coded for their CRAM Attribute condition class of good, fair, and poor. Pie charts depict the estimated % of stream miles in each health class.

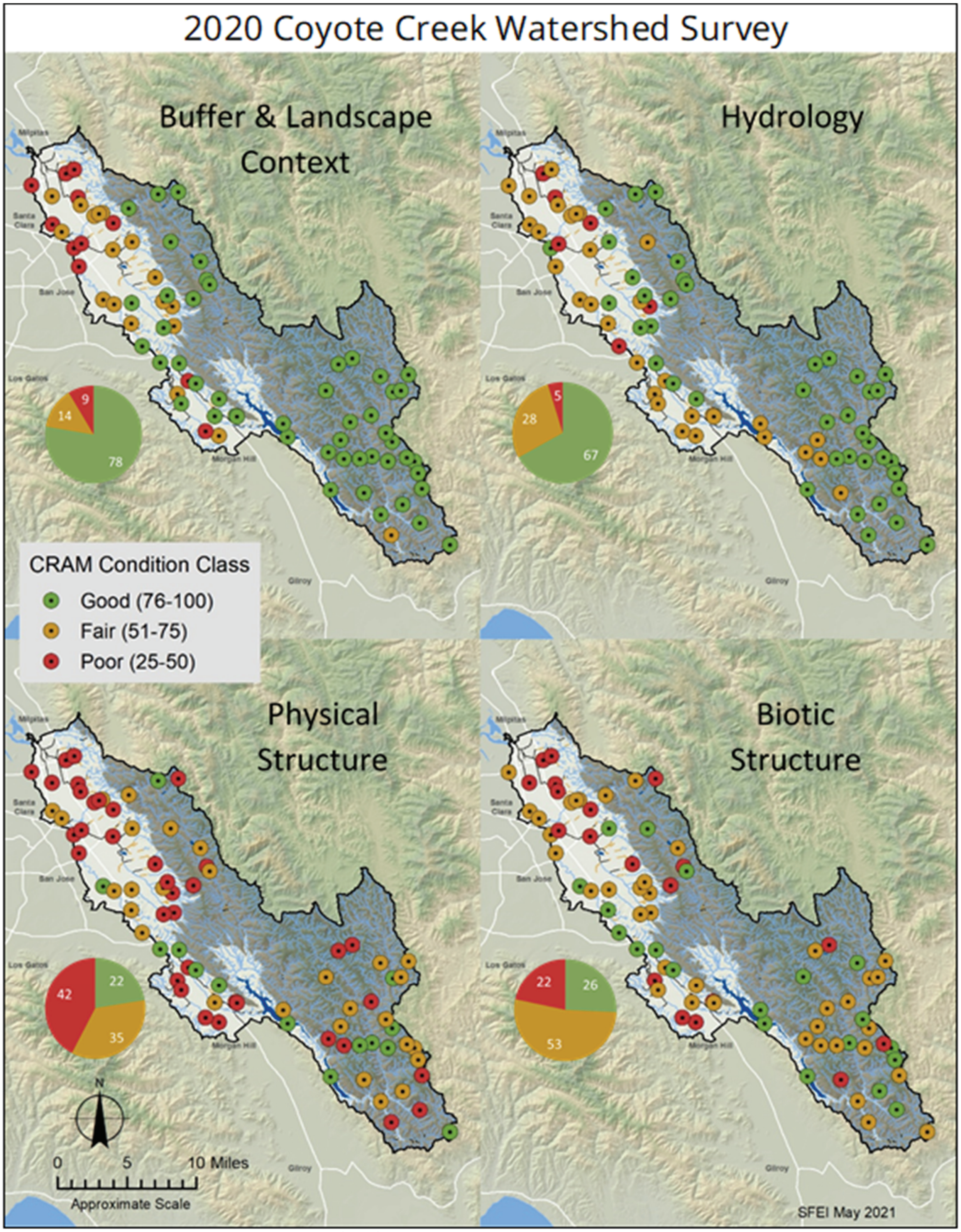

Figure 24. Stream condition survey sites (AAs) in 2020 for the Coyote Creek watershed and its Hills and Valley PAIs color-coded for their CRAM Attribute condition class of good, fair, and poor. Pie charts depict the estimated % of stream miles in each health class.

The CRAM Attribute Figures (21 and 22) and Table 12 (which lists the estimated proportions of streams in good, fair, and good condition along with the lower and upper 95% CLs) present the same 2010 and 2020 ambient survey results in several formats to visually parse and compare spatial and temporal differences at the watershed scale, among PAIs, and between survey periods. The bar charts show categorical condition class estimates of the proportions of streams in good, fair, and poor condition, while the CDF plots show continuous data, estimating the proportion of streams by CRAM Score for the entire population.

The bar charts (Figure 21) show relatively little difference between periods for the Buffer and Landscape Context and Hydrology Attributes at the categorical level, and more pronounced differences for the Physical Structure and Biotic Structure Attributes. However, the *change analysis* test that compares the condition class estimates between survey periods (Appendix D) indicates that the standard error is relatively large compared to the percent change observed at the watershed and PAI scales. Therefore, the temporal changes are not significantly different at the categorical level of good, fair, and poor condition classes for all CRAM Attributes.

The CDF plots provide more information. Figure 22.A shows that the 2010 (blue) and 2020 (black) curves overlap each other for each CRAM Attribute except Biotic Structure at the watershed scale and a Wald F test confirms the visual inspections, that there are no significant differences in Attribute-level CDF estimates between survey periods at the watershed scale except for Biotic Structure.

Figure 22.B overlays Attribute-level condition CDFs and 95% CLs for the Valley 2010 and 2020 curves (gold and dark orange, respectively) and Hills (lime and dark green, respectively), showing: 1) the two survey period curves and their CLs generally overlap each other for each PAI; and 2) differences between PAIs are very clear for the Buffer and Landscape Context and Hydrology Attributes, and less clear for Physical Structure and Biotic Structure.

The statistical Wald F test results provided additional confirmation of visual inspections of the overlaid CDFs. No significant differences were observed in Attribute-level CDF estimates between survey periods for either PAI except for Biotic Structure in the Hills, and Hydrology within the Valley. And interestingly, because the CDF curves overlap so much in Figure 22.B, the Wald F test also confirmed that there was no significant difference in Biotic Structure CDF estimates between the Valley and Hills for the 2010 survey (gold and lime green, respectively), but there was a significant difference in 2020 (dark orange and dark green respectively, see Appendix C). These differences may (in part) be due to the many years of drought that occurred since 2010, or perhaps due to the changes in the survey design between survey periods (see Methods section).

The following sections include excerpts from the CRAM User's Manual (CWMW, 2013a) to describe each CRAM Attribute and their component Metrics, then explore possible ecological drivers and explanations behind the differences (or lack of) observed between survey periods, and among PAIs.

Buffer and Landscape Context

CRAM Manual (CWMW, 2013a): "A buffer is a zone of transition between the immediate margins of a stream (or wetland) and its surrounding environment that is likely to help protect the wetland from anthropogenic stress. Areas adjoining wetlands that probably do not provide protection are not considered buffers. Buffers can protect wetlands by filtering pollutants, providing refuge for wetland wildlife during times of high water levels, acting as barriers to disruptive incursions by people and pets into wetlands, and moderating predation by ground-dwelling terrestrial predators. Buffers can also reduce the risk of invasion by non-native plants and animals, by either obstructing terrestrial corridors of invasion or by helping to maintain the integrity and therefore, the resistance of wetland communities to invasions. The presence of buffer is important both extending laterally from the stream and longitudinally along the stream corridor.

Because regulation and protection of wetlands historically did not extend to adjacent uplands, these areas in some cases have been converted to recreational, agricultural, or other human land uses and may no longer provide their critical buffer functions for wetlands. CRAM includes two metrics to assess the Buffer and Landscape Context attribute of streams: the Stream Corridor Continuity metric and the Buffer metric. The buffer metric is composed of three submetrics: (1) percentage of the AA perimeter that has a buffer; (2) the average buffer width; and (3) the condition or quality of the buffer.

At the watershed scale and in the Hills, the Buffer and Landscape Context of streams in the Coyote Creek watershed is largely in good condition (76% and 100% in 2020, respectively), and the majority of the channel network has adjacent buffer areas that are in their natural state. There is no change in the proportions of streams in good condition between time periods (Table 12). The CDF plots (Figures 22.A and B) for the watershed and Hills PAI show overlapping curves within each region, statistical Wald F and *change analysis* tests confirm no difference between survey periods within each PAI (see Appendix C).

The difference in Buffer and Landscape Context conditions between the Valley and Hills is clear, and generally intuitive considering land use settings surrounding the streams in each PAI, as described in the *Watershed Setting* section. Streams in the Hills are located within the undeveloped upper watershed and upper foothills, and have 100% Buffer and Landscape Context in good ecological condition (Figure 21 and Table 12) indicating undeveloped natural conditions. The Valley streams, which are largely located in urban and agricultural areas, even though this PAI includes some undeveloped foothill areas below 1,000 feet, have a mix of conditions. In 2020, 39% of streams in the Valley are in good condition (95% CLs 28-49), 37% in fair condition (95% CLs 25-50), and 24% in poor condition (95% CLs 14-33). These conditions are not significantly different from the 2010 survey. In addition, CDF plots (Figure 22.B) for each PAI clearly overlap each other, and the statistical Wald F and *change analysis* tests confirm no difference between survey periods within each PAI (see Appendix C).

Review of the 52 revisit sites indicated there were only a handful of AAs with different buffer metric scores between survey periods, and they typically only differed by a single letter grade. It is possible this difference was due to the way field Practitioners interpret site conditions; a difference of 1 letter grade is typically within the precision of CRAM, as described in the CRAM QAPP (CWMW, 2018). Overall, the adjacent buffer and stream corridor largely has not changed in the past decade.

Hydrology

CRAM Manual (CWMW, 2013a): "Hydrology includes the sources, quantities, and movements of water, plus the quantities, transport, and fates of water-borne materials, particularly sediment as bed load and suspended load. Hydrology is the most important direct determinant of wetland functions (Mitsch and Gosselink, 2007). The physical structure of a stream or wetland is largely determined by the magnitude, duration, and intensity of water movement. For example, substrate grain size, depth of wetland sediments, and total organic carbon in sediments tend to be inversely correlated to duration of inundation in a lacustrine wetland. The hydrology of a wetland directly affects many physical processes, including nutrient cycling, sediment entrapment, and pollution filtration. For example, Odum and Heywood (1978) found that leaves in freshwater depressional wetlands decomposed more rapidly when submerged. The hydrology of a wetland constitutes a dynamic habitat template for wetland plants and animals. For example, Richards *et al.*, 2002 concluded that meandering and braiding in riverine systems control habitat patch dynamics and ecosystem turnover. Additionally, the spatial distribution of plants and animals in a tidal marsh closely correspond to patterns of tidal inundation or exposure (Sanderson *et al.*, 2000). CRAM includes three metrics to assess the hydrologic condition of streams: Water Source, Channel Stability, and Hydrologic Connectivity."

At the watershed scale, the Hydrology Attribute can be characterized as in good condition with 67% of the streams in good condition in 2020 (95% confidence range of 60-74), see Figure 21 and Table 12. Similar to the Buffer and Landscape Context, the high proportion of stream miles in the Hills drives the overall hydrological conditions observed at the watershed scale, as evident by comparing the shape of the CDF curves between the whole watershed and the Hills PAI in Figures 22.A and B. The watershed scale figures (21.A and 22.A) show little change in the proportions of streams in each of the three condition categories and similar shapes of the CDF curves between the 2010 baseline and 2020 reassessment survey (the Wald F and *change analysis* tests confirm this, see Appendices C and D). The 95% CLs in Table 12 and *change* *analysis* test results (Appendix D) indicate that there are not significant differences between survey periods at the categorical level at the watershed scale.

The Wald F test compared CDF estimates between periods, and found no significant difference between survey periods in the Hills, and a significant difference between survey periods in the Valley, which may be due to “flattening of curve” in 2020, and tighter confidence ranges. The difference might be due to the change in the survey design in 2020 that increased the number and distribution of AAs within the Valley (i.e., 46 Valley AAs in 2020 and 30 in 2010).

At the PAI scale, the Hydrology Attribute conditions are clearly different between the Valley and Hills, as shown in the bar chart and CDF figures. The 2020 survey results indicated most of the streams in the Hills region have good hydrologic conditions (86% with 95% confidence range of 78-94) and the remaining streams in fair condition (14% with 95% confidence range of 6-22). The Valley has about half of the streams in fair condition (52% with 95% confidence range of 40-65), a third in good condition (35% with 95% confidence range of 23-46), and a small percentage in poor condition (13% with 95% confidence range of 4-22).

Hydrology condition differences between the Hills and Valley are primarily driven by surrounding land use, channel incision and modification history. Streams in the Hills are in better condition due to the lack of developed land uses, greater length of channel in equilibrium, and reaches that have high entrenchment ratios (floodwaters able to access the floodplain in the lower elevations, where the mountains are not so steep). In contrast, Valley streams are generally in worse condition due to the greater amount of development in the contributing watershed area, more complex channel incision history, and typically lower entrenchment ratios due to either incision or engineered channel elements (e.g., levees, flood walls, straightening, ditching).

Physical Structure

CRAM Manual (CWMW, 2013a): “Physical structure is defined as the spatial organization of living and non-living surfaces that provide habitat for biota (Maddock, 1999). For example, the distribution and abundance of organisms in riverine systems are largely controlled by physical processes and the resulting physical characteristics of habitats (e.g., Frissell *et al.*, 1986). Metrics of the Physical Structure attribute in CRAM therefore focus on physical conditions that are indicative of the capacity of a wetland to support characteristic flora and fauna. CRAM includes two metrics to assess the Physical Structure of streams: Structural Patch Richness and Topographic Complexity.”

At the watershed scale, the Physical Structure Attribute can be characterized as in fair and poor condition. Streams across the entire watershed have a variety of conditions and the relative proportions by condition class are driven by the largely fair and poor conditions measured within both PAIs. Especially compared to the previous two Attributes, the overall lower condition of the Physical Structure is striking. The results suggest that large portions of the channel network are structurally simplistic, regardless of the underlying cause of the simplicity (e.g., relative dryness of the entire watershed, history of channel network modifications, flow regulation). While Figure 21 shows more pronounced differences in the proportions of streams in good, fair, and poor condition between survey periods, when considering the confidence intervals and the *change analysis* test (Appendix D), there was no change between time periods. In addition, the CDF plot for the watershed (Figure 22.A) shows overlapping curves and the statistical Wald F test confirmed no difference between survey periods at the watershed scale (see Appendix C).

Moving from the watershed to PAI scale, differences in Physical Structure condition classes in the Valley have not changed between survey periods (Figure 21). In the Hills, the shift in the proportion of stream miles from fair to good (0 to 27%) appears to be substantial, however, the *change analysis* test indicates that the standard error is relatively large compared to the proportion of change and therefore may not be significant (Appendix D).

The CDF curves in Figure 22.B, show a lot of overlap between survey periods, especially for the Valley. The Wald F test confirmed that there were no significant differences between survey periods within each PAI (see Appendix C). Because of the visible overlap in CDF curves between PAIs in Figure 22.B, the Wald F test results were included in Appendix C (Table C.4) to confirm that there were significant differences in Physical Structure conditions between the Valley and Hills within each survey period.

There were clear differences between percent of stream miles in each Physical Structure condition class between the Valley and Hills (Figure 21 and Table 12). In the 2020 survey, streams in the Hills exhibited a range of Physical Structure condition, likely stemming from the spectrum of channel types, ranging from narrow, steep, and incised low order channels to broad, shallow, not incised higher order channels. These driving characteristics resulted in the 2020 Hills having 27% of the streams in good condition (95% CLs 11-42), 42% in fair condition (95% CLs 25-58) and 31% in poor condition (95% CLs 17-46). Valley streams also have a wide variety of conditions, but were generally in poor condition, likely due to the historical incision along the Coyote Creek mainstem (and resultant response of the tributaries), and construction/simplification of tributary channels intended for efficient routing of flood waters to San Francisco Bay. The Valley in 2020 had 15% of the streams in good condition (95% CLs 6-24), 24% in fair condition (95% CLs 13-35) and 61% in poor condition (95% CLs 50-72).

Biotic Structure

CRAM Manual (CWMW 2013a): "The biotic structure of a wetland includes all of its organic matter that contributes to its material structure and architecture. Living vegetation and coarse detritus are examples of biotic structure. Plants strongly influence the quantity, quality, and spatial distribution of water and sediment within wetlands. For example, in many wetlands, including bogs and tidal marshes, much of the sediment pile is organic. Vascular plants in estuarine and riverine wetlands entrap suspended sediment. Plants reduce wave energies and decrease the velocity of water flowing through wetlands. Plant detritus is a main source of essential nutrients, while vascular plants and large patches of macroalgae function as habitat for wetland wildlife. CRAM includes three metrics to assess the Biotic Structure of streams: Plant Community Composition, which includes three sub-metrics (Number of Plant Layers, Number of Co-dominant Species, and Percent Invasion), Horizontal Interspersion, and Vertical Biotic Structure."

At the watershed scale, the Biotic Structure Attribute in 2020 can be characterized as in fair condition (52% with 95% confidence range of 42-63). Streams across the entire watershed have a wide range of conditions that generally vary with type and size of the channel, flow regime, presence/absence of floodplain, and adjacent land use.

Figure 21 bar charts do not show pronounced differences in the proportions of streams in good, fair, and poor condition between survey periods at the watershed scale, when considering the confidence intervals (Table 12) and the relatively large standard errors in the *change analysis* tests (Appendix D). As a result, there was no significant change between time periods at the categorical level. Visual inspection of the overlaid Biotic Structure CDFs and their 95% CLs for the whole watershed (Figure 22.A) show the 2010 and 2020 Biotic Attribute curves do not overlap each other, and the statistical Wald F test confirmed that they are significantly different at the watershed scale (see Appendix C).

To explore the temporal differences at the watershed scale, conditions within each PAI and between survey periods were evaluated. Both the Hills and Valley PAIs show a shift from good to fair condition and an increase in poor condition streams between survey periods (Figure 21). However, looking at the amount of overlap in the 95% CLs in Table 12 and the *change analysis* test, the downward shift in the proportions of streams among condition classes are not significantly different between survey periods (Appendix D).

Figure 22.B indicates that all four CDFs generally overlap between survey periods and PAIs and that Biotic Structure conditions are quite variable, as indicated by the wide range in 95% CLs. Even with the variation the Wald F test confirmed a significant temporal difference in the CDFs between the 2010 and 2020 surveys in the Hills, and no significant temporal difference in the Valley (Appendix C).

The significant downward shift in Biotic Structure condition CDFs in 2020 compared to 2010 at the watershed scale and within the Hills PAI may (in part) be due to the several years of drought that occurred since 2010, or may (in part) be due to the change in survey design between survey periods. More AAs were assessed in the Valley PAI in 2020 (n=46) compared to 2010 (n=30), which supported a broader spatial distribution and better characterization of stream conditions across the whole watershed (see Figures 23 and 24, and the Methods section).

Because of the visible overlap in the Biotic Structure CDFs between the Valley and Hills PAIs for each survey period, the Wald F test results were included in Appendix C (Table C.4) to evaluate if there were significant differences between regions within each survey period. Interestingly, there was no significant difference between the Valley and Hills PAIs in 2010, and there was a significant difference between the Valley and Hills in 2020.

Streams in the Hills have a variety of Biotic Structure scores, and are largely in fair condition. Although the vegetation community is likely affected by the lower average annual precipitation, as well as the introduction of non-native grasses and forbs for grazing, a large portion of the streams in this PAI have a less altered vegetation community.

Biotic Structure in the Valley is also largely in fair condition, but with a larger proportion of poor condition streams. Like Hydrology and Physical Structure, varied conditions likely reflect the wide variety of stream types present in the Valley, including the Coyote Creek mainstem, natural and constructed tributaries, constructed ditches and engineered channels, and natural unmodified small tributaries. The size of the channel, flow regime, position in the valley floor, management, and adjacent land use likely have the largest impact on the composition and complexity of the Biotic Structure.

7.2.2. WHAT ARE THE LIKELY STRESSORS IMPACTING STREAM CONDITIONS BASED ON THE CRAM STRESSOR CHECKLIST?

CRAM includes a checklist of up to 52 different stressors (depending on the Module), where field teams answer two questions for each stressor:

1. Is the stressor visibly present?
2. Do they expect the stressor to significantly and adversely influence the AA, based on a list of standard indicators and sets of considerations?

A CRAM stressor is defined as an anthropogenic perturbation within the AA or its environmental setting that is likely to negatively influence condition and function of the wetland or stream (CWMW, 2013a). Stressors for hydrology, physical structure, and biotic structure must be evident within 50 meters of the AA, and buffer and landscape context stressors must be present within 500 meters of the AA in order for the field team to record them.

Tables 13 and 14 list the most common and significant CRAM stressors in the Coyote Creek watershed and PAIs (Hills and Valley) for both the 2010 and 2020 survey periods. They summarize the: 1) percentage of AAs where the stressor was observed within the PAI, 2) percentage of AAs where the observed stressor was thought to have a significant and adverse impact on the AA; and (3) up or down arrow, if significant negative impacts observed in each

PAI increased (up arrow) or decreased (down arrow) between the 2010 and 2020 survey periods. The full list of stressors observed in the watershed is in Appendix E.

The stressor checklist is a highly subjective field observation that is based on practitioners' experience, and there is no specific guidance as to when a stressor should be flagged as observed or significantly impacting the AA. Therefore the comparative results between the 2010 and 2020 field observations are informal observations and should not be over-interpreted.

For the purposes of this report, the most common stressors were defined as those observed within at least 25% of the AAs in the Coyote Creek watershed as a whole, or its PAIs in the 2020 reassessment survey. Many of the same stressors (but not all) were also observed within at least 25% of the AAs in the 2010 baseline survey. Some stressors were commonly observed, but did not always show a significant and adverse impact on ecological conditions – those stressors are listed in the tables and will have 0% negative impacts.

The 3 most commonly observed stressors that have a significant negative impact on the overall stream conditions within the Coyote Creek watershed include:

- Urban residential
- Transportation corridor
- Non-point Source discharges (urban runoff, farm drainage)

Other stressors that continue to be observed and to a lesser degree have significant negative impacts on stream conditions include:

- Trash and refuse
- Vegetation management
- Lack of treatment of invasive plants adjacent to AA or buffer
- Mowing, grazing, excessive herbivory (within AA)

Many of these urban stressors are ubiquitous and intrinsic to highly developed areas, and difficult to eliminate. Therefore, it is expected that stressors such as transportation corridors, urban residential land use, and non-point source discharges are common in urban areas. Nonetheless, many stressor impacts respond to management efforts, and can be mitigated through the presence of riparian buffers, and changes in-stream and riparian management.

It should be noted that the relative importance of different stressors and their significant impact on the stream is not recorded by CRAM. For example the nutrient impairment stressor listed in Table 14 indicates a decline between 2010 and 2020, which is believed to be a result of seasonal nutrient patterns (e.g. visible algae growth) and/or practitioner interpretation. The

Practitioner is not asked to rank stressors, nor provide any additional information about the frequency, duration, or extent of the stress. The Checklist simply records the presence or absence of the stressor, and then adds a subjective determination about whether the stressor is causing a significant negative effect upon the AA. Practitioners are taught that stressors should be considered significant if they are directly affecting the score of any given CRAM Metric within the AA, or if the activity is clearly affecting morphology, function, or other natural processes within the stream.

Table 13. CRAM stressors observed in at least 25% of the field assessments in the Coyote Creek watershed Hills PAI. The percent of AAs where the stressor was observed (% Observed) and percent of AAs where the stressor was thought to negatively impact the AAs (% Neg. Impact) are listed for the 2010 (n=47) and 2020 (n=32) survey periods. Some stressors were commonly observed, and did not show significant negative impacts on ecological conditions.

Attribute	Hills Observed in ≥ 25% of AAs	% Observed		% Neg. Impact		2010-2020 Neg. Impact Change
		2010	2020	2010	2020	
Buffer and Landscape Context	Active recreation (off-road vehicles, mountain biking, hunting, fishing)	47	44	0	0	.
	Passive recreation (bird-watching, hiking, etc.)	51	72	0	0	.
	Ranching (enclosed livestock grazing or horse paddock or feedlot)	40	28	17	9	↓
Biotic Structure	Lack of treatment of invasive plants adjacent to AA or buffer	11	34	0	0	.
	Predation and habitat destruction by non-native vertebrates (e.g., Virginia opossum and domestic predators, such as feral pets)	0	28	0	3	↑

Table 14. CRAM stressors observed in at least 25% of the field assessments in the Coyote Creek watershed Valley PAI. The percent of AAs where the stressor was observed (% Observed) and percent of AAS where the stressor was thought to negatively impact the AAs (% Neg. Impact) are listed for the 2010 (n=30) and 2020 (n=46) survey periods.

Attribute	Valley Observed in ≥ 25% of AA	% Observed		% Neg. Impact		2010-2020 Neg. Impact Change
		2010	2020	2010	2020	
Buffer and Landscape Context	Active recreation (off-road vehicles, mountain biking, hunting, fishing)	47	39	3	2	↓
	Industrial/commercial	33	48	20	15	↓
	Passive recreation (bird-watching, hiking, etc.)	57	59	7	2	↓
	Rangeland (livestock rangeland also managed for native vegetation)	47	52	13	4	↓
	Transportation corridor	67	83	20	30	↑
	Urban residential	63	67	47	41	↓
Hydrology	Engineered channel (riprap, armored channel bank, bed)	53	43	30	11	↓
	Flow obstructions (culverts, paved stream crossings)	17	30	3	4	↑
	Non-point Source (Non-PS) discharges (urban runoff, farm drainage)	63	83	13	26	↑
Physical Structure	Grading/compaction (N/A for restoration areas)	50	43	10	11	↑
	Nutrient impaired (PS or Non-PS pollution)	30	7	17	0	↓
	Trash or refuse	50	65	10	13	↑
	Vegetation management	27	46	7	11	↑
Biotic Structure	Excessive human visitation	63	37	30	11	↓
	Lack of treatment of invasive plants adjacent to AA or buffer	30	54	17	11	↓
	Mowing, grazing, excessive herbivory (within AA)	37	39	17	11	↓
	Predation and habitat destruction by non-native vertebrates (e.g., Virginia opossum and domestic predators, such as feral pets)	60	39	20	0	↓

8. Discussion

Federal and State resource agencies continue to move toward watershed-based environmental regulation, permitting, and management (USEPA and United States Army Corps of Engineers (USACE) 2008, SWRCB 2021). Valley Water's D5 Project's watershed monitoring and assessment framework aligns with the statewide watershed approach. It employs the CWMW's recommended geospatial Level-1 tools, and Level-2 rapid assessment methods (CRAM) along with a probability-based watershed monitoring approach to characterizing and tracking the amount, distribution, and diversity of streams and wetlands that integrate with the statewide wetland tracking toolset (EcoAtlas).

The D5 Project's efforts to employ these standardized monitoring and assessment tools is an exceptional step towards implementing cross-program stream stewardship, coordinated mitigation/restoration planning, and project performance tracking at a landscape scale: not only for streams within Valley Water properties, but also for streams on properties owned or managed by other agencies (e.g. Santa Clara County Parks and Recreation Department, Santa Clara Valley Open Space Authority, Santa Clara Valley Habitat Agency) or even privately owned. The fact that Valley Water has selected to put the ambient survey CRAM data and CDFs online through EcoAtlas not only helps Valley Water coordinate among it's programs and projects, but also supports county wide collaboration across resource agencies and open public access to regional monitoring data (see Appendix F for more information about EcoAtlas and the Landscape Profile tool).

The 2020 Coyote Creek watershed reassessment found that about half of the streams within the Coyote Creek Watershed are in good condition and that there was no significant change in the overall ecological condition of streams at the watershed scale between 2010 and 2020 based on the CRAM Index Score CDF estimate. However, at the Attribute level there was a small but statistically significant leftward shift in the Biotic Structure CRAM Attribute CDF between 2010 and 2020 at the watershed scale and within the Hills PAI. In addition, the Hydrology Attribute CDFs were statistically different between survey periods within the Valley. The underlying cause/s of these shifts to lower ecological conditions between survey periods is interesting. This flattening and shift to the left could (in part) be due to the many years of drought that occurred since 2010, or perhaps the leftward shift to lower condition scores was partly due to the change in survey design between survey periods where more AAs were assessed within the Valley, improving the condition assessment in that PAI.

A significant amount of change at the Index Score level in just 10 years for a large watershed scale ambient survey was not expected for the following reasons. First, given the size of the watershed, and the relatively low number of assessment locations (78 randomly selected AAs across nearly 3,000 miles of streams), the likelihood that an assessment site would be located in areas where significant change has occurred is low. Second, while changes in individual Metrics within CRAM are more common, a change at the Index Score level requires multiple Metric scores to shift in the same direction, which is less common. And finally, change in condition is driven by natural disturbances (e.g. flood, wildfire, and drought) and anthropogenic actions and stress (e.g. deforestation, large-scale changes in grazing, channel management projects, or implementation of broad restoration and/or mitigation actions). The Coyote Creek watershed was subject to many of these drivers between 2010 and 2020 including:

- the 2017 flood (peak discharge of 7,120 cfs at the Madrone gauge (https://www.cnrfc.noaa.gov/graphicalRVF.php?id=CYTC1) due to intense rainfall and spilling from Anderson Dam, resulting in widespread flooding downstream in Coyote Valley and mainstream Coyote Creek reaches in the City of San Jose displacing adjacent communities within the Coyote Creek floodplain);
- wildfires;
- drought (between Water Years 2012-2015), where the watershed received 45-85% of the annual average amount of precipitation (CNRFC, 2021);
- the socio-economic downturn of the 2008 recession and the 2020 COVID-19 pandemic, increasing homeless encampments within the adjacent riparian areas;
- stream restoration, enhancement or flood management projects;
- changes in flow volume or timing of water releases from Anderson Dam;
- non-native plant species invasions and removals; and
- encroachment from new development.

Despite the number of stream restoration, enhancement or flood management projects, and natural and anthropogenic disturbances that occurred in the watershed within the 10 years between survey periods (see Valley Water Projects section), the amount of stream resources affected was relatively small compared to the scale of the watershed survey and the large-scale watershed based ambient survey did not detect a significant change in stream conditions.

The D5's ambient surveys are not designed to track localized change in condition, but are intended to characterize and track the overall ecological conditions of streams at the watershed and PAI scales and so that the CDFs can be used to evaluate and track restoration and mitigation projects within a watershed/PAI context. Individual projects should utilize CRAM within the project footprint to assess ecological conditions directly related to the project, and to compare project conditions with the watershed-scale ambient condition. To maintain healthy watersheds, projects should aim to improve the overall ecological condition of streams to above the 50th percentile CRAM Score for the watershed. Based on the 2020 Coyote Creek reassessment survey that is a CRAM Index Score of 77 (95% CLs 73 to 80) or higher for the whole watershed and 65 (95% CLs 59 to 74) or higher for the Valley PAI. For more information about how to use CRAM and the D5 ambient surveys to support project planning and tracking please refer to the Five Watershed Synthesis report (Lowe *et al.*, 2020).

8.1. Recommended Actions to Improve Stream Condition

Based on the CRAM survey, there are specific activities that Valley Water and other stream stewards can do to improve the overall condition of streams, such that the cumulative actions might improve the watershed or Valley scale conditions. As described in the Level-1 Results above, Valley Water only owns about 4% of the total channel network length in the watershed, and has easement access to another 1% of the total length. This limits the effect that Valley Water can have on the overall channel network through its programs, projects and management. Because of this limitation, Valley Water must continue to collaborate with other agencies, organizations and land owners to improve stream conditions at the watershed scale. The CCNEET tool was developed to support this collaboration and is Coyote Creek's Stream Corridor Priority Plan under Project D5. As mentioned above, CCNEET is a publicly available, interactive tool within the EcoAtlas web-service that presents a broad set of science based ecological restoration opportunities within the Coyote Creek mainstem channel between Anderson Dam and Montague Expressway (Valley Water and SFEI, 2020). Existing CRAM assessment data, among a multitude of other scientific study data, were used to help characterize the CCNEET reaches, as well as overall ecological conditions within the mainstem channel.

CRAM, with its detailed Metric-level descriptions and scoring observable ecological characteristics of poor to good condition, provides direct prescriptive information to assist Valley Water in identifying specific activities to improve the AAs. Low scoring CRAM Metrics imply room for ecological improvement, however some activities may be more cost effective than others. Below are specific Metric level actions that, if implemented in low condition stream reaches could help to improve the conditions of streams within the Coyote Creek watershed. These recommendations are based on the results of the 2020 Coyote Creek Reassessment survey and organized by CRAM Attribute.

8.1.1. BUFFER AND LANDSCAPE CONTEXT

Metrics within the Buffer and Landscape Context indicate that stream managers should prioritize maintaining and/or restoring dedicated stream corridors that provide high-quality ecological buffers that support natural stream and riparian zone processes. Stream restoration and enhancement projects that improve the condition of adjacent riparian habitats by enhancing cover of native vegetation, and reducing the amount of disturbance (human and soil) will improve the quality and function of buffer areas.

Recommended actions to improve Buffer and Landscape Context conditions include:

- Decommission roads adjacent to a channel, or remove buildings from floodplains to dedicate land as ecological buffer.
- Do not allow development within a certain distance of a stream channel, but instead dedicate the space for the channel corridor.
- Daylight segments of channels that are currently underground or remove channel crossings.
- Remove non-native plant species, plant natives, and limit human disturbance.

8.1.2. HYDROLOGY

Metrics within the Hydrology Attribute are generally more difficult to change, compared with other metrics within CRAM. However, these metrics indicate that channel stability is an issue in select locations within the watershed, and can be improved through large-scale efforts to stabilize incising reaches, or reduce sediment contributions to aggrading reaches. For incised reaches, data should be collected to determine if incision is still occurring. If so, solutions that stabilize the bed elevation and prevent further incision or headcutting should be explored. However, if the incision is arrested, channel condition could be improved by excavating and creating a new floodplain at the appropriate elevation. These solutions are possible, but often expensive and subject to continued future change. Due to cost, only reaches that have a severe stability issue, or that have large consequences if they were to continue to incise or aggrade, or that provide significant flood risk benefits (by creating new floodplain areas) should be considered for future projects.

Recommended actions to improve Hydrology conditions include:

- Installing naturalistic channel features that provide grade controls, reduce channel incision, and improve channel complexity. This includes installing habitat features (e.g. riffles and pools, large woody debris, cobbles and boulders, vegetated islands, bars), and supporting fish passage if needed with log step ladders. Other actions for returning natural channel functions to a reach could include raising the stream bed elevation, increasing floodplain connectivity, and restoring deposition zones.
- Addressing sources of erosion upstream within a watershed (e.g., controlling bank erosion, hillslope erosion) to reduce the amount of sediment available for deposition in a reach that is chronically aggrading.

- Improving sediment transport through a low gradient reach subject to continued deposition and aggradation.
- Creating new floodplain surfaces at appropriate elevations within an incised reach that could reduce flood risks in downstream reaches.

8.1.3. PHYSICAL STRUCTURE

Metrics in the Physical Structure Attribute indicate that channel complexity is currently variable across the watershed and in generally poor condition in many individual AAs. This means that the number of different obvious types (and arrangements) of physical surfaces or features that provide habitat for aquatic, wetland, or riparian species within the AAs are generally low as measured by CRAM. Channel complexity can relatively easily be increased by placing specific patch types into the channel network (e.g. riffles and pools, large woody debris, cobbles and boulders, vegetated islands, bars). Although this is essentially a temporary solution that does not address the underlying natural hydrologic and physical conditions needed to create and maintain a diversity of patch types (e.g. floodplain connectivity, depositional zones, variations in channel grading), it can quickly provide missing habitat features.

The Physical Structure Attribute also characterizes Topographic Complexity. Activities to improve Hydrology metrics should also consider the topographic complexity of the channel reach, as a single action could potentially improve both metrics. While Physical Structure is generally low throughout the watershed, efforts to increase channel complexity should focus on the mainstem channels within the Valley.

Recommended actions to improve Physical Structure conditions include:

- When designing flood projects and larger maintenance activities, include more channel complexity by installing habitat features (e.g. riffles and pools, large woody debris, cobbles and boulders, vegetated islands, bars), variable topography in the immediate floodplain, shade and other habitat cover within the channel and floodplain to support fisheries and other wildlife.
- Fisheries studies that indicate reaches supporting native fish do not have enough cover elements, consider installing habitat features (e.g. riffles and pools, large woody debris, cobbles and boulders, vegetated islands, bars), shade and other habitat cover within the channel and floodplain.
- Projects creating or enhancing floodplains for flood risk reduction should also consider adding topographic complexity and habitat for a diversity of wildlife and plant species that could be provided by those floodplains.

8.1.4. BIOTIC STRUCTURE

Metrics in the Biotic Structure Attribute can relatively easily be improved. However, the costs for maintaining improvements can be ongoing and expensive. Managers should utilize the Biotic Structure metrics to identify locations that would benefit from invasive species removal or have simple vegetation communities in locations expected to be more complex.

Recommended actions to improve Biotic Structure conditions include:

- AAs with the lowest Biotic Structure scores are often located on tributaries within the Valley PAI. These locations should be further evaluated to see if additional vegetation can be planted, trees encouraged, or maintenance modified so reaches can become more vegetatively complex. In addition, managers might evaluate how physical structure conditions might be adjusted to help the vegetation community naturally regenerate and thrive (e.g. variable topography, large woody debris, and depositional areas).
- The number of Co-dominant Species and Percent Invasive sub-metrics can be used to identify specific AA locations where invasive plant species are currently a problem, and could be targeted for invasive species removal.
- Improve riparian corridor connectivity and complexity of vegetation along a larger (more continuous) length of channel or sub-watershed by removing invasives, planting natives, and encouraging complexity in plant zones and layers.
- Reach out to other agencies and private landowners who own land along the stream riparian corridors to educate and/or collaborate on ways to reduce invasive plants and/or the benefits of increasing biotic structure complexity along the channels.

8.2. Environmental Challenges and Risks to Stream Condition

The primary drivers of change in ambient condition of streams in the Bay Area for the next few decades are land use, climate, and direct human alteration. Water is life and its availability is the most critical hydrologic source of stream, watershed, and ecosystem condition. Water supply, demand, land use and human alteration of landscapes shaped the modern Coyote watershed, and will determine its future under increased pressures. Local precipitation and groundwater supplies from regional climate conditions are dynamic, and insufficient for Santa Clara County the past several decades to the present, and foreseeable future. The Coyote watershed below Coyote and Anderson Reservoirs is augmented by imported water. Livestock watering ponds, which are dammed stream channels commonly found in the upper-watershed, will be affected by climatic change. The amount and pattern of precipitation, drought, rising temperatures and evapotranspiration drive water supply, demand, surface runoff, groundwater, and stream flow. These drivers will increase the risk of significant negative impacts, such as reduced or inadequate stream flows for ecosystem health, biological invasion, water contamination, increased destructive flooding, excessive erosion and sedimentation. The drivers will become increasingly interrelated, as stream and watershed management actions focus on mitigating the negative impacts of land use, consumptive water use (supplies for multiple needs), and climate change.

Watershed management will need to evolve immediately to meet the environmental challenges of rapid climate change. Despite decades of environmental protection, pressures remain to alter streams and their habitats by draining, channelizing, excavating, vegetation clearing, filling, damming, hardscape, culverts and piping, etc. The principles of flood risk reduction, storm damage prevention, and to some extent, disease vector control are based on removing water from the landscape as quickly as possible, short circuiting natural processes of water retention, recharge, and recycling that add resilience to indigenous water supplies and local ecosystems. Advances in green infrastructure, best management practices (BMPs), and Leadership in Energy and Environmental Design (LEED) are fairly recent, and implemented on limited scales. Most land development continues to add impervious hardscape, amplifying the expected negative impacts of climate change. Poorly designed stewardship actions and their slow pace will cause them to fail. Redesign, restoration and replacement are expensive. Recent policies that encourage watershed-based environmental planning and regulation (e.g., USEPA and USACE 2008, SWRCB 2021), and the emerging initiative to reduce administrative obstacles to voluntary restoration are intended to address inadequacies of compensatory mitigation (e.g., Ambrose *et al.*, 2007, Matthews and Endress, 2008, Matthews, 2015) and voluntary restoration (CNRA 2002, CLSN 2020).

Valley Water is evaluating ways to adapt its operations to climate change now and in the future. These efforts involve the Climate Change Action Plan[18] (CCAP, SCVWD 2021), 5-year update of the Groundwater Management Plan19 (GMP), Monitoring and Assessment Program (MAP) of the Water Supply Master Plan 2040[20] (Master Plan), Urban Water Management Plan[21] (UWMP), Local Hazard Mitigation Plan[22] (LHMP), goals and targets of the One Water Plan, and the Safe, Clean Water and Natural Flood Protection Program. As a

[18] https://www.valleywater.org/your-water/water-supply-planning/climate-change-action-plan

[19] https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

[20] https://www.valleywater.org/your-water/where-your-water-comes/groundwater/sustainable

[21] https://www.valleywater.org/your-water/water-supply-planning/urban-water-management-plan

[22] https://www.valleywater.org/flooding-safety/local-hazard-mitigation-plan

product of Project D5, this report begins to address how it might support the other climate adaptation efforts with regard to three major aspects of climate change impacts.

8.2.1. BIOLOGICAL INVASION

The invasion of stream riparian zones by non-native, invasive vegetation and other organisms (including mammals (e.g. nutria), birds, reptiles, amphibians, fishes, and invertebrates[23]) is already a ubiquitous problem. Its impacts are likely to continue unless there is a more concerted effort among landowners to effectively treat the invasions. For vegetation, Valley Water implements the IPMP to control listed invasive plant species on its fee title properties and easements. Project D2: Revitalize Stream, Upland and Wetland Habitat, and other Safe, Clean Water and Natural Flood Protection Program projects and grants are attempting to stop or even reverse the invasions. The Safe, Clean Water and Natural Flood Protection Program renewed by voters in 2020 increases efforts to control invasive vegetation. Valley Water is in the early stages of developing an Integrated Pest Management Program (IPMP).

The D5 Project could support these efforts by producing a comprehensive, living, interactive map of the invasions, consistent with the Valley Water IPMP, and early detection and rapid response (EDRR, now part of the D2 Project) networks. There are statewide attempts to do this (e.g., see the California Invasive Plant Council (Cal-IPC) and Calflora, where Valley Water collaborates with both organizations). The City of San Jose with Valley Water co-funded H.T. Harvey and Associates (2018) to complete a survey of key nonnative vegetation species along Coyote Creek within the City's properties under a D2 Project partnership. In addition, the watershed assessments conducted by the D5 Project are helping to identify the locations of dominant invasive species within Santa Clara County watersheds. The D5 Project could help complete the map of invasive vegetation throughout the watersheds, consistent with a One Water identified countywide action, and train qualified stewards to help update and maintain the map using a standardized quality assessment / quality control (QA/QC) procedure. Online information technology to support a living map can be adapted readily from the Bay Area Aquatic Resource Inventory (BAARI) and managed for data visualization and access as a component of EcoAtlas with input from the Remote Sensing and Geospatial Workgroup of the SF Estuary Wetlands RMP. This will avail Valley Water of the regional and statewide expertise in vegetation mapping and related online informatics. A comprehensive, living map of invasive plant species could serve to guide, track, and assess all vegetation control efforts within the County.

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[23] https://wildlife.ca.gov/Conservation/Invasives/Species, and https://wildlife.ca.gov/Conservation/Invasives/Quagga-Mussels

8.2.2. LAND DEVELOPMENT

The negative impacts of roads, parking lots, buildings, and other land development are likely to continue unless economically and politically difficult mitigating measures are successfully implemented. The watershed assessments produced by the D5 Project show where land uses of different kinds are strongly affecting poor, fair, and good stream health. In general, these data indicate that floodplain width, longitudinal riparian continuity, and the spatial complexity of streams should be increased for streams that border roads and suburban or urban areas.

Other uses of streams and adjoining lands, such as day-use recreation and legal or illegal camping, can have their own types of impacts. Physical destruction of stream habitat and trash accumulation are impacts caused by overuse (Kakoyannis and Stankey, 2002) that are evidenced in the watershed assessments conducted by the D5 Project. Valley Water is currently updating its recreational trail policy. Chemical pollution also can be an impact of these land uses (Venohr *et al.*, 2018). To date, the watershed assessments have not included direct measures of chemical pollution.

The occurrence of encampments adjacent to water bodies has been linked to their contamination (Devuona-Powell, 2013, White, 2013). These are socio-economic and public health problems, where affordable housing and improved medical care provide substantial solutions. Valley Water has spent considerable resources to clean creekside encampments, in cooperation with municipalities, including providing social services. Also in partnership with cities, Valley Water monitors water quality, and removes trash and debris under the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). The number of homeless residents in Santa Clara County increased from an estimated 6,500 in 2015 to nearly 10,000 in 2019 (County of Santa Clara, Office of Supportive Housing[24]). How the encampments along streams will change in the future is uncertain, especially considering the COVID-19 pandemic, but the impacts have been measurable for decades, and are likely to increase without additional socio-economic progress.

A variety of BMPs can help improve stream health. Stream setback ordinances can be helpful, if they are designed to protect desired levels of riparian functions. A review of the science of setback ordinances and their effectiveness in the region would be worthwhile. To clarify and streamline local permitting for streamside activities, representatives from Valley Water, 15 cities, the county, business, agriculture, streamside property owners and environmental interests formed the Water Resources Protection Collaborative in 2002. The Collaborative adopted *Guidelines and Standards for Land Use Near Streams: A Manual of Tools,*

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[24] https://osh.sccgov.org/continuum-care/reports-and-publications/santa-clara-county-homeless-census-and-survey-reports

Standards, and Procedures to Protect Streams and Streamside Resource in Santa Clara County in 2007[25]. Following the adoption of the Guidelines and Standards, Valley Water repealed its existing Ordinance 83-2 and enacted the Water Resources Protection Ordinance[26], which it applies to all Valley Water owned land.

Going further, Low Impact Development (LID) and LEED measures should be used to retain and treat runoff from roads, parking lots, and rooftops before it reaches the streams. This can also assist with minimizing flood risks by reducing peak storm flows. Given that modern paved roads are a major source of microplastics in developed landscapes (Sutton *et al.*, 2019), LID can also help reduce microplastic loading into streams. GreenPlan-IT can be very helpful in siting cost-effective LID installations. The Santa Clara Basin Stormwater Resource Plan (SWRP) developed by Valley Water and SCVURPPP includes green stormwater infrastructure projects intended to improve water quality, and provide multiple benefits for climate change resiliency by reducing runoff, building resilience to drought via groundwater recharge and augmentation of water supplies, reducing urban heat island effects, and contributing to sequestration of carbon. Similarly, the South County SWRP developed by Valley Water, County of Santa Clara, cities of Gilroy and Morgan Hill identifies water quality issues, presents local and regional stormwater projects that provide increased resilience, water quality and other benefits.

The watershed assessments conducted by the D5 Project could be further designed to help assess the efficacy of these and other BMPs. The geospatial datasets of surface waters developed for the D5 Project can serve as a common basemap for all stream and watershed management actions undertaken by Valley Water or its partners. EcoAtlas' Project Tracker and CCNEET tools can be used to map and track the actions, such that they can be planned together.

8.2.3. CLIMATE CHANGE IMPACTS

Climate change is likely to exacerbate all other economic, physical, and ecological threats to stream conditions. With regard to changes in the distribution, abundance, diversity, and conditions of streams and other non-tidal surface waters in the region, the most important climatic parameters are precipitation and evaporation (water loss due to air temperature and wind). In addition to driving evaporation, air temperature can affect water temperature, stressing native species. Between 1950 and 2019, an analysis of historical data shows that Santa Clara County's annual average maximum temperature has increased by 2.5 degrees

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[25] https://www.valleywater.org/contractors/doing-businesses-with-the-district/permits-working-district-land-or-easement/guidelines-and-standards-land-use-near-streams

[26] https://www.valleywater.org/sites/default/files/WRPO.pdf

Fahrenheit (˚F, NOAA 2020). Transpiration through vegetation also removes water from streams and other surface waters, but is strongly influenced by air temperature and wind. For the South Bay Area streams, the most important physical factors affected by changes in precipitation and evaporation are runoff and streamflow. Changes in these factors can have major effects on the hydrologic cycle and therefore, influence all ecosystem goods and services, including water supplies. As noted above, Valley Water has multiple programs and projects to examine the likely consequences of climate change on its mission to meet the demands of its service area for water supplies, flood management, and stewardship (stream ecosystem conditions and healthy watersheds).

Efforts to forecast regional climate change are continuing. Recent reports suggest that by 2080, the climate in the Bay Area would be 40 percent drier, about 7 degrees hotter in the winter (Fitzpatrick and Dunn 2019), and the number of extreme hot days will increase (Dahl *et al.*, 2019). Precipitation may increase in overall volume. Extreme heat and precipitation events are likely to increase in frequency. Santa Clara County is also expected to experience more frequent and severe droughts, increased risk of wildfire, increased threats to surface water quality, and sea level rise. California's snowpack, a source of Valley Water's imported water supply, is expected to decline as a result of climate change.

For Santa Clara County, trends using downscaled global climate model (GCM) projections from Cal-Adapt (CEC 2020) show temperature in Santa Clara County projected to rise by 1.8˚F by 2050 (Representative Concentration Pathway (RCP) 4.5) or 2.0˚F by 2050 (RCP 8.5) (draft CCAP 2021[27]). Increases in the number of extreme heat days, which are days when the daily maximum temperature is above the extreme heat threshold of 93.1°F, on average from model projections are 2.7 to 5.6 more days per year by 2050 (Under RCPs 4.5 to 8.5, draft CCAP 2021).

The forecasted increases in air temperature would generally cause an increase in total annual evaporative losses. Unless these losses are offset by increased above or below ground storage, the total average annual amount of water in the watersheds will probably decrease, causing a reduction in wetland acreage and lower aquifers.

Precipitation in the Bay Area will continue to exhibit high year-to-year variability. The region's largest winter storms will likely become more intense and potentially more damaging in the coming decades (Ackerly *et al.*, 2018, OPR *et al.*, 2018). For the Santa Cruz Mountains in the South Bay Area, modeling predicted reduced early and late wet season runoff, and possibly a longer dry season, with greater inter-annual variability (Flint and Flint, 2012). An analysis of modeled precipitation for Santa Clara County shows that future changes in precipitation are marginally significant with RCP 4.5 and significant with RCP 8.5, where annual precipitation

[27] https://www.valleywater.org/your-water/water-supply-planning/climate-change-action-plan

may rise 0.5 inches to 1.3 inches by 2050, respectively (SCVWD 2021). Despite potentially more rain and consistent with seasonal predictions above, models for Valley Water indicate the wet season will be shortened, precipitation events will become less frequent, but more extreme.

Changes in the amount, intensity, and pattern of precipitation will affect runoff and stream flow. Most models project more intense storms and possibly increased return frequencies. For example, given a modest scenario of global warming through 2100, a once-in-20 year storm is likely to become a once-in-seven-year or more frequent storm (Ackerly *et al.*, 2018), and a once-every-200-year sequence of storms comparable to what caused the great California flood of 1862 could occur every 40-50 years (OPR *et al.*, 2018). As the inter-annual variability in flow will increase, some stream reaches that are currently perennial will likely become seasonal or ephemeral. The amplitude of changes in stream flow will depend in part on water management practices that affect runoff, including increased retention, reuse and recycling, and decreased consumption.

The increased air temperature, shortened wet season, and increased inter-annual variability in precipitation are likely to cause longer and more severe droughts, posing major problems for water supplies across decadal and longer time periods (Cayan *et al.*, 2011, Ackerly 2012, OPR *et al.*, 2018, Ackerly *et al.*, 2018). This may already be occurring, as evidenced by the increased intensity and frequency of drought in Santa Clara County from 2000 to 2020 (see Figure 25), the decades of the first and second Coyote watershed assessments.

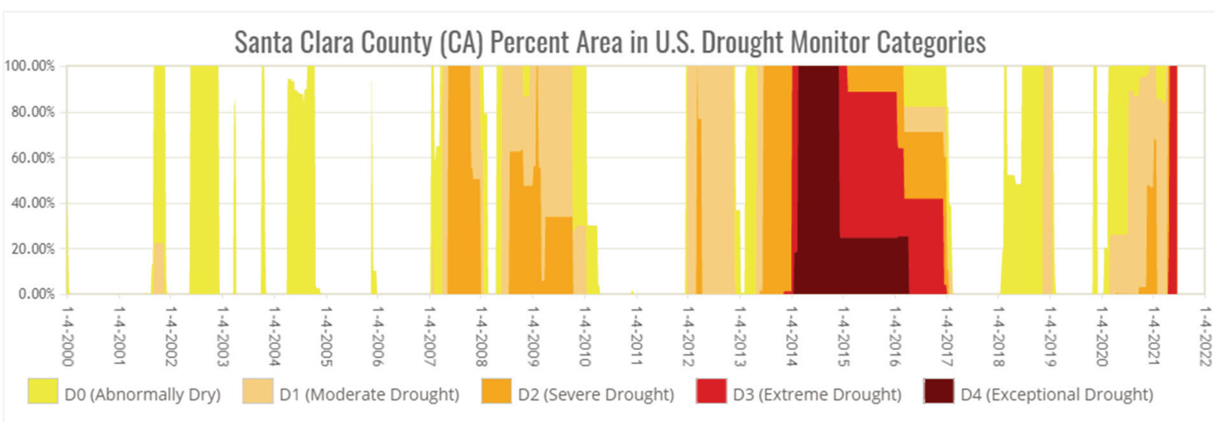

Figure 25. Severity and frequency of drought in Santa Clara County from 2000 to June 2021 (US Drought Monitor 2021)

The changes in runoff and streamflow, as well as the predicted increases in wildfire frequency and intensity, will affect the amount of terrigenous sediment that is conveyed to and through streams. An increase in peak flows through incised stream channels could initiate their chronic down-cutting and headward erosion, greatly increasing sedimentation downstream. These changes in sediment supplies will also be influenced by erosion control measures applied to hillsides and streams.

At the watershed scale, ecological responses to these changes in climate, stream flow, and sediment yields will be complex, as species remix along changing spatial and temporal gradients in their habitat conditions, subject to inter- and intra-species interactions.

The watershed assessments conducted by the D5 Project are designed mainly to assess the status and trends in overall stream condition. The value of the monitoring results could be greatly increased by using them to develop and calibrate numerical models designed to forecast future conditions, based on alternative scenarios for climate change, land use change, and climate adaptation actions. For example, Valley Water might consider intensifying its efforts to monitor stream flow and water temperature in streams. The Riparian Zone Estimator Tool (RipZET) could be further developed to guide riparian forest restoration and predict and assess its effect on stream temperature and channel habitat.

Any efforts to improve stream conditions through purposeful changes in the form or structure of channels or their riparian areas should reflect the best available information on likely future changes in rainfall and temperature regimes. Scientific frameworks and guiding principles are available to help assure the success of large-scale ecological restoration (e.g., Beller *et al.*, 2015).

Table 15 lists possible major effects of climate change on the distribution and abundance of aquatic resources in the five major watersheds of Santa Clara County. Valley Water should consider the effects of these changes on its ability to continue providing reliable water supplies and flood protection, while meeting stewardship goals and objectives. It must be recognized that more science is needed to understand the likelihood of these various possible landscape responses to climate change.

Project D5 has the potential to further support coordinated climate adaptation within Valley Water and beyond. This will require careful consideration of how watershed-based monitoring and assessment by D5 can help Valley Water meet the goals and objectives of CCAP, GMP and its 5-year updates, MAP, One Water, D5 itself and other projects of the Safe, Clean Water and Natural Flood Protection Program. The basic approach might be for D5 in coordination with the Santa Clara Valley Habitat Plan (VHP) within its permit area to produce base maps of the surface waters and riparian areas for Santa Clara County watersheds, help maintain a map of on-the-ground actions to improve the condition of surface waters, and conduct watershed-based surveys to assess effectiveness of the actions in the context of climate and land use change. Future efforts to improve the health of surface waters will benefit from numerical models to predict the effects of climate and land use change.

Project D5 can be the source of empirical observations of field conditions to develop and calibrate the models. Eventually, D5 may need to integrate surface water and groundwater monitoring to more realistically account for changes to aquatic resources affected by Valley Water operations, projects, activities, as well as other resulting from other stressors.

Table 15. List of possible landscape responses to climate change

Climate Change	***Potential Major Landscape Responses***
Increased temperature translates into increased evaporation, which has similar landscape-scale effects as decreased precipitation	Decreased dry season surface water storage
	Decreased aquifer storage
	Decreased acreage of perennial wetlands
	Increased acreage of seasonal wetlands
	Reduced perennial stream base flow
	Reduced total length of perennial streams
	Increased total length of episodic streams
	Increased risk of wildfires
Increased precipitation, or decreased duration of the wet season with no increase in precipitation, translates into increased peak flows	Increased channel incision and bank erosion in upper watershed
	Increased channel head-cutting
	Increased hillslope gullying
	Increased landslides
	Increased sediment yields
	Decreased reservoir capacity
	Reduced flexibility to manage reservoir levels and stream flows
	Increased threat of flooding and storm damage

A regional approach to climate change adaptation at the landscape or watershed scale is warranted (Beagle *et al.*, 2019). A growing number of Bay Area local governments, regional agencies, nonprofits, and private sector organizations (including Valley Water) have initiatives to advance climate planning and adaptation. Examples include Silicon Valley 2.0 (Santa Clara County[28]), Resilient by Design: Bay Area Challenge[29], Sonoma County Regional Climate Authority[30], Adapting to Rising Tides[31], Bay Area Regional Reliability Project[32], UC

[28] https://www.sccgov.org/sites/osp/Pages/sv2.aspx

[29] http://www.resilientbayarea.org/

[30] https://rcpa.ca.gov/

[31] https://www.adaptingtorisingtides.org/

[32] https://www.bayareareliability.com/

Berkeley's Climate Readiness Institute[33], Marin County C-SMART[34], Sea Change San Mateo County[35], Climate Ready North Bay[36], San Francisco Bay Restoration Authority[37], Bay Regional Regulatory Integration Team[38], Bay Conservation and Development Commission Bay Plan Amendment[39], San Francisco Bay Shoreline Adaptation Atlas[40], and the forthcoming Amendment of Bay Area Regional Water Quality Control Basin Plan[41]. Valley Water is an active member or familiar with these initiatives and collaborates as appropriate. Valley Water participates in the San Francisco Bay Area and Pajaro River Watershed Integrated Regional Water Management Plans (IRWMPs). Likewise, Valley Water will want to stay tuned to state and federal policies and funding for climate change adaptation.

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33 https://www.criberkeley.org/

34 https://www.marincounty.org/depts/cd/divisions/planning/csmart-sea-level-rise

35 https://seachangesmc.org/

36 http://climate.calcommons.org/crnb/home

37 https://www.sfbayrestore.org/

38 https://www.sfbayrestore.org/san-francisco-bay-restoration-regulatory-integration-team-brrit

39 https://bcdc.ca.gov/BPAFHR/FillHabitat.html

40 https://www.sfei.org/adaptationatlas

41 https://www.waterboards.ca.gov/sanfranciscobay/basin_planning.html

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10. Appendix A - CRAM Assessment Results

Coyote Creek watershed stream condition assessment results for the original 2010 baseline and the 2020 reassessment surveys employing CRAM are presented in figures and tables below (A.1 and A.2 respectively). The data can be accessed and downloaded online at www.ecoatlas.org[42]. To help with accessing the D5 ambient survey project AAs online, the eCRAM Project Names start with "SCVWD D5 Project".

Please note that the 2010 CRAM survey employed an older version of the CRAM Riverine Field Book (v5.2.0) and the data are stored in eCRAM as two separate Project Names: "SCVWD D5 Project Coyote Crk Ambient_2010" and "SCVWD D5 Project_Coyote Crk Ambient_UpperPenFocus_2010". For this report and *change analysis* SFEI's CRAM expert, Sarah Pearce who also led the 2010 ambient field survey, reviewed and updated the original Metric Scores according to Field Book v6.1 guidance to maximize comparability between the 2010 and 2020 surveys (see Methods section for more information). As a result, the 2010 CRAM results listed in Table A.1 below are the updated (v 6.1) results employed in this report.

[42] Once in https://ecoatlas.org/ click on the Bay Area region on the map and then click on the "Show Tools" button on the top right of the screen. Select the "Wetland Condition (CRAM)" tool and filter by Project Name(s). You can download the publicly available CRAM AA results as a CSV, KML, or ESRI shapefile using the "Download CRAM Data" button at the bottom of the screen.

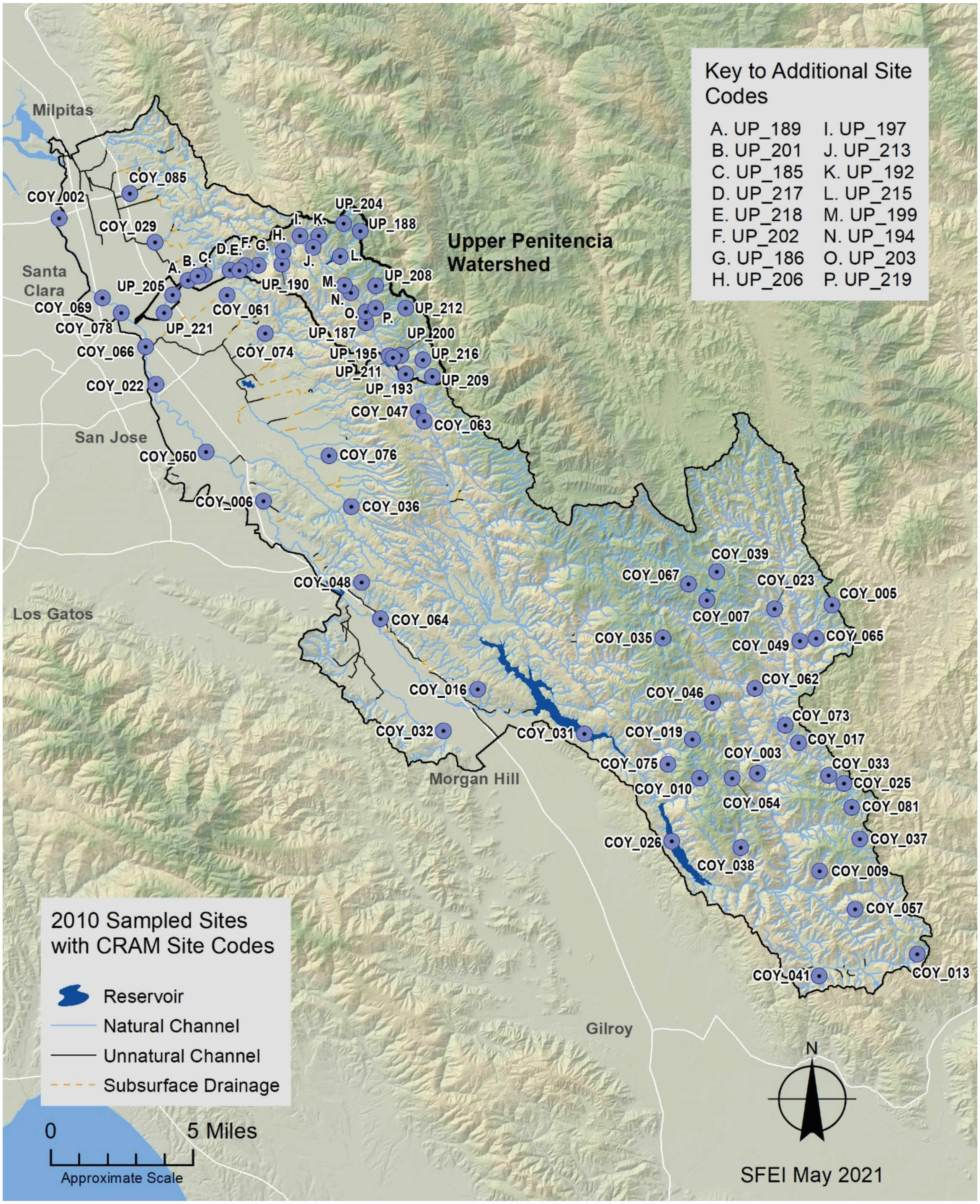

Figure A.1. Map of Valley Water's D5 Project's CRAM ambient stream condition survey sites assessed in the Coyote Creek watershed in 2010 with their site codes.

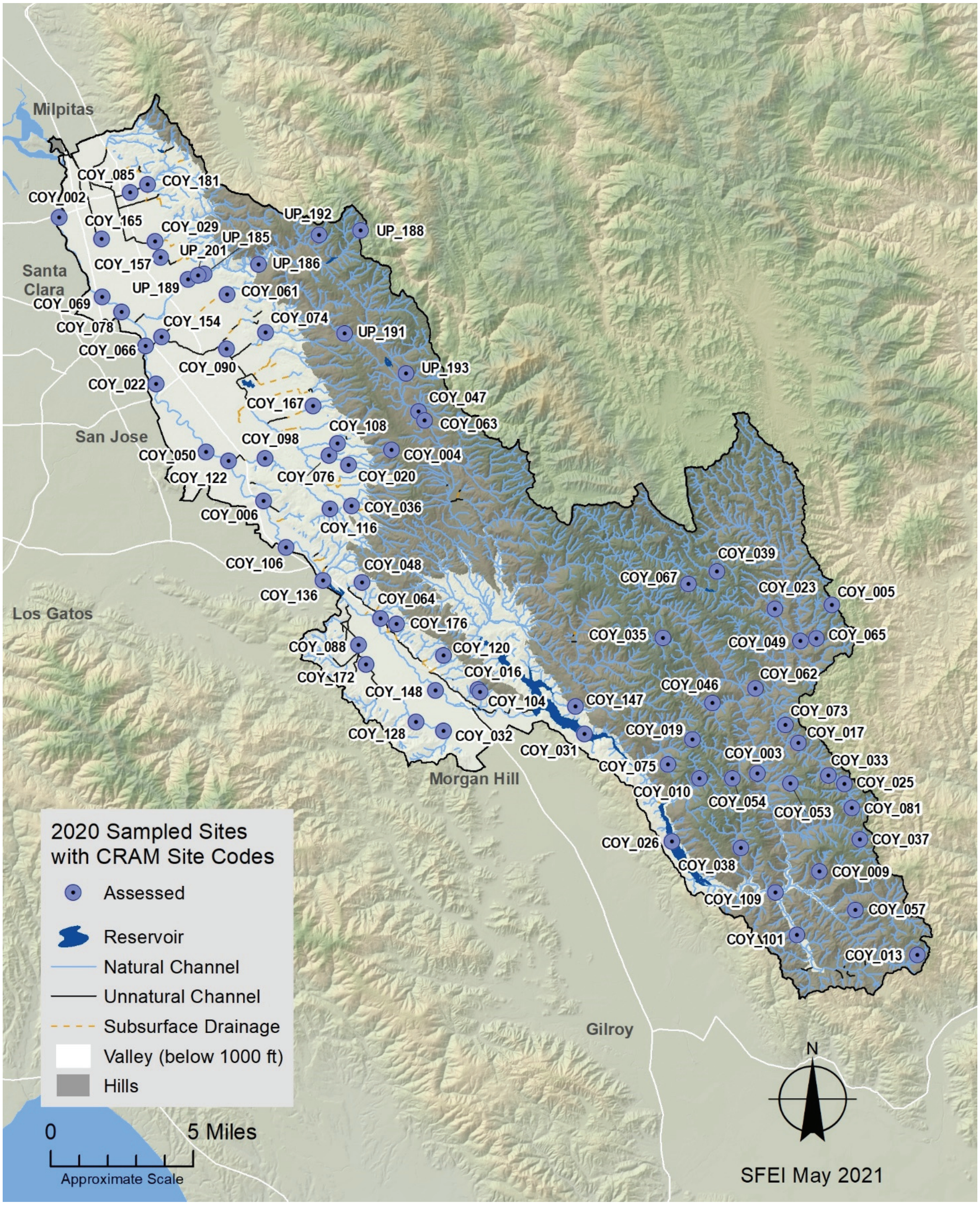

Figure A.2. Map of Valley Water's D5 Project's CRAM ambient stream condition survey sites assessed in the Coyote Creek watershed in 2020 with their site codes.

Table A.1. 2010 Coyote Creek watershed CRAM stream survey results updated to CRAM Field Book v.6.1 including assessment area (AA) site IDs, eCRAM AARowIDs, visit date, basic wetland site information, and CRAM Index and Attribute Scores. 7 of the 77 AAs are not listed here because the landowners did not want the specific field assessment results published. See Methods section for more information about the updated scores.

Site ID	AA Name	eCRAM AARowID	Visit Date	Riverine Sub-class	Hydroregime	Flowing Water Present?	Bankfull Width (m)	Longitude (centroid)	Latitude (centroid)	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
COY_002	Highway 237	1196	7/12/2010	non-confined	perennial	1	13	-121.92799	37.42197	63	37.50	83.33	62.50	69.44
COY_003	COIT HORSE CAMP	1275	8/17/2010	confined	ephemeral	0	1	-121.48672	37.13359	78	100.00	91.67	62.50	58.33
COY_005	Henry Coe-Bear Mt Trail	1350	8/18/2010	non-confined	intermittent	0	1	-121.43836	37.21921	79	100.00	91.67	62.50	61.11
COY_006	Penitencia Creek Park	1245	8/4/2010	non-confined	perennial	1	9.8	-121.79911	37.27574	82	75.00	75.00	87.50	91.67
COY_007	Booze Lake	1345	8/31/2010	confined	intermittent	0	1	-121.51826	37.2218	80	100.00	100.00	37.50	80.56
COY_009	Middle Steer Ridge	1346	8/25/2010	confined	intermittent	0	3	-121.45083	37.08467	79	93.30	83.33	62.50	75.00
COY_010	Moskowitz-Larios Canyon	1263	8/20/2010	confined	intermittent	0	2.9	-121.52435	37.1322	74	100.00	75.00	62.50	58.33
COY_013	Canada de los Osos	1352	8/23/2010	confined	intermittent	0	2	-121.38872	37.03973	85	93.30	91.67	75.00	80.56
COY_016	Kirby Canyon	1360	8/11/2010	non-confined	perennial	1	0	-121.66512	37.17901	66	85.36	83.33	37.50	58.33
COY_017	Kelly Cabin Trail	1274	8/17/2010	confined	intermittent	0	0.8	-121.46117	37.14943	79	93.30	91.67	75.00	55.56
COY_019	Cordoza Ridge Road	1276	8/24/2010	confined	intermittent	0	1.5	-121.52888	37.15166	79	100.00	75.00	75.00	66.67
COY_022	William St. Park	1195	7/12/2010	confined	perennial	1	9.8	-121.86711	37.33591	61	62.50	66.67	50.00	66.67
COY_023	Henry Coe-Little Long Canyon	1351	8/18/2010	non-confined	ephemeral	0	4	-121.47496	37.21781	80	93.30	83.33	62.50	80.56
COY_025	Kelly Cabin Trail	1272	8/16/2010	non-confined	intermittent	0	1.5	-121.43188	37.1274	86	100.00	100.00	62.50	83.33
COY_026	Above Coyote Lake	1317	9/9/2010	non-confined	intermittent	0	9.1	-121.49971	37.07407	92	100.00	83.33	100.00	86.11
COY_029	Berryessa Morrill Road	1247	8/5/2010	non-confined	intermittent	0	1.3	-121.86619	37.40899	52	62.50	75.00	37.50	33.33
COY_031	Above Anderson Dam-Shell Crossing	1316	9/9/2010	non-confined	perennial	1	10.2	-121.56379	37.13623	83	100.00	66.67	75.00	91.67
COY_032	Earls Court	1256	8/19/2010	non-confined	intermittent	0	2.6	-121.68695	37.15763	52	71.02	83.33	25.00	27.78
COY_033	Kelly Cabin Canyon Trail	1273	8/16/2010	non-confined	intermittent	0	2.5	-121.44174	37.13181	76	100.00	83.33	62.50	58.33
COY_035	Henry Coe-Frog Lake	1271	8/17/2010	confined	intermittent	0	1	-121.54645	37.20466	86	100.00	100.00	62.50	80.56
COY_036	Thompson Creek-Silver Creek Rd	1359	8/11/2010	non-confined	intermittent	0	2	-121.7433	37.27286	74	75.00	91.67	50.00	80.56

Table A.1. 2010 Coyote Creek watershed CRAM stream survey results updated to CRAM Field Book v.6.1 (continued)

Site ID	AA Name	eCRAM AARowID	Visit Date	Riverine Sub-class	Hydroregime	Flowing Water Present?	Bankfull Width (m)	Longitude (centroid)	Latitude (centroid)	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
COY_037	Tule Pond and Grizzly Gulch	1348	9/1/2010	non-confined	intermittent	0	1	-121.4233	37.09953	75	93.30	100.00	50.00	58.33
COY_038	Dexter Canyon	1262	8/19/2010	confined	intermittent	1	6	-121.49881	37.09589	77	100.00	75.00	62.50	69.44
COY_039	Henry Coe -Booze Lake Road	1270	8/16/2010	non-confined	intermittent	0	6.1	-121.51157	37.23707	63	93.30	83.33	37.50	36.11
COY_041	Jamison Rd	1354	8/23/2010	non-confined	intermittent	0	2.5	-121.44987	37.02942	77	93.30	83.33	62.50	69.44
COY_046	Henry Coe-Madrone Soda Springs Trail	1288	8/17/2010	confined	ephemeral	0	2.5	-121.51543	37.17052	75	100.00	83.33	62.50	55.56
COY_047	Joseph Grant-Lower Hotel Trail	1235	7/28/2010	non-confined	ephemeral	0	2.9	-121.69995	37.32105	68	93.30	91.67	37.50	50.00
COY_048	Motorcycle Park	1250	8/9/2010	confined	perennial	1	2	-121.73715	37.23415	83	90.30	83.33	87.50	69.44
COY_049	Henry Coe-Bear Mt Road	1349	8/31/2010	non-confined	ephemeral	0	5	-121.45837	37.20141	87	93.30	100.00	75.00	80.56
COY_050	Golf Course-Los Lagos	1286	8/26/2010	non-confined	perennial	1	10.9	-121.83526	37.30148	81	75.00	83.33	75.00	91.67
COY_054	Little Rough Gulch	1264	8/20/2010	non-confined	intermittent	0	2.7	-121.50413	37.13175	85	100.00	75.00	75.00	88.89
COY_057	Henry Coe-Phegley Ridge	1347	8/31/2010	confined	intermittent	0	1	-121.42524	37.06385	85	93.30	100.00	62.50	83.33
COY_061	Miguelita Creek	1287	8/26/2010	non-confined	intermittent	0	1.9	-121.82044	37.38178	53	38.25	75.00	37.50	61.11
COY_062	Poverty Flat-Jackass Hill	1341	9/7/2010	confined	intermittent	0	1.5	-121.48825	37.17725	77	93.30	83.33	62.50	69.44
COY_063	Grant-San Felipe Creek	1291	8/31/2010	non-confined	intermittent	0	4.8	-121.69678	37.31632	82	93.30	91.67	75.00	69.44
COY_064	Malech Road-County Parks Rifle Range	1292	8/31/2010	confined	intermittent	0	2.7	-121.72712	37.21602	49	45.40	66.67	37.50	47.22
COY_065	Bear Mountain Rd	1340	9/7/2010	non-confined	intermittent	0	2	-121.44786	37.20177	91	100.00	100.00	75.00	88.89
COY_066	Lower Silver Creek-Kellogg's	1303	9/3/2010	non-confined	perennial	1	8.1	-121.87325	37.35553	62	50.00	75.00	50.00	72.22
COY_067	NW of Booze Lake	1344	9/7/2010	confined	ephemeral	0	0.5	-121.53013	37.23056	81	100.00	100.00	50.00	75.00
COY_069	Ridder Park	1302	9/3/2010	non-confined	perennial	1	8.2	-121.90048	37.3807	60	37.50	58.33	62.50	80.56
COY_073	Kelly Cabin Trail COY-073	1339	9/8/2010	confined	intermittent	0	0.7	-121.46326	37.15686	83	100.00	91.67	62.50	77.78
COY_074	COY-074	1358	9/14/2010	non-confined	perennial	1	2	-121.79652	37.36209	74	70.40	83.33	62.50	80.56

Table A.1. 2010 Coyote Creek watershed CRAM stream survey results updated to CRAM Field Book v.6.1 (continued)

Site ID	AA Name	eCRAM AARowID	Visit Date	Riverine Sub-class	Hydroregime	Flowing Water Present?	Bankfull Width (m)	Longitude (centroid)	Latitude (centroid)	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
COY_075	Otis Canyon	1357	9/15/2010	confined	intermittent	0	0.75	-121.54197	37.13439	81	100.00	83.33	50.00	88.89
COY_076	Evergreen College - Yerba Buena Creek	1305	9/7/2010	non-confined	perennial	1	1.9	-121.75726	37.29885	70	80.62	75.00	50.00	75.00
COY_078	COY-078	1355	9/10/2010	non-confined	perennial	1	7	-121.88831	37.37275	67	66.45	66.67	62.50	72.22
COY_081	Henry Coe	1343	9/15/2010	confined	intermittent	0	0.8	-121.42944	37.11428	84	100.00	91.67	62.50	80.56
COY_085	Arroyo de los Coches	1337	9/13/2010	confined	perennial	1	3	-121.88219	37.43448	32	25.00	33.33	37.50	30.56
UP_185	Upper Penitencia Creek Road	1363	7/26/2010	non-confined	perennial	1	5	-121.83493	37.39246	61	67.68	66.67	50.00	61.11
UP_186	Alum Rock-Visitor Center	1233	7/27/2010	confined	perennial	1	6	-121.8011	37.39664	77	73.27	83.33	62.50	88.89
UP_188	Canada de Pala-Charlie Dean Springs	1266	8/12/2010	confined	ephemeral	0	2.2	-121.73536	37.41363	69	93.30	91.67	37.50	52.78
UP_189	Piedmont school	1251	8/10/2010	non-confined	perennial	1	4.5	-121.84584	37.38951	66	72.86	58.33	62.50	69.44
UP_190	Alum Rock Waterfall	1268	8/11/2010	confined	intermittent	1	5.6	-121.78389	37.39797	86	100.00	83.33	87.50	72.22
UP_193	Joseph Grant-McCreery Lake	1234	7/28/2010	non-confined	intermittent	0	3	-121.70723	37.33994	78	93.30	91.67	50.00	77.78
UP_194	Blue Oaks Ranch Reserve	1252	8/13/2010	non-confined	intermittent	0	1.5	-121.74254	37.38246	74	93.30	91.67	37.50	72.22
UP_195	Joseph Grant-Lower Halls Valley Lake	1194	7/13/2010	non-confined	intermittent	0	3.3	-121.71808	37.34922	79	93.30	100.00	50.00	72.22
UP_199	Blue Oaks Ranch Reserve	1253	8/13/2010	non-confined	intermittent	0	1.5	-121.74692	37.38593	72	93.30	83.33	37.50	75.00
UP_200	Upper Halls Valley Lake	1193	7/13/2010	non-confined	intermittent	0	0	-121.70996	37.34974	75	93.30	100.00	37.50	69.44
UP_201	Upper Penitencia Creek Road	1364	7/26/2010	non-confined	perennial	1	6	-121.83892	37.39151	59	62.50	58.33	37.50	77.78
UP_202	Alum Rock Park-Lower Reach	1232	7/27/2010	confined	perennial	1	5.3	-121.80918	37.39676	78	90.30	66.67	87.50	69.44
UP_203	Blue Oaks Ranch Reserve-Arroyo Aguague	1258	8/13/2010	confined	intermittent	0	5.2	-121.73272	37.37235	83	93.30	83.33	87.50	69.44
UP_205	Capitol Ave upstream side	1243	8/2/2010	non-confined	perennial	1	5.2	-121.85516	37.38284	57	62.50	50.00	50.00	66.67
UP_208	Blue Oaks Ranch Reserve-Deer Creek Tributary	1257	8/13/2010	confined	intermittent	0	1.5	-121.7257	37.38551	73	93.30	83.33	50.00	63.89

Table A.1. 2010 Coyote Creek watershed CRAM stream survey results updated to CRAM Field Book v.6.1 (continued)

Site ID	AA Name	eCRAM AARowID	Visit Date	Riverine Sub-class	Hydroregime	Flowing Water Present?	Bankfull Width (m)	Longitude (centroid)	Latitude (centroid)	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
UP_209	Joseph Grant-Lick Observatory	1209	7/15/2010	confined	intermittent	0	5.5	-121.69027	37.33903	79	93.30	83.33	75.00	63.89
UP_211	Joseph Grant-Middle Halls Valley Lake	1208	7/15/2010	non-confined	intermittent	0	1.9	-121.7155	37.34891	62	93.30	75.00	50.00	30.56
UP_212	Joseph Grant-Deer Valley	1249	8/6/2010	non-confined	intermittent	1	0.8	-121.70722	37.37388	72	93.30	100.00	50.00	44.44
UP_216	Joseph Grant-Lower Halls Valley Trail	1248	8/6/2010	confined	intermittent	0	1.6	-121.69717	37.34714	75	93.30	91.67	50.00	66.67
UP_217	Alum Rock	1261	8/10/2010	confined	perennial	1	6	-121.8187	37.39396	71	83.89	50.00	75.00	75.00
UP_218	Alum Rock-Rustic Lands Picnic	1304	9/7/2010	non-confined	perennial	1	6.1	-121.81248	37.3943	75	90.30	66.67	75.00	66.67
UP_219	Blue Oaks Ranch Reserve-Deer Creek	1336	9/13/2010	confined	intermittent	0	3.3	-121.72581	37.37371	85	93.30	91.67	75.00	80.56
UP_221	UP-221	1362	9/14/2010	non-confined	perennial	1	5	-121.86169	37.37304	53	37.50	58.33	50.00	66.67

Table A.2. 2020 Coyote Creek watershed CRAM stream survey results, CRAM Field Book v.6.1, including assessment area (AA) site IDs, eCRAM AARowIDs, visit date, basic wetland site information, and CRAM Index and Attribute Scores. 4 of the 78 AAs are not listed here because the landowners did not want the specific field assessment results published.

Site ID	AA Name	eCRAM AARowID	Visit Date	Riverine Sub-class	Hydroregime	Flowing Water Present?	Bankfull Width (m)	Longitude (centroid)	Latitude (centroid)	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
COY_002	COY 002 Coyote Creek upstream of Highway 237	7739	7/28/2020	non-confined	perennial	1	16.67	-121.92819	37.42188	56	37.50	75.00	37.50	75.00
COY_003	COY 003 Small Tributary to Coyote Creek	7787	8/3/2020	confined	intermittent	0	1.68	-121.48679	37.13351	92	100.00	100.00	87.50	80.56
COY_005	COY 005 Henry Coe - Bear Mountain Trail	7789	7/30/2020	non-confined	intermittent	0	2.43	-121.4383	37.21923	81	100.00	100.00	62.50	61.11
COY_006	COY_006 Petencia Creek Park Chain	7732	8/24/2020	non-confined	perennial	1	29.17	-121.79911	37.27576	75	75.00	66.67	75.00	83.33
COY_009	COY 009 Henry Coe - Middle Steer	7740	7/29/2020	confined	intermittent	0	6.73	-121.44868	37.08429	83	93.30	91.67	62.50	86.11
COY_013	COY 013 - Canada de Los Osos	7764	9/15/2020	confined	intermittent	0	3.1	-121.38865	37.03966	86	93.30	91.67	87.50	72.22
COY_016	COY_016 Kirby Canyon	7734	8/5/2020	confined	perennial	1	6.11	-121.66512	37.17901	58	85.36	66.67	37.50	41.67
COY_017	COY 017 Tributary to Kelly Canyon at Cross Canyon Trail	7765	7/29/2020	confined	ephemeral	0	1.29	-121.46121	37.14939	88	93.30	100.00	87.50	72.22
COY_019	COY 019 Henry Coe - Cordoza Ridge Road	7861	10/12/2020	confined	ephemeral	0	1.4	-121.52886	37.15155	75	100.00	75.00	62.50	61.11
COY_022	COY_022 William Street Park	7735	10/1/2020	confined	perennial	1	10.17	-121.86714	37.33591	58	50.00	66.67	50.00	66.67
COY_023	COY_023 Canada de Los Osos - Water Gulch	7868	7/29/2020	non-confined	intermittent	0	2.9	-121.4749	37.21769	89	93.30	100.00	75.00	86.11
COY_025	COY 025 Henry Coe - Kelly Cabin Trail	7790	7/29/2020	non-confined	intermittent	0	2.3	-121.43189	37.12742	91	100.00	100.00	75.00	88.89
COY_026	COY_026 Above Coyote Lake	7736	8/3/2020	non-confined	intermittent	0	14	-121.49948	37.07428	94	93.30	91.67	100.00	91.67
COY_029	COY 029 Berryessa Morrill Road	7792	7/28/2020	non-confined	ephemeral	0	1.81	-121.86624	37.40907	41	43.12	41.67	37.50	41.67
COY_031	COY 031 Above Anderson Lake - Shell Crossing	7768	9/15/2020	non-confined	perennial	1	13.5	-121.56381	37.13631	86	100.00	75.00	87.50	80.56
COY_032	COY_032 Earl's Court	7752	8/28/2020	non-confined	ephemeral	0	2.37	-121.68695	37.15763	49	64.87	75.00	25.00	30.56
COY_033	COY 033 Henry Coe	7793	7/29/2020	non-confined	intermittent	0	3.17	-121.44169	37.13181	74	100.00	83.33	62.50	50.00
COY_035	COY 035 Henry Coe - Frog Lake	7770	7/30/2020	non-confined	intermittent	0	1.8	-121.54652	37.20472	89	100.00	100.00	75.00	80.56

Table A.2. 2020 Coyote Creek watershed CRAM stream survey results, CRAM Field Book v.6.1 (continued)

Site ID	AA Name	eCRAM AARowID	Visit Date	Riverine Sub-class	Hydroregime	Flowing Water Present?	Bankfull Width (m)	Longitude (centroid)	Latitude (centroid)	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
COY_036	COY_036 7010 San Felipe Road	7754	8/24/2020	non-confined	intermittent	0	2.7	-121.74327	37.27286	71	71.02	91.67	50.00	69.44
COY_037	COY_037 Henry Coe - Creek at Tule Pond	7757	8/5/2020	non-confined	intermittent	0	2.31	-121.42352	37.10015	79	93.30	100.00	50.00	72.22
COY_038	COY_038 Dexter Canyon	7756	9/22/2020	confined	intermittent	1	4.7	-121.4988	37.096	70	100.00	75.00	62.50	44.44
COY_039	COY 039 Henry Coe - Booze Lake Road	7794	8/3/2020	non-confined	intermittent	0	6.42	-121.51161	37.23706	59	93.30	83.33	25.00	36.11
COY_046	COY_046 Henry Coe - Madrone Soda Springs	7758	7/30/2020	confined	ephemeral	0	2.5	-121.51544	37.17076	83	100.00	91.67	75.00	66.67
COY_047	COY 047 Joseph Grant - Lower Hotel Trail	7773	8/4/2020	non-confined	ephemeral	0	2.3	-121.69995	37.32107	59	93.30	83.33	25.00	36.11
COY_048	COY_048 Motorcycle Park	7759	7/31/2020	confined	perennial	1	2.84	-121.73713	37.23422	85	90.30	83.33	87.50	80.56
COY_049	COY 049 Henry Coe - Bear Mt Road	7795	7/30/2020	non-confined	intermittent	0	6	-121.45835	37.20141	88	93.30	100.00	87.50	69.44
COY_050	COY_050 Los Lagos Golf Course	7816	9/30/2020	non-confined	perennial	1	15.3	-121.83519	37.3015	82	75.00	75.00	87.50	91.67
COY_053	COY 053 Henry Coe	7850	7/29/2020	confined	intermittent	0	4.28	-121.46671	37.12833	82	100.00	83.33	87.50	58.33
COY_054	COY_054 Little Rough Gulch	7818	10/19/2020	non-confined	ephemeral	0	3.1	-121.50325	37.1314	86	100.00	83.33	87.50	72.22
COY_057	COY 057 Henry Coe - Phegley Ridge	7741	7/30/2020	confined	intermittent	0	2.78	-121.42512	37.0634	78	93.30	91.67	50.00	77.78
COY_061	COY 061 Miguelita Creek	7776	11/24/2020	non-confined	intermittent	0	1.5	-121.82003	37.38201	44	38.25	50.00	37.50	50.00
COY_062	COY_062 Henry Coe - Jackass Hill	7820	7/30/2020	confined	ephemeral	0	1.96	-121.48835	37.17719	70	93.30	83.33	50.00	52.78
COY_063	COY 063 San Felipe Creek	7779	8/4/2020	non-confined	intermittent	0	6.5	-121.6968	37.31632	83	93.30	83.33	75.00	80.56
COY_064	COY_064 Rifle Range	7823	7/31/2020	non-confined	ephemeral	0	3.16	-121.72712	37.21603	53	45.40	75.00	37.50	55.56
COY_065	COY 065 Henry Coe - Bear Mt Road	7851	7/30/2020	non-confined	ephemeral	0	4	-121.44799	37.20186	78	100.00	83.33	62.50	66.67
COY_066	COY_066 Lower Silver Creek-Kellogg's	7896	9/30/2020	non-confined	perennial	1	8.5	-121.87321	37.35557	61	50.00	83.33	50.00	61.11
COY_067	COY 067 Henry Coe - NW of Booze Lake	7852	8/3/2020	confined	intermittent	0	2.3	-121.53012	37.23056	74	100.00	83.33	50.00	61.11

Table A.2. 2020 Coyote Creek watershed CRAM stream survey results, CRAM Field Book v.6.1 (continued)

Site ID	AA Name	eCRAM AARowID	Visit Date	Riverine Sub-class	Hydroregime	Flowing Water Present?	Bankfull Width (m)	Longitude (centroid)	Latitude (centroid)	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
COY_069	COY 069 Ridder Park Drive	7865	10/22/2020	non-confined	perennial	1	11.7	-121.90095	37.38105	57	37.50	66.67	62.50	61.11
COY_073	COY 073 Henry Coe - Kelly Cabin Canyon	7781	7/29/2020	confined	ephemeral	0	1.3	-121.46327	37.15683	85	100.00	100.00	62.50	77.78
COY_074	COY_074 Morrie Road	7826	10/23/2020	non-confined	ephemeral	0	2.2	-121.79655	37.3621	74	70.40	83.33	62.50	77.78
COY_075	COY 075 Otis Canyon	7782	10/12/2020	confined	ephemeral	0	1.1	-121.54197	37.13439	71	100.00	66.67	50.00	66.67
COY_076	COY_076 Yerba Buena Creek-Evergreen College	7827	8/25/2020	non-confined	intermittent	0	2.19	-121.75724	37.29888	68	75.00	75.00	62.50	58.33
COY_078	COY_078 SJ Municipal Golf Course	7828	10/22/2020	non-confined	perennial	1	11	-121.88827	37.37276	67	73.27	75.00	62.50	58.33
COY_081	COY 081 Henry Coe	7784	8/15/2020	confined	ephemeral	0	1.46	-121.42942	37.11428	86	100.00	100.00	62.50	80.56
COY_085	COY 085 Arroyo de los Coches	7747	7/28/2020	confined	intermittent	0	3	-121.88219	37.43448	31	25.00	33.33	25.00	38.89
COY_088	COY_88	7831	10/5/2020	non-confined	perennial	1	7.3	-121.74005	37.20173	58	75.00	75.00	37.50	44.44
COY_090	COY_090 Lower Silver Creek at Story Road	7654	7/27/2020	confined	perennial	1	6.5	-121.82186	37.35325	55	62.50	66.67	50.00	41.67
COY_098	COY_098	7832	8/25/2020	non-confined	perennial	1	4.16	-121.79773	37.29761	74	83.89	83.33	62.50	66.67
COY_101	COY_101 Bianki Ranch Drainage	7867	8/5/2020	non-confined	ephemeral	0	1.55	-121.46454	37.05092	64	73.27	100.00	25.00	58.33
COY_104	COY_104 SE of Landfill #1	7833	8/5/2020	confined	perennial	1	2.65	-121.66335	37.17781	62	85.36	66.67	37.50	58.33
COY_106	COY_106	7834	7/28/2020	confined	perennial	1	40	-121.78685	37.2529	73	80.62	50.00	75.00	86.11
COY_108	COY_108 Tributary to Evergreen at Urban Edge	7835	8/26/2020	non-confined	intermittent	0	0	-121.75139	37.30515	67	90.30	83.33	37.50	55.56
COY_109	COY_109 Gilroy Hot Springs Road and Canada Road	7837	8/3/2020	non-confined	intermittent	0	13.7	-121.47566	37.07281	77	90.30	100.00	62.50	55.56
COY_116	COY_116 Coyote Creek	7836	7/31/2020	non-confined	perennial	1	2	-121.75745	37.27104	74	93.30	100.00	37.50	63.89
COY_120	COY_120	7863	10/5/2020	confined	perennial	1	1.8	-121.68638	37.19565	90	100.00	100.00	87.50	72.22
COY_122	COY_122 Singleton Rd at Tuers Rd	7839	8/27/2020	non-confined	perennial	1	7.6	-121.82362	37.29815	69	55.18	75.00	75.00	69.44
COY_128	COY_128	7840	7/30/2020	non-confined	intermittent	0	2.5	-121.70399	37.16223	40	47.86	58.33	25.00	27.78

Table A.2. 2020 Coyote Creek watershed CRAM stream survey results, CRAM Field Book v.6.1 (continued)

Site ID	AA Name	eCRAM AARowID	Visit Date	Riverine Sub-class	Hydroregime	Flowing Water Present?	Bankfull Width (m)	Longitude (centroid)	Latitude (centroid)	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
COY_136	COY_136 Coyote Creek at Forsum Road	7843	7/31/2020	non-confined	perennial	1	12.6	-121.76188	37.23518	86	86.41	75.00	100.00	83.33
COY_147	COY 147 Packwood Creek	7853	10/23/2020	non-confined	intermittent	0	6	-121.60229	37.16917	85	100.00	75.00	75.00	91.67
COY_148	COY_148	7844	7/31/2020	non-confined	perennial	1	15.3	-121.69162	37.17834	71	90.30	66.67	75.00	52.78
COY_154	COY_154 Silver Creek at King Pond	7845	10/1/2020	confined	perennial	1	14	-121.86331	37.36021	37	50.00	33.33	25.00	38.89
COY_157	COY_157 Sierra Creek at Hostetter Road	7897	7/28/2020	non-confined	intermittent	0	2.4	-121.86324	37.40051	53	66.45	75.00	37.50	33.33
COY_165	COY 165 Pinewood Park	7746	10/6/2020	confined	perennial	1	5.6	-121.90087	37.41021	43	53.95	58.33	25.00	33.33
COY_167	COY 167 Murillo	7866	10/6/2020	non-confined	ephemeral	0	1.15	-121.76773	37.32397	54	68.12	83.33	25.00	38.89
COY_172	COY_172	7846	10/29/2020	non-confined	perennial	1	7	-121.73509	37.19156	66	85.36	75.00	50.00	52.78
COY_176	COY_176	7847	10/29/2020	confined	perennial	1	2	-121.71551	37.21283	88	93.30	91.67	87.50	77.78
COY_181	COY 181 Arroyo Coches	7745	10/22/2020	non-confined	ephemeral	0	1.8	-121.87181	37.43803	45	25.00	75.00	37.50	44.44
UP_185	UP_185 Upper Penitencia Creek at Toyon	7652	7/17/2020	non-confined	intermittent	0	5.8	-121.83494	37.3925	63	67.68	66.67	62.50	55.56
UP_186	UP_186 Alum Rock- Visitor Center	7655	7/25/2020	non-confined	perennial	1	6.5	-121.8011	37.39665	73	78.49	91.67	62.50	58.33
UP_188	UP_188 Canada de Paula - Charlie Dean Springs	7848	11/30/2020	confined	intermittent	0	2.71	-121.73541	37.41354	61	85.36	83.33	37.50	38.89
UP_189	UP 189 Piedmont School	7744	7/31/2020	non-confined	intermittent	0	3.87	-121.84585	37.38951	59	55.18	66.67	50.00	63.89
UP_191	UP 191 End of AlumRock Falls Road	7743	9/25/2020	non-confined	intermittent	0	4.2	-121.74702	37.36132	80	90.30	75.00	75.00	80.56
UP_193	UP 193 Joseph Grant - McCreery Lake	7854	7/31/2020	non-confined	intermittent	0	3.29	-121.70729	37.33995	81	93.30	83.33	75.00	72.22
UP_201	UP 201 Penitencia Creek Rd	7742	8/26/2020	non-confined	intermittent	0	4.3	-121.83887	37.39153	64	71.65	66.67	50.00	66.67

11. Appendix B – CRAM Survey CDF Percentile Estimates (Summary Statistics)

Table B.1. CRAM Index Score CDF percentile estimates for the 2010 and 2020 Surveys

PAI	CRAM Indicator	Statistic	2010					2020				
			n AAs	CRAM Score Estimate	Std. Error	LCB95 Pct	UCB95 Pct	n AAs	CRAM Score Estimate	Std. Error	LCB95 Pct	UCB95 Pct
Coyote Creek Watershed	Index	5Pct	2	50		31	53	5	44		38	52
	Index	10Pct	7	58		49	63	11	54		45	57
	Index	25Pct	24	72		65	74	25	62		59	69
	Index	50Pct	47	78		76	80	49	77		73	80
	Index	75Pct	62	83		80	86	61	85		82	87
	Index	90Pct	74	86		84	92	69	88		86	94
	Index	95Pct	74	87		85	92	74	89		88	93
	Index	Mean	77	75	1	73	78	78	74	1	71	76
	Index	Variance	77	141	31	80	202	78	195	19	157	233
	Index	Std. Deviation	77	12	1	9	14	78	14	1	13	15
Valley	Index	5Pct	0	32		32	32	2	38		31	41
	Index	10Pct	1	48		31	51	4	41		32	46
	Index	25Pct	4	52		48	62	9	53		45	57
	Index	50Pct	13	65		59	74	22	63		58	68
	Index	75Pct	24	80		70	83	33	74		70	85
	Index	90Pct	26	83		80	92	41	85		82	92
	Index	95Pct	29	91		82	92	43	88		85	94
	Index	Mean	30	66	3	60	72	46	64	2	61	67
	Index	Variance	30	234	60	116	351	46	246	35	177	315
	Index	Std. Deviation	30	15	2	11	19	46	16	1	14	18
Hills	Index	5Pct	3	68		31	74	0	59		59	59
	Index	10Pct	9	74		67	75	3	62		58	70
	Index	25Pct	18	76		74	78	8	73		69	78
	Index	50Pct	31	79		78	83	15	81		77	84
	Index	75Pct	39	84		80	86	23	86		82	88
	Index	90Pct	45	86		84	91	28	88		87	92
	Index	95Pct	45	87		85	91	30	90		88	92
	Index	Mean	47	80	1	78	82	32	79	1	76	82
	Index	Variance	47	34	8	18	50	32	82	16	52	113
	Index	Std. Deviation	47	6	1	4	7	32	9	1	7	11

Table B.2. CRAM Buffer and Landscape Context Score CDF percentile estimates for the 2010 and 2020 Surveys

PAI	CRAM Indicator	Statistic	2010					2020				
			n AAs	CRAM Score Estimate	Std. Error	LCB95 Pct	UCB95 Pct	n AAs	CRAM Score Estimate	Std. Error	LCB95 Pct	UCB95 Pct
Coyote Creek Watershed	Buffer	5Pct	4	38		26	45	6	44		36	49
	Buffer	10Pct	7	57		38	71	12	53		48	66
	Buffer	25Pct	22	85		74	91	32	84		74	87
	Buffer	50Pct	26	92		92	93	42	92		91	92
	Buffer	75Pct	57	96		94	97	59	95		94	97
	Buffer	90Pct	57	98		97	100	59	98		96	100
	Buffer	95Pct	57	99		98	100	59	99		97	100
	Buffer	Mean	77	88	1	85	90	78	87	1	85	89
	Buffer	Variance	77	343	71	203	483	78	322	33	257	387
	Buffer	Std. Deviation	77	19	2	15	22	78	18	1	16	20
Valley	Buffer	5Pct	1	25		25	38	2	29		25	38
	Buffer	10Pct	1	33		25	43	5	39		26	47
	Buffer	25Pct	6	48		30	68	11	52		47	62
	Buffer	50Pct	14	71		61	79	23	73		67	75
	Buffer	75Pct	22	85		74	95	36	86		81	92
	Buffer	90Pct	27	95		87	100	40	93		89	100
	Buffer	95Pct	27	98		89	100	43	96		92	100
	Buffer	Mean	30	68	4	61	75	46	70	2	66	74
	Buffer	Variance	30	495	96	306	683	46	423	50	325	521
	Buffer	Std. Deviation	30	22	2	18	26	46	21	1	18	23
Hills	Buffer	5Pct	0	91		91	91	2	90		84	91
	Buffer	10Pct	0	91		91	91	2	91		90	91
	Buffer	25Pct	0	92		92	92	2	92		91	92
	Buffer	50Pct	30	93		92	95	2	93		93	94
	Buffer	75Pct	30	97		95	98	16	97		95	98
	Buffer	90Pct	30	99		97	100	16	99		97	100
	Buffer	95Pct	30	99		98	100	16	99		98	100
	Buffer	Mean	47	97	0	96	98	32	96	0	95	97
	Buffer	Variance	47	11	0	11	11	32	15	2	10	19
	Buffer	Std. Deviation	47	3	0	3	3	32	4	0	3	4

Table B.3. CRAM Hydrology Score CDF percentile estimates for the 2010 and 2020 Surveys

PAI	CRAM Indicator	Statistic	2010 n AAs	2010 CRAM Score Estimate	2010 Std. Error	2010 LCB95 Pct	2010 UCB95 Pct	2020 n AAs	2020 CRAM Score Estimate	2020 Std. Error	2020 LCB95 Pct	2020 UCB95 Pct
Coyote Creek Watershed	Hydrology	5Pct	7	60		33	64	6	51		34	60
	Hydrology	10Pct	7	66		62	68	8	62		56	65
	Hydrology	25Pct	14	74		71	76	19	71		69	74
	Hydrology	50Pct	27	81		79	84	37	80		78	82
	Hydrology	75Pct	50	90		86	95	64	92		86	95
	Hydrology	90Pct	65	96		92	100	64	97		94	100
	Hydrology	95Pct	65	98		94	100	64	98		95	100
	Hydrology	Mean	77	85	1	82	87	78	83	1	81	86
	Hydrology	Variance	77	167	42	85	250	78	217	33	152	281
	Hydrology	Std. Deviation	77	13	2	10	16	78	15	1	13	17
Valley	Hydrology	5Pct	1	33		33	59	2	35		33	43
	Hydrology	10Pct	3	54		33	61	4	43		33	58
	Hydrology	25Pct	7	64		59	68	8	62		53	66
	Hydrology	50Pct	14	73		66	78	18	71		67	74
	Hydrology	75Pct	19	79		75	83	32	80		74	90
	Hydrology	90Pct	19	82		78	92	42	92		85	98
	Hydrology	95Pct	19	83		79	92	42	96		90	100
	Hydrology	Mean	30	74	3	69	79	46	74	2	69	78
	Hydrology	Variance	30	183	76	33	332	46	281	55	174	388
	Hydrology	Std. Deviation	30	14	3	8	19	46	17	2	14	20
Hills	Hydrology	5Pct	0	70		69	70	1	68		33	72
	Hydrology	10Pct	0	73		72	74	1	72		68	75
	Hydrology	25Pct	8	79		76	81	5	78		76	80
	Hydrology	50Pct	22	86		82	91	17	84		80	91
	Hydrology	75Pct	35	94		89	98	22	94		89	98
	Hydrology	90Pct	35	97		93	100	22	98		94	100
	Hydrology	95Pct	35	99		94	100	22	99		95	100
	Hydrology	Mean	47	90	1	87	92	32	89	1	86	92
	Hydrology	Variance	47	75	10	56	94	32	93	13	67	119
	Hydrology	Std. Deviation	47	9	1	8	10	32	10	1	8	11

Table B.4. CRAM Physical Structure Score CDF percentile estimates for the 2010 and 2020 Surveys

PAI	CRAM Indicator	Statistic	2010					2020				
			n AAs	CRAM Score Estimate	Std. Error	LCB95 Pct	UCB95 Pct	n AAs	CRAM Score Estimate	Std. Error	LCB95 Pct	UCB95 Pct
Coyote Creek Watershed	Physical	5Pct	1	27		25	30	10	25		25	25
	Physical	10Pct	1	31		28	33	10	25		25	30
	Physical	25Pct	15	42		36	48	23	38		32	43
	Physical	50Pct	33	55		52	59	36	55		48	61
	Physical	75Pct	57	65		60	71	52	73		63	80
	Physical	90Pct	57	73		66	100	64	82		76	100
	Physical	95Pct	71	77		73	100	64	85		79	100
	Physical	Mean	77	60	2	57	63	78	61	2	56	65
	Physical	Variance	77	242	34	175	309	78	429	44	343	514
	Physical	Std. Deviation	77	16	1	13	18	78	21	1	19	23
Valley	Physical	5Pct	1	25		25	29	8	25		25	25
	Physical	10Pct	1	26		25	31	8	25		25	26
	Physical	25Pct	1	33		28	37	8	28		25	33
	Physical	50Pct	7	46		35	59	19	41		34	51
	Physical	75Pct	21	65		51	85	34	63		54	75
	Physical	90Pct	25	83		65	100	39	80		71	95
	Physical	95Pct	29	90		77	100	39	86		77	100
	Physical	Mean	30	56	5	47	65	46	52	3	47	58
	Physical	Variance	30	445	96	257	633	46	489	61	369	608
	Physical	Std. Deviation	30	21	2	17	26	46	22	1	19	25
Hills	Physical	5Pct	0	31		30	31	2	25		25	38
	Physical	10Pct	0	37		35	38	2	35		25	41
	Physical	25Pct	19	50		41	53	4	46		41	51
	Physical	50Pct	19	57		54	60	10	60		52	69
	Physical	75Pct	36	65		59	72	25	76		65	83
	Physical	90Pct	36	71		63	88	25	83		75	88
	Physical	95Pct	36	73		65	88	25	85		77	88
	Physical	Mean	47	62	2	59	65	32	65	3	59	71
	Physical	Variance	47	135	22	92	178	32	333	58	219	447
	Physical	Std. Deviation	47	12	1	10	13	32	18	2	15	21

Table B.5. CRAM Biotic Structure Score CDF percentile estimates for the 2010 and 2020 Surveys

PAI	CRAM Indicator	Statistic	2010					2020				
			n AAs	CRAM Score Estimate	Std. Error	LCB95 Pct	UCB95 Pct	n AAs	CRAM Score Estimate	Std. Error	LCB95 Pct	UCB95 Pct
Coyote Creek Watershed	Biotic	5Pct	3	32		28	46	2	33		32	34
	Biotic	10Pct	7	47		31	55	7	37		32	41
	Biotic	25Pct	13	58		55	65	19	53		42	57
	Biotic	50Pct	42	71		67	78	41	65		59	69
	Biotic	75Pct	57	79		78	84	58	75		70	79
	Biotic	90Pct	70	86		81	89	62	80		78	90
	Biotic	95Pct	70	88		85	92	71	86		80	92
	Biotic	Mean	77	69	2	66	73	78	64	2	60	67
	Biotic	Variance	77	246	42	163	329	78	258	29	202	315
	Biotic	Std. Deviation	77	16	1	13	18	78	16	1	14	18
Valley	Biotic	5Pct	1	28		28	33	2	31		28	33
	Biotic	10Pct	1	29		28	46	4	36		29	39
	Biotic	25Pct	4	56		29	66	7	41		38	52
	Biotic	50Pct	12	69		58	78	19	57		54	63
	Biotic	75Pct	22	79		71	90	34	70		65	79
	Biotic	90Pct	27	89		80	92	40	83		77	91
	Biotic	95Pct	27	90		84	92	43	90		80	92
	Biotic	Mean	30	66	4	58	73	46	60	2	55	64
	Biotic	Variance	30	390	93	208	573	46	315	44	229	402
	Biotic	Std. Deviation	30	20	2	15	24	46	18	1	15	20
Hills	Biotic	5Pct	4	48		28	54	1	34		28	38
	Biotic	10Pct	6	54		43	56	3	37		33	52
	Biotic	25Pct	9	58		56	67	8	58		43	61
	Biotic	50Pct	28	73		66	79	16	67		60	71
	Biotic	75Pct	35	80		77	87	22	76		70	80
	Biotic	90Pct	42	83		80	89	24	80		77	89
	Biotic	95Pct	44	87		81	89	29	85		80	89
	Biotic	Mean	47	71	2	67	75	32	66	2	62	70
	Biotic	Variance	47	168	34	100	236	32	211	40	132	290
	Biotic	Std. Deviation	47	13	1	10	16	32	15	1	12	17

12. Appendix C - Wald F Test Results

The Wald and Rao-Scott statistical test (or Wald F test) is a function in the GRTS *spsurvey* data analysis package. It is used to identify significant differences between the CDF estimates and was used to evaluate if the 2010 baseline and the 2020 reassessment surveys were statistically different for the whole watershed and its PAIs (Hills and Valley). The tables below compare combinations of CDF results and survey periods by CRAM Index and Attribute with grey highlights indicating the combinations that are significantly different at a p-value of <0.05.

Table C.1. Wald F Test Results Comparing the 2010 baseline survey and 2020 reassessment survey CDF estimates for the whole Coyote Creek Watershed

Subpopulation 1	*Subpopulation 2*	*CRAM Indicator*	*Wald F*	*Degrees of Freedom 1*	*Degrees of Freedom 2*	*p Value*
Coyote Creek 2010	Coyote Creek 2020	Index	2	2	150	0.17
Coyote Creek 2010	Coyote Creek 2020	Buffer	0	2	150	0.85
Coyote Creek 2010	Coyote Creek 2020	Hydrology	1	2	150	0.57
Coyote Creek 2010	Coyote Creek 2020	Physical	2	2	150	0.09
Coyote Creek 2010	Coyote Creek 2020	Biotic	4	2	150	0.02

Table C.2. Wald F Test Results Comparing the 2010 and 2020 CDFs for the Valley (below the 1000 ft. elevation boundary)

Subpopulation 1	*Subpopulation 2*	*CRAM Indicator*	*Wald F*	*Degrees of Freedom 1*	*Degrees of Freedom 2*	*p Value*
Valley 2010	Valley 2020	Index	0	2	71	0.83
Valley 2010	Valley 2020	Buffer	1	2	71	0.56
Valley 2010	Valley 2020	Hydrology	5	2	71	0.01
Valley 2010	Valley 2020	Physical	0	2	71	0.92
Valley 2010	Valley 2020	Biotic	2	2	71	0.11

Table C.3. Wald F Test Results Comparing the 2010 and 2020 CDFs for the Hills Region

Subpopulation 1	*Subpopulation 2*	*CRAM Indicator*	*Wald F*	*Degrees of Freedom 1*	*Degrees of Freedom 2*	*p Value*
Hills 2010	Hills 2020	Index	1	2	73	0.30
Hills 2010	Hills 2020	Buffer	NA	NA	NA	NA
Hills 2010	Hills 2020	Hydrology	0	2	73	0.69
Hills 2010	Hills 2020	Physical	2	2	73	0.13
Hills 2010	Hills 2020	Biotic	4	2	73	0.03

Table C.4. Other Wald F Test Results Comparing differences between the Valley and Hills Physical and Biotic Structure Attribute CDFs within survey periods because they appeared to overlap in the overlaid plots (see Figure 22.B).

Subpopulation 1	*Subpopulation 2*	*CRAM Indicator*	*Wald F*	*Degrees of Freedom 1*	*Degrees of Freedom 2*	*p Value*
Valley 2010	Hills 2010	Physical	6	2	72	0.00
Valley 2020	Hills 2020	Physical	5	2	72	0.01
Valley 2010	Hills 2010	Biotic	1	2	72	0.49
Valley 2020	Hills 2020	Biotic	5	2	72	0.01

13. Appendix D - Change Analysis Test Results

Change analysis test results, from the *spsurvey's analysis package in R*. The test takes into account the 52 paired revisit sites in effectively a paired t-test and was run on the categorical condition class results of the estimated proportions of stream miles in good, fair, and poor condition for the Coyote Creek watershed as a whole, and its Hills and Valley PAIs. The test compares the 2020 reassessment survey (survey2) to the 2010 baseline assessment (survey1). The table lists the estimated percent change (or percent difference; DiffEst P) and standard error (StdError P) in the proportions of stream miles in poor, fair, and good ecological condition between survey periods. A negative difference (DiffEst P) indicates a decline in the proportion of stream miles by condition class (or Category) from 2010 to 2020, taking into account the percent standard error and upper and lower 95% confidence bounds (LCB95 P and UCB95 P). Ecological condition classes are based on the full range of possible CRAM Scores (25-100) divided into three equal-intervals of poor (25-50), fair (51-75), and good (76-100) conditions.

Table D.1. Coyote Creek Watershed – Change Analysis

PAI	Indicator	Category	Percent Difference				survey1 (Coyote Creek 2010)					survey2 (Coyote Creek 2020)				
			DiffEst P	StdError P	LCB95Pct P	UCB95Pct P	NResp 1	Estimate P 1	StdError P 1	LCB95Pct P 1	UCB95Pct P 1	NResp 2	Estimate P 2	StdError P 2	LCB95Pct P 2	UCB95Pct P 2
Coyote Creek Watershed	Index	1. Good	-13	6	-24	-1	40	64	5	54	73	30	51	5	42	60
	Index	2. Fair	9	6	-3	22	35	32	5	22	42	39	41	5	32	51
	Index	3. Poor	3	3	-2	9	2	4	2	0	9	9	8	2	4	11
	Buffer	1. Good	-2	3	-8	4	57	79	3	73	86	49	78	2	73	82
	Buffer	2. Fair	2	3	-3	8	13	11	3	6	17	18	14	3	9	19
	Buffer	3. Poor	-1	2	-5	4	7	9	3	4	15	11	9	2	5	12
	Hydrology	1. Good	-6	4	-14	2	50	73	4	64	82	41	67	3	60	74
	Hydrology	2. Fair	4	5	-5	13	24	25	4	16	33	31	28	3	22	35
	Hydrology	3. Poor	2	2	-1	6	3	2	2	0	6	6	5	2	1	8
	Physical	1. Good	17	5	7	27	6	6	3	1	10	14	22	5	12	33
	Physical	2. Fair	-25	6	-36	-14	38	60	5	51	69	28	35	5	24	46
	Physical	3. Poor	8	5	-1	17	33	35	5	25	44	36	42	5	32	52
	Biotic	1. Good	-15	7	-29	-2	23	41	7	28	54	20	26	5	16	36
	Biotic	2. Fair	5	8	-10	21	45	47	7	34	60	39	53	6	42	63
	Biotic	3. Poor	10	4	2	18	9	12	3	5	18	19	22	4	14	29

Table D.2. Valley PAI – Change Analysis

PAI	Indicator	Category	Percent Difference				survey1 (Coyote Creek 2010)					survey2 (Coyote Creek 2020)				
			DiffEst P	StdError P	LCB95Pct P	UCB95Pct P	NResp 1	Estimate P 1	StdError P 1	LCB95Pct P 1	UCB95Pct P 1	NResp 2	Estimate P 2	StdError P 2	LCB95Pct P 2	UCB95Pct P 2
Valley	Index	1. Good	-5	8	-20	10	9	27	8	10	43	9	22	5	12	31
	Index	2. Fair	-3	11	-24	18	19	61	10	41	80	28	58	6	45	70
	Index	3. Poor	8	8	-8	24	2	13	7	0	27	9	21	5	11	30
	Buffer	1. Good	3	9	-14	20	10	36	9	18	53	17	39	5	28	49
	Buffer	2. Fair	2	9	-15	20	13	35	9	17	53	18	38	6	25	50
	Buffer	3. Poor	-6	7	-19	8	7	29	9	12	46	11	24	5	14	33
	Hydrology	1. Good	-9	10	-28	9	11	44	10	24	64	14	35	6	23	46
	Hydrology	2. Fair	4	11	-17	24	16	48	10	28	69	26	52	6	40	65
	Hydrology	3. Poor	6	6	-6	17	3	8	5	0	17	6	13	5	4	22
	Physical	1. Good	-2	8	-18	14	5	17	8	1	32	7	15	4	6	24
	Physical	2. Fair	-2	9	-20	16	11	26	8	10	42	13	24	5	13	35
	Physical	3. Poor	4	9	-13	21	14	57	10	37	77	26	61	6	50	72
	Biotic	1. Good	-11	9	-28	6	9	33	9	15	50	10	22	5	12	31
	Biotic	2. Fair	2	11	-21	24	17	44	10	24	64	23	46	6	33	58
	Biotic	3. Poor	9	8	-7	26	4	23	9	6	40	13	32	6	21	44

Table D.3. Hills PAI – Change Analysis

PAI	Indicator	Category	Percent Difference				survey1 (Coyote Creek 2010)					survey2 (Coyote Creek 2020)				
			DiffEst P	StdError P	LCB95Pct P	UCB95Pct P	NResp 1	Estimate P 1	StdError P 1	LCB95Pct P 1	UCB95Pct P 1	NResp 2	Estimate P 2	StdError P 2	LCB95Pct P 2	UCB95Pct P 2
Hills	Index	1. Good	-13	8	-29	2	31	81	6	70	92	21	68	7	55	81
	Index	2. Fair	13	8	-2	29	16	19	6	8	30	11	32	7	19	45
	Buffer	1. Good	0	0	0	0	47	100	0	100	100	32	100	0	100	100
	Hydrology	1. Good	-1	5	-10	8	39	87	4	78	95	27	86	4	78	94
	Hydrology	2. Fair	1	5	-8	10	8	13	4	5	22	5	14	4	6	22

Table D.3. Hills PAI – Change Analysis (continued)

PAI	Indicator	Category	Percent Difference				survey1 (Coyote Creek 2010)					survey2 (Coyote Creek 2020)				
			DiffEst P	StdError P	LCB95Pct P	UCB95Pct P	NResp 1	Estimate P 1	StdError P 1	LCB95Pct P 1	UCB95Pct P 1	NResp 2	Estimate P 2	StdError P 2	LCB95Pct P 2	UCB95Pct P 2
Hills (continued)	Physical	1. Good	27	8	11	42	1	0	0	0	1	7	27	8	11	42
	Physical	2. Fair	-34	8	-49	-19	27	76	5	65	86	15	42	8	25	58
	Physical	3. Poor	7	6	-4	19	19	24	5	14	35	10	32	7	17	46
	Biotic	1. Good	-17	9	-35	1	14	45	9	28	62	10	28	7	14	42
	Biotic	2. Fair	8	10	-12	28	28	49	8	32	65	16	56	8	42	71
	Biotic	3. Poor	9	4	1	18	5	6	3	0	12	6	15	5	5	26

14. Appendix E - CRAM Stressor Checklist Summary

List of CRAM stressors that were observed (% AAs where Observed) and thought to have a negative impact (NegImpact) on stream condition (% AAs with NegImpact) in the Coyote Creek watershed Hills and Valley PAIs based on the D5 Project's 2010 and 2020 ambient stream condition surveys.

Attribute		***% Observed***	***% Observed***	***% NegImpact***	***% NegImpact***	***% Observed***	***% Observed***	***% NegImpact***	***% NegImpact***
	Year	***2010***	***2020***	***2010***	***2020***	***2010***	***2020***	***2010***	***2020***
	PAI	***Hills***	***Hills***	***Hills***	***Hills***	***Valley***	***Valley***	***Valley***	***Valley***
	Num. AAs	***47***	***32***	***47***	***32***	***30***	***46***	***30***	***46***
Buffer and Landscape Context	Active recreation (off-road vehicles, mountain biking, hunting, fishing)	47	44	0	0	47	39	3	2
	Biological resource extraction (aquaculture, commercial fisheries)	0	0	0	0	0	2	0	0
	Dams (or other major flow regulation or disruption)	6	0	4	0	7	4	3	2
	Dryland farming	0	0	0	0	7	0	0	0
	Industrial/commercial	0	0	0	0	33	48	20	15
	Intensive row-crop agriculture	0	0	0	0	0	9	0	0
	Military training/Air traffic	0	9	0	0	3	2	0	0
	Orchards/nurseries	0	3	0	0	3	7	0	0
	Passive recreation (bird-watching, hiking, etc.)	51	72	0	0	57	59	7	2
	Physical resource extraction (rock, sediment, oil/gas)	2	19	2	3	7	22	7	7
	Ranching (enclosed livestock grazing or horse paddock or feedlot)	40	28	17	9	30	15	7	7

Appendix E - CRAM Stressor Checklist Summary (continued)

Attribute		***% Observed***	***% Observed***	***% NegImpact***	***% NegImpact***	***% Observed***	***% Observed***	***% NegImpact***	***% NegImpact***
	Year	***2010***	***2020***	***2010***	***2020***	***2010***	***2020***	***2010***	***2020***
	PAI	***Hills***	***Hills***	***Hills***	***Hills***	***Valley***	***Valley***	***Valley***	***Valley***
	Num. AAs	***47***	***32***	***47***	***32***	***30***	***46***	***30***	***46***
Buffer and Landscape Context (cont.)	Rangeland (livestock rangeland also managed for native vegetation)	0	0	0	0	47	52	13	4
	Transportation corridor	2	3	0	0	67	83	20	30
	Urban residential	0	6	0	0	63	67	47	41
Hydrology	Actively managed hydrology	2	0	2	0	13	15	10	2
	Dams (reservoirs, detention basins, recharge basins)	6	6	4	0	3	9	3	7
	Dike/levees	0	0	0	0	20	4	17	2
	Ditches (agricultural drainage, mosquito control, etc.)	4	0	0	0	3	4	0	0
	Dredged inlet/channel	0	3	0	0	0	0	0	0
	Engineered channel (riprap, armored channel bank, bed)	0	0	0	0	53	43	30	11
	Flow diversions or unnatural inflows	2	13	0	0	13	17	10	4
	Flow obstructions (culverts, paved stream crossings)	9	3	4	0	17	30	3	4
	Non-point Source (Non-PS) discharges (urban runoff, farm drainage)	0	6	0	0	63	83	13	26
	Point Source (PS) discharges (POTW, other non-stormwater discharge)	0	0	0	0	13	2	13	0
	Weir/drop structure, tide gates	2	0	0	0	23	15	3	2

Appendix E - CRAM Stressor Checklist Summary (continued)

Attribute		% Observed	% Observed	% NegImpact	% NegImpact	% Observed	% Observed	% NegImpact	% NegImpact
	Year	2010	2020	2010	2020	2010	2020	2010	2020
	PAI	Hills	Hills	Hills	Hills	Valley	Valley	Valley	Valley
	Num. AAs	47	32	47	32	30	46	30	46
Physical Structure	Bacteria and pathogens impaired (PS or Non-PS pollution)	9	0	0	0	23	15	20	0
	Excessive runoff from watershed	0	0	0	0	3	4	0	2
	Excessive sediment or organic debris from watershed	0	3	0	0	7	4	3	0
	Filling or dumping of sediment or soils (N/A for restoration areas)	0	0	0	0	0	2	0	2
	Grading/compaction (N/A for restoration areas)	6	3	0	0	50	43	10	11
	Heavy metal impaired (PS or Non-PS pollution)	0	0	0	0	7	4	0	0
	Nutrient impaired (PS or Non-PS pollution)	4	0	0	0	30	7	17	0
	Pesticides or trace organics impaired (PS or Non-PS pollution)	0	0	0	0	0	7	0	0
	Plowing/Discing (N/A for restoration areas)	0	0	0	0	0	7	0	2
	Trash or refuse	4	3	0	0	50	65	10	13
	Vegetation management	4	0	2	0	27	46	7	11
Biotic Structure	Biological resource extraction or stocking (fisheries, aquaculture)	0	0	0	0	0	2	0	0
	Excessive human visitation	2	0	0	0	63	37	30	11
	Lack of treatment of invasive plants adjacent to AA or buffer	11	34	0	0	30	54	17	11

Appendix E - CRAM Stressor Checklist Summary (continued)

Attribute		% Observed	% Observed	% NegImpact	% NegImpact	% Observed	% Observed	% NegImpact	% NegImpact
	Year	***2010***	***2020***	***2010***	***2020***	***2010***	***2020***	***2010***	***2020***
	PAI	***Hills***	***Hills***	***Hills***	***Hills***	***Valley***	***Valley***	***Valley***	***Valley***
	Num. AAs	***47***	***32***	***47***	***32***	***30***	***46***	***30***	***46***
Biotic Structure (cont.)	Lack of vegetation management to conserve natural resources	0	9	0	0	0	11	0	4
	Mowing, grazing, excessive herbivory (within AA)		16	11	0	37	39	17	11
	Pesticide application or vector control	0	6	0	0	7	9	0	0
	Predation and habitat destruction by non-native vertebrates (e.g., Virginia opossum and domestic predators, such as feral pets)	0	28	0	3	60	39	20	0
	Removal of woody debris	0	3	0	0	0	11	0	0
	Treatment of non-native and nuisance plant species	2	3	2	0	7	9	0	0
	Tree cutting/sapling removal	0	6	0	0	3	24	0	2

15. Appendix F - Online Data Access and the Landscape Profile Tool

As mentioned in the report, the D5 Project utilizes EcoAtlas and CRAM's statewide data entry and management service to manage their CRAM data (www.cramwetlands.org) and publish their ambient survey watershed assessment CDFs (via the Landscape Profile Tool described below). CRAM data can be accessed online, visualized, explored, and downloaded on EcoAtlas (www.EcoAtlas.org).

EcoAtlas is a free, statewide data access, visualization, and summary tool that supports a watershed approach to stream and wetland restoration and mitigation project planning, monitoring, and assessment. It is designed around the WRAMP framework of using geospatial data, field rapid assessments of condition, and more involved field samples to support resource management and regulation. EcoAtlas is the public access point for CARI, which is the interactive base map on the site that includes:

- data upload tools for adding wetland restoration and compensatory mitigation projects to the EcoAtlas map (via Project Tracker), and uploading CRAM scores (via the CRAM website),
- data visualization and access for habitat maps (including CARI, historical ecology, CALVEG, SSURGO hydric soils),
- data visualization and access to CRAM and California Stream Condition Index ecological condition assessment scores and data, and other water quality monitoring data from the California Environmental Data Exchange Network database (CEDEN), and
- data summary tools that support landscape based aquatic resource management including the Landscape Profile Tool and Project Tracker.

15.1. Landscape Profile Tool

EcoAtlas' Landscape Profile Tool summarizes the amount, distribution, and condition of aquatic resources, and other ecological information at various spatial scales for assessment, planning, and reporting. Based on a user-specified area of interest, or predefined areas such as the USGS Hydrologic Units (HUCs), and Valley Water's five watersheds within Santa Clara County. The tool generates graphical summaries of the following data sources:

- abundance and diversity of existing aquatic resources based on BAARI and CARI;
- abundance and diversity of historical aquatic resources, and terrestrial plant communities;
- abundance of protected aquatic resources based on CARI and CPAD and CCED;

- survey and project summary statistics for eelgrass aquatic resources;
- ecological restoration or compensatory mitigation based on Wetland Habitat Projects;
- aquatic resource condition assessments based on CRAM; includes a comparison of selected CRAM scores to the local watershed or eco-regional *CDF* curve (when available).
- Stream condition based on the California Stream Condition Index CSCI.
- human population (2010 Census) and language spoken at home (2008-2012 American Community Survey);
- species of special status (federally and California listed species) based on the California Natural Diversity Database (CNDDB); and
- developed land cover by the 2011 National Land Cover Database (NLCD).

Through EcoAtlas CARI, wetland habitat project information, and CRAM assessment results (including Valley Water's D5 Project's ambient survey results and any other assessments uploaded to eCRAM and marked as public), and several other environmental datasets are available to regulatory managers, scientists, and the public.

EcoAtlas has several interactive data access and evaluation tools that support wetland project tracking and ecological condition assessments that employ CRAM. These tools are part of the statewide WRAMP framework for standardized monitoring and assessment and can be used at various landscape scales. It is intended that, over time, local and regional entities will develop watershed specific project performance curves (a.k.a., habitat development curves) and ambient condition assessments using CRAM (a.k.a., GRTS surveys and CDF estimates). The D5 Project is a frontrunner in that regard and has already posted its ambient watershed survey CDFs for the 5 major watersheds online through EcoAtlas' Landscape Profiles.

1. HDCs: Wetland Habitat Development Curves are used to evaluate project performance to the expected rate of habitat development for the same age and habitat type based on CRAM. HDCs have been developed for three BAARI wetland types (riverine, estuarine, and depressional) using existing CRAM assessments from wetlands across California. Each curve represents the average rate of development bounded by its 95% Confidence Interval (CI), average condition and 95% CI for a set of reference sites. Projects that are well designed for their location and setting, and well managed tend to be on or above the curve. In general, as projects age, their habitats should mature and their CRAM scores should increase at a similar rate as the HDC. Comparing project Index and/or Attribute scores to the expected level on HDCs can help identify general ecological functions that are performing well, or that may warrant corrective actions.
2. CDFs: Cumulative distribution functions (CDFs) are developed from probabilistic ambient surveys using CRAM. CDFs estimate the relative abundance of stream miles

(or wetland areas) within a surveyed geographic extent that is likely to have conditions below (or above) any particular score. CDFs can be developed for any geographic extent, from large wetland project areas to watersheds, eco-regions, or statewide. CRAM project scores or other targeted assessments can be compared to CDF curves of wetlands of the same type in the same geographic area. These comparisons provide a watershed (or eco-regional) context to evaluate if a targeted assessment falls within the upper or lower 50th percentile of similar wetlands in the area, or if it falls within the top (or bottom) 25th percentile of similar wetlands in the surveyed area. This information helps inform management actions.

The CDFs for the five watersheds in Santa Clara County are available through the Landscape Profile Tool on EcoAtlas (Figure F.1). A manager can view existing CRAM assessment scores plotted on a watershed CDF by:

- Going to www.EcoAtlas.org and zooming into Santa Clara County on the map (in the lower South Bay area within the Bay/Delta Ecoregion)
- Go to “Layers” dropdown and select “CRAM” to see the distribution of CRAM scores on the map. You can also turn on the “Habitat Projects” layer to see restoration or mitigation project areas on the map if they have been uploaded to Project Tracker.
- Click on the “Show Tools” button in the top right side and select “Landscape Profiles”[43].
    - The “Landscape Profiles” tool summarizes CARI, CRAM, and other environmental data for a specific region or user defined area. There are three profiles available:
        1. *Landscape* (which is a summary of geospatial data),
        2. *Condition* (which summarizes ecological conditions based on available CRAM and California Stream Condition Index (CSCI) data and includes interactive access to local and regional CDFs), and
        3. *Connectivity* (which characterizes several aquatic resource connectivity metrics such as nearest neighbors and wetland size categories based on CARI).
    - A user can define a profile region by drawing a polygon, selecting a predefined area, uploading a KML, or shape file and then run any of the profiles. For example to compare a set of user selected riverine CRAM scores within Coyote Creek to the D5 Project’s Coyote Creek riverine CDF curve, zoom into the target

[43] Side note: The “Wetland Condition (CRAM)” tool allows a user to select, view, and download CRAM data.

area on the map that includes the CRAM AAs of interest (Figure F.1). Select the "Condition" profile option, the "Draw a Polygon" option, and then use the edit tool to draw your area by clicking around the perimeter of the area of interest.

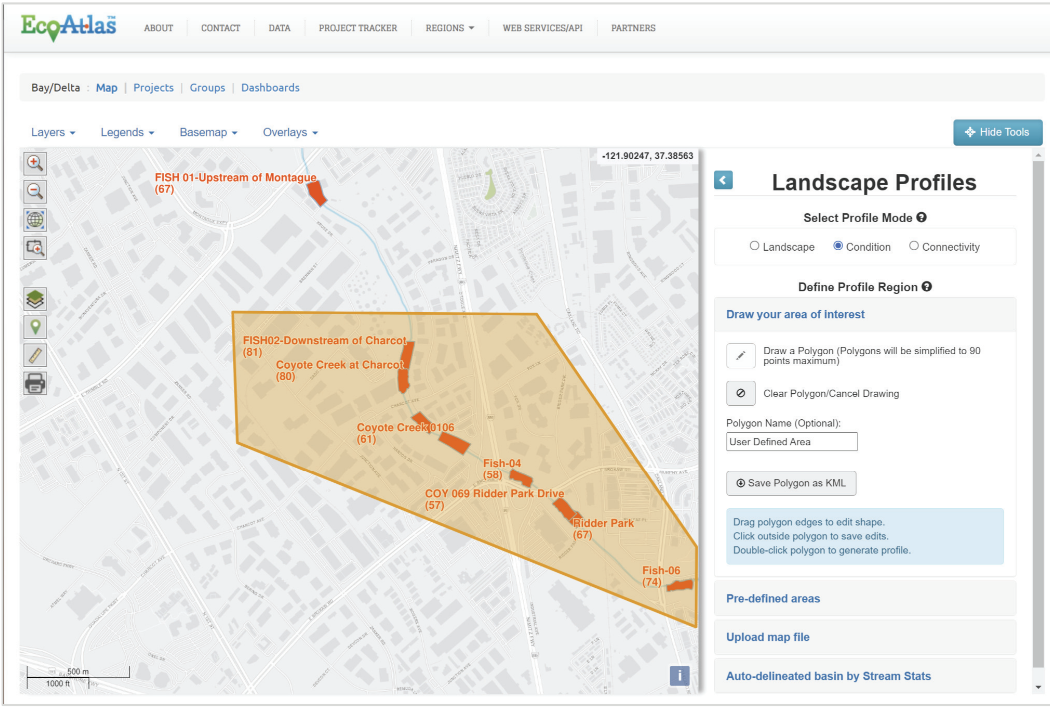

Figure F.1. Screenshot of CRAM AAs and a user defined area within the Coyote Creek mainstem.

- Double-click inside the polygon to generate a pop-up box that lists the CRAM AAs located within the polygon and plots any CSCI scores within the area on a chart indicating the number of scores by condition class (Figure E.2). You can explore specific AA information by clicking on the Site Name in the list.
    - Click on the "View Scores on CRAM CDF" button and final pup-up allows you to select wetland type and available CDFs (from drop-down lists). The CRAM scores from the user-defined area are then plotted on the selected watershed or regional CDF (they appear as grey diamonds, Figure E.2).

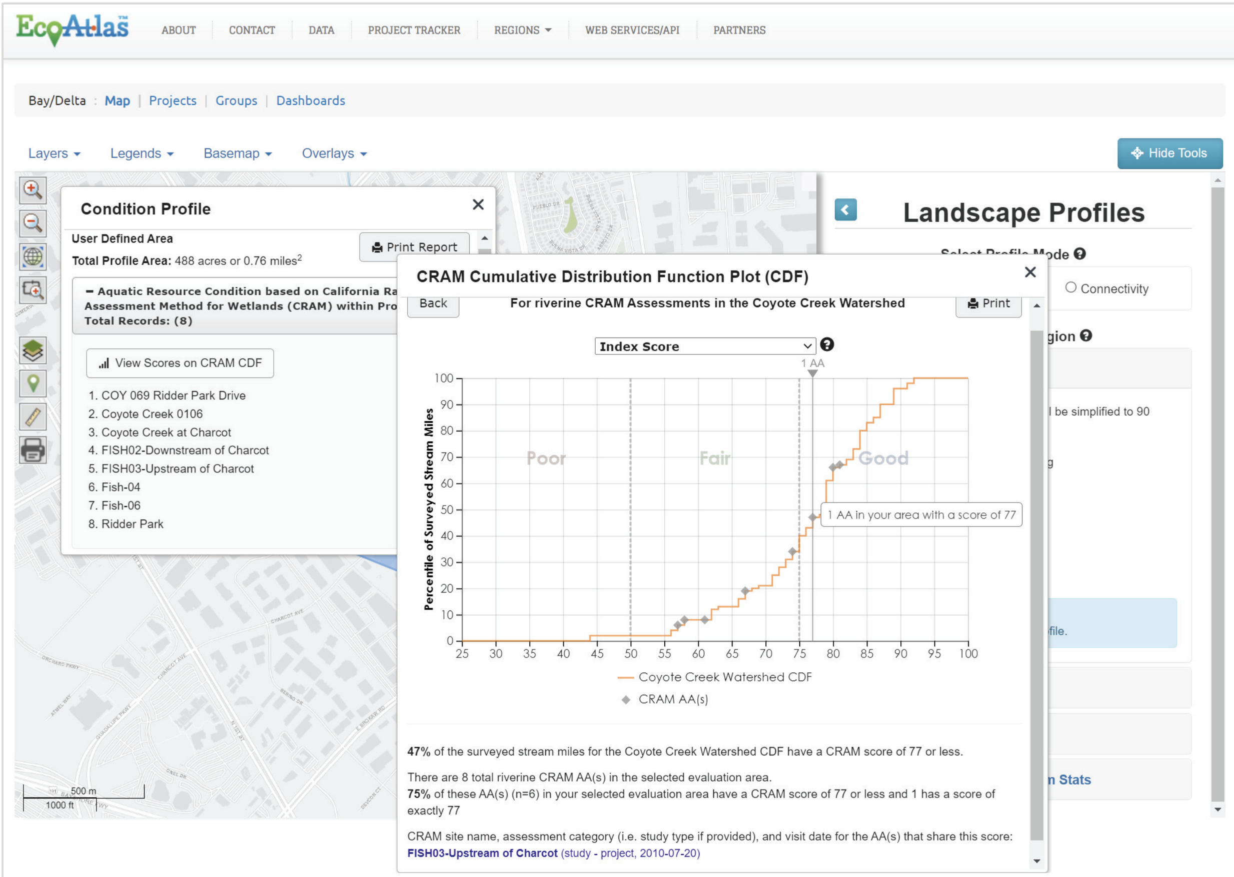

Figure F.2. Screenshot of the Coyote Creek watershed CDF (2010) accessed through EcoAtlas with overlaid CRAM scores (grey diamonds) from AAs located within the user defined area shown in Figure F.1.