National Water Quality Initiative

Watershed Assessment

Salt River Watershed

Humboldt County, California

2021

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NATIONAL WATER QUALITY INITIATIVE

United States Department of Agriculture's (USDA) National Water Quality Initiative (NWQI) focuses on improving water quality in select priority watersheds across the nation. This initiative provides multi-year funding to develop watershed assessment plans and invest in agricultural practices that address resource issues that impact water quality.

Developed in 2011, NWQI is a partnership between the Natural Resources Conservation Service (NRCS), state water quality agencies, and the U. S. Environmental Protection Agency (EPA). Within this program, NRCS and state water quality agencies evaluated watersheds across the nation to determine where additional implementation of conservation practices would provide the greatest water quality benefits for local, regional, and national water quality. Among the identified priority watersheds across the nation, Northern California's Salt River watershed was chosen at the inception of this program and has since implemented over 550 NRCS practices across the watershed to improve water quality in the immediate waterways and in the larger Eel River watershed in which the Salt River is located.

This Salt River watershed assessment plan will contribute information to guide, expand, and further target NRCS assistance to agricultural producers across the watershed to meet established water quality goals.

SECTION 1: **INTRODUCTION**

Salt River Watershed Summary

The Salt River watershed is located along the northern California coast in Humboldt County and encompasses the southern extent of the Eel River delta. The watershed encompasses an area of approximately 47 square miles and is bordered by the Eel River to the north and east, the Wildcat Hills to the south, and the Pacific Ocean to the west.

This watershed derives its name from the Salt River that courses west-northwest for 13.6 miles through the watershed's alluvial floodplain and outlets into the Eel River estuary within one mile of the Pacific Ocean. Five tributaries originating in the Wildcat Hills feed the Salt River – Williams, Francis, Reas, Smith, and Russ Creeks.

Most of the alluvial floodplain is managed as agricultural pasture lands. Agricultural activities are dominated by family-owned pasture-based dairies, many of which are certified organic. Other floodplain agriculture practices include the production of beef cattle, hay, silage, and corn. The upper slopes of the Wildcat Hills are home to coniferous and deciduous trees species such as Sitka spruce, redwood, Douglas fir, grand fir, red alder, willow, and western red cedar. The upper watershed is almost entirely in private ownership and supports several small-to mid-sized timber and ranching operations.

The natural ecology of the Salt River watershed not only includes the forested upper watershed and floodplains of the lower watershed, but it also contains dune and estuary systems along the western border that supports native and non-native vegetation as well as habitat for resident and migrating birds that include Snowy Plovers, Aleutian geese, Brant's geese, Harrier hawks, and White-Tailed Kites. The estuary and freshwater waterways are also home to aquatic marine species such as top smelt and Dungeness crab, anadromous species including Coho and Chinook salmon, and freshwater species such as three-spined stickleback, sculpins, and invasive Sacramento pikeminnow.

The Wildcat Hills are composed of steeply sloped, loosely consolidated sedimentary rock formations and are susceptible to large scale landslides and significant erosion. Intense, short lived winter rains that frequently occur on California's north coast cause significant sediment erosion in the Wildcat Hills where extremely turbid water enters the five tributaries to the Salt River. These sediments settle in the channels of the trans-delta reaches of the tributaries and within the Salt River, decreasing channel capacity. Therefore, sediment laden flood waters escape onto the floodplain, across pasture fields, roads, and around infrastructure and houses leaving drifts of sediment. This sediment aggradation causes significant hydrologic dysfunction in the lower Salt River watershed.

Multiple studies, assessments, and inventories have been produced for the watershed between 1993 and 2020 by state and federal agencies and private consultants. These documents primarily focus on sediment sources, resulting sediment impacts to socio-economic and natural resource areas, and proposed remediation prescriptions.

Water Quality Concern

The Salt River watershed is located within the Eel River Delta. The Eel River is California's third largest watershed. In 2007, California's North Coast Regional Water Quality Control Board identified the Lower Eel River as an impaired waterway for sediment and temperature. The Lower Eel River Total Maximum Daily Loads for Temperature and Sediment document was prepared by the EPA and can be found at the following link: https://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/eel_river_lower/pdf/LER-TMDL-final-121807-signed.pdf. Sediment and temperature degradation of this river comes from a variety of nonpoint sources, including natural processes such as landslides as well as land use and management activities such as agriculture and forestry operations. Much of the Lower Eel River watershed is privately owned, with timber, grazing, and dairy as the primary agricultural operations. Activities associated with these land uses can negatively influence water quality for beneficial uses, especially salmonid spawning and early development, habitat for rare/threatened or endangered species, and municipal and domestic water supplies.

As in the Lower Eel River, sediment is a persistent problem in the Salt River Watershed due to natural geologic processes and human activities in the upper watershed located in the Wildcat Hills. Land flows, upslope roads, cattle grazing along waterways, lack of riparian vegetation, legacy forestry practices, and bank erosion during high stream flows contribute to sediment loads in the watershed. Water temperatures are elevated in the Salt River watershed during non-winter periods, similar to the Lower Eel River. Temperature is impacted by suspended sediment loads, nutrient inputs, restricted water flow, and fragmented riparian corridors. Elevated nutrient inputs have also been identified during winter rain events and could be associated with agricultural management practices or insufficient infrastructure such as rain catchment on facility roofs or appropriate sized waste storage ponds.

Opportunities and Goals to Improve Water Quality

Nearly 90% of the Salt River watershed is privately owned and approximately 87% of that is in agricultural production. With the goal of improving water quality and overall watershed health, agricultural producers have implemented a multitude of best management practices to reduce sediment, temperature, and nutrient inputs in waterways. Private landowners, USDA NRCS, University of California Cooperative Extension, Humboldt County Resource Conservation District, Western United Dairymen, Six Rivers Dairy Association, and other local and state agencies have collaborated to identify vulnerable resource sites and implement practices. More potentially impaired sites across the Salt River watershed need to be identified and prioritized to provide the most significant impact to achieve water quality goals.

Notably, the Salt River Ecosystem Restoration Project is one of North America's largest riverine restoration project on the west coast. The project is excavating and restoring seven miles of a completely aggraded river channel through the alluvial floodplain of the watershed. The project goals are to increase hydraulic conveyance and ecological processes in the river corridor, improve water quality and drainage efficiencies, and manage and transport excess sediment loads. Over 40 private landowners are participating in the project along with more than 10 federal, state, and local agencies, including NRCS. The National Water Quality Initiative program is complementary to the Salt River Ecosystem Restoration Project.

NRCS' Role

USDA NRCS works to assist producers with best management practices in the Salt River watershed and is dedicated to improving watershed health by providing technical and financial cost-share assistance to reduce nonpoint source pollution. Over 550 NWQI water quality improvement practices have been implemented across the watershed between 2012 to 2019. NRCS will continue to engage with willing landowners and coordinate with ongoing restoration projects to continue executing water quality improvement practices across the Salt River watershed.

SECTION 2: WATERSHED CHARACTERIZATION

Location

The Salt River watershed is located 15 miles south of the City of Eureka, in far northern coastal California in Humboldt County. The watershed encompasses approximately 47 square miles (30,425 acres) and encompasses the City of Ferndale. The Salt River is the western most tributary to the Eel River before the Eel River enters the Pacific Ocean. The Salt River flows in a west-northwest direction for approximately 13.5 miles in the southern floodplain of the Eel River Estuary, and confluences with the Eel River within one mile of the Pacific Ocean (Figure 1).

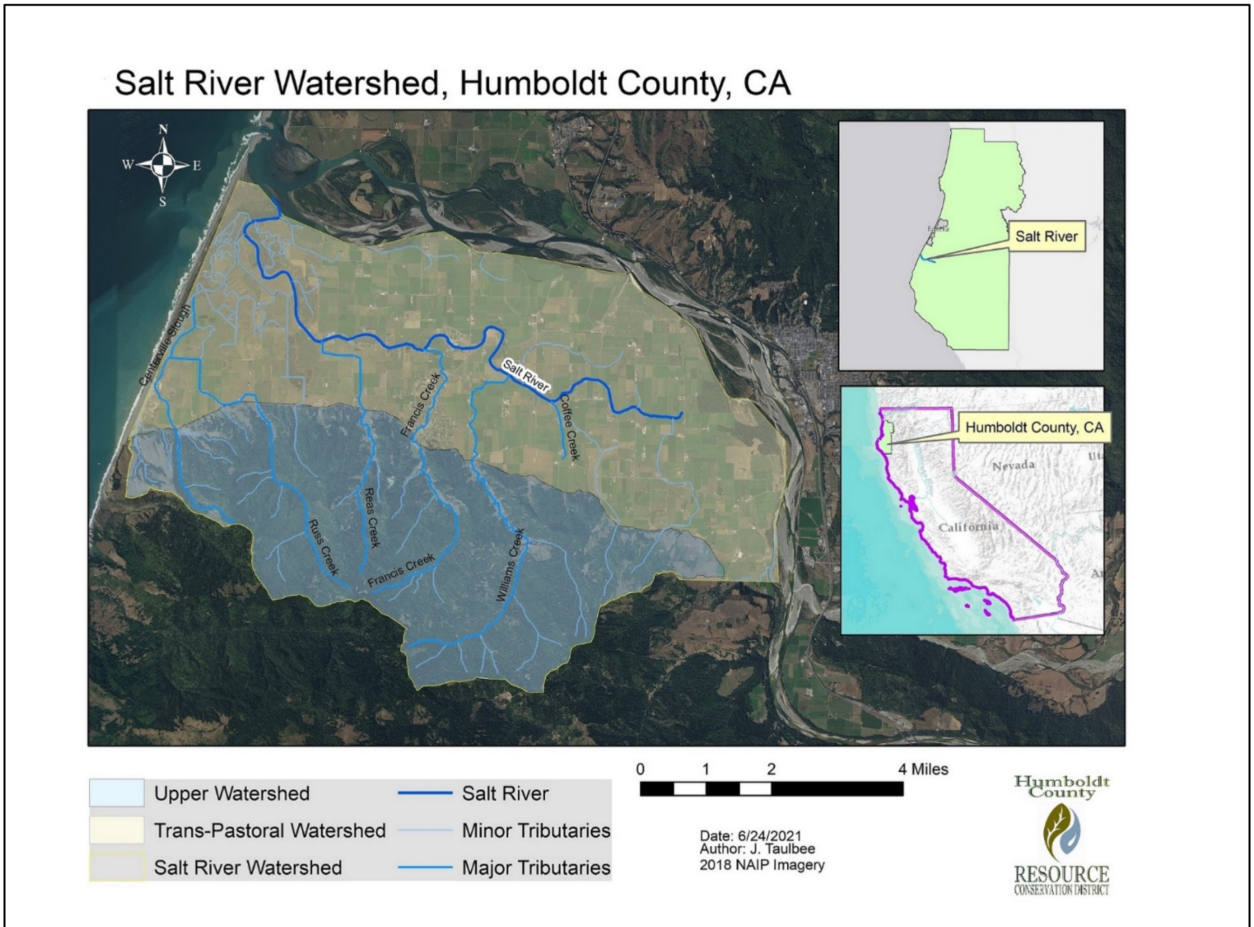

Figure 1. Location map of the Salt River Watershed

Landscape Characteristics

The Salt River watershed is located in the Major Land Resource Area (MLRA) 4B – Coastal Redwood Belt. This MLRA covers a regional area that includes 4,670 square miles in northern coastal California and a very small portion of southern coastal Oregon. The Coastal Redwood Belt elevation ranges from sea level to 3,940 feet. The Pacific Ocean is located to the west of the MLRA and the Coast Range is on the eastern boundary. Average rain fall is from 23 to 98 inches with drier summers. Heavy fog is common from spring to fall. Groundwater is plentiful in the alluvial floodplains adjacent to rivers and coastal valleys. Dominant soil types are Alfisols, Entisols, Inceptisols, and Ultisols. This area supports forest and grassland ecosystems. Common wildlife includes black tailed deer, coyote, fox, racoon, raptors, turkey, salmonids, and other freshwater and marine species. Privately owned dairies, farms, ranches and non-industrial timber operations are present in the watershed (USDA NRCS 2006).

Climate

Given that the location of the Salt River watershed is along the coast of Northern California, it is greatly influenced by the Pacific Ocean. The regional climate is on average damp and cool, with dry summers and wet winters. Coastal fog is common throughout the year due to warm inland air masses drawing cool oceanic air towards the coast. Air temperatures are mild and the average temperature range is from 46.1 F to 59.6 F (National Weather Service Forecast Office, Eureka, CA). September is the warmest month with an average daily high of 63.7 F (1981 to 2020).

Precipitation in the basin is seasonal and is primarily associated with weather systems that move over northern California from the Pacific Ocean. The majority of precipitation falls during the period between October and April. Rainfall is generally uncommon between May and September, though coastal fog and low clouds provide light precipitation throughout the summer and fall. Normal rain fall has been recorded to be 40.33 inches annually from 1981 to 2010 (National Weather Service Forecast Office, Eureka, CA), where the 50-year average is 41.6 inches. The region can experience periods of both drought and extreme wet conditions.

Topography

Topography in the Salt River watershed varies from sea level, to alluvial flatlands, to steep mountains (Figure 2). The flat alluvial delta of the watershed is punctuated by undulations due to remnant slough channels. The floodplain ranges from 3 feet to 80 ft (MSL). This trans-delta alluvial floodplain makes up 17,650 acres.

In contrast to the trans-delta floodplain of the watershed, the Wildcat Hills are extremely steep with an average slope of approximately 42 percent, where slopes exceeding 100 percent are common. The Wildcat Hills cover 12,775 acres and range from 80 feet upwards to approximately 1,700 feet (MSL).

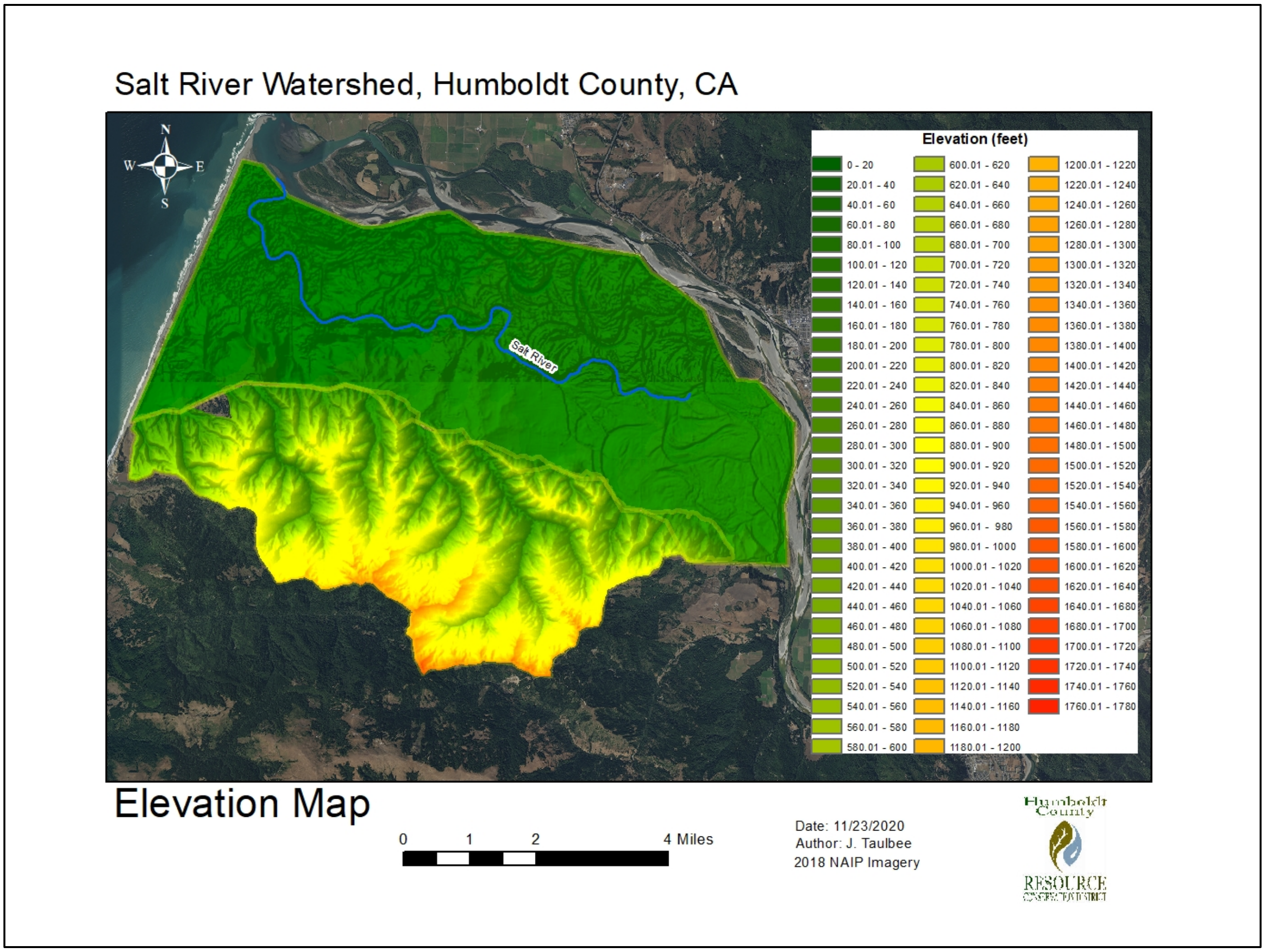

Figure 2. Salt River Watershed elevational map

Geology

Formations and Soils

The Salt River watershed and the surrounding area is geologically young and unstable. The Wildcat Hills are loosely consolidated sedimentary rock formations that are susceptible to large landslides and contribute substantial sediment in waterways across the watershed. These sedimentary formations of the Wildcat Hills are approximately 5 to 10 million years old and are primarily made of indurated mudstone, claystone, siltstone, sandstone, and conglomerate. The foundation of the Wildcat Hills within the Salt River watershed is composed of 5 to 6 depositional formations (Table 1) (Ogle 1953):

Table 1: Geologic Formations of the Wildcat Hills in the Salt River Watershed, CA (listed from oldest to youngest)

Geologic Formation	Description
Pullen Formation	Mudstone, diatomaceous mudstone, and local sandstone
Eel River Formation	Mudstone, siltstone, and sandstone
Rio Dell Formation	Partially cemented, compact massive mudstone, alternating thin sandstone and mudstone, and very fine-grained sandstone
Scotia Bluffs Formation	Very compact massive, fine-grained, shallow marine sandstone with minor amounts of siltstone and mudstone
Carlotta Formation	Partially cemented, nonmarine conglomerate, sandstone, and claystone
Hookton Formation	Soft marine to nonmarine sand, gravel, and silts that were deposited by the historic Eel and Van Duzen Rivers. Though not listed as part of the Wildcat Formation, Ogle identifies the Hookton formation as capping the Carlotta Formation in the Salt River watershed area.

The Eel River Delta, including the Salt River watershed, is a depositional alluvial formation created by the shifting back and forth of the Eel River in the confined delta area as well as sediment deposits delivered from the surrounding tributaries originating in the upper Salt River watershed. The migration of the Eel River across the delta plain not only deposited alluvial materials from the upper slopes of the Eel River watershed, it also created abandoned channels and slough features across the lower watershed.

The soils of the alluvial valley floodplain within the Salt River watershed have been surveyed and mapped by the USDA Natural Resources Conservation Service. In 2019, an updated survey effort was completed. The survey indicates that area is primarily (81%) made up of nine different soil types (Table 2), though a total of 30 soil types are present (USDA NRCS Web Soil Survey).

Seismic activity

The larger Eel River Delta, which includes the Salt River watershed, is located in a prominently active tectonic zone, specifically on the southernmost portion of the Cascadia subduction zone in an area called the Mendocino Triple Junction (Figure 3). This junction straddles three geologic plates, where both the Gorda Plate (northwest) and Pacific Plate (south west) are colliding and subducting beneath the North American Plate (east).

Table 2: Primary Soils Types Found in the Salt River Watershed Floodplain

Soil Type	Soil Description	Percent of Delta Floodplain
110 Weott	Silt loam	21
116 Swainslough	Decomposed plant material and silty clay loam	4
119 Arlynda	Slightly decomposed plant material and silty clay loam	6
126 Loleta	Loam and find sandy loam	8
140 Occidental	Peat and silty clay loam	6
195 Russ	Loam, fine sandy loam, and stratified loamy fine sand to silt loam	13
210 Dungan	Silt loam, fine sandy loam, silty clay loam	5
211 Barbercreek	Silt loam and silty clay loam	8
220 Ferndale	Silt loam and fine sandy loam	10

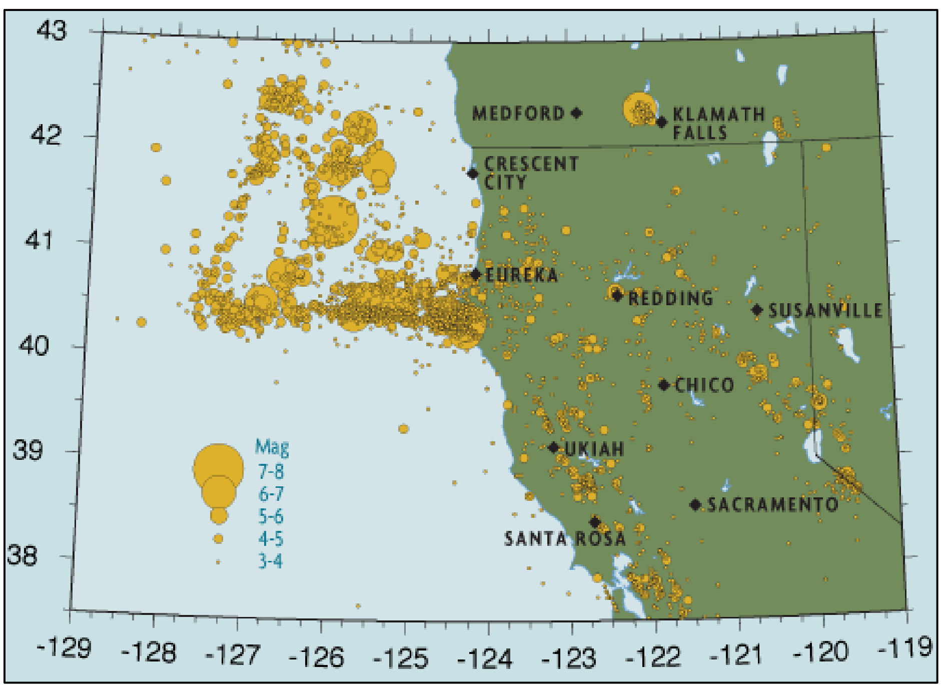

Figure 3: Earthquakes depicted in Northern California between 1970 and 2009. Notably the number of earthquakes occurring on coastal California, and offshore, at the Mendocino Triple Junction area. (Humboldt State University 2011)

Due to the high seismic activity, the Eel River delta is subsiding by an average rate of 1 mm/yr in the north to 3 mm/yr in the south, though the delta is punctuated by large subsidence events (Li and Carver 1992). Given that the rate of subsidence is uneven through the delta, the area with the lowest elevation will determine the course of the Eel River. However, periodic Eel River flood events occurring in the delta bring immense quantities of sediment from the upper watershed and subsequently deposit them across lower elevations, thus maintaining the river location and alluvial floodplain elevation in the face of continuous local subsidence and sea level rise (USDA SCS 1993).

Flooding

Flooding is common along the Eel River in the delta region. Nearly the entire Eel River Delta lies within FEMA's 100-year flood zone and a substantial portion of the delta is also located within the Eel River Floodway (Figure 4). Flood stage is categorized at 20-feet at the USGS Fernbridge gauging station, although overbank flooding can occur in some areas of the delta before this. Between the 2015 and 2019 water years, the Eel River exceeded the 20-foot flood stage height four times. The following table (Table 3) provides the 10 largest historic flood events in the Eel River.

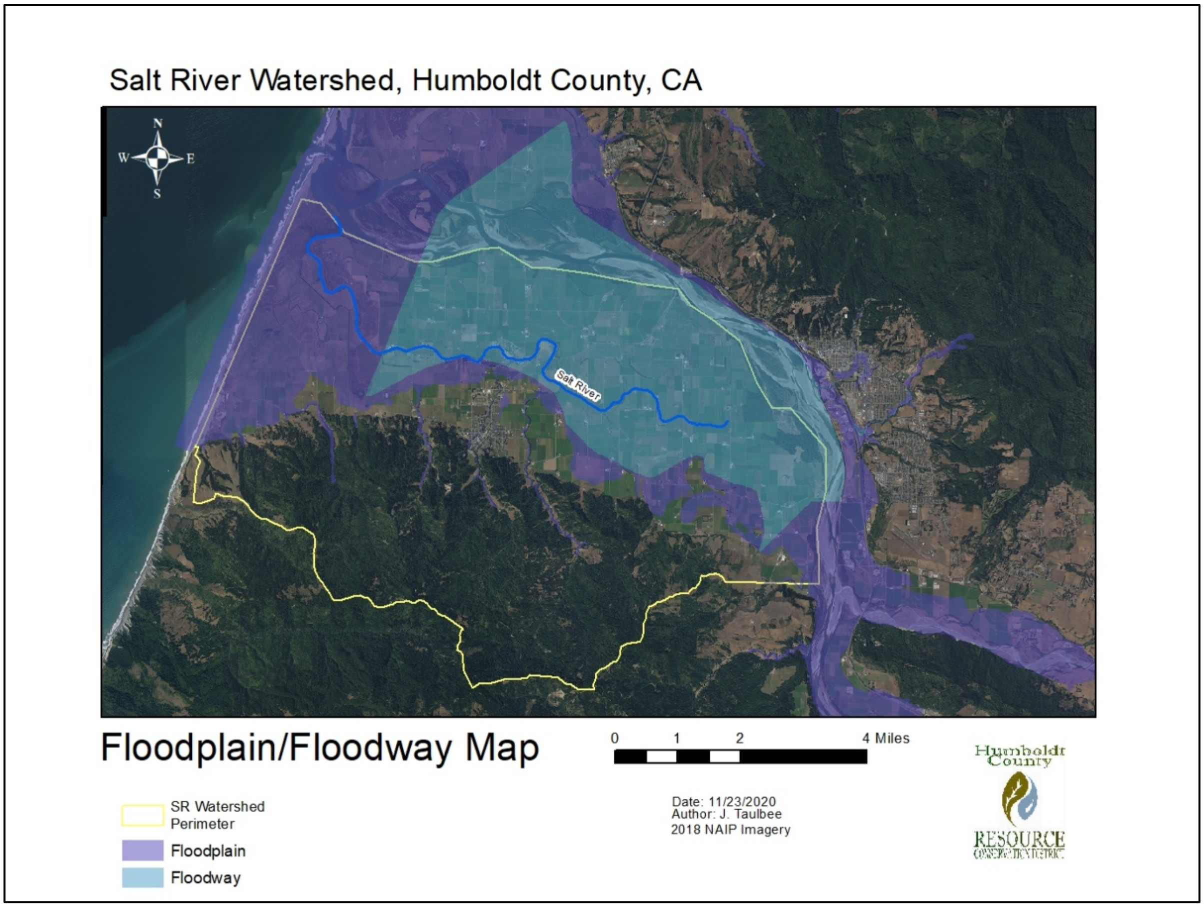

Figure 4. FEMA Flood zone designation map for the Salt River Watershed.

Table 3: Historic peak water level (state) heights measured at the USGS Fernbridge gauge.

Date	Stage (ft)
12/23/1964	29.50
12/22/1955	27.70
1/16/1974	26.33
2/18/1986	26.00
2/27/2019	25.62
12/11/1937	25.40
12/31/2005	25.39
1/9/1995	25.31
1/1/1997	25.28

1/11/2017	24.94

The record 1964 Eel River flood crested at 29.5 feet. This flood event was calculated as a 180-year event (Ritter 1972). Approximately 5,100 acre-ft of sand and 6,300 acre-ft of silt was deposited across the Eel River delta (McLaughlin and Harradine 1965). In reaction to this destructive flood event, the Leonardo Levee was built by the Army Corps of Engineers in 1967 across west bank of the Eel River, on the eastern most edge of the Salt River watershed, in order to prevent impacts from Eel River floods up to a 10 year event.

In addition to flood hazards from the Eel River, the Salt River watershed flood impacts come from local tributary overbank flows. These chronic flood events carry large volumes of sediment that contribute to the building of the delta floodplains and to the dysfunction of the watershed's hydrologic system. The reduction of channel capacity due to the sediment aggradation in the tributaries and the Salt River channel has led to frequent extensive flooding across the floodplain. These flood waters can persist across the landscape for 4 to 8 months per year due to the lack of adequate drainage in the compromised waterways.

Land Uses

Historically, the Salt River watershed was dominated by forest, wetlands, and estuary features. Conversion of this natural state began in the late 1800's with the clearing of trees on the floodplain and the construction of levees, dikes, and drains to transform much of the tidal marsh area into agricultural lands. The floodplains, wetlands, and former tidal marsh began producing row crops and dairy products. The upper watershed saw the extraction of timber and the introduction of grazing. A successful salmon fishery industry also developed, fostering multiple canneries located in the delta.

In the 21st century, the upper watershed continues to be primarily forested with coniferous and deciduous trees and is dominated by non-industrial timber production. Some prairies and open spaces sporadically occur in the upper watershed that support beef cattle and sheep grazing operations.

Presently, 85% of the Salt River watershed alluvial floodplain is in agricultural production (Figure 5). The floodplain is dominated by pasture for dairy and beef livestock grazing. In 2020, approximately 35 dairies (2020) are in operation, averaging 250 acres and 300 cows. The majority of dairy producers manage their herds with intensive rotational grazing practices. Pasture grazing occurs year-round except during periods where pastures are oversaturated during the winter. When access to pastures is limited, cows are housed on facilities in freestall barns, open corrals, or bedding lots. Though the north coast sees substantial precipitation in the winter months, approximately 10,300 acres are irrigated between May and October using 5 dominant sprinkler irrigation equipment types that include handline, traveling gun, center pivot, K-line, and wheel-line (HCRCD 2016). Pastures are further managed with the application of animal/bedding wastes collected during the time when cows are confined during milking or inclement weather periods. This waste is spread as solids and in liquid form throughout the year and particularly in the fall before winter rains arrive.

Other agricultural crops are produced on the floodplain, though in modest amounts compared to pasture. Acreages of different crop types will vary year to year, but as reported by HCRCD (2016), corn silage was grown across 1,062 acres; quinoa covered 50 acres, and other row crops totaled nearly 16 acres.

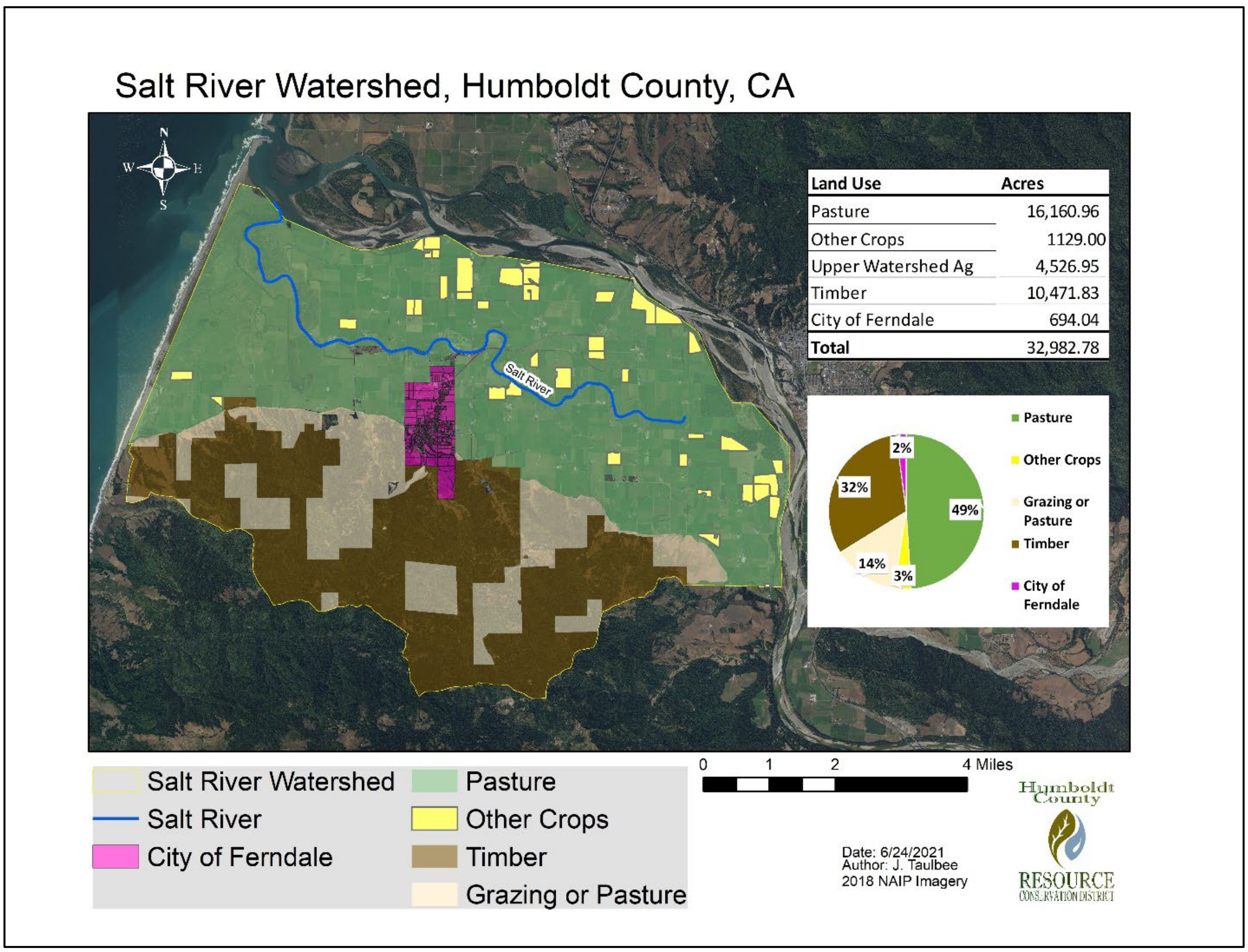

Figure 5. Land use in the Salt River Watershed

Though zoned as agriculture by the County of Humboldt, approximately 800 acres of estuary and dunes make up the westerly edge of the Salt River watershed's delta floodplain bordering the Pacific Ocean. The Lower Eel River Estuary is one of the largest and most biologically valuable estuaries in California and is designated as critical habitat for federally listed Coho and Chinook salmon, northern California steelhead, and tidewater goby (Downie and Lucey 2011). It also supports one of the largest assemblages of wintering and migrating shorebirds and waterfowl on the Pacific Coast. Multiple wetlands, dune, and estuary restoration projects are implemented, being implemented, or planned in this region of the watershed.

The City of Ferndale is the only urban area located in the Salt River watershed. The City covers 694 acres and straddles Francis Creek. It has a population of approximately 1,366 (US Census 2020). Other small residential and business clusters sprinkle the watershed and include Port Kenyon, Arlynda Corners, and Waddington.

Public lands in the watershed include the City of Ferndale's Russ Park (approximately 96 acres) located immediately south of the city limits. A former dairy, known as Riverside Ranch (440 acres), was recently acquired by the California Department of Fish and Wildlife, is managed under the department's Wildlife Management Area, and is part of the Eel River Wildlife Area (Region 1). A 39-acre, river front, parcel located on the eastern edge of the watershed is owned by the US Government. This property is covered with riparian vegetation and is currently unmanaged.

Socio-Economic Conditions

Socio-Economic variables include population, income, occupation, and education. US Census and American Community Survey data for the entire Salt River watershed is limited given that 96 percent of the watershed area is rural. Therefore, the City of Ferndale's census data (which includes residents one mile outside of city of limits) will be the surrogate for the larger watershed for much of the following information.

The approximate population of the Salt River watershed is 2,600 (2010 CA Census Viewer). The City of Ferndale population is 1,366 (US Census 2020). The median age is 50.5 years. The population is 92 percent white (non-Hispanic) with the remainder consisting of a combination of Hispanic and Asian. The mean household income is $88,858 with a poverty rate of 12.09 percent. The larger watershed area is considered a disadvantaged community as the median household income is less than 80 percent of the statewide annual median household income (CA Water Code Section 79505.5).

Of the population, 22 percent of community members achieved a high school degree, 32 percent attended some college courses, 20 percent have a bachelor's degree, and 16 percent attained graduate degrees.

The employment rate is 54.5 percent. The City of Ferndale is a tourist destination due to its abundance of Victorian architecture, therefore, services related to the hospitality industry dominate, followed by construction and education services. The area has an unusually high number of residents working in specialized services such as law enforcement, farming and forestry, and architecture and engineering.

Nearly 96 percent of the Salt River watershed is zoned as agriculture. Of the approximate 50 active dairies in Humboldt County, the 35 dairies operating in the Salt River watershed make up the lion's share of Humboldt County's $99 million dairy industry (Humboldt County Department of Agriculture 2016). The upper watershed supports a small number of non-industrial timber and non-industrial timber-grazing operations which helps support the County's $70 million timber and $50 million cattle industry.

SECTION 3: HYDROLOGIC AND WATER QUALITY CHARACTERIZATION

The Salt River watershed is an impaired watershed along the northern coast of California where hydrologic and water quality systems impact natural resources that are relied upon by humans and fish and wildlife. Some of these impairments cause multiple annual flooding events which impact agriculture producers and residents across the watershed. Hydrologic and water quality impairments also cause habitat loss and degradation to terrestrial and aquatic wildlife species, including threatened and endangered salmonids and bird species.

According to anecdotal information, hydrologic dysfunction within the watershed became apparent to producers and residents in the 1960s. By the late 1980s, community members organized and created the Eel River Resource Conservation District (now the Humboldt County Resource Conservation District). This local organization elicited support to begin studies across the watershed to develop solutions to hydrologic issues. This effort led to numerous watershed studies and assessments to assist with the creation of a large watershed scale project named the Salt River Ecosystem Restoration Project. Further assessment and studies have been performed to address groundwater use, plan restoration projects, and promote efficient agricultural practices.

AVAILABLE DATA AND RESOURCES

Information Compiled by Others

The following provides a chronological list, and description, of documents produced to assess hydrologic and water quality conditions across the Salt River watershed.

USDA Soil Conservation Service (1993) Salt River Local Implementation Plan provides an overall summary of the Salt River watershed and specifically addresses sediment impacts to the Salt River. The plan also offers possible solutions to the lack of a river channel and hydraulic conveyance.

California Department of Fish and Game (2005) Salt River Watershed Assessment presents a summary of the watershed including a basin profile, climate, hydrology, geology, vegetation, water quality, and fish and wildlife habitat. The assessment focuses on the need for salmonid habitat restoration.

Lee Benda and Alice Berg and Associates (2007) Sources, Magnitude, and Mitigation of Erosion and Sedimentation in the Salt River Basin, with Emphasis on Francis and Williams Creek Basins concentrated on sediment sources and the scale of the sources' impacts across the Salt River watershed watersheds.

Timberland Resource Consultants (2010) Upslope and Instream Erosion Hazard Inventory, Assessment and Restoration Project for Williams and Francis Creeks identified and analyzed erosion and sediment sources such as roads, instream, and mass wasting sites in the two sub-watersheds.

Grassetti Environmental Consulting (2011) Final Environmental Impact Report: Salt River Ecosystem Restoration Project provides historic and current watershed conditions, as well as results of recent studies, in support of the California Environmental Quality Act process for the Salt River Ecosystem Restoration Project.

Kamman Hydrology and Engineering, Inc (2012) Basis of Design Report, Salt River Ecosystem Restoration Project, Riverside Ranch Tidal Marsh Restoration, and Preliminary Salt River Channel Design describes sediment and hydrologic studies performed in the Salt River and Francis Creek to inform the design of the Salt River Ecosystem Restoration Project.

Fenton and Wilson, County of Humboldt (2012 to 2018) The Francis Creek Annual Suspended Sediment Yield, Turbidity Threshold Sampling Summary Reports provides results from a turbidity threshold sampling station on Francis Creek to determine annual suspended sediment yield with associated creek flows.

*Humboldt County Resource Conservation District (2016) Evaluation of Irrigated Acres and Irrigation Water Use Rates in the Eel River Valley and Groundwater Basi*n assessed irrigation methods by agricultural producers and estimated the number of acres of land irrigated in the Salt River watershed and the larger Eel River Delta.

Humboldt County Resource Conservation District and GHD (2016) North Coast Irrigation Water & Fertigation Management Plan User's Guide and Tool Version 1.0 assists agricultural producers in determining the optimum level of irrigation and nutrient application given environmental conditions.

SHN Engineers and Geologists (2016) Eel River Valley Groundwater Basin, Humboldt County, CA Groundwater Sustainability Plan Alternative is a report developed in response to the Department of Water Resources' designation of the Eel River Basin being identified as a medium-priority groundwater basin. The report describes the basin, principal aquifers, water quality, recharge areas, surface water bodies, groundwater storage, and sea water intrusion.

Graham Mathews and Associates (GMA) Hydrology, Inc. (2018) Williams Creek Streamflow and Sediment Transport Monitoring presents results from a turbidity and creek flow monitoring station installed in the trans-delta region of Williams Creek. The monitoring determined sediment transport at differing stream flow, sediment loads and suspended sediment discharge, and bedload transport.

US Environmental Protection Agency (2019) Field Report/Data Transmittal – Salt River Watershed Monitoring provides monitoring results in Francis, Williams, and Russ Creek tributaries. Monitoring included turbidity, suspended sediments, macroinvertebrates, and other water quality measurements. The monitoring assessed watershed health and effectiveness of the implementation of best management practices through community composition of instream biota (i.e. macro-invertebrates). Monitoring was performed from 2013 to 2019 (excluding 2017).

Humboldt County Resource Conservation District (2019) Technical Memo Update to the Williams Creek Upslope and Instream Erosion Inventory consolidated sediment source information for the Williams Creek watershed by reviewing previous studies, analyzing aerial imagery, performing on the ground field work, and compiling Natural Resource Conservation Services' implemented practices.

GHD and Mike Love and Associates (2020) Williams Creek Restoration Project: Alternatives Analysis begins the restoration planning process on the trans-delta reach of Williams Creek. The assessment uses sediment monitoring and hydrologic modeling to inform 10% design level plans.

Gaging Stations in the Salt River Watershed

The Salt River Watershed has one permanent water level stream-gaging station in the Eel River on Fernbridge (USGS Streamgage 11479560), in the community of Fernbridge, CA, located just outside of the Salt River watershed on the eastern-most boundary. This stream-gaging station is operated by the US Geological Survey and provides continuous monitoring of river stage on the lower reach of the Eel River, six miles upstream of its confluence with the Pacific Ocean.

In coordination with the Salt River Ecosystem Restoration Project, the Francis Creek Turbidity Threshold Sampling Station collected suspended sediment samples and recorded water level in trans-delta reach of Francis Creek at the northern end of the City of Ferndale. Turbidity sampling and water level data collection occurred from 2012 to 2018. As of 2019, the City of Ferndale currently operates the station to record only water levels.

Stream gaging and sediment transport sampling monitoring was installed for two water years, 2017 and 2018, in the trans-delta reach of Williams Creek. The monitoring station and additional sampling collected continuous water levels and turbidity, stream flow measurements, suspended sediment samples, and bedload samples. The monitoring results informed restoration planning on Williams Creek.

Surface and Groundwater Sampling Sites

In addition to the water level and turbidity monitoring stations that are operating, or operated, in the Salt River watershed, surface water and ground water sampling are being collected under varying monitoring programs.

As the Salt River Ecosystem Restoration Project completes its implementation, numerous annual monitoring tasks are executed post construction across the 7-mile restoration footprint. Water quality spot sampling occurs monthly through the winter and into early summer at established fish sampling sites in the Salt River, Reas Creek, and Francis Creek. Approximately 20 sites are monitored for temperature, dissolved oxygen, conductivity, and salinity in the restored estuary and river corridor.

In 2013, an annual Surface Water Group Monitoring Program was developed by a local dairy producer group, Six River Dairy Association, in order to comply with the North Coast Regional Water Quality Control Board's dairy General Waste Discharge Requirements. Surface water sampling events occur during or directly following three storm events with one inch or more rain within 24 hours, at least one month apart. Thirty-four surface water sampling sites are established in the Salt River watershed. Nine of these sites are randomly selected for each sampling event. Temperature, pH, electrical conductivity, and ammonia are measured at each site and results are provided to the North Coast Regional Water Quality Control Board.

The EPA and the Humboldt County Resource Conservation District operated three water quality sampling stations in the Salt River watershed for three years between 2013 and 2015. The stations were located in the low gradient portions of Francis, Williams, and Russ Creeks. The stations collected turbidity samples with corresponding water depth. Seasonal spot water quality sampling also tested for coliform, nitrate, phosphate, chloride, temperature, dissolved oxygen, conductivity, and salinity. No annual summary reports have been produced for water quality chemistry results; however, data sheets and laboratory results are available.

A Groundwater Sustainability Plan Alternative (GSPA), led by the County of Humboldt, was initiated in 2016 as a response to the Sustainable Groundwater Management Act's designation of the Eel River Basin as a medium-priority basin in 2015 by the California Department of Water Resources (DWR). The County of Humboldt conducted groundwater sampling across the larger Eel River Basin in the latter portion of 2016, encompassing the Salt River watershed. The County of Humboldt continues to monitor over 40 private, California State Groundwater Elevation Monitoring (CASGEM), municipal, and newly installed monitoring wells in the Salt River watershed to abide by the Sustainable Groundwater Management Act. In addition to well monitoring results, the GSPA document provides a description of historic and current groundwater conditions, a groundwater budget, groundwater levels, storage, seawater intrusion, and water quality information.

Biological Monitoring

Seasonal fish sampling is performed across implemented portions of the Salt River Ecosystem Restoration Project. As of 2020, over 20 sites are monitored for species presence and distribution across 5 miles of river and creek channels. The sites encompass restored saltwater, brackish water, and freshwater habitats. California Department of Fish and Wildlife, Humboldt State University, Ross Taylor and Associates, and Humboldt County Resource Conservation District staff partner to perform monthly fish sampling surveys that occur from November to July each year. Annual monitoring reports are developed and available on the Humboldt County Resource Conservation District website.

Annual vegetation monitoring in the restored Salt River corridor and tidal marsh area has occurred since 2014. Monitoring of vegetation percent cover for native and invasive species, habitat acreages, and tree basal measurements are performed by JB Lovelace and Associates to determine if the Salt River Ecosystem Restoration Project is achieving required habitat thresholds. Annual habitat and vegetation monitoring reports are available on the Humboldt County Resource Conservation District website.

Avian point count surveys document and compare species richness and abundance of bird species pre- and post-Salt River Ecosystem Restoration Project implementation. Currently, baseline surveys have been performed across the entire 7-mile restoration project area. Post construction surveys for years three and five were completed across 330 acres of the restored tidal marsh. The surveys are performed by consultant Sean McAllister and avian monitoring reports are available on the Humboldt County Resource Conservation District website.

The EPA and the Humboldt County Resource Conservation District collected benthic macroinvertebrates at sites located on Williams, Frances, and Russ Creeks for years 2013 through 2016, 2018, and 2019 . Macroinvertebrates are considered indicator species to estimate the health of a watershed. The creeks selected for benthic macroinvertebrate monitoring all had National Resource Conservation Service best management practices implemented in the upper watershed. EPA anticipated that macroinvertebrate abundance would indicate whether implemented practices improved water quality and other habitat characteristics in the watershed. Results were mixed, where two tributaries (Francis and Reas Creeks) saw improvement in healthy water quality indicator species by 2019, while one tributary (Williams Creek) saw a decline.

STREAM FLOW HYDROLOGY, RUNOFF & FLOODING, GROUNDWATER AND AQUIFERS, AND IRRIGATION

Stream Flow Hydrology

Two hydrologic systems exist in the Salt River watershed – the Eel River and the Salt River with its associated tributaries.

EEL RIVER

The Eel River courses 11 miles along the northern and eastern boundaries of the Salt River watershed until it enters the Pacific Ocean. The Eel River is fed by tributary water sources located throughout its approximate 200-mile length. The Salt River is one of the Eel River’s last tributaries thus contributes little to the Eel River’s flow. Hydrologically the Eel River interacts with the Salt River watershed in three ways: 1) diurnal high tide cycles push Pacific tidal and Eel River waters into the estuary and lower portion of the Salt River; 2) the Eel River recharges underground aquifers in the immediate region; 3) and the Eel River overbank flows during large winter events cause flooding across the landscape.

SALT RIVER & TRIBUTARIES

The Salt River is the last tributary of the Eel River prior to it entering the Pacific Ocean. The Salt River courses through the watershed’s alluvial floodplain for over 13 miles. Six main tributaries, originating in the Wildcat Hills, feed the Salt River (Figure 1 and Table 4). Approximately three additional unnamed minor tributaries also contribute flow to the Salt River.

Table 4: Salt River Watershed Tributary Information[1]

Tributary Name	Upper Watershed Area (acres)	Elevation (feet)	Salt River Mile (miles)	Stream Length (miles)[2]
Russ Creek	2,335	20 to 1550	1.1	5.2
Smith Creek	190	35 to 950	2.4	2.6
Reas Creek	1,300	40 to 1500	3.5	3.5
Francis Creek	2,035	60 to 1500	5.1	4.3
Williams Creek	3,770	50 to 1750	7.5	7.2
Coffee Creek	505	40 to 950	7.9	2.5

[1] Table adapted from the Salt River Ecosystem Restoration Project Final Environmental Impact Report (Grassetti Environmental Consulting 2011)
[2] Stream Length estimates provided by CDFW 2004 field observation and mapping

Streamflow characteristics of the Salt River and its tributaries are subject to the regional climate. Tributary streams respond quickly to rain events in the upper sub-watersheds as surface runoff enters the channels from the steep hillslope areas. High flows are limited to the wet season between October and April. Baseflow conditions are reduced, but are perennial during the dry season. Summer base flow in Williams, Francis, and Reas Creeks are less than 1.0 cfs (GMA 2018 and Kamman 2012). As of 2020, perennial flow in the main stem Salt River occurs downstream of the confluence of Francis Creek. Base flow from Williams Creek and Coffee Creek are currently disconnected from the system.

Historically the Salt River was largely influenced by the tides while tributaries meandered across the floodplain, producing alluvial fans at the base of the Wildcat hills, before entering the Salt River. Over the last 150 years, levees, tide gates, dikes, and berms have been installed or built to reclaim wetlands for agricultural conversion and to control high water events. These actions reduced tidal prism, channelized tributaries, and altered stream flows which led to significant instream aggradation and eventual dysfunction of the hydrologic system. Aggradation of the Salt River and its tributaries increased, which ultimately reduced the capacity of the Salt River channel to convey runoff and drain the watershed, triggering extensive flooding across the watershed.

The tributaries of the Salt River are perched in the trans-delta reaches due to excessive sediment deposition in the channels and banks (i.e., channel bottoms and banks are higher in elevation compared to the adjacent land). Therefore, during winter flood events, out-of-bank flows either remain on the landscape or re-enter the system much further downstream. To partially ameliorate the situation in one portion of the watershed, two drainage systems exist on either side of the City of Ferndale to accommodate sheeting and flooding waters from Williams and Francis Creeks. The East Side and West Side Drainage systems employ a network of street gutters, drainage channels, culverts, storm sewers, County ditches, and existing swales which eventually direct flood waters to the Salt River.

Runoff & Flooding

Surface runoff occurs when water either enters or leaves a waterway. In the Salt River watershed, location is key to the direction of surface runoff taking place.

Upper Watershed Runoff

The Wildcat Hills make up less than half of the total land area in the Salt River watershed but produces the majority of surface runoff and sediment inputs. Precipitation in the steep upper watershed quickly produces surface runoff which immediately enters tributary streams. This runoff can be detrimental to the watershed as it can mobilize and carry significant sediment loads into waterways. Though sediments can originate from various sources across the upper watershed, three specific elements are identified that exacerbate runoff: roads, livestock access to streams, and lack of riparian buffers.

Rural unpaved roads within the upper watershed increase runoff and sediment loading into the waterways due to the inability of precipitation to percolate into the earth through compacted road surfaces. In the upper Williams Creek watershed, over 55 miles of roads exist (HCRCD 2019). Over 29 miles of roads are in the Francis Creek watershed. NRCS and private landowners have been implementing conservation practices to improve water conveyance from road surfaces and decrease sediment inputs into the hydrologic system.

Much of the upper watershed is managed as grazing operations. Some stream side areas are open to livestock access. These livestock access sites provide a source of unfiltered runoff that increases sediment and nutrient inputs in the waterways.

A majority of the upper watershed creeks have an intact riparian corridor. Riparian buffers slow surface water runoff to allow the absorption of water into the soils and lower sediment and nutrient inputs into streams. However, some sections of creeks have sparse vegetation or completely lack riparian vegetation, promoting further runoff impacts in the steeply sloped upper watershed landscape.

Lower Watershed Runoff

Much of the lower Salt River watershed experiences runoff annually during large winter rain events. Runoff in the lower watershed is in the form of waterflow leaving a waterway to flow across the landscape, eventually returning to the waterway further downstream or entering another waterway. In the case of the Salt River watershed tributaries, runoff from the tributaries primarily stays ponded across the landscape given that a majority of the tributaries are perched due to sedimentation along the banks and channel bottom. This hydrologic exchange involves the Eel River, Salt River, and the Salt River tributaries.

As mentioned previously, the Eel River contributes significant surface runoff during out-of-bank flows. Flood conditions are reached when the Eel River reaches 20 feet at the stream-gaging station at Fernbridge (USGS). Between 2010 and 2020, nine flood events occurred (> 20.00 feet river stage). A flood event taking place in February 2019 was determined to be the fifth largest in recorded history, reaching 25.62 feet. Historically, overbank flood waters from the Eel River (primarily on the eastern boundary of the Salt River watershed) were directed into the far upstream reaches of the Salt River, where waters would course downstream and be directed back to the Eel River at the Salt River confluence. However, with the creation of the Leonardo levee by the US Army Corps of Engineers in 1967 on the eastern boundary of the watershed and with ever-changing Eel River channel conditions (such as migration of the channel bottom location and formation of gravel bars), unpredictable overflow points along the northern edge of the Salt River watershed began to appear. Recently, aerial monitoring photos showed out-of-bank flows of the Eel River entering the Salt River watershed at multiple sites along the northernmost boundary during typical flood events (20 feet to 23 feet). This overflow then travels west across the length of the watershed where most of the flow enters the lower Salt River (Figure 6).

Figure 6. January 2016 flood event on the Eel River and Salt River Watershed. Photo credit: Brad Finney.

During winter periods, after the landscape has been saturated by precipitation, a typical one-inch rain event will create surface runoff. Depending on the location of the runoff in the lower Salt River floodplain, the surface water will either remain trapped on the floodplains and not enter adjacent waterways, due to the elevated or perched tributaries, or flow can meander and be captured in the lower restored areas of the Salt River (downstream of the Williams Creek confluence (as of 2021)). In the westernmost portion of the watershed floodplain where elevations reach sea level, soils have limited drainage capacity and groundwater levels are shallow, so freshwater surface runoff during precipitation events will enter depressional areas and either remain ponded on the landscape or gradually flow to the restored Salt River.

Surface runoff is exacerbated by larger rain events which causes out-of-bank flooding in all tributaries and in portions of the unrestored Salt River. Flooding due to overbank flow from the unrestored Salt River and its tributaries has increased in recent decades due to geomorphic changes that have reduced the capacity of the Salt River channel to convey runoff. Annual flooding of lowland areas is now commonly triggered by relatively minor precipitation events and areas along the unrestored Salt River that formerly drained relatively quickly now remain ponded well into the summer. Tauzer (2009) estimates that flooding along the unrestored Salt River occurs well under a one-year recurrence interval. This level of flooding threatens residences, closes roads, impacts City of Ferndale businesses, and floods agricultural fields (Figure 7).

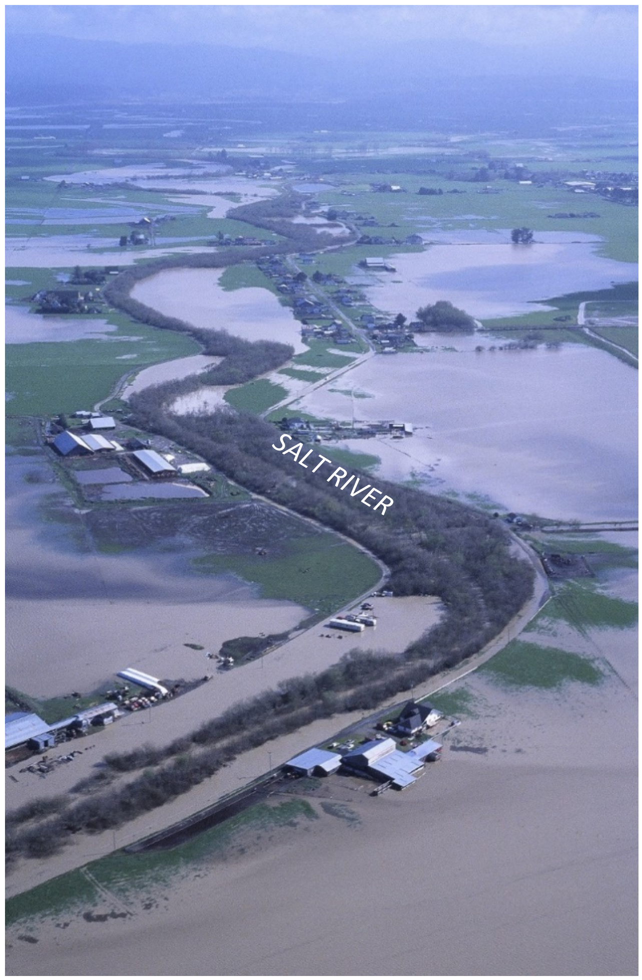

Figure 7. Salt River 2004 flood event impacting roads, pastures, dairy facilities, and residences. Photo Credit: Don Tuttle.

The restored portions of the Salt River now contain up to a 2 year flood event. Unrestored portions of the Salt River remain dysfunctional. As of 2021, the lack of a Salt River channel at the confluence of Williams Creek and Salt River causes Williams Creek to splay across 40 acres of agricultural pasture lands, where most of the flow slowly collects into the restored Salt River. The furthest upstream remaining tributary, Coffee Creek, is disconnected from the lower portion of the watershed due to a massive buildup of sediment downstream of the Coffee

Creek and Salt River confluence. Coffee Creek flow and additional surface water runoff originating in the eastern portion of the watershed will collect near Perry Slough and if flows are high enough, will enter the Eel River through Old River Slough (Figure 8).

Figure 8. Williams Creek and Coffee Creek flow immediately after a 2017 flood event. Photo Credit: Brad Finney)

Irrigation and Runoff

A 2016 study (HCRCD 2016) evaluated current and recent irrigation in the Salt River watershed and the larger Eel River basin. Through on-the-ground observations, producer surveys, and interviews with local industry specialists and County representatives, the study determined the number of acres irrigated, period of irrigation, water source, crop types, irrigation equipment types, and methods. The study determined that 10,299 acres are irrigated in the Salt River alluvial floodplain (Figure 9); irrigation occurs primarily between May and October; and five main sprinkler irrigation methods are used – handline, traveling gun, wheel line, K-line, and center pivot.

Through the irrigation study and observations by agricultural specialists, surface runoff due to agricultural irrigation practices is not of a great concern in the area. Irrigation commonly occurs across 58% of the nearly zero percent sloped alluvial floodplains of the lower watershed during the dry season. However, occasional irrigation events have taken place where producers locate their traveling guns (sprinkler mounted on a cart (gun cart) connect by a large flexible hose to a water supply) too close to swales, causing minor runoff incidents occur at discrete sites.

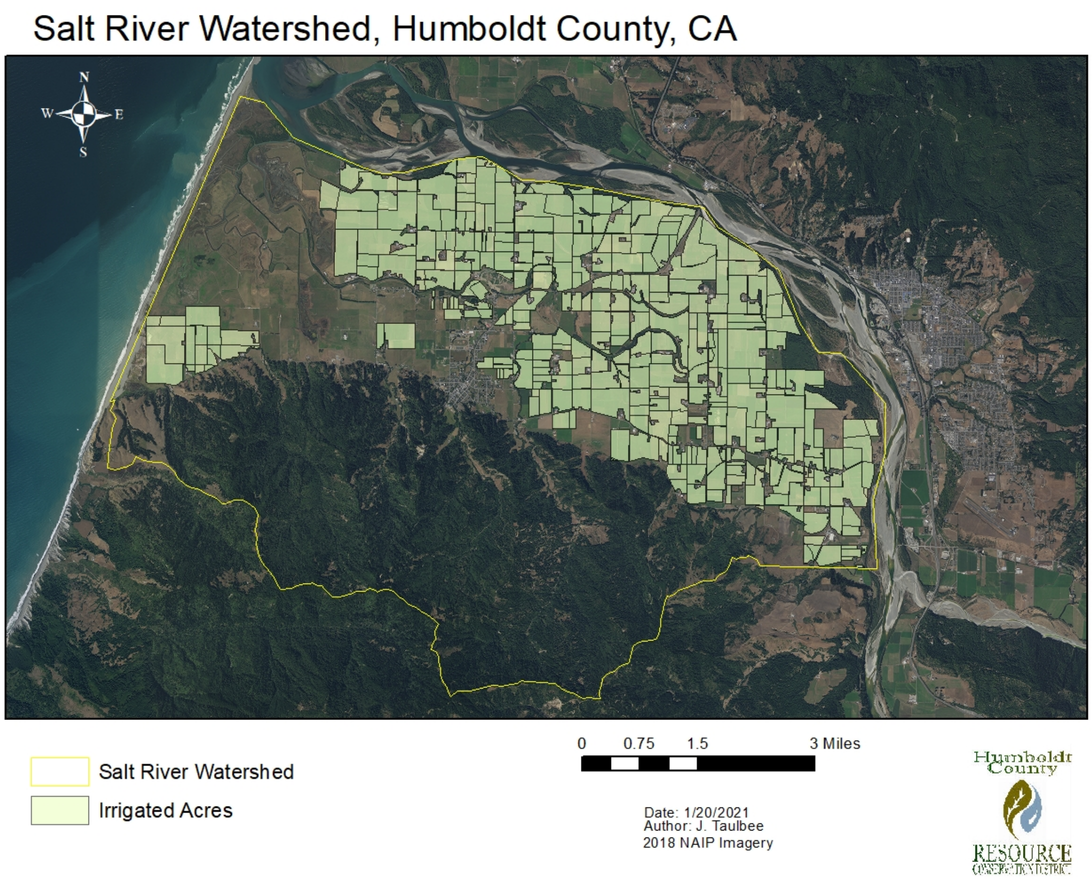

Figure 9: Map of Irrigated Acres in the Salt River Watershed

Evapotranspiration

Unfortunately, evapotranspiration rates in the Salt River watershed are too low to help regulate runoff from either irrigation or flood events. Evaporation (ET) is the process by which liquid water moves from the soil or plants to vapor form in the atmosphere. It is governed by solar radiation, wind, temperature, and humidity. ET in the Salt River watershed is one of lowest in the state due to the prevailing climate (frequent cloud cover or fog, mild temperatures, and high humidity). Though persistent wind in the watershed will increase ET, it is not enough to substantially affect surface water runoff.

Groundwater

In 2016, a geologic and hydrogeologic investigation of the groundwater basin (SHN 2016) including the Salt River watershed, was conducted. The study included the monitoring of approximately 40 wells across the Salt River watershed in the spring and fall of 2016. Results determined that current groundwater levels at the basin scale reflect historic elevations and are thus generally stable. The investigation also concluded that groundwater usage is a small percentage of annual recharge and groundwater storage volume.

The study confirmed the large, unconfined, alluvial water-bearing unit located in the Eel River delta floodplain as the primary aquifer for the basin. This aquifer is a highly productive and is mainly utilized for irrigation and is recharged by the Eel River, area tributaries, precipitation, and surface flooding during winter events. Groundwater is shallow, with the water table located from a few feet to 20 feet below ground level. Most wells in the area are less than 50 feet in depth and can produce from 20 to 600 gallons per minute. Monitoring of wells throughout the Salt River watershed found that groundwater quality is good, though chloride levels are elevated near the coast. Though shallow wells have a higher potential for dissolved solids, water quality measurements seem to indicate that agricultural runoff is not substantially affecting the aquifer.

WATER QUALITY CONDITIONS IN THE WATERSHED

Numerous water quality monitoring sampling programs and studies have been implemented across the Salt River watershed for various projects. Recent studies evaluating sediment, nutrients, pathogens, and other inputs have been performed since the early 1990s and these constituents continue to be monitored. Currently the Lower Eel River, in which the Salt River is located, is listed as an impaired waterway for sediment and temperature by the North Coast Regional Water Quality Control Board. Previous studies also identify nutrient inputs from the Ferndale wastewater treatment plant and farms/dairies as a concern. Given that the Salt River watershed supports endangered and threatened populations of salmonids and waterfowl, the level of water quality is of particular importance.

Sediment

The steep slopes of the Wildcat Hills and its highly erosive geologic formations, along with abundant winter annual rain fall, contribute to naturally high sediment loads in the Salt River and its tributaries. Land use activities in the upper watershed further increase sediment loads.

Numerous studies have estimated and monitored sediment in the subwatersheds and have demonstrated that sediment loads are exceptionally high.

The USDA Soil Conservation Service performed an assessment on the Salt River watershed in 1993 to identify resource concerns, characterize sediment loads in the subwatersheds and impacts to creek and river channels, as well as develop possible solutions to the dysfunctional hydrologic system. Though no direct measurements were made, the assessment estimated that sediment delivery from the Wildcat Hills was approximately 58,420,000 lbs./year (Table 5). Of that amount, approximately 60% would be deposited on the alluvial flood plain and approximately 40% of that sediment load would reach the Salt River.

Table 5. Annual Sediment Delivery in the Salt River Watershed (1993)[1]

Tributary/Subwatershed	Est Sediment Delivery to Base of Wildcat Hills			Estimated Sediment Delivery to Salt River		
	tons	lbs	cy	tons	lbs	cy
Cuttoff Slough	870	1,740,000	669	440	880,000	338
Centerville Slough	2,700	5,400,000	2,077	1,350	2,700,000	1,038
Russ Creek	3,730	7,460,000	2,869	380	760,000	292
Smith Creek	700	1,400,000	538	250	500,000	192
Unnamed	520	1,040,000	400	180	360,000	138
Reas Creek	2,690	5,380,000	2,069	1,540	3,080,000	1,185
Francis creek	5,480	10,960,000	4,215	2,000	4,000,000	1,538
Williams Creek	9,960	19,920,000	7,662	5,240	10,480,000	4,031
Unnamed	580	1,160,000	446	0	0	0
Coffee Creek	1,050	2,100,000	808	0	0	0
Unnamed	930	1,860,000	715	0	0	0
TOTAL	**29,210**	**58,420,000**	**22,469**	**11,380**	**22,760,000**	**8,754**

[1] Table adapted from the USDA SCS 1993 Salt River Watershed Assessment

In relation to the Salt River Ecosystem Restoration Project, Benda and Berg (2007) studied sediment sources in the subwatersheds of Francis and Williams Creeks. Their evaluation found that the USDA SCS (1993) assessment underestimated sediment loads by upwards of 100% and overestimated storage of delivered sediment on the alluvial floodplain. No estimated sediment loads to the Salt River were predicted in the study.

Further monitoring was performed in Francis Creek in order to inform the development of the Salt River Ecosystem Restoration Project. The County of Humboldt, the City of Ferndale, and Humboldt County Resources Conservation District funded and installed a turbidity threshold sampling station on Francis Creek that measured suspended sediments in the water column of

Francis Creek during the hydrologic year. This station ran from 2007 to 2018 and was located at the intersection of Van Ness Avenue and Francis Creek, approximately midway from the base of the Wildcat Hills to the Salt River. Suspended sediments are mainly sand and silt particles that mobilize in the water column during increased flow events. Suspended sediment loads were calculated using turbidity measurements. Data across the 11 years revealed that delivered sediment loads are correlated with amount of rainfall where Francis Creek on average delivers 62,754,567 lbs./yr (Fenton and Wilson 2018) (Table 6). The annual suspended sediment loads are concluded to be some of the highest in the United States. The purpose of this sampling and monitoring is to provide guidance on how much suspended sediment can be expected to enter the Salt River and would be needed to be removed or captured.

Table 6: Francis Creek Annual Suspended Sediment Loads[1]

Hydrologic Year	Total Suspended Sediment lbs.	Total Suspended Sediments cubic yards
2008	41,739,922	18,187
2009	12,578,664	5,480
2010	38,979,924	16,985
2011	70,342,760	30,650
2012	65,859,288	28,696
2013	139,352,629	60,720
2014	2,419,062	1,054
2015	84,450,445	36,798
2016	77,129,899	33,608
2017	146,698,718	63,921
2018	10,748,930	4,684
TOTAL	**690,300,241**	**300,783**
AVERAGE	**62,754,567**	**27,344**

[1] Table Adapted from the Francis Creek Annual Suspended Sediment Yield Turbidity Threshold Sampling Summary Report (Fenton & Wilson 2018)

In support of a Williams Creek restoration project, sediment monitoring in Williams Creek took place during the hydrologic years of 2017 and 2018, which happened to represent a wet and dry year, respectively. Monitoring measured both suspended sediment and bedload in the trans-delta reach of Williams Creek (near Rose Avenue). Total sediment loads in Williams Creek for this period ranged from 5,470,000 lbs./yr to 193,506,000 lbs./yr (GHD and Love 2019) (Table

7). Sediment load delivery appears to positively correlate with amount of rainfall occurring during the hydrologic years.

Table 7: Estimated Total Transport Sediment Loads in Williams Creek for HY 2017 and 2018

Hydrologic Year	Total Suspended Sediment		Total Bedload		Total Sediment Load	
	lbs.	cubic yards	lbs.	cubic yards	lbs.	cubic yards
2017	193,340,000	74,362	16,600	64	193,506,000	74,425
2018*					5,470,000	2,104

* 2018 only measured bedload and suspended sediments, excluding clays and silts.

Other tributaries such as Reas Creek in the Salt River watershed have not been extensively monitored compared to Francis and Williams Creeks. Though these tributary watersheds are smaller in size, their upper watersheds contribute an abundance of sediment that could be managed through various practices.

Excessive sediment inputs impact waterways, agricultural lands, residences, business, and County roads. Sedimentation in the waterways has severely aggraded creek and river channels. Over seven miles of the 13-mile Salt River channel had completely filled in with sediment and lost its hydrologic function in the watershed. Sediment accrued between three to five feet in the Salt River (Figure 10) between the late 1960s to the early 2000s, resulting in flooding and lack of drainage. The flooding and ponding impacts pasture availability and access, as well as degrades production. Reduction of channel capacity and habitat degradation negatively affect aquatic habitat. Business, residences, City and County infrastructure are inundated by sediment ladened flood waters causing damage and closures. This excessive sediment needs to be a priority management focus in order to alleviate impacts to water quality, aquatic habitat, and community livelihood.

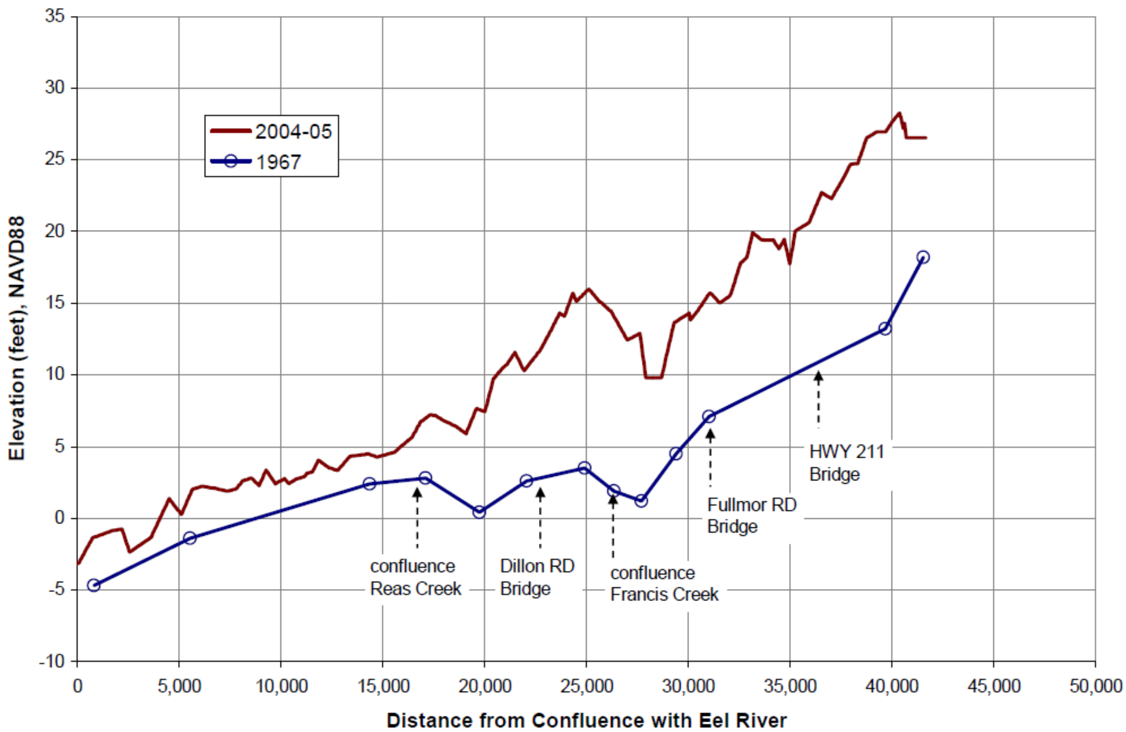

Figure 10: Sediment aggradation in the Salt River Channel[1]

[1] Figure adapted form the Basis of Design Report, Salt River Ecosystem Restoration Project (Kamman 2012)

Temperature

Temperature measurements have been taken across the watershed during the performance of multiple monitoring programs associated with the Salt River Ecosystem Restoration Project.

The Humboldt County Resource Conservation District measured temperatures in Williams, Francis, and Reas Creeks from 2011 to 2015 from May to October. This water quality monitoring effort attempted to determine if water quality parameters meet the needs of salmonids. The summer optimum temperature target range for salmonids is from 50° to 60° F, where 68° F is the suboptimal maximum, and over 75° F is lethal (CDFW). The five years of monitoring showed that most monitoring sites achieved the optimal target temperature range. However, the lower monitoring sites on Reas Creek consistently exceeded the optimum temperatures, and occasionally reached lethal ranges, across the summer months.

Annual salmonid surveys across the Salt River Ecosystem Restoration recorded temperatures in the restored portions of the Salt River tidal marsh estuary, in the Salt River corridor, and in lower Francis Creek since 2014. Winter water temperature measurements were found to be consistently suitable for salmonids. Summer temperatures in some areas of the tidal estuary averaged above the suboptimal target range and occasionally exceeded the lethal limit of 75°F.

In the late summer months, temperatures in the newly restored Salt River corridor were recorded to exceed the maximum suboptimal 68°F limit yet remained below the lethal temperature of 75°F in the months of July and August.

Other sampling sporadically occurring in the watershed support findings that temperatures in the upper watershed tend to be cooler and within salmonid target ranges, while temperatures in the lower watershed during summer months can exceed optimal salmonid temperature target ranges.

Nutrients

The Salt River watershed is an intensively managed watershed. Approximately 98% of the watershed's alluvial floodplain is under agricultural management, including dairies, beef cattle grazing, and row crops. The City of Ferndale's wastewater treatment plant, farm waste, and manure runoff have been sources of water quality concern in the recent past.

Prior to 2014, the Ferndale water treatment plant, located at the confluence of the Salt River and Francis Creek, would release secondary treatment effluent into Francis Creek. However, with the complete aggradation of Salt River and lower reaches of Francis Creek, the wastewater treatment plant could not meet required dilution rates due to lack of freshwater flow. The Northern California Regional Water Quality Control Board placed a Cease-and-Desist Order on the wastewater treatment plant because of the violation of effluent ratios and because large flood events would overwhelm the adjacent settling basin and effluent would discharge across the immediate landscape. The City of Ferndale addressed the situation by upgrading the treatment plant to include tertiary treatment, developing a wetland system next to the settling pond, and supporting the Salt River Ecosystem Project to restore the hydrologic system adjacent to the treatment plant. Currently, the treatment plant is operating under regulated conditions and is no longer a water quality concern.

The Humboldt County Resource Conservation District sponsored studies in the 1990s that evaluated farm waste impacts on water quality. These studies indicated that water quality problems existed in multiple tributaries due to farm or dairy wastes. Within this same period a group of dairy producers in the Eel River valley became concerned about impacts to water quality and joined together to proactively address dairy waste issues. Regular meetings were held to find better ways for dairy producers to handle wastewater and solids. These meetings led to the formation of the Sustainable Agriculture Committee (SAC), which functioned under the umbrella of the Humboldt County Resource Conservation District. The SAC evolved to consist of staff from various resource management agencies, such as the California Department of Fish and Game and the Regional Water Quality Control Board, who all worked together to find improved methods for dairy waste management. Several funding sources were secured and enabled the completion of multiple improvement projects on dairies throughout the valley.

The SAC determined that waste collection areas should provide protection from the 1995 Eel River flood levels (a 25-50 year event). The SAC has since transitioned into its current existence as the Dairy Advisory Group under the HCRCD. This group of producers volunteers their time to function in an advisory capacity and to prioritize and recommend dairy improvement projects for funding as resources become available (HCRCD 2011).

Beginning in 2012, the North Coast Regional Water Quality Control Board has required Dairy Permits[1]. The permit required producers to develop and submit Comprehensive Nutrient Management Plans (CNMP) and perform annual surface water quality monitoring. In response, dairy producers formed the Six River Dairy Association and created a water quality sampling regime in which 9 sites are randomly sampled in the Salt River watershed after three storm events larger than one inch, at least one month apart. Water quality sampling began in the winter of 2012/13. Temperature, pH, electrical conductivity (EC), and total ammonia are measured at each site. Early in the sampling program, some sites showed elevated EC and total ammonia. Area producers were informed of these results and have implemented practices, such as improved manure application practices and installation of new storage systems. Subsequently sampling showed improved water quality. Additional water quality sampling in Francis, Williams, and Russ Creek by the Environmental Protection Agency in years 2013 to 2016, 2018, and 2019 found that phosphate levels were nondetectable while Total Phosphorus exceeded recommended levels by 0.01 to 0.03 mg/L.

Pathogens

Given the concentrated number of cattle in the upper and lower watersheds, E. coli and Total Coliforms are expected to be elevated in waterways. In addition to sampling other water quality parameters mentioned above, the Environmental Protection Agency also measured E. coli and Total Coliforms on Francis, Williams and Russ Creeks. Sampling occurred once a year during the summer, between 2013 and 2019 (except for 2017). Sampling sites were located at the base of the Wildcat Hills in each of the three tributaries to attempt to capture water quality improvements resulting from Natural Resource Conservation Service's implemented practices through the NWQI program. The EPA recommends that both E. Coli and Total Coliforms do not exceed 126 MPN/100mL. Pathogen results across all tributaries for all sampling years far exceeded this limit by four to 75 times, or more (Table 8).

[1] Conditional Waiver of Waste Discharge Requirements, Order No. R1-2012-0003 Waiver, and General Waste Discharge Requirements, Order No. R1-2019-0001 GWDR (amended in 2019).

Table 8. Total Coliforms and E. Coli Levels in the Salt River Watershed[1]

Sampling Site	Pathogen MPN/100mL	2013	2014	2015	2019
Russ Creek 1	Total Coliforms	9,700	2,400	>24,000	6,300
	E. Coli	2,600	2,400	2,800	640
Russ Creek 2	Total Coliforms	13,000	2,400	2,900	4,200
	E. Coli	12,000	440	360	280
Francis Creek	Total Coliforms	3,300	2,400	2,500	4,200
	E. Coli	640	2,400	240	400
Williams Creek	Total Coliforms	3,000	2,400	4,900	7,300
	E. Coli	770	1,300	3,000	490

[1] Samples taken by the Environmental Protection Agency

SECTION 4: RESOURCE ANALYSIS AND SOURCE ASSESSMENT

Sediment and temperature are water quality impairments in the lower Eel River watershed which includes the Salt River watershed (North Coast Regional Water Quality Control Board Integrated Report, 2014-2016). Nutrients and pathogens are other resource concerns that may be impacting water quality, given the ubiquitous agricultural management of livestock across the watershed. In this section, each resource concern is described as to its source and the current and potential tools used to reduce or control impacts to water quality. Additional outreach strategies that prioritize treatment areas are also considered.

SEDIMENT

Sources - Sediment

Prior to settlement by Europeans in the mid-1800, the naturally high sediment loads originating from the upper subwatersheds deposited across the alluvial floodplain in a seemingly random manner, causing the periodic shifting of tributary channels over the floodplain as sediment accrued in various areas. However, as Europeans settled the watershed in the late 19th century, activities in the upper watershed added further sediments into the system and the desire to control a static location for tributary channels across the floodplain culminated in continuous challenges to landowners, as well as fish and wildlife.

Sediment aggradation in the watershed has increased and exacerbated flood events, impacting residents and agricultural producers who live and work along the banks of the tributaries and Salt River. Sedimentation has also degraded water quality, fish habitat, and fish passage. Multiple monitoring efforts have been employed in the subwatershed to measure the amounts of sediment contributed to the various waterways, specifically in Williams and Francis Creeks, with some periodic turbidity monitoring on Russ Creek. The 2007 Lower Eel River Total Maximum Daily Load document and Benda and Berg's 2007 study evaluated sediment sources in Salt River watershed. The two studies agreed that natural background sediment sources (landslides and mass wasting sites) (Figure 11) contribute the majority of sediment loads and that managed lands contribute a small percentage. These findings can be applied to the other subwatersheds in the larger Salt River watershed given the consistent geologic formations, vegetation presence, and anthropogenic activity across the entire watershed.

Figure 11: 2011 debris torrent and landslide in the upper Francis Creek subwatershed (Photo Credit D. Braun, Department of CA Conservation Geologic Survey)

The Benda and Berg 2007 study focused specifically in the Francis Creek and Williams Creek subwatersheds and evaluated sediment control measures. The study used a computerized watershed analysis tool, NetMap (Benda et al. 2007), to analyze the subwatersheds to predict the likely occurrence of deep-seated landslides/earthflow, shallow landslides, bank erosion, and other habitat conditions using estimates of slope gradient and hillslope profile information. NetMap, along with aerial photograph analysis and field observations, predicts that virtually all of the upper regions of the subwatersheds are comprised of topography indicative of deep-seated landslides and earthflows (Figure 12). These deep-seated landslides contribute the majority of sediment to the system and are understood to be uncontrollable, where attempted practices such as revegetation at the toes of landslides would have minimal effect. Roads constructed on shallow landslide terrain and at stream crossings were found to contribute to erosion to a small degree, and the authors suggested that sediment reduction efforts be concentrated at stream crossings. Similar to roads, bank erosion contributes sediment into the system, though not as significantly as existing landslides. Ultimately, the study suggests that the major sediment sources are not controllable by conservation practices in the near term, therefore efforts should be expended towards trapping sediment lower in the subwatersheds either by employing sediment basins or developing active floodplains. However, while major sediment sources are difficult to control, multiple sediment sources within the watershed are treatable.

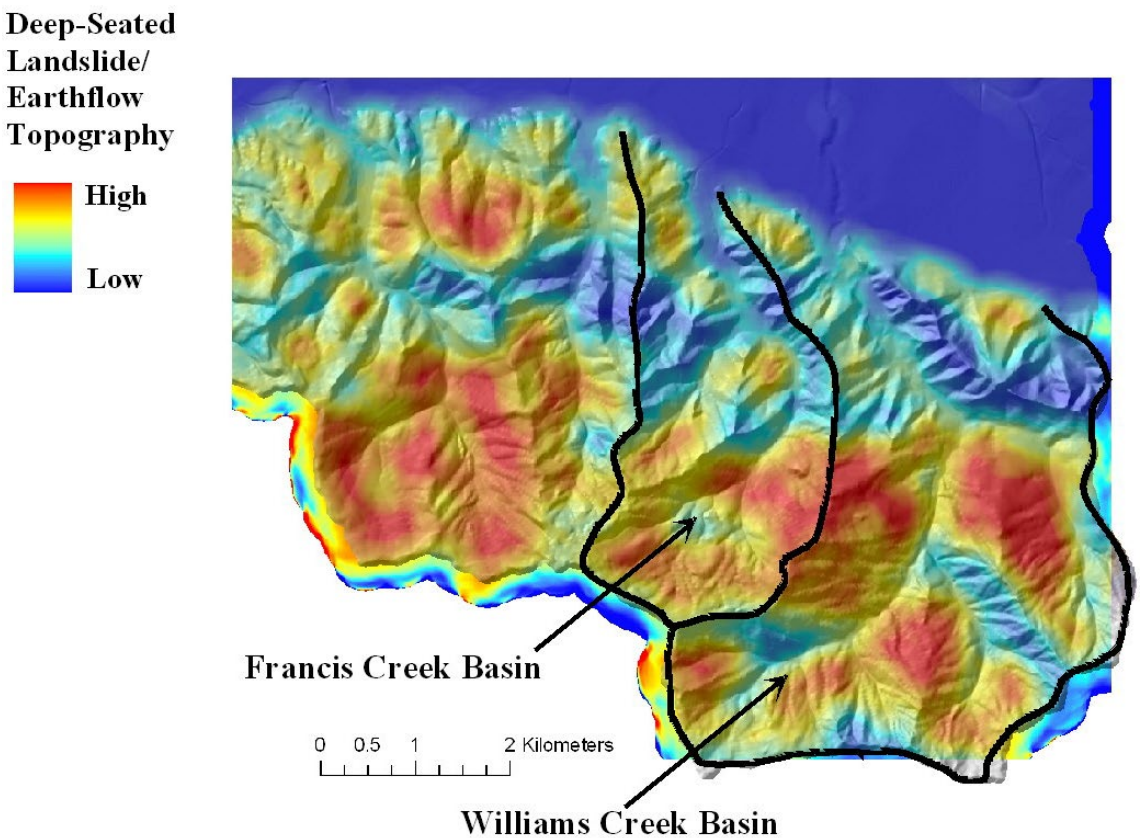

Figure 12. NetMap predicted likelihood of deep-seated landslides in the Francis Creek and Williams Creek subwatersheds (Benda and Berg 2007). Aerial photo analysis and field observations support the NetMap findings.

Following the Benda and Berg 2007 study, the Humboldt County Resource Conservation District funded upslope and instream erosion assessments in both the Francis Creek and Williams Creek subwatersheds in 2010 (Timberland Resource Consultants 2010). This effort identified sediment sources such as roads, landslides, and failing instream banks. Sites were identified through field inventories. Nearly 400 erosion sites were identified in the Williams Creek subwatershed, while nearly 240 sites were identified in the Francis Creek subwatershed. The assessments prioritized sites by estimating the amount of sediment delivered to a stream and cost effectiveness of treatment. The Williams Creek subwatershed had 90 high priority sites that would save approximately 35,000 cubic yards of sediment from entering the waterway. Most of these sites are related to road and stream crossing issues. The Francis Creek subwatershed had 63 high priority sites that would save approximately 24,331 cubic yards of sediment from entering the waterway. Many of the high priority sites are located in the upper half of the subwatersheds.

Sediment sources in the lower watershed across the alluvial floodplain are insignificant contributors to the system's sediment load compared to upper watershed sources. Bank erosion and undercutting has been occasionally observed along the trans-delta reaches of tributaries, though the capacity of most tributaries is undersized and sediment transport is limited. Historically the lower watershed has operated as a sediment sink and continues to do so, though in a dysfunctional manner.

Treatment Areas – Sediment

Control of sediment inputs needs to occur in the upper watershed where the sources reside. Treatment of seasonal and abandoned roads, especially sites where roads cross waterways, should be concentrated in the upper portions of the subwatershed (Figure 13). Bank erosion also directly delivers sediment loads to waterways. Identified bank erosion sites are found throughout the entire length of tributaries. Both road and bank erosion sites have been identified in the Williams Creek and Francis Creek subwatersheds in the Timberland Resource Consultants assessments (2010); though these sites are not identified by priority in the assessment report's map. Implemented Natural Resources Conservation Service (NRCS) practices occur across a majority of the Salt River's upper watershed, but these sites are confidential, therefore locations are unavailable. For the Francis Creek and Williams Creek subwatersheds, consultation between the local NRCS field office and Timberland Resource Consultants, and other practitioners, would be recommended to identify restored sites and prioritize sites with unaddressed resource concerns.

Figure 13: Road crossing over a failed culvert in the upper Salt River watershed.

As described above and determined in the Benda and Berg (2007) report, background sediment inputs are tremendous and recommending practices to capture, rather than prevent and control, sediment would make a significant difference. Through restoration planning in the both the Salt River Ecosystem Restoration Project and the Williams Creek Restoration Project, hydrologists and engineers determine that capturing sediment in the waterways is best suited to the lower sloped areas in the watershed. These areas include the wider valley, or meadow, areas at the base of the Wildcat Hills and extending out onto the alluvial floodplain.

Treatment Tools – Sediment

Upper Watershed Sediment Treatment Tools

Numerous NRCS practices are used to increase water quality in the upper Salt River watershed by reducing or controlling sediment delivery. These upper watershed practices involve road treatment, riparian buffer enhancements, instream bank stabilization, and livestock exclusion. Table 9 lists practices that have been implemented during the National Water Quality Initiative program (2012 to 2019) that are targeted for sediment control or reduction in the upper watershed.

Table 9: Implemented NRCS Sediment Control and Reduction Practices for Upper Watershed Water Quality Improvements (2012 to 2019)

NRCS Practices	Code	Description
Access Road	560	Provides a fixed route for vehicle travel. Designed to reduce or control erosion and be constructed away from water sources.
Critical Area Planting	342	Establish permanent vegetation on sites that have, or are expected to have, high erosion rates where normal vegetation practices fail.
Fence	382	Fencing to restrict access to sensitive environments to prevent damage by people, livestock, and wildlife.
Heavy Use Area Protection	561	Stabilize areas intensively used by people, animals, or vehicles by developing non-eroding surfaces.
Riparian Forest Buffer	391	Planting of trees and shrubs along waterways to promote lower temperatures, reduce excess amounts of sediment and nutrients in surface runoff.
Spring Development	574	Capture water from springs or seeps for livestock purposes to avoid livestock using waterways for drinking.

Stream Crossing	578	Stabilize a stream crossing for people, livestock, equipment, and vehicles. Designed to reduce stream bed and bank erosion. Includes rocked/concrete fords and bridge installation.
Stream Habitat Improvement	395	Improve or manage stream habitat including floodplains, riparian areas, and wetlands.
Streambank and Shoreline Protection	580	Stabilize and protect streambanks. Designed to reduce erosion and improve habitat.
Tree & Shrub Establishment	612	Establish woody plants to improve plant diversity, control erosion, and improve water quality.
Watering Facility	614	Provides drinking water to livestock or wildlife to avoid sensitive habitats.
Prescribed Grazing	528	Improve or maintain surface and/or subsurface water quality and/or quantity, improve or maintain riparian and/or watershed function, reduce soil erosion and maintain or improve soil health.

According to the Benda and Berg study (2007) and the TRC assessment (2010), practices that address stream crossings and instream bank erosion will provide the most remediation of sediment inputs into waterways. Gravel and dirt seasonal and abandoned roads pose the most likely road sources for sediment entering the waterways. Seasonal roads in the upper portion of the subwatersheds located near, or crossing, main waterways are the areas of greatest need of treatment. According to the Bend and Berg (2007) and Timberland Resource Consultants, stream crossings should be the highest priority for treatment. Bank erosion sites are also a high priority for treatment. These sites have been identified throughout the entire length of Francis and Williams Creeks, along with their respective tributary arms. Bank erosion sites undoubtedly exist along the length of other tributaries in the other subwatersheds, namely Reas and Russ, and should be identified and addressed accordingly. In support of stream crossing and instream bank erosion practices, associated treatments such as fencing and revegetation will be also needed.

The Humboldt County Resource Conservation District (2019) funded a technical memorandum to consolidate and update the Williams Creek subwatershed sediment assessment work. This document, in part, analyzed NRCS efforts in the subwatershed. Using NRCS Resource Inventories, performed by the Eureka Field Office between 2012 and 2018, over 145,000 linear feet of roads, over 280 stream crossings, and nearly 35 stream bank erosion sites were identified as sediment sources. Of those, 21% of roads, 22% of stream crossings, and 35% of bank erosion sites were addressed. Identification of these sites took place on only 12 of the 57 parcels existing in the subwatershed, working voluntarily with private landowners. Therefore, further unidentified sites remain in the subwatershed to be assessed by NRCS.

Lower Watershed Sediment Treatment Tools

The NWQI-NRCS practices available to address sediment inputs in the lower watershed are included in Table 10. These practices include controlling livestock access to streams through fencing, developing watering sources for cattle away from waterways, and re-establishing or enhancing the riparian corridor. These practices are designed to reduce sediment contributed to the system through runoff. Though these implemented practices will ultimately control insignificant volumes of sediment when compared to the massive sediment loads coming to the lower watershed from the upper watershed.

The lower Salt River watershed historically functioned as a sediment sink for the tremendous amount of sediment flowing out of the upper watershed. Therefore, sediment control efforts in the lower watershed would be more effective by concentrating on practices that capture sediment and increase transport of uncaptured sediments out of the system.

TABLE 10: Implemented NRCS Sediment Control and Reduction Practices for Lower Watershed Water Quality Improvements

NRCS Practices	Code	Description
Fence	382	Fencing to prevent access to sensitive environments to prevent damage by people, livestock, and wildlife.
Heavy Use Area Protection	561	Stabilize areas intensively used by people, animals, or vehicles by developing non-eroding surfaces.
Riparian Forest Buffer	391	Planting of trees and shrubs along waterways to promote lower temperatures, reduce excess amounts of sediment and nutrients in surface runoff.
Stream Habitat Improvement	395	Improve or manage stream habitat including floodplains, riparian areas, and wetlands.
Tree & Shrub Establishment	612	Establish woody plants to improve plant diversity, control erosion, and improve water quality.
Watering Facility	614	Provides drinking water to livestock or wildlife to avoid sensitive habitats.

Additional existing NRCS practices could be added to the suite of practices available in the NWQI to address sediment control in the lower watershed. One practice to consider is the Stream Habitat Improvement (395) that evaluates and plans for the restoration of floodplains which the impaired Salt River watershed hydrologic system has lost and would greatly benefit from reestablishment. Furthermore, not listed in the practice tables (Table 9 and 10) for either the upper or lower watershed is the Sediment Basin practice (350). As mentioned previously, capturing sediment loads in the lower watershed is a high priority strategy to improve water quality and hydrologic functionality in the watershed. Yet, if this practice strictly follows its stated criteria, the practice is not appropriate in the lower watershed as it will not meet regulated fish passage guidelines and is designed to be overly efficient in capturing sediment, causing the sediment basin to be sized so large that no landowner or producer would consent to taking that much land out of production. If the design criteria for the sediment basin practice could be modified to enhance fish passage and only capture bedload and larger sediment particles, the practice would highly benefit the watershed. As it stands now, this practice could also be implemented in the farthest upper reaches of the upper watershed, above fish anadromy, where sediment loads are smaller and would not require frequent clean-out. Other practices that could help reduce sediment inputs into water ways include Prescribed Grazing (528) and Hedgerows (422) (Table 11). Both these practices stabilize soils and provides further riparian protection or enhancement to trap sediments and avoid erosion.

Currently the Salt River Ecosystem Restoration Project and the Williams Creek Restoration Project is restoring a majority of their respective waterways to both reestablish hydrologic functionality and fish and wildlife habitat. The designs of both projects are based on extensive hydraulic modeling and facilitates the capture and transport of sediments. Both projects develop floodplains and sediment basins in the lower alluvial floodplain (Figure 14). The Salt River Ecosystem Restoration Project has constructed over 3 miles of floodplains and one six-acre sediment basin, which are functioning as designed. The Williams Creek Restoration Project is currently in its planning phase and is incorporating existing landscape features as floodplains and is siting a sediment basin in the lower watershed.

Figure 14: Sediment Management Area (SMA) on Francis Creek at the Confluence of the Salt River. The SMA is a restoration feature of the Salt River Ecosystem Restoration Project (Photo Credit: D. Hansen, HCRCD)

Table 11: Additional NRCS Practices to Consider for Sediment Control or Reduction

NRCS Practices	Code	Description
Hedgerows	422	Stabilize soils, improve sediment trapping, improve water capture, water quality and habitat structural and species diversity.
Prescribed Grazing	528	Improve or maintain surface and/or subsurface water quality and/or quantity, improve or maintain riparian and/or watershed function, reduce soil erosion and maintain or improve soil health.
Sediment Basin	350	Capture and detain sediment in a basin configuration with an outlet. *Consider practice modification for siting basin lower in a watershed.

Outreach & Opportunities – Sediment

NRCS has worked in the Salt River watershed for over 30 years. Over 35 producers have contracted with NRCS and implemented practices qualifying under the National Water Quality Initiative since 2012. NRCS will initiate a broad scale effort to identify producers and sites based on anticipated conservation opportunities to address sediment inputs. NRCS Eureka Office will review current participating and non-participating producers in the Salt River watershed. Upslope property owners will be contacted directly or through partner facilitation. Applications will be prioritized by project locations which will garner the highest benefits to control sediment concerns.

Further NRCS funding and planning programs, such as the Wetlands Reserve Easement (WRE) program, will be explored to determine if those programs' benefits are suitable to addressing conservation concerns. Other funding sources, such as the EPA's Nonpoint Source Pollution 319(h) grants and other CA Proposition 1 and 68 programs, will also be considered for project implementation.

Additionally, as the Salt River Ecosystem Restoration Project and the Williams Creek Restoration Project move forward with implementation and planning with private landowners, NRCS has worked with some participating landowners to implement complementary sediment reduction and sediment capture practices to facilitate restoration within the project footprints.

TEMPERATURE

Source - Temperature

The Salt River watershed was identified as being temperature impaired, and in 2007 a Total Maximum Daily Load was completed for the Lower Eel River watershed. It was found that natural summer stream temperatures are elevated in the watershed and could harm anadromous fish. Multiple factors affect stream temperature: air temperature, solar radiation, stream flow, channel morphology, and local shading. In the case of the Salt River watershed, shade was identified as the greatest factor influencing stream temperatures, though stream flow should be a consideration. The assessment determined that topographic and vegetation canopy are the main contributors to shade in the watershed, where the size of conifers was determined to be the most influential factor in creating shade.

In the TMDL, Francis Creek and Reas Creek data were utilized in the Q2SHADE modeling software to evaluate the influences of different shade scenarios. Modeling results determined that temperatures slightly deviate from suitable salmonid targeted natural summer stream temperatures in the upper subwatersheds of Francis and Reas Creeks. However, Reas Creek temperatures began increasing over targeted natural summer stream temperatures in the lower watershed by approximately 0.51°C to 1°C. Data collected in the lower reaches of Francis Creek, downstream of the City of Ferndale, were elevated from targeted natural summer stream temperatures between 1°C and 4°C. These temperatures are considered in the marginal range for salmonid habitat.

Temperature data collected by the Humboldt County Resource Conservation District at stream sites in the upper and lower subwatersheds of Williams, Francis, and Reas Creeks from 2011 to 2016 support the findings in the Total Maximum Daily Load study. Upper watershed sites achieved target temperature ranges, while lower tributary reaches experienced temperature ranges that would reach suboptimal and occasionally lethal ranges. The upper watershed has more consistent vegetation canopy and topographic shade, while the lower reaches of the tributary creeks lack both vegetation canopy and topographic shade.

Additionally, stream flow and sediment are considered contributing factors to elevated temperatures. Stream flow reduces during summer periods in all tributary creeks in the Salt River watershed. Given the hydrologic dysfunction of the watershed, flow has recently been diverted across pastures or confined in marginal channel configurations. Turbidity, or suspended sediment, is also found to increase water temperatures as sediment particles continually absorb solar radiation during daylight hours and release that radiation in the form of heat into the water column. Deposited sediment fills channel bottoms making waterways shallower and broader, contributing to solar radiation exposure.

Treatment Areas - Temperature

According to the Total Maximum Daily Load study and the supporting temperature data collected by the Humboldt County Resource Conservation District, lower reaches of the Salt River tributaries have the highest elevated temperatures during summer months. Over 0.5 miles of channel on Reas Creek, in the alluvial floodplain, is devoid of riparian vegetation (Figure 15). This should be a high priority area, given that fish surveys in Reas Creek at the confluence of Salt River consistently find Coho juveniles each spring. Francis Creek also has approximately 0.5 miles of absent riparian vegetation canopy; however, through the Salt River Ecosystem Project, this entire length of stream channel has been replanted with a diverse native riparian palette. Williams Creek has sporadic riparian vegetation through its lower fluvial floodplain reach. The Williams Creek Restoration Project plans call for enhancing the riparian corridor when the project is implemented. Russ and Smith Creeks also lack a riparian corridor in much of their lower reaches. The larger Salt River riparian corridor is currently being replanted with diverse native species during the implementation of the Salt River Ecosystem Restoration Project.


Figure 15: Lower reach of Reas Creek devoid of riparian canopy vegetation.

Treatment Tools – Temperature

NRCS has implemented a number of practices that reestablish, enhance, and protect riparian corridors. Table 12 lists the riparian associated practices that NRCS has implemented in the Salt River watershed under the National Water Quality Initiative program to date.

Table 12: Implemented NRCS Temperature Reduction Practices for Water Quality Improvements

NRCS Practices	Code	Description
Critical Area Planting	342	Establish permanent vegetation on sites that have, or are expected to have, high erosion rates where normal vegetation practices fail.
Fence	382	Fencing to prevent access to sensitive environments to prevent damage by people, livestock, and wildlife.
Riparian Forest Buffer	391	Planting of trees and shrubs along waterways to promote lower temperatures, reduce excess amounts of sediment and nutrients in surface runoff.
Tree & Shrub Establishment	612	Establish woody plants to improve plant diversity, control erosion, and improve water quality.

Additional practices that could be included in the above table is the Riparian Herbaceous Cover (390) which focuses on the establishment and maintenance of grasses, grass-like plants, and forbs that are tolerant of intermittent flooding or saturated soils within the riparian corridor, as well as the Prescribed Grazing (528) practice that involves improving and maintaining riparian corridors (Table 13).

Table 13: Additional NRCS Practices to Consider for Temperature Reduction for Water Quality Improvements

NRCS Practices	Code	Description
Prescribed Grazing	528	Improve or maintain surface and/or subsurface water quality and/or quantity, improve or maintain riparian and/or watershed function, reduce soil erosion and maintain or improve soil health.
Riparian Herbaceous Cover	390	Establishment of riparian herbaceous cover, such as grasses, sedges, ferns, to provide a transition zone from aquatic to uplands and improve water quality.

Outreach and Opportunities – Temperature

Outreach efforts will include landowners along Salt River watershed tributaries. These landowners will be prioritized by absence of riparian vegetation along tributaries. Given the absence of riparian vegetation along significant stretches of lower Reas, Russ, and Smith Creeks, outreach to landowners and land managers in these subwatersheds is recommended as high priority for creek corridor restoration. Current (2021) NRCS Wetland Restoration Easement program projects are in the planning process on both Russ and Smith Creeks. Planning for these projects provides an opportunity to address reestablishing a riparian corridor in these areas.

In other areas of the watershed, NRCS has worked with participating landowners to implement complementary temperature reduction treatment practices to facilitate restoration on the Salt River Ecosystem Restoration Project. Further opportunities to partner with landowners continue to arise as planning and implementation continue to move forward on the Salt River Ecosystem Restoration Project and the Williams Creek Restoration Project.

NUTRIENTS

Sources - Nutrients

Nearly the entire Salt River watershed is under agricultural management. Beef and dairy cattle are ubiquitous across the landscape. Though nutrients are not identified as a source of impairment, therefore not addressed in the 2007 Total Maximum Daily Load for the Salt River watershed, due diligence is merited to avoid nutrient sources entering waterways and impacting water quality. Currently, water quality monitoring takes place in the winter months to abide by the North Coast Regional Water Quality Control Board's Dairy Program General Waste Discharge Requirements (GWDR). Current monitoring consists of surface water samples taken across the watershed after a one-inch rain accumulation in a 24-hour period; taken three times each winter, at least 30 days apart. Monitoring is performed using handheld water quality meters for temperature, pH, and conductivity, and test strips for total ammonia-nitrogen. Since monitoring began in 2012, early water quality monitoring program results informed where agricultural practices needed to be improved. Subsequent sampling at the same sites showed water quality improvements. Additionally, the U.S. Environmental Protection Agency performed water quality sampling in the tributaries, in 2013-2016, 2018, and 2019 during summer. Lab analysis identified elevated Total Phosphorus levels (however, phosphate levels were nondetectable).

Potential locations of nutrient sources are in both the upper and lower Salt River watershed. In both areas, waste can be introduced through runoff during wet months. Waste can also be directly delivered to waterways if cattle access to creeks is insufficiently controlled. Runoff from inefficient irrigation or nutrient application practices can also contribute to loads. Nutrients can also originate at dairy facilities or pastures, where animal wastes may enter waterways or remnant slough channels that lead to waterways. Row crops that produce corn apply manure fertilizer with limited use of imported organic fertilizers and amendments. However, corn and other row crops, such as quinoa, make up less than 3% of agricultural production on the landscape and likely contribute a miniscule portion of nutrient runoff to the environment, if any.

Treatment Areas – Nutrients

As mentioned above, nutrient loads can originate in both the upper and lower watershed. Pastures and facilities adjacent to waterways or located next to landscape conveyance features, such as swales, should be of the highest priority.

Treatment Tools - Nutrients

Many of the tools to control nutrients are combinations of practices that support agricultural production systems such as irrigation and waste management systems. Promoting efficient irrigation systems prevents runoff from fields. Runoff is further controlled in waste management systems to avoid waste from entering surface and groundwater sources. Further practices such as fencing around riparian corridors, developing robust riparian buffers, and mulching assist in protecting waterways and increasing water quality (Table 14).

Table 14: Implemented NRCS Nutrient Reduction Practices for Water Quality Improvements

NRCS Practices	Code	Description
Fence	382	Fencing to prevent access to sensitive environments to prevent damage by people, livestock, and wildlife.
Heavy Use Area Protection	561	Stabilize areas intensively used by people, animals, or vehicles by developing non-eroding surfaces.
Irrigation Pipeline	430	Irrigation pipeline system to deliver water to efficient irrigation system.
Irrigation System, Sprinkler	442	Irrigation system to efficiently apply irrigation without causing water quality impairment.
Irrigation Water Management	449	Evaluate irrigation management to improve efficiency increase water quality.
Lined Waterway or Outlet	468	Runoff generated from structures or other water concentrations to have erosion resistant lining to prevent surface runoff, erosion, or flooding.

Livestock Pipeline	516	Convey water to point of use for livestock or wildlife.
Mulching	484	Improve efficient use of irrigation, prevent excessive bank erosion and reduce runoff.
Nutrient Management	590	Plan to manage nutrients for plants and minimize nonpoint source pollution of surface and groundwater.
Pumping Plant	533	Deliver water or wastewater efficiently and remove surface runoff or excess subsurface water.
Riparian Forest Buffer	391	Planting of trees and shrubs along waterways to promote lower temperatures, reduce excess amounts of sediment and nutrients in surface runoff.
Roof Runoff Structure	558	Structures to control precipitation from roofs to increase water quality and reduce erosion.
Roofs and Covers	367	Roof structure placed over a waste management facility, or other facility, to protect clean water and water quality.
Spring Development	574	Capture water from springs or seeps for livestock purposes to avoid livestock using waterways for drinking.
Structure for Water Control	587	Structure to convey and control water rate to reduce runoff.
Tree & Shrub Establishment	612	Establish woody plants to improve plant diversity, control erosion, and improve water quality.
Underground Outlet	620	Conduit installed beneath ground surface to convey runoff or a suitable outlet.
Waste Storage Facility	313	Agricultural waste storage containment.
Waste Transfer	634	Manure conveyance system to assist with appropriate application.
Watering Facility	614	Provides drinking water to livestock or wildlife to avoid sensitive habitats.

Fortunately, nearly all dairies in the Salt River watershed have developed Comprehensive Nutrient Management Plans (CNMP) with NRCS. This was achieved as all dairies are required to develop an CNMP to operate under the North Coast Regional Water Quality Control Board's GWDR dairy permit adopted in 2019. The CNMP identifies areas for improvement on operations and qualifies dairies for NRCS financial assistance programs. There is increasing interest by dairy producers in adopting on-farm manure composting practices that provide more stabilized nutrient sources for land applications. The composting process has been shown to bind nitrogen into more organic forms that are slowly released, resulting in less risk for nitrogen leaching or run-off when compared to untreated manure applications (Sustainable Conservation 2017). The conservation practice Soil Carbon Amendment (808) is currently undergoing evaluation by NRCS and once approved, could provide an incentive for increased adoption of composting on dairy farms in the watershed.

Additional existing NRCS conservation practices that can be added to Table 14 include Prescribed Grazing (528) and Hedgerows (422) (Table 15). Both the Prescribed Grazing and Hedgerow practices will enhance and maintain the vegetative riparian buffer along waterways to provide a filter zone for runoff and increase water quality.

Table 15: Additional NRCS Practices to Consider for Nutrient Reduction for Water Quality Improvements

NRCS Practices	Code	Description
Prescribed Grazing	528	Improve or maintain surface and/or subsurface water quality and/or quantity, improve or maintain riparian and/or watershed function, reduce soil erosion and maintain or improve soil health.
Riparian Herbaceous Cover	390	Establishment of riparian herbaceous cover, such as grasses, sedges, ferns, to provide a transition zone from aquatic to uplands and improve water quality.
Soil Carbon Amendment (Pending)	808	Increase composting on dairy farms to lower risk of nitrogen leaching or run-off compared to untreated manure applications.

Outreach & Opportunities – Nutrients

Extensive implementation of the above practices has transpired across the Salt River watershed under the NWQI program. Over 30,000 feet of fence, 6 sprinkler systems, 120 roof runoff structures, and 20 acres of riparian forest buffer were installed between 2013 and 2019. Outreach to producers with livestock grazing operations will be prioritized along with other relevant producer groups and organizations.

PATHOGENS

Sources - Pathogens

Monitoring for pathogens is limited in the Salt River watershed. In years 2013-2016, 2018, and 2019, the U.S. Environmental Protection Agency spot tested for E. coli and Total Coliforms at the base of the Wildcat Hills on Francis, Williams, and Russ Creeks. Pathogen results across all sampled tributaries for all monitoring years far exceeded recommended safety limits by four to 75 times, or more. The grazing of cattle in the upper watershed is likely the source of the pathogen loads, although wildlife could play a role as well.

No coliform sampling occurred further downstream in the lower watershed, though the concentration of dairies on the pasture-rich floodplain may add to pathogen loads. Nearly 100% of dairies have developed CNMPs and may have been implementing recommended practices to improve manure management. Annual winter season nutrient monitoring results indicate that most waste is being effectively managed in the lower watershed. However, further water quality sampling is warranted to help determine pathogen loads.

Treatment Areas – Pathogens

Pathogen sources can originate in both the upper and lower watershed. Grazing lands and animal feeding facilities adjacent to waterways or located next to landscape conveyance features, such as swales, should be of the highest priority.

Treatment Tools - Pathogens

Similar to sediment and nutrients, the prevention of runoff is key to reducing loading of pathogens in waterways as well as keeping pathogen sources a significant distance from waterways. Therefore, protecting stream areas from cattle through fencing, enhancing a riparian corridor, reducing runoff during irrigation, and containing waste will alleviate pathogen delivery and increase water quality (Table 16).

Table 16: Implemented NRCS Pathogen Reduction Practices for Water Quality Improvements

NRCS Practices	Code	Description
Critical Area Planting	342	Establish permanent vegetation on sites that have, or are expected to have, high erosion rates where normal vegetation practices fail.
Fence	382	Fencing to prevent access to sensitive environments to prevent damage by people, livestock, and wildlife.

Heavy Use Area Protection	561	Stabilize areas intensively used by people, animals, or vehicles by developing non-eroding surfaces.
Irrigation Pipeline	430	Irrigation pipeline system to deliver water to efficient irrigation system.
Irrigation System, Sprinkler	442	Irrigation system to efficiently apply irrigation without causing excessive erosion or water quality impairment.
Irrigation Water Management	449	Evaluate irrigation management to improve efficiency, minimize erosion, and increase water quality.
Lined Waterway or Outlet	468	Waterway or outlet runoff from structures or other water concentrations to have erosion resistant lining to prevent erosion or flooding.
Livestock Pipeline	516	Convey water to point of use for livestock or wildlife.
Mulching	484	Improve efficient use of irrigation, prevent excessive bank erosion, reduce runoff.
Nutrient Management	590	Plan to manage nutrients for plants and minimize nonpoint source pollution of surface and groundwater.
Pumping Plant	533	Deliver water or wastewater efficiently and remove surface runoff or excess subsurface water.
Riparian Forest Buffer	391	Planting of trees and shrubs along waterways to promote lower temperatures, reduce excess amounts of sediment and nutrients in surface runoff.
Roof Runoff Structure	558	Structures to control precipitation from roofs to increase water quality and reduce erosion.
Roofs and Covers	367	Roof structure placed over a waste management facility, or other facility, to protect clean water and water quality.
Spring Development	574	Capture water from springs or seeps for livestock purposes to avoid livestock using waterways for drinking.
Spring Development	574	Capture water from springs or seeps for livestock purposes to avoid livestock using waterways for drinking.
Stream Habitat Improvement	395	Improve or manage stream habitat including floodplains, riparian areas, and wetlands.
Structure for Water Control	587	Structure to convey and control water rate to reduce runoff.

Tree & Shrub Establishment	612	Establish woody plants to improve plant diversity, control erosion, and improve water quality.
Underground Outlet	620	Conduit installed beneath ground surface to convey runoff or a suitable outlet.
Waste Storage Facility	313	Agricultural waste storage containment.
Waste Transfer	634	Manure conveyance system to assist with appropriate application.
Watering Facility	614	Provides drinking water to livestock or wildlife to avoid sensitive habitats.

Conservation practices that can help intercept pathogens occurring in runoff would involve establishing additional riparian buffer enhancements. These include Hedgerows (422), Prescribed Grazing (528), and Riparian Herbaceous Cover (390) (Table 17).

Table 17: Additional NRCS Practices to Consider for Pathogen Reduction for Water Quality Improvements

NRCS Practices	Code	Description
Hedgerows	422	Stabilize soils, improve sediment trapping, improve water capture, water quality and habitat structural and species diversity.
Prescribed Grazing	528	Improve or maintain surface and/or subsurface water quality and/or quantity, improve or maintain riparian and/or watershed function, reduce soil erosion and maintain or improve soil health.
Riparian Herbaceous Cover	390	Establishment of riparian herbaceous cover, such as grasses, sedges, ferns, to provide a transition zone from aquatic to uplands and improve water quality.

Outreach & Opportunities – Pathogens

Given that pathogens originate primarily through the same sources as nutrients, outreach efforts for pathogens will mirror those in the nutrient section.

SECTION 5: SUMMARY AND RECOMMENDATIONS

As a subwatershed in the Lower Eel River watershed, the Salt River watershed has formally been identified to have both sediment and temperature water quality impairments, and a Total Maximum Daily Load (TMDL) has been established for these impairments. The TMDL study and the study performed by Benda & Berg (2007) determined that exceedingly high sediment loads are naturally inherent to the watershed as deep-seated landslides and earthflows contribute the lion's share of background levels. The TMDL document estimates that sediment sources from land use activities such as roads, timber harvest, and grazing in the upper watershed delivers approximately 10% of the watershed's sediment load, while instream bank erosion causes less than 1%. The TMDL document and annual water quality monitoring throughout the watershed also find water temperatures, mainly in lower reaches of tributaries, exceed favorable temperatures for salmonids in the mid to late summer months. Elevated temperatures were found to be caused by lack of instream shading.

Though nutrients are not formally identified as an impairment in the Salt River watershed, conservation practices should be implemented to avoid wastes entering the waterways given that the watershed is under intensive beef and dairy cattle operations. Recent annual monitoring shows that Total Ammonia-Nitrogen appears to be under control during winter periods (although intensive monitoring may be necessary, especially during larger rainfall events). However, Total Phosphorus levels were elevated during summer months between 2013 and 2019 during water quality monitoring conducted by the US Environmental Protection Agency. Natural nutrient background levels are difficult to determine given the ubiquitous livestock in the watershed; nevertheless, best management practices should be implemented to prevent water quality impacts.

As with nutrients, pathogens are not formally identified as impairments in the Salt River watershed. The US EPA tested pathogen levels in Williams, Francis, and Russ Creeks, the Salt River's three main tributaries. Each testing site was located at the transition between the upper and lower watersheds, at base of the Wildcat Hills. Pathogens, in the form of E. coli and Total Coliforms, were found to exceed recommended safety levels by four to 75 times. Cattle grazing in the upper watershed is the likely source of the resulting pathogen loads. As with nutrients, best management practices should be implemented to reduce livestock access and runoff to waterways in both the upper and lower watershed.

Water Quality Goals

Sediment - Goals

Sediment loads and delivery is complex both spatially and temporally. Sediment sources vary from deep-seated landslides, earthen flows, instream erosion, road surfaces, to agricultural management practices. Sediment loads vary due to time of year and whether the region experienced wet or drought conditions across the winter. Most of the sediment delivered to the Salt River is associated with non-management activities. The US EPA set the allowable Salt River watershed sediment TMDL at 125% of natural background levels, using a 15-year rolling average to determine whether the watershed achieves this level. Most watersheds in the north coast of California receive this same level of allotment.

In the 2007 Lower Eel River TMDL document, analysis of data between 1955 and 2003 estimated that the Salt River watershed's natural background level is 1,102.7 tons/mi^2/yr (management activities are estimated to contribute an additional 97 tons/mi^2/yr). However, the same TMDL document determined that the entire Lower Eel River watershed naturally contributes 718 tons/mi^2/yr. Therefore, this allows all combined subwatersheds within the Lower Eel River watershed to contribute, in total, 898 tons/mi^2/yr of sediment under the TMDL allocation of 125% of natural background levels. It must be noted, the Salt River sub-watershed's estimated natural background levels alone exceed the total allowable TMDL recommendations for the larger Lower Eel River.

Annual sediment monitoring in Francis Creek (2007 to 2018) and Williams Creek (2017 and 2018) estimated actual sediment loads in winter flows. Francis Creek's average suspended sediment load is 9,805 tons/mi^2/yr. (Fenton and S. Wilson 2018) and Williams Creek is 8,290 tons/mi^2/yr. (GHD and M. Love 2020). It is extremely unlikely that the vast difference between the TMDL document estimations and the instream measurement is due to management activities in the upper watershed. The discrepancy in values reveal the difficulty of estimating sediment levels. A re-evaluation of natural sediment background levels is recommended. Once a realistic natural sediment background level is determined for the watershed, conservation efforts can be evaluated to determine if sediment reduction practices achieve the recommended 125% of actual background levels.

Even in the face of uncertain sediment load rates, sediment delivery and loads can be reduced by implementing practices identified in multiple sediment studies. Road stream crossing and bank erosion conservation practices are suggested as significant remedies to control sediment sources in the upper watershed. Capturing sediments in the lower watershed will ensure the removal of substantial sediment loads from the system; however, NRCS will need to consider modifying the sediment basin practice to meet fish passage criteria and sizing constraints.

Temperature - Goals

Temperature pollution, specifically heat, exceeds TMDLs in portions of the Salt River watershed. The TMDL (2007) specified that heat loads in the Salt River tributaries be reduced by 11% and reach 362 langleys/day. In order to achieve this, the TMDL recommended that riparian shade in the watershed be increased by 14% during the critical period (July 15 to August 14). Ultimately, all tributaries should achieve a minimum of 59% of shade throughout their length. In the 2007 evaluation, the alluvial floodplain reach of Reas Creek reach was identified to have the greatest heat impairment. As of 2021, much of lower Reas Creek's stream corridor still lacked riparian vegetation. This is also true for Russ and Smith Creeks. The alluvial floodplain riparian reach of Francis Creek was restored in 2017 and is currently reaching vegetation goals. Williams Creek's lower reach is currently under restoration planning. These restoration planning and implementation efforts will re-establish a riparian corridor consisting of diverse native woody species that can be more resilient in the face of climate change. NRCS conservation practices that assist with riparian restoration, including riparian forest buffers and fencing, will improve water quality by reducing heat loads in waterways.

Nutrients - Goals

Water quality in the Salt River watershed does not appear to be impacted by nutrient levels. Multiple water quality monitoring efforts, including annual winter monitoring and recent summer monitoring, indicate Total Ammonia to be within acceptable ranges, while Total Phosphorus levels were slightly elevated. Intensive agricultural land uses in both the upper and lower watershed warrant efforts to conserve water quality. Preventing surface runoff and livestock access to waterways will reduce pollutants and maintain water quality goals. Fencing, riparian buffer planting, off-site watering, dairy facility upgrades, and efficient irrigation conservation practices have been, and should continue to be implemented in the watershed to protect water quality.

Pathogens - Goals

Multiple-year water quality sampling by the US EPA showed significant elevated coliform levels in three Salt River tributaries. As with nutrients, access to streams by livestock and runoff to waterways need to be reduced. Though it is difficult to tease out naturally occurring pathogens from agricultural inputs, pathogen loads must be reduced by up to 73%, if not more, to meet water quality standards. Conservation practices that would reduce pathogen levels are similar to those that would reduce nutrients; including fencing, riparian buffer planting, off-site watering, dairy facility upgrades, and efficient irrigation practices.

Tracking Progress – Metrics

Sediment - Metrics

Although numeric goals for sediment reduction levels need to still be determined, reducing sediment loads through restoration practices is still a priority. Multiple studies determined that improving road-stream crossings and road surfaces will provide the most achievable reduction of sediment rates in the upper watershed. Sediment basins constructed in the lower watershed, with fish passage mitigation elements, could capture considerable sediment from water flows. Increasing riparian buffers will also increase sediment capture from surface runoff.

The following metrics will help to accomplish meaningful sediment reduction levels.

- At least 30 landowners contacted in the upper watershed by 2024
- At least 15 landowners contacted in the lower watershed by 2024
- At least 50 individual conservation practices planned in the upper watershed by 2025
- At least 50 individual conservation practices planned in the lower watershed by 2025
- Post-implementation cross sectional analysis on the major blue line streams shows less than 10% of reduction in channel capacity across 5 years
- Complete engineering analysis of at least one sediment basin in a Salt River tributary

Temperature - Metrics

The TMDL recommends that river and tributary shade increase by 14% during the critical period (July 15 to August 14) in the watershed. The reduction of temperature, heat, or solar radiation can be measured through percentage of shade. The TMDL recommends that all reaches of the watershed's river and tributaries achieve a minimum of 59% shade. Shade can be measured using a solar pathfinder.

Interim metrics leading to increased shade and reduced temperatures/heat include:

- At least 8 landowners contacted in the upper watershed by year 2024
- At least 12 landowners contacted in the lower watershed by year 2024
- At least 15 individual conservation practices planned in the upper watershed by year 2025
- At least 30 individual conservation practices planned in the lower watershed by year 2025
- At least 10,000 linear feet of riparian stream bank planted and protected by year 2025
- Percent shade increasing in post-restoration years 3 and 5 at restored sites on each tributary

Nutrients and Pathogens - Metrics

The water quality goals regarding both nutrients and pathogens consist of limiting runoff to waterways and controlling livestock access to streams, therefore these pollutants are combined under one metric. Recent water quality pathogen sampling revealed that pathogens, in the form of coliforms, were in excess of 100 to 24,000 MPN/100mL. Decreasing overall levels of nutrients and reducing pathogens to the maximum recommended 126 MPN/100ml can begin to be achieved by the following metrics:

- At least 20 landowners contacted in the upper watershed by year 2024
- At least 40 landowners contacted in the lower watershed by year 2024
- At least 40 conservation practices planned in the upper watershed by year 2025
- At least 40 conservation practices planned in the lower watershed by year 2025
- At least 20,000 linear feet of fencing installed
- Develop and implement a summer water quality monitoring plan by 2025
- Total Ammonia, Total Phosphorus, Bacteroides and E. coli trending towards normal levels over a three-year period post conservation practice implementation.

Planned Practices

Implementing a conservation practice to reduce the delivery of one pollutant to a waterway will moreover reduce other pollutants impacting water quality. For example, livestock exclusion fencing will prevent erosion and sediment delivery by precluding cattle from entering stream corridors and waterways. Fencing will also protect riparian vegetation, which provides shade to reduce temperatures and filters runoff to limit the introduction of sediment, nutrients, and pathogens.

When considering both the TMDL identified sediment and temperature, conservation practices such as road/stream crossing improvements, sediment basin, fence, and riparian treatments will likely provide the most improvement. Fence, riparian, and waste management conservation practices will likely provide the most reduction in nutrients and pathogens.

The table below lists the major practices most likely to be used in the Salt River watershed, along with the average cost per unit. Please see the project budget for further details.

Practice Code	*Practice Name*	*Avg Cost per Unit*
391	Riparian Forest Buffer	$3,000/ac
560	Access Road	$15/ft
382	Fence	$4/ft

574	Spring Development	$3,000/each
578	Stream Crossing	$1,600/each
580	Streambank and Shoreline Protection	$60/ft
614	Watering Facility	$1,000/each
516	Livestock Pipeline	$2/ft
587	Structure for water control	$4,200/each
612	Tree/Shrub Establishment	$500/ac
582	Open Channel	$5/ft

NEPA Concerns

The Salt River watershed lies within multiple jurisdictions of State and Federal agencies, and multiple concerns exist that will be addressed through NEPA review at the project or program level. As part of the NRCS Environmental Evaluation, Special Environmental Concerns are addressed by NRCS. For this watershed applicable Special Environmental Concerns common to this watershed are:

- Clean Water Act/Waters of the US: Projects will adhere to Section 404 of the Clean Water Act, and if an impact to Waters of the US is anticipated NRCS will engage in consultation with the Army Corps of Engineers on a project by project basis.

- Coastal Zone Management: Approximately XX% of the watershed is within the jurisdiction of the California State Coastal Commission. Projects will adhere to the Coastal Zone Management Act, and if an impact is anticipated NRCS will engage with the CA Coastal Commission on a project by project basis

- Cultural Resources/Historical Properties: All projects identified by NRCS will be submitted for internal review by NRCS Cultural Resources staff if they are NRCS practices that are listed as an undertaking. Project by project clearance will be given following established NRCS Cultural Resources review protocols.

- Endangered and Threatened Species: Multiple federally protected Endangered and Threatened species are present in the watershed. If any impacts are anticipated, NRCS will initiate consultation with the Federal Agency with jurisdiction over the species on a project by project basis.

- Essential Fish Habitat: areas within the watershed are designated essential fish habitat. If any impacts are to occur, NRCS will initiate consultation with the National Marine Fisheries Service on a project by project basis

- Migratory Birds, Bald and Golden Eagle Protection Act: NRCS will implement best management practices including Limited Operating Periods on a project by project basis if any impacts to Migratory Birds, Bald and/or Golden Eagles are anticipated. Area Biologist will be consulted on NRCS practices that could potentially have unintentional take of a migratory bird.

There are additional Special Environmental Concerns that may be applicable for an NRCS project within the watershed, however, these Special Environmental Concerns are anticipated to be uncommon. If Special Environmental Concerns are identified, NRCS will follow Agency protocol in developing alternatives to avoid impacts for all concerns.

SECTION 6: OUTREACH PLAN

Strategies and Producer Engagement

Strategies to engage producers will vary depending on watershed location and identified conservation opportunities. Targeted outreach will be categorized under three primary pollutant areas:

- Sediment
- Temperature
- Nutrient and Pathogens

Multiple producer group and partner organizations exist that include the Salt River Watershed Council, Six Rivers Dairy Association, Humboldt-Del Norte Cattleman's and Cattlewoman's association, and the Humboldt County Farm Bureau.

Producer groups and partner organizations representing producers will be directly contacted via telephone, email, and mailing to inform them of the opportunity to participate in the NRCS NWQI program.

Individual producers and landowners who have not participated in NRCS programs in the past will be outreached to on specific conservation opportunities via telephone, email, and small group meetings hosted by NRCS.

Producers who have participated in NRCS programs in the past will be directly contacted by the District Conservationist or designated lead planner for that producer to discuss opportunities identified for their parcel, depending on pollutants and position in the watershed.

Targeted Landowner Outreach

NRCS will initiate a broad scale effort to identify producers and sites based on anticipated conservation opportunities, depending on the pollutant. NRCS will compile a producer outreach list that will track anticipated pollutants, past conservation activities, and whether the producers have planned conservation practices (not implemented) to reduce pollutants. In order to determine which producers are in targeted resource areas and have not participated in NRCS programs, but would likely qualify, producers and sites will be identified based on the anticipated pollutants and conservation activities that would be expected to be associated with each property. Targeted outreach efforts are described below:

1. Sediment - All upslope property owners should be contacted in each targeted subwatersheds. Subwatersheds will be grouped into outreach areas such as Francis Creek landowners, Williams Creek landowners, Reas Creek landowners, etc. The southern boundary of each subwatershed area will be defined by Centerville Road and Grizzly Bluff Road.

2. Temperature – Outreach efforts will include all producers who have a blue line stream bordering or bisecting their properties in the Salt River watershed. Producers will be identified and prioritized for outreach efforts depending on visual riparian vegetation presence or absence on their parcels from aerial photographs. Special emphasis will be made to directly outreach to landowners in the Reas Creek subwatershed due to identified elevated temperatures from past monitoring work.

3. Nutrient and pathogens - All producers should be contacted who have livestock grazing or manure application on their parcels in the Salt River watershed. Producers will be identified by studying aerial imagery, using NRCS and HCRCD knowledge of individual parcel agricultural activities, and outreaching to producer groups. Forestry and non-grazed parcels will not be targeted for outreach.

Once initial identification of producers by priority area has been completed, and two months after the acceptance of the watershed assessment (summer-fall of 2021), NRCS will begin to communicate general NWQI program availability to watershed stakeholders. Conservation planning with eligible participants will commence concurrently, with an initial funding opportunity Spring of 2022. Further outreach and conservation planning will continue in the following years. Monitoring efforts as well as stakeholder input will inform yearly program priorities but will generally follow the major priorities set forth in the watershed plan.

REFERENCES

Lee Benda and Associates and Alice Berg and Associates. 2007. Sources, Magnitude, and Mitigation of Erosion and Sedimentation in the Salt River Basin. Prepared for the Humboldt County Resource Conservation District, California Coastal Conservancy, and the California Department of Fish and Game. Eureka, CA.

Benda, L., Miller, D., Andras, K., Begelow, P., Reeves, G., and Michael, D. 2007. NetMap: A New Tool in Support of Watershed Science and Resource Management Forest Science, Vol. 53, No. 2. (April 2007), pp. 206-219

Downie, S. T., Lucey, K. P. 2005. Salt River Assessment. Coastal Watershed Planning and Assessment Program. Department of Fish and Game.

Fenton, C. and Wilson, S. 2018. The Francis Creek Annual Suspended Sediment Yield, Turbidity Threshold Sampling Summary Reports, Hydrologic Year 2018. Prepared for the Salt River Ecosystem Restoration Project.

Grassetti Environmental Consulting. 2011. Final Environmental Impact Report: Salt River Ecosystem Restoration Project, SCH #SD2007-05-06. Prepared for the Humboldt County Resource Conservation District. Eureka, CA. http://humboldtrcd.org/SaltRiverFinalEIR.pdf

GHD, Inc. and Michael Love & Associates. 2020. Williams Creek Restoration Project: Alternatives Analysis. Prepared for the Humboldt County Resource Conservation District. Final Report for CDFW Grant Agreements P1596013 & P1796009. Eureka, CA.

Graham Mathews and Associates (GMA) Hydrology, Inc. 2018. 2018 Williams Creek Streamflow and Sediment Transport Monitoring. Prepared for GHD, Inc. Eureka, CA. http://humboldtrcd.org/WCSedimentandFlow/WCSedimentandFlowReport2018.pdf

Humboldt County Department of Agriculture. 2016. 2016 Crop Report. Eureka, CA. https://humboldtgov.org/DocumentCenter/View/61579/2016-CROP-REPORT?bidId=

Humboldt County Resource Conservation District. 2016. Evaluation of Irrigated Acres & Irrigation Water Use Rates in the Eel River Valley Groundwater Basin 2016. Technical Memorandum. Eureka, CA.

Humboldt County Resource Conservation District. 2019. Technical Memo Update to the Williams Creek Upslope and Instream Erosion Inventory. Eureka, CA.

Humboldt County Resource Conservation District and USDA Natural Resources Conservation Service. 2011. Fact Sheet on Dairy Operations in Humboldt County, California. Eureka, CA.

Humboldt State University. 2011. Living on Shaky Ground – How to Survive Earthquakes and Tsunamis in Northern California. Humboldt Earthquake Education Center. Arcata, CA https://www2.humboldt.edu/shakyground/0.ShakyGroundMagazineFINALforWeb.pdf

Kamman Hydrology & Engineering, Inc. 2012. Basis of Design Report, Volume 1. Salt River Ecosystem Restoration Project, Riverside Ranch Tidal Marsh Restoration and Preliminary Salt River Channel Design. San Rafael, CA.

Li, W. H., and Carver, G. A. 1992. The Late Holocene Stratigraphy of the Eel River Delta. Prepared for the Eel River Resource Conservation District and the California State Coastal Conservancy. Eureka, CA

McLaughlin, J., and Harradine, F. 1965. Soils of Western Humboldt County, California. Department of Soils and Plant Nutrition, University of California, Davis.

Ogle, B. A. 1953. Geology of Eel River Valley Area, Humboldt County, California. State of California Department of Natural Resources, Division of Mines: 128. http://earthjay.com/GIS/geologic_mapping/ogle/ogle_1953_geology_eel_river.pdf

Ritter, J. R. 1972. Sand Transport by the Eel River and Its Effect on Nearby Beaches. U. S. Department of Geological, Water Resources Division. Open-File Report. Menlow Park, CA https://pubs.usgs.gov/of/1973/0236/report.pdf

Sustainable Conservation. 2017. Compost: Enhancing the value of manure. An assessment of the environmental, economic, regulatory, and policy opportunities of increasing the market for manure compost. May 2017. https://suscon.org/pdfs/compostreport.pdf

Tauzer, M. 2009. Salt River Ecosystem Channel Design. National Marine Fisheries Service. Arcata, CA.

Timberland Resource Consultants. 2010. Upslope and Instream Erosion Hazard Inventory, Assessment and Restoration Project, Francis Creek, Humboldt County. Prepared for Humboldt County Resource Conservation District. Fortuna, California. September 20, 2010.

Timberland Resource Consultants. 2010. Upslope and Instream Erosion Hazard Inventory, Assessment and Restoration Project, Williams Creek, Humboldt County. Prepared for Humboldt County Resource Conservation District. Fortuna, California. September 20, 2010.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050898.pdf

United States Department of Agriculture, Soil Conservation Service. 1993. Salt River Local Implementation Plan, Humboldt County, California. March 1993. Davis and Eureka, CA

U.S. Environmental Protection Agency. 2007. Lower Eel River Total Maximum Daily Loads for Temperature and Sediment. U. S. Environmental Protection Agency Region IX. December 18, 2007. https://19january2017snapshot.epa.gov/www3/region9/water/tmdl/lower_eel/LER-TMDL-final-121807-signed.pdf

U.S. Environmental Protection Agency. 2019. Memorandum - Field Report/Data Transmittal – Salt River Watershed Monitoring Salt River Watershed, Ferndale, CA.