California Environmental Protection Agency

Central Coast Regional Water Quality Control Board

Total Maximum Daily Loads for Turbidity in the Gabilan Creek Watershed, Monterey County California

TMDL Project Technical Report
October 2021

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LIST OF ACRONYMS AND ABBREVIATIONS

303(d) List	Federal Clean Water Act section 303(d) List of impaired waters
Basin Plan	Water Quality Control Plan for the Central Coastal Basin
ACOE	U.S. Army Corp of Engineers
CASQA	California Stormwater Quality Association
CCAMP	Central Coast Ambient Monitoring Program
CCWQP	Central Coast Water Quality Preservation Inc.
CDFW	California Department of Fish and Wildlife
CEDEN	California Environmental Data Exchange Network
CFS	Cubic Feet per Second
CIMIS	California Irrigation Management Information System
CMP	Cooperative Monitoring Program for Irrigated Agriculture
CWA	Federal Clean Water Act
DACs	Disadvantaged Communities
EJ	Environmental Justice
GIS	Geographic Information System
IQR	Interquartile Range
mg/L	Milligrams per liter

MS4s	Municipal Separate Storm Sewer Systems
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric turbidity units
OAL	Office of Administrative Law
ppb	Parts per billion, ug/kg, ng/g, or ug/L
ppm	Parts per million, mg/kg, ug/g or mg/L
QAPP	Quality Assurance Project Plan
SWAMP	Surface Water Ambient Monitoring Program
State Water Board	State Water Resource Control Board
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
WDR	Waste Discharge Requirements

1. Introduction

1.1. Project Description and Location

This project establishes Total Maximum Daily Loads (TMDLs) for turbidity impaired waterbodies in the Gabilan Creek watershed (watershed) and establishes a plan to restore beneficial uses of these waterbodies. The watershed is in the northern portion of the Salinas River watershed in the central coast of California (refer to Figure 1). Waterbodies in the watershed are identified as not meeting water quality standards (impaired) for turbidity on the 2014-2016 federal Clean Water Act section 303(d) List of impaired waters (303(d) List). This TMDL technical report provides the regulatory and technical basis for addressing turbidity impairments by identifying pollutants, water quality regulations, sources of pollution, numeric targets, TMDLs, and implementation and monitoring programs.

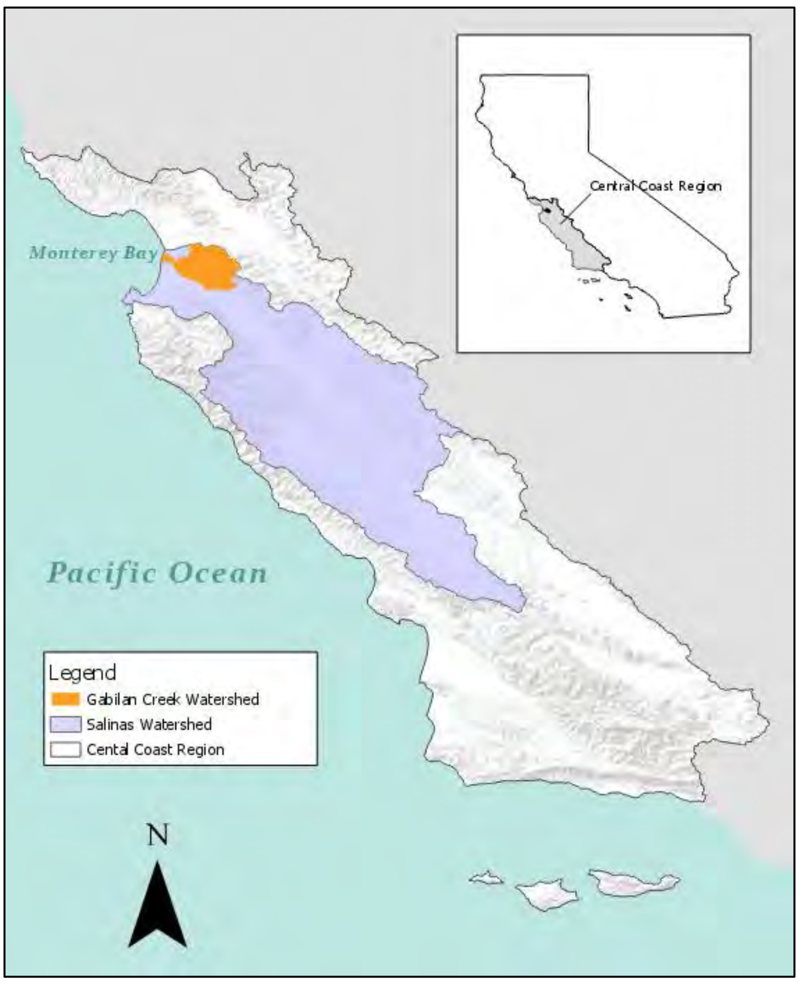

Figure 1. Location map of the Salinas watershed and the project location, the Gabilan Creek watershed.

1.2. Project Area

The TMDL project area is the 160 square mile Gabilan Creek watershed, which extends from the southwestern slope of the Gabilan Mountains west to the Pacific Ocean (refer to Figure 2). Gabilan Creek is the major stream in the watershed that flows out of the Gabilan Mountains into an alluvial coastal valley. Gabilan Creek is the first of a series of interconnected waterbodies including the Salinas Reclamation Canal, Tembladero Slough, and Old Salinas River. Land use varies throughout the watershed with the Gabilan Mountains being mostly undeveloped. The valley floor is mainly comprised of lands intensively farmed with irrigated agricultural crops and developed urban lands including the City of Salinas, which is in approximately the center of the watershed.

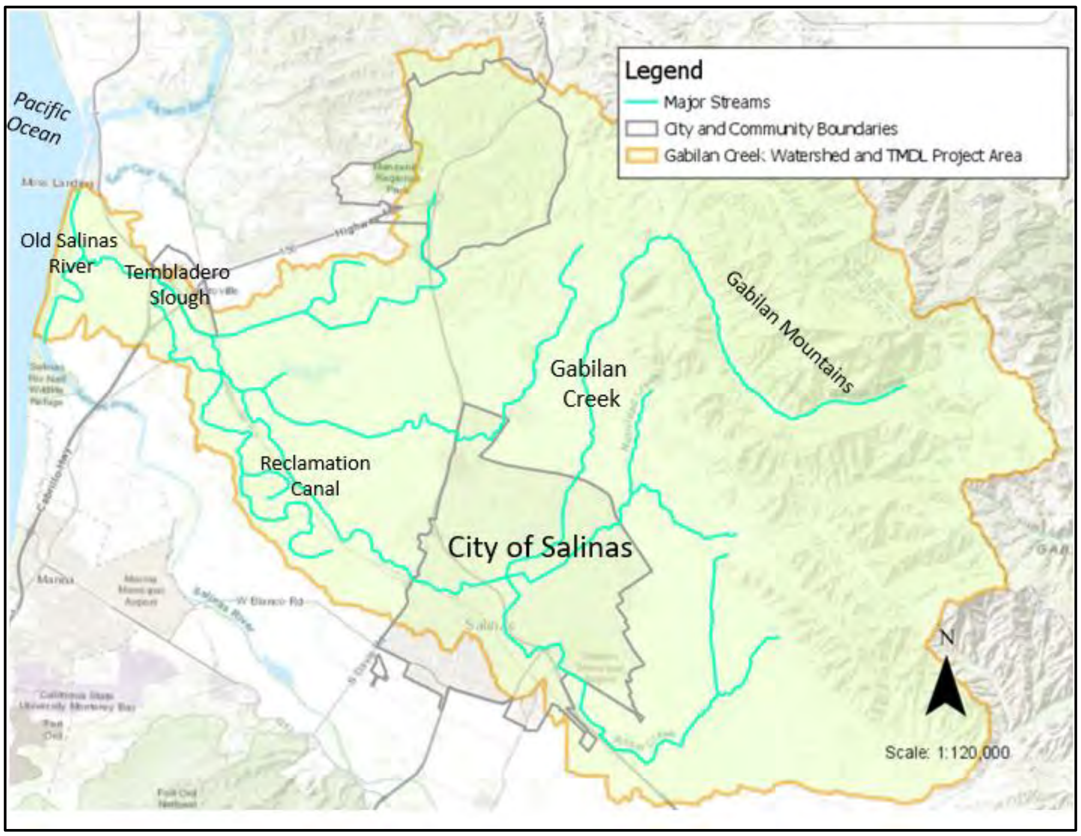

Figure 2. Map of project area and major streams in the Gabilan Creek watershed.

1.3. Pollutants Addressed

All the major streams in the Gabilan Creek watershed are impaired for turbidity (refer to Figure 4). Turbidity is an optical measure of stream water clarity, reported in nephelometric turbidity units (NTU). Turbidity can be caused by suspended solids such as clay, silt, finely divided inorganic and organic matter, algae, and other microscopic organisms in water that scatter light transmitted through the water and reduce clarity (USGS, 2016). At elevated levels, turbidity and associated suspended solids can have detrimental impacts on aquatic ecosystems. Regarding suspended sediments portion of suspended solids, the USEPA recommends suspended sediments not reduce light penetration by more than 10% from the seasonally established norm for aquatic life (USEPA, 1986). Increased turbidity can result in increased temperature, which in turn reduces the concentrations of dissolved oxygen (DO). Warm water holds less DO than cold. Decreased visual water clarity decreases light penetration into waterbodies and reduces primary production (i.e., plant growth). Decreased clarity also reduces the ability for fish to capture prey. A conceptual model of the biological effects of suspended and bedded sediments on aquatic ecosystems is shown in Figure 3.

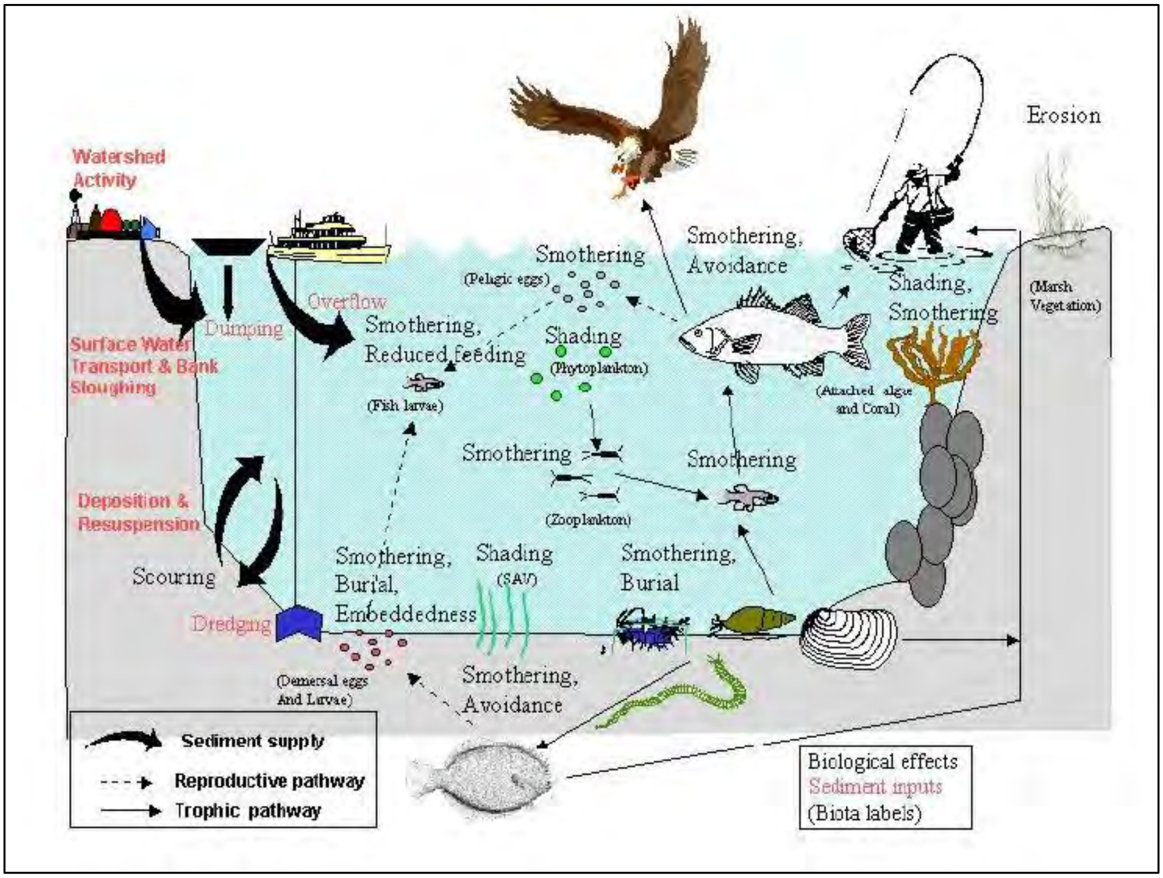

Figure 3. Schematic showing a conceptual model of biological effects of suspended and bedded sediments (USEPA, 2006)Clean Water Act Section 303(d) List

The federal Clean Water Act (CWA) establishes the basis for protecting our nation's surface waters from pollution. The CWA was originally enacted in 1948 and was extensively revised in 1972 with the goal established "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (USEPA, 2002). Section 303(d) of the CWA requires states to:

1) Identify those waters not attaining water quality standards (these waters are referred to as impaired waters) and are listed on the CWA section 303(d) List;

2) Set priorities for addressing the identified pollution problems; and
3) Establish a TMDL for each identified waterbody and pollutant to attain water quality standards.

In the Central Coast Region, water quality standards are described in the Water Quality Control Plan for the Central Coastal Basin (Basin Plan). The Basin Plan designates beneficial uses to all waters of the state and defines water quality objectives and waste discharge prohibitions to protect those uses. The Basin Plan also identifies programs of implementation. The objective of the Basin Plan is to show how water quality in the region should be managed to provide the highest water quality reasonably possible.

Waterbodies in the Gabilan Creek watershed are identified as impaired for turbidity on the 303(d) List. The impaired waters and the number of water quality samples and exceedances of water quality standards are summarized in Table 1. These impaired waters are mapped in Figure 4 along with two waterbodies, Alisal Creek and Alisal Slough that were identified as impaired subsequent to approval of 2014-2016 303(d) List, during development of the turbidity TMDL.

Table 1. Waterbodies identified on the 2014-2016 303(d) List as impaired for turbidity and a summary of samples and exceedances of water quality standards.

Waterbody	Sample Count	Exceedance Count	Percentage of Exceedance
Gabilan Creek	22	21	95%
Natividad Creek	23	23	100%
Salinas Reclamation Canal	99	72	73%
Old Salinas River	604	455	75%
Tembladero Slough	249	232	93%
Merritt Ditch	25	22	88%
Espinosa Slough	25	21	84%
Santa Rita Creek	12	10	83%

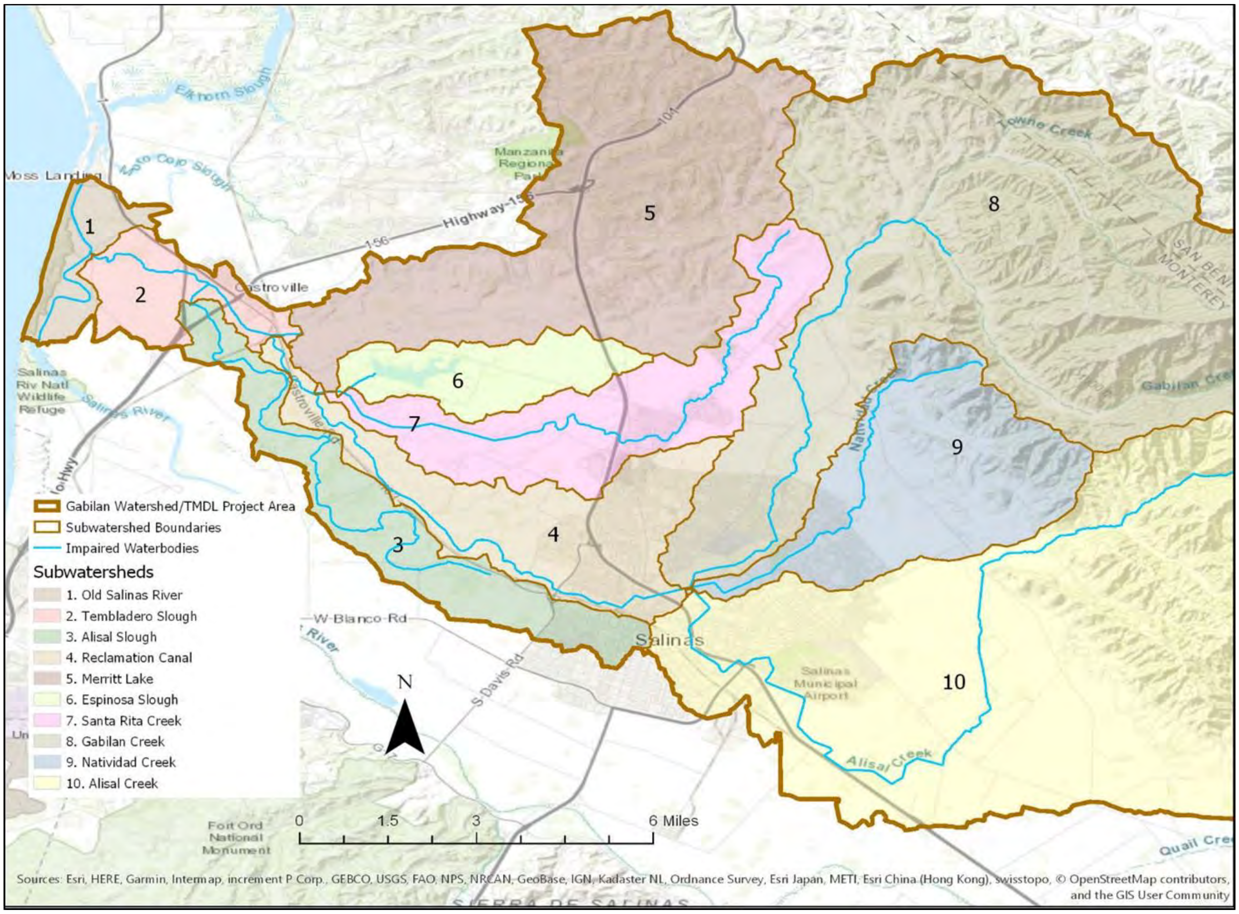

Figure 4. Map of turbidity impaired surface waters and subwatersheds in the Gabilan Creek watershed.

1.4. Watershed Conceptual Model

The Gabilan Creek watershed can be conceptually divided into several parts: the headwaters in the Gabilan Mountains, an alluvial valley, and a coastal slough system. The headwaters support perennial streams but the stream flows from the Gabilan Mountains are ephemeral with seasonal storm flows entering the valley (refer to Figure 4 and Figure 7). The upper streams in the alluvial valley have course beds and streams generally loose water to groundwater. Streams in the lower Gabilan Creek watershed, which is from just above the City of Salinas to coast, are perennial (refer to Figure 9). These perennial streams in the lower Gabilan Creek watershed are support by groundwater baseflow along with anthropogenic in puts from sources such as agricultural tile drains agricultural irrigation runoff. The watershed outlets through a low gradient, slow moving slough system to the coast via tide gates to Moss Landing Harbor.

1.5. Beneficial Uses and Water Quality Objectives

The establishment of beneficial uses and water quality objectives is the foundation of water quality protection and state policies aim to achieve the highest water quality consistent with maximum benefit to the people of the State.

The Basin Plan designates beneficial uses to all waters of the state within the Central Coast Region. The Basin Plan also defines the water quality objectives to support the designated beneficial uses. Turbidity impaired waterbodies do not meet the Basin Plan's water quality objectives for turbidity, described below.

<u>Turbidity Water Quality Objectives:</u>
Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.
Increase in turbidity attributable to controllable water quality factors shall not exceed the following limits:

1. *Where natural turbidity is between 0 and 50 Nephelometric Turbidity Units (NTU), increases shall not exceed 20 percent.*
2. *Where natural turbidity is between 50 and 100 NTU, increases shall not exceed 10 NTU.*
3. *Where natural turbidity is greater than 100 NTU, increases shall not exceed 10 percent.*

The Basin Plan contains both narrative and numeric objectives for turbidity. The narrative objective states that waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. The numeric objective sets limits on increases of natural turbidity from controllable sources. Both objectives apply to all waters of the state.

The numeric component of the turbidity water quality objective is consistent with USEPA national criteria for suspended sediments and turbidity, which state the following for the protection of freshwater fish and other aquatic life (USEPA, 1986):

> *Settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.*

Staff used numeric turbidity thresholds from published studies that are protective of local aquatic life species to interpret the narrative turbidity water quality objective and to identify waterbodies that should be placed on the 303(d) List. One published study identifies turbidity levels that impact bass, a common warm water fish, and sets a level of 40 NTU for waters with WARM beneficial uses (Shoup and Wahl, 2009). A second published study identifies turbidity levels that impact a cold-water fish, salmonids at 25 NTU (Sigler et al., 1987). These studies are summarized along with others in Section 4.
The second component of the Basin Plan's turbidity water quality objective is the protection of natural water quality from controllable sources of turbidity. The Gabilan Creek watershed is highly modified from its natural watershed conditions with numerous discharges into its waterbodies from controllable sources such as irrigated agricultural runoff, agricultural and urban stormwater runoff, and drainage pumps (e.g. flood control pumps). Additionally, the surrounding agricultural and urban landscapes are highly modified and do not have natural infiltration and runoff patterns.

<u>Beneficial Uses</u>:
The Basin Plan designates beneficial uses for all waterbodies in the Central Coast Region. Some waterbodies are designated beneficial uses in Table 2-1 of the Basin Plan. Alternatively, the Basin Plan states that "surface waterbodies within the Region that do not have beneficial uses designated for them in Table 2-1 [of the Basin Plan] are assigned the following designations: municipal and domestic supply, protection of both recreation and aquatic life uses." Table 2 defines the abbreviations used for each of the beneficial uses and Table 3 summarizes the beneficial uses designated to waterbodies in the Gabilan Creek watershed.

Table 2. Descriptions of beneficial uses.

Abbreviations	Descriptions
MUN	Municipal and domestic water supply
AGR	Agricultural supply
GWR	Ground water recharge
REC1	Water contact recreation
REC2	Non-Contact water recreation
WILD	Wildlife habitat
COLD	Cold freshwater habitat
WARM	Warm freshwater habitat
MIGR	Migration of aquatic organisms
SPWN	Spawning, reproduction, and/or early development
BIOL	Preservation of biological habitats of special significance
RARE	Rare, threatened, or endangered species
EST	Estuarine habitat
COMM	Municipal and domestic water supply
SHELL	Shellfish Harvesting

Table 3. Beneficial uses of waterbodies in the project area.

Waterbodies	Beneficial Uses
Old Salinas River	REC1, REC2, WILD, COLD, WARM, MIGR, SPWN, BIOL, RARE, EST, COMM,
Tembladero Slough	REC1, REC2, WILD, WARM, MIGR, SPWN, RARE, EST, COM, SHELL
Alisal Slough	MUN, REC1, REC2, WARM, COLD

Waterbodies	Beneficial Uses
Salinas Reclamation Canal	REC1, REC2, WILD, WARM, MIGR, COMM
Merritt Ditch	MUN, REC1, REC2, WARM, COLD
Espinosa Slough	REC1, REC2, WILD, WARM, COMM
Santa Rita Creek	MUN, REC1, REC2, WARM, COLD
Gabilan Creek	MUN, AGR, GWR, REC1, REC2, WILD, COLD, WARM, MIGR, SPWN, BIOL, RARE, COMM
Natividad Creek	MUN, REC1, REC2, WARM, COLD
Alisal Creek	MUN, AGR, GWR, REC1, REC2, WILD, COLD, WARM, SPWN, BIOL, RARE, COMM

This TMDL project is primarily focused on the protection and restoration of aquatic life beneficial uses in the watershed and in particular the restoration of migration corridors. Steelhead trout (*Oncorhynchus mykiss*) migrate through the Old Salinas River, Tembladero Slough, and Salinas Reclamation Canal to reach spawning habitat in Gabilan Creek. Turbidity in the watershed severely impairs the migration beneficial use and the ability of fish to reach the upper watershed. Gabilan Creek is designated a critical habitat for *O. mykiss* (NMFS, 2013). The Center for Ecosystem Management and Restorations (CEMAR) prepared a report that located California coastal streams for steelhead restoration in areas south of San Francisco (Becker et al., 2010). CEMAR found Gabilan Creek to be a stream suitable for restoration and noted in their report multiple occurrences of steelhead trout and miles of suitable stream habitat. The following are excerpts from the CEMAR report appendix (Becker et al., 2010a):

- In 2000 DFG staff conducted a stream inventory of Gabilan Creek from the Cienega del Gabilan Ranch property line upstream 1.4 miles. A total of three young of the year, 15 age 1+, and six age 2+ steelhead were captured. No steelhead were captured past 2,051 feet upstream of the Ranch property line. The survey ended 1.4 miles upstream from the Ranch property line due to lack of access, but this was not believed to be the end of the anadromous reach (DFG, 2000a).

- A 2002 fish distribution study evaluated 117 meters of stream within the headwaters of Gabilan Creek and determined the average potential population density for steelhead young-of-year to be 1.6 fish per meter for the surveyed area (Casagrande 2003, p. 116).

- An adult steelhead was collected from Gabilan Creek in 2004 (DFG, 2004).

In 2018, the Central Coast Water Board amended the Basin Plan and added the MIGR beneficial use designation to the following waterbodies in the lower Gabilan Creek watershed: Old Salinas River, Tembladero Slough, and the

Salinas Reclamation Canal. MIGR was added because the waterbodies are a migration corridor between the Pacific Ocean and streams in the Gabilan Mountains. Staff findings were based on National Marine Fisheries Services designation of Gabilan Creek watershed as critical habitat for steelhead recovery (NMFS, 2012).

In addition to being important for healthy aquatic life, turbidity can also adversely affect safe drinking water, industrial supply, and recreation uses. Turbidity and suspended sediments interfere with the effectiveness of water treatments such as filtration and chlorination. The Basin Plan has drinking water objectives based on contaminant levels in the California Code of Regulations (CCR) (SWRCB, 2016). CCR Title 22 establishes a secondary maximum contaminant Level (MCL) for turbidity in drinking water of 5 NTU. The 5 NTU criteria may be exceeded if it is determined that the exceedance was caused by unusual or unpredicted events. Secondary MCLs are not incorporated in the TMDL. Instead, staff use the Basin Plan numeric objective because it is consistent with USEPA recommended criteria and is adequately protective of the natural conditions in surface waters (USEPA, 1986).

The Basin Plan designates recreational beneficial uses to all waterbodies identified in the TMDL. Turbidity can also impair recreational uses of surface waters such as swimming and boating. In surface waters with high turbidity, submerged objects may be hidden, and water depth may be concealed. Further, turbidity and visual clarity can affect the suitability of waterbodies for swimming (or any water contact activity) due to potential fecal contamination. A study of streams in New Zealand found an inverse correlation between reduced water clarity and fecal contamination from livestock (Davis-Colley, et al., 2018). As guidance, the authors recommended avoiding swimming in water with clarity less than 1 meter. This project does not define turbidity TMDLs for the recreation beneficial uses because the criteria for protection of fish and aquatic life are considered adequate for protection of recreation (USEPA, 1986).

1.6. Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne), California Water Code, is the state law that establishes and describes the responsibilities and authorities of the State Water Resources Control Board and Regional Water Quality Control Boards (collectively referred to as the Water Boards) for the protection of water quality. On the central coast of California, the Central Coast Regional Water Quality Control Board (Central Coast Water Board) establishes water quality objectives and programs of implementation by amending the Basin Plan. This TMDL is proposed for adoption by the Central Coast Water Board as a Basin Plan amendment. Porter-Cologne also contains key definitions for the project such as the following:

> ***"Waters of the state"*** *means any surface water or groundwater, including saline waters, within the boundaries of the state.*
>
> ***"Beneficial uses"*** *of the waters of the state that may be protected against quality degradation include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.*
>
> ***"Quality of the water"*** *refers to chemical, physical, biological, bacteriological, radiological, and other properties and characteristics of water which affect its use.*
>
> ***"Water quality objectives"*** *means the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area.*

1.7. Anti-degradation Policy Resolution No. 68-16

The Statement of Policy with Respect to Maintaining High Quality of Waters in California (Anti-degradation Policy), Resolution No. 68-16 is intended to maintain the highest level of water quality in the state (refer to Basin Plan Appendix A-2). The Anti-degradation Policy states that wherever the existing quality of water is better than the quality of water established in the Basin Plan as objectives, such existing quality shall be maintained unless it has been demonstrated to the state that any change in water quality will be consistent with the maximum benefit of the people of the state, and will not unreasonably affect present and probable future beneficial uses of such water. Practically speaking, this means that where water quality is better than necessary to support designated beneficial uses, such existing high-water quality shall be maintained and further lowering of water quality is not allowed except under conditions provided for in the Anti-degradation Policy.

The USEPA, Region IX, has also issued detailed guidelines for implementation of federal Anti-degradation regulations for surface waters (40 CFR 131.12). The State Water Resources Control Board (State Water Board) has interpreted Resolution No. 68-16 (i.e., the state Anti-degradation Policy) to incorporate the federal Anti-degradation Policy to ensure consistency. It is important to note that federal policy only applies to surface waters, while state policy applies to both surface and ground waters.

1.8. Human Right to Water Law and Environmental Justice

Porter-Cologne section 106.3, the Human Right to Water Law, signed into law September 2012, requires the Water Boards to consider how state actions impact the human right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes. This Law directs the Water Boards and other state agencies to explicitly consider the human right to water when revising, adopting, or establishing policies, regulations, and grant criteria when those policies, regulations, and grant criteria within their relevant administrative processes, measures, and actions. Environmental Justice (EJ) is defined by State statute as the fair treatment of people of all ethnicities, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of all environmental laws, regulations, and policies.

On January 26, 2017, the Central Coast Water Board adopted Resolution No. R3-2017-0004 directing Water Board staff to implement the Human Right to Water law and protect human health as the top priority. The Central Coast Water Board directed staff to prioritize regulatory programs and activities to prevent and/or address discharges that could threaten human health by causing or contributing to pollution or contamination of drinking water sources of waters of the state.

The TMDL Project aims to engage those individuals and communities disproportionately impacted by pollution and to lift the unfair burden of pollution from those most vulnerable to its effects, especially disadvantaged communities (DACs) and California Native American Tribes.

The TMDL Project's EJ, DAC, and Tribal Program goals include:

- Integrating EJ and tribal considerations into the development, adoption, and implementation of the TMDLs.
- Promoting meaningful public participation and community capacity building to allow communities and tribes to be effective participants in the TMDL processes.
- Researching and collecting information on EJ, DAC, and tribal communities in the Gabilan Creek watershed.
- Ensuring effective cross-media coordination and accountability when addressing environmental justice and tribal issues.

The TMDL Project addresses surface water quality impairments from turbidity including the protection of drinking water via of the MUN and GWR beneficial uses of streams. Waterbodies throughout the entire Gabilan Creek watershed are highly impaired for turbidity and waterbodies such as Gabilan and Natividad Creek have MUN and GWR beneficial uses. Turbidity has no direct health effects. However, high levels of turbidity can interfere with disinfection and provide a medium for microbial growth (SWRCB, 2016). Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches. This TMDL Project aims to restore water quality in the watershed and protect human health by establishing water quality targets that are protective of both aquatic life and drinking water beneficial uses.

In addition to the Water Boards to efforts to ensure safe drinking water, the County of Monterey on December 4, 2018 adopted a County policy proclaiming that all residences in Monterey County have the right to safe and affordable water. Monterey County is the first county in the State to pass this type of policy. The County resolution is based on the State Order and it directs the County to focus on the issues of pollution in domestic wells and water systems.

1.9. Disadvantaged Communities

The Central Coast Water Board implements regulatory activities and water quality projects in a manner that ensures the fair treatment of people of all ethnicities, cultures, backgrounds and income levels, including DACs. Therefore, staff conduct focused outreach to ensure all interested parties are notified of opportunities to participate in the planning and implementation of this TMDL. DACs are located within the TMDL project area and staff recognizes that the cost of implementing the TMDL may be significant and could be a burden to these communities. By identifying DACs in the project area staff and stakeholders will be able to increase outreach and work towards identifying grant funds to reduce the implementation costs.

Porter-Cologne section 79505.5(a) defines DACs as “a community with an annual median household income that is less than 80 percent of the statewide annual median household income.” The median household income for the State of California was $63,783 in 2016. For the TMDL Project, staff reviewed existing watershed planning documents and California Department of Water Resources (DWR) map-based U.S. Census survey tools to identify DACs (DWR, 2016).

The Greater Monterey County IRWM group identified several DACs in the greater Monterey planning region as part of their planning efforts (IRWM Group, 2017). In the Gabilan Creek watershed, the community of Boronda was considered a DAC and the City of Salinas and the community of Castroville were just below the threshold and therefore, are not DACs. The Census Bureau categorizes cities and communities as “places” and they define a “place” as a concentration of population. Places also must have designation boundaries such as a city incorporation or be a recognized community. The Census Bureau also identifies smaller geographic population groupings and staff mapped Census “Block Groups” using the DWR map tool. In 2016, a community was designated as disadvantaged if it had a median household income (MHI) of less than $51,026 and was designated as severely disadvantage if the MHI was less than $38,270. A map of the census data shows that many Census block groups in and around the City of Salinas are either disadvantage or severely disadvantaged (refer to Figure 5). The community of Castroville also has disadvantaged and severely disadvantaged block groups.

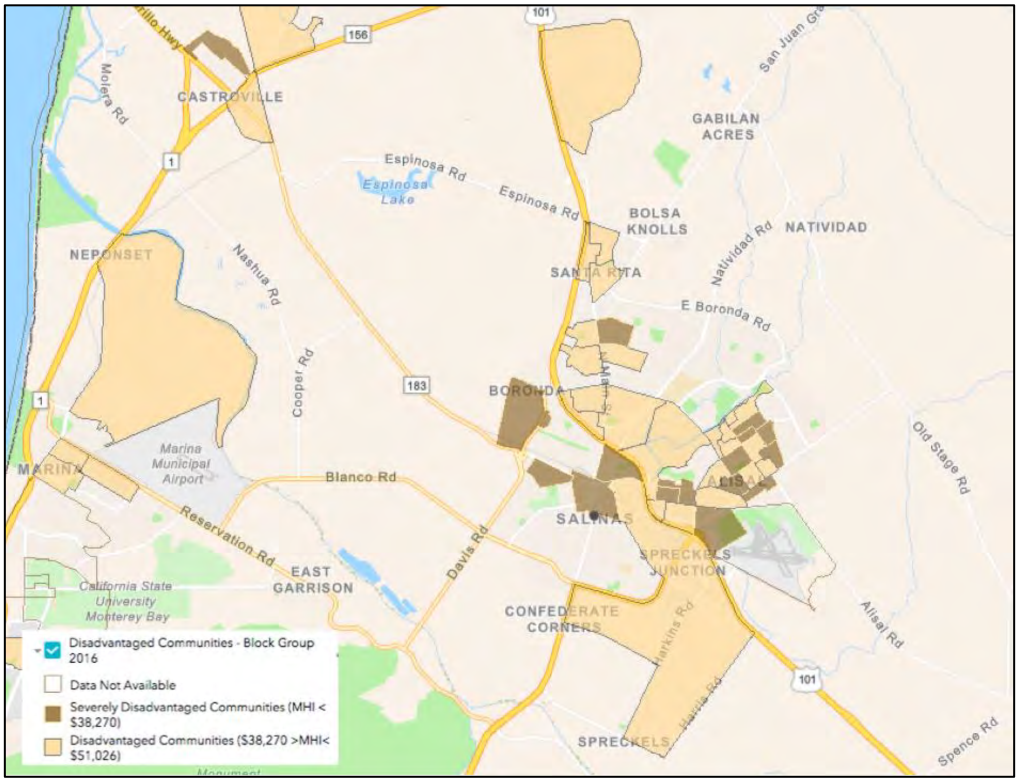

Figure 5. A map of disadvantage and severely disadvantage Census block groups in proximity to the City of Salinas and community of Castroville.

1.10. Climate Change

The focus of this section is to evaluate the potential climate change impacts to freshwater ecosystems in the Gabilan Creek watershed and to discuss potential mitigation. Freshwater stream hydrology and habitats are climate dependent and climate change has the potential to greatly impact the aquatic ecosystems that this TMDL is designed to protect and restore. The State of California Energy Commission assessed central coast climate change in a special peer reviewed report (climate report) as part of a series of 12 assessments in the State (CEC, 2017). The climate report provides the peer reviewed scientific basis for understanding regional climate change, projected impacts to aquatic resources, and mitigation management strategies. In addition to this climate report, staff reviewed published papers on the projected impacts of climate change on freshwater ecosystems.

The climate report includes an assessment of central coast climate science and projected climate changes. The projected climate change increases from historical levels to the end of the century in Monterey County are outlined below:

- Annual average maximum temperatures in Monterey County are projected to increase 7.5 (degrees F.); and
- Annual average precipitation is projected to increase about 5.1 inches per year.

In addition to temperature increases, more extreme temperatures above established thresholds are projected. Wet and dry years may become more severe and the wettest day of the year will become wetter compared to historical conditions.

The climate report evaluated potential increases in wildfires and post fire impacts such as increased runoff and streamflow. The research was not definitive, but the authors expressed concerns that large wildfires in the region will continue to be a major issue followed by increased post fire runoff and streamflow risks.

Based on the climate report and additional studies, staff anticipates that climate change could have severe impacts on aquatic and riparian ecosystems in the Gabilan Creek watershed. For example, with climate change, the forested headwaters of the Gabilan Creek watershed could be more susceptible to extreme fires and subsequently would be vulnerable to more extreme storms, flooding, and erosion (Filipe et al., 2013). Increased sedimentation in the watershed is also a concern as a result of climate change.

The Gabilan Creek watershed streams have severely degraded aquatic health and climate change could hinder their recovery and delay the restoration of aquatic habitats. Climate driven changes in hydrology from episodic storm events with channel degrading flows could alter habitats for fish and benthic macroinvertebrates species. Climate change can also influence stream temperature and concentrations of dissolved oxygen. In a model developed of Sierra Nevada watersheds, temperatures were projected to rise 1 to 5.5 degrees Celsius and DO was modeled to decrease 10% by 2100 in spring and summer flows (Ficklin et al., 2013). As stream temperatures rise, the distribution of cold water species may shift towards higher elevations with cooler temperatures (Filipe et al., 2013).

Sea level rise is another climate change issue that could greatly affect communities, agriculture, and aquatic and riparian habitats in the lower Gabilan Creek watershed. Much of lower portion of the watershed that outlets to Moss Landing Harbor is tidally influenced and sea level rise could extend tidal influence further inland and inundate adjacent lands and groundwater basins. The State has prepared several climate change assessments and the most recent and fourth assessment predicted that sea level rise based on several models. The assessment projects that sea level will rise 50 cm (~20 inches) by 2030 (Thorne et al., 2018). The National Oceanic and Atmospheric Administration developed a sea level rise mapping tool to illustrate the potential impact of sea level rise on coast areas. A sea level rise map indicates with a 60 cm rise lands in the lower watershed near Castroville and Moss Landing will be inundated (refer to Figure 6)

This TMDL incorporates riparian restoration as an implementation strategy for protecting water quality from sources of erosion, sedimentation, and turbidity.

Riparian habitat not only protects water from these pollutants but also provides shading, which serves to mitigate increases in temperature by providing additional shading to stream channels. Also, by reducing turbidity, the TMDL reduces the amount of suspended particles in streams that absorb heat and achieving the TMDL targets should result in a lowering of stream temperatures.

Figure 6. Map on left showing current sea level and second map on right showing 60 cm sea level rise near Castroville. (Source NOAA Sea Level Rise Viewer)

1.11. Impaired Waters Guidance and Policy

In 2005, the State Water Board approved the Impaired Waters Guidance and the Water Quality Control Policy for Addressing Impaired Water: Regulatory Structure and Options (guidance) (SWRCB, 2005). The guidance establishes a consistent framework for developing TMDLs and addressing impaired waters to meet federal regulations and to improve communication with stakeholders. The guidance framework is the basis of this TMDL technical report outline and the overall project work plan. The guidance also ensures that impaired waters are efficiently and effectively addressed. It outlines regulatory methods for addressing impaired waters and clarifies the TMDL process by providing definitions of key TMDL terms, some of which are listed below.

Total Maximum Daily Load (TMDL): *A numerical calculation of the loading capacity of a water body to assimilate a certain pollutant and still attain all water quality standards. The sum of the individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, and a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standards.*

Impaired Water: *A waterbody that has been determined under state policy and federal law to be not meeting water quality standards. An* *impaired water is a water that has been listed on the California 303(d) List or has not yet been listed but otherwise meets the criteria for listing. A water is a portion of a surface water of the state, including ocean, estuary, lake, river, creek, or wetland. The water currently may not be meeting state water quality standards or may be determined to be threatened and have the potential to not meet standards in the future.*

Pollutants: *The term pollutant is defined in section 502(6) of the CWA as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water."*

Pollution: *The term pollution is defined in section 502(19) of the CWA as the "man-made or man induced alteration of the chemical, physical, biological, and radiological integrity of water" The term pollution thus includes impairments caused by discharges of pollutants. Pollution is also defined in section 13050(l) of the California Water Code as an alteration of the quality of the waters of the state by waste to a degree that unreasonably affects either the waters for beneficial uses or the facilities that serve these beneficial uses.*

Water Quality Standard. *Provisions of state and federal law that consist of a designated use or uses for the waters of the United States, water quality criteria for such waters based upon such uses, and an Anti-degradation policy. Water quality standards are to protect public health or welfare, enhance the quality of the water, and serve the purpose of the Clean Water Act (40 CFR section 131.3). Under California law, designated uses are referred to as beneficial uses. In addition to federally promulgated criteria such as the California Toxics Rule, water quality criteria include California adopted narrative or numerical water quality objectives in the Basin Plan.*

1.12. Listing Policy

The Water Quality Control Policy for Developing California's Clean Water Act section 303(d) List (Listing Policy) provides guidance on identifying waters that do not meet water quality standards (SWRCB, 2015). Staff followed the Listing Policy procedure to analyze data and identify waterbodies impaired by turbidity, in addition to those waterbodies already identified on the 303(d) List for turbidity. Although the Listing Policy procedure is used for TMDL data analysis, TMDL analysis is a separate process from the 303(d) List assessment. Additional analysis and information gathering may be necessary before incorporating the results of the TMDL analysis into the next update to the 303(d) List.

1.13. Seasonal Effects of Flow and Runoff on Turbidity

In natural watershed settings, there are two sources of stream flows overland surface runoff and baseflow. Overland surface runoff naturally occurs only after storms when soils are saturated during the wet season. Baseflow is stream flow derived from soil moisture and shallow groundwater. Natural streams that flow during the dry season (May – September) are hydrologically supported with baseflow. Baseflow is apparent in the perennial streams found in the lower Gabilan Creek watershed (e.g., lower Salinas Reclamation Canal, Tembladero Slough, and Old Salinas River) and baseflow also supports perennial streams in the steelhead habitat of the upper Gabilan headwaters.

Wet season surface runoff and associated sediment erosion is highly variable depending on watershed conditions such as rainfall, vegetation cover, soil types, and slopes. The central coast is prone to episodic rain events and this results in dramatic variability in wet season stream flows and velocities, which in turn results in variable turbidity levels.

In contrast, dry season flows in Central Coast Region are naturally supported by baseflow, which steadily enters streams at low velocities with minimal, if any, bed and bank erosion. These low velocity flows produce minimal if any bed erosion or resuspension of sediments that could contribute to turbidity. The characteristics of natural baseflow and storm runoff are described in the following excerpt from the United States Geologic Survey Water Science School (USGS, 2016).

> *During periods of low flow (base flow), many rivers are a clear green color, and turbidities are low, usually less than 10 NTU. During a rainstorm, particles from the surrounding land are washed into the river making the water a muddy brown color, indicating water that has higher turbidity values. Also, during high flows, water velocities are faster and water volumes are higher, which can more easily stir up and suspend material from the stream bed, causing higher turbidities (USGS, 2016).*

1.14. Biological Integrity

The CWA provides the basis for water quality protection and TMDL development. The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. This TMDL project follows a holistic approach to watershed health and protection by restoring both the water quality conditions and biological integrity of impaired waters. It sets water quality targets (i.e., numeric turbidity targets) and biological integrity targets (i.e., benthic inveterate community scores) for the impaired waters.

Biological integrity is the overall health of the biological communities and their habitats in a waterbody. It is a balance of five factors: habitat structure (natural features that support plants and animals), water quality (physical and chemical properties of water), energy source (nutrients supporting the food chain), flow regime, and biotic interactions (links between species in food chain) (Murdoch et al, 1999). Table 4 summarizes the five factors. Aquatic vegetation has a variety of functions; plants collect energy and produces organic matter that serve as energy sources and plants provide habitat for invertebrates, fish, and wildlife. Turbidity directly impacts primary producers (algae and plants) in aquatic environments by reducing the availability of sunlight for photosynthesis and aquatic life by reducing habitat quality and functionality.

Table 4. The five factors of biological integrity and their descriptions.

Factor	Description
Water Quality	The extent to which a stream strays from its natural chemical makeup due to human impacts.
Energy Source	The source of biotic nutrients for the stream's food chain. These sources may be natural such as decaying leaves and woody debris, or human caused, such as sewage and fertilizer runoff.
Biotic Interactions	The links between species in the food chain (or simply who's eating whom), and an awareness of the impacts on one species when another disappears. For example, caddisflies, mayflies, and stoneflies are primary food sources for salmon, steelhead, and trout. If these insects are not present in your stream, those fish dependent on them will not be present.
Flow Regime	The volume of water flowing through a stream over time. Changes in flow regimes and attendant impacts of fish and wildlife must be evaluated on par with flooding, erosion, and municipal/industrial/agricultural uses of water
Habitat Structures	The types and amounts of natural features that provide fish and wildlife habitat structures, e.g. instream logs, pools and riffles, and undercut banks for fish; and abundant and diverse vegetation for wildlife.

2. WATERSHED DESCRIPTION

2.1. Watershed Drainage Boundaries

The Gabilan Creek watershed encompasses an area of approximately 100,000 acres or 160 square miles. It is comprised of 10 major named waterbodies and associated subwatersheds. The watershed with its waterbodies and subwatershed boundaries are shown in Figure 7 and watershed areas are summarized in Table 5.

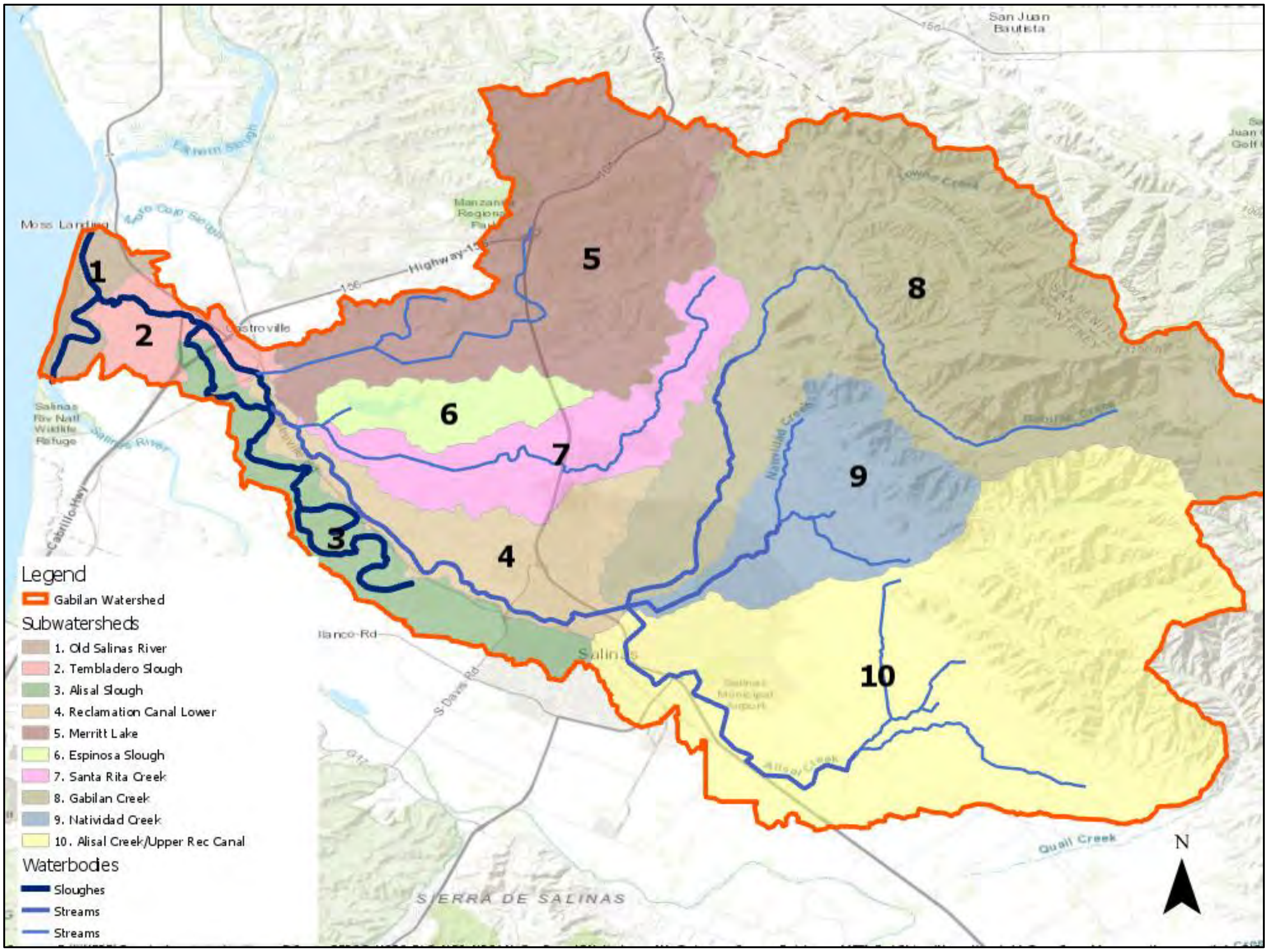

Figure 7. Map showing the ten subwatersheds in the Gabilan Creek watershed.

Table 5. Subwatersheds names and associated size.

ID	Subwatershed	Acres	Square Miles
1	Old Salinas River	1,492	2.3
2	Tembladero Slough	2,154	3.4
3	Alisal Slough	4,621	7.2
4	Salinas Reclamation Canal, Lower	5,729	9.0
5	Merritt Lake	14,236	22.2
6	Espinosa Slough	2,655	4.1
7	Santa Rita Creek	6,348	9.9
8	Gabilan Creek	27,957	43.7
9	Natividad Creek	7,337	11.5
10	Alisal Creek/Salinas Reclamation Canal, Upper	29,656	46.3
Total		102,185	160

2.2. Geomorphology

Researchers from the California State University Monterey Bay (CSUMB) Watershed Institute classified and mapped stream types as part of a watershed study conducted for Monterey County Water Resources Agency (MCWRA). They classified streams by channel slopes, channel hydrology, and the presence of absence of vegetation in the channel (MCWRA, 2005). Staff overlaid the results of the CSUMB channel slope analysis on a geology map layer to illustrate the relationship between geology and stream slopes (refer to Figure 8) and on separate relief map to illustrate the relationship to topography (refer Figure 9).

The Gabilan Creek watershed is bound on its eastern side by the Gabilan Mountains that run in a southeast-northwest direction and it is bound on the western side by coastal sand dunes and the Pacific Ocean (refer to Figure 8). A flat alluvial valley spans between the steep granitic bed Gabilan Mountains and the coast. The stream channels in the lower valley floor slope less than 1% slope towards the coast. This includes the Old Salinas River, Tembladero Slough, and Alisal Slough. The upper valley floor streams such as Gabilan Creek, Natividad Creek, Alisal Creek, Salinas Reclamation Canal, Espinosa Slough, Merritt Ditch, and Santa Rita Creek slope less than 2% towards the coast. Stream channels are classified by slope, hydrology (perennial or non-perennial) and vegetation in Table 6.

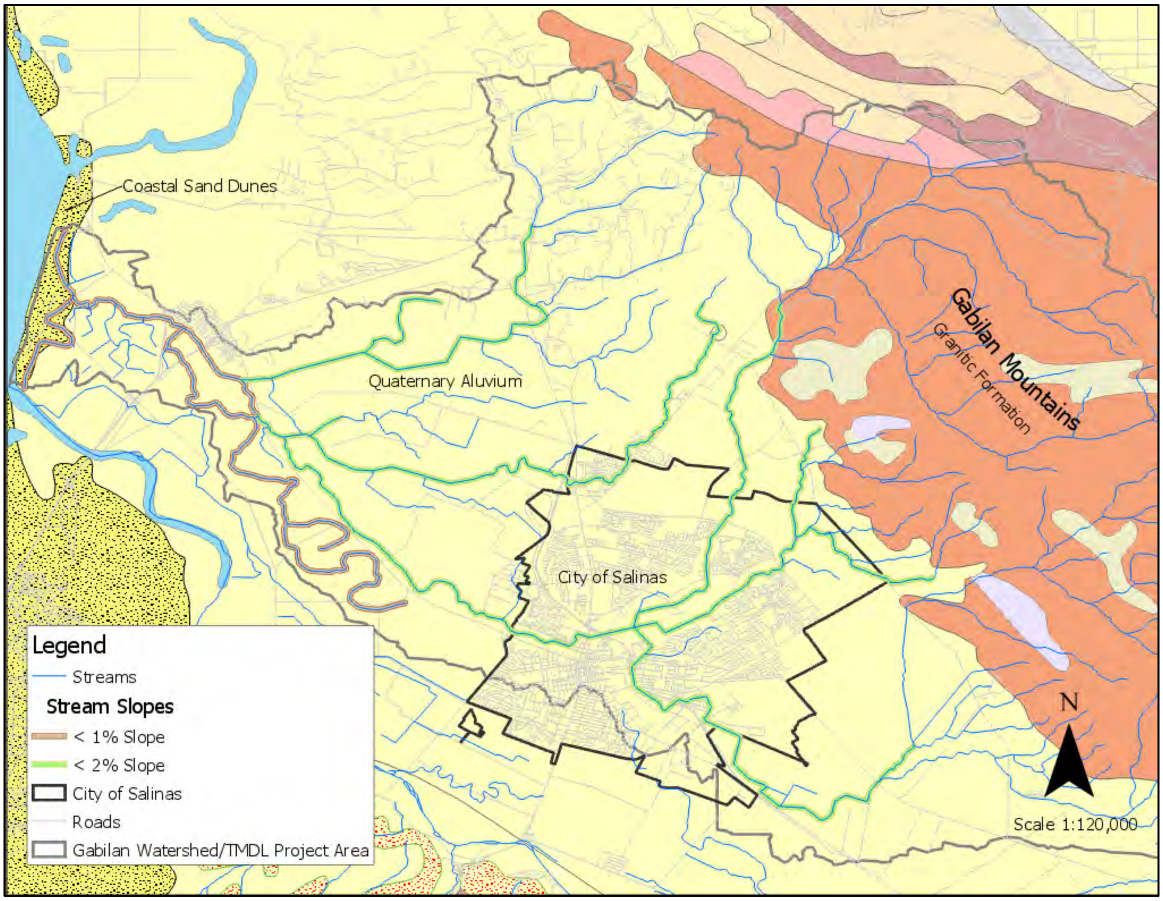

Figure 8. A map of the Gabilan Creek watershed showing streams and stream slopes.

Table 6. Channel classifications of turbidity impaired waters.

Channel Classifications	Waterbodies
Foothill, 2 - 4% Slope	Merritt Ditch, Santa Rita Creek, Gabilan Creek, Natividad Creek, Alisal Creek
Vegetated, < 2% Slope, Low-gradient, Perennial	Gabilan Creek, Natividad Creek
Vegetated, <2% Slope, Non-perennial	Merritt Ditch, Santa Rita Creek, Gabilan Creek, Natividad Creek, Alisal Creek
Ditch, <2% Slope, Non-perennial	Merritt Ditch, Espinosa Slough, Santa Rita Creek, Gabilan Creek, Alisal Creek
Ditch/Canal. < 2% Slope, Perennial	Salinas Reclamation Canal, Merritt Ditch, Espinosa Slough, Santa Rita Creek
Slough (fresh and brackish), < 1% Slope	Tembladero Slough, Alisal Slough

Channel Classifications	Waterbodies
Slough (brackish), < 1% Slope	Old Salinas River

Note: Some waterbodies have reaches with different channel classifications. For example, Tembladero Slough is primarily a freshwater system, but the lower ¼ mile is brackish, as is the Old Salina River.

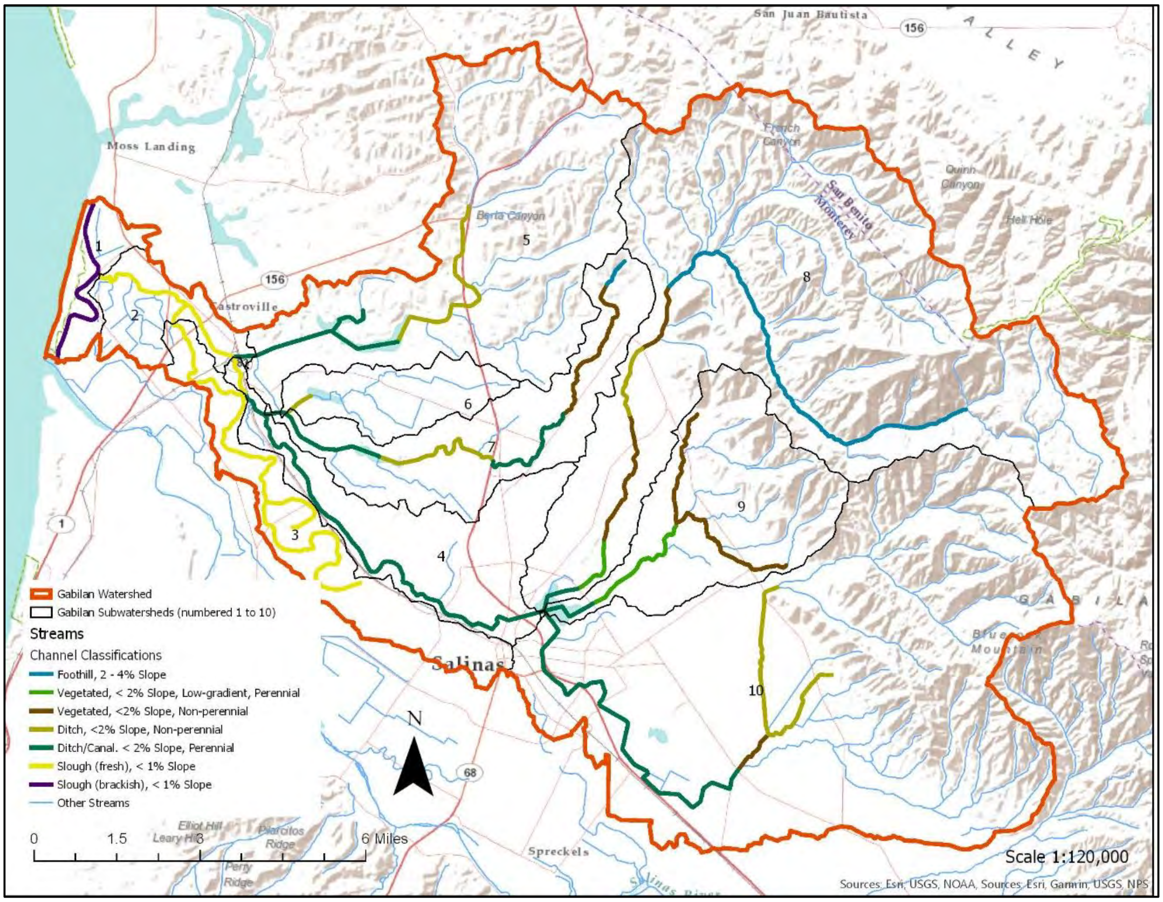

Figure 9. Map of stream channel classifications and subwatersheds in the Gabilan Creek watershed (MCWRA, 2005).

2.3. Hydrology

The Gabilan Creek watershed is a complex and highly modified hydrologic system. Gabilan Creek flows from its headwaters in the Gabilan Range to Carr Lake, which is within the City of Salinas. Flow is channelized in Carr Lake where it and two other tributaries, Alisal and Natividad Creeks converge and flow into the Salinas Reclamation Canal (Figure 10). The Salinas Reclamation Canal flows westerly from the City of Salinas towards the community of Castroville. During summer months, the primary flow into Carr Lake and the Salinas Reclamation Canal is from Alisal Creek (MCWRA, 2015). CSUMB conducted watershed assessment of Alisal Creek hydrology in 2005 (MCWRA, 2005). Lower Alisal Creek is described in this study as having “artificially perennial summer flow.”

During the dry season, water from Alisal Creek and other sources, pools in the flat modified channels within Carr Lake and then flows into the Salinas Reclamation Canal at Main Street.

During the 2014 dry season, MCWRA monitored flow leaving Carr Lake and it averaged 0.7 cubic feet per second (cfs) (MCWRA, 2015). The USGS continuously monitors stream flow in the Salinas Reclamation Canal downstream of the City of Salinas at the San Jon Road crossing. During the 2014 dry season study period, flow averaged 1.3 cfs at the San Jon Road gauge. This indicates that the Salinas Reclamation Canal gains about half its dry season flow downstream of Carr Lake. An evaluation of stream and baseflow from the USGS gage on the Salinas Reclamation Canal indicates that the majority of the gaged streamflow during the summer months is from baseflow as opposed to runoff (refer to Table 7).

Table 7. Streamflow and baseflow in the Salinas Reclamation Canal at San Jon Road.

Date	Streamflow (cfs)	Baseflow (cfs)	Runoff (cfs)	Baseflow (%)
Jan-14	1.4	0.88	0.52	63
Feb-14	13.3	1.42	11.92	11
Mar-14	10.6	1.44	9.13	14
Apr-14	4.6	1.5	3.1	33
May-14	1.2	0.98	0.25	79
Jun-14	1.2	1.01	0.22	82
Jul-14	1.3	1.14	0.19	86
Aug-14	1.5	1.06	0.48	69
Sep-14	1.4	0.91	0.48	65
Oct-14	2.4	0.75	1.69	31
Nov-14	7.1	1.11	6.01	16
Dec-14	74.5	29.2	45.3	39

Downstream of the USGS gage at San Jon Road, and near the City of Castroville, the Salinas Reclamation Canal flows into Tembladero Slough, which is a wide, very low gradient waterbody. The stream then flows from upper Tembladero Slough into the tidally influenced lower Tembladero Slough and ultimately into the Old Salinas River at the bottom the watershed. There are several perennial tributaries that drain into the Salinas Reclamation Canal below San Jon Road including Santa Rita Creek, Espinosa Slough, Merritt Ditch, and Alisal Slough.

Stream flows are not all natural in the watershed. For example, waters from several points in the watershed including points along Santa Rita Creek, Espinosa Slough, Merritt Ditch, Alisal Creek, and the Salinas Reclamation Canal near Carr Lake are lifted by surface water pumps to increase flow (refer to Figure

10) (MCWRA, 2005). MCWRA operates most pump stations shown in the figure; however, agricultural operations operate some such as one discharging into Alisal Creek near monitoring site 309ALG and the Salinas Airport.

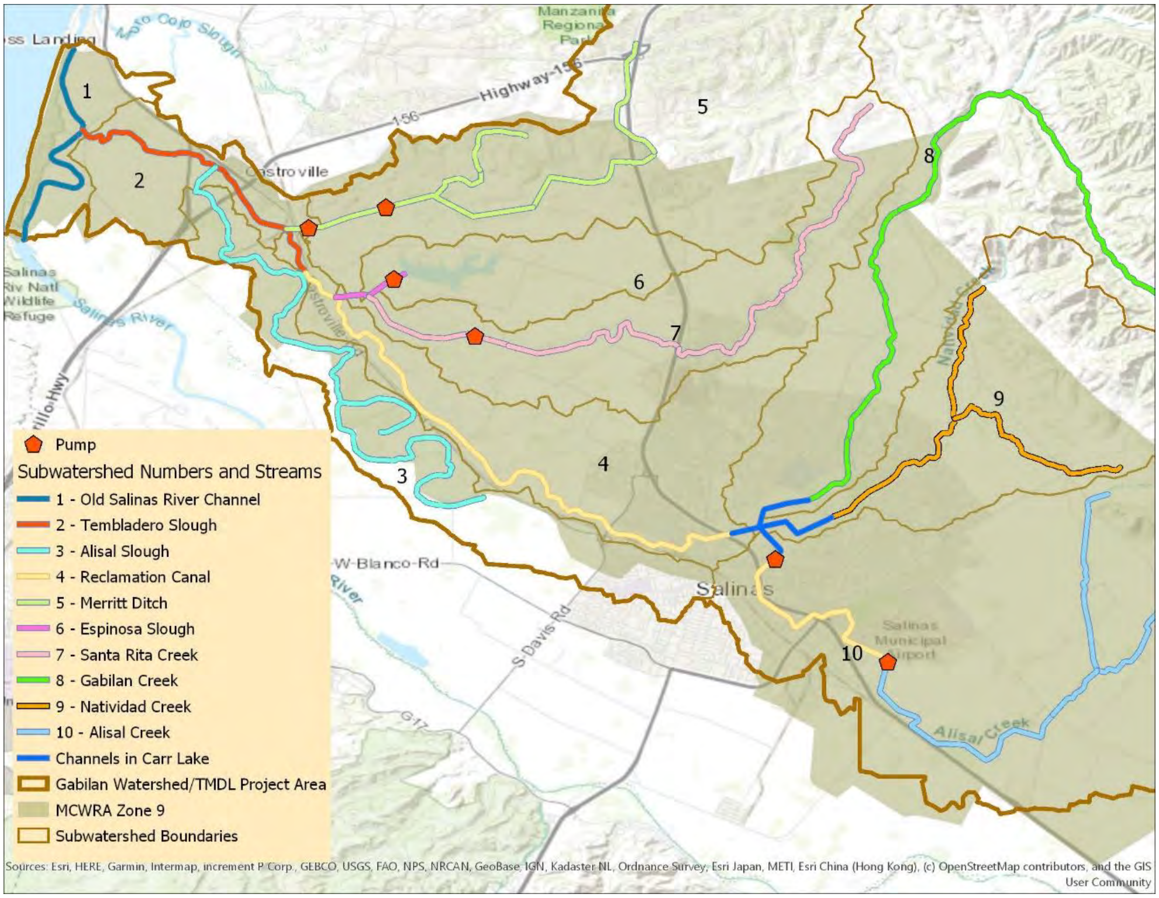

Figure 10. Map of major surface water pumps in the Gabilan Creek watershed (MCWRA, 2005).

2.4. Historical Ecology Wetland Assessment

Historical ecology is a way to understand past and present wetland ecology and hydrology in a watershed. The Elkhorn Slough Foundation and Elkhorn Slough National Estuarine Research Reserve researched and mapped the historical ecology of Elkhorn Slough and lower Salinas River watershed, including the Gabilan Creek watershed. The historic ecology map (Figure 11), is based on historic accounts and maps of the watershed including, Mexican rancho maps from the early 1800s, early American land surveys, newspaper accounts, soil surveys, and engineering maps and plans (Elkhorn Slough Foundation, 2015).

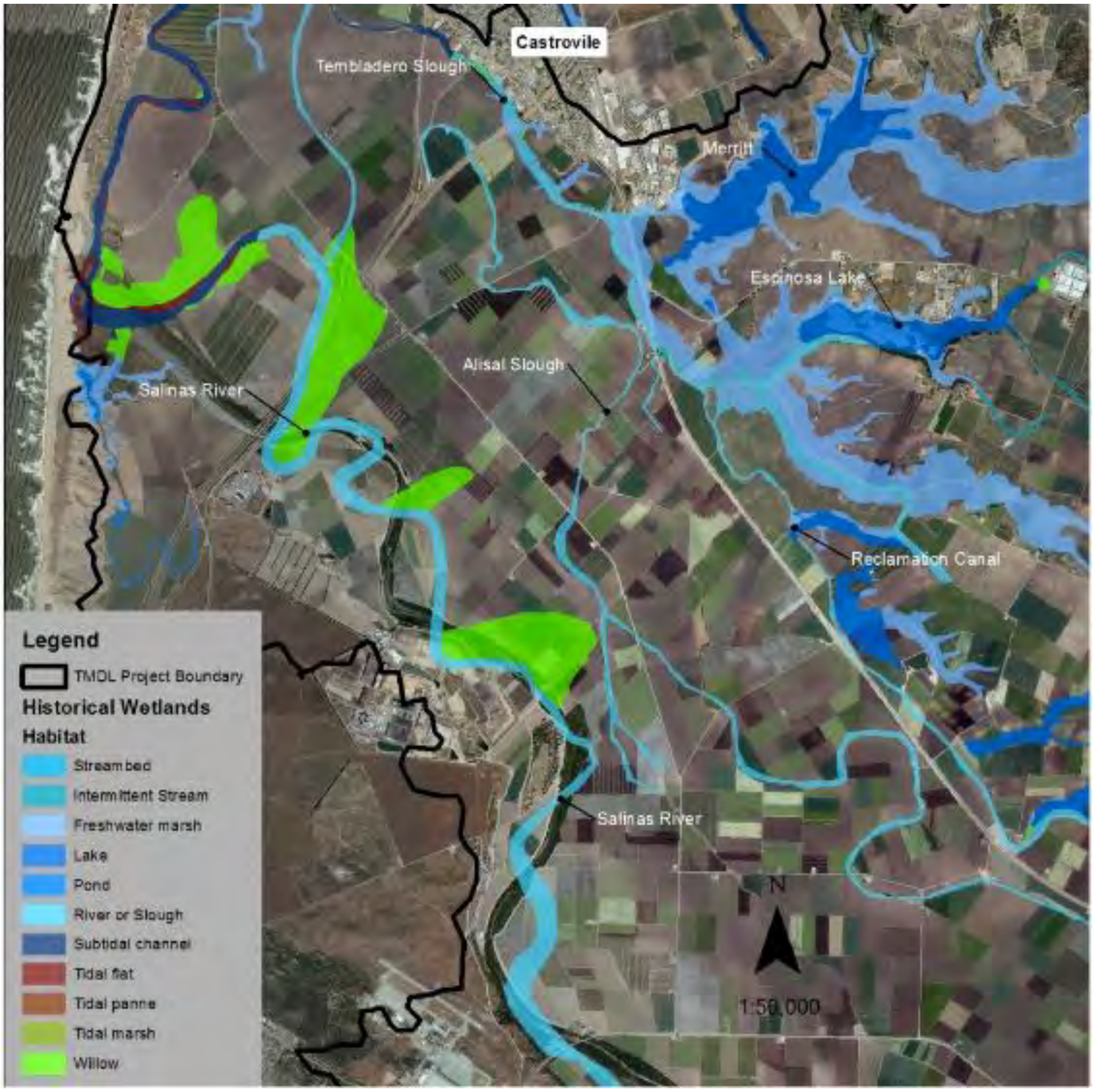

Figure 11. Map of historical wetlands in the lower Salinas River watersheds, including the lower Gabilan Creek watershed.

Historic development and land reclamation significantly altered the hydrology and wetland habitats in the watershed. In the early 1900s, the Chief Engineer of Salinas, Lou. G Hare, drew plans to construct canals and laterals to drain sloughs and lakes in the Gabilan Creek watershed and reclaim those areas for other uses (refer to Figure 12). Some of the reclaimed open water lakes are Merritt Lake, Espinosa Lake, Santa Rita Slough, Vierra Lake, Boronda Lake, Mill Lake, Carr Lake, Mud Lake, and Heinz Lake. In addition to draining the lakes, the reclamation project drained the extensive freshwater marsh wetlands that once surrounded the lakes and filled adjacent lands. The Salinas Reclamation Canal continues to drain these former wetlands.

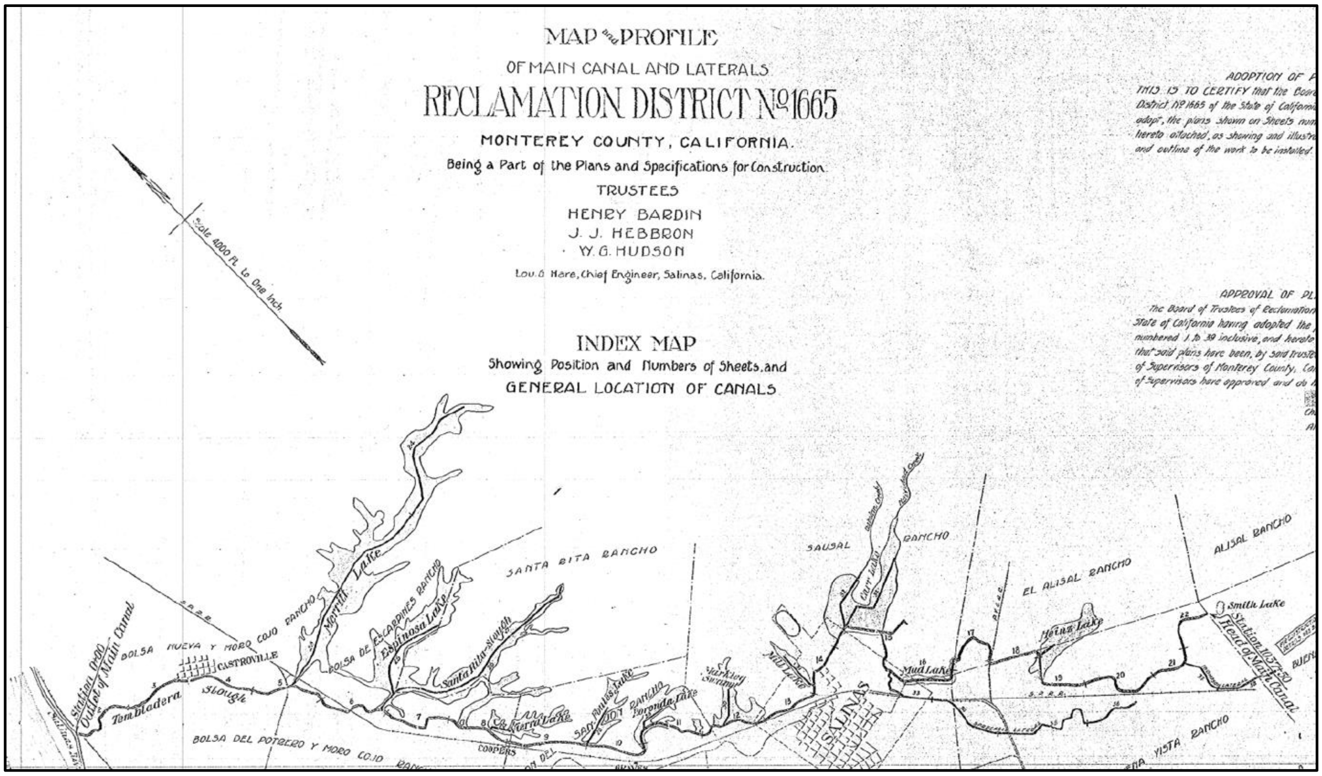

Figure 12. Historic map of the Salinas Reclamation Canal.

2.5. Communities, Housing and Populations

The City of Salinas and the unincorporated communities of Castroville and Spreckels are the major communities in the Gabilan Creek. Salinas is the largest city in Monterey County with a population of over 150,000 and it is the major population center in the watershed (Census 2010). According to the U.S. Census Bureau, over one third of the Salinas population is foreign born and over 20% of the population is below the poverty level. Additionally, the education level is much lower than the county and state levels. Castroville and Spreckels are small towns under Monterey County jurisdiction. Castroville has a population of 6,481 and Spreckels is much smaller with a population of 673 (refer to Table 8).

Table 8. U.S. Census data for communities in the Salinas River watershed and county and statewide facts.

Community Fact	Castroville	Salinas	Spreckels	Monterey County	State of California
Population	6,481	150,441	673	415,057	37,253,956
Foreign born population	3,077	55,776	25	126,439	10,104,739
Housing Units	1,500	42,652	308	139,086	13,667,226
Age (median)	26.8	28.6	36.1	32.9%	35.2

Community Fact	Castroville	Salinas	Spreckels	Monterey County	State of California
Income (median)	52,771	50,587	79,358	60,143	61,400
Individuals below Poverty Level	20.7%	20.8%	1.4%	16.1%	15.3%
Education Attainment: % high school grad or greater	34.4%	60.0%	94.6%	70.4%	81.0%

Source: 2010 U.S. Census

2.6. Climate

The Gabilan Creek watershed has a cool-summer and mild winter Mediterranean climate, which is strongly influenced by its location along the Pacific Ocean. The ocean influence has a moderating effect on the average temperatures as indicated in Figure 13, which is a summary of climate data from the California Irrigation Management Information System (CIMIS) weather station in Castroville. The California Department of Water Resources manages CIMIS weather stations to assist growers and irrigators efficiently manage water resources.

Rainfall patterns in the Gabilan Creek watershed are also typical of a Mediterranean climate with rain predominantly in the winter months and little if any rainfall during the summer months as shown in Figure 14. The figure summarizes average monthly rainfall data from the Castroville CIMIS station.

California and central coast are also prone to episodic rainfall events driven by a phenomenon known as atmospheric rivers. Atmospheric rivers are narrow air currents that carry large amounts of tropical to California (DWR, 2020). They are estimated to provide up to 50% of California’s water supply but are also responsible for flooding. The Gabilan Creek watershed is particularly susceptible to flooding from atmospheric rivers due to the proximity of the steep Gabilan Mountains to the Pacific Ocean and orientation facing the coast and oncoming storms. Atmospheric Rivers occur on average five to six times a season but some years only one or two occur.

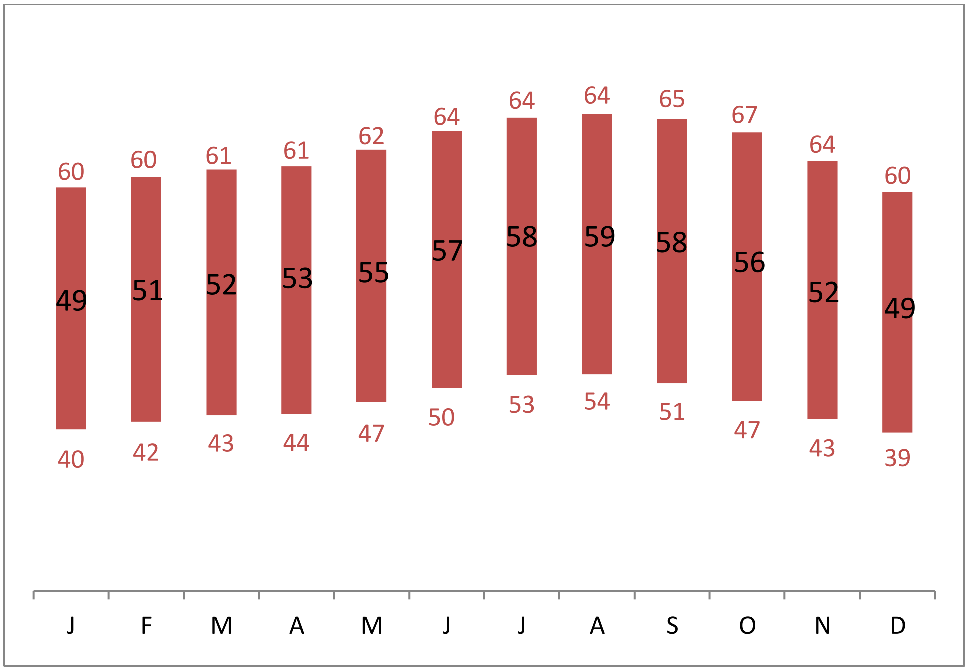

Figure 13. Graph showing the range and average monthly air temperatures (F) at the Castroville CIMIS station. Average maximum and minimum shown in red text at top and bottom of bars, and daily average in black text in center of bar (data from 1990 to 2012).

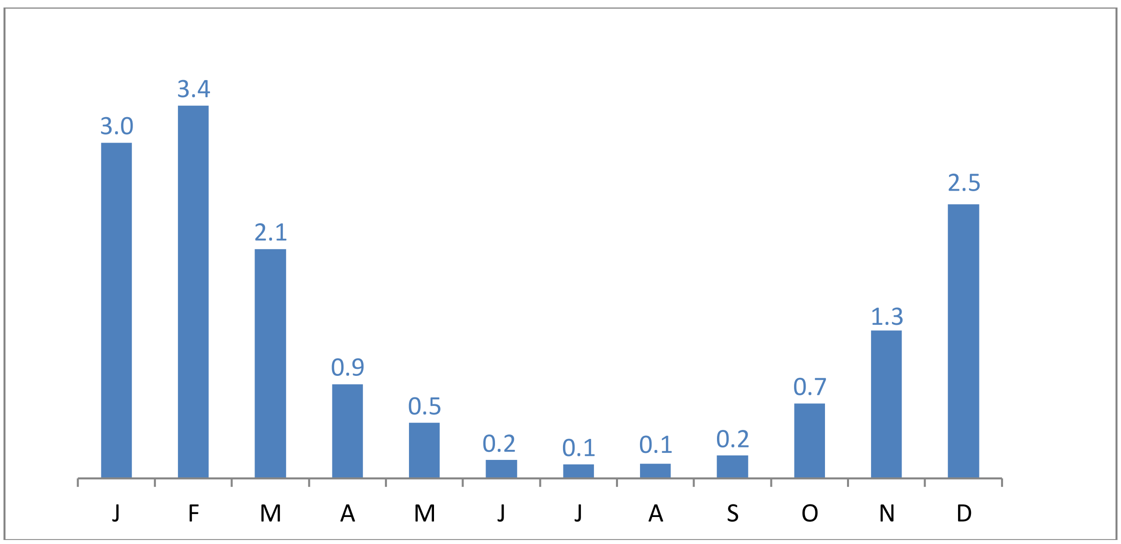

Figure 14. Graph of average monthly rainfall in inches at the Castroville CIMIS station.

2.7. Land Use

Staff used National Land Cover Data (NLCD) to summarize major land uses in the watershed (refer to Table 9). Cropland is the predominant land use in the valley floor, and it encompasses 28% of the watershed acreage. A large portion of the watershed is developed at 14%. Developed lands are located primarily on the valley floor. Large portions of the upper watershed areas have forest/scrub and grassland land uses and area less disturbed. Wetlands (open water, woody wetlands, and emergent herbaceous wetlands) comprise only a small portion of the total land uses at 1%.

Table 9. Summary of land uses the project area (source 2011 NLCD).

Land Cover Type	Percent	Acres
Developed	14%	14,676
Wetlands	1%	1,251
Forest/Scrub/Barren Land	27%	27,537
Grassland	18%	18,640
Cropland	28%	28,441
Open Space	11%	11,639
Total	100%	102,184

2.8. Farmland

The majority of farmland in the Gabilan Creek watershed is considered prime land with the best combination of soil, water, and climatic growing conditions for supporting high yields. Many other farmlands in the watershed are still of high value but of somewhat less quality than prime. The farmland mapping also indicates the watershed has extensive grazing land in the foothills as well as other land, which include forests and scrub. Maps of farmland of importance are compiled by the California Department of Conservation Farmland Mapping and Monitoring Program. These maps are used in this project to analyze impacts on agricultural resources, included in the California Environmental Quality Act (CEQA) component of the TMDL project.

2.9. Major Agricultural Crops

The Gabilan Creek watershed is in Monterey County, one of the most productive agricultural regions in the world with annual crop production in the billions of dollars. The value and production of the county’s major crops are summarized in Table 10 (Monterey, 2013). The highest value crops in Monterey County are lettuce, strawberries, and broccoli. Except for grapes, all the major crops are grown extensively on prime land in the Gabilan Creek watershed.

Table 10. Major crop acreage in Monterey County

Crops	Acres*	Value
Artichokes	5,203	$47,390,000
Broccoli	65,577	$426,933,000
Cauliflower	20,987	$163,319,000
Celery	13,570	$217,452,000
Grapes (Wine)	42,986	$226,982,000
Head Lettuce	44,680	$550,628,000
Leaf Lettuce	65,008	$659,646,000
Mushrooms	N/A	$71,534,000
Nursery Products	12,317	$122,676,000
Spinach	12,317	$122,676,000
Strawberries	10,980	$869,488,000
Total of above Crops	**276,648**	**$3,668,394,000**

* Production Acres. Note: many sites may produce more than once crop in a year on the same acreage. N/A: acreage is not available for mushroom production.

3. Turbidity Monitoring Data Analysis

3.1. Analysis of Turbidity Monitoring Data

In this report, staff analyzed ambient turbidity water quality monitoring data from 13 monitoring sites on the major waterbodies/streams in the Gabilan Creek watershed. Table 11 and Table 12 summarize the monitoring results and Table 13 describes the monitoring sites. Staff also charted the results of the analysis, shown in Figure 15 and Figure 16. Regional monitoring programs such as the Central Coast Ambient Monitoring Program (CCAMP) and the Cooperative Monitoring Program for Irrigated Agriculture (CMP) routinely monitoring these sites. In addition, local organizations such as the City of Salinas, regularly monitor streams for compliance with their stormwater permit. Staff downloaded monitoring data for the TMDL analysis from the California Environmental Data Exchange Network (CEDEN).

Turbidity Monitoring Data Protocols

Receiving water turbidity monitoring data collected by CCAMP, CMP, and City of Salinas are typically field measurements, collected with probes that have been calibrated before and after every field day. On the rare occasion when probes failed calibration or were unavailable, grab samples were collected. In all instances, measurements and grab sample are collected subsurface and following standard operating procedures defined by the CCAMP program. All field measurement and grab sample results are compared to the monitoring program's measurement quality objectives, as defined in their Quality Assurance Program Plans (QAPPs), which are comparable to the measurement quality objectives (MQOs) defined by the state's Surface Water Ambient Monitoring Program (SWAMP) (SWAMP, 2017).

Turbidity Monitoring Designs

- CCAMP – equal interval sampling (monthly).
- CMP - equal interval sampling (monthly) with two wet season events occurring within 18 hours of storm events, defined as resulting in greater than a half-inch of rain within a 24-hour period.
- City of Salinas – monthly October - April (include 2 rain events: first flush event +1 other) and 2 dry months - July and September

<u>TMDL Waterbody Impairment Assessment</u>

For this TMDL, staff identified turbidity impaired waterbodies in accordance with the Listing Policy. Specifically, staff compared turbidity data to turbidity evaluation guidelines protective of COLD and WARM aquatic life beneficial uses (refer to Table 11) and determined impairment using the methodology described in section 3 of the Listing Policy (SWRCB, 2015). Staff based decisions about impacts to COLD aquatic habitats on the frequency of exceedances of a 25 NTU salmonid guideline (Sigler et al., 1984), and impacts to WARM water habitats on exceedances of a 40 NTU evaluation guideline (Shoup and Wahl, 2009) and summarized these results in Table 11, for each monitoring site, by percent exceedance of the applicable guidelines. Some waterbodies such as Gabilan Creek and the Old Salinas River are designated both COLD and WARM beneficial uses while waterbodies such as the Salinas Reclamation Canal and Tembladero Slough are designated only WARM.

Turbidity is a conventional pollutant and staff used Table 3.2 of the Listing Policy to determine if the number of exceedances supports placement on the 303(d) List.

Key findings from this turbidity impairment assessment include the following:

- Monitoring data analysis indicates that all waterbodies assessed in the watershed are impaired for turbidity;
- Alisal Slough, station 309ASB, had the lowest percent exceedance with 45% of 157 samples greater than or equal to the guideline for WARM beneficial use;
- The Salinas Reclamation Canal at stations 309ALD and 309JON, had the next lowest exceedances at 61% and 57% respectively of the guideline for WARM beneficial guideline; and
- Several sites exceeded the COLD beneficial use guideline in 80% or more of the samples. These sites include the following: Gabilan Creek (309GAB), Natividad Creek (309NAD), Old Salinas River (309OLD), Merritt Ditch (309MER), and Santa Rita Creek (309RTA).

Table 11. Turbidity monitoring samples used in this TMDL and percent exceedances of 303(d) List guidelines for waterbodies designated COLD and WARM beneficial uses. Note: n/a represents not applicable.

Waterbody	Site Id	Number of Samples	COLD % of Samples ≥ 25 (NTU)	WARM % of Samples ≥ 40 (NTU)
Gabilan Creek	309GAB	92	91	86
Natividad Creek	309NAD	164	88	76
Salinas Reclamation Canal/Alisal Creek	309ALG	158	89	81
Salinas Reclamation Canal	309ALD	104	n/a	61
Salinas Reclamation Canal	309JON	161	n/a	57
Tembladero Slough	309TEH	162	n/a	90
Tembladero Slough	309TDW	176	n/a	84
Tembladero Slough	309TEM	38	n/a	76
Old Salinas River	309OLD	299	81	70
Alisal Slough	309ASB	157	65	45
Merritt Ditch	309MER	162	93	86
Espinosa Slough	309ESP	161	80	76
Santa Rita Creek	309RTA	60	90	83

Ranges of Turbidity Levels in the Watershed

Staff analyzed the ranges of turbidity levels at monitoring sites in the watershed and calculated the year-round turbidity monitoring data. Data from this analysis are summarized by quartiles (25th, 50th, and 75th percentiles) and interquartile ranges for each site (refer to Table 12). The median or 50th percentile is the turbidity level that divides the data into two halves. For example, the median year-round turbidity value for station 309TEH is 114 NTU; therefore, half the annual samples are greater the 114 NTU and the other half are lower. Median values are also charted in Figure 15.

The following are key points from the median turbidity assessment:

- Median turbidity values for Gabilan Creek (309GAB) and Santa Rita Creek (309RTA) exceed 200NTU, the greatest in the watershed and nearly 10 times the level that is known to reduce growth and the ability of fish to find food;

- Median turbidity values for Natividad Creek (309NAD), Reclamation Canal/Alisal Creek (309ALG), Tembladero Slough (309TDW and 309TEH), Merritt Ditch (309MER), and Espinosa Slough (309ESP) exceed 100 NTUs; and

- The lowest median turbidity values in the Gabilan Creek watershed occur in Alisal Slough (309ASB) and the Salinas Reclamation Canal (309ALD and 309JON), 57 NTUs and 47 NTUs respectively.

Staff summarizes year-round turbidity data for each monitoring station in Table 12 using quartiles (i.e., the 25th , 50th, and 75th percentile NTU values) along with interquartile range (IQR) for each site. For example, out of 299 turbidity samples from the Old Salinas River (309OLD), the 25th percentile value is 33 NTU and the 75th percentile value is 153 NTU. This indicates that 25% of the samples are below 33 NTU and 75% are below 154 NTU, however 25% are also greater than 154 NTU. The IQR is the range of turbidity values between the 25th and 75th percentiles and includes the median or the 50th percentile. The IQR is the numeric spread of the middle range of samples. In a healthy watershed, the IQR and the median turbidity would be low. The IQRs for all sites are charted in Figure 16. Gabilan Creek (309GAB) and Santa Rita Creek (309RTA) have very high IQRs at over 800 NTU and the lowest IQR is in Alisal Slough at site 309ASB with an IQR of 53 NTU.

Table 12. Summary of year-round turbidity monitoring data

Waterbody	Site Id	Number of Samples	25th Percentile (NTU)	50th Percentile Median (NTU)	75th Percentile (NTU)	IQR* (NTU)
Gabilan Creek	309GAB	92	86	259	907	821
Natividad Creek	309NAD	164	42	100	322	280
Salinas Reclamation Canal/Alisal Creek	309ALG	158	47	119	321	274
Salinas Reclamation Canal	309ALD	104	29	56	154	125
Salinas Reclamation Canal	309JON	161	22	52	146	124
Tembladero Slough	309TEH	162	69	114	220	151
Tembladero Slough	309TDW	176	54	100	169	114
Tembladero Slough	309TEM	38	45	68	116	70
Old Salinas River	309OLD	299	33	74	153	120
Alisal Slough	309ASB	157	19	36	71	53
Merritt Ditch	309MER	162	54	107	214	159
Espinosa Slough	309ESP	161	45	108	361	317
Santa Rita Creek	309RTA	60	63	200	998	936

Note: *Interquartile Range (IQR) = 75th percentile minus 25th percentile

Table 13. Description of monitoring site locations

Site Id	Description of Site Location
309GAB	Gabilan Creek at Independence Road and East Boranda Road
309NAD	Natividad Creek up stream of Salinas Reclamation Canal
309ALG	Salinas Reclamation Canal at La Guardia
309ALD	Salinas Reclamation Canal at Boronda Road
309JON	Salinas Reclamation Canal at San Jon Road
309TEH	Tembladero Slough at Haro Street
309TEM	Tembladero Slough at Preston Road
309TDW	Tembladero Slough at Molera Road
309OLD	Old Salinas River at Monterey Dunes Way
309ASB	Alisal Slough at White Barn (Blanco Road)
309MER	Merritt Ditch upstream from Highway 183
309ESP	Espinosa Slough upstream from Alisal Slough
309RTA	Santa Rita Creek at Santa Rita Park

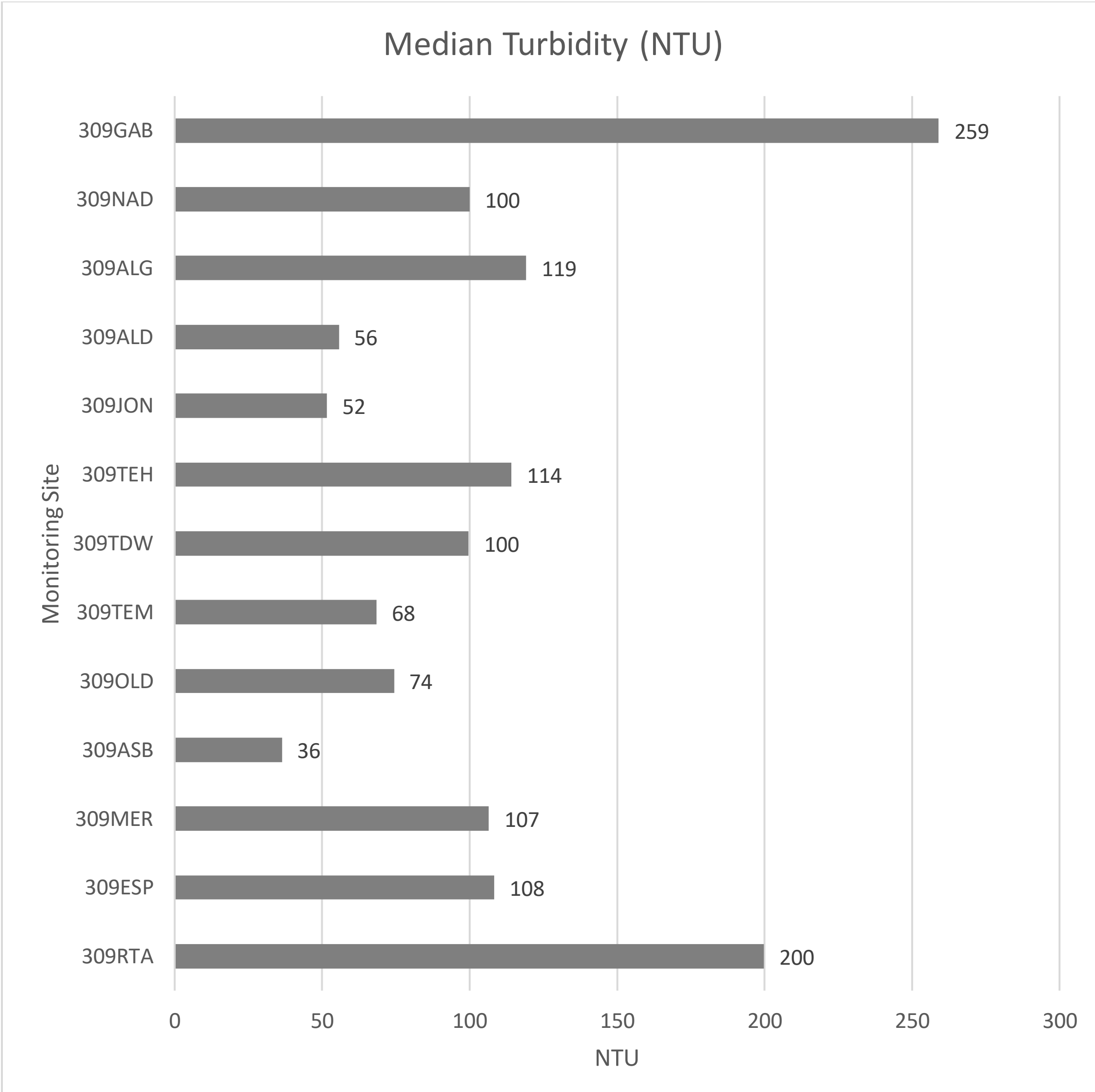

Figure 15. Chart of median year-round turbidity levels for monitoring sites in the Gabilan Creek watershed.

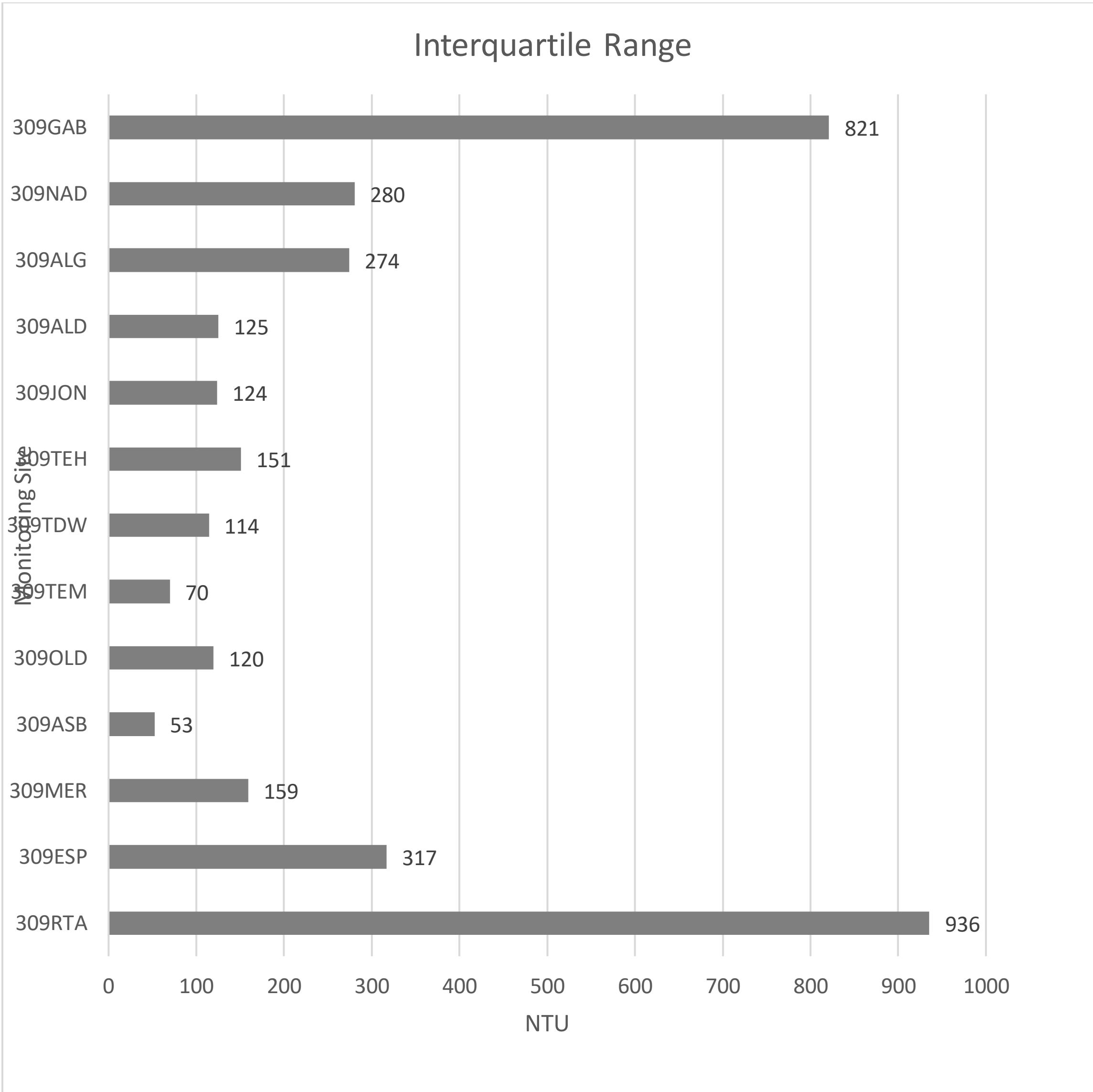

Figure 16. Chart of year-round turbidity interquartile ranges for monitoring sites in the Gabilan Creek watershed.

Spatial Patterns of Turbidity Monitoring Data

Staff mapped Gabilan Creek watershed monitoring sites and median turbidity values in Figure 17 and Figure 18. Figure 17 shows the streams and monitoring stations around the Carr Lake area including, Gabilan, Natividad, and Alisal Creeks, entering the City of Salinas, and converging at Carr Lake. The streams are channelized in the former lakebed and converge to form the Salinas Reclamation Canal, which then drains to the west and out of the City. The data indicates that water entering the City is very turbid, but it is much lower after it leaves the City in the Salinas Reclamation Canal. For example, above the City in Gabilan Creek at site 309GAB, the median turbidity is 276 NTU. Similarly entering the City, the median turbidity of Natividad Creek at site 309NAD, the turbidity is 99 NTU and the median turbidity of Alisal Creek at site 309ALD is 119 NTU. Downstream of the City and Carr Lake, the Salinas Reclamation Canal the median turbidity at site 309ALD is 56 NTU and further downstream, the median turbidity at site 309JON is 52 NTU.

The Salinas Reclamation Canal flows west from the City of Salinas to Tembladero Slough, and the Old Salinas River, which outlets to Moss Landing Harbor and ultimately the Pacific Ocean (refer to Figure 18). Several tributaries join this main flow path between the City of Salinas and the Pacific Ocean including Espinosa Slough, Santa Rita Creek, Merritt Ditch, and Alisal Slough. As previously noted, the median turbidity in the Salinas Reclamation Canal at 309JON is 52 NTU and the median turbidities of two tributaries entering the main channel (Espinosa Slough and Merritt Ditch) are higher. The median year-round turbidity for Espinosa Slough at site 309ESP is 108 NTU and for Merritt Ditch at site 309MER it is 107 NTU. Following the convergence of these two tributaries the Salinas Reclamation Canal flows into Tembladero Slough, where the year-round median turbidity level at site 309TEH is 114 NTU. This is over two times the year-round turbidity of the Salinas Reclamation Canal (309JON). Alisal Slough is a tributary of Tembladero Slough and it has the lowest median turbidity levels of the monitoring sites summarized in the lower Gabilan Creek watershed at 36 NTU at site 309ASB.

Figure 17. Map of water quality monitoring sites around the City of Salinas and median turbidity levels in parenthesis.

There are two monitoring sites, 309TEM and 309TEH, in the middle reach of Tembladero Slough and they have median turbidities of 68 NTU and 114 NTU respectively. There is one monitoring site, 309TDW, at the bottom of Tembladero Slough and just above the confluence with the Old Salinas River. The median turbidity at 309TDW is 100 NTU (refer to Figure 18). There is one monitoring site on the Old Salinas River, 309OLD, and it has a median turbidity of 74 NTU, note this site and site 309TDW are tidally influenced. Salinity effects water clarity by causing suspended sediment particles to aggregate and settle to the bottom of a waterbody (Fondriest Environmental Inc., 2014).

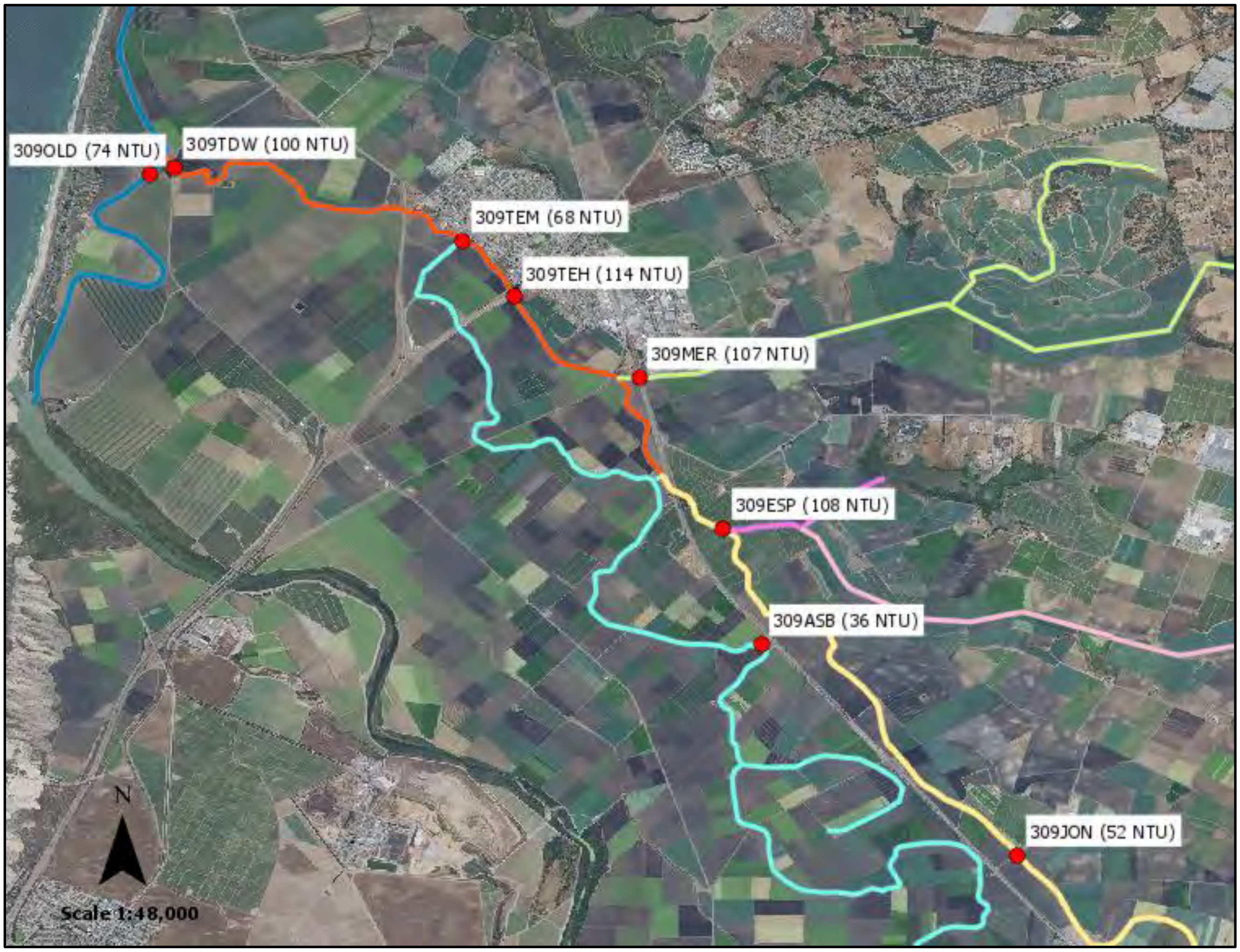

Figure 18. Map of water quality monitoring sites in the lower Gabilan creek watershed and median turbidity levels in parenthesis.

<u>Seasonal Variation</u>
Monitoring data analysis indicates that turbidity levels vary greatly from wet and dry seasons in the watershed. The turbidity monitoring data for select sites in the Gabilan Creek watershed are summarized by quartiles (25^{th}, 50^{th}, and 75^{th} percentiles) for the wet and dry seasons in Table 14. The wet season includes the months from October to April and the dry season includes the months from May to September. The wet and dry season average rainfall patterns in the watershed are described above in section 2.5. The dry season represents a period when there should be no natural surface water runoff in the watershed and streams should only be supported by baseflow. Baseflow is water that has infiltrated the soil and flows subsurface into streams.

The wet and dry season turbidity levels are illustrated in Figure 19 and Figure 20. These figures show that there are great differences between wet and dry season turbidities at most sites. For example, at Salinas Reclamation Canal/Alisal Creek site (309ALG) the median dry season turbidity is 55 NTU and the wet season turbidity is 196 NTU. The greatest differences between wet and dry season turbidities occurs at 75th percentile level. For example, Santa Rita Creek (309RTA) has a 75th percentile dry season turbidity of 214 NTU and a wet season turbidity of 1,144 NTU. One exception to this pattern is the Old Salinas River, which has nearly identical dry and wet season turbidity levels at all percentiles. This may be the result of tidal influence.

Both dry and wet seasons have a wide range of turbidity levels in the watershed, which is reflected in the IQRs of the samples from these periods. IQR is a statistical measure of variability and captures the middle range of the samples. For example, the dry season IQR for Merritt Ditch at site 309MER is 80 NTU and the wet season IQR is 300 NTU. One stream reach with a relatively low IQR is the Salinas Reclamation Canal at site 309JON where the dry season IQR is 26 NTU. For comparison, regional turbidity levels are summarized in a report prepared by staff, Proposed Methodology to Derive Natural Conditions for Turbidity and Development of Site-Specific Water Quality Criteria for Turbidity in the Central Coast Region (Natural Turbidity Report). In the Natural Turbidity Report, staff found that the year-round IQR for low-vegetated reference streams is 3.4 NTU and for the general populations streams it is 26.6 NTU. The reference streams are defined in the Natural Turbidity Report as least impacted streams. The Natural Turbidity Report is included as Appendix 2.

Table 14. Dry and wet season percentiles for monitoring stations in the Gabilan Creek watershed.

Waterbody and (Site Id)	**Season**	**Number of Samples**	**25th Percentile (NTU)**	**50th Percentile Median (NTU)**	**75th Percentile (NTU)**	**IQR* (NTU)**
Gabilan Creek (309GAB)	dry	32	40	178	366	326
Gabilan Creek (309GAB)	wet	60	124	346	1010	886
Natividad Creek (309NAD)	dry	72	53	106	246	193
Natividad Creek (309NAD)	wet	92	38	95	451	412
Salinas Reclamation Canal/Alisal Creek (309ALG)	dry	67	27	55	157	130
Salinas Reclamation Canal/Alisal Creek (309ALG)	wet	91	72	196	612	540
Salinas Reclamation Canal (309ALD)	dry	44	19	37	57	38

Waterbody and (Site Id)	Season	Number of Samples	25th Percentile (NTU)	50th Percentile Median (NTU)	75th Percentile (NTU)	IQR* (NTU)
Salinas Reclamation Canal (309ALD)	wet	60	43	110	337	294
Salinas Reclamation Canal (309JON)	dry	69	18	25	44	26
Salinas Reclamation Canal (309JON)	wet	92	43	102	275	232
Tembladero Slough (309TEH)	dry	69	57	88	159	102
Tembladero Slough (309TEH)	wet	93	84	140	399	315
Tembladero Slough (309TDW)	dry	76	59	125	183	124
Tembladero Slough (309TDW)	wet	100	49	87	161	111
Tembladero Slough (309TEM)	dry	17	38	54	87	49
Tembladero Slough (309TEM)	wet	21	52	86	134	82
Old Salinas River (309OLD)	dry	131	29	75	152	123
Old Salinas River (309OLD)	wet	168	36	74	152	116
Alisal Slough (309ASB)	dry	67	12	23	42	30
Alisal Slough (309ASB)	wet	90	27	51	102	75
Merritt Ditch (309MER)	dry	69	42	76	122	80
Merritt Ditch (309MER)	wet	93	67	156	367	300
Espinosa Slough (309ESP)	dry	67	13	69	217	204
Espinosa Slough (309ESP)	wet	94	65	153	536	471
Santa Rita Creek (309RTA)	dry	20	51	94	214	163
Santa Rita Creek (309RTA)	wet	40	65	357	1175	1109

Note: *Interquartile Range (IQR) = 75th percentile minus 25th percentile

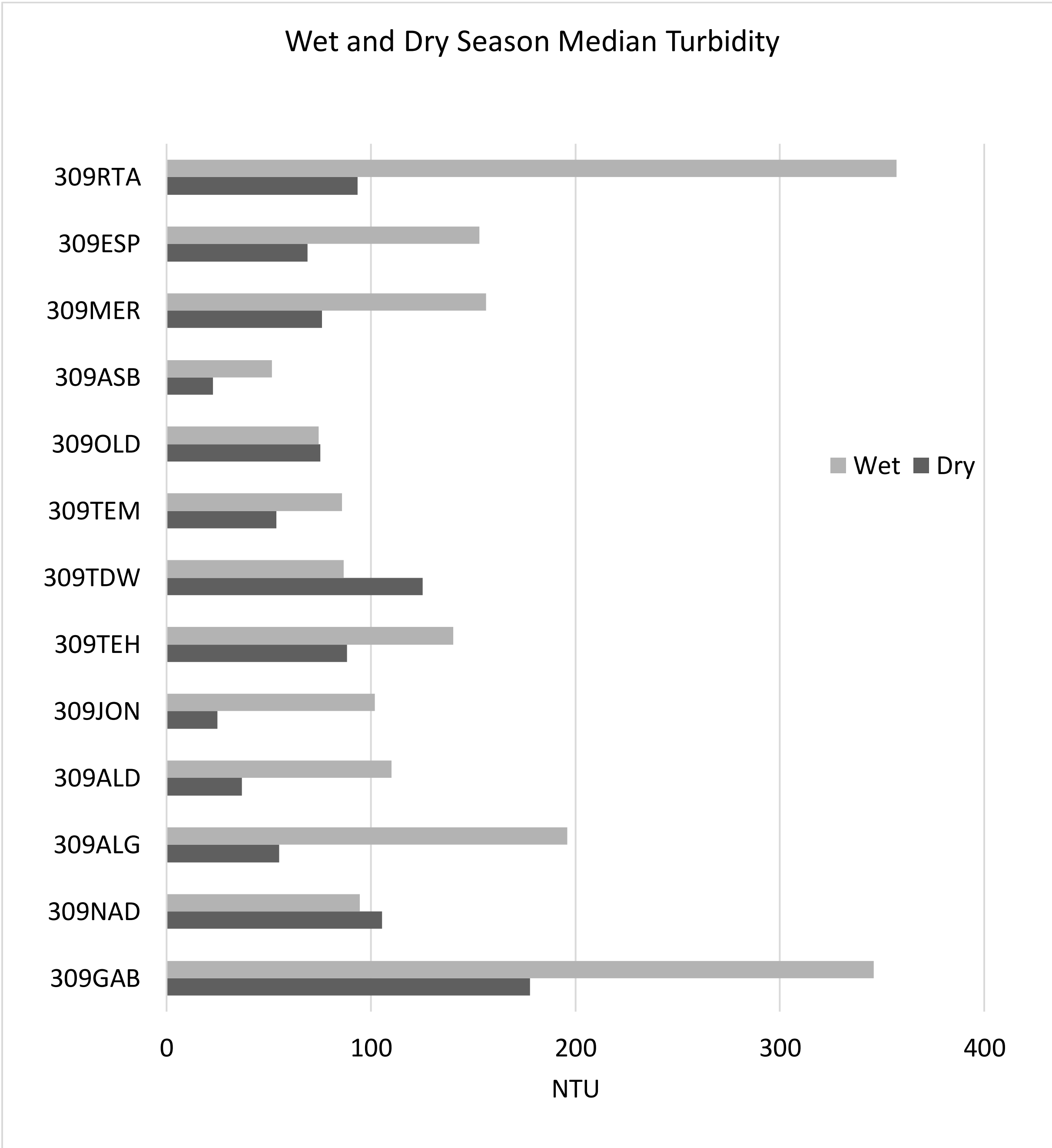

Figure 19. Chart of wet and dry season median turbidity levels at monitoring sites in the Gabilan Creek watershed.

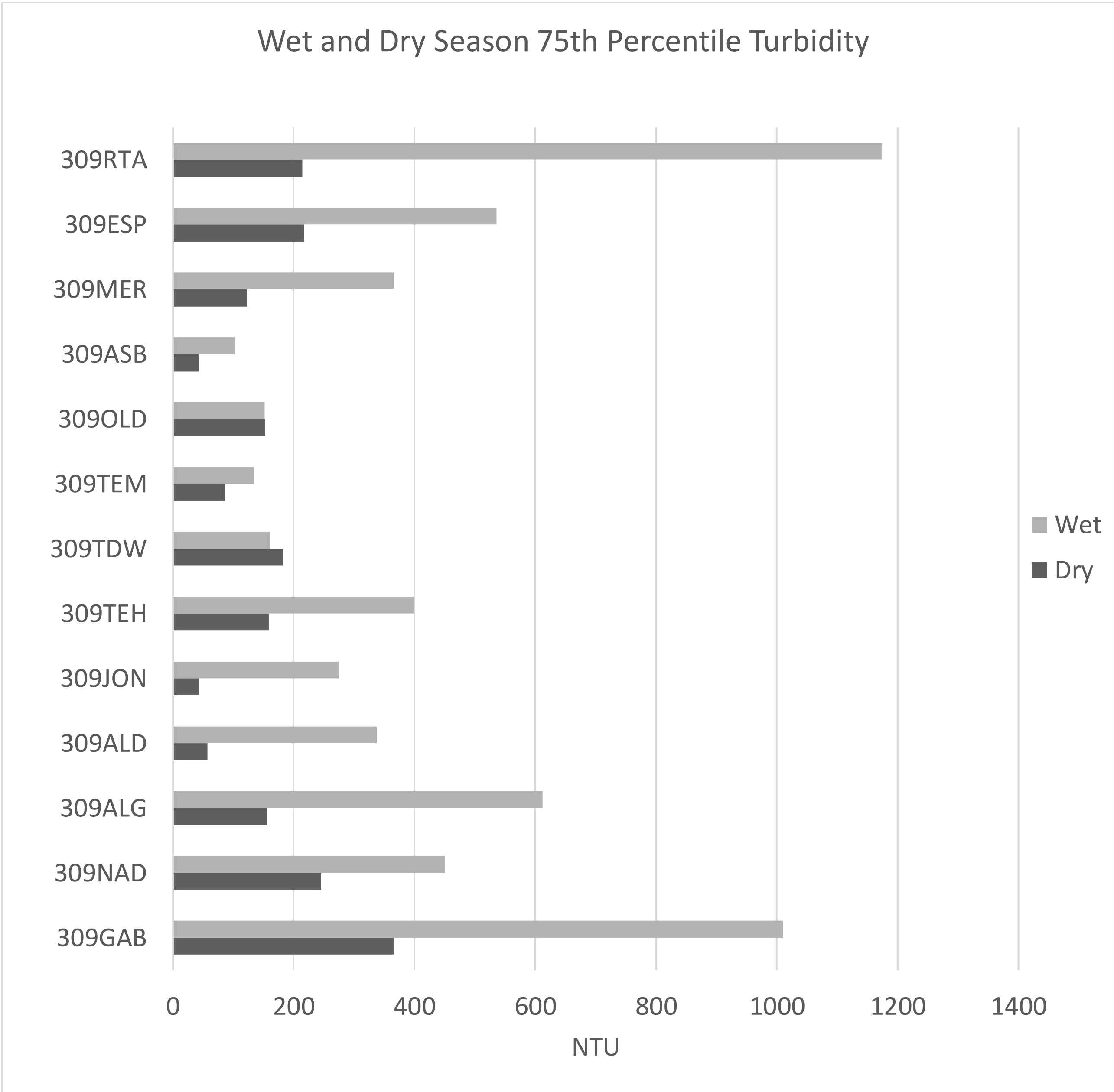

Figure 20. Chart of wet and dry season 75th percentile turbidity values at monitoring sites in the Gabilan Creek watershed.

4. Development of Turbidity Numeric Targets

Numeric targets define the turbidity levels, in NTU, necessary to achieve the water quality objective and therefore the water quality necessary to support designated beneficial uses (i.e., water quality standard attainment). The turbidity water quality objective in the Basin Plan states the following:

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.

Increase in turbidity attributable to controllable water quality factors shall not exceed the following limits:

1. *Where natural turbidity is between 0 and 50 Nephelometric Turbidity Units (NTU), increases shall not exceed 20 percent.*
2. *Where natural turbidity is between 50 and 100 NTU, increases shall not exceed 10 NTU.*
3. *Where natural turbidity is greater than 100 NTU, increases shall not exceed 10 percent.*

The turbidity water quality objective has two parts, and both are considered in the development of potential turbidity numeric targets. Part one (a narrative water quality objective) protects beneficial uses of water from adverse effects of turbidity, and part two (a numeric water quality objective) limits on increases above natural turbidity.
The turbidity water quality numeric objective and the turbidity numeric targets in this TMDL Project are based on defined natural turbidity levels and setting a limit for increases in turbidity above the defined natural turbidity level. These limits are consistent with USEPA water quality criteria for suspended solids and turbidity which states the following (USEPA, 1986):

> **Freshwater fish and other aquatic life**
> Settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.

A precursor to published USEPA criteria was a National Technical Advisory Committee report on water quality criteria (NTAC, 1968). This report describes the causes of turbidity, the physical properties of turbidity in water, and the impacts to primary producers from reduced light penetration caused by turbidity.

Turbidity is caused by the presence of suspended solids such as clay, silt, finely divided organic matter, bacteria, plankton, and other microscopic organisms. Turbidity is an expression of the optical property of a sample of water which causes light to be scattered and absorbed rather than transmitted in straight lines through the sample. Excessive turbidity reduces light penetration into the water and, therefore, reduces photosynthesis by phyto-plankton organisms, attached algae, and sub-mersed vegetation.

This section of the report summarizes potential numeric targets based on both the narrative and numeric components of the turbidity water quality objective. Staff developed potential turbidity numeric targets to interpret the narrative component by reviewing published studies and developed potential numeric targets to interpret the numeric component by determining natural conditions for the watershed. Staff used this information to determine the final and interim numeric targets for the watershed. Interim targets apply to the highly impaired conditions in the lower Gabilan Creek watershed as means to achieve and mark progress towards meeting the final targets.

In addition, staff considered the USEPA methods for the derivation of aquatic life criteria (USEPA, 1985). The USEPA criteria derivation method includes eight standardized lab aquatic toxicity tests (assays) and results in the derivation of acute and chronic criteria but these types of toxicity tests are not available for turbidity. However, existing USEPA criteria are based on seasonal normal levels, which is comparable to the method selected by staff.

4.1. Development of Potential Turbidity Numeric Targets Based on Interpretation of the Narrative Component of the Turbidity Water Quality Objective

Staff reviewed published studies to identify turbidity levels that adversely affect aquatic life and aquatic ecosystems. Then, to develop turbidity numeric targets that do not adversely affect aquatic organisms, staff applied a safety factor (i.e., divided the turbidity level from the published study by a factor of two or ten). Key published studies are summarized in this section and potential turbidity numeric targets identified in published studies are summarized Table 17.

The Effects of Turbidity on COLD Beneficial Uses

The following published studies evaluated effects of turbidity on COLD aquatic ecosystems and identified levels that adversely affect aquatic life, including steelhead trout (*Oncorhynchus mykiss*), a species that utilizes spawning habitat in the upper Gabilan Creek watershed:

Sigler, et al., 1987 – Effects of Chronic Turbidity on Density and Growth of Steelheads and Coho Salmon: The researchers evaluated the effects of chronic turbidity on fish growth and determined that as little as 25 NTUs of turbidity caused a reduction in fish growth. The study was conducted in oval channels and the fish were fed brine shrimp the first year and pellets the second. The feeding scenario in the study is different than natural stream setting and staff hypothesized that the response to natural foods such as invertebrates would be lower. Staff used this threshold for the COLD freshwater beneficial use to interpret the Basin Plan's narrative turbidity objective when developing the 303(d) List of impaired waters. Since 25 NTU is a level when fish are negatively impacted, and therefore the beneficial use of the waterbody is impaired, 25 NTU is not protective of the beneficial use.

Lloyd, et al., 1987 – Effects of Turbidity in Fresh Waters of Alaska: Lloyd provides thorough research on the effects of turbidity on freshwater lakes and streams in Alaska. The research evaluated the effects of turbidity on light penetration, algal and primary (plant) production, zooplankton abundance, macroinvertebrate abundance, and human use. The paper also presents research and regression analysis on the relationship of turbidity to suspended sediment concentrations for Alaska streams (refer to Figure 21). Table 15 summarizes the results of the research on the effects of turbidity and Figure 22 illustrates the specific effects of turbidity on plant production. Lloyd found that a 5 NTU increase in turbidity above natural would reduce light penetration and result in an 80% decrease in the plant production. Lloyd concluded in the paper that water quality standards for turbidity could be developed based on the research summarized in his paper.

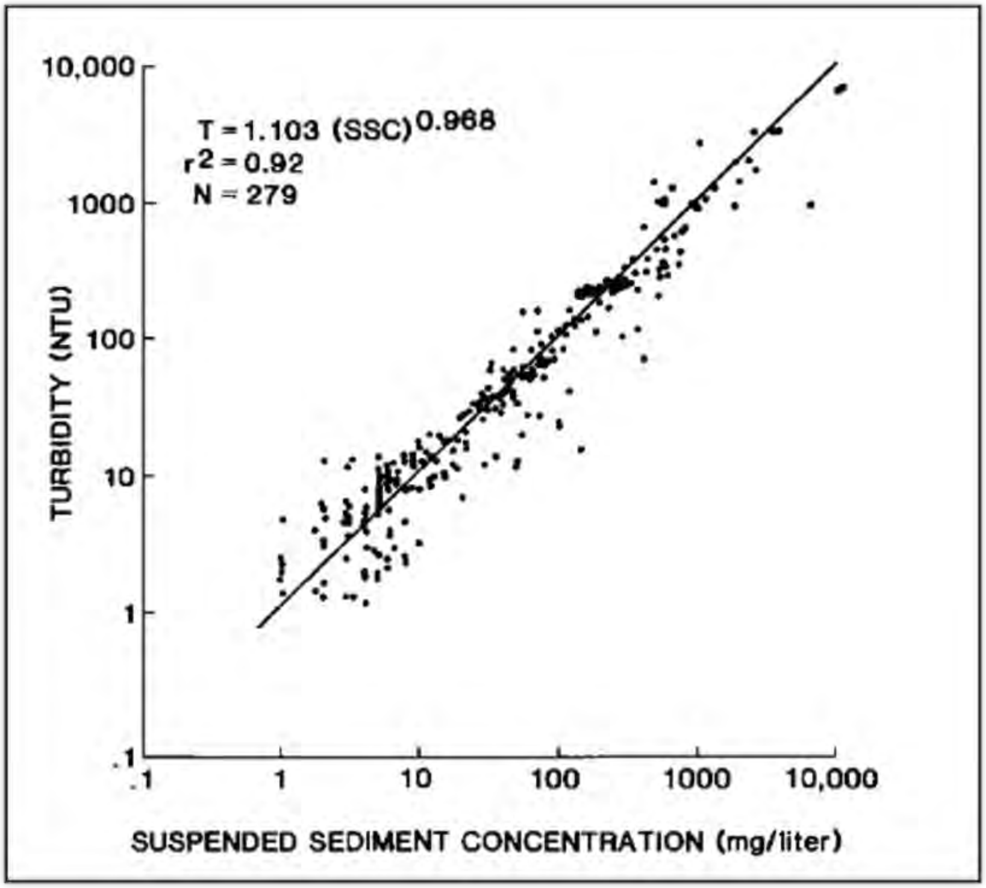

Figure 21. Graph showing turbidity versus suspended sediment concentration for five interior Alaska streams (Lloyd et al., 1987).

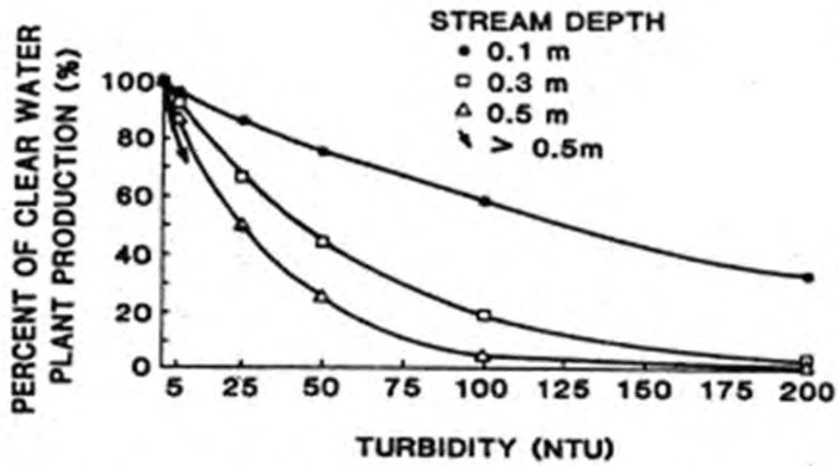

FIGURE 5.—Reduction in plant production with increased turbidity in artificially turbid streams of various depths in interior Alaska (derived from equation 7); NTU is nephelometric turbidity unit.

Figure 22. Graph showing reduction in plant production with increased turbidity (Lloyd et al., 1987).

Table 15. Effects of turbidity on cold freshwater ecosystems (Lloyd et al., 1987).

Waterbody	Effect	Turbidity	Notes
Lakes	Light penetration	A 5-NTU increase of a naturally clear lake	May reduce productive euphotic volume by 80% (depth in lake that photosynthesis occurs)
Lakes	Light penetration	Just above 5-NTUs	The 1% light depth decrease markedly
Lakes	Primary production (plants)	Between 4 and 15 NTUs	Disruption of expected relationship between light penetration, phosphorus, and chlorophyll a
Lakes	Zooplankton abundance	10 NTU	Declines in feeding rate and food assimilation

Waterbody	Effect	Turbidity	Notes
Lakes	Fish production - juvenile sockeyes salmon (*Oncorhynchus nerka*)	n/a	Decreased euphotic volume results in less food for fish, which leads to lower fish production
Streams	Light penetration and primary production	5 NTU	3-13% decrease in primary productivity
Streams	Light penetration and primary production	25 NTU	13-50% decrease in primary production
Streams	Abundance of macroinvertebrates	n/a	Populations of benthic invertebrates lower in turbid mined streams than unmined streams
Streams	Effects on fish (salmonids)	30 NTU	Avoidance of turbid water

Shaw and Richardson 2001- Direct and Indirect Effects of Sediment Pulse Duration on Stream Invertebrate Assemblages and Rainbow Trout (*Oncorhynchus mykiss*) Growth and Survival: This study evaluated the effects of sediment pulse duration on invertebrate populations and on trout growth and survival in experimental channels. With increases in sediment pulse duration, the benthic invertebrate abundance (number of individuals) and family richness (number of unique taxa) declined while the total abundance of drift invertebrates increased. Trout length and mass gain decreased with increased pulse duration. Analysis suggests that reduced trout growth is related to impaired vision, which leads to reduce prey capture and increased effort (energy expended) to capture them.

Sweka and Hartman 2001a – Influence of Turbidity on Brook Trout Reactive Distance and Foraging Success: The reactive distance of brook trout (*Salvelinus fontinalis*) decreased in a curvilinear pattern as turbidity increased. Reactive distance (the ability of the fish to detect and respond to the presence of prey) decreased by 50% at 10 NTU (refer to Figure 23).

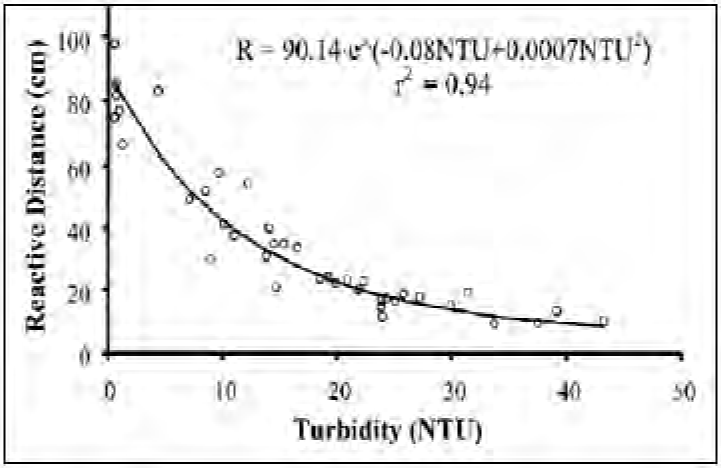

Figure 23. Graph showing the relationship of turbidity and reactive distance for brook trout (Sweka and Hartman, 2001a).

Sweka and Hartman 2001b – Effects of Turbidity on Prey Consumption and Growth in Brook Trout and Implications for Bioenergetics Modeling: Findings show that brook trout (*Salvelinus fontinalis*) growth rates decreased significantly with increased turbidity. Turbidity had no significant influence on mean daily consumption however, as turbidity increased fish transitioned from a drift-feeding strategy (at 10 to 20 NTUs) to an active searching strategy with greatly increased movement and energy output for foraging. Although consumption rates did not decrease with increased turbidity, specific growth rates did significantly decrease. The study found a 62% decrease in growth rate when comparing clear water (turbidity level of approximately 0.6 NTU) to highest levels of turbidity (> 40 NTU). The researchers proposed that the increased effort to feed at higher turbidity levels appears to reduce growth.

Effects of Turbidity on WARM Beneficial Uses

Buck, D.H., 1956 - Effects of Turbidity on Fish and Fishing: Increased turbidity directly affect production of warm water fish; largemouth bass, bluegills, and channel catfish (Buck, 1956). The USEPA Bluebook of water quality criteria (NAS, 1972) cites Buck's findings as supporting evidence for turbidity criteria. Buck noted that turbidity was monitored using Jackson turbidity meters, which are outdated instruments with limited low range capabilities. In addition, staff found inconsistencies with how Buck reported monitoring data. Buck described using a Jackson turbidity meter to measure turbidity but reported the results as ppm, which are a measure of concentration. Therefore, the specific values in the studies could not be used in the TMDL Project; the results do however provide insight on the relative impacts of turbidity on fish. Average per acre yield of warm water fish production greatly decreased with reductions in water clarity (refer to Table 16). Clear ponds with lower turbidity were found in the study to have greater number and larger fish.

Table 16. Table of warm water fish yields at various turbidity levels (Buck, 1956).

Water Clarity	Turbidity*	Yield of fish after 2 growing Seasons
Clear ponds	< 25	161.5 lb/acre
Intermediate ponds	25 – 100	94.0 lb/acre
Muddy ponds	> 100	29.3 lb/acre

Note: * The exact units of measurement could not be verified and therefore were not included.

Shoup and Wahl, 2009. - The Effects of Turbidity on Prey Selection by Piscivorous Large Mouth Bass: Turbidity influences prey selection and overall foraging rate of largemouth bass (*Micropterus salmoides*). Shoup and Wahl found that the foraging rate of largemouth bass was greatly reduced at 40 NTU. Staff use 40 NTU to interpret the Basin Plan narrative objective for the 303(d) List assessment and the WARM beneficial use. Since 40 NTU is a level when fish are adversely affected, this guideline illustrates when water quality is impaired, and therefore it is not a level that represents a healthy waterbody.

Effects of Turbidity on Both WARM and COLD (Benthic Algal Study)

Davies-Colley et al., 1992 - Fecal Contamination and Visual Clarity in New Zealand Rivers: Correlation of Key Variables Affecting Swimming Suitability. Journal of Water and Health: Increased turbidity reduces benthic primary productivity in streams due to increased light attenuation in water. A study conducted in New Zealand streams, on discharges of suspended clay from placer mining, found that increased turbidity (15 NTU) reduced benthic algal biomass and lowered the phototrophic content of the epilithon (algae growing on rocks) (Davies-Colley et al., 1992). In comparison, turbidity upstream of the mining activity, in a healthier stream reach, had a median turbidity of 2.4 NTU.

Studies Selected for Interpretation of Narrative Objective

Based on the studies described in this section, staff selected appropriate turbidity levels for interpreting the turbidity narrative objective. The four levels range from 10-40 NTUs and the effects they have on beneficial uses are described as follows:

1. 10 NTU of turbidity reduced the reactive distance of brook trout (*Salvelinus fontinalis*), an impact on COLD beneficial uses (Sweka and Hartman, 2001a).

2. 15 NTU median turbidity reduced benthic algal biomass, an impact on both COLD and WARM beneficial uses (Davies-Colley et al., 1992).

3. 25 NTU of turbidity caused a reduction in cold water fish growth, Steelhead (*Oncorhynchus mykiss*) an impact on COLD beneficial uses (Sigler et al., 1987). This is the 303(d) List COLD guideline.

4. 40 NTU of turbidity reduced foraging rate of warm water fish, Large Mouth Bass (*Mocropterus salmoides*), an impact to WARM beneficial uses (Shoup and Wahl, 2009). This is the 303(d) List WARM guideline.

Potential Turbidity Numeric Targets Based on Published Studies

To interpret the narrative component of the turbidity water quality objective, staff considered the effects levels from the four turbidity published studies. The effects levels on their own, however, cannot be used as turbidity numeric targets since the studies report levels that adversely affect aquatic life beneficial use and would therefore not meet the Basin Plan objective for turbidity. To derive potential turbidity numeric targets protective of aquatic life beneficial uses from the studies, staff applied a safety factor to the effect levels to address the uncertainty between the levels of effect and a level protective of beneficial uses.

To address this type of uncertainty, safety factors are commonly applied to derive water quality criteria. These methods involve multiplying or dividing the lowest values in a data set by a factor (TenBrook and Tjeerdema, 2006). Common safety factors used for regulatory programs as divisors are in the range of 10, 20, and 100. The California Ocean Plan methodology to derive water quality objectives uses a safety factor of 10 in some cases (SWRCB, 1990). Selenium, for example, has a chronic toxic level of 147 ug/L, that was divided by 10 and rounded to give a final Ocean Plan objective of 15 ug/L.

USEPA also incorporates safety factors in developing their drinking water criteria and aquatic life benchmark calculations for pesticides. For human health drinking water criteria, USEPA recommends safety factors of 10, 100, or 1000, depending on the quality of data. USEPA recommends using a safety factor of 10 for a situation with good quality data. For aquatic life benchmark calculations, the USEPA Office of Pesticide Planning divides the lowest toxicity values by two (Bower, 2020).

Selection of a safety factor is considered both a science and a policy decision with the goal of protecting the environment while not setting targets that are over-protective. With incomplete information on the risk of turbidity on aquatic life in the watershed, staff outlines a range of potential turbidity numeric targets based on the effect levels found in the select published studies with applied safety factors (divisors of 2 and 10). Table 17 summarizes the select published studies, effect levels, and potential turbidity numeric targets considered for interpretation of the narrative component of the turbidity water quality objective.

Table 17. Potential turbidity numeric targets based on the effect levels in published studies considered in the TMDL.

Number	Description of the Study	Effect Level (NTU)	Potential Target with a Safety Factor of 2 (NTU)	Potential Target with a Safety Factor of 10 (NTU)
1.	Trout reactive distance study (Sweka and Hartman, 2001a)	10	5	1.0
2.	Reduced benthic algal biomass study (Davies-Colley et al., 1992)	15	7.5	1.5
3.	Reduced steelhead growth study (cold water habitat) (Sigler et al., 1987)	25	12.5	2.5
4.	Reduced foraging rate of warm water habitat fish study (Shoup and Wahl, 2009)	40	20	4.0

4.2. Development of Potential Turbidity Numeric Targets Based on Interpretation of the Numeric Component of the Turbidity Water Quality Objective

Staff also identified potential turbidity numeric targets to interpret the numeric component of the turbidity water quality objective, which sets numeric limits based on increases of turbidity above natural turbidity. Although the water quality objectives allow for an increase above natural, the potential targets do not include an increase, thereby providing a margin of safety and ensuring conservative protection of water quality.

Waterbodies in the Gabilan Creek watershed are highly impaired and consequently, staff could not determine natural turbidity based solely on monitoring data from the Gabilan Creek watershed. Instead, staff determined natural conditions by analyzing monitoring data from reference (less impaired but similar) streams outside the watershed but within the same ecoregion. Staff use the following USEPA definition of a reference stream in the selection of turbidity targets (USEPA, 2000a).

“A reference stream is a least impacted waterbody within an ecoregion that can be monitored to establish a baseline to which other waters can be compared. Reference streams are not necessarily pristine or undisturbed by humans.”

Staff used several approaches to interpret the numeric portion of the turbidity water quality objective and identify natural turbidity in the watershed. This includes a hydrogeomorphic approach, a USEPA ecoregional approach, and analysis of regional agricultural monitoring data (CMP approach). Three approaches are based on analysis of regional water quality monitoring data and GIS spatial analysis. The regional data analysis methods and summaries are included in Appendices 1, 2, and 3.

Hydrogeomorphic Approach

Staff used the hydrogeomorphic approach to identify reference sites and natural turbidity for the streams in the lower Gabilan Creek watershed. The U.S. Army Corp of Engineers (ACOE) developed the hydrogeomorphic approach for classifying streams as part of their approach for assessing wetland functions, a CWA section 404 regulatory program requirement. Under this program, the ACOE regulates the discharge of dredged or fill materials in "waters of the United States." The ACOE hydrogeomorphic approach is designed to set chemical, physical, and biological standards of comparison for project sites using the using the conditions of less disturbed reference sites (ACOE, 1995).

With the hydrogeomorphic approach, staff selected reference sites by evaluating watershed hydrogeomorphic characteristics and water quality monitoring data of regional monitoring sites. In this approach, turbidity-monitoring data are summarized from streams and sloughs in watersheds with similar hydrogeomorphic characteristics to the Gabilan Creek watershed including the following:

1. <u>Geomorphic setting</u>;
2. <u>Water source</u>; and
3. <u>Hydrodynamics</u>.

<u>Geomorphic setting</u> is the landform of a stream, the geological landscape, and the topographic position in the landscape. The geomorphic setting of the lower/impaired sections of the Gabilan Creek watershed flow through a flat alluvial valley landform below a coastal foothill mountain range.

<u>Water source</u> is the location of water before it enters a wetland. Baseflow from shallow groundwater is the natural source of water in perennial streams in the lower portions of the Gabilan Creek watershed. Streams intermittently flow into the valley and are naturally supported by seasonal rainfall. In the headwaters of the Gabilan Mountains, perennial baseflow naturally supports year-round streams and pools. The lower Gabilan Creek watershed is highly modified and year-round anthropogenic sources of water such as urban stormwater, agricultural runoff, tile drains, and pumps support stream flows.

Hydrodynamics is the energy level of the moving water and the direction of the flow in a wetland. For example, the level of energy of a wetland on a river floodplain is naturally much lower than a fast-flowing steeper gradient mountain stream. Impaired waters in the lower Gabilan Creek watershed flood plain are naturally slow moving with the stream channels draining in a westerly direction from the Gabilan Mountains towards the ocean across a low gradient alluvial plain. Stream velocities further diminish when the streams reach the slough systems at the bottom of the watershed in the Tembladero Slough and the Old Salinas River. The Old Salinas River and portions of the lower Tembladero Slough are brackish with tidal influence and depending on the tides, their flows can be bidirectional. Tide gates separate the Old Salinas River Estuary, at the very bottom of the watershed from Moss Landing harbor and ultimately the Pacific Ocean.

Table 18 summarizes the results of the natural turbidity analysis for perennial streams in the lower Gabilan Creek watershed and
Table 19 summarizes the results for the sloughs. The tables summarize monitoring data seasonally; year-round, dry season, and wet season and by average quartiles. Table 18 summarizes data from 19 riverine monitoring sites and from two slough monitoring sites. Appendix 1 further details the results of the hydrogeomorphic approach.

Table 18. Average quartiles of year-round, dry season, and wet season turbidity monitoring data from perennial riverine reference sites.

Season	25th Percentile (NTU)	Median (NTU)	75th Percentile (NTU)
Year-round	4	8	20
Dry	3	6	13
Wet	5	11	28

Table 19. Average of quartiles of year-round, dry season, and wet season turbidity monitoring data from slough reference sites.

Season	25th percentile (NTU)	Median (NTU)	75th percentile (NTU)
Year-round	14	32	77
Dry	12	22	55
Wet	15	37	83

USEPA Ecoregional Approach

Using the USEPA ecoregional approach, staff developed a methodology to define and document natural conditions for turbidity for streams in the entire Central Coast Region including the Gabilan Creek watershed. Appendix 2, *Proposed Methodology to Derive Natural Conditions for Turbidity and Development of Site-Specific Water Quality Criteria for Turbidity in the Central Coast Region* describes a methodology for deriving natural turbidity conditions for central coast and summarizes the conditions (CCRWQCB, 2020).The methodology is based on guidance published by the USEPA as described in the *Nutrient Criteria Technical Guidance Manual* (USEPA, 2000a), the *Ambient Water Quality Criteria Recommendations, Rivers and Streams in Nutrient Ecoregion III* (USEPA, 2000b), and *A Framework for Defining and Documenting Natural Conditions for Development of Site-Specific Natural Background Aquatic Life Criteria for Temperature, Dissolved Oxygen, and pH: Interim Document* (USEPA, 2015).

The USEPA ecoregional approach includes classifying streams using slope, system size, and substrate, then further using land use to ascertain a degree of relative impact due to anthropogenic sources. The methodology then applies an empirical statistical approach to characterize the distribution of turbidity values in two populations of streams: those deemed least impacted and the general population of streams. The Central Coast Region's turbidity monitoring data set includes monthly monitoring from over 190 monitoring stations from streams throughout the Region. Staff used this distribution of turbidity values to ascertain natural conditions for turbidity in the watershed. The least impacted approach bases the determination of natural turbidity on the 75th percentile turbidity from reference streams (refer to Appendix 2, Table 2). In the Gabilan Creek watershed, waterbodies are classified as "head-low-vegetated" and "medium-low-unconsolidated" with year-round natural turbidity derived from regional reference stream monitoring data.

<u>Natural turbidity derived from head-low-vegetated reference streams</u>

- Year-round - 2.5 NTU
- Dry Season - 2.2 NTU
- Wet Season - 3.3 NTU

<u>Natural turbidity derived from medium-low-unconsolidated reference streams</u>

- Year-round - 3.9 NTU
- Dry Season - 2.4 NTU
- Wet Season - 6.5 NTU

CMP Approach

Staff analyzed regional monitoring data from the Cooperative Monitoring Program (CMP) for irrigated agriculture to support the identification of natural conditions for the Gabilan. For regulatory compliance, the CMP collects monthly turbidity measurements from over 50 monitoring sites in agricultural areas of the

Central Coast Region, including 10 sites in the Gabilan Creek watershed. Appendix 3 includes a complete analysis of CMP turbidity data. The CMP monitoring data approach was recommended by agricultural stakeholders who wanted staff to specifically consider the water quality conditions from watersheds with similar agricultural settings to the Gabilan Creek watershed. Although the CMP has sampled over 50 sites, only 47 sites had enough samples for the TMDL analysis.

Staff analyzed the range of monitoring data from CMP monitoring sites throughout the Central Coast Region and summarized the data by quartiles (refer to Appendix 3). Since the agricultural watersheds are highly modified and no longer in natural conditions, staff identified the 25th percentile of samples as most representative of least disturbed waters and these data are summarized for the Gabilan Creek watershed, the sites throughout the region, and for CMP sites except ones in the Gabilan Creek watershed in Table 20. The later selection of sites outside of the Gabilan Creek watershed have better water quality (lower turbidity) and more closely represent natural conditions. The year-round turbidity outside of the Gabilan is 16 NTU, the dry season is 12 NTU, and the wet season is 21 NTU.

Table 20. Average 25th percentile of turbidity monitoring data from CMP monitoring sites.

Location	Number of monitoring sites	Year-round (NTU)	Dry (NTU)	Wet (NTU)
Gabilan Creek Watershed	10	65	52	153
All CMP Sites	47	26	20	49
CMP Sites except ones in the Gabilan Creek Watershed	37	16	12	21

4.3. Summary of Potential Numeric Targets

Staff considered four potential numeric targets from published literature values and another four based on derivation of natural turbidity conditions from reference sites. Table 21 summarizes the potential numeric targets, expressed as year-round turbidity, dry season turbidity, and wet season turbidity. The potential numeric targets from published studies (numbers 1 to 4) are year-round targets only since the studies did not specify seasonal values. The numeric targets derived from published studies are based on the effects of turbidity on aquatic life and include a safety factor of 2 to assure protection. To determine attainment of a potential turbidity numeric target, compare the median turbidity data value for year-round or seasonal data to the appropriate potential turbidity numeric targets summarized in Table 21.

Table 21. Summary of year-round and seasonal median potential turbidity numeric targets (as NTU), considered for non-tidal waterbodies in the Gabilan Creek Watershed.

No.	Description of Potential Turbidity Numeric Target (Beneficial Uses)	Year Round	Dry Season	Wet Season
1	Trout Reactive Distance Study (COLD) 10 NTU/Safety Factor 2	5	n/a	n/a
2	Reduced Benthic Algal Growth Study (COLD and WARM) 15 NTU/Safety Factor 2	7.5	n/a	n/a
3	Reduced Steelhead Growth Study (COLD) 25 NTU/Safety Factor 2	12.5	n/a	n/a
4	Reduced Warm Water Fish Foraging Rate Study (WARM) 40 NTU/Safety Factor 2	20	n/a	n/a
5	Hydrogeomorphic Approach Reference Sites - 25th Percentile (COLD and WARM)	4	3	5
6	Hydrogeomorphic Approach Reference Sites - 50th Percentile (COLD and WARM)	8	6	11
7	USEPA Ecoregional Reference Approach – Natural Turbidity Derived from 75th percentile for medium-low-unconsolidated streams (COLD and WARM)	3.9	2.4	6.5
8	USEPA Ecoregional Reference Approach – Natural Turbidity Derived from 75th percentile for head-low-vegetated streams (COLD and WARM)	2.5	2.2	3.3
9	CMP All Non-Gabilan Reference Sites - 25th Percentile (COLD and WARM)	16	12	21

Note: Potential targets 1, 2, 3, and 4 are from published studies with a safety factor of 2.

5. Selection of Turbidity Numeric Targets

Staff selected final and interim numeric targets based on the potential numeric targets summarized in Table 21. Final turbidity numeric targets are levels that indicate that both the narrative and numeric components of the turbidity water quality objective in the Basin Plan are met. Streams in the lower Gabilan Creek watershed are highly impaired for turbidity and the necessary improvements in land management practices to achieve the final TMDL targets will take substantial time and effort. Therefore, staff developed interim targets as transitional milestones established to measure improvements in water quality and progress toward attaining the final numeric targets. The interim numeric targets are turbidity levels in which some level of impairment and impacts to aquatic life would occur.

5.1. Final Numeric Targets

Staff evaluated the eight potential numeric targets summarized in Table 21 to determine the appropriate final numeric targets for the Gabilan Creek watershed. The first four potential final numeric targets from published studies and modified by applying a safety factor (published value divided by two). These turbidity levels demonstrate year-round protection of specific aquatic organisms. Some organisms, such as algae, are found in WARM and COLD habitats but others have specific habitats. For example, turbidity effects on trout and steelhead are the basis of potential numeric targets 1 and 3 and these species are representative of COLD habitats. Turbidity effects on warm water fish such as bass are representative of WARM water habitats and are the basis of target number 4. Target number 2 is from a study on the effects of turbidity on algae, which are found in all types of streams and this target represents both WARM and COLD habitats.

The first four potential numeric targets are considered protective of the species in the published studies but are not considered be protective of the all species in an aquatic ecosystem. Therefore, it is necessary to consider them in conjunction with the next four potential targets that are based on natural conditions.

The natural conditions vary in the watershed depending on the many factors including geomorphology, hydrology, steelhead habitat, and land cover/use. To set final turbidity targets, the watershed was divided into two geographic regions. The first area is the upper Gabilan Creek watershed headwaters, which have relatively undisturbed natural land cover and viable steelhead habitat. The second area is the lower alluvial valley with highly developed lands that includes streams from the base of the Gabilan Range to the outlet of the watershed at Moss Landing. Staff separated brackish waterbodies near the coastal outlet from these other freshwater streams in lower watershed area since final natural condition targets could not be determined for these waters due to limited monitoring data from similar tidally influenced reference waterbodies in the region.

Final numeric targets from the two major geographic areas in the watershed are based on seasonal natural turbidity conditions, which is consistent with USEPA national criteria for turbidity and with the numeric component of the turbidity objective. Attainment of these turbidity numeric targets is based on comparing equal interval turbidity samples in waters (i.e. collected monthly) from the Gabilan Creek watershed and statistical summaries of those data (percentiles) to the turbidity numeric targets.

Final Turbidity Numeric Targets

Upper Gabilan Creek: Staff selected the most protective numeric targets for the upper Gabilan Creek watershed headwater streams because this area is relatively undisturbed and is designated steelhead trout habitat. The final numeric targets are based on the reference conditions defined in Table 21 derived using the USEPA Ecoregional Approach for streams classified as “head-low-vegetated”. Specifically, the year-round numeric target at 2.5 NTU; the dry season numeric target at 2.2 NTU; and the wet season target at 3.3 NTU. Attainment of the final turbidity numeric targets for the upper Gabilan Creek watershed shall be assessed by comparing the 75th percentile value of samples collected from upper Gabilan Creek for the designated seasonal monitoring periods to the final numeric targets. Samples should be collected at even intervals (e.g., weekly). The protection of existing high-quality waters in the upper Gabilan Creek watershed is consistent with State Anti-Degradation Policy.

1) The final turbidity numeric targets for waterbodies in the **upper Gabilan Creek** watershed (headwaters):
    - Year-Round Target: **2.5 NTU**
    - Dry Season Target: **2.2 NTU**
    - Wet Season Target: **3.3 NTU**

To determine attainment of the final numeric targets for the upper Gabilan Creek watershed, compare the seasonal 75th percentile value of samples collected from upper Gabilan Creek to the appropriate seasonal final numeric target. Samples should be collected at even intervals (e.g., weekly or monthly) to evaluate numeric target attainment.

Lower Gabilan Creek: Staff selected numeric targets based on the Hydrogeomorphic Reference Site Approach for streams in the lower Gabilan Creek watershed. Streams in the lower Gabilan Creek include Gabilan Creek (below Old Stage Road), Natividad Creek, Alisal Creek, Salinas Reclamation Canal, Santa Rita Creek, Espinosa Slough, Alisal Slough, Merritt Ditch, and Tembladero Slough (above tidal influence/brackish water). These final numeric targets are equal to median turbidity levels from reference sites with similar hydrogeomorphic characteristics to the lower Gabilan Creek. The lower Gabilan Creek watershed is highly impaired for turbidity and these final numeric targets are not the most protective potential numeric targets in Table 21 but, are reasonably protective of aquatic life beneficial uses.

2) The final targets for waterbodies in the **lower Gabilan Creek** watershed:
    - Year-round Targets: **8 NTU**

- Dry Season Targets: **6 NTU**
- Wet Season Target: **11 NTU**

To determine attainment of the final numeric targets for the lower Gabilan Creek watershed, compare the seasonal median value of samples collected from the lower Gabilan Creek to the appropriate seasonal final numeric target.

Brackish Waters: Final numeric targets were not developed for the Old Salinas River and the lower Tembladero Slough due to limited monitoring data from brackish water references sites in the region. Staff researched but could not identify targets for these habitats from published studies. Brackish conditions typically occur at the Old Salinas River (station 309OLD) and lower Tembladero Slough (station 309TDW). The other monitoring sites on the Tembladero Slough, 309TEH and 309TEM, are freshwater habitats and final numeric targets were developed for these locations.

Table 22. Table of final numeric targets.

Site Id	Waterbody	Year-round	Dry Season	Wet Season
Old Stage Road and above	Upper Gabilan Creek	2.5	2.2	3.3
Old Stage Road and above	Upper Natividad Creek	2.5	2.2	3.3
309GAB	Lower Gabilan Creek Watershed	8	6	11
309NAD	Natividad Creek	8	6	11
309ALG	Salinas Reclamation Canal/ Alisal Creek	8	6	11
309MER	Merritt Ditch	8	6	11
309RTA	Santa Rita Creek	8	6	11
309JON	Salinas Reclamation Canal	8	6	11
309ESP	Espinosa Slough	8	6	11
309ASB	Alisal Slough	8	6	11

Site Id	Waterbody	Year-round	Dry Season	Wet Season
309TEH	Tembladero Slough	8	6	11
309TEM	Tembladero Slough	8	6	11
309TDW	Tembladero Slough (brackish)	n/a	n/a	n/a
309OLD	Old Salinas River (brackish)	n/a	n/a	n/a

5.2. Interim Wet and Dry Season Turbidity Numeric Targets

Staff developed dry and wet season interim turbidity numeric targets for impaired waters in the lower Gabilan Creek watershed (Table 23 and Table 24). Waterbodies in the less disturbed upper Gabilan Creek watershed have not been identified as impaired and therefore do not have interim turbidity numeric targets.

Staff established the following levels of interim targets as quantifiable milestones to measure improvements in water quality and progress toward attaining the final numeric targets. For development of the Interim-2 Numeric Targets, staff placed waterbodies with brackish waters into a separate group.

- Interim-1 Numeric Target: Equal to the wet and dry season 25th percentile monitoring data from each waterbody monitoring station (refer to Table 14). For example, the dry season Interim-1 target for Santa Rita Creek (309RTA) is 51 NTU, which is the 25th percentile value from its monitoring data analyzed for the TMDL Project. Santa Rita Creek already achieves this interim numeric target 25 percent of the time during the dry season.

- Interim-2 Numeric Target: Equal to the 25th percentile of dry and wet season data from CMP monitoring sites outside of the Gabilan Creek watershed (12 NTU and 21 NTU respectively), refer to Table 20. However, for brackish waters, including the lower Tembladero Slough and Old Salinas River, the dry season Interim-2 numeric target for these waterbodies are based on the lowest 25th percentile of the two waterbodies (Old Salinas River – 29 NTU for dry season and 36 NTU for wet season).

To determine attainment of the interim numeric targets, compare the median of the data from a given monitoring station to the appropriate interim numeric target for that monitoring station.

Table 23. Table of dry season turbidity interim numeric targets.

Site Id	Waterbody	Interim Numeric Target-1 (NTU)	Interim Numeric Target-2 (NTU)
309GAB	Gabilan Creek	40	12
309NAD	Natividad Creek	53	12
309ALG	Salinas Reclamation Canal/ Alisal Creek	27	12
309MER	Merritt Ditch	42	12
309RTA	Santa Rita Creek	51	12
309JON	Salinas Reclamation Canal	18	12
309ESP	Espinosa Slough	13	12
309ASB	Alisal Slough	12	12
309TEH	Tembladero Slough	57	12
309TEM	Tembladero Slough	38	12
309TDW	Tembladero Slough (Brackish)	59	29
309OLD	Old Salinas River (Brackish)	29	29

Table 24. Table of wet season turbidity interim numeric targets.

Site Id	Waterbody	Interim Target-1 (NTU)	Interim Target-2 (NTU)
309GAB	Gabilan Creek	124	21
309NAD	Natividad Creek	38	21

Site Id	Waterbody	Interim Target-1 (NTU)	Interim Target-2 (NTU)
309ALG	Salinas Reclamation Canal/ Alisal Creek	72	21
309MER	Merritt Ditch	67	21
309RTA	Santa Rita Creek	65	21
309JON	Salinas Reclamation Canal	43	21
309ESP	Espinosa Slough	65	21
309ASB	Alisal Slough	27	21
309TEH	Tembladero Slough	84	21
309TEM	Tembladero Slough	52	21
309TDW	Tembladero Slough (brackish)	49	36
309OLD	Old Salinas River (brackish)	36	36

6. BIOLOGICAL CONDITION NUMERIC TARGETS

In addition to the final and interim turbidity numeric targets defined in the above sections, staff developed biological condition numeric targets for the restoration of aquatic life beneficial uses in the Gabilan Creek watershed. Turbidity pollution severely impacts instream plant and algae (primary producers) communities, which are the foundations of aquatic ecosystems. Turbidity also interferes with aquatic life activities that are visual such as finding food and migration of steelhead. The TMDL Project follows a framework developed by USEPA and builds upon traditional TMDL approaches to water quality numeric targets that focus solely on numeric pollutant limits (USEPA, 2006). Instead, this TMDL project combines turbidity numeric targets with numeric targets for instream biological and physical habitat responses (biological condition numeric targets). Adding biological condition numeric targets allows for a more complete evaluation of water quality standards attainment, which includes both protecting beneficial uses and achieving water quality objectives. Staff developed two types of biological condition numeric targets: one is based on physical habitat and biological assessments and the second is based on a rapid habitat assessment method.

6.1. Physical Habitat and Biological Assessments

Physical habitat and biological assessments are standard field methods used by monitoring programs in California to assess the health of aquatic ecosystems (Ode et al., 2007 and Ode et al., 2016). Biological assessments include stream surveys of benthic macroinvertebrate (BMI) populations, and result in measures of a populations diversity and relative tolerance to pollution. Physical, diversity of current velocities, canopy shading, and channel gradient. These data compared with data from less impacted or reference streams makes the assessment method suitable for determining if the narrative component of the turbidity water quality objective is achieved. The water quality objective states the following:

> *Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.*

Assessment Methods and Analysis

The CMP monitors and assesses physical habitat and biological conditions of stream habitats in the Gabilan Creek watershed and in agricultural drainages throughout the Central Coast Region. These data are collected in accordance with the SWAMP standard operating procedures for conducting biological assessments (Ode et al., 2016). Key physical habitat and biological condition elements useful for evaluating turbidity impacts to aquatic health and for comparison between restoration and reference sites include the following:

- Taxa richness (total number of different benthic invertebrate taxa in stream, which include dragonfly, mayfly, caddisfly, and stonefly larvae, snails, worms, and beetles)
- EPT richness (total number of unique taxa from three orders of common, typically sensitive benthic invertebrate taxa in a stream)
    - E – Ephemeroptera (mayflies)
    - P – Plecoptera (stoneflies)
    - T – Tricoptera (caddisflies)
- Percent fines and sands in streambed substrate

<u>Methodologies to evaluate biological condition:</u> In follow-up to the Pajero River watershed sediment TMDL, researchers developed guidance for evaluating impacts to EPT richness based on instream measurements of percent fines and sands (Herbst et al., 2014). The guidance was prepared in 2014 as a Water Board grant funded project. The guidance, states that BMI populations are impacted by sediment where EPT richness <12 and instream habitats have >40 percent fines and sand. In the Gabilan Creek watershed, sites are almost all 100 percent fines and sands and there are no EPT Taxa. Therefore, following the Herbst et al., method one would conclude that the instream sediment conditions are likely contributing to or causing the degraded biological condition.

However, it is not appropriate to utilize the Herbst et al., method in regulated streams, specifically streams influenced by flow control structures such as dams and lift stations like the pumps that control flow in serval stream reaches in this watershed. Only the Gabilan Creek headwaters and upper reaches have unregulated natural flows and are suitable for this method to develop biological condition numeric targets for EPT taxa and percent fines and sand. For stream reaches downstream of the Gabilan Creek headwaters, staff use other measures of biological community condition (taxa richness) to establish biological condition numeric targets.

Table 25 summarizes key physical habitat and biological conditions in the Gabilan Creek watershed and for comparison, Table 26 summarizes the conditions from other regional sites.

<u>Identifying appropriate reference sites:</u> The data from sites in the Pajaro River, Gabilan Creek, and the Santa Maria River watersheds were collected by the CMP in 2013 and 2014. The Morro Bay National Estuary Program (MBNEP) collected data from the Morro Bay watershed. This report includes annual MBNEP data from 2008 to 2016. The CMP sites are from agricultural watersheds with similar geomorphology and land use to the lower Gabilan Creek watershed and are not considered high quality waters. Morro Bay watershed is also alluvial and has agricultural land use however, the riparian and aquatic habitats are generally in better condition than other watershed summarized in this section.

Additionally, and as previously noted, the lower Gabilan Creek watershed has hydrologic features, which control the flow of water and restrict the natural movement of coarse sediments from the upper watershed to the lower. These types of controls are not found in the Morro Bay watershed. Therefore, the MBNEP data is informational but not suitable for reference target sites in the lower Gabilan Creek watershed.

Of the CMP monitoring sites outside of the Gabilan Creek watershed the sites in the lower Orcutt Creek watershed (312ORC, 312GVS, 312SMA) are most comparable to the lower Gabilan Creek watershed. This is because lower Orcutt Creek has similar geomorphology and hydrology to the lower Gabilan Creek watershed. Lower Orcutt Creek is downstream of an historic lakebed referred to as Betteravia Lakes or Guadalupe Lakes and this is like waterbodies downstream of Carr Lake, Espinosa Lake and Merritt Lake in the lower Gabilan Creek watershed. These watershed characteristics restrict upland flow and bedload to streams in the lower watersheds and it results in the streams having high percentage of fines in the streambed. Orcutt Creek watershed monitoring sites 312GVC and 312ORC, similarly to the ones in the lower Gabilan Creek watershed, have very low taxa richness and no EPT. Site 312SMA on the Santa Maria River is another comparable site since it has year-round flows predominantly from the Orcutt Creek watershed. 312SMA does receive intermittent flows the Santa Maria River but the site still has high percent fines and is considered a comparable site. It has greater taxa richness than other sites in Orcutt Creek and except for 309ESP has greater taxa richness than ones in the lower Gabilan Creek watershed.

Table 25. Table of key physical habitat and biological conditions of streams at sites in the Gabilan Creek watershed (CMP 2013/14).

Sites ID-Waterbody	% Fines	%Sand	%Fines and Sands	Taxa Richness	EPT Taxa
309ALG – Salinas Reclamation Canal /Alisal Creek	100	0	100	9	0
309ASB – Alisal Slough	100	0	100	13	0
309ESP – Espinosa Slough	100	0	100	19	0
309ESP -Dup			100	24	0
309JON – Salinas Reclamation Canal	18	0	18	18	0
309MER- Merritt Ditch	100	0	100	16	0
309OLD – Old Salinas River	100	0	100	14	0
309TEH – Tembladero Slough	100	0	100	14	0

Table 26. Table of key physical habitat and biological conditions of comparable streams in the Pajaro River, Morro Bay, and Santa Maria River watersheds.

Sites	% Fines	%Sand	%Fines and Sands	Taxa Richness	EPT Taxa
305CAN	2	20	22	21	0
305CHI	0	95	95	38	0
305COR	20	36	56	28	0
305LCS	65	18	83	27	0
305PJP	9	91	100	42	0
310MNO*	4.6	16	20	57	14
310UPN*	2.7	10	11	62	20
310LSL*	12.2	14	26	49	49
310TWB*	12.3	22	34	45	7
312GVS	100	0	100	10	0
312ORI	100	0	100	11	0
312SMA	91	9	100	24	0

Note: * average conditions

Biological Condition Numeric Target – Taxa Richness

Staff selected a biological condition numeric target taxa richness score of 24 for sites in the lower Gabilan Creek watershed. This selection is based on the highest taxa richness score available for sites in the watershed (from the Espinosa Slough site 309ESP) and a comparable site in the lower Santa Maria River (site 312SMA). These two sites are comparable sites because, like lower Gabilan watershed streams, they also have high percentage of fines in the substrate. The sites in the lower Gabilan Creek watershed have taxa richness that range from 9 to 24 with an average of 16. This biological condition numeric target represents an improvement from the existing conditions in the lower Gabilan Creek watershed, but it still represents a highly degraded condition.

- Biological Assessment Numeric Target - Taxa Richness of ≥ 24.

This biological condition numeric target is an interim numeric target for streams in the lower Gabilan Creek watershed and will need to be reevaluated in the future as habitat conditions improve and additional data become available for the watershed. The taxa richness score is a measurement of the number of different benthic macroinvertebrate taxa (e.g., genera or species) observed at a monitoring site. Macroinvertebrate taxa include mayfly, caddisfly, dragonfly, and stonefly larvae, as well as snails, worms, beetles, etc. The data shall be collected in accordance with the current Surface Water Ambient Monitoring Program (SWAMP) standard operating procedures for conducting biological assessments. There is no final numeric target established at this time, but one will be developed when sufficient data is available.

6.2. California Rapid Assessment Method - CRAM

Staff also developed biological condition numeric targets based on the California Rapid Assessment Method (CRAM). CRAM is a standardized field level framework for holistically mapping and assessing wetland conditions and stressors referred to as the index score, which is an average of four site attribute scores. The four types of CRAM attribute scores are Wetland Landscape Buffers, Hydrology, Physical Structure, and Biotic Structure. Of these scoring methodologies, Biotic Structure Score is the most relevant metric for evaluating direct turbidity impacts to aquatic ecosystems and for use as biological condition numeric targets. Biotic Structure Score represents relative level of habitat diversity, biological integrity, food web support, etc., most directly supported by a functioning wetland’s aquatic zone. The CRAM Biotic Structure Score assessment includes the plants, algae, and the primary producers that are directly impacted by turbidity.

CRAM Assessment Methods and Analysis

Table 27 summarizes CRAM Index Scores and Biotic Structure Scores from 49 different sites in the Gabilan Creek Watershed and adjacent watersheds. The site numbers in the table follow the CRAM station naming convention and correspond to the mapped site locations. An Index Score of 100 indicates the best possible overall condition and a Biotic Structure Score of 100 indicated best possible aquatic habitat. In the Gabilan Creek watershed, the average CRAM Index Score is 51 and the average Biotic Structure Score is 54.

Table 27. Table of CRAM site numbers, locations, CRAM Index Scores, and Biotic Structure Scores in the Gabilan Creek watershed and adjacent watersheds.

SITE No.	Site Description	Existing CRAM Index Score	Existing Biotic Structure Score
1	Tembladero Slough Lower Marsh	66	77
2	Elkhorn Slough	66	78
3	Lower Natividad	59	67
4	Tembladero Upper	47	36
5	Tembladero Lower	57	72
6	Cesar Chavez	42	33
7	Lower Natividad 1	67	81
8	Lower Natividad 2	61	83
9	Lower Natividad 3	55	78
10	Old Salinas River	82	75
11	Natividad Creek	58	72
12	Natividad Creek - u/s Freedom Pkwy	56	81
13	Gabilan Creek - 100 m south of dirt farm road	63	69
14	Natividad Creek - at park, above footbridge	62	81
15	Gabilan Creek - 2nd Cul de Sac of Londonderry Way	73	64
16	Gabilan Creek - 150 m u/s Constitution Blvd.	63	69
17	Gabilan Creek - 130 m u/s of bridge at Sports Complex	51	64
18	Natividad Creek at Barton Elementary School	49	44
19	Natividad Creek Upper / Agricultural	39	50
20	Santa Rita Creek at elementary school	48	33

SITE No.	Site Description	Existing CRAM Index Score	Existing Biotic Structure Score
21	Santa Rita Creek Restoration (Upstream)	44	50
22	Santa Rita Creek Restoration (downstream)	39	39
23	Santa Rita Creek Restoration (downstream)	43	33
24	Santa Rita Creek Above N Main St	27	25
25	Santa Rita Creek at Santa Rita Elementary	43	28
26	Santa Rita Creek 140m Upstream of Van Buren	52	44
27	Santa Rita Creek along San Juan Grade Rd	54	42
28	Lower Natividad	64	83
29	Alisal Creek at Old Stage Rd.	47	39
30	Alisal Creek at Alisal Rd.	42	42
31	Alisal Creek at work St.	30	25
32	Salinas Reclamation Canal at San Jon Rd.	39	39
33	Salinas Reclamation Canal at 101	30	25
34	Alisal at Cesar Chavez	41	44
35	Salinas Reclamation Canal at Victor St.	39	39
36	Salinas Reclamation Canal at 183	47	39
37	Espinosa Slough at 183	50	58
38	Prunedale Creek	59	67
39	Gabilan Creek at Natividad Rd.	63	75
40	Alisal Slough at McFadden Rd.	41	81
41	Natividad at Old Stage Rd	62	58
42	Santa Rita Creek at Herbert Rd.	33	25
43	Santa Rita Creek at Golf Course	34	36
44	Upper Gabilan Creek at Vierra Ranch	70	75
45	Tembladero Slough at Highway 1	41	39
46	Gabilan Creek at Old Stage Road	62	67
47	Gabilan Creek at Crazy Horse	40	33
48	Alisal Slough at Cooper	38	36

SITE No.	Site Description	Existing CRAM Index Score	Existing Biotic Structure Score
49	Marklee Swamp	52	67
	Average	51	54
	Median	50	50
	25th Percentile	41	38
	75th Percentile	62	74

Biological Condition Numeric Targets - CRAM

Staff developed CRAM biological condition numeric targets based on a guidance document developed by California Wetland Monitoring Workgroup (CWMW) (CWMW, 2019). The CWMW guidance provides an objective approach for evaluating CRAM Biotic Structure Scores with ratings at three levels: poor, fair, and good. CRAM sites receive scores in a range between 25 and 100, with 25 and not zero as the lowest possible score. Zero is not possible because all waterbodies provide some functional value. The CWMW guidance categorizes the Biotic Structure Scores into the following three classes:

- 25 to 50 - Poor
- 51 to 75 - Fair
- 76 to 100 - Good

Many CRAM sites in the Gabilan Creek watershed have low Biotic Structure Scores; the existing median Biotic Structure Scores is 50, and 25th percentile Biotic Structure Score is only 38. Santa Rita Creek is an example of a waterbody with low Biotic Structure Scores. Of the six sites assessed on Santa Rita Creek, the average Biotic Structure Score was 36. Other waterbodies with similarly low Biotic Structure Scores include the Salinas Reclamation Canal and Alisal Creek. Some waterbodies such as Gabilan Creek, Tembladero Slough, Old Salinas River, and Alisal Slough have a mix of high and low scoring sites. For example, Alisal Slough has a Biotic Structure Score of 36 at the Cooper Road site and 81 at the McFadden Road site while Gabilan Creek has a Biotic Structure Score of 75 at the Natividad Road crossing and only 33 at Crazy Horse Road.

The goal of the TMDL Project is for all waterbodies in Gabilan Creek watershed to have “good” CRAM Biotic Structure Scores, which would be scores in the range of 76 to 100. Several sites have existing Biotic Structure Scores in the 70s and 80s and the 75th percentile Biotic Structure Score of all sites assessed was 74. This indicates that 25 percent of the fifty sites assessed scored higher than 74 and shows the potential for the restoration of aquatic life beneficial uses in the watershed. Several of the high scoring sites are from reaches of lower Natividad Creek that were the focus of prior restoration efforts. Additional sites with good scores include Alisal Slough at McFadden, Tembladero Slough lower marsh, and

Old Salinas River, which all had Biotic Structure Scores greater than 75 (i.e., 76 and above). The TMDL Project sets the following biological conditions numeric targets for CRAM data:

- CRAM Biotic Structure Score > 75

This biological condition numeric target is a final numeric target. Biotic Structure Score represents relative level of habitat diversity, biological integrity, food web support, etc., most directly supported by a functioning wetland's aquatic zone. The CRAM Biotic Structure Score assessment includes the plants, algae, and the primary producers that are directly impacted by turbidity.

7. SOURCE ANALYSIS

The TMDL Project source analysis identifies different types of management conditions and activities in the watershed that cause erosion of fine sediments and mobilization of instream fine sediments and therefore are sources of turbidity. Staff used several methods to identify sources and responsible parties in the watershed. The sources were identified by using GIS to analyze water quality monitoring data in relation to land cover data. Sources were also identified from watershed sediment studies, modeling, field observations, and discussions with stakeholders. Since suspended sediments cause turbidity, studies that analyzed sources of sediment are particularly relevant to understanding sources of turbidity. Algae and other organic materials are also potential sources of turbidity, but they are not the focus of this TMDL Project; the focus is inorganic materials such as fine sediments. The Salinas Watershed nutrient TMDL Project addresses the impacts of biostimulation and biostimulatory responses (such as algal density) on water quality (CCRWQCB, 2013).

Development of a new watershed erosion model was not necessary for this project. Instead, this project relies on the model developed in 2003 when the Central Coast Water Board funded the Watershed Institute at CSUMB to conduct an extensive Salinas River watershed sediment source analysis study and develop a sedimentation model, that includes the Gabilan Creek watershed (CCoWS, 2003).

7.1. Salinas Valley Sediment Sources Study (2003)

Researchers from CSUMB identified sources of sediment in the Gabilan Creek watershed as part of an in-depth sediment-loading study conducted of the entire Salinas Valley (CCoWS, 2003). The Salinas Valley Study was specifically designed to identify sources for a possible Salinas Valley sediment TMDL. Water Board staff resources and grant funding supported the project. Although this study was for the entire Salinas Valley two parts of the study specifically analyzed sediment sources in the Gabilan Creek watershed. The first part analyzed sources by land uses types in the Gabilan Creek watershed and the second part analyzed sediment loading specifically from irrigated agricultural fields.

The sediment land use source analysis included rainfall and irrigation event summaries of discharge, bedload, and suspended sediment concentrations at a subwatershed. In the winter 2000/01, the researchers monitored three storm events from eleven publicly accessible sites on Gabilan Creek and the Salinas Reclamation Canal. From the site locations, the watershed was divided into subwatersheds and the land use within each subwatershed was calculated and proportioned by three land use types grazing/natural, crops, and urban. The study calculated the watershed as being comprised of 60 percent grazing and natural lands, 31 percent cropland, and 9 percent urban.

The study divided the valley floor portion of the Gabilan Creek watershed into two reaches based on hydrologic and sediment loading characteristics. The Gabilan Creek reach above the City of Salinas with monitoring site 309GAB has a course bed comprised of sands and gravels. It is characterized as technically a “loosing” stream with streamflow from small storm events mostly infiltrating and with little bedload below the monitoring site. The reaches in the lower Gabilan Creek watershed from the Salinas Reclamation Canal down to Old Salinas River have perennial flow and the bed material is primarily fine sediments (silt and clays) with small portions of sand. The study monitored discharge and calculated loading from storm events. Stormflows in the reach above 309GAB (at Boronda Road) percolated and sediment was deposited, while stormwater flows and sediment loads increased in the lower reaches below Boronda Road.

Staff reviewed the conclusions and discussions on sources in the sediment source section of the study and summarize key findings below:

- Based on the conclusions in the study, row-crop agriculture contributed the highest suspended sediment loads per unit area.
- Urban areas contributed the greatest volume of runoff, but runoff had low concentrations of suspended sediments.
- Construction stormwater runoff contributes sediment loading to surface waters.
- Grazing land generally contributed little runoff or suspended sediment. However, sediment load can be high if stream-bank vegetation is removed or along cattle trails in the creek bed.
- Localized high-velocity flows from plastic lined strawberry fields are a likely source of course bedload material.
- Remobilization of deposited sediments is a source of turbidity and this was not analyzed in the study. The study discussed channel maintenance activities such as dredging that mobilizes and generates suspend sediments, but they were not monitored.

The research incorporated the results of the winter 2000/01 monitoring into a static model of sediment loading and compiled in a separate report (Casagrande, 2001). The model predicted Total Suspended Solids (TSS) loads from the three storm events, which were considered typical storm events in the Gabilan Creek watershed. The results of the model and land use analysis are summarized in Table 28. Note, the researchers reported their results in metric units and tonnes is similar but not equal to the standard unit of measurement tons. The summary provides an indication of proportional loading from storm events in the watershed. The greatest most significant source of TSS are lands used for crop production with 826.3 tonnes and 86.8% of the total TSS in the watershed. Grazing/Natural lands are estimated to produce only minimal TSS at 23.1 tonnes and 2.4% of the total TSS in the watershed. Urban areas are estimated to produce 102.2 tonnes and 10.8 % of the total TSS in the watershed.

Table 28. Modeled loads for TSS for major land uses types from a storm event.

Land Use Practice	**TSS (tonnes)**	**TSS (% of total)**	**Area (km^2)**	**% of Watershed**	**TSS (tonnes/ km^2)**
Grazing/Natural	23.1	2.4%	188	60%	0.1
Crop	826.3	86.8%	98.37	31%	8.4
Urban	102.2	10.8%	29.12	9%	3.5
Total	951.6	100%	315.8	100%	3.0

In addition to evaluating discharge and suspended sediments from land use types in the Gabilan Creek watershed, researchers conducted a separate study of sediment loads from individual agricultural fields in the Gabilan Creek watershed. The researchers comprehensively monitored on-farm runoff from 16 plots of land on seven properties. They monitored both rainfall and irrigation events and measured water applied and the total amount of water and sediment running off the individual fields from individual events. Based on the monitoring, the researchers estimated annual loads of sediment from agricultural fields. Staff reviewed the results of the field loading study and the results of the on-farm measurements indicate that irrigation and stormwater runoff from agricultural field crops are sources of suspended sediments and turbidity impairments in the Gabilan Creek watershed.

7.2. Salinas Reclamation Canal Watershed Assessment

In 2005, researchers from CSUMB and MCWRA conducted a watershed assessment of the Salinas Reclamation Canal watershed and developed a community-based management plan (MCWRA, 2005) with grant funds provided by the State Water Board. The Salinas Reclamation Canal watershed shares essentially the same watershed boundaries as the area referred to in this TMDL as the Gabilan Creek watershed. The Salinas Reclamation Canal watershed study included assessments of historical conditions, hydrology and channel conditions, water quality, and biology and botanical communities. The hydrology and channel conditions assessment section specifically addressed channel sedimentation and erosion. The study notes a concern with sediment deposition in channels limiting channel capacity and increasing flood risk. The following are examples of major sediment sources documented in the study.

- Agricultural fields;
  - During storms or when irrigation generates excessive tailwater, when fields are fallow without cover crops and/or without appropriate sediment management practices.
  - Stormwater sediment erosion from farms growing strawberries on relatively steep land with highly erodible soils.
  - Evidence from the 2000-01 study period suggests that row crop agriculture contributed the highest sediment load per unit area.
- Rural roads;
  - Extensive erosion was noted from roadside ditches along paved county roads such as Old Stage Road, which drains to Alisal Creek.
- Grazing lands;
  - When they are over-grazed or otherwise de-vegetated.
  - If cattle have access to channels without riparian vegetation.
  - When there are no vegetated buffers between range land and creeks.
- Dirt agricultural roads; and
- Stream channel or ditch erosion.
  - When they are un-vegetated and channel banks are over steepened.
  - Steep channel or ditch walls are prone to failure and the erosion of fine sediments into channels.

7.3. Pump Stations, Agricultural Drainage Pumps, and Tile Drains

Monitoring data and photo documentation indicate that pump stations, agricultural drainage pumps (large pumps and sump pumps), and tile drains are sources of turbidity in the watershed. MCWRA and agricultural operations operate pumps on the major tributaries in the lower watershed and discharge from these stations contribute to turbidity (refer to Figure 10). During TMDL development, MCWRA monitored their pump stations and provisional results indicate that turbidity increases in downstream channels during pump operation. Staff also identified an agricultural lift station that discharges into Alisal Creek near monitoring site 309ALG and observed evidence of severe bank and channel erosion associated with the pump (refer to Figure 24).

Figure 24. Photo taken of a large agricultural pump that discharges to Alisal Creek near monitoring station 309ALG. Photo taken by staff on January 9, 2019. The bank opposite the pump outlet was severely eroded.

7.4. Highways and Rural Paved Roads

Stormwater runoff from rural paved roads and highways contributes to the erosion of road shoulders and concentrated flows collected and discharged through culverts contribute to channel erosion and stream turbidity. An example of a rural paved road shoulder erosion is shown in Figure 26. Many of the paved roads in the watershed are within the municipal boundaries of the City of Salinas boundaries or the communities of Castroville and Spreckels but others are outside municipal boundaries and are maintained by the County of Monterey. Additionally, the California Department of Transportation (Caltrans) is responsible for highways in the watershed, which contribute concentrated runoff into streams. Major roads and highways in the watershed are shown in Figure 25 and the highways in the watershed under Caltrans jurisdiction are listed in Table 29.

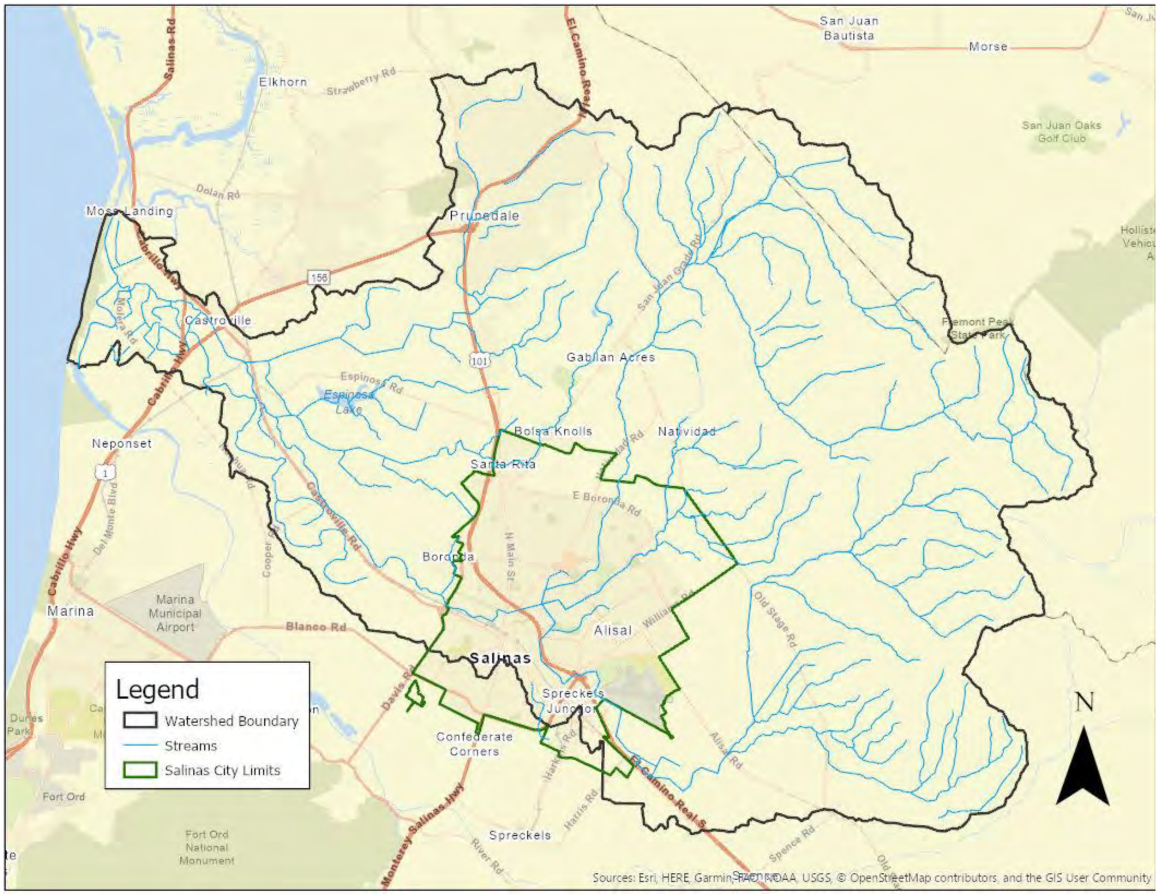

Figure 25. Map of streams, major roads, and highways in the Gabilan Creek watershed.

Table 29. List of Highways in the Gabilan Creek watershed.

Highway Number	Description
U.S. Route 101	El Camino Real
State Route 1	Cabrillo Highway
State Route 183	Castroville Road
State Route 156	Prunedale – Castroville Route
State Route 68	Monterey Salinas Highway

Figure 26. Photo of eroded road shoulder and channel along Boronda Road, west of the City of Salinas. Photo taken by staff on January 9, 2019.

7.5. Stream Bank and Channel Conditions

Degraded stream bank and channel conditions are sources of sediment erosion and turbidity in the watershed. Runoff over steep unvegetated banks and concentrated flows in unvegetated stream channels are sources of sediments and turbidity in the watershed. Staff observed unvegetated stream banks and channels in several locations in the watershed during a field visit on January 9, 2019 (refer to Figure 27. Photo taken of an unvegetated stream channel west of Boronda Road. Photo taken by staff on January 9, 2019.). Additionally, CCAMP and CMP monitoring reports document a lack of stabilizing stream bank vegetation in the watershed and a lack of vegetation shading of channels surface waters. Unstable stream channel banks can cause excessive channel erosion and deposition of fine sediments.

Balance Hydrologics, in a study prepared for MCWRA on the characteristics of the Carr Lake drainage system, also documented severely degraded stream banks and channel conditions (MCWRA, 2015a). They reported extensive erosion and sedimentation in Carr Lake and drainage channels of the Salinas Reclamation Canal, Gabilan Creek, and Natividad Creek that converge in Carr Lake. Balance Hydrologics reported channel sediment deposition in the range of

1.0 to 1.3 feet on average and identified general bank erosion and rilling as sources of sediment. They also noted steep ditch banks and almost complete lack of vegetative cover to be conducive to erosion.

The remobilization, also referred to as resuspension of fine sediments, is a potential source of turbidity in Carr Lake and throughout the lower watershed (i.e. all reaches with the exception of upper Gabilan Creek). The lower watershed is comprised of low gradient and low flow sloughs with mucky channel beds and little if any Wetland emergent vegetation for cover and stabilization (refer to Figure 8 and Table 6). The lack of instream and bank vegetation increases the risk of resuspension of fine sediments. The sloughs and similarly low gradient tributary channels are susceptible to fine sediment resuspension due discharges from pump stations operated by MCWRA and high capacity discharges from agricultural pumps (refer to Figure 29). Large flows out of urban outfalls and off paved roads are also a potential mechanism for the resuspension of channel sediments and turbid waters.

Figure 27. Photo taken of an unvegetated stream channel west of Boronda Road. Photo taken by staff on January 9, 2019.

Figure 28. Photo of bank rilling and erosion the Salinas Reclamation Canal upstream of Highway 101. Source (MCWRA, 2015a).

Figure 29. Photo of low gradient slough in the lower watershed.

7.6. Cannabis Operations

Commercial cannabis operations in the Gabilan Creek watershed pose a potential risk to water quality and turbidity impairments. Cannabis operations located on steep slopes with disturbed soils and/or that have disturbed areas in within riparian setbacks pose a risk for erosion and increased turbidity in surface waterbodies. Cannabis is also cultivated indoors, and greenhouses and imperious surfaces can increase and concentrate stormwater runoff.

There are currently 28 commercial cannabis cultivators in the Gabilan Creek watershed enrolled in the Cannabis General Order (refer to Table 42).

7.7. TMDL Turbidity Watershed Land Cover Source Analysis

Staff also conducted an analysis of the spatial relationship between turbidity monitoring data and land use in the watershed to identify sources. The Gabilan Creek watershed has diverse land cover. The dominant land covers include: Developed (13%), Forest/Scrub (27%), Grassland (18%), and Cropland (28%). The land cover types are previously described in Section 2.7 of this TMDL Project Technical Report. Staff analyzed the relationship between the types of land cover and turbidity water quality monitoring data for the TMDL Project by delineating subwatersheds above CMP monitoring sites with discernable land covers.

Descriptions of Subwatersheds: Figure 30 shows the results of the subwatershed and monitoring sites analysis. Staff calculated the land cover in the subwatersheds using GIS and summarized the results as percentages of land cover types and total acreages in Table 30. The subwatersheds and their land cover characteristic are described as follows.

- 309JON subwatershed is named after, and delineated as, the watershed up gradient from monitoring site 309JON on the Salinas Reclamation Canal. This site is a cumulative site at the base of all the subwatersheds shown in Figure 30 and it represents a mix of highly developed urban and industrial areas, cultivated crops, and natural areas. It encompasses subwatersheds 309GAB, 309NAD, 309ALG, and Urban AG Area.

- 309GAB, 309NAD, and 309ALG are the respective subwatersheds of Gabilan, Natividad, and Alisal Creeks and are named after, and delineated up from, the monitoring sites in the lower reaches of each watershed. All three monitoring sites are just above the urban boundary of the City of Salinas and based on GIS analysis, the sites are very minimally influenced by urban runoff. However, staff previously identified a few sources of industrial stormwater and highway runoff into Alisal Creek. These subwatersheds have minimal medium density land cover and no high-density urban areas. The subwatersheds have extensive cultivated crop production in the valley floor within close proximity to the monitoring sites. These subwatersheds have developed open space and low density developed land cover, which is generally comprised of rural roads and farm buildings. Natural land cover is the highest percentage of land cover in the subwatershed. Natural land cover is comprised of forests, scrub/shrub areas, and grasslands, all of which are in the upland areas of the subwatershed.

- Salinas Urban AG Area is the subwatershed between the urban area boundary and monitoring site 309JON on the Salinas Reclamation Canal. This subwatershed encompasses the City of Salinas and has a high percentage of developed land covers especially medium intensity, which represents impervious urban buildings, residences, and roads. It also includes cropland within the City at Carr Lake and below the City along the Salinas Reclamation Canal. There are no monitoring sites that isolate the urban areas as there is a mix of agricultural, industrial, urban, and undeveloped land draining into this subwatershed. The downstream monitoring station at 309JON is a cumulative monitoring site and the nearest downstream site that includes this subwatershed.

Results of Subwatershed Analysis: The three subwatersheds (309GAB, 309NAD, and 309ALG) above the urban area boundary have elevated turbidity levels during both the wet and dry seasons (see the bottom of Table 35). These watersheds are above the City of Salinas' urban limits and land cover analysis indicates no high intensity development and minimal medium intensity development (refer to Table 35) in these watersheds; therefore, urban stormwater is not considered a source of turbidity in these watersheds. Irrigated agriculture, development such as rural roads and farm buildings, and natural land cover are the primary sources in these subwatersheds. However, industrial stormwater discharges have been identified upstream of monitoring site 309ALG.

Natural areas and croplands are the primary land covers in the 309GAB, 309NAD, and 309ALG subwatersheds and both have the potential for contributing sediment to streams and being sources of turbidity at the respective monitoring sites. For the wet season analysis, monitoring data summarized in Table 30 represents ambient conditions and monitoring programs sample generally on predetermined monthly schedules. The Irrigated Lands Program MRP requires the CMP to conduct two wet season monitoring events, specifically within 18 hours of storm events, preferably including the first flush run-off event that results in significant increase in stream flow (greater than 1-inch of rain within a 24-hour period). Therefore, the wet season samples may or may not reflect storm events and overland surface runoff. During the dry season, stream flows in these subwatersheds are supported by irrigation runoff from farm fields and natural areas are not sources.

309JON subwatershed encompasses all of the land in the watershed above monitoring site 309JON and all subwatersheds discussed in this section (309GAB, 309NAD, 309ALG, Urban AG Area) (refer to Table 30 and Figure 30). 309JON watershed represents a mix of agricultural, urban, industrial, and natural land covers. The Carr Lake area in the middle of the City of Salinas detains streams flows from the upper subwatershed and forms a depositional area for fine sediments. The Salinas Reclamation Canal watershed study noted that the Four Corners area of Carr Lake, where Gabilan, Natividad, and Alisal Creeks converge is a silt basin (MCWRA, 2005). Sediment deposition is particularly evident in dry season monitoring data at site 309JON with median turbidity levels (25 NTU) being much lower than median turbidity levels at up gradient sites, 309GAB (190 NTU), 309NAD (106 NTU), 309ALG (55 NTU).

Urban AG Area subwatershed below the urban area boundary in the watershed has a marked increase of median intensity developed land cover, which is comprised of paved areas, housing, and other structures within the City of Salinas. This subwatershed also has a significant percentage of cropland at 22 percent of the total area. There is cropland in Carr Lake and there is cropland, below the City limits and between the City and the 309JON monitoring site. Since this watershed is down gradient of the other subwatersheds, water quality reflects a mixture of all up-gradient sources and the influence of land cover strictly from the Urban AG Area could not be discerned.

Table 30. Table summarizing the percentage of land cover, total acreage, and seasonal turbidity at outlet monitoring site for each subwatershed.

Description of Land Cover	309JON	309GAB	309NAD	309ALG	Urban AG Area
Developed, Open Space (Percentage)	7%	6%	8%	6%	11%
Developed, Low Intensity (Percentage)	5%	1%	2%	3%	15%
Developed, Medium Intensity (Percentage)	8%	1%	1%	3%	42%
Developed, High Intensity (Percentage)	2%	0%	0%	0%	10%
Cultivated Crops (Percentage)	20%	7%	15%	32%	22%
Total Natural Areas (Percentage)	59%	85%	75%	55%	1%
Acreage in watershed	69,337	25,679	5,864	26,235	11,560
Median Dry Season Turbidity at site (NTU)	25 NTU	178 NTU	106 NTU	55 NTU	n/a
Median Wet Season Turbidity at site (NTU)	102 NTU	346 NTU	95 NTU	196 NTU	n/a

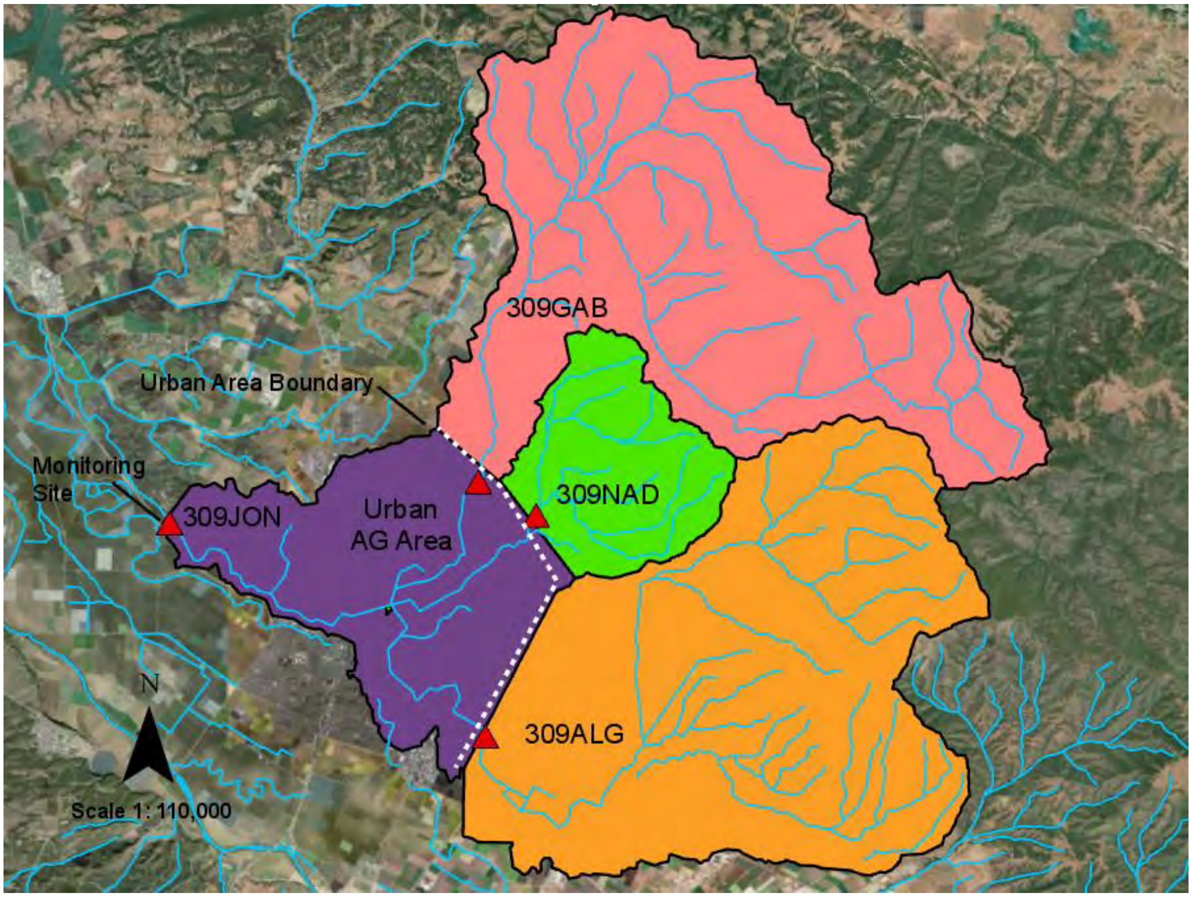

Figure 30. Map of subwatersheds used for turbidity land cover analysis.

7.8. City of Salinas Urban Stormwater

Staff identified urban sources of turbidity by evaluating monitoring data from the City of Salinas' urban stormwater monitoring program. The City's municipal stormwater permit (the most recent are Order R3-2019-0073, NPDES No. CA0049981) and associated monitoring and reporting program (MRP) require the City to monitor stormwater flows for several pollutants, including turbidity. Two monitoring reports (years 2018 and 2019) were reviewed along with monitoring data from ambient monitoring sites in the Gabilan Creek watershed. The water year monitoring for 2018 started on October 1, 2017 and continued until September 30, 2018. Water year monitoring was planned for five subsequent years starting with 2018. The City's MRP requires urban catchment monitoring (storm drain outfall monitoring), receiving water monitoring downstream of the City, and background receiving water monitoring upstream of the City.

Urban Catchment Monitoring: To assess turbidity from urban catchments, staff reviewed the results from two of the City's annual monitoring reports, water years 2018 and 2019. The City monitors storm event discharge from the outfalls of three urban catchments (subwatersheds) ranging in size from 184 to 343 acres and representing different urban settings. The City monitors conventional parameters including turbidity and TSS using automated samplers installed in outfall culverts and they sample all storm events throughout the water year. The automated samplers capture discharge at different flows during the storm event. The 2018 and 2019 monitoring reports stated that turbidity and TSS exceeded the monitoring program water quality goals. The City's stormwater permit establishes an action level for turbidity of 126 NTU and action level of 263 mg/L for TSS (Salinas, 2020). Table 31 contains a summary of the urban outfall exceedance frequency of the action levels for the 2019 water year.

Table 31. A table summarizing the percentage of urban outfall sample exceedances for water quality parameters in the 2019 water year.

Pollutant	Acosta Catchment	Alisal Catchment	Downtown Catchment
TSS	48%	63%	29%
Turbidity	35%	63%	42%

<u>Receiving Water Monitoring</u>: The City's monitoring program also includes stormwater monitoring to characterize background ambient water quality conditions in streams that flow through the City. The background (or upstream) monitoring sites are located at the City limits on Gabilan Creek at site 309GAB and on Natividad Creek at site 309NAD. Both sites are highly influenced by agricultural runoff and are also routine monitoring sites for the CMP for agriculture (monitored monthly). The monitoring site downstream of the City is on the Salinas Reclamation Canal at site 309ALD**.**

The City monitors storm events and staff analyzed data collected by the City from 2012 to 2016; the City provided monitoring data directly to staff. Storm events stream flow data from upstream and downstream of the City are summarized in Table 32 and accompanying turbidity monitoring data are summarized Table 33. The data indicates that storm event stream flows greatly increase downstream of the City; as an example, in monitoring event 47 (12/2/2012) the stream flow at upstream sites 309GAB and 309NAD were 6.35 and 9.55 cfs respectively and the flow at downstream site 309ALD was 164.4 cfs. Likewise, during monitoring event 47, the turbidity dropped from sites 309GAB and 309NAD having turbidities of 2512 NTU and 3000 NTU respectively to 780 NTU at the site 309ALD downstream of the City (refer to Table 33). Although the timing of sample collection at each site relative to the hydrograph may have some influence on these results, monitoring event 47 is an example of how flows increase downstream of the City, as would be expected because three major tributaries and stormwater runoff from within the city contribute to the flows at site 309ALD. The other monitoring events have similar flow characteristics.

Table 32. Table of storm event streamflow from stations above (background at 309NAD and 309GAB) and below the City of Salinas (at 309ALD).

Monitoring Event	Date	309GAB (cfs)	309NAD (cfs)	309ALD (cfs)
47	12/2/12	6.35	9.55	164.4
59	2/8/14	0.47	0	90.42
60	2/27/14	0.05	0	53.18
70	10/31/14	*	*	86.87
72	12/2/14	0.32	0.68	166.77
89	11/3/15	0	0	81.28
95	3/6/16	81.13	0	*
108	10/16/16	0	0	49.51

Note: * Flow could not be measured due to unsafe conditions. Some samples had “0” flow but have corresponding water samples in the following table. Therefore, staff infers that samples with “0” flow have standing water.

Table 33. Table of turbidity from storm water event monitoring of stations above (background at 309NAD and 309GAB) and below the City of Salinas (at 309ALD).

Monitoring Event	Date	309GAB (NTU)	309NAD (NTU)	309ALD (NTU)
47	12/2/12	2512	3000	780
59	2/8/14	300.5	25.1	298.8
60	2/27/14	1250	114	1296
70	10/31/14	3000	1639	677
72	12/2/14	964	963	170.7
89	11/3/15	637	190.6	421
95	3/6/16	658*	621	1652
108	10/16/16	103.6	68.3	47.8

Note: *high flow event at 309GAB

Summary: Based on the City’s storm event monitoring it appears the discharge from the City contributes to turbidity impairments in the Gabilan Creek watershed and urban storm water is a source of impairments. Urban outfall water quality monitoring indicates that storm runoff exceeds turbidity action levels of 126 NTU at the stormwater outfalls and storm flows greatly increase below the City. In addition, high velocity flow discharged into the Salinas Reclamation Canal from stormwater outfalls can suspend bed sediments and cause turbidity. It is important to note that there is a large agricultural tract of land (Carr Lake) within the City limits and these farms also contribute to turbidity in receiving waters downstream of the City.

7.9. Source Analysis Summary

Turbidity is caused by in large part by suspended sediment and many different activities and land uses in the watershed contribute to turbidity impairments. This section summarizes land use types and specific land management conditions of these lands that are potential sources of turbidity; also included in this summary are the parties responsible for discharges (refer to Table 34). The information on land management is primarily from the studies included in this source analysis section.

In addition to identifying broad sources of turbidity by land use type, the magnitude that each source contributes to turbidity is imperative for effective implementation. Monitoring data indicates that turbidity is a year-round problem and many management activities could contribute to increases in turbidity that are not driven by stormwater runoff. These, non-stormwater activities include pumping and irrigation runoff. The CSUMB watershed model found that runoff from cropland contributed by far the greatest proportion of suspended sediments to streams in the watershed. Therefore, land management activities associated with this land use would contribute the greatest proportion of suspended sediment loading. Sources of concern include erosion from farm fields and erosion of unvegetated ditches and resuspension of channel sediments.

Table 34. Table describing land management conditions, activities in the watershed, and responsible parties.

Type of Land Cover/Use	Description	Responsible Parties
Natural Areas	Erosion from undeveloped areas and woodlands	Landowners, ranching operations
Wetlands	Channel maintenance	MCWRA, landowners, owners and operators of agricultural lands
Wetlands	Stream or channel bank erosion and resuspension/remobilization of fine sediments	MCWRA, landowners, landowners, owners and operators of agricultural lands
Croplands	Sediment erosion from strawberry fields with plastic mulch	Owners and operators of agricultural lands
Croplands	Irrigation runoff from farm fields	Owners and operators of agricultural lands
Croplands	Stormwater runoff from farm fields	Owners and operators of agricultural lands
Nurseries and Greenhouses	Stormwater runoff from imperious surfaces	Owners and operators of agricultural lands, cannabis cultivators
Rural roads	Roadside ditch erosion, stormwater runoff	County of Monterey, landowners, owners and operators of agricultural lands

Type of Land Cover/Use	Description	Responsible Parties
Highways	Stormwater runoff from impervious surfaces causing highway shoulder and channel erosion	Caltrans
Grasslands	Grazing	Landowners and operators of ranching operations
All	Insufficient vegetative buffers along creeks	Landowners and land managers
Developed urban areas	Urban stormwater runoff	City of Salinas, County of Monterey
Developed urban areas	Construction stormwater runoff	Landowners
Developed urban areas	Industrial stormwater	Landowners
All	Pumping (pump stations, agricultural drainage pumps)	MCWRA, owners and operators of agricultural lands

8. LOADING CAPACITY, TMDLS AND ALLOCATIONS

8.1. Loading Capacities, TMDLs

Turbidity loading capacities, also referred to as turbidity TMDLs, are the amount of turbidity that surface waterbodies in the Gabilan Creek watershed can receive without exceeding the Basin Plan's turbidity water quality objective. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.

Compliance with the TMDL shall be measured at receiving water monitoring sites and based on seasonal, even interval sampling (e.g., weekly or no less frequently than monthly). TMDLs are based on the 75th percentile of data in the upper Gabilan Creek headwaters and seasonal medians of data in the lower watershed. These statistical ranges were selected because episodic storms and large events would skew analysis of seasonal data based other statistical summaries such as averaging or by comparing individual samples to targets (refer to Table 35). Lower Tembladero Slough and Old Salinas River, which are brackish waters with EST beneficial uses, do not have TMDLs because they do not have final numeric targets.

Table 35. Table of Gabilan Creek waterbodies and seasonal tubidity loading capacity (TMDLs).

Waterbody	Year-round (NTU)	Dry Season (NTU)	Wet Season (NTU)
Gabilan Creek Headwaters (upper watershed above Old Stage Road)	**2.5**	**2.2**	**3.3**
Natividad Creek Headwaters (upper watershed above Old Stage Road)	**2.5**	**2.2**	**3.3**
Gabilan Creek – Old Stage Road to Reclamation Canal	**8**	**6**	**11**
Natividad Creek	**8**	**6**	**11**
Alisal Creek	**8**	**6**	**11**
Salinas Reclamation Canal	**8**	**6**	**11**
Tembladero Slough (freshwater section upstream of Highway 1)	**8**	**6**	**11**
Tembladero Slough (brackish portion)	**n/a**	**n/a**	**n/a**
Old Salinas River (brackish)	**n/a**	**n/a**	**n/a**
Merritt Ditch	**8**	**6**	**11**
Espinosa Slough	**8**	**6**	**11**
Alisal Slough	**8**	**6**	**11**
Santa Rita Creek	**8**	**6**	**11**

8.2. Linkage Analysis

The goal of the linkage analysis is to establish the connection between TMDLs and numeric targets. The linkage analysis therefore represents the critical quantitative link between the TMDLs and attainment of the water quality standards. The turbidity TMDLs (refer to Table 35) are equal to the turbidity final numeric targets (refer to Table 22), which are in turn based on the water quality objectives. Therefore, attainment of the turbidity TMDLs will result in the attainment of the turbidity water quality objectives, the protection and restoration of beneficial uses of waterbodies in the Gabilan Creek watershed.

8.3. Allocations

To address turbidity impairments in the Gabilan Creek watershed, turbidity TMDLs are allocated to point and nonpoint sources of discharge. Point source discharges, such as urban stormwater, are regulated with NPDES permits and receive a waste load allocations. Irrigated agricultural discharges are considered nonpoint sources) and they are assigned load allocations. TMDLs are calculated as the sum of waste load allocations and load allocations along with a margin of safety. Table 36 describes the various types of allocations.

Table 36. Summary of the TMDL turbidity final allocation compliance levels.

Allocations	Location	Year-round (NTU)	Dry Season (NTU)	Wet Season (NTU)
Load Allocations	Headwater streams in the upper Gabilan Creek watershed (COLD and WARM)[1]	**2.5**	**2.2**	**3.3**
Waste Load Allocations and Load Allocations	Streams in the lower Gabilan Creek watershed (COLD and WARM)[2]	**8**	**6**	**11**
Waste Load Allocations and Load Allocations	Brackish Sloughs (EST)	**-**	**-**	**-**

[1]To determine attainment of the load allocations for the upper Gabilan Creek watershed, compare the 75th percentile of the upper Gabilan Creek data to the appropriate seasonal allocation compliance level.
[2]To determine attainment of the waste load allocations and load allocations for the lower Gabilan Creek watershed, compare the median of the lower Gabilan Creek data to the appropriate seasonal allocation compliance level.

In accordance with the Basin Plan, sources of controllable water quality conditions shall be managed to meet the water quality objectives as well as the waste load allocations and load allocations contained in this TMDL. The Basin Plan defines controllable water quality conditions as follows: *"Controllable water quality conditions are those actions or circumstances resulting from man's activities that may influence the quality of the waters of the State and that may be reasonably controlled*." (Basin Plan Chapter 3, Water Quality Objectives, page

30). The implementation section of this document describes strategies to attain the waste load allocations and load allocations listed in Table 37, for both controllable and uncontrollable conditions.

Table 37. Table describing the TMDL waste load allocations and load allocations for all surface waterbodies in the Gabilan Creek watershed.

Turbidity Source	Type of Allocation
Urban stormwater runoff	Waste Load Allocations
Construction and industrial stormwater runoff	Waste Load Allocations
Highway stormwater runoff	Waste Load Allocations
Low threat discharges	Waste Load Allocations
Irrigated agriculture/cropland	Load Allocations
Undeveloped areas and woodlands	Load Allocations
Grazing	Load Allocations
Wetlands (streams, lake, channel, sloughs, marshes)	Load Allocations
Rural roads stormwater runoff	Load Allocations
Channel maintenance	Load Allocations
pumping (lift stations and sump pumps)	Load Allocations
Nurseries and greenhouses	Load Allocations

8.4. Interim Allocations

Due to the magnitude of turbidity water quality problems in the lower Gabilan Creek watershed and the significant amount of time and effort necessary to meet the final TMDL numeric targets, TMDLs, and allocations, staff developed interim allocations for these waterbodies. Interim allocations are quantifiable milestones used to evaluate TMDL implementation progress toward achieving the final allocations. Table 38 and Table 39 summarize interim allocations for dry and wet seasons. The interim allocations are based on the interim targets previously described in Table 23 and Table 24.

The interim allocations are not established for the upland areas because the waters are higher quality and assumed to be meeting the interim allocations. The following interim allocations are established for waterbodies in the lower Gabilan Creek watershed:

- Interim-1 Allocation - Equal to the wet and dry season 25th percentile monitoring data from each waterbody monitoring station (refer to Table 14 (i.e., the interim-1 allocation for Merritt Ditch (309MER) is the 25th percentile of the seasonal monitoring data from Merritt Ditch. For example, the dry season 25th percentile is 42 NTU and the wet season 25th percentile is 67 NTU).

- Interim-2 Allocation - Equal to the 25th percentile of dry and wet season data from CMP monitoring sites outside of the Gabilan Creek watershed (12 NTU and 21 NTU respectively), refer to Table 20. However, for brackish waters, including the lower Tembladero Slough and Old Salinas River, the dry season Interim-2 numeric target for these waterbodies are based on the lowest 25th percentile of the two waterbodies (Old Salinas River – 29 NTU for dry season and 36 NTU for wet season).

To determine attainment of the interim allocations, compare the seasonal median of the data from a given monitoring station to the appropriate seasonal interim allocation compliance level for that monitoring station in Tables 39 and 40.

Table 38. Table of interim **dry** season TMDL allocation compliance levels.

Type of Allocation	Waterbody	Interim-1 Allocation (NTU)	Interim-2 Allocation (NTU)
Load Allocations	Upland area streams	n/a	n/a
Waste Load Allocations and Load Allocations	Gabilan Creek (309GAB)	40	12
Waste Load Allocations and Load Allocations	Natividad Creek (309NAD)	53	12
Waste Load Allocations and Load Allocations	Salinas Reclamation Canal/ Alisal Creek (309ALG)	27	12
Waste Load Allocations and Load Allocations	Merritt Ditch (309MER)	42	12
Waste Load Allocations and Load Allocations	Santa Rita Creek (309RTA)	51	12

Type of Allocation	Waterbody	Interim-1 Allocation (NTU)	Interim-2 Allocation (NTU)
Waste Load Allocations and Load Allocations	Salinas Reclamation Canal (309JON)	18	12
Waste Load Allocations and Load Allocations	Espinosa Slough (309ESP)	13	12
Waste Load Allocations and Load Allocations	Alisal Slough (309ASB)	12	12
Waste Load Allocations and Load Allocations	Tembladero Slough (309TEH)	57	12
Waste Load Allocations and Load Allocations	Tembladero Slough (309TEM)	38	12
Waste Load Allocations and Load Allocations	Tembladero Slough (309TDW) (brackish)	59	29
Waste Load Allocations and Load Allocations	Old Salinas River (309OLD) (brackish)	29	29

Table 39. Table of interim **wet** season TMDL allocation compliance levels.

Allocation	Waterbody	Interim-1 (NTU)	Interim-2 (NTU)
Load Allocations	Upland area streams	n/a	n/a
Waste Load Allocations and Load Allocations	Gabilan Creek (309GAB)	124	21
Waste Load Allocations and Load Allocations	Natividad Creek (3039NAD)	38	21

Allocation	Waterbody	Interim-1 (NTU)	Interim-2 (NTU)
Waste Load Allocations and Load Allocations	Salinas Reclamation Canal/Alisal Creek (309ALG)	72	21
Waste Load Allocations and Load Allocations	Merritt Ditch (309MER)	67	21
Waste Load Allocations and Load Allocations	Santa Rita Creek (309RTA)	65	21
Waste Load Allocations and Load Allocations	Salinas Reclamation Canal (309JON)	43	21
Waste Load Allocations and Load Allocations	Espinosa Slough (309ESP)	65	21
Waste Load Allocations and Load Allocations	Alisal Slough (309ASB)	27	21
Waste Load Allocations and Load Allocations	Tembladero Slough (309TEH)	84	21
Waste Load Allocations and Load Allocations	Tembladero Slough (309TEM)	52	21
Waste Load Allocations and Load Allocations	Tembladero Slough (309TDW) (brackish)	49	36
Waste Load Allocations and Load Allocations	Old Salinas River (309OLD) (brackish)	36	36

8.5. Compliance with TMDL Allocations

Dischargers must comply with TMDL allocations. Dischargers must not cause or contribute to an exceedance of the TMDL allocations and the turbidity water quality objectives in the Basin Plan.

Dischargers shall verify compliance with TMDL allocations in receiving waters by evaluating turbidity monitoring data at established watershed receiving water monitoring sites and comparing the data to TMDL allocations. If additional monitoring sites are necessary, compliance shall not be limited to the sites mentioned below. The following receiving water sites shall be monitored at equal intervals (e.g., weekly but not less frequently than monthly) and data analyzed yearly.

- Gabilan Creek (309GAB)
- Natividad Creek (3039NAD)
- Salinas Reclamation Canal / Alisal Creek (309ALG)
- Salinas Reclamation Canal (309ALD)
- Salinas Reclamation Canal (309JON)
- Santa Rita Creek (309RTA)
- Merritt Ditch (309MER)
- Alisal Slough (309ASB)
- Espinosa Slough (309ESP)
- Tembladero Slough (309TEH)
- Tembladero Slough (309TDW)
- Old Salinas River (309OLD)

8.6. Margin of Safety

The margin of safety component of a TMDL accounts for uncertainty concerning the relationship between pollution controls and water quality responses. (See 40 C.F.R. section 130.7(c)(1).) The margin of safety for these TMDLs is achieved through allocations and numeric targets based on numeric turbidity water quality objectives that are established from natural conditions. This turbidity water quality objective allows for an increase above the natural conditions in the range of 10 to 20 percent. The allocations and numeric targets do not incorporate the 10 to 20 percent increase above natural conditions. Establishing turbidity numeric targets and allocations at natural stream levels, without allowing for increases of 10 to 20 percent above natural, ensures protection of aquatic ecosystems and provides an explicit margin of safety.

An additional type of margin of safety included in this TMDL Project is found in the potential numeric targets from published studies on the effects of turbidity on aquatic ecosystems (i.e., effect levels known to interfere with aquatic life health). To derive the potential numeric target, a safety factor of 2 is applied to the published values (i.e., one half of the published effect level) to ensure protection of aquatic ecosystems. These potential numeric targets were not selected as final TMDL numeric targets since they are based on effect levels, or levels at which an adverse effect occurs, and therefore are not as protective as natural levels. The published values do, however, provide a level for comparison and assurances that key species are protected. The conservative difference between the potential turbidity numeric targets based on effect levels and the selected targets based on natural conditions provides another margin of safety.

8.7. Critical Conditions and Seasonal Variations

According to the Impaired Waters Guidance, TMDL projects must include a consideration of seasonal factors and a description of when and under what conditions the impairment occurs. Specifically, the evaluation of temporal patterns in water quality data can provide substantial insight because the analysis identifies the times of greatest impairment and quantifies the seasonal variations (e.g., flow and weather conditions, and source activity).

The turbidity in the lower Gabilan Creek watershed results in chronic impairments of the designated beneficial uses. Under natural conditions, turbidity is typically associated with rainfall and stormwater runoff events. However, based on the water quality monitoring data, streams throughout the lower Gabilan Creek exhibit year-round high turbidity levels. Therefore, implementing parties need to address activities that occur daily and cause turbidity.

Turbidity naturally occurs at elevated levels during the wet season and the turbidity TMDL Project explicitly accounts for seasonal variation by establishing separate wet and dry season interim and final turbidity numeric targets and allocations for the Gabilan Creek watershed.

9. TMDL IMPLEMENTATION PLAN

The TMDL Implementation Plan identifies the regulatory and non-regulatory mechanisms that responsible parties will use to meet their TMDL allocations. The TMDL Implementation Plan includes an implementation schedule and cost estimates.

The Basin Plan and statewide policies form the basis for regulatory actions taken by the Central Coast Water Board to protect waters of the state and ensure compliance with portions of Porter-Cologne and the Clean Water Act. The Basin Plan describes the programs, projects, prohibitions, and other actions that are necessary to achieve water quality objectives (implementation).

Table 40. Table of sources, allocations, and implementation, and section.

Turbidity Source	Type of Allocation	Implementation Plan
Urban stormwater runoff	WLA	Section 9.2 Municipal Stormwater Programs

Turbidity Source	Type of Allocation	Implementation Plan
Construction and industrial stormwater runoff	WLA	Section 9.3 Construction and Industrial Stormwater Permits
Highway stormwater runoff	WLA	Section 9.9 Highways and Rural Paved Roads
Low threat discharges	WLA	Section 9.11 NPDES General Permit Holders
Irrigated agriculture/ cropland	LA	Section 9.1 Irrigated Agricultural Lands Discharges
Undeveloped areas and woodlands	LA	Section 9.8 Rangeland and Natural Areas
Grazing	LA	Section 9.8 Rangeland and Natural Areas
Wetlands (degraded streams and channels)	LA	Section 9.4 Regional Stormwater Management Plan
Rural roads stormwater runoff	LA	Section 9.5 Prohibition of Discharge and Section 9.9 Highways and Rural Paved Roads
Channel maintenance	LA	Section 9.12 Prohibition of Discharge. Section 9.12 Channel Maintenance
Pumping (pump stations and agricultural drainage pumps)	LA	Section 9.6 Pump Stations and Section 9.7 Agricultural Drainage Pumps
Nurseries and greenhouses	LA	Section 9.2 Irrigated Agricultural Lands Discharges and Section 9.10 Cannabis Order

Under the federal Clean Water Act, sources of pollution are categorized as either "point source" or "nonpoint source" and these two categories have different mechanisms for implementation that are outlined in this section (USEPA, 2018). A point source is defined in section 502(14) of the Clean Water Act as follows:

> *any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.*

The National Pollutant Discharge Elimination System (NPDES) permit is the mechanism for translating waste load allocations into enforceable requirements for point sources. Under Clean Water Act section 402, discharges of pollutants to waters of the United States are authorized by obtaining and complying with the terms of an NPDES permit. The Central Coast Water Board is the permitting authority for NPDES permits in the Central Coast Region.

Nonpoint sources (NPS) refer to pollution that is not released through pipes but rather originates from multiple sources over a relatively large area. Nonpoint sources are assigned the load allocation component of a TMDL. The load allocation is the portion of the receiving water's pollutant loading capacity attributed to (1) the existing or future nonpoint sources of pollution and (2) natural background sources. Regional Water Boards regulate nonpoint source pollution using the permitting authorities provided by Porter-Cologne, the principle legal authority in California for the application and enforcement of TMDL load allocations for nonpoint sources.

In July 2000, the State Water Board and the California Coastal Commission developed the Plan for California's Nonpoint Source Pollution Control Program to reduce and prevent nonpoint source pollution in California, expanding the State's nonpoint source pollution control efforts. The NPS Program's long-term goal is to "improve water quality by implementing the management measures" identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013. Under the California NPS Program Pollution Control Plan, TMDLs are considered one type of implementation planning tool that will enhance the State's ability to foster implementation of appropriate NPS management measures.

The Policy for Implementation and Enforcement of the NPS Control Program adopted in August 2004 (State Water Board, 2004a), explains how Water Board authorities granted by the Porter-Cologne Act will be used to implement the California NPS Program Plan. The Nonpoint Source Implementation and Enforcement Policy requires the Regional Water Boards to regulate all NPSs of pollution using the administrative permitting authorities provided by the Porter-Cologne Act.

Nonpoint source dischargers must comply with Waste Discharge Requirements (WDRs), waivers of WDRs, or Basin Plan Prohibitions by participating in the development and implementation of Nonpoint Source Pollution Control Implementation Programs. NPS dischargers can comply either individually or collectively as participants in third-party coalitions. The "Third-party" Programs are restricted to entities that are not actual discharges under Regional Water Board permitting and enforcement jurisdiction. These may include Non-Governmental Organizations, citizen groups, industry groups, watershed coalitions, government agencies, or any mix of these. All NPS implementation programs must meet the requirements of the following five key elements described in the NPS Implementation and Enforcement Policy (refer to Table 41. Each NPS implementation program must be endorsed or approved by the Regional Water Board or the Executive Officer (if the Water Board has delegated authority to the Executive Officer).

Table 41. Table describing the key elements of a NPS program.

Key Element	Description
Key Element 1:	A NPS control implementation program's ultimate purpose must be explicitly stated and at a minimum address NPS pollution control in a manner that achieves and maintains water quality objectives.
Key Element 2:	The implementation program shall include a description of the management practices (MPs) and other program elements dischargers expect to implement, along with an evaluation program that ensures proper implementation and verification.
Key Element 3:	The implementation program shall include a time schedule and quantifiable milestones, should the Regional Water Board require these.
Key Element 4:	The implementation program shall include sufficient feedback mechanisms so that the Regional Water Board, dischargers, and the public can determine if the implementation program is achieving its stated purpose(s), or whether additional or different MPs or other actions are required (See Section 12, Monitoring Program).
Key Element 5:	Each Regional Water Board shall make clear, in advance, the potential consequences for failure to achieve an implementation program's objectives, emphasizing that it is the responsibility of individual dischargers to take all necessary implementation actions to meet water quality requirements.

9.1. Irrigated Agricultural Lands Discharges

Discharges from irrigated agricultural lands are nonpoint sources of pollution, which are therefore not subject to federal NPDES permits, but which are required to meet State WDRs. Owners and operators of irrigated agricultural land in the Gabilan Creek watershed will implement this TMDL Project through compliance with a permit regulating waste discharges from irrigated lands, currently the General Waste Discharge Requirements for Discharges From Irrigated Lands (Order No. R3-2021-0040; the "Order") and the Monitoring and Reporting Program in accordance with Order No. R3-2021-0040. Owners and operators of irrigated agricultural lands must meet load allocations, achieve the TMDLs according to the TMDL attainment schedule, and help rectify the impairments addressed in this TMDL Project by complying with requirements in the Order that are relevant to reducing erosion and sediment discharges and actions that mobilize instream sediments. The Order regulates:

(1) discharges of waste from commercial irrigated lands, including, but not limited to, land planted to row, vineyard, field and tree crops where water is applied for producing commercial crops;

(2) discharges of waste from commercial nurseries, nursery stock production, and greenhouse operations with soil floors that do not have point source-type discharges and are not currently operating under individual WDRs; and

(3) discharges of waste from lands that are planted to commercial crops that are not yet marketable, such as vineyards and tree crops.

The Order requires owners and operators of irrigated lands to do the following:

A. Comply with load allocations and achieve the applicable TMDLs. The Order incorporates applicable load allocations as surface receiving water limits for owners and operators of irrigated lands in TMDL project areas.

B. Conduct surface receiving water quality monitoring and reporting, implement follow-up actions to meet interim milestones and load allocations, and potentially complete ranch-level surface discharge monitoring and reporting in areas where water quality issues persist or applicable load allocations are not met by their compliance dates.

C. Report on irrigation system type, discharge type, slope, impermeable surfaces (i.e., plastic covered surfaces that do not allow fluid to pass through, including polyethylene mulch and hoop houses), and presence and location of any waterbodies on or adjacent to irrigated lands.

D. Manage stormwater discharge intensity and volume from fields with 50 to 100 percent coverage of impermeable surfaces or with greater than or equal to 0.5 acre of impermeable surfaces so as not to exceed stormwater discharges from the equivalent permeable field area.

E. Implement, assess, and report on all sediment, erosion, irrigation, stormwater, road, agricultural drainage pump, and impermeable surface management practices and maintain records of all management practices used to reduce erosion and sediment loading.

F. Avoid disturbance (e.g., removal, degradation, or destruction) of existing, naturally occurring, and established native riparian vegetative cover and report on average width and length of riparian area.

The agricultural monitoring and reporting program for turbidity in the watershed must be adequate to determine progress toward achieving load allocations with sufficient statistical power. Upon approval of the TMDLs, the existing monitoring and reporting requirements of the Order must be evaluated to determine whether they are adequate. If the requirements of the Order are inadequate, then the monitoring and reporting program should be updated through the development of follow-up implementation work plans as required in the Order. Follow-up implementation planning must address the need for increased monitoring frequency and additional monitoring sites to achieve adequate statistical power necessary to evaluate progress toward achieving load allocations.

9.2. Municipal Stormwater Programs

The two MS4s in the watershed, City of Salinas and Monterey County, are required to implement and comply with the TMDLs. They must develop implementation plans to attain waste load allocations in the receiving waters into which they discharge.

City of Salinas:

The City of Salinas is subject to a Phase I MS4 Stormwater Permit (currently Order No. R3-2019-0073, NPDES No. CA0049981). This Permit requires the City to comply with applicable interim and final water quality-based effluent limitations and associated compliance schedules that implement the waste load allocations assigned to the City in approved TMDLs. Within one year of approval by the OAL, the City must prepare a plan to address the TMDL waste load allocations assigned to the City. The Permit requires the City's plan, referred to as a Pollutant Load Reduction Plan, to address all waterbody-pollutant combinations identified in the Permit, for which the City has not yet demonstrated waste load allocation attainment. As such, the City will be required to update its Pollutant Load Reduction Plan to incorporate its assigned interim and final waste load allocations for turbidity in the Lower Gabilan Creek Watershed. In addition, the City will be required to meet the requirements of the reissued permit, which will incorporate the TMDL waste load allocations and TMDL attainment schedule.

Monterey County:

The County is subject to the State Water Board Phase II MS4 General Stormwater Permit (Order No. 2013-0001 DWQ). This General Permit requires the County to develop, submit, and begin implementation of a Waste Load Allocation Attainment Program that identifies actions the County will take to attain its waste load allocation within one year following approval of this TMDL by the Office of Administrative Law, or within one year of General Permit renewal, whichever comes first. The following permit requirements related to TMDL attainment may change in subsequent permit reissuances and the County is required to implement updates.

The Waste Load Allocation Attainment Program shall include:

1. A detailed description of the strategy the MS4 will use to guide Best Management Plan (BMP) selection, assessment, and implementation to ensure that BMPs implemented will be effective at abating pollutant sources, reducing pollutant discharges, and achieving waste load allocations according to the TMDL schedule.
2. Identification of sources of the impairment within the MS4's jurisdiction, including specific information on various source locations and their magnitude within the jurisdiction.
3. Prioritization of sources within the MS4's jurisdiction, based on suspected contribution to the impairment, ability to control the source, and other pertinent factors.
4. Identification of BMPs that will address the sources of impairing pollutants and reduce the discharge of impairing pollutants.
5. Prioritization of BMPs, based on suspected effectiveness at abating sources and reducing impairing pollutant discharges, as well as other pertinent factors.
6. Identification of BMPs the MS4 will implement, including a detailed implementation schedule. For each BMP, identify milestones the MS4 will use for tracking implementation, measurable goals the MS4 will use to assess implementation efforts, and measures and targets the MS4 will use to assess effectiveness. MS4s shall include expected BMP implementation for future implementation years, with the understanding that future BMP implementation plans may change as new information is obtained.
7. A quantifiable numeric analysis that uses published BMP pollutant removal estimates, performance estimates, modeling, best professional judgment, and/or other available tools to demonstrate that the BMP selected for implementation will likely achieve the MS4's waste load allocation by the schedule identified in the TMDL. This analysis will most likely incorporate modeling efforts. The MS4 shall conduct repeat numeric analyses as the BMP implementation plans evolve and information on BMP effectiveness is generated. Once the MS4 has water quality data from its monitoring program, the MS4 shall incorporate water quality data into the numeric analyses to validate BMP implementation plans.
8. A detailed description, including a schedule, of a monitoring program the MS4 will implement to assess discharge and receiving water quality, BMP effectiveness, and progress towards any interim targets and ultimate attainment of the MS4s' waste load allocation. The monitoring program shall be designed to validate BMP implementation efforts and quantitatively demonstrate attainment of interim targets and waste load allocations.
9. If the approved TMDL does not explicitly include interim targets, the MS4 shall establish interim targets (and dates when stormwater discharge conditions will be evaluated) that are equally spaced in time over the TMDL attainment schedule and represent measurable, continually

decreasing MS4 discharge concentrations or other appropriate interim measures of pollution reduction and progress towards the waste load allocation. At least one interim target and date must occur during the first five years commencing on January 1, 2019. The MS4 shall achieve its interim targets by the date it specifies in the Waste load Allocation Attainment Program. If the MS4 does not achieve its interim target by the date specified, the MS4 shall develop and implement more effective BMPs that it can quantitatively demonstrate will achieve the next interim target.

10. A detailed description of how the MS4 will assess BMP and program effectiveness. The description shall incorporate the assessment methods described in the CASQA Municipal Storm Water Program Effectiveness Assessment Guide.
11. A detailed description of how the MS4 will modify the program to improve upon BMPs determined to be ineffective during the effectiveness assessment.
12. A detailed description of information the MS4 will include in annual reports to demonstrate adequate progress towards attainment of waste load allocations according to the TMDL schedule.
13. A detailed description of how the MS4 will collaborate with other agencies, stakeholders, and the public to develop and implement the Wasteload Allocation Attainment Program.
14. Any other items identified by Integrated Report fact sheets, TMDL Project Reports, TMDL Resolutions, or that are currently being implemented by the MS4 to control its contribution to the impairment.

Non-stormwater discharges consist of all discharges from an MS4 that do not originate from precipitation events. The stormwater permits pertaining to the City and County effectively prohibit non-stormwater discharges through an MS4 into waters of the United States. Certain categories of non-stormwater discharges are conditionally exempt from the prohibition of non-stormwater discharge as specified at 40 C.F.R section 122.26(d)(2)(iv)(B)(1). Non-stormwater discharges that are regulated by a separate NPDES permit are not subject to the discharge prohibition.

9.3. Industrial and Construction Stormwater Discharges

Industrial facilities and construction operators are expected to meet the proposed waste load allocations through their existing permits. To maintain existing water quality and prevent any further water quality degradation, these permitted industrial facilities and construction operators shall continue to implement and comply with the requirements of the statewide Industrial General Permit (Order No. 2009-0009 amended by Order No. 2014-0057-DWQ, NPDES No. CAS000001) or the Construction General Permit (Order No. 2012-0006-DWQ, NPDES No. CAS000002), or any subsequent Industrial or Construction General Permits.

Dischargers disturbing one or more acres are required to enroll under the Construction General Permit. The Construction General Permit requires the development of a Storm Water Pollution Prevention Plan (SWPPP) by a certified Qualified SWPPP Developer. The SWPPP development includes site assessment and sediment and erosion control BMP selection.

The Industrial General Permit regulates industrial stormwater discharges from industrial facilities in California. Industrial facilities such as manufacturers, landfills, mining, steam generating electricity, hazardous waste facilities, transportation with vehicle maintenance, larger sewage and wastewater plants, recycling facilities, oil and gas facilities, and agricultural processing facilities are typically required to obtain Industrial General Permit coverage. Except for non-stormwater discharges authorized in Section IV of the Industrial General Permit, discharges of liquids or materials other than stormwater, either directly or indirectly to waters of the United States, are prohibited unless authorized by another NPDES permit. Unauthorized non-stormwater discharges must be either eliminated or authorized by a separate NPDES permit.

9.4. Monterey County Regional Stormwater Resource Management Plan

TMDLs will be implemented through projects that restore aquatic and riparian habitat or reduce turbidity that are identified in the Monterey County Regional Stormwater Resource Management Plan (Regional Plan), which was developed by the Greater Monterey Integrated Regional Water Management (IRWM) stakeholders. The Regional Plan is a comprehensive stormwater management strategy for the greater Monterey Region, which encompasses the Gabilan Creek watershed. The Regional Plan is an integrated approach implemented by collaborating stormwater management agencies and other stakeholders to optimize their stormwater planning and implementation efforts. The IRWM planning group represents government agencies, nonprofit organizations, educational organizations, water service districts, private water companies, and organizations representing agricultural, environmental, and community interests.

The Regional Plan aims to achieve multiple benefits for the watershed including increased water supply, improved water quality, better flood protection, enhanced environmental quality, and greater community opportunity. The Regional Plan's specific goals and their benefits are as follows:

- Water Quality: *Improve water quality so that waters in the planning area are suitable for human and environmental uses.*

- Water Supply: *Manage storm water to increase water supply for urban, agricultural and environmental uses.*

- Flood Protection Benefits: *Manage storm water systems to reduce surface water peak flows and flood risk.*

- Environmental Benefits: *Protect, preserve, restore, and/or enhance watershed features and processes through storm water management.*

- Community Benefits: *Enhance economic prosperity and quality of life through improved urban spaces, availability of clean water, and related job creation and training.*

The Regional Plan includes a wide range of projects to achieve the five goals. The projects are categorized into two stages of development. Some projects are in design proposal stage, which means they have been designed and are ready for funding and implementation and other projects are in the concept proposal stage. The following is a list of projects that not only meet the goals of the Regional Plan but also meet the goals of the turbidity TMDL Project.

1. Carr Lake Project: The Big Sur Land Trust and partners propose a transformation of Carr Lake, in the center of the City of Salinas, from seasonally flooded farmland to restored wetland habitat, community parks and other uses. (Concept Proposal)

2. Salinas to the Sea Storm Water Management, Community Development, and Habitat Enhancement Project: The Central Coast Wetlands Group proposes restoring wetland habitat, bicycle and walking trails, water storage and treatment along 25 miles of highly modified stream channel. (Concept Proposal)

3. Castroville and Moss Landing Storm Water Enhancement Project: The Central Coast Wetlands Group and partners propose creating stormwater storage and treatment in seasonally flooded farmlands that historically were wetland habitat. (Design Proposal)

4. Espinosa Lake Flood Retention Project: The Central Coast Wetlands Group and partners propose creating stormwater storage and treatment in seasonally flooded farmlands that historically were wetland habitat. (Design Proposal)

5. Old Salinas River Treatment Wetland: The Central Coast Wetlands Group and partners propose creating stormwater storage and treatment in seasonally flooded farmlands that historically were wetland habitat. (Design Proposal)

6. Gabilan Floodplain Enhancement Project: The Central Coast Wetlands Group and partners propose re-establishing watershed processes to allow a highly modified channel to reconnect to areas of its floodplain to restore wetland habitat, attenuate flood peak flows and promote aquifer recharge. (Concept Proposal)

7. Acosta Plaza Urban Drainage Restoration: The City of Salinas proposes low impact development installations to promote groundwater recharge and reduce stormwater pollution and flooding. (Concept Proposal)

8. Lincoln Green/Complete Street: The City of Salinas proposes low impact development installations to promote groundwater recharge and reduce stormwater pollution and flooding. (Concept Proposal)

9. Salinas Water Quality and Agricultural Reuse Efficiency Project: Monterey One Water, Central Coast Wetlands Group and the City of Salinas propose engineered infrastructure and new treatment wetlands to store and treat stormwater and industrial wash water. (Design Proposal)

10. Storm Water Management, Collection, and Infiltration on Private and Public Lands: The Resource Conservation Districts of Monterey and Santa Cruz Counties propose diverting agricultural stormwater to ponds and treatment wetlands to facilitate groundwater recharge. (Concept Proposal)

The Regional Plan includes estimated costs and completion dates for the design and concept proposals that are summarized the in the TMDL implementation section.

The Regional Plan uses watershed, stormwater, and pollutant models to characterize the watershed and prioritize projects. The IRWM group considers the Regional Plan a working document and staff recommends they investigate and model sediment sources in the Gabilan Creek watershed. This TMDL relies on modeling conducted over 18 years ago by CCoWs and this work needs to be updated. Specifically, modeling should include a geomorphic study of channel conditions and an assessment of excess erosion, deposition, and remobilization of fine sediments.

The resuspension of sediments in unvegetated or sparsely vegetated stream channels in the lower watershed is a source of turbidity that could be address through wetland restoration and improvements to pumping and stormwater systems that discharge in the channel. Staff supports the efforts by the IRWM group to restore wetlands and encourages continued regional coordination to address these sources of turbidity.

9.5. Prohibition of Discharge

Unpermitted land disturbance activities such as road grading, channel maintenance, and channel dredging are identified as potential sources of turbidity in the TMDL. Beneficial uses of waters are protected from unauthorized discharges of sediment and organic materials by a land disturbance prohibition in the Basin Plan, section 4.8.5.1. This prohibition, or any future prohibitions addressing land disturbance, sediment discharges, or any activity that impacts turbidity in waters of the State, applies to unpermitted discharges in the watershed.

4.8.5.1 Land Disturbance Prohibitions
The discharge or threatened discharge of soil, silt, bark, slash, sawdust, or other organic and earthen materials into any stream in the basin in violation of best management practices for timber harvesting, construction, and other soil disturbance activities and in quantities deleterious to fish, wildlife, and other beneficial uses is prohibited.

The placing or disposal of soil, silt, bark, slash, sawdust, or other organic and earthen materials from timber harvesting, construction, and other soil disturbance activities at locations above the anticipated high water line of any stream in the basin where they may be washed into said waters by rainfall or runoff in quantities deleterious to fish, wildlife, and other beneficial uses is prohibited.

Soil disturbance activities not exempted pursuant to Regional Board Management Principles contained in Chapter Five are prohibited:

1. *In geologically unstable areas,*

2. *On slopes in excess of thirty percent (excluding agricultural activities), and*

3. On soils rated a severe erosion hazard by soil specialists (as recognized by the Executive Officer) where water quality may be adversely impacted;
Unless,

   a. *In the case of agriculture, operations comply with a Farm Conservation or Farm Management Plan approved by a Resource Conservation District or the USDA Soil Conservation Service;*

   b. *In the case of construction and land development, an erosion and sediment control plan or its equivalent (e.g., EIR, local ordinance) prescribes best management practices to minimize erosion during the activity, and the plan is certified or approved, and will be enforced by a local unit of government through persons trained in erosion control techniques; or,*

   c. There is no threat to downstream beneficial uses of water, as certified by the Executive Officer of the Regional Board.

9.6. Pump Stations

MCWRA operates pump stations in several streams in the lower Gabilan Creek watershed and large volume discharges from the pumps are sources of turbidity. The pump stations house large instream pumps used for flood control and to drain low-lying stream channels in agricultural areas. The pumps were originally constructed and operated by agricultural landowners, but are currently operated and maintained by MCWRA. Although MCWRA operates these pumps, both landowners and MCWRA are both responsible parties for meeting load allocations.

The pump stations are considered agricultural discharges and therefore are nonpoint sources of pollution. Since the pump stations are categorizes as nonpoint sources of pollution, and discharges from these pumps are not regulated by any permit, responsible parties must develop a Nonpoint Source (NPS) program that meets the five key elements of the Nonpoint Source Policy. The ultimate purpose of their NPS program is to meet the receiving water turbidity TMDL numeric targets and the turbidity water quality objectives. Within one year of TMDL approval by OAL, MCWRA shall submit the NPS implementation plan to the Central Coast Water Board's Executive Officer for approval. The five key elements of a NPS program must include the following:

1. A NPS control implementation program's ultimate purpose must be explicitly stated and at a minimum address NPS pollution control in a manner that achieves and maintains water quality objectives.
2. The implementation program shall include a description of the management practices (MPs) and other program elements dischargers expect to implement, along with an evaluation program that ensures proper implementation and verification.
3. The implementation program shall include a time schedule and quantifiable milestones, should the Regional Water Board require these.
4. The implementation program shall include sufficient feedback mechanisms so that the Regional Water Board, dischargers, and the public can determine if the implementation program is achieving its stated purpose(s), or whether additional or different MPs or other actions are required.
5. Each Regional Water Board shall make clear, in advance, the potential consequences for failure to achieve an implementation program's objectives, emphasizing that it is the responsibility of individual dischargers to take all necessary implementation actions to meet water quality requirements.

MCWRA may proactively implement a NPS program and meet their TMDL load allocations using agency resources along with outside funding such as grants. However, failure to implement projects that address the pump station contribution to turbidity in receiving waters may result in the Central Coast Water Board addressing discharges through regulatory mechanisms such as waste discharge requirements, waivers, or cleanup and abatement orders.

9.7. Agricultural Drainage Pumps

Agricultural drainage pumps are a potential source of turbidity in the watershed and dischargers operating agricultural pumps must implement management practices to achieve load allocations and turbidity water quality objectives in the Basin Plan.

The Order addresses agricultural drainage discharges as follows:

1. **Prohibition**: *Dischargers who utilize agricultural drainage pumps must implement management practices to dissipate flow and prevent channel and/or streambank erosion resulting in increased sediment transport and turbidity within surface water.*[1]

2. **Farm Water Quality Management Plan (Farm Plan) that includes a Sediment and Erosion Management Plan (SEMP):** Dischargers must develop and implement a Sediment and Erosion Management Plan (SEMP) to identify specific water quality management practices implemented and assessed for effectiveness on the ranch to reduce water quality impacts and achieve turbidity load allocations. The SEMP is a section of the Farm Plan, must be maintained in the Farm Plan, and submitted to the Central Coast Water Board upon request. Dischargers must incorporate planning elements from this TMDL project into their SEMP(s) and, as appropriate, into their follow-up surface receiving water implementation work plan(s). More specifically the SEMP must identify:

    a. Planning and management practice implementation and assessment that results in compliance with turbidity load allocations;
    b. All sediment, erosion, irrigation, stormwater, road, agricultural drainage pump, and impermeable surface management practices implemented on the ranch; and
    c. Assessment of management practice effectiveness.

3. **Annual Compliance Form (ACF):** Dischargers must submit summary information from the SEMP in the ACF. The ACF requires information about management practice implementation, assessment, and effectiveness to reduce water quality impacts. Methods for assessing the effectiveness of agriculture drainage pump management practice(s) can include visual inspection, photo documentation, and upstream and downstream turbidity monitoring. Management practices to reduce erosion

[1] Order No. R3-2021-0040, Pt. 2, Section D, at p. 44, para. 14.

and resuspension of sediments can include flow dissipation structures, channel vegetation, proper sizing of pumps, and armoring of channels.

4. **Follow-Up Surface Receiving Water Implementation:** Dischargers, either individually or as part of a third-party program, must develop a follow-up surface receiving water implementation work plan to achieve the following:

    a. Identify and abate sources of water quality impacts;
    b. Evaluate the impact of irrigated agricultural waste discharges on receiving waters;
    c. Evaluate the condition of existing perennial, intermittent, and ephemeral streams and riparian and wetland areas, including degradation resulting from erosion or irrigated agricultural discharges of waste;
    d. Evaluate compliance with the numeric limits described in the Order;
    e. Identify follow-up actions, including outreach, education, additional monitoring and reporting, and management practice implementation that will be implemented to achieve compliance with the numeric limits described in the Order.

9.8. Rangeland and Natural Areas

Rangeland and natural lands in the Gabilan Creek headwaters are nonpoint sources of turbidity and the implementation of management practices are necessary to protect sensitive areas such as creeks and wetlands from controllable sources. Currently on a proactive basis, ranchers in the Gabilan Creek watershed implement management practices to protect water quality and riparian areas. Examples of practices[1] include:

- Rotational grazing to keep livestock away from creeks and from disturbing native plants adjacent to the waterbodies.
- Minimizing erosion from all pasturelands to avoid erosion as much as possible.
- Using troughs as the main water source for livestock and not natural waterbodies.
- Keeping livestock away from the waterbodies when providing hay for feeding. This also applies to mineral sources such as salt blocks if they are used.

Water quality monitoring data for the upper watershed was limited, however the primary sources of turbidity in the watershed are from activities and conditions in the lower watershed. Therefore, it is recommended that ranching operations and landowners continue with voluntary practices. It is also recommended that

[1] Personal communication with Norm Groot, April 4, 2020. Norm contacted ranchers in the watershed about their management practices to protect water quality and relayed the information to staff.

management practices and water quality in the headwaters of the Gabilan Creek watershed be monitored and evaluated on a regular basis. If monitoring data indicates that TMDL load allocations and water quality standards are not met in the future, responsible parties will be required to develop a NPS program that meets the five key elements of the NPS Policy, implement additional management practices, and regulatory approaches will be considered.

Additional mechanisms that could be utilized to implement this TMDL include requiring rangeland management plans or a rangeland certification program and a prohibition of discharge. Rangeland plans should address erosion control, adequate pasture stand density, and rangeland conditions (SWRCB, 2018). Recommended nonpoint source management practices include but are not limited to the following:

- Maintaining vegetative cover to stabilize soils and to prevent erosion from wind or water.
- Using fences and other practices such as providing alternative sources of water to exclude livestock from creeks.
- Maintaining vegetative buffers of native vegetation along creeks.
- Installing structural practices including improvements to unpaved access roads, grade stabilizers, sediment ponds, troughs and tanks, and streambank protection.

9.9. Highways and Rural Paved Roads

In the Gabilan Creek watershed, stormwater runoff from highways and rural roads are sources of roadside erosion, which result in stream sedimentation and turbidity. Caltrans is responsible for state highways and Monterey County Resource Management Agency, Public Works Division (County Public Works), is responsible for operation and maintenance of rural roads and right of ways.

Stormwater discharges from State highways are regulated under the Caltrans Statewide Order No. 2012-0011-DWQ, NPDES NO. CAS000003. To maintain and protect water quality and prevent any further water quality degradation, Caltrans shall continue to implement and comply with the requirements of the statewide permit. TMDL allocations for turbidity apply at the watershed level and Caltrans shall assess their contribution to turbidity impairments and develop a plan to meet their waste load allocations. The assessment shall identify sources, Caltrans' contribution to loading, and the effectiveness of existing BMPs in addressing sedimentation and hydromodification. The implementation plan shall include implementation measures, monitoring, and a time schedule to achieve their waste load allocations. Within one year of TMDL approval by OAL, Caltrans shall submit the assessment and implementation plan to the Central Coast Water Board or the Executive Officer for approval.

Monterey County rural roads and right of way ditches outside of the Monterey County's MS4 boundaries are nonpoint sources of turbidity. Monterey County Public Works shall develop a NPS program to meet load allocations. The implementation program must include the five key elements described in the NPS Policy (as described above in the section titled Pump Stations). Within one year of TMDL approval by OAL, Monterey County Public Works shall submit a NPS implementation plan to the Central Coast Water Board for endorsement or approval by the Water Board's Executive Officer. Monterey County may proactively implement a NPS program and meet their TMDL load allocations using agency resources along with outside funding such as grants. However, failure to implement projects that address Monterey County's contribution to turbidity in receiving waters may result in the Central Coast Water Board addressing discharges through regulatory mechanisms such as waste discharge requirements, waivers, or cleanup and abatement orders.

9.10. Cannabis Order

Owners, operators, and landowners of commercial cannabis operations will implement the TMDLs through achieving the TMDL load allocations and complying with the General Waste Discharge Requirements and Waiver of Waste Discharge Requirements for Dischargers of Waste Associated with Cannabis Cultivation Activities (Order No. WQ 2019-0001-DWQ) (Cannabis General Order), the associated monitoring and reporting program, and any future permits regulating the discharge of waste from commercial cannabis operations.

The Cannabis General Order provides a statewide tiered approach for permitting discharges. Tiers are defined by amount of disturbed area wherein sites with a disturbed area of an acre or more are placed into Tier 2 and sites with disturbed areas less than one acre are Tier 1. Sites are further characterized using a risk designation based on the slope of disturbed area and proximity to a water body. Moderate risk sites are those in which any portion of the disturbed area is located on a slope greater than 30 percent and less than 50 percent. High risk sites are those in which any portion of the of the disturbed area is located within the minimum riparian setback. Finally, indoor cultivation and outdoor sites with disturbed area less than 2,000 square feet are considered conditionally exempt under the Cannabis General Order and enrolled under the Waiver of the Cannabis General Order.

There are currently 28 commercial cannabis cultivators in the Gabilan Creek watershed (refer to Table 42 and Figure 31) enrolled in the Cannabis General Order. Table 42 summarizes the number of enrolled cannabis cultivators in each tier.

Table 42. Summary of cannabis program enrollment in the watershed.

Enrollment Type	Count
Tier 1, Low Risk (1L)	3
Tier 2, High Risk (2H)	5

Enrollment Type	Count
Tier 2, Low Risk (2L)	19
Conditionally Exempt (WAIVER)	1
Grand Total	**28**

The Cannabis General Order specifically requires owners, operators, and landowners of commercial cannabis cultivation operations (dischargers) to comply with the following general requirements and prohibitions:

- Prior to commencing any cannabis cultivation activities, including cannabis cultivation land development or alteration, the cannabis cultivator shall comply with all applicable federal, state, and local laws, regulations, and permitting requirements as applicable (Cannabis General Order, Attachment A, Section 1, Requirement 1).
- The cannabis cultivator shall apply for a Lake and Streambed Alteration Agreement (LSA Agreement) or consult with CDFW to determine if an LSA Agreement is needed (Cannabis General Order, Attachment A, Section 1, Requirement 3).
- To avoid water quality degradation from erosion and sedimentation, land disturbance activities shall not occur during the winter period[2] unless authorized by a Regional Water Board Executive Officer. Cannabis cultivators shall ensure land disturbing activities are in place prior to the onset of the winter period. All land disturbing activities during the winter period shall be supervised by a Qualified Professional[3] (Cannabis General Order, Attachment A, Section 1, Requirement 6).
- The cannabis cultivator shall cease land disturbance activities and shall implement erosion control requirements described in the Cannabis General Order during any 24-hour period in which the applicable daily weather forecast or any 24-hour forecast reports a 50 percent or greater chance of precipitation greater than 0.5 inch per 24 hours (Cannabis General Order, Attachment A, Section 1, Requirement 9).

[2] The Cannabis General Order defines the winter period as October 15 to April 15 for Santa Clara County, Santa Cruz County, and Monterey County, and November 15 to April 1 for all other counties located in the central coast region.

[3] The Cannabis General Order defines Qualified Professional as: (1) individuals licensed in California under the Professional Engineer Act (e.g., Professional Engineer), Geologist and Geophysicist Act (e.g., Professional Geologist, Certified Engineering Geologist, or Certified Hydrogeologist), and Professional Land Surveyors’ Act (e.g., Professional Land Surveyor) (2) a California Registered Professional Forester (RPF), and (3) a Qualified Storm Water Pollution Prevention Plan (SWPPP) Developer (QSD). Qualified QSDs are California licensed civil engineers; professional geologists; landscape architects; professional hydrologists; certified professionals in erosion and sediment control; certified inspectors of sediment and erosion control; and certified erosion, sediment, and storm water inspectors.

- The cannabis cultivator shall comply with all water quality objectives/standards, policies, and implementation plans adopted or approved pursuant to the Porter-Cologne section 13000, et seq. or CWA section 303 (33 U.S.C. section 1313) (Cannabis General Order, Attachment A, Section 1, Requirement 14).

The Cannabis General Order includes additional requirements for sites where any portion of the disturbed area is located on slopes greater than 30 percent or within the minimum riparian setback outlined in the Cannabis General Order, Attachment A, Section 1, Requirement 37. These additional requirements include supplemental technical documents and expanded monitoring and reporting. Tier 1 or Tier 2 cannabis cultivators who have any portion of the disturbed area on slopes greater than 30 percent and less than 50 percent are considered moderate risk and must submit a Site Erosion and Sediment Control Plan.

Tier 1 or Tier 2 cannabis cultivators who have any portion of the disturbed area within the minimum riparian setback are considered high risk and must submit a Disturbed Area Stabilization Plan. The Disturbed Area Stabilization Plan must describe the actions the discharger will take to move all land disturbing activities out of the minimum riparian setback. Both plans must include a description of the actions the discharger will take to stabilize bare or unstable ground. Both plans must include a time schedule for implementation and must be approved by the Executive Officer prior to the cannabis cultivator initiating any land stabilization activities. Added monitoring requirements for moderate or high-risk sites include stormwater quality monitoring and annual reporting of site maintenance status. Stormwater quality monitoring includes monthly analysis of stormwater runoff for turbidity and pH. Reporting of site maintenance status includes monthly visual surface water runoff monitoring, soil erosion control and sediment capture measures implemented or maintained, and disturbed areas stabilized.

The Cannabis General Order also requires dischargers to implement management practices to minimize erosion and sediment discharges associated with earthmoving, soil and bulk amendment storage, access road development and maintenance, land drainage, drainage culverts and stream crossings, and soils disposal and management. Specific requirements related to land development, erosion control, access roads, drainage, and stream crossings can be found in the Cannabis General Order, Attachment A, Section 2, Requirements 1 through 62.

In addition to the requirements described in the current Cannabis General Order, the TMDL also establishes additional requirements aimed to reduce turbidity impairments in the Gabilan Creek watershed. All cannabis cultivators in the Gabilan Creek watershed must develop a sitewide Sediment Discharge Monitoring and Reporting Plan. At a minimum, the plan must include:

- Sitewide Stormwater Management Plan, including location and condition of all stormwater conveyance channels. This plan must include a time schedule for rehabilitating all unstable conveyances.
- Monthly stormwater runoff monitoring for turbidity and pH and reporting of site maintenance status. Sampling locations must represent stormwater discharging from the cannabis disturbed area. Multiple sampling locations may be necessary to characterize the discharge from all disturbed areas. The Cannabis General Order includes additional details for stormwater monitoring and site maintenance status reporting.
- Instream (receiving water) turbidity monitoring for sites that are adjacent to surface water and have any amount of unstable ground present on site or are undergoing land disturbing activities. Samples must be taken for all days in which flow is present in the channel when land disturbing activities are taking place or ground conditions are unstable. Monitoring must include the following:
    - Quantification of baseline turbidity levels by sampling instream levels prior to work commencing for land disturbing activities or in dry weather for unstable ground conditions present on site.
    - Quantification of relative increase in turbidity, if any, due to land disturbing activities onsite or unstable ground conditions by taking instream samples upstream and downstream of disturbed area.

The effectiveness of erosion prevention and sedimentation control measures will be determined by comparing discharge events and instream receiving water monitoring to established watershed discharge goals for turbidity in the Basin Plan.

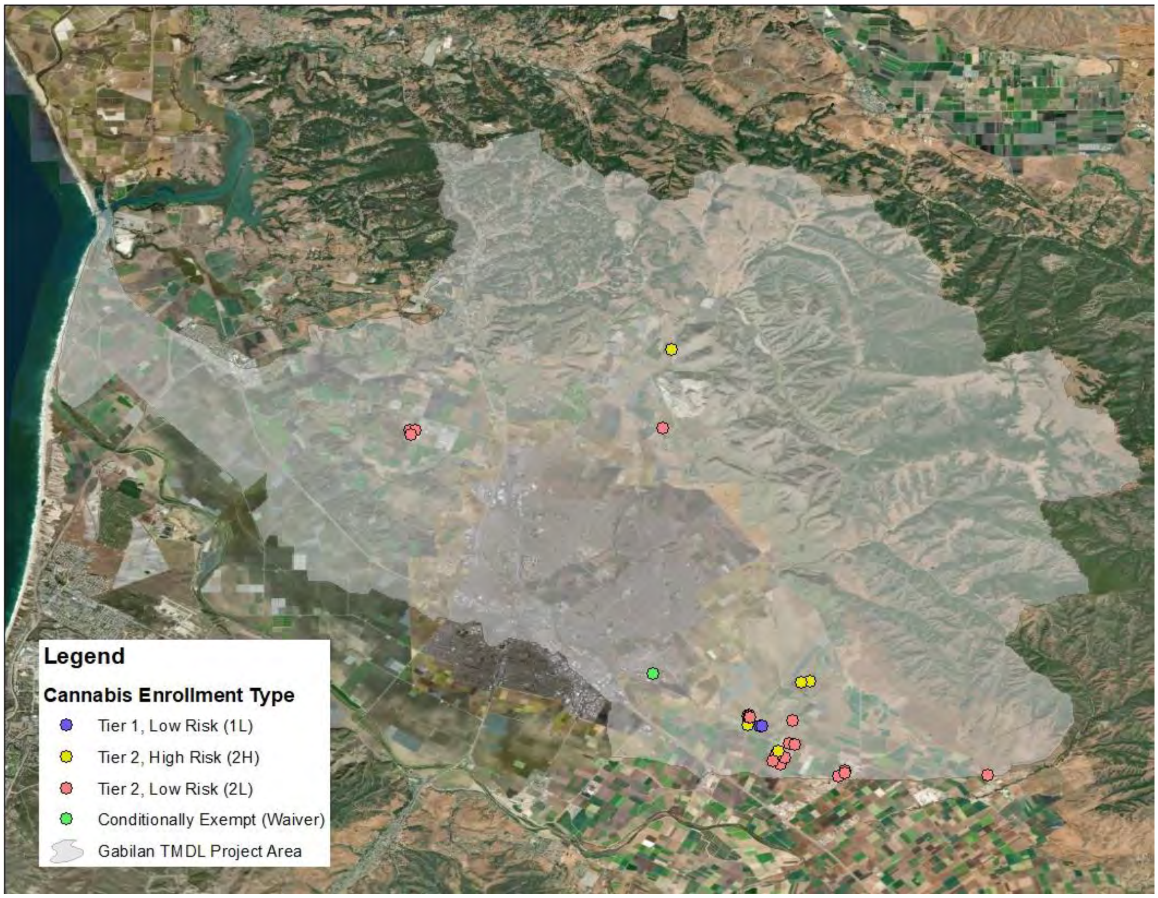

Figure 31. A map of cultivators enrolled in the Cannabis Order.

9.11. NPDES General Permit Holders

NPDES General Permit holders shall implement the TMDLs and meet their waste load allocations through the following NPDES General Permits and updates. NPDES General Permits issued in the watershed include low threat to water quality, highly treat groundwater, aquaculture and aquarium permits.

Table 43. Table of NPDES General Permits issued in the project area.

NPDES Permit Number	Order Number	Description
CAG993001	R3-2011-0223	Low Threat to Water Quality
CAG993002	R3-2016-0035	Highly Treated Groundwater
CAG993003	R3-2019-0001	Aquaculture & Aquarium

9.12. Channel Maintenance

The State Water Resources Control Board and the Central Coast Water Board have the authority to regulate discharges of dredged or fill materials under section 401 of the Clean Water Act (CWA) and the Porter-Cologne Water Quality Control Act (Porter-Cologne).

CWA section 401 water quality certifications are issued to applicants for a federal license or permit for activities that may result in a discharge into waters of the United States, including but not limited to the discharge or dredged or fill material. WDRs under Porter-Cologne are issued for discharges of dredged or fill material to waters of the State.

9.13. Cost Estimate

The California Water Code requires the Central Coast Water Board to take "economic considerations," into account when adopting TMDLs. This cost analysis is based on the range of reasonably foreseeable methods of compliance with the waste load allocations and load allocations and provides general programmatic cost estimates for irrigated agriculture, municipalities, construction and industrial stormwater permittees, MCWRA, and regional stakeholders to implement the TMDL. This section provides a summary of costs and a more comprehensive cost estimate is provided with the Staff Report in Attachment 4 – Economic Analysis Report. The TMDL Project cost estimates focus on additional costs for implementation, also referred to as incremental costs, and it does not include total program implementation costs. The annual estimated incremental costs for implementing the TMDL Project are summarized in Table 44.

Table 44. Summary of estimated incremental compliance costs for monitoring and watershed planning to implement the proposed Gabilan Creek TMDLs.

Category	**Incremental Cost Estimate ($/year)**
NPDES Stormwater Permittees	$6,050 - $24,600
NPDES Municipal and Industrial Wastewater Permittees	$0
NPDES Low Threat Wastewater General Permittees	$0
Irrigated Land Program	$62,000
Cannabis Growers	$2,970
Flood Control Pump stations and Agricultural Field Drainage Pumps	$36,500 - $772,000
Total	**$107,000 - $882,000 per year**

The level of detail in the cost estimates was limited to available data and for some categories the costs reflect only monitoring costs and for others it includes the costs of implementation. Compliance costs for additional control activities (e.g., implementation of additional stormwater control best management practices [BMPs]) which may be necessary to comply with waste load allocations and load allocations under the TMDL were not estimated due to data limitations (e,g., data was insufficient to identify permittees and entities which cannot immediately comply with the proposed waste load allocations or load allocations). In addition, costs for stormwater BMPs are highly site-specific and require site data input which are beyond the scope of this project to collect. Consequently, costs associated with these activities were not assessed in this analysis. However, Appendix A of the Economic Analysis Report provides unit cost information associated with a wide variety of control activities—including BMP implementation, turbidity monitoring, and pollution control planning activities which are applicable to the community of entities assigned waste load and load allocations under the proposed TMDL. Members of the regulated community may refer to Appendix A of the Economic Analysis Report for information to develop estimates of possible compliance costs with their permits as a result of these TMDLs which are more narrowly tailored to their specific individual circumstances.

9.14. Funding Sources

In accordance with section 13141 of the California Water Code, prior to implementation of any agricultural water quality control program the Water Board is required to identify potential sources of funding. Accordingly, in this section, staff provides some examples of funding sources available to both point source and nonpoint source entities. Potential sources of financing to TMDL implementing parties include the following:

Federal Clean Water Act - 319(h) Grant Program

The State Water Board, Division of Financial Assistance administers the federal Clean Water Act section 319(h) grant program, which is referred to as the 319(h) program. The 319(h) program annually funds grants addressing nonpoint sources of pollution and is focused on controlling activities that impair beneficial uses. Project proposals that implement TMDLs and those that address problems in impaired waters are favored in the selection process. There is also a focus on implementing management activities that lead to reduction and/or prevention of pollutants that threaten or impair surface waters.

Stormwater Grant Program Proposition 1 (2014 Water Bond)

Proposition 1 (Assembly Bill 1471, Rendon) authorized billions of dollars for water projects including surface and groundwater storage, ecosystem and watershed protection and restoration, and drinking water protection. The State Water Board administers Proposition 1 funds. Stakeholders specifically interested in ecosystem and watershed restoration and protection aspects of Proposition 1, should also consider the Ocean Protection Council (OPC), State Coastal Conservancy, Wildlife Conservation Board, and Department of Fish and Wildlife administered funds.

Other Sources of Funding for Growers and Landowners

The local Resource Conservation District (RCD) offices can provide access to and/or facilitate a landowner's application for federal cost-share assistance through various local, state and federal funding programs. For certain projects the RCD may also be able to apply for other grant funds on behalf of a cooperating landowner, grower or rancher. More information is available from the Monterey County RCD.

9.15. TMDL Attainment Schedule and Milestones for TMDL Implementation

Waterbodies in the lower Gabilan Creek watershed are highly impaired for turbidity and the TMDL Project establishes a schedule over 20 years to achieve the final TMDLs allocations and numeric targets (Table 45). The TMDL Project also establishes interim milestones based on the Interim TMDL allocations to verify progress towards meeting the final allocations. The timeline for achieving the TMDL milestones and final attainment date starts upon the date of OAL approval of the TMDL. The TMDL attainment schedule is as follows.

1) First Interim TMDL Milestone: This milestone is equal to the Interim Allocation – 1 and must be achieved **ten years** after OAL approval of the TMDL. Staff considers this to be a reasonable first milestone because it is based on levels currently achieved at the existing monitoring sites in the Gabilan Creek watershed but with moderate increased level of compliance. Interim Allocation -1 is equal to the wet and dry season 25th percentile of all data from a given waterbody. Compliance with this allocation is determined by calculating the seasonal median for any given year from the waterbody and comparing that value to the allocation. To attain this allocation within ten years of OAL approval, ambient monitoring sites must show improvement in 25% more of the seasonal data from a given waterbody.

2) Second Interim TMDL Milestone: This milestone is equal to the Interim Allocation – 2 and must be achieve **fifteen years** after OAL approval of the TMDL. Staff considers this to be a reasonable milestone since is it based on levels already achieved at all existing agricultural monitoring sites in the region with the exclusion of the lower Gabilan Creek monitoring sites. Interim Allocation - 2 is the 25th percentile of turbidity data from all the CMP monitoring sites outside of the lower Gabilan Creek Watershed. To determine attainment this allocation, compare the median of the seasonal data from a given monitoring station in the lower Gabilan Creek watershed to the appropriate seasonal Interim Allocation -2. Attaining this allocation means half of the data from a wet or dry season is comparable to the 25th percentile of all the data from streams in other agricultural areas of the Region.

3) Final TMDL Attainment Date: The Final Allocations and must be achieved **twenty years** after OAL approval of the TMDL. The final TMDL attainment date is established after taking the following factors into consideration:
   a. Magnitude of the turbidity impairments.
   b. Sources turbidity are well understood and characterized.
   c. Established regulatory programs address major source of turbidity.
   d. Existing integrated region planning efforts specifically address sources of turbidity and the restoration of aquatic habitats.
   e. Turbidity is a relatively simple and inexpensive parameter to monitor and existing monitoring programs can provide necessary feedback to implementing parties and regulatory programs for effective implementation.

Streams in the Gabilan Creek watershed have turbidity at levels that impact aquatic ecosystems; therefore, this TMDL project includes biological condition numeric targets to restore aquatic health. The combined final goal of the TMDL is to both meet turbidity numeric targets and restore instream biological and physical habitat conditions. Two types of biological condition numeric targets are included in the TMDL project: one is an interim benthic invertebrate taxa richness target and the second is a CRAM biotic structure target. These two biological condition targets will be evaluated and considered when determinations are made whether waterbodies are achieving TMDL allocation and may be considered proxies for turbidity TMDL allocations.

Table 45. Table summarizing the TMDL attainment schedule.

Year After OAL Approval	Description	Allocation
Ten Years	First Interim TMDL Milestone	Interim Allocation - 1
Fifteen Years	Second Interim TMDL Milestone	Interim Allocation - 2
Twenty Years	Final TMDL Attainment Date	Final Allocation and Targets Achieved

9.16. Determination of Progress Toward and Attainment of Waste Load Allocations

The City of Salinas, the County of Monterey, Caltrans, construction and industrial stormwater permittees, and low threat to discharge NPDES permittees have turbidity TMDL waste load allocations. Waste load allocations will be achieved through a combination of implementation of management practices and strategies to address turbidity. To allow for flexibility, Central Coast Water Board staff will assess progress towards and attainment of waste load allocations using one or a combination of the following:

1. Attaining the interim and final waste load allocations in the receiving water.

2. Demonstrating compliance with the permit limit for turbidity by measuring turbidity in stormwater outfalls.
3. Any other effluent limitations and conditions that are consistent with the assumptions and requirements of the waste load allocations.
4. MS4 entities may be deemed in compliance with waste load allocations through implementation and assessment of pollutant loading reduction projects, capable of achieving interim and final waste load allocations identified in this TMDL in combination with water quality monitoring for a balanced approach to determining program effectiveness.

9.17. Determination of Progress Toward and Attainment of Load Allocations

Demonstration of compliance with the load allocations is consistent with compliance with the Agricultural Order, Cannabis General Order, nonpoint source implementation programs, and/or the Basin Plan Load allocations will be achieved through a combination of implementation of management practices and strategies to reduce turbidity, and water quality monitoring. Flexibility to allow owners and operators of irrigated lands to demonstrate progress toward and attainment of load allocations is a consideration; additionally, staff is aware that not all implementing parties are necessarily contributing to or causing surface water impairments.

To allow for flexibility, Central Coast Water Board staff will assess progress towards and attainment of load allocations using one or a combination of the following:

1. Attaining the interim and final load allocations in the receiving water.
2. Implementing management practices to achieve the interim and final load allocations identified in this TMDL.
3. Monitoring of non-stormwater points of discharge into receiving waters.
4. Providing sufficient evidence to demonstrate that they are and will continue to be in compliance with the load allocations; such evidence could include documentation submitted by the owner or operator of irrigated lands, to the Executive Officer that the owner or operator is not causing waste to be discharged to impaired waterbodies resulting or contributing to violations of the load allocations.

10. Monitoring and Reporting Recommendations

The TMDL monitoring and reporting recommendations (TMDL monitoring) are designed to provide feedback and to verify that water quality standards are achieved in the watershed. TMDL monitoring provides feedback and fills gaps in our understanding of the extent of pollution in the lower watershed and the refines source analysis. It also establishing baseline conditions in headwater streams that have not been widely monitored. Staff organized the TMDL monitoring section around achieving these goals and objectives. Staff recognizes that TMDL monitoring and implementation will occur over many years and there is uncertainty in the projected outcomes. Therefore, staff recommends that monitoring and implementation programs include adaptive management and an iterative process to review monitoring data and adjust planning and implementation strategies accordingly.

10.1. Monitoring to Document Restoration of Impaired Waters

The purpose of the TMDL Project is to restore impaired waters as identified at existing ambient water monitoring sites in the watershed. Monitoring programs such as CMP, the City of Salinas, and CCAMP routinely monitor these sites, at monthly intervals and during storm events. This level of monitoring was adequate for identifying impairments and for calculating long-term trends. However, the TMDL establishes interim targets on short timeframes. To verify interim targets and to provide feedback to implementing parties, staff recommends TMDL monitoring at increased frequencies, which could be achieved through a variety of methods such as deploying in stream monitoring equipment and data loggers or by taking frequent grab samples for laboratory analysis.

10.2. TMDL Monitoring to Fill in Data Gaps

Brackish Water Reference Sites
Staff found insufficient turbidity monitoring data from comparable regional reference sites to derive turbidity targets for the brackish water estuarine waterbodies in the lower Gabilan Creek watershed (i.e., lower Tembladero Slough and the Old Salinas River Channel). Staff recommends that programs such as CCAMP conduct additional monitoring in reference brackish waterbodies such as Watsonville Slough, Moro Cojo Slough, Goleta Slough, and Devereux Slough.

Headwaters
Staff recommends the establishment of additional ambient monitoring sites in the headwaters of the Gabilan Creek watershed. This part of the watershed is relatively undeveloped and undisturbed, but grazing is also prevalent and a potential source of turbidity. Staff recommends that CCAMP monitor these headwaters during its rotations in the watershed. The headwaters are documented steelhead habitat and staff further recommends that biological assessments be conducted in these streams.

Additional Receiving Water Monitoring Sites
Staff recommends establishment of additional receiving water monitoring sites in the lower watershed. Additional sites should be established between existing ambient sites and upstream of them to increase monitoring resolution. For example, the CMP monitors in the lower portions Merritt Ditch and Espinosa Slough and monitoring sites could be established upstream in these watersheds

to better characterize stream pollution and sources. Likewise, the City of Salinas monitoring sites are at the City limits, upstream and downstream of the City. Additional monitoring sites below the Carr Lake area should be established to bracket and characterize the water quality in the Salinas Reclamation Canal below Carr Lake.

10.3. TMDL Monitoring of Discrete Observable Discharges

To ensure compliance with the TMDL and the turbidity water quality objective, staff recommends TMDL monitoring of discrete observable discharges into waterbodies from activities such as, but not limited to, lift pump stations and agricultural pumps. To verify compliance with the turbidity water quality objectives, these discharges should be directly monitored in conjunction with background and downstream monitoring of the receiving waters. MCWRA must develop and implement a monitoring and reporting plan for the pump stations they operate in the watershed (refer to Figure 10) to determine compliance with load allocations. MCWRA shall report the data into CEDEN and submit an annual monitoring report.

10.4. Coordinated Watershed Monitoring

Staff recommends that stakeholders responsible for implementing the TMDL develop a coordinated watershed monitoring plan. Although turbidity is a relatively inexpensive parameter to monitor, combining efforts would reduce monitoring costs, increase understanding of the watershed processes, and improve planning and implementation of BMPs. Additionally, coordination would facilitate better communication between stakeholders and Central Coast Water Board implementation and assessment programs.

10.5. Deploy Continuous Monitoring Sondes

Staff recommends that existing ambient monitoring programs consider augmenting their monitoring with continuous turbidity and flow monitoring, using sondes. Sondes have the benefit of capturing episodic stormflows and discharge from human activities such as pumps.

10.6. Existing Monitoring Programs

The CMP and the City of Salinas’s stormwater monitoring program are two major annual monitoring and reporting programs in the watershed that will provide information on ambient and discharge water quality for TMDL implementation. In addition, CCAMP extensively monitors the watershed on a five-year cycle. These programs provide the foundation of monitoring data that support the TMDL and will be the foundation of monitoring during implementation. Key components of the existing monitoring programs and additional monitoring recommendations for TMDL implementation are summarized below.

City of Salinas Monitoring and Reporting Program

The City of Salinas' stormwater MRP is described in detail in the TMDL source analysis section (refer to Section 7.8). The City's MRP is designed to meet their stormwater permit monitoring requirements and to inform stormwater managers on land use management implementation effectiveness. The City's MRP is comprised of three parts: urban outfall monitoring, receiving water monitoring, and background monitoring. The monitoring data collected from these parts help characterize urban runoff and receiving water quality and assess the effectiveness of the City's stormwater program.

Staff reviewed the City's MRP and their MRP Quality Assurance Plan and found that the urban outfall drainage outfall monitoring program provides valuable information for evaluating discharge from urban outfalls and drainages (Salinas, 2020 and Salinas, 2019). However, because the City is assigned receiving water turbidity waste load allocations, receiving water monitoring is necessary to determine compliance. The existing MRP focuses on improved land management and staff recommends additional focus on restoration of receiving waters. Under the current MRP, the City is only required to collect four grab samples for one year during the five-year span of the MRP and staff recommends the City monitor receiving waters at a minimum of three samples per year that coincide with existing outfall monitoring and reporting requirements. The City should be monitoring the following receiving waters and sites (at a minimum):

- Gabilan Creek (309GAB)
- Natividad Creek (309NAD)
- Alisal Creek (309ALG or 309ALU)
- Salinas Reclamation Canal (site to be determined) within Carr Lake
- Salinas Reclamation Canal (309ALD) downstream of the City

The background and receiving water monitoring should include flow, as well as turbidity, since high storm event flows downstream of the City are a potential source of erosion and resuspension of fine sediments that cause turbidity. Additionally, the City currently conducts annual benthic invertebrate assessments in the Reclamation Canal (309ALD) and the addition of a CRAM assessment is recommended.

Irrigated Lands Program Monitoring and Reporting

The CMP currently conducts monthly monitoring for turbidity and other parameters in the watershed, including two storm events. Staff developed a trend detection model and ran a power analysis to determine if the existing CMP turbidity monitoring design would have sufficient power (80% or higher) to detect significant ($\alpha = 0.05$) trends towards the turbidity numeric targets within the TMDL schedule. Significant trends would be detected at this power level four times out of five if they were present. Staff conducted the analysis for three numeric target scenarios: year-round, dry season, and wet season.

The year-round scenario comprises the following conditions:

- a sample size of n=12 per site per year, i.e. monthly sampling;
- an end target of 8 NTU;
- a total timeframe of 20 years; and
- a 5-year evaluation cycle, i.e. 5 years of data are necessary to detect significant trends.

Staff determined that the current design would provide a power level of 82% for the year-round scenario and is therefore adequate.

Staff define the 5-month dry season as May through September. The dry-season scenario comprises the following conditions:

- a sample size of n=5 per site per year;
- an end target of 6 NTU;
- a total timeframe of 20 years; and
- a 5-year evaluation cycle.

Staff determined that the current design would provide a power level of 43% for the dry season scenario and is therefore inadequate. Staff adjusted the sample size and found that sampling twice per month and three times per month would yield power levels of 70% and 86% respectively. Staff therefore recommend increasing dry season monitoring to three times per month.

Staff define the 7-month wet season as October through April of the following year. The wet-season scenario comprises the following conditions:

- a sample size of n=7 per site per year;
- an end target of 11 NTU;
- a total timeframe of 20 years; and
- a 5-year evaluation cycle.

Staff determined that the current design would provide a power level of 56% for the wet season scenario and is therefore inadequate. Staff adjusted the sample size and found that sampling twice per month would yield a power level of 84%. Staff therefore recommend increasing wet season monitoring to two times per month.

In summary, the existing CMP monitoring frequency is adequate for determining if year-round targets are achieved but is insufficient to determine if agriculture load allocations are met during wet and dry seasons. Therefore, staff recommends increasing the frequency of monitoring in the watershed to two grab samples per month during the wet season and three grab samples per month during in the dry season. If possible, the additional monitoring should be incorporated into follow-up monitoring required under the Order. Staff also recommends expansion of the number of monitoring sites to for enhanced source analysis.

The CMP conducts monitoring of benthic invertebrates and associated physical habitats for the Irrigated Lands Program, however the current Order does not include requirements for this type of monitoring in the Gabilan Creek Watershed. Staff recommends that Bioassessment monitoring be required in the Gabilan Creek Watershed every three to five years to determine if these biologic condition targets are achieved. Staff recommend that the Irrigated Lands Program monitoring of biological conditions expand to included periodic CRAM monitoring (or other rapid riparian habitat assessment) on a similar schedule to benthic invertebrate monitoring.

CCAMP Monitoring

CCAMP monitors the Salinas River hydrologic unit, including the Gabilan Creek watershed, as part of its regional ambient monitoring program. This program rotates on an annual basis through five major geographic parts of the region including Santa Barbara, Santa Lucia, Pajaro, Salinas, and Santa Maria. Every five years, CCAMP conducts monthly monitoring throughout the Gabilan Creek watershed and analyzes conventional pollutants including turbidity. Staff recommends that CCAMP establishes additional monitoring sites in the upper Gabilan Creek area (upstream of Old Stage Road) and establish a continuous monitoring station at the San Jon Road site (309JON) to collect daily or hourly turbidity measurements and to characterize the turbidity in the receiving water during stormwater runoff events.

11. PUBLIC PARTICIPATION

Program staff held several stakeholder meetings during the development of the TMDL. The following is a summary of TMDL meetings and information items:

- January 22, 2019 – Kick-off meeting in Salinas
- April 21, 2019 – Meeting with Grower-Shipper Association of Central California
- April 21, 2021 – CEQA scoping meeting
- October 19, 2021 to December 3, 2021 - Public Comment Period February 17-18, 2021 – Board hearing (date to be determined)

Staff developed an email distribution list to communicate with stakeholders. The distribution list built upon an existing TMDL distribution list for the watershed and was augmented with outreach commercial cannabis operations, disadvantaged community service providers, and tribes.

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