SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD INVASIVE SPECIES TOTAL MAXIMUM DAILY LOAD FOR SAN MATEO CREEK

FINAL STAFF REPORT

November 2023

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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INVASIVE SPECIES TOTAL MAXIMUM DAILY LOAD FOR SAN MATEO CREEK

Staff Report, November 2023

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REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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EXECUTIVE SUMMARY

Water Body	San Mateo Creek
Impaired Uses	Migration of Aquatic Organisms Spawning, Reproduction, and/or Early Development Rare, Threatened, or Endangered Species
Clean Water Act 303(d) Listing	Invasive Species
Causative Pollutant	Invasive Species
Sources	Private ponds In-stream reproduction and recruitment
Total Maximum Daily Load	0 invasive aquatic species
Numeric Targets: Apply during the summer dry season only	*Surface Water:* • 0 invasive aquatic species present *Surface Water:* • 70 adult steelhead until or unless an alternative self-sustaining, viable Core 1 Population number is determined in consultation with NMFS • Presence of Juvenile Steelhead
Load and Waste Load Allocations for Invasive Species	Load Allocation: 0 invasive aquatic species Margin of Safety: Implicit
Implementation Mechanisms	Nonpoint Source Program Enforcement of Existing Regulations
Estimated Attainment of Numeric Targets and Beneficial Uses	2037

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List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
Basin Plan	Water Quality Control Plan for the San Diego Basin
BMP	Best Management Practice
CDFW	California Department of Fish and Wildlife, formerly Department of Fish and Game (DFG)
CEQA	California Environmental Quality Act
CNF	Cleveland National Forest
CPU	Catch Per Unit Effort
CSCI	California Stream Condition Index
CWA	Clean Water Act
DO	Dissolved oxygen
Impaired Waters Policy	Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options
LA	Load Allocation
MS4	Municipal Separate Storm Sewer System
MOS	Margin of Safety
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
Ocean Plan	Water Quality Control Plan for the Ocean Waters of California
SWAMP	Surface Water Ambient Monitoring Program
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geologic Survey
USMC	U.S. Marine Corps
WDR	Waste Discharge Requirement
WLA	Wasteload Allocation
WQO	Water Quality Objective
WQS	Water Quality Standard

1. Introduction and Purpose

San Mateo Creek watershed is situated in northern San Diego County and encompasses an area of approximately 178 square miles, with about 200 miles of stream habitat (Figure 1). The upper reaches of San Mateo Creek are located within the Cleveland National Forest. Less than 15 miles of San Mateo Creek are designated as critical habitat[1] for the federally listed endangered Southern California Steelhead (*Oncorhynchus mykiss*, Figure 2). The presence of aquatic non-native aquatic invasive species (hereinafter referred to generally as "invasive species") within San Mateo Creek restricts the ability of its waters to support the Beneficial Uses designated in the Water Quality Control Plan for the San Diego Basin (Basin Plan), specifically the RARE (Rare, Threatened, or Endangered Species), MIGR (Migration of Aquatic Organisms), and SPWN (Spawning, Reproduction, and/or Early Development) uses for steelhead (San Diego Water Board 2016a). As a result, San Mateo Creek was placed on the 2014/16 Clean Water Act (CWA) section 303(d) list of impaired water bodies (San Diego Water Board 2016b). The impairment occurs throughout the year, but the critical time period is the summer-dry weather season when natural flows in San Mateo Creek are at their lowest.[2] During this critical period, pools sustained by groundwater and springs provide over-summering pools and refugia habitat for rearing juvenile steelhead. At the same time, aquatic non-native species co-occur with steelhead and outcompete them for resources while also degrading water quality and potentially introducing disease (Moyle and Light 1996, Moyle 1999, Moyle and Marchetti 1999, Marchetti et al. 2004, Moyle 2013, NMFS 2022). With the projected drying conditions that will result from future climate change, this condition is like to be exacerbated, making the removal of invasive species more critical (Moyle et al. 2013; see also, Moyle et al. 1998).

[1] Note there is no designated critical habitat within the boundaries of Marine Corps Base Camp Pendleton

[2] Summer base flows can also be impacted by the water intake of non-native vegetation such as *Arundo donax* (Dudley and Cole 2018; see also, Faber et al. 1989)

Figure 1. San Mateo Creek Watershed. The watershed is outlined in white. San Mateo Creek and its tributaries (excluding Cristianitos) are indicated with blue lines. Shaded land areas indicate federal and state agency land ownership, including USMC Camp Pendleton (white), United States Forest Service (green), and California Department of Fish and Wildlife (yellow).

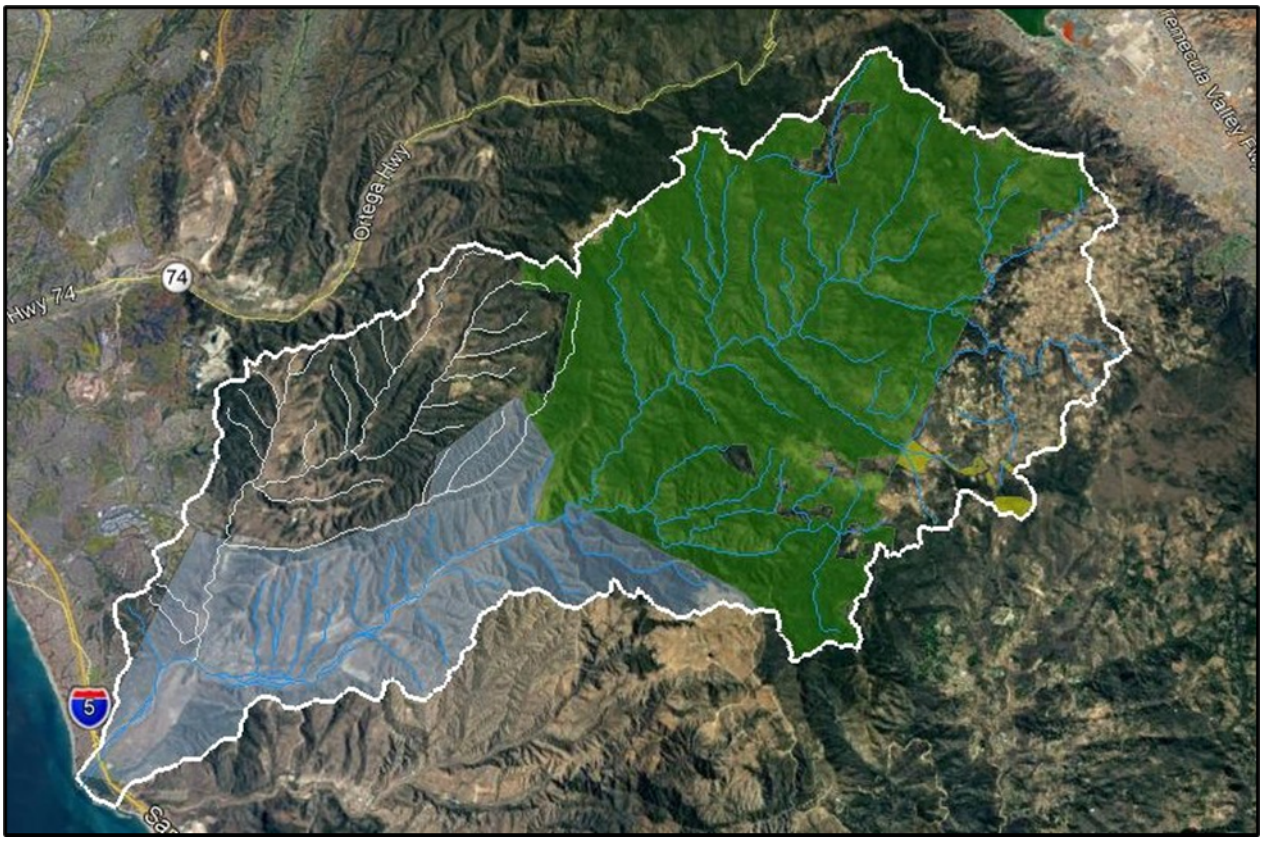
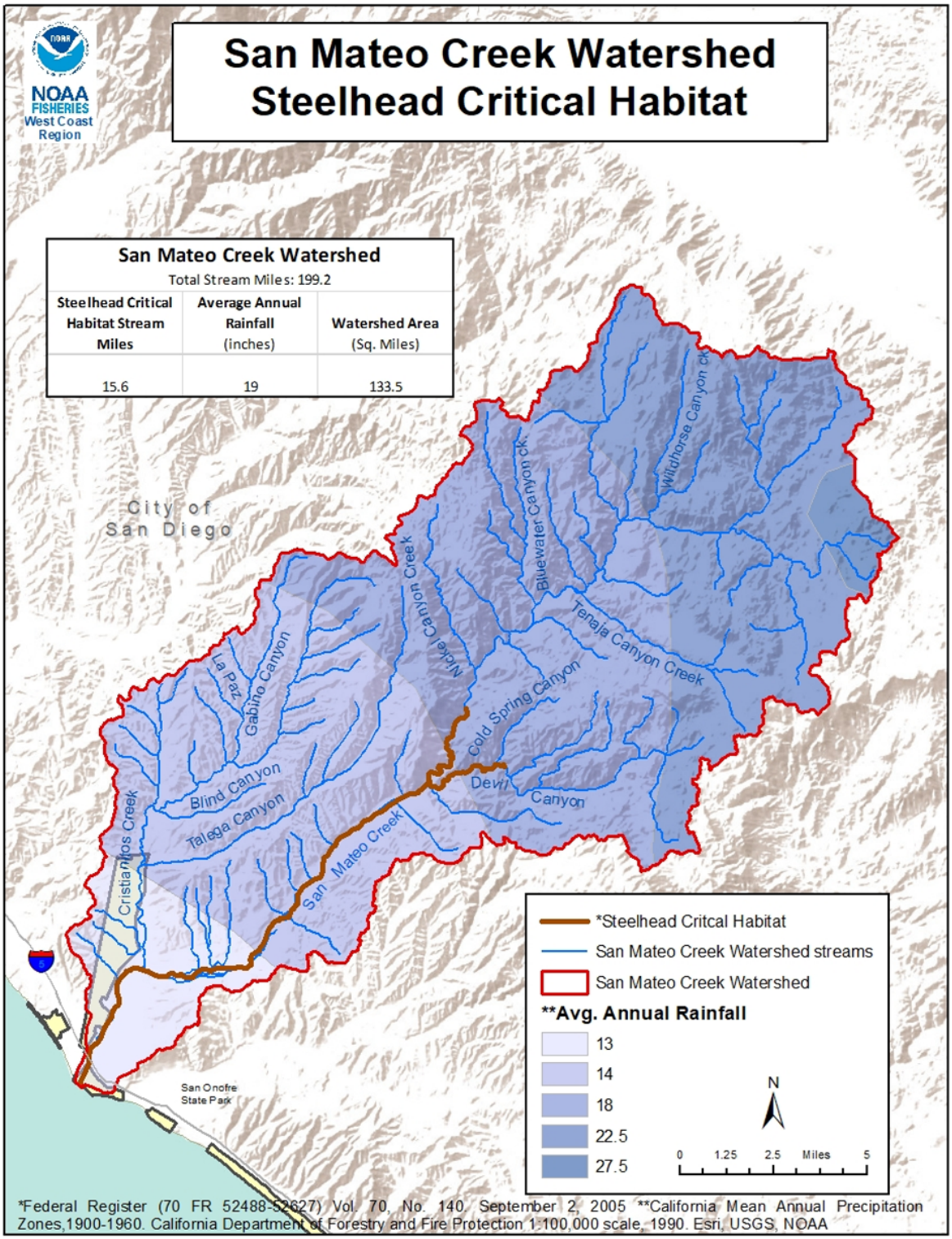


Figure 2. Critical Habitat Map for San Mateo Creek. Note that there is no designated critical habitat within the boundaries of Marine Corps Base Camp Pendleton.



The California Regional Water Quality Control Board, San Diego Region (San Diego Water Board or Board), other state and federal agencies, and local stakeholders have investigated the conditions, sources of pollutants (including invasive species), loading capacity, and existing control requirements affecting the conditions in San Mateo Creek that impact steelhead. The National Marine Fisheries Service's Southern California Steelhead Recovery Plan (2012) has identified non-native species in San Mateo Creek as a "Very High Threat" (See Table 13-2 Threat Sources rankings in watersheds of the Santa Catalina Gulf Coast BPG [Biogeographic Population Group].)

For waters that are not meeting their Beneficial Uses, the State and Regional Water Quality Control Boards are required to ensure that the impairments are addressed, and Beneficial Uses restored, in a timely and meaningful manner. The regulatory pathways for addressing impairments are outlined in State Water Resources Control Board (State Water Board) Resolution 2005-0050, "Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options" (Impaired Waters Policy, State Water Board 2005). The Impaired Waters Policy identifies the following pathways to address impairments as part of implementation plans or TMDLs:

1) Issue or Revise a Permit to Correct the Impairment
2) Take an Enforcement Action to Correct the Impairment
3) Certify Regulatory Actions of Another Agency will Correct the Impairment
4) Certify that Non-regulatory Action will Correct the Impairment
5) Adopt a Basin Plan Amendment

The San Diego Water Board used the Impaired Waters Policy to determine the most appropriate actions to take to restore the impairment. This Staff Report identifies the cause of the impairment as nonpoint source (NPS) anthropogenic pollutants. The Report also includes a remedial plan for restoration of the impairment using non-regulatory Board actions and existing non-regulatory actions of other state and federal agencies. Most importantly, NPS pollution prevention and land restoration efforts, such as those recommended by federal fisheries, wildlife, and land management agencies for San Mateo Creek, can reasonably be expected to address the sources of the impairment such that the beneficial uses of San Mateo Creek would be restored. Because NPS pollution is causing San Mateo Creek to be listed as impaired under CWA section 303(d) and restoration of habitat for sensitive species is a NPS priority of the San Diego Water Board, such projects are eligible for USEPA CWA section 319 funding through the NPS Grant Program administered by the State Water Board. Thus, the impairment will be addressed through Board certification of non-regulatory actions of another entity, or entities, that will be taken via the NPS program, consistent with the Impaired Waters Policy.

Once restored, existing State of California regulations will ensure the protection of Beneficial Uses to prevent re-impairment. This Report presents the TMDL for the invasive species as well as the implementation plan for restoration of the impairment. The TMDL represents the maximum amount of invasive species that San Mateo Creek can assimilate and still effectively support its recognized Beneficial Uses. The implementation plan represents the necessary steps and actions to meet the TMDL and thus restore the impairment. The purpose of this TMDL and implementation plan is to identify a pathway to restore the impaired Beneficial Uses in San Mateo Creek related to steelhead. The impaired Beneficial Uses include RARE, MIGR, and SPWN. After the restoration of these Beneficial Uses, San Mateo Creek can be removed from the CWA 303(d) list for impairment from invasive species.

The implementation plan to achieve the TMDL relies on the removal of non-native species, through mitigation of upstream ponds to prevent reintroduction, as well as removal of certain existing non-native species in San Mateo Creek and its tributaries. Additional implementation actions will include informing property owners in the watershed about the impacts of invasive species on aquatic habitats and native species, monitoring the effectiveness of the non-native species control program, and enforcing current regulations that prohibit the discharge of dredge or fill material to waters of the state without a Water Quality Certification required by Sections 404 and 401 of the Clean Water Act and/or Waste Discharge Requirements required by California Water Code section 13260.

2. The Total Maximum Daily Load (TMDL) Process

TMDLs are traditionally developed in response to chemical pollutants (e.g., metals, nutrients), and identify actions to better regulate discharges of those chemicals from point sources. Although a TMDL for invasive species may be considered non-traditional, its development is still required to follow the standard TMDL process and include all mandatory TMDL elements. All discharges of invasive species are considered nonpoint source for the purposes of this section and the TMDL.

The purpose of a TMDL is to identify a pathway to attain Water Quality Objectives (WQOs) that support the Beneficial Uses of a water body. The calculation of a TMDL is the maximum amount of a pollutant that a water body can assimilate and maintain water quality sufficient to protect its Beneficial Uses. The TMDL load is allocated to point sources as wasteload allocations (WLA), to nonpoint sources as load allocations (LA), and to a margin of safety (MOS) to account for uncertainties and unknowns. Mathematically, the TMDL can be expressed as:

$$TMDL = WLA + LA + MOS.$$

The TMDL also includes a strategy for meeting WQOs by allocating quantitative limits for point and nonpoint pollution sources. Once the total maximum pollutant load is calculated, it is allocated among contributing sources in the watershed.

The TMDL process begins with the development of a technical analysis that includes the following seven components:

1) *Problem Statement* – generally describes impairment (Section 4)

2) *Numeric Targets* – identifies the numeric target(s) which when achieved will result in attainment of the WQOs and protection of Beneficial Uses (Section 5)

3) *Source Assessment* – identifies all known point sources and nonpoint sources of the impairing pollutant in the watershed (Section 6)

4) *Linkage Analysis* – establishes the relationship between pollutant sources and receiving water conditions and calculates the loading capacity of the waterbody, which is the maximum load of the pollutant that may be discharged to the water body without causing exceedances of WQOs and impairment of Beneficial Uses (Section 7)

5) *Margin of Safety (MOS)* – accounts for uncertainties in the analysis (Section 8)

6) *Seasonal Variation and Critical Conditions* – describes how these factors are accounted for in the TMDL determination (Section 9)

7) *Allocation of the TMDL* – division of the TMDL among each of the contributing sources in the watershed; wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint and background sources (Section 10)

The USEPA provides additional guidance regarding the statutory and regulatory requirements for establishing TMDLs.[3] Table 1 lists these requirements and location of the information in this report.

Table 1. USEPA TMDL Elements.

USEPA TMDL ELEMENT	SECTION/COMMENTS
The name and geographic location of the impaired waterbody for which the TMDL is being established and the names and geographic locations of the waterbodies upstream of the impaired waterbody that contribute significant amounts of the pollutant for which the TMDL is being established.	Section 3
Identification of the pollutant for which the TMDL is being established and quantification of the pollutant load that may be present in the waterbody and still ensure attainment and maintenance of water quality standards.	Sections 4 and 5
Identification of the amount, or degree, by which the current pollutant load in the waterbody deviates from the pollutant load needed to attain or maintain water quality standards.	Section 4 and 5
Identification of the source categories, source subcategories, or individual sources of the pollutant for which the wasteload allocations and load allocations are being established.	Section 4
Wasteload allocations to each industrial and municipal point source permitted under § 402 of the Clean Water Act discharging the pollutant for which the TMDL is being established; wasteload allocations for storm water, combined sewer overflows, abandoned mines, combined animal feeding operations, or any other discharges subject to a general permit may be allocated to categories of sources, subcategories of sources or individual sources; pollutant loads that do not need to be allocated to attain or maintain water quality standards may be included within a category of sources, subcategory of sources or considered as part of background loads; and supporting technical analyses demonstrating that wasteload allocations when implemented, will attain and maintain water quality standards.	Sections 6 and 10

[3] http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/TMDL-ch3.cfm

USEPA TMDL ELEMENT	SECTION/COMMENTS
Load allocations, ranging from reasonable accurate estimates to gross allotments, to nonpoint sources of a pollutant, including atmospheric deposition or natural background sources; if possible, a separate load allocation must be allocated to each source of natural background or atmospheric deposition; load allocations may be allocated to categories of sources, subcategories of sources or individual sources; pollutant loads that do not need to be allocated may be included within a category of sources, subcategory of sources or considered as part of background loads; and supporting technical analyses demonstrating that load allocations, when implemented, will attain and maintain water quality standards.	Section 10
A margin of safety expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL; e.g., derivation of numeric targets, modeling assumptions, or effectiveness of proposed management actions which ensures attainment and maintenance of water quality standards for the allocated pollutant.	Section 8
Consideration of seasonal variation such that water quality standards for the allocated pollutant will be met during all seasons of the year.	Section 9
An allowance for future growth that accounts for reasonably foreseeable increases in pollutant loads.	Section 8.1
An implementation plan.	Section 11

The USEPA has also provided guidance on the requirements for a TMDL implementation plan. Table 2 presents the Implementation Plan Elements and where they are located in this report.

Table 2. USEPA Implementation Plan Elements

USEPA IMPLEMENTATION PLAN ELEMENT	SECTION/COMMENTS
A description of the control actions and/or management measures which will be implemented to achieve the wasteload allocations and load allocations, and a demonstration that the control actions and/or management measures are expected to achieve the required pollutant loads	Section 11.1
A timeline, including interim milestones, for implementing the control actions and/or management measures, including when source-specific activities will be undertaken for categories and subcategories of individual sources and a schedule for revising NPDES permits.	Section 11.2
A discussion of reasonable assurances that wasteload allocations and load allocations will be implemented.	Section 11.1
A description of the legal authorities under which the control actions will be carried out.	Section 11.1
An estimate of the time required to attain and maintain water quality standards and discussion of the basis for that estimate.	Section 11.2
A monitoring and/or modeling plan designed to determine the effectiveness of the control actions and/or management measures and whether allocations are being met.	Section 11.2
A description of measurable, incremental milestones for the pollutant for which the TMDL is being established for determining whether the control actions and/or management measures are being implemented and whether water quality standards are being attained.	Section 12
A description of the process for revising TMDLs if the milestones are not being met and projected progress toward attaining water quality standards is not demonstrated.	Section 12

3. Background Information

3.1. Description of San Mateo Creek

San Mateo Creek, historically referred to on United States Geologic Survey (USGS) maps as San Mateo Canyon Creek, is a free-flowing stream. Its headwaters begin in unincorporated southwest Riverside County in the Elsinore Mountains and its outlet ends in San Mateo Lagoon in San Diego County on the United States Marine Corps (USMC) Base at Camp Pendleton (Figure 1). The mainstem of San Mateo Creek is approximately 29 miles in length and its watershed encompasses parts of San Diego, Riverside, and Orange Counties. Major tributaries to San Mateo Creek include Cristianitos, Devil Canyon, Nickel Canyon, Bluewater Canyon, Tenaja Canyon, and Los Alamos Canyon creeks that add an additional 171 stream miles to the watershed. The upper reaches of San Mateo Creek and its tributaries run through the Cleveland National Forest and are within the San Mateo Canyon Wilderness[4], which affords a high degree of protection from adverse land uses. The lower reaches of San Mateo Creek and its associated tributaries run through Camp Pendleton and are included within the base's Integrated Natural Resources Management Plan (2017). The lowermost reach of San Mateo Creek and the San Mateo Creek Lagoon are located within San Onofre State Beach. Cristianitos Creek, which is located near the San Mateo Creek Lagoon, is not tributary to the impaired portion of San Mateo Creek.

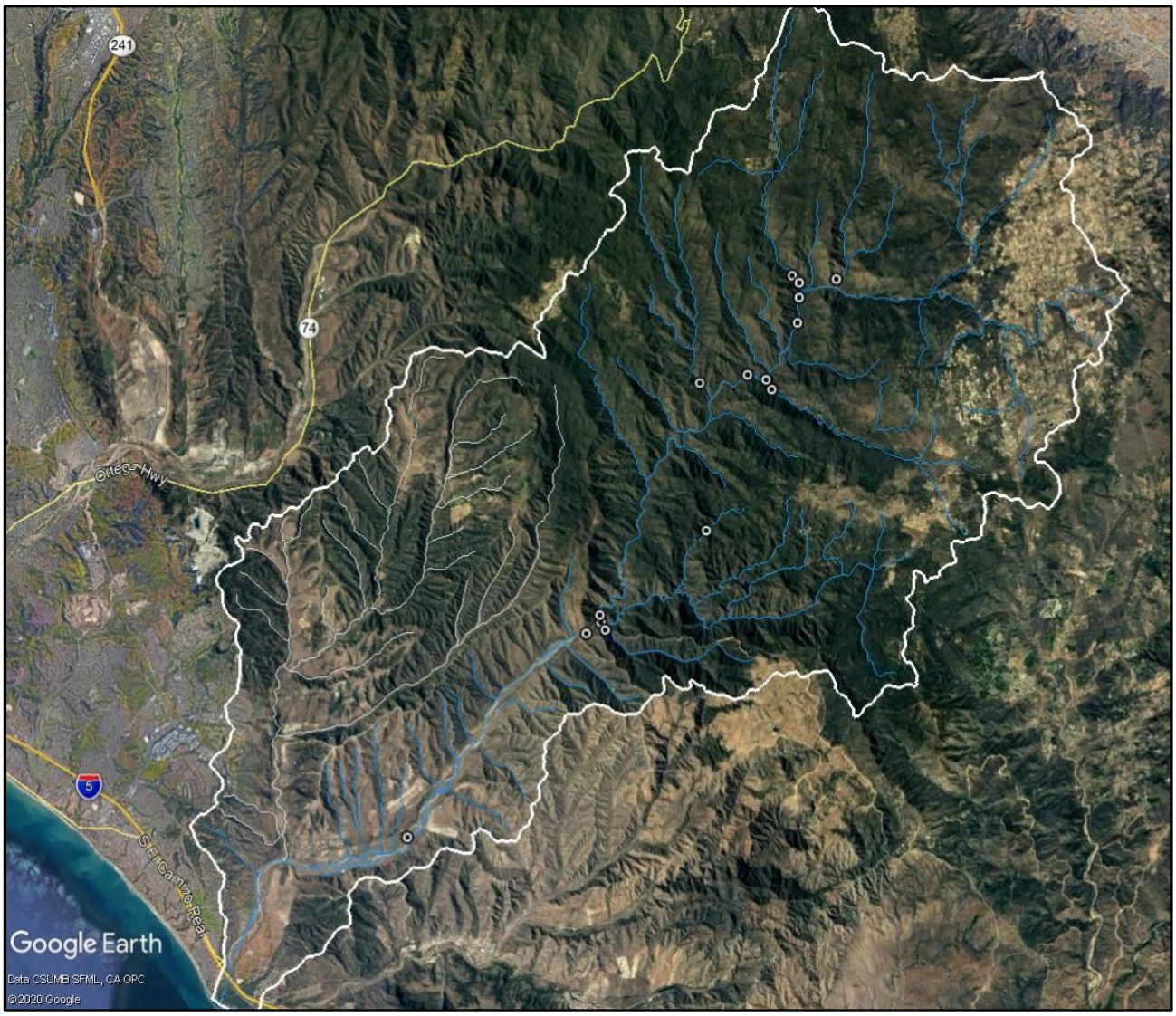
Large sections of San Mateo Creek and its tributaries are intermittent (Trout Unlimited and Duff 2007, Wilcox 2012, Barabe and Nickerson 2015, Mazor et al. 2015, Loflen et al. *in preparation*), with stream baseflow beginning to increase in the fall to early winter during the "rainy season" (generally October 1st to May 1st). Continuous flows can persist, depending on winter rainfall, into late spring to summer. During the dry summer season water remains in San Mateo Creek in a series of pools, which persist due to a direct hydrologic connection to groundwater (Hovey 2004, Barabe and Nickerson 2015), whereas continuous surface flow in tributaries largely ceases. This condition of alternating reaches of surface and subsurface flows – known as an interrupted flow regime – is common in many southern California watersheds.

During continuous flow conditions, San Mateo Creek and its tributaries exhibit good biological integrity as measured by stream benthic macroinvertebrates and algae (San Diego Water Board 2016c). Recent California Stream Condition Index (CSCI) scores collected by the Surface Water Ambient Monitoring Program (SWAMP) and others during baseflow conditions have all been above the 0.79 threshold for determining impairment in San Mateo Creek and its tributaries (Figure 3).

[4] Federal lands may be designated as Wilderness by the United States Congress (see Wilderness Act, 16 U.S.C. 1131-1136). Wilderness areas are afforded special protections under the Wilderness Act from specific anthropogenic actives, such as timber harvesting, mining, commercial development, and motor vehicle use.

In addition, multiple sensitive aquatic species have been documented in San Mateo Creek's intermittent tributaries, including arroyo toad (*Anaxyrus californicus*, federally endangered), California newt (*Taricha torosa*, state species of concern), and southwestern pond turtle (*Emys pallida* formerly *Actinemys pallidas*, state species of special concern). Lastly, San Mateo Lagoon is habitat for the federally endangered tidewater goby (*Eucyclogobius newberryi*, USFWS 2005) and is included in the species recovery plan (USFWS 2005).

Figure 3. Map of San Mateo Creek Watershed with stream benthic macroinvertebrate bioassessment sampling sites. All sites achieved California Stream Condition Index scores that indicated the stream reaches have intact biological integrity.



3.2. San Mateo Creek Watershed

The San Mateo Creek Watershed is part of the southern Santa Ana Mountains, which form part of the Peninsular Range. The watershed, with an area of approximately 133 square miles with a peak watershed elevation of 1074 meters above sea level (Figure 1). The watershed is primarily open space with limited development, with 6.6 percent of the watershed consisting of developed lands (NLCD 2011). Approximately 48% of the San Mateo Creek watershed is in public ownership, with 95% of the total watershed in various types of "open space" land uses. Approximately 30% of the watershed the San Mateo Creek watershed, including its principal headwaters, is within the Cleveland National Forest (Berg et al 2004, Stephenson et al. 1999, NMFS 2012). Development in the watershed is primarily limited to the upper portion of the watershed in Riverside County, with the tributary Los Alamos Creek draining private property that largely consists of low-density rural residential housing. Average impervious percentage in the watershed is 1.3 (NLCD 2011). Publicly owned lands include United States Forest Service (USFS) and California Department of Fish and Wildlife (CDFW) lands in the upper portion, and USMC lands and California State Parks (CDPR) where San Mateo Creek enters the coastal plain (Figure 1).

3.3. Southern California Steelhead and San Mateo Creek

Southern California Steelhead are considered a Distinct Population Segment (DPS) under the federal Endangered Species Act[5] and were originally listed as endangered in southern California – from the Santa Maria River to Topanga Creek – in 1997 (62 Fed.Reg. 43937); the range of the listed steelhead population the southern California was from Topanga Creek south to the U.S.-Mexico Border in 2002 (67 Fed.Reg. 21586). The endangered southern California steelhead DPS includes all naturally spawned anadromous *O. mykiss* (i.e., steelhead) originating below natural and manmade impassible barriers (71 Fed.Reg. 834). Genetic studies of southern California steelhead populations identified native genetic ancestry in coastal populations such as those in San Mateo Creek (Abadı´a-Cardoso et al. 2016).

Southern California is considered at or near the southern end of the range of steelhead, with an estimated 500 adult steelhead in the Southern California DPS in 2009 (NMFS 2007). Central Coast and Southern California Steelhead are documented to exhibit more plasticity in their phenotype and life-history variability than other *O. mykiss* (Bell 2011), and are adapted to high flow regimes with naturally elevated sediment regimes (Bell et al. 2011, Boughton et al. 2009) and variable freshwater/ocean access (Hayes et al. 2008, Hayes 2011), as well as higher temperatures and lower dissolved oxygen (Matthews and Berg 1997, Boughton et al. 2007, Spina 2007, Sloat and Osterback 2012).

The final critical habitat designation for Southern California Steelhead was issued on September 2, 2005, with only San Juan Creek and San Mateo Creek included in the San Diego Water Board Region (70 Fed.Reg. 52488). San Mateo Creek and Watershed exhibit natural conditions similar to studies on Central Coast and Southern California Steelhead (see Boughton et al. 2022), with highly variable flow regimes dependent entirely upon rainfall, intermittent tributaries (Figure 4), perennial groundwater-fed pools (Figure 5), and a bar-built estuary infrequently breached (Figure 6).

San Mateo Creek is a "Core 1" priority population by the National Marine Fisheries Service (NMFS) in the Southern California Steelhead Recovery Plan. According to the NMFS Recovery Plan, "[t]he Core 1 populations are those populations identified as the highest priority for recovery actions based on a variety of factors, including: the intrinsic potential of the population in an unimpaired condition; the role of the population in meeting the spatial and/or redundancy viability criteria; the current condition of the populations; the severity of the threats facing the populations; the potential ecological or genetic diversity the watershed and population could provide to the species; and the capacity of the watershed and population to respond to the critical recovery actions needed to abate those threats." (NMFS 2012).

The intrinsic potential maps are based on information on observed associates between fish distributions and the values of environmental factors such as stream gradient, summer mean discharge and air temperature, valley-width to mean discharge, and the presence of alluvial deposits that are essential to steelhead spawning and rearing (Boughton and Goslin 2006). One limitation of this methodology is that it may not fully account for groundwater inputs and may miss or underestimate some steelhead spawning and rearing areas, particularly summer refugia.

The U.S. Fish and Wildlife Service (USFWS) indicated that San Mateo Creek "may have been one of the most important steelhead spawning streams on the south coast" (USFWS 1998), with the total potential spawning area of the stream and tributaries historically estimated as 25 miles or more (Becker et al 2010); this estimated stream mileage falls between the amount of habitat that NMFS identified in its critical habitat designation (15.6 miles) and its intrinsic potential steelhead spawning and rearing habitat assessment (33.8 miles, see Figures 3 and 7, see also, California Department of Fish and Game 2000, Chambers Group, Inc. and ERORP Consulting 2008). Historic steelhead numbers for San Mateo Creek are unknown, though historic documentation estimates numbers in the thousands (USFWS 1998, Becker et al. 2010), with an estimated 19,000 fingerlings observed in the past in San Mateo Creek (Becker and Reining 2008).

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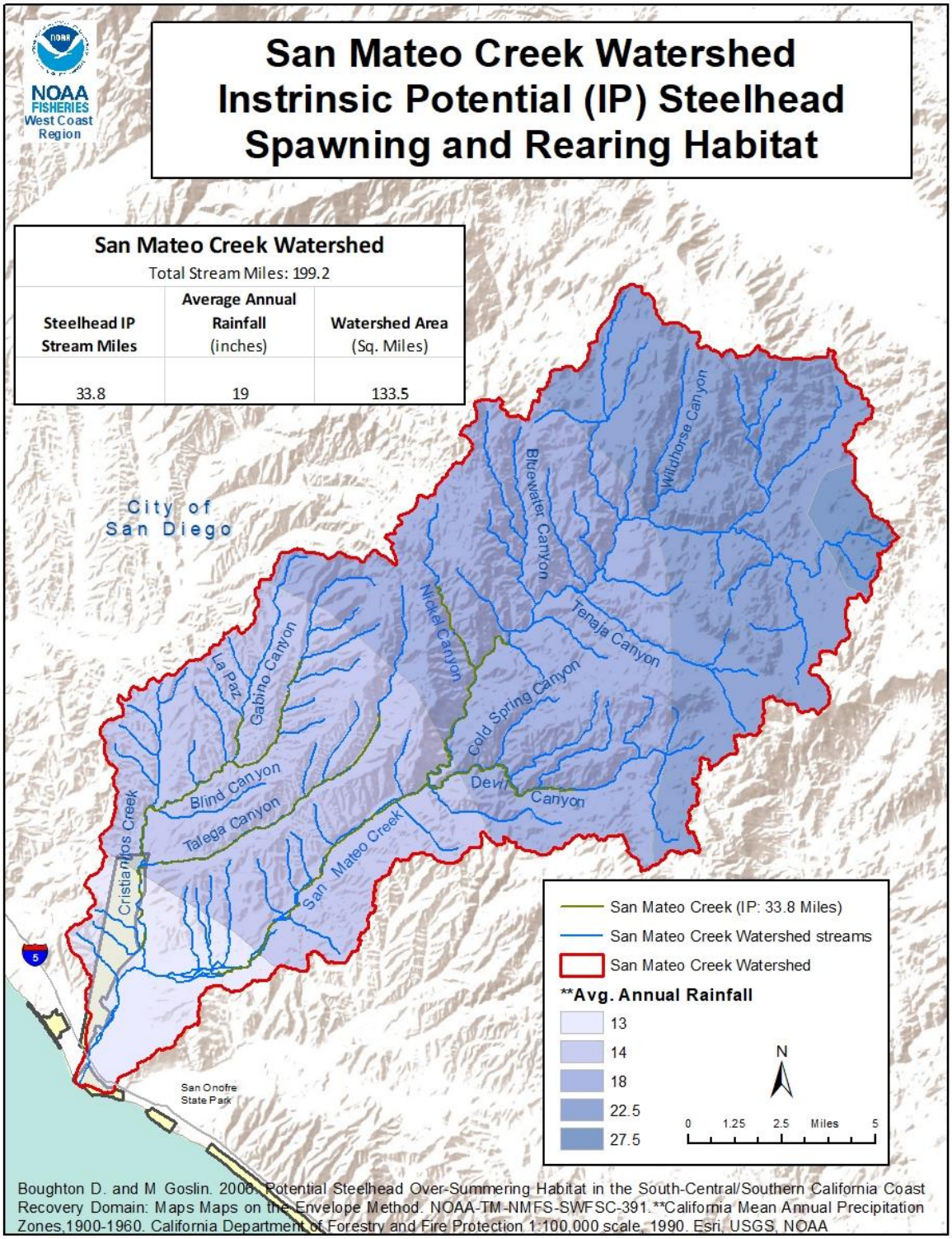
[5] Note the Southern California Steelhead have been petitioned for listing as endangered under the State of California Endangered Species Act

Figure 4. Tenaja Canyon Creek, an Intermittent Tributary (photo: Loflen)

Figure 5. Perennial Pool in San Mateo Creek (photo: Barabe)

Figure 6. San Mateo Creek Lagoon Mouth and Sand Berm. (photo: Woodward)

Figure 7. San Mateo Creek Watershed Intrinsic Potential Steelhead Spawning and Rearing Habitat Map. The map identifies additional areas beyond the critical habitat designation.



3.4. Water Quality Standards

CWA section 303 and section 13240 of the California Water Code (Water Code) require the San Diego Water Board to establish water quality standards for each water body within its region. Water quality standards include Beneficial Uses, water quality objectives (WQOs), and the antidegradation policy. The water quality standards applicable for San Mateo Creek are presented in the Basin Plan and the Water Quality Control Plan for Ocean Waters of California (Ocean Plan). The Basin Plan contains implementation programs to achieve water quality standards.

3.4.1. Beneficial Uses

San Mateo Creek is located within the San Mateo Canyon Hydrologic Area (901.4) of the San Juan Hydrologic Unit (901.00). The Basin Plan designates existing Beneficial Uses for San Mateo Creek (Table 3).

Table 3. Beneficial Uses in the San Diego Water Board Basin Plan for San Mateo Creek

Beneficial Use	Abbreviation	Description of Beneficial Use
Warm Freshwater Habitat	WARM	support warm water ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates
Cold Freshwater Habitat	COLD	support cold water ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates
Wildlife Habitat	WILD	support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources
Rare, Threatened, or Endangered Species	RARE	support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered
Migration of Aquatic Organisms	MIGR	support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish
Spawning, Reproduction, and/or Early Development	SPWN	support high quality habitats suitable for reproduction, early development and sustenance of marine fish and/or cold freshwater fish
Non-Contact Water Recreation	REC 2	Waters that support recreational activities not normally involving water contact or ingestion of water. REC 2 activities include sightseeing, aesthetic enjoyment of the water body alone or in conjunction with other activities such as bird watching, picnicking, sunbathing and hiking.

4. Problem Statement

The MIGR, SPWN, and RARE Beneficial Uses of San Mateo Creek are impaired because non-native aquatic invasive species within the creek and tributaries displace, outcompete, and otherwise prevent the presence of sustaining populations of federally threatened and endangered species including steelhead, arroyo toad, and tidewater goby (in San Mateo Lagoon). The presence of the non-native aquatic species is due to periodic releases from upstream residential properties.

4.1. Impairment of RARE, SPAWN, MIGR, COLD

In 2017, San Mateo Creek was placed on the 2014/16 CWA section 303(d) list of impaired water bodies, with RARE as the overarching impaired use. The impairment of San Mateo Creek is the result of the release and introduction of invasive species from upstream areas during wet weather events and the continued propagation and dispersal of these species, once released, within San Mateo Creek. The presence of invasive species in San Mateo Creek impairs its use by steelhead due to a combination of competition, predation (including potential transmission of disease), and degraded water quality (Hovey 2004, Wilcox 2012, Barabe and Nickerson 2015).

Since the 2002 listing of southern California steelhead as endangered in the San Diego Region, and the designation of critical habitat for this species, conditions for southern California steelhead in San Mateo Creek have continued to deteriorate due in part to the presence of invasives. Recent surveys have resulted in no steelhead detected above Camp Pendleton (Hovey 2004, NMFS 2012, Wilcox 2012, Barabe and Nickerson 2015, Barabe 2019 *personal communication*). NMFS identified the presence of non-native species in San Mateo Watershed as a “high threat” to steelhead recovery and identified recovery actions to address this threat, specifically:

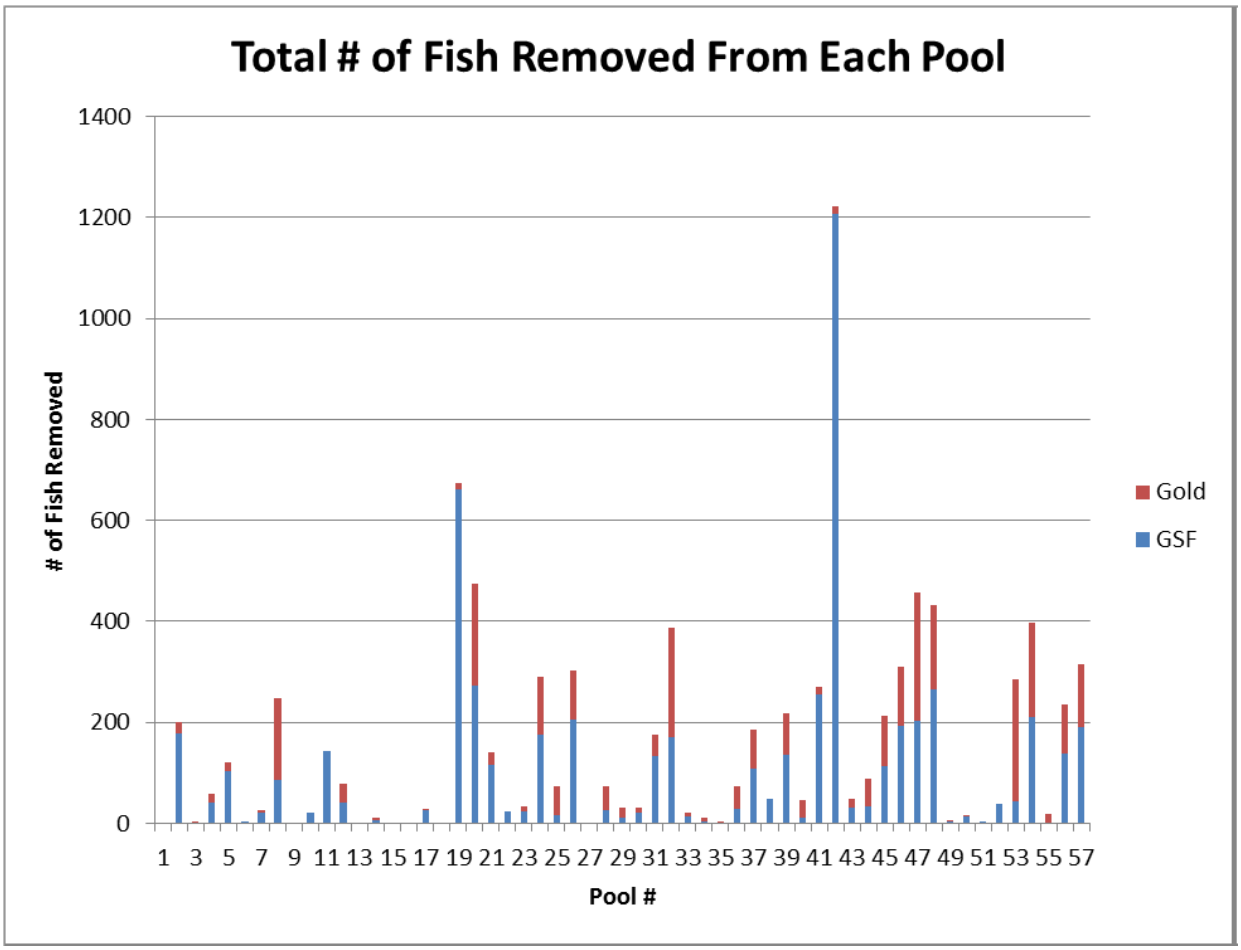
1. “Develop and implement a watershed-wide plan to assess the impacts of non-native species and develop control measures”;
2. “Develop and implement a non-native species monitoring program”; and
3. “Develop and implement [a] public education program on non-native species impacts” (NMFS 2012).

Current conditions in San Mateo Creek impair its utilization by steelhead, primarily during the summer-fall dry season. During summer and early fall, continuous surface flows in San Mateo Creek are absent; however, perennial pools supported by subsurface flows and springs do provide potential over-summering refugia habitat for rearing juvenile steelhead. These perennial pools are largely disconnected, with little to no surface flows between pools. The presence and proliferation of invasive species in perennial pools (Figure 8) causes adverse ecological effects for steelhead that rely upon San Mateo Creek, particularly during the critical summer-fall months (Moyle 1999, Marchetti et al. 2004). This condition also limits the ability of San Mateo Creek to support the RARE, MIGR, and SPWN Beneficial Uses.

While the CWA 303(d) listing of San Mateo Creek is for impairment of the RARE, SPWN and MIGR Beneficial Uses for steelhead, other federally endangered species are

present in the watershed that are impacted by the presence of invasive species. The Recovery Plan for the federally endangered Tidewater Goby in downstream San Mateo Lagoon identifies non-native species (green sunfish) as a factor impacting Tidewater Goby recovery (USFWS 2005). In addition, the federally endangered Arroyo Toad is historically documented with a critical habitat designation in Upper San Mateo Creek (USFWS 2014), and lower San Mateo Creek is included in the Species Recovery Plan (USFWS 1999) as part of the Southern Recovery Unit (USFWS 2014). Invasive species have been identified as the primary threat to arroyo toad in San Mateo Creek, specifically crayfish and bullfrog (USGS 2006).

Figure 8. From Barabe and Nickerson 2015. Summer removal quantities for invasive species from San Mateo Creek Perennial Pools. Gold = golden shiner, GSF = green sunfish.



4.2. Causes of the Impairment

The introduction (loading or discharge) of invasive species into San Mateo Creek, and their subsequent proliferation, is the direct cause of the impairment. While additional pollutants may be associated with slight decreases in water quality during storm flows, such pollutants would have a limited impact on the SPWN or MIGR Beneficial Uses. In addition, ancillary lines of evidence for water quality shows no indication of impairment, with CSCI scores for San Mateo Creek and its tributaries demonstrating very good biological integrity for benthic macroinvertebrates, which are sensitive to impacts associated with chemical pollutants (Figure 4, Mazor et al. 2016, San Diego Water Board 2016b and 2016c). Thus, this TMDL focuses on invasive species as the causative pollutant for the impairment within San Mateo Creek.

The presence and proliferation of invasive species results in competitive exclusion of steelhead through direct competition for resources (primarily food) and the prevention of population recruitment through predation upon juveniles (Fresh 1997, Stouder et al. 1997, Hovey 2004, NMFS 2016). Hovey (2004) directly documented declines in steelhead with increases in invasives, while USFS (2011) and Barabe and Nickerson (2015) found an absence of species concurrent with “infestation” levels of invasives. Notably, Hovey (2004) documented successful steelhead spawning and reproduction in Devil Canyon and found a lack of invasive species during the survey period attributed to a natural physical barrier preventing their movement from San Mateo Creek. Although recent surveys are limited and occurred during a drought period, they were unable to document steelhead in Devil Canyon (Barabe 2016). However, two juvenile steelhead were found in San Mateo Creek just upstream of the estuary in 2017 (Sherri Sullivan, pers comm), and eDNA analysis in San Mateo Creek in 2019 above Devil Canyon detected steelhead, though very low numbers of gene copies were detected (Loflen *unpublished data*) with no co-occurring visual documentation. This data suggests some low-level occupation and a potentially successful breeding pair somewhere in the San Mateo Creek Watershed.

The propagation of invasive species can also directly degrade water quality and quantity (McCormick et al. 2009, Dudley and Cole 2018). Due to the natural hydrologic and geomorphic conditions within San Mateo Creek, the proliferation of non-natives can produce higher water temperatures, higher biological oxygen demand, lower dissolved oxygen, and excessive algal growth. Steelhead require relatively cold, well oxygenated water for survival, though Southern California Steelhead are adapted to higher temperature and lower dissolved oxygen regimes (Matthews and Berg 1997, Boughton et al. 2007, Spina 2007, Sloat and Osterback 2012). The competition and predation by non-natives, however, can degrade this adaptive characteristic by increasing the bioenergetic demands on rearing juvenile steelhead. Data on perennial pools during the summer indicates that in the presence of non-natives water temperatures are sufficient to sustain steelhead (Hovey 2004, Wilcox 2012), though dissolved oxygen levels are unknown.

Historic surveys (described in Hovey 2004) documented the presence of < 70 steelhead in San Mateo Creek and Devil Canyon starting from 1999 to 2003 (Figure 9); see also, Higgins (1991) and Becker & Reining (2008). More recent surveys of the same locations within San Mateo Creek documented 0 steelhead, while concurrently finding thousands of invasive species (MRCD 2006, Wilcox 2012, Barabe and Nickerson 2015, Ralston and Barabe 2017). In addition, more recent surveys in 2017 documented steelhead in lower San Mateo Creek on USMC Camp Pendleton following high precipitation that opened the San Mateo Creek Lagoon. However, no successful steelhead reproduction and survival was documented in San Mateo Creek.

Figure 9. From CDFW 2004. Resident steelhead (rainbow trout) from San Mateo Creek watershed in 2003.

The invasive species that are causing the impairment include vertebrates and invertebrates in Table 4, below.

Table 4. List of Invasive Species Causing RARE Impairment for Steelhead

Invasive Species Causing Impairment (Common Name/Scientific Name)
Green Sunfish (*Lepomis cyanellus*)
Golden Shiner (*Notemigonus crysoleucas*)
Bluegill (*Lepomis macrochirus*)
Largemouth Bass (*Micropterus salmoides*)
Bullhead (*Ameiurus* genus)
Bullfrog (*Lithobates catesbeianus*)
Crayfish (*Procambarus clarkii*)

5. Invasive Species TMDL and Numeric Targets

A TMDL numeric target is an interpretation of existing water quality standards; it is not a water quality standard, and therefore, the process required when adopting such standards, including application of Water Code section 13241, does not apply. The existing water quality standard for San Mateo Creek that is impaired includes the Beneficial Uses MIGR, SPWN, and RARE, and the following narrative water quality objective:

> "All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the Regional Board." (California Regional Water Quality Control Board, San Diego Region Basin Plan p. 3-34)

5.1. Total Maximum Daily Load

The TMDL for San Mateo Creek is the number of total invasive species per month that San Mateo Creek is able to assimilate from nonpoint sources and still meet the numeric targets. This can also be expressed as density of invasive species per unit length or area of stream habitats. Once those numeric targets are achieved, the water quality of San Mateo Creek will be sufficient to support all designated Beneficial Uses. At that point, the impairment due to invasive species will no longer exist and San Mateo Creek may be removed from the 303(d) list, though periodic monitoring will be required to assess and document that the numeric targets are met in the future.

The invasive species TMDL that San Mateo Creek can assimilate is **zero invasive individuals of species listed in Table 4 per month**. The primary basis for this TMDL calculation is as follows:

1. The Southern California Steelhead is an endangered species and is threatened by the presence of invasive species in San Mateo Creek.

2. From 1999 to 2003 less than 70 individual steelhead were present in the watershed.

3. A single organism of an invasive species can result in direct take of juvenile steelhead through predation.

4. Invasive species can successfully reproduce in San Mateo Creek.

This TMDL calculation also includes secondary considerations for other native species. While San Mateo Creek is not 303(d) listed under the CWA for invasive species impacts to tidewater goby or arroyo toad, these federally endangered species are considered a secondary basis for the TMDL calculation.

1. The Recovery Plan for the federally endangered Tidewater Goby (*Eucyclogobius newberryi*) in downstream San Mateo Lagoon identifies non-native species (green sunfish) as a factor impacting Tidewater Goby recovery (USFWS 2005).

2. The federally endangered Arroyo Toad (*Anaxyrus californicus*) is historically documented in Upper San Mateo Creek, which is included as critical habitat for the species (USFWS 2014). San Mateo Creek is included in the Species Recovery Plan (USFWS 1999) as part of the Southern Recovery Unit (USFWS 2014) and invasive species have been identified as a threat to the arroyo toad population of San Mateo Creek (Brehme et al. 2006).The decline of arroyo toad in the upper watershed has co-occurred with steelhead decline, with no arroyo toad documented in 2005 and 2010 surveys (USFWS 2014), though tadpoles were detected in Los Alamos Canyon, an upper watershed tributary, in 2017 (WRCRCA 2018).

5.2. Numeric Targets

The numeric targets considered for selection are based on southern California steelhead (*Oncorhynchus mykiss*), the two other federally endangered species in the watershed (tidewater goby and arroyo toad), and the invasive species causing the impairment.

5.2.1. Potential Numeric Targets

There are several potential numeric targets applicable for San Mateo Creek. These include:

- The number and type of invasive species in San Mateo Creek can be a numeric target, because it is a direct link to the impairment of Beneficial Uses of San Mateo Creek.

- The amount of reproduction of invasive species in San Mateo Creek can be a numeric target, because it is a direct link to the impairment of Beneficial Uses of San Mateo Creek.

- The presence of steelhead (or their progeny) in San Mateo Creek can be a numeric target, because it is a direct assessment of Beneficial Use attainment.

- Successful reproduction and survival of steelhead in San Mateo Creek can be a numeric target, because it is a direct assessment of Beneficial Use attainment.

- The Basin Plan's WQO for dissolved oxygen can be a numeric target because it may be associated with the impairment of the Beneficial Uses of San Mateo Creek.

- The summer temperature of perennial pools can be a numeric target because it may be associated with the impairment of the Beneficial Uses of San Mateo Creek.

- Macroalgae biomass and cover can be a numeric target because they may be measurable biological symptoms associated with the impairment of the Beneficial Uses of San Mateo Creek.

5.2.2. Selection of Numeric Targets

This staff report identifies the number of invasive species and the sustained presence of steelhead as primary numeric targets for San Mateo Creek. Dissolved oxygen and temperature are secondary monitoring indicators.

Steelhead and non-native species numeric targets are a valid interpretation of the Basin Plan's water quality standards as they are directly linked to Beneficial Use attainment and impairment. The interim numeric target for steelhead is based on the original survey from 1999, which estimated approximately 70 steelhead in the watershed. While this number is approximate, it is also possibly an underestimate. Prior work on steelhead using general population models has suggested a minimum effective population size of 500 to constitute a sustainable population (NMFS 2000); however, recent research indicates that this number could be lower in systems comprised of populations with both anadromous and non-anadromous form of *O. mykiss* such as the populations in southern California, including San Mateo Creek (see Boughton et al. 2022). Therefore, a self-sustaining, viable Core 1 Population size for the Southern California DPS is uncertain at this time (Boughton et al. 2022). Provisionally, 70 is identified as an interim and final numeric target, until sufficient data on San Mateo Creek is collected for NMFS and other responsible agencies to determine a site-specific self-sustaining viable Core 1 Population (see NMFS 2000, 2016; Boughton et al. 2022). The meeting of both the numeric target for invasives and the interim target for steelhead presence simultaneously is expected to promote a self-sustaining, viable Core 1 population over time.

Table 5. Numeric Target: Invasive Species in San Mateo Creek

Species	Numeric Target	Interim CPU Target*
Green Sunfish (*Lepomis cyanellus)*	0	0
Bluegill (*Lepomis macrochirus*)	0	0
Bullhead Catfish (*Ameiurus)*	0	0
Golden Shiner (*Notemigonus crysoleucas*)	0	0
Largemouth Bass (*Micropterus salmoides*)	0	0
Bullfrog (*Lithobates catesbeianus*)	0	0
Crayfish (*Procambarus clarkii*)	0	0

*Catch Per Unit Effort (CPU) using standardized methods in areas with perennial surface water

Table 6. Numeric Target: Steelhead Presence in San Mateo Creek Watershed

Class	Number
Adults	Interim: 70 Final: 70 until or unless an alternative self-sustaining, viable Core 1 Population number is determined in consultation with NMFS
Juveniles	Present

These numeric targets represent alternative numeric targets to Basin Plan WQOs. The inclusion of alternative numeric targets as assessment endpoints is supported by the USEPA (Creager et al. 2006).

Table 7. Monitoring Indicator: Water Quality Criteria

Water Quality Parameter	Monitoring Indicator (Summer Dry)
Dissolved Oxygen	Temperature and time-dependent (see Table 2 in Matthews and Berg 1997)
Temperature	Instantaneous Max Surface < 28 7-Day Mean < 24

Dissolved oxygen and temperature are included as numeric monitoring indicators because they are important water quality parameters that can be degraded by the presence of invasive species (Moyle and Light 1996, Moyle 1999, Marchetti et al. 2004). As a result, these parameters may be indirectly associated with impairment of the Beneficial Uses of San Mateo Creek. The collection of dissolved oxygen and temperature data during and after non-native species removal will provide important data regarding:

1) Improvements associated with removal of invasives
2) The suitability of habitat for steelhead following invasive removal
3) Potential habitat availability to determine optimal population size

The reproduction rates of non-native species and steelhead were not selected as numeric targets for the TMDL. Documentation and monitoring of reproduction in San Mateo Creek would be challenging due to its remote location and status as a Wilderness area. While these numeric targets may be indicators of effectiveness of the program to achieve the goal of eliminating or reducing invasives and promoting the recovery of the endangered southern California steelhead (and federally endangered southern tidewater goby and arroyo toad), they can also be misleading. First, for invasive species, in-stream reproduction may not reflect control of potential upstream introductions. This would confound in-stream surveys if upstream sources are still a source of invasives. Second, threats other than invasives (such as droughts, wildfires, anthropogenic instream disturbances, or ocean conditions) may impact migration and spawning success of steelhead. Additionally, conducting surveys of spawning steelhead evidence presents logistical issues (e.g., access to the stream during higher flows, detecting small numbers of adults of may be problematic due to their status as endangered and due to challenges with monitoring in remote mountainous terrain, NMFS 2016).

Macroalgae biomass and cover were dismissed as numeric targets for the TMDL because there is no documented linkage between macroalgal biomass or cover and the impairment of waters for steelhead at this time.

6. Invasive Species Sources (Source Analysis)

Source analysis identifies the specific or categories of sources that are causing and/or contributing to the impairment. For San Mateo Creek, nonpoint sources of invasive species have been identified as the sources.

6.1. Point Sources

Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels from, for example, municipal wastewater treatment plants or from a municipal separate storm sewer system (MS4). Point source discharges are regulated under the CWA, commonly through National Pollutant Discharge Elimination System (NPDES) Permits for discharges to waters of the United States, as well as through State of California Waste Discharge Requirements (WDRs) for discharges to waters of the United States and/or State of California. Known point source discharges in the San Mateo Creek Watershed include discharges of stormwater from the MS4 associated with development. Potential additional point source discharges include stormwater discharges associated with construction stormwater activities. There is no data to suggest these point sources are a significant source of invasive species.

6.2. Nonpoint Sources

Nonpoint sources do not originate from regulated point sources and come from many diffuse sources. Nonpoint source pollution generally occurs when rainfall flows off the land, roads, buildings, and other features of the landscape. This diffuse runoff carries pollutants, such as invasive species, into drainage ditches, lakes, rivers, wetlands, and bays. The CWA requires States to develop a program to protect the quality of water resources from the adverse effects of nonpoint source water pollution. As a result, the State of California has developed a Nonpoint Source Pollution Control Program (NPS).

Nonpoint sources are causing the invasive species impairment for San Mateo Creek. Ponds in the watershed stocked with invasives are the primary nonpoint source and they lead to invasive species in-stream presence and reproduction which is a second nonpoint source (TU and Duff 2007, NMFS 2012). These two nonpoint sources are related and therefore must be simultaneously addressed to restore Beneficial Uses. Without identifying and managing ponds as the primary loading source, in-stream removals can be ineffective, as documented in recent surveys (Wilcox 2012, Barabe and Nickerson 2015, Ralston and Barabe 2017, Barabe 2018).

6.3. Other Sources

Other sources of potential introduction of invasives to San Mateo Creek include the direct, intentional release of these species by the public to San Mateo Creek. The direct release of these species typically occurs in waterbodies to get rid of unwanted pets or to improve recreational opportunities. Due to the remote location of San Mateo Creek and its intermittent and interrupted flow, it is unlikely that the public would drive to the trailheads, hike to a perennial pool, and release aquatic non-native species, but the possibility cannot be ruled out completely. Continued efforts to monitor and remove nonpoint sources would identify and address any other potential sources, as well as the implementation of on-site educational best management practices ("BMPs", e.g., trailhead signage).

7. Linkage Analysis

Eliminating loading of invasive species from wet weather events, which transports non-natives from upstream sources, and in-stream reproduction will provide the needed conditions for the restoration of RARE, SPWN, and MIGR Beneficial Uses for San Mateo Creek through the prevention of invasive species competition with, predation upon (including the transmission of diseases), and deteriorating water quality conditions for steelhead.

Historic stock ponds and recreational ponds (hereinafter referred to as "ponds") are present in the upper watershed of San Mateo Creek. Ponds are located primarily on private inholdings in the Cleveland National Forest and on private property in the Los Alamos Canyon tributary and Devil Canyon tributary watershed (Figure 10). The ponds have historically been stocked with invasive species and serve as a refuge and loading source for re-seeding of downstream areas in San Mateo Creek (MRCD 2006, Hovey 2017). As many ponds have been constructed in-line with streams (e.g., Figure 10), they overflow during heavy precipitation events, which results in downstream transport of invasives. Then the invasive species can reproduce in-stream. Ponds with hydrologic connectivity to downstream surface waters are considered the primary nonpoint source. Additionally, ponds in the watershed may be subject to more frequent flooding because of climate change-induced changes to the frequency of high intensity storms in the southern California region (Kalansky et al. 2018, Dong et al. 2019, Huang et al. 2020).

Figure 10. Example of Pond (circled) in the Upper San Mateo Creek Watershed. This pond is constructed in-line with the stream, which allows any stocked non-native species to move downstream during high flow events (photo: Google Earth).

Sustained in-stream invasive species presence and reproduction are considered secondary nonpoint sources. Once invasives are introduced into San Mateo Creek, their sustained presence, including proliferation and infestation through reproduction and dispersal, results in continued impairment.

For example, reproduction of bullfrog occurs at multiple points in San Mateo Creek (Loflen, *personal observation*), and species counts and class sizes in multi-year surveys, including during drought years (e.g., Barabe 2018), indicates invasives can support self-sustaining populations, which prevents steelhead recovery, even without upstream loading from ponds. The presence and in-stream reproduction of invasive species is considered a secondary nonpoint source because the primary loading comes from upstream ponds. Prior invasive species removal efforts successfully removed 32,000 invasives from 2 miles of upper San Mateo Creek (MRCD 2006, Hovey 2017). However, these efforts were not sustained, and upstream sources were not addressed.

8. Margin of Safety

An implicit Margin of Safety (MOS) is used in the TMDL calculation. The use of an implicit MOS is appropriate because of the conservative assumption of a zero numeric target for invasive species. This is conservative as it allows for no assimilative capacity for San Mateo Creek for invasives during the critical summer dry-weather season. This is the critical season for steelhead survival, as well as for other native aquatic species that are susceptible to impacts, such as predation (Figure 11).

Figure 11. From Nicholson et al. 2020: *Hatchling western pond turtle found in the stomach of a bullfrog in the San Luis Rey River, San Diego Co. USA. Source: U.S. Geological Survey, Western Ecological Research Center, San Diego, CA, USA*.

8.1. Consideration of Future Development in the San Mateo Creek Watershed

Future development in the San Mateo Creek watershed could result in changed conditions affecting the loading of invasive species into San Mateo Creek. It is unlikely that legal land development will result in additional unmitigated in-line ponds stocked with invasive species. There are existing regulatory instruments that contain prohibitions to ensure future development does not contribute additional loading of invasive species.

1. The CWA requires any dredge or fill activities in waters of the United States to obtain a Section 401 Water Quality Certification from the Regional Board. As part of the implementation plan, the San Diego Water Board will not certify dredge or fill activities that do not take appropriate avoidance, minimization, and/or mitigation efforts to prevent additional loading of invasive species.

2. The Water Code requires any dredge or fill activities in waters of the State of California to obtain Waste Discharge Requirements. As part of the implementation plan, the San Diego Water Board will not permit dredge or fill activities that do not take appropriate avoidance, minimization, and/or mitigation efforts to prevent additional loading of invasive species.

In addition, the California Department of Fish and Wildlife has an Invasive Species Program (focused on invasive species, such as dreissenid [Quagga] mussels), and an Invasive Species Management Plan (2008).

9. Seasonal Variations and Critical Conditions

Allocations and reductions are applicable year-round, though May through October is the seasonal period that is critical for over-summering steelhead survival (see section 4). The TMDL can also be temporarily exceeded at times as a result of high stream flows during the wet season if invasives are transported into and through San Mateo Creek to San Mateo Lagoon and the Pacific Ocean.

10. Invasive Species Loading Capacity (Load Allocations and Reductions)

Load Allocations and necessary reductions are determined based on historic invasive species data and the status of steelhead as endangered (as well as tidewater goby and arroyo toad). The assimilative capacity and resulting allocations are based upon the need to completely remediate all potential loading sources into San Mateo Creek, as well as maintain levels of steelhead that support a sustainable population for San Mateo Creek.

10.1. Upstream Sources (Invasive Species Loading – Ponds)

The allocation of invasive species from ponds in the watershed to San Mateo Creek is 0 species per month. This represents an implicit assumption that San Mateo Creek has no assimilative capacity for listed invasive species, as any continued loading presents an unmitigated risk of impairment downstream through propagation and infestation. Continued loading can also undo the benefits of any/all in-stream invasive species removal efforts.

10.2. In-Stream Sources (Invasive Species Loading – In-Stream)

The allocation of invasive species loading from in-stream propagation in the San Mateo Creek watershed is 0 species per month. This represents an implicit assumption that San Mateo Creek has no assimilative capacity for listed invasive species. Invasive species removal is needed to prevent steelhead competition and predation, proliferation of invasives through reproduction, and to restore the impairment.

10.3. Invasive Species Reduction (Load Reductions and Other Considerations)

The existing load of non-native species does not meet the required 0 species per month. Thus, a 100 percent load reduction is required. Upstream ponds and in-stream reproduction are identified as the only significant nonpoint sources of invasive species to San Mateo Creek.

11. Implementation and Monitoring

Implementation of NPS management programs will attain and maintain the targeted invasive species loading. Upstream ponds and instream reproduction are the two sources contributing invasives to San Mateo Creek. Because both of these are nonpoint sources, no modifications to NPDES permits or effluent limitations are necessary to meet the TMDL. The numeric targets will be met as soon as the sources are addressed through NPS implementation. Once the numeric targets are met, the San Diego Water Board will take the necessary actions to delist San Mateo Creek from the 303(d) list for invasive species and on-going monitoring will be performed to ensure that the Beneficial Uses are maintained.

The San Diego Water Board will rely on three types of TMDL implementation:
(1) Programs funded by the NPS program for eradication and mitigation measures;
(2) Existing regulations of other agencies, like CDFW;
(3) Permitting and enforcement consistent with existing regulations and policy.

11.1. Implementation

Of the three types of implementation that will occur to ensure the TMDL is met and impairment restored, one will directly restore the impairment, while two will use existing regulations by the State of California to protect against future impairment.

The first method of implementation, which will directly address the impairment, will be initiated by the San Diego Water Board through nonpoint source pollution control activities that incentivize, facilitate, and/or contribute resources to public and private actions that prevent releases of invasive species from ponds and that eradicate invasive species from the waters of the San Mateo Creek watershed (see further discussion below in 11.1.1). The Board will seek a memorandum of agreement (MOA) with the public and private parties that will remove the invasive species.

The second form of implementation, which will protect against future impairment, relies upon CDFW's existing regulations. CDFW regulates the private transportation and stocking of live aquatic plants and animals for waters of the state (Fish and Game Code 6400, also 15200). This includes stocking or release of invasive species in San Mateo Creek and its tributaries, including "ponds" on private property (Cal. Code Regs., tit. 14, § 238.5) in the watershed. Any such activity requires permission from CDFW. The purpose of the permit system is to prevent the introduction and spread of organisms that would harm aquatic resources, such as steelhead. Thus, implementation of these regulations will prevent the transport and stocking of invasive species in the watershed. Furthermore, CDFW may prohibit the placement of specific species of aquatic plants or animals in designated waters of the state (Fish & G. Code, § 15202). This implementation will prevent the introduction (stocking) of invasive species into waters of the State in the San Mateo watershed.

The third type of implementation, which will also protect against future impairment, will be initiated by the San Diego Water Board using its existing regulations. The CWA requires any dredge or fill activities in waters of the United States to obtain a Section 401 Water Quality Certification from the Regional Board. As part of the implementation plan, the San Diego Water Board, consistent with existing policy, will not certify dredge or fill activities that do not take appropriate avoidance, minimization, and/or mitigation efforts to prevent additional loading of invasive species to San Mateo Creek or its tributaries. In addition, the Water Code requires any dredge or fill activities in waters of the State of California to obtain Waste Discharge Requirements. As part of the implementation plan, the San Diego Water Board will not permit dredge or fill activities that do not take appropriate avoidance, minimization, and/or mitigation efforts to prevent additional loading of invasive species to San Mateo Creek or its tributaries.

11.1.1. Restoration Implementation through the NPS program

In accordance with the Impaired Waters Policy, all NPS control implementation programs must meet the 5 key elements in the State Water Board Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (State Water Board 2004). This TMDL report includes information required to meet the 5 key elements.

California conducts nonpoint source implementation planning on a 5-year basis through development of a Five-Year NPS Implementation Plan (NPS Plan), with the current plan being from 2020 to 2025 (2020 NPS Plan). The NPS Plan presents, in one place, the general goals and objectives of the co-lead agencies (California Regional Boards) for addressing nonpoint source pollution over the timeframe of July 2020 to June 2025. This five-year plan was also prepared to meet the requirements of Clean Water Act section 319 (CWA 319).

This TMDL and its implementation actions are consistent with the 2020 NPS Plan because the Plan includes the following objective and milestones for San Mateo Creek:

- *Objective: Improve stream and wetlands conditions by protecting and restoring natural flow regimes and controlling NPS pollution to support ecologically-balanced communities of native organisms*

- *Milestones: Participate in collaborative effort(sic) to address invasive species in high quality streams, like San Mateo watershed.*
  i. Collaborate with stakeholder groups to reduce invasive species threats to areas with BIOL or RARE beneficial uses, such as San Mateo watershed: 2024

Since the NPS Plan identifies how the State sets priorities and determines eligibility for federal nonpoint source pollution funding, public and private parties will be eligible to compete for funding for projects that address nonpoint sources of invasive species that are causing the impairments in San Mateo Creek.

The NPS program funding sources support the following (State Water Board 2019):

1) Development and implementation of watershed management and TMDL plans.

2) Implementation of management measures and practices.

3) Education and technical assistance on nonpoint source pollution problems and solutions.

Third party organizations will be able to apply for NPS program funding to correct the impairment in San Mateo Creek. For example, California Trout, a non-profit organization that coordinates efforts between federal, state, and local governments and private parties, has started to work on a project in the San Mateo Creek that will remove non-native species that are detrimental to native trout survival. California Trout will use NPS program funding to expand its programing to pursue public outreach to control source populations of non-native species upstream that are the cause of this impairment. California Trout will not be the only organization that will be able to apply for funding. This TMDL anticipates that several parties will be able to correct the impairment in the San Mateo Creek once this funding is available to carry out the plans that they have developed.

The Board will seek an MOA with these parties to carry out restoration of the impairment. The MOA will include the following: the voluntary efforts that will be undertaken to attain the load allocations of this TMDL, outline roles and responsibilities of the Board and cooperative parties, a timeline to meet conditions on trackable progress towards meeting load allocations and numeric targets, a provision that the MOA must be revoked based upon findings that the program is not achieving its goal of restoring water quality. The MOA must comply with the *Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options ("Policy"),* including part II, section 2 (c)(ii) and related provisions. The MOA must be consistent with the requirements of this TMDL. The purpose of the MOA is not to create evidence of responsibility or ascertain legal liability for subsequent restoration, but rather to organize the stakeholders who have an interest in the restoration.

11.1.2. Development of a Focused Watershed Management Plan for San Mateo Creek

The impairment of San Mateo Creek by invasive species is associated with sources throughout the watershed and thus will require a watershed-based planning and management approach. NMFS has identified that a watershed planning approach to address invasive species is a needed recovery action (NMFS 2012).[6] A watershed management plan for San Mateo Creek is needed to identify specific steps, actions, milestones, and funding needs for addressing the impairment through NPS

[6] Ideally a management plan for steelhead would encompass other components for tidewater goby and arroyo toad.

implementation actions. A focused watershed management plan can also serve to better coordinate the current management plans, measures, and monitoring efforts being undertaken by agencies (e.g., USFS, USMC Camp Pendleton, CDFW), as well as identify additional monitoring needs (see section 11.2).
Several related management plans have been developed by federal entities in the watershed and/or for its species, and these could form the basis for a watershed management plan to implement this TMDL for invasive species in San Mateo Creek. These include:

1) USFS: Land Management Plan for the Cleveland National Forest (USFS 2006)

2) USMC Camp Pendleton: Integrated Natural Resources Management Plan (USMC 2018)

3) NMFS: Southern California Steelhead Recovery Plan (NMFS 2012)

11.1.3. Management Measures and Practices

Three major management measures must occur to implement this TMDL:

1) Remediation and mitigation of ponds that hold invasive species.
2) Removal of invasive species from San Mateo Creek.
3) Monitoring and assessment of the implementation of the TMDL (discussed in section 11.2).

First, the remediation and mitigation of existing ponds would address the primary nonpoint source for the TMDL. These ponds represent the upstream loading sources to San Mateo Creek. The ponds will be addressed through on-site source control measures and practices to prevent future reseeding of non-natives downstream. The remediation and mitigation are also necessary to maintain the in-stream loading allocation following eradication efforts. Mitigation measures and practices may include, but are not limited to:

1) Pond removal and stream restoration;
2) Pond modification to separate them from stream flows (i.e., taking them "off-line");
3) Installation of pond outflow mitigation measures;
4) Removal of invasive species; and
5) Landowner and general public education about the effects of invasive species on San Mateo Creek.

Second, the removal of invasive species from San Mateo Creek will address the secondary nonpoint source (invasive species in-stream presence and reproduction). The removal of invasive species should occur, if feasible, concurrently with tributary efforts to mitigate upstream ponds.

The USMC currently has an invasive species removal program for Camp Pendleton under its land management plan (USMC 2018).

These management measures and practices to restore habitat to support salmonids are identified as a priority by the California legislature and governor, most recently through the passage of Assembly Bill 315 and Senate Bill 155, which are intended to expedite habitat restoration throughout the State.

11.1.4. Education and Technical Assistance regarding Nonpoint Source Pollution Problems and Solutions

Educational and technical assistance are needed to address the nonpoint sources of invasive species in San Mateo Creek Watershed. Examples include:

- Mapping and assessment of loading sources
- Evaluation of priority remediation and mitigation areas
- Evaluation of mitigation measure feasibility for ponds
- Public outreach and communication for private property owners

11.2. Monitoring Plan

Monitoring is a critical component of every TMDL and is needed to assess progress toward achieving TMDL implementation and TMDL numeric targets. Importantly, steelhead monitoring methods and results must be compatible with larger data needs and monitoring conducted to evaluate species recovery across the Southern California DPS in accordance with the Recovery Plan (see section 14.4 in NMFS 2012).

Multiple entities conduct steelhead and non-native species monitoring in the San Mateo Creek Watershed, including USMC Camp Pendleton, USFS, CDFW, San Diego Water Board, and California Trout.

The USFS is required by court order (see Wilcox 2012) to monitor steelhead in San Mateo Creek. The Court found that a "steelhead monitoring and tracking program is necessary to prevent irreparable harm to the species by ensuring that adverse impact to the steelhead will not rise to the level of jeopardy" (Center for Biological Diversity, et al., Plaintiffs, v. United States Fish and Wildlife Service, et al., Defendants. Case No. C-08-1278 EMC). The USFS identified the following as the long-term monitoring plan (Wilcox 2012):

> "The CNF (Cleveland National Forest) will initiate a survey for steelhead trout occupancy whenever the San Mateo Creek sandbar is breached, as this would provide potential upstream anadromous access to adult steelhead. Stream discharge flow information from the USGS stream gauge station 11046300, near San Clemente, CA on the Camp Pendleton Marine Corps Base, will be a primary trigger for survey initiation. Survey methodologies will mirror those described in this document, with an increase in snorkel observation expected during higher water conditions. Additionally, water temperature monitoring will continue, with a focus on identifying and tracking suitable microhabitats for steelhead based upon magnitude and duration of stressing temperatures. All inventory and monitoring progress and results will be made available to interested parties such as NOAA and CDFG, as well as the public."

In accordance with their Natural Resource Management Plan, USMC Camp Pendleton conducts their own steelhead monitoring program on USMC lands within the San Mateo Creek Watershed, including for San Mateo Creek (USMC 2018).

Ideally, a long-term coordinated watershed monitoring program will be implemented within the watershed management plan that includes the multiple agencies and entities who conduct steelhead, invasive species, water quality, and other relevant monitoring in the San Mateo Creek Watershed. The monitoring program should be consistent with Boughton et al. 2022 in order to assist in the determination of an alternative site-specific self-sustaining, viable Core 1 Population number. The coordinated monitoring program must be consistent with Boughton et al. 2022 and would include the following elements:

1) Steelhead Habitat Suitability
    a. Water quality monitoring for perennial pools
    b. Water quality monitoring for spawning habitat
2) Invasive Species Population
    a. Population estimates
    b. Age class and evidence of reproduction
    c. San Mateo source tributary flow monitoring
3) Steelhead Population
    a. Population estimates
    b. Age class and evidence of reproduction
4) Hydrologic Connectivity Information
    a. Tributary Flow Data

Specific monitoring program methods are not included in this document and will be developed by the San Diego Water Board or a third party in consideration of current monitoring efforts by various entities and in consult with applicable resource agencies. Monitoring of invasive species can utilize a variety of standard techniques to determine their presence/absence, as well as distribution and density over time (Wallace and Bargeron 2014, Oswalt et al. 2021). Steelhead population estimate methods would be developed in consultation with NMFS for consistency with the *California Coastal Monitoring Plan* and the *Integration of Steelhead Viability Monitoring, Recovery Plans and Fisheries Management in the Southern Coastal Area* (Boughton et al. 2022). Multiple methods to monitor for steelhead are available and in use in southern California (see also, discussion in NMFS 2012, 2016). Specific monitoring methods are best determined based on site-specific conditions in consultation with NMFS and applicable resource agencies. Steelhead monitoring must be designed to support viability monitoring of the ESU as well Biogeographic Population Group (see Boughton et al. 2022). Additional monitoring programs could be implemented to evaluate the effectiveness of management measures, if feasible. This could include, but not be limited to, tagging of non-native fish in mitigated ponds, use of environmental DNA "eDNA" (Abbott et al. 2021), and/or use of cameras to capture non-native amphibians in pools (Brown et al. 2020).

At a minimum, this TMDL could be assessed using the information in Table 8:

Table 8. Minimum Monitoring for the Invasive Species TMDL for San Mateo Creek

Monitoring Item	Frequency	Metrics
Steelhead Population Survey	Annual	Counts
Non-native Population Estimates	Annual (summer dry)	Counts, CPU, Population Estimates
Hydrologic Connectivity of Tributaries	Continuous	CFS, Water Level, Water Presence/Absence

12. Schedule and Compliance

A detailed schedule for the implementation of the TMDL and attainment of the numeric targets is in Table 9. As noted in section 11, most elements of the schedule could be eligible for federal and State NPS Plan funding. In fact, addressing invasive species in San Mateo Creek is identified as a fundable project in the 2022 Nonpoint Source Grant Program Guidelines. The San Diego Water Board will also advocate for the addition of this TMDL into the 2025 State Water Board update of the NPS Plan. Thus, implementation could be largely funded using CWA section 319 awards granted to eligible parties. Other implementation measures, such as some species surveys, will rely on existing efforts of federal agencies. The San Diego Water Board will play a role in implementation through advocating for funding, collaborating planning and actions, and providing field, laboratory, or other technical resources to implement the watershed management plan.

The attainment of numeric targets is required by 2037 and is based on the following considerations:

- An update of the NPS Plan, which guides funding, will not occur until 2025.
- Source remediation management actions have yet to be prioritized.
- In-stream and watershed remediation will take multiple seasons.
- The timeframe for development of a sustained steelhead population is unknown and influenced by climatic factors.

Table 9. Implementation Schedule for the Invasive Species TMDL for San Mateo Creek

Activity	Entity	Year*
San Diego Water Board adoption of TMDL	San Diego Water Board	2022
Begin Collaborative Stakeholder Process for TMDL Implementation per NPS Implementation Plan	San Diego Water Board, Interested Stakeholders	2022
Draft Scope of Work for San Mateo Creek Watershed Management Plan and development of MOA	San Diego Water Board, Interested Stakeholders	2022
Obtain Funding for San Mateo Creek Watershed Management Plan Development	319 Grant Recipient	2023
Develop San Mateo Creek Watershed Management Plan	319 Grant Recipient	2023
Begin Watershed Mapping of Potential Invasive Species Sources	319 Grant Recipient	2023
San Diego Water Board Assessment of TMDL Progress via NPS Program Implementation	San Diego Water Board	2024
Steelhead Population Estimation Surveys	USMC**, USFS**, 319 Grant Recipient	On-going
Inclusion of TMDL Implementation in the 2025-2030 NPS Plan	San Diego Water Board	2024
Begin Invasive Species Surveys in San Mateo Creek and Tributary Streams	319 Grant Recipient	2024
Produce Landowner Outreach Materials for Project	319 Grant Recipient	2024
Initiate Landowner Outreach	319 Grant Recipient	2024
Initiate Source Control Management Measures: Invasive Species In-Stream Removals	319 Grant Recipient	2025
Initiate Source Control Management Measures: Remediation and Mitigation Planning for Priority Sources	319 Grant Recipient	2026
Continued Implementation of Source Control Management Measures	319 Grant Recipient	2026 – 2031
Continued Monitoring for Numeric Targets	USMC**, USFS**, 319 Grant Recipient	2026 – 2031
Assess Progress Towards Meeting Numeric Targets Milestones: • Invasive species reduction (Population and CPU declines) • Increase in Steelhead Population Numbers • Increase in remediated priority sources	San Diego Water Board	2031

Evaluation of Scientific Data for Determination of a Site-Specific Self-Sustaining, Viable Core 1 Population	San Diego Water Board in Consult with NMFS	2031
Continued Implementation of Source Control Management Measures	319 Grant Recipient	2031 – 2036
Continued Monitoring for Numeric Targets	USMC**, USFS**, 319 Grant Recipient	2031 – 2036
Attainment of Final Numeric Targets	NA	2037
Continued Monitoring of Steelhead Population and Invasive Species	USMC**, USFS**, 319 Grant Recipient	On-going

* The Implementation dates for 319 grant recipient items is contingent upon addition of this TMDL to the next State Water Board update of the Nonpoint Source Implementation Plan in 2025. Allocation of other funding sources may assist in expedition of TMDL implementation.
**Continuation of existing land management monitoring programs as previously described

12.1. Compliance

Achievement of the TMDL will be assessed through continuous monitoring of San Mateo Creek, which is presently conducted by the CDFW, USMC, USFS, San Diego Water Board, and other agencies and entities as described in previous sections of this report. These monitoring efforts should largely be sufficient to monitor steelhead population status, though additional monitoring surveys and methods may be warranted to supplement the information collected. For instance, information from additional invasive species surveys may also be needed to fill data gaps identified during load allocation monitoring.

Numeric target monitoring, as described in Table 9, will demonstrate whether the targets have been achieved by 2037, with interim progress assessed in 2031. This timeframe and milestones could be adjusted based on NPS funding considerations.

The availability of federal and State NPS Program funds to implement this TMDL and leverage existing federal activities in the watershed provides the reasonable assurance that the Beneficial Uses can be restored in a reasonable timeframe.

If the NPS Plan implementation is not successful in restoring the Beneficial Uses, the San Diego Water Board will evaluate the use of other options to address the sources of impairment. The San Diego Water Board will assess NPS implementation progress by the end of 2024. Pursuant to the Impaired Waters Policy Section II.2.d, the San Diego Water Board will rely on fallback provisions to ensure that the impairment will be addressed in a reasonable period of time if the program is unsuccessful. Potential alternative actions include enforcement actions to cleanup and abate the sources of pollutants to San Mateo Creek and WDRs, a Basin Plan amendment to prohibit the

discharge of non-native aquatic species in the watershed, or a reconsideration of the TMDL. The San Diego Water Board must pursue a fallback provision if the impairment is not resolved as outlined in the timeline above.

13. Other Considerations

13.1. Incorporating TMDL into the Basin Plan Not Required

In accordance with State Board Resolution 2005-0050 and the associated guidance document *Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options* (Impaired Waters Policy), the implementation plan developed to address the impairment (e.g., the use of NPS funds to supplement existing remediation projects and the sufficiency of existing regulatory programs) does not require a Basin Plan Amendment.

13.2. Scientific Peer Review Not Required

This TMDL does not require a scientific peer review because no rulemaking is occurring to adopt or implement it. Section 57004 of the California Health and Safety Code requires the submission of the scientific basis for any rulemaking to an external peer review for evaluation prior to taking an action on the proposed rule. Section 57004 defines a rule as a regulation or a policy adopted by the State Water Resources Control Board that has the effect of a regulation or is adopted to implement or make effective a regulation. The TMDL implements an existing standard and relies on existing program requirements for implementation. The TMDL is not being adopted with and reflected in assumptions underlying a basin plan amendment, or another regulation or policy. Therefore, it does not meet the conditions that require a scientific peer review.

13.3. California Environmental Quality Act

The California Environmental Quality Act (CEQA) is codified at Public Resources Code Section 21000 et seq. The CEQA Guidelines are codified at Title 14 California Code of Regulations section 15000 et seq.

This TMDL is an action to assure the restoration of Beneficial Uses in San Mateo Creek through NPS planning and by enforcing the existing laws, regulations, and standards administered by the San Diego Water Board.[7] As such, it is categorically exempt from the provisions of CEQA pursuant to Public Resources Code (PRC) sections 15308 (for Class 8 exemptions) and 15307 (for Class 7 exemptions).

[7] State Water Board implementation regulations are in 23 CCR Chapter 27, §3720 et seq. and available at: http://www.waterboards.ca.gov/laws_regulations/docs/wrregs.pdf

- Class 8 consists of actions taken by regulatory agencies, as authorized by state or local ordinance, to assure the maintenance, restoration, enhancement, or protection of the environment where the regulatory process involves procedures for protection of the environment. Construction activities and relaxation of standards allowing environmental degradation are not included in this exemption.

- Class 7 consists of actions taken by regulatory agencies as authorized by state law or local ordinance to assure the maintenance, restoration, or enhancement of a natural resource where the regulatory process involves procedures for protection of the environment. Examples include but are not limited to wildlife preservation activities of the State Department of Fish and Game. Construction activities are not included in this exemption.

An exemption is justified because no standards will be relaxed to allow environmental degradation and there is no reasonable possibility that the investigative projects or activities will have a significant negative effect on the environment. Therefore, this action is also exempt from CEQA provisions in accordance with section 15061(b)(3) of Article 5, Chapter 3, Title 14 of the California Code of Regulations because it can be seen with certainty that there is no possibility that the activity in question may have a significant negative effect on the environment. CEQA will be complied with as necessary by individual parties when and if remedial actions are proposed.

In addition, this TMDL meets the requirements of PRC section 21080.56, as the project is specifically to conserve, restore, protect, or enhance, and assist in the recovery of California native fish and wildlife, and the habitat upon which they depend. This TMDL meets all requirements under PRC section 21080.56(a)-(d). The San Diego Water Board may obtain the concurrence of the Director of Fish and Wildlife to invoke this statute.

13.4. Stakeholder and Public Participation

Opportunities for stakeholders and the public to participate in the TMDL process began in 2022. A Public Workshop to discuss this TMDL Report will be held 2022. The public will be provided with a minimum 90-day comment period. The public will be provided the opportunity to give the San Diego Water Board oral testimony during a Public Meeting for consideration of adoption of a Resolution to certify the TMDL.

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