APPENDIX H

LAKE WOHLFORD DAM REPLACEMENT PROJECT WATER QUALITY TECHNICAL REPORT

Draft Water Quality Technical Report

Lake Wohlford Dam Replacement Project

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Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

°F	degrees Fahrenheit
AGR	agricultural supply
AMSL	above mean sea level
Bear Valley HGF	Bear Valley Hydroelectric Generating Facility
BMP	best management practice
cfs	cubic feet per second
City	City of Escondido
COLD	Cold Freshwater Habitat
CWA	Clean Water Act
DPP	design pollution prevention
DSOD	Division of Safety of Dams
DWR	Department of Water Resources
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Federal Insurance Rate Map
HA	Hydrologic Area
HMP	Hydromodification Management Plan
HSA	hydrologic sub area
HU	Hydrologic Unit
JURMP	Jurisdictional Urban Runoff Management Plan
LID	low-impact development
ml	milliliter
MUN	municipal and domestic supply
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
PMF	Probable Maximum Flood
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
POW	Hydropower Generation
proposed project	Lake Wohlford Dam Replacement Project
RCC	roller-compacted concrete
REC-1	Contact Recreation
REC-2	Non-contact Recreation
RWQCB	Regional Water Quality Control Board
SDCWA	San Diego County Water Authority
SFHA	Special Flood Hazard Area
SUSMP	Standard Urban Stormwater Mitigation Plan
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board

TDS	total dissolved solids
TMDL	total maximum daily load
USACE	US Army Corps of Engineers
WARM	Warm Freshwater Habitat
WDR	waste discharge requirement
WILD	Wildlife Habitat
WQTR	Water Quality Technical Report
WQO	water quality objective

Executive Summary

This Water Quality Technical Report (WQTR) discusses the Lake Wohlford Dam Replacement Project (proposed project) relative to the environmental setting of the project area and the regulatory framework with respect to water quality. It also characterizes the quality of surface water and groundwater resources within the proposed project area based on available information, describes existing water quality impairments and beneficial uses, identifies potential water quality impacts and benefits associated with the proposed project, and recommends avoidance and minimization measures for potentially adverse impacts.

The proposed project would include dam replacement to alleviate public safety and flooding concerns due to seismic instability of the existing dam and to restore municipal water-storage capacity in Lake Wohlford. The proposed project area is located in San Diego County, along Escondido Creek in the City of Escondido.

The proposed project is within the jurisdiction of the San Diego Regional Water Quality Control Board (Region 9) and is located within the Escondido Creek Hydrologic Area within the Carlsbad Hydrologic Unit (HU). Inland surface waters and groundwater within the Carlsbad HU have water quality objectives for total dissolved solids (TDS), chloride, sulfate, percent sodium, nitrate, nitrogen, phosphorus, iron, manganese, methylene blue activated substances, boron, turbidity, color, and fluoride.

Escondido Creek is included on the 2010 Clean Water Act Section 303(d) list of impaired water bodies (State Water Resources Control Board [SWRCB] 2011). Escondido Creek has been listed as impaired by Dichlorodiphenyltrichloroethane, enterococcus, fecal coliform bacteria, manganese, phosphate, selenium, sulfates, TDS, nitrogen, and toxicity. Sources include unknown point and nonpoint sources and urban runoff/storm sewers. Total maximum daily load action plans for these pollutants have not been completed yet and are scheduled for completion in 2019.

Project construction has the potential to cause short-term and temporary impacts from the generation of pollutants such as sediment/turbidity, metals, soil stabilization residues, oil and grease, nutrients, organic compounds, and trash and debris. A Storm Water Pollution Prevention Plan (SWPPP), which is required for projects greater than 1 acre, would be prepared and implemented during construction of the proposed project to mitigate these potential impacts. The SWPPP would identify project-specific best management practices (BMPs) to be implemented during construction. Furthermore, BMPs implemented as part of the proposed project would meet the technology requirements as stipulated in the National Pollutant Elimination Discharge System Construction General Permit (SWRCB 2009). The proposed project would be required to meet all applicable water quality objectives for surface waters and groundwater of the Carlsbad HU.

Based on current project design, the proposed project would increase impervious area; however, peak flows would be reduced as compared to existing conditions. Thus, hydromodification effects (i.e., increased erosion and sediment transport from greater runoff flow) would not be expected to occur and hydromodification control facilities would not be required. However, project design elements would consider upgrades to drainage facilities and storm water treatment, as appropriate. The proposed project is required to implement design pollution prevention measures (permanent pollutant source control BMPs) and low-impact development designs to improve runoff water quality in compliance with the San Diego County Municipal Permit and the City's Jurisdictional Urban Runoff Management Plan (City of Escondido 2008) and Standard Urban Stormwater Mitigation Plan (City of Escondido 2011).

The proposed project would be required to comply with the measures specified in Section 5, Avoidance and Minimization Measures, of this WQTR. With proper and successful implementation of the identified measures, the project construction, design, and operation would comply with applicable storm water requirements.

Chapter 1. Introduction

The purpose of this Water Quality Technical Report (WQTR) is to discuss the potential water quality impacts and benefits associated with the construction and operation of the proposed Lake Wohlford Dam Replacement project (proposed project), and to recommend avoidance and minimization measures for potentially adverse impacts on water quality. The report also identifies temporary and permanent storm water best management practices (BMPs) that would be implemented during project construction to mitigate runoff impacts associated with the construction of the dam replacement.

1.1. Project Location

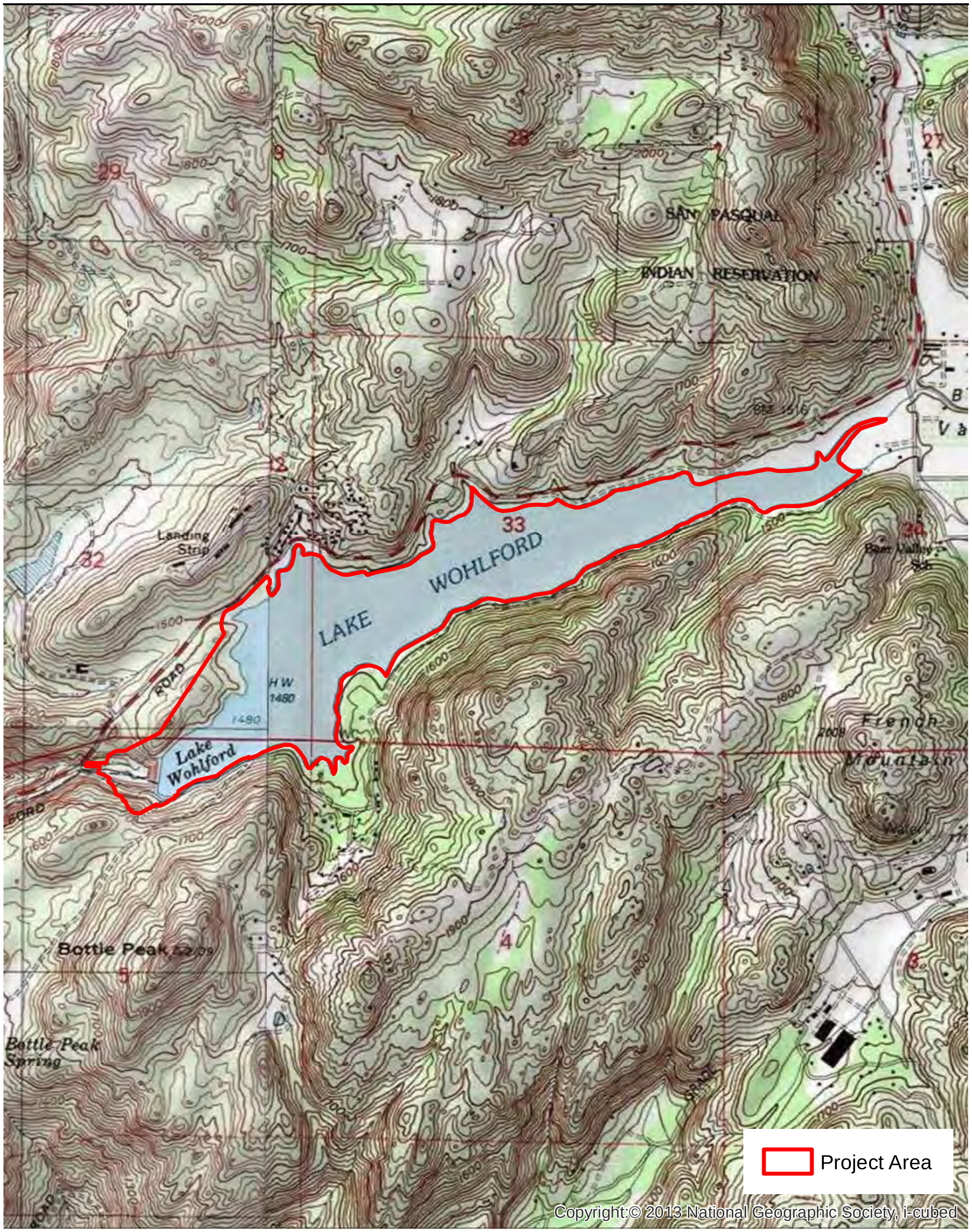
The proposed project area is located in unincorporated San Diego County approximately 7 miles east of Interstate 15 (Figure 1). Lake Wohlford is located along Escondido Creek, northeast of the jurisdictional limits of the City of Escondido (City). Figure 2 shows the proposed project area boundary and surrounding features for the dam replacement location.

1.2. Project Description

Lake Wohlford is a man-made reservoir owned and operated by the City. The reservoir is formed by Lake Wohlford Dam, which is a 100-foot-high embankment dam composed primarily of rock fill on the downstream side and hydraulically placed fill on the upstream side. Lake Wohlford, located along Escondido Creek, is filled by runoff from its 7.3-square-mile drainage area, as well as water released from Lake Henshaw reservoir, which is diverted from the San Luis Rey River through the 13-mile-long Escondido Canal.

Lake Wohlford Dam was originally constructed of rock fill in 1895 at a height of approximately 76 feet, creating an important component of the City's initial municipal water supply. In 1924, the City enlarged the dam using hydraulic fill, pumping earth from the lake bottom through a pipe and placing this material on the downstream side of the existing dam. The enlargement of the dam increased the dam's height to 100 feet and expanded Lake Wohlford's storage capacity to serve the City's growing population (GEI Consultants, Inc. 2010). When the water level is at the existing spillway crest elevation of 1,480 feet above mean sea level (AMSL), the dam has a storage capacity of approximately 6,500 acre-feet and covers a surface area of approximately 225 acres. The reservoir's beneficial uses include municipal and agricultural water supply; flood control; non-contact water recreation, including fishing; and wildlife habitat.

Figure 1
Regional Map



Source: USGS 7.5' Topo Quads Rodriguez Mtn 1988 and Valley Center 1975

2,000 1,000 0 2,000 Feet

Scale: 1 = 24,000 1 inch = 2,000 feet

Figure 2
Project Vicinity

Path: P:\2012\60278081_Lk_Wohlford\06GIS\6.3_Layout\WQTR\VicinityMap.mxd, 1/13/2015, janssenn

Most of the water released from Lake Wohlford passes through the Wohlford Penstock to the Bear Valley Hydroelectric Generating Facility (Bear Valley HGF), which is operated by the City under a license granted by the Federal Energy Regulatory Commission (FERC) (Escondido Project, FERC No. 176) and generates electricity that is sold to San Diego Gas & Electric. After passing through the Bear Valley HGF, the Lake Wohlford water is transported to the Escondido-Vista Water Treatment Plant, where it is treated and distributed to the City's municipal customers. Due to the connection to the hydroelectric facility, FERC has regulatory involvement in matters pertaining to Lake Wohlford, including seismic safety. The California Department of Water Resources, Division of Safety of Dams (DSOD) also regulates the safety of the dam under Division 3 of the California Water Code.

1.3. Purpose and Need

A seismic analysis of the dam, conducted in 2007 in compliance with a directive from FERC, identified a stability concern for the portion of the dam that was raised in 1924. The 2007 report concluded that the method used to place the hydraulic fill during the dam raise, in addition to its placement overtop of new lake-bottom sediment that had accumulated at the base of the rock fill dam, resulted in inconsistency of the fill material's coarseness and created conditions where the fill could liquefy during a strong earthquake on the Elsinore Fault. Liquefaction of the fill material could result in a structural failure of the dam's upstream slope, including the material that was raised above the elevation of the original rock fill dam (GEI Consultants, Inc. 2007). This failure could, in turn, cause flood inundation downstream in Escondido Creek and lead to public safety concerns.

Based on the results of the analysis and report recommendations, FERC directed the City to reduce the Lake Wohlford reservoir level to 1,460 feet AMSL, which is 20 feet below its prior spillway crest elevation. This level corresponds to the top of the relatively stable downstream rock fill section of the dam. The City reduced the reservoir's water level decreasing the reservoir's capacity to approximately 40 percent of its prior capacity, and has continued to maintain that lowered level. To alleviate seismic safety concerns with the existing dam and regain the Lake Wohlford reservoir's lost water storage capability for the City's municipal water system, the City is planning to construct a replacement dam immediately downstream (west) of the existing dam and deconstruct the problematic portion of the existing dam. The proposed dam design is the result of an exhaustive engineering analysis conducted since 2008 that considered and compared several alternatives for their feasibility, safety, longevity, environmental impact, and cost.

1.4. Project Objectives

The project is intended to achieve the following primary objectives:

1. Alleviate public safety and flooding concerns due to seismic instability of the existing Lake Wohlford Dam.

2. Restore the City's municipal water-storage capacity in Lake Wohlford to its historic capacity of 6,500 acre-feet.

3. Restore water level in Lake Wohlford to previous levels and support fishing and other water-dependent recreational opportunities.

4. Provide a dam facility with a life expectancy of 100 years.

5. Minimize the project's temporary and long-term impact on the environment.

1.5. Project Characteristics

The proposed project entails constructing a replacement dam immediately downstream (west) of the existing dam and partially deconstructing the existing dam by removing the hydraulic fill material that is at a higher elevation than the original rock fill. The replacement dam would feature an outlet tower that is integrated into the dam's upstream face; the top of the existing outlet tower would be demolished, and the bottom of the existing outlet tower and the outlet pipe would be abandoned in place. To accommodate the replacement dam's configuration, the proposed project also entails realignment of the portion of Oakvale Road that passes the southern dam abutment. This portion of the road would be realigned south of its current location, requiring excavation into the adjacent hillside.

The replacement dam would be constructed so the resultant reservoir level and storage capacity are equal to the elevation and capacity prior to the water level restriction, at 1,480 feet AMSL and 6,500 acre-feet, respectively. The proposed project recommends no changes to Lake Wohlford's historic high water level or storage capacity.

The following sections present additional detail on the proposed project components and a discussion of anticipated construction methods and construction activity.

1.5.1. Project Components

Replacement Dam

The replacement Lake Wohlford Dam would be constructed immediately downstream of the existing dam, with the replacement dam's crest approximately 200 feet downstream of the existing dam's crest. The replacement dam's crest would rise approximately 125 feet above the foundation grade, to an elevation of 1,490 feet AMSL, and the crest would span approximately 650 feet from the right (north) abutment to the left (south) abutment. The dam crest would feature a pedestrian and vehicle access path with a pedestrian access bridge constructed over the spillway. This access would be for maintenance purposes only and would not be open to the public. Based on DSOD requirements, the dam is being designed to handle site-specific seismic conditions based on a maximum magnitude 7.64 earthquake occurring on the Elsinore Fault, which is approximately 11 miles east of the proposed project site.

The dam would be constructed of roller-compacted concrete (RCC), which is a modern method of placing mass concrete for gravity dams that has recently been employed by the San Diego County Water Authority (SDCWA) for construction of its Olivenhain Dam and San Vicente Dam Raise projects. This method utilizes the materials of conventionally placed concrete (cement, coarse aggregate, sand, and water), but minimizes the water content to allow material handling with conventional soil-placing methods. RCC is placed using conveyors, dump trucks, dozers, and roller compactors. Like engineered soil placement, RCC is placed in thin layers starting from the base of the dam (usually 12 inches thick), as opposed to conventionally placed mass concrete, which is poured in large sections that are typically 5 feet thick (SDCWA 2008). The RCC method reduces water content such that the mix is dry enough to prevent roller equipment from sinking, but wet enough to permit adequate distribution of the material in each layer. Approximately 100,000 cubic yards of RCC concrete are anticipated to be placed to form the dam.

A drainage gallery would be installed during construction of the dam. The gallery is designed to be 8 feet wide by 10 feet high, with a floor elevation of 1,400 feet AMSL.

Dam Foundation

Material would be excavated from the downstream canyon floor and rocky slopes to create a solid foundation and suitable surfaces to place the abutments. Preliminary location and depth of the foundation have been identified using the results of geotechnical investigation, and the preliminary foundation has been designed such that all soil, decomposed rock, and rock that is generally excavated using large earthwork equipment would be removed, leaving solid bedrock for placing the dam's foundation. Consolidation grouting would be provided to ensure a more uniform foundation modulus for support of the dam. A double-row grout curtain would be installed in the foundation to strengthen the foundation and reduce seepage.

Approximately 59,520 cubic yards of earth and rock are anticipated to be excavated for establishment of the dam foundation. Due to its high quality, reuse of the rock is anticipated and disposal at a landfill is unlikely. It is anticipated that the excavated material would be hauled off site for reuse, with the contractor having the option of selling the excess material to a nearby quarry for processing and reuse as aggregate.

Spillway, Stilling Basin, and Outlet Tower

A spillway would be constructed in the center of the dam, built of cast-in-place concrete, with an elevation of 1,480 feet AMSL. The dam's central spillway has been designed to handle the maximum storm events approved by FERC, including the General Storm "All Season" Probable Maximum Flood (PMF) and the Local Storm PMF. The spillway is designed to flow into an energy dissipation stilling basin at the downstream foot of the dam, constructed of reinforced concrete, which catches water that overtops the dam before it discharges into the downstream river channel. The spillway would be stepped on the dam's downstream slope to dissipate energy along the entire spillway length and reduce the stilling basin size at the end of the spillway. The stilling basin would be approximately 90 feet wide by 85 feet long. Riprap would be installed at the transition from the stilling basin to the existing channel to prevent erosion and protect the stilling basin.

A new outlet tower would be constructed on the upstream side of the dam, built as a cast-in-place, reinforced concrete structure anchored to the dam's face and extending to the dam crest at elevation of 1,490 feet AMSL. The outlet tower would be connected to the proposed dam's downstream emergency release valve and appurtenances located on the south side of the new stilling basin and spillway. Releases would be projected into the stilling basin for discharge to Escondido Creek. The emergency release valve would enable reservoir water releases in the event of a dam safety event, in accordance with DSOD requirements that 10 percent of the reservoir could be released in 7 days. The proposed outlet would be capable of draining the entire reservoir contents within 90 days.

Oakvale Road Improvements

Oakvale Road skirts a steep rock face just southwest of the existing left abutment of the existing dam and conflicts with the proposed location for the replacement dam's left abutment. The proposed project entails realigning approximately 1,200 feet of the road toward the south and straightening the road. To create enough of a surface that would accommodate the realignment, the project requires excavation into the hillside to the south at a slope of 0.75:1 (horizontal:vertical) and removal of approximately 56,000 cubic yards of rock and earth. The maximum height of the proposed finished slope is 110 feet, though much of the slope would be shorter. A 30-foot-wide work area is assumed around grading areas to enable equipment access.

The excess materials would be hauled off site for reuse, with the contractor having the option of selling the excess material to a nearby quarry for processing and reuse as aggregate. Due to its quality, reuse of the rock is anticipated and disposal at a landfill is unlikely. It is anticipated that the material would be sold and hauled to a nearby quarry.

The new road would be constructed to San Diego County standards and would be 28 feet wide, including two 12-foot lanes and 2-foot paved shoulders, with a 10-foot non-motorized lane constructed on the downhill (northern) side. Drainage improvements would include reconstruction of a storm drain beneath the western end of the roadway improvements, and a new 18-inch storm drain beneath the road on the eastern side of the proposed project limits. A brow ditch would be constructed at the top of the slope that would divert storm flows down the slope. The brow ditch on the western side would carry water to an existing ditch situated at the toe of the slope along the road's southern edge and into a storm drain that flows beneath the road. This storm drain is located at the far western end of the roadway improvements and would be reconstructed as part of the proposed project. The brow ditch on the eastern side would carry water to a proposed storm drain that would be constructed beneath the road and empty into an earthen swale on the northern side of the road.

These Oakvale Road improvements are being permitted separately from the Lake Wohlford Dam Replacement project.

1.5.2. Construction Activity and Temporary Features

This section describes the temporary activities that would occur during project construction and the temporary features required to construct the proposed project. Many aspects of project construction would be subject to the discretion of the contracting team that is selected to do the work. This section is based on assumptions of likely scenarios for construction work, as indicated by the proposed project's design engineers and their construction management team.

Foundation Development

Excavation of the dam's foundation and the adjacent slopes for placement of the abutments would begin with tree removal and vegetation clearing from the downstream work area and side slopes. Earth and rock would be removed from the dam foundation zone and rock would be scaled from the slopes using backhoes, loaders, and dozers staged from the area downstream of the existing dam. In areas where large rocks cannot be easily moved by a backhoe, the proposed project would entail blasting and hydraulic splitting. Identification of a suitable foundation would be performed by an experienced, licensed engineering geologist, with the approval of DSOD and FERC, and would be deemed adequate when rock is reached that is too hard to excavate with large equipment; when rock joints are generally slightly weathered or less; and when the surface is rough and generally level in an upstream to downstream direction.

The entire foundation surface would be cleaned by barring and prying loose rock, using an air/water jet to remove as much loose material as possible. The contractor would be required to prepare a detailed work plan to identify potential hazard areas and specify appropriate protective actions ensuring safe conditions. Foundation and side slope excavation would require blasting and hydraulic drilling, which also would be addressed in the contractor's work plan.

A double-row grout curtain would be installed in the foundation to strengthen the foundation and reduce seepage. Grout would be used to fill open fractures, voids, and irregularities within the rock foundation, reducing secondary permeability and providing more homogeneous foundation conditions.

Consolidation grouting would be performed to fill open cracks, joints and other geologic discontinuities below the foundation surface to provide more consistent and predictable foundation conditions in the shallow zone. The consolidation grouting would improve the modulus of deformation of bedrock in the shallow dam foundation, helping to mitigate the chance for differential settlement that could result from the added stress increase to the shallow foundation due to construction. Consolidation grouting is the injection of grout from the rock surface at low pressures into an evenly spaced pattern of shallow grout holes (15 - 20 feet in depth for this dam) for the purpose of treating the near surface dam foundation and abutments.

Material from the foundation and abutment slopes would be temporarily stockpiled on site and then hauled to a nearby quarry. Based on current estimates of the excavation area, the amount of rock to be exported for this phase of work would be approximately 59,516 cubic yards, equating to approximately 5,952 truckloads of 10 cubic yards each. It is estimated that approximately 960 cubic yards would be excavated in each work day during this phase of the proposed project, resulting in 96 haul trips per day. It is estimated this hauling would occur over a 9-week period. The destination of excavated material would ultimately be determined by the contractor; however, it is anticipated that haul trucks would travel from the project site through Escondido to Interstate 15.

Dam Construction

Once the foundation is completed, consecutive layers of RCC would be placed to form the dam structure. The RCC placement method is described above in Section 1.5.1. This phase of project construction is anticipated to involve 24-hour work (weather permitting) to maximize the effectiveness of placing the RCC layers.

Project engineers are in the process of developing an RCC mix design appropriate for this project, and initially considered both on-site aggregate sources (e.g., materials that would be excavated from the dam foundation) and off-site sources from local quarries. Due to limited space available in the proposed project work areas and staging areas, the project engineers determined it would be more feasible to use an off-site source. Accordingly, the proposed project would entail hauling of concrete materials to the proposed project site. Project engineers estimate the 100,000 cubic yards of RCC would require 175,000 tons of aggregate material, 9,250 tons of fly ash, and 8,750 tons of cement, or a total of 193,000 total tons of RCC material that would need to be delivered to the site. Assuming a 25-ton capacity per 20-cubic yard truck, hauling of RCC materials is anticipated to require 7,720 total truck trips. This hauling is anticipated to be distributed over approximately 13 weeks during the 4- to 5-month period of dam construction.

A batch mixer would be established at the primary staging yard located at the Lake Wohlford Marina. Concrete would be mixed at the staging yard and then transported to the dam construction area via the access road to the right abutment, which is discussed below. RCC can be transported via truck or conveyor, or some combination of the two, and the project engineers intend to maintain flexibility in the transport mode, giving the contractor the option of establishing a conveyor or using trucks. However, the project design is likely to include a conveyor system for transporting material along the access road and placing the material onto the dam. This would minimize the amount of equipment traveling on and off of the lift surface to prevent contamination of the material, minimize lift joint cleaning, and increase the shear strength between successive lifts. Conveyor operation would also limit the number of on-site hauling trips. Truck hauling is unlikely due to limited space available for haul trucks to pass each other and turn around. Therefore, it is anticipated that RCC material would be transported along the access road via conveyor.

Construction of the new outlet tower would occur while the existing dam is still in place, so no cofferdams or in-the-wet construction would be required.

Staging Yards and Construction Work Areas

The primary staging area for project construction is anticipated to be located at the Lake Wohlford Marina and on the adjacent lakeshore area to the west (Marina staging area) (Figure 3). A screened chain-link fence would be installed around the staging yard to prevent trespassing and to minimize visual disturbance to users of Lake Wohlford Road and the community to the north. Lake Wohlford and the Lake Wohlford Marina are planned to remain open to the public during project construction, with the exception of the existing dam demolition, during which the reservoir and marina would be closed due to additional reservoir drawdown.

An additional area of construction staging and project construction activity would also occur in the canyon immediately downstream of the dam. Establishment of this downstream staging and work area would require removal of vegetation, including mature oak trees, rock removal, and grading to create level surfaces and usable space for equipment movement and temporary stockpiling of excavated materials.

Permanent Access Road

To enable worker and material access from the Marina staging area to the dam construction zone, the proposed project entails construction of a permanent access road northeast of the existing dam (Figure 3). This would require some excavation into the hillside to create a level surface for installation of the road. The road would remain following construction. The road has been designed to fully avoid several cultural resources sites recorded in the area, based on input from the archaeological research and field survey. Public access to this road would be prohibited through the use of fencing, a gate, and other means.

Flood Control and Temporary Outlet Bypass

Lake Wohlford would remain at its current water level, between 1,450 and 1,460 feet AMSL, during project construction, and the existing dam would serve as the cofferdam during construction of the replacement dam. Flood protection during the construction period would be provided by releases through temporary pumps provided by the contractor. Hydraulic model runs performed by the project design team indicate that, by maintaining reservoir levels at or below 1,460 feet AMSL and by allowing releases through the temporary pumps, Lake Wohlford can accommodate the Local Storm PMF and all smaller storm events, including the 100-year event.

Demolition of Existing Dam and Existing Outlet Tower

After completion of the new dam construction, the hydraulic fill portion of the existing dam would be removed down to 1,450 feet AMSL. A notch would be constructed in the existing dam to 1,420 feet AMSL to allow full flow access from the reservoir to the new outlet tower. The left abutment of the existing dam would be removed in its entirety to existing natural grade. Excavation quantity for the existing dam removal is estimated at approximately 37,100 cubic yards, which would require 3,710 truck trips in 10-cubic-yard trucks. This hauling is anticipated to entail approximately 96 haul trips per day over an approximately 6-week period.

The City intends to issue a bid alternative for this construction contract that would involve full removal of the existing dam. This would require additional drawdown of the reservoir, and additional excavation and off-hauling of material. The full demolition excavation is estimated at 22,000 additional cubic yards beyond that described above for the top part of the dam, for a total of 59,100 cubic yards of excavated material that would be hauled off site. Off-hauling of this material would extend the number of days of 96 haul trips by another 3 weeks.

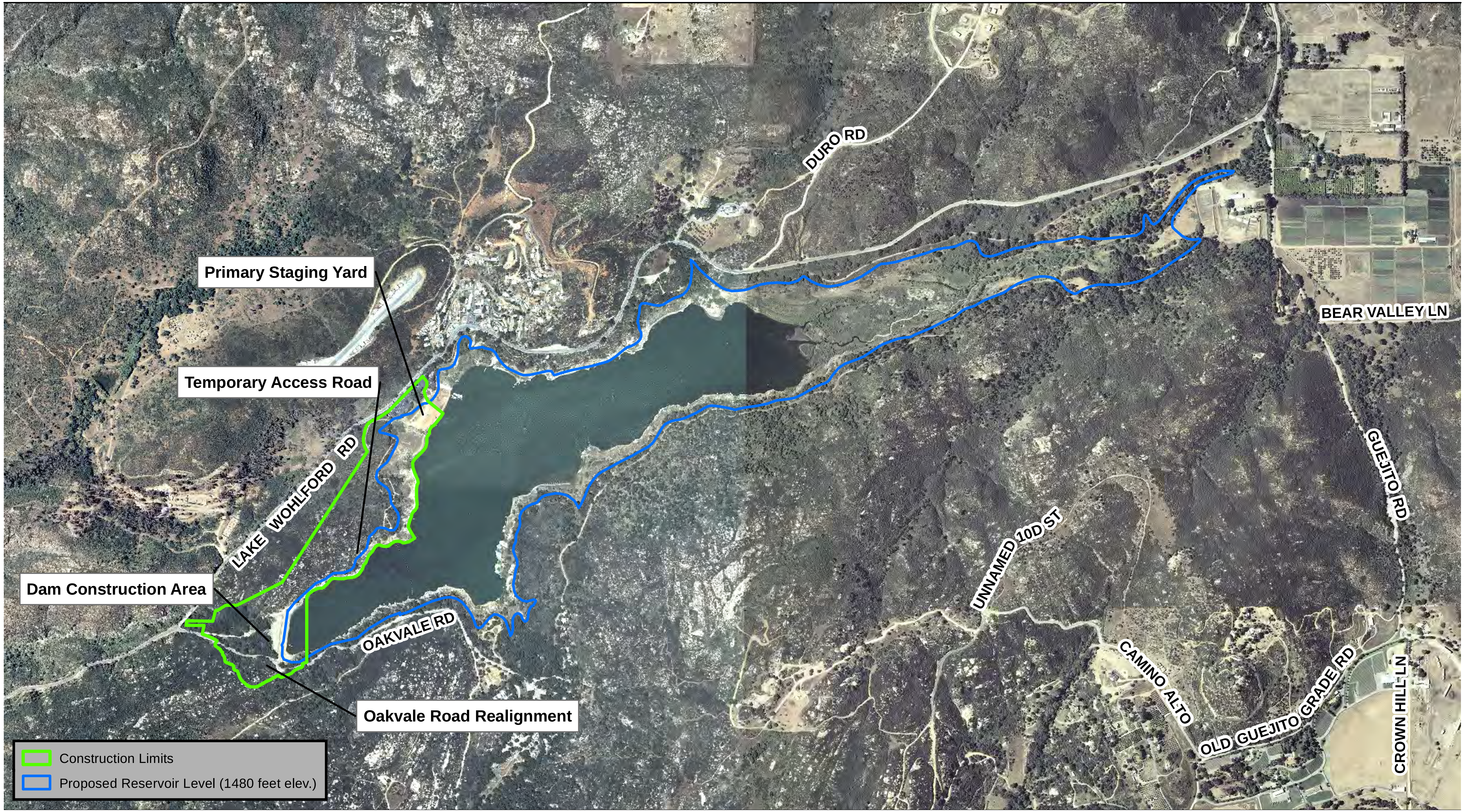
The existing outlet tower east of the dam would be demolished above 1,442 feet AMSL and the material would be removed. Below 1,442 feet AMSL, the existing outlet tower would be filled and abandoned in place. The outlet tunnel leading to the existing dam would also be filled and abandoned in place.

Schedule

Total project construction, including contractor mobilization and demobilization, is expected to require approximately 16 months. Excavation of the foundation is anticipated to take 2 to 3 months. Establishment of the access road is anticipated to take 1 to 2 months. The dam raise construction is anticipated to take 5 months.

1.5.3. Drainage Facility Improvements and Best Management Practices

The proposed dam replacement work would increase impervious surface area and alter existing drainage patterns; however, peak flows into Escondido Creek would be reduced compared to existing conditions. Drainage improvements would include reconstruction of



Source: SanGIS 2012; Black & Veatch 2014; USGS 2013

1,000 500 0 1,000 Feet

Scale: 12,000; 1 inch = 1,000 feet

Figure 3
Project Overview

Path: P:\2012\60278081_Lk_Wohlford\06GIS\6.3_Layout\WQTR\ProjectOverview.mxd, 1/22/2015, janssenn,

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storm drains and construction of brow ditches to divert downslope drainage. Storm drains would empty into earthen swales via riprap outlets to slow runoff velocities and prevent scour. In addition, the project's new spillway would be designed to flow into an energy dissipation stilling basin. Riprap would also be installed at the transition from the stilling basin to the existing channel to prevent erosion.

Temporary construction soil stabilization and sediment-control BMPs would be implemented under a contractor-prepared Storm Water Pollution Prevention Plan (SWPPP). As determined by site conditions, weather, and contractor preference, temporary construction BMPs may include check dams, straw bales, fiber rolls, hydraulic mulch, and sediment traps. A description of anticipated BMPs and other design features to avoid and minimize adverse water quality impacts is provided in Section 5, Avoidance and Minimization Measures.

It is anticipated that permanent erosion control measures, such as hydroseed or mulch, would be applied to all disturbed areas. When no longer necessary, temporary access roads would be regraded to conform to the existing contours and would be stabilized.

1.6. Approach to the Water Quality Assessment

This WQTR addresses potential impacts on surface water quality and groundwater resources that may result from implementation of the preferred alternative. A regulatory framework is first presented, outlining water quality compliance needs, which is further supported by local surface water and groundwater resources data as well as water quality impairment and beneficial use information, to assess potential water quality impacts and benefits associated with the proposed project. Furthermore, relative to anticipated potential water quality impacts, avoidance and minimization measures to reduce such impacts are recommended.

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Chapter 2. Regulatory Setting

The various laws and regulations described in this section protect surface water quality and hydrology by establishing water quality compliance standards and waste discharge requirements (WDRs). These mandates require implementation of a number of design, construction, and operational controls for proper storm water runoff management and water quality treatment and protection.

2.1. Federal Laws and Requirements

2.1.1. Clean Water Act

The federal Clean Water Act (CWA) of 1972 is the basic federal law that addresses surface water quality control and protection of beneficial uses of water. The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters through prevention, reduction, and elimination of pollution. The CWA applies to discharges of pollutants into waters of the U.S. The CWA establishes a framework for regulating storm water discharges from municipal, industrial, construction, and other activities under National Pollutant Discharge Elimination System (NPDES) regulations. In California, the State Water Resources Control Board (SWRCB) administers the NPDES program. The following CWA sections are most relevant to regulation of surface water in the project area.

2.1.1.1. CWA Section 303(d)

CWA Section 303 requires states to adopt water quality standards for all surface waters of the U.S. As defined by the CWA, water quality standards consist of four elements:

- designated beneficial uses of water bodies,
- water quality criteria to protect designated uses,
- an anti-degradation policy to maintain and protect existing uses and high-quality waters, and
- general policies addressing implementation issues.

Under CWA Section 303(d), states, territories, and authorized tribes are required to develop a list of water bodies that are considered to be "impaired" from a water quality standpoint. Water bodies that appear on this list either do not meet or are not expected to meet water quality standards, even after the minimum required levels of pollution control technology have been implemented to reduce point-source discharges. The law requires that respective jurisdictions establish priority rankings for surface water bodies on the list and develop action plans, referred to as total maximum daily loads (TMDLs), to improve water quality. A TMDL is a calculation of the maximum amount of a specific pollutant that a water body can receive and still meet federal water quality standards as provided in the CWA (EPA 2012). TMDLs account for all sources of pollution, including point sources, nonpoint sources, and natural background sources.

The CWA Section 303(d) list of impaired water bodies provides a prioritization and schedule for development of TMDLs for states. The SWRCB, in compliance with CWA Section 303(d) publishes the list of water quality-limited segments in California, which includes a priority schedule for development of TMDLs for each contaminant or "stressor" affecting the water body (SWRCB 2011).

2.1.1.2. CWA SECTION 401

Every applicant for a federal permit or license for any activity that may result in a discharge to a water body must obtain a CWA Section 401 Water Quality Certification for the proposed activity and must comply with state water quality standards prescribed in the certification. In California, these certifications are issued by the SWRCB under the auspices of nine regional water quality control boards (RWQCBs). Most certifications are issued in connection with CWA Section 404 U.S. Army Corps of Engineers (USACE) permits for dredge and fill discharges.

2.1.1.3. CWA SECTION 402

CWA Section 402 sets forth regulations that prohibit the discharge of pollutants into waters of the U.S. from any point source without first obtaining an NPDES Permit. The SWRCB and nine RWQCBs administer the NPDES Permit program. The SWRCB implements the NPDES and the state's water quality programs by regulating point-source discharges of wastewater and agricultural runoff to land and surface waters to protect their beneficial uses. To comply with the CWA water quality regulations, nine RWQCBs in California develop and enforce water quality objectives and implementation plans, issue waste discharge permits, take enforcement action, and monitor water quality within their hydrologic areas.

Permitting the construction or modification of outfall structures, where the discharged effluent is authorized or otherwise complies with an NPDES Permit, also is governed under Nationwide Permit #7, requiring the permittee to submit a pre-construction notification to the district USACE engineer before beginning any project activity.

Although the NPDES Permit program initially focused on point source discharges of municipal and industrial wastewater that were assigned individual permits for specific outfalls, results of the Nationwide Urban Runoff Program identified contaminated storm water as one of the primary causes of water quality impairment. To regulate runoff-related (nonpoint source) discharges, the U.S. Environmental Protection Agency (EPA) developed a variety of general NPDES Permits for controlling industrial, construction, and municipal storm water discharges.

2.1.1.4. CWA Section 404

CWA Section 404 establishes a permit program, administered by USACE, regulating discharge of dredged or fill materials into waters of the U.S., including wetlands. Activities in waters of the U.S. that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. CWA Section 404 permits are issued by USACE.

Under CWA Section 404(e), USACE can issue general permits to authorize activities that have minimal individual and cumulative adverse environmental effects. General permits can be issued for a period of no more than 5 years. USACE can issue nationwide permits, which is a general permit that authorizes activities across the country, unless revoked by a district or division commander. Nationwide permits authorize a wide variety of activities such as linear transportation projects, residential development, commercial and industrial developments, utility lines, road crossings, bank stabilization activities, wetland and stream restoration activities, and certain maintenance activities. Two new nationwide permits were added in 2012 to evaluate land-based and water-based renewable energy proposals in support of U.S. clean energy initiatives.

2.1.2. Federal Antidegradation Policy

The Federal Antidegradation Policy has been in existence since 1968. The policy protects existing uses, water quality, and national water resources. It directs states to adopt a statewide policy that includes the following primary provisions:

- maintain and protect existing instream uses and the water quality necessary to protect those uses;
- where existing water quality is better than necessary to support fishing and swimming conditions, maintain and protect water quality unless the state finds that allowing lower water quality is necessary for important local economic or social development; and

- where high-quality waters constitute an outstanding national resource, such as waters of national and state parks, wildlife refuges, and waters of exceptional recreational or ecological significance, maintain and protect that water quality.

2.1.3. Section 10 of the Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act, administered by USACE, prohibits the creation of any obstruction, excavation or fill, or any alteration or modification of any navigable water of the U.S. unless the work has been permitted by USACE (33 USC Section 403).

2.1.4. Executive Order 11988—Floodplain Management

Executive Order 11988 directs federal agencies to avoid, to the extent practicable and feasible, short- and long-term adverse impacts associated with the occupancy and modification of floodplains, and to avoid direct and indirect support of floodplain development wherever a practicable alternative exists. Each agency is responsible for reducing the risk of flood loss, minimizing the impact of floods on human safety, health, and welfare, and restoring and preserving natural and beneficial values served by flood plains.

The basic tools for regulating construction in potentially hazardous floodplain areas are local zoning techniques and Federal Emergency Management Agency (FEMA) floodplain mapping. The Federal Insurance Rate Map (FIRM) is the official map created and distributed by FEMA and the National Flood Insurance Program (NFIP) that delineates Special Flood Hazard Areas (SFHAs)—areas that are subject to inundation by a base flood—for every county and community that participates in the NFIP. FIRMs contain flood risk information based on historic, meteorological, hydrologic, and hydraulic data, as well as open-space conditions, flood control works, and development.

For projects that would, upon construction, affect the hydrologic or hydraulic characteristics of a flooding source, and thus would result in the modification of the existing regulatory floodway, effective Base Flood Elevations, or an SFHA, a conditional letter of map revision would need to be prepared and approved by the County of San Diego and FEMA before beginning any project construction activities.

2.1.5. National Flood Insurance Act

The National Flood Insurance Act of 1968 established the NFIP. The NFIP is a federal program administered by the Flood Insurance Administration of the FEMA. It enables individuals who have property within the 100-year floodplain to purchase insurance against flood losses. Community participation and eligibility, flood hazard identification, mapping, and floodplain management aspects are administered by state and local programs and support directorate within FEMA. FEMA works with the states and local communities to identify flood hazard areas and publishes a flood hazard boundary map of those areas.

2.1.6. Federal Wild and Scenic Rivers Act

The Federal Wild and Scenic Rivers Act was created to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Act protects the special character of these rivers, while also recognizing the potential for their appropriate use and development. It encourages river management that crosses political boundaries and promotes public participation in developing goals for river protection.

2.2. State Regulations and Policies

2.2.1. Porter-Cologne Water Quality Control Act

Division 7 of the California Water Code is the basic water-quality control law for California. This law, titled the Porter-Cologne Water Quality Control Act (Porter-Cologne Act) and enacted in 1969, establishes a regulatory program to protect water quality and beneficial uses of state waters.

The Porter-Cologne Act is California's comprehensive water quality control law and is a complete regulatory program designed to protect water quality and beneficial uses of the state's waters. It requires the nine RWQCBs to adopt water quality control plans (basin plans) for watersheds within their regions. These basin plans are reviewed triennially and amended as necessary by the RWQCBs, subject to the approval of the California Office of Administrative Law, SWRCB, and EPA. Moreover, pursuant to the Porter-Cologne Act, these basin plans become part of the California Water Plan when such plans have been reported to the legislature (California Water Code, Section 13141). The Porter-Cologne Act also regulates river or stream crossings during road, pipeline, or transmission line construction that may result in a discharge into a state water body that is not considered to be under USACE jurisdiction.

In some cases, a RWQCB may issue WDRs under the Porter-Cologne Act that define activities, such as the inclusion of specific features, effluent limitations, monitoring, and plan submittals that are to be implemented for protecting or benefiting water quality. WDRs can be issued to address both permanent and temporary discharges of a project.

2.2.2. Cobey-Alquist Flood Plain Management Act

The Cobey-Alquist Act encourages local governments to plan, adopt, and enforce land use regulations to accomplish floodplain management, in order to protect people and property from flooding hazards. This act also provides state financial assistance for flood control projects.

2.2.3. Statewide Construction General Permit

Dischargers whose projects disturb 1 or more acres of soil, or less than 1 acre but are part of a larger common plan of development that in total disturbs 1 or more acres, are required to obtain coverage under the SWRCB’s Order 2009-0009-DWQ (as amended by Orders 2010-0014-DWQ and 2012-0006-DWQ), known as the Construction General Permit (SWRCB 2009). Construction and demolition activities subject to this permit include clearing, grading, grubbing, and excavation, or any other activity that results in a land disturbance equal to or greater than 1 acre.

Permit applicants are required to submit a Notice of Intent to the SWRCB and to prepare a SWPPP. The SWPPP must identify BMPs that are to be implemented to reduce construction impacts on receiving water quality based on potential pollutants. The SWPPP also must include descriptions of the BMPs to reduce pollutants in storm water discharges after all construction phases are completed at a site (post-construction BMPs).

The Construction General Permit also includes requirements for risk-level assessment for construction sites, a storm water effluent monitoring and reporting program, rain event action plans, and numeric action levels for pH and turbidity.

2.2.4. California Wild and Scenic Rivers Act

The California Wild and Scenic Rivers Act was passed in 1972 to preserve designated rivers possessing extraordinary scenic, recreation, fishery, or wildlife values in their free-flowing state, together with their immediate environments, for the benefit and enjoyment of the people of the state.

2.3. Regional and Local Requirements

2.3.1. San Diego Regional Water Quality Control Board

As outlined above, the SWRCB carries out its water quality protection authority through the adoption of basin plans. These plans establish water quality standards for particular surface water bodies and groundwater resources.

The San Diego RWQCB (Region 9) is responsible for the basin plan for the San Diego Basin. The RWQCB implements management plans to modify and adopt standards under provisions set forth in Section 303(c) of the CWA and California Water Code (Division 7, Section 13240).

In addition to basin plan requirements, the RWQCB issues water quality certifications under CWA Section 401.

2.3.2. Water Quality Control Plan for the San Diego Basin (Basin Plan)

The basin plan for the San Diego Basin (RWQCB Region 9) establishes water quality objectives for constituents that could potentially cause an adverse effect or impact on the beneficial uses of water. Specifically, basin plans are designed to accomplish the following:

1. Designate beneficial uses for water bodies,
2. Set the narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to California's anti-degradation policy,
3. Describe implementation programs to protect the beneficial uses of all water in the region, and
4. Describe surveillance and monitoring activities to evaluate the effectiveness of the basin plans (RWQCB 1994).

The basin plans incorporate by reference all applicable SWRCB and RWQCB plans and policies.

The SWRCB and nine RWQCBs also regulate discharges to, and the quality of, groundwater resources through the issuance of WDRs. WDRs are issued for discharges that specify limitations relative to the basin plan (RWQCB 1994).

2.3.3. Total Maximum Daily Loads

CWA Section 303(d) mandates that states, territories, and authorized tribes develop a list of segments of water that do not meet water quality standards, even after pollution control technology has been implemented for point sources of pollution. RWQCBs are required to prepare the CWA Section 303(d) List of Water Quality Limited Segments Requiring TMDLs (SWRCB 2011) and submit it to SWRCB, who then is to submit it to EPA for final approval.

RWQCBs are required by law to establish TMDLs. These are action plans designed to improve the quality of water resources. As part of the TMDL process, municipalities must examine their water quality problems and identify sources of pollutants to create specific actions, designed to improve water quality.

Refer to Section 3.3.2, List of Impaired Waters, for a list of water quality impairments that are applicable to the project watershed.

2.3.4. San Diego County Municipal Storm Water Permit

Under Phase I of its storm water program, EPA published NPDES permit application requirements for municipal storm water discharges for municipalities that own and operate separate storm drain systems serving populations of 100,000 or more, or that contribute significant pollutants to waters of the U.S. The proposed project design would have to comply with requirements and measures outlined in Order R9-2013-0001 (Municipal Storm Water Permit) to minimize impacts to water quality and runoff hydrology for the construction and operational phases of the proposed project life.

The Municipal Storm Water Permit requires that each jurisdiction covered under the permit prepare a Jurisdictional Urban Runoff Management Plan (JURMP). Each of these JURMPs includes a component addressing construction activities, development planning, and existing development.

2.3.5. City of Escondido Jurisdictional Urban Runoff Management Plan

The goal of the City's JURMP (City of Escondido 2008) is to improve the quality of urban runoff so that local waterbodies are better protected. It addresses regulatory compliance needs for developing and implementing a Hydromodification Management Plan (HMP), which will be integrated into the City's Standard Urban Stormwater Mitigation Plan (SUSMP).

The City's JURMP is designed to reduce the discharge of pollutants in runoff to the municipal separate storm sewer system or surface waters during the three major phases of urban development:

1. Existing development
2. Planning
3. New development construction

To accomplish this, the City has implemented a strategic set of pollution prevention measures through various programs implemented by a number of City departments. These measures include:

- Monitoring water quality;
- Evaluating sites and activities associated with new development or redevelopment;
- Recommending controls, designs, and/or treatment needs to reduce potential pollutants;
- Educating the public about storm water issues; and
- Enforcing pollution prevention regulations.

2.3.6. Standard Urban Stormwater Mitigation Plan

In accordance with the provisions of the San Diego County Municipal Storm Water Permit, the City is required to implement storm water treatment requirements and criteria for controlling runoff from development projects.

The objectives of the City’s SUSMP (City of Escondido 2011) include the following:

- incorporate a unified low-impact development (LID) design procedure that integrates site planning and design measures with engineered, small-scale integrated management practices such as bioretention;

- develop a single integrated design that complies with requirements for LID, storm water treatment, and runoff peak-and-duration control (hydromodification management);

- provide guidance for proper implementation of LID facilities and design approaches, and

- provide guidance for conformance with regional hydromodification management requirements.

All development projects must include control measures to reduce the discharge of storm water pollutants to the maximum extent practicable. In general, all development projects must include:

- implementation of source-control BMPs;

- inclusion of some LID features that conserve natural features, set back development from natural water bodies, minimize imperviousness, maximize infiltration, and retain and slow runoff; and

- compliance with requirements for construction-phase controls on sediment and other pollutants for all phases of construction.

2.3.7. Hydromodification Management Plan

The Municipal Storm Water Permit requires the San Diego storm water co-permittees (the municipalities within the San Diego region as well as the County government) to implement an HMP "to manage increases in runoff discharge rates and durations from all priority development projects, where such increased rates and durations are likely to cause increased erosion of channel beds and banks, sediment pollutant generation, or other impacts to beneficial uses and stream habitat due to increased erosive force."

To address this permit condition, the co-permittees proceeded with developing an HMP that meets the intent of the Order as a part of their SUSMP. The Countywide Model includes the HMP as an appendix. The Order requires the co-permittees to develop an HMP for all priority development projects, with certain exemptions. The HMP must include standards to control flows within the geomorphically significant flow range. The HMP was prepared in 2009 and was finalized in January 2011 (County of San Diego 2011). This finalized plan supersedes all previous versions and criteria.

The HMP requires priority development projects to implement hydrologic control measures so that post-project runoff flow rates and durations do not exceed pre-project flow rates and durations where they would result in an increased potential for erosion or significant impacts to beneficial uses or violate the channel standard. The project proponent would have to:

(1) Demonstrate that there would be no net increase in impervious area and peak flow rates through incorporation of LID BMPs,

(2) Mitigate flow and duration of runoff by using extended detention basins,

(3) Prepare continuous simulation hydrologic models to compare pre-project and mitigated post-project runoff peaks and durations (with hydromodification flow controls), and/or

(4) Show that projected increases in runoff peaks and/or durations would not accelerate erosion by implementing in-stream rehabilitation controls (County of San Diego 2011).

Additionally, the County developed an LID handbook for guidance in the BMP selection process (County of San Diego 2014). Design techniques include minimizing impervious areas, conserving natural areas, and utilizing vegetation and landscaping for water quality treatment benefits.

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Chapter 3. Existing Conditions

This section discusses existing conditions in the proposed project vicinity, including water quality objectives and standards as well as current water quality issues associated with project-related receiving waters.

3.1. General Setting

The proposed project area is situated in the rural foothills of unincorporated San Diego County. The proposed project area is located along Escondido Creek in the City of Escondido within the North County Region approximately 30 miles (48 kilometers) north from downtown San Diego.

3.1.1. Population and Land Use

According to the U.S. Census Bureau, the population of Escondido was estimated at 148,738 in 2013 (U.S. Census Bureau 2013).

The majority of land uses in the vicinity of the proposed project area are made up of lake/reservoir/large pond and open space park or preserves. Other land uses include vacant and undeveloped land, rural residential, and mobile home park (Figure 4).

3.1.2. Site Topography

The topography at the proposed project location is a shallow valley ringed by rocky hills. Elevations of the proposed project area range from 1,384 to 1,712 feet AMSL. The average slope of the proposed project area is approximately 28 percent.

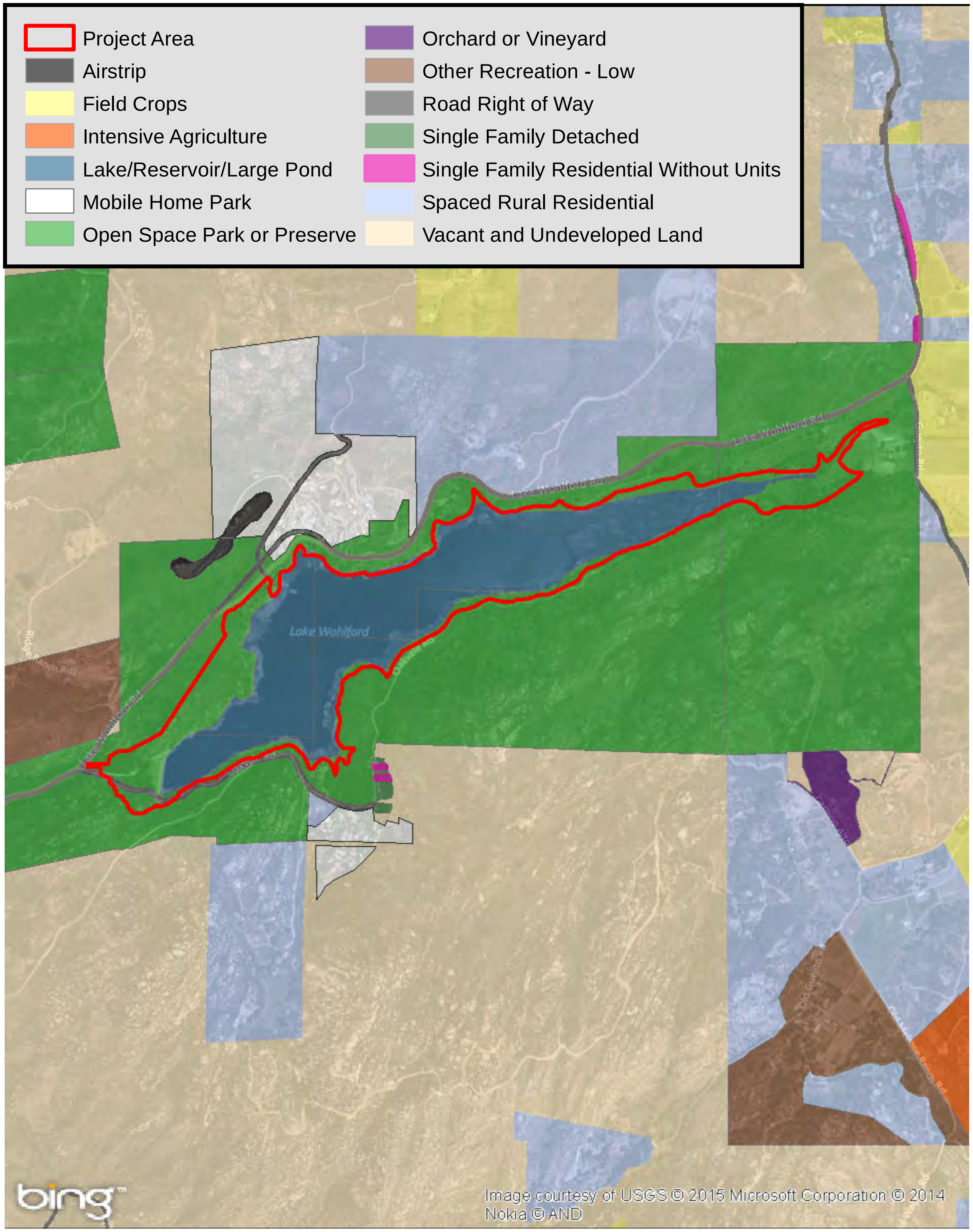
3.1.3. Impervious Surface

The area downstream of the existing dam (between the dam and Lake Wohlford Road) covers approximately 21 acres (0.032 square miles). This area is currently undeveloped; the majority of vegetation is dense brush with some trees. Currently, this area is approximately 4.5 percent impervious.

3.1.4. Staging Yards/Construction Work Areas

The primary staging area for project construction is anticipated to be located at the Lake Wohlford Marina and on the adjacent lakeshore area to the west (Marina staging area) (Figure 3).

An additional area of construction staging and project construction activity would also occur in the canyon immediately downstream of the dam. Establishment of this



Source: USGS 7.5' Topo Quads Rodriguez Mtn 1988 and Valley Center 1975

2,000 1,000 0 2,000 Feet

Scale: 1 = 24,000 1 inch = 2,000 feet

Figure 4
Land Use

Path: P:\2012\60278081_Lk_Wohlford\06GIS\6.3_Layout\WQTR\LandUse.mxd, 1/15/2015, janssenn downstream staging and work area would require removal of vegetation, including mature oak trees, rock removal, and grading to create level surfaces and usable space for equipment movement and temporary stockpiling of excavated materials.

3.1.5. Hydrology

3.1.5.1. Regional Hydrology

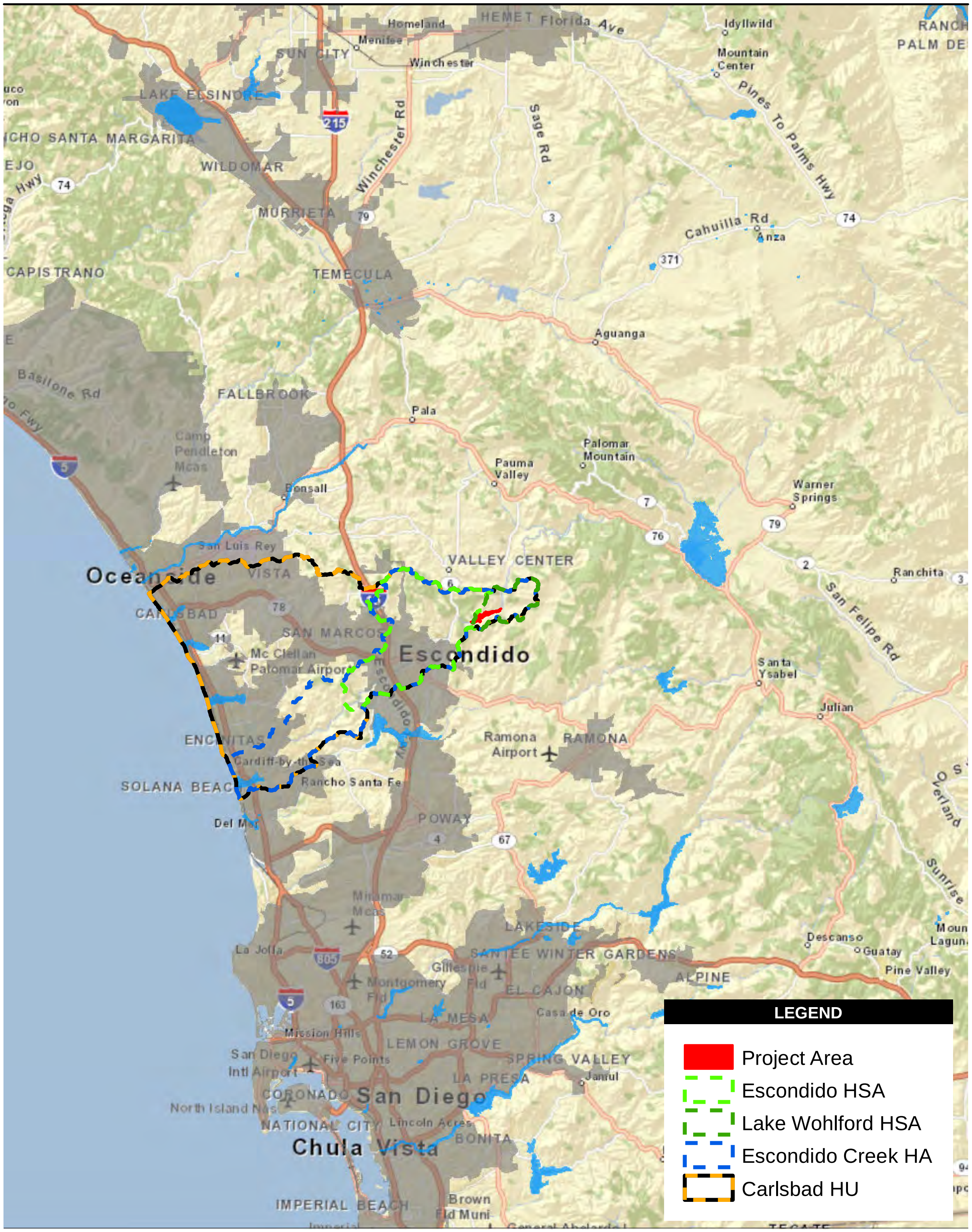
The proposed project area lies within the San Diego Region (RWQCB Region 9), which occupies approximately 3,900 square miles in the southwest corner of California and encompasses most of San Diego County and parts of southwestern Riverside County and southwestern Orange County. The Pacific Ocean coastline is the western boundary of the region, which extends approximately 85 miles north from the California/Mexico border. The San Diego region's northern boundary is formed by the hydrologic divide starting near Laguna Beach and extending inland through El Toro and easterly along the ridge of the Elsinore Mountains into the Cleveland National Forest. The eastern boundary is formed by the Laguna Mountains and other mountains located in the Cleveland National Forest. The California/Mexico border forms the southern boundary of the region. The San Diego region is divided into 11 major hydrologic units (HUs).

3.1.5.2. Local Hydrology

The proposed project area is located in the Escondido Creek Hydrologic Area (HA) within the Carlsbad HU (Figure 5). The majority of the proposed project area is located in the Lake Wohlford hydrologic sub area (HSA) and a small portion on the western edge of the proposed project area is located in the Escondido HSA. The Carlsbad HU is approximately 210 square miles extending from the headwaters above Lake Wolhford in the east to the Pacific Ocean in the west, and from Vista and Oceanside in the north to Solana Beach, Escondido, and the community of Rancho Santa Fe to the south. Escondido Creek extends approximately 28 miles from its headwaters and discharges into San Elijo Lagoon and out to the Pacific Ocean.

3.1.5.3. Precipitation and Climate

Precipitation in San Diego County is derived from frontal low-pressure systems that originate over the Pacific Ocean and generally travel southeast into Southern California. The climate at the proposed project location is a typical Mediterranean climate with warm summers and cool wet winters. The mean annual precipitation is approximately 17 inches, with most of the precipitation occurring from November through March. Rainfall totals are higher in the hills to the north and east, with 20 to 24 inches falling in most areas above 2,000 feet elevation. The mean annual temperature ranges from approximately 52° Fahrenheit (F) to 77°F.



Source: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013; NHD; CalWater 2014

10 5 0 10 Miles

Scale: 1 = 633,600 1 inch = 10 miles

Figure 5
Hydrology

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3.1.5.4. Floodplains

Figure 6 illustrates the FEMA 100-year and 500-year floodplain extent for the proposed project area. The majority of the proposed project location is a "Zone X" and is outside of the 100- and 500-year Flood Hazard Zones. A very small portion of the proposed project location in the northeastern area is within the 100-year flood zone and has a one percent chance of flooding each year.

3.1.5.5. Municipal Supply

Lake Wohlford is a man-made reservoir formed by Lake Wohlford Dam and is filled by runoff from its 7.3-square-mile drainage area, as well as water released from Lake Henshaw reservoir, which is diverted from the San Luis Rey River through the 13-mile-long Escondido Canal. The basin plan (RWQCB 1994) identifies municipal and domestic supply as a beneficial use of Escondido Creek and Lake Wohlford.

3.1.5.6. Groundwater Hydrology

Groundwater basins in San Diego County are relatively small and shallow. The proposed project site is entirely underlain by the Escondido Valley Groundwater Basin. The basin has a surface area of 2,890 acres (4.5 square miles) and is bounded by the contact of residuum with impermeable Cretaceous granitic rocks and pre-Cretaceous metamorphic rocks (DWR 2004). The water-bearing units in the basin are Quaternary-age alluvium and residuum; groundwater production in this basin is largely from residuum (DWR 1967 as cited in DWR 2004). Groundwater within this basin is generally found at less than 50 feet in depth (DWR 1967 as cited in DWR 2004).

3.1.6. Geology/Soils

The soils in the proposed project area consist mainly of Water, Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes, and Visalia sandy loam, 0 to 2 percent slopes. Small portions of the project area consist of Fallbrook-Vista sandy loams, 9 to 15 percent slopes, Las Posas fine sandy loam, 15 to 30 percent slopes, eroded, Las Posas fine sandy loam, 9 to 15 percent slopes, eroded, Las Posas stony fine sandy loam, 30 to 65 percent slopes, Visalia sandy loam, 5 to 9 percent slopes, Visalia sandy loam, 9 to 15 percent slopes, and Vista coarse sandy loam, 15 to 30 percent slopes (Figure 7).

The Cieneba series consists of shallow, somewhat excessively drained soils that formed in material weathered from granitic rock (NRCS 2014). These soils have low to high runoff potential and moderately rapid permeability in the soil and much slower permeability in the weathered bedrock. The Visalia series consists of moderately well drained very deep sandy loams derived from granitic alluvium. These soils have moderately rapid permeability with slow runoff potential. The Fallbrook series consists of deep, well drained soils that formed in material weathered from granitic rocks. These soils are well drained, with medium to very rapid runoff and moderately slow permeability. The Las Posas series consists of moderately deep, well drained soils that formed in material weathered from basic igneous rocks. These soils are well drained, with medium to rapid runoff and slow permeability. The Vista series consists of moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks. These soils are well drained, and have slow to rapid runoff and moderately rapid permeability.

3.1.7. Wild and Scenic Rivers

The proposed project area is not listed as a Wild and Scenic River under the federal or California Wild and Scenic Rivers Acts.

3.1.8. Coastal Resources

The proposed project area is not located in a coastal zone.

3.1.9. Biological Communities

The following section includes applicable summaries of biological communities from the Lake Wohlford Dam Replacement Project Biological Technical Report (AECOM 2014) that relate to surface water features of the proposed project.

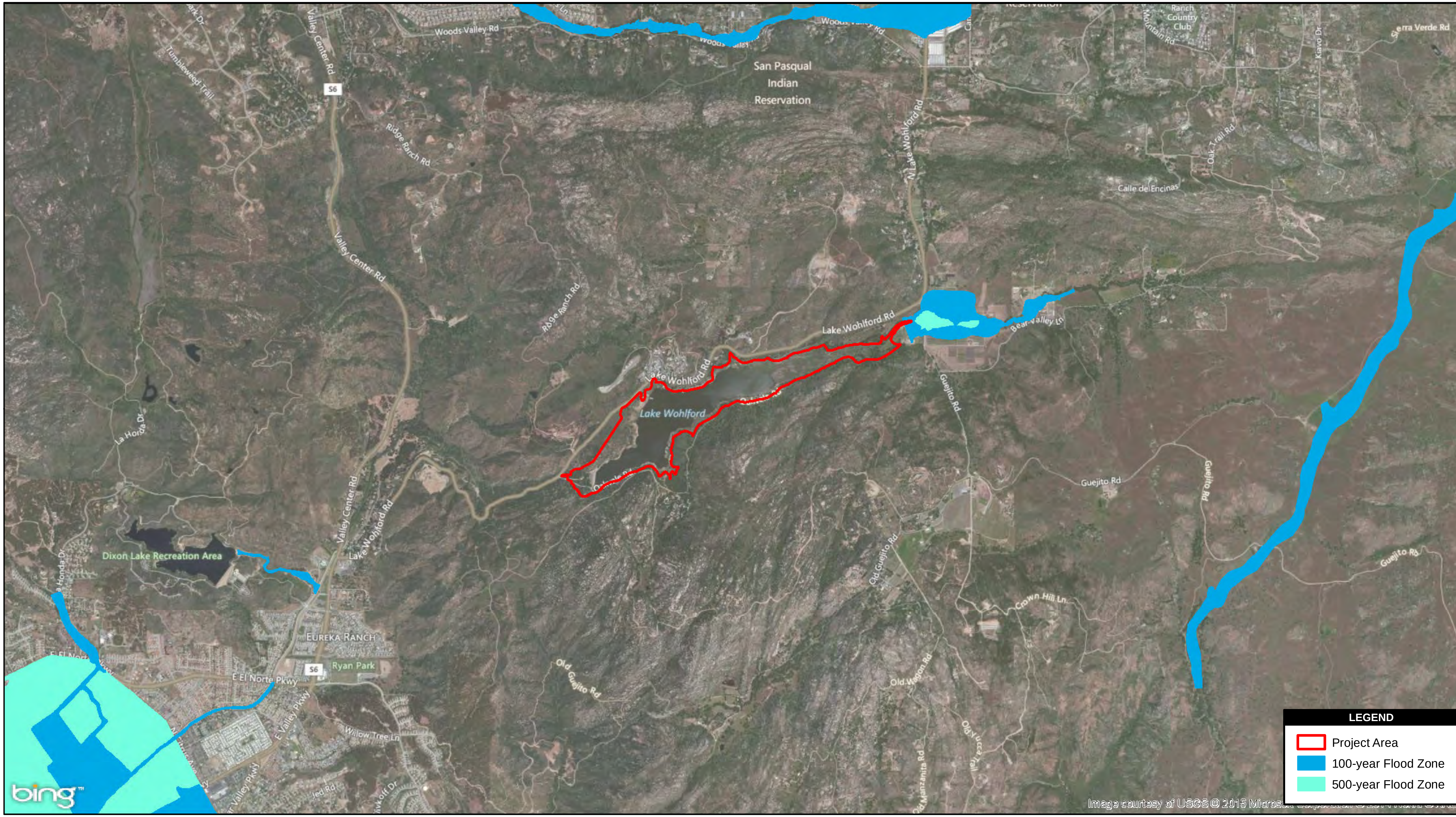
3.1.9.1. WETLAND VEGETATION COMMUNITIES

Emergent Wetland

Emergent wetland occurs at the mouth of Escondido Creek where it enters the Lake Wohlford impoundment in the floodplain at its east end. It occurs mostly at the drier margin of the tree canopy. Riparian herbs such as mugwort (*Artemisia douglasiana*), giant nettle (*Urtica dioica*), Mexican rush (*Juncus mexicanus*), muhley grass (*Muhlenbergia rigens*), some remnant stands of bulrush (*Schoenoplectus californicus*), and common mullein (*Verbascum thapsus*) dominate the outer portions of this lowland habitat. This habitat is apparently shifting to less aquatic plant species such as brome grasses and velvet ash (*Fraxinus vetlutina*) after the draw-down of the reservoir (circa 2008).

Freshwater Marsh

Freshwater marsh is composed mostly of emergent wetland species, and occurs where marshes or lake edges are permanently inundated. It is dominated by cattail (*Typha domingensis*) and bulrush. At Lake Wohlford, it occurs where these species still dominate the upstream floodplain since the draw-down of the lake, although it is being replaced by willows (*Salix gooddingii, S. lasiolepis, S. exigua*) and mulefat (*Baccharis salicifolia*).



Source: ESRI; Microsoft 2010; FEMA 2002

3,000 0 3,000 Feet

Scale: 1:36,000; 1 inch = 3,000 feet

Figure 6
FEMA Flood Zones

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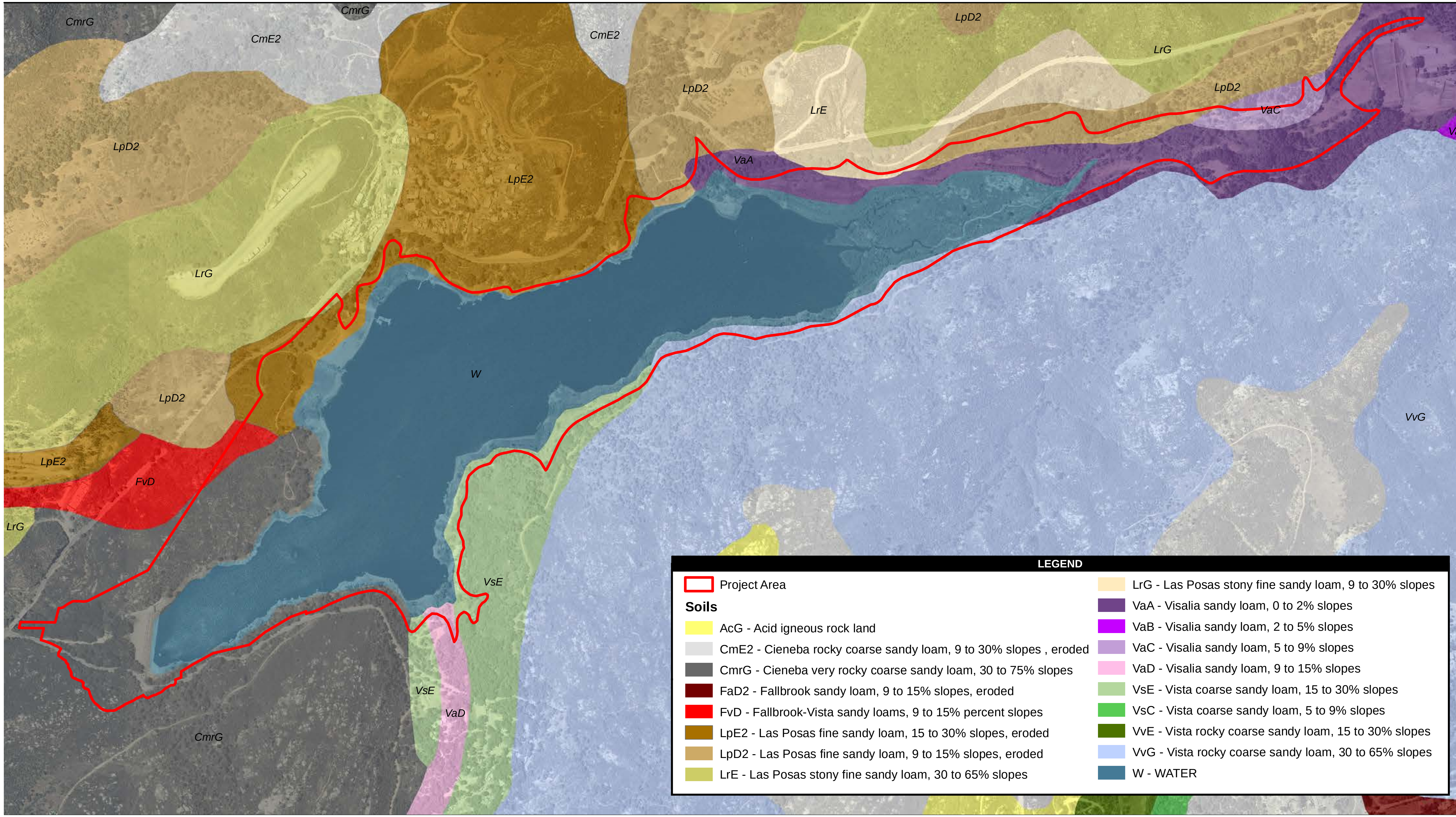

Source: ; USDA; AECOM 2014

750 0 750 Feet

Scale: 1:9,000; 1 inch = 750 feet

Figure 7
Soils

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Large clones of these emergent wetland species persist as thickets of dried stems and leaves that are being gradually replaced by southern willow scrub.

Lakeshore

Lakeshore is the region at the margin of the water level that varies according to rainfall and inputs from the Escondido Canal and Escondido Creek. The inundation level is currently maintained at approximately 1,458 feet in elevation (AMSL). The draw-down from the 1,480-foot margin has exposed a wider lake margin that is beginning to support a zone that is dominated by wetland/upland transitional species such as telegraph weed (*Heterotheca grandiflora*), dock (*Rumex* spp.), knotweed (*Polygonum* sp.), Hooker's primrose (*Oenothera elata*), salt heliotrope (*Heliotropium curassavicum*), Bermuda grass (*Cynodon dactylon*), narrow-leaf frog fruit (*Phyla nodiflora*), willows (mostly *Salix gooddingii*, but including *S. exigua* and *S. lasiolepis*), cattail, and bulrush.

Open Water

Open water is any open body of water, including rivers, streams, bays, or ponds, or any inundated waterway that has no emergent vegetation. Open water applies strictly to the Lake Wohlford reservoir itself and the Escondido Canal, its upstream source. The lake surface may change seasonally according to rainfall, input from Escondido Creek and Escondido Canal, and the lake surface level as it is maintained by the City. Although there are some plants, such as algae, open water is mostly unvegetated.

Southern Willow Scrub

Southern willow scrub occurs mostly at the mouth of Escondido Creek where it enters the Lake Wohlford impoundment in a floodplain at its east end. Streams that meander through the alluvium at the east end of this basin support linear stands of riparian scrub composed mostly of black willow (*Salix gooddingii*), with some mulefat at its margins. Recently, the lake has been drawn down, reducing the level of the lake surface (circa 2008), exposing more of this alluvium above the formerly inundated zone. This draw-down has allowed the expansion of willow scrub that had formerly been dominated exclusively by freshwater marsh. The lowered level of the lakeshore has also become populated by dense thickets of willows, especially along portions of the southern lakeshore and at several tributaries that enter the lake along its northern lakeshore. Other wetland trees associated with this habitat include western sycamore (*Platanus racemosa*) and western cottonwood (*Populus fremontii*).

3.2. Water Quality Objectives/Standards and Beneficial Uses

The basin plan (RWQCB 1994) identifies water quality objectives (WQOs), standards, and beneficial uses for surface water and groundwater in the proposed project area. The following sections summarize relevant WQOs and beneficial uses.

3.2.1. Surface Water Quality Objectives/Standards and Beneficial Uses

3.2.1.1. BENEFICIAL USES

The existing beneficial uses that have been identified for Escondido Creek and Lake Wohlford are listed below (RWQCB 1994).

- Municipal and Domestic Supply (MUN)
- Agricultural Supply (AGR)
- Hydropower Generation (POW)
- Contact Water Recreation (REC-1)
- Non-contact Water Recreation (REC-2)
- Warm Freshwater Habitat (WARM)
- Cold Freshwater Habitat (COLD)
- Wildlife Habitat (WILD)

Descriptions of these beneficial uses are shown in Table 3-1.

Table 3-1: Beneficial Use Descriptions

Beneficial Use	Description
Municipal and Domestic Supply (MUN)	Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
Agriculture (AGR)	Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
Hydropower Generation (POW)	Uses of water for hydropower generation.
Contact Water Recreation (REC-1)	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.
Non-contact Water Recreation (REC-2)	Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Table 3-1: Beneficial Use Descriptions

Beneficial Use	Description
Warm Freshwater Habitat (WARM)	Uses of water that 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)	Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.
Wildlife Habitat (WILD)	Uses of water that 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.

3.2.1.2. WATER QUALITY OBJECTIVES

Narrative and numeric WQOs have been established to protect the beneficial uses of waters and/or prevent a nuisance in a specific area. The narrative water quality objectives presented in the basin plan (RWQCB 1994) apply to all surface waters and groundwater in the San Diego Basin. The narrative water quality objectives relevant to the project's receiving waters are summarized in Table 3-2.

Numeric WQOs for surface waters within the Escondido Creek HA are established for total dissolved solids (TDS), chloride, sulfate, percent sodium, nitrogen and phosphorus, iron, manganese, methylene blue activated substances, boron, turbidity, color, and fluoride. Refer to Table 3-2 in the basin plan (RWQCB 1994) for the specific WQOs.

Table 3-2: Narrative Water Quality Objectives for Surface Waters and Groundwater

Constituent	Water Quality Objective
Ammonia, un-ionized	The discharge of wastes shall not cause concentrations of un-ionized ammonia to exceed 0.025 milligram per liter (mg/l; as Nitrogen) in inland surface waters, enclosed bays and estuaries and coastal lagoons.
Bacteria	In waters designated REC-1, the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 milliliter (ml), nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml. In waters designated REC-2, the average fecal coliform concentrations for any 30-day period, shall not exceed 2,000/100 ml nor shall more than 10 percent of samples collected during any 30-day period exceed 4,000/100 ml.
Biostimulatory Substances	Inland surface waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growths cause nuisance or adversely affect beneficial uses.

Table 3-2: Narrative Water Quality Objectives for Surface Waters and Groundwater

Constituent	Water Quality Objective
Chemical Constituents	Water designated for use as MUN shall not contain concentrations of chemicals in excess of the maximum contaminant levels specified in Title 22 of the California Code of Regulations (see Tables 3-4 and 3-5 in the basin plan [RWQCB 1994]).
Color	Water shall be free of coloration that causes nuisance or adversely affects beneficial uses.
Dissolved Oxygen	Dissolved oxygen levels shall not be less than 5.0 mg/l in inland surface waters with designated MAR or WARM beneficial uses or less than 6.0 mg/l in waters with designated COLD beneficial uses. The annual mean dissolved oxygen concentration shall not be less than 7 mg/l more than 10 percent of the time.
Floating Material	Waters shall not contain floating material, including solids, liquids, foams, and scum in amounts that cause nuisance or adversely affect beneficial uses.
Oil and Grease	Waters shall not contain oils, greases, waxes, or other materials in concentrations which result in a visible film or coating on the surface of the water or on objects in the water, or which cause nuisance or which otherwise adversely affect beneficial uses.
pH	In inland surface waters, the pH shall not be depressed below 6.5 nor raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 units in fresh waters with designated COLD or WARM beneficial uses.
Pesticides	Waters designated for use as MUN shall not contain concentrations of pesticides in excess of the maximum contaminant levels set forth in Title 22 of the California Code of Regulations (Table 3-5 in basin plan [RWQCB 1994]). No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. Pesticides shall not be present at levels which will bioaccumulate in aquatic organisms to levels which are harmful to human health, wildlife or aquatic organisms.
Phenolic Compounds	Water designated for use as MUN shall not contain concentrations of phenolics in excess of 1.0 micrograms per liter.
Radioactivity	Radionuclides shall not be present in concentrations that are harmful to human, plant, animal or aquatic life nor that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal or aquatic life. Waters designated for use as MUN shall not contain concentrations of radionuclides in excess of the maximum contaminant levels specified in Section 64441 of Title 22 of the California Code of Regulations.
Secondary Drinking Water Standards	Water designated for use as MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels specified in Table 64449-A of Section 64449 of Title 22 of the California Code of Regulations.
Sediment	The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Suspended and Settleable Solids	Waters shall not contain suspended and settleable solids in concentrations that cause nuisance or adversely affect beneficial uses.

Table 3-2: Narrative Water Quality Objectives for Surface Waters and Groundwater

Constituent	Water Quality Objective
Tastes and Odors	Waters shall not contain taste or odor-producing substances at concentrations which cause a nuisance or adversely affect beneficial uses.
Temperature	The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the RWQCB that such alteration in temperature does not adversely affect beneficial uses. At no time or place shall the temperature of any COLD water be increased more than 5°F above the natural receiving water temperature.
Toxicity	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 RWQCB. The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with requirements specified in EPA, SWRCB or other protocol authorized by the RWQCB. At a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour acute bioassay.
Trihalomethanes	Waters designated for use as MUN shall not contain concentrations of trihalomethanes in excess of the criteria set forth in Section 64439 of Title 22 of the California Code of Regulations.
Turbidity	Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits: • Where natural turbidity is between 0 and 50 nephelometric turbidity unit (NTUs), increases shall not exceed 20 percent. • Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs. • Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

3.2.2. Groundwater Quality Objectives/Standards and Beneficial Uses

3.2.2.1. Beneficial Uses

All groundwater within Lake Wohlford and Escondido HSAs is considered as suitable for MUN, AGR, and industrial service supply (RWQCB 1994).

3.2.2.2. Water Quality Objectives

Narrative water quality objectives relevant to the project's groundwater are summarized in Table 3-2. Numeric WQOs for groundwater within the Escondido Creek HA are established for TDS, chloride, sulfate, percent sodium, nitrate, iron, manganese, methylene blue activated substances, boron, turbidity, color, and fluoride. Refer to Table 3-3 in the basin plan (RWQCB 1994) for the specific WQOs.

3.3. Existing Water Quality

3.3.1. Regional Water Quality

The proposed project site is situated within the Carlsbad watershed, which is experiencing degrading water quality due to rapid development. Constituents of concern in Carlsbad watershed surface waters include indicator bacteria, nutrients, and sediment. Groundwater quality is impacted by TDS, nitrates, and sulfates (DWR 2004). Many of the water quality problems in the Carlsbad watershed are due to urban and agricultural runoff, sewage spills, livestock, and domestic animals. Along the proposed project footprint, it would be expected that sediment would be a principal pollutant of concern.

3.3.2. List of Impaired Waters

Escondido Creek is included on the 2010 CWA 303(d) list of impaired water bodies (SWRCB 2011). Escondido Creek has been listed as impaired by Dichlorodiphenyltrichloroethane, enterococcus, fecal coliform bacteria, manganese, phosphate, selenium, sulfates, TDS, nitrogen, and toxicity. Sources include unknown point and nonpoint sources and urban runoff/storm sewers. TMDL action plans for these pollutants have not been completed yet and are scheduled for completion in 2019.

Chapter 4. Environmental Consequences

4.1. Introduction

This section provides an overview of the short-term and long-term consequences of the proposed project on water quality.

4.2. Potential Impacts on Water Quality

As appropriate, the following discussion examines the biological, physical/chemical, and human use constituents, as well as short-term and long-term impacts, to assess whether the proposed project would cause or contribute to the violation of water quality standards or WQOs and/or would affect the beneficial uses.

4.2.1. Anticipated Changes to the Physical/Chemical Characteristics of the Aquatic Environment

Temporary soil disturbance during construction activities, including establishment of staging areas and access roads within the lake's drainage area, would have the potential to impact Lake Wohlford or Escondido Creek water quality. Construction-phase BMPs would be implemented that would avoid or minimize potential changes to the physical/chemical characteristics of the proposed project area. In addition, drainage control designs (i.e., brow ditches, earthen swales, energy dissipaters, and riprap) would be incorporated in the proposed project that would improve and protect drainage within the proposed project footprint and further reduce any potential water quality impacts.

Although percent impervious surface of the area downstream of the dam would increase, peak flows downstream of the dam into Escondido Creek following dam replacement would decrease. Post-construction runoff rates and volume and drainage patterns would be improved over existing conditions.

Because of the decrease in peak flows, the improved drainage control designs to be incorporated in the proposed project, and storm water BMPs, no adverse water quality impacts to the Lake Wohlford or Escondido Creek aquatic environments would be expected. The potential for the following changes or impacts would be insignificant, and relative to final design characteristics, would be expected to improve with proposed project implementation:

- Drainage patterns;
- Suspended particulate loading (turbidity);
- Oil, grease and chemical pollutants (including metals and pesticides);
- Temperature, oxygen depletion, and other water quality concerns (e.g., litter);
- Flood control hazards;
- Erosion and accretion patterns;
- Aquifer recharge/groundwater replenishment; and
- Base flow.

4.2.2. Anticipated Changes to the Biological Characteristics of the Aquatic Environment

Direct changes to the biological characteristics of the aquatic environment would include removal of riparian vegetation to accommodate the new dam footprint (i.e., increase in impervious surface of the proposed improvements). Accordingly, construction-related BMPs (described below) would be implemented to avoid or minimize potential changes to the biological characteristics of the proposed project area.

Although aquatic habitat resides within the proposed project drainage area, the potential for modifying biological characteristics of the aquatic environment would be low. Construction BMPs would serve to protect the watercourse during construction activities, and post-construction operations would be similar to existing conditions. Relative to biological concerns, proposed project implementation would not result in an adverse impact on the following habitat designations:

- WARM
- COLD
- WILD

Refer to Section 3.1.9, Biological Communities, for biological resources discussion.

4.2.3. Anticipated Changes to the Human Use Characteristics of the Aquatic Environment

Human uses of surface waters within the project area are designated MUN, AGR, REC-1, REC-2, and POW. Human uses of groundwater in the project area include MUN and AGR designations.

Construction activities could have the potential to impact these uses; however, construction-phase BMPs would be implemented that would avoid or minimize potential changes to the human use characteristics of the proposed project area and post-construction operations would be similar to existing conditions. In addition, drainage control designs (i.e., brow ditches, earthen swales, energy dissipaters, and riprap) to be incorporated in the proposed project would also improve and protect drainage within the proposed project footprint and further reduce any potential water quality impacts. Relative to human use concerns, proposed project implementation would not result in an adverse impact on beneficial uses or the aquatic resources of the Lake Wohlford or Escondido Creek drainage areas associated with proposed project implementation.

4.2.4. Short-Term Construction Impacts

Construction of the proposed project would involve temporary disturbance for excavation and demolition of the existing dam foundation and outlet tower, new dam construction, access road, staging area and construction work area activities, and spillway and outlet tower construction activities.

The estimated disturbed soil acreage for the proposed project is unknown at this time. Without implementation of construction-phase BMPs, construction of the proposed project has the potential to impact water quality. The types of activities described above have the potential to release pollutants such as sediment, metals, soil stabilization residues, oil and grease, nutrients, organic compounds, and trash and debris. Any type of soil disturbance would expose soil to erosion from wind and water that could result in sedimentation in downgradient surface waters if left uncontrolled. Temporary construction BMPs would be implemented to properly control erosion, minimize sediment transport, and manage site runoff discharge points in accordance with Construction General Permit (Order 2009-0009-DWQ, as amended) requirements for SWPPP implementation.

Specific pollution prevention measures, including slope aspects and stabilization measures, would be identified during the design phase. The minimum anticipated temporary erosion control measures for this proposed project would include:

- Silt fence;
- Fiber rolls;
- Sandbag barrier;
- Gravelbag berm;
- Hydroseed, mulch, or rolled erosion control product; and
- Re-establishment of vegetation or other stabilization measures on disturbed areas and newly constructed slopes.

The proposed project would require a SWPPP that complies with the Construction General Permit and would include the following:

- Site maps;
- Description and location of the BMPs using best conventional pollutant control technology;
- Routine inspections to ensure proper working conditions of BMPs;
- Rain event action plans;
- Construction site monitoring and reporting plan;
- BMP maintenance and repair; and
- Stormwater monitoring for storm events not exceeding the 20-year, 1-hour storm event.

In addition, Lake Wohlford would remain at its current water level, between 1,450 and 1,460 feet AMSL, during proposed project construction. Flood protection during the construction period would be provided by releases through temporary pumps provided by the contractor. By maintaining current reservoir levels and by allowing releases through the temporary pumps, Lake Wohlford would be expected to accommodate the Local Storm PMF and all smaller storm events, including the 100-year event; thus, flooding impacts would not be anticipated to occur during construction activities because they would avoid construction scheduling during wet weather.

Section 5, Avoidance and Minimization Measures, further discusses the measures that are proposed for water quality and environmental protection. No adverse short-term water-quality impacts would be expected during construction of the proposed project.

4.2.4.1. No-Build Alternative

Under the No-Build Alternative, no improvements would be made. Therefore, this alternative would result in no short-term water quality impacts from project construction-related activities.

4.2.5. Long-Term Impacts on Water Quality during Operation and Maintenance

Impervious surface area of the drainage area downstream of the proposed dam (between the dam and Lake Wohlford Road) is expected to increase from 4.6 percent to 11.8 percent with implementation of the proposed project. However, peak flows into Escondido Creek under the proposed condition would be lower than existing conditions due to the reduction in size of the drainage area. The drainage area between the dam and Lake Wohlford Road would decrease in size by approximately 4 acres (from 20.6 to 17.0 acres) due to the installation of the new dam downstream of the existing dam. Since the proposed project would reduce peak flows in the Escondido Creek reach downstream of the dam, hydromodification effects (i.e., increased erosion and sediment transport) would not be expected to occur. Hydromodification control facilities would not be required because of the decrease in peak flows as compared to existing conditions.

In accordance with the County of San Diego Hydrology Manual's (County of San Diego 2003) Rational Method, the proposed project drainage area downstream of the replacement dam (approximately 17 acres) would generate approximately 51 cubic feet per second (cfs) of flow into Escondido Creek for a 50-year storm, which would represent a 3.8 cfs decrease in flow over existing conditions (Table 4-1). See the Lake Wohlford Dam Replacement Drainage Study (Black and Veatch 2014; Appendix A) for more detailed information on site drainage areas and patterns, existing and proposed hydrology conditions, peak discharge rates, and calculations.

Table 4-1: Existing and Proposed On-Site Conditions for 50-Year Storm Flows

Parameter	Existing	Proposed
Drainage Area (acres)	20.6	17
C	0.33	0.37
I_{50} (in/hr)	8.2	8.2
Q_{50} (cfs)	54.8	51.0

C = Runoff coefficient
I_{50} = Rainfall intensity for 50-year storm event
Q_{50} = Flow for 50-year storm event
in/hr = inches per hour

The proposed project would not impact flood control, as the majority of project site is in a FEMA "Zone X" that is located outside the 100- and 500-year Flood Hazard Zone. The reduction in peak runoff flow would also contribute to lowering flood hazard potential. In addition, although an assessment of flows discharging from Lake Wohlford Dam was not evaluated in the project drainage study (Appendix A), the new dam, which would be installed downstream of the existing dam, would have a redesigned spillway. The higher elevation of the new spillway would reduce the occurrence of spillover events relative to existing conditions and correspondingly reduce the lake-related discharges to Escondido Creek once the new dam is constructed. Furthermore, the dam's emergency release valve would enable reservoir water releases to Escondido Creek in the event of a dam safety event to minimize flooding impacts. Discharges from such release valves generally disperse the released water in a manner to minimize scouring forces.

Operation of the proposed project is subject to the requirements of the San Diego County Municipal Permit, and the City's JURMP (City of Escondido 2008) and SUSMP (City of

Escondido 2011). As part of these requirements, the proposed project must avoid causing runoff-related impacts through the following:

- considering approved design pollution prevention (DPP) and structural treatment control BMPs for the project site; and
- constructing DPPs and treatment control BMPs where feasible.

This proposed project would incorporate DPP measures (permanent pollutant source control BMPs) and LID designs to manage runoff water quality and minimize potential impacts to Lake Wohlford and Escondido Creek. DPPs would need to target the pollutants of concern (sediment/turbidity, nutrients, and bacteria) and treat runoff relative to applicable Escondido Creek HA inland surface water and groundwater WQOs (e.g., TDS, chloride, sulfate, percent sodium, nitrate, nitrogen, phosphorus, iron, manganese, boron, turbidity, and color).

Potential DPP and LID measures that may be considered for this project would include to:

- Preserve existing vegetation where feasible;
- Schedule major earthwork to occur outside the rainy season, to the extent practicable;
- Apply permanent erosion controls, such as hydroseed and mulch, to all disturbed areas immediately after grading is completed;
- Construct fill slopes as flat as feasible; and
- Re-grade and blend temporary access roads to conform to existing pre-construction conditions following construction.

Drainage improvements would be implemented into the site design and would include reconstruction of storm drains, construction of brow ditches, and incorporation of earthen swales and energy dissipaters. A storm drain beneath the western end of the Oakvale roadway improvements would be reconstructed, and a new 18-inch storm drain beneath the road on the eastern side of the project limits would be constructed. A brow ditch would be constructed at the top of the slope that would divert downslope storm water runoff. The brow ditch on the western side would carry water to an existing ditch situated at the toe of the slope along the road’s southern edge and into a storm drain that flows beneath the road. This storm drain would be located at the far western end of the roadway improvements and would be reconstructed as part of the proposed project. The brow ditch on the eastern side would carry water to a proposed storm drain that would be constructed beneath the road and empty into an earthen swale on the northern side of the road.

The new basin spillway would be designed to flow into an energy dissipation stilling basin at the downstream foot of the dam, which would catch water that overtops the dam before it discharges into the downstream river channel. The spillway would be stepped on the dam's downstream slope to dissipate energy along the entire spillway length and reduce the stilling basin size at the end of the spillway. The stilling basin would be approximately 90 feet wide by 70 feet long. Riprap would be installed at the transition from the stilling basin to the existing channel to prevent scour and erosion.

Through complying with state and municipal requirements and implementation of minimization measures WQ-1 through WQ-3 to the maximum extent practicable, the construction, operation, and maintenance of the proposed project would not be expected to cause adverse impacts on water quality. The project has been designed to minimize long-term water quality impacts to the extent practicable. Potential impacts from increased sediment loads, changes in storm water runoff rates and volumes, and changes in storm water pollutant loads would not be expected to occur.

4.2.5.1. No-Build Alternative

Under the No-Build Alternative, no improvements would be made. Therefore, this alternative would result in no long-term water quality impacts relative to existing operation and maintenance activities.

4.3. Cumulative Impacts

The cumulative study area for assessing the potential water quality and storm water runoff impacts of the proposed project is the Escondido Creek HA within the Carlsbad HU. Any drainage from the proposed project site drains into Lake Wohlford and/or Escondido Creek. Existing surrounding land uses include open space, vacant/undeveloped land, and rural residential.

The population of the Carlsbad watershed is projected to increase to over 700,000 residents in 2015 (PCW 2014). Conversion of undeveloped land to transportation, commercial/industrial, retail, and residential uses can result in hydromodification and increased loading of pollutants into surface waters and, indirectly, into groundwater provided there are soils with adequate percolation properties. Urbanization can also introduce new sources of pollutants associated with the new land uses. To counteract the impacts associated with increased development, all projects proposed in this watershed must undergo review by the applicable lead agency for compliance with NPDES permits for construction activities and project operations, as well as compliance with local urban runoff ordinances. BMPs must be employed in site designs to reduce sources of pollutants and to treat storm water runoff.

As discussed in Section 2, the purpose of the NPDES permit program, and, by extension, the State’s TMDL program, is to restore the beneficial uses of receiving waters. NPDES permits are updated every 5 years by the RWQCB, based on local watershed conditions. Compliance with the NPDES program is considered sufficient to mitigate impacts to water quality. Because the proposed project would reduce peak flows into Escondido Creek, thereby limiting hydromodification influences, water quality impacts would be avoided and/or minimized. Further, because the proposed project would employ minimization measures WQ-1 through WQ-3 as outlined in Section 5, the proposed project would be expected to improve the management of runoff in the proposed project area and, therefore, would not contribute to cumulative water quality impacts. The proposed project would be expected to have a net benefit cumulative impact on Lake Wohlford and Escondido Creek water quality.

Chapter 5. Avoidance and Minimization Measures

To prevent potential impacts on receiving waters resulting from project construction activities and operations, temporary and permanent measures would be implemented in accordance with applicable storm water regulations and standards. Short-term temporary measures would focus on implementing construction BMPs aimed at reducing erosion and subsequent sediment transport. Long-term permanent measures would consider factors such as preserving existing vegetation, permanent stabilization of disturbed soil, and re-grading temporary access roads to conform to existing pre-construction contours. Compliance with the standard requirements of the Construction General Permit, County Municipal Permit, and the City's JURMP and SUSMP would be required. To address these requirements and avoid the potential for short-term (during construction) and long-term (post-construction/maintenance) impacts, the following minimization measures would need to be implemented.

WQ-1: In accordance with the Construction General Permit, Order 2009-0009-DWQ (as amended by Orders 2010-0014-DWQ and 2012-0006-DWQ), a SWPPP would be prepared and implemented to address all construction-related activities, equipment, and materials that have the potential to impact water quality. The SWPPP would identify the sources of pollutants that may affect the quality of storm water, include construction site BMPs to control sedimentation, erosion, and potential chemical pollutants. The SWPPP would also provide for construction materials management, non-storm-water BMPs, and include routine inspections and a monitoring and reporting plan. The SWPPP, along with project design elements, would constitute an erosion and sediment control plan for the proposed project (dam footprint, batch plant, access roads, staging areas, and other ancillary disturbances). It would be particularly important for SWPPP safeguards and BMP implementation to control the foundation surface-cleaning process where loose material would be dislodged using an air/water jet. The contractor would be required prepare a detailed work plan to identify potential hazard areas and specify appropriate BMPs to protect water quality. Blasting and hydraulic drilling at the foundation and on side slope excavations would also require special attention to avoiding water quality impacts in areas of steep (and largely impervious) terrain.

Similarly, the establishment of a batch mixer at the primary staging yard located at the Lake Wohlford Marina would require focused BMPs to protect lake receiving water, including the transport of dam construction materials via the access road to the right abutment. The use of a conveyor system for transporting material along the access road and placing the material onto the dam would minimize vehicle and equipment traveling, minimize lift joint cleaning, and reduce the water quality impact potential relative to truck transport. Truck hauling is unlikely due to limited space available for haul trucks to pass each other and turn around. Construction of the new outlet tower would also require focused BMPs to protect nearby lake receiving water.

All construction-site BMPs would follow the latest edition of the Construction BMP Handbook (California Stormwater Quality Association) to control and minimize the impacts of construction-related activities, materials, and pollutants on the watershed. These include temporary sediment controls, temporary soil stabilization, scheduling management, waste management, materials handling, and other non-storm-water BMPs. Post-construction standards to address hydromodification impacts are not anticipated due to the decrease in peak flows following the dam replacement.

The contractor would be required to implement, at the minimum, the following BMPs to reduce effects on receiving water quality based on the potential pollutants expected to be generated during construction:

- Stabilized Construction Entrance/Exit
- Stabilized Construction Roadway
- Street Sweeping and Vacuuming
- Scheduling
- Silt Fence
- Fiber Rolls
- Sandbag Barrier
- Gravelbag Berms and Check Dams
- Vehicle and Equipment Cleaning
- Vehicle and Equipment Maintenance
- Material Delivery and Storage
- Material Use
- Stockpile Management
- Spill Prevention and Control
- Solid Waste Management
- Preserve Existing Vegetation

The BMPs identified are directed at implementing both sediment- and erosion-control measures and other measures to control potential chemical contaminants.

WQ-2: The proposed project would implement a variety of source-control pollution prevention BMPs to help minimize pollutant sources and their potential discharge in storm water runoff. Source-control BMPs to be implemented for the proposed project would typically include, but not be limited to, the following:

- Proper storage and containment safeguard for building materials, paints, solvents, fuels, lubricants, and other construction-related materials to avoid or minimize exposure to weather (rain and wind). Spill prevention and control protocols, as well as refueling safeguards, would be incorporated in the project SWPPP.

- Proper site management for the control of trash, vegetation debris, construction waste, and other byproducts of construction to avoid rainfall contact and runoff.

- Suitable stockpile management to avoid wind and storm water erosion, including perimeter controls to properly manage runoff.

- Adequate safeguards to protect against rock debris and other construction-related equipment, materials, or products from accidently falling into lake receiving water or downstream drainage conveyances.

WQ-3: Complementing source-control BMPs, the proposed project would minimize storm water quality runoff impacts to the surrounding environment (Lake Wohlford and Escondido Creek) through the use of the low-impact site designs discussed below.

- ***Preservation of Natural Drainage Features:*** The general sloping nature of the site would be preserved, and existing gradients would be maintained as much as possible. Drainage patterns within the watershed or proposed project area would not be substantially altered by the proposed project; peak flows into Escondido Creek would actually be reduced due to a decrease in the size of the drainage area downstream of the new dam, thereby improving runoff water quality and limiting hydromodification impacts.

- ***Using Drainage as a Design Element:*** The project design would be required to incorporate LID elements that minimize environmental degradation while offering water quality improvements. Drainage improvements would include reconstruction of storm drains, conveyances, and inlet/outlets. These would include, but not be limited to, new brow ditches to divert downslope discharges, protected riprap outlets and vegetated earthen swales to slow runoff velocities and prevent scour, permanent erosion controls (e.g., hydroseed and mulch), grading fill slopes as flat as feasible, energy dissipaters at outfalls, and proper drainage conveyance without hydromodification.

In addition, the proposed project's new spillway would incorporate an energy-dissipation stilling basin to control discharge energy. Riprap would also be installed at the transition from the stilling basin to the existing channel to prevent scouring forces and erosion.

Following construction, temporary access roads would also be re-graded and blended to conform to pre-construction contours.

Chapter 6. References

AECOM

2014 Lake Wohlford Dam Replacement Project Biological Technical Report. December.

Black and Veatch

2014 Lake Wohlford Dam Replacement Drainage Study. October.

California Department of Water Resources (DWR)

2004 California's Groundwater Bulletin 118. Hydrologic Region South Coast, Escondido Valley Groundwater Basin. February.

1967 (as cited in DWR 2004). Ground Water Occurrence and Quality, San Diego Region. Bulletin 106-2. 233 p.

City of Escondido

2008 Jurisdictional Urban Runoff Management Plan. March.

2011 City of Escondido SUSMP. Standard Urban Stormwater Mitigation Plan Requirements for Development Projects. January.

County of San Diego

2003 Department of Public Works, Flood Control Section. San Diego County Hydrology Manual. June.

2011 Countywide Model Standard Urban Storm Water Mitigation Plan. January 13.

2014 Low Impact Development Handbook. Stormwater Management Strategies. July.

GEI Consultants, Inc.

2007 Liquefaction Evaluation of Lake Wohlford Dam, prepared for City of Escondido. December.

2010 Evaluation of Alternatives for Replacement of Lake Wohlford Dam. Prepared for City of Escondido. June.

Natural Resources Conservation Service (NRSC)

2014 *Official Soil Series Descriptions*. Available at http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/home/?cid=nrcs142p2_053587.

Project Clean Water (PCW)

2014 San Diego's Watersheds. Available at http://www.projectcleanwater.org/html/ watersheds.html.

Regional Water Quality Control Board (RWQCB)

1994 Water Quality Control Plan for the San Diego Basin. September 8 (with amendments effective on or before April 4, 2011).

San Diego County Water Authority (SDCWA)

2008 Final Environmental Impact Report/Environmental Impact Statement for the Carryover Storage and San Vicente Dam Raise Project, Volume I. April.

State Water Resources Control Board (SWRCB)

2009 Order 2009-0009-DWQ (as amended by Orders 2010-0014-DWQ and 2012-0006-DWQ), NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit). September 2.

2011 Board Approved of 2010 Integrated Report. Clean Water Act Section 303(d) List/305(b) Report. Available at http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml. October.

U.S. Census Bureau, Population Division

2013 Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2013. 2013 Population Estimates. Available at http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.

United States Environmental Protection Agency (EPA)

2012 Overview of Impaired Waters and Total Maximum Daily Loads Program. Available at http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/intro.cfm.

Chapter 7. Preparer(s) Qualifications

Amy Gardner is an environmental analyst with 11 years of professional experience. Ms. Gardner received her Bachelors of Science from Ohio University in 1998 and her Master's in Tropical Marine Ecology and Fisheries Biology from James Cook University in Townsville, Australia, in 2001. Ms. Gardner's experience includes environmental analyses pertaining to water quality studies, environmental permit compliance, and storm water management. Ms. Gardner has prepared documents such as water quality technical reports, BMP effectiveness assessment reports, compliance monitoring reports, and environmental impact reports.

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Appendix A Drainage Report

LAKE WOHLFORD DAM REPLACEMENT

Drainage Study

B&V PROJECT NO. 177740

PREPARED FOR

City of Escondido

13 OCTOBER 2014

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DECLARATION OF RESPONSIBLE CHARGE

I hereby declare that I am the Civil Engineer of work for this project, that I have exercised the responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current design.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as Engineer of Work, of my responsibilities for project design.

Signature

11-17-14

Date

JAMES BYRL RASMUS

Printed Name

C46127

License/R.C.E. #

12/31/14

Expiration

Table of Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES LIST

ACRONYMS AND ABBREVIATIONS

AMC	Antecedent Moisture Condition
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Standard Testing Methods
City	City of Escondido
CN	Curve Number
CSD	County of San Diego
DSOD	California Department of Water Resources, Division of Safety of Dams
El., Elev.	Elevation
FAA	Federal Aviation Agency
FERC	Federal Energy Regulatory Commission
GEI	GEI Consultants
HEC	U.S. Army Corps of Engineer's Hydrologic Engineering Center
HMR	Hydrometeorological Report
HSG	Hydrologic Soil Group
N/A, NA	not applicable
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
Project	Lake Wohlford Dam Replacement Project
PZN	Precipitation Zone Number
RCC	Roller Compacted Concrete
TM	technical memorandum
USACE	United States Army Corps of Engineers
USBR	United States Department of Interior, Bureau of Reclamation

LIST OF UNITS

Ac-ft	acre-feet/foot
cf	cubic feet
cfs	cubic feet per second
ft	feet
in	inch
mi^2	square miles

1 General, Facilities, and Operation

1.1 PURPOSE

The purpose of this document is to present the drainage study as part of the preliminary design for the Lake Wohlford Dam Replacement Project (Project). Information is included to describe analyses completed to date that will serve as the basis for the detailed design. Drawings associated with this design package are included in Appendix A.

1.2 PROJECT BACKGROUND & DESCRIPTION

The existing Lake Wohlford Dam is a 100-foot high embankment dam on Escondido Creek, composed of rockfill, hydraulic fill, and wagon fill. Through previous investigations and analyses, it was concluded that the hydraulic fill portion of the dam has the potential to experience a liquefaction induced flow slide as a result of earthquake loading. Due to this finding, and as required by the Federal Energy Regulatory Commission (FERC), the City of Escondido (City) has been maintaining Lake Wohlford Reservoir in a lowered state for dam safety purposes. The California Department of Water Resources, Division of Safety of Dams (DSOD) also regulates the safety of Lake Wohlford Dam under Division 3 of the California Water Code. Current reservoir level restrictions are set to elevation 1,460 feet. The existing spillway crest elevation is 1,480.2 feet.

The Project will include the following facilities:

- RCC Dam: The new RCC dam will be constructed downstream of the existing dam, maintaining the existing normal operating reservoir levels.
- Spillway and Stilling Basin: A new integral spillway will be a passive component, capable of passing the maximum required storm events. A reinforced concrete energy dissipation stilling basin will be provided at the spillway terminus.
- Outlet Tower: A reinforced conventional concrete tower will be constructed on the upstream face of the new RCC dam. The tower will utilize a wetwell configuration with four slide gates for water discharge from different levels in the reservoir.
- Outlet Pipeline: The outlet pipeline will extend from the new tower through the dam to connect with the existing downstream pipeline.
- Emergency Release Valve: A new emergency release valve will discharge into the stilling basin to meet DSOD and FERC dam safety requirements.

1.3 APPROACH

Downstream of Lake Wohlford Dam, additional facilities are required and will be developed in what is currently undeveloped land. The watershed between the dam and Lake Wohlford Road will be analyzed in the drainage study to determine the impact of the Project on flows in this reach. The purpose of this drainage study is to assess the impact on peak flows in this reach of Escondido Creek due to the facilities associated with the Project. The watershed between the dam and road will be analyzed by the Rational Method. The Rational Method is appropriate for estimating peak flows for basins less than 1 sq. mile.

The alignment of Oakvale Road will be modified as part of a project that will be completed well before the commencement of the replacement dam construction. As such, the proposed alignment for this section of Oakvale Road is shown as existing features for the purpose of this evaluation. The new road will not alter the watershed boundaries as delineated in this study.

An assessment of flows discharging from Lake Wohlford Dam is not part of the scope of this drainage study. However, it is known that the new dam, which will be installed downstream of the existing dam, will have a redesigned spillway. The new spillway will have reduced conveyance compared to the existing spillway. As a result, we will see higher water levels in the reservoir with lower spillway discharges to Escondido Creek once the new dam is constructed.

2 Hydrologic Parameters

2.1 WATERSHED DESCRIPTION

Lake Wohlford Road lies approximately 900 feet downstream of the existing dam. There will be some additional development along Escondido Creek, in the reach between Lake Wohlford Dam and Lake Wohlford Road due to the project. In addition to the new dam, this reach of Escondido Creek will also contain a stilling basin, a new access road from Oakvale Road to the stilling basin, and a small paved area for maintenance vehicles to park. The impacted watershed downstream of the existing dam covers approximately 21 acres (0.032 sq. miles). This watershed is currently undeveloped (natural), and aerial imagery indicates that the current vegetation is dense brush with some trees. Since the new dam is being constructed downstream of the existing dam, this watershed will effectively decrease in size by about 4 acres, and the watershed upstream of Lake Wohlford Dam will effectively increase in size by an equivalent amount. Figure 1 presents the existing and proposed watershed downstream of Lake Wohlford Dam.

2.2 HYDROLOGIC APPROACH - RATIONAL METHOD

Per the County of San Diego (CSD) Hydrology Manual (June, 2003), the Rational Method should be applied for the estimation of peak runoff for drainages that are less than 1 sq. mile (640 acres) in area. The Rational Method is as follows:

$$Q = CIA$$

Where: Q = peak discharge, cfs

C = Runoff coefficient

I = average rainfall intensity (inches/hour) for a duration equal to the time of concentration for the area/basin

A = drainage area contributing to the design location, acres

2.3 HYDROLOGIC PARAMETERS

The runoff coefficient is a function of both soil type and land use. The soils types used in the study were based on the CSD Hydrology Manual, Soil Hydrologic Groups Map for the area. Soils were found to belong to HSG C for the Downstream Lake Wohlford Dam Watershed. Refer to Appendix B for the County of San Diego's Soils Map.

The predominant land use for the watershed is Undisturbed Natural Terrain (Natural). See Figure 2 for an aerial view of the existing land cover. Based on Table 3-1 of the County's hydrology manual, this would correspond to a Runoff Coefficient (C) of 0.30. A weighted runoff coefficient was developed for both the existing and future conditions to account for changes in the watershed percent impervious. Currently, this watershed is approximately 4.5% impervious. In the future, the watershed is estimated to be approximately 11.8% impervious. Refer to Figure 3 for the impervious areas. Weighted runoff coefficients of 0.33 and 0.37 were estimated for the existing and future conditions, respectively.

The average slope of the watershed is 28.2%. The travel distance from the most remote point in the watershed to the outlet is 1,164 feet with an elevation change of 328 feet (1,712 feet at the upstream end and 1,384 feet at the outlet). The watershed is very steep with average slopes as high as 30-40% at the upstream end of the small basin. This is well beyond the applicability of the Federal Aviation Agency (FAA) equation for sheet flow. Sheet flow was estimated using the NRCS TR-55 approach. An initial travel time of 2.5 minutes was estimated for the first 100 feet of sheet flow. The Kirpich Equation was used to estimate a travel time of 3.2 minutes through the rest of the basin. The total estimated time of concentration is 5.7 minutes by the combination of these methods.

Alternately, using the NRCS approach presented in TR-55 which accounts for sheet flow, shallow concentrated flow, and channel flow, a time of concentration of 4.7 minutes was estimated. The first 100 feet of the flow path is steep, with large expanses of rock broken up by areas of shrubs and vegetation. There is some uncertainty as to which Manning's n value best describes resistance to flow over this heterogeneous surface, so several n values between 0.24 (grass) and 0.011 (rock) were considered in calculations. In each case, the total watershed times of concentration calculated by the TR-55 methodology were less than or equal to the 5-minute minimum given in the CSD Hydrology Manual to determine precipitation intensity for subsequent calculations. Thus the TR-55 methodology for determining the time of concentration yielded a value of 5 minutes.

A 5-minute Time of Concentration was selected for subsequent calculations. This value, as calculated by the TR-55 methodology, was selected because it produces a more conservative peak discharge estimate and it was calculated using more site-specific characteristics than the Kirpich method.

2.4 DESIGN STORM

According to the CSD Hydrology Manual, the flood frequency for determining the design storm discharge is 50 years for drainage that is upstream of any major roadway, and 100 years for all design storms crossing a major road or downstream thereof. The first major roadway crossing of Escondido Creek is Lake Wohlford Road, which is immediately downstream of the drainage basin under consideration. Thus, the 50-year return frequency storm event is the design storm for this drainage study. Isopluvial Maps in Appendix B of the County Hydrology Manual were referenced to determine the 6-hour precipitation depth (P_6) for the 50-year storm event for the Escondido Creek Watershed. A precipitation depth of 3.1 inches was estimated. Refer to Appendix B of this document for the County of San Diego's Rainfall Isopluvial Map.

The rainfall intensity for durations less than six hours are developed using the following equation:

$$I = 7.44 \cdot P_6 \cdot D^{-0.645}$$

Where: P_6 = 6-hour storm rainfall amount (inches)

D = duration (minutes), equivalent to the time of concentration

The 50-year rainfall intensity for a 5 minute time of concentration is 8.2 inches/hour.

3 Results

Table 3-1 presents the hydrologic parameters under the existing and future conditions. Peak discharges are also presented.

Table 3-1 Hydrologic Results for Downstream Lake Wohlford Dam Watershed

PARAMETER	EXISTING	FUTURE
Drainage Area (acres)	20.6	17.0
Longest Flow Path Length (feet)	1164	1164
Time of Concentration (minutes)	5	5
Rainfall Intensity (inch/hour)	8.2	8.2
Percent Impervious	4.6%	11.8%
Runoff Coefficient, C	0.33	0.37
Peak Discharge (cfs)	54.8	51.0

4 Summary

The hydrologic assessment indicates that peak flows into Escondido Creek will decrease as a result of the proposed project to replace Lake Wohlford Dam. Although the watershed between the dam and the road will have a higher percent impervious (increase from 4.6% to 11.8%) under the proposed condition, peak flows under the proposed condition are lower than existing due to the reduction in size of this watershed. This watershed will reduce from 20.6 to 17.0 acres due to the installation of the new dam downstream of the existing dam.

Generally, the proposed project tends to reduce peak flows in the Escondido Creek reach downstream of the dam. As a result, no mitigation structures are proposed at this time.

5 References

Black & Veatch, (2013). "DRAFT Geotechnical Interpretative Report, Lake Wohlford Dam Replacement Project."

Black & Veatch, (2013). "Final Design Criteria Memo, Lake Wohlford Dam Replacement Project."

County of San Diego (CSD), Department of Public Works – Flood Control Section. (2003). "San Diego County Hydrology Manual."

Federal Energy Regulatory Commission (FERC), (2001). "Engineering Guidelines for the Evaluation of Hydropower Projects."

GEI Consultants, Inc., (2002a). Letter Dated: January 23, 2002. "Revised Probable maximum Flood Hydrology for Lake Wohlford Dam." Project No. 020190".

GEI Consultants, Inc., (2002b). Letter Dated: December 04, 2002. "Re: Revised Probable maximum Flood Hydrology for Lake Wohlford Dam, January 23, 2002 Report by GEI Consultants, INC." Project No. 020190".

GEI Consultants, Inc., (2004). "Lake Wohlford Dam, Probable Maximum Flood Analysis, Response to FERC's February 27, 2004 Letter.

GEI Consultants, Inc., (2007). "Liquefaction Evaluation of Lake Wohlford Dam".

GEI Consultants, Inc., (2010). "Lake Wohlford Dam Replacement Geotechnical Data Report."

GEI Consultants, Inc., (2010). "Evaluation of Alternatives for Replacement of Lake Wohlford Dam."

Kleinfelder and Black & Veatch, (2013). "Geotechnical Data Report Amendment No.1, Wohlford Dam Replacement Project."

Kleinfelder and Black & Veatch, (2013a). "Geotechnical Exploration Work Plan, Rev 1, Wohlford Dam Replacement Design Project."

Kleinfelder, (2013b). "Proposed Laboratory Testing Program for Wohlford Dam Replacement Design Project Rev1."

Kleinfelder, (2014). "Seismic Hazard Analysis Report, Wohlford Dam Replacement Design Project."

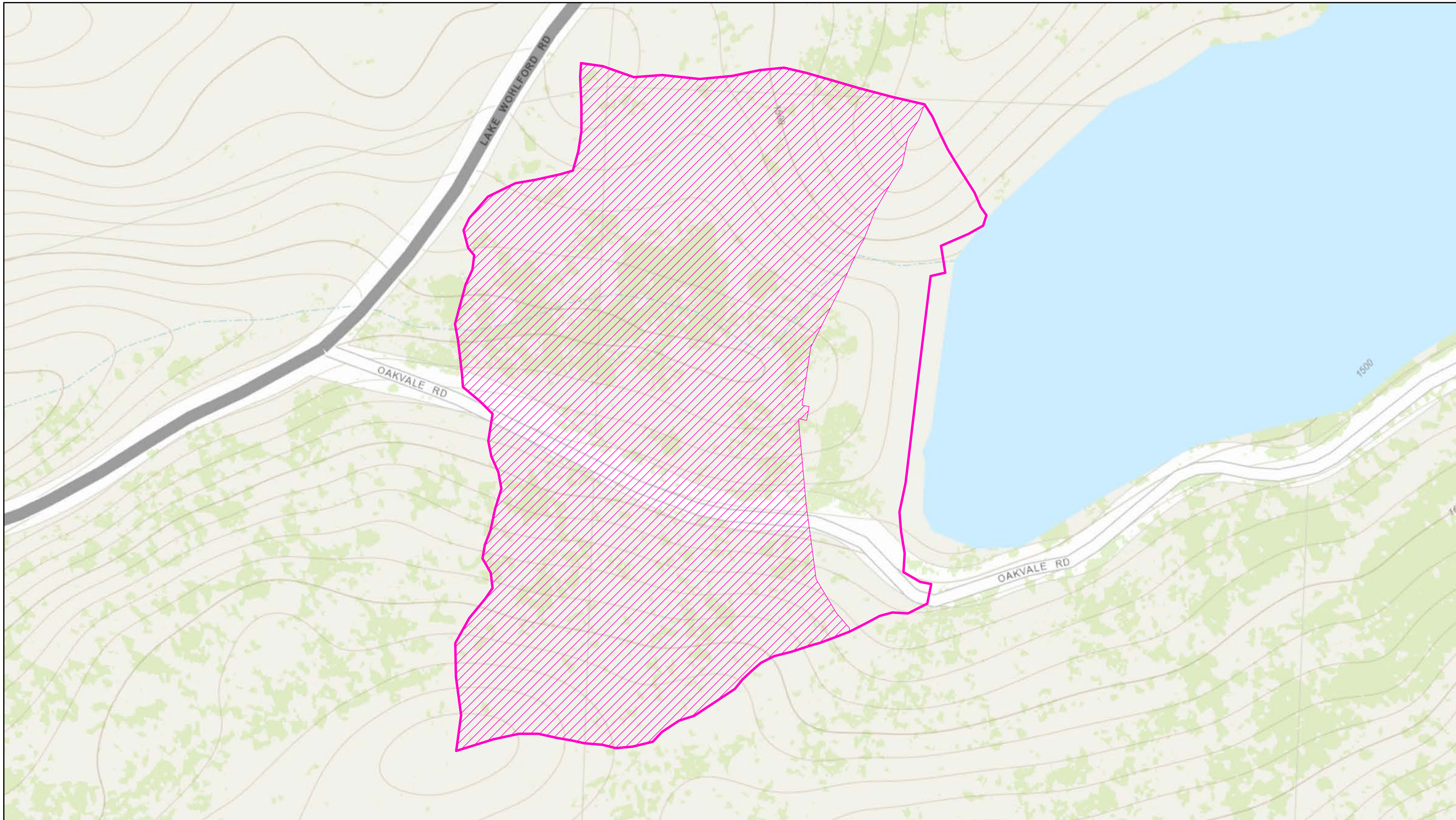
National Weather Service (NWS), (1998). "Hydrometeorological Report (HMR) 58: Probable Maximum Precipitation for California – Calculation Procedures".

U.S. Bureau of Reclamation (USBR), (1987). "Design of Small Dams", Third Edition.

U.S. Bureau of Reclamation (USBR), (2011). "Design Standards No. 14 – Appurtenant Structures for Dam Design Standards."

U.S. Bureau of Reclamation (USBR). "EM-25 Hydraulic Design of Stilling Basins and Energy Dissipators."

U.S. Army Corps of Engineers (USACE), (1992). "EM 1110-2-1603, Hydraulic Design of Spillways."



Map Features

Watersheds

Existing

Proposed

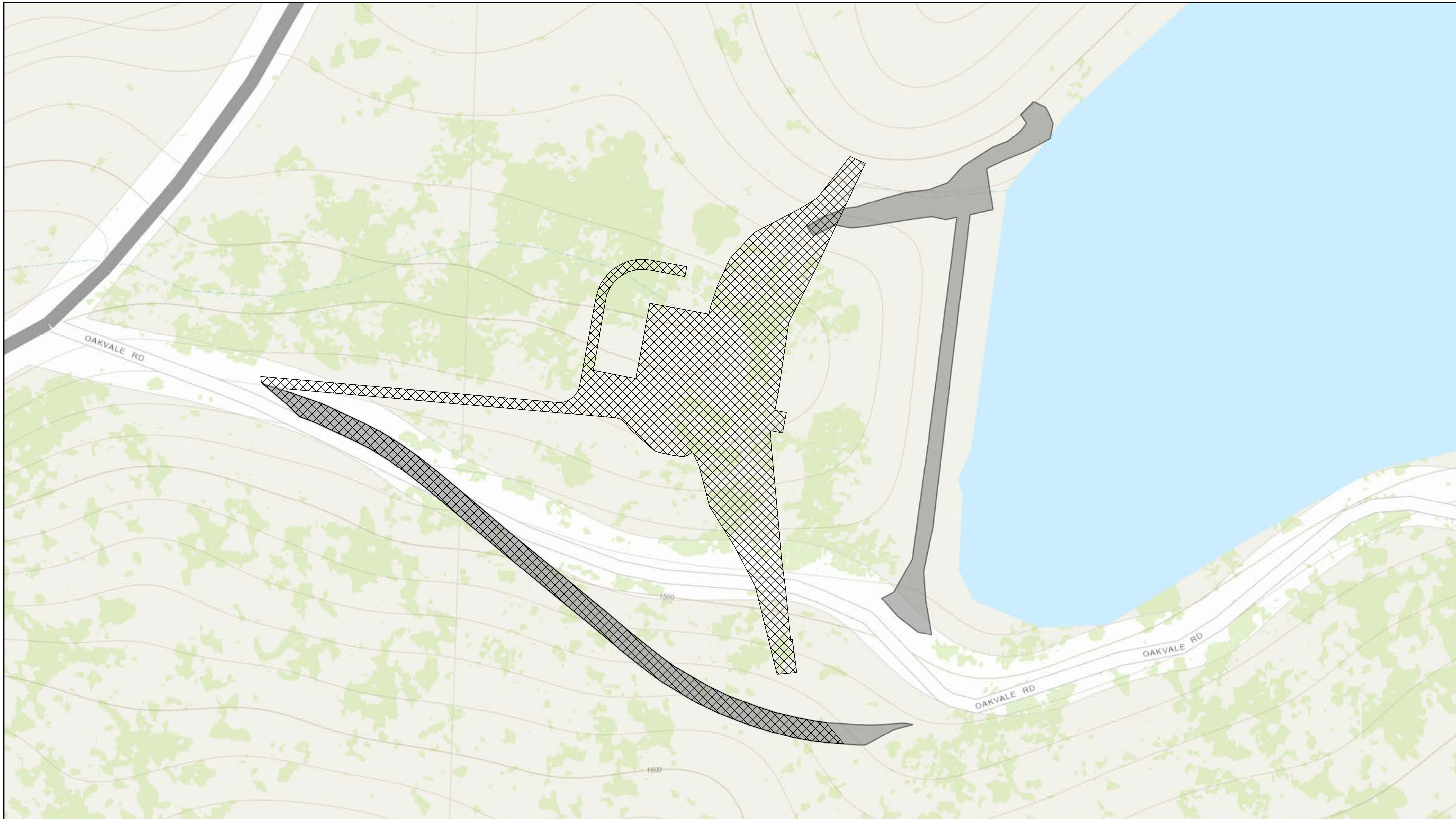
Figure 1: Watershed Boundaries and Topographic Map

N

0 90 180 360 Feet

Figure 2: Existing Land Cover

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Map Features

Impervious Areas

Proposed

Existing

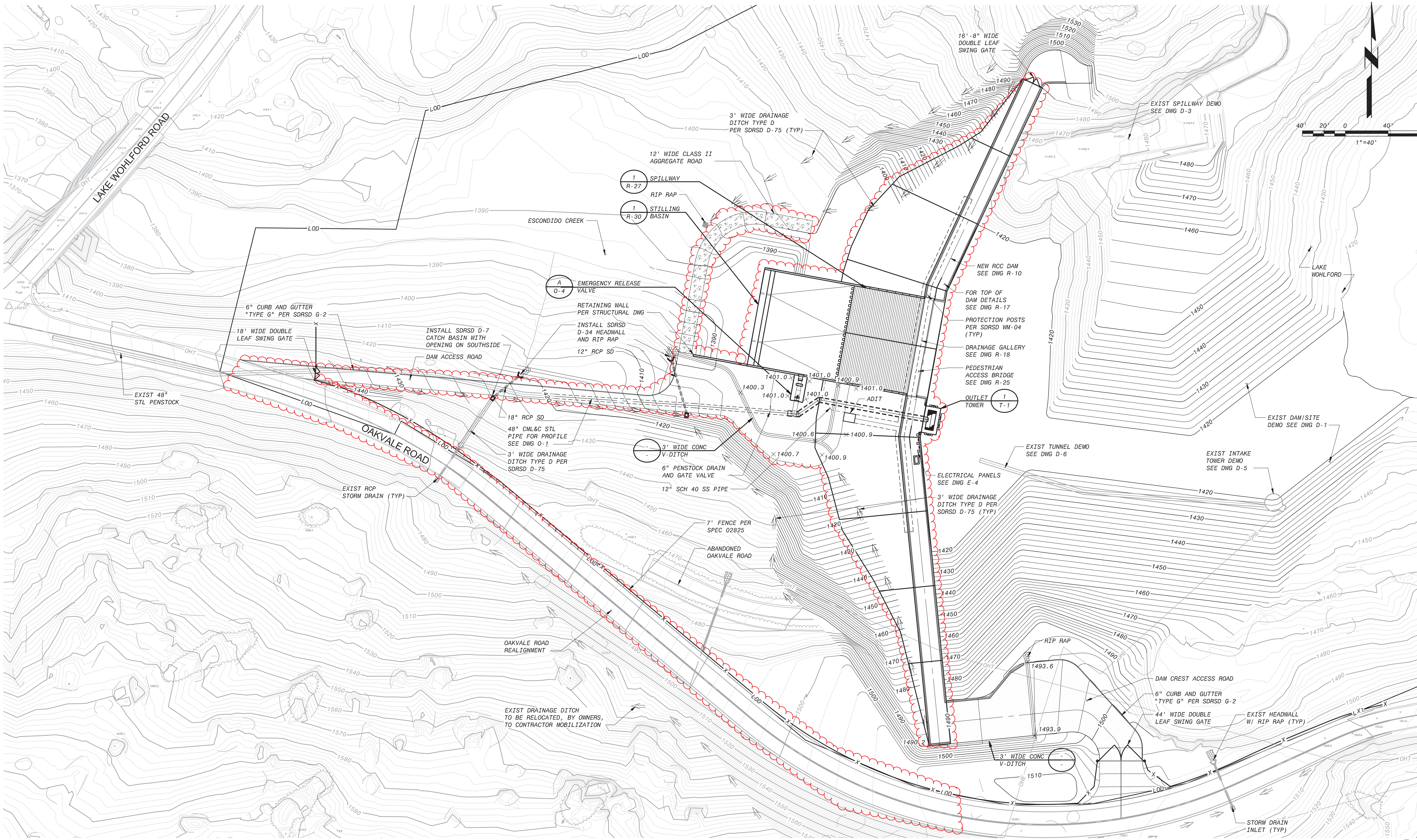
Figure 3: Impervious Areas

N

0 60 120 240 Feet

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

APPENDIX A – 60% DESIGN DRAWINGS



SITE PLAN
1" = 40'-0"

PRELIMINARY - NOT FOR CONSTRUCTION

ESCONDIDO City of Choice

REGISTERED PROFESSIONAL ENGINEER JOHN T. BEKMANIS No. C59947 Exp. 6/30/16 CIVIL STATE OF CALIFORNIA

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LAKE WOHLFORD DAM
REPLACEMENT PROJECT

DRAWING NO. C-1

CITY OF ESCONDIDO

CIVIL
PLAN OF DAM SITE

Sheet of

CONSTRUCTION RECORD	REFERENCES	Date	By	REVISIONS	App'd	Date	BENCH MARK	SCALE		Designed By	Drawn By	Checked By	
Contractor							MONUMENT 2179 NORTH 2005276.219 EAST 6331748.463 ELEVATION 1548.017 2" IRON PIPE WITH DISC STAMPED "ESCS 1992 2179" ON TOP OF A DIRT SLOPE	Horizontal 1"=40'	Office	CTD	JEG	JWB	Submitted
Inspector								Vertical NO SCALE	Filmed	Plans Prepared Under Supervision Of			By Deputy Director of Utilities
Date Completed							ELEVATION 806.75 NGVD 29 DATUM; US FEET		Traffic	Date R.C.E. No.			

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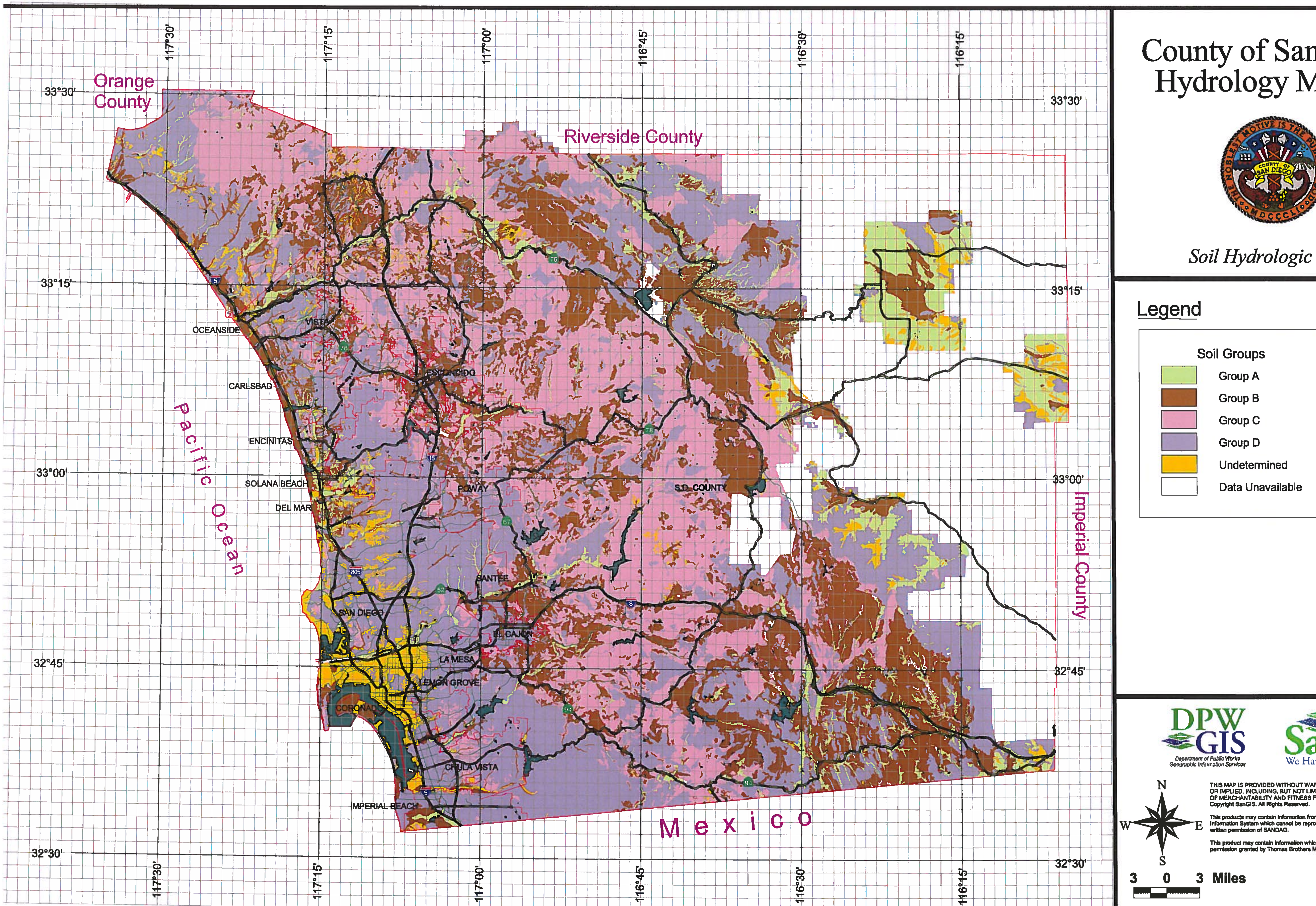
APPENDIX B – ISOPLUVIAL AND SOIL MAPS FROM THE COUNTY OF SAN DIEGO

County of San Diego Hydrology Manual

Soil Hydrologic Groups



DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
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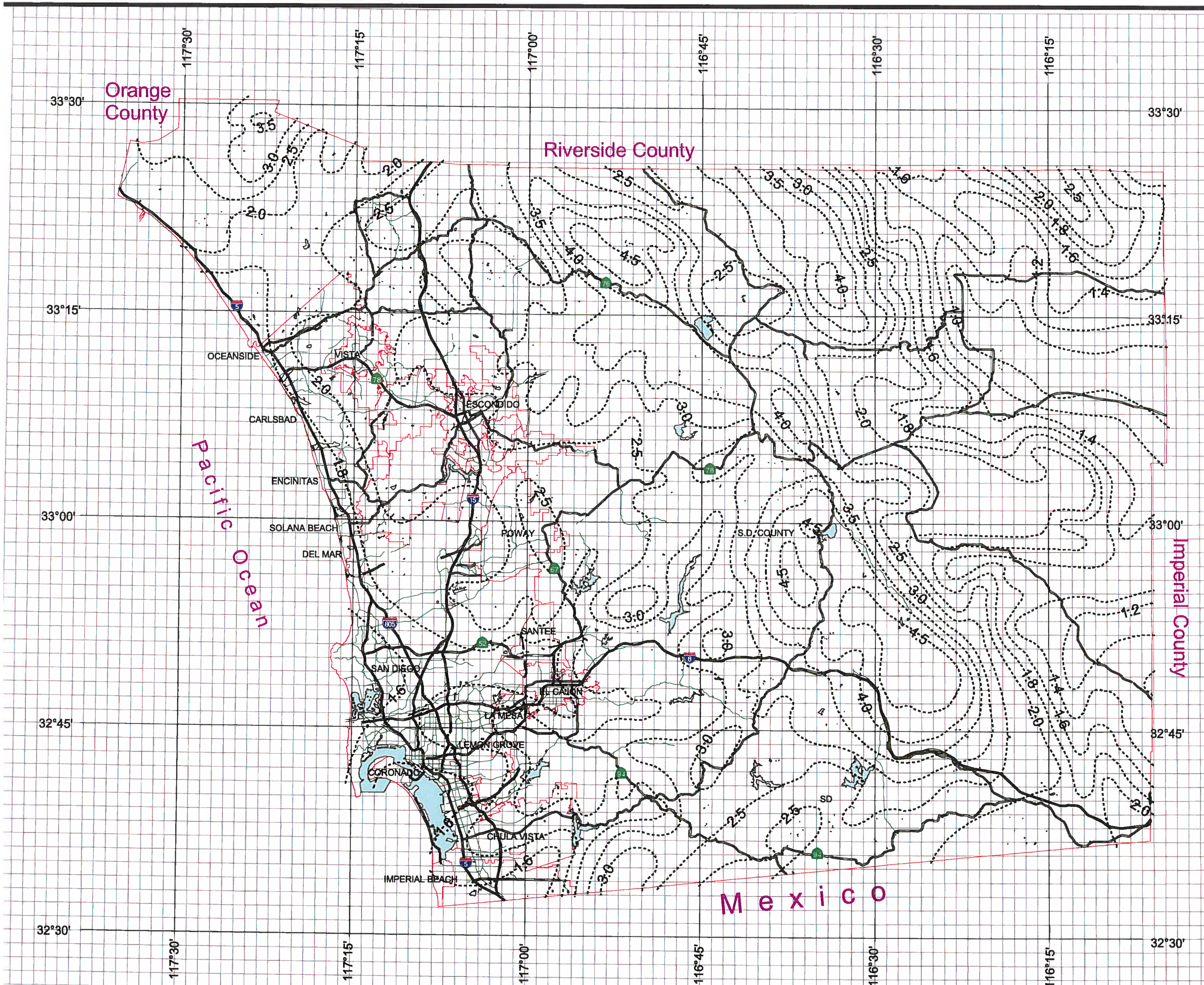

County of San Diego Hydrology Manual

Rainfall Isopluviais

2 Year Rainfall Event - 24 Hours

Isopluvial (inches)

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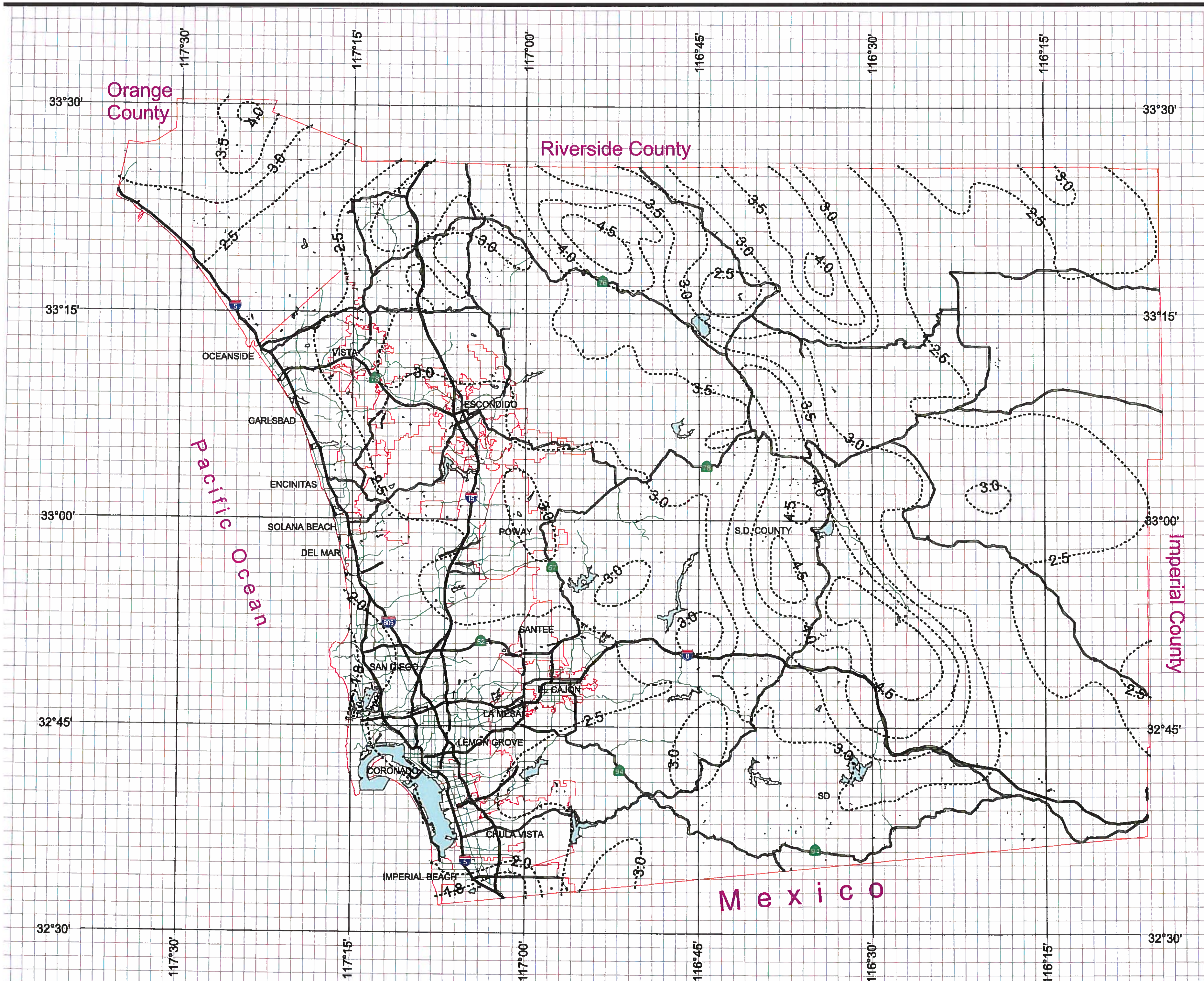
N S W E

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

50 Year Rainfall Event - 6 Hours

-------- Isopluvial (inches)

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N S E W

3 0 3 Miles

APPENDIX C – TIME OF CONCENTRATION CALCULATIONS

Watershed Information from CAD and GIS:

Condition	Area_Acres	Area_SqMi	Percent Impervious
Existing_Imperv	0.9	1.5E-03	4.55%
Proposed_Imperv	2.0	3.1E-03	11.75%
Existing_All	20.6	3.2E-02	
Proposed_All	17.0	2.7E-02	

Rational Method Calculations

	Existing	Proposed	
WS Area (acres)	20.57	17.00	
Impervious Area	0.94	2.00	
% Imperv	4.55%	11.75%	
WS C	0.3	0.3	Undisturbed Natural Terrain
Imp C	0.87	0.87	Commercial/Industrial - General Industrial
Weighted C	0.33	0.37	

Tc 5.00 minutes — Minimum Tc for Rational Method is 5 minutes per CSD Hydrology Manual

$$I = 7.44\ P_6\ D^{-0.645}$$

Where: P_6 = adjusted 6-hour storm rainfall amount (see discussion below)
D = duration in minutes (use T_c)

50 Yr, P6	3.1	inches
I_{Tc}	8.17	inches/hour
Soil Type	C	

$$Q = C\ I\ A$$

Where: Q = peak discharge, in cubic feet per second (cfs)
C = runoff coefficient, proportion of the rainfall that runs off the surface (no units)
I = average rainfall intensity for a duration equal to the T_c for the area, in inches per hour (Note: If the computed T_c is less than 5 minutes, use 5 minutes for computing the peak discharge, Q)
A = drainage area contributing to the design location, in acres

Qp Existing	54.76	cfs
Qp Future	50.97	cfs

Time of concentration calculations: Three variations

Case #1 - Full TR-55 methodology

Sheet Flow

n	0.2	(considered at a range from 0.24 to 0.011)
L	100	ft
P_2	2.9	in
Starting Elevation	1712	ft
Ending Elevation	1588	ft
S	1.24	ft/ft
T1	0.041	hr
	2.5	min

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}\, s^{0.4}} \quad \text{[eq. 3-3]}$$

where:

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1)
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

Figure 3-1 (average velocities for estimating travel time for shallow concentrated flow):
Unpaved $V = 16.1345\,(s)^{0.5}$
Paved $V = 20.3282\,(s)^{0.5}$

where

V= average velocity (ft/s)
s = slope of hydraulic grade line (watercourse slope, ft/ft)

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600V} \quad \text{[eq. 3-1]}$$

where:

T_t = travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours.

Shallow Concentrated Flow

L	780	ft
Starting Elev	1588	ft
Ending Elev	1388	ft
S	0.256	ft/ft
Avg V (unpaved)	8.17	ft/s
T2	0.027	hr
	1.59	min

Channel Flow

T3	0.01	hr	see sketch
	0.6	min	

Total Tc	4.68	**min**

Case #2 - Shallow concentrated flow from head of basin to channel (no sheet flow)

L	1688	ft
Starting Elevation	1712	ft
Ending Elev	1388	ft
S	0.19	ft/ft
Avg V (Unpaved)	7.07	ft/s
Alt T1+T2	0.07	hr
	3.98	min
Total Tc, Alt 2	4.58	min

Case #3 - Kirpich equation used to determine travel time after sheet flow

Starting Elevation	1588	ft
Ending Elevation	1384	ft
ΔE	204	ft
L	0.20	mi
Alt T2+T3	0.05	hr
	3.16	min
Total Tc, Alt 3	5.65	min

EQUATION

$$Tc = \left(\frac{11.9L^3}{\triangle E}\right)^{0.385}$$

Tc = Time of concentration (hours)
L = Watercourse Distance (miles)
△E = Change in elevation along effective slope line (See Figure 3-5) (feet)

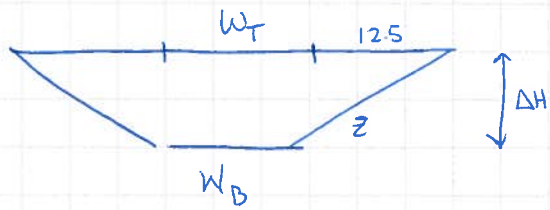
③ Channel flow :

Bottom width = 5'
Top width = 29'

ΔH = 4'

Starting Elev = 1388
End Elev. = 1384

Z = 3
L = 285'



$$V = \frac{1.49\, R^{2/3} \cdot S^{1/2}}{n}$$

Assume d = 2'

n = 0.025

$$S = \frac{4}{285} = 0.014$$

$$R = \frac{5(2) + 3(2)^2}{5 + 2(2)\sqrt{3^2+1}} = 1.25$$

V = 8.18

$$T_3 = \frac{L}{3600 * V} = 0.010 \text{ hr}$$

= 0.6 min

$$T_T = 3.2 + 1.6 + 0.6 = 5.4 \text{ minutes}$$

DO NOT WRITE IN THIS SPACE