FINAL

Channel Maintenance Special Study – Sorrento Maintenance Project

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ACRONYMS

ACOE	U.S. Army Corps of Engineers
BMP	best management practice
CDFW	California Department of Fish and Wildlife
CFR	Code of Federal Regulations
City	City of San Diego
FEMA	Federal Emergency Management Agency
I-	Interstate
IA	Individual Technical Assessment
IHHA	Individual Hydrologic and Hydraulic Assessment
IMP	Individual Maintenance Plan
LID	Low-Impact Development
LOSSAN	Los Angeles–San Diego–San Luis Obispo
MHPA	Multi-Habitat Planning Area
MMP	Master Storm Water System Maintenance Program
MS4	municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
RWQCB	Regional Water Quality Control Board
TMDL	total maximum daily load
USFWS	U.S. Fish and Wildlife Service

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1 INTRODUCTION

The City of San Diego (City) developed the Master Storm Water System Maintenance Program (MMP) (City of San Diego 2011) to govern channel operation and maintenance activities in an efficient, economic, environmentally and aesthetically acceptable manner to provide flood control for the protection of life and property. A lawsuit was filed regarding the MMP (*San Diegans for Open Government et al v. City of San Diego*, San Diego Superior Court Case No. 37-2011-00101571), and the City entered into a settlement agreement (Settlement Agreement), which requires the City to conduct a special study (Channel Maintenance Special Study) to evaluate the purpose, need and alternatives to channel maintenance activities for each channel maintained during the first two years of MMP implementation in City Fiscal Years 2014-2015 and 2015-2016 (FY 14-15).

The current phase of the Soledad Canyon/Sorrento Creek & Flintkote Channel Maintenance Project (Sorrento Maintenance Project) includes the mechanized removal of sediment, vegetation, trash, and debris from two concrete-lined drainage channels in the Sorrento Valley area using heavy equipment. Four drainage facilities converge in this area of Sorrento Valley:

- Soledad Canyon Channel (commonly known as the Sorrento Creek Channel) – MMP Maps 7, 11, and 12
- Los Peñasquitos Creek Channel – MMP Maps 7 and 8
- Roselle Street/11100 Flintkote Avenue Channel (commonly known as the Flintkote Channel) – MMP Map 9
- Dunhill Street at Roselle Street Channel (commonly known as the Dunhill Street Channel) – MMP Map 10

The current phase of the Sorrento Maintenance Project includes maintenance of two concrete-lined facilities (MMP Maps 9 and 11) during fiscal years 2014–2015. This special study fulfills Section 1.8 of the Settlement Agreement for channel maintenance activities occurring within the Sorrento Maintenance Project area.

1.1 Background

The overall Channel Maintenance Special Study summarizes the suite of channel assessment and retrofit opportunities for channels maintained during FY 14–15. Within the framework of the MMP, channel assessment and retrofit evaluation requires consideration of maintenance practices, environmental avoidance and minimization measures, adjacent infrastructure, and project alternatives. Combined, these elements address the specific terms of the underlying legal

agreement for each focal channel. Table 1 provides a summary of the channel assessment and retrofit opportunity elements addressed in this Channel Maintenance Special Study.

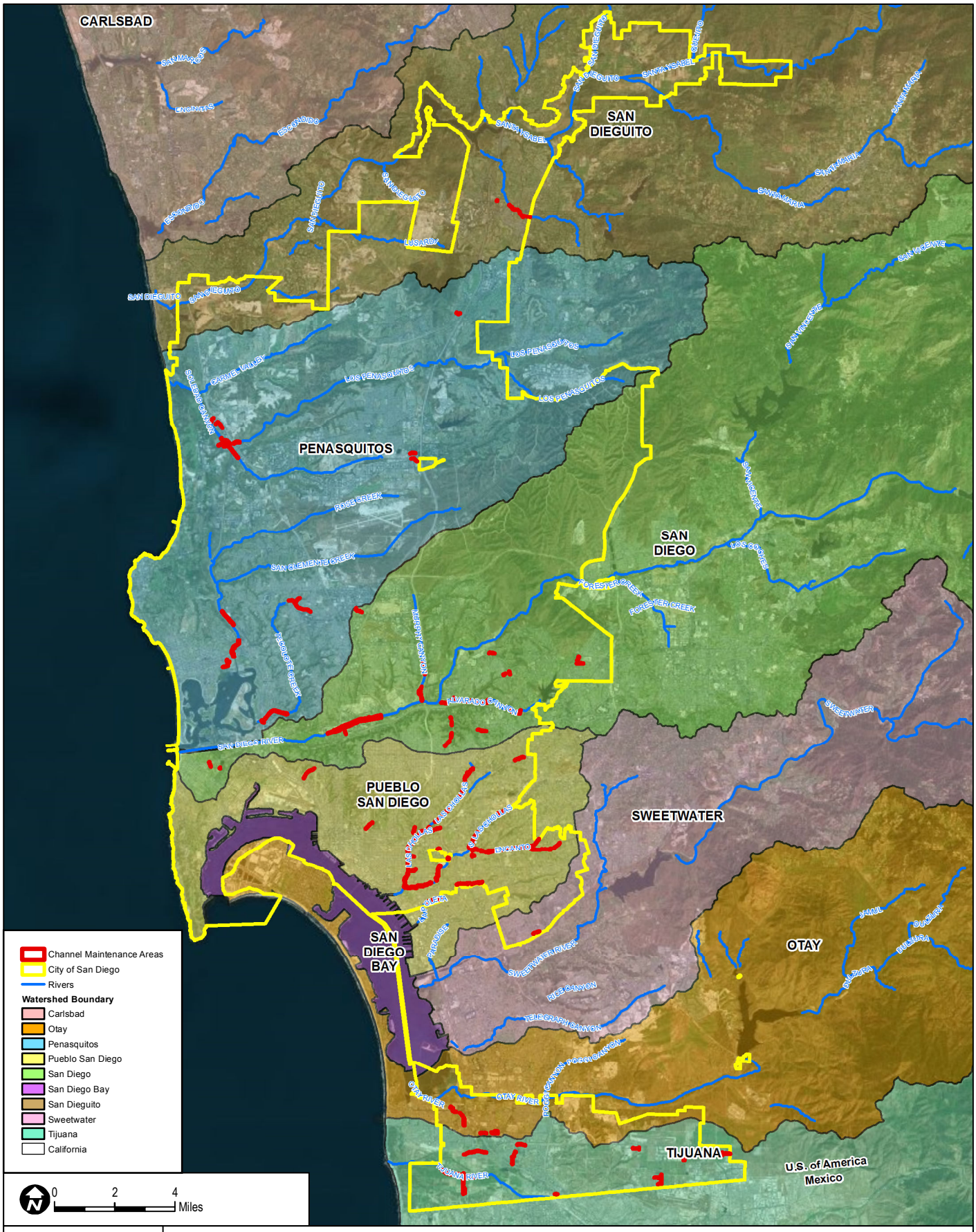
Table 1
Channel Maintenance Special Study Overview Based on Settlement Agreement Item 1.8

Settlement Agreement Requirements	Section of Special Study
Evaluate Current Maintenance Level	
Purpose of conveyance system location	2.1
Need for conveyance system	2.1
Need for maintenance at individual locations	2.2
Potential to modify maintenance practices	2.2
A comparison of vegetation trimming and vegetation removal by roots	2.2
Frequency of maintenance	2.3
Need for herbicide treatment	2.4
Vegetation analysis – native/non-native	2.5
Potential to support endangered or threatened species, or regionally sensitive species	2.6
Infrastructure opportunities surrounding the channel	2.7
Retrofit Opportunities to Reduce Maintenance Needs	
Daylighting concrete channels	3.1
Preserving habitat that is a wildlife corridor, habitat for special-status species	3.2
Discharges into 303(d) listed water body, reduce downstream flooding through localized Low Impact Development (LID), including land acquisition for conversion to wetlands	3.3

This Channel Maintenance Special Study evaluates the purpose, need, and alternatives to channel maintenance activities in the Sorrento Maintenance Project area.

1.2 Master Maintenance Program Overview

The MMP identifies a specific planning, impact assessment, and mitigation process for channel maintenance activities within portions of the City (Figure 1). For each channel maintenance project, an Individual Maintenance Plan (IMP) and related Individual Technical Assessments (IAs) were prepared (City of San Diego 2011a). The IMPs identify the scope of work, maintenance methodology and procedures, equipment, and duration of maintenance activities planned in the channels, and include as appendices the channel-specific IAs. The IAs consist of an Individual Biological Assessment, Individual Historical Assessment, Individual Hydrologic and Hydraulic Assessment (IHHA), Individual Water Quality Assessment, and Individual Noise Assessment. The IMPs also include a comprehensive list of best management practices (BMPs); maintenance protocols and mitigation measures derived from the applicable permits; and regulations that are being implemented to avoid, minimize, and/or mitigate potential environmental effects to sensitive resources.



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SOURCE: Bing Maps 2014; City of San Diego 2013, 2014; SANGIS 2014; DWR 2014

FIGURE 1

Master Maintenance Program Channel Overview

Channel Maintenance Special Study - Sorrento

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As part of the IMP process, the IHHA and IWQA provide data that allows for evaluation of the purpose, need and alternatives to channel maintenance activities and serve as a basis for this special study. The IWQA also provides a suite of water quality and soil monitoring activities that may be used to evaluate the potential water quality benefits of channel maintenance projects that remove sediment and pollutants from channel areas. The IMPs and IAs comprise the Substantial Conformance Review package for review and approval by the City's Development Services Department under the MMPs Programmatic Environmental Impact Report (City of San Diego 2011a).

In addition to the City's Substantial Conformance Review process, the City is also required to obtain permit authorization from the California Department of Fish and Wildlife (CDFW), Regional Water Quality Control Board (RWQCB), U.S. Army Corps of Engineers (ACOE), California Coastal Commission (CCC) and U.S. Fish and Wildlife Service (USFWS) for approval under the terms and conditions of their respective regulatory authorities.

1.3 Project Channels

The two maintenance channels for the Sorrento Maintenance Project discussed in this special study are located in the Sorrento Valley area, within the jurisdiction of the City. The major drainage facilities that serve the region consist of the Soledad Canyon Channel, Los Peñasquitos Creek, the Flintkote Channel, and the Dunhill Street Channel. The Sorrento Maintenance Project is generally located near the interchange of Interstate (I) 5 with I-805 within the City's Coastal Overlay Zone (Figure 2). The area falls within the City's Torrey Pines Community Plan and Local Coastal Program.

For the purposes of a detailed analysis required under the MMP, portions of the drainage facilities in the Sorrento Valley area were assigned a reach number (Figure 3). Detailed descriptions of each reach are provided in the IMP (URS 2013).

Reach 3 (Sorrento Creek Channel; MMP Map 11) and Reach 7 (Flintkote Channel; MMP Map 9) are concrete-lined portions of the drainage facilities and the only sections where maintenance has occurred under the MMP. The remaining reaches (1, 2, 4, 5, 6, and 8) are not currently proposed for maintenance.

Reach 3 refers to a trapezoidal, concrete-lined portion of lower Soledad Canyon Creek (Figure 4). It extends from the southerly end of Reach 2 to the southeast for approximately 2,290 feet to a point located approximately 1,550 feet to the southeast of Sorrento Valley Boulevard, where the trapezoidal concrete-lined channel ends and transitions to an earthen-bottom channel.

The trapezoidal channel geometry consists of a 5-foot-deep, 63-foot-wide bottom, and 1.5-to-1 side slope section. Reach 3 is located on the U.S. Geological Survey 7.5-minute series, Del Mar quadrangle, Township 15 South, Range 3 West, and Section 5. The approximate center of Reach 3 is located at latitude 32°53'58''N and longitude 117°13'20''W.

Reach 7 refers to an unnamed, trapezoidal, concrete-lined channel that extends for approximately 1,100 feet from the easterly side of Flintkote Avenue to Reach 2 of Sorrento Creek near its confluence with Soledad Canyon Creek (Figure 5).

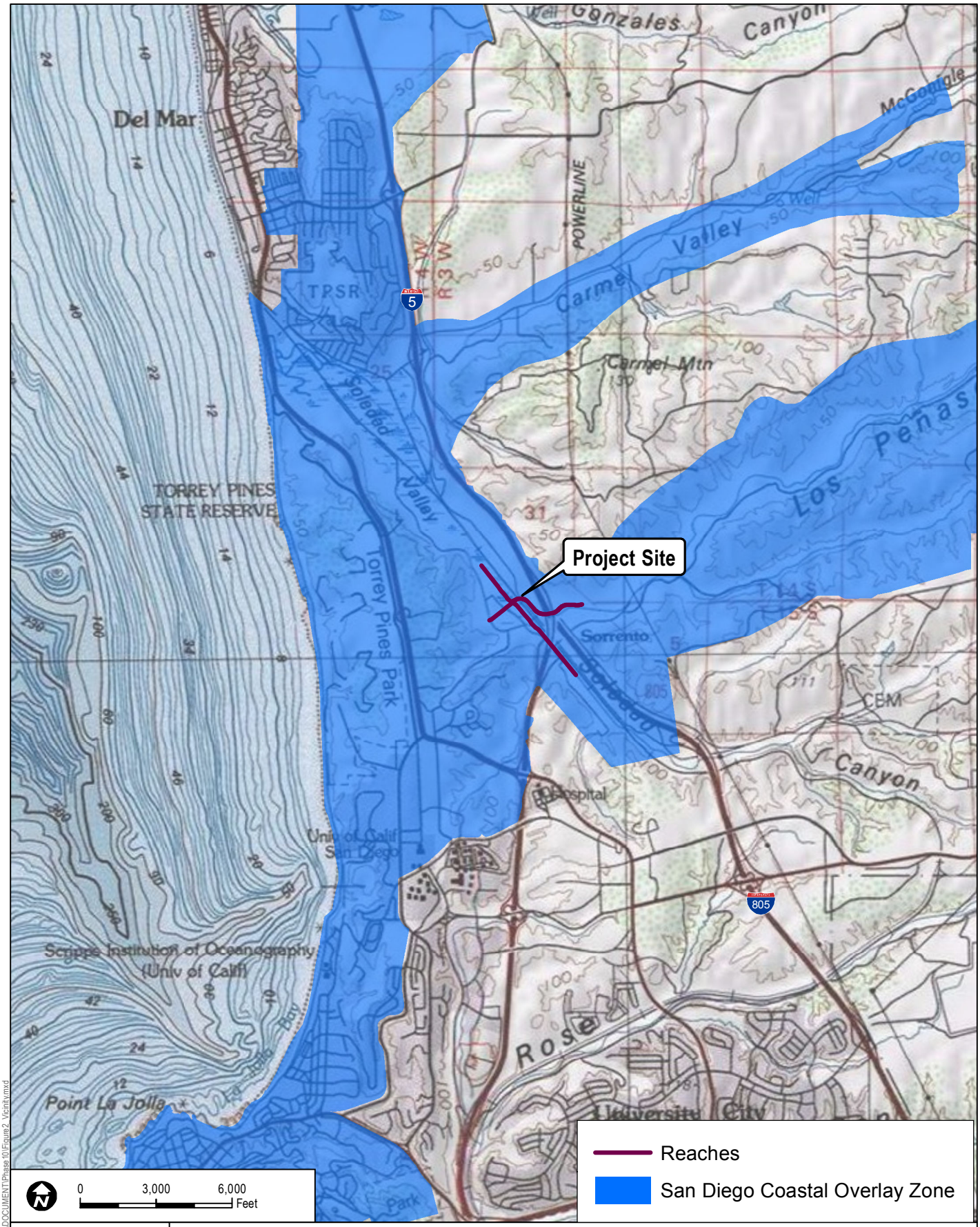
Reach 7 flows roughly in a southwest to northeast direction, bisecting a light industrial park along its entire length and crossing Roselle Street. A 2-foot-high, 12-foot-wide culvert conveys the storm flows under Roselle Street, and a dual 36-inch-diameter reinforced concrete pipe culvert discharges the storm flows into Reach 2 of Sorrento Creek. The trapezoidal geometry is described as a 4-foot-deep, 8-foot-wide bottom with 1-to-1 side slopes. Reach 7 is located on the U.S. Geological Survey 7.5-minute series, Del Mar quadrangle, Township 14 South, Range 3 West, and Section 31. The approximate center of Reach 7 is located at latitude 32°54'15''N and longitude 117°13'49''W.

These facilities are located within the Los Peñasquitos watershed (Los Peñasquitos Hydrologic Unit). This watershed drains to Los Peñasquitos Lagoon and eventually to the Pacific Ocean. Surrounding uses include the Los Angeles–San Diego–San Luis Obispo (LOSSAN) rail corridor, commercial, and industrial development, and to the north, Torrey Pines State Reserve. The area immediately adjacent to the maintenance channels is zoned IL-3-1 (Industrial-Light) and designated for industrial and open space land uses in the Torrey Pines Community Plan Local Coastal Program. Reaches 3 and 7 are adjacent to but outside of the City's Multiple Species Conservation Program's Multi-Habitat Planning Area (MHPA).

These reaches are each supplied by different subwatersheds. The contributing watershed to Reach 3 is Soledad Canyon. The contributing watershed to Reach 7 consists of unnamed stream channels flowing downhill and east from Torrey Pines mesa.

The project area is located within a Special Flood Hazard Area as specified by the Federal Emergency Management Agency (FEMA), and is subject to inundation by the 1% annual chance flood and 100-year floodway (Figure 6).

As a result of National Pollution Discharge Elimination System (NPDES) regulatory and other drivers, the City has prepared both jurisdictional and watershed scale plans that detail operational, administrative and structural activities for compliance with requirements. In 2015, the City updated its Jurisdictional Runoff Management Plan (JRMP) and is working collaboratively with stakeholders in the Los Penasquitos watershed to complete a watershed plan, known as Water Quality Improvement Plan (WQIP). The City's dual responsibility for water quality management and operation and maintenance of the storm drain system are integrated by implementation of the MMP, JRMP and WQIP. The City therefore performs operation and maintenance activities in the Sorrento Maintenance Project within the context of the integrated water quality improvement and flood control risk management approach identified in the MMP, JRMP and WQIP documents.



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SOURCE: USGS 7.5-Minute Series - Del Mar Quadrangle.

FIGURE 2

Sorrento Maintenance Project Vicinity

Channel Maintenance Special Study - Sorrento

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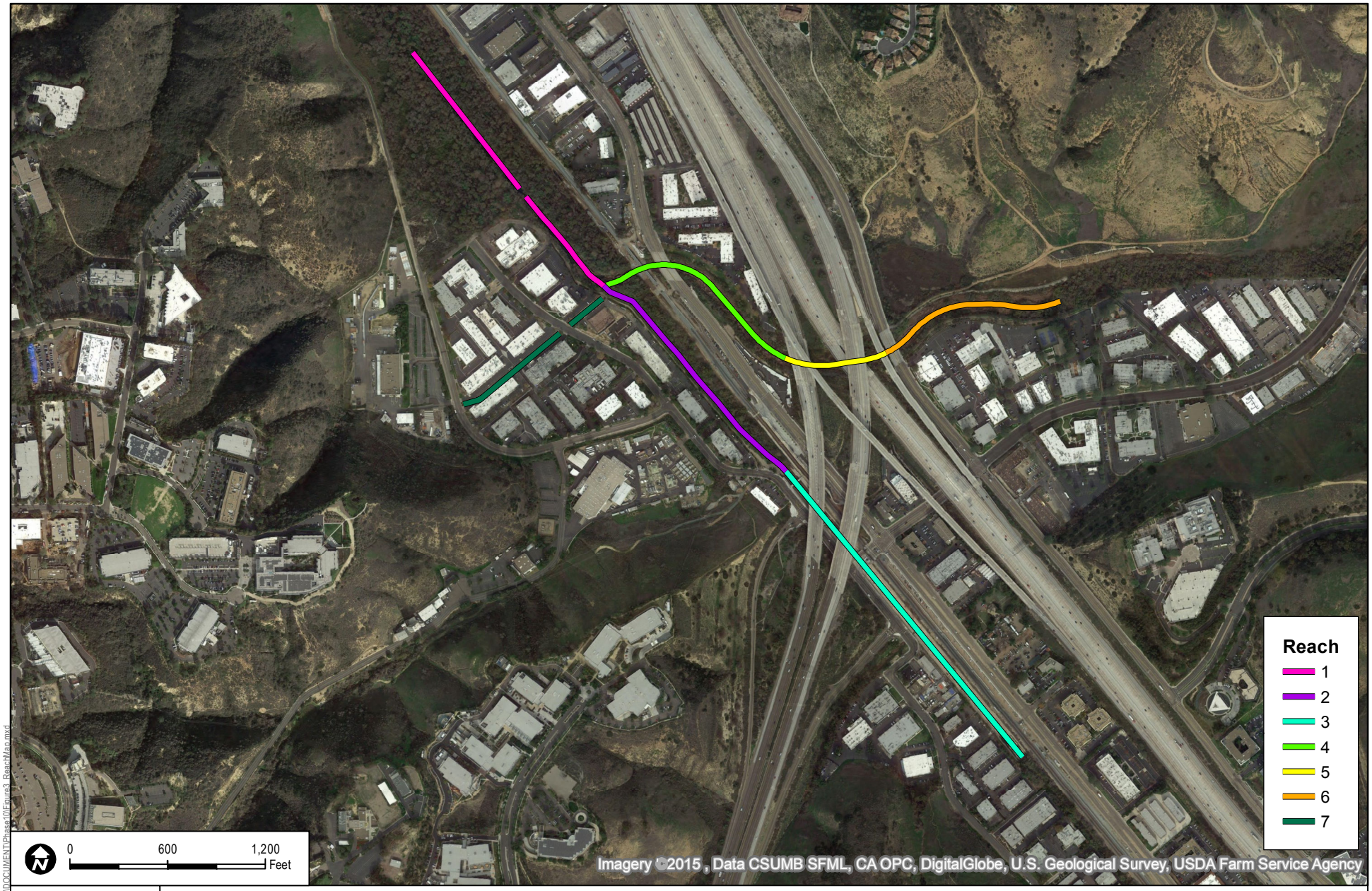

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SOURCE: Google Imagery, 2015.

FIGURE 3

Sorrento Maintenance Project Reach Areas

Channel Maintenance Special Study - Sorrento

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Figure 4 Reach 3, Looking Upstream from Sorrento Valley Boulevard

Figure 5 Reach 7, Looking Downstream from the Pedestrian Bridge

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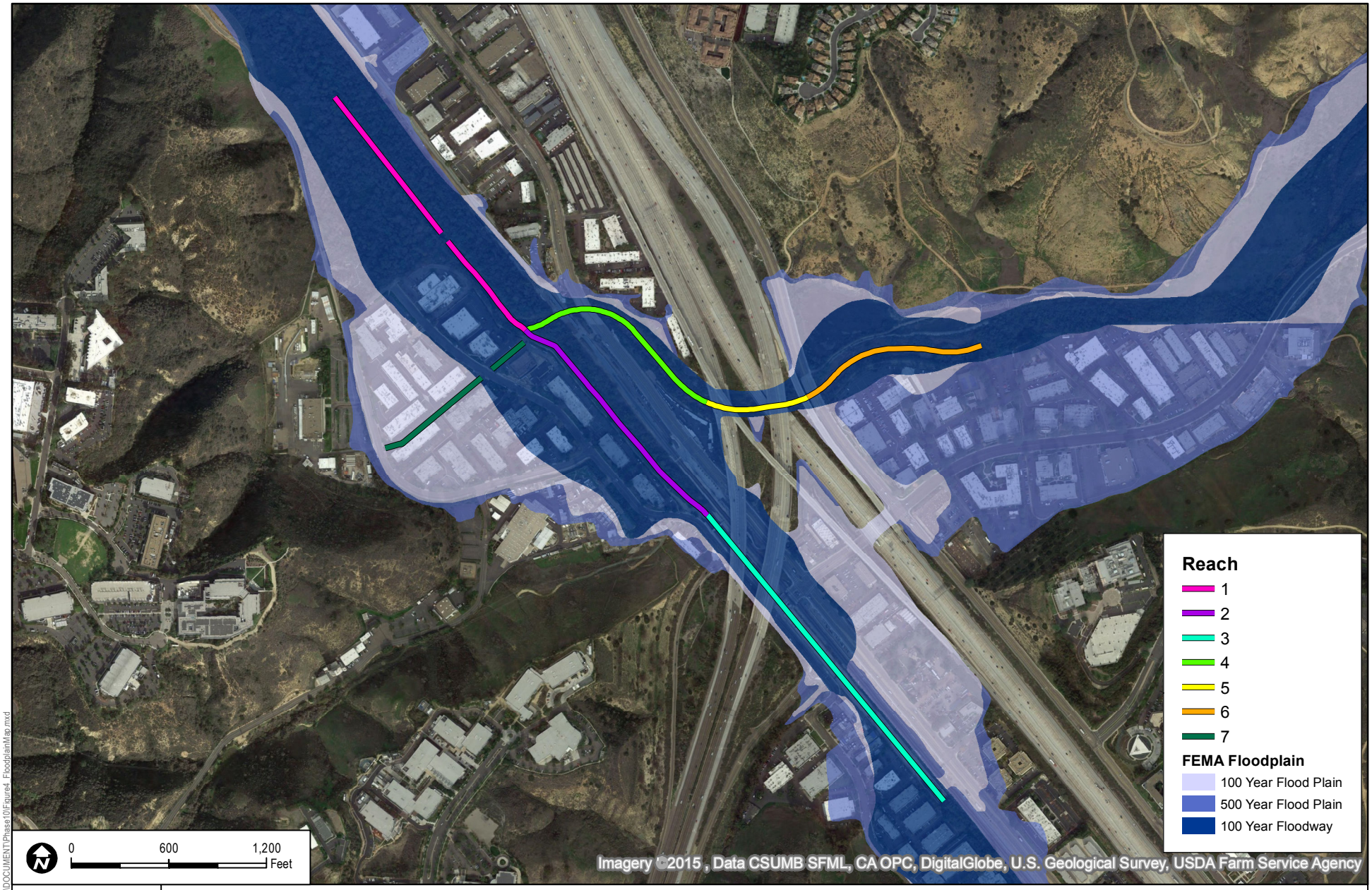

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SOURCE: Google Imagery, 2015; FEMA, 2014.

FIGURE 6

Sorrento Maintenance Project Floodplain Map

Channel Maintenance Special Study - Sorrento

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1.4 Maintenance Activity

The Sorrento Maintenance Project's IMP and IA package received Substantial Conformance Review approval in October 2013. Approriate environmental permits were also issued by CDFW, RWQCB, USFWS, ACOE, and the California Coastal Commission in 2013. Sorrento Creek Channel maintenance activities described in this report were conducted between September 16, 2014 and November 11, 2014; maintenance activities in the Flintkote Channel occurred between March 4 and March 14, 2014 and between March 11 and 14, 2015. These were the first maintenance activities within the Sorrento Creek Channel that were authorized under the MMP; previous maintenance activities were authorized under emergency maintenance permits.

The Sorrento Maintenance Project consists of excavating vegetation, sediment, and trash that restrict the capacity of the channels to convey storm flows. The City was permitted to use heavy equipment to remove between 2,000 and 4,000 cubic yards of material within the Sorrento Creek Channel, and 125 to 175 cubic yards of material from within the Flintkote Channel.

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2 CHANNEL ASSESSMENT

This section summarizes current maintenance practices, avoidance and minimization measures, and existing adjacent infrastructure and constraints for the Sorrento Maintenance Project.

2.1 Current Maintenance Level

From its early origination as a stream-cut valley more than 15,000 years ago, the convergence of channels in Sorrento Valley presumably functioned as a dynamic river system (LPLF 2015). In a dynamic system, channels that convey water during major storm events shift location over time, depending on channel and vegetation stability, storm event size and frequency, large-scale climatic dynamics, and other factors. Beginning with the 1823 purchase of Rancho Los Peñasquitos, which included 8,486 acres within Los Peñasquitos Canyon and its upper drainages, landscape alterations and development in the watershed have influenced the structure and function of the Sorrento Maintenance Project area. Rapid urban development within Sorrento Valley in the 1960s and 1970s led to channelization and constriction of stream flows within the region to facilitate development of infrastructure, including, roads, the railroad, and industrial and commercial uses. Channel alteration and maintenance levels varied through this period. Sorrento Valley is now considered a regional center for biotechnology, research and development, and other light industrial activity.

Based on a review of historic aerials, it appears that Reach 3 was channelized in 1965 to divert flows adjacent to Sorrento Valley Road and adjacent businesses (Historic Aerials 2015). Reach 7 was channelized between 1966 and 1980. Combined, landscape alterations, urban development, and channelization resulted in a change to the natural system, thus creating the need for periodic maintenance of various reaches of the Sorrento Maintenance Project areato reduce flood risk in the adjacent built environment.

Past Maintenance

The majority of the configuration changes that led to the current channel alignments in Sorrento Valley occurred in the 1970s. However, little documentation is available regarding the construction of these channels and maintenance efforts throughout the 1980s and 1990s. In 1997, the City conducted an emergency maintenance operation to dredge approximately 67,000 cubic yards of sediment and vegetation from the earthen and concrete channels (Sipes 2010). Emergency maintenance efforts occurred again in 2011 because of flooding in the area that was impacting bio-technology and other businesses (City of San Diego 2011b). Flooding during the 2010-11 wet season caused the rail lines to be submerged for more than one week (Del Mar Times 2013).

The approval of the MMP has allowed the City to pursue an integrated effort for environmental permitting and maintenance activities in the Sorrento Maintenance Project concrete-lined

channel areas. The surrounding biological habitat and sensitive downstream resources necessitate that the City use the MMP to coordinate evaluation of maintenance need and impacts, and to develop appropriate mitigation strategies. Recent maintenance efforts occurred in fall and winter 2014 and again in March 2015, and are described below.

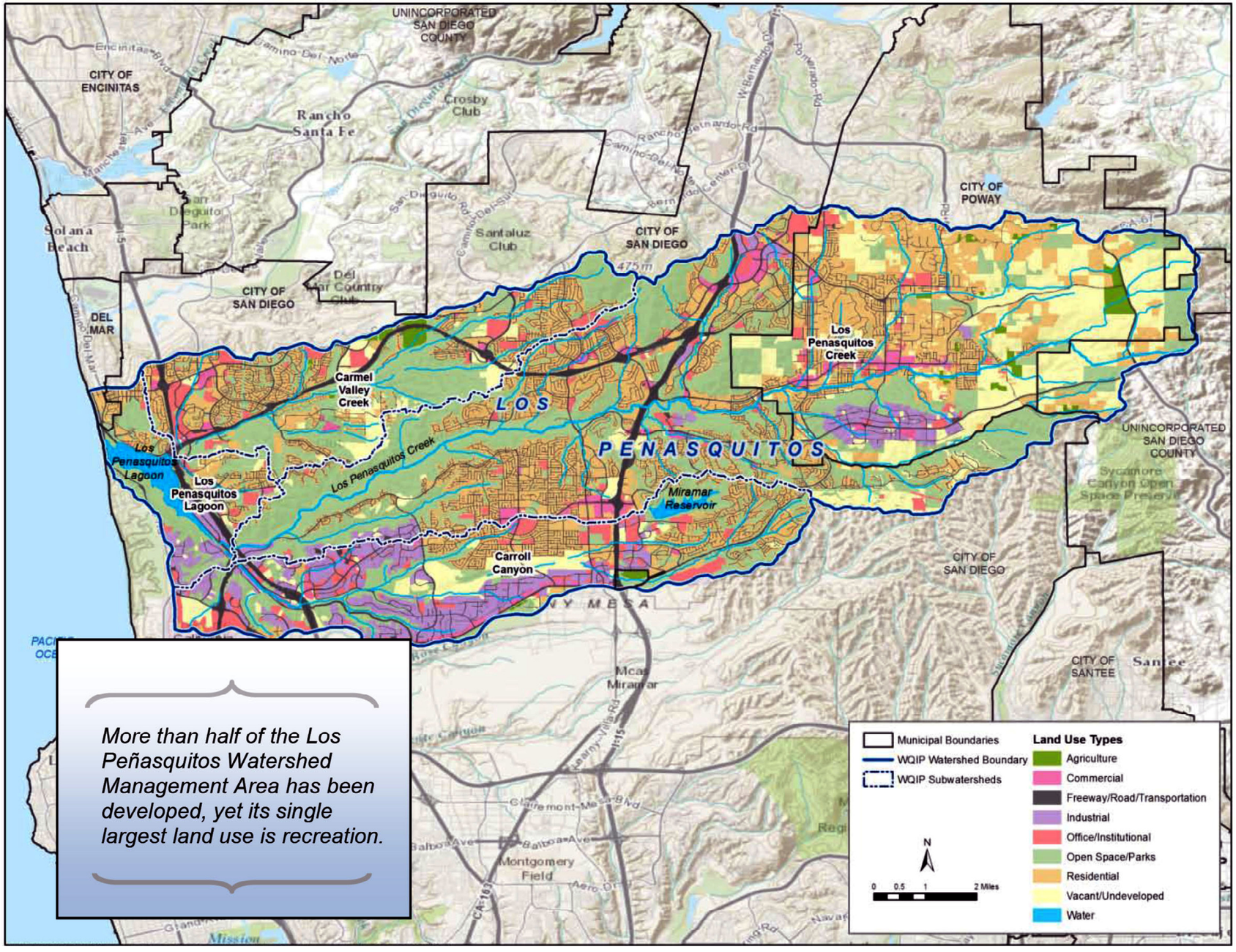
In 2014, the City removed between 2,000 and 4,000 cubic yards of accumulated vegetation and sediment from Reach 3, and between 125 and 175 cubic yards of accumulated vegetation and sediment from Reach 7 (URS 2013). In March 2015, an additional 763 linear feet of accumulated sediment was removed from the lower portion of Reach 3. Maintenance methods included diversion of dry-weather stream flows, excavation and stockpiling of material using heavy equipment, and disposal of sediment and vegetation at an appropriate landfill involving truck transport.

Purpose and Location

The Los Peñasquitos watershed drains a highly urbanized region west of I-15, south of Del Mar, and north of the San Diego River. The 100-square-mile watershed supports at least 400,000 residents (Figure 7). The purpose of the Sorrento Maintenance Project is to maintain concrete-lined portions of the channel areas to provide flood protection to surrounding properties and reduce impacts to the Los Peñasquitos Lagoon from downstream transport of accumulated sediment, trash, and pollutants. Past and future maintenance projects may include maintenance of earthen-lined channels, downstream of the concrete-lined Reaches 3 and 7.

Three major streams drain the watershed and flow into the tidal lagoon. Los Peñasquitos Creek is the largest catchment in the watershed, draining 59 square miles (approximately 37,760 acres) through its central portion (Figure 8). Carroll Canyon Creek (also referred to as Sorrento Creek or Soledad Canyon Creek) is the second largest catchment (approximately 18 square miles or 11,520 acres) and drains the southern portion of the watershed. Carmel Creek is located along the northern coastal area and drains the remaining 16 square miles (approximately 10,240 acres). Los Peñasquitos Creek and Carroll Canyon Creek converge just north of the Sorrento Maintenance Project area, prior to entering the Los Peñasquitos Lagoon.

The Los Peñasquitos Lagoon is listed on the 303(d) list for sediment/siltation (SRWQCB 2010). In addition, the U.S. Environmental Protection Agency approved a Basin Plan amendment on October 30, 2014, to incorporate the Los Peñasquitos Lagoon sediment Total Maximum Daily Load (TMDL) (AMEC 2014). Ongoing maintenance of these channels to reduce the potential for downstream sediment deposition and pollutants is important for meeting the TMDL requirements.



More than half of the Los Peñasquitos Watershed Management Area has been developed, yet its single largest land use is recreation.

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SOURCE: SOURCE: Project Clean Water 2015

FIGURE 7

Los Penasquitos Watershed Management Area Land Use

Channel Maintenance Special Study - Sorrento

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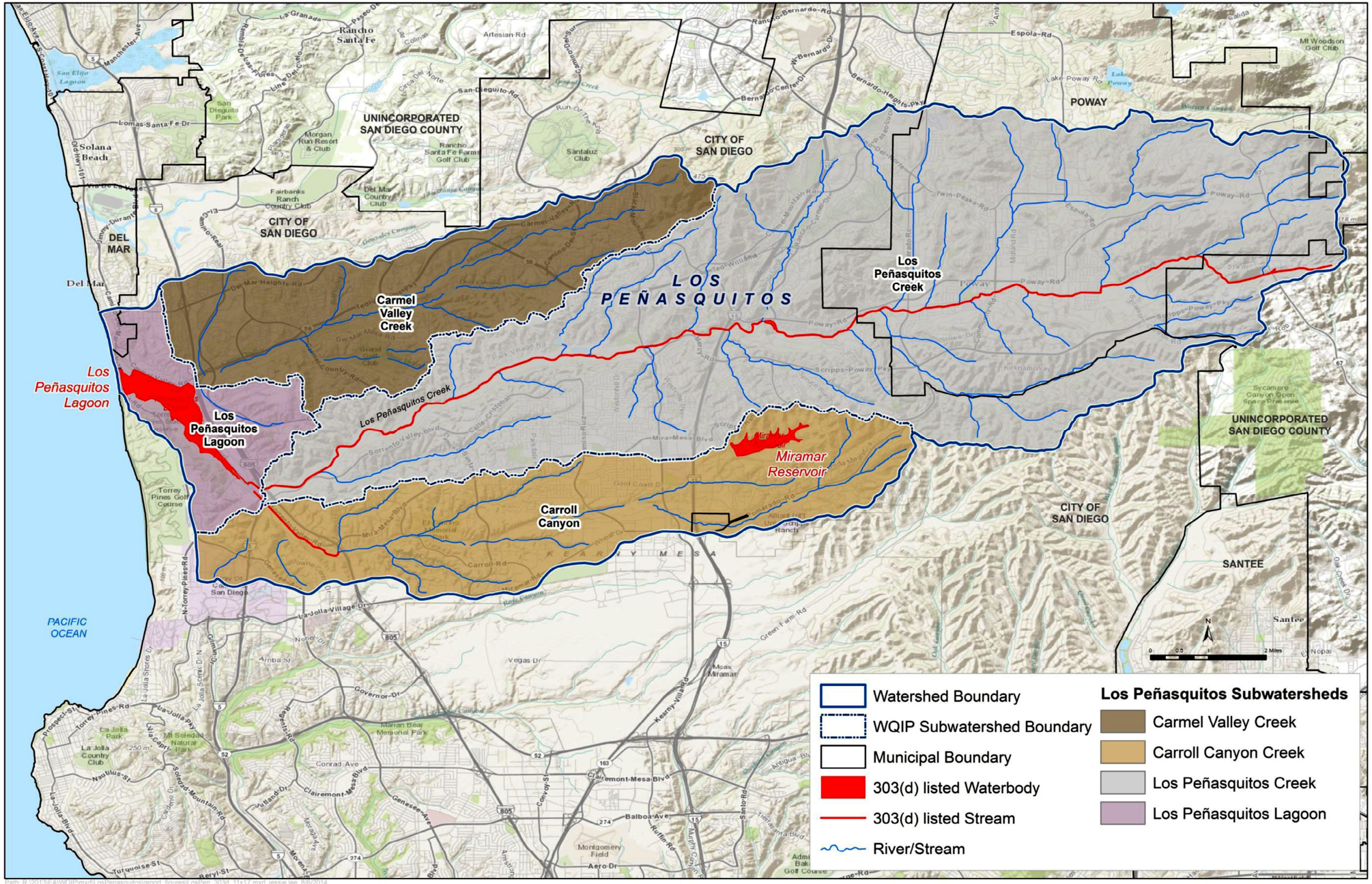

SOURCE: SOURCE: Project Clean Water 2015

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FIGURE 8

Los Penasquitos Subwatersheds and 2010 303(d) Listed Waterbodies

Channel Maintenance Special Study - Sorrento

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The results of the IMP indicate that the Sorrento Creek (Reach 3) portion of the Sorrento Maintenance Project channel has the capacity to convey approximately the 10-year storm flow in the pre-maintenance condition (Table 2). With sediment removed, the channel capacity is increased to convey approximately the 15- to 20-year storm event. In addition, in the pre-maintenance condition, the Flintkote Channel portion (Reach 7) of the channel area has the capacity to contain the 1-year storm due to the low gutter flow line elevations of the curb inlets in Roselle Street. If no maintenance occurs in Flintkote Channel, the capacity will continue to be reduced. With sediment removed, channel capacity is increased to convey the 2-year storm event. Generally, given the relatively sporadic nature of vegetation recolonization and fact that removal of vegetation alone may cause instability for the accumulated sediment in the channel areas leading to erosion and downstream water quality impacts, the minor increases in flood conveyance capacity gained by removing only vegetation do not provide ecological or operational benefits.

Based on a review of the pre-maintenance and design conveyance capacity of Reaches 3 and 7, current maintenance practices in Reach 7 provide limited flood protection for surrounding areas. Maintenance in Reach 3 provides some flood protection for typical storms (i.e., smaller than 20-year storms). Reduced maintenance practices such as hand trimming of vegetation and leaving root structures and accumulated sediment in the channels would further reduce this limited level of flood protection to surrounding property and infrastructure because there is little vegetation present. Reduced maintenance practices would not provide a flood-protection benefit due to the limited amount of vegetation that is present within both channels. Regular sediment removal is needed to maximize channel conveyance capacity and minimize flood risk.

Table 2
Sorrento Creek Channel and Flintkote Channel Conveyance Capacity Summary

Channel	Storm Event	Estimated Storm Event Flow Rate (cfs)	Calculated Design Capacity[a] (cfs)	Pre-Maintenance Capacity (cfs)
Sorrento Creek Channel (Reach 3)	10-year	1,500	1,900[b]	1,500
Flintkote Channel (Reach 7)	2-year	76	80[c]	60[d]
Flintkote Channel (Reach 7)	5-year	97	80[c]	60[d]

Source: Data derived from URS 2013
[a] Based on Master Storm Water System Maintenance Program channel dimensions (i.e., post-maintenance condition)
[b] This flow rate corresponds to the approximately 15- to 20-year storm event, assuming that the downstream reaches, Reach 1 and 2, are unmaintained.
[c] This flow corresponds to approximately the 2- to 3-year storm event.
[d] This flow corresponds to the less than 1-year storm event.
cfs = cubic feet per second

It is anticipated that ongoing maintenance to remove accumulated sediment and vegetation may be needed to allow maximization of the existing conveyance capacity for Reach 3 and, in particular, Reach 7. In its maintained condition, Reach 3 can support less than the 20-year storm event. In its maintained condition, the estimated design capacity of Reach 7 can convey flow slightly greater than a 2-year storm event. The inherent capacity of these channels is limited even in their maintained conditions.

The data presented in Table 2 does not account for various factors that may contribute to flooding in the Sorrento Maintenance Project channel areas. Presented flow rates assume that downstream reaches are maintained such that flows through Reach 3 and 7 are conveyed unimpeded through Los Peñasquitos Lagoon to the ocean. However, land ownership, sensitive habitat conditions, and other factors occurring downstream of the Sorrento Maintenance Project area and within Los Peñasquitos Lagoon prevent unimpeded flows to the ocean. As a result, current conditions both downstream and within the channel maintenance area contribute to a backwater condition and lead to increased incidences of localized flooding.

Reach 3 and Reach 7 within the Sorrento Creek Channel are subject to regular sediment deposition and vegetation establishment (URS 2013). Sediment transport is a natural and complex phenomenon that occurs as a result of natural processes and also is accelerated by development and urbanization activities in the watershed. When a stream has an excess of energy (flow) to transport a certain amount of sediment load, degradation or scour/erosion will occur. Conversely, when a stream has insufficient energy, aggradation or deposition will occur. Both of these processes usually occur along subsequent reaches of the same stream. In the case of Reaches 3 and 7, flatter slopes of the concrete-lined channels result in lower flow velocities, where eroded sediment particles generated from the upstream watershed settle out of the stormwater runoff along the channel beds. The establishment of vegetation in the deposited material facilitates a further reduction in flow velocities, and, in turn, encourages more sediment to deposit.

2.2 Maintenance Practice Modification Evaluation

Current maintenance practices include sediment and vegetation removal. This section evaluates the efficacy of these practices.

Maintenance Practices

The general maintenance procedure within the channels consists of removing accumulated sediment, vegetation, and other debris from the concrete channel bottom using earth-moving equipment (skid steer or similar type equipment) and pushing the accumulated material to a central site within the channel. Material is then scooped up with an excavator (operating within

the channel) and the excavated material is deposited into a waiting dump truck. The loaded truck then leaves the facility area and transports the material to a temporary stockpile area where disposal sorting is performed and the material is ultimately transported to a landfill. Trucks and equipment enter and exit the concrete-lined channels through designated access routes.

Dry-weather flow diversion berms (water-filled barriers, sandbags, and visqueen) are set up at either end of the channels to ensure that downstream water-quality impacts do not occur. Diversion hoses are set up to maintain the area in a dewatered state. Crews accesses the area from designated access routes, and heavy equipment is used to excavate sediment and vegetation from the authorized reaches. Sediment is stockpiled on site and then disposed of at the Miramar landfill.

The maintenance practices employed for Reaches 3 and 7 are appropriate for concrete-lined channel areas covered under the MMP. As outlined in Section 3 of the MMP, maintenance methods depend on site-specific characteristics, including size, flow characteristics, surrounding land uses and vegetation, access, and whether the channel is concrete-lined or earthen bottom. These methods present little potential for biological and cultural resources impacts in concrete-lined Reaches 3 and 7. Further, the MMP identifies maintenance frequencies as typically occurring at 3-year intervals (City of San Diego 2011a).

Based on a review of the pre-maintenance and design conveyance capacity of Reaches 3 and 7 areas, current maintenance practices provide limited flood protection for surrounding areas. Reduced maintenance practices such as hand trimming of vegetation and leaving root structures and accumulated sediment in the channels would further reduce this limited level of flood protection to surrounding property and infrastructure by providing a mechanism for additional sediment accumulation and vegetation growth. Leaving the roots in place would likely result in rapid regrowth of aboveground biomass, reducing channel capacity and negatively affecting adjacent habitats and the flood capacity within the adjacent areas.

Alternatives

This section describes potential alternative maintenance methods.

Vegetation Clearing. Vegetation clearing is identified in the MMP as a maintenance alternative to minimize habitat and/or water-quality impacts in sensitive channel areas. The concrete lining in Reaches 3 and 7 minimize establishment potential for quality wetland habitat within the maintenance area. Further, vegetation clearing only in the concrete lined sections can reduce stability of accumulated sediment and lead to erosion and downstream water quality impacts. Combined, the vegetation-clearing-only option has potential impacts counter to the purpose of the maintenance activity, which is to provide reduced flood risk by increasing channel capacity.

Frequency. Observational evidence indicates that even relatively small storm events can can result in sediment accumulation and allow vegetation establishment in the Sorrento Maintenance Project channel areas. Maintenance frequency is discussed in detail in Section 2.3.

Native Species Recruitment. Colonization of native species may occur within existing concrete-lined channels in the absence of routine maintenance and sediment accumulation. However, the concrete lining and limited soil substrate in Reaches 3 and 7 in the maintained condition (Table 2) limits the potential for plants to become established. These factors limit native species recruitment to herbaceous species and other species without extensive root systems.

Enhance Channel Capacity. Both channels are concrete lined and, therefore, constrained by surrounding development, including existing industrial and commercial uses and roads. There are limited opportunities to enhance the channel capacity unless significant infrastructure changes are considered. The IHHA discusses four potential alternatives to improve channel capacity: raising the channel banks by constructing walls or berms along the top of the channels, diverting stormwater in pipes around constrained segments, widening channels to accommodate vegetation, and reducing off-site runoff (URS 2013). Of the discussed alternatives, off-site runoff reduction is likely the most feasible long-term option for reducing flow volumes and localized flooding in the Sorrento Valley area. However, watershed-based projects that result in measurable runoff reduction to Sorrento Valley area may take decades to implement. Existing infrastructure and the proximity of the channels to the FEMA floodway provide significant constraints to channel capacity enhancements. The physical constraints of the channels are discussed in more depth in Section 2.7, and opportunities for enhancing channel capacity are elaborated on in Section 3.1.

2.3 Maintenance Frequency Assessment

Over the past decade, maintenance within the Sorrento Maintenance Project area has been performed intermittently. This is due to hydrological conditions, sensitive biological resource protections, environmental permitting challenges, and weather constraints. This section analyzes the current frequency of maintenance, and evaluates the potential impacts from changes to maintenance frequency.

Recent maintenance occurred in 2010, fall/winter 2014, and March 2015. Data related to results of maintenance effort before 2014 is not available. Moving forward, the MMP process provides a framework to document maintenance effort, sediment accumulation and vegetation establishment rates. The City may use current maintenance effort documentation processes and other data such as local precipitation and large scale climactic information to estimate optimum frequency of maintenance activities in the Sorrento Maintenance Project area. It is expected that sediment accumulates within the two channels at different rates, depending on such

environmental factors as the timing and volume of water discharged through the channel area, soil type and erodibility of the upstream subwatersheds that contribute to each reach, the intensity of rain events, the timing of rain events during the wet season, and the quantity of trash that is mixed in with sediment.

Observational evidence after the 2014 maintenance activities in Reach 3 indicates that sediment can rapidly accumulate within the reach. A qualified biologist surveyed Reach 3 approximately three months after maintenance was completed, and observed that approximately 0 to 4 inches of sediment had begun to accumulate within the reach. At least one rain event occurred during the period between maintenance completion and the biologist's observation. Very limited vegetation had recruited in Reach 3 during this period (Figure 9). The City obtained reauthorization and maintenance was conducted in March 2015 for Reach 3.

2.4 Herbicide Needs Assessment

Prior to maintenance activities, both channels were characterized as open channels with limited amounts of vegetation present. In both channels, the only vegetation community present was freshwater marsh. Based on the species that are currently present, removal of sediment and vegetation within these concrete-lined channels will likely not lead to recruitment of non-native species and therefore limit the need for herbicide use.

Herbicide use within these channels is not part of the current maintenance activities. There is very little vegetated acreage within the channels (i.e., most of the channels are open water or non-vegetated channel), and it is not expected that vegetation removal alone (i.e., through herbicide use) would result in improvements in flood conveyance capacity. Furthermore, as the channels are both lined with concrete, there is no natural substrate and limited soil depth that would typically allow vegetation to become established. As such, only sediment accumulation in the concrete-lined channel provides substrate for recruitment of vegetation.

2.5 Vegetation Assessment

In the pre-maintenance condition, areas mapped as freshwater marsh within Reaches 3 and 7 contain accumulated sediment supporting herbaceous vegetation and young trees. The dominant species is cattail (*Typha* sp.); other species present include sycamore (*Platanus racemosa*), young arroyo willows (*Salix lasiolepis*), and mulefat (*Baccharis salicifolia*). Given the limited amount (less than 1 acre) of native habitat within the channel maintenance impact area, maintenance activities do not have a substantial effect on native plant species within the region.

Approximately 3.46 acres of waters of the U.S., including wetlands under the jurisdiction of ACOE, RWQCB, and CDFW, occurs within Reaches 3 and 7, including 0.81 acre of freshwater marsh and 2.65 acres of unvegetated stream channel (Figure 10).

These vegetation communities and land covers are described below and listed in Table 3.

Table 3
Existing Jurisdictional Waters of the U.S. by Reach (Acres and Linear Feet)

Reach	Freshwater Marsh – Acres (Linear Feet)	Unvegetated Stream Channel – Acres (Linear Feet)	Total Acres (Linear Feet)
3	0.63 (802)	2.65 (1,478)	3.28 (2,280)
7	0.18 (1,000)	0	0.18 (1,000)
Total	**0.81 (1,802)**	**2.65 (1,478)**	**3.46 (3,280)**

Source: Data from URS 2013

Vegetation removal has had little impact on overall habitat and species composition within the Sorrento Maintenance Project area. Much of the impacted channels are mapped as unvegetated stream channels, which refers to concrete-lined channels within the project area that are sparsely vegetated (i.e., less than 20% cover) or lack vegetation completely. Reach 3 is a perennial resource northwest of Sorrento Valley Boulevard and an intermittent resource southeast of Sorrento Valley Boulevard. Reach 7 appears to support intermittent stream flow.

2.6 Habitat Assessment

Reach 3 is a concrete-lined portion of the channel that connects patches of riparian scrub habitat that occur northwest and southeast of the maintenance area. Habitat within the reach itself is of low value to wildlife because it is a predominantly unvegetated, concrete-lined channel interspersed with small fragments of freshwater marsh habitat. Reach 3 does not provide cover for larger terrestrial mammals such as bobcats (*Lynx rufus*) and coyotes (*Canis latrans*) that may use the area to cross between the riparian scrub habitat adjacent to the northwest and southeast ends of this area. Therefore, maintenance within the narrow confines of concrete-lined Reach 3 is not expected to disrupt the integrity of the surrounding riparian habitat.

Figure 9 2014–2015 Wet-Season Photos of Sorrento Creek Reach 3

September 15, 2014, prior to maintenance

October 7, 2014, after maintenance

February 20, 2015, approximately 4.74 inches of rainfall was recorded between October 1, 2014, and February 20, 2015, at the San Diego Airport; the largest storm, a 2.12-inch event, occurred on December 2–3, 2014

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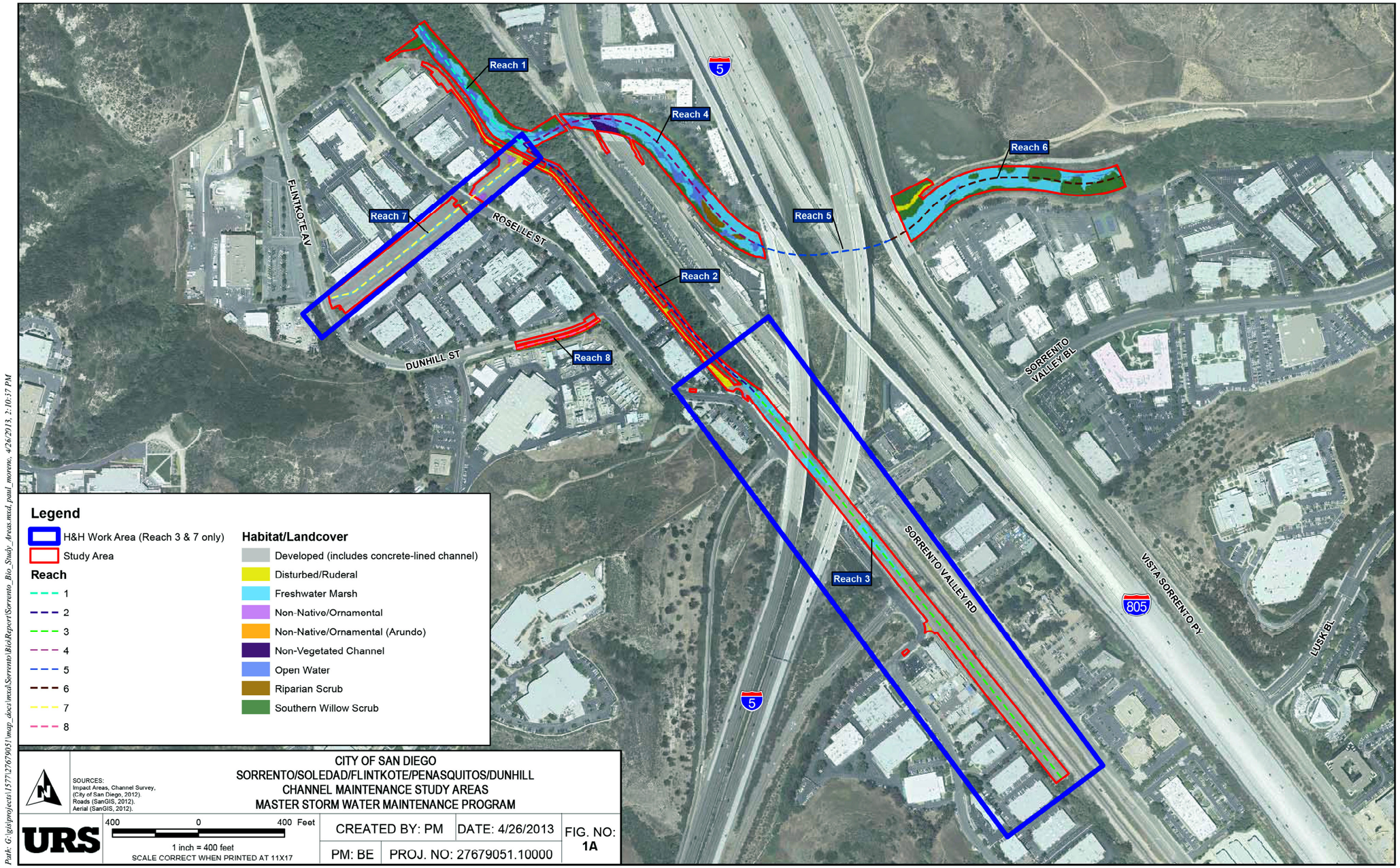

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DUDEK

SOURCE: SOURCE: URS 2013

FIGURE 10

Channel Maintenance Study Areas

Channel Maintenance Special Study - Sorrento

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Reach 7 does not function as a wildlife corridor, and the freshwater marsh habitat within the channel has a low habitat value for freshwater marsh species due to its narrow width, proximity to development and human disturbance, and the shallow substrate limited by the concrete channel bottom. Reach 7 is almost completely surrounded by a parking lot and other urban hardscape, including commercial development to the north and south. Within the channel, there is very little native habitat, as most of the channel is either unvegetated channel or open water.

The Sorrento Maintenance Project area reaches are located adjacent to sensitive habitat and wildlife corridors in the Los Peñasquitos watershed. The mouth of the Los Peñasquitos watershed is a critical wildlife corridor within the northern part of the City. Several special-status species have been documented within and adjacent to the channel maintenance area, including white-tailed kite (*Elanus leucurus*), a CDFW Fully Protected species, and Cooper's hawk (*Accipiter cooperi*), a CDFW Watch List species (URS 2013). No special-status plant species have been documented within or adjacent to the channel maintenance area. Additional species with potential to occur include least Bell's vireo (*Vireo bellii pusillus*), a state and federal endangered species, and light-footed clapper rail (*Rallus longirostris levipes*), state and federal endangered species (URS 2013). Additional special-status species are expected to occur north of the channel maintenance area within Torrey Pines State Reserve and Los Peñasquitos Lagoon.

Although the Sorrento Maintenance Project channel area is in the San Diego Multiple Species Conservation Program study area, it is not located within the City's MHPA. Both Reaches 3 and 7 flow directly into land that has been designated as part of the MHPA. Reach 7 drains a hillside that is designated as part of the MHPA, and flows entering Reach 3 are designated as part of the MHPA farther upstream. Maintenance activities follow all mitigation measures and BMPs outlined in the permits issued for the Sorrento Maintenance Project and the overall PEIR(City of San Diego 2011a).

The Sorrento Maintenance Project is not expected to substantially adversely affect any species found within the project area or Los Peñasquitos watershed. The ACOE concluded that the project would have no effect on listed species, because the habitat removed was not suitable for listed species and the work was conducted outside the breeding season, thus avoiding potentially significant indirect effects. The project CDP required authorization from the USFWS to conduct maintenance between February 15 and March 15. As such, the project complies with a letter of conditions that USFWS issued for the project (USFWS 2014).

2.7 Infrastructure Assessment

The watershed configuration, land ownership types, and adjacent infrastructure components provide limits to channel maintenance alternatives in the Sorrento Maintenance Project area. As described above, the impacts of floodplain development, increased urbanization and associated

impervious surfaces, and channelization conducted to accommodate various roadway and transit infrastructure projects all converge within the Sorrento Maintenance Project area (Figure 2). The hardened channel, freeway support piers, roadway culverts, and other infrastructure have reduced the dynamic capacity of the river system. These factors, in addition to climatic changes, impact watershed dynamics and indubitably affect the feasibility of alternatives to the channel maintenance needed to reduce flood risk to life and property in the Sorrento Creek area.

Upstream of Los Peñasquitos Lagoon, Peñasquitos Creek, Carrol Creek, and Soledad Creek all meet within the Sorrento Valley area where I-5, I-805, State Route 56, the LOSSAN rail corridor, local surface streets, and existing development also converge. Much of the infrastructure in this area is contained within the 100-year floodplain and subject to periodic flooding (Figure 11). Riverine flooding occurs when rivers, streams, and lakes overflow their banks. Areas adjacent to rivers can also experience flooding as a result of excessive runoff from heavy rainfall and accumulation of water flowing over broad, flat areas. In the Sorrento Creek area, riverine flooding can be widespread, with floodwaters persisting for several hours to days.

Flood management requirements are rooted in the Code of Federal Regulations (CFR) mandating minimum flood protection requirements and building practices (44 CFR 1). These requirements set a minimum level of protection and are administered through FEMA. Federal regulations are legally enforceable and are applied uniformly to all privately and publicly owned land within flood-prone, mudslide, or flood-related erosion areas.

FEMA maps show that a large portion of the Sorrento Maintenance Project channel area is mapped as Zone AE, with an included regulatory floodway (Figures 12A and 12B). A regulatory floodway is a special purpose area that FEMA and the local floodplain administrator (the City) agree is the minimum area necessary to safely convey the expected flood flows. Within a regulatory floodway, the local floodplain administrator is prohibited from allowing any encroachments (including fill, new construction, substantial improvements, and other development) unless it has been demonstrated through hydrologic and hydraulic analyses that the proposed encroachment will not result in any increase in flood levels within the limits of the floodway during a 100-year runoff event.

DUDEK

SOURCE: Google Imagery, 2015; SANGIS, 2014.

FIGURE 11

Sorrento Maintenance Project Land Use

Channel Maintenance Special Study - Sorrento

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NOTES TO USERS

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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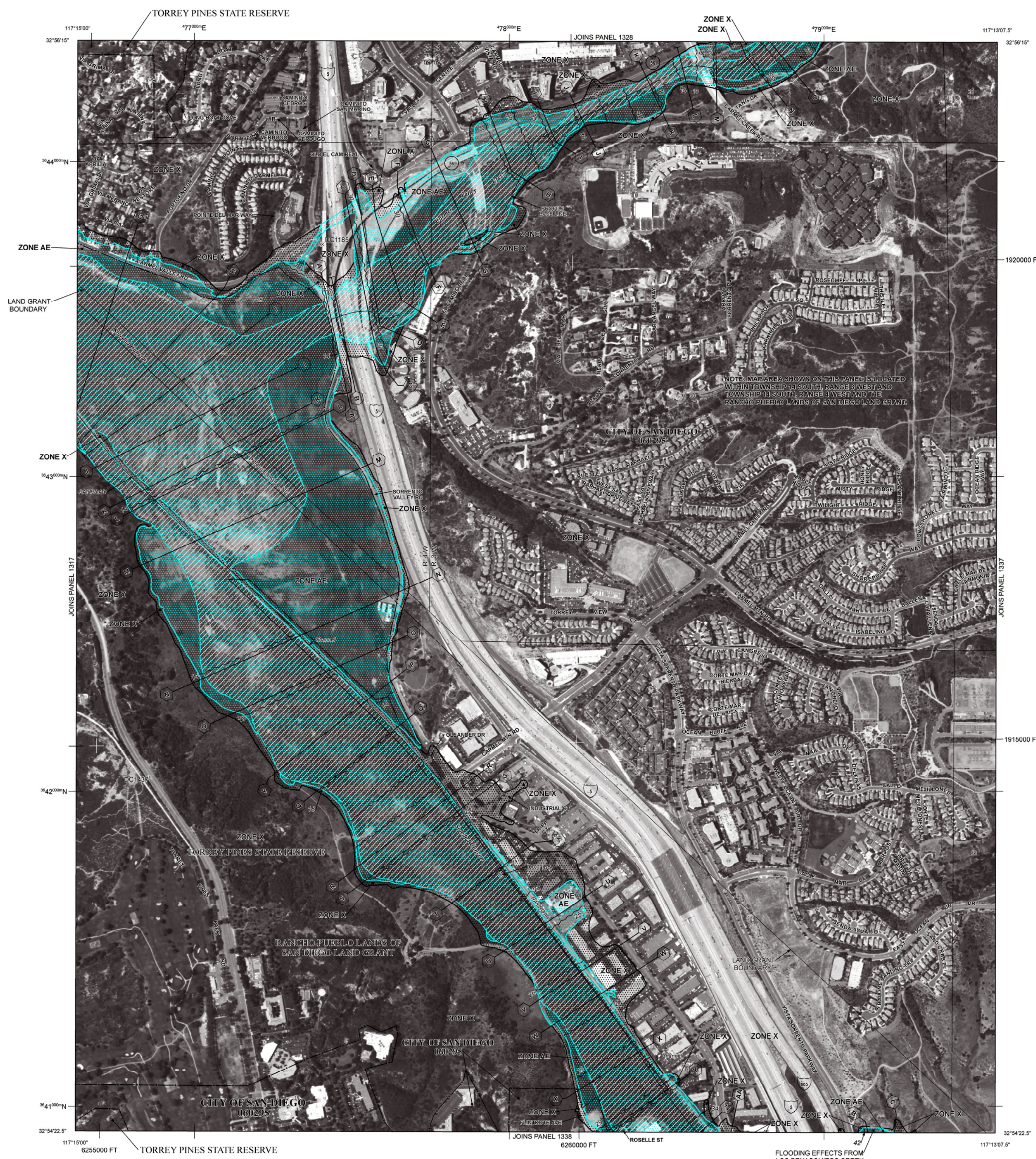

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)—(A)	Cross section line
(23)- - - -(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4275000mE	1000-meter Universal Transverse Mercator grid ticks, zone 11
6000000 FT	5000-foot grid values: California State Plane coordinate system, Zone VI (FIPSZONE = 406), Lambert projection
DX5510×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
June 19, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
May 16, 2012 – to update corporate limits, to add roads and road names, to incorporate previously issued Letters of Map Revision, and to update map elevations to North American Vertical Datum of 1988.

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MAP SCALE 1" = 500'

250 0 250 500 750 1,000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1336G

FIRM
FLOOD INSURANCE RATE MAP
SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 1336 OF 2375
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO, CITY OF	060295	1336	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06073C1336G

MAP REVISED
MAY 16, 2012

Federal Emergency Management Agency

SOURCE: SOURCE: FEMA, 05/16/2012.

DUDEK

FIGURE 12A
FEMA Flood Insurance Rate Map

Channel Maintenance Special Study - Sorrento

Date: 4/27/2015 - Last saved by: hpanno - Path: Z:\Projects\j866501\MAPDOC\DOCUMENT\TaskOrder17\Figure12A_FEMA.mxd

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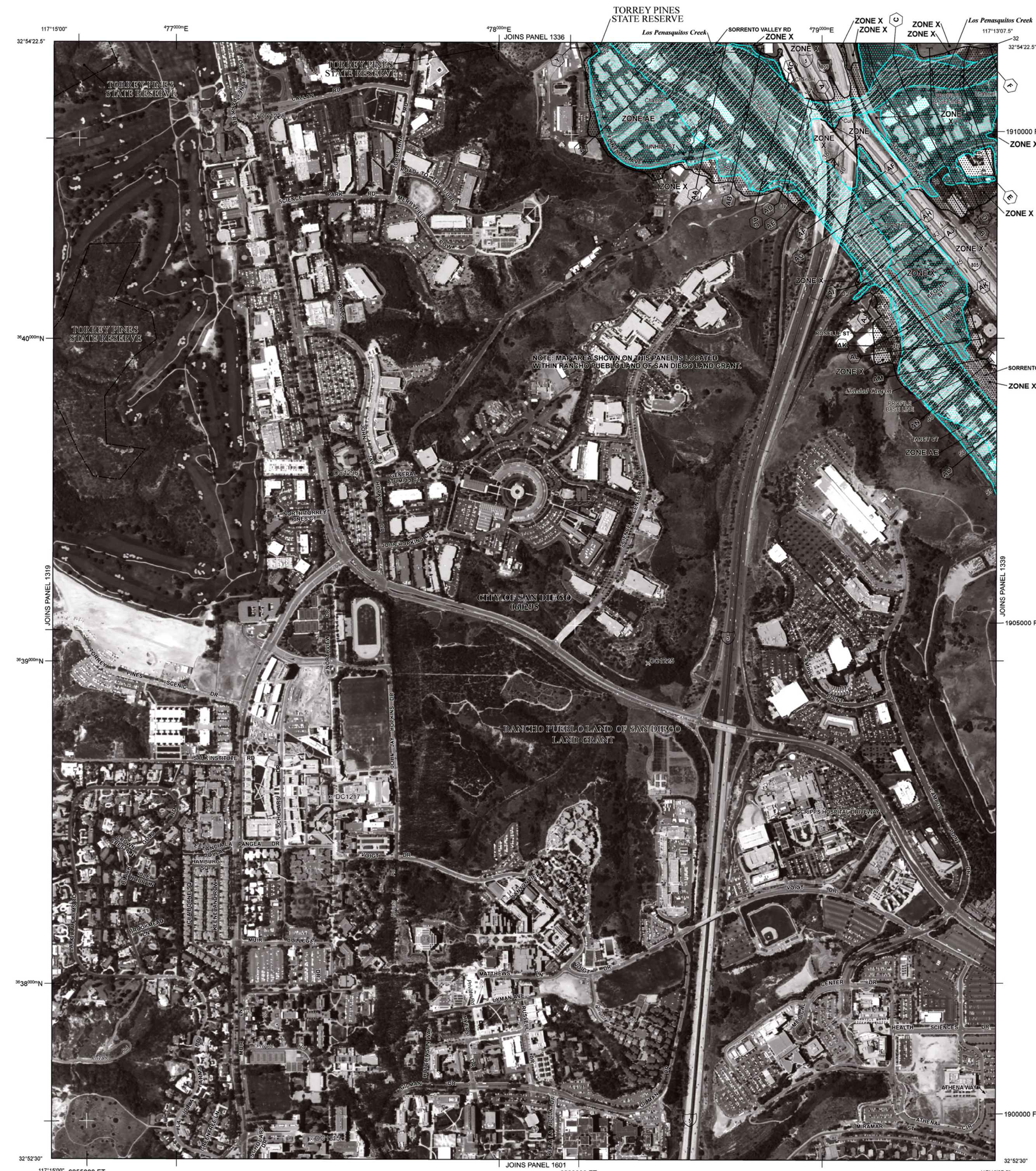

LEGEND

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0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
~~~ 513 ~~~ Base Flood Elevation line and value; elevation in feet*
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DX5510× Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5 River Mile

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EFFECTIVE DATE OF COUNTYWIDE
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June 19, 1997

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MAP SCALE 1" = 500'

250 0 250 500 750 1,000 FEET
150 0 150 300 METERS

NFIP — NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1338G

FIRM
FLOOD INSURANCE RATE MAP
SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 1338 OF 2375
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO, CITY OF	060295	1338	G

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MAP NUMBER
06073C1338G

MAP REVISED
MAY 16, 2012

Federal Emergency Management Agency

Date: 4/27/2015 - Last saved by: hpanno - Path: Z:\Projects\j866501\MAPDOC\DOCUMENT\TaskOrder17\Figure12B_FEMA.mxd

DUDEK

SOURCE: SOURCE: FEMA, 05/16/2012.

FIGURE 12B
FEMA Flood Insurance Rate Map

Channel Maintenance Special Study - Sorrento
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A significant portion of the property adjacent to the Sorrento Creek area is designated as a light industry land use (Figure 7). Other adjacent land uses include roadways, commercial, and open space. Generally, the light industrial area along Reaches 3 and 7 are contained within the regulatory floodway. The open space areas are generally confined to the higher slope areas and bluffs leading to the Torrey Pines, Del Mar, and Peñasquitos mesa areas. I-5 and I-805 are generally constructed on armored berms or pilings at elevations well above the floodway and 500-year floodplain areas.

Portions of the watershed area upstream of the Sorrento Maintenance Project area are outside the jurisdictional authority of the City. Adjacent municipal agencies covered under the Phase I National Pollutant Discharge Elimination System (NPDES) permit,[1] consisting of the cities of Poway and Del Mar, the County of San Diego, and the California Department of Transportation, have jurisdictional authority over portions of the watershed land area. In addition, NPDES Phase II, industrial facilities covered under the state-wide NPDES Industrial General Permit, and federal- and state-owned land and Indian Reservations have pollutant discharge responsibility in the watershed.

[1] California Regional Water Quality Control Board (RWQCB) San Diego Region Order No. R9-2013-0001 National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds Within the San Diego Region

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3 RETROFIT OPPORTUNITIES

This section identifies retrofit opportunities for channel maintenance operations, and analyzes the present channel configuration and opportunities to alter the capacity, habitat preservation options in the Sorrento Maintenance Project channel area and the Los Peñasquitos watershed, and channel discharge maintenance opportunities.

3.1 Channel Configuration

As discussed in section 2.7, there are limited opportunities to alter the Sorrento Maintenance Project channel area configuration due to limited space, adjacent parcel ownership, and projected cost. Reach 3 and the downstream extent of Reach 7 are located within the 100-year floodway, and the upstream extent of Reach 7 is located within the 100-year floodplain (Figure 6). Flood risk in the vicinity of the channels indicates that ongoing efforts to manage storm flows with potential flood conveyance impacts is needed in the Sorrento Maintenance Project channel area.

One potential retrofit opportunity outlined in the Settlement Agreement is to "daylight" the channels, which aims to restore the channels to a more natural state. Reaches 3 and 7 of the Sorrento Maintenance Project channel area are already open channels. Consequently "daylighting" could potentially be considered removal of the concrete channel lining. In order to maintain design capacity of a previously concrete-lined reach as an earthen channel, the width of the channel would need to be increased. Due to adjacent infrastructure such as private property, surrounding gas and sewer main lines, and major transit lines, there is not available space to expand Reach 3 or 7 and provide adequate flood conveyance capacity.

Additional channel configuration alternatives originally considered as part of the PEIR and described in the IHHA are discussed below.

Raising the channel banks by constructing walls or berms along the top of the channels. Raising the channel banks in Reaches 3 and 7 to increase the flood conveyance capacity is not anticipated to be a feasible option. The accumulation of sediment and vegetation in the concrete channel may cause flooding impacts upstream by raising the water surface elevation and negatively impacting upstream properties. Also, the existing storm drain pipe systems that discharge into the channel will likely be blocked by the buildup of sediment and vegetation, and may cause additional flooding impacts to surrounding infrastructure. Because of the flat topography of the surrounding area and relatively low ground elevations within portions of the business park relative to the bottom of the channel, it is unlikely that the existing storm drain pipe elevations can be raised to allow for the accumulation of sediment and vegetation.

Diverting stormwater in pipes around constrained segments. The flat and low-lying topography of the area adjacent to Reach 3 would require retrofits to the underground storm drain system.

Because of its size, the underground culvert would need a similar cross-sectional area as the channel, if not larger, due to the changes in the hydraulic condition. Locating a large culvert in the street would likely require relocation of other utilities, and re-routing the existing storm drain pipes that discharge into the channel. For Reach 7, a storm drain diversion to an off-site basin downstream of the existing infrastructure may provide some limited flood control benefit. Further, using pipes around constrained segments to divert storm water does not eliminate the need for channel maintenance. In order to sustain the wetland habitat a diversion structure would need to be designed which maintains a low flow through the existing channel. Without maintenance, sediment and/or vegetation would build up in the existing channel and ultimately block the desired low flows from entering the channel, which would cause the wetland to dry out.

Widening channels to accommodate vegetation. This alternative is likely infeasible for both Reach 3 and Reach 7, as the areas adjacent to these reaches are currently developed and occupied by existing businesses. There are no City-owned parcels or easements in the area where the channels could be widen. Transit infrastructure, including Roselle Street and the railroad tracks, run parallel to Reach 3 along its entire length. Reach 7 is located between commercial buildings and their associated parking lots along its entire length.

At a watershed scale, the watershed configuration, property ownership, and infrastructure framework upstream of the Sorrento Maintenance Project Area provide limited opportunities to integrate alternative approaches to channel maintenance efforts aimed at reducing flood risk. The FEMA floodway boundaries encompass the channel and surrounding light industrial area because of the flat topography of the surrounding area and relatively low ground elevations within portions of the business park relative to the bottom of the channel. Finally, existing storm drain pipe elevations that drain the business park locations discharge to the existing channels at relatively low surface elevations. As a result of the watershed and infrastructure framework upstream and adjacent to the Sorrento Maintenance Project area, “daylighting” or removal of concrete from the channel maintenance area is infeasible.

One option often considered for existing infrastructure subject to periodic riverine flooding is property acquisition and conversion to more compatible land uses that will not cause obstruction to flood flows. Generally, property acquisition efforts are directed to willing sellers and linked to local real estate and land values. In the Sorrento Creek area, a portion of the designated light industrial area houses life science, research and development, and other office industry. The area is considered a key component of San Diego’s biotechnology and high-tech corridor. The Sorrento Creek area provides tenants a central location with nearby professional support services. Accordingly, comparable land value in the area based on recent property acquisitions indicates that acquisition may be cost-prohibitive in the current real estate market.

Given these constraints, the City may seek to identify appropriate partnership and grant programs that may provide capital and/or long-term operation and maintenance funding for purchase of property from willing sellers that may be restored to improve flood conveyance capacity and/or reduce flood risk to infrastructure. Benefits may include expansion of existing riparian corridors and native habitat, improved recreational trails, and reduction of infrastructure requiring flood protection.

3.2 Habitat Preservation

Sorrento Valley was rapidly developed starting in the 1970s, and now much of the area surrounding the channels is urbanized and generally contains impervious surfaces. Both of the channels are concrete-lined and flow into additional reaches that are earthen and dominated by mature riparian forest habitats that support native wildlife species. Eventually, flows enter Los Peñasquitos Lagoon and the Pacific Ocean.

Much of the surrounding habitat within the watershed has been set aside as part of the MHPA or other preserve lands, including Torrey Pines State Reserve. Both Reaches 3 and 7 flow directly into land that has been designated as part of the MHPA. Reach 7 drains a hillside that is designated as part of the MHPA, and flows entering Reach 3 were designated as part of the MHPA farther upstream.

Los Peñasquitos Canyon and Soledad Canyon are important habitat corridors within the vicinity of the channels. Due to the higher mitigation ratios that are required as part of the Multiple Species Conservation Program, development within these areas is discouraged. Effectively, this process preserves lands surrounding the focal concrete-lined reaches. Habitat preservation is an important tool for reducing flooding. Natural areas with native soils absorb stormwater flows, intact native vegetation slows down flows, and natural areas filter pollutants from stormwater.

However, habitat preservation options are limited. Existing development is well established in the area adjacent to the focal channels. Furthermore, there are additional projects underway to expand both interstates within the watershed (I-805 and I-5) and the LOSSAN rail corridor that is adjacent to Reach 3. These infrastructure projects provide impediments to habitat preservation options in the watershed.

3.3 Channel Discharge

The discussion of channel discharge is related downstream water quality and flooding. Discharges from the four drainage facilities that converge in the Sorrento Valley area and the watershed in general have negative impacts on downstream water quality. Fecal indicator bacteria, sediment/siltation, hydromodification and freshwater discharges are the highest priority water quality conditions for the Los Peñasquitos Watershed Management Area as outlined in the

watershed's WQIP (Los Peñasquitos Responsible Parties 2015). Los Peñasquitos Creek and Los Peñasquitos Lagoon are both listed on the Clean Water Act Section 303(d) list (SWRCB 2010) (Table 4). Soledad Canyon, Los Peñasquitos Creek, and Los Peñasquitos Lagoon are 303(d) listed as impaired water bodies, in which standards are not met. Pollutants within Los Peñasquitos Creek include enterococcus, fecal coliform, selenium, total dissolved solids, total nitrogen as N, and toxicity. Pollutants within Los Peñasquitos Lagoon include sedimentation/siltation. The lagoon was first established on the 303(d) list in 1992 (Table 4). The sources of these pollutants are urban runoff, point and nonpoint sources, unknown sources, natural sources, and flow regulation/modification (SWRCB 2010).

Table 4
Regional Water Quality Control Board 303(d) Listed Pollutants

Pollutant	Water Body Name		
	Soledad Canyon	*Los Peñasquitos Creek*	*Los Peñasquitos Lagoon*
Enterococcus	-	√	-
Fecal Coliform	-	√	-
Sediment Toxicity	√	-	-
Sedimentation/Siltation	-	-	√
Selenium	√	√	-
Total Dissolved Solids	-	√	-
Total Nitrogen as N	-	√	-
Toxicity	-	√	-

Source: SWRCB 2010

As outlined in the IMP, sediment removal would remove a larger pollutant load than what would be theoretically removed during ambient stream flows (URS 2013). This provides a benefit to overall water quality in Reach 3 of the Sorrento Creek Channel. Modeling estimates for Reach 7[2] indicate the same conclusion of improving water quality through removal of pollutant-laden sediment. Sediment excavation in Reaches 3 and 7 would prevent the re-suspension and downstream transport of sediment-bound pollutants during wet weather, and regrowth of fresh water marsh species in Reach 3 within 1 year would further enhance dry-season pollutant removal from the channel.

The proposed maintenance activities would provide pollutant reduction benefit due to sediment (and associated pollutant) removal. Soil samples from Reach 7 had detectable concentrations of cadmium, phosphorus, and Diazinon (URS 2013). The pre-maintenance water-quality impact analysis suggested that sediment removal during maintenance of Reach 3 would remove a larger pollutant load than what is theoretically removed during ambient flow by natural pollutant removal processes

[2] An evaluation of Reach 3 could not be conducted due to a lack of discernable flow.

from ambient vegetation over a 3-year maintenance period. As such, the maintenance activity is presumed to provide an overall water-quality benefit. Similarly, the sediment pollutant loading estimates for Reach 7 indicate that the maintenance activities would result in a pollutant reduction benefit through the removal of pollutant-laden sediment. Therefore, the removal of sediment from within the channels would result in removal of pollutants that could potentially contribute to water quality downstream, human health complications, and native vegetation impacts.

During maintenance, sediment control measures such as silt fences, temporary sediment basins, berms, fiber rolls, and gravel bags were implemented to prevent sediment from entering the water column. Removing sediment from within the channels and preventing the introduction of soil and sediment to the water column during maintenance results in removal of pollutants that could potentially negatively affect water quality downstream and could contribute to human health complications and native vegetation impacts. Sediment removal prevents the metals and inorganic non-metals present in the sediment from being mobilized during storm events, thus benefiting the overall water quality in the areas downstream of the maintenance area.

Channel flow is a primary contributing factor to flood risk in the area adjacent to the Sorrento Maintenance Project. To the general public, localized implementation of Low Impact Development (LID)-type BMP features in the watershed is often considered to be a potential solution to reduce downstream flooding. LID features, such as bioretention areas and other best management practices (BMPs) do not have an impact on the need to perform channel maintenance. Typically retention basins are created to improve water quality, but these features can also reduce runoff volumes and flow rates. However, LID features are usually designed based on the 85th percentile storm, which is much smaller than the 10-, 50-, or 100-year peak storms used for flood control design. For that reason, LID installation would not have a measurable impact on peak flows for large storms, downstream flooding. In addition, LID BMP implementation opportunities are generally associated with new development and redevelopment projects as part of an overall site-specific water quality management strategy. Therefore, the rate of LID BMP implementation in the Los Penasquitos Watershed Management Area is dependent on new and re-development project initiation, site-specific topography and configuration constraints, and LID design standards. It is anticipated that these factors will limit overall LID BMP impacts to channel flows until widespread implementation is accomplished throughout the watershed. Accordingly, in the flood control analysis conducted as part of the IHHA, the benefit of LID BMPs (e.g., reducing the impermeable area and redirecting runoff to pervious areas) was considered negligible due to the limited implementation opportunities.

The City's LID BMP implementation Program, while outside the scope of the MMP, is being conducted to work towards the long-term goal of improved water quality and reduced channel flows and associated need for future channel maintenance. Although the City does not expect to see appreciable reductions in maintenance needs over the term of the current MMP, any reductions in

maintenance needs resulting from the City's LID Program would be captured by the annual hydrology studies, and channel maintenance activities would be adjusted accordingly.

A suite of water-quality BMPs are required as part of the Coastal Development Permit authorizing channel maintenance activities in Reaches 3 and 7 (Table 5). Implementation of these BMPs may potentially have minor impacts on the the need for maintenance through the integrated suite of required pollution prevention, source control, and treatment activities.

Table 5
Sorrento Maintenance Project Coastal Development Permit Required Water Quality BMPs

Water Quality Activity Type	Description	Implementation Frequency	Duration
Pollution Prevention	Commercial and residential property sediment reduction outreach distribution	250 parcels	Approximately 1 month prior to maintenance initiation
Source Control	Street sweeping improvements: targeted vacuum-assisted/regenerative air machine usage	19.4 curb miles	1 year subsequent to sediment removal maintenance events
Source Control	Street sweeping improvements: targeted median sweeping route addition	10.8 curb miles	
Treatment	Enhanced catch basin inspection and as-needed cleaning implementation	25 inlet locations	1 year subsequent to sediment removal maintenance event
Special Study	The need and potential effectiveness of implementing slope stabilization measures and small-scale water-quality basin BMPs on City-owned parcels within the Los Peñasquitos drainage area	N/A	1 year subsequent to sediment removal maintenance event
Special Study	Degraded canyon area municipal separate storm sewer (MS4) outfall evaluation and improvement process	N/A	1 year subsequent to sediment removal maintenance event for one priority channel segment
Pilot Implementation Study	Conduct repairs on a prioritized representative degraded outfall to determine the relative level of planning, engineering, and implementation effort needed to address identified canyon-area outfall problems	1 outfall location (La Jolla Farms location)	5 years

Source: California Coastal Commission 2012
BMP = best management practice; N/A = not applicable

4 DISCUSSION

The City's MMP is designed to allow flood control channel operation and maintenance activities for the protection of life and property to be conducted in an efficient, economic, and environmentally and aesthetically acceptable manner. This special study evaluated the purpose, need, and alternatives to channel maintenance activities in the Sorrento Maintenance Project channel areas. This Channel Maintenance Special Study is required under a legal agreement related to the MMP.

The City performs maintenance activities in the Sorrento Maintenance Project channel areas to reduce flood risk to life and property. Current maintenance practices for the Sorrento Maintenance Project include periodic vegetation and sediment removal from concrete-lined channel segments using mechanized equipment. Maintenance implementation in Reach 3 reduces impairments to channel conveyance capacity. However, the calculated design capacity is less than the 20-year storm event. Biological and other restrictions limit maintenance of downstream Reaches 1 and 2, restricting flow conveyance throughout the Sorrento Maintenance Project area. Limited flow conveyance capacity is present in Reach 7 even after maintenance. The calculated design capacity in Reach 7 is approximately 5% greater than the 2-year storm event flow rate.

Topography, channel design and configuration, adjacent biological resources, transportation infrastructure, and private property generally limit maintenance practice modifications and alternatives to current activities. Potential engineering alternatives to improve channel capacity each will require consideration of significant infrastructure changes. Further, watershed-based projects that result in measurable runoff reduction to the Sorrento Valley area will likely take decades to implement.

Reach 3 is a concrete-lined, predominantly unvegetated channel interspersed with small fragments of freshwater marsh habitat. The habitat value and benefit to wildlife of of this section of channel is low. Concrete-lined Reach 7 is a narrow channel surrounded by development and human disturbance, with shallow, low-value freshwater marsh habitat that does not function as a wildlife corridor. The City is in the process of performing habitat enhancement activities to satisfy mitigation requirements for wetland impacts resulting from maintenance in Reaches 3 and 7.

The Sorrento Maintenance Project channel area is located in only a small portion of the overall watershed. Existing conditions in the contributing watershed upstream from the maintenance area and altered hydrology in the lower main river floodplain generally result in sediment accumulation and maintenance need. The root cause of sediment and debris accumulation within the channels is not appropriately addressed by maintenance. Additional measures such as

watershed-based sediment management and runoff reduction projects may reduce sediment and vegetation accumulation and the need for maintenance.

The City is participating with other municipal agency dischargers to develop a WQIP aimed at reducing pollutants in the municipal separate storm sewer system (MS4). Under the current NPDES regulatory framework, dischargers have identified hydromodification, siltation/sedimentation, freshwater discharges, and indicator bacteria as high-priority water-quality conditions for the Los Peñasquitos Watershed Management Area. The WQIP identifies a suite of water quality improvement strategies to effectively and efficiently eliminate non-stormwater discharges to the MS4, reduce pollutants in stormwater discharges from the MS4 to the maximum extent practicable, and achieve identified interim and final regulatory numeric goals. The Los Penasquitos WQIP identifies a strategy of implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, channels as allowed by resource agencies, detention basins, pump stations, etc.) for water quality improvement and for flood control risk management.

Through this and other partnership efforts, the City aims to pursue appropriate operational and multi-agency projects to reduce sediment and non-stormwater discharges conveyed by the MS4 prior to discharge to the Sorrento Maintenance Project channel areas. While these activities are anticipated to have ancillary benefits that may reduce the long-term need for channel maintenance activities, the current channel configuration and adjacent infrastructure limits opportunities to reduce channel maintenance in the Sorrento Maintenance project area.

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