5.9 Hydrology and Water Quality

5.9.1 Introduction

Purpose

The purpose of this section is to identify potential impacts to hydrology and water quality from project implementation on the project site and the surrounding area. This section also identifies mitigation measures to reduce any potentially significant hydrology and water quality impacts and describes the residual impact, if any, after imposition of the mitigation.

Sources

The following sources were used in consideration and discussion of the potential environmental impacts:

- *Forecasting California's Earthquakes – What Can We Expect in the Next 30 Years,* prepared by US Geological Survey, 2008. (http://pubs.usgs.gov/fs/2008/3027/)

- *Preliminary Water Quality Management Plan (PWQMP), City of Orange,* by Fuscoe Engineering, Inc., September 20, 2012 as provided in Technical Appendix K, *Water Quality Technical Report*, to this Draft EIR.

- *Rio Santiago, Hydrological Assessment Report, City of Orange*, by Fuscoe Engineering, Inc., December 16, 2011, as provided in Technical Appendix J, *Hydrology Study Report*, to this Draft EIR.

- *Rio Santiago Water Quality Technical Report, City of Orange*, by Fuscoe Engineering, Inc., May 1, 2013, as provided in Technical Appendix K, *Water Quality Technical Report*, to this Draft EIR.

- *Table of Dam Failures:*
  http://cee.engr.ucdavis.edu/faculty/lund/dams/Dam_History_Page/Failures.htm

- Villa Park Dam information:
  http://bos.ocgov.com/legacy3/newsletters/pdf/Villa_Park_Dam_emails.pdf.

- Comments received during the public review period and at the scoping meetings. These comments are contained in Appendix A, *Public Participation Process*.

5.9.2 Existing Environmental Setting

Materials Recycling

Approximately five acres in the southeastern portion of the project site are used as a materials recycling area. This area includes apparatus for the crushing of boulders, bricks, rocks, etc. for recycling. The materials recycling area additionally includes operations that provide for the cement treatment of base materials. Material for this operation originates primarily from off-site sources. Access to the materials recycling area is from a controlled entrance along East Santiago Canyon Road. Materials generated by this operation have historically been used on and transported off the project site. The materials generated by this operation at issuance of the NOP were being taken off-site. Materials recycling will continue on the project site through the construction of the proposed project until Planning Area D is developed.

Backfilling Operation

To restore previously mined portions of the site, a portion of the project site is presently being backfilled as a permitted land use. The existing backfill operation is not a permanent use. The project site is presently being backfilled in sequentially defined phases. The project site is being over excavated (i.e., removal of unsuitable materials) and filled in the present backfill operation. The applicant has indicated that grading permit(s) will be requested from the City to complete backfilling of all previously mined portions of the project site. As previously noted, the project site was used from 1919 to 1995 for surface mining of sand, gravel, and other aggregates. Previously mined portions of the project site were used for residue silt deposition, otherwise known as silt ponds. The backfilling operation addresses both mined and silt pond areas.

Approximately 2,248,200 cubic yards of material will be over excavated per Tentative Tract Map No. 17344. Once removed, the material will be spread and dried on the project site. The material will then be mixed with imported materials. A total of 1,100,000 cubic yards of material will be imported to the site. Please refer to Section 5.16, *Transportation and Traffic* for detail information related to truck trips. The imported materials will be based on recommendations of the soils engineer and include concrete, asphalt, rock, and soil. The imported materials will be crushed on-site by either the existing materials recycling facility or additional operations. A total of 3,348,200 cubic yards of material will be blended during the project site grading (including backfilling operation and mass grading). This includes materials both over excavated and imported to the project site.

This approved, on-going backfill operation currently is separate and distinct from the proposed project. However, most of this grading would have to occur to construct the proposed project. Therefore, as a practical result, from the date of project approval the backfilling and grading will become project site preparation activities and, as such, are analyzed as part of the construction phase of the project.

Existing Drainage Patterns and Storm Drain Systems

The areas of the property where development is to occur generally drains in a northwesterly direction, and under existing conditions entering Santiago Creek directly through surface swales or indirectly via the

Handy Creek Storm Channel (E08S06) first and then to Santiago Creek. The existing drainage areas and planning area boundaries as defined by the Specific Plan are not the same. The drainage patterns at the time of issuance of the NOP are shown on Figure 5.9-1, *Existing Drainage Condition Map* are described below.

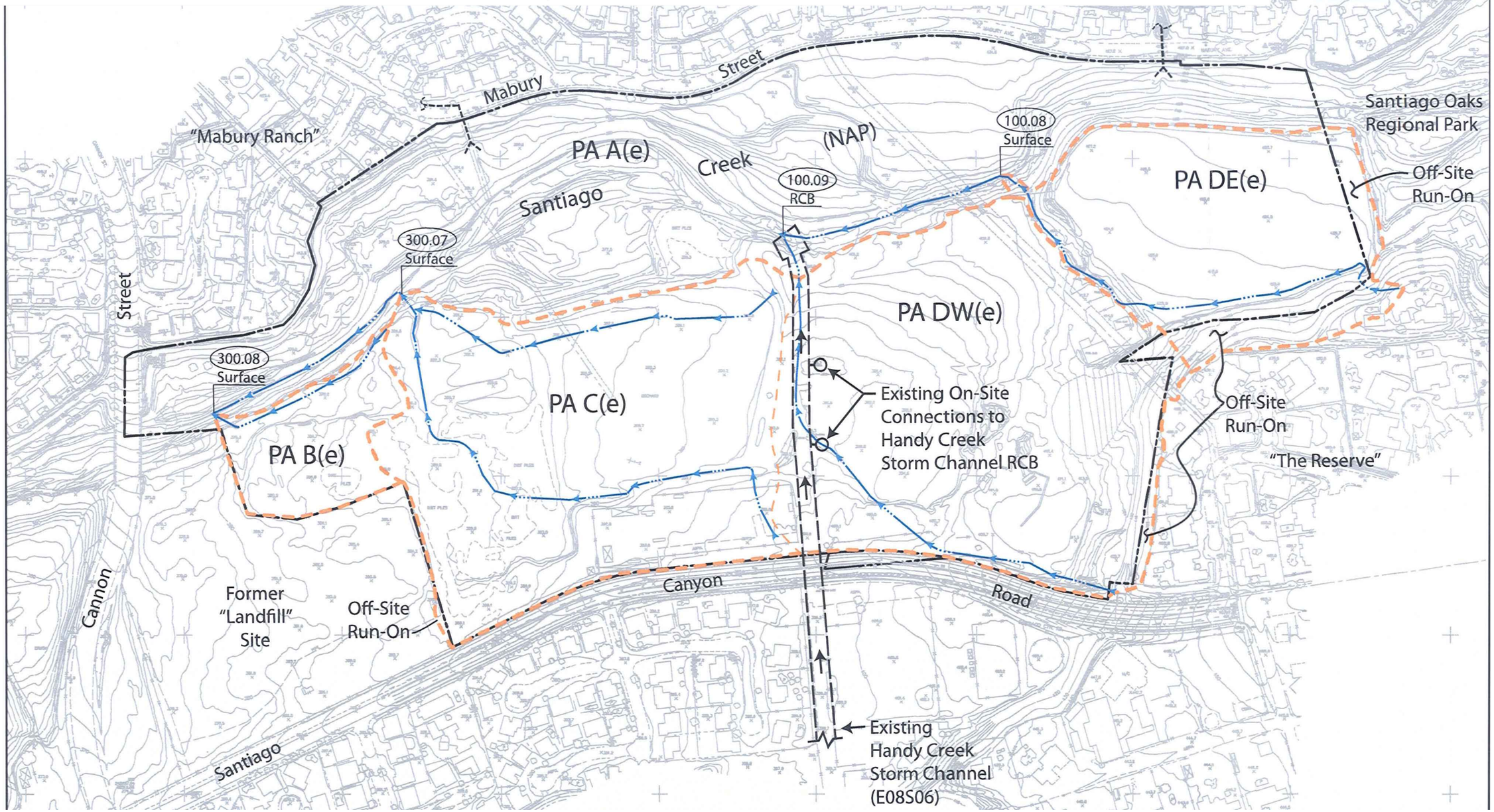
Drainage Area A (existing)

Drainage Area A (existing), includes Santiago Creek and is approximately 69 acres in ground surface area. It is bounded by Mabury Street and the existing Mabury Ranch residential community on the north, Cannon Street on the west, Santiago Oaks Regional Park and upstream portions of Santiago Creek to the east, and undeveloped property to the south which will become proposed Planning Areas B, C and D. The majority of Drainage Area A (existing) is not part of the hydrologic analysis included in this study, but receives run-off from the hydrologic area (proposed on-site development areas) under consideration. Santiago Creek within the project site is defined being located between Stations 100+00 and 150+00, approximately 5,000 feet in length as shown on Figure 5.9-2, *Planning Area Map*.

The ground surface includes incised portions of Santiago Creek where the majority of Creek flows are conveyed, higher floodway shelves which are intermittently flooded by large storm events or periodic significant flood releases from the upstream dams, and even higher shelves which remain dry. Santiago Creek changes flow directions several times within the project site. From Station 150+00 to 136+00, the channel flows in a westerly direction. At Station 136+00, the channel begins to turn toward the south bank. Downstream of Station 126+00, the channel begins to head back toward the north bank until it reaches Station 119+00. Downstream of Station 119+00, the channel generally remains in a southwesterly direction flowing out of the project site. In channel profile, the upper portion of the Santiago Creek between Stations 124+00 and 150+00 is deeply incised with the bedrock exposed on the Creek bottom. The middle portion of the Santiago Creek from Station 113+00 to 124+00 is wide and shallow. Historically, this portion of the channel was used as a desilting pond for mining operations. The lower portion of the reach from Station 100+00 to 113+00 is also incised with a bedrock invert near the surface.

The ground throughout Drainage Area A (existing) is lightly covered by grasses, shrubs, brush, and trees. The ground surface slopes generally from east to west and its elevations range from 354’ above to 420’ above msl. In addition to run-off from the Santiago Creek Watershed east of the project site, storm water run-off enters Drainage Area A (existing) from the Mabury Ranch community to the north via sheet flow and two existing storm drain outlets. Storm water run-off also enters Drainage Area A (existing) from the south via surface swales from Drainage Areas B, C, and D (existing) and via the existing Handy Creek Storm Channel RCB. Refer to Figure 5.9-1, *Existing Drainage Condition Map,* for a depiction of existing drainage features in Drainage Area A (existing).

Rio Santiago Property Boundary (109.75 Acres)
Existing Watershed Overall Boundary (72.7 Acres)
Existing Sub-Watershed Boundary
Existing Watercourse (Surface)
Handy Creek Storm Channel (RCB)
Existing Storm Drain Outlet
PA C(e) Existing Drainage Area Designation
300.08 Hydrologic Node



SOURCE: Fuscoe Engineering.

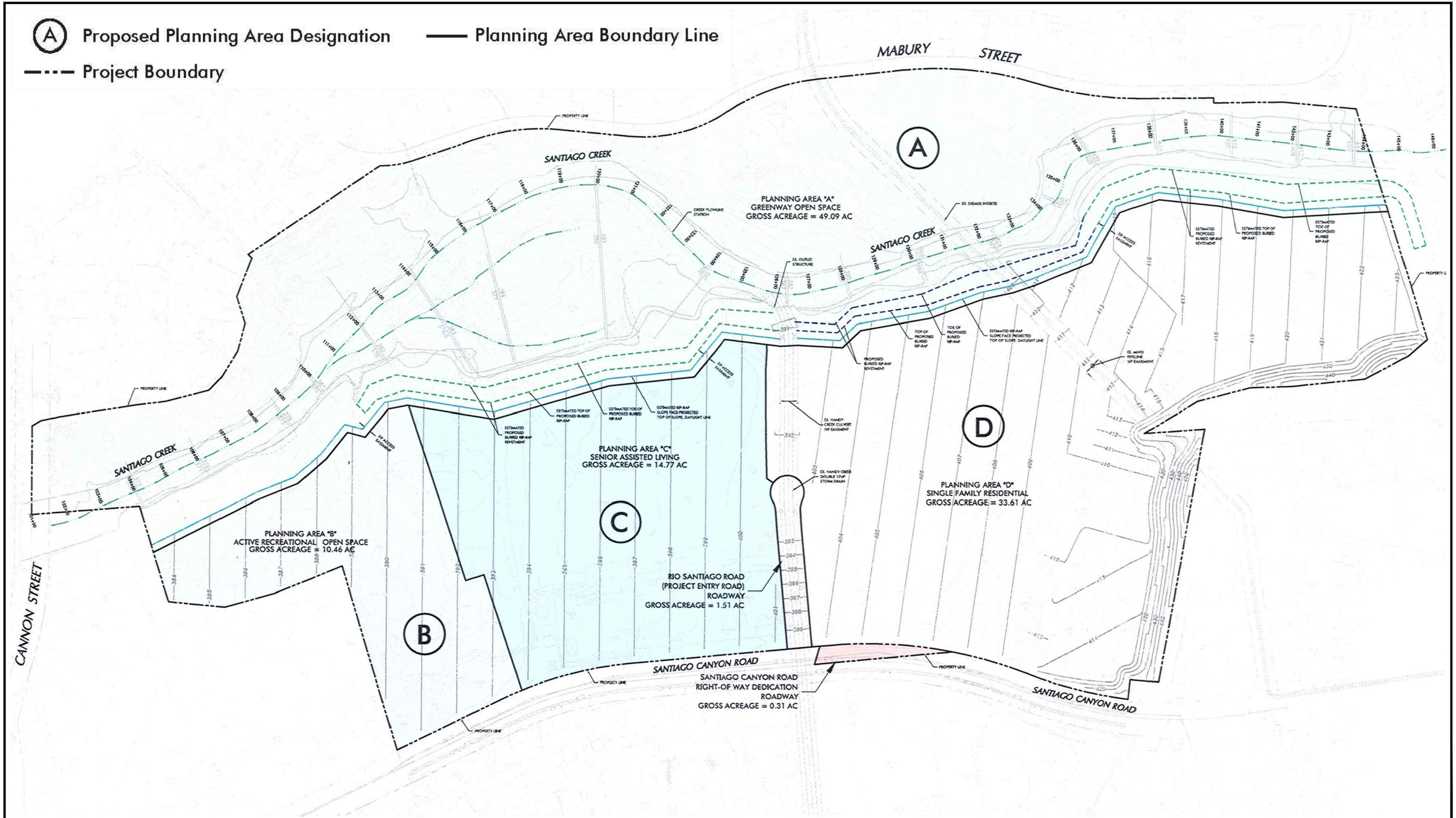
EXISTING DRAINAGE CONDITION MAP

RIO SANTIAGO PROJECT - CITY OF ORANGE

VISTA
NO SCALE

N

FIGURE 5.9-1



SOURCE: Fuscoe Engineering.

PLANNING AREA MAP

RIO SANTIAGO PROJECT - CITY OF ORANGE

VISTA

NO SCALE

N

FIGURE 5.9-2

Drainage Area B (existing)

Drainage Area B (existing) is approximately 4 acres in ground surface area. It is bounded by Santiago Creek [Drainage Area A (existing)] on the north. The westerly and southerly edge of Drainage Area B (existing) adjoins a landfill (Villa Park) owned by the County of Orange, which is currently closed. Drainage Area C (existing) forms the easterly boundary of Drainage Area B (existing). The existing ground surface consists primarily of silt (residue) deposits placed during the former mining operations on the property. The silt deposits are lightly covered by grasses, shrubs, brush and trees. The ground surface slopes generally from southeasterly to northwesterly and its elevation ranges from 355' above msl to 390' above msl. According to the Orange County Hydrology Manual, Soil Group "B" predominates, indicating a pervious area loss rate due to infiltration that is in the moderate range. Drainage Area B (existing) is part of the present backfilling operation and in the past it had been used for mining operations. Storm water run-off in the drainage area sheet flows northwesterly to a swale which conveys the flow to the northwest corner of the drainage area and outlets the flow on the top of bank above Santiago Creek where it falls to the Creek flowline below (Hydrologic Node 300.08). The bank is moderately eroded where the swale outlet occurs. Refer to Figure 5.9-1, *Existing Drainage Condition Map,* for a depiction of existing drainage features in Drainage Area B (existing).

Drainage Area C (existing)

Drainage Area C (existing) is approximately 25.5 acres in ground surface area. It is bounded by Santiago Creek on the north and East Santiago Canyon Road on the south. The westerly edge of Drainage Area C (existing is a natural ridgeline separating it from Drainage Area B (existing). A natural ridgeline just west of the existing Handy Creek Storm Channel forms the easterly boundary of Drainage Area C (existing). The existing ground surface consists primarily of silt (residue) deposits placed during the former mining operations on the property. The silt deposits are lightly covered by grasses, shrubs, brush, and trees. The ground surface slopes generally from southeasterly, to northwesterly and its elevation ranges from 362' above msl to 398' above msl. According to the Orange County Hydrology Manual, Soil Group "B" predominates, indicating a pervious area loss rate due to infiltration that is in the moderate range. Drainage Area C (existing) part of the present backfilling operation and in the past it had been used for mining operations. Storm water run-off in the drainage area sheet flows in a northwesterly direction and is collected in two swales. One swale traverses the middle of the drainage area and the other swale traverses the northerly portion of the drainage area. The swales confluence near the northwest corner of the drainage area and the flow outlets on the bank above Santiago Creek where it falls to the Creek flowline below (Hydrologic Node 300.07). The bank has minor erosion where the swale outlet occurs. Refer to 5.9-1, *Existing Drainage Condition Map,* for a depiction of existing drainage features in Drainage Area C (existing.

Drainage Area D (existing)

West

Drainage Area D West (existing) is approximately 28 acres in ground surface area. It is bounded by Santiago Creek on the north and East Santiago Canyon Road on the south. A natural ridgeline just west

of the existing Handy Creek Storm Channel forms the westerly boundary of Drainage Area D West (existing). An existing residential neighborhood named "The Reserve" and a natural ridgeline just east of the existing Metropolitan Water District (MWD) Allen McCulloch Pipeline (Diemer Transmission) forms the easterly boundary of Drainage Area D West (existing). Approximately 2.01 acres of off-site flow from "The Reserve" neighborhood runs onto Drainage Area D West (existing). The existing ground surface consists primarily of granular compacted artificial fill that is lightly covered by grass, shrubs, brush and trees. The ground surface slopes generally from east to west and its elevation ranges from 390' above msl to 460' above msl. According to the Orange County Hydrology Manual, Soil Group "B" predominates, indicating a pervious area loss rate due to infiltration that is in the moderate range. A materials recycling currently operates at the south easterly end of the Drainage Area D West (existing), while the balance of the site is unoccupied. The vast majority of storm water flow originating in Drainage Area D West (existing) enters the existing Handy Creek Storm Channel at two connection locations as shown on Figure 5.9-1, *Existing Drainage Condition Map*. Handy Creek is a double cell reinforced concrete box channel that discharges run-off to Santiago Creek (Hydrologic Node 100.09). The Handy Creek Storm Channel is described in further detail below. Refer to Figure 5.9-1, *Existing Drainage Condition Map* for a depiction of existing drainage features in Drainage Area D West (existing).

East

Drainage Area D East (existing) is approximately 15 acres in ground surface area. It is bounded by Santiago Creek [Drainage Area A (existing)\ on the north and The Reserve residential neighborhood on the south. The easterly edge of Drainage Area D East (existing) adjoins Santiago Oaks Regional Park. A natural ridgeline just east of the existing Diemer pipeline forms the westerly boundary of Drainage Area D East (existing). The existing ground surface consists primarily of silt (residue) deposits placed during the former mining operations on the property. The silt deposit is lightly covered by grasses, shrubs, brush and trees. The ground surface slopes generally from northeast to southwest and its elevation ranges from 385' above msl to 430' above msl. Approximately 0.55 acres of off-site flow from the Santiago Oaks Regional Park and approximately 2.0 acres of off-site flow from The Reserve runs onto Drainage Area D East (existing). According to the Orange County Hydrology Manual, Soil Group "B" predominates, including a pervious area loss rate due to infiltration that is in the moderate range. Drainage Area D East (existing) is unused at present; however, in the past it had been used for agricultural purposes. Storm water run-off in Drainage Area D East (existing) East sheet flows westerly until intercepted by an existing drainage ditch. The ditch flows northerly and disposes of the flow by a direct connection to Santiago Creek (Hydrologic node 100.08). Refer to Figure 5.9-1, *Existing Drainage Condition Map*, for a depiction of existing drainage features in Drainage Area D East (existing).

Handy Creek

Traversing through the Study Watershed is the existing Handy Creek Storm Channel (E08S06), an underground Dbl 12'(w) x 9'(h) reinforced concrete box (RCB) structure. The Handy Creek Storm Channel, operated by the Orange County Flood Control District, is located in the central portion of the project site. Off-site storm water run-off originating in areas south of East Santiago Canyon Road is conveyed through the project site in this underground facility and outletted directly into Santiago Creek.

Although the majority of Handy Creek Storm Channel tributary flows originate upstream (south) of the Study Watershed, and pass through the project site in the underground RCB structure, a portion of the Study Watershed tributary area in the east central portion of the project site [Drainage Area D West (existing)] also contributes flow to the Handy Creek Storm Channel via two existing on-site sump inlets. The percentage of the Study Watershed's existing tributary area contributing to the Handy Creek Storm Channel is 38.7% (28.13-acres/72.77acres).

According to the County of Orange in their May 25, 2011 comment letter to Notice of Preparation circulation (Appendix A), "the Handy Creek Storm Channel (E08S06) is a deficient flood control facility and is not capable of conveying run-off from the 100-year storm event. For this reason, it is recommended that the run-off from the development be drained directly into Santiago Creek and not into Handy Creek Storm Channel". This request has been integrated into the proposed condition hydrologic routing pattern and is discussed later in this section.

The existing Handy Creek Storm Channel RCB is the only existing underground conduit in the Study Watershed, and its discharge, including Study Watershed tributary areas, outlets into Santiago Creek at Node 100.09 near the center of the project site. Refer to Figure 5.9-1, *Existing Drainage Condition Map*, for a depiction of the existing Handy Creek Storm Channel drainage feature.

Unnamed Storm Drain

Two unnamed storm drains are located in the northerly portion of the project site and convey storm water collected in the Mabury Ranch area (to the north) directly into Santiago Creek. The storm drains will not be altered with the construction of this project. Refer to Figure 5.9-1, *Existing Drainage Condition Map,* for a depiction of the unnamed storm drain features.

Allen McCulloch Pipeline (Diemer Transmission)

The Allen McCulloch Pipeline (Diemer Transmission) trunk water distribution line, operated by the MWD, traverses the easterly portion of the site and is located entirely below grade.

Watershed Setting

The project site is a part of the Santiago Creek Watershed, which is a major tributary to the Santa Ana River (Figure 5.9-3, *Santa Ana River Watershed*). The Santiago Creek Watershed is depicted in Figure 5.9-4, *Santiago Creek Regional Watershed*. More specifically, Santiago Creek (Reach 1, Hydrologic Unit [HU] No. 801.21) is tributary to the Santa Ana River (Reach 2, HU No. 801.11). Santiago Creek, designated as system "E08" in the Orange County Drainage System, is 29 miles in length and drains approximately 110 square miles of mostly undeveloped land. The Creek originates at Santiago Peak in the Santa Ana Mountains and generally flows northwest to the east of the project site where it turns and flows in a southwesterly direction until it confluences with the Santa Ana River, approximately 3,600 feet south of the Garden Grove Freeway (SR-22) in the City of Santa Ana. The Santa Ana River ultimately discharges, to the west, into the Pacific Ocean. Reach 2 of the Santa Ana River is listed on the 303(d) List for Impaired Waterbodies for Indicator Bacteria. There are two existing dams on the Santiago Creek

which have major influence on channel discharge and sediment transport. The Santiago Reservoir is located approximately five miles upstream of the project site. The Villa Park Dam is located approximately one and one-half miles upstream of the project site. Based on the current disclosed dam failure inundation map of these two dams, the project site is located within the dam failure inundation zone.

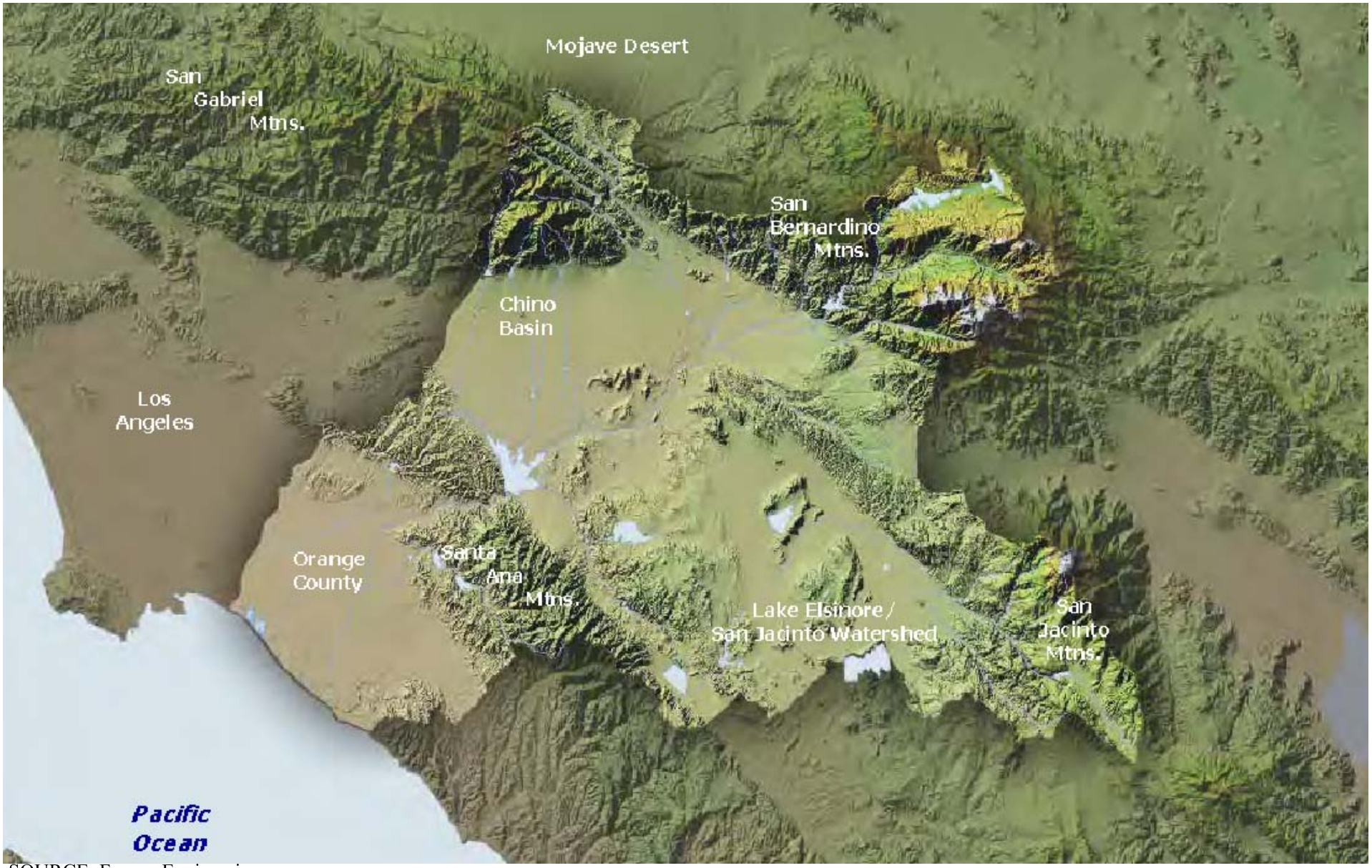
Hydrologically, the subject watershed (referred to as the "Study Watershed" in this section) lies directly north of East Santiago Canyon Road and east of Cannon Drive in the City of Orange, California. The Study Watershed is south of and tributary to Santiago Creek, although Santiago Creek flows are not a part of this analysis. Additional off-site residential areas north of the project site (Mabury Avenue) also contribute to Santiago Creek, but drainage conditions in those areas are also not a part of the Study Watershed analysis.

The subject watershed is 72.43 acres in size and is comprised primarily of Planning Areas B, C, and D (depicted on Figure 5.9-2, *Planning Area Map)*, as well as 3.56 acres of off-site run-on (included in the 72.43 acres). Table 5.9-1, *Watershed Area Statistics* provides a summary of the watershed area statistics.

Table 5.9-1: Watershed Area Statistics

Description	Existing Tributary Watershed Area (acres)		Existing On-Site Property Not Tributary to Watershed Study	Proposed Tributary Watershed Area (acres)		Proposed On-Site Property Not Tributary to Watershed Study
	On-Site	Off-Site		On-Site	Off-Site	
Planning Areas B, C, D, and A (portion)	69.36	-	-	68.87	-	-
Santiago Oaks Park	-	0.55	-	-	0.75	-
Run-on from "The Reserve"	-	2.81	-	-	2.81	-
Santiago Creek (PA A-portion)	-	-	39.48	-	-	39.90
East Santiago Canyon Road R/W Dedication	-	-	0.98	-	-	0.98
Yorba Landfill	-	0.05	-	-	-	-
Sub-Total	69.36	3.41	40.46	68.87	3.56	40.88
Total	**72.77**			**72.43**		

Source: Appendix J, Hydrology Study Report



SOURCE: Fuscoe Engineering.

SANTA ANA RIVER WATERSHED

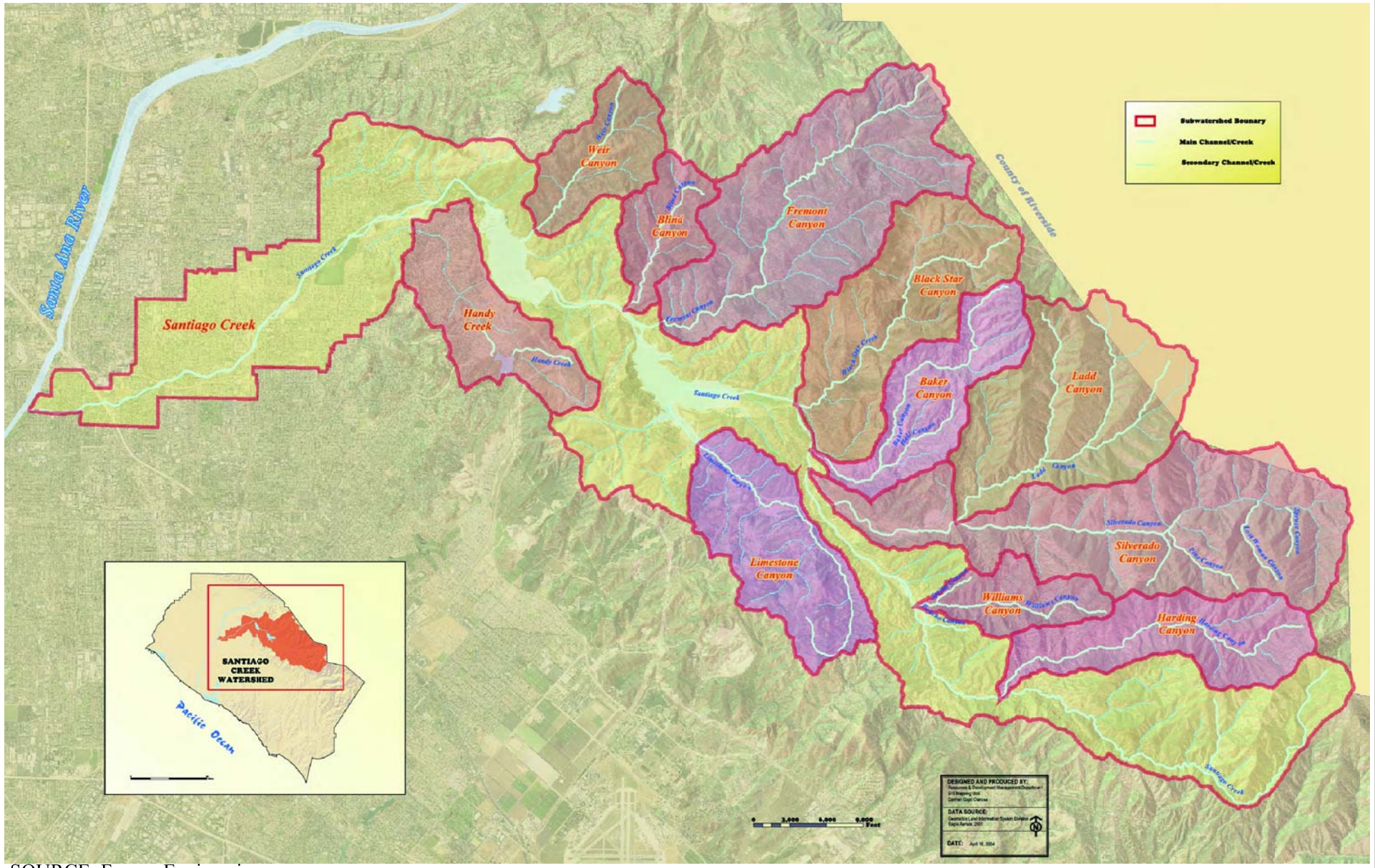
RIO SANTIAGO PROJECT - CITY OF ORANGE

VISTA

NO SCALE

N

FIGURE 5.9-3



SOURCE: Fuscoe Engineering.

SANTIAGO CREEK REGIONAL WATERSHED

RIO SANTIAGO PROJECT - CITY OF ORANGE

VISTA

NO SCALE

N

FIGURE 5.9-4

Beneficial Uses

The beneficial uses of Reach 1 of Santiago Creek, as outlined in the Basin Plan, are:

- MUN – Municipal and Domestic Supply;
- GWR – Groundwater Recharge;
- REC1 – Contact Water Recreation[1];
- REC2 – Non-Contact Water Recreation;
- WARM – Warm Freshwater Habitat; and,
- WILD – Wildlife Habitat.

Water Quality Objectives

In order to maintain the beneficial uses listed in the previous section, surface waters must achieve certain water quality objectives outlined in the Basin Plan. Table 5.9-2, *Water Quality Objectives for Santiago Creek, Reach 1* summarizes the Specific Water Quality Objectives for Santiago Creek, Reach 1.

Table 5.9-2: Water Quality Objectives for Santiago Creek, Reach 1

Water Quality Objectives: Surface Water						
Total Dissolved Solids	**Hardness**	**Sodium**	**Chloride**	**Total Inorganic Nitrogen**	**Sulfate**	**Chemical Oxygen Demand**
600	--	--	--	--	--	--

Note: All units in mg/L unless otherwise stated.
-- No specific water quality objectives established.
Source: Regional Water Quality Control Board (RWQCB) Santa Ana Region. Water Quality Control Plan for the Santa Ana River Basin (8). January 24, 1995, updated February 2008.

Source: Appendix K, Water Quality Technical Report

In addition to the specific objectives, qualitative and quantitative general water quality objectives have been set in the Basin Plan for the following constituents:

- algae
- ammonia
- bacteria/coliform
- boron
- chemical oxygen demand
- chloride
- chlorine
- color
- total dissolved solids
- floatables
- fluoride
- hardness
- nitrogen
- metals
- nitrate
- oil & grease
- dissolved oxygen
- pH

[1] Access prohibited in all or part by Orange County Resources Development and Management Division (RDMD).

- radioactivity
- sodium
- settleable solids
- sulfate
- sulfides
- surfactants
- taste & odor
- temperature
- toxic substances
- turbidity
- methylene blue-activated substances (MBAS)

Current Surface Water Quality Conditions

As part of the County-wide storm water program and OC DAMP, surface water monitoring is conducted along Santiago Creek. Currently, there are no monitoring locations for Santiago Creek Reach 1 within the proximity of the proposed project site. However, sampling within the Project's vicinity has been performed in the past. Field screening data and channel monitoring data were collected at two monitoring stations; one upstream and one downstream of the project site, during the periods of 1967 to 1994, and 1992 to 1996 respectively (see Figure 5.9-5, *Santiago Creek Sampling Points*). The County's field screening program includes on-site physical and chemical evaluations including dry weather and storm event sampling, as part of an effort to detect illicit connections and illegal discharges. The channel monitoring was conducted using automated samplers, and typically on a monthly basis. A summary of the collected data is provided in Table 5.9-3, *Field Screening Data Santiago Creek* and Table 5.9-4, *Channel Monitoring Data Summary* and refer to Figure 5.9-5, *Santiago Creek Sampling Points* for locations of the sampling sites.

No receiving water impairments or TMDLs have been listed for Santiago Creek Reach 1 or the Lower Santa Ana River Reach 1. Reach 2 is listed on the 303(d) list for Indicator Bacteria.

Floodplain Mapping

The National Flood Insurance Act (1968) established the National Flood Insurance Program (NFIP), which provides for the minimal requirements for floodplain management and is designed to minimize flood drainage within Special Flood Hazard Areas. The Federal Emergency Management Agency (FEMA) is the agency that administrates the National Flood Insurance Program. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. The 1% annual 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. Areas of Special Flood Hazard include Zones: A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation (BFE) is the water-surface elevation of the 1% annual chance flood. Flood Insurance Rate Maps (FIRMs) were developed by the NFIP to identify areas of flood hazards within a community.

Per the Flood Insurance Rate Map (FIRM) catalog, the project site falls entirely within the limits of FIRM Map Number 06059C0158J, which has an effective date of December 3, 2009. Figure 5.9-6, *Santiago Creek FIRM Depiction,* illustrates the project boundary and Planning Area boundaries superimposed onto the FIRM map. As shown in Figure 5.9-6, *Santiago Creek FIRM Depiction,* the Santiago Creek floodway traverses the northerly areas of the property where no development will occur and where existing conditions will be maintained. The Santiago Creek floodway is designated on the FIRM map as Zone AE

in this area. Zone AE is defined as the floodway of the channel/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. The Zone AE floodway limits are identified along with Santiago Creek BFE's. Figure 5.9-6, *Santiago Creek FIRM Depiction, articulates* that project development areas are outside of Zone AE flood limits and are currently designated Zone X (outside any SFHA). Preliminary project grading plans indicate fills of 0-feet to 12-feet will be placed in on-site development areas to create final landform grading conditions. This graded fill condition coupled with non-encroachment into Santiago Creek floodway (Zone AE) areas ensures that Zone X designations will continue within development areas of the project site and also ensures that project improvements will not impede the existing 100-year floodplain. It should be noted that the hydrologic condition (discharge value), leading to BFE designations identified on FIRM Map Number 06059C0158J, is unknown. Accordingly, the project has performed hydraulic modeling of the Santiago Creek utilizing local jurisdiction established discharge values (6,000 cfs), Manning's "n" values (0.17), and modified grading conditions for the proposed regional recreational facilities along the south side of Santiago Creek, to compare modeled Santiago Creek water surface elevations against FIRM BFE's and proposed grading elevations along the Santiago Creek/development edge interface.

The Santiago Creek Study analysis is not a part of this "on-site" drainage report but is included in the separate report *"Hydraulic and Sediment Transport Report for Santiago Creek (June 28, 2011)."* Hydraulic modeling water surface results from the Santiago Creek Study are included herein in Table 5.9-5, *Santiago Creek Water Surface Elevation Comparison,* and indicate a -2.8 foot (Sta. 144+00) to 3.9 foot (Sta. 110+00) difference in water surface elevations between FIRM BFE's and Santiago Creek Study water surface elevations from the Santiago Creek Hydraulic Study. Higher Santiago Creek water surface elevations (e.g., higher than FIRM BFE's) are expected in the Santiago Creek Study because of the conservative "n" value used in the Santiago Creek Study. Also included in Table 5.9-5, *Santiago Creek Water Surface Elevation Comparison* are proposed project grading elevations that have been extracted from the conceptual grading exhibit. The grading elevations represent the proposed finished grade on the property line separating Planning Area A (Santiago Creek Greenway Reserve) from the Planning Area B, C, and D development areas (see Figure 5.9-7, *Proposed Grading Interface with Santiago Creek*), and are taken at the intersection of the Santiago Creek station line projection with the property line.

A comparison of the project grading elevation with the higher of the two water surface elevations (FIRM BFE or Creek Study WSE) at any given station indicates the project grading is always higher than the Santiago Creek 100-year water surface with the smallest differential being 0.10 foot at station 144+00. This result indicates the project development areas in the post development condition will remain outside of any Special Flood Hazard Area (SFHA).

Table 5.9-3: Field Screening Data Santiago Creek

FIELD SCREENING DATA																					
Station Name	**Location**	**Sampling Date**	**Flow (cfs)**	**pH**	**COND (umhos)**	**Temp (C)**	**DO (mg/l)**	**Diss. C12 (ug/l)**	**Diss. Cu (ug/l)**	**Diss. Cr (ug/l)**	**Diss. Zn (ug/l)**	**Free CN (mg/l)**	**Total CN (mg/l)**	**NO3 (mg/l)**	**Phenol (mg/l)**	**COD (mg/l)**	**Hardness (mg/l)**	**Cr (ug/l)**	**Cu (ug/l)**	**Cd (ug/l)**	**Pb (ug/l)**	**Zn (ug/l)**
Santiago Creek Channel at Bristol St (38)	Down-stream of Project	2/13/1992	5.3	7.8	327	17.4	10.5								<0.01	<58	180	<10	19	<5		64
		1/6/1993	200	7.9	182	13.8	7.8									44	45	<10	<10	<10		<20
		5/5/1993	2	8.5	912	22	8.6	0.39	<5.0	<10	<30	<0.014			<0.01		440					
		3/7/1994	100	9.1	145	17.8	17.9							2.6	ND	81	30	<5	7		<5	<20
		11/10/1994	0.5	7.9	230	8.4	15.5					<0.014		<1	ND	62	58	<5	8		<5	<20
		1/16/1996	5.3	7.6	158	16.1	7.8					<0.014		1.1	ND	143	27	<5	24		<5	73
Villa Park Dam at Lolita St (39)	Upstream of Project	3/3/1992		7.2	863	16.3	5.1						<0.02		0.01	<58	240	<10	17	<5		<20
		6/8/1992		7.3	598	22	1.4	0.08	30	<10		<0.014			0.01		300					
				7.3	590	28	2.1	<0.05	<30	<10		<0.014			0.01		312					
		3/7/1995	700	8.1	710	15.5	12.2					<0.014		<1	ND	<25	241	<5	<5		<5	<20
Basin Plan Objective				6.5-8.5			> 5							< 45					< 37	< 4	< 28	

ND designates not detected.

Source: Appendix K, Water Quality Technical Report

Table 5.9-4: Channel Monitoring Data Summary

CHANNEL MONITORING DATA (HISTORICAL) SANTIAGO CANYON ROAD BRIDGE (STATION 38)						
Parameter	**Unit**	**Sampling Period**	**Maximum**	**Minimum**	**Mean**	**1995 Basin Plan Objective**
Temp	cent	1977-1994	22	8	14.36	
Flow	cfs	1964-1994	1,500	0.5	180.24	
Turbidity	hatch ftu	1973-1980	3,000	1	530.21	
Conductivity	micromho	1978-1994	912	145	442.57	
Dissolved Oxygen	mg/L	1978-1994	17.9	7.8	12.48	> 5
COD	mg/L	1978-1994	467	22	106.77	
pH	su	1978-1994	**9.1**	7.4	8.05	6.5-8.5
HCO3 ION	mg/L	1967-1975	257	179	215	
CO3 ION	mg/L	1967-1975	18	0	7.58	
Total Residue (nflt)	mg/L	1977-1980	14,000	12	2,704.4	
Oil & Grease	mg/L	1978-1980	18.8	3	9.08	
Total N (NH3+NH4)	mg/L	1977-1980	1.3	0.1	0.25	
NH3-N (un-ionized)	mg/L	1977-1980	0.013	0.0006	0.003	< 0.098
NH3-NH3 (un-ionized)	mg/L	1977-1980	0.016	0.007	0.004	< 0.12
TKN	mg/L	1977-1980	8.2	0.1	2.89	
Total PO4	mg/L	1977-1980	0.74	0.12	0.37	
Total Hardness (CACO3)		1973-1994	440	30	202.67	
Dissolved Calcium	mg/L	1967-1975	75	61.4	68.9	
Dissolved Magnesium	mg/L	1967-1975	21.3	18	19.35	
Dissolved Sodium	mg/L		26	18	22	
Dissolved Potassium	mg/L	1967-1974	1.4	1	1.16	
Total Chloride	mg/L	1967-1975	16	9	12.83	
Total Sulfate	mg/L	1967-1978	101	15	81.67	
Dissolved Flouride	mg/L	1967-1974	0.3	0.2	0.24	0.9
Dissolved Silica	mg/L	1969-1980	21.7	3	15.85	
Dissolved Boron	ug/L	1967-1974	200	16	93.2	750
Total Cadmium	ug/L	1977-1993	10	2	4.25	
Total Chromium	ug/L	1977-1994	53	0.8	20.42	
Total Copper	ug/L	1978-1994	40	4	19.98	
Total Lead	ug/L	1977-1994	90	0.9	36.22	
Total Zinc	ug/L	1977-1994	290	9	78.77	
Dissolved Zinc	ug/L	1993	30	30	30	
Total Coliform	MPN/100mL	1978-1980	**240,000**	90	**46,747**	100
Phenol (Dissolved)	ug/L	1992-1993	10	10	10	
Calcium Hardness	mg/L	1967-1975	264	236	251.73	
TDS	mg/L	1967-1974	368	328	353.4	600
Chloride	mg/L	1993	0.39	0.39	0.39	
Nitrate (total)	mg/L	1967-1980	26.4	0	7.34	< 45
Dissolved Nitrate (NO3)	mg/L	1994	2.8	2.8	2.8	

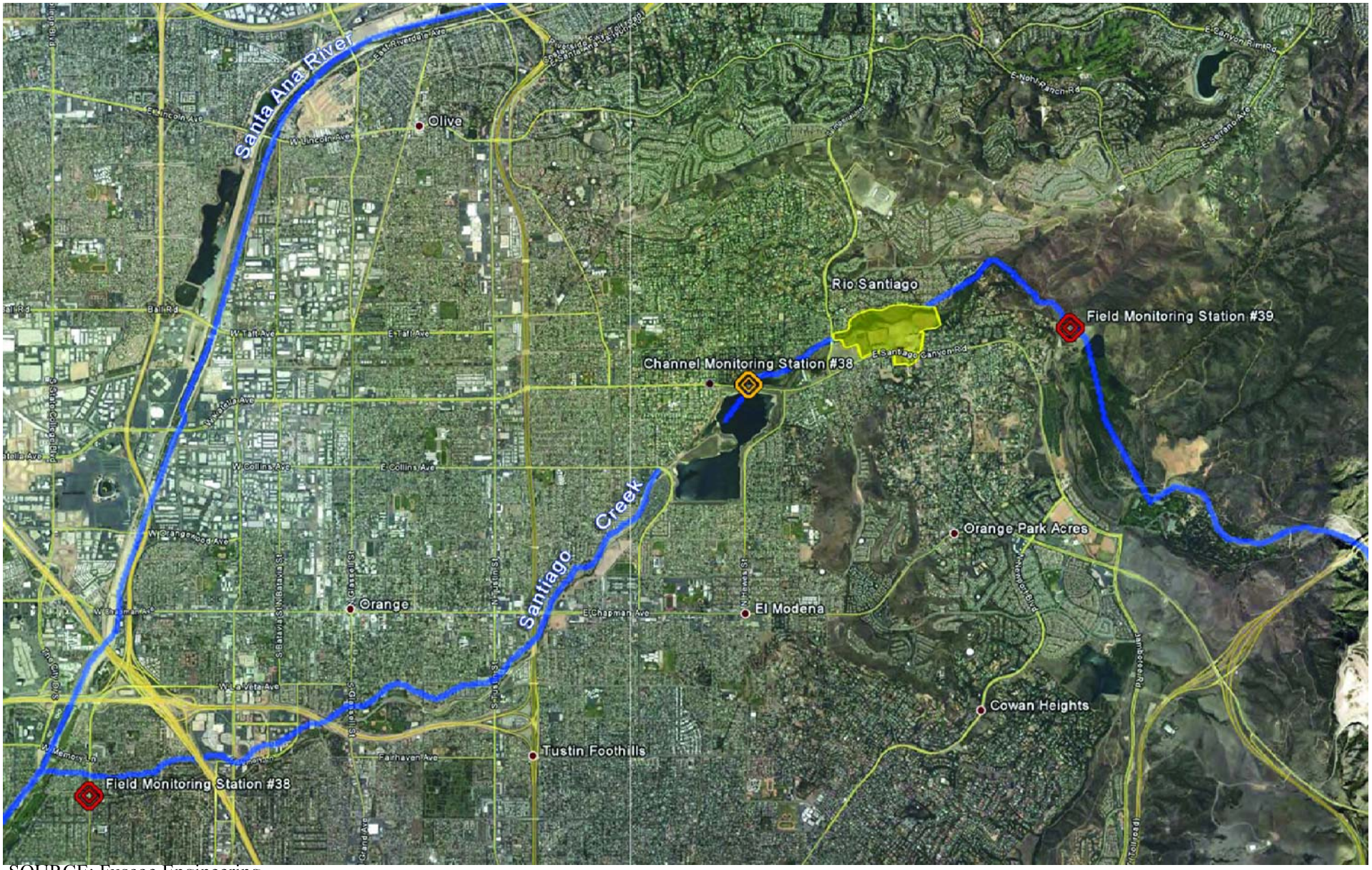
Source: Appendix K, Water Quality Technical Report

Table 5.9-5: Santiago Creek Water Surface Elevation Comparison

Creek Station	FIRM BFE[(1)]	Creek Study W.S.E.[(2)]	Project Grading Elevation[(3)]
104+00	370.0	371.9	383.0
106+00	373.0	375.4	385.0
110+00	377.0	380.9	389.0
114+00	380.0	382.2	393.2
118+00	382.0	383.1	395.7
122+00	385.5	385.6	397.8
126+00	388.0	391.9	400.6
130+00	396.5	400.1	410.1
134+00	405.0	406.8	412.9
138+00	409.0	410.6	413.7
142+00	414.0	413.0	415.9
144+00	417.0	414.2	417.1

(1) Extracted from FIRM Map Number 06059C0158J
(2) Extracted From Santiago Creek Hydraulic and Sediment Transport Study, Chang Consulting, July, 2011 (*Reference 1*)
(3) See Rio Santiago Conceptual Grading Exhibit

Source: Appendix J, Hydrology Study Report



SOURCE: Fuscoe Engineering.

SANTIAGO CREEK SAMPLING POINTS

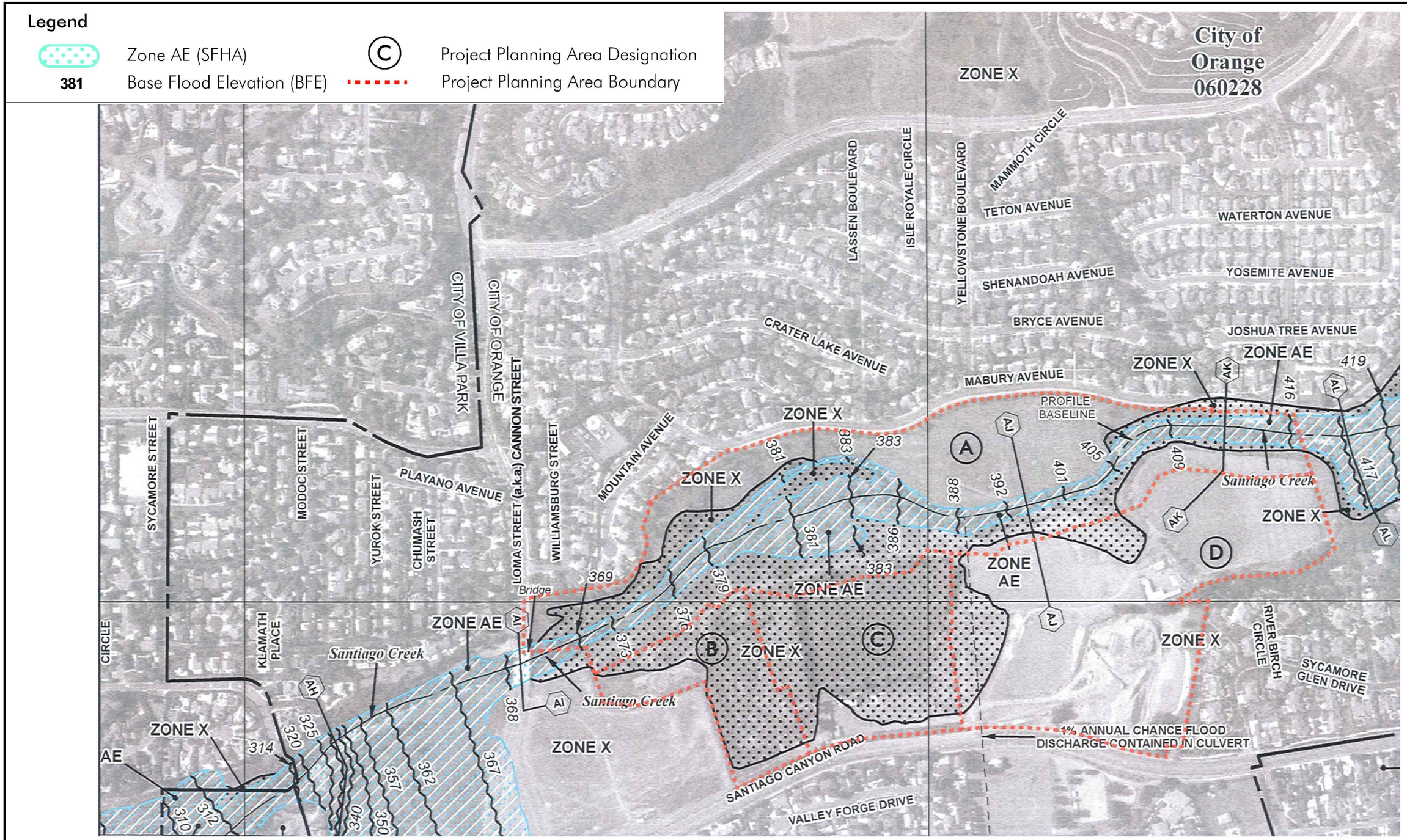
RIO SANTIAGO PROJECT - CITY OF ORANGE

VISTA

NO SCALE

N

FIGURE 5.9-5



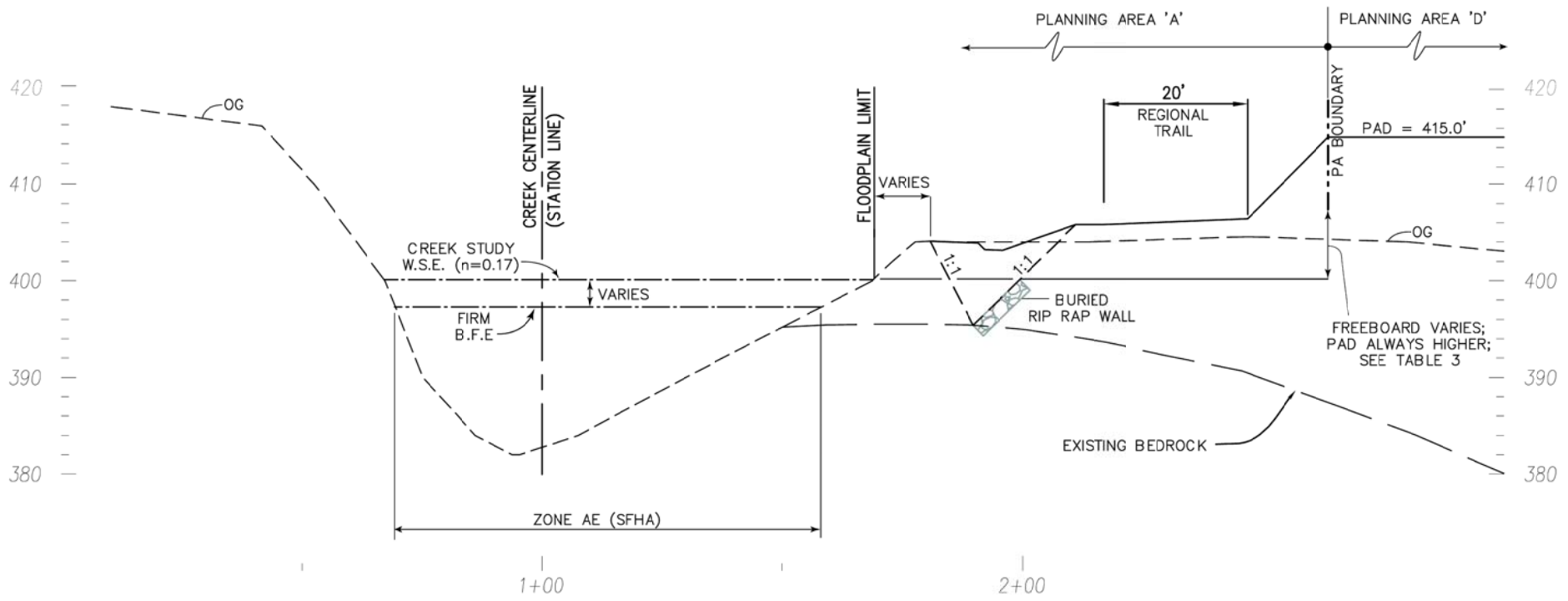
SOURCE: Fuscoe Engineering and Federal Emergency Management Agency.

SANTIAGO CREAK FIRM DEPICTION

RIO SANTIAGO PROJECT - CITY OF ORANGE

VISTA
NO SCALE
N

FIGURE 5.9-6



CREEK STATION 132+00

(REPRESENTATIVE SECTION) NTS

SOURCE: Fuscoe Engineering.

PROPOSED GRADING INTERFACE WITH SANTIAGO CREEK

RIO SANTIAGO PROJECT - CITY OF ORANGE

VISTA

NO SCALE

FIGURE 5.9-7

5.9.3 Regulatory Setting

Federal Water Quality Requirements

The water quality objectives for all waters in the State are established under the applicable provisions of Section 303 of the Federal Clean Water Act (CWA) and the State Porter-Cologne Water Quality Control Act. The State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Board (RWQCB) are responsible for assuring implementation of and compliance with the provisions of the CWA and the Porter-Cologne Act. The applicable provisions of the CWA related to surface water run-off are discussed below.

Federal Clean Water Act

Section 303 of the CWA requires that States adopt water quality standards for all surface waters of the United States. Section 304(a) of the CWA requires that the U.S. Environmental Protection Agency (EPA) publish water quality criteria that accurately reflect the most current scientific knowledge regarding the effects on health and welfare from the presence of pollutants in the surface water. Where multiple uses occur, water quality standards must protect the most sensitive land use. Typically, water quality standards are numeric, although narrative criteria based upon biomonitoring methods may be used where numerical standards cannot be established or where they are needed to supplement numerical standards. States are required to adopt numerical water quality standards for toxic pollutants for which the EPA has published water quality criteria and which could be expected to interfere with designated uses in a water body.

National Pollutant Discharge Elimination System Permits

The National Pollutant Discharge Elimination System (NPDES) permit system was established in the CWA to regulate municipal and industrial discharges to the surface waters of the United States. Section 402 of the CWA contains general requirements regarding NPDES permits. Section 307 of the CWA describes the factors the EPA must consider in setting effluent limits for priority pollutants.

Amendments adopted in 1972 to the CWA prohibit the discharge of pollutants to navigable waters from a point source (discharge from a single conveyance such as a pipe) unless the discharge is authorized by an NPDES permit. In 1987, in recognition that diffuse or non-point sources were significantly impairing surface water quality, Congress amended the CWA to address storm water run-off pollution in a phased program requiring NPDES permits for operators of municipal separate storm sewer systems (MS4s), construction projects, and industrial facilities. Phase I, approved in 1990, required municipal permits for MS4s generally serving populations over 100,000, construction permits for projects five acres or greater, and industrial permits determined by Standard Industrial Classification Code (SIC).

In December 1999, the EPA finalized Phase II of the NPDES program, which requires that operators of small MS4s located in urban areas implement programs and policies to control polluted storm water run-off through the use of NPDES permits. In addition, Phase II includes small construction activities that result in land disturbances of equal to or greater than one and less than five acres within the NPDES program.

The purpose of the NPDES municipal program is to establish a comprehensive water quality program to manage urban storm water in order to minimize pollution of the environment to the maximum extent practicable. The NPDES program consists of: characterization of the receiving water quality; identification of harmful constituents; identification of potential sources of pollutants; and, implementation of a Comprehensive Storm Water Management Program. One of the primary objectives of water quality regulations, including the NPDES program, is the reduction of pollutants and sediments in urban storm water run-off to the maximum extent possible through the use of Best Management Practices (BMPs).

There are two categories of BMPs: structural BMPs and non-structural BMPs. Structural BMPs involve the specific construction, modification, operation, maintenance, or monitoring of facilities to minimize the introduction of pollutants from the drainage system. Non-structural BMPs are activities, programs, and other non-physical measures that would contribute to the reduction of pollutants from non-point source pollutants to the drainage system.

State Water Quality Requirements

In California, the regulation, protection, and administration of water quality are carried out by the State Water Resources Control Board (SWRCB) and nine California Regional Water Quality Control Boards (RWCQBs). The State is divided into nine regions due to regional concerns and issues related to water quality and quantity. In compliance with Section 303 of the CWA and the Porter-Cologne Water Quality Control Act, each RWQCB is required to adopt a Water Quality Control Plan or Basin Plan which recognizes and reflects regional differences in existing water quality, the beneficial uses of the region's ground and surface water, and local water quality conditions and problems. The project site is located within the Santa Ana Region which is addressed in the *Water Quality Control Plan for the Santa Ana Basin (8)*, dated January 24, 1995, and updated in October 2008. The Santa Ana Basin Plan is designed to preserve and enhance water quality and protect the beneficial uses of its regional waters.

The Santa Ana RWQCB has the authority to implement water quality protection standards through the issuance of permits to waters within its jurisdiction. As previously stated, pursuant to Section 303(d) of the CWA, the Santa Ana RWQCB has included Reach 2 of the Santa Ana River on the 2010 Clean Water Act 303(d) list of "impaired water bodies" for indicator bacteria. Reach 1 of the River and the Pacific Ocean is not listed for any impairments.

The Santa Ana RWQCB administers the NPDES permit requirements for the project area, including the project site. As discussed above, in 1990 the EPA established Phase I of the NPDES storm water program to address discharges from construction activities disturbing five acres or more of land. In 1992, the State adopted a related NPDES General Permit for Storm Water Discharges Associated with Construction Activities (Construction Activities General Permit) for projects greater than five acres in size. The permit required that applicable projects have a Storm Water Pollution Prevention Plan (SWPPP) which: specifies BMPs that would prevent construction pollutants from contacting storm water with the intent of keeping all products of erosion from moving off-site into receiving waters; eliminates or

reduces non-storm water discharges to storm sewer systems and waters of the State; and, provides a monitoring program for the routine inspection of all BMPs.

In 1999, the State adopted the NPDES General Permit for Storm Water Discharges Associated with Construction Activities (Construction Activities General Permit) (State Water Resources Control Board Order No 99-08-DWQ, NPDES CAS000002) which requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) for the aforementioned applicable projects. The SWPPP is required to achieve two major objectives: to help identify the sources of sediment and other pollutants that affect the quality of storm water discharges; and, to describe and ensure the implementation of BMPs to reduce or eliminate sediment and other pollutants in storm water and non-storm water discharges, including non-visible pollutants. In September 2009, the SWRCB updated the General Construction Permit (GCP). Order No. 2009-0009-DWQ became effective July 1, 2010.

The 1987 Amendment to the CWA required municipalities to obtain NPDES permits for storm water discharges to storm drain systems. In 1990, the County of Orange, County Flood Control District (OCFCD) and incorporated cities received a regional NPDES permit. A "Second Term" permit was renewed in 1996. A "Third Term" permit was renewed in 2002 and the "4th Term" permit was renewed in 2009.

Local Water Quality Requirements

City of Orange Storm Water Program

A total of three State and County NPDES permits apply to storm water regulations within the City. These permits are listed below:

1. State General Permit CAS000001 regulates discharges of storm water associated with industrial activities.

2. State General Permit CAS000002 regulates discharge of storm water run-off associated with construction activities.

3. Orange County Order Number R8-2009-0030 and State Permit CAS618030 regulates waste discharge requirements (WDR).

Third term Permit R8-2002-0010 required cities and the County to mitigate, among other things, illegal discharges into the storm drainage system. The programs include: (1) inspections of commercial and industrial properties; (2) inspection and cleaning of storm water pipelines; and, (3) responding to complaints.

Local Implementation Plan (LIP)

The City adopted a Local Implementation Plan (LIP) to regulate the water quality of storm water run-off. The Plan became effective on July 1, 2003. The LIP states that the City complies with the NPDES permit. The LIP requires various development projects within the City to submit a Water Quality

Management Plan (WQMP). The City LIP was developed and adopted on July 1, 2003, and a revised LIP adopted on September 13, 2011.

Drainage Area Management Plan (DAMP)

The Drainage Area Management Plan (DAMP) is Orange County's principal policy and guidance document for the NPDES program. The County and stakeholders created the DAMP, which has been in effect since 1993, with subsequent updated elements. A revised DAMP was submitted to the Santa Ana Regional Water Quality Control Board in July 2006, known as the 2007 DAMP. In May 2009, the Santa Ana RWQCB re-issued the MS4 Permit for the Santa Ana Region of Orange County (fourth term permit), which will result in future changes to the OC DAMP and City of Orange LIP and storm water program. In addition to the previous requirements under the third term permit, the requirements of the new 4th term permit include requirements pertaining to hydromodification and low impact development (LID) features associated with new developments and redevelopments.

5.9.4 Significance Thresholds

After considering the preliminary thresholds set forth in Appendix G of the State CEQA Guidelines (to the extent applicable to the proposed project), the adopted regulations of the County of Orange, and the thresholds set forth by City, the following thresholds of significance have been established for the evaluation of the proposed project's potential hydrology impacts:

Threshold HWQ-A Would the proposed project violate any water quality standards or waste discharge requirements?

Threshold HWQ-B Would the proposed project substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?

Threshold HWQ-C Would the proposed project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?

Threshold HWQ-D Would the proposed project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface run-off in a manner which would result in flooding on- or off-site?

Threshold HWQ-E Would the proposed project create or contribute run-off water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted run-off?

Threshold HWQ-F Would the proposed project otherwise substantially degrade water quality?

Threshold HWQ-G Would the proposed project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?

Threshold HWQ-H Would the proposed project place within a 100-year flood hazard area structures which would impede or redirect flood flow?

Threshold HWQ-I Would the proposed project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?

Threshold HWQ-J Would the proposed project expose people or structures to inundation by seiche, tsunami, or mudflow?

Threshold HWQ-K Would the proposed project potentially impact storm water run-off from construction activities?

Threshold HWQ-L Would the proposed project potentially impact storm water run-off from post-construction activities?

Threshold HWQ-M Would the proposed project result in a potential for discharge of storm water pollutants from areas of material storage, vehicle or equipment fueling, vehicle or equipment maintenance (including washing), waste handling, hazardous materials handling or storage, delivery areas, loading docks or other outdoor work areas?

Threshold HWQ-N Would the proposed project result in the potential for discharge of storm water to affect the beneficial uses of the receiving waters?

Threshold HWQ-O Would the proposed project create the potential for significant changes in the flow velocity or volume of storm water run-off to cause environmental harm?

Threshold HWQ-P Would the proposed create significant increases in erosion of the project site or surrounding areas?

5.9.5 Evaluation of Potential Project Impacts

This section will evaluate whether the proposed project would potentially have a substantial adverse effect on hydrology and water quality. This evaluation assumes that the project will be implemented consistent with the Project Description, including all Project Design Features (PDF's).

Project Design Features

All Project Design Features (PDF's) associated with hydrology and water quality are noted below in Table 5.9-6, *Project Design Features & Hydrology and Water Quality Impact Comparison*. The table identifies the PDF's related to each CEQA threshold. The checkmark indicates that the PDF reduces, eliminates, and/or avoids impacts associated with the related threshold. Refer to the threshold analysis for specific details.

The remainder of this page left intentionally blank.

Table 5.9-6: Project Design Features & Hydrology and Water Quality Comparison

Project Design Features		CEQA Thresholds															
		Water Quality Standards/Discharge Requirements	Groundwater Supplies/Recharge	Drainage Pattern: Erosion or Siltation	Drainage Pattern: Flooding	Drainage System Capacity/Polluted Run-off	Degraded Water Quality	Housing Placement: Flood Hazard Area	Structure: Impede or Redirect Flood Flow	Flooding	Seismic Related Inundation	Construction Activities: Stormwater	Post-Construction Activities Stormwater	Stormwater Pollutants Discharge	Stormwater Discharge	Velocity or Volume Stormwater Run-off	Erosion
PDF-HWQ-1	The proposed project will provide drainage collection (inlets) and drainage conveyance (storm drain pipe or street flow) to collect the run-off and convey it in a safe manor to Santiago Creek.				x											x	
PDF-HWQ-2	The proposed project drainage features will be sized in a manner to meet City of Orange and County of Orange requirements for flow conveyance and flood protection.				x											x	
PDF-HWQ-3	The proposed project will provide two storm drain system (Lines 'A' and 'B') consistent with storm drain routing alignments established in the hydrologic analysis.				x											x	
PDF-HWQ-4	The proposed project will provide a storage facility in the downstream areas of Planning Area B to provide controls of 2-year run-off volumes in excess of the existing 2-year condition. The type of storage facility will be determined during final design and will be either a surface (basin) facility or an underground vault facility or combination thereof. The proposed facility will be sized to detain a minimum of 0.75-acre-feet of storm run-off and either infiltrate the volume or include an outlet to drain the facility within 48-hours after a rain event has ended or a combination thereof.				x											x	
PDF-HWQ-5	The proposed project will reduce Planning Area B/C peak flow rates to a level consistent with existing conditions. The proposed project will provide a mainline storm drain split flow device utilized to extract storm water to the volume				x											x	

Table 5.9-6: Project Design Features & Hydrology and Water Quality Comparison

Project Design Features		CEQA Thresholds															
		Water Quality Standards/Discharge Requirements	Groundwater Supplies/Recharge	Drainage Pattern: Erosion or Siltation	Drainage Pattern: Flooding	Drainage System Capacity/Polluted Run-off	Degraded Water Quality	Housing Placement: Flood Hazard Area	Structure: Impede or Redirect Flood Flow	Flooding	Seismic Related Inundation	Construction Activities: Stormwater	Post-Construction Activities Stormwater	Stormwater Pollutants Discharge	Stormwater Discharge	Velocity or Volume Stormwater Run-off	Erosion
	control storage facility. The facility will be sized and configured to reduce mainline run-off rates to pre-project levels downstream of the split flow structure. Final type selection and detailing of the split flow structure will occur during final design stages of the proposed project																
PDF-HWQ-6	The proposed project will delay Times of Concentration's at the Planning Area D outlet to Santiago Creek and will arrive slightly sooner at the Planning Area B/C outlet to Santiago Creek.				**x**											**x**	
PDF-HWQ-7	The proposed project Lines "A" and "B" of the project storm drain system outlets will be located in the same general vicinity as existing surface flow outlets into Santiago Creek. Because confined flows in a drainage conduit outletting into a natural area tend to have erosive potential velocities and energy, scour reduction facilities or energy dissipation facilities or both will be provided at each outlet location in order to reduce local erosion potential to non-impactful levels.			**x**	**x**											**x**	
PDF-HWQ-8	The proposed project will collect, route, and outlet project site tributary flows directly to Santiago Creek. The existing Orange County Flood Control District (OCFCD) Handy Creek Storm Channel traverses the project site and currently accepts 28.13-acres of project site watershed tributary via two sets of on-site inlets is a "deficient flood control facility and is not				**x**											**x**	

Table 5.9-6: Project Design Features & Hydrology and Water Quality Comparison

Project Design Features		CEQA Thresholds															
		Water Quality Standards/Discharge Requirements	Groundwater Supplies/Recharge	Drainage Pattern: Erosion or Siltation	Drainage Pattern: Flooding	Drainage System Capacity/Polluted Run-off	Degraded Water Quality	Housing Placement: Flood Hazard Area	Structure: Impede or Redirect Flood Flow	Flooding	Seismic Related Inundation	Construction Activities: Stormwater	Post-Construction Activities Stormwater	Stormwater Pollutants Discharge	Stormwater Discharge	Velocity or Volume Stormwater Run-off	Erosion
	capable of conveying run-off from the 100-year storm event."																
PDF-HWQ-9	The proposed project will prepare a Storm Water Prevention Pollution Plan (SWPPP) to include erosion and sediment control Best Management Practices (BMPs) that would meet or exceed measures required by the Construction General Permit, as well as BMPs that control other potential construction-related pollutants. The SWPPP would be prepared and implemented at the project site and revised as necessary as administrative or physical conditions change, as required by, and in compliance with, the General Construction Permit.	x	x			x	x					x	x	x	x		x
PDF-HWQ-10	The proposed project will prepare a Water Quality Management Plan consistent with the 2011 County-wide Model WQMP and accompanying Technical Guidance Document (TGD) which includes the LID hierarchy and implementation criteria, site design, source control and treatment control BMPs.	x	x			x	x					x	x	x	x		x

Source: KTGY and Vista Community Planners (Vista).

Water Quality Standards/Discharge Requirements

Threshold HWQ-A	**Would the proposed project violate any water quality standards or waste discharge requirements?** **[CEQA Hydrology and Water Quality Threshold 9(a)]**

Construction

The potential impacts of construction activities on water quality focus primarily on sediments, turbidity, and pollutants that might be associated with sediments (e.g., phosphorus and legacy pesticides). Construction-related activities that are primarily responsible for sediment releases are related to exposing soils to potential mobilization by rainfall/run-off and wind. Such activities include removal of vegetation and existing structures from the site, grading of the site, and construction of new buildings, roadways, and landscaped areas. Environmental factors that affect erosion include topographic, soil, and rainfall characteristics. Non-sediment-related pollutants that are also of concern during construction include waste construction materials; chemicals, liquid products, and petroleum products used in building construction or the maintenance of heavy equipment; and, concrete-related waste streams.

During construction activities, excavated soil would be exposed and there would be an increased potential for soil erosion compared to existing conditions. Additionally, during a storm event, soil erosion could occur at an accelerated rate. Clearing, grading, excavation, and construction activities associated with the proposed project could potentially impact water quality due to sheet erosion of exposed soils and subsequent deposition of particles and pollutants in drainage ways or introduction of construction-related pollutants. Grading activities and sediment stockpiles, in particular, can lead to exposed areas of loose soil that are susceptible to uncontrolled sheet flow. The use of materials such as fuels, solvents, and paints during construction also presents a potential risk to surface water quality due to an increased potential for pollutants entering the storm drain system. Additionally, the present on-site soils have pollutants (Section 5.8, *Hazards and Hazardous Materials*) that presently have the potential to wash away until the soil is stabilized or treated.

A SWPPP was prepared and implemented for all operations currently on the project site. The proposed project would include a new SWPPP. PDF HWQ-9 requires a SWPPP that would help to prevent potential impacts during construction. The General Construction Permit (GCP) requires that the SWPPP include erosion and sediment control BMPs that would meet or exceed measures required by the General Permit, as well as BMPs that control other potential construction-related pollutants. The SWPPP would be prepared and implemented at the project site and revised as necessary as administrative or physical conditions change, as required by, and in compliance with, the GCP. The GCP requires the SWPPP to include a menu of BMPs to be selected and implemented (based on the Project's Risk Level) to address erosion and sediment control. Erosion control BMPs are designed to prevent erosion, whereas sediment controls are designed to trap sediment once it has been mobilized. The selected BMPs would meet the BAT/BCT standards required by the current applicable GCP, would address pollutant source reduction, and would ensure that water quality standards are not exceeded in receiving waters due to construction activities. Details related to the estimated risk level (Risk Level 2), types of applicable sediment and

erosion control BMPs along with the estimated acreage for sedimentation basins are provided in Appendix K, *Water Quality Technical Report,* Section 5.1. The SWPPP would provide BMPs that are to be maintained for the duration of the construction as well as measures that are specific to each phase of construction. These BMPs include but are not limited to erosion controls, sediment controls, tracking controls, non-storm water management, materials and waste management, and good housekeeping practices.

The SWPPP would address site-specific conditions related to project construction, identify the sources of sediment and other pollutants that may affect the quality of storm water discharges, and describe and ensure the implementation and maintenance of BMPs to reduce or eliminate sediment, pollutants adhering to sediment, and other non-sediment pollutants in storm water as well as non-storm water discharges. Compliance with the GCP has been determined by the SWRCB to ensure that water quality standards (protection of beneficial uses and adherence to water quality objectives) are adequately protected during the construction period. Therefore, with the PDF HWQ-9 that requires adherence to local and State regulatory requirements for construction activities potential construction impacts related to storm water run-off quality during construction activities a less than significant impact would occur and no mitigation measures would be required.

Since the groundwater table is anticipated approximately 34 to 52 feet below ground surface, the proposed project is not expected to have an impact on groundwater quality during its construction. Collection of surface water runoff during the construction phases will be detained and filtered as necessary before discharging off-site and is not anticipated to be infiltrated into the ground thereby minimizing groundwater impacts. No mitigation measures would be required.

Post-Construction

Several pollutants are commonly associated with storm water run-off, including sediment, nutrients, bacteria, oxygen-demanding substances, petroleum products, heavy metals, toxic chemicals, and floatables. The pollutants of concern for water quality are those pollutants that are anticipated (expected) or potentially could be generated by the proposed project, based on the past and proposed land uses. Potential and anticipated pollutants of concern associated with storm water or urban run-off during operation of the proposed project are listed in Table 5.9-7, *Anticipated and Potential Pollutants of Concern*.

As discussed in detail in Appendix K, *Water Quality Technical Report,* Section 5.2 the proposed project includes site design, LID BMPs, source control, and treatment BMPs as necessary to reduce pollutants and treat run-off prior to exiting the project site. With implementation of the selected BMPs, or equivalent, as required by the City of Orange and its WQMP guidelines, water quality exceedances are not anticipated, and pollutants are not expected in project run-off that would adversely affect beneficial uses in Santiago Creek and Lower Santa Ana River. Therefore, with PDF HWQ-10 that requires the development and implementation of LID, site design, source control, and other BMPs through a project-

specific WQMP a less than significant impact would occur and no mitigation measures would be required.

With respect to groundwater, PDF HWQ-10 that requires the development and implementation of site design BMPs, LID features and treatment control BMPs would not cause or contribute to impairments to groundwater quality. BMPs that utilize the process of infiltration, such as permeable pavement and infiltration trenches, require a depth of 10 ft or greater to groundwater to minimize impacts from storm water pollutants in accordance with the OC DAMP and 4th Term MS4 Permit.

Infiltration BMPs include those such as infiltration trenches, infiltration basins, drywells, underground infiltration units, unlined permeable pavement and bioretention cells without underdrains. When properly designed to store and infiltrate the entire Design Capture Volume (DCV), infiltration BMPs are considered highly effective at treating pollutants of concern from a project site. However, the 2011 Model WQMP identifies several site constraints that may limit the use of infiltration BMPs or reduce their treatment effectiveness. These include conditions where the infiltration of storm water would result in significant risk to drinking water and groundwater quality by the presence of shallow groundwater (i.e., less than 10 feet below the BMP), presence of water supply wells within 100 feet of the BMP, presence of existing groundwater contaminants, and other factors that cannot be reasonably and technically mitigated. In addition, infiltration BMPs should not be used in Type D soils and were measured infiltration rates are less than 0.3 inches per hour on-site. Under these situations, infiltration is not recommended and other LID BMPs should be utilized.

As a result of the previous on-site mining conditions, various portions of the site have been disturbed and infilled with undocumented and non-engineered compacted artificial fills commonly derived locally; and, which consist of silty to gravelly sand with cobbles, boulders, and local concrete and asphalt fragments. In addition, major portions of the site were used for residue silt deposition (known as silt ponds). In order for the soils to be suitable for development, all undocumented fills will require complete removal and replacement with compacted engineered fill for the support of structures. The engineered fill will consist of clay mixed with granular material and compacted to a minimum 90% compaction for all proposed land uses, creating conditions unsuitable for infiltration within the fill layer itself. In certain areas, compaction may be up to 95% compaction dependent upon the specific land use such as high density residential. In addition, infiltration into the younger alluvium below the fill may create conditions for differential settlement of the proposed structure's foundation slabs due to water infiltrating permeable lenses that are laterally variable, creating unsuitable geotechnical conditions.[2] For additional information please refer to Appendix G, *Geotechnical Investigation*.

[2] Ginter & Associates, Inc. (2011, October 21). Preliminary Geologic and Geotechnical Engineering Investigation and Grading Plan Review for Tentative Tract 17344, Rio Santiago Development Site, City of Orange, California.

Due to the extensive amounts of excavation, the depths of engineered fill placed will range from 5 feet to 50 feet in Planning Area B, 40 feet in Planning Area C, and 27 feet to 40 feet in Planning Area D. In most locations, the separation between the bottom of the proposed fill to the historical high groundwater elevations is less than 10 feet, which is the minimum separation required for infiltration in accordance with the 2011 Model WQMP. In portions of the site, groundwater was also observed to be under pressure/head resulting in upward seepage into the undocumented fill, creating instability in the existing soils and is one of the primary reasons for the over-excavation and compaction process.[3]

The former Villa Park Landfill is located adjacent to Planning Area B (to the west). The direction of groundwater flow moves parallel with the Creek and flows east to west from the project site towards the Landfill. The Model WQMP Technical Guidance Document, Appendix VIII, prohibits the use of infiltration within 250 feet of contaminated sites, and the Orange County Water District (OCWD) has indicated concern over potential infiltration zones up-gradient of the landfill material.[4]

There are two locations on-site identified as potentially suitable for infiltration of runoff, since these locations have older alluvium and greater separation to groundwater from the bottom of the engineered fill: the western-most portion of Planning Area B and the southern-most portion of Planning Area C. However, the portion in Planning Area C suitable is located at a topographical and grading high point, and does not receive runoff from upstream or other drainage areas on the project site. In addition, this area is located near the 250 feet buffer zone and upstream of the existing landfill area, and OCWD has expressed concerns with infiltration of runoff upstream of the landfill. Similarly, the location in the western part of Planning Area B is located within the 250 feet buffer of the existing landfill, and infiltration is not proposed in this area to protect groundwater quality.

As discussed in above, infiltration of runoff will be restricted throughout the majority of the project site due to the extensive excavation & replacement with compacted engineered fill to depths ranging 20 to 50 feet below ground surface. Since groundwater depths are approximately 34 to 52 feet below ground surface, BMPs placed below the engineered fill will not be able to meet the margin of safety required to implement infiltration type BMPs. In addition, infiltration will be restricted within 250 feet and upgradient of the existing Villa Park landfill site to protect groundwater quality. In addition, biotreatment BMPs within these areas will be lined to restrict infiltration. Therefore, a less than significant impact related to violation of any water quality standards or waste discharge requirements would occur and no mitigation measures would be required.

[3] Ginter & Associates, Inc. (2012, February 27). Infiltration Opportunities, Constraints and Recommendations for Water Quality Treatment Purposes, Rio Santiago Development Site, City of Orange, California.

[4] Ibid.

Table 5.9-7: Anticipated and Potential Pollutants of Concern

Anticipated and Potential Pollutants Generated by Land Use Type								
Priority Project Categories and/or Project Features	**Suspended Solid / Sediments**	**Nutrients**	**Heavy Metals**	**Pathogens (Bacterial/ Virus)**	**Pesticides**	**Oil & Grease**	**Toxic Organic Compounds**	**Trash & Debris**
Detached Residential	E	E	N	E	E	E	N	E
Attached Residential	E	E	N	E	E	E(2)	N	E
Commercial/ Industrial	E(1)	E(1)	E(5)	E(3)	E(1)	E	E	E
Automotive Repair Shops	N	N	E	N	N	E	E	E
Restaurants	E(1)(2)	E(1)	E(2)	E	E(1)	E	N	E
Hillside Development > 5,000 ft^2	E	E	N	E	E	E	N	E
Parking Lots	E	E(1)	E	E(4)	E(1)	E	E	E
Streets, Highways & Freeways	E	E(1)	E	E(4)	E(1)	E	E	E

Notes:
E = Expected to be of concern
N = Not expected to be of concern
(1) Expected pollutant if landscaping or open area exist on-site, otherwise not expected.
(2) Expected pollutant if the project includes uncovered parking areas, otherwise not expected.
(3) Expected pollutant if land use involves food or animal waste products, otherwise not expected.
(4) Bacterial indicators are routinely detected in pavement runoff.
(5) Expected if outdoor storage or metal roofs, otherwise not expected.

Source: Technical Guidance Document, May 2011,

Level of Significance

The proposed project would have a less than significant impact relating to violation of any water quality standards or waste discharge requirements and no mitigation measures would be required.

Groundwater Supplies/Recharge

Threshold HWQ-B	**Would the proposed project substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?** **[CEQA Hydrology and Water Quality Threshold 9(b)]**

Under the existing conditions, infiltration potential is very minimal on-site due to the excessive silt pond deposits that occurred in the past, bedrock conditions in areas throughout the site, and existing artificial compacted fill areas from previous grading operations. Under the proposed conditions, the majority of the site will be subject to silt pond removals and re-compaction of a clay-based fill to 90% compaction,

similar to areas of the site that already have significant compacted fill areas. Upon completion of the required removal and compaction process, the majority of the site will have low infiltration potential similar to existing conditions. Implementation of the proposed project would not substantially deplete or interfere with groundwater recharge based on the existing conditions or result in a net deficit of the underlying aquifer or local groundwater table. Therefore, the proposed project as designed would require the capping of the existing on-site well. The proposed project will not include any groundwater wells nor any other features to withdraw groundwater from the existing aquifer. The potential water quality impacts to groundwater are discussed in Threshold HWQ-A, *Water Quality Standards/Discharge Requirements.* Therefore, no impact would be anticipated and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to groundwater supplies/recharge and no mitigation measures would be required.

Drainage Pattern: Erosion or Siltation

Threshold HWQ-C	**Would the proposed project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?** **[CEQA Hydrology and Water Quality Threshold 9(c)]**

The proposed project will alter the existing drainage pattern of the site or area. The proposed project will not alter the course of a stream or river. As provided for in PDF-HWQ-7, the proposed project outlets of storm drain Lines "A" and "B" will be located in the same general vicinity as existing surface flow outlets into Santiago Creek. Concentrated flows in a drainage conduit discharging into a natural area tend to have erosive potential velocities and energy. To compensate for this affect, scour reduction facilities or energy dissipation facilities or both will be provided at each outlet location in order to reduce local erosion potential to non-impactful levels. Therefore, with the implementation of PDF-HWQ-7, the project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial on-site erosion, on-site siltation, off-site erosion or off-site siltation. A less than significant impact would occur and no mitigation measures would be required related to the alteration of existing on-site or off-site drainage patterns.

Level of Significance

The proposed project would have a less than significant impact related to drainage pattern of the site including through the alternation of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site and no mitigation measures would be required.

Drainage Pattern: Flooding

Threshold HWQ-D	**Would the proposed project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface run-off in a manner which would result in flooding on- or off-site?** **[CEQA Hydrology and Water Quality Threshold 9(d)]**

The proposed project would alter existing drainage patterns on the proposed project site. Residential improvements would be confined to Planning Areas C and D. All other planning areas would be reserved as some form of open space or recreational related area use. Proposed project tributary watersheds will continue to drain to Santiago Creek and will enter the Creek as two distinct sub-watersheds (B/C and D). As indicated in Table 5.9-8, *Watershed Acreage Comparison*, existing and proposed sub-watershed acreages are similar, with the proposed condition acreage being 0.5% smaller (72.43-acres vs. 72.77-acres).

Proposed development will generate landform conditions requiring drainage. PDF-1 through PDF-8 will reduce the effect of the alteration of the existing drainage patterns so as to not substantially increase the rate or amount of surface run-off in a manner which would result in flooding on- or off-site. As indicated in Table 5.9-9, *2-Year Volume Amount Comparison*, and Table 5.9-10, *100-Year Volume Amount Comparison*, proposed project run-off volumes will increase by 0.83 acre-feet in a 2-year event and will decrease by 2.49-acre-feet in a 100-year event.

Table 5.9-8: Watershed Acreage Comparison

Area Designation	Existing Tributary Area (Acres)	Proposed Tributary Area (Acres)	Difference (Acres)	Change (%)
Planning Area D (east)	43.03	42.91	-0.12	-0.3
Planning Areas B/C (west)	29.74	29.52	-0.22	-0.8
Total	**72.77**	**72.43**	**-0.34**	**-0.5**

Source: Appendix J, Hydrology Study Report

Table 5.9-9: 2-Year Volume Amount Comparison

Area Designation	Existing Condition Volume (Ac-Ft)	Proposed Condition Volume (Ac-Ft)	Difference (Ac-Ft)	Change (%)
Planning Area D (east)	2.15	2.34	+0.19	+8.8
Planning Area B/C (west)	1.33	1.97	+0.64	+48.1
Total	**3.48**	**4.31**	**+0.83**	**+23.8**

Source: Appendix J, Hydrology Study Report

Table 5.9-10: 100-Year Volume Amount Comparison

Area Designation	Existing Condition Volume (Ac-Ft)	Proposed Condition Volume (Ac-Ft)	Difference (Ac-Ft)	Change (%)
Planning Area D (east)	15.68	13.19	-2.49	-15.9
Planning Area B/C (west)	9.84	9.77	-0.07	-0.7
Total	**25.52**	**22.96**	**-2.56**	**-10.0**

Source: Appendix J, Hydrology Study Report

PDF HWQ-3 provide two storm drain systems (Lines 'A' and 'B') consistent with storm drain routing alignments established in the hydrologic analysis. To reduce 2-year run-off volumes to a level consistent with existing conditions, PDF-HWQ-4 will provide a storage facility in the downstream areas of Planning Area B (see Figure 5.9-8, *Project Drainage Design Features Map*). The type of storage facility will be determined during final design and will be either a surface (basin) facility or an underground vault facility. Regardless, the facility will be sized to retain a minimum of 0.83-acre-feet of storm run-off, if feasible. If infeasible, the post-development runoff 2-year peak flow must be reduced to no greater than 110% of the pre-development runoff 2-year peak flow rate through a controlled outlet for the facility.

As indicated in Table 5.9-11, 2-*Year Peak Flow Rate Comparison,* and Table 5.9-12, *100-Year Peak Flow Rate Comparison,* 2-year and 100-year proposed project peak flow rates will be neutral or will increase slightly from existing conditions at the Planning Area D storm drain outlet to Santiago Creek, and 2-year and 100-year rates will increase over existing conditions at the Planning Area B/C storm drain outlet to Santiago Creek.

Table 5.9-11: 2-Year Peak Flow Rate Comparison

Area Designation	Existing Condition Flow Rate (cfs)	Proposed Condition Flow Rate (cfs)	Difference (cfs)	Change (%)
Planning Area D (east)	37.2	39.24	+2.04	+5.5
Planning Area B/C (west)	18.1	23.29	+5.19	+28.7
Total	**55.3**	**62.53**	**+7.23**	**+13.10**

Source: Appendix J, Hydrology Study Report

Table 5.9-12:100-Year Peak Flow Rate Comparison

Area Designation	Existing Condition Flow Rate (cfs)	Proposed Condition Flow Rate (cfs)	Difference (cfs)	Change (%)
Planning Area D (east)	126.9	129.02	+2.12	+1.67
Planning Area B/C (west)	64.7	75.43	+10.73	+16.58
Total	**191.6**	**204.45**	**+12.85**	**+6.71**

Source: Appendix J, Hydrology Study Report

PDF-HWQ-5 will reduce Planning Area B/C peak flow rates to a level consistent with existing conditions, the mainline storm drain split flow device utilized to extract storm water to the volume control storage facility described in Item 1 above will also be sized and configured to reduce mainline run-off rates to pre-project levels downstream of the split flow structure. Final type selection and detailing of the split flow structure will occur during final design stages of the project.

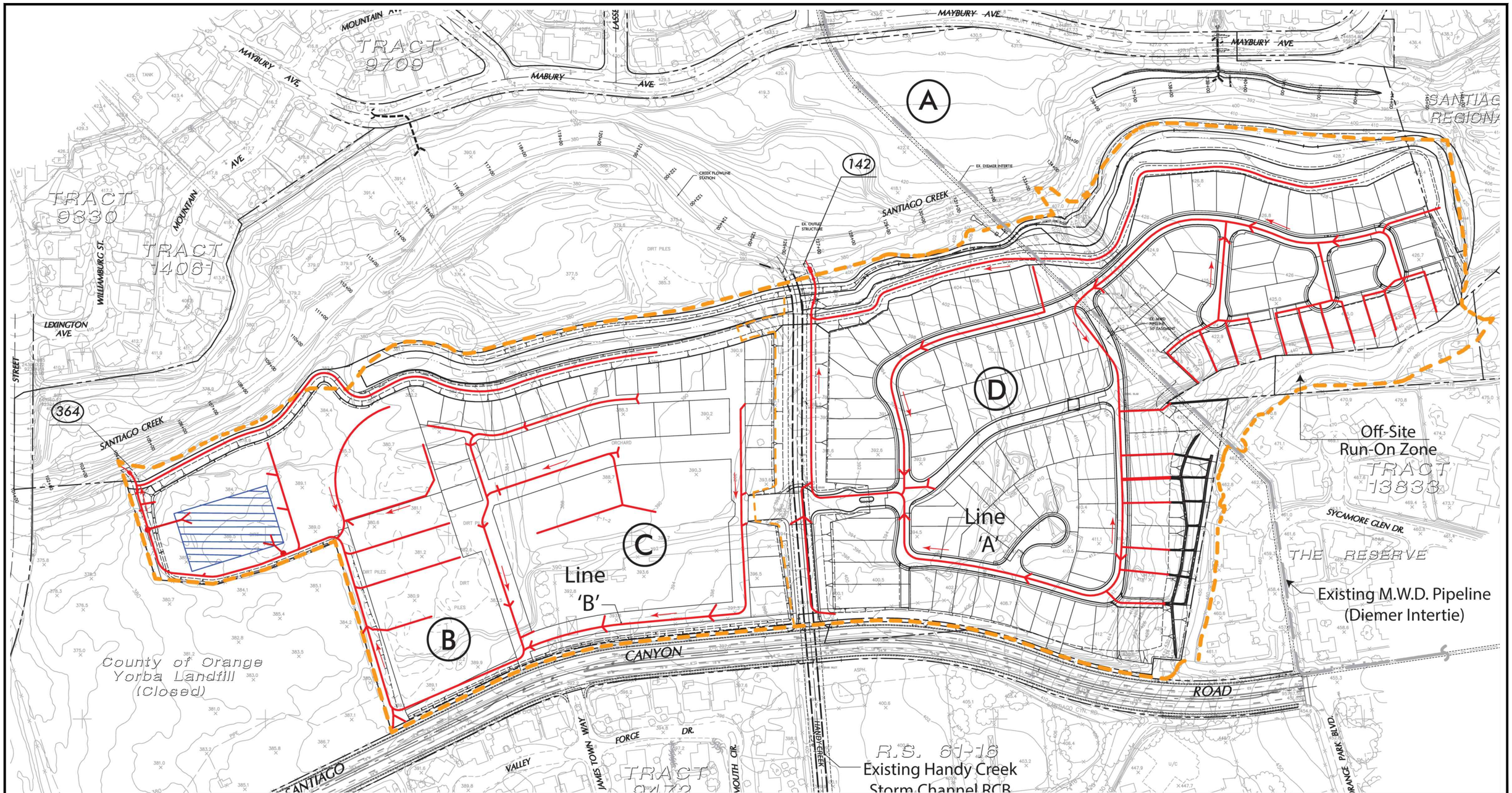
As indicated in Table 5.9-13, *Time of Concentration Comparison*, PDF-HWQ-6 will delay Times of Concentration's at the Planning Area D outlet to Santiago Creek and will arrive slightly sooner at the Planning Area B/C outlet to Santiago Creek.

Table 5.9-13: Time of Concentration Comparison

Area Designation	2-Year Event				100-Year Event			
	Existing Tc (min)	Prop Tc (min)	Diff (min)	Change (%)	Existing Tc (min)	Prop Tc (min)	Diff (min)	Change (%)
Planning Area D (east)	13.7	14.9	+1.2	+8.8	11.8	12.6	+0.8	+6.8
Planning Area B/C (west)	20.7	18.5	-2.2	-11.9	16.7	15.8	-0.9	-5.7

Source: Appendix J, Hydrology Study Report

Changes in the on-site 100-year event durations (Tc's) will have little effect to Santiago Creek flows as the 100-year hydrograph presented in "Hydraulic and Sediment Transport Report for Rio Santiago" indicates, peak flows in Santiago Creek arrive at the project site 53 hours into the 100-year storm event which far exceeds the 100-year duration of project site flow delivery to Santiago Creek. While hydrographs are not available from *Reference 1* for Santiago Creek mainline 2-year event storms, it is widely accepted that events less than 5-year flood have limited discharge and hence transport capacity (scour) consequences on the Creek. Likewise, 2-year event project durations are less than 12% different from pre-project durations and these differences are considered minor.



Rio Santiago Property Boundary (109.75 Acres)
Proposed Watershed Overall Boundary (72.43 Acres)
Proposed Sub-Watershed Boundary
Proposed Underground Storm Drain
Proposed Storm Drain Outlet/Energy Dissipator
Proposed Storm Drain Diversion Structure and Return Structure
Proposed Storage Facility
Proposed Planning Area Designation
364 Hydrologic Node
Existing Handy Creek Storm Channel (RCB)
Existing Storm Drain

SOURCE: Fuscoe Engineering.

PROPOSED DRAINAGE DESIGN FEATURES MAP

RIO SANTIAGO PROJECT - CITY OF ORANGE

VISTA
NO SCALE

N

FIGURE 5.9-8

As provided for in PDF-HWQ-7, the proposed project Lines "A" and "B" storm drain system outlets will be located in the same general vicinity as existing surface flow outlets into Santiago Creek. Because confined flows in a drainage conduit outletting into a natural area tend to have erosive potential velocities and energy, scour reduction facilities or energy dissipation facilities or both will be provided at each outlet location in order to reduce local erosion potential to non-impactful levels. No changes to the existing Handy Creek drain as it enters Santiago Creek are proposed. The existing energy dissipater will remain.

The existing OCFCD Handy Creek Storm Channel traverses the project site and currently accepts 28.13-acres of project site watershed tributary via two sets of on-site inlets (see Figure 5.9-1, *Existing Drainage Condition Map*). The OCFCD has indicated the Channel to be a "deficient flood control facility and is not capable of conveying run-off from the 100-year storm event." Through the NOP process, the OCFCD has recommended project on-site tributary flows be removed from the Handy Creek Storm Channel system to moderate deficiency in the public channel. As provided for in PDF-HWQ-8, the proposed project will collect, route and outlet project site tributary flows directly to Santiago Creek. Figure 5.9-8, *Project Drainage Design Features Map*, illustrates the outlet location (Line "A") near the current Handy Creek Storm Channel outlet location. Routing analysis of Line "A" flows is demonstrated in the hydrologic calculations found in Appendix J, *Hydrology Study Report*.

The significance of altering existing drainage patterns on the project site is discussed below by drainage planning areas.

Planning Area A

The majority of Planning Area A would be protected-in-place and re-used for open-space. Planning Area A would include all of the land area northerly of the Santiago Creek, the Santiago Creek bed, both banks and a narrow sliver of ground surface on the south side of the Santiago Creek.

North Side of the Santiago Creek

No improvements would occur in Planning Area A on the north side of the Santiago Creek. Storm water run-off would continue to drain directly to Santiago Creek by surface sheet flow and overtopping the north bank. The existing drain inlets entering Santiago Creek from the Mabury Ranch residential community would not be altered.

South Side of the Santiago Creek

On the south side of the Santiago Creek, a series of regional trails are planned to lie adjacent to the residential development areas. The trails would stabilize the upper edge of the Santiago Creek bank and would be pitched to drain away from the Creek so that no erosive effects of surface flow overtopping the top of the bank would occur. The trail run-off would be collected by inlets on the trail and be conveyed in a storm drain which would eventually connect to the development area storm drain systems prior to outletting into Santiago Creek, if applicable. The construction of the trails would result in a very slight increase in imperviousness in Planning Area A, however the collection of trail run-off and confluencing

with development area storm drains along with Project Design Features (PDFs) proposed for those systems would ensure run-off outletting into Santiago Creek will be less than existing conditions.

Therefore, a less than significant impact would occur and no mitigation measures would be required related to the increase in flow conditions from Planning Area A.

Planning Area B

Recreational open space uses are proposed for Planning Area B. These improvements would consist of habitable and non-habitable building structures, that may include up to 81,000 square feet of community serving recreational buildings [please refer to Section 3.0, *Project Description* and Section 5.1, *Aesthetics* for a full list of uses (permitted and conditional) for Planning Area B], access roads, parking lots, pedestrian walkways, athletic fields and landscaping that would replace the existing natural ground surface.

The proportion of existing pervious ground cover would decrease as it is replaced with new impervious improvements. This replacement would generally result in a decrease to the natural infiltration rate as well as provide a shorter hydrologic Time of Concentration (Tc). A shorter Tc would tend to increase the post-development run-off rate. To ensure post-development run-off rates and volumes are consistent with pre-development conditions, several techniques in the form of PDFs will be integrated into the on-site drainage system.

To capture, convey and dispose of the post-development storm water run-off, PDF HWQ-1 and PDF HWQ-3, an on-site storm drain system is proposed for installation throughout Planning Area B. PDF HWQ-2, the proper sizing of the storm drain system to agency criteria and standards, will ensure on-site flooding does not occur. PDF HWQ-6, a circuitous storm drain flow path alignment, would be provided to lengthen the Tc. A circuitous flow path route would tend to increase the post-development Tc. By generating an increased Tc, this technique would tend to reduce to the greatest extent practicable, the post-development run-off rate towards a match of the pre-development rate.

PDF HWQ-4 has been provided to provide a storage facility in the downstream areas of Planning Area B. A diversion structure will be provided from the on-site storm drain system described in PDF HWQ-3 to divert a portion of on-site storm water run-off into the storage facility. The type of storage facility will be determined during final design and will be either a surface (basin) facility or an underground vault facility. The proposed facility will be sized to retain/detain a minimum of 0.83-acre feet of storm run-off and, if detained, match pre-development 2-year peak flow rates to within 110% of pre-development condition. The outlet will drain and connect back into the on-site storm drain system prior to the storm drain system outlet into Santiago Creek.

PDF HWQ-5 has been provided to reduce Planning Area B/C peak flow rates to a level consistent with existing conditions. This will be accomplished by the use of the same diversion structure and storage facility described in PDF HWQ-4 above. The diversion and storage of portions of storm water run-off in the storage facility and subsequent release and reconnection to the on-site storm drain system will delay

and reduce the peak flow run-off rate leaving the planning area. The facility will be sized and configured to reduce mainline run-off rates to pre-project levels. Final type selecting and detailing of the storage facility and diversion structure will occur during the final design stages of the project.

The storm drain system would have an outlet pipe at the westerly end of the planning area that would outlet on-site project storm water run-off into Santiago Creek. PDF HWQ-7 has been provided to mitigate for the high flow velocity associated with confined flow exiting the drainage conduit which outlets into a natural area. The purpose of the scour reduction facility (rip-rap blankets), energy dissipation facility, or both would be to dissipate energy in the flowing water departing the outlet pipe. Energy dissipation would reduce flow velocity and mitigate any impact that the increased flow rate may have on the existing bed and bank of Santiago Creek.

Therefore, with the implementation of the PDFs described above, a less than significant impact would occur in Planning Area B and no mitigation measures would be required related to the alteration of existing on-site drainage patterns.

Planning Area C

Age-qualified residences would occupy Planning Area C. These facilities would consist of numerous building structures, access roads, pedestrian walkways and landscaping that would replace the existing natural ground surface. As a result, the proportion of existing pervious ground cover would decrease as it is replaced with new impervious improvements. This replacement would generally result in a decrease to the natural infiltration rate as well as provide a shorter hydrologic Time of Concentration (Tc). A shorter Tc would tend to increase the post-development run-off rate. To ensure post-development run-off rates and volumes are consistent with pre-development conditions, several techniques in the form of Project Design Features will be integrated into the on-site drainage system. Because Planning Areas B and C form one on-site drainage sub-watershed and share a common storm drain system, some of the PDFs serving Planning Area C are located in Planning Area B.

To capture, convey, and dispose of the post-development storm water run-off, PDF-HWQ-1 and PDF HWQ-3, an on-site storm drain system is proposed for installation throughout Planning Area C. PDF HWQ-2, the proper sizing of the storm drain system to agency criteria and standards, will ensure on-site flooding does not occur. PDF HWQ-6, a circuitous storm drain flow path alignment, would be provided to lengthen the Tc. A circuitous flow path route would tend to increase the post-development Tc. By generating an increased Tc, this technique would tend to reduce to the greatest extent practicable, the post-development run-off rate towards a match of the pre-development rate.

PDF HWQ-4 and PDF HWQ-5 have been provided in the form of a mainline storm drain diversion structure and a storage facility to detain increased run-off volume amounts and to reduce mainline run-off rates to pre-project levels that are caused by the impervious factors associated with the new project. These features will be located in Planning Area B but will serve Planning Area C as well.

Therefore, with the implementation of the PDFs described above, a less than significant impact would occur in Planning Area C and no mitigation measures would be required related to the alteration of existing on-site drainage patterns.

Planning Area D

Single-family residences would occupy Planning Area D. This planning area would consist of numerous single-family residences, private streets, pedestrian walkways and landscaping that would replace the existing natural ground surface. As a result, the proportion of existing pervious ground cover would decrease as it is replaced with new impervious improvements. This replacement would generally result in a decrease to the natural infiltration rate as well as provide a shorter hydrologic Time of Concentration (Tc). A shorter Tc would tend to increase the post-development run-off rate. To ensure post-development run-off rates and volumes are consistent with pre-development conditions, several techniques in the form of PDFs will be integrated into the on-site drainage system.

To capture, convey, and dispose of the post-development storm water run-off, PDF HWQ-1 and PDF HWQ-3, an on-site storm drain system is proposed for installation throughout Planning Area D. PDF HWQ-2, the proper sizing of the storm drain system to agency criteria and standards, will ensure on-site flooding does not occur. PDF HWQ-6, a circuitous storm drain flow alignment, would be provided to lengthen the Tc. A circuitous flow path route would tend to increase the post-development Tc. By generating an increased Tc, this technique would tend to reduce to the greatest extend practicable, the post-development run-off rate towards a match of the pre-development rate. Because Planning Area D would construct a storm drain system that would outlet on-site project storm water run-off directly into Santiago Creek, PDF HWQ-7 has been provided to mitigate for the high flow velocity associated with confined flow exiting the drainage conduit into a natural area. The purpose of the scour reduction facility, (rip-rap blankets), energy dissipation facility, or both, would be to dissipate energy in the flowing water departing the outlet pipe. Energy dissipation would reduce flow velocity and mitigate any impact that the flow rate may have on the existing bed and bank of Santiago Creek.

The existing OCFCD Handy Creek Storm Channel traverses the project site and currently accepts 28.13-acres of project site watershed tributary via two sets of on-site inlets (see Figure 5.9-1, *Existing Drainage Condition Map*). The OCFCD has indicated the Channel to be a "deficient flood control facility and is not capable of conveying run-off from the 100-year storm event." Through the NOP process, the OCFCD has recommended project on-site tributary flows be removed from the Handy Creek Storm Channel system to moderate deficiency in the public channel. As provided for in PDF-HWQ-8, the proposed project will collect, route, and outlet project site tributary flows directly to Santiago Creek and eliminate the current on-site direct connections to the Handy Creek Storm Channel. Figure 5.9-8, *Project Drainage Design Features Map*, illustrates the outlet location (Line "A") near the current Handy Creek Storm Channel outlet location.

Therefore, with the implementation of the PDFs described above, a less than significant impact would occur in Planning Area D and no mitigation measures would be required related to the alteration of existing on-site drainage patterns.

Overall, the proposed project would alter the existing drainage pattern of the site or area. As indicated above, PDF-1 through PDF-8 will reduce the effect of the alteration of the existing drainage patterns. Therefore, a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to alteration of existing drainage patterns of the project site, including through the alternation of the course of a stream or river, or substantially increase the rate or amount of surface run-off in a manner which would result in flooding on-or off-site and no mitigation measures would be required.

Drainage System Capacity/Polluted Run-off

Threshold HWQ-E	**Would the proposed project create or contribute run-off water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted run-off?** **[CEQA Hydrology and Water Quality Threshold 9(e)]**

Proposed development will generate landform conditions requiring drainage. PDF-1 through PDF-8 will reduce the effect of the alteration of the existing drainage patterns so as to not exceed the capacity of existing or planned stormwater drainage systems. The proposed project will potentially provide additional sources of polluted run-off during construction and operational phases.

Construction

As discussed in detail under Threshold HWQ-A, *Water Quality Standards/Discharge Requirements*, during construction activities, excavated soil would be exposed, and there would be an increased potential for soil erosion during storm events compared to existing conditions. Grading activities and sediment stockpiles, in particular, can lead to exposed areas of loose soil that are susceptible to uncontrolled sheet flow. Raw materials and construction wastes are also potential sources of pollution that would previously not be on-site. These impacts would be potentially significant and adverse. However, implementation of PDF HWQ-9 would help to prevent these potential impacts during construction. The Best Managed Practices (BMPs) for construction activities are briefly discussed below:

- Erosion control BMPs, such as hydraulic mulch, soil binders, geotextiles and mats, protect the soil surface by covering and/or binding the soil particles. Temporary earth dikes or drainage swales may also be employed to divert runoff away from exposed areas and into more suitable locations. If implemented correctly, erosion controls can effectively reduce the sediment loads entrained in storm water runoff from construction sites.

- Sediment controls are designed to intercept and filter out soil particles that have been detached and transported by the force of water. All storm drain inlets on the project site or within the project vicinity (i.e., along streets immediately adjacent to the project boundary) should be adequately protected with an impoundment (i.e., gravel bags) around the inlet and equipped with a sediment filter (i.e., fiber roll). They should also be placed around areas of soil disturbing activities, such as grading or clearing.

- Stabilize all construction entrance/exit points to reduce the tracking of sediments onto adjacent streets. Wind erosion controls should be employed in conjunction with tracking controls.

- Non-storm water management BMPs prohibit the discharge of materials other than storm water, as well as reduce the potential for pollutants from discharging at their source. Examples include: avoiding paving and grinding operations during the wet season where feasible, and performing any vehicle equipment cleaning, fueling and maintenance in designated areas that are adequately protected and contained.

- Waste management consists of implementing procedural and structural BMPs for collecting, handling, storing and disposing of wastes generated by a construction project to prevent the release of waste materials into storm water discharges.

Therefore, with the PDF HWQ-9 that requires adherence to local and State regulatory requirements for construction activities, a less than significant impact would occur and no mitigation measures would be required during construction.

Post-Construction

Due to the proposed change in land use, the amount of run-off will increase and additional pollutant sources will be introduced to the project site. As discussed in detail in Threshold HWQ-A, *Water Quality Standards/Discharge Requirements,* the proposed project includes PDF HWQ-10, which incorporates site design, source control, Low Impact Design (LID) (i.e., bioretention) and other BMPs.

For each Planning Area, LID features have been incorporated into the proposed land uses to provide water quality treatment and flow attenuation. The following principles are being followed for the project and will be supported by construction level documents in the final Water Quality Management Plans (WQMPs) per each phase of development and prior to grading permit(s) issuance by the City:

- Where feasible, LID features will be sized for water quality treatment credit according to local Regional Board sizing criteria as defined in the 4th Term MS4 Storm Water Permit for either flow-based or volume-based BMPs. There will be a significant effort to integrate LID techniques within the internal development areas (site design objectives), thereby providing treatment of low-flow runoff directly at the source and runoff reduction of small (i.e., more frequent) storm event runoff (first-flush). In most instances, LID features will be sized by volume-based analyses to demonstrate compliance with the required Design Capture Volume (DCV) for the Project.

- All LID features identified in this report and in the Preliminary WQMP are preliminary in nature but have been sized to show their relative footprint requirements for technical planning purposes (siting, treatment volumes, typical profiles, etc.). Upon further site planning, it is expected that the LID footprint shown will be further broken-up and incorporated into the upstream development area. Detailed drainage calculations, grading, and confirmation of sizing to occur during the detailed design phase and subsequent WQMP documentation.

- Where feasible, LID features will be designed in accordance with feasibility criteria as defined in the new Countywide Model WQMP (submitted May 2010, approved by RWQCB in May 2011, implementation date August 2011). Further details on LID BMP feasibility are included in the Community-wide Preliminary WQMP (March 2012).

- For those areas of the project where infiltration is not recommended or feasible and harvest/reuse landscaping demands are insufficient, biotreatment LID features will be designed to treat runoff and discharge controlled effluent flows to downstream receiving waters.

The OC DAMP and 2011 Model WQMP identifies example site design BMPs to be implemented where applicable and feasible. Several site design measures are listed below that will be applicable to the Planning Areas within the proposed project:

- Maximize the permeable area. This can be achieved in various ways, including, but not limited to increasing building density (number of stories above or below ground) and increasing the amount of landscaping versus the existing condition. Decreasing the project's footprint can reduce the project's impacts to water quality and hydrologic conditions;

- Construct walkways, trails, patios, overflow parking lots, alleys, driveways, low-traffic streets and other low-traffic areas with open-jointed paving materials or permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials;

- Construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and a walk able environment for pedestrians are not compromised;

- Incorporate landscaped buffer areas between sidewalks and streets;

- Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs;

- Where soils conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration;

- Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm drain. Drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping;

- Increase the use of vegetated drainage swales in lieu of underground piping or imperviously lined swales;

- Design driveways with shared access, flared (single lane at street) or wheel strips (paving only under tires); or, drain into landscaping prior to discharging to the municipal storm drain system; and/or

Implementation of these features will mitigate the anticipated changes in pollutant sources and provide protection to local receiving waters. The manner in which this will be accomplished is described as follows:

1. As indicated in Table 5.9-9, *2-Year Volume Amount Comparison,* and Table 5.9-10, *100-Year Volume Amount Comparison*, proposed project runoff volumes will increase by 0.83 acre-feet in a 2-year event and will decrease by 2.49-acre-feet in a 100-year event. To reduce 2-year runoff volumes to a level consistent with existing conditions, a mainline storm drain diversion structure will divert a portion of storm runoff to a storage facility in the downstream areas of Planning Area B (PDF HWQ-4). The type of storage facility will be determined during final design and will be either a surface (basin) facility or an underground vault facility. Regardless, the facility will be sized to detain a minimum of 0.83-acre-feet of storm runoff and include an outlet to drain the facility within 48-hours after a rain event has ended.

2. As indicated in Table 5.9-11, 2-*Year Peak Flow Rate Comparison*, and Table 5.9-12, *100-Year Peak Flow Rate Comparison*, 2-year and 100-year proposed project peak flow rates will be neutral or will increase from existing conditions at the Planning Area D storm drain outlet to Santiago Creek, and 2-year and 100-year rates will increase over existing conditions at the Planning Area B/C storm drain outlet to Santiago Creek. To reduce peak flow rates to a level consistent with existing conditions, the mainline storm drain diversion structure and volume control storage facility described in Item 1 above will also function to reduce mainline runoff rates to pre-project levels downstream of the split flow structure. Final type selection and detailing of the diversion structure and storage facility will occur during final design stages of the project.

3. As indicated in Table 5.9-13, *Time of Concentration Comparison*, proposed project Times of Concentration's will be delayed at the Planning Area D outlet to Santiago Creek and will arrive slightly sooner at the Planning Area B/C outlet to Santiago Creek. Changes in the on-site 100-year event durations will have little effect to Santiago Creek flows as the 100-year hydrograph indicates peak flows in Santiago Creek arrive at the project site 53 hours into the 100-year storm event which far exceeds the 100-year duration of project site flow delivery to Santiago Creek

mainline 2-year event storms, it is widely accepted that events less than 5-year flood have limited discharge and hence transport capacity (scour) consequences on the creek. Likewise, 2-year event project durations are less than 12% different from pre-project durations and these differences are considered minor.

Therefore, no impact related to the contribution of runoff water exceeding the capacity of existing or planned stormwater drainage systems would occur and no mitigation measures would be required. Additionally, with PDF HWQ-10 that requires the development and implementation of LID, site design, source control, and other BMPs through a project-specific WQMP, a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to drainage system capacity and pollutant run-off and no mitigation measures would be required.

Degrade Water Quality

Threshold HWQ-F	**Would the proposed project otherwise substantially degrade water quality?** **[CEQA Hydrology and Water Quality Threshold 9(f)]**

The proposed project includes PDF HWQ-9 that would help to prevent potential impacts during construction through the development and implementation of site specific SWPPP. The SWPPP would include erosion and sediment control BMPs that would meet or exceed measures required by the General Construction Permit (GCP), as well as BMPs that control other potential construction-related pollutants. Additionally, the proposed project includes PDF HWQ-10 that requires compliance with the 2011 Countywide Model WQMP including site design, LID, source control and other BMPs. Within the Hydrology and Water Quality impact analysis section, each Planning Area has identified appropriate LID features to provide water quality treatment and flow attenuation. Through the implementation of these LID features, water quality exceedances are not anticipated, and pollutants are not expected in project run-off that would degrade water quality in the Santiago Creek (Reach 1) and Lower Santa Ana River (Reach 1 & 2). Therefore, with PDF HWQ-9 and PDF HWQ-10 that require substantial conformance with local and state regulatory requirements for construction and post-construction operations a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to degrading water quality and no mitigation measures would be required.

Housing Placement: Flood Hazard Area

Threshold HWQ-G	**Would the proposed project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?** **[CEQA Hydrology and Water Quality Threshold 9(g)]**

According to the Federal Emergency Administration Flood (FEMA) Insurance Rate Map 06059C0158J, a portion of the project site, specifically Planning Area A, is within a mapped 100-year flood hazard area. However, the proposed project would not place housing or habitable structures, specifically Planning Areas B, C and D within a 100-year flood hazard area mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map. According to the Federal Emergency Administration Flood Insurance Rate Map, the proposed housing and habitable structures on the project site (Planning Areas B, C and D) are within Zone X (Other Flood Areas) which is not considered to be within a mapped 100-year flood hazard area. Therefore, no impact related to housing and habitable structures within a 100-year flood hazard area would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to housing placement in flood hazard area and no mitigation measures would be required.

Structure: Impede or Redirect Flood Flow

Threshold HWQ-H	**Would the proposed project place within a 100-year flood hazard area structures which would impede or redirect flood flow?** **[CEQA Hydrology and Water Quality Threshold 9(h)]**

According to the Federal Emergency Administration Flood Insurance Rate Map 06059C0158J, a portion of the project site, specifically Planning Area A, is within a mapped 100-year flood hazard area. However, the proposed project would not place housing or habitable structures, specifically Planning Areas B, C, and D within a 100-year flood hazard area mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map. According to the Federal Emergency Administration Flood Insurance Rate Map, the proposed housing and habitable structures on the project site (Planning Areas B, C and D) are within Zone X (Other Flood Areas) which is not considered to be within a mapped 100-year flood hazard area. Improvements that will occur within Planning Area A, specifically the regional trail improvement along the southerly edge consisting of grading and paving, will also occur outside of the mapped floodway Zone AE (SFHA) boundary. Therefore, no impact related to structures within a 100-year flood hazard area which would impede or redirect flood flow would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to structures which would impede or redirect flood flows and no mitigation measures would be required.

Flooding

Threshold HWQ-I	**Would the proposed project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?** **[CEQA Hydrology and Water Quality Threshold 9(i)]**

Two dams are present along Santiago Creek: Villa Park Dam and Santiago Dam (Irvine Lake). Both are located in the foothill areas of east Orange and are upstream of the project site.

Santiago Dam

The Santiago Dam is a roller compacted earth and rockfill structure 136 feet (41 m) high and 1,425 feet (434 m) long. It is roughly 760 feet (230 m) wide at the base and contains some 790,000 cubic yards (600,000 m^3) of material. The construction of the dam started in 1929 and was completed in 1931. The Dam's spillway is a concrete overflow structure to the left side, equipped with nine openings each 15 feet (4.6 m) wide and 28 feet (8.5 m) high, able to pass a flow exceeding 30,000 cubic feet per second (850 m^3/s). This spillway has only been used a few times, such as the floods of 1938, 1969, 1983, 1998 and 2005. The Dam crest is 804 feet (245 m) above sea level. The Dam and reservoir receive water from a catchment area totaling 64 square miles (170 km^2), controlling water from about two-thirds of the Santiago Creek watershed. Santiago Dam is designed to contain up to a 50-year flood and withstand a 500-year flood of over 30,000 cubic feet per second (850 m^3/s). It is currently owned by the Irvine Ranch Water District and the Serrano Water District (the former Serrano Irrigation District). Today the dam marks the usual ending point of surface flow in Santiago Creek, as all the discharge is retained in the reservoir and downstream flow is limited to seepage and stormwater.

Villa Park Dam

The Villa Park Dam that forms the Villa Park Reservoir was completed in 1963. Villa Park Dam is a flood control dam located downstream from Santiago Dam. It is an earthfill structure with a capacity of 15,600 acres-feet and is owned by the Orange County Flood Control District.

According to Herb Nakasone (County of Orange), County staff operates and maintains the Villa Park Dam to provide maximum flood protection to downstream residents and businesses and is prepared to respond to emergencies if necessary. A County staff person lives on the Villa Park Dam site perpetually monitoring and operating storm discharges from the Dam to maximize storage behind the Dam thereby providing maximum flood protection. Santiago Dam also has a dam keeper on-site at all times. A 24 hour, seven day week operational plan with trained personnel who understand the operations of the Dam is ready to be implemented in the event a storm is anticipated to fill the storage behind the Dam and control discharges are necessary 24 hours a day.

Damage or failure to the Dam is highly unlikely scenario. Villa Park Dam performed exceptional well during the major storm events of 1969 providing even more assurance of its structural stabilities. Nonetheless, the County's Emergency Operations Center (EOC), managed by the Sheriff's Department, is prepared to respond to such an emergency event. The EOC has an Operational Plan for such an

emergency and is staffed with representatives from Orange County Public Works, Sheriff's Department, Orange County Fire Authority, Red Cross, Orange County Department of Education and other County Departments as necessary.

The Sheriff's Communications Center is at the EOC and is able to communicate directly with all City police departments in Orange County to inform cities directly and quickly of emergency conditions. The EOC has flood inundation maps which identifies evacuation limits should the unlikely event of dam break occur and evacuation is necessary. The Executive Committee of the Orange County Emergency Operations which includes representatives from cities and special districts meets regularly to discuss and coordinate emergency operational requirements. Villa Park Dam, along with all dams owned by the Orange County Flood Control District, is inspected yearly by County staff and also by the State Division of Dam Safety on a regular basis.

Dam Failure

The areas below (downstream from) the dams are areas of potential flood hazard in case of catastrophic dam failure. There is no published data on the potential velocity of the water traveling across the project site should there be a dam failure. According to the City's General Plan Public Safety Element, "these facilities are maintained and safety-inspected to ensure that risks are minimized." In addition, the Safety Element indicates that the Santiago Dam/Irvine Lake were not intended or designed to serve as flood control facilities and, if these facilities failed, flooding would occur to the properties located along Santiago Creek and a large portion of Old Town.

Santiago Creek is a major tributary of the Santa Ana River. It originates on the western slope of Santiago Peak in the Santa Ana Mountains. From there, it generally flows in a northwest direction through the Cleveland Nation Forest, the Irvine Ranch, the Irvine Regional Park and the Santiago Oaks Regional Park. As it departs the Santiago Oaks Regional Park, it enters the project site and flows generally in a southwesterly direction. Approximately two miles upstream of the project site along the flow path of Santiago Creek, the path is interrupted by the presence of the existing Villa Park Dam. The Villa Park Dam is owned and operated by the Orange County Flood Control District. Three miles further upstream of the Villa Park Dam, the existing Irvine Lake Santiago Reservoir Dam again interrupts the Santiago Creek flow path. The Irvine Lake Santiago Reservoir Dam is owned and operated by the Irvine Ranch Water District. Dam owners are required to prepare maps showing potential inundation areas due to catastrophic dam failures.

There have been a total of 45 dam failures in California. Failures have occurred for a variety of reasons, the most common failure being overtopping. Other dams have failed due to specific shortcomings in the dam itself or an inadequate assessment of the surrounding geomorphologic characteristics. The first notable dam failure occurred in 1883 in Sierra County, while the most recent failure occurred in 1965. The greatest catastrophe relating to California dam failures was William Mulholland's St. Francis Dam, which failed in 1928. Overall, there have been a least 460 deaths from dam failures in California according to a report prepared by the University of California at Davis.

Public concern for the safety of dams resulted in the adoption of the Nation Dam Inspection Act in 1972, which authorized the U.S. Army Corps of Engineers to inventory and inspect all non-Federal dams. Continued interest in dam safety was evidenced in the passing of the Water Resources and Development Act of 1996 and the Dam Safety and Security Act of 2002.

The project site lies within the inundation limits and would be vulnerable to flooding resulting from a catastrophic failure of either of the dams. Dam failure inundation is not normally used as a land-use planning constraint, since one of the benefits of dam construction is to prevent periodic flooding of land downstream of the dam or at other areas that would otherwise be underutilized or unusable in the absence of the dam. However, since dam failures are well documented, governing agencies have developed Emergency Response Plans (ERP's) designed to provide first responder services in the unlikely event of failure followed by inundation flooding. In the case of the project site, two ERP's are in place. The City and the County of Orange have both incorporated ERP's as Safety Element Overlays into their respective General Plans. Emergency needs resulting from inundation flooding would be met by both City and County emergency personnel.

The project geotechnical consultant has reviewed documentation pertaining to dam construction, past performance and earthquake faults in the vicinity of the dams to evaluate the impacts due to dam failure and ensuing inundation flooding. Based on the information provided in the Draft EIR, Appendix G, *Geotechnical Investigation*, there is only a very low risk of catastrophic failure considering the past favorable dam inspection reports, the remote location of active faults in the area, the factor of safety and stringent design criteria used in modern dam design and construction. As such, they are considered to be safe for continued use.

The project civil engineering consultant has reviewed documentation pertaining to dam failure flood wave travel time between the Santiago Reservoir and the project site, and between the Villa Park Dam and the project site. The documentation consists of Appendix I, *Hydrology Study Report, Attachment C, Dam Reservoir Failure Annex Background, Water Timeline, Notification and Inundation Maps* contained within the *Dam/Reservoir Failure Annex* of the *Orange County Operational Area Emergency Action Plan*. According to this documentation, the times listed Table 5.9-14, *Dam Failure Flood Wave Travel* Time indicate the time it would take a flood wave from each dam site to reach the Santiago Canyon and Orange Park Boulevard location, e.g., the approximate location of the project site.

Table 5.9-14: Dam Failure Flood Wave Travel Time

Dam	Distance to Site	Time
Santiago Reservoir	5.0 miles	225 min.
Villa Park Dam	1.55 miles	105 min.

Source: Appendix J, Hydrology Study Report

Based on U.S. Geological Survey (USGS) Forecasting California Earthquakes Report, there is a 59% that the Southern San Andreas Fault would have the probability of one or more magnitude 6.7 or greater quake in 30-year probabilities. However, if in a highly unlikely circumstance a dam break were to occur, the project site would be in the path of inundation that would cover the majority of the proposed project site. Therefore, the following impact would have the potential to occur and mitigation is proposed:

Impact HWQ-1: The proposed project would have the potential to be in the path of inundation was a dam break to occur.

MM HWQ-1: In compliance with the California Natural Hazards Disclosure Act (California Civil Code § 1103), prior to the occupancy of any on-site uses a disclosure shall be provided to the future purchasers or occupants of the property. Additionally, it will be the purchasers/owners responsibility to notify any and all subsequent users, occupants, and/or tenants of said disclosure. The disclosure shall state that the project lies within the inundation zone, and that emergency response plans are in place and if needed would be implemented as provided in MM HWQ-2. The notification shall be made through escrow instructions at the time of purchase or sooner as needed.

MM HWQ-2 Prior to the issuance of any building permit in Planning Areas C and D, the project applicant shall provide an Emergency Evacuation Plan to the City for review and approval, incorporating the following recommendations:

Evacuation Elements. The Emergency Management Program shall include the following evacuation elements:

1. Finalized specific City Fire Department access routes shall be defined in accordance with the City Fire Department standards and CBC and CFC requirements. Each route shall be clearly identified to assist the City Fire Department with site access strategies.

2. Finalized specific City Fire Department staging areas shall be defined. Each staging area shall be established to assist the City Fire Department with coordinate site access/response strategies.

3. The structural integrity and performance of the age-qualified units against flooding shall be established in the Operations and Management Program.

Operations and Management Program. The Emergency Management Program shall be developed to coordinate response efforts and evacuation strategies in the event of an emergency affecting a portion or entire Rio Santiago development. The Emergency Management Program shall include the following elements:

1. *Emergency Management Team Structure:* The Team structure will identify emergency response resources that are available to respond to the incident, how they can be accessed, and how they can be utilized during an incident. The emergency response team may include, but not be limited to, facility owners, facility operators, facility occupants, law enforcement, public fire services, rescue and medical response teams, and environmental and utility departments or agencies.
2. *Emergency Management Response Protocols:* Such protocols shall include, but not be limited to, crisis communication and public information dissemination, protective actions for life safety, and resource management.
3. *Emergency Media Program:* An emergency media program shall include, but not be limited to, plans and procedures to disseminate and respond to requests for pre-incident, incident, and post-incident information to and from internal audiences such as employees or external audiences including the media and special needs populations.
4. *Emergency Evacuation Response Protocols and Information:* Such protocols shall include, but not be limited to, relocation of occupants to specific areas of the site, complete and immediate evacuation of all occupants from the site, or phased evacuation of the site.
5. *Local Authority Coordination Protocols:* Such protocols shall include, but not be limited to, staging locations, site access points, direct and alternate routes to the site, and emergency communications.
6. *Emergency Management Program Documents/Forms:* Such documents and forms shall include, but not be limited to, a pre-incident plan, building information, and emergency management team contact information.

Flooding Program. The Flooding Program hall be developed to coordinate preparation and response steps to be taken in the event of a flooding from a dam failure emergency is reported and/or is predicted due to weather or other conditions. The Flood Program shall consider and incorporate the existing protocols for dam monitoring and emergency response procedures utilized by both dam operators, as described earlier in this report. The City shall review and approve the Flooding Program prior to issuance of any building permit in Planning Areas C and D. The Flood Program shall include the following elements:

1. *Flood Response Procedures and Strategies:* Such procedures and strategies shall include, but not be limited to, staging and coordination areas, strategies for evacuation or relocation of facility occupants, and staff responsibilities.

2. *Flood Barriers and Location Information:* This information will identify the location and description of flood barriers that should be considered during any flood incident which may impact the onset time of dangerous conditions.

3. *Shelter-In Place/Phased Evacuation Strategies:* The flood program will identify strategies for either relocation of occupants within the site to designated areas or evacuation of the project site, depending on the conditions of the incident.

4. *Local Authority Coordination Strategies:* Such protocols shall include, but not be limited to, staging locations, site access points, direct and alternate routes to the site, hazardous conditions on site, and emergency communications.

5. *Flood Inundation Communication Protocols (Residents and Responders):* Such protocols shall include, but not be limited to, emergency communication between responders, residents, and staff. The protocols shall identify the message content that needs to be sent, requested, and received between levels and functions of the residents and responders and identify the communication mechanisms to execute such communication (human, systems, tools, networks).

6. Mutual Aid Agreements—For coordination of age qualified units that may need assistance: Such agreements may include, but not be limited to, cooperative assistance agreements with private organizations or government bodies, adjacent developments, and local organizations as a means for one entity to provide resources, services, and other required support to another entity during an incident.

Access/Egress Routes. The City shall be included in the overall review and development of the access/egress routes, staging areas, etc. to assist in the coordination of response efforts upon their arrival to the development.

Emergency Management Training Program. Emergency Management Training Program shall be developed prior to the occupancy of the development and be presented to the defined Emergency Management Team responsible for coordination of emergency response and evacuation steps. The Emergency Management Training Program shall include:

1. Emergency Management Classroom Training Program—Staff

2. Emergency Management Table-Top Exercises—Staff

3. Emergency Management Full-Scale Exercise—Staff and Residents

Resident Emergency Management Guide. A Resident Emergency Management Guide shall be developed and provided to all residents of the development to identify information the residents should understand in the event of an emergency. This guide should serve as a basic outline for residents to use in the event of a flood from a dam failure emergency and what they should do and/or expect from the management and the City.

Additionally, PDF PS-4 requires that prior to the issuance of the grading or building permit, the project applicant shall submit to the Police Chief or designee, and Community Development Director or designee, a Construction Phase Emergency Access Plan. PDF PS-5 requires that prior to the approval of the grading plan or issuance of the first grading or building permit, the project applicant shall submit to the Police Chief or designee, and Community Development Director or designee, an applicant funded Operations Emergency Access Plan for on-going proposed project operations showing all proposed means of emergency access for both police and other emergency personnel into and around the proposed project.

PDF HAZ-8 requires that individualized Emergency Evacuation Plans (EEP) shall be prepared for each planning area by the project applicant to the satisfaction of City Emergency Responder Department reviewing Staff. The EEP shall be based on initial anticipated occupancy of the planning area. The EEP shall be reviewed and revised every five years or when a significant change in structure use occurs within a planning area. The EEP shall be reviewed by the Directors of Community Development and Public Works and approved by the Police and Fire Departments prior to the occupancy of the first structure in each individual Planning Area. Even with implementation of the recommendations in the EEAS, it would not be possible to completely eliminate the risks associated with potential dam failure.

The project design component for mitigation to dam break failure has been considered and it is concluded it is unfeasible to raise the site grading to a level that would mitigate this significant unavoidable condition. Mitigation Measures HWQ-1 and HWQ-2 would not reduce the potential impact (Impact HWA-1) and this potential impact remains a significant unavoidable impact. This is because no mitigation measure can completely eliminate the risk of loss, injury, or death involving flooding as a result of the failure of a levee or dam. Further, future property purchasers or occupants will be informed that flood insurance is available to insure their properties against loss in the event of inundation from a dam break and purchasers or occupants are encouraged to purchase such insurance policies at their discretion. The disclosure would state that the project lies within the inundation zone and that emergency response plans are in place and if needed would be implemented. The notification would be made through escrow instructions at the time of purchase or sooner as needed and would be attached to the proposed project as a condition of approval prior to occupancy.

Based on the City's General Plan Safety Element, these dam facilities are maintained and safety-inspected to ensure that risks are minimized; the information provided in Draft EIR, Appendix G, *Geotechnical Investigation* suggests that only a very low risk of catastrophic failure exists considering the past favorable dam inspection reports, the remote location of active faults in the area and the factor of safety

and stringent design criteria used in modern dam design and construction; and, with the incorporation of Mitigation Measure MM HWQ-1 and MM HWQ-2, the potential impact would be reduced; however, not to a less than significant level. Therefore, this would remain a significant unavoidable impact due to the potential for a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.

Level of Significance

With the inclusion of Mitigation Measures HWQ-1 and HWQ-2, the proposed project impact (Impact HWQ-1) remains a significant unavoidable impact related to being in the path of inundation were a dam break to occur.

Seismic Related Inundation

Threshold HWQ-J	**Would the proposed project expose people or structures to inundation by seiche, tsunami, or mudflow?** **[CEQA Hydrology and Water Quality Threshold 9(j)]**

The proposed project is not in an area subject to seiches, tsunami, or mudflows. There are no enclosed water bodies within the vicinity of the project site that could experience seiches. In addition, due to the distance of the project site from the ocean and the elevation of the project site, the proposed project would not be subject to the effects of a tsunami. The project site and the surrounding area are relatively flat and developed and the proposed project would not be subject to the risk of mudflows. Therefore, a less than significant impact would be anticipated and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to seismic related inundation and no mitigation measures would be required.

Construction Activities: Stormwater Run-off

Threshold HWQ-K	**Would the proposed project potentially impact storm water run-off from construction activities?** **[CEQA Hydrology and Water Quality Threshold 9(k)]**

The proposed project includes PDF HWQ-9 that would help to prevent potential impacts during construction. The General Construction Permit (GCP) requires that the SWPPP include erosion and sediment control BMPs that would meet or exceed measures required by the GCP, as well as BMPs that control other potential construction-related pollutants. By obtaining coverage under the GCP, the proposed project will be required to develop and implement an effective combination of erosion and sediment control BMPs to mitigate and abate the erosive conditions created by the exposure of disturbed soil areas. BMPs will also be implemented to control construction waste and materials used on-site. Implementation of construction BMPs will provide the necessary protection measures to prevent contaminants from being entrained in storm water run-off, thereby achieving levels of storm water run-off quality deemed acceptable by local and State regulatory agencies. Therefore, with PDF HWQ-9 and that

require substantial conformance with local and state regulatory requirements a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to construction activities stormwater run-off and no mitigation measures would be required.

Post- Construction Activities: Stormwater Run-off

Threshold HWQ-L	**Would the proposed project potentially impact storm water run-off from post-construction activities?** **[CEQA Hydrology and Water Quality Threshold 9(l)]**

The proposed project includes PDF HWQ-10 that requires compliance with the 2011 Countywide Model WQMP including site design, LID, source control and other BMPs. Within this section, each Planning Area has identified appropriate LID features to provide water quality treatment and flow attenuation from post-construction run-off. Through the implementation of these LID features, water quality exceedances are not anticipated, and pollutants are not expected in project run-off that would degrade water quality in the Santiago Creek (Reach 1) and Lower Santa Ana River (Reach 1). Please refer to Threshold HWQ-A and HWQ-E for details of BMPs and LID features for the proposed project. Therefore, with PDF HWQ-9 and PDF HWQ-10 that require substantial conformance with local and State regulatory requirements for construction and post-construction operations a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to post-construction activities stormwater run-off and no mitigation measures would be required.

Stormwater Pollutants Discharge

Threshold HWQ-M	**Would the proposed project result in a potential for discharge of storm water pollutants from areas of material storage, vehicle or equipment fueling, vehicle or equipment maintenance (including washing), waste handling, hazardous materials handling or storage, delivery areas, loading docks or other outdoor work areas?** **[CEQA Hydrology and Water Quality Threshold 9(m)]**

The proposed project includes PDF HWQ-9 that would help to prevent potential impacts during construction. The General Construction Permit (GCP) requires that the SWPPP include non-stormwater management and material management BMPs to control potential construction-related pollutants. The proposed project will be required to control the generation of pollutants from source areas such as those mentioned above, if they exist on-site. Please refer to Threshold HWQ-A and HWQ-E for details of BMPs and LID features for the proposed project. Non-structural and structural source control BMPs prescribed in the CASQA Construction BMP Handbook and the Model WQMP, in particular, will be required at material storage areas, vehicle or equipment fueling areas, vehicle or equipment maintenance

(including washing) areas, trash enclosures, hazardous materials handling or storage areas, delivery areas, loading docks and other outdoor work areas. Therefore, with PDF HWQ-9 and PDF HWQ-10 that require substantial conformance with local and State regulatory requirements for construction and post-construction operations of the proposed project a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to stormwater pollutants discharge and no mitigation measures would be required.

Stormwater Discharge

Threshold HWQ-N	**Would the proposed project result in the potential for discharge of storm water to affect the beneficial uses of the receiving waters?** **[CEQA Hydrology and Water Quality Threshold 9(n)]**

Storm water run-off discharged from the project site during construction and post-construction of proposed project will not detrimentally affect beneficial uses of downstream receiving waters, such as Santiago Creek and the Santa Ana River. The Santa Ana River, Reach 2 is listed as impaired for bacteria indicators on the 2010 303(d) list of impaired segments; however, Santiago Creek is not listed as impaired. No TMDLs have been established for receiving water bodies.

The proposed project includes PDF HWQ-9 that would help to prevent potential impacts during construction. The General Construction Permit (GCP) requires that the SWPPP include erosion and sediment control BMPs that would meet or exceed measures required by the GCP, as well as BMPs that control other potential construction-related pollutants. Additionally, the proposed project includes PDF HWQ-10 that requires compliance with the 2011 Countywide Model WQMP which requires the incorporation of site design, LID, source control and other BMPs. With the incorporation of the LID features proposed for each of the Planning Areas, water quality exceedances are not anticipated, and pollutants are not expected in project run-off that would degrade water quality in the Santiago Creek (Reach 1) and Lower Santa Ana River (Reach 1 & 2).

The storm water run-off from the proposed project is not anticipated to cause or contribute to any water quality exceedances within downstream receiving waters. The development of a site-specific SWPPP and WQMP, through State and local regulatory requirements, will ensure that construction and post-construction BMPs will be appropriately implemented to protect beneficial uses. Please refer to Threshold HWQ-A and HWQ-E for details of BMPs and LID features for the proposed project. Therefore, with PDF HWQ-9 and PDF HWQ-10 that require substantial conformance with local and State regulatory requirements for construction and post-construction operations of the proposed project, a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to stormwater discharge and no mitigation measures would be required.

Velocity or Volume Stormwater Run-off

Threshold HWQ-O	**Would the proposed project create the potential for significant changes in the flow velocity or volume of storm water run-off to cause environmental harm?** **[CEQA Hydrology and Water Quality Threshold 9(o)]**

The proposed project will not significantly increase the peak flow rate or volume of storm water run-off to result in environmental harm. Project design features (PDF's HWQ-1 through HWQ-8) have been provided to address velocity or volume of stormwater run-off. Specifically, as discussed in Threshold HWQ-D, Drainage Pattern: Flooding and Technical Appendix Source: Appendix K, *Water Quality Technical Report*. Section 6, *Hydrologic Conditions of Concern (HCOCs)* the project will incorporate on-site LID features to provide retention and infiltration for increased run-off from the development areas. In addition, detention basins will be utilized to control the rate of discharge of the excess run-off volume associated with the 2-year hydrology analysis due to the increase of impervious surfaces as compared to existing conditions. The rate of flows discharged from the site will also be managed from the detention facility in a manner that matches existing flow conditions. Therefore, excess peak flow velocity and volumes associated with the 2-year storm for the proposed project would be controlled and discharged in a manner designed to protect Santiago Creek from scour and erosion above the existing conditions and a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to velocity or volume stormwater run-off and no mitigation measures would be required.

Erosion

Threshold HWQ-P	**Would the proposed project create the potential for significant changes in the flow velocity or volume of storm water run-off to cause environmental harm?** **[CEQA Hydrology and Water Quality Threshold 9(p)]**

Construction

During construction of the proposed project, approximately 68 acres of the 110-acre property will be disturbed, thereby creating erosive conditions on-site that may affect water quality. The proposed project includes PDF HWQ-9 that would help to prevent potential impacts during construction; the General Construction Permit (GCP) requires that the SWPPP include erosion and sediment control BMPs that would meet or exceed measures required by the GCP, as well as BMPs that control other potential construction-related pollutants. Minimum sediment basin sizing has been identified to control run-off from the maximum expected disturbance area noted above. Please refer to Threshold HWQ-A and HWQ-

E for details of BMPs and LID features for the proposed project. Therefore, with PDF HWQ-9 a less than significant impact would occur and no mitigation measures would be required.

Post- Construction

Under post-development conditions, there will not be significant increases in erosion of the project site that would affect water quality. A hydrology study was prepared for the proposed project to analyze any potential impacts on Santiago Creek in terms of erosion and/or sedimentation. PDF HWQ-10 provides that for those areas with erosion potential, such as open space/landscaped areas, erosion will be controlled through the implementation of site design, source control, and treatment control BMPs, as specified in the project-specific WQMP. Therefore, with the PDFs mentioned above, a less than significant impact would occur and no mitigation measures would be required.

Level of Significance

The proposed project would have a less than significant impact related to erosion and no mitigation measures would be required.

5.9.6 Evaluation Summary

Table 5.9-15 *Evaluation Summary Table – Hydrology and Water Quality*, summarizes potentially significant project impacts from this Draft EIR.

Table 5.9-15: Evaluation Summary Table – Hydrology and Water Quality

Threshold	Potential Impact	Mitigation Measure	Level of Significance
Water Quality Standards/Discharge Requirements	Less than significant	None required	Less than significant
Groundwater Supplies/Recharge	Less than significant	None required	Less than significant
Drainage Pattern: Erosion or Siltation	Less than significant	None required	Less than significant
Drainage Pattern: Flooding	Less than significant	None required	Less than significant
Drainage System Capacity/Polluted Run-off	Less than significant	None required	Less than significant
Degrade Water Quality	Less than significant	None required	Less than significant
Housing Placement: Flood Hazard Area	Less than significant	None required	Less than significant
Structure: Impede or Redirect Flood Flow	Less than significant	None required	Less than significant
Flooding	Impact HWQ-1	MM HWQ-1 MM HWQ-2	Significant unavoidable
Seismic Related Inundation	Less than significant	None required	Less than significant
Construction Activities: Stormwater Run-off	Less than significant	None required	Less than significant
Post- Construction Activities: Stormwater Run-off	Less than significant	None required	Less than significant
Stormwater Pollutants Discharge	Less than significant	None required	Less than significant
Stormwater Discharge	Less than significant	None required	Less than significant
Velocity or Volume Stormwater Run-off	Less than significant	None required	Less than significant
Erosion	Less than significant	None required	Less than significant