

Appendix K
Hydrology and Water Quality Technical Report



Appendices

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IRVINE BUSINESS COMPLEX VISION PLAN & MIXED USE OVERLAY ZONING CODE

WATER QUALITY TECHNICAL REPORT

CITY OF IRVINE
COUNTY OF ORANGE, CALIFORNIA

PREPARED FOR:

THE PLANNING CENTER
1580 Metro Drive
Costa Mesa, CA 92626
714.966.9220

PREPARED BY:

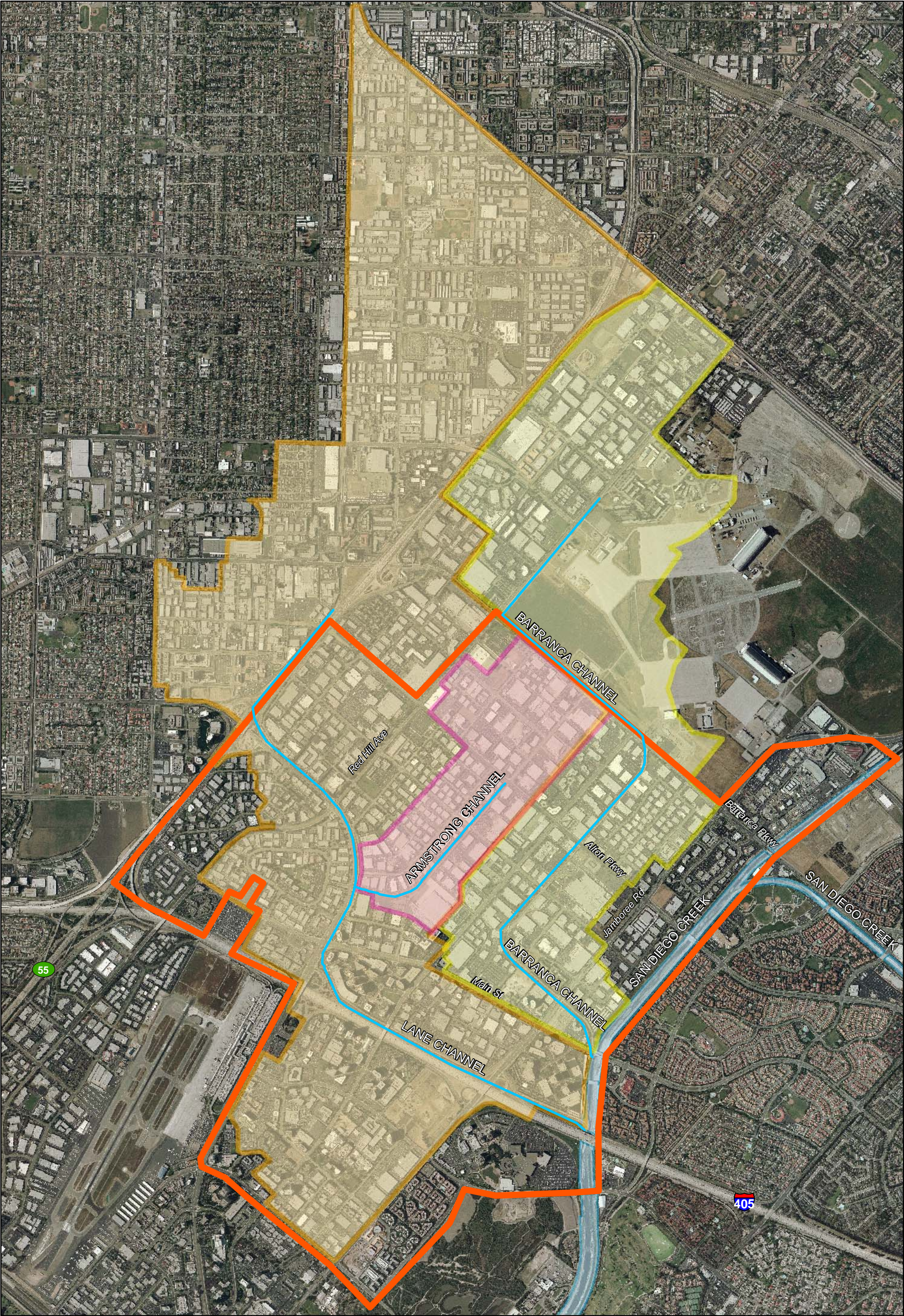
FUSCOE ENGINEERING, INC.
16795 Von Karman Suite 100
Irvine, CA 92606
949.474.1960
www.fuscoengineering.com

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I. INTRODUCTION

The Irvine Business Complex (IBC) project site generally encompasses 3,312 gross-acres within the City of Irvine, California. The area is generally located east of John Wayne Airport, south of the former Marine Corps Air Station (MCAS) Tustin, and west of the San Diego Creek channel (see Figure 1 for location of San Diego Creek in relation to the Irvine Business Complex). Currently, the predominant land uses within the Complex are commercial and industrial uses. The proposed Project involves a General Plan Amendment and Zoning Ordinance Amendment to adopt the Irvine Business Complex Mixed Use Community Vision Plan, which includes the inclusion of residential and mixed use developments within the Irvine Business Complex.

This report analyzes potential water quality impacts related to the Irvine Business Complex Vision Plan and Overlay Zoning Code (1) long-term operations and (2) construction activities at a Program-EIR Level. Measures to reduce the potential impacts to surface water as a result of construction and post-construction operations will be addressed in this report. This includes structural best management practices (BMPs), and low impact development (LID) strategies for post-construction water quality protection. Details on water quality improvements for specific areas within the IBC project study area will occur through individual project submittals and their associated Water Quality Management Plans (WQMPs).



VA Consulting Inc, Draft City of Irvine Business Complex Master Drainage Study Update - September 2008

Legend

Drainage Channel

IBC Study Area

Armstrong Drainage Boundary

Barranca Drainage Boundary

Lane Drainage Boundary

San Diego Creek Channel



1" = 2000'

02-11-2009

II. REGULATORY FRAMEWORK

Clean Water Act

Controlling pollution of the nation's receiving water bodies has been a major environmental concern for more than three decades. Growing public awareness of the impacts of water pollution in the United States culminated in the establishment of the federal Clean Water Act¹ (CWA) in 1972, which provided the regulatory framework for surface water quality protection.

The United States Congress amended the CWA in 1987 to specifically regulate discharges to waters of the US from public storm drain systems and storm water flows from industrial facilities, including construction sites, and require such discharges be regulated through permits under the National Pollutant Discharge Elimination System (NPDES).² Rather than setting numeric effluent limitations for storm water and urban runoff, CWA regulation calls for the implementation of Best Management Practices (BMPs) to reduce or prevent the discharge of pollutants from these activities to the Maximum Extent Practicable (MEP) for urban runoff and meeting the Best Available Technology Economically achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) standards for construction storm water. Regulations and permits have been implemented at the federal, state, and local level to form a comprehensive regulatory framework to serve and protect the quality of the nation's surface water resources.

In addition to reducing pollution with the regulations described above, the CWA also seeks to maintain the integrity of clean waters of the United States – in other words, to keep clean waters clean and to prevent undue degradation of others. As part of the CWA, the Federal Antidegradation Policy [40 CFR Section 131.12] states that each state “shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy...” [40 CFR Section 131.12(a)]. Three levels of protection are defined by the federal regulations:

1. Existing uses must be protected in all of the Nation's receiving waters, prohibiting any degradation that would compromise those existing uses;
2. Where existing uses are better than those needed to support propagation of aquatic wildlife and water recreation, those uses shall be maintained, unless the state finds that degradation is “...necessary to accommodate important economic or social development” [40 CFR Section 131.12(a)(2)]. Degradation, however, is not allowed to fall below the existing use of the receiving water; and

¹ Also referred to as the Federal Water Pollution Control Act of 1972.

² CWA Section 402(p).

3. States must prohibit the degradation of Outstanding National Resource Waters, such as waters of National and State parks, wildlife refuges, and waters of exceptional recreation or ecological significance.

Porter-Cologne Water Quality Act

In the State of California, the State Water Resources Control Board (SWRCB) and local Regional Water Quality Control Boards (RWQCBs) have assumed the responsibility of implementing US EPA's NPDES Program and other programs under the CWA such as the Impaired Waters Program and the Antidegradation Policy. The primary quality control law in California is the Porter-Cologne Water Quality Act (Water Code Sections 13000 et seq.). Under Porter-Cologne, the SWRCB issues joint federal NPDES Storm Water permits and state Waste Discharge Requirements (WDRs) to operators of municipal separate storm sewer systems (MS4s), industrial facilities, and construction sites to obtain coverage for the storm water discharges from these operations.

Basin Plan for the Santa Ana River

In addition to its permitting programs, the SWRCB, through its nine RWQCBs, developed Regional Water Quality Control Plans (or Basin Plans) that designate beneficial uses and water quality objectives for California's surface waters and groundwater basins, as mandated by both the CWA and the state's Porter-Cologne Water Quality Control Act. Water quality standards are thus established in these Basin Plans and provide the foundation for the regulatory programs implemented by the state. The Santa Ana RWQCB's Basin Plan, which covers the Irvine Business Complex project area, specifically (i) designates beneficial uses for surface waters and ground waters, (ii) sets narrative and numerical objectives that must be met in order to protect the beneficial uses and conform to the state's antidegradation policy, and (iii) describes implementation programs to protect all waters in the Region.³ In other words, the Santa Ana RWQCB Basin Plan provides all relevant information necessary to carry out federal mandates for the antidegradation policy, 303(d) listing of impaired waters, and related TMDLs, and provides information relative to NPDES and WDR permit limits.

CWA 303(d) List of Water Quality Limited Segments

Under Section 303(d) of the CWA, states are required to identify water bodies that do not meet their water quality standards. Once a water body has been listed as impaired, a Total Maximum Daily Load (TMDL) for the constituent of concern (pollutant) must be developed for that water body. A TMDL is an estimate of the daily load of pollutants that a water body may receive from point sources, non-point

³ California Regional Water Quality Control Board, Santa Ana Region. (2008, February). *Water Quality Control Plan for the Santa Ana River Basin* (8). Retrieved January 27, 2009, from http://www.swrcb.ca.gov/santaana/water_issues/programs/basin_plan/index.shtml

sources, and natural background conditions (including an appropriate margin of safety), without exceeding its water quality standard. Those facilities and activities that are discharging into the water body, collectively, must not exceed the TMDL.

Storm water runoff from the Irvine Business Complex project site ultimately discharges into Reach I of the San Diego Creek, which ultimately outlets into Upper Newport Bay. According to the 2006 303(d) list published by the Santa Ana RWQCB, San Diego Creek Reach I is listed as impaired for fecal coliform, selenium, and toxaphene. Additionally, the Upper Newport Bay is listed as impaired for chlordane, copper, DDT, metals, polychlorinated biphenyls (PCBs), and sediment toxicity.

Total Maximum Daily Loads (TMDLs)

Once a water body has been listed as impaired on the 303(d) list, a TMDL for the constituent of concern (pollutant) must be developed for that water body. A TMDL is an estimate of the daily load of pollutants that a water body may receive from point sources, non-point sources, and natural background conditions (including an appropriate margin of safety), without exceeding its water quality standard. Those facilities and activities that are discharging into the water body, collectively, must not exceed the TMDL. In general terms, municipal, small MS4, and other dischargers within each watershed are collectively responsible for meeting the required reductions and other TMDL requirements by the assigned deadline.

Several TMDLs have been established jointly for the San Diego Creek and Newport Bay water bodies. Table 1 below summarizes the current TMDLs for the San Diego Creek and Newport Bay watersheds.

TABLE 1 TOTAL MAXIMUM DAILY LOADS FOR SAN DIEGO CREEK & NEWPORT BAY				
Pollutant	Applicable Water Body	Load Allocations, Numeric Targets, or TMDL		
Sediment	Newport Bay San Diego Creek	50% reduction in sediment loads within 10 years	No more than 28,000 tons per year of sediment discharged to Newport Bay from open space, 19,000 tons from agricultural land, 13,000 tons from construction sites, and 2,500 tons from urban areas.	No more than 28,000 tons per year of sediment discharged to San Diego Creek from open space, 19,000 tons from agricultural land, 13,000 tons from construction sites, and 2,500 tons from urban areas.

TABLE 1 TOTAL MAXIMUM DAILY LOADS FOR SAN DIEGO CREEK & NEWPORT BAY				
Pollutant	Applicable Water Body	Load Allocations, Numeric Targets, or TMDL		
Nutrients	Newport Bay Watershed	Achieve by December 31, 2002: Summer Load Total Nitrogen 200,097 lbs, Total Phosphorous 86,912 lbs.	Achieve by December 31, 2007: Summer Load Total Nitrogen 153,861 lbs, Total Phosphorous 62,080 lbs.	Achieve by December 31, 2012: Winter Load Total Nitrogen 14,364 lbs
	San Diego Creek (Reach 2 only)	Winter Load Total Nitrogen 14 lbs		
Fecal Coliform	Newport Bay	Less than 200 ^a organisms/100 mL, with no more than 10% of the samples exceed 400 organisms /100 mL for any 30-day period.	Monthly median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	
Organo-phosphate Pesticides	Newport Bay (upper only)	Chlorpyrifos: Acute = 20 ng/L, Chronic = 9		
	San Diego Creek	Diazinon: Acute = 80 ng/L, Chronic = 50 ng/L Chlorpyrifos: Acute = 20 ng/L, Chronic = 14		
Organochlorine Compounds	San Diego Creek	Total DDT = 1.08 average grams per day Toxaphene = 0.02 average grams per day		
	Newport Bay (upper only)	Total DDT = 0.44 average grams per day Chlordane = 0.25 average grams per day Total PCBs = 0.25 average grams per day		
	Newport Bay (lower only)	Total DDT = 0.16 average grams per day Chlordane = 0.09 average grams per day Total PCBs = 0.66 average grams per day		

In addition to the approved TMDLs summarized in Table 1, there are additional TMDLs being considered for approval by the Santa Ana RWQCB after being established by the US EPA (toxics TMDLs). These include TMDLs for selenium and other metals such as cadmium, copper, lead, zinc, chromium and mercury. Lastly, TMDLs have not yet been developed for fecal coliform in San Diego Creek (Reach 1).

General Construction Permit & Storm Water Pollution Prevention Plans (SWPPPs)

The General Construction Permit (GCP), NPDES Permit No. CAS000002, regulates storm water and non-storm water discharges associated with construction activities disturbing 1 acre or greater of soil. Construction sites that qualify must submit a Notice of Intent (NOI) to gain permit coverage or otherwise be in violation of the CWA and California Water Code. The existing GCP, SWRCB Order No. 99-08-DWQ was updated in September 2009 as Order No. 2009-0009-DWQ, and takes

effect July 1, 2010. In addition to the requirements of the existing GCP, Order No. 2009-0009-DWQ contains additional requirements for construction sites based on the sites risk of discharging construction-related pollutants, as well as additional monitoring and reporting requirements. Each construction project must complete a Risk Assessment prior to commencement of construction activities, which assigns a Risk Level to the site and determines the level of water quality protection/requirements the site must comply with. The updated permit also includes provisions for meeting specific Numerical Effluent Limits and Action Levels for pollutants based on the sites' Risk Level. Risk levels may change throughout the course of the project dependent on the specific construction activities, timing and areas of disturbance during construction.

Similar to the existing GCP, the updated GCP requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) for each individual construction project greater than or equal to 1 acre of disturbed soil area (regardless of the site's Risk Level). The SWPPP must list Best Management Practices (BMPs) that the discharger will use to control sediment and other pollutants in storm water and non-storm water runoff; the BMPs must meet the BAT and BCT performance standards. Additionally, the SWPPP must contain a visual monitoring inspection program; a chemical monitoring programs for sediment and other "non-visible" pollutants to be implemented based on the Risk Level of the site, as well as inspection, reporting, training and record-keeping requirements.

Individual projects within the Irvine Business Complex that disturb greater than 1 acre within the City of Irvine, will be subject to the storm water discharge requirements of the GCP. The projects will require submittal of an NOI, SWPPP, Risk Assessment and other Project Registration Documents (PRDs) required by the GCP prior to the commencement of soil disturbing activities. In the Santa Ana Region, the SWRCB is the permitting authority, while the Santa Ana RWQCB provides local oversight and enforcement of the GCP.

General WDR Permit for Groundwater Discharges

Due to the relatively shallow groundwater levels within portions of the San Diego Creek and Newport Bay watersheds, excess pollutants in groundwater may pose threats to surface water quality when discharged. Discharges that may pose a threat to water quality include wastes associated with well installation, development, test pumping, dewatering from subterranean seepage, and groundwater dewatering wastes from construction sites. The Santa Ana RWQCB requires a permit for discharges from activities involving groundwater extraction or discharge within the Newport Bay watersheds. Under Order No. R8-2006-0065, Permittees (dischargers) are required to monitor discharges to surface waters that pose an insignificant (de minimus) threat to water quality. This order only covers short term discharges, such as intermittent discharges and/or one year or less in duration. For discharges of longer

durations, Permittees are required to apply for coverage under Order No. R8-2006-0004. Alternatively, long term or permanent discharges from groundwater extraction or dewatering activities may require a separate individual permit issued by the RWQCB.

County of Orange MS4 Permit & Drainage Area Management Plan (OC DAMP)

In January 2002, the Santa Ana RWQCB reissued the MS4 Storm Water Permit (WDR Order R8-2002-0010, NPDES Permit No. CAS618030) to the County of Orange and the incorporated cities of Orange County within the Santa Ana Region. Pursuant to the MS4 permit, (currently in its third term) the County of Orange and incorporated cities were required to develop a Drainage Area Management Plan (DAMP), which provides area-wide guidance for cities in developing their storm water programs. The Orange County Drainage Area Management Plan (OC DAMP) approved by the Santa Ana RWQCB in early 2002, includes a model Local Implementation Program (LIP) for municipalities, such as the City of Irvine, to implement in their jurisdiction. The LIP describes the City's storm water pollution control efforts implemented to meet the requirements of the third term MS4 permit. Therefore, the City LIP and the OC DAMP, in effect, act as companion parts of the City's storm water compliance program.

In May 2009, the Santa Ana RWQCB re-issued the MS4 Permit for the Santa Ana Region of Orange County (Order No. R8-2009-0030). Re-issuance of the third term permit will likely result in future changes to the OC DAMP and City of Irvine LIP and storm water program. This new fourth-term permit includes new requirements that follow similar changes that other Regional Boards have made in their recent permit renewals, such as the San Diego RWQCB and Los Angeles RWQCB. This includes requirements pertaining to hydromodification⁴ and low impact development (LID) features associated with new developments and redevelopments. During the first 12 to 24 months after permit adoption, City's will be required to update their LIP and storm water programs to reflect any new permit requirements and associated changes.

City of Irvine Water Quality Management Plan (WQMP)

One component of the New Development / Significant Redevelopment Section of the City's LIP is the provision to prepare a project-specific Water Quality Management Plan (WQMP) for specified categories of development aimed at reducing pollutants in post-development runoff. Specifically, a WQMP includes Santa Ana RWQCB approved BMPs, where applicable, that address post-construction management of storm water runoff water quality. This includes operation and maintenance requirements for all structural or treatment control BMPs required for specific categories of developments to reduce pollutants in post-development runoff to the Maximum Extent Practicable (MEP). In addition, projects designated as "Priority Projects" are required to incorporate treatment control BMPs to address pollutants of

⁴ Hydromodification is generally defined as the alteration of natural flow characteristics.

concern from the project site. In accordance with the OC DAMP and City LIP, a project is considered a Priority Project if it meets any of the following criteria:

- Residential development of 10 units or more;
- Commercial and industrial development greater than 100,000 square feet including parking area;
- Automotive repair shops (SIC codes 5013, 5014, 5541, 7532-7534, and 7536-7539);
- Restaurants where the land area of development is 5,000 square feet or more including parking area (SIC code 5812);
- Hillside developments on 10,000 square feet or more, which are located on areas with known erosive soil conditions or where natural slope is twenty-five percent or more;
- Impervious surface of 2,500 square feet or more located within, directly adjacent to (within 200 feet), or discharging directly to receiving waters within Environmentally Sensitive Areas;
- Parking Lots 5,000 square feet or more, or with 15 parking spaces or more, and potentially exposed to urban storm water runoff;
- All significant redevelopment projects, where significant redevelopment is defined as the addition of 5,000 or more square feet of impervious surface on an already developed site.

As required by the City of Irvine's LIP and municipal ordinances on storm water quality management, project-specific WQMPs must be submitted to the City for approval prior to the City issuing any building or grading permits. Since the overall Irvine Business Complex project includes the development of several of the categories listed above, the individual projects will be subject to the requirements of the City of Irvine WQMP. Individual projects within the Business Complex will be required to submit a project-specific WQMP to ensure all requirements of the City of Irvine's LIP and ordinances on storm water quality are addressed for that project. This includes meeting any new requirements associated with Priority Projects, as well as the requirements of the MS4 permit re-issuance, which includes LID features and/or hydromodification controls, once the City's LIP is revised and requirements are implemented within the City.

III. EXISTING WATER QUALITY CONDITIONS

Regional Drainage

As previously mentioned, runoff from the Irvine Business Complex ultimately discharges into Reach 1 of San Diego Creek, which outlets into the upper Newport Bay downstream. Refer to Figure 1 for the location of San Diego Creek and other major drainage channels located within the Irvine Business Complex. According to the Santa Ana River Basin Plan, the Irvine Business Complex is located within the larger Lower Santa Ana River Hydrologic Unit (801.0) and the East Coast Range Hydrologic Sub-Area (801.11). Beneficial uses and water quality objectives have been developed for San Diego Creek, and are discussed below.

Beneficial Uses

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

- REC1 – Contact Water Recreation;
- REC2 – Non-Contact Water Recreation;
- WARM – Warm Freshwater Habitat; and
- WILD – Wildlife Habitat.

In addition, there are intermittent beneficial uses for the various tributaries to San Diego Creek, such as Peters Canyon Wash, Bonita Creek, Sand Canyon Wash and other tributaries. These intermittent beneficial uses are:

- GWR – Groundwater Recharge;
- REC1 – Contact Water Recreation;
- REC2 – Non-Contact Water Recreation;
- WARM – Warm Freshwater Habitat;
- WILD – Wildlife Habitat; and
- RARE – Rare, Threatened, or Endangered Species.⁵

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 2 summarizes the specific water quality objectives for San Diego Creek, Reach 1.

⁵ RARE beneficial use applies to Sand Canyon Wash only.

TABLE 2 WATER QUALITY OBJECTIVES FOR SAN DIEGO CREEK, REACH 1 (MG/L)						
Total Dissolved Solids	Hardness	Sodium	Chloride	Total Inorganic Nitrogen	Sulfate	Chemical Oxygen Demand
1,500	--	--	--	13	--	90
-- 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.						

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
- 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 current Countywide storm water program and OC DAMP, surface water monitoring is conducted along San Diego Creek and several of its tributaries. Currently, there are four monitoring locations for San Diego Creek Reach 1 and its tributaries within the vicinity of the Irvine Business Complex. A summary of the site locations is provided in Table 3, and Table 4 provides a summary of the recent monitoring data available for these sites.

TABLE 3 COUNTY OF ORANGE IRVINE BUSINESS COMPLEX MONITORING LOCATIONS			
Site Name	Water Body	General Location	Type
IRVF05TBN1	San Diego Creek	~500 ft downstream of Peters Canyon Channel confluence near Civic Center Plaza	Targeted
IRVF05TBN2	San Diego Creek	~200 ft downstream of Harvard Avenue and Barranca Road intersection	Targeted
IRVF06P06	Peters Canyon Channel	At Barranca Road, upstream of confluence with San Diego Creek	Targeted
IRVFF08P01	Lane Channel	~100 ft downstream of Von Karman Avenue bridge at I-405.	Random

In general, exceedances for Basin Plan water quality objectives were observed consistently for reactive phosphorous, and exceedances were observed on occasion for turbidity, dissolved oxygen and surfactants. However, it should be noted that exceedances for reactive phosphorous were also observed at the majority of the monitoring locations throughout Orange County streams and channels, indicating that the problems may be watershed-wide and not specific to San Diego Creek. Lastly, although the Basin Plan does not identify numerical objectives for these constituents, levels of nitrate, bacteria, electrical conductivity and water temperature were also high based on experience and tolerance intervals (see Table 4).

Table 4
Summary of Existing Water Quality Data (County of Orange)

Type	Site Name	Date	Physicals							Chemical										Bacteria			Pesticides					Dissolved Metals							Arsenic	Selenium	Mercury		
			Time	Dissolved Oxygen	Electrical Conductivity	pH	Water Temperature	Turbidity	Hardness as CaCO ₃	Phenols	Ammonia as N	Nitrate as N	Surfactants (MBAS)	Reactive Phosphorous	Total Chlorine	Total Suspended Solids (TSS)	Oil & Grease	Dissolved Copper	Dissolved Hexa Chrom.	Total Organic Carbon	Total Coliform	Fecal Coliform	Enterococcus	Diazinon	Chlorpyrifos	Malathion	Dimethoate	Disulfoton	Chromium	Nickel	Copper	Zinc	Silver	Cadmium				Lead	
Criterion 1	Outside Tolerance Interval			5.98		7.27-8.3	23.08	15.9		0.02	1.46	5.5	0.35	2.92	0.12	46.48					300,000	80,000	52,000	125	17.44	68.5	10			88	13	69		8.6	2.53				
Criterion 2	Basin Plan Objective			5		6.5-9		20					0.5	0.1		75																							
Criterion 3	Out of Bounds for Site																																						
Criterion 4	Warning Level based on Experience				6000		40			0.02	0.65	10			1																								
Criterion 5	CTR Acute Criterion																												1707.86	1512.89	49.62	379.3	37.44	19.1	280.01				
Criterion 6	CTR Chronic Criterion																												554.01	168.04	29.28	382.4		6.25	10.91				
Criterion 7	LC ₅₀ for Toxicity Test Organism																							450	570	5000	43000												
	Targeted Site	Random Site																																					
Targeted	IRVF05TBN1	5/25/2007	10:05	6.73	6256	7.27	20.88	0.88	1505	0.02	0.05	3.9	0.16	2.2	0.06	<5	<5	0.11	0.01	10	3,000	1,100	2,300	<2.0	<1.0	<3.0	<3.0	<1.0	0.53	9.4	8.2	12	<0.50	<0.50	<0.50	3.7	5.2	<0.10	
Targeted	IRVF05TBN1	6/28/2007	08:50	14.31	2921	7.51	21.69	0.63	1490	0	0	4.7	0.05	2.52		<5	<5	0.04	0.01	7.8	3,000	690	200	<2.0	<1.0	<3.0	<3.0	<1.0	0.57	5.8	7.6	13	1.1	<0.50	<0.50	4.2	8.6	<0.10	
Targeted	IRVF05TBN1	7/27/2007	10:10	6.28	901	6.99	23.98	0.37	1930	0.02	0.02	3.8	0.05	2.25	0.1	6	<5	0.06	0.01	7.1	4,200	600	1,700	<2.0	<1.0	<3.0	<3.0	<1.0	0.53	11	11	33	<0.50	0.72	<0.50	3.3	6.5	<0.10	
Targeted	IRVF05TBN1	8/23/2007	10:25	6.45	5412	6.86	26.5	0.42	1295	0.02	0.02	2.2	0.07	1.89	0.11	<5	<5	0.04	0.02	5.2	400	300	<10	<2.0	<1.0	<3.0	<3.0	<1.0	<0.50	4.7	3.9	8.2	<0.50	<0.50	<0.50	4.3	4.7	<0.10	
Targeted	IRVF05TBN1	9/19/2007																																					
Targeted	IRVF05TBN1	9/27/2007	09:29	5.23	7946	7.13	22.66	0.4	2065	0.02	0.01	0.9	0.14	2.28	0.08	<5	<6	0.04	0.01	7.5	3,000	200	100	<2.0	<1.0	<3.0	<3.0	<1.0	<0.50	10	5.2	61	1.1	<1.00	<1.00	3.4	4.9	<0.10	
Targeted	IRVF05TBN1	5/30/2008	10:40	6.29	7753	7.24	19.51	0.85	1690		0.1	4.3	0.1	2.63	0.08	<5	<5	0.2	0.05	9.1	>330	40	30	<2.0	<1.0	<3.0	<3.0	<1.0	<0.50	9.2	7	9.5	0.61	<0.50	<0.50	3.3	6.4	<0.10	
Targeted	IRVF05TBN1	6/25/2008	09:20	4.54	6296	7.15	20.62	1.97	1420		0.1	3.2	0.1	2.4	0.09	35	<5	0.2	0.05	16	>15,000	1,900	2,200	<10.0	<10.0	<10.0	<10.0	<10.0	<0.50	8	9.1	15	<0.50	<0.50	<0.50	3.6	4.3	<0.05	
Targeted	IRVF05TBN1	7/24/2008	10:03	8.31	7734	7.24	22.02	0.44	1675		0.1	1.6	0.1	2.17	0.1	<5	<5	0.2	0.05	7.1	260	120	50	<10.0	<10.0	<10.0	<10.0	<10.0	0.54	7.8	7.7	14	<0.50	<0.50	<0.50	4.8	6.6	<0.05	
Targeted	IRVF05TBN1	8/19/2008	11:25	6.77	8851	7.38	22.78	0.42	1910		0.1	2	0.1	2.46	0.1	<5	<5	0.2	0.05	6.7	480	99	140	12	<10.0	<10.0	<10.0	<10.0	16	<0.50	8.2	6.3	13	0.95	<0.50	<1.00	4.9	8.1	<0.05
Targeted	IRVF05TBN1	9/9/2008	08:50	7.8	8603	7.53	24.41	0.75	1830		0.1	2	0.1	2.28	0.07	<5	<5	0.2	0.05	7.4	>920	340	360	<10.0	<10.0	<10.0	<10.0	<10.0	<2.50	8.7	6.8	14	<2.50	<2.50	<2.50	4.2	5.2	<0.05	
	n			10	10	10	10	10	10	5	10	10	10	10	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10		
	Max			14.31	8851	7.53	26.5	1.97	2065	0.02	0.1	4.7	0.16	2.63	0.11	35	<6	0.2	0.05	16	>15000	1900	2300	12	<10.0	<10.0	<10.0	<10.0	16	<2.5	11	11	61	<2.5	<2.5	<2.5	4.9	8.6	<0.10
	Min			4.54	901	6.86	19.51	0.37	1295	0	0	0.9	0.05	1.89	0.06	<5	<5	0.04	0.01	5.2	260	40	<10	<2.0	<1.0	<3.0	<3.0	<1.0	<0.5	4.7	3.9	8.2	<0.5	<0.5	<0.5	3.3	4.3	<0.05	
	Mean			7.271	6267.3	7.23	22.505	0.713	1681	0.016	0.06	2.86	0.097	2.308	0.087778	8.1	<6	0.129	0.031	8.39	3059	538.9	709	5.4	<10.0	<10.0	<10.0	5.2	0.717	8.28	7.28	19.27	0.876	0.772	<2.5	3.97	6.05	<0.1	
Targeted	IRVF05TBN2	5/31/2007	10:15	11.15	3150	7.46	22.88	0.23	1000	0.02	0.03	21.8	0.07	0.86	0.11	<5	<5	0.12	0.02	1.5	330	60	80	<2.0	<1.0	<3.0	<3.0	<1.0	1.3	0.98	1.3	2.8	<0.50	<0.50	<0.50	6.4	35	<0.10	
Targeted	IRVF05TBN2	6/28/2007	10:10	13.07	4952	7.19	24.74	4.76	1545	0	0.32	2.1	0.05	0.45		5	<5	0.06	0.01	6.1	6,800	2,700	400	15.4	<1.0	<3.0	<3.0	<1.0	<0.50	1.9	2	4.2	<0.50	<0.50	<0.50	4.9	4.8	<0.10	
Targeted	IRVF05TBN2	7/27/2007	08:45	8.48	3015	7.53	24.13	0.16	1105	0.02	0.02	18.8	0.07	0.6	0.05	5	<5	0.05	0.01	1.7	2,800	690	920	<2.0	<1.0	<3.0	<3.0	<1.0	1.4	3.9	9	6.8	<0.50	<0.50	<0.50	6.1	39	<0.10	
Targeted	IRVF05TBN2	8/23/2007	09:01																																				

As previously discussed, there are several TMDLs currently implemented or in development within the San Diego Creek and Newport Bay watersheds. TMDLs have been developed jointly for the San Diego Creek and Newport Bay Watersheds for nutrients, sediment, and toxics, and a TMDL was also developed for fecal coliform in the Newport Bay. Brief summaries of these TMDLs are provided below. Refer to Table 1 for a breakdown of the TMDL target dates and waste load allocations.

Nutrients

In 1996 the Newport Bay and San Diego Creek watersheds were placed on the CWA Section 303(d) list as being impaired for nutrients. This listing was in response to excess nutrient loadings in the Newport Bay that resulted in seasonal algal blooms and subsequent impairments to beneficial uses, including recreation, navigation, and habitat uses. The primary source of the algal blooms was identified to be from San Diego Creek discharging nitrogen and phosphorous in the Bay. Sources of these excess nutrients within San Diego Creek included nurseries, groundwater dewatering facilities, urban runoff, agricultural discharges and other undefined sources (open space, atmospheric deposition, etc.).

In 1998, the Santa Ana RWQCB approved Order No. 98-9 (amended by Resolution No. 98-100), establishing targets to reduce the annual load of nitrogen and phosphorous in the Newport Bay by 50% and meeting water quality objectives by 2012. A regional monitoring program was also developed to monitor discharges of total nitrogen and total phosphorous, monitor algal blooms, and to track progress towards meeting the TMDL requirements.⁶

Sediments

Excess sediment discharging into the Newport Bay can result in loss of marine aquatic, mudflat, salt marsh, and riparian habitat within and adjacent to the Newport Bay Ecological Reserve and subsequently impairing these and other beneficial uses of the Bay. In March of 1999, the Santa Ana RWQCB adopted a TMDL for sediment in the San Diego Creek and Upper Newport Bay watersheds into the Basin Plan, and established Monitoring and Reporting Program No. 99-74 to require sediment monitoring and maintenance throughout the watershed per the TMDL. In order to meet the TMDL, habitat acreages and marine habitat basin depths must be maintained, and not change as a result of sediment deposition.⁷ In addition, the overall objectives of the TMDL are to reduce the annual average sediment load in the San Diego Creek watershed by 50% over a 10-year period. The 125,000 tons per

⁶ County of Orange, OC Watersheds Program. San Diego Creek/Newport Bay Nutrient TMDL Website. Retrieved January 26, 2009, from <http://www.ocwatersheds.com/Watersheds/default.aspx?ID=1000299>

⁷ California Regional Water Quality Control Board, Santa Ana Region. (2008, February). *Water Quality Control Plan for the Santa Ana River Basin* (8). Retrieved January 27, 2009, from http://www.swrcb.ca.gov/santaana/water_issues/programs/basin_plan/index.shtml

year annual average sediment load target is allocated equally between the San Diego Creek watershed (62,500 tons per year) and the Newport Bay watershed (62,500 tons per year).⁸ The TMDL also includes an Upstream Monitoring Element for activities that are performed in San Diego Creek upstream of Jamboree Road, and a Newport Bay Monitoring Element to monitor activities in the upper and lower Newport Bay.

Toxics

In 2002, the US EPA established a TMDL for 14 different toxic constituents for the San Diego Creek and Newport Bay. The constituents included organophosphate pesticides (chlorpyrifos & diazinon), organochlorinated compounds (chlordane, dieldrin, DDT, PCBs, & toxaphene), and metals (cadmium, chromium, copper, lead, mercury, selenium, & zinc).⁹ Table 5 summarizes which of these constituents apply to the specific water bodies within the San Diego Creek and Newport Bay watersheds.

TABLE 5 WATER BODIES SUBJECT TO THE TOXICS TMDL			
Water Body	Organophosphate Pesticide	Organochlorinated Compound	Element/Metal
San Diego Creek	Chlorpyrifos, Diazinon	Chlordane, Dieldrin DDT, PCBs, Toxaphene	Cd, Cu, Pb, Se, Zn
Upper Newport Bay	Chlorpyrifos	Chlordane, DDT, PCBs,	Cd, Cu, Pb, Se, Zn
Lower Newport Bay	Not Applicable	Chlordane, Dieldrin, DDT, PCBs	Cu, Pb, Se, Zn
Rhine Channel	Not Applicable	Chlordane, Dieldrin, DDT, PCBs	Cu, Pb, Se, Zn, Cr, Hg
Source: County of Orange, OC Watersheds Program. San Diego Creek/Newport Bay Toxics TMDL. Retrieved January 26, 2009, from http://www.ocwatersheds.com/Watersheds/default.aspx?ID=1000300			

The primary sources of toxic substances that lead to the impairment of the watersheds include agricultural runoff, industrial discharges, groundwater discharges, and urban runoff. For some constituents that are no longer in use today, such as DDT and PCBs, historical discharges and erosion may serve as sources. Due to bioaccumulation, adverse impacts to aquatic organisms as a result of these substances may include (but

⁸ County of Orange, OC Watersheds Program. San Diego Creek/Newport Bay Sediment TMDL Website. Retrieved January 26, 2009, from <http://www.ocwatersheds.com/Watersheds/default.aspx?ID=1000298>

⁹ County of Orange, OC Watersheds Program. San Diego Creek/Newport Bay Toxics TMDL Website. Retrieved January 26, 2009, from <http://www.ocwatersheds.com/Watersheds/default.aspx?ID=1000300>

are not limited to) cellular injury, mutagenic impairment, reduced reproductive success, and carcinogenic responses.¹⁰

Currently, a TMDL for organophosphate pesticides (chlorpyrifos & diazinon) has been approved by the SWRCB and EPA for implementation under Order No. R8-2003-0039, and in 2007, the Santa Ana RWQCB approved the TMDL for organochlorinated compounds (Order No. R8-2003-0039). TMDLs for metals are currently in development by the RWQCB. However, as part of the County's Nitrogen Selenium Management Program (see Groundwater Quality Conditions Section for further details), sources and treatment options for selenium are currently being investigated to be used in the development of the TMDL for selenium.

Fecal Coliform

Due to consistently high bacteria levels in Newport Bay, portions of the Upper Newport Bay has been closed to contact recreational uses (REC1) since 1974. The principal sources contributing to the excess bacteria levels were determined to be urban runoff sources, particularly during wet weather. However, exact sources of the bacteria in urban runoff are undetermined. Additional sources to the Bay include, but are not limited to, manure fertilizers, fecal wastes from humans, pets, birds, and other animals, as well as restaurants and food sources and vessel sanitary wastes. Previous monitoring data has shown that the bacteria concentrations in the Bay are strongly influenced by storm water runoff. In addition, due to the hydrologic and estuarine conditions of the Bay, the bacteria concentrations within the Bay are influenced by tidal mixing, sunlight, and sediment conditions within the Bay. These conditions may increase or decrease the levels, once they reach the Bay from upstream sources.¹¹

Accordingly, in 1999, Santa Ana RWQCB Resolution No. 99-10 established a TMDL for fecal coliform bacteria in Newport Bay. The TMDL established waste load allocations for both point sources and nonpoint sources in a prioritized phased approach to allow sufficient time for reducing bacteria concentrations. The phased approach allows for revisions to the program or control measures implemented if annual monitoring efforts show that the bacteria levels are not being reduced to the desired levels.

¹⁰ US Environmental Protection Agency, Region 9. (2002, June). *Total Maximum Daily Loads for Toxic Pollutants, San Diego Creek and Newport Bay, California. Summary Document*. Retrieved January 26, 2009, from <http://www.epa.gov/region09/water/tmdl/nbay/summary0602.pdf>

¹¹ Pednekar, A. M., Grant, S. B., Jeong, Y., Poon, Y., & Oancea, C. (2005). Influence of climate change, tidal mixing, and watershed urbanization on historical water quality in Newport Bay, a saltwater wetland and tidal embayment in southern California. *Environmental Science & Technology*, 39, 9071-9082.

IV. EXISTING GROUNDWATER CONDITIONS

Regional Drainage

Geographically, the Irvine Business Complex is located within the Irvine Groundwater Management Zone of the lower Santa Ana River basin. As defined in the Basin Plan, the Irvine Groundwater Management Zone is generally bounded by Newport Bay and the San Joaquin Hills to the south/southwest, the Santa Ana Mountains to the east, and the Orange County Groundwater Management Zone to the north.

Beneficial Uses

The Basin Plan identifies the Irvine Groundwater Management Zone as having four beneficial uses. They are:

- MUN – Municipal and Domestic Supply;
- AGR – Agricultural Supply;
- IND – Industrial Service Supply; and
- PROC – Industrial Process Supply.

Water Quality Objectives

Specific water quality objectives have been established for the Irvine Groundwater Management Zone to maintain its beneficial uses, and are summarized in Table 6.

TABLE 6 WATER QUALITY OBJECTIVES FOR THE IRVINE GROUNDWATER MANAGEMENT ZONE					
Total Dissolved Solids	Hardness	Sodium	Chloride	Nitrate as Nitrogen	Sulfate
910	--	--	--	5.9	--
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.					

In addition to specific numeric water quality objectives, narrative objectives for all groundwaters in the Santa Ana Region also apply to the Irvine Groundwater Management Zone. Narrative objectives have been established for the following constituents:

- | | | |
|--------------------------|----------------------|----------------------------------|
| ▪ arsenic | ▪ bacteria, coliform | ▪ barium |
| ▪ boron | ▪ chloride | ▪ color |
| ▪ cyanide | ▪ fluoride | ▪ hardness (as CaCO_3) |
| ▪ MBAS | ▪ metals | ▪ nitrate |
| ▪ oil & grease | ▪ pH | ▪ radioactivity |
| ▪ sodium | ▪ sulfate | ▪ taste & odor |
| ▪ total dissolved solids | ▪ toxicity | |

Groundwater Quality Conditions

Due to the increasing urbanization in the watershed over the past 100 years, shallow groundwater within portions of the San Diego Creek and Newport Bay watersheds contains high levels of nutrients and selenium. The high concentrations in groundwater developed as a result of the draining of the Swamp of the Frogs in the 1960s, a large swamp that was previously disconnected from the Newport Bay. Over time, the swamp accumulated nutrients and selenium in sediments that discharged to the swamp from the adjacent hillsides, and became mobilized in groundwater when the swamp was drained and hydrologic regime of the watershed was changed. Since groundwater levels in portions of the watershed are relatively close to the ground surface, groundwater may come into contact with surface waters by seeping through channel bottoms, cracks in storm drain pipes, and through groundwater dewatering activities. As a result, the high levels of nutrients and selenium in the groundwater may discharge into receiving waters.

The Santa Ana RWQCB recognized the potential treat groundwater discharges may have on surface water quality, and began regulating discharges of groundwater into surface waters through NPDES permits. Due to the concerns from short-term discharges of nitrogen and selenium into surface waters, a separate permit was issued by the RWQCB specific to the San Diego Creek and Newport Bay watersheds. Order No. 2004-0021 recognized that while groundwater contained high levels of selenium, there were no feasible treatment technologies for reducing selenium concentrations in discharges. A Working Group was subsequently formed, and the Orange County Nitrogen Selenium Management Program (NSMP) was developed to investigate alternative compliance approaches and develop an overall understanding and management plan for selenium and nitrogen as a result of groundwater discharges in the watershed. The NSMP Working Group consists of various stakeholders and technical representatives to develop a Work Plan for addressing nitrogen and selenium issues as a result of groundwater discharges in the watersheds. The research and information collected under the NSMP will also be beneficial in the development of the TMDL specific for selenium, as well as improving compliance with the existing TMDL for nutrients.

V. PROPOSED WATER QUALITY CONDITIONS

Construction Activities

Clearing, grading, excavation and construction activities associated with the individual projects under the Irvine Business Complex may impact water quality due to sheet erosion of exposed soils and subsequent deposition of particulates in local drainages. Grading activities, in particular, lead to exposed areas of loose soil, as well as sediment stockpiles, that are susceptible to uncontrolled sheet flow. Although erosion occurs naturally in the environment primarily from weathering by water and wind action, improperly managed construction activities can lead to substantially accelerated rates of erosion that are considered detrimental to the environment.

Prior to the issuance of grading permits, the applicants shall provide evidence that the development of the projects as part of the Irvine Business Complex shall comply with the most current General Construction Permit (GCP) and associated local NPDES regulations to ensure that the potential for soil erosion is minimized on a project-by-project basis. In accordance with the updated GCP (Order No. 2009-0009-DWQ), the following Permit Registration Documents (PRDs) are required to be submitted to the SWRCB prior to commencement of construction activities:

- Notice of Intent (NOI)
- Risk Assessment (Standard or Site-Specific)
- Particle Size Analysis (if site-specific risk assessment is performed)
- Site Map
- SWPPP
- Post-Construction Water Balance Calculator (not required – project is covered under the North Orange County MS4 permit Order No. R9-2009-0030)
- Active Treatment System (ATS) Design Documentation (if ATS is determined necessary)
- Annual Fee & Certification

In accordance with the existing and updated GCP, construction SWPPPs must be prepared and implemented at the project sites, and revised as necessary, as administrative or physical conditions change. The SWPPPs must be made available for review by the RWQCB, upon request, and must describe construction BMPs that address pollutant source reduction and provide measures/controls necessary to mitigate potential pollutant sources. These include, but are not limited to: erosion controls, sediment controls, tracking controls, non-storm water management,

materials & waste management, and good housekeeping practices.¹² The above-mentioned BMPs for construction activities are briefly discussed below.

- Erosion control BMPs, such as hydraulic mulch, soil binders, and 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 (e.g., gravel bags) around the inlet and equipped with a sediment filter (e.g., 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 and roadways. 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.

Prior to commencement of construction activities, the individual project-SWPPP will be prepared in accordance with the site specific sediment risk analyses based on the final rough grading plans and erosion and sediment controls proposed for each phase of construction for each project. The phases of construction will define the maximum amount of soil disturbed, the appropriate sized sediment basins and other control measures to accommodate all active soil disturbance areas and the appropriate monitoring and sampling plans.

¹² California Stormwater Quality Association. (2003, January). *Stormwater Best Management Practices Handbook for New Development and Redevelopment*. Retrieved January 27, 2009, from <http://www.cabmphandbooks.com>

Post-Construction Activities

With the proposed land use changes, redevelopment of the Irvine Business Complex may result in long-term impacts to the quality of storm water and urban runoff, subsequently impacting downstream water quality. Redevelopments similar to the proposed Irvine Business Complex can potentially create new sources for runoff contamination through changing land uses. As a consequence, the projects associated with the Irvine Business Complex have the potential to increase the post-construction pollutant loadings of certain constituent pollutants associated with the proposed land uses and their associated features, such as landscaping.

In accordance with the requirements of the City of Irvine LIP and consistency with OC DAMP and third-term MS4 permit, new development and significant redevelopment projects must incorporate site design and source control BMPs to address post-construction storm water runoff management. In addition, projects that are identified as Priority Projects are required to implement site design/LID and source control BMPs applicable to their specific priority project categories, as well as implement treatment control BMPs. Selection of treatment control BMPs is based on the pollutants of concern for the specific project site and the BMP's ability to effectively treat those pollutants, in consideration of site conditions and constraints. Further, both Priority and Non-Priority projects must develop a project-specific Water Quality Management Plan (WQMP) that describes the menu of BMPs chosen for the project site, as well as include operation and maintenance requirements for all structural and treatment control BMPs.

Predicted Pollutants and Sources

The pollutants of concern for water quality are those pollutants that are anticipated (expected) or potentially could be generated by the project, based on past and proposed land uses, along with those pollutants that have been identified by regulatory agencies as potentially impairing beneficial uses in receiving water bodies. Based on the various land uses for the Irvine Business Complex, the pollutants of concern can be divided up into anticipated pollutants and potential pollutants. Table 7, derived from the Countywide Model WQMP, summarizes typical pollutants of concern for major land uses and project categories, including those that are proposed for the Irvine Business Complex.

**TABLE 7
ANTICIPATED AND POTENTIAL POLLUTANTS GENERATED BY LAND USE TYPE**

Priority Project Categories and/or Project Features	Bacteria/Virus	Heavy Metals	Nutrients	Pesticides	Organic Compounds	Sediment	Trash & Debris	Oxygen Demanding Substances	Oil & Grease
Detached Residential	X		X	X		X	X	X	X
Attached Residential	P		X	X		X	X	P ⁽¹⁾	P ⁽²⁾
Commercial/Industrial	P ⁽³⁾	P	P ⁽¹⁾	P ⁽¹⁾	P ⁽⁵⁾	P ⁽¹⁾	X	P ⁽¹⁾	X
Automotive Repair Shops		P			X ^(4,5)		X		X
Restaurants	X						X	X	X
Hillside Development >10,000ft ²	X		X	X		X	X	X	X
Parking Lots	P ⁽⁶⁾	X	P ⁽¹⁾	P ⁽¹⁾	X ⁽⁴⁾	P ⁽¹⁾	X	P ⁽¹⁾	X
Streets, Highways & Freeways	P ⁽⁶⁾	X	P ⁽¹⁾	P ⁽¹⁾	X ⁽⁴⁾	X	X	P ⁽¹⁾	X

Notes:

X = Anticipated

P = Potential

(1) A potential pollutant if landscaping or open area exist on-site.

(2) A potential pollutant if the project includes uncovered parking areas.

(3) A potential pollutant if land use involves food or animal waste products.

(4) Including petroleum hydrocarbons.

(5) Including solvents.

(6) Analyses of pavement runoff routinely exhibit bacterial indicators.

Source: County of Orange Flood Control District, 2003 Drainage Area Master Plan, Table 7-1.3, July 1, 2003.

Bacteria/Pathogens. Elevated pathogens are typically caused by the transport of human or animal fecal wastes from the watershed. Runoff that flows over land such as urban runoff can mobilize pathogens, including bacteria and viruses. Even runoff from natural areas can contain pathogens (e.g., from wildlife, plant matter, and soils). Other sources of pathogens in urban areas include pets and leaky sanitary sewer pipes. The presence of pathogens in runoff can impair receiving waters. Total and fecal coliform, enterococcus bacteria, and *E. coli* bacteria are commonly used as indicators for pathogens due to the difficulty of monitoring pathogens directly.

Metals. The primary sources of trace metals in storm water are metals typically used in transportation, buildings and infrastructure and also paints, fuels, adhesives and coatings. Copper, lead, and zinc are the most prevalent metals typically found in urban runoff. Other trace metals, such as cadmium, chromium, mercury are typically

not detected in urban runoff or are detected at very low levels.¹³ Trace metals have the potential to cause toxic effects on aquatic life and are a potential source of groundwater contamination.

Nutrients. Nutrients are inorganic forms of phosphorous and nitrogen. The main sources of nutrients in urban areas include fertilizers in lawns, pet wastes, failing septic systems, and atmospheric deposition from automobiles and industrial operations. The most common impact of excessive nutrient input is eutrophication of the receiving water body, resulting in excessive algal production, hypoxia or anoxia, fish kills and potential releases of toxins from sediment due to changes in water chemistry profiles.

Oil and Grease. The most common sources of oil and grease in urban runoff stem from spilled fuels and lubricants, discharge of domestic and industrial wastes, atmospheric deposition, and runoff. Runoff can contain leachate from roads, breakdown of tires/rubber and deposition of automobile exhaust. Some petroleum hydrocarbons, such as polycyclic aromatic hydrocarbons (PAHs), can bioaccumulate in aquatic organisms and are toxic at low concentrations. Hydrocarbons can be measured in a variety of ways including petroleum hydrocarbons, oil and grease, or as individual groups such as PAHs. Hydrocarbons can persist in sediment for long periods of time in the environment and can result in adverse impacts on the diversity and abundance of benthic communities.

Organic Compounds. Organic compounds are carbon-based, and are typically found in pesticides, solvents, and hydrocarbons. Dirt, grease, and other particulates can also adsorb organic compounds in rinse water from cleaning objects, and can be harmful or hazardous to aquatic life either indirectly or directly.

Oxygen Demanding Substances. Oxygen-demanding substances include biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds, such as proteins, carbohydrates, fats, as well as ammonia and hydrogen sulfide. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions, resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds.

Pesticides. Pesticides (including herbicides) are chemical compounds commonly used to control insects, rodents, plant diseases, and weeds. Excessive application of a pesticide or impractical application of pesticides (i.e., right before rain events) may result in runoff containing toxic levels to receiving water bodies and the microorganisms.

¹³ Los Angeles County, Department of Public Works. (2000, September). Los Angeles County 1994–2000 Integrated Receiving Water Impacts Report. Retrieved January 27, 2009, from <http://ladpw.org/WMD/npdes/IntTC.cfm>

Sediment. Sheet erosion and the transport and deposition of sediment in surface waters can be a significant form of pollution that may result in water quality problems. Increases in runoff velocities and volumes can cause excessive stream erosion and sediment transport altering the sediment equilibrium of a stream or channel. Excessive fine sediment, such as total suspended solids, can impair aquatic life through changes to the physical characteristics of the stream (light reduction, temperature changes, etc.).

Trash and Debris. Improperly disposed or handled trash such as paper, plastics and debris including the biodegradable organic matter such as leaves, grass cuttings, and food waste can accumulate on the ground surface where it can be entrained in urban runoff. The large amount of trash and debris can have significant negative impacts on the recreational value of water body. Excessive organic matter can create a high biochemical oxygen demand in a stream and lower its water quality.

Site Design / Low Impact Development BMPs

Careful consideration of site design is a critical first step in storm water pollution prevention from new developments and redevelopments. In general, site design objectives include a combination of factors that may include: minimization of impervious surfaces including roads and parking lots; preservation of native vegetation and root systems; minimization of erosion and sedimentation from susceptible areas such as slopes; incorporation of water quality wetlands, biofiltration swales, etc. where such measures are likely to be effective and technically and economically feasible; and minimization of impacts from storm water and urban runoff on the biological integrity of natural drainage systems and water bodies. In accordance with the current MS4 Permit, OC DAMP and City of Irvine LIP, new development and redevelopment projects are required to implement site design BMPs to minimize directly connected impervious areas and promote infiltration of runoff. The OC DAMP identifies example site design BMPs to be implemented where applicable and feasible. Site design measures are listed below that may be applicable to the redevelopment projects within the Irvine Business Complex, including:

- 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
- Other design concepts that are comparable and equally effective.

Many of the site design BMPs may also be considered low impact development (LID) features. The goal of using LID features is to mimic the sites existing hydrology by using design measures that capture, filter, store, evaporate, detain and infiltrate runoff, rather than runoff flowing directly to piped or impervious systems. This includes directing runoff to vegetated areas and reducing the amount of impervious surfaces. The incorporation of site design BMPs and LID features may reduce the need and/or sizing of treatment control BMPs needed for the site. These features must also be designed in accordance with the OC DAMP sizing requirements to use in conjunction with treatment control BMPs. In addition, the emphasis on the use of LID features is of greater importance in the re-issued MS4 permit (fourth term permit), and may be used to replace the use of structural or proprietary treatment control BMPs as primary treatment BMPs upon suitable site conditions. LID features that may also serve as treatment control BMPs are briefly described below.

Bioretention / Rain Gardens

Bioretention cells (also known as rain gardens or biocells) are vegetated basins that promote filtration of storm water runoff. They combine shrubs, grasses, and flowering perennials in depressions (approximately 6 to 8 inches deep) that allow water to pool, infiltrate, evaporate and/or slowly drain out within 48 to 72 hours. Additional design details include a soil planting depth between 18 inches to 4 feet deep (depending on plants selected), with a 2 to 3 inch mulch layer on top to protect from erosion.

Perforated underdrains may be provided for soils with low infiltration rates and in areas with high groundwater levels to discharge treated water back into the storm drain system.

Bioretention systems function as a soil and plant-based filtration devices that remove pollutants through a variety of physical, biological, and chemical treatment processes. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the plant cover and planting soil which aids in dropping out particulates, sediment and pollutants adsorbed onto sediment (including, for example certain pesticides and pathogens). Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter.

Bioswales

Bioswales (also known as vegetated swales) are treatment BMPs that provide filtration through a grassed or vegetated bottom and the vegetation provides a mechanism for retarding surface runoff and filtering flows to drop sediments, fines, debris, and organics. Due to the slow velocity of runoff through the swale, fine particulates can settle in the bottom of the channel and the runoff will infiltrate into the soil profile where the vegetation will uptake nutrients (e.g., nitrogen and phosphorous), microbial contaminants, oil and grease, and pesticides. Swales also provide treatment of runoff within the upper soil zone where biological and chemical reactions occur to absorb pollutants entering from the top soil.

Bioswales are designed using several factors in order to achieve water quality benefits without additional channelization or excess flooding. Factors included in the design are the residence time of runoff in the swale, depth of flow, flow velocity, longitudinal and side slopes, and Manning's Roughness Coefficient (n). An impervious liner is recommended at a depth of approximately 2 to 5 feet below the swale to minimize potential impacts to groundwater.

Flow-Through Planters

Flow-through planters are structural, vegetated planters that receive storm water runoff and allow pollutants to filter and settle out prior to discharging off-site. These planters receive runoff from roof downspouts or sheet flow, and allow it to filter through a minimum of 18 inches of soil where vegetation will uptake nutrients, microbial contaminants, oil and grease, and pesticides, and sediments and fine particulates can settle out.¹⁴ Treated runoff is drained at the bottom of a planter through a gravel layer and perforated underdrain system. Planters may be constructed above-ground in

¹⁴ LFR Inc. and Dan Cloak Environmental Consulting. (2005, April 1). Contra Costa Clean Water Program Infiltration Site Characterization Criteria and Guidance Study, Milestone Report #3. <http://www.cccleanwater.org/construction/>

elevated structures, such as a concrete planter box, or below the paved surface grade. Elevated planters are typically designed to intercept roof runoff, and below grade planters treat surface runoff from paved surfaces.

Flow-through planters can contain a variety of vegetation, including trees, shrubs, perennials and wetland vegetation, and can be proprietary structures or design-build. An example of a proprietary tree-box filter is Filterra® by Americast. Filterra units feature a specially designed media filter mixture within a below-grade concrete box. One tree or large shrub is planted within the media to provide additional pollutant removal, and function similar to bioretention cells.¹⁵

Flow-through planters can also contain wetland vegetation to increase pollutant removal efficiency of nutrients and bacteria in storm water runoff. Examples of proprietary wetland planters include MWS-Linear Filtration Systems by Modular Wetland Systems Inc. and StormTreat Wetlands by Bio Clean Environmental Services, Inc. These systems contain multi-stage treatment processes constructed below-grade in a concrete box, with wetland vegetation above grade. A catch basin inlet filter, settling chamber, perimeter media filter, and a sub-surface wetland provide the multi-stage treatment of storm water runoff.¹⁶

Pervious Pavement

Pervious pavement, such as permeable pavers, grass pavers, porous concrete, and porous asphalt, provides a surface suitable for light-loads and parking areas in which water can drain through pore spaces to an underlying rock reservoir (approximately 1 to 3 feet deep) underneath. The sub-surface base allows for physical and microbial filtering processes to take place thereby removing pollutants such as particulates, organics, hydrocarbons and total suspended sediments, including attached heavy metals.

It should be noted that the OC DAMP recommends that infiltration-based BMPs, such as pervious pavement, should not be used where the seasonal high water table is less than 10 feet below the base of the gravel layer, unless an underdrain is installed. Since in portions of the Irvine Business Complex area the depth to groundwater may be less than 10 feet below ground surface (bgs), an underdrain system would be appropriate at these locations. The principal is similar to that which the County recommends for septic leach fields – maintaining a separation between the zone of infiltration and the water table.

¹⁵ Americast. (n.d.). Filterra Bioretention Systems. Retrieved January 27, 2009, from <http://www.filterra.com>

¹⁶ Modular Wetland Systems, Inc. (n.d.). MWS-Linear Stormwater Filtration System. Retrieved January 27, 2009, from <http://www.modularwetlands.com>

Infiltration Trenches

An infiltration trench is a long, narrow, rock-filled trench that temporarily stores storm water runoff within the void spaces between the stones, and allows it to infiltrate into the subsoil. Infiltration trenches usually do not contain an outlet or underdrain system, and as a result, are highly effective at treating the majority of storm water pollutants since low flow and first flush runoff is not discharged into receiving waters. However, as with other types of infiltration-based BMPs, infiltration trenches are not recommended for use in areas with low infiltrating soils and high groundwater tables, due to the risk of contaminating groundwater.¹⁷

Drywells

Drywells are underground storage facilities that receive runoff and allows it to infiltrate to soil via gravity. Drywells typically consist of a structural chamber or vertical perforated pipe. Systems may incorporate a pretreatment chamber to trap sediment, trash and debris, and oil and grease. Pretreated flows are then diverted to the drywell and surrounding soil for final treatment. With the incorporation of pretreatment and infiltration treatment mechanisms, drywells have high removal effectiveness for all storm water pollutants of concern. However, similar to other infiltration-based systems, drywells are not recommended for use in areas with low infiltrating soils and high groundwater tables, due to potential risks of contaminating groundwater.¹⁸

Source Control BMPs

The second phase of water quality management includes source control BMPs. Source control BMPs effectively minimize the potential for typical urban pollutants to come into contact with runoff, thereby limiting water quality impacts downstream. This includes both non-structural measures, such as activity restrictions, maintenance, and training practices, and structural measures, such as material storage area and loading dock design features. A list of potential source control measures are provided below as identified in the Countywide Model WQMP:

- (N1) *Education for Property Owners, Tenants, and Occupants.* Educational materials related to urban runoff can be provided to tenants/homeowners (via project owner, HOA, and/or POA) and employees to reduce pollutants from reaching the storm drain system. Examples of environmental awareness materials include, but are not limited to: guidelines for landscaping and gardening, tips for pet care, vehicle cleaning, and proper disposal of household hazardous waste.

¹⁷ California Stormwater Quality Association. (2003, January). *Stormwater Best Management Practices Handbook for New Development and Redevelopment*. Retrieved January 27, 2009, from <http://www.cabmphandbooks.com>

¹⁸ Torrent Resources. (2004, November). Maxwell IV Drainage Systems Product Literature.

- (N2) *Activity Restrictions*. Activity restrictions can be developed to restrict activities that have the potential to create adverse impacts on water quality. Activities include but are not limited to: the handling and disposal of contaminants, trash management and litter control, irrigation and landscaping practices, vehicle and equipment cleaning, fertilizer applications and household waste management practices.
- (N3) *Common Area Landscape Management*. Common area landscape management that includes minimizing fertilizer and pesticide application, use of slow-release fertilizers, maintenance activities, providing education to homeowners and tenants (via project owner, HOA and/or POA), and providing education and training for employees on management of landscape materials and storm water management.
- (N4) *BMP Maintenance*. In accordance with the City LIP and OC DAMP, the project owners, HOAs and/or POAs of the individual project sites will be responsible for the implementation and maintenance of each applicable non-structural BMP, as well as scheduling inspections and maintenance of all applicable structural BMP facilities through its landscape contractor and any other necessary maintenance contractors for the project site. In addition, the project owner will be required to verify treatment control BMP implementation and ongoing maintenance through inspection, self-certification, survey, or other equally effective measure. The certification shall verify that, at a minimum, the inspection and maintenance of all structural BMPs including inspection and performance of any required maintenance in the early fall, prior to the start of the rainy season, and in accordance with frequencies outlined in the project-specific WQMP prepared for the project site.
- (N5) *Title 22 CCR Compliance*. Where applicable, project sites shall comply with Title 22 of the California Code of Regulations and relevant sections of the California Health and Safety Code regarding hazardous waste management, which will be enforced by County Environmental Health on behalf of the State.
- (N7)¹⁹ *Spill Contingency Plan*. Any facilities that store liquid materials or wastes shall maintain procedures for spill response and cleanup activities. Emergency spill kits shall be kept on-site at all times. Activities will be coordinated between the respective departments and the Police and Fire departments in the event of a spill.
- (N8) *Underground Storage Tank Compliance*. Any underground storage tanks proposed shall meet applicable Federal, State, County, and local regulations.

¹⁹ (N6) *Local Water Quality Permit Compliance*. The City of Irvine does not issue water quality permits, and therefore this BMP is not applicable to the Project.

- (N9) *Haz-Mat Disclosure Compliance.* Any projects that store or utilize hazardous wastes, where applicable, shall comply with the County of Orange Fire Authority hazardous material disclosure requirements.
- (N10) *Uniform Fire Code Implementation.* The owner, HOA and/or POA shall ensure all structures comply with Article 80 of the Uniform Fire Code, City codes, County of Orange Fire Authority, and local standards.
- (N11) *Common Area Litter Control.* Includes regular litter control for the entire project area including trash pick up and sweeping of littered common areas, as performed by the maintenance crew. In addition, pet waste receptacles should be provided throughout the project site where applicable.
- (N12) *Employee Training.* Employees of the owner, HOA and/or POA, as well as any contractors of the aforementioned entities will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain.
- (N13) *Housekeeping of Loading Docks.* Loading dock housekeeping measures will be implemented where applicable to keep the areas clean and orderly condition.
- (N14) *Common Area Catch Basin Inspection.* Includes routine maintenance of all catch basins, grate inlets, etc. for debris and litter removal. All on-site catch basins inspected and cleaned prior to the rainy season, no later than October 1st each year.
- (N15) *Street Sweeping Private Streets and Parking Lots.* Street sweeping of all impervious streets and parking lots performed at a frequency that reduces or prevents sediment and debris from entering receiving waters and prior to the rainy season.
- (N17)²⁰ *Retail Gasoline Outlets.* Any retail gasoline outlets proposed shall implement, where feasible, the following measures: (1) maintaining clean fuel-dispensing areas, (2) appropriately designed fueling areas to minimize storm water exposure, (3) minimization of pooling of water, (4) utilization of fueling safeguards, (5) regular inspections of fueling equipment, (6) spill kits on-site (7) underground storage tanks fit with spill containment and overflow prevention systems that meet regulations of Section 2635(b) of Title 23 of the Code of California Regulations, (8) canopy to eliminate direct precipitation and grade breaks to reduce runoff and runoff, and (9) a posted notice to remind employees not to top off fuel tanks. Additionally, the fueling stations shall have an oil/water separator to treat pollutants discharged into the sewer system.

²⁰ There is no BMP with the designation N16.

- *Storm Drain Stenciling and Signage.* Storm drain stenciling or signage on all catch basins with highly visible source control messages (e.g., “no dumping drains to ocean”).
- *Proper Outdoor Hazardous Material Storage Design.* Any areas proposed for outdoor hazardous material storage shall be paved accordingly and storage bins will include sidewalls to contain the materials. There will be a drainage grate along the front of the storage bins with an outlet screen that traps material to prevent pollutants from entering the storm drain. Any hazardous materials shall be stored in storage cabinets, sheds or enclosures that meet all applicable regulations.
- *Trash Enclosures.* All trash and waste shall be stored in containers that have lids or tarps to minimize direct precipitation into the containers. The storage areas shall be paved, and either be sloped or include a barrier to keep drainage out of the storm drain.
- *Efficient Irrigation Systems and Landscape Design.* Installing and maintaining efficient irrigation systems designed to minimize water by eliminating overspray to hardscape areas, and setting irrigation timing and cycle lengths in accordance with water demands, given time of year, weather, and day and night temperatures. Where feasible, incorporation of native tolerant species for landscaping, protection of slopes and efficient irrigation. May be used in conjunction with educational materials to homeowners/tenants as well as activity restrictions.
- *Protect Slopes and Channels.* The site drainage design shall include appropriate BMPs to decrease the potential for erosion of slopes and/or channels. The design shall be consistent with Federal, State, and local standards (e.g., RWQCB, ACOE, CDFG). Where feasible, the following principles shall be considered: 1) convey runoff safely from the tops of slopes, 2) avoid disturbing steep or unstable slopes, as well as natural channels, 3) implement a permanent stabilization BMP on disturbed slopes and channels as quickly as possible, such as native vegetation, and 4) install energy dissipaters at the outlets of new storm drains, culverts, or channels.
- *Loading Dock Areas.* Any new loading docks shall be built at-grade, generally draining away from the buildings towards the drive aisles. In addition, loading dock housekeeping measures shall be implemented where applicable to keep the areas clean and orderly condition.
- *Maintenance Bays.* Any maintenance bays proposed shall be designed in accordance with OC DAMP standards. Examples include locating facilities indoors, and draining nuisance flows to an oil/water separator that is connected to the sanitary sewer system.
- *Equipment Wash Areas.* Any equipment wash areas proposed shall be designed in accordance with OC DAMP standards. Examples include

designing the area to be self-contained and covered, preventing the runoff from entering the storm drain system with berms or containment structures, and collecting runoff in a sump for disposal. Discharge from an equipment wash area to the storm drain system is prohibited.

- *Vehicle Wash Areas.* Any vehicle wash areas proposed shall be designed in accordance with OC DAMP standards. Vehicle wash areas shall be self-contained or covered, equipped with a wash rack and clarifier or other pretreatment facility. Discharge from a vehicle wash area to the storm drain system is prohibited.
- *Outdoor Processing Areas.* Any outdoor processing areas proposed shall be designed in accordance with OC DAMP standards. Areas shall be enclosed and covered to preclude storm water, and not be allowed to discharge into the storm drain system.
- *Fueling Areas.* Any fueling areas proposed shall be designed in accordance with City and OC DAMP standards. Any fueling areas proposed for the project site shall implement, where feasible the following measures: (1) maintaining clean fuel-dispensing areas, (2) appropriately designed fueling areas to minimize storm water exposure, (3) minimization of pooling of water, (4) utilization of fueling safeguards, (5) regular inspections of fueling equipment, (6) spill kits on-site (7) underground storage tanks fit with spill containment and overflow prevention systems that meet regulations of Section 2635(b) of Title 23 of the Code of California Regulations, (8) canopy to eliminate direct precipitation and grade breaks to reduce runoff and runoff, and (9) a posted notice to remind employees not to top off fuel tanks. Additionally, the fueling stations shall have an oil/water separator to treat pollutants discharged into the sewer system.
- *Hillside Landscaping.* The owner shall be responsible for the vegetative establishment on all manufactured or disturbed slopes with a mixture of native species and approved ornamentals by the City of Irvine.
- *Wash Water Controls for Food Preparations Areas.* Any food preparation facilities proposed shall meet all health and safety, building and safety and any other applicable regulations, codes requirements. Discharge of wash water from food preparation areas to the storm drain system is prohibited.
- *Community Car Wash Racks.* Any community car wash racks proposed shall be designed in accordance with City and OC DAMP standards. Wash waters from area may be directed to the sanitary sewer (with approval), to an engineered infiltration system, or an equally effective alternative. Discharge from a wash area to the storm drain system is prohibited.

Treatment Control BMPs

The third component to sound water quality management is incorporating treatment control BMPs designed to reduce the impacts of urban development on downstream water bodies to the MEP. The purpose of treatment control BMPs is to remove the pollutants typically associated with each type of urban land use, including the designated residential and commercial land uses, prior to discharging into receiving waters.

In keeping consistent with local water quality treatment requirements and the requirements of the OC DAMP, treatment control BMPs shall be designed to infiltrate, filter, and/or treat runoff from the individual project footprints to one of the numeric sizing treatment standards listed below. Structural treatment BMPs may be located on- or off-site, used singly or in combination with other treatment controls, or shared by multiple projects.

In accordance with the OC DAMP, volume-based BMPs (e.g., detention basins, infiltration trenches) shall be designed to mitigate (infiltrate, filter, or treat) either:

- The volume of runoff produced from a 24-hour 85th percentile storm event, as determined from the local historical rainfall record; or
- The volume of runoff produced by the 85th percentile 24-hour runoff event, determined as the maximized capture urban runoff volume for the area, from the formula recommended in Urban Runoff Quality Management, WEF Manual of Practice No. 23/ ASCE Manual of Practice No. 87, (1998); or
- The volume of annual runoff based on unit basin storage volume, to achieve 90 percent or more volume treatment by the method recommended in California Stormwater Best Management Practices Handbook – Industrial/ Commercial, (1993); or
- The volume of runoff, as determined from the local historical rainfall record, that achieves approximately the same reduction in pollutant loads and flows as achieved by mitigation of the 85th percentile 24-hour runoff event.

Flow-based BMPs (e.g., vegetated swales, media filters, hydrodynamic separators) shall be designed to mitigate (infiltrate, filter, or treat) either:

- The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour for each hour of a storm event; or
- The maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity, as determined from the local historical rainfall record, multiplied by a factor of two; or

- The maximum flow rate of runoff, as determined from the local historical rainfall record that achieves approximately the same reduction in pollutant loads and flows as achieved by mitigation of the 85th percentile hourly rainfall intensity multiplied by a factor of two.

Selection of treatment control BMPs is based on the pollutants of concern of the project site (identified under Table 7) and the BMP's ability to effectively mitigate those pollutants, in consideration of site conditions and constraints (such as low-permeable soils or high groundwater table). In particular, the selected BMPs should be capable of treating pollutants that have been listed as impaired on the CWA 303(d) list or have TMDLs established should be treated to a medium-to-high effectiveness level. Table 8 provides general pollutant removal efficiencies for treatment control BMP categories (derived from the Countywide Model WQMP).

TABLE 8 TREATMENT CONTROL BMP SELECTION MATRIX						
Pollutant of Concern	Biofilters ¹	Detention Basins ²	Infiltration Basins ³	Wet Ponds or Wetlands	Filtration	Hydrodynamic Separators ⁴
Sediment/Turbidity	H/M	M	M	H/M	H/M	H/M (L for Turbidity)
Nutrients	L	M	H/M	H/M	L/M	L
Organic Compounds	U	U	U	U	H/M	L
Trash & Debris	L	M	U	U	H/M	H/M
Oxygen Demanding Substances	L	M	H/M	H/M	H/M	L
Bacteria & Viruses	U	U	H/M	U	H/M	L
Oil & Grease	H/M	M	U	U	H/M	L/M
Pesticides (non-soil bound)	U	U	U	U	U	L
L: Low removal efficiency H/M: High or medium removal efficiency U: Unknown removal efficiency 1. Includes grass swales, grass strips, wetland vegetation swales, & bioretention 2. For detention basins with minimum 36-48-hour drawdown time. Includes extended/dry detention basins with grass lining or impervious lining 3. Includes infiltration trenches, infiltration basins, & pervious/porous pavements 4. Includes hydrodynamic separators, baffle boxes, swirl concentrators, & cyclone separators Source: Excerpted, with minor revision, from the Orange County Model Water Quality Management Plan. September 26, 2003.						

There are several types of treatment control systems that are commonly used today, including natural systems and proprietary systems. Several treatment control BMPs are also considered LID features. The features listed below were previously described under the Site Design / LID BMPs section of this report.

- Bioretention / Rain Gardens
- Bioswales
- Flow-Through Planters
- Permeable Pavement
- Infiltration Trenches
- Dry Wells

Although use of site design and LID features are recommended for use at project sites where feasible, there may be instances where based on existing site drainage and sizing constraints, the use of LID features may not be sufficient for providing adequate water quality treatment. In these instances, other structural treatment control BMPs may be utilized to specifically target the pollutants of concern from the individual project sites. Additional treatment control BMPs that are not considered LID features are briefly described below. Use of these features will require approval by the City of Irvine during the preparation of individual project-specific WQMPs. All treatment control BMPs implemented will be sized to adequately treat first flush runoff from the project drainage areas.

Catch Basin Inserts

Catch basin inserts, also commonly called water quality inlets, consist of one or more chambers that promote sedimentation of coarse materials and separation of free oil from storm water. A typical catch basin insert/water quality inlet consists of a sedimentation chamber, an oil separation chamber, and a discharge chamber. Catch basin inserts are typically effective at removing trash, coarse sediment and oil and grease from storm water, and are moderate to low effective at removing fine particulates, nutrients, metals, bacteria and organics.²¹ Specific pollutant removal efficiencies depend on the type of unit installed.

Downspout Filters

Downspout filters are building-mounted filters designed to collect particulates, debris and metals from rooftop storm water runoff. The chambers typically contain geotextile fabric liners that encapsulate an adsorbent which is easily replaced and provides for

²¹ California Stormwater Quality Association. (2003, January). *Stormwater Best Management Practices Handbook for New Development and Redevelopment*. Retrieved January 27, 2009, from <http://www.cabmphandbooks.com>

flexibility, ease of maintenance and economy. They are designed to collect particulates and debris, as well as metals and petroleum hydrocarbons. Filters also contain a bypass that allows for effective treatment at low flow and first flush rates while safely bypassing high flows.

Hydrodynamic Separators

Hydrodynamic separators (also known as vortex separators or swirl concentrators) are pre-cast vault systems that are installed underground in the storm drain system. They typically contain a round chamber where particulates and suspended solids are removed via centrifugal force. Some units may contain additional baffles, weirs, and/or screens to allow settling and further capture pollutants in storm water runoff. Additional oil adsorbents may be used within the unit to capture oil and grease. Examples of hydrodynamic separators include Continuous Deflective Separation (CDS) units and Vortechs[®] systems by Contech Stormwater Solutions, Inc., and Stormceptor[®] by Rinker Group, Ltd., among others.²²

Media Filtration Units

Media filter units (e.g., StormFilter[®] by Contech Stormwater Solutions, Inc., Bay Filter[™] by Bay Saver Inc., and others) are proprietary, structural BMPs installed underground within the storm drain system. They typically consist of a pre-cast vault storm drain insert containing media-filled cartridges to trap and adsorb particulates and pollutants in storm water runoff. Typical media types include perlite, zeolite, activated carbon, activated alumina, and leaf media. Targeted pollutants include total suspended solids (TSS), oil & grease, soluble metals, nutrients, organics, and trash and debris.

Sand Filters

Sand filters are typically a two-chambered system that temporarily store storm water runoff and allow it to filter through a layer of sand for treatment before discharging downstream. There are several design variations for sand filters, including Austin Sand Filters, Delaware Sand Filters, and underground filters. In general, sand filters feature a pre-treatment basin or chamber to allow large particulates to settle out, and a filtration chamber where storm water runoff is filtered through a layer of sand (typically 18 inches deep at a minimum). Other variations include utilizing a mixture of organic compost or peat within the sand layer (organic filter) and combining the sand filter layer within the pre-treatment basin (pocket sand filter). Further, sand filters may also be designed without an impermeable bottom to allow infiltration into the subsoil where feasible.²³

²² California Stormwater Quality Association. (2003, January). *Stormwater Best Management Practices Handbook for New Development and Redevelopment*. Retrieved October 18, 2008, from <http://www.cabmphandbooks.com>

²³ Claytor, R. A., & Schueler, T. R. (1996, December). *Design of Stormwater Filtering Systems*. Silver Spring, MD: The Center for Watershed Protection.

Regional Treatment Programs

Alternatively, projects may participate in regional or watershed-based treatment programs in lieu of site-specific treatment control BMPs. Regional programs are designed to provide large scale treatment solutions for new developments and redevelopments, and can treat runoff from multiple project areas (depending on program design). Thus, they are ideal in that off-site and existing runoff conditions are considered. Projects that utilize regional treatment BMPs, however, are still required to implement all applicable site design/LID and source control BMPs identified in the regional plan, City LIP, or OC DAMP. Regional or watershed programs that plan to incorporate treatment control BMPs to support new development or significant redevelopment projects must be approved by each Permittee utilizing the program (i.e., City of Irvine or County of Orange).²⁴

In accordance with the OC DAMP, the regional or watershed treatment control BMPs must be sized and selected to meet the following criteria:

- The regional or watershed treatment control BMP(s) collectively must have the capacity to treat more than the cumulative volume (or flow rate) of runoff from all new development or significant redevelopment projects included in the regional or watershed plan, calculated using the applicable project-based water quality design volume or flow rate from each project.
- Treatment control BMP selection will be determined as part of the regional or watershed program planning. regional or watershed treatment control BMPs must be selected to address pollutants of concern in the downstream receiving waters and anticipated to be generated from the type of new development or significant redevelopment within the watershed. In the alternative, individual projects that intend to rely on the regional or watershed treatment facility must incorporate site-specific BMPs to address any specific pollutant of concern from that project that is not addressed by the regional or watershed treatment control BMPs

Common treatment control BMPs that are utilized for regional programs include detention basins, infiltration basins, and constructed wetlands. Brief descriptions are provided below.

Detention Basins and Wet Ponds

Detention basins are frequently used for flood control; however they can provide treatment of storm water runoff when properly designed as a water quality facility. In general, these are constructed basins that are designed to pond storm water runoff to

²⁴ County of Orange. (2003, July 1) *Drainage Area Management Plan (DAMP)*. Retrieved January 27, 2009, from <http://www.ocwatersheds.com/stormwaterprogram/>

depths 3-5 feet and allow it to slowly discharge or infiltrate over a period of 48-72 hours to reduce potential for mosquito breeding. Sedimentation is the primary treatment mechanism for basins, and may also include infiltration and vegetative uptake depending on the design.

There are several types of water quality detention basins, including dry detention facilities, wet ponds, and infiltration basins. Wet ponds are basins that have a permanent pool of water throughout most of the year, but differ from constructed wetlands by having greater ponding depths. Dry detention basins are similar to wet ponds, but do not have a permanent pool and go dry between storm events. Infiltration basins are basins designed to temporarily pond storm water runoff within the basin, and allow it to infiltrate into the soils below the basin, rather than discharge it downstream.²⁵

Constructed Wetlands

Constructed wetlands are typically considered one of the most effective systems at treating pollutants in water. Constructed wetlands can also provide several other benefits, including vegetative and wildlife habitat, groundwater recharge, flood attenuation, and provides aesthetic values to the area. They are shallow basins that differ from detention basins by having shallower ponding depths, a permanent water source, and greater vegetation coverage. In addition, wetlands feature a more complex microtopography, with varying zones of shallow (less than 6 inches) and moderately shallow (less than 18 inches) water ponding depths, and utilize berms to create varying zones and flow paths through the wetland.

It should be noted that constructed wetlands for storm water treatment differs from utilizing natural wetlands for storm water treatment. Although natural wetlands provide some attenuation of pollutants, the practice is not recommended for new development and redevelopment projects as natural wetlands are protected under the CWA and the US Army Corps of Engineers.²⁶

Wetlands utilize several processes to treat or remove pollutants from storm water, including physical, chemical, and biological processes, and as a result, are able to effectively treat the majority of typical pollutants in storm water runoff. Because of the extremely slow water velocity in the wetland, sedimentation is the primary process for removing larger pollutants, including sediment, suspended solids, particulate nitrogen, and heavy metals. Metals, phosphorous and some hydrocarbons are removed by adsorption to sediments and the wetland vegetation. The vegetation also traps trash,

²⁵ California Stormwater Quality Association. (2003, January). *Stormwater Best Management Practices Handbook for New Development and Redevelopment*. Retrieved January 27, 2009, from <http://www.cabmphandbooks.com>

²⁶ Tiner, R.W. (1999). *Wetland Indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping*. Boca Raton, FL: Lewis Publishers.

debris, floatables and particulates, and removes settled nutrients and metals through their roots. Nitrogen is removed by nitrifying and denitrifying bacteria, and aerobic bacteria help decompose organic matter in the water. In addition, soluble phosphorous and ammonia are partially removed by plankton and benthic algae.²⁷

One example of a regional treatment control BMP program is the Irvine Ranch Water District's (IRWD) Natural Treatment System (NTS) Program for the San Diego Creek watershed. To help improve water quality in San Diego Creek and its major tributaries, IRWD proposes a network of constructed water quality treatment wetlands at 31 sites throughout the watershed as part of the program. The proposed wetlands are generally categorized into three configurations: 1) off-line facilities adjacent to existing stream channels, 2) in-line facilities constructed within existing channels, and 3) wetlands that are incorporated into existing and proposed flood control basins. All of the proposed facilities are designed to treat dry weather and low flows from San Diego Creek; however several of the facilities are also designed to treat runoff from small storm events.²⁸

VI. IMPACT ASSESSMENT & CONCLUSION

Currently, the Irvine Business Complex area is predominately built-out, and the proposed land use changes associated with the Project will not significantly increase impervious surfaces or drainage patterns as compared to existing conditions. In addition, the development and implementation of project-specific WQMP(s) for the individual projects under the Irvine Business Complex will effectively minimize the off-site discharge of anticipated and potential pollutant runoff during the operational or post-construction phase of the project, through the implementation of site design/LID, source control, and treatment control BMPs. Moreover, the WQMPs will address and minimize the discharge of storm water and non-storm waters that may compromise the beneficial uses of downstream receiving water bodies and their applicable water quality standards.

In addition, the development of project-specific SWPPPs for the individual projects and adherence to its prescribed BMPs in accordance with the GCP will minimize the potential for a net increase in sediment loads in storm water discharges, relative to pre-construction levels. The SWPPPs will also prevent or minimize the discharges of polluted storm water and prohibited non-storm waters at levels that would cause or

²⁷ United States Environmental Protection Agency, Office of Water. (1999d, September). *Storm Water Technology Fact Sheet: Storm Water Wetlands*. (Document No. EPA 832-F-99-025). Retrieved November 15, 2008, from <http://www.epa.gov/owm/mtb/mtbfact.htm>

²⁸ Geosyntec Consultants. (2005, June). Irvine Ranch Water District San Diego Creek Watershed Natural Treatment System Master Plan. Retrieved January 27, 2009, from <http://www.naturaltreatmentsystem.org/MasterPlan.html>

contribute to the exceedance of applicable water quality standards of downstream receiving waters during the construction period

Based on the proposed land use changes under the Irvine Business Complex Vision Plan & Overlay Zoning Code Project, no substantial additional sources of pollutants or significant increases in project runoff are anticipated, and no adverse levels of pollutants are expected in Project runoff that would violate water quality standards or adversely effect beneficial uses of downstream receiving waters. Based on the findings of this technical study, the incorporation of site design/LID features and BMPs as required under the City LIP and OC DAMP, the individual projects will adequately reduce all project related impacts to water quality to a level less than significant.