

Prepared for:

Rancho Mission Viejo
P.O. Box 9
San Juan Capistrano, CA 92693

DRAFT

**RANCHO MISSION VIEJO
REVISED CONCEPTUAL WATER QUALITY
MANAGEMENT PLAN
Alternative B-10 Modified**

Prepared by:



GeoSyntec Consultants, Inc.
475 14th Street, Suite 450
Oakland, California 94612
(510) 836-3034

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List of Abbreviations

ASCE	American Society of Civil Engineers
BMP	Best Management Practice
Bti	Bacillus thuringiensis israeliensis (natural microbial pesticide for mosquitoes)
CDFG	California Department of Fish and Game
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CWA	Clean Water Act
CTR	California Toxics Rule
DAMP	Drainage Area Management Plan
EIR	Environmental Impact Report
EMC	Event Mean Concentration
ET	Evapotranspiration
FESA	Federal Endangered Species Act
GPA/ZC	General Plan Amendment/Zone Change
HCP	Habitat Conservation Plan
JURMP	Jurisdictional Urban Runoff Management Plan
MS4	Municipal Separate Storm Sewer System
msl	mean sea level
NCCP/MsAA/HCP	Natural Communities Conservation Plan/Habitat Conservation Plan
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NTS	Natural Treatment System
OCFCD	Orange County Flood Control District
OCHCA	Orange County Health Care Agency
OCRDMD	Orange County Resources and Development Management Department
OCVCD	Orange County Vector Control District
OCWD	Orange County Water District
PA	Planning Area
PCB	Polychlorinated Biphenyl
PEL	Probable Effects Limit
ppb	parts per billion
RMV	Rancho Mission Viejo
SAMP	Special Area Management Plan/Master Streambed Alteration Agreement
SCS	Soil Conservation Service
SDRWQCB	San Diego Regional Water Quality Control Board
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	California State Water Resources Control Board
TMDL	Total Maximum Daily Load
TKN	Total Kjeldahl Nitrogen

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TP	Total Phosphorus
TSS	Total Suspended Solids
USCOE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WQMP	Water Quality Management Plan

1 INTRODUCTION AND WATERSHED ENVIRONMENTAL SETTING

1.1 ROLE OF THE WATER QUALITY MANAGEMENT PLAN IN THE COORDINATED PLANNING PROCESS

This Conceptual Water Quality Management Plan (WQMP) was developed by Rancho Mission Viejo (RMV) consistent with the County of Orange Drainage Area Management Plan (DAMP) Local Implementation Plan and in support of planning efforts for RMV lands in the San Juan Creek and western San Mateo Creek watersheds involved in the coordinated planning process.

Water quality management, including planning for the hydrologic and geomorphologic processes, is central to assuring the long-term viability of important habitat systems and species dependent upon those systems. The San Diego Regional Water Quality Control Board (SDRWQCB) has established a program for implementing federal stormwater/water quality management requirements, including the implementation of the Jurisdictional Urban Runoff Management Plan (JURMP). In February 2002, the SDRWQCB issued 3rd Term NPDES Permits requiring the implementation of the Drainage Area Management Plan (DAMP), which includes a program for managing the effects of New Development/Significant Redevelopment. In response, the County of Orange prepared a County Local Implementation Plan (LIP) (2003 DAMP Appendix A). The County of Orange LIP contains provisions for identifying “pollutants of concern” and “hydrologic conditions of concern” that are applicable to species protection and management and to hydrologic and geomorphologic processes that need to be addressed. The LIP also specifically addresses the CEQA requirements associated with preparing a project specific Water Quality Management Plan. The County LIP and the DAMP’s Model WQMP provided the overall context for the preparation of this document.

This Conceptual WQMP is the first of four levels of WQMP preparation. These levels include the Conceptual WQMP, the Master Area Plan WQMP, the Sub-Area Plan WQMP, and the final project-specific WQMP. The Conceptual WQMP sets the framework for the future levels of WQMP preparation.

Prior to the approval of a Master Area Plan for each Planning Area, a Master Area Plan WQMP will be prepared consistent with the terms and content of this Conceptual WQMP. The Master Area Plan WQMP will provide more specific information and detail concerning how the provisions of the Conceptual WQMP will be implemented within the area covered by the individual Master Area Plan. At a minimum, each Master Area Plan will provide supplemental and refined information concerning: (1) how site design, source control, and treatment control BMPs will be implemented at the Master Area Plan level for the area in question; (2) potential facility sizing and location within the subject Area Plan area; and (3) monitoring and operation and maintenance of stormwater BMPs within the relevant Area Plan area.

Prior to the approval of a Sub-Area Plan for any portion of the project area that is the subject of an approved Master Area Plan, a Sub-Area Plan WQMP will be prepared that is consistent with

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the terms and content of this Conceptual WQMP as well as the relevant Master Area Plan WQMP. The Sub-Area Plan WQMP will provide supplemental and refined information concerning: (1) how site design, source control, and treatment control BMPs will be implemented at the Sub-Area Plan level for the area in question; (2) sizing, location, and design features for the stormwater BMP facilities to be developed within the subject Sub-Area Plan area; and (3) monitoring and operation and maintenance of stormwater BMPs within the relevant Sub-Area Plan area.

A final WQMP that specifically identifies the BMPs to be used on site will be submitted for review prior to the recordation of any final subdivision map (except those maps for financing or conveyance purposes only) or the issuance of any grading or building permit (whichever comes first). The project-specific WQMP will identify, at a minimum: (1) site design BMPs (as appropriate); (2) the routine structural and non-structural BMPs; (3) treatment and flow control BMPs; and (4) the mechanism(s) by which long-term operation and maintenance of all structural BMPs will be provided.

This Conceptual WQMP is intended to support the water quality, geomorphic, and habitat goals of the following planning processes:

- Southern NCCP/MSAA/HCP. The Southern Natural Community Conservation Plan/Master Streambed Alteration Agreement/Habitat Conservation Plan (Southern NCCP /MSAA /HCP) is being prepared by the County of Orange in cooperation with the California Department of Fish and Game (CDFG) and the U.S. Fish and Wildlife Service (USFWS) in accordance with the provisions of the state natural Community Conservation Planning Act of 1991 (NCCP Act), the California Endangered Species Act (CESA), and the federal Endangered Species Act (FESA). The Southern Orange County Subregion is part of the five-county NCCP Study Area established by the state as the Pilot Study Area under the NCCP Program.
- San Juan/San Mateo Watersheds SAMP. A Special Area Management Plan (SAMP) is being prepared by the U.S. Army Corps of Engineers (USACE) and covers generally those portions of the San Juan Creek and San Mateo Creek watersheds located within the Southern NCCP/MSAA/HCP Subregion. As in the case of the NCCP/MSAA/HCP, the SAMP is a voluntary process. The purpose of the SAMP is to provide for the protection and long-term management of sensitive aquatic resources (biological and hydrological) on a landscape level. The SAMP is also designed to enable economic uses to be permitted within the SAMP study area portions of the San Juan Creek watershed consistent with the requirements of federal and state laws (particularly the federal Clean Water Act (CWA), including Sections 401 and 404) and California Fish & Game Code Sections 1600 et seq.

This Conceptual WQMP has employed and addressed applicable NCCP/MSAA/HCP and SAMP Guidelines and Principles at both the watershed and sub-basin scale. In this way, species,

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habitat, and hydrologic and geomorphic considerations identified through the planning processes have been fully integrated into the Conceptual WQMP.

Water quality management, including planning for the hydrologic and geomorphologic processes identified in Tenet 7 of the Southern NCCP Science Advisors Report, is central to assuring the long-term viability of important habitat systems and species dependent upon those systems. The State of California Nonpoint Source Plan emphasizes the need to address water quality planning at a large geographic scale (SWRCB, 2000). One of the policy directives set forth in the State NPS Plan is to:

“Manage NPS pollution, where feasible, at the watershed level – including pristine areas and watersheds that contain water bodies on the Clean Water Act (CWA) 303(d) list – where local stewardship and site-specific MPs (Management Practices) can be implemented through comprehensive watershed protection or restoration plans.”

The San Diego Regional Water Quality Control Board (SD RWQCB) has established a program for implementing federal stormwater/water quality management requirements, including the preparation of a Jurisdictional Urban Runoff Management Plan (JURMP) within a time frame that generally parallels the NCCP/MSAA/HCP and SAMP. In February 2002, the SDRWQCB published a Model Standard Urban Storm Water Mitigation Plan that can be addressed through the preparation of a JURMP. Subsequently, as part of its MS4/Drainage Area Management Program (DAMP), the County of Orange has prepared a Model Water Quality Management Plan adapted to Orange County conditions and intended to address SDRWQCB MS4 requirements. Both the SDRWQCB and the County of Orange model plans contain provisions for identifying “pollutants of concern” and “hydrologic conditions of concern” that are applicable to species protection and management and to hydrologic and geomorphologic processes that need to be addressed pursuant to the NCCP/MSAA/HCP and SAMP.

In addition, the SAMP must address CWA water quality requirements. Accordingly, there is a need to assure the coordination of water quality management with the RMV Adaptive Management Program. Thus, water quality management planning must address and integrate: (1) the requirements and policies of the SDRWQCB, County of Orange DAMP/MS4, and the State of California NPS Plan; (2) the requirements of CWA Section 401 and the USACE 404(b)(1) water quality guidelines in conjunction with the SAMP; and (3) species and habitat protection, management and enhancement/restoration considerations relating to “pollutants of concern” and “hydrologic conditions of concern” in the context of NCCP/SAMP planning, including, as applicable, Draft Planning Guidelines and Watershed and Sub-basin Planning Principles prepared by the NCCP/SAMP Working Group.

Water quality planning is intended to coordinate applicable SDRWQCB policies, measures, and implementation programs with the RMV Open Space and associated Adaptive Management Plan. In this way, open space protection considerations will include the protection of important areas for sediment generation, planning to protect against detrimental turbidity in stormwater

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runoff, and recommendations for the location of Best Management Practices (BMPs) to address pollutants of concern and hydrologic conditions of concern potentially affecting the Sensitive Species. Emphasis should be placed on addressing: (i) pollutants that may affect individual species/habitats that are addressed in the draft NCCP/MSAA/HCP Planning Guidelines and SAMP Watershed Principles; and (ii) important hydrologic/geomorphologic processes and conditions identified in the SAMP Watershed Principles.

1.2 WATERSHED PLANNING

Water quality planning embraces a wide array of planning considerations including: (a) the formulation of treatment systems and measures to address specific pollutants potentially impacting species (termed “pollutants of concern”); and (b) open space planning/development considerations and hydrology/sediment management programs for purposes of protecting hydrologic and geomorphic processes essential to maintaining both uplands and aquatic/riparian habitat systems (termed “hydrologic conditions of concern”).

The State NPS Plan emphasizes watershed planning and contains an implementation measure, Management Measure 3.1A – Watershed Protection, that emphasizes a watershed approach to water quality management and includes reference to CWA Section 402 (the section governing NPDES stormwater programs) as a primary statutory element of the Management Measure. The State NPS Plan also includes Management Measures 6B and C, which emphasize the use of natural treatment systems to address non-point source pollution.

1.2.1 SAMP

Recognizing the need for more comprehensive planning in 1998, a resolution by the United States House of Representatives’ Committee on Public Works authorized the Corps of Engineers, Los Angeles District Regulatory Branch (Corps) to initiate a Special Area Management Plan (SAMP) within the San Juan Creek and San Mateo Creek watersheds. A SAMP is a management tool that will achieve a balance between aquatic resource protection and economic development and will promote the resolution of conflicts between aquatic resource conservation and those development and infrastructure projects affecting aquatic resources in a coordinated process with federal, state and local agencies and local stakeholders. Accordingly, the SAMP process is being coordinated with the NCCP/MSAA/HCP environmental review program for the Southern Orange County NCCP Subregion.

The broad goals of the SAMP are to allow for comprehensive management of aquatic resources and to increase regulatory predictability for development and infrastructure projects that would impact aquatic resources.

Watershed and Sub-Basin Planning Principles

The USACE, Los Angeles District previously prepared a set of general watershed tenets (planning framework) that was presented at the public workshops on December 13, 2001 and

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May 15, 2002. The Statewide NCCP Guidelines were adopted in 1993 by the CDFG. The NCCP/SAMP Working Group concluded that the preparation of a set of more geographically-specific planning principles would help provide focus for the SAMP planning effort and provide valuable guidance during preparation of the Southern NCCP/MSAA/HCP.

The draft Watershed and Sub-basin Planning Principles for the San Juan/Western San Mateo watersheds (“Watershed Planning Principles”) provide a link between the broader SAMP Tenets for protecting and conserving aquatic and riparian resources and the known, key physical and biological resources and processes that will be addressed in formulating the reserve program for the Southern SAMP and NCCP/MSAA/HCP. The principles refine the planning framework tenets and identify key physical and biological processes and resources at both the watershed and sub-basin level. These tenets and principles are to be the focus of the aquatic resources reserve and management program. Application of the planning recommendations is consistent with the NCCP Science Advisors recognition that the NCCP Reserve Design Principles are not absolutes and “that it may be impractical or unrealistic to expect that every design principle will be completely fulfilled throughout the subregion” (NCCP Science Advisors, 1997).

The Watershed Planning Principles represent a synthesis of the following sources:

- Southern SAMP tenets.
- USACE Watershed Delineation and Functional Assessment reports.
- Baseline Geomorphic and Hydrologic Conditions Report (Baseline Conditions Report), and associated technical reports, prepared by Balance Hydrologics, PCR Services Corporation, and Philip Williams & Associates, Ltd. for RMV.
- Reserve Design Principles (1997) prepared by the Science Advisors for the Southern NCCP/MSAA/HCP.
- Southern Subregion databases.

The Watershed Planning Principles provide a key link between the SAMP and the NCCP/MSAA/HCP. Recognizing the significance of watershed physical processes, the Science Advisors added a new tenet of reserve design (Tenet 7 – “Maintain Ecosystem Processes and Structures”). Tenet 7 was directed in significant part toward protecting to the maximum extent possible the hydrology regimes of riparian systems. The fundamental hydrologic and geomorphic processes of the overall watersheds and of the sub-basins not only shape and alter the creek systems in the planning area over time but also play a significant role in influencing upland habitat systems. The hydrologic “sub-basin” has been selected as the geographic planning unit because it is important to focus on the distinct biologic, geomorphic and hydrologic characteristics of each sub-basin while formulating overall reserve programs for the NCCP/MSAA/HCP and SAMP. For each sub-basin, the important hydrologic and geomorphic processes and aquatic/riparian resources are identified and reviewed under the heading of

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“planning considerations.” This review is then followed by protection and enhancement/restoration recommendations under the heading of “planning recommendations.” Thus, if for some reason either the SAMP or NCCP (or even both) were not finalized, the use of the Watershed Planning Principles in the WQMP assures that key species, habitat, hydrologic and geomorphic water quality related considerations have been addressed by the Conceptual WQMP.

1.2.2 NCCP

The NCCP program is a cooperative effort to protect habitats and species. The program, which began in 1991 under the State's Natural Community Conservation Planning Act, is broader in its orientation and objectives than the California and Federal Endangered Species Acts. These laws are designed to identify and protect individual species that have already declined in number significantly. The primary objective of the NCCP program is to conserve natural communities at the ecosystem scale while accommodating compatible land uses. The program seeks to anticipate and prevent the controversies and gridlock caused by species' listings by focusing on the long-term stability of wildlife and plant communities and including key interests in the process.

The focus of the initial effort was the coastal sage scrub habitat of Southern California, home to the California gnatcatcher and approximately 100 other potentially threatened or endangered species. This much-fragmented habitat is scattered over more than 6,000 square miles and encompasses large parts of three counties - Orange, San Diego, and Riverside - and smaller portions of two others - Los Angeles and San Bernardino. Fifty-nine local government jurisdictions, scores of landowners from across these counties, federal wildlife authorities, and the environmental community are actively participating in the program. As reviewed in the prior discussion, the NCCP/MSAA/HCP and SAMP have a goal of preparing a Habitat Reserve and associated long-term management program that addresses the objectives of both the NCCP/MSAA/HCP and the SAMP.

1.3 THE GPA/ZC

The County of Orange Board of Supervisors approved a General Plan Amendment and Zone Change (GPA/ZC) on November 8, 2004, that provides for new development and preservation of natural habitat and other open space within the remaining 22,815 acres of Rancho Mission Viejo's lands located in southern Orange County. The Rancho Mission Viejo lands included in the GPA/ZC constitute a central focus of the Southern NCCP/MSAA/HCP and SAMP planning programs because these lands comprise 90 percent of the remaining privately owned lands in the Southern NCCP/MSAA/HCP and SAMP planning areas (Figure 1-1) and over 98 percent of the privately owned lands actively involved in the NCCP/MSAA/HCP and SAMP that are not already developed or approved for development.

RMV had submitted the GPA/ZC application to the County of Orange in connection with the proposed development of the Ranch Plan Project (“the Ranch Plan,” also known as Alternative B-4). A Conceptual WQMP was prepared in support of the GPA/ZC application that considered

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Alternative B-4, Alternative B-9 (an alternative formulated by the NCCP/SAMP Working Group designed to meet the NCCP Guidelines and Watershed Planning Principles), and the other “B and County” alternatives that were under consideration in conjunction with the coordinated planning process (GeoSyntec, 2004). This earlier Conceptual WQMP was an appendix to Draft Program Environmental Impact Report No. 589 (State Clearinghouse Number 2003021141), dated June 10, 2004.

In response to comments and testimony received during Orange County Planning Commission hearings, and as a result of further analysis and consideration by the County concerning, in relevant part, perceived impacts to sensitive biological resources associated with implementation of the Ranch Plan, the County identified and evaluated a supplemental alternative to the proposed Ranch Plan project, Alternative B-10 Modified (B-10M). This Conceptual WQMP assesses potential water quality, water balance, and hydromodification impacts associated with the B-10M development alternative, and recommends control measures to address those potential impacts.

1.4 GEOGRAPHIC AREA ADDRESSED BY THE WATER QUALITY MANAGEMENT PLAN

The Conceptual WQMP focuses on approximately 22,815-acres that constitute the remaining undeveloped portions of the Rancho Mission Viejo located within unincorporated Orange County (Figure 1-2). The planned community of Ladera Ranch and the cities of Mission Viejo, San Juan Capistrano and San Clemente surround the Project area on the west. The City of Rancho Santa Margarita bounds the northern edge of the Project area; the southern edge is bounded by Marine Corps Base Camp Pendleton in San Diego County. Caspers Wilderness Park and the Cleveland National Forest bound the property on its eastern edge.

As proposed by Rancho Mission Viejo, the B-10M Alternative includes 22,815 acres general planned and zoned for residential development of up to 14,000 dwelling units and other uses on 7,683 acres in nine planning areas (Figure 1-3 and Table 1-1). The B-10M Alternative proposes 15,132 acres of open space. Other uses include 251 acres of urban activity center uses, 80 acres of business park uses, 50 acres of neighborhood retail uses, and up to three golf courses. Ranching activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools.

The B-10M Alternative includes development within the following sub-basins in the San Juan Creek Watershed: Narrow Canyon and Lower San Juan Creek, Cañada Chiquita, Cañada Gobernadora, Central San Juan & Trampas Canyon, and Verdugo Canyon. The Conceptual WQMP distinguishes Narrow Canyon and Lower San Juan Creek from the Cañada Chiquita Sub-basin, which are combined in the NCCP/MSAA/HCP and SAMP planning documents. The B-10M Alternative includes development within the following sub-basins in the San Mateo Watershed: Cristianitos, Lower Cristianitos, Gabino, Blind Canyon, and Talega.

1.5 ANALYTICAL APPROACH EMPLOYED IN FORMULATING THE CONCEPTUAL WQMP

The Conceptual WQMP has been developed using a watershed-based approach that addresses pollutants of concern and hydrologic conditions of concern that can affect aquatic and upland habitat and natural resources, including species associated with these habitats and natural communities. The Conceptual WQMP includes site design, source control, and treatment control Best Management Practices (BMPs), selected consistent with Orange County's LIP and which address the applicable Draft NCCP/MSAA/HCP Planning Guidelines and the Draft Watershed and Sub-basin Planning Principles developed by the NCCP/SAMP Working Group.

The Watershed and Sub-Basin Planning Principles are founded on the terrain analysis of the geology, soils, topography, and other environmental conditions in the watersheds and serve to integrate review and planning criteria for the SAMP with review and planning criteria for the NCCP/MSAA/HCP (particularly with the NCCP Science Advisors Reserve Design Tenet 7). In turn, these SAMP Principles are linked with the analyses of pollutants of concern and hydrologic conditions of concern as articulated in the County of Orange LIP's Local WQMP.

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Table 1-1: B-10M Alternative Proposed Land Use Areas by Planning Area

Land Uses	Land Use Area within Planning Area (gross acres)										
	PA1	PA2	PA3	PA4	PA5	PA6	PA7	PA8	PA9	PA10	Total
Residential	451	975	1939	1291	1145	61	473	922	20		7277
Urban Activity Center	89	40	122								251
Neighborhood Center		10	10	10	10			10			50
Business Park								80			80
Golf Resort								25			25
Total Proposed Development	540	1025	2071	1301	1155	61	473	1037	20	0	7683
Open Space	270	606	100	230	36	214	968	312	118	12278	15132
TOTAL	810	1631	2171	1531	1191	275	1441	1349	138	12278	22815

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Table 1-2: B-10M Alternative Proposed Land Use Areas by Sub-basin

Land Use	Land Use Area within Sub-basin (acres) ¹										
	Narrow/ Lower San Juan	Chiquita	Gobernadora	Central San Juan / Trampas	Verdugo Canyon	Cristianitos	Gabino	La Paz Canyon	Blind/ Talega/ Canyon	Lower Cristianitos	Total
Estate	75	0	0	0	0	120	184	0	0	0	379
Golf Course	0	158	0	0	0	250	0	0	225	0	633
Golf Residential	0	211	25	0	0	0	0	0	0	0	235
Golf Resort	0	0	0	0	0	0	0	0	25	0	25
Proposed Development	465	326	1037	3316	479	0	0	0	713	75	6411
Total Proposed Development	540	695	1062	3316	479	370	184	0	963	75	7683
Open Space	1429	2036	1113	1498	1368	922	4096	1361	1093	214	15132
TOTAL	1969	2731	2175	4814	1847	1292	4280	1361	2055	289	22815

¹Land use area within the post-development sub-basin boundary.

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As reviewed in the above-referenced NCCP/MCAA/HCP AND SAMP planning guidelines and planning principles, watershed scale protection, enhancement, and management of natural resources require an understanding of the landscape-scale processes that govern the integrity and long-term viability of aquatic and other natural resources. By taking a landscape perspective in assessment and planning, cumulative impacts and appropriate mitigation measures can be better addressed. Furthermore, the constraints associated with natural resources and processes can be integrated early in the development process, thereby minimizing impacts. Accordingly, the goal of the management alternatives presented in the Conceptual WQMP is to provide for protection of major wetlands and riparian areas, maintain aquatic resource functions, and address sensitive species in terms of hydrology, geomorphology, and water quality.

Potential changes in pollutants of concern and hydrologic conditions of concern in nine sub-basins – Cañada Chiquita, Cañada Gobernadora, Central San Juan north of San Juan Creek, Trampas Canyon and Central San Juan south of San Juan Creek, Cristianitos, Gabino, Blind, Talega, and Verdugo - are addressed based on runoff water quality and quantity modeling, literature information, and professional judgment. The level of significance of impacts is evaluated based on significance criteria that include predicted runoff quality and quantity for proposed versus existing water quality and quantity conditions, water quality standards, MS4 Permit requirements, and effects on NCCP/MCAA/HCP “planning species”. Because the analyses and water quality management recommendations for these sub-basins involve areas with a wide diversity of terrains and proposed development types, the results of these sub-basin analyses have been used to predict the potential impacts and recommended management measures for the areas encompassed by the B-10M Alternative in the manner summarized in Section 1.3 above and discussed more specifically below.

1.6 CONCEPTUAL WQMP CONTENT AND ORGANIZATION

The Conceptual WQMP introduction in this chapter provides general information on the environmental and regulatory settings affecting the preparation and regulatory review of the Conceptual WQMP. The remainder of the Conceptual WQMP is organized into seven chapters. Chapters 2 through 4 contain the preliminary project description, site description, BMP description, and operation and maintenance program as required by the County of Orange LIP (Table 1-2). Chapters 5 through 7 provide the CEQA analysis of impacts assuming implementation of the Conceptual WQMP. The scope of each chapter is as follows.

- Chapter 2 identifies the pollutants of concern and the hydrologic conditions of concern for the San Juan and San Mateo watersheds and lists the significance criteria and thresholds that are used in the assessment of the potential impacts of each alternative.
- Chapter 3 provides an overview of the approach used in selection of runoff control BMPs and the method used in modeling the effectiveness of the BMPs.

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- Chapter 4 describes both general WQMP elements that apply to all of the proposed development areas (site design, source control BMPs, and BMP operation and maintenance) and sub-basin specific runoff control BMPs for the B-10M Alternative.
- Chapter 5 presents the impact analysis for the B-10M Alternative.
- Chapter 6 presents a plan for long term adaptive management of the proposed control system.
- Chapter 7 presents a cumulative impact analysis for the B-10M Alternative.

Table 1-3: LIP WQMP Template and Conceptual WQMP Elements

LIP WQMP Template Element	RMV Conceptual WQMP Element
<p>1. Title Page with following:</p> <ul style="list-style-type: none"> • “Water Quality Management Plan” • Project Name • Permit #, Tract #, CUP, SUP, or APN • Project Owner/Developer • Owner’s Name, address, and telephone # • Name of Consultant that prepared WQMP • WQMP Preparation Date 	<p>1. Cover page includes all required elements, except the Permit #, Tract #, CUP, SUP, or APN, which will be included in future WQMP submittals.</p>
<p>2. Owner’s Certification</p>	<p>2. Will be included on future WQMP submittals.</p>
<p>3. Table of Contents</p>	<p>3. Included on pages i - xiii.</p>
<p>4. Discretionary Permits and Water Quality Conditions</p> <ul style="list-style-type: none"> • Include a Separator and Tab for Section I for ready reference. • Provide County of Orange Permit/Application and Tract/Parcel Map Number(s); • Provide Water Quality Condition Number, if applicable, requiring the preparation of a Water Quality Management Plan; • List WQMP condition(s) verbatim, if applicable; • Specify the Lot and Tract/Parcel Map number describing the subject property 	<p>4. Will be included in future WQMP submittals.</p>
<p>5. Project Description:</p> <ul style="list-style-type: none"> • Include a Separator and Tab for Section II for ready reference. 	<ul style="list-style-type: none"> • Will be included in future WQMP submittals.
<p>Describe the type of project, size and details of project, and associated uses, including the following:</p>	

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LIP WQMP Template Element	RMV Conceptual WQMP Element
<p>For All Projects:</p> <ul style="list-style-type: none"> • Identify the potential stormwater or urban runoff pollutants reasonably expected to be associated with the project; • Type and location of parking (ex. Surface, garage, and/or carport) and portion of site on which parking is located; • Describe landscaped areas; • Percent of site covered by impermeable surfaces; • Specify if a homeowners or property owners association will be formed, and if a master association will be involved in maintenance activities; • Describe ownership of all portions of site (ex., open space/landscape lots/easements, which streets are to be public and private, etc.). 	<ul style="list-style-type: none"> • The potential runoff pollutants are identified in Section 2.3. • A general project description is provided in Section 1.4 • Detailed project descriptions (parking, landscaped areas, percent of site covered with impervious surface, and site ownership) will be included in future WQMP submittals. • The Stormwater BMP Operation and Maintenance Program is presented at a conceptual level in Section 4.1.4. Further detail will be included in future WQMP submittals.
<p>For Commercial/Industrial Projects</p> <ul style="list-style-type: none"> • Type(s) of use(s) for each building or tenant space; Specify location(s) for each type of food preparation, cooking and/or eating areas; • Specify location (and design, if below grade) of designated delivery areas and loading docks. Specify type(s) of materials expected to be delivered; • Describe and depict location(s) of outdoor materials storage area(s) and type(s) of materials expected to be stored; • Specify if there will be waste generation, car washing, auto repair (include number of service bays), and/or vehicle fueling (include number of fuel pumps). 	<ul style="list-style-type: none"> • A general project description is provided in Section 1.4 • Detail information on proposed commercial areas will be provided in future WQMP submittals.
<p>For Residential Projects</p> <ul style="list-style-type: none"> • Provide the range of lot and home sizes, attached/detached, etc.; • Describe pools, parks, open spaces, tot lots, etc., and any maintenance issues related to them. 	<ul style="list-style-type: none"> • A general project description is provided in Section 1.4 • Details on residential lots and home sizes, pools, parks, open spaces will be provided in future WQMP submittals.
6. Site Description	
<ul style="list-style-type: none"> • Planning Area/Community Name: Provide exhibit of subject and surrounding Planning Areas in sufficient detail to allow project location to be plotted on a base map of the County; 	<ul style="list-style-type: none"> • Project location and Planning Areas are illustrated in Figures 1-2, 1-3, and 1-4. • A more detailed exhibit will be provided in future WQMP submittals.
<ul style="list-style-type: none"> • Provide site specifics such as general and specific location, site address, and size (acreage to the nearest 1/10 acre); 	<ul style="list-style-type: none"> • A general project description is provided in Section 1.4 • Site specifics will be provided in future WQMP submittals.

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LIP WQMP Template Element	RMV Conceptual WQMP Element
<ul style="list-style-type: none"> Site characteristics: Include description of site drainage and how it ties with drainage of surrounding property (ex., The on-site drainage system connects to the drainage system in tract to the west, which drains to a detention/desilting basin located , and then to Creek, as specified in the Basin/Urban Runoff Management Plan). Reference the WQMP's Plot Plan showing drainage flow arrows and how drainage ties to drainage of surrounding property. 	<ul style="list-style-type: none"> Site drainage is generally described in Chapter 4 by sub-basin. Each sub-basin section contains a description of the combined control system elements by sub-basin catchment (e.g., Section 4.2.3 describes the drainage, by land use type, within the Cañada Chiquita sub-basin). A detailed site assessment is contained in the Baseline Geomorphic and Hydrologic Conditions Report (PCR et al, 2002). Drainage details will be provided in future WQMP submittals.
<ul style="list-style-type: none"> Identify the zoning or land use designation; 	<ul style="list-style-type: none"> Land uses designations for sub-basin are listed in the site assessment sections of Chapter 4 (e.g., Section 4.2.1 lists the land uses proposed for Cañada Chiquita in Table 4-5).
<ul style="list-style-type: none"> Identify soil types and the quantity and percentage of pervious and impervious surface for pre-project and project conditions; 	<ul style="list-style-type: none"> Soil types and the quantity and percentage of pervious and impervious surface for pre-project and post-development conditions are provided in Appendix A.
<ul style="list-style-type: none"> Identify known Environmentally Sensitive Areas (ESAs) and Areas of Special Biological Significance (ASBSs) within the vicinity and their proximity to the project. 	<ul style="list-style-type: none"> ESAs and ASBSs within the vicinity of the project are discussed in Section 1.8.2.
<ul style="list-style-type: none"> Identify the watershed in which the project is located and the: <ul style="list-style-type: none"> - downstream receiving waters - known water quality impairments as included in the 303(d) List - applicable Total Maximum Daily Loads (TMDLs) - hydrologic conditions of concern, if any. 	<ul style="list-style-type: none"> The San Juan Creek Watershed and the San Mateo Creek Watershed are described in Section 1.7.1. Each sub-basin within the project area is described in more detail in the site assessment sections of Chapter 4 (e.g., the Cañada Chiquita Sub-basin is described in Section 4.2.1). 303(d) listings and TMDLs are discussed in Section 1.8.1. Hydrologic conditions of concern are discussed in general in Section 1.7.3, and specifically for each sub-basin in the Site Assessment sections of Chapter 4 (e.g., hydrologic conditions of concern for Cañada Chiquita are discussed in Section 4.2.1).
7. Best Management Practices (BMPs)	
<ul style="list-style-type: none"> Include a Separator and Tab for Section IV for ready reference. 	<ul style="list-style-type: none"> Will be included in future WQMP submittals.
<ul style="list-style-type: none"> Describe how the project complies with each post-construction water quality-related condition of approval. 	<ul style="list-style-type: none"> Will be included in future WQMP submittals.

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LIP WQMP Template Element	RMV Conceptual WQMP Element
<ul style="list-style-type: none"> The WQMP shall identify Best Management Practices (BMPs) that will be used on-site to control predictable pollutant runoff, and shall identify, at a minimum, the measures specified in the Countywide Water Quality Management Plan (WQMP) and NPDES Drainage Area Management Plan (DAMP), the assignment of long-term maintenance responsibilities (specifying the developer, parcel owner, maintenance association, lessee, etc.), and the location(s) of all structural BMPs. 	<ul style="list-style-type: none"> Chapter 4 identifies the proposed BMPs by sub-basin for each Planning Area. Further detail will be included in future WQMP submittals. The Stormwater BMP Operation and Maintenance Program is presented at a conceptual level in Section 4.1.4. Further detail will be included in future WQMP submittals.
<ul style="list-style-type: none"> Routine Source Control BMPs are required to be incorporated in all new development redevelopment projects unless not applicable. Indicate in the tables provided all BMPs to be incorporated in the project. For those designated as not applicable, state brief reason why. 	<ul style="list-style-type: none"> Routine source control BMPs are identified in Section 4.1.3.
<ul style="list-style-type: none"> List and describe all the source control (“routine” structural and non-structural) BMPs; show locations of structural BMPs in the project plans; 	<ul style="list-style-type: none"> Routine source control BMPs are identified in Section 4.1.3. Locations of structural BMPs will be identified in future WQMP submittals.
<ul style="list-style-type: none"> List and describe, including locations, all site design BMPs employed in the project; show locations of site design BMPs in the project plans; 	<ul style="list-style-type: none"> Site design BMPs are identified in Section 4.1.2. Locations of site design BMPs will be identified in future WQMP submittals.
<ul style="list-style-type: none"> Describe project design characteristics/features used to implement each BMP; 	<ul style="list-style-type: none"> Implementation of site design options/ characteristics are listed in Table 4-1.
<ul style="list-style-type: none"> List and describe any treatment BMPs (designated to address specific pollutant problems identified in the water quality planning process, runoff management plan, CEQA process or similar watershed planning); 	<ul style="list-style-type: none"> Treatment BMPs are described in general in Section 3.4 and specifically for each sub-basin in Chapter 4 (e.g., BMP facilities and sizing for Cañada Chiquita are listed in Tables 4-7 and 4-8).
<ul style="list-style-type: none"> Describe how the BMPs listed in the WQMP comply with each post-construction water quality-related condition of approval for this project. 	<ul style="list-style-type: none"> Will be included in future WQMP submittals.
<ul style="list-style-type: none"> Identify any scenic/slope/landscape easements or lots, and their role(s) in implementing applicable BMPs. Clearly describe (and depict in the plot plan) ownership and who will be responsible for maintenance. 	<ul style="list-style-type: none"> Will be included in future WQMP submittals.

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LIP WQMP Template Element	RMV Conceptual WQMP Element
8. Inspection/Maintenance Responsibility for BMPs	
<ul style="list-style-type: none"> • Include a Separator and Tab for Section V for ready reference. • Describe the party(ies) responsible for source control, site design and treatment control BMPs. Include name, title, company, address and telephone number. • Inspection and Maintenance Responsibility and Frequency Matrix: <ul style="list-style-type: none"> - Specify each source control, site design and treatment control BMP; - Name, title, company, and telephone number(s) of the party(ies) responsible for inspecting and maintaining each BMP; - Inspection and maintenance activity(ies) required; - Minimum frequency of inspection and maintenance necessary to ensure full implementation and effectiveness of each BMP. 	<ul style="list-style-type: none"> • The Stormwater BMP Operation and Maintenance Program is presented at a conceptual level in Section 4.1.4. Further detail will be included in future WQMP submittals.
9. Location Map, Plot Plan, & BMP Details	
<ul style="list-style-type: none"> • Include a Separator and Tab for Section VI for ready reference. 	<ul style="list-style-type: none"> • Will be included in future WQMP submittals.
<ul style="list-style-type: none"> • Prepare 11" x 17" plot plan(s). The plot plan(s) shall be readable and depict the following: • A table with the following: North arrow; Scale; Site area in square feet and/or acres; Number of units each building/tenant space as projected at the time of the drafting of the WQMP; Type of use (or range of uses allowed) in each building/tenant space as projected at the time of the drafting of the WQMP. • All source control (structural) BMPs proposed. Also include detail drawings as separate exhibits as necessary to demonstrate compliance with each BMP. Each detail shall include the BMP title (and number if any), and shall depict how the design features of the project implement each BMP. • Car wash racks; • Outdoor food preparation areas; • Trash container areas; • Washing/cleaning/maintenance/repair areas; • Outdoor storage areas; • Motor fuel dispensing areas; • Loading docks (and drainage); • Parking areas. • Drainage flow information, including general surface flow lines, concrete or other surface ditches or channels, as well as storm drain facilities such as 	<ul style="list-style-type: none"> • Will be included in future WQMP submittals.

LIP WQMP Template Element	RMV Conceptual WQMP Element
catch basins and underground storm drain pipes and any receiving waters; <ul style="list-style-type: none"> • Treatment control BMPs. 	
9. Educational Materials Included	
<ul style="list-style-type: none"> • Include a Separator and Tab for Section VII for ready reference. • Each educational handout included shall be listed by name in the table of contents. Include a cover page with the name of each educational handout attached as part of the WQMP. 	<ul style="list-style-type: none"> • Will be included in future WQMP submittals.

1.7 ENVIRONMENTAL SETTING

The following geomorphic, hydrologic, and biological information is summarized from the Baseline Geomorphic and Hydrologic Conditions Report (PCR et al., 2002). As part of developing the Baseline Report, extensive field reconnaissance, as required in Local WQMP Section A-7.VI-3.2.4, was conducted.

1.7.1 Physical Setting

San Juan Creek Watershed

The San Juan Creek watershed, located in the southern portion of Orange County, encompasses a drainage area of approximately 176 square miles and extends from the Cleveland National Forest in the Santa Ana Mountains to the Pacific Ocean at Doheny State Beach near Dana Point Harbor. The upstream tributaries of the watershed flow out of steep canyons and widen into several alluvial floodplains. The major streams in the watershed include San Juan Creek, Bell Canyon Creek, Chiquita Creek, Gobernadora Creek, Verdugo Canyon Creek, Oso Creek, Trabuco Creek, and Lucas Canyon Creek. Elevations range from over 5,800 feet above sea level at Santiago Peak to sea level at the mouth of San Juan Creek (PCR et al., 2002).

The San Juan Creek watershed is bounded on the north by the Santiago Creek, Aliso Creek, and Salt Creek watersheds and on the south by the San Mateo Creek watershed. The Lake Elsinore watershed, which is a tributary of the Santa Ana River watershed, is adjacent to the eastern edge of the San Juan Creek watershed.

San Mateo Creek Watershed

The San Mateo Creek watershed is located in the southern portion of Orange County, the northern portion of San Diego County, and the western portion of Riverside County. The watershed is bounded on the north and west by the San Juan Creek watershed, to the south by the San Onofre Creek watershed, and to the northeast by the Lake Elsinore watershed. San Mateo

Creek flows 22 miles from its headwaters in the Cleveland National Forest to the ocean just south of the City of San Clemente. The total watershed is approximately 139 square miles and lies mostly in currently undeveloped areas of the Cleveland National Forest, the northern portion of Marine Corps Base Camp Pendleton (MCBCP), and ranch lands in southern Orange County (PCR et al., 2002). Major (named) streams in the watershed include Cristianitos Creek, Gabino Creek, La Paz Creek, Talega Creek, Cold Spring Creek, and Devil Canyon Creek. The WQMP includes only the portion of the San Mateo Creek drainage within Orange County (approximately 17 percent of the watershed). Elevations range from approximately 3,340 feet above sea level in the mountains of the Cleveland National Forest to sea level at the mouth of San Mateo Creek.

1.7.2 Climatic Conditions

The Mediterranean climate in Southern California is characterized by brief, intense storms between November and March. It is not unusual for a majority of the annual precipitation to fall during a few storms in close time proximity to one another. The higher elevation portions of the watershed typically receive significantly greater precipitation due to the effect of the Santa Ana Mountains. In addition, rainfall patterns are subject to extreme variations from year to year and longer term wet and dry cycles. The combination of steep, short watershed, brief intense storms and extreme temporal variability in rainfall results in “flashy” systems where stream discharge can vary by several orders of magnitude over very short periods of time.

Southern California is characterized by wet and dry cycles, typically lasting up to 15 to 20 years. The WQMP area appears to be emerging from a wetter-than-normal cycle of years beginning in 1993 (Figure 1-4). Previously, five consecutive years of sub-normal rainfall and runoff occurred in 1987 through 1991. Prior droughts of note include severe droughts in 1976-77 and 1946-51. Previous notable wet periods in the past occurred in 1937-44 and 1978-83. An unusually long period of generally dry years extended from 1945 through 1977. During this period, rainfall was approximately 25 percent below normal. Both groundwater recharge and sediment transport were considerably diminished during this period. Dry conditions were sufficiently persistent during this period to cause lower groundwater levels and to contract the extent of riparian corridors. Additionally, landslide activity was lessened during this period.

The watersheds have been subject to numerous large-scale fires during the past 100 years. Most of these fire events were of human origin. The majority of ignitions have been associated with roadways, arson and person-related activities. Large fire events in the watersheds occurred in 1989, 1961, 1959, 1958, 1952, 1937, 1917 and 1915. The primary effects of these fires are a sharp increase in sediment yield and downstream channel aggradation for a period of time following the fire.

1.7.3 Geomorphology, Terrains, and Hydrology

The San Juan Creek and San Mateo Creek watersheds are located on the western slopes of the Santa Ana Mountains, which are part of the Peninsular Ranges that extend from the tip of Baja California northward to the Palos Verdes peninsula and Santa Catalina Island.

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There are three major geomorphic terrains found within the San Juan Creek and San Mateo Creek watersheds: sandy and silty-sandy, clayey, and crystalline (Figure 1-5). These terrains are manifested primarily as roughly north-south oriented bands of different soil types. The soils and bedrock that comprise the western portions of the San Juan Creek watershed (i.e., Oso Creek, Arroyo Trabuco, and the lower third of San Juan Creek) contain a high percentage of clays in the soils. The soils typical of the clayey terrain include the Alo and Bosanko clays on upland slopes and the Sorrento and Mocho loams in floodplain areas. In contrast, the middle portion of the San Juan basin, (i.e., Cañada Chiquita, Bell Canyon, and the middle reaches of San Juan Creek) is a region characterized by silty-sandy substrate that features the Cieneba, Anaheim, and Soper loams on the hillslopes and the Metz and San Emigdio loams on the floodplains. The upstream portions of the San Juan Creek watershed, which comprise the headwaters of San Juan Creek, Lucas Canyon Creek, Bell Creek, and Trabuco Creek, may be characterized as a "crystalline" terrain because the bedrock underlying this mountainous region is composed of igneous and metamorphic rocks. Here, slopes are covered by the Friant, Exchequer, and Cieneba soils, while stream valleys contain deposits of rock and cobbly sand. The upland slopes east of both Chiquita and Gobernadora Canyons are unique in that they contain somewhat of a hybrid terrain. Although underlain by deep sandy substrates, these areas are locally overlain by between two and six feet of exhumed hardpan (a cemented or compacted layer in soil that is impenetrable by roots).

Runoff patterns typical of each terrain are affected by basin slope, configuration of the drainage network, land use/vegetation, and, perhaps most importantly, the underlying terrain type. Although all three terrains exhibit fairly rapid runoff, undisturbed sandy slopes contribute less runoff than clayey ones because it is easier for water to infiltrate into the coarser substrate. During low to moderate storm events terrains influence the likelihood and extent of channel migration, avulsion, or incision. However, during extreme storm events, the influence of terrains is minimal and runoff is more strongly influenced by soil hydrogroup. For example, a Type C soil in a sandy terrain would produce less runoff during a 5-year event than a Type C soil in a clayey terrain. However, during a larger storm event, runoff from both terrains would be comparable (assuming similar vegetation, slope, and land use).

San Juan Creek Watershed

Hydrologically, the San Juan Creek watershed can be organized into three regions: (1) the western portion of the watershed with the highly developed Oso Creek Sub-basin and the moderately developed Trabuco Creek Sub-basin; (2) the relatively undeveloped sub-basins of the central San Juan watershed (i.e., Cañada Chiquita, Cañada Gobernadora, Bell Canyon, Lucas Canyon, Trampas Canyon and Verdugo Canyon); and (3) the steeper eastern headwater canyons. In the San Juan Creek watershed, many tributary valleys are comprised of sandy terrains and, as such, include swales that do not have a clearly defined channel form (i.e., channel-less swales).

Overall, infiltration in the San Juan Creek watershed is relatively low, due to the prominence of poorly infiltrating soils (e.g., 79.8 percent of the watershed is underlain by soil types C or D) and

the significant proportion of development in the western watershed. However, there are significant pockets of the watershed, particularly in the central watershed, which do have more permeable soils and offer better potential infiltration.

Results of HEC-1 model analysis the 2-year, 10-year, and 100-year storm events in the San Juan Creek watershed were included in the Baseline Report (PCR et al., 2002). Peak flows in San Juan Creek upstream of Horno Creek (approximately the location of the USGS stream flow gauge at La Novia Street, see Figure 1-6) predicted by the model ranged from 2,940 cubic feet per second (cfs) for the 2-year event to 44,120 cfs for the 100-year event.

San Mateo Creek Watershed

The 139.2 square mile San Mateo Creek watershed has two principal drainage systems that join in the lower stream valley, 2.7 miles upstream of the ocean. The sub-basins of interest, including La Paz, Gabino, Cristianitos, Blind, and Talega Canyons upstream of the Cristianitos and San Mateo creek confluence, are located in the western watershed north of the main stem of San Mateo Creek. Approximately 17 percent of the total runoff in the San Mateo Creek basin emanates from these tributaries.

Overall, infiltration in the San Mateo Creek watershed is relatively low due to the prominence of poorly infiltrating soils (e.g., 89.8 percent of the watershed is underlain by soil types C or D). However, there are portions of the watershed along the tributary stream corridors which do have more permeable soils and offer higher infiltration.

Results of HEC-1 model analysis the 2-year, 10-year, and 100-year storm events were included in the Baseline Report for Cristianitos Creek downstream of Talega Canyon and in San Mateo Creek downstream of Cristianitos Creek. Peak flows in Cristianitos Creek predicted by the model ranged from 740 cfs for the 2-year event to 11,800 cfs for the 100-year event. Peak flows in San Mateo Creek downstream of Cristianitos Creek predicted by the model ranged from 3,200 cfs for the 2-year event to 47,070 cfs for the 100-year event.

1.7.4 Water Quality

Surface Water Quality

Pollutant pathways and cycles within diverse settings such as the San Juan Creek and San Mateo Creek watersheds can be complex. Although the biogeochemical relationships that govern the fate of different constituents can be complicated, a number of generalizations are possible regarding the effect of the environmental setting and the terrains on water quality. In general, pollutants are transported by stormwater runoff and dry weather flows. Pollutants are either in dissolved form, particulate form, or are adsorbed to other particles in the water such as colloidal clays. The type and availability of particulates and pH affect the distribution of pollutants between the dissolved and particulate-bound forms. Therefore, land use characteristics that

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promote infiltration and slow the flow of water allowing sediments to settle or filter out are important factors that control pollutant mobility.

Geology can also have a direct impact on specific water quality constituent concentrations. For example, the Monterey shale bedrock, which occurs in several of the San Juan Creek sub-basins, has been reported to be a source of high levels of phosphate and certain metals, such as cadmium (PCR et al., 2002).

Terrains can influence the mobilization, loading, and cycling of pollutants. Some general water quality characteristics of the major terrains in the San Juan Creek and San Mateo watersheds are:

- *Sandy terrains.* Sandy terrains generally favor infiltration of rainfall and therefore have the potential to direct pollutants mobilized in low to moderate rainfall events into sub-surface pathways, with little or no actual biogeochemical cycling taking place in surface waters. Sequestered in sands, pollutants have the opportunity to degrade and attenuate via contact with soils and plants in the root/vadose zones before passage to groundwater or mobilization and transport to surface waters during larger storm events.
- *Silty terrains.* Silty terrains are characterized by higher runoff rates and tend to favor surface water pathways more than sandy terrains (but less than clayey terrains). Silty substrates can also be a significant source of turbidity (i.e., fine sediments). Conversely, the finer sediments derived from the silty substrates promote the transport of metals and certain pesticides in particulate form. This makes them less-readily available in first and second-order stream reaches, but potentially allows transport to higher order streams and subsequent deposition over long distances.
- *Clayey terrains.* Clayey terrains are characterized by very high rates of surface runoff during low and moderate storm events. Although clay soils are generally quite resistant to erosion, they can be very significant sources of turbidity during extreme or high intensity rainfall events when erosion occurs and/or headcutting or incision within the stream bed begins.
- *Crystalline terrains.* Crystalline terrains are common only in the uppermost reaches of the San Juan and San Mateo Creek systems where development and agricultural activities are absent. Similar to clayey terrains and in contrast to sandy terrains, during low to moderate rainfall events, primary pollutant pathways will be in surface water flow, leading to the potential for rapid mobilization and transport of constituents. Unlike clayey terrains, however, the crystalline substrates tend to generate coarse (rather than fine) sediments and thus are not a significant source of the finer particles that cause turbidity. Like all terrain types, extreme events will likely result in the mobilization and transport of all sizes of sediments from these areas.

Orange County Monitoring Data

Balance Hydrologics (Balance Hydrologics, 2001a) performed a literature review and compilation of available water quality data in the SAMP study area. Most of the available monitoring data were from the San Juan Creek watershed; less data were available from the San Mateo Creek watershed. The majority of water quality data from San Juan Creek were collected by the Orange County Resources and Development Management Department (OCRDMD) in the 1990's at three monitoring stations (Figure 1-6):

- The La Novia Street Bridge monitoring station is located on the main stem of San Juan Creek in San Juan Capistrano. The watershed at this point includes all terrain types and diverse land-uses, including urban, grazing, nurseries, and mining uses. Monitoring data include a significant number of dry weather samples in addition to storm monitoring data.
- The Caspers Regional Park station is on the main stem of San Juan Creek approximately 10 miles upstream from the La Novia Street Bridge station. The majority of the watershed at this point is protected open space coastal scrub and chaparral on crystalline terrains. Available monitoring data at this station is less extensive than the La Novia Street Bridge station.
- The Mission Viejo station in Oso Creek represents mostly urban land uses on clayey terrains.

Available TSS monitoring data from Orange County are summarized in Table 1-4. In general, elevated TSS concentrations are strongly associated with runoff from winter storm events. It is generally expected that TSS concentrations in storm runoff will be greater from open and agricultural land uses than from urban land uses, where impervious surfaces and urban landscaping limit sediment delivery. Stormwater monitoring data from the San Juan Creek and Oso Creek Watershed are consistent with this expected trend. The average TSS concentration at the Caspers Park stations (predominantly open) is substantially greater than average TSS concentrations at the Mission Viejo station (predominantly urban) and the La Novia station (mixed land-uses). These data suggest that TSS concentrations in runoff from the proposed developments should, on average, be less than existing in-stream TSS concentrations during storm runoff conditions.

Table 1-4: Average TSS Concentrations from Orange County Monitoring, 1991-1999

	Caspers Regional Park (open space)	La Novia (mixed land use)	Mission Viejo (urban land use)
No. Samples	12	43	79
No. Non-Detects	1	1	1
TSS (mg/L)	1555	326	296

Source: Balance Hydrologics, 2001a

Nutrient monitoring data from Orange County are summarized in Table 1-5 and Table 1-6. Nutrient data are shown as a function of 3-day antecedent rainfall measured at the Tustin rain gage located approximately 15 miles to the northwest of the water quality stations on San Juan and Oso Creeks.

Data from San Juan Creek indicate that nitrogen concentration increases between the upstream location at Caspers Park (open space) and the downstream station at La Novia (mixed land-use). All stations show a general increase in nitrogen concentration with increasing antecedent rainfall. Comparison between the San Juan and Oso Creek data reveals that nitrate concentrations in low flows are elevated at the urban station (Mission Viejo), and that storm flow concentrations at the urban station are comparable to or higher than those from the San Juan Watershed. These data suggest that non-stormwater runoff from urbanized areas could result in increased nitrogen concentrations.

Phosphate data from San Juan Creek in Table 1-6 reveal an opposite trend from nitrate. Phosphate concentrations generally decrease between the upstream station (open space land use) and the downstream station (mixed land use). An explanation is based on the general trend that sediment loads are greater in storm runoff from vacant and agricultural land-uses (upstream monitoring location) in comparison with storm runoff from urban land-uses (mixed land-uses at downstream location). Phosphorus strongly adheres to soil particles, thus greater phosphorus loads are expected with greater sediment loads and higher TSS values (Table 1-4). For example, the median phosphate concentration at Caspers Regional Park is about 3.6 mg/l for data in which the 3-day antecedent rainfall is 0.51-1.0 inches, far higher than comparable values at the La Novia and Mission Viejo stations.

Table 1-5: Average Nitrate Concentrations from Orange County Monitoring, 1991-1999 (mg/L NO₃ as N)

3-day precedent rainfall (in)	San Juan Creek						Oso Creek		
	Caspers Regional Park (open space)			La Novia (mixed land use)			Mission Viejo (urban land use)		
	# samples	mean	median	# samples	mean	median	# samples	mean	median
0	32	0.1	0.1	43	0.3	0.2	10	0.9	1
0.01-0.5	10	0.2	0.1	21	0.5	0.5	23	1.2	1.3
0.51-1.0	6	0.9	0.1	15	1.2	1.2	15	1.2	1.2
1.01-1.5	1	0.7	0.7	7	1.5	1.7	15	1.4	1.3
>1.5	0	-	-	5	0.4	0.4	18	1	0.8

Source: Balance Hydrologics, 2001a

Table 1-6: Average Phosphate Concentrations from Orange County Monitoring, 1991-1999 (mg/L PO₄ as P)

3-day precedent rainfall (in)	San Juan Creek						Oso Creek		
	Caspers Regional Park (open space)			La Novia (mixed land use)			Mission Viejo (urban land use)		
	# samples	mean	median	# samples	mean	median	# samples	mean	median
0	31	0.1	0.1	43	0.1	0.1	10	0.7	0.6
0.01-0.5	9	0.4	0.1	21	0.2	0.2	23	0.4	0.3
0.51-1.0	5	4.4	3.6	15	0.6	0.4	15	0.7	0.5
1.01-1.5	1	1.0	1.0	7	0.7	0.7	15	0.7	0.6
>1.5	0	-	-	5	0.5	0.5	18	1	0.5

Source: Balance Hydrologics, 2001a

Dry weather and stormwater data collected by Orange County for trace metals is summarized in Table 1-7. Most samples were analyzed only for total metal concentrations. A few samples from the Oso Creek station were analyzed for dissolved metals. Data from the Caspers station had a high percentage of non-detects, and high detection limits, especially for lead.

Data from San Juan Creek reveal consistently greater average total metal concentrations during storm flow conditions. This is expected due to the affinity of metals to adsorb to soil particles, which are present in larger quantities in storm runoff.

Comparisons of average total metal concentration in storm flow measurements between the Mission Viejo Station (primarily urban) and those from Caspers Park (primarily open space) and La Novia (mixed use) provides an indication of the effect of development. For copper, total metal concentrations increase with greater levels of development. This is the expected trend,

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because heavy metal concentrations in general have been found to increase with urbanization. For lead and zinc, the data reveal a decreasing trend in total metal concentration with increasing levels of urbanization, which is somewhat counter to the expected trend. A partial explanation could be related to differences in the runoff regimes at the three stations resulting in different levels of dilution and/or sediment loads. Balance Hydrologics (2001a) indicated that the zinc values at the Caspers Park Station were abnormally high, and postulated that they might be indicative of high background zinc levels in the San Juan Creek watershed. Average hardness values at the Caspers Park station also exhibit unexpected trends. Typically, hardness values are expected to decrease with increasing flows; however the opposite trend at the Caspers station suggests the possibility of natural sources of carbonates.

Table 1-7: Average Trace Metal Concentrations from Orange County Monitoring, 1991-1999

	Caspers Regional Park (open space)		La Novia (mixed land use)		Mission Viejo (urban land use)	
	Storm flows ¹	Dry weather flows ¹	Storm flows ¹	Dry weather flows ¹	Storm flows ¹	Storm flows ²
No. Samples	16	9	47	11	79	14
Hardness (mg/L as CaCO ₃)	230	150	260	290	560	-
Copper						
No. Non-Detects	10	7	20	6	17	0
Mean conc. (µg/L)	15.8	5.5	20.7	4.0	23.8	13.8
Lead						
No. Non-Detects	6	7	20	9	18	10
Mean conc. (µg/L)	11.8	4.7	7.3	1.3	6.2	1.4
Zinc						
No. Non-Detects	1	2	6	2	2	0
Mean conc. (µg/L)	77.9	29.8	46.9	26.4	75.9	34.4

¹Concentrations are for total metals

²Concentrations are for dissolved metals

Note: a value of one-half the detection was used for reported results below the detection limit)

Source: Balance Hydrologics, 2001a

Rancho Mission Viejo Monitoring Data

Surface water quality data were collected at several stations within the San Juan and San Mateo watersheds by Rivertech, Inc. and Wildermuth Environmental, Inc. for Ranch Mission Viejo. Data were collected between October 2001 and March 2003 during five wet weather events and three dry weather flows at six stations of concern for this report. The monitoring station locations are summarized in Table 1-8 and are illustrated in Figure 1-6. Monitoring results are summarized in Table 1-8 through Table 1-13 and are included in Appendix C.

The RMV monitoring data provide a snapshot of existing water quality in the project area. These data are qualitatively assessed below; however, the relatively small number of data collected limits confidence in interpretation of the monitoring data.

Average TSS concentrations from RMV wet weather monitoring in the San Juan Creek watershed (Table 1-8) were comparable to levels and trends observed in the Orange County monitoring data (Table 1-4). Average TSS concentrations were similar at the open space station at Caspers, and were substantially reduced and similar in magnitude in the developed watersheds (Mission Viejo vs. SW-6). There are no Orange County monitoring stations in the San Mateo Creek watershed. RMV monitoring data in Table 1-8 show that average TSS levels in the San Mateo Creek watershed were substantially greater than the San Juan Creek watershed, likely due to the silty terrains present in the Cristianitos and Upper Gabino sub-basins. These comparisons suggest that wet weather TSS monitoring data collected by Orange County is generally representative of existing and proposed conditions in the San Juan Creek watershed portion of the project area, but is not representative of conditions in the San Mateo Creek watershed, which has greater average TSS levels.

RMV monitoring of nutrient levels in wet weather flows are presented in Table 1-10. Average nitrate levels were low at all stations in both watersheds, and were generally comparable to average levels in the Orange County monitoring data (Table 1-5). The RMV data do not exhibit clear trends with land use, whereas the Orange County data exhibit slightly lower average concentrations at the open space station at Caspers. Phosphorus levels in wet weather monitoring data are also generally comparable between the RMV monitoring (Table 1-10) and the Orange County monitoring data (Table 1-6). Both data sets show slightly higher average phosphorus levels at the open space station at Caspers.

RMV monitoring of nutrient levels in dry weather flows in the San Juan Creek watershed (Table 1-11) show no detections at most stations, with the exception of moderately high levels at SW-1, possibly due to nursery sources, and a small amount of nitrate detected below the urban catchment in Coto de Caza.

RMV monitoring results of fecal coliform bacteria are presented in Table 1-12 and Table 1-13 for wet and dry weather conditions, respectively. In the San Juan Creek watershed, wet weather fecal coliform levels were generally consistent with nationwide monitoring information indicating average fecal coliform in the range of 5,000 to 20,000 MPN/100mL, with higher fecal

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coliform concentrations in the developed watershed (SW-6). Monitoring information from the open space land uses in the San Mateo Creek watershed (SW-8 and SW-9) also show very high fecal coliform levels in wet weather flows, possibly due to sources from grazing activities in the Gabino Sub-basin. Fecal coliform levels in dry weather samples in the San Juan Creek watershed were low, with the exception of moderately elevated levels at SW-1.

RMV monitoring of trace metals in wet weather flows are presented in Table 1-14. Average dissolved metal concentrations were generally low, even in the urban catchment (SW-6). In fact, average dissolved metal concentration at SW-6 were substantially lower than the average levels in the Orange County data in the urban catchment in Mission Viejo (see Table 1-7).

Table 1-8: Surface Water Monitoring Station Locations

Watershed	Stream	Station	Description	Sample Type
San Juan	San Juan	SW-1	San Juan Creek at Equestrian Park. Large watershed with mixed land uses and geomorphic terrains	Continuous
	San Juan	SW-2	San Juan Creek at Caspers Regional Park. Small watershed without development, crystalline terrain	Grab
	Gobernadora Creek	SW-6	Gobernadora Creek downstream of Coto de Caza. Small developed watershed with sandy terrain.	Continuous
	Gobernadora Creek	SW-7	Gobernadora Creek at the mouth of the canyon.	Grab
San Mateo	Cristianitos Creek	SW-8	Downstream of the confluence of Gabino and Cristianitos Creeks. Undeveloped crystalline terrain.	Continuous
	Gabino Creek	SW-9	Downstream of the confluence of Gabino and La Paz Creeks. Undeveloped crystalline terrain.	Grab

Table 1-9: Average TSS Concentrations during Wet and Dry Weather

	SW-1 San Juan Creek at Equestrian Park (mg/L)	SW-2 San Juan Creek at Caspers (mg/L)	SW-6 Gobernadora Downstream of Coto De Caza (mg/L)	SW-7 Gobernadora Upstream of San Juan Creek (mg/L)	SW-8 Cristianitos Creek (mg/L)	SW-9 Gabino Creek (mg/L)
Wet Weather	913	1372	368	432	7067	4767
Dry Weather	36	NA	10	10	NA	NA

NA – Not Analyzed

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Table 1-10: Average Nutrient Concentrations during Wet Weather

Nutrient	SW-1 San Juan Creek at Equestrian Park (mg/L)	SW-2 San Juan Creek at Caspers (mg/L)	SW-6 Gobernadora Downstream of Coto De Caza (mg/L)	SW-7 Gobernadora Upstream of San Juan Creek (mg/L)	SW-8 Cristianitos Creek (mg/L)	SW-9 Gabino Creek (mg/L)
Ammonia-N	ND	ND	ND	ND	NA	NA
Nitrate-N	1.2	0.78	0.86	0.54	0.63	0.60
Total Phosphorus	0.96	1.5	0.82	0.83	0.73	0.64

ND – None Detected

NA – Not Analyzed

Table 1-11: Average Nutrient Concentrations during Dry Weather

Nutrient	SW-1 San Juan Creek at Equestrian Park (mg/L)	SW-2 San Juan Creek at Caspers (mg/L)	SW-6 Gobernadora Downstream of Coto De Caza (mg/L)	SW-7 Gobernadora Upstream of San Juan Creek (mg/L)	SW-8 Cristianitos Creek (mg/L)	SW-9 Gabino Creek (mg/L)
Ammonia-N	0.35	NA	ND	ND	NA	NA
Nitrate-N	9.0	NA	ND	0.10	NA	NA
Orthophosphate	2.8	NA	ND	ND	NA	NA

ND – None Detected

NA – Not Analyzed

Table 1-12: Fecal Coliform Data during Storm Events

Sample Date	SW-1 San Juan Creek at Equestrian Park (MPN/100 mL)	SW-2 San Juan Creek at Caspers (MPN/100 mL)	SW-6 Gobernadora Downstream of Coto De Caza (MPN/100 mL)	SW-7 Gobernadora Upstream of San Juan Creek (MPN/100 mL)	SW-8 Cristianitos Creek (MPN/100 mL)	SW-9 Gabino Creek (MPN/100 mL)
2/12/03	800	NA	1700	5000	5000	300
2/25/03	9000	8000	28000	13000	23500	24000
3/15/03	3000	800	16000	9000	16000	16000
2/13/03	8000	NA	13000	NA	8000	NA
3/16/03	NA	NA	NA	NA	16000	NA
Geometric Mean	3626	2530	9975	8363	11920	4866

NA – Not Analyzed

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Table 1-13: Fecal Coliform Data during Dry Weather

Sample Date	SW-1 San Juan Creek at Equestrian Park (MPN/100 mL)	SW-2 San Juan Creek at Caspers (MPN/100 mL)	SW-6 Gobernadora Downstream of Coto De Caza (MPN/100 mL)	SW-7 Gobernadora Upstream of San Juan Creek (MPN/100 mL)	SW-8 Cristianitos Creek (MPN/100 mL)	SW-9 Gabino Creek (MPN/100 mL)
9/24/02	1600	NA	300	70	NA	NA

NA – Not Analyzed

Table 1-14: Average Trace Metal Concentrations during Wet Weather

Trace Metal	SW-1 San Juan Creek at Equestrian Park (µg/L)	SW-2 San Juan Creek at Caspers (µg/L)	SW-6 Gobernadora Downstream of Coto De Caza (µg/L)	SW-7 Gobernadora Upstream of San Juan Creek (µg/L)	SW-8 Cristianitos Creek (µg/L)	SW-9 Gabino Creek (µg/L)
Cadmium, Dissolved	0.09	0.12	0.06	0.06	0.17	0.05
Copper, Dissolved	2.5	5.5	1.7	1.6	6.3	6.5
Lead, Dissolved	0.17	0.63	0.91	0.24	1.1	0.58
Zinc, Dissolved	5.3	10.4	3.9	4.9	21.8	11.5

Orange County Health Care Agency Bacteria Study

The Orange County Public Health Laboratory conducted a monitoring study in 1998 in the San Juan Creek watershed to help determine the sources of pathogen indicators during *dry weather* conditions (Moore et al., 2002). Monitoring stations were located in the ocean, in creeks in the San Juan Creek watershed, and in storm drains. One finding of the study was that “the highest concentrations of fecal coliforms and Enterococcus were found in the storm drains as compared to the creeks and ocean sampling sites. Samples taken from creek sites distant to human habitat also had low to moderate levels of bacteria, suggestive of fecal contamination by non-human sources.”

Data obtained in San Juan Creek above the Ortega Highway (SJ30) indicated a log mean concentration for fecal coliform of about 300 colony forming units (CFUs) compared with a storm drain at La Novia Bridge (SJ07) where the concentration was about 1,400 CFUs.

Pathogen indicator concentrations during *wet weather* tend to be higher than during dry weather.

1.7.5 Biological Resources

Although not the focus of this report, a brief overview of biological resources is provided here. A total of 16 vegetation community types are mapped within the San Juan Creek and San Mateo Creek watersheds (PCR et al., 2002). Riparian woodlands and forests occur along most portions of the stream corridors. Some of the major stands of riparian vegetation can be found in the following areas: San Juan to the confluence with Oso Creek, Cañada Gobernadora tributaries, Bell Canyon, and many of the other tributaries to San Juan and San Mateo creeks. The slopes along these corridors are dominated by coastal sage scrub or chaparral communities. With increasing elevation, chaparral communities replace coastal sage. Coastal sage scrub is restricted to xeric, south facing slopes. Oak woodlands and forest become common in the upper reaches of the watersheds on north-facing slopes and along drainages. The proposed development area also contains slope wetlands, concentrated mainly along the toe of slopes in Cañada Chiquita.

The San Juan Creek watershed supports a large variety of sensitive species. Information on sensitive species is set forth in the Biological Resources Section of the GPA/ZC EIR (Final EIR 589 County of Orange).

1.8 REGULATORY SETTING

1.8.1 Clean Water Act

Overview

In 1972, the Federal Water Pollution Control Act (later referred to as the Clean Water Act) was amended to require that the discharge of pollutants to waters of the United States from any point source be effectively prohibited, unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. In 1987, the Clean Water Act (CWA) was again amended to require that the Environmental Protection Agency (EPA) establish regulations for permitting of stormwater discharges (as a point source) by municipal and industrial facilities and construction activities under the NPDES permit program. The EPA published final regulations regarding stormwater discharges on November 16, 1990. The regulations require that municipal separate storm sewer system (MS4) discharges to surface waters be regulated by a NPDES permit.

In addition, the CWA requires the States to adopt water quality standards for water bodies and have those standards approved by the EPA. Water quality standards consist of designated beneficial uses for a particular water body (e.g. wildlife habitat, agricultural supply, fishing etc.), along with water quality criteria necessary to support those uses. Water quality criteria are set concentrations or levels of constituents – such as lead, suspended sediment, and fecal coliform bacteria – or narrative statements which represent the quality of water that support a particular use. In 2000, EPA established numeric water quality criteria for toxic constituents in waters with human health or aquatic life designated uses in the form of the California Toxics Rule (“CTR”) (40 CFR 131.38).

CWA Section 303(d) - TMDLs

When designated beneficial uses of a particular water body are being compromised by water quality, Section 303(d) of the Clean Water Act requires identifying and listing that water body as “impaired”. Once a water body has been deemed impaired, a Total Maximum Daily Load (“TMDL”) must be developed for each water quality constituent that compromises a beneficial use. A TMDL is an estimate of the total load of pollutants, from point, non-point, and natural sources, that a water body may receive without exceeding applicable water quality standards (with a “factor of safety” included). For point sources, including stormwater, the load allocation is referred to as a “Waste Load Allocation” whereas for nonpoint sources, the allocation is referred to simply as a “Load Allocation”. Once established, the TMDL allocates the loads among current and future dischargers into the water body. Table 1-15 lists the water bodies within the San Juan and San Mateo watersheds that have been included on the 2002 303(d) list.

As indicated in Table 1-15, the lower portion of San Juan Creek is listed for bacteria indicators. The SDRWQCB, along with U.S. EPA and Tetra Tech, Inc., have developed a Technical Draft titled “Bacteria-Impaired Waters TMDL Project I for Beaches and Creeks in the San Diego Region”. The pollutants addressed by the TMDL consist of the “indicator bacteria”, namely total and fecal coliform, and enterococcus bacteria, some species of which are pathogenic. This document is in a very preliminary form, with technical issues still to be resolved and public input to be considered prior to adoption by the SDRWQCB. It is presented here as it represents the currently available TMDL information.

For dry weather conditions, the TMDL was set equal to the fecal and enterococcus bacteria numeric water quality objectives (WQOs) for water contact (REC1) beneficial use defined in the Water Quality Control Plan for the San Diego Basin (San Diego Basin Plan) (SDRWQCB, 1994). For total coliform, the TMDL was set equal to the WQO for shellfish harvesting (SHELL) beneficial use. Because of the stringency of the SHELL WQO, interim targets based on REC1 were developed to provide adequate time for further investigation into the appropriateness of using the SHELL WQO.

For wet weather conditions, an interim numeric target was established based on a “reference approach” designed to account for uncontrollable natural sources of bacteria. The reference approach ensures that water quality objectives are at least as good as conditions observed in a reference watershed that represents natural conditions. The San Mateo Creek watershed was identified as the best candidate for assessment of natural background sources of bacteria. Monitoring data collected near the mouth of San Mateo Creek and at San Onofre State Beach were analyzed to estimate the percentage of samples that exceeded the water quality objectives. Because of the limited data collected at these stations, the SDRWQCB chose, as an interim condition, to use data collected by the LARWQCB in the Arroyo Sequit watershed. Data collected at Leo Carillo Beach indicated that 19 percent of wet weather fecal coliform data were observed to exceed the WQOs. This exceedance percentage is proposed as the interim reference target until additional data become available from reference locations within the San Diego

Basin. Based on selecting 1993 as a critical wet year, which represents the 92nd percentile rainfall amount for the period 1990 through 2002, the number of wet days in the San Juan Creek watershed for 1993 was estimated at 76 days. Applying the 19 percent exceedance allowable for natural sources, the number of days in the San Juan Creek watershed during which fecal coliform could exceed the WQOs is 14. It is recognized that this is an interim target that will be modified as additional data and analysis are conducted.

The Implementation Plan for this TMDL will be developed by the SDRWQCB at a future date. To the extent that this or other TMDLs are adopted in the future, the TMDLs and associated waste load allocations will be addressed in future RMV WQMPs (e.g., Master Area Plan WQMP, Sub-Area Plan WQMP, and final project-specific WQMP) as project elements become more defined.

Table 1-15: 2002 CWA Section 303(d) Listings for the San Juan and San Mateo Watersheds

Water Body	Pollutant	Extent	TMDL Priority	TMDL schedule
Pacific Ocean Shoreline, Lower San Juan HAS	Bacteria Indicators	1.2 miles	Medium	7/2004 – 11/2007
Lower San Juan Creek	Bacteria Indicators	1 mile and at mouth (6.3 acres)	Medium	7/2004 – 11/2007

CWA Act Section 404 Dredge and Fill Permits

Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Activities in waters of the United States that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. The SAMP specifically addresses the 404 permitting requirements (including the Section 404(b) (1) Guidelines at 40 CFR 230, et seq).

CWA Act Section 404(b)(1) Water Quality Guidelines

EPA and the Corps have issued Section 404(b)(1) Guidelines (40 CFR 230) that regulate dredge and fill activities, including water quality aspects of such activities. Subpart C at Sections 230.20 thru 230.25 contains water quality regulations applicable to dredge and fill activities. Among other topics, these guidelines address: (a) discharges which alter substrate elevation or contours, suspended particulates, water clarity, nutrients and chemical content, current patterns and water circulation, water fluctuations (including those that alter erosion or sediment rates), and salinity gradients.

CWA Section 401

Section 401 of the Clean Water Act requires that any person applying for a federal permit or license which may result in a discharge of pollutants into waters of the United States must obtain a state water quality certification that the activity complies with all applicable water quality standards, limitations, and restrictions. No license or permit may be issued by a federal agency until certification required by Section 401 has been granted. Further, no license or permit may be issued if certification has been denied. CWA Section 404 permits and authorizations are subject to section 401 certification by the Regional Water Quality Control Boards (RWQCBs).

California Toxics Rule

The California Toxics Rule (CTR) is a federal regulation issued by the USEPA providing water quality criteria for toxic constituents in waters with human health or aquatic life designated uses in the State of California. CTR criteria are applicable to the receiving water body and therefore must be calculated based upon the probable hardness values of the receiving waters for evaluation of acute (and chronic) toxicity criteria. At higher hardness values for the receiving water, copper, lead, and zinc are more likely to be complexed (bound with) components in the water column. This in turn reduces the bioavailability and resulting toxicity of these metals.

Due to the intermittent nature of stormwater runoff (especially in Southern California), the acute criteria are considered to be more applicable to stormwater conditions and therefore used in assessing project impacts, while chronic criteria are more applicable to base flow conditions. Acute criteria represent the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects; chronic criteria equal the highest concentration to which aquatic life can be exposed for an extended period of time (four days) without deleterious effects.

When the CTR was promulgated in May 2000, the SWRCB developed implementation guidance titled the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (SWRCB Resolution No. 2000-015, called the State Implementation Policy or SIP). The SIP applies to point source, non-ocean discharges. Neither the SIP nor the water quality criteria apply directly to discharges of stormwater runoff. Nonetheless, water quality criteria provide a basis for comparison to assess the potential for project discharges to affect the water quality of receiving waters. In this document, the CTR criteria are used as one measure to help evaluate the potential ecological impacts of stormwater runoff to the receiving waters of the Project.

1.8.2 California Porter-Cologne Act

The federal CWA places the primary responsibility for the control of water pollution and for planning the development and use of water resources with the states, although it does establish certain guidelines for the states to follow in developing their programs. The CWA Section 101 requires that the chemical, physical, and biological integrity of the nation's waters be maintained.

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California’s primary statute governing water quality and water pollution issues is the Porter-Cologne Water Quality Control Act of 1970 (Porter-Cologne Act). The Porter-Cologne Act grants the State Water Resource Control Board (SWRCB) and the Regional Water Quality Control Boards (RWQCBs) broad powers to protect water quality and is the primary vehicle for implementation of California’s responsibilities under the federal Clean Water Act. The Porter-Cologne Act grants the SWRCB and the RWQCBs authority and responsibility to adopt plans and policies, to regulate discharges to surface and groundwater, to regulate waste disposal sites and to require cleanup of discharges of hazardous materials and other pollutants. The Porter-Cologne Act also establishes reporting requirements for unintended discharges of any hazardous substance, sewage, or oil or petroleum product.

Each RWQCB must formulate and adopt a water quality plan for its region. The regional plans are to conform to the policies set forth in the Porter-Cologne Act and established by the SWRCB in its state water policy. The Porter-Cologne Act also provides that a RWQCB may include within its region plan water discharge prohibitions applicable to particular conditions, areas or types of waste. The RWQCBs are also authorized to enforce discharge limitations, take actions to prevent violations of these limitations from occurring and conduct investigations to determine the status of the quality of any of the waters of the state. Civil and criminal penalties are also applicable to persons who violate the requirements of the Porter-Cologne Act or SWRCB/RWQCB orders.

The Water Quality Control Plan for the San Diego Basin (San Diego Basin Plan) (SDRWQCB, 1994) provides quantitative and narrative criteria for a range of water quality constituents. Specific criteria are provided for the larger water bodies within the region and general criteria or guidelines are provided for bays and estuaries, inland surface waters, and ground waters. In general, the narrative criteria require that degradation of water quality does not occur due to increases in pollutant loads that will impact the designated beneficial uses of a water body. For example the San Diego Basin Plan requires that “Inland surface waters shall not contain suspended or settleable solids in amounts which cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors”.

Beneficial uses of the water bodies within the Project area listed in the San Diego Basin Plan are shown in Table 1-16.

Table 1-16: Beneficial Uses of Receiving Waters

Water Body	Beneficial Uses								
	MUN	AGR	IND	REC1	REC2	WARM	COLD	WILD	RARE
San Juan Creek	E	P	P	P	P	P	P	P	
Verdugo Canyon	E	P	P	P	P	P	P	P	

Water Body	Beneficial Uses								
	MUN	AGR	IND	REC1	REC2	WARM	COLD	WILD	RARE
Trampas Canyon	E	P	P	P	P	P	P	P	
Cañada Gobernadora	E	P	P	P	P	P	P	P	
Cañada Chiquita	E	P	P	P	P	P	P	P	
San Mateo Creek	E			P	P	P		P	P
Cristianitos Creek	E			P	P	P		P	
Gabino Creek	E			P	P	P		P	
La Paz Canyon	E			P	P	P		P	
Blind Canyon	E			P	P	P		P	
Talega Canyon	E			P	P	P		P	

P – Present or potential beneficial use

E – Excepted from MUN designation

California Marine State Water Quality Protection Areas (SWQPA) are defined in Section 36700(f) of the Public Resources Code (PRC) as “ a nonterrestrial marine or estuarine area designated to protect marine species or biological communities from an undesirable alteration in natural water quality, including, but not limited to, areas of special biological significance that have been designated by the State Water Resources Control Board through its water quality control planning process.” Point source waste or thermal discharges to SWQPAs are prohibited. There are a total of 34 areas along the California coastline; two of these areas in the San Diego Region. These areas do not include the coastal areas into which San Juan Creek or San Mateo Creek discharge.

1.8.3 State of California Nonpoint Source Plan

The Nonpoint Source (NPS) Program’s roots were established in 1988 in response to the federal Clean Water Act Section 319 (CWA 319). CWA 319 required states to develop assessment reports that described the state’s NPS problems and to establish an NPS management program to control or prevent the problems. In 1998, the State of California began the implementation of its Fifteen-Year Program Strategy for the Nonpoint Source Pollution Prevention Program (NPS Program), as described in the *Plan for California’s Nonpoint Source Pollution Control Program*. The Strategy prescribed the vision and goals of the NPS Program, which included basic process components of Planning, Coordination, Implementation, Monitoring and Tracking, and Assessment of NPS Program achievements.

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The NPS Plan expresses a preference for watershed-scale approaches to control point and NPS pollution. The NPS Plan achieves this goal by dealing with NPS pollution via 61 Management Measures (MMs). Management measures serve as general guidelines for the control and prevention of polluted runoff and the attainment of water quality goals. Site-specific management practices are then used to achieve the goals of each management measure.

Specifically, the Plan:

- Adopts 61 MMs as goals for six NPS categories (agriculture, forestry, urban areas, marinas and recreational boating, hydromodification, and wetlands/riparian areas/vegetated treatment systems);
- Uses a "Three-Tiered Approach" for addressing NPS pollution problems (Tier 1: Self-Determined Implementation of Management Practices [formerly referred to as "voluntary implementation"]; Tier 2: Regulatory Based Encouragement of Management Practices; and Tier 3: Effluent Limitations and Enforcement Actions).
- Expresses a preference for managing NPS pollution on a watershed scale where local stewardship and site-specific management practices can be implemented through comprehensive watershed protection or restoration plans.

The SWRCB, California Coastal Commission, and other State agencies have identified fifteen MMs to address urban sources of pollution, which utilize two primary strategies: (1) the prevention of pollutant loadings and (2) the treatment of unavoidable loadings. The Urban Category MM strategy emphasizes pollution prevention and source reduction practices over treatment practices, as the most cost-effective means of controlling urban runoff pollution from affecting waters of California.

The NPS Program Plan acknowledges the types of pollution that are derived from urban runoff, which are addressed through a variety of regulatory and non-regulatory programs in the State. Each State department and program may have separate and distinct programmatic objectives and authorities to enforce them, but all maintain the common goal of reducing or eliminating the effects of polluted runoff in waters of the State. These programs include the TMDL and the NPDES Stormwater Programs as implemented by SWRCB and the RWQCBs; the coastal planning and permitting programs that are the jurisdiction of the California Coastal Commission (CCC) and San Francisco Bay Conservation Development Commission (BCDC); and other local ordinances and initiatives. All of these are part of the strategy that California is utilizing to address urban sources of pollution.

The Urban NPS Program and Storm Water Programs are related in that both programs address aspects of urban runoff pollution. With respect to programs within the SWRCB and the RWQCBs, urban runoff is addressed primarily through the National Pollution Discharge Elimination System (NPDES) Permitting Program. The SWRCB NPS Program will apply where runoff is not regulated as a permitted point source discharge, such as to agriculture areas.

1.8.4 Municipal NPDES Permit

The San Diego RWQCB issued the third term permit (Order No. R9-2002-0001) for stormwater discharges in southern Orange County to the County, the Orange County Flood Control District, and the Orange County cities within the San Diego Region (collectively “the Co-permittees”) in February 2002. This permit regulates stormwater discharges in the Project area. The NPDES permit details requirements for new development and significant redevelopment projects, including specific sizing criteria for treatment Best Management Practices (BMPs).

To implement the requirements of the NPDES permit, the Co-permittees have developed a 2003 Drainage Area Management Plan (DAMP) that includes a New Development and Significant Redevelopment Program (OCDMD, 2003). This New Development and Significant Redevelopment Program provides a framework and a process for following the NPDES permit requirements and incorporates watershed protection/stormwater quality management principles into the Co-permittees’ General Plan process, environmental review process, and development permit approval process. The New Development and Significant Redevelopment Program includes a Model Water Quality Management Plan (WQMP) that defines requirements and provides guidance for compliance with the NPDES permit requirements for project specific planning, selection, and design of BMPs in new development or significant redevelopment projects. The Model WQMP also defines two levels of analysis: a preliminary or conceptual WQMP at a planning level of detail suitable for supporting a CEQA analysis; and a project-specific WQMP at a project level of detail that will be submitted as part of the development approval permitting process.

Local jurisdictions must adopt a Local Implementation Plans (LIPs) that describe the process by which each Permittee will approve project-specific WQMPs as part of the development plan and entitlement approval process for discretionary projects, and prior to issuing permits for ministerial projects. The County of Orange and the Orange County Flood Control District LIP (2003 DAMP Appendix A) was adopted in July, 2003. Exhibit A-7.VI of the County’s Local Implementation Plan, the County of Orange Local WQMP, contains the requirements placed upon all new development and significant redevelopment projects in the unincorporated County south of El Toro Road. These requirements apply to the RMV project.

The RMV project is considered by the Orange County LIP as a “priority” new development and significant redevelopment project and is therefore required to develop and implement a Project WQMP that addresses:

- Regional or watershed programs (if applicable)
- Pollutants of Concern
- Hydrologic Conditions of Concern
- Routine structural and non-structural Source Control BMPs

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- Site Design BMPs (as applicable);
- Treatment Control BMPs (Treatment Control BMP requirements may be met through either project specific (on-site) controls or regional or watershed management controls that provide equivalent or better treatment performance);
- The mechanism(s) by which long-term operation and maintenance of all structural BMPs will be provided

The sizing criteria for volume-based treatment control BMPs in the LIP are as follows:

1. The volume of runoff produced from a 24-hour, 85th percentile storm event, as determined from the local historical rainfall record; or,
2. The volume of annual runoff produced by the 85th percentile, 24-hour rainfall event, determined as the maximized capture stormwater 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,
3. 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,
4. 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.

The sizing criteria for flow-based BMPs in the LIP are as follows:

1. 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
2. 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
3. The maximum flow rate of runoff, as determined from the local historical rainfall record, which 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.

1.8.5 CDFG Code 1601/1603

The WQMP addresses “hydrologic conditions of concern” that address in-stream changes in sediment transport, erosion and sedimentation, and ultimately channel stability. Thus there is a

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nexus between the WQMP and the habitat and species protection programs administered by the California Department of Fish and Game (CDFG) and the U.S. Fish and Wildlife Service.

The CDFG is responsible for conserving, protecting, and managing California's fish, wildlife, and native plant resources. To meet this responsibility, the law requires the proponent of a project that may impact a river, stream, or lake to notify the CDFG before beginning the project. This includes rivers or streams that flow at least periodically or permanently through a bed or channel with banks that support fish or other aquatic life and watercourses having a surface or subsurface flow that support or have supported riparian vegetation.

Section 1603 of the Fish and Game Code requires any person who proposes a project that will substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake or use materials from a streambed to notify the CDFG before beginning the project. Similarly, under section 1601 of the Fish and Game Code, before any State or local governmental agency or public utility begins a construction project that will: 1) divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake; 2) use materials from a streambed; or 3) result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake, it must first notify the CDFG of the proposed project.

If the CDFG determines that the project may adversely affect existing fish and wildlife resources, a Lake or Streambed Alteration Agreement is required.

1.8.6 Endangered Species

The federal Endangered Species Act (ESA) and its implementing regulations prohibit any person from harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing or collecting any listed threatened or endangered species. The purpose of the ESA is to conserve the ecosystems upon which endangered and threatened species depend and to conserve and recover listed species. Endangered means a species is in danger of extinction throughout all or a significant portion of its range. Threatened means a species is likely to become endangered within the foreseeable future. The law is administered by the U.S. Fish and Wildlife for terrestrial and freshwater organisms, while the National Marine Fisheries Service has responsibility for marine species such as salmon and whales.

Section 2080 of the California Fish and Game Code prohibits "take" of any species that the Fish and Game Commission determines to be an endangered species or a threatened species. Take is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill."

As reviewed below, the NCCP/MSAA/HCP and SAMP programs focus heavily on listed species and their associated habitats, as well as other sensitive species and associated habitats. As reviewed earlier in this Chapter, the WQMP is a management plan that is intended to address the

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protection, restoration and long-term management of water flows from future urbanized areas that may affect species and habitats addressed by the NCCP/MSAA/HCP and SAMP.

2 POLLUTANTS OF CONCERN AND HYDROLOGIC CONDITIONS OF CONCERN FOR THE SAN MATEO AND SAN JUAN WATERSHEDS

2.1 OVERVIEW

Urbanization of a watershed can result in environmental stressors which may have adverse effects on ecosystem characteristics such as vegetation communities and species. Environmental stressors which are adverse can generally be described as:

- Altered hydrology due to urban development or public works projects with the potential to impact species and habitats;
- Altered geomorphic processes with the potential to impact species and habitats; and
- Pollutants generated by urban development with the potential to impact species and habitats.

The potential effects of these environmental stressors are described below.

2.1.1 Potential Effects of Development on Streamcourse Hydrologic and Geomorphic Processes

Urbanization of a watershed can profoundly change the physical characteristics of streams, harming stream habitat and beneficial uses. Urbanization is defined as the transformation of land into residential, commercial, and industrial properties and associated infrastructure such as drainages, roads, and sewers.

Urbanization modifies vegetation and soil characteristics, introduces pavement and buildings (impervious surfaces), and creates drainage and flood control infrastructure. These changes affect hydrologic processes of a watershed – the extent to which rain is intercepted by vegetation, infiltrates into the ground, or results in stormwater runoff, and the rate and magnitude of stream flows.

As the area of impervious surfaces increases, infiltration of rainfall decreases, causing more water to run off the surface as overland flow (stormwater runoff), and decreasing the time between when the rainfall occurs and when the runoff occurs. Since runoff ultimately discharges into streams (and other water bodies), increases in the volume and rate of runoff increase the frequency and duration of stream flows. This effect is more pronounced for smaller storms than for the large storms responsible for flooding.

Longer periods of increased stream flows intensify sediment transport, causing excessive erosion and modifying the geomorphology (width, depth, and slope) of stream channels. Larger peak flows and volumes and intensified stream erosion also impair the habitat in stream channels.

2.1.2 Potential Effects of Post-Development Surface and Subsurface Water Flows on Riparian Habitat

The magnitudes, frequencies, and patterns of surface flow through uplands and within stream channels are the most deterministic factor of the integrity and distribution of wetlands and riparian habitat (PCR et al., 2002). Changes in the magnitude or frequency of peak flows for moderate events (i.e., 2 year), channel-forming events (i.e., 5-year or 10-year return interval), or extreme events (i.e., 25 year, 50-year, or 100-year return interval) can affect the long-term viability of riparian habitat and influence the type of community that persists. Increased frequency of high flows (resulting from increased runoff) can destabilize channels and encourage invasion by aggressive non-native plant species. Changes in base flow can change the physical and biological structure of the stream. Habitat for sensitive species may also be affected by changes in the physical, chemical, or biological condition of the stream that results from alteration of surface water hydrology.

Persistent base flows throughout the normal dry season due to irrigation runoff or discharges from sewage treatment plants can cause changes in vegetation by encouraging the growth of riparian species, some native and some introduced (Wetlands Research Associates, 2002). This growth not only stabilizes the banks, but may also deepen channels beyond a depth suitable for breeding pools for species such as the southwestern arroyo toad; such vegetation growth may also shade the water, thus lowering water temperatures below the level required for southwestern arroyo toad or other aquatic species larval growth and survival.

The long-term sustainability of riparian habitats suitable for species such as the arroyo toad, least Bell's vireo and southwestern willow flycatcher depends on both frequent runoff events and episodic geomorphic disturbance (PCR and Dudek, 2002). Early successional habitats, important for breeding, are created by small, frequent flooding within adjacent terraces and ideally contain a dense shrub layer. Periodic overbank flooding facilitates development of riparian habitat by depositing sediment, dispersing seeds, re-hydrating floodplain soils, and flushing accumulations of salts.

2.1.3 Potential Effects of Development on Pollutants

Pollutants are carried from urbanized areas to receiving waters in stormwater and dry weather runoff. As water washes over the land, whether it comes from rain, car washing, or the watering of lawns, it intercepts and picks up an array of contaminants that it encounters along the way. These contaminants include a wide variety of material, such as oil, sediment, litter, bacteria, nutrients, toxic materials, and general debris from urban and suburban areas. Construction can be a major source of sediment erosion. Petroleum hydrocarbons result mostly from automobile sources. Nutrient and bacterial contaminants include garden fertilizers, yard waste, and animal waste. Impervious surfaces also may adsorb solar radiation, act as a heat source, and increase the temperature of runoff. As populations increase, the potential for increase in pollutant

loadings in runoff also increases, and if left untreated, these pollutant loadings will eventually find their way into waterways, either directly or through constructed storm drains.

2.1.4 WQMP Approach to Addressing Potential Impacts of Stressors

This Conceptual WQMP addresses four broad categories of potential “stressors” potentially impacting habitats and species:

- Altered hydrology due to urban development or public works projects with the potential to impact species and habitats;
- Altered geomorphic processes with the potential to impact species and habitats;
- Pollutants generated by urban development with the potential to impact species and habitats; and
- Elevated temperatures with the potential to impact species and habitats.

The Local WQMP guidance address each of these categories of stressors, and provide a framework for identifying pollutants and hydrologic conditions of concern, pollutant sources, and guidance on selection of suitable site design, source controls, and treatment controls for addressing pollutants of concern. The Local WQMP also provides specific guidance on the applicability of treatment controls that could affect groundwater quality, and the conditions under which controls that rely on infiltration will be permitted. Those conditions include requirements on minimum depth to high seasonal groundwater table, limitations on infiltrating dry weather flows, and other requirements that are addressed in Section 3.5.2 Groundwater Impacts.

Similarly the SAMP Tenets and Baseline Conditions Watershed Planning Principles set forth in the *Watershed and Sub-basin Planning Principles* provide policy direction for addressing each of the above stressors.

The SAMP Tenets policies include:

- Protect headwaters
- Maintain and/or restore floodplain connection
- Maintain and/or restore sediment sources and transport equilibrium

The Watershed Planning Principles address the stressors (Altered Hydrology is sub-divided into Changes in Surface Water Hydrology and Changes in Groundwater Hydrology) under the following sets of principles. For each set of Watershed Principles, a summary of the WQMP approach addressing the Principle(s) is provided.

Pollutants

The Baseline Conditions Watershed Planning Principles Section “v) Water Quality” sets forth the following principle for water quality/pollutants:

- Principle 9 – Protect water quality by using a variety of strategies, with particular emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas and application of Best Management Practices within development areas to assure comprehensive water quality treatment prior to the discharge of urban runoff into the Habitat Reserve.

The WQMP approach to address this principle is to incorporate into the stormwater system a mix of site design, source control, and treatment control BMPs, pursuant to the Orange County Local WQMP, that will be protective of both surface and groundwater quality. These BMPs include the use of natural treatment systems such as bioswales and wetlands, extended detention basins, infiltration, cisterns, and provisions for utilizing stormwater for irrigating common area landscaping and golf courses. Potential changes in pollutants of concern are addressed based on comparison to runoff water quality modeling of the Ranch Plan conducted previously, literature information, and professional judgment. The level of significance of impacts is evaluated based on significance criteria that include predicted runoff quality for proposed versus existing water quality and quantity conditions, water quality standards, MS4 Permit requirements, and effects on NCCP/MSAA/HCP “planning species.”

Changes in Surface Water Hydrology

Baseline Conditions Watershed Planning Principles Section “ii) Hydrology” sets forth the following planning principles for surface water hydrology:

- Principle 2 – Emulate, to the extent feasible, the existing runoff and infiltration patterns in consideration of specific terrains, soil types, and ground cover.
- Principle 3 – Address potential effects of future land use changes on hydrology.
- Principle 4 – Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks.
- Principle 5 – Maintain and/or restore the inherent geomorphic structure of major tributaries and their floodplains.

The WQMP approach to address this principle is to incorporate all of these hydrologic planning principles into the design of the stormwater system. Hydrologic modeling techniques will be implemented in the preparation of the Master Area Plan WQMP to estimate the pre-developed runoff flow rates and volumes considering existing terrains, soil types, and ground covers. Detention and infiltration BMPs will then be sized accordingly to match, to the extent feasible,

post-development hydrologic conditions to the pre-developed conditions at the development bubble, catchment, and sub-basin levels. Hydrologic conditions will be matched for monthly water balances and flow versus duration for a continuous segment of the precipitation record. This analysis was conducted for the Ranch Plan Conceptual WQMP. The modeling techniques employed considered the role of longer-term wet/dry cycles and how such cycles influence hydrologic conditions. A detailed description of the models previously employed is included in Appendix A.

Changes in Groundwater Hydrology

Baseline Conditions Watershed Planning Principles Section “iv) Groundwater Hydrology” sets forth the following principles:

- Principle 7 – Utilize infiltration properties of sandy terrains for groundwater recharge and to off-set potential increases in surface runoff and adverse effects to water quality.
- Principle 8 – Protect existing groundwater recharge areas supporting slope wetlands and riparian zones; and maximize groundwater recharge of alluvial aquifers to the extent consistent with aquifer capacity and habitat management goals.

To replicate (or emulate to the maximum extent practicable) pre-development infiltration and to protect groundwater quality, flow and water quality control facilities that incorporate infiltration will be located in the head end of side canyons where depth to groundwater is greatest. Extended detention also will provide pre-treatment to the infiltrated water to minimize impacts to groundwater quality. Additional treatment will occur through natural soils processes as infiltrated water moves through soils into the groundwater system.

Changes in Geomorphic Processes

Baseline Conditions Watershed Planning Principles Section “i) Geomorphology/Terrains” sets forth the following principle:

- Principle 1 – Recognize and account for the hydrologic response of different terrains at the sub-basin and watershed scale.

Land use planning should strive to mimic the hydrologic response of existing terrains by primarily locating development in areas which have low infiltrative soils, such as the “hardpan” areas and areas of clay soils found on the ridges in Cañada Chiquita and Canada Gobernadora. Surface runoff flows have been directed to water quality treatment, detention, and infiltration BMPs located in the permeable substrate of the major side canyons and along the valley floor. Setbacks from the mainstem creek channels are incorporated through a variety of means, including proposed Habitat Reserve areas and water quality buffer strips.

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Baseline Conditions Watershed Planning Principles Section “i) Geomorphology/Terrains” and “iii) Sediment Sources, Storage, and Transport” sets forth the following principle:

- Principle 6 – Maintain coarse sediment yields, storage, and transport processes.

The WQMP approach to address this principle is to design water quality and flow control facilities “offline” of the storm drainage and flood control system, so that large flows and attendant sediment loads will bypass the water quality facilities. The WQMP facilities will be designed to capture primarily fine sediments that contain the majority of pollutant mass and which cause adverse effects to aquatic species and habitats through increased turbidity and settlement in breeding habitats. Matching post-development flow durations to pre-development flow durations in the flow control facilities will help ensure that the pre-development transport processes in the mainstem channels are preserved.

As noted previously, each of the above Principles includes specific policies providing more specific guidance for maintaining net habitat value at a watershed scale. Further, the sub-basin “Planning Considerations” and “Planning Recommendations” set forth in the draft Watershed and Sub-Basin Planning Principles provide geographic-specific planning and resource protection guidance for each sub-basin within the 22,815 acres of RMV lands that are the subject of this WQMP. Accordingly, the WQMP addresses both the overall principles set forth in the Baseline Conditions Watershed Principles and the specific Planning Considerations and Planning Recommendations for each sub-basin set forth in the draft Watershed and Sub-Basin Planning Principles document.

The WQMP addresses the above principles within the water quality management framework established by the County of Orange and the San Diego Regional Water Quality Control Board (SDRWQCB). The County and the SDRWQCB require that potential development impacts are to be analyzed under two broad headings: (1) Hydrologic Conditions of Concern, and (2) Pollutants of Concern.

2.2 HYDROLOGIC CONDITIONS OF CONCERN

Hydrologic Conditions of Concern are addressed in the Conceptual WQMP in accordance with the following methodology established in the Local WQMP:

1. Determine whether a downstream stream channel is fully natural or partially improved with a potential for erosive conditions or alteration of habitat integrity to occur as a result of upstream development.
2. Evaluate the project’s conditions of concern considering the project area’s location (from the larger watershed perspective), topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and other relevant hydrologic and environmental factors to be protected specific to the project area’s watershed.

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3. Review watershed plans, drainage area master plans or other planning documents to the extent available for identification of specific implementation requirements that address hydrologic conditions of concern.
4. Conduct a field reconnaissance to observe and report on representative downstream conditions, including undercutting erosion, slope stability, vegetative stress (due to flooding, erosion, water quality degradation, or loss of water supplies) and the area's susceptibility to erosion or habitat alteration as a result of an altered flow regime or change in sediment transport.
5. Compute rainfall runoff characteristics from the project area including peak flow rate, flow velocity, runoff volume, time of concentration, and retention volume.
6. A drainage study report must be prepared identifying the project's conditions of concern based on the hydrologic and downstream conditions discussed above. Where downstream conditions of concern have been identified, the drainage study shall establish that pre-project hydrologic conditions affecting downstream conditions of concern would be maintained by the proposed project by incorporating the site design, source control, and treatment control requirements identified in the County/SD RWQCB Model Water Quality Management Plan. For conditions where a reduction in sediment transport from the project development and features would significantly impact downstream erosion, the Treatment Control BMPs proposed should be evaluated to determine if use of the BMPs would result in reducing beneficial sediment (i.e. sand and gravel) significantly below pre-development levels. Under such conditions alternative BMPs (such as watershed based approaches for erosional sediment control) may need to be considered.

The WQMP includes sections documenting the consistency of the WQMP both with the above County/SD RWQCB requirements and with applicable principles of the Watershed Planning Principles. In particular, the WQMP analysis of the Hydrologic Conditions of Concern specifically analyzes hydrologic conditions set forth in the Watershed Planning Principles for the purpose of maintaining net habitat value with regard to: (1) potential increases in dry season stream base flow and wet season base flow between storms; (2) changes in the magnitude, frequency, and duration of annually expected flow events (typically 1-2 year events); (3) changes in hydrologic response to major episodic storm events; (4) potential changes in sediment supply, with short term reductions related to impervious/landscaped ground cover; and (5) potential changes in the infiltration of surface/soil water to groundwater. The analysis is conducted qualitatively through comparison of the proposed development in Alternative B-10M to that proposed for the previously modeled Ranch Plan Alternative and Alternative B-9.

For the Cañada Gobernadora Sub-basin, the sub-basin exhibiting existing conditions stressors due to prior upstream development in Coto de Caza, specific performance criteria for implementation of the Gobernadora Multipurpose Basin have been prepared to complement

Gobernadora Sub-basin water management measures set forth in the WQMP and thereby increase net habitat value.

2.3 POLLUTANTS OF CONCERN

The pollutants of concern for the water quality analysis are those pollutants that are anticipated or potentially could be generated by the Project, based on the proposed land uses and past land uses, that have been identified by regulatory agencies as potentially impairing beneficial uses in the receiving water bodies or that could adversely affect receiving water quality or endangered species.

Primary pollutants of concern are those which have been identified as causing impairment of receiving waters. Pathogens (bacteria indicators) have been identified on the 303(d) list as impairing the beneficial uses in Lower San Juan Creek and are therefore a primary pollutant of concern.

Other pollutants of concern addressed in the Conceptual WQMP include:

- Sediment (Total Suspended Solids)
- Nutrients (Ammonia, Nitrate, and Total Phosphorus)
- Trace Metals (Aluminum, Cadmium, Copper, Lead, and Zinc)
- Hydrocarbons (Oil and Grease, Polycyclic Aromatic Hydrocarbons)
- Pesticides
- Trash and Debris

The Local WQMP includes two additional categories of pollutants of concern – organic compounds and oxygen-demanding compounds. The pollutants in these two categories are also included in the categories above. For example, typical organic compounds in urban runoff include pesticides, petroleum hydrocarbons, and vegetative debris. Oxygen-demanding substances typical in urban stormwater runoff are included in trash and debris, such as biodegradable food and vegetation waste. Chemical oxygen-demanding compounds, such as ammonia, are included in the nutrient category.

Appropriate regulatory standards, including special standards applicable to species pursuant to the California Toxics Rule, have been applied in formulating the Conceptual WQMP BMPs and in addressing the Water Quality principles set forth in the *Watershed and Sub-basin Planning Principles*.

2.3.1 Pathogens

Urban runoff typically contains elevated levels of pathogenic organisms. The presence of pathogens in runoff may result in waterbody impairments such as closed beaches, contaminated drinking water sources, and shellfish bed closings. The proliferation of pathogens is typically caused by the transport of animal or human fecal wastes from the watershed. Total and fecal coliform, Enterococcus bacteria, and E. coli bacteria (strains of which are pathogenic) are commonly used as an indicator for pathogens due to the difficulty of monitoring for pathogens directly.

2.3.2 Sediment

Excessive erosion, transport, and deposition of sediment in surface waters is a significant form of pollution resulting in major water quality problems. Excessive stream erosion and sediment transport can be caused by increases in runoff volumes and peak flow rates and is discussed below. Excessive fine sediment carried in urban runoff, measured as total suspended solids, can impair aquatic life by filling interstitial spaces of spawning gravels, impairing fish food sources, filling rearing pools, and reducing beneficial habitat structure in stream channels. By contrast, coarse sediments are a critical component of the hydrologic regime and riparian habitat and measures must be undertaken to maintain conditions supporting the generation and transport of these sediments.

2.3.3 Nutrients

Nutrients are inorganic forms of nitrogen and phosphorus. There are several sources of nutrients in urban areas, mainly fertilizers in runoff from lawns, pet wastes, failing septic systems, and atmospheric deposition from industry and automobile emissions. Nutrient over-enrichment is especially prevalent in agricultural areas where manure and fertilizer inputs to crops significantly contribute to nitrogen and phosphorus levels in streams and other receiving waters.

Eutrophication due to excessive nutrient input can lead to changes in periphyton, benthic, and fish communities; extreme eutrophication can cause hypoxia or anoxia, resulting in fish kills. Surface algal scum, water discoloration, and the release of toxins from sediment can also occur.

2.3.4 Trace Metals

The primary sources of trace metals in stormwater are typically commercially available metals used in transportation, buildings, and infrastructure. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Metals are also found in fuels, adhesives, paints, and other coatings. Metals are of concern because of toxic effects on aquatic life and the potential for ground water contamination. Copper, lead, and zinc are the most prevalent metals found in urban runoff. High metal concentrations can bioconcentrate in fish and shellfish and affect beneficial uses of a waterbody.

2.3.5 Petroleum Hydrocarbons/Oil and Grease

The sources of oil, grease, and other petroleum hydrocarbons in urban areas include spillage fuels and lubricants, discharge of domestic and industrial wastes, atmospheric deposition, and runoff. Runoff can be contaminated by leachate from asphalt roads, wearing of tires, and deposition from automobile exhaust. Also, do-it-yourself auto mechanics may dump used oil and other automobile-related fluids directly into storm drains. Petroleum hydrocarbons, such as polycyclic aromatic hydrocarbons (PAHs), can accumulate in aquatic organisms from contaminated water, sediments, and food and are toxic to aquatic life at low concentrations. Hydrocarbons can persist in sediments for long periods of time and result in adverse impacts on the diversity and abundance of benthic communities. Hydrocarbons can be measured as total petroleum hydrocarbons (TPH), oil and grease, or as individual groups of hydrocarbons, such as PAHs.

2.3.6 Pesticides

Pesticides (including herbicides) are chemical compounds commonly used to control insects, rodents, plant diseases, and weeds. Excessive application of a pesticide may result in runoff containing toxic levels of its active component. Pesticides are of particular concern with respect to the protection and restoration of endangered aquatic and terrestrial species (Wetland Research Associates, 2002)

2.3.7 Trash & Debris

Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape. The presence of trash & debris may have a significant impact on the recreational value of a water body and aquatic habitat. Excess organic matter can create a high biochemical oxygen demand in a stream and thereby lower its water quality. Also, in areas where stagnant water exists, the presence of excess organic matter can promote septic conditions resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds such as hydrogen sulfide.

2.4 THRESHOLDS OF SIGNIFICANCE

Thresholds of significance for hydrology and water quality have been developed for the proposed development alternatives. Significant water resources impacts are presumed to occur if the proposed alternative would:

- Substantially increase the rate or amount of surface runoff in a manner that would expose people or structures to onsite or offsite flooding or result in peak runoff rates from the site that would exceed existing or planned capacities of downstream flood control systems.

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- Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.
- Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation.
- Substantially increase the frequencies and duration of channel adjusting flows.
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.
- Violate surface and/or ground water quality standards or waste discharge requirements for the receiving drainages, including applicable provisions of:
 - County of Orange SUSMP
 - California Toxics Rule for metals
 - RWQCB Standards
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam, or inundation by seiche, tsunami, or mudflow.
- Require the construction of new storm water drainage facilities or expansion of existing facilities where the construction would cause significant environmental effects.
- Conflict with any applicable plan, policy or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental effect related to hydrology or water quality.
- Conflict with applicable San Juan Creek Watershed/Western San Mateo Creek Watershed SAMP Planning Principles

For convenience, the specific thresholds identified above are provided in the following subsections. Significance thresholds listed above that relate to flooding impacts have not been included and are addressed in a separate report, titled: Alternatives Analysis: Hydrologic Comparison of Baseline and Alternative Land Use Conditions for San Juan and San Mateo Watersheds (PWA, 2004).

2.4.1 Significance Thresholds for Hydrologic Conditions of Concern Set Forth in the County of Orange LIP

Table 2-1 summarizes the hydrologic conditions of concern and significance thresholds set forth in the LIP.

Table 2-1: Hydrologic Condition of Concern and Significance Thresholds

Hydrologic Conditions of Concern	Significance Threshold
1. Increased Stormwater Runoff Flow Rate, Volume, and Flow Duration	A. Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation. B. Substantially increase the frequencies and duration of channel adjusting flows.
2. Decreased Infiltration and Groundwater Recharge	A. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.
3. Changed Base Flow	A. Substantially increase or decrease base flows as to negatively impact riparian habitat. B. Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.

2.4.2 Significance Thresholds for Pollutants of Concern

The significance thresholds for pollutants of concern are the narrative and numeric surface and groundwater quality objectives and criteria in the Basin Plan and the CTR. As discussed earlier the State’s Implementation Plan for the CTR criteria do not apply to stormwater discharges; nonetheless, the criteria do provide a basis for comparison and one means of evaluating the potential effects of discharges of pollutants on aquatic toxicity.

Surface water quality criteria in the CTR are presented as both acute criteria and chronic criteria. Based on rainfall analyses of local rain gauges, the average duration of rainfall events in the Project area is 11.6 hours (Appendix A). This duration is representative of an acute rather than a chronic exposure. Acute criteria represent the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (one hour) without deleterious effects; chronic criteria equal the highest concentration to which aquatic life can be exposed for an extended period of time (four days) without deleterious effects. Chronic criteria are applicable to base flow conditions.

As there is no water quality objective or criteria for total aluminum in the San Diego Basin Plan or the CTR, the national water quality criteria recommended by the USEPA will be used for comparison (USEPA, 2002b).

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Water quality criteria do not apply directly to discharges of stormwater runoff. Nonetheless, water quality criteria can provide a useful means to assess the potential for project discharges to affect the water quality of receiving waters. In this document, the water quality criteria are used as a comparative measure to evaluate potential ecological impacts.

The only pollutant of concern with a water quality objective for groundwater in the proposed development’s hydrologic unit (the San Juan Hydrologic Unit) in the San Diego Basin Plan is nitrate-nitrogen. The Basin Plan objective for nitrate in groundwater is 10 mg/L as N.

Pollutants of concern and significance thresholds for surface water are summarized in Table 2-2.

Table 2-2: Pollutants of Concern and Significance Thresholds for Surface Water

Pollutants of Concern	Significance Thresholds
Sediment: Total Suspended Solids (TSS)	<ol style="list-style-type: none"> Narrative objective in the Basin Plan¹: “The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.”
Nutrients: Nitrate Nitrogen, Total Kjeldahl Nitrogen, and Total Phosphorus	<ol style="list-style-type: none"> Narrative objective in the Basin Plan: “Concentrations of nitrogen and phosphorus, by themselves or in combination with other nutrients, shall be maintained at levels below those which stimulate algae and emergent plant growth.” Basin Plan objective: “A desired goal in order to prevent plant nuisances in streams and other flowing waters appears to be 0.1 mg/L total Phosphorus.” Basin Plan objective: “Analogous threshold values have not been set for nitrogen compounds; however, natural ratios of nitrogen to phosphorus are to be determined by surveillance and monitoring and upheld.”
Trace metals: Aluminum, Cadmium, Copper, Lead, and Zinc	<ol style="list-style-type: none"> Narrative objective in the Basin Plan: Toxic substances shall not be discharged to levels that will adversely affect beneficial uses. The CTR² criteria for Cd, Cu, Pb, and Zn are the applicable water quality objectives for protection of aquatic life. The CTR criteria are expressed for acute and chronic (4-day average) conditions; however, only acute conditions are applicable for stormwater discharges because the duration of stormwater discharge is typically less than 4 days. CTR criteria for Cd, Cu, Pb, and Zn are expressed for dissolved metal concentrations and are determined on the basis of hardness in the receiving water. In application of criteria to the Project, local hardness data will be used to determine most appropriate criteria. EPA’s national recommended acute water quality criterion (NAWQC)³ for total aluminum is 750 µg/L within the pH range of 6.5 to 9.0.

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Pollutants of Concern	Significance Thresholds
Pathogens (Fecal Coliform, Viruses, and Protozoa)	<ol style="list-style-type: none"> Basin Plan objectives are based on the designated uses of the water body. The most restrictive designation for the Project’s receiving waters is Primary Contact Recreation. The Basin Plan water quality objective for this use designation is, for not less than 5 samples for any 30-day period, fecal coliform shall not exceed a log mean of 200 MPN/100 mL, nor shall more than 10% of total samples during any 30-day period exceed 400 MPN/100mL.
Petroleum Hydrocarbons: Oil & Grease and Polycyclic Aromatic Hydrocarbons (PAHs)	<ol style="list-style-type: none"> CTR objectives are available for some organic compounds. PAHs are a class of compounds. CTR values for individual PAHs are available for protection of human health only. There are no regulatory standards for the protection of aquatic health. Narrative objective in the Basin Plan for oil & grease: “Waters shall not contain oils, greases, waxes, or other materials in concentrations which result in a visible film or coating on the surface of the water, or which cause nuisances or which otherwise adversely affect beneficial uses.”
Pesticides	<ol style="list-style-type: none"> Narrative objective in the Basin Plan: Toxic substances shall not be discharged to levels that will adversely affect beneficial uses. CTR lists numeric objectives for some, but not all pesticides. There are no CTR criteria for diazinon and chlorpyrifos.
Trash and Debris	<ol style="list-style-type: none"> Basin Plan narrative floatables objective: “Waters shall not contain floating materials, including solids, liquids, foams, and scum, in concentrations which cause nuisance or adversely affect beneficial uses.”

¹Water Quality Control Plan for the San Diego Basin (San Diego Basin Plan) (SDRWQCB, 1994).

²U.S. Environmental Protection Agency, Federal Register, Volume 65, No. 97 (Thursday, 18 May 2000), pp. 31682-31719; and Federal Register, Volume 66, No. 30 (Tuesday 13 February 2001), pp. 9960-9962 (California Toxics Rule and Correction).

³U.S. Environmental Protection Agency, Office of Water, *National Recommended Water Quality Criteria 2002*, EPA 822-R-02-047 (November 2002).

2.4.3 Significance Thresholds for Compliance with Plans, Policies, Regulations, and Permits

The following are significance thresholds associated with compliance with plans, policies, regulations, and permits applicable to hydrologic conditions of concern and pollutants of concern:

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1. Violate waste discharge requirements including applicable provisions of the County of Orange SUSMP, the MS4 NPDES Permit, and MEP.
2. Construction of new storm water drainage facilities or expansion of existing facilities would cause significant environmental effects.
3. Conflict with any applicable plan, policy, or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental effect related to hydrology or water quality.
4. Conflict with applicable San Juan Creek Watershed/Western San Mateo Creek Watershed SAMP Planning Principles (including Corps 404(b) (1) water quality guidelines).

The first three sets of plans and policies and regulations will be addressed in Chapters 4 and 5. The Baseline Conditions Watershed Principles discussed in Section 1.2.1 provide guidance for the WQMP. The Watershed Principle Sub-Basin “Planning Considerations” and “Planning Recommendations” will be addressed within the specific chapters of the WQMP addressing specific sub-basins.

3 WATER QUALITY AND FLOW CONTROL CONCEPT AND ANALYSIS APPROACH

This chapter describes the proposed concept for controlling runoff water quality and flows and the analysis approach used to evaluate the effectiveness of the control system and the effect of the proposed project on flow and water quality. With regard to nomenclature, control of pollutants is defined as “treatment control” whereas control of hydrologic effects is defined herein as “flow control.” This nomenclature differs from that in the LIP where treatment control applies to both water quality and hydrology.

3.1 OVERVIEW

Urban development affects hydrology in two important ways. First, where no urban development has previously occurred, natural vegetated pervious ground cover is converted to impervious surfaces such as paved highways, streets, rooftops, and parking lots. Natural vegetated soil can both absorb rainwater and remove pollutants, providing a very effective natural purification process. Because pavement and rooftops can neither absorb water nor remove pollutants, the natural purification characteristics of the land are lost. As a consequence of adding impervious surfaces, drainage infrastructure is introduced which more rapidly conveys runoff to receiving waters. Secondly, urban development creates new pollution sources as human population density increases and brings with it proportionately higher levels of car emissions, car maintenance wastes, fertilizers, pesticides, household hazardous wastes, pet wastes, trash, etc., which can be washed into the municipal separate storm sewer system (MS4). As a result of these two changes, the runoff leaving a newly developed urban area may be significantly greater in volume, velocity and/or pollutant load than pre-development runoff from the same area. Minimizing a development’s detrimental effects on runoff water quality and quantity can be most effectively achieved through the use of a combination of site design, source control, treatment control, and flow control Best Management Practices (BMPs).

3.1.1 Hydromodification

“Hydromodification” is the term used to refer to changes in runoff characteristics and associated stream impacts that result from land use changes. Many factors and processes interact to influence hydromodification. Figure 3-1 illustrates the hydrologic processes relevant to hydromodification. Regional factors of climate, geology, and physical geography affect the amount of runoff and sediment discharged to stream channels. Land use, soil, and vegetation characteristics affect the proportion of rainfall that infiltrates into the ground or runs off the surface. Local climate, geology, and physical geography also affect the type and amount of sediment that is supplied to the stream system. The changes in stream flow and sediment load that result from land use changes ultimately change the physical characteristics and habitat value of the stream channel.

3.1.2 Local WQMP – Hydrologic Conditions of Concern

In Section A-7.VI-3.2.4 of the Local WQMP, there is a requirement to conduct a drainage study that:

“...shall compute rainfall runoff characteristics from the project area including, at a minimum, peak flow rate, flow velocity, runoff volume, time of concentration, and retention volume. These characteristics shall be developed for the two-year and 10-year frequency, Type I storm of six-hour or 24-hour duration (whichever is the closer approximation of the site’s time of concentration), during critical hydrologic conditions for soil and vegetative cover.”

The requirement also allows the applicant to calculate the storm events using local rain data. For the WQMP, local rain data were used to estimate runoff continuously using a 53-year record of rainfall. This analysis, as described later, takes into account the full spectrum of rainfall runoff events contained in this record, including the two-year and 10-year events called for in the Local WQMP. Advantages of the continuous modeling approach used in this WQMP include:

- Uses continuous long-term records of observed rainfall rather than short periods of data representing hypothetical storm events, thereby allowing the analysis to evaluate effects associated with wet and dry climactic cycles;
- Allows modeling to incorporate detailed information on actual site conditions;
- Allows direct examination of flow duration data for assessing the impact of development on stream erosion and morphology;
- Allows for evaluating effectiveness of control facilities taking into account antecedent conditions such as closely spaced rainfall events and soil saturation; and
- Takes into account the complete range of rainfall-runoff events contained in an approximately 53-year record, including 2 and 10 year return period events.

3.2 APPROACH TO EVALUATING IMPACTS

The assessment of impacts for the B-10M Alternative is based on a combination of quantitative and qualitative analyses. The quantitative analyses include hydrologic modeling (flow duration and water balance studies) and water quality modeling (pollutant loadings modeling) of similar development alternatives (primarily the B-4 Alternative and to a lesser extent, the B-9 Alternative) within various sub-basins. The quantitative analysis approach is summarized in the subsequent sections and is described in detail in Appendices A and B.

The knowledge and understanding achieved through the quantitative impact analysis was used as a basis for qualitative analysis of the B-10M Alternative. Modeling results from analyses of the

B-4 and B-9 Alternatives are extrapolated to the B-10M Alternative in sub-basins where the proposed land uses and associated activities under the B-10M Alternative are comparable or less than those of the modeled development alternatives. The modeled alternative refers to either the B-4 or B-9 Alternative. The B-4 Alternative is the basis for qualitative analyses of the B-10M Alternative in the following sub-basins: the Narrow and Lower San Juan, Chiquita, Gobernadora, PA 3 and PA 5 in Central San Juan and Trampas, Cristianitos, and Gabino. The B-9 Alternative is the basis for qualitative analyses of the B-10M Alternative in the following sub-basins: PA 4 in Central San Juan and Trampas, Verdugo Canyon, Blind and Talega, and Lower Cristianitos.

Table 3-1 shows the basis of qualitative analyses of the B-10M Alternative for each sub-basin. Quantitative modeling results for the B-4 and B-9 Alternatives are provided in Appendix D and Appendix E, respectively.

3.3 HYDROLOGIC MODELING

The USEPA Storm Water Management Model (SWMM) was used to estimate the effects of the proposed development on the hydrologic balance. SWMM is a public domain model that is widely used for modeling hydrologic and hydraulic processes affecting runoff from urban and natural drainages. The model can simulate all aspects of the urban hydrologic cycle, including rainfall, surface and subsurface runoff, flow routing through the drainage network, storage, and treatment. The model is particularly appropriate for analyzing post-development flow duration because the model takes into account the effects of precipitation, topography, land use, soils, and vegetation on surface runoff, infiltration, evapotranspiration, and groundwater recharge.

A detailed description of the hydrologic model, data sources and values, and calibration results is provided in Appendix A.

In the previously conducted modeling, PC-SWMM Version 4 was applied to each sub-basin to model the hydrologic response of the sub-basin under existing and proposed land use conditions, and to assess the hydrologic effectiveness of the proposed BMPs. Each sub-basin was divided into catchments to account for changes in topography, soils, and land use. For example, the Cañada Chiquita Sub-basin was divided into 18 catchments.

The model was applied in a continuous mode in which the model is driven with a continuous record of rainfall. The record extended for 53 years, from Water Year (WY) 1949 to WY 1998. The model was run for 3 periods:

- The entire 53 year period;
- a wet period of 17 years (WY 1978 - 1983 and 1991- 2001); and
- a dry period of 36 years (WY 1949 - 1977 and 1984 - 1990).

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The model incorporates a continuous soil moisture accounting algorithm which requires soil properties to model infiltration and vegetation type to model evapotranspiration. Soils information was obtained from the US Department of Agriculture Soil Survey of Orange County and Western Part of Riverside County, California (1978) and also the hardpan areas mapped by Morton (Morton, 1974). More recent information on hardpan areas was provided by Balance Hydrologics. Evapotranspiration estimates utilized vegetation typing based on the PWA Codes contained in the Baseline Hydrologic Conditions Report (PCR et al., 2002). Reference evapotranspiration rates were obtained from the California Irrigation Management Information System (CIMIS) website (CIMIS, 2003).

Once calibrated for specific sub-basins, the SWMM model was used to model all aspects of the hydrologic cycle (e.g. rainfall, runoff, stream flow, evaporation, infiltration, percolation, and groundwater discharge) over the 53-year period of rainfall records. The output from the model includes:

- Continuous stream flow hydrographs for storm events at any location in the sub-basin
- Continuous stream flow hydrographs for dry weather base flows
- The amount of precipitation that is infiltrated within each modeled catchment
- A continuous estimation of evaporation losses from the surface and subsurface due to evapotranspiration by plants within each modeled catchment

This output was then used to accumulate, by month, the volume of storm runoff, groundwater flows, and evapotranspiration.

Runoff volumes and flows were predicted for three scenarios:

- Pre-development or existing condition
- Post-development condition without BMPs
- Post-development with BMPs condition

The latter scenario involved evaluating the effectiveness of the flow and water quality management facilities, and trying to optimize the performance of these facilities.

Table 3-1: Basis of Qualitative Analyses of the B-10M by Sub-basin

	San Juan Watersheds					San Mateo Watersheds				
	Narrow/ Lower San Juan	Chiquita	Gobernadora	Central San Juan/ Trampas	Verdugo Canyon	Cristianitos	Gabino	La Paz Canyon	Blind/ Talega Canyon	Lower Cristianitos
Basis for qualitative assessment of the B-10M alternative	This sub-basin not modeled. Based on modeling of B-4 Alt. in Chiquita and Gobernadora Sub-basins	Modeling of B-4 Alt. in Chiquita	Modeling of B-4 Alt. in Gobernadora	Modeling of B-4 Alt. in PA3 and PA5, and modeling of B-9 Alt in PA4	Modeling of B-9 Alt. in PA4	Modeling of B-4 Alt. in Cristianitos Canyon	Modeling of B-4 Alt. in Gabino	NA ¹	Modeling of B-9 Alt in Talega/ Blind	This sub-basin not modeled. Based on modeling of B-9 Alt in Talega/ Blind

¹ Not assessed. Alternative has no proposed development within sub-basin.

3.4 WATER BALANCE AND FLOW DURATION ANALYSIS

The effect of development on modifying the hydrologic regime within the riparian corridors and the subsequent effect on sediment transport and habitat are “hydrologic conditions of concern”. This effect was analyzed by comparing pre- versus post-development monthly *water balance* and *flow duration*.

3.4.1 Water Balance Analysis

This Conceptual WQMP strives to manage the overall balance, termed “*water balance*”, of all the hydrologic components of the water cycle. The water balance concept is a useful accounting tool for evaluating and controlling the effects of land use changes on hydrology. A water balance, like a checkbook balance, is intended to show the balance between the “deposits”, which include precipitation and irrigation, and “withdrawals” which include (1) infiltration into the soils, (2) evapotranspiration, and (3) water which runs off the surface of the land. This latter “withdrawal” is called surface runoff and occurs during storm events or wet weather conditions. Surface runoff includes runoff from open areas as well as runoff from urban areas. The water balance is a monthly accounting of how precipitation and irrigation water becomes distributed among (a) surface runoff, (b) groundwater infiltration that contributes to base flows in streams or deep groundwater recharge, and (c) evapotranspiration. The elements in the water balance are described below and are depicted in Figure 3-1.

Water that infiltrates into the ground ultimately moves down gradient and can contribute to stream flows. The contribution of groundwater flow provides for flow in streams when it is not raining, and it often referred to as “base flow.” In semi-arid areas, the water balance varies dramatically from season to season, and from stream to stream. In streams where the groundwater storage is sufficient to sustain stream flows throughout the year, the streams are referred to as perennial. In streams where groundwater aquifers have limited infiltration capacity, the base flows are limited to the wet season and the streams are called intermittent or ephemeral streams. In the San Juan and San Mateo watersheds, both types of streams exist, and the distinction is carefully preserved in the impact analysis.

A key element in the evaluation of impacts for the proposed alternatives is modeling changes to the water balance caused by development and the extent to which the existing water balance could be maintained using BMPs. The description of the overall modeling approach is provided below and in Appendix A.

- *Precipitation.* In undeveloped areas, precipitation is the main source of water to the watershed. Precipitation occurs primarily as rain from general winter storms during the wet season from October through March. Little rainfall occurs during the dry season from April through September. The average annual rainfall in the study area is about 15 inches.

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- *Landscape Irrigation.* In developed areas, the importation of non-domestic water supplies for irrigation is an important additional source of water in semi-arid areas.
- *Surface Runoff.* The amount of surface runoff from precipitation depends on the rainfall intensity, vegetation, slope, soil properties, and antecedent soil moisture. Impervious areas and drainage infrastructure associated with urban development can dramatically increase surface runoff if hydrologic responses are not considered and/or hydrologic source controls are inadequate.
- *Infiltration.* For typical small frequent storms, the vast majority of the precipitation will infiltrate into the subsurface. The amount and rate of infiltration depends on the surficial and sub-surface soil types, vegetation coverage, slope, and soil moisture. Infiltration diminishes over the duration of storm events and in relation to the state of saturation in the soils. Urban development can potentially cause hydromodification by covering infiltration areas with impervious surfaces and also by irrigating the pervious areas.
- *Groundwater Discharge and Base flows.* Groundwater discharge supports dry season stream flow and wet season base flow between storms. The duration and aerial extent of groundwater flows vary among the sub-basins, influenced by the geologic and hydrologic characteristics of the sub-basins. Sandy sub-basins (Chiquita and Gobernadora) support perennial or near perennial flows. Other sub-basins only sustain intermittent or ephemeral stream flow following the rainy season because the geologic conditions do not enable the storage and movement of substantial volumes of water to the creek through groundwater.
- *Evapotranspiration.* Plant roots uptake water from the soils and transpire the water through pores in the leaves. Plant water requirements depend on the type of plant, the root structure, the time of year, and the availability of water. Many plants such as coastal sage scrub have relatively low water requirements whereas wetland and riparian plants such as willows have high water usage. Typically, plant water uptake is higher in the summer.

Historical dry and wet cycles over a period of years or decades have an important effect on the water balance, and thus the water balance analyses were conducted for dry and wet cycles within the available rainfall record. In semi-arid areas, the variability in the water balance between wet and dry cycles is important to characterize when defining the baseline conditions.

Anticipated water usage for landscape irrigation was incorporated into the water balance based on data obtained from the Santa Margarita Water District's *Plan of Works for Improvement Districts 4C, 4E, 5, and 6* (Tetra Tech, 2003). The District receives domestic water supply from the South County Pipeline, which conveys imported water from the Metropolitan Water District of Southern California to south Orange County via the Allen-McColloch Pipeline. The San Juan Groundwater Basin, which underlies the Planning Area, is another potential supply source. RMV has historically taken up to 3,500 acre-feet per year from this basin for agricultural

irrigation. However, because of the uncertainty regarding water reliability and water quality for domestic supply, it was assumed in the *Plan of Works* report that 100 percent of the domestic water supply for the Planning Area will come from imported water via the South County Pipeline (Tetra Tech, 2003).

The Chiquita Water Reclamation Plant (CWRP) will supply non-domestic water through tertiary treatment of domestic wastewater. Groundwater supply from the San Juan Groundwater Basin could augment the reclaimed water supply provided by the CWRP. Although the groundwater is high in TDS, treatment might not be required for landscape and golf course irrigation. However, because water reliability and water quality have not been established at this time, it is assumed for the *Plan of Works* that groundwater from the San Juan Groundwater Basin will not be available and 100 percent of the non-domestic water supply will come as reclaimed water from CWRP (Tetra Tech, 2003).

Based on this information, the water balance analysis assumed that all irrigation water will be imported from outside the sub-basin.

An example illustration of the existing conditions water balance results is shown in Figure 3-2 for the Chiquita Sub-basin. The water balance reflects the entire 53-year rainfall record used in the SWMM modeling. The figure shows the predicted monthly water balance for existing conditions in terms of surface runoff, groundwater infiltration that ultimately will contribute to stream base flows, and evapotranspiration. Surface runoff is predicted to occur in the months of November through April and constitutes only about one to three percent of the water balance. The majority of water is predicted to either infiltrate or evapotranspire. The infiltration that feeds base flows continues throughout the year, which is consistent with the observation that Chiquita is perennial in its lower reaches. Base flows are predicted to be highest in February through March, while evapotranspiration peaks in April and May.

3.4.2 Flow Duration Analysis

The impacts of urbanization on hydrology include increased runoff volumes, peak flow rates, and the duration of flows, especially modest flows less than the 10 year event. Yet it is these more frequent, modest flows that can have the most effect on long-term channel morphology (Leopold, 1997). The effect of changes in flow on stream geomorphology is a cumulative one; therefore the magnitude of the flows (volume and flow rate), how often the flows occur (the frequency), and for how long (the duration) are all important. Managing the frequency and duration of flows is referred to herein as “*flow duration matching*” and refers to matching the post-development flow duration conditions with pre-development conditions. This matching is achieved through appropriate sizing of a flow duration basin and design of the outlet structure. In order to achieve flow duration matching, “*excess flows*”, defined as the difference in runoff volume between the post-development without controls condition and the pre-development condition, must be captured and either infiltrated, stored and recycled, or diverted to a less sensitive stream or stream reach. The technical aspects of the flow duration analysis are presented below, along with an example of flow duration matching.

Flow duration can be expressed in a “histogram form” that illustrates the amount of time that flow in a stream is within various ranges (Figure 3-3), or alternatively in the form of a “cumulative distribution” that illustrates how often flow exceeds a given value. The latter form is referred to as a “flow duration curve.” Note that a flow duration analysis addresses all flows in a given record and is different from a peak flow frequency analysis which is conducted for flood control.

An example flow duration curve for a catchment in the Gobernadora Sub-basin is shown in Figure 3-4. The three curves correspond to pre-development or existing conditions, post-development without control, and post-development with flow control. The post-development curve illustrates that the effect of development is to increase the duration of flows; that is, the flow duration curve moves to the right indicating that both volume and duration of flows increase. Also note that this is a logarithmic scale on the horizontal axis, so small changes along the axis may indicate large changes in volume and duration. The effect of flow control is to reduce the durations to more closely approximate the existing condition.

The flow duration analyses were conducted for the 53-year continuous rainfall record and the dry and wet cycles within that record as described above.

3.5 COMBINED FLOW AND WATER QUALITY CONTROL SYSTEM

In order to achieve flow duration matching, address the water balance, and provide for water quality treatment, a combined flow and water quality control system (termed *combined control system*) will be utilized.

3.5.1 Combined Control System Components

The proposed combined control system will include one or more of the following components, each of which provides an important function to the system (Figure 3-5):

- Flow Duration Control and Water Quality Treatment (FD/WQ) Basin
- Infiltration Basin
- Bioinfiltration Swale
- Storage Facility for Recycling Water for Non-Domestic Supply
- Diversion Conduit to Export Excess Flows out of the Sub-basin.

The flow duration control and water quality treatment basin provides the initial flow and water quality treatment control functions to the system. The remaining components address the excess flows, alone or in combination with each other, generated during wet weather. Additional water quality treatment control is also provided in the infiltration basin and bioinfiltration swale.

The treatment components were selected taking into account the pollutants of concern and those BMPs that are effective at treating them (Table 3-2). BMP performance data used for this purpose included national as well as local data, including DAMP Appendix E1, *BMP Effectiveness and Applicability for Orange County* (June 2003).

Table 3-2: Treatment Control BMP Selection Matrix¹

Pollutant of Concern	Treatment Control BMP Categories					
	Biofilters	Detention Basins	Infiltration Basins	Wet Ponds or Wetlands	Filtration	Hydrodynamic Separator Systems
Sediment/Turbidity	H/M	H/M	H/M	H/M	H/M	H/M
Nutrients	L	H/M	H/M	H/M	H/M	L
Trace Metals	M	M	H	H	H	L
Pathogens	U	U	H/M	U	H/M	L
Petroleum Hydrocarbons	H/M	H/M	U	U	H/M	L/M
Pesticides	U	U	U	U	U	L
Trash and Debris	L	H/M	U	U	H/M	H/M

¹Local WQMP Table A-7.VI-6, except for Trace Metals treatment performance, which was taken from the California Stormwater Best Management Practices Handbook for New Development and Redevelopment (CASQA, 2003).

H/M = High or medium removal efficiency; L = low removal efficiency; U = unknown removal efficiency.

The following sub-sections describe each combined control system component in more detail.

Flow Duration Control and Water Quality Treatment (FD/WQ) Basin

The flow duration control and water quality treatment (FD/WQ) basin will provide both flow control and water quality treatment in the same basin. Detention basins are the most common means of meeting flow control requirements. The concept of detention is to collect runoff from a developed area and release it at a slower rate than it enters the collection system. The reduced release rate requires temporary storage of the excess amounts in a basin with release occurring over a few hours or days. The volume of storage needed is dependent on 1) the size of the drainage area; 2) the extent of disturbance of the natural vegetation, topography and soils, and creation of impervious surfaces that drain to the stormwater collection system; 3) the desired detention capacity/time for water quality treatment purposes; and 4) how rapidly the water is allowed to leave the FD/WQ basin, i.e., the target release rates.

The FD/WQ basin will incorporate extended detention with a 48-hour draw down time to provide water quality treatment for storm flows. Extended detention basins are designed with outlets that detain the runoff volume from the water quality design storm (e.g., the 85th percentile 24-hour event) for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Laboratory settling column tests indicate that 48 hour settling achieves 70 to 90 percent TSS removal depending on the influent TSS (Grizzard et. al., 1986). According to the

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data contained in EPA's International BMP Database, the median TSS effluent concentration for extended detention ponds is approximately 30 mg/L (Winer, 2000). TSS effluent concentrations for extended detention basins based on Caltrans studies resulted in a mean concentration of 39 mg/L (DAMP Appendix E1). These fact sheets provide information on design, operation and maintenance, relative removal effectiveness (high, medium, low) and experience with emphasis on California conditions and where available, experience in Orange County. Dry Extended Detention basins are described in fact sheet TC-22 which indicates that the relative removal effectiveness for solids is medium. These fact sheets, along with other data sources, were used to help select appropriate source and treatment control BMPs.

The FD/WQ basin will also incorporate wetland vegetation in a low flow channel along the bottom of the basin for the treatment of dry weather flows and small storm events (Figure 3-6 and 3-7). Water cleansing is a natural function of wetlands, offering a range of treatment mechanisms. Sedimentation of particulates is the major removal mechanism. However the performance is enhanced as plant materials allow pollutants to come in contact with vegetation and soils containing bacteria that metabolize and transform pollutants, especially nutrients. Plants also take up nutrients in their root system. These processes are most effective when the wetland is designed to have a retention time for dry weather flows of one to two weeks. The effectiveness of this natural treatment concept has been demonstrated regionally in the Irvine Ranch Water District's (IRWD) San Joaquin Marsh and in the Prado Dam wetlands that treat reclaimed water that ultimately is recharged in the recharge basins in the Santa Ana River. The success of the San Joaquin Marsh has led IRWD to propose a network of constructed wetlands as part of a Natural Treatment System Master Plan (IRWD, 2003). This plan would locate multiple wetlands throughout the 122 square mile San Diego Creek Watershed. Modeling has indicated that the system will substantially meet the ultimate target nitrogen reductions called for in the Upper Newport Bay TMDL. Monitoring data collected by Orange County as part of their Regional Monitoring Program are showing that interim nutrient targets are already being met. Dry weather flows and small storm flows will tend to infiltrate into the bottom of the basin after receiving treatment in the low flow wetlands.

To the extent feasible depending on the topography and grade, the FD/WQ basin will be located in areas where there is a larger depth to groundwater and more infiltrative soils. For example, in Chiquita and Gobernadora, FD/WQ basins will be located in the side canyons if feasible. The FD/WQ basin is designed to have two active volumes, a low flow volume and a high flow volume. The low flow volume is designed to capture small to moderate size storms, the initial portions of larger storms, and dry weather flows. The high flow volume is designed to store and release higher flows to maintain, to the extent possible, the pre-development runoff conditions.

Infiltration Basin

The second element in the combined control system is a separate downstream, shallow infiltration basin designed consistent with the LIP requirements for groundwater protection. Suitable soils are those having a high infiltration capacity. Such conditions tend to be more prevalent in the San Juan Creek watershed in contrast to the San Mateo Creek watershed. Water

captured in the low flow volume of the FD/WQ basin will be routed to the infiltration basin after treatment. The infiltration basin is sized to infiltrate all the flows released from the lower volume in the FD/WQ basin; nonetheless, an overflow system would convey excess flows that may occur during very wet years to the bioinfiltration swale discussed below. Additional water quality treatment is achieved in the subsurface soils below the infiltration basin through the natural filtering ability of the soil.

Infiltration is identified as having a high/medium removal efficiency for bacteria and viruses by the Orange County Local WQMP, and therefore is an appropriate treatment choice for this primary pollutant of concern.

The quality of infiltrated stormwater has been studied extensively and it has generally been concluded that many pollutants in stormwater are effectively treated in the uppermost soil layers of infiltration basins. A Nationwide Urban Runoff Program Project conducted in Fresno, California, indicated that chemicals that tend to adsorb to particulates (e.g., trace metals) are effectively removed in the upper few centimeters of the soil column (Brown & Caldwell, 1984). Even chemicals such as organochlorine pesticides and polycyclic aromatic hydrocarbons in an industrial catchment in Fresno were found to be adsorbed to the upper 4 centimeters of sediment (Schroeder, 1995).

A nationwide review by Pitt (1994) pointed out that the greatest risk to groundwater was associated with dissolved pollutants such as nitrates that are relatively mobile in groundwater, and especially in soil conditions that lack organics. Features of the proposed combined control system that guard against groundwater contamination include: (1) pretreatment of all runoff in a FD/WQ basin (see review discussion of the ability of natural treatment systems to remove dissolved pollutants such as nitrates) before it enters the infiltration basin, and (2) locating infiltration basins where there is at least 10 feet of separation to the groundwater. Some incidental infiltration will occur in the FD/WQ basin upstream of the infiltration basins; however, in these basins pollutants will be taken up by the wetland vegetation and the adsorptive organic layer that will form on the bottom of the basin.

Bioinfiltration Swale

The third element of the combined control system is a bioinfiltration swale that leads from the FD/WQ basin to the stream channel. A bioinfiltration swale is a relatively flat, shallow vegetated conveyance channel that removes pollutants through infiltration, soil adsorption, and uptake by the vegetation. Pollutant removal in bioinfiltration systems is sensitive to swale length and detention time, but well designed swales show good performance for many pollutants. For example, according to EPA's International BMP database, the mean effluent TSS from bioswales is about 24 mg/L. Median TSS removal ranges from about 70 to 90 percent depending on the swale type (Winer, 2000). According to DAMP Appendix E1, vegetated swales studied by Caltrans at highway sites achieved a mean effluent concentration of 47 mg/L.

In areas characterized by terrains with good infiltration capabilities, flows released from the FD/WQ basin and carried in the bioinfiltration swale will mimic pre-development conditions, in which low flows infiltrate in the soils and only high flows reach the main stem of the stream channel. In catchments where development is located on less pervious soils and therefore pre-development runoff is higher, the swale may be lined to better mimic pre-development hydrology.

Flows in the swales also will be controlled by the upstream flow duration/water quality basins so as to minimize the re-suspension of sediments and associated pollutants during high flow events.

Storage Facility for Recycling Water for Non-Domestic Supply

The fourth possible element of the combined control system is storage of surface water flows for recycling where there is opportunity for reuse of water for irrigation, such as a golf course, residential common area, or local parks. Diversion of outflows from the FD/WQ basin to non-domestic water supply reservoirs will be conducted if feasible and cost effective.

Diversions Conduit to Export Flows out of the Sub-basin

The fifth possible element of the combined control system is the provision to export flows out of the sub-basin. This element provides an additional option that may be employed to better preserve the pre-development water balance within the sub-basin. Such diversions may be desirable where excess runoff could result in increased stormwater flows or increased base flows in sensitive streams. The diversions would be for excess runoff only and would only be feasible for development that adjoins other sub-basins having less sensitive stream channels, or are close to San Juan Creek or Lower Cristianitos Creek, which have characteristics that allow them to handle additional flows without causing damage to the stream channel. In some locations, such as Cañada Chiquita, it may also be feasible to divert flows to the wastewater treatment plant for reclamation.

Although the concept shown in Figure 3-5 is the basis for the impact analysis, the actual application of the concept to specific development area within each catchment could differ. For example, alternative infiltration opportunities could include golf course water features, or opportunities within the development itself, including the use of recreation fields or common landscaped areas for detention or infiltration, or roadside infiltration trenches. Non-domestic water supply reservoirs could also be used to store water for irrigation or other non-potable use, which would reduce the amount of infiltration required to match flow durations. Figures 3-6 and 3-7 are graphical illustrations of the plan and section views of the combined control system concept.

3.5.2 Sizing and Design of Flow Duration and Water Quality Basins

The FD/WQ basins will be sized to maintain, to the extent possible, the pre-development runoff volume and flow duration over the total range of flows predicted by the hydrologic model for a

53-year rainfall record at the Trabuco Canyon rain gauge. Maintaining the pre-development duration of flows serves to control increases in downstream channel erosion that may otherwise occur due to development. The simplest way to visualize this control strategy is a histogram of pre- and post-development flows which shows the duration of flows within various “flow bins”, where a flow bin is defined as a specific range of flows. For example, a sequence of flow bins could contain all flows between 10 to 20 cfs, 20 to 30 cfs, 30 to 40 cfs, 40 to 50 cfs, etc. Figure 3-3 illustrates the concept of a flow duration histogram for pre-development conditions and post development conditions without any flow control. To maintain flow duration requires that the combined control system modify the post-development flow frequency (counts) shown in the figure such that the post-development-with-controls flow frequency matches the pre-development flow frequency for each flow bin.

The FD/WQ basins were sized using an iterative process of adjusting basin storage while selecting and adjusting orifice sizes in the outlet structure in the following manner:

1. The low flow volume within the basin was initially sized to capture the increase in runoff volume that is generated from the impervious surfaces. This capture volume is dependent on the development characteristics, the soil types, and the magnitude of change in runoff created by the proposed development. For example, for development bubbles in the Gobernadora Sub-basin where proposed development would be located on extensive areas of hardpan, the capture volumes required were small, or in some cases, zero.
2. Once the lower volume was sized to capture the correct runoff volume, the upper volume of the basin was sized to detain and discharge larger flows through a specific set of orifices in such a way as to reproduce the pre-developed flow duration curve. The number, diameter, and elevation of these orifices were determined using a trial and error approach. Experience indicates that sizing the lower portion of the basin to capture the correct volume of runoff, and designing the outlet structure to detain and discharge high flows from the upper portion of the basin allows one to match the pre-development flow duration curve.

The effectiveness of the combined control system, by including a sequence of treatment controls, will be shown in later sections to meet or exceed the “percent treated” performance standards called for in the Orange County Local WQMP.

FD/WQ Basin Sizing Example

Table 3-3 below presents the results for Gobernadora Catchment 1 as an example to illustrate FD/WQ basin sizing. The first group of data specifies the basin footprint (area), side slopes, and resulting basin dimensions. The second group of data specifies the orifice sizes and elevations. The third group of data defines how the area, volume (V2), and discharge (O2) of the basin vary with the water depth in the basin. The table clearly illustrates how the various sets of orifices affect outflow as a function of water depth in the basin.

Note that there is no unique solution to matching flow duration and that a number of orifice configurations and basin sizes can reproduce the flow duration curve and capture volumes. Thus some of the variability between catchments is due to this non-uniqueness as well as catchment specific conditions.

There are four sets of orifices that range in size from 9.5 to 18-inches and range in elevation from 0 to 3.7 feet. The required number of orifices and flow area are also provided. Figure 3-8 illustrates the configuration of orifices in an outlet structure headwall. Other configurations are possible, as well as other types of discharge devices, such as sharp or broad crested weirs. The final basin has an area of 4.2 acres, a depth of 5 feet, and total storage volume of about 20 acre-feet. The low flow volume is essentially the storage up to 3 feet, or to the bottom of the row labeled Orifice Row 2 (Figure 3-8). The orifices labeled Orifice Row 1 help to maintain the proper number of hours of very low flows. The area of the single orifice in Row 1 is too small to significantly affect the drain time, which is an important consideration for water quality treatment. (Clogging of small orifices is always of concern, but measures such as extending a vertical riser with gravel packs and filter fabric can be used to avoid clogging.) Table 3-4 shows the resulting drain time after sizing the combined control system for flow duration and volume control in Gobernadora Catchment 1. The objective is to provide about 48 hours of detention at 3-foot depth for water quality treatment. The 3-foot elevation is the division between the low and high volumes. This system provides about 48 hours of detention for storms that are large enough to fill the lower portion of the basin, and at least 24 hours for smaller storms that only fill the basin to 1 foot depth, as recommended in the California Stormwater BMP Handbook (CASQA, 2003). This design criterion ensures that even very small storms receive reasonable treatment. These drain times are typical of all of the proposed FD/WQ basins.

3.6 WATER QUALITY ANALYSIS

3.6.1 Surface Water

Water Quality Modeling – Wet Weather Flows

The purpose of the water quality analysis was to compare pre- vs. post-development loads and concentrations for the pollutants of concern. An empirical method is used that incorporates measured data of stormwater quality in runoff from specific land use types. The ideal form of the data is event mean concentrations, which are flow composite samples. Stormwater quality data is quite variable and the preferred sources of data are those where there are sufficient storm events sampled that statistical measures are reliable. Sources of land use runoff water quality data included that collected by Wildermuth Environmental within the Project area (presented in Appendix C), data collected by Los Angeles County (Los Angeles County, 2000), and data collected by Ventura County (VCFCD, 1997 - 2001). Pollutant loads were estimated by combining the water quality data with flow estimates obtained from the SWMM modeling.

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Table 3-3: Pond Design Using Flow Duration Control

Pond Design									
width	length	side slope (H:1V)	Δt (sec)		VOLUME 19.8 AC-FT				
400	400	3	600		SURF. AREA 4.2 AC				
ORIFICES	@ depth (ft)	#	diameter (in)	diameter (ft)	A	Total A	Asqrt(2g)	Cd	
Orifice 0	0	1	9.50	0.792	0.4922	0.492	3.950	0.62	Diverted
Orifice 1	2	1	10.00	0.833	0.5454	0.545	4.377	0.62	To Stream
Orifice 2	3	20	15.00	1.250	1.2272	24.5	197.0	0.62	To Stream
Orifice 3	3.7	20	18.00	1.500	1.7671	35.3	283.6	0.62	To Stream
STAGE	Area	V2	Retained	FlowOri1	FlowOri2	FlowOri3	O2	0.5O2Dt	0.5O2Dt+V2
0.0	160000	0	0.00	0.00	0.00	0.0	0.0	0	0
0.5	162409	80602	1.68	0.00	0.00	0.0	1.7	503	81104
1.0	164836	162412	2.37	0.00	0.00	0.0	2.4	711	163123
1.3	166056	203773	2.65	0.00	0.00	0.0	2.7	795	204568
1.5	167281	245441	2.90	0.00	0.00	0.0	2.9	871	246311
1.8	168510	287414	3.14	0.00	0.00	0.0	3.1	941	288355
2.0	169744	329696	3.35	0.00	0.00	0.0	3.4	1006	330702
2.3	170982	372287	3.56	1.313	0.00	0.0	4.9	1461	373747
2.5	172225	415188	3.75	1.857	0.00	0.0	5.6	1681	416869
2.8	173472	458400	3.93	2.275	0.00	0.0	6.2	1862	460261
3.0	174724	501924	4.11	2.626	0.00	0.0	6.7	2020	503944
3.3	175980	545762	4.27	2.936	59.09	0.0	66.3	19891	565653
3.5	177241	589915	4.43	3.217	83.57	0.0	91.2	27367	617281
3.8	178506	634383	4.59	3.474	102.35	38.1	148.5	44542	678925
4.0	179776	679168	4.74	3.714	118.19	93.2	219.9	65958	745126
4.3	181050	724271	4.89	3.940	132.14	126.2	267.2	80154	804425
4.5	182329	769694	5.03	4.153	144.75	152.2	306.2	91846	861539
4.8	183612	815436	5.17	4.355	156.35	174.4	340.3	102078	917515
5.0	184900	861500	5.30	4.549	167.14	194.0	371.0	111311	972811
			IO %Error	%Stream Q	%Treated	Max Stage			
			0.00386	0.37	0.63	4.51			

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Table 3-4: Drain Time as Function of Stage in FD/WQ Basin

Stage (feet)	Drain time (hours)	Cumulative Drain Time (hours)	Storage (ac-ft)
0	0	0	0
0.50	13.4	13.4	1.9
1.00	9.6	22.9	3.7
1.25	4.3	27.3	4.7
1.50	4.0	31.3	5.6
1.75	3.7	35.0	6.6
2.00	3.5	38.5	7.6
2.25	2.4	40.9	8.5
2.50	2.1	43.0	9.5
2.75	1.9	45.0	10.5
3.00	1.8	46.8	11.5
3.25	0.2	47.0	12.5
3.50	0.1	47.1	13.5
3.75	0.1	47.2	14.6
4.00	0.1	47.2	15.6
4.25	0.0	47.3	16.6
4.50	0.0	47.3	17.7
4.75	0.0	47.4	18.7
5.00	0.0	47.4	19.8

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Orange County also conducts an extensive Regional Monitoring Program, however the focus is on monitoring in streams to help evaluate TMDL compliance, rather than monitor in storm drain systems where the tributary areas are dominated by a single land use. These data have been used in helping to establish the environmental setting, but are not suitable as input for modeling land use runoff quality.

In addition to predicting runoff water quality, the effectiveness of proposed treatment facilities was predicted. BMP effectiveness data were obtained in the form of effluent water quality for various BMP types as contained in the ASCE/EPA International BMP Database (Strecker et al., 2001). Relative performance information provided in the Orange County BMP Fact Sheets were also reviewed for consistency. BMPs for golf courses were selected based on previous experience of GeoSyntec Consultants and the Arroyo Trabuco Golf Course WQMP (Psomas, 2003). Loads were estimated by combining the flows provided by SWMM with the effluent water quality data.

The preferred form of data used to address water quality are flow composite storm event samples, which are measures of the average water quality during the event. To obtain such data usually requires automatic samplers that collect data at a frequency that is proportionate to flow rate. The pollutants for which there are sufficient flow composite sampling data are: total suspended solids, nutrients, and trace metals.

The other pollutants of concern - pathogens, pesticides, hydrocarbons, and trash and debris, are not amenable to this type of sampling either because of short holding times (e.g., pathogens), difficulties in obtaining a representative sample (e.g., hydrocarbons), low detection levels (e.g., pesticides), or cost. These pollutants were addressed qualitatively using literature information and best professional judgment due to the lack of statistically reliable monitoring data for these pollutants. Site specific monitoring data collected by Wildermuth Environmental within the Project area were also used to qualitatively address certain pollutants, especially pesticides.

Dry Weather Flows

The wet weather water quality analysis focuses on the changes in water quality during storm events. However, water quality effects during dry weather conditions also are important, especially given that much of the dry weather flows in this region are of anthropogenic origin.

Dry weather flows are typically low in sediment because the flow rates are relatively low and coarse suspended sediment tends to settle out or are filtered out by vegetation. As a consequence, pollutants that tend to be associated with suspended solids (e.g., phosphorus, some trace metals, and some pesticides) are typically found in very low concentrations in dry weather flows. The focus of the dry weather analysis is therefore on constituents that tend to be dissolved, e.g., nitrate, or constituents that are as small as to be effectively transported, e.g., bacteria and some organophosphate pesticides. The analysis conducted for dry weather flows was further simplified because most post-development dry weather flows will be infiltrated in the FD/WQ basins, or subsequent downstream facilities prior to any discharge downstream.

3.6.2 Groundwater Quality

Groundwater quality will be protected from potential impacts through the implementation of the restrictions on the use of infiltration BMPs outlined in the DAMP. The DAMP restrictions include the following:

- Landscape drainage features will be designed so that they promote infiltration of runoff, but do not inject runoff so that it bypasses the natural processes of filtering and transformation that occur in the soil.
- Reasonable steps will be taken to prevent the illegal discharge of wastes to the drainage system.
- Infiltration basins will not collect drainage from, or be located near, work areas where wash water or liquid wastes will be generated or where hazardous chemicals are stored.
- Infiltration basins will be clearly marked with “no dumping” signs and will be inspected regularly.
- Source Control BMPs will be implemented at a level appropriate to protect groundwater quality (see WQMP Section 4.1.3).
- All runoff will be pretreated in a FD/WQ basin before it enters an infiltration basin.
- The vertical distance from the base of all infiltration basins to the seasonal high groundwater mark will be at least 10 feet.
- The soil through which infiltration is to occur has physical and chemical characteristics (such as appropriate cation exchange capacity, organic content, clay content, and infiltration rate) that are adequate for proper infiltration durations and treatment of urban runoff for the protection of groundwater beneficial uses.
- Stand alone infiltration BMPs will not be used directly for areas of industrial or light industrial activity; areas subject to high vehicular traffic; automotive repair shops; car washes; fleet or RV storage areas (bus, truck, etc.); nurseries; and other high threat to water quality land uses and activities as designated in the Orange County Local Implementation Plan. Drainage from these areas will be combined with runoff from residential and open space areas prior to receiving treatment and infiltrating in a combined control system facility.
- The horizontal distance between the base of any infiltration basin and any water supply wells will be 100 feet or as determined on an individual, site-specific basis by the County of Orange.

3.7 SPATIAL SCALES OF ANALYSIS

The various analyses described above were applied at one or more of the following spatial scales.

- Development planning area scale
- Catchment scale
- Sub-basin scale
- Watershed Scale

The development planning area is the area affected by development, and is the area which causes the major changes in surface water hydrology and water quality. The flow duration analysis and selection and design of the BMPs were conducted at this scale. Sizing BMPs for the other scales would have led to much larger flow control and water quality facilities.

Each of the sub-basins was divided into catchments for the hydrologic and water quality modeling. This sub-aggregation is necessary to take into account the variability in soils, vegetation, topography, and land use in the modeling. The water quality modeling and water balance were conducted at this scale, but the results were aggregated and are presented primarily on the sub-basin scale.

The sub-basin scale is the basic planning scale that has been used in the various resource studies conducted to date, and has been used for the WQMP development and impact assessment. This scale allows for analysis of the potential impacts of the proposed land uses on the hydrology and water quality of the tributaries to San Juan Creek and San Mateo Creek within the boundary of the proposed alternatives. The WQMP strives to protect and enhance the designated beneficial uses which are provided in these tributaries.

The watershed scale encompasses various sub-basins and includes portions of two watersheds - the San Juan Creek watershed and the San Mateo Creek watershed. Impacts at this scale may include other factors beyond the proposed alternatives (e.g., the effects of major transportation corridors) and are addressed in the cumulative impact analysis in Chapter 7. Impacts to San Juan Creek and San Mateo Creek are assessed as cumulative impacts.

4 WATER QUALITY MANAGEMENT PLAN ELEMENTS

This chapter presents the Water Quality Management Plan elements for Alternative B-10M. The WQMP elements have been developed based on the general Local WQMP requirements (identified by italics) and sub-basin specific water quality and hydrologic issues as identified in the *Draft Watershed and Sub-basin Planning Principles* (NCCP/SAMP Working Group, 2003a). The WQMP elements can be divided into two categories: 1) general elements that apply to all of the Planning Areas, and 2) sub-basin specific elements. The general elements - including site design BMPs, source control BMPs, and operations and maintenance - are presented in Section 4.1.

The sub-basin specific elements, described in Sections 4.2 through 4.9, build on information set forth in the *Baseline Conditions Report* (PCR et al, 2002) and in the *Draft Watershed and Sub-basin Planning Principles* (NCCP/SAMP Working Group, 2003a). Specifically, the *Sub-basin Planning Principles* have been employed and the sub-basin “Planning Considerations” and “Planning Recommendations” have been addressed and employed in formulating flow control and water quality control strategies in response to the geographic-specific conditions found in each sub-basin.

4.1 GENERAL WATER QUALITY MANAGEMENT PLAN ELEMENTS (WQMP)

4.1.1 BMP Selection

New development and significant redevelopment projects are required by the Local WQMP to develop and implement a Project WQMP that includes BMPs. Priority projects such as the RMV Project must include types of BMPs in each of the following categories:

- *Site Design BMPs;*
- *Source Control BMPs; and*
- *Project-based Treatment Control BMPs and/or participation in an approved regional or watershed management program.*

Projects for which hydrologic conditions of concern have been identified shall also control post-development peak stormwater runoff discharge rates and velocities to maintain or reduce pre-development downstream erosion rates and to protect stream habitat.

The BMPs that have been incorporated into the WQMP have been selected to address the pollutants and hydrologic conditions of concern listed in Chapter 2. Site design BMPs are discussed below in Section 4.1.2 and source control BMPs are discussed in Section 4.1.3. The conceptual combined control system, which addresses both pollutants of concern and hydrologic conditions of concern, is described in Section 3.2.

4.1.2 Site Design BMPs

Projects can partially address the Local WQMP objectives through the incorporation of appropriate site design BMPs intended to create a hydrologically functional project design that attempts to mimic the natural hydrologic regime. Mimicking a site's natural hydrologic regime can be pursued by:

- Reducing imperviousness, conserving natural resources and areas, maintaining and using natural drainage courses in the municipal storm drain system, and minimizing clearing and grading.
- Providing runoff storage measures dispersed uniformly throughout a site's landscape with the use of a variety of detention, retention, and runoff practices.
- Implementing on-lot hydrologically functional landscape design and management practices.

Runoff from developed areas may be reduced by using alternative materials or surfaces with a lower coefficient of runoff, or "C Factor". The C Factor is a representation of the ability of a surface to produce runoff. Surfaces that produce higher volumes of runoff are represented by higher C Factors. By incorporating more pervious lower-C-factor surfaces into a development, lower volumes of runoff will be produced. Lower volumes and rates of runoff translate directly to smaller treatment design volumes.

The Local WQMP requires that the site design options and characteristics listed in Table 4-1 be considered and incorporated, where applicable and feasible, during the site planning and approval process consistent with applicable General Plan policies, other development standards and regulations, and with any site design BMPs included in an applicable regional or watershed program. The site design BMPs that are incorporated into the WQMP are also listed in Table 4-1.

Table 4-1: Implementation of Site Design BMPs

LOCAL WQMP SITE DESIGN OPTION/CHARACTERISTICS	PROJECT IMPLEMENTATION
Design Options	
<p>1. <i>Maximize the permeable area.</i></p>	<ul style="list-style-type: none"> • The proposed development areas are predominantly located on the less infiltrative soils to preserve the permeable substrate often located in the major side canyons and along the valley floor. • In areas not subject to mass grading, the smallest site disturbance area possible will be delineated and flagged and temporary storage of construction equipment will be restricted in these areas to minimize soil compaction on site.
<p>2. <i>Conserve natural areas.</i></p>	<ul style="list-style-type: none"> • 66% of the total Project area will be conserved as open space in the B-10M Alternative.
<p>3. <i>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.</i></p>	<ul style="list-style-type: none"> • Trails in reserve areas and parks, and golf cart paths will be constructed with open-jointed paving materials, granular materials, or other pervious materials.
<p>4. <i>Construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised. Incorporate landscaped buffer areas between sidewalks and streets.</i></p>	<ul style="list-style-type: none"> • Streets, sidewalks, and parking lot aisles will be constructed to the minimum widths specified in the County Land Use Code and in compliance with regulations for the Americans with Disabilities Act and safety requirements for fire and emergency vehicle access.
<p>5. <i>Reduce widths of street where off-street parking is available.</i></p>	<ul style="list-style-type: none"> • Streets, sidewalks, and parking lot aisles will be constructed to the minimum widths specified in the County Land Use Code and in compliance with regulations for the Americans with Disabilities Act and safety requirements for fire and emergency vehicle access.
<p>6. <i>Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs.</i></p>	<ul style="list-style-type: none"> • Existing native trees and shrubs will be conserved in the open space reserve areas. • Native or drought tolerant non-invasive trees and large shrubs will be incorporated into open space and landscaped areas, where feasible.
<p>7. <i>Minimize the use of impervious surfaces, such as decorative concrete, in the landscape design</i></p>	<ul style="list-style-type: none"> • Impervious surfaces will be minimized in landscape design.
<p>8. <i>Use natural drainage systems.</i></p>	<ul style="list-style-type: none"> • Vegetated swales will be used to collect runoff

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LOCAL WQMP SITE DESIGN OPTION/CHARACTERISTICS	PROJECT IMPLEMENTATION
	where feasible. Bioinfiltration swales will be used to route flows from the FD/WQ basins to the stream channel.
9. <i>Where soils conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration.</i>	<ul style="list-style-type: none"> • Infiltration basins are used in the combined control system to manage increases in runoff volume.
10. <i>Construct onsite ponding areas or retention facilities to increase opportunities for infiltration</i>	<ul style="list-style-type: none"> • The combined control system includes a FD/WQ basin, an infiltration basin, and vegetated swales that will provide opportunities for infiltration where soil conditions are suitable.
11. <i>Other site design options that are comparable, and equally effective</i>	<ul style="list-style-type: none"> • Low impact design concepts that are distributed within the development bubble will be considered as options that could reduce the need for treatment.
<i>Design Characteristics</i>	
1. <i>Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm drain.</i>	<ul style="list-style-type: none"> • Roof runoff for low-density housing, education, or commercial development may be directed to planter boxes or vegetated swales located in common areas, or within individual lots.
2. <i>Where landscaping is proposed, drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping.</i>	<ul style="list-style-type: none"> • Runoff from sidewalks, walkways, trails, and patios will be directed into adjacent landscaping or to vegetated swales.
3. <i>Increase the use of vegetated drainage swales in lieu of underground piping or imperviously lined swales.</i>	<ul style="list-style-type: none"> • Unlined vegetated swales will be incorporated except where such infiltration will affect slope stability.
4. <i>Use one or more of the following:</i> <ol style="list-style-type: none"> a. <i>Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings</i> b. <i>Urban curb/swale system: street slopes to curb; periodic swale inlets drain to vegetated swale/biofilter</i> c. <i>Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to municipal storm drain systems</i> d. <i>Other design concepts that are comparable and equally effective</i> 	<ul style="list-style-type: none"> • Conveyance design will incorporate a rural swale design in estate areas and an urban curb/swale system in residential areas or other design concepts that are comparable and equally effective.

LOCAL WQMP SITE DESIGN OPTION/CHARACTERISTICS	PROJECT IMPLEMENTATION
<p>5. <i>Use one or more of the following features for design of driveways and private residential parking areas:</i></p> <p>a. <i>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</i></p> <p>b. <i>Uncovered temporary or guest parking on private residential lots may be: paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the municipal storm drain system</i></p> <p>c. <i>Other design concepts that are comparable and equally effective</i></p>	<ul style="list-style-type: none"> Uncovered temporary or guest parking in residential areas will be paved with a permeable surface, designed to drain into landscaping prior to discharging to the municipal storm drain system, or other design concepts that are comparable and equally effective.
<p>6. <i>Use one or more of the following design concepts for the design of parking areas:</i></p> <p>a. <i>Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design</i></p> <p>b. <i>Overflow parking (parking stalls provided in excess of the Permittee’s minimum parking requirements) may be constructed with permeable paving</i></p> <p>c. <i>Other design concepts that are comparable and equally effective</i></p>	<ul style="list-style-type: none"> Where landscaping is proposed in parking areas, landscape areas will be incorporated into the drainage design, or other design concepts that are comparable and equally effective.

4.1.3 Source Control BMPs

Source controls BMPs (routine non-structural BMPs, routine structural BMPs, and BMPs for individual categories/project features) are required by the Local WQMP within all new development and significant redevelopment projects unless they do not apply due to the project characteristics. The proposed alternative’s land uses include single and multi-family residential, school, roadways, parks, golf courses, commercial (urban activity center, business park, and neighborhood retail), and open space.

Non-Structural Source Control BMPs

Table 4-2 lists the routine non-structural BMPs from the Local WQMP BMPs that are applicable to the proposed land uses and will be implemented.

Table 4-2: Routine Non-Structural Source Control BMPs

Identifier	Name	Check One	If not applicable, state brief reason
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		Included	Not Applicable	
N1	<i>Education for Property Owners, Tenants, and Occupants</i>	X		
N2	<i>Activity Restrictions</i>	X		
N3	<i>Common Area Landscape Management</i>	X		
N4	<i>BMP Maintenance</i>	X		
N5	<i>Title 22 CCR Compliance (How development will comply)</i>	X		
N6	<i>Local Water Quality Permit Compliance</i>	X		
N7	<i>Spill Contingency Plan</i>	X		
N8	<i>Underground Storage Tank Compliance</i>	X		
N9	<i>Hazardous Materials Disclosure Compliance</i>	X		
N10	<i>Uniform Fire Code Implementation</i>	X		
N11	<i>Common Area Litter Control</i>	X		
N12	<i>Employee Training</i>	X		
N13	<i>Housekeeping of Loading Docks</i>	X		
N14	<i>Common Area Catch Basin Inspection</i>	X		
N15	<i>Street Sweeping Private Streets and Parking Lots</i>	X		
N17	<i>Retail Gasoline Outlets</i>	X		

The routine non-structural source control BMPs will be implemented as follows:

Education for property owners, tenants and occupants (N1) – Education is a key element in the source control plan, as preventing pollutants from entering the storm drain system is the most cost effective of all BMPs. Education must be keyed to the various practices that lead to pollutant generation, but which most homeowners and renters are unaware. Such practices on the surface appear mundane, but actually may have severe cumulative effects on water quality. These practices include car washing, littering, landscape maintenance, cleaning up after pets, etc. Environmental awareness education materials will be provided to all members of the POA periodically. At a minimum, these materials will cover the following topics:

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1. The use of chemicals (including household type) that should be limited to the property, with no discharge of specified wastes via hosing or other direct discharge to gutters, catch basins, and storm drains.
2. The proper handling of material such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals.
3. The environmental and legal impacts of illegal dumping of harmful substances into storm drains and sewers.
4. Alternative household products which are safer to the environment.
5. Household hazardous waste collection programs.
6. Used oil recycling programs.
7. Proper procedures for spill prevention and clean up.
8. Proper storage of materials which pose pollution risks to local waters.
9. Carpooling programs and public transportation alternatives to driving.

Activity Restrictions (Conditions, Covenants, and Restrictions) (N2) – Conditions, Covenants, and Restrictions (CC&Rs) will be prepared for the purpose of surface water quality protection, or use restrictions will be developed through lease terms.

Common Area Landscape Management (N3) - Ongoing maintenance will be consistent with County Water Conservation Resolution, plus fertilizer and/or pesticide usage will be consistent with County Management Guidelines for Use of Fertilizers (DAMP Section 5.5).

BMP Maintenance (N4) – Home Owners Associations (HOAs) or another designated entity shall be responsible for the inspection and maintenance of structural BMPs within their boundaries. The overall scope of the proposed operation and maintenance plan is provided in Section 4.1.4.

Local Water Quality Permit Compliance (N6) – Occupants/tenants will be responsible for applying for and complying with appropriate local water quality permits for stormwater discharges from fuel dispensing areas or other areas of public concern to public properties.

Spill Contingency Plan (N7) – Occupants/tenants will develop a spill contingency plan which mandates stockpiling of cleanup materials, notification of responsible agencies such as the County of Orange Environmental Health, Fire Department, etc., disposal of cleanup materials, and documentation.

Hazardous Materials Disclosure Compliance (N9) – Occupants/tenants will comply with County of Orange ordinances enforced by the fire protection agency for the management of hazardous materials.

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Uniform Fire Code Implementation (N10) – Occupants/tenants will comply with Article 80 of the Uniform Fire Code enforced by the fire protection agency.

Common Area Litter Control (N11) - Litter patrol, emptying of trash receptacles in common areas, and noting trash disposal violations by tenants/homeowners or businesses and reporting the violations to the owner/HOA for investigation will be conducted.

Housekeeping of Loading Docks (N13) - Loading docks typically found at large retail and warehouse-type commercial and industrial facilities will be kept in a clean and orderly condition through a regular program of sweeping and litter control and immediate cleanup of spills and broken containers. Cleanup procedures will minimize or eliminate the use of water. If wash down water is used, it will be disposed of in an approved manner and not discharged to the storm drain system. If there are no other alternatives, discharge of non-stormwater flow to the sanitary sewer will be considered only if allowed by the local sewerage agency through a permitted connection.

Common Area Catch Basin Inspection (N14) - 80% of all privately-maintained drainage facilities will be inspected each year and, if necessary, cleaned and maintained prior to the storm season, no later than October 15th each year; 100 % of all privately-maintained drainage facilities will be inspected, cleaned and maintained in a two year period. Drainage facilities include catch basins and inlets, water quality basins, detention basins, open drainage channels, and lift stations.

Street Sweeping Private Streets And Parking Lots (N15) - Streets will be swept prior to the storm season, no later than October 15th each year. Parking lots shall be swept weekly at a minimum, weather permitting.

Retail Gasoline Outlets (N17) - Retail gasoline outlets (RGOs) will implement the following BMPs:

- Fuel dispensing areas will be paved with Portland cement concrete (or, equivalent smooth impervious surface), with a 2% to 4% slope to prevent ponding, and will be separated from the rest of the site by a grade break that prevents run-on of storm water to the extent practicable. The fuel dispensing area is defined as extending 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less. The paving around the fuel dispensing area may exceed the minimum dimensions of the "fuel dispensing area" stated above.
- The fuel dispensing area will be covered and the cover's minimum dimensions will be equal to or greater than the area within the grade break or the fuel dispensing area, as defined above. The cover will not drain onto the fuel dispensing area.
- Outdoor waste receptacle and air/water supply areas will be graded and paved to prevent run-on of storm water to the extent practicable.

Structural Source Control BMPs

Table 4-3 lists the routine structural BMPs that are required by the Local WQMP and will be implemented.

Table 4-3: Routine Structural Source Control BMPs

Name	Check One		If not applicable, state brief reason
	Included	Not Applicable	
<i>Provide Storm Drain System Stenciling and Signage</i>	X		
<i>Design Outdoor Hazardous Material Storage Areas to Reduce Pollutant Introduction</i>	X		
<i>Design Trash Storage Areas to Reduce Pollutant Introduction</i>	X		
<i>Use Efficient Irrigation Systems and Landscape Design</i>	X		
<i>Protect Slopes and Channels</i>	X		
Requirements Applicable to Individual Project Features			
<i>Loading Dock Areas</i>	X		
<i>Maintenance Bays</i>	X		
<i>Vehicle Wash Areas</i>	X		
<i>Outdoor Processing Areas</i>	X		
<i>Equipment Wash Areas</i>	X		
<i>Fueling Areas</i>	X		
<i>Hillside Landscaping</i>	X		
<i>Wash Water Controls for Food Preparation Areas</i>	X		
<i>Community Car Wash Racks</i>	X		

The routine structural source control BMPs will be implemented as follows:

Provide Storm Drain Stenciling and Signage - all storm drain inlets and catch basins, constructed or modified, within the Project area will be stenciled or labeled. Signs which prohibit illegal dumping will be posted at public access points along channels and creeks within the Project area. Legibility of stencils and signs shall be maintained.

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Trash Area Design – trash areas will be paved, designed not to allow run-on, screened or walled to prevent off-site transport of trash; and covered to minimize direct precipitation. Connection of trash area drains to the municipal storm drain system will be prohibited.

Efficient Irrigation - the timing and application methods of irrigation water will minimize the runoff of excess irrigation water into the stormwater conveyance system (See O&M Plan, Section 4.1.4).

Protect Slopes and Channels - stormwater BMPs will be included to decrease the potential for erosion of slopes and/or channels.

Hillside Landscaping - hillside areas that are disturbed by project development will be landscaped with deep-rooted, drought tolerant plant species selected for erosion control.

Loading Dock Areas - Loading/unloading dock areas will include the following:

- Cover loading dock areas, or design drainage to preclude urban run-on and runoff.
- Runoff from below grade loading docks (truck wells) or similar structures will be treated with a Treatment Control BMP applicable to the use prior to discharge to the storm drain.
- Housekeeping of loading docks will be consistent with N13.

Community Car Wash Racks – a designated car wash area that drains to the sanitary sewer or an engineered infiltration system will be included in complexes larger than 100 dwelling units. Signage will be provided prohibiting discharges of car wash water outside of the designated car wash area. Alternatively, car washing will not be allowed.

Golf Course

A number of site design and source control BMPs listed above apply to the proposed golf courses. The following BMPs address specific issues associated with golf course water quality management. All control measures will be the same as those included in the final Arroyo Trabuco Golf Course Water Quality Management Plan, or will provide equivalent control.

The following site design controls will be implemented:

Rough Buffer Zones: Rough areas will serve as buffer strips to separate the fairways, greens, and tees from native vegetation and nearby stream channels. The rough will be maintained at a height of cut higher than the fairways, greens, and tees. The rough buffer zone will disperse stormwater runoff energy and will aid in erosion and sedimentation control, as well as providing treatment control of pesticides and nutrients.

Greens: Greens will be constructed with a layered soil profile according to the United States Golf Association or similar specifications. This layered soil profile allows for water to be

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retained and held near the root zone, which conserves moisture and nutrients for the purposes of maintaining and promoting root growth and vigor while minimizing the loss of nutrients to groundwater. Excess water will be drained away from the root zone to a tile drainage system consisting of gravel and piping beneath the surface of the green. Flows in the sub-drains will be routed to non-domestic water supply reservoirs for recycling as irrigation water or may be directed to a nearby wastewater treatment plant for reclamation.

Fairway and Bunker Drainage: Fairway and bunker drainage will be directed to water features (e.g., lakes and ponds) designed for flow control, treatment and/or infiltration; bioinfiltration swales; or buffer strips.

The following source controls will be implemented.

Outdoor Storage Area Design - hazardous materials with the potential to contaminate urban runoff will either be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the stormwater conveyance system; or (2) protected by secondary containment structures (not double wall containers) such as berms, dikes, or curbs on a paved surface and under cover.

Cart Wash Areas - areas for washing golf carts will be located inside the cart barn building. The floor area will be paved with Portland cement concrete, bermed around the perimeter and covered, preventing wash water from contacting stormwater runoff. Wash water will be drained directly to the sanitary sewer.

Equipment Wash Areas – equipment wash areas, located in the maintenance yard, will be paved with Portland cement concrete, bermed, fenced, and covered to protect the area from rainfall and overspray from leaving the area. Wash water will be drained directly the sanitary sewer.

Fueling Areas - Fuel dispensing areas will be located in the maintenance yard and will contain the following:

1. At a minimum, the concrete fuel dispensing area will extend 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less.
2. The fuel dispensing area will be paved with Portland cement concrete (or equivalent smooth impervious surface). Asphalt concrete will not be used.
3. An appropriate slope (2% - 4%) will be provided to prevent ponding, and will be separated from the rest of the site by a grade break that prevents stormwater run-on.
4. An overhanging roof structure or canopy will be provided. The cover's minimum dimensions will be equal to or greater than the area within the grade break. The cover will not drain onto the fuel dispensing area and the downspouts will be routed to prevent drainage across the fueling area. The fueling area will drain to a spill control device prior to discharging to the stormwater conveyance system.

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Wash Water Control for Food Preparation Areas – food preparation areas in restaurants will have either contained areas and/or sinks, each with sanitary sewer connection for the disposal of wash waters containing kitchen and food wastes.

Irrigation Controls and Management: Irrigation controls and full time irrigation management will ensure that irrigation is conducted efficiently. Efficient irrigation systems reduce irrigation runoff and conserve water resources; such systems may include computerized and/or radio telemetry that controls the amount of irrigation based on soil moisture or other indicators. Considering that irrigation in semi-arid areas generally exceeds mean annual precipitation, irrigation control is one of the most effective traditional controls for low flow runoff.

Pesticide and Fertilizer Management: Pesticide and fertilizer management will follow the guidelines for Integrated Pest Management (IPM) as outlined in the Orange County Management Guidelines for Use of Fertilizers (DAMP Section 5.5). IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural and mechanical practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, which may include damage threshold exceedance. Treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial or non-target organisms, and the environment.

The following runoff treatment control BMPs will be implemented on the golf courses:

Clubhouse Runoff: Dry weather flows and wet weather stormwater runoff from commercial areas (e.g. the clubhouse and associated parking lots) will be treated in biofiltration swales or planter boxes in the landscaped areas before discharging into the storm drain system. Parking lots will be swept at least weekly to remove coarse sediment and debris.

Cart Storage and Maintenance Buildings: Dry weather flows from these areas will be routed to the sanitary sewer. Stormwater runoff will be pretreated with catch basin insert prior to entering the storm drain system. All storm drain flows will receive treatment in a combined control system located within the golf course.

4.1.4 Stormwater BMP Operation and Maintenance Program

The Local WQMP requires that project WQMPs identify the mechanisms by which long-term operation and maintenance of all structural BMPs will be provided. This section outlines a general stormwater BMP operation and maintenance program.

Objectives

The objectives of the operation and maintenance program are:

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1. To optimize combined control system performance and the management of flows and water quality leaving the system.
2. To minimize adverse environmental impacts from maintenance activities.

Proposed maintenance activities are described below. Maintenance activities may be modified over time as experience is gained. Substantive modifications to the maintenance program will be made only with County of Orange approval.

Maintenance Responsibility

Home Owners Associations (HOAs) or another designated entity will be responsible for the inspection and maintenance of structural BMPs.

General Operation and Maintenance Activities

A standard operations and maintenance program is described below. The categories of operation and maintenance activities are “routine” and “major”. Each category and its respective activities are described in the following sections. Table 4-4 indicates the types of activities that are typically performed on the different BMP components (e.g., basins, mechanical equipment, access roads/paths). Each of the facilities will be operated and maintained with some variations from the standard program as appropriate for each site.

At some BMP facility sites, measures will be taken to limit potential impacts on sensitive species from the standard maintenance activities. These “minimization measures” will include avoidance of the nesting seasons for special status avian species to the extent feasible.

Table 4-4: Typical Operation & Maintenance Activities

	Combined Control System Component						Probable Average Frequency
	Basins	Swale	Vegetation	Inlet/Outlet	Mechanical Equipment (where applicable)	Access Roads/Paths	
Routine Operation and Maintenance							
Site Inspection	X	X	X	X	X	X	Monthly
Trash/Debris Removal	X	X	X	X	X	X	Quarterly
Pump/Valve Inspection, Adjustment & Maintenance				X	X		Monthly
Irrigation System Inspection & Adjustment			X		X	X	Monthly
Inlet/Outlet Inspection & Maintenance			X	X			Monthly

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	Combined Control System Component						Probable Average Frequency
	Basins	Swale	Vegetation	Inlet/Outlet	Mechanical Equipment (where applicable)	Access Roads/Paths	
Minor Vegetation Removal/Thinning	X	X	X	X		X	Quarterly
Snag Removal	X	X	X	X			Monthly
Minor Sediment Removal	X	X	X	X		X	Quarterly
Integrated Pest/Plant Management	X	X	X	X		X	Weekly* (seasonal)
Major Maintenance							
Structural Modifications	X	X	X	X	X	X	As needed; infrequent
Pump/Valve Removal & Replacement				X	X		3-5 years
Major Vegetation Removal/Planting	X	X	X	X		X	1-5 years
Major Sediment Removal	X	X	X	X		X	1-5 years or longer

* These operations will only be performed if needed; weekly is expected to be the maximum frequency.

Routine Operation and Maintenance Activities

Routine operation and maintenance activities are summarized in Table 4-4. A maintenance checklist for each facility will be developed and all routine maintenance activities will be recorded in a maintenance log. The various activities are described below.

Site Inspection

All combined control system sites will be inspected on a regular, scheduled basis to ensure that the sites are operating properly, to record observations, and to initiate any actions that may be required, including those discussed below. While the frequency of site inspections may vary depending on the type of site and season, it will typically be on a monthly basis. During the break-in period and during the wet season, more visits may be required to collect data, record observations and make adjustments to equipment and control structures (weir heights, valves, etc.).

Trash & Debris Removal

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Litter may be picked up at any time during site visits for other purposes. Regular, scheduled trash/debris removal will be performed at all sites on a quarterly basis and/or after storm events that result in heavy trash accumulations. In constructed wetland areas, care will be taken to avoid damage by the crew or equipment to plants or other areas that may be used as incidental habitat.

Pump/Valve Inspection, Adjustment & Maintenance

Some sites will require the use of pumps, valves and other mechanical equipment. Such equipment requires regular, scheduled preventive maintenance and adjustment. Emergency repairs may also be required. Routine work would typically be performed in conjunction with the monthly site inspections.

Irrigation System Inspection & Adjustment

Some combined control system sites may require temporary or permanent irrigation systems for transitional vegetation areas or other non-wetland areas of the properties. At these sites, the irrigation system will be inspected and adjusted during the regular, scheduled site inspection by the site inspector.

Minor Vegetation Removal/Thinning

Vegetation growth at inlets and outlets, in each FD/WQ basin, and in vegetated swales will be inspected annually, and removed or thinned as necessary. Vegetation at inlets and outlets will be manually or mechanically removed if vegetation is found to be clogging or otherwise affecting the operation of the facility. Access roads will remain clear of vegetation and obstructions. Fruit and nut trees will not be permitted on the facility sites to limit rodent food supply. Vegetation removal will generally be conducted in the summer and fall to avoid impacts on wildlife. Significant vegetation removal is covered under the major maintenance activities section below.

Snag Removal

This work typically includes the removal of sticks, dead branches, brush, and small trees that block water flow or otherwise interfere with the operation of the sites.

In the basins, the work also includes the removal of bushes and small trees that interfere with the natural water quality treatment or water storage aspects of the basins. This work may be performed as needed on a quarterly basis.

Minor Sediment Removal

It is expected that at some sites there will be a minor amount of sediment deposition at points within the basins, primarily at inlet flow spreaders and in forebays near the inlet(s). When such deposits obstruct water flow, the deposits will be removed.

Integrated Pest/Plant Management

Although the basins in the combined control system will be designed to prevent standing water to the extent feasible, any natural environment is susceptible to harmful insect invasion. Whether harmful to property, person, or wildlife, some insects will need to be managed. Management may include measures from taking no action to using natural predators to chemical or biological spraying. Some methods that are more natural include intermittent flooding and drying, vegetation thinning, and installation of “swallow boxes” and “bat boxes” to attract more swallows and bats, both of which feed voraciously on mosquitoes.

While more natural methods will be the methods of choice, it may be necessary at times to use sprays. Any application of chemical or biological agents will be performed by certified pesticide applicators in accordance with manufacturer recommendations and applicable laws and regulations. Maintenance activities for the control of mosquitoes may entail the application of *Bacillus thuringiensis israeliensis* (Bti), a natural microbial pesticide.

Undesirable vegetation, especially non-native invasive plant materials, will typically be removed on a quarterly basis, although occasionally more frequent removal may be required to prevent establishment of undesirable seed banks or other propagation means. In constructed water quality wetlands areas, care will be taken to avoid damage by the crew or truck to plants or other areas that may be used as incidental habitat. While this work is not expected to have any negative impacts on wildlife, such work will be conducted in accordance with any minimization measures established by the wildlife agencies.

Major Operation and Maintenance Activities

Major operation and maintenance activities are summarized in Table 4-4. All major maintenance activities will be recorded in maintenance logs.

Structural Modifications

Structural modifications may be required at the sites as part of the adaptive management approach. The purposes of such modifications could include improvement of combined control system performance, upsizing or downsizing of facilities, or improvement of uses such as flood control. Plans for structural modifications will be submitted to appropriate regulatory agencies in compliance with permit requirements.

Pump/Valve Removal & Replacement

Any pipeline, mechanical, or electrical equipment installed for a combined control system facility will have expected useful lives of 1 to 50 years. As a result, at some point in time all equipment will need to be removed and replaced or upgraded. To the extent practical, such work will be scheduled outside nesting seasons of species of concern. However, it is possible that emergency removal/ replacement may be required if such equipment fails suddenly.

Major Vegetation Removal & Planting

During the establishment period for wetland species within the FD/WQ basins, there may be a need for replacing or replanting species in order to achieve the desired mix and density of wetland plants, or to replace plants disturbed by maintenance activities.

Wetland vegetation near inlets and at random locations within the wetlands will be tested and monitored for accumulation of pollutants, similar to sediment monitoring activities. If elevated pollutant levels are detected, the need for plant harvesting to reduce potential exposure to wildlife will be evaluated and performed if deemed necessary. Harvesting typically entails cutting the stalks of the wetland plants to remove edible parts of the plant, and to enhance pollutant volatilization from the roots. Disposal of harvested plants shall be in accordance with appropriate regulations and levels of pollutants.

To the extent practical, basins will be configured to allow “rotational” vegetation removals. That is, portions of the basin/vegetation will be left undisturbed during vegetation removal. On subsequent cycles, the disturbed and undisturbed areas will be “rotated.” This allows for continuous retention of runoff within basins and allows wildlife to move to undisturbed areas while maintenance activities proceed in other areas.

Major Sediment Removal

Most FD/WQ basins will be designed with a forebay or other sediment trapping area just downstream of their inlets. These areas are designed as sediment “traps” where coarser sediments and gross pollutants will accumulate. Sediment accumulation will be monitored annually prior to the wet season. Sediments will be removed when accumulations approach about 25 percent of the designed forebay volume.

Where practical, sediment removal will be performed in conjunction with major vegetation removal/replacement using the same impact avoidance schedules/techniques as appropriate. However, sediment removal will be scheduled based on the amount of accumulation and/or the character of the sediment. Although pollutant accumulation in basin sediments is not expected to meet hazardous waste levels, sediments will be tested for pollutant levels prior to removal. Sediment disposal will follow appropriate regulations in accordance with detected levels of pollutants.

4.2 WQMP FOR THE CAÑADA CHIQUITA SUB-BASIN

4.2.1 Site Assessment

Cañada Chiquita is located in the San Juan Creek watershed (Figure 4-1). Cañada Chiquita is the last major tributary to San Juan Creek before its confluence with Trabuco Creek, near Mission San Juan Capistrano. The sub-basin area as delineated for the WQMP encompasses 6.6 square miles, including a catchment (Catchment 18) that drains directly to San Juan Creek (Figure 4-2). The sub-basin is aligned north-to-south and ranges in elevation from 1,168 ft (MSL) in the north

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to 154 ft (MSL) in the south. Elevation differences from the top of the ridge to the canyon floor gradually increase southward in the sub-basin, reaching a maximum of approximately 500 feet (PCR et al, 2002).

The Cañada Chiquita Sub-basin is underlain by bedrock of the Monterey, San Onofre, Topanga, Sespe, and Santiago formations. The lower portion of the sub-basin is underlain primarily by the Santiago formation.

The surficial geologic units within the sub-basin consist of alluvium, colluvium, nonmarine terrace deposits, and landslide deposits. Several large bedrock landslide complexes occur along and adjacent to the Cristianitos fault system, particularly west of the fault zone. These larger landslides are located within the southwestern one-third of the sub-basin and appear to have failed along weak, sheared bedrock associated with the Cristianitos fault system.

Cañada Chiquita is one of the few naturally perennial streams in the watershed and contains riparian habitat, freshwater and alkaline marsh, and slope wetlands (PCR et al, 2002). The relatively high proportion of permeable soils and low percentage of developed area result in relatively low runoff and sediment yields of the sub-basins in the watershed. Many of the lateral tributaries are channel-less swales.

Below the “narrows” in middle Cañada Chiquita, soils are predominately sands, silts, and clays. Above the narrows, the soils contain slightly more gravels and cobbles. The sandy substrates cause the main creek to be prone to incision under altered hydrologic conditions. Several active head cuts are present in Chiquita Creek, and the channel is presently incising in several locations. Layers of cohesive silts and clays inferred as lake deposits formed upstream of the more elevated valley fill of San Juan Creek, and create a groundwater barrier that helps support perennial flows in Cañada Chiquita (PCR et al, 2002).

The perennial stream in Cañada Chiquita supports wetland vegetation in some areas. Little native vegetation remains on the valley floor beyond the riparian zone.

The mainstem creek supports herbaceous riparian, southern willow scrub, arroyo willow riparian forest, and coast live oak riparian forest habitats that support the least Bell’s vireo and several other sensitive riparian and aquatic species, including yellow-breasted chat, yellow warbler, southwestern pond turtle (near the confluence with San Juan Creek), western spadefoot toad, and two-striped garter snake (NCCP/SAMP Working Group, 2003b). The slopes and ridges adjacent to the main creek are dominated by coastal sage scrub that supports a major population of California gnatcatcher, both within the Southern Subregion and within the range of the gnatcatcher in southern California. The sub-basin provides breeding and/or foraging habitat for a variety of other sensitive wildlife species.

Existing Development in Cañada Chiquita

Cañada Chiquita is relatively undeveloped, including the Upper Chiquita Canyon Conservation Area and the Ladera Land Conservancy (open space on Chiquita ridge associated with the Ladera Ranch). Two existing developed areas are a publicly owned wastewater treatment plant in the lower canyon and the Tesora High School in the middle of the sub-basin (Figure 4-2). Portions of the sub-basin have been used historically and are currently used for agriculture and grazing.

Proposed Development in Cañada Chiquita

Alternative B-10M covers approximately 2,730 acres in Cañada Chiquita (Figure 4-2 and Table 4-5) within Planning Area 2. Catchment 18 depicted on Figure 4-2 drains directly into San Juan Creek, but has been included in the Cañada Chiquita analysis. Under the B-10M Alternative, approximately 2,036 acres would remain as open space, with the remaining 695 acres being developed. The proposed development occurs in the middle and lower portion of the sub-basin and primarily east of Chiquita Creek.

Table 4-5: Project Land Uses and Areas in the Chiquita Sub-basin

Alternative	Land Uses	Land Use Area within the Chiquita Sub-basin (acres)
B-10M	Golf Course	158
	Golf Residential	211
	Proposed Development	326
	Open Space	2036
	TOTAL	2731

4.2.2 Planning Considerations and Planning Recommendations for Cañada Chiquita

In addition to the general Local WQMP requirements summarized in Section 4.1.1, the WQMP has been developed based on sub-basin specific water quality and hydrologic issues as identified in the *Draft Watershed and Sub-basin Planning Principles* (NCCP/SAMP Working Group, 2003a). Specific hydrologic planning considerations for Cañada Chiquita include:

- Main canyon and side canyon terrains are primarily sandy or silty sand and the sub-basin generally has high infiltration capacity.
- Side canyons (particularly east of the creek) contain deep sandy deposits and serve important hydrologic functions through infiltrating low volume storms to groundwater and high volume storms to the main stream channel.
- Ridges on the east side of the valley are characterized by rock outcroppings and areas of hardpan which are remnants of claypans formed in the geologic past that have eroded to

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form mesas, and locally steep slopes. These areas have minimal infiltration and channel flows into the major side canyons.

- The sand substrates beneath the tributary swales make them prone to incision under existing and altered hydrologic regimes.
- Based on comparisons with 1938 aerial photographs, the main creek channel has been relatively stable over the last 60 years. The deepening of the creek channel in portions of the mainstem of Chiquita Creek may be a result of long-term, gradual geologic processes, terrains, land use, or a combination of factors. The current channel bed elevation may be somewhat stabilized by pre-historic cohesive lake-bed or quiet-water sediments.
- Groundwater derived from beneath the hill slopes and ridges is a major source of water contributing to the perennial nature of the creek system. Inferences have been drawn indicating that water levels in the alluvium below Chiquita Creek are in large part isolated from those in the sands and gravels beneath San Juan Creek by a sub-surface barrier to groundwater movement into San Juan Creek.
- The sub-basin provides some of the lowest predicted sediment yields and transport rates of the sub-basins in the San Juan watershed, except during extraordinary episodic events, when large volumes of coarse sediment may be mobilized and transported to San Juan Creek.
- Relative to Gobernadora Creek and lower Gabino Creek, the area of floodplain connection is fairly limited. The hydrologic connections, both surface and subsurface, to the main side canyons appear to be more important in hydrologic terms than the floodplain connection.
- The combination of perennial flow in Chiquita Creek and subsurface water movement in Chiquita Canyon support riparian habitats, freshwater and alkaline marsh, and slope wetlands.
- Many of the slope wetlands on the east side of the valley appear to be sustained by large volumes of stored groundwater within the Santiago (and to a lesser extent the Sespe) formations that move along low permeability silt beds and discharge at breaks in the slope. The slope wetlands on the west side of the valley are sustained by fairly localized recharge of San Onogre breccia and derivative landslide deposits.

The selection and sizing of the facilities in the combined control systems for the Chiquita Sub-basin was guided by site conditions, the type of development land use, and incorporation of the planning recommendations. Table 4-6 lists the planning recommendations for Cañada Chiquita set forth in the *Draft Watershed and Sub-basin Planning Principles* and how the recommendations affected the choice and configuration of the combined control systems.

Table 4-6: Incorporation of the *Planning Recommendations* into BMP Selection for Cañada Chiquita

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> Protect the headwaters of Upper Chiquita Canyon. 	<ul style="list-style-type: none"> No development planned for headwaters.
<ul style="list-style-type: none"> Avoid creating impervious surfaces in the sandy soils of the canyon floor. To the extent feasible, land uses in the major side canyons should be limited to primarily pervious surfaces in order to maintain infiltration. 	<ul style="list-style-type: none"> Canyon floor is Habitat Reserve and pervious golf course. Maintain infiltration capacity in golf course areas.
<ul style="list-style-type: none"> Mimic existing terrains/hydrology by locating development on the ridges, which under present conditions have higher runoff rates and direct surface runoff flows to the permeable substrate of the major side canyons and along the valley floor. 	<ul style="list-style-type: none"> Residential development is located primarily on the ridges. Route runoff from ridge areas to combined control systems located on side canyon floors, sized to preserve pre-development water balance and flow duration in the main stem channel.
<ul style="list-style-type: none"> Promote stormwater surface flow connectivity between the major side canyons and the main stream channel to maintain transient surface channel connections that occur following extreme rainfall events, without significantly changing connections during small storms. 	<ul style="list-style-type: none"> Direct excess flows from detention basin to mainstem channel using vegetated swale in which hydraulic connectivity to mainstem will mimic pre-development condition, namely connectivity under large, but not small or moderate events.
<ul style="list-style-type: none"> Identify natural treatment systems for water quality treatment and stormwater detention that would be appropriate in the sandy soils of the major side canyons and the valley floor. 	<ul style="list-style-type: none"> Combined control system consists of extended detention with low flow wetland treatment, infiltration, and vegetated swale connected to main stem channel.
<ul style="list-style-type: none"> Maintain groundwater recharge to the shallow subsurface water system to sustain flows to Chiquita Creek. 	<ul style="list-style-type: none"> Incorporated infiltration basins to help mimic pre-development recharge and runoff volumes. Pre-treat water to be infiltrated in FD/WQ basin to protect groundwater quality.
<ul style="list-style-type: none"> Address existing areas of channel incision that result from primarily localized processes/land use practices, as contrasted with terrace-forming valley-deepening areas that are primarily a result of long-term geologic conditions. Site by site geomorphic analysis will be undertaken to define these areas. 	<ul style="list-style-type: none"> Refer to the Habitat Restoration Plan. New development will not exacerbate existing channel incision.
<ul style="list-style-type: none"> To the maximum extent practical, avoid direct impacts to the slope wetlands and maintain primary recharge characteristics that support these wetlands. 	<ul style="list-style-type: none"> Slope wetlands will be avoided. Infiltration incorporated within ridge developments to help sustain pre-development infiltration and slope wetlands.

4.2.3 Combined Control System Elements

Although the specific types of developments have yet to be determined, the following mix of development types are likely and the following describes how the proposed combined control system might be configured for each type of development.

Golf Course Residences

Golf course residences may be located on the ridges along the east side of the canyon. The ridges contain substantial areas of hard pan caps, which combined with geotechnical considerations for slope stability, limit the feasibility of infiltration. To restrict infiltration, lined bioswales with an underdrain will be located along streets and driveways. The swale system will direct wet and dry weather flows to an engineered conduit that will carry water down the slope to the side canyons, or if required by grade considerations, to the main canyon floor. In the canyons, water will be directed to a combined control system. The combined control system will consist of three major elements: a FD/WQ basin, a separate infiltration basin or series of infiltration basins, and a vegetated bioinfiltration swale. The FD/WQ basin will store and treat wet and dry weather flows using natural treatment processes. The outlet structure will be designed to direct low flows to an infiltration basin to take advantage of the infiltrative soils in the side canyons and in the main canyon floor. Higher flows will be directed to a vegetated swale that will connect to the main stem of Chiquita Creek. Depending on topographic and grade considerations, the combined control system facilities will, to the extent feasible, be located near the head end of the side canyons where depth to groundwater is greatest.

Single Family Residential Development

The concept for controlling flow and water quality for the single family residential development is different than that for the less dense golf course residences. A series of vegetated swales within the development will direct flows to a FD/WQ basin located on the canyon floor. In order to avoid increasing base flows in lower Chiquita Creek, infiltration will not be implemented. Instead the excess flows that would have been infiltrated will be directed from the FD/WQ basin to either San Juan Creek, to non-domestic water supply reservoirs, or the wastewater treatment plant for treatment and non-potable water supply. (San Juan Creek, given its size and cobbly bed, is considered to be able to accept additional flows without causing erosion, and there are potential benefits to habitat and downstream water supply.) The higher flows will be directed from the FD/WQ basin to Chiquita Creek in a vegetated swale in order to maintain the hydrologic regime in the stream channel. These flows will be treated in the FD/WQ basin and swale prior to discharge into San Juan Creek.

Urban Activity Center/Neighborhood Center/Business Park Development

The combined control system proposed for the urban activity center, neighborhood center, and business park areas would be slightly different than those proposed for golf course and single family residential development. For each catchment, the FD/WQ basin is sized to capture and

treat the water quality design volume. Low flows are then directed to an infiltration basin and high flows are directed to Chiquita Creek in a bioinfiltration swale. Roof runoff could be directed to stormwater planter areas or bioinfiltration swales, and landscaped areas could be used to treat runoff from parking and courtyard areas. Street runoff and excess roof/parking area runoff would be directed to the combined control system described above.

Golf Course

Golf course water quality and flow controls will vary depending on the specific area under consideration as discussed below.

Greens: Greens will be constructed with a layered soil profile according to the United States Golf Association or similar specifications. This layered soil profile allows for water to be retained and held near the root zone, which conserves moisture and nutrients for the purposes of maintaining and promoting root growth and vigor while minimizing the loss of nutrients to groundwater. Excess water will be drained away from the root zone to a tile drainage system consisting of gravel and piping beneath the surface of the green. Flows in the sub-drains will be routed to non-domestic water supply reservoirs or water features (e.g., lakes or ponds) for recycling as irrigation water or may be directed to a nearby wastewater treatment plant for reclamation. Surface runoff from greens is very limited because of the drainage system. However, what surface runoff does occur will be treated in a similar way to the water discharged from the sub-drains.

Fairway and Bunker Drainage: Fairway and bunker drainage will be directed to water features (e.g., lakes and ponds) designed for flow control, treatment and/or infiltration; bioinfiltration swales; or buffer strips.

4.3 WATER QUALITY MANAGEMENT PLAN FOR THE CAÑADA GOBERNADORA SUB-BASIN

4.3.1 Site Assessment

The 11.10 square mile Cañada Gobernadora Sub-basin is an elongated valley that is aligned north to south (Figure 4-3). Like the Chiquita Sub-basin, it is long and narrow and is characterized by deep alluvial deposits in the canyon floor (PCR et al, 2002). Sandy and silty substrates on many of the hill slopes and ridges in the sub-basin are overlain by several feet of exhumed hardpan or contain exposed rock outcrops. These ridge areas presently exhibit rapid runoff comparable to Class D soils.

Cañada Gobernadora contains some of the highest potential infiltration areas in the study area. This is especially true in the valley floor, which is characterized by deep alluvial deposits with interbedded clay lenses. In the valley floor, many of the tributaries are channel-less swales. These areas represent high infiltration zones that likely convey stream runoff to the main-stem of Gobernadora Creek and only exhibit surface connection following extreme runoff events. These

infiltration zones may also contribute to base flow and the perennial nature of Gobernadora Creek.

Depth to groundwater data reported by Balance Hydrologics for the spring of 2003 vary from 35 feet in some of the upper portions of the canyons to 5 to 10 feet in the riparian corridor. Depths are less in areas near the mouth of the canyon, where inferred lake bed deposits block groundwater outflow.

Cañada Gobernadora is predominantly underlain by sands and silts and has the potential to generate relatively high amounts of sediment where the surface is disturbed and channelized. In recent years, natural sediment sources have been augmented by sediment runoff from graded slopes in the developing areas of the upper sub-basin (outside of the Project boundary). Much of the sediment generated from the upstream development in Coto de Caza deposits in the lower portion of the canyon, typically within the riparian zone.

This sub-basin is likely a significant source of nitrogen and phosphorus loadings from grasslands/agriculture, urbanization in the upper reaches with minimal use of BMPs, and the presence of large nursery operations. Conditions favor the transport of metals and pesticides in particulate form.

Existing Land Uses

There is extensive existing urban development in Upper Gobernadora, which constitutes about the upper two-thirds of the sub-basin and is outside of the RMV boundary (Figure 4-4). The development is referred to as Coto de Caza and includes primarily single and multi-family residential housing. Some residential development is also located in Wagon Wheel Canyon which flows into Gobernadora Creek just downstream of Coto de Caza. The hydrologic effects of runoff from Coto de Caza and Wagon Wheel have been considered in the hydrologic analysis. There is also some agricultural development in the form of nurseries in the extreme southern portion of the sub-basin.

Future Land Uses

The development alternatives in Cañada Gobernadora addresses approximately 2,175 acres within Planning Areas 2 and 3 (Figure 4-4 and Table 4-7). Under the B-10M Alternative, approximately 1,113 acres would remain as open space, with the remaining area being developed into single family and golf residential housing with some urban activity center, neighborhood center, business park, and transportation. Development is planned to be located in Planning Area 2 (the eastern portion of Lower Gobernadora Canyon) and in Planning Area 3 (the western portion of Lower Gobernadora Canyon), while the riparian area and central portion of the valley floor is part of the Gobernadora Ecological Reserve Area.

The Santa Margarita Water District and RMV are jointly considering the Gobernadora Multi-purpose Modulation Basin project which calls for the installation of a multi-purpose control

facility along Gobernadora Creek, downstream of its confluence with Wagon Wheel Creek. Water stored in the facility would be pumped to non-domestic water supply reservoir(s) owned by SMWD where the water would be utilized for irrigation purposes. It is anticipated that the project would help to reduce excessive flows and sediment discharges to lower Gobernadora, provide a higher quality of water to lower Gobernadora Creek and San Juan Creek, and provide an additional source of non-domestic water supply.

Table 4-7: Land Uses and Areas in Cañada Gobernadora

Alternative	Land Uses	Land Use Area within the Gobernadora Sub-basin (acres)
B-10M	Golf Residential	25
	Proposed Development	1,037
	Open Space	1,113
	TOTAL	2,175

4.3.2 Planning Considerations and Planning Recommendations for Cañada Gobernadora

Specific hydrologic planning considerations for Cañada Gobernadora set forth in the *Draft Watershed and Sub-basin Planning Principles* include:

- Cañada Gobernadora contains some of the highest potential infiltration areas in the study area, particularly in the valley floor which is characterized by deep alluvial deposits with interbedded clay lenses. However, high groundwater levels may affect the overall infiltration capacity of the sub-basin.
- Total runoff in Cañada Gobernadora is proportionately higher than other sub-basins, due to the size, elongated shape, and amount of existing development in the upper portion of the watershed.
- The hill slopes and ridges in the sub-basin exhibit areas of exhumed hardpan overlying sandy and silty substrates (the eroded remnants of claypans formed in the geologic past) or contain exposed rock outcrops or other areas of steep slopes. These areas presently exhibit rapid runoff comparable to Class D soils, although having less soil moisture storage they likely generate runoff with most storms.
- Due to the elongated configuration and the predominance of sandy terrains in the Gobernadora Sub-basin, first order streams are proportionally less of the total stream length than in several other sub-basins. Many of the tributaries consist of channel-less swales. These swales likely convey a combination of surface and subsurface flow to the main-stem creek and may exhibit surface connection following extreme runoff events.

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- Historic photos indicate that the mainstem creek meandered freely across the valley floor over most of the length of the valley downstream from the mouth of Wagon Wheel Canyon.
- Groundwater derived from beneath the hill slopes and ridges is a major source of water contributing to the perennial nature of the creek system. Inferences have been drawn indicating that water levels in the alluvium below Cañada Gobernadora are at least in large part isolated from those in the sands and gravels beneath San Juan Creek. The perennial nature of the creek in its upper reaches is likely influenced primarily by urban runoff from upstream development, while perennial flow in the lower portion of the creek is influenced by a combination of urban runoff, increased recharge from upstream areas, and lateral subsurface inflow to the valley floor.
- High sediment yields are currently generated from the already developed, disturbed upper portion of the sub-basin and have been deposited in the flats below Coto de Caza, where flows from Wagon Wheel Canyon enter the sub-basin. In 2001, the creek moved out of its previous channel in this location, cut a new channel (i.e., avulsed) and resulted in downstream deposition of sediments.
- Emergent marsh habitat, including alkali wetlands, and willow habitats are present in the GERA wetlands restoration area, with a mix of southern willow riparian and sycamore-willow woodland areas upstream to the boundary of Coto de Caza.

The selection and sizing of the facilities in the combined control systems for the Gobernadora Sub-basin were guided by site conditions (including surface and subsurface flows from existing upstream development), the type of development land use, and incorporation of the planning recommendations. Table 4-8 lists the planning recommendations for Cañada Gobernadora set forth in the *Draft Watershed and Sub-basin Planning Principles* and how the recommendations affected the choice and configuration of the combined control systems.

Table 4-8: Incorporation of the *Planning Recommendations* into BMP Selection for Cañada Gobernadora

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> • Protect Cañada Gobernadora valley floor above the knickpoint to provide for creek meandering (as occurred historically) and for restoration of riparian processes and habitat. 	<ul style="list-style-type: none"> • Proposed development protects the valley floor above the knickpoint to allow for restoration of the creek meander and also includes a wide open space corridor along Gobernadora Creek.
<ul style="list-style-type: none"> • In order to emulate current hydrologic patterns, development areas should be set back from the valley floor and focus on areas that presently manifest Class D soils runoff characteristics, including those areas with existing hardpan caps. 	<ul style="list-style-type: none"> • A major portion of proposed development will be located in ridge areas where there are less infiltrative soils and hardpan caps.
<ul style="list-style-type: none"> • Deep alluvial deposits that function as important 	<ul style="list-style-type: none"> • The combined control system is intended to be

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<p align="center">Planning Recommendations</p>	<p align="center">Site Planning and Treatment/Flow Control BMPs</p>
<p>infiltration/recharge areas underlie the valley floor and adjacent tributary swales. At the same time, any changes in future stormwater flows to these areas may need to be accompanied by groundwater management due to limited infiltration capacity resulting from high groundwater levels.</p>	<p>located to the extent feasible in upper portions of side canyons where depth to groundwater is greatest.</p> <ul style="list-style-type: none"> • The combined control system will result in infiltration being distributed over a fairly large area, which will help prevent localized high perched water. • Stormwater flow management will include provisions for capturing flows in excess of existing conditions for use in development area irrigation and provisions for routing flows to San Juan Creek in the lower sub-basin. • The use of non-domestic water supply reservoirs for storing water that could be recycled for irrigation would be an alternative to infiltration basins that would result in less infiltrated water.
<ul style="list-style-type: none"> • Given the size of the valley floor, there are opportunities for creating natural treatment systems to treat potential existing and future urban runoff from the Gobernadora Sub-basin, as well as provide opportunities for expanded wetland habitat areas. 	<ul style="list-style-type: none"> • The combined control system employs natural treatment processes including the utilization of low flow wetlands treatment in the flow control/water quality basin, bioinfiltration swales, and infiltration basins. • The use of non-domestic water supply reservoirs to store water for irrigation is also a natural “land application” treatment alternative.
<ul style="list-style-type: none"> • Sediment management and creek restoration activities may be necessary in Lower Gobernadora Canyon to address the present excessive sediment input from upstream urbanized areas. The increased sediment resulting from upstream construction will likely be moving through the system for a prolonged period. Eventually, sediment loads may decrease due to buildout of the upper watershed. Consequently, floodplain restoration should account for both the existing and future sediment regimes. 	<ul style="list-style-type: none"> • Refer to the Habitat Restoration Plan. • The proposed Gobernadora Multipurpose Basin* is intended to address excessive water flows, sediment and pollutant load from Coto de Caza.
<ul style="list-style-type: none"> • Existing channel incision that has isolated the Creek from the floodplain in some areas should be addressed as part of the restoration effort. 	<ul style="list-style-type: none"> • Refer to the Habitat Restoration Plan.
<ul style="list-style-type: none"> • Protect the GERA and, to the extent feasible, minimize impacts to major riparian areas consistent with the overall restoration and management plan. 	<ul style="list-style-type: none"> • The combined control system is designed to manage flows and water quality outside of the GERA. The quality and magnitude of surface and groundwater flows entering the GERA from the combined control system will mimic existing undeveloped conditions to the extent practicable.

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> In order to maintain the sediment transport functions of the central reach of San Juan Creek, the timing of peak flows in Cañada Gobernadora at the confluence with San Juan Creek should be managed to emulate existing conditions and avoid coincident peak flows with San Juan Creek. 	<ul style="list-style-type: none"> The combined control system is designed to emulate existing hydrologic conditions, and therefore would mimic the existing timing of peak flows.

* The NCCP sub-basin restoration recommendations for the Gobernadora Sub-basin state: “Implement a restoration program in Gobernadora creek which addresses... (2) upstream land use induced channel incision and erosion, including potentially excessive surface and groundwater originating upstream” (Policy 49) (This is the only policy addressing upstream flow management.)

4.3.3 Combined Control System Elements

The following describes the proposed combined facilities for each type of development for Alternative B-10M.

General Development – Residential, Urban Activity Center, Neighborhood Center, and Business Park

Development is proposed in the eastern and western portions of lower Gobernadora Canyon. The riparian area and central portion of the valley floor is reserved as open space in the Gobernadora Ecological Reserve Area (GERA). The concept for controlling flow and water quality calls for a series of vegetated swales within the development and a combined facility located on the side canyon or main canyon floor, outside of the GERA. If portions of the development are located in the side canyons, roof runoff may be directed to infiltration trenches, planter boxes, or infiltrative swales. Although depth to groundwater generally decreases in Lower Gobernadora because of the effects of inferred lake bed deposits, data indicates that infiltration is feasible in this area. Infiltration and flow management issues relating to excessive surface and sub-surface water flows from upstream development are addressed in Chapter 5. Centrally located non-domestic water supply reservoirs also may be feasible in this development and could be used for recycling dry and low wet weather flows for irrigation of common landscape areas. In the urban activity center, neighborhood center, and business park areas, roof runoff could be directed to stormwater planter areas or bioinfiltration swales, and landscaped areas could be used to treat runoff from parking and courtyard areas. Street runoff and excess roof/parking area runoff would be directed to the combined control system.

In the side canyons and on the canyon floor, runoff will be treated by a combined facility designed to provide water quality treatment and flow control. The facility will consist of three main elements: a flow duration and water quality treatment detention basin, a separate infiltration basin or series of infiltration basins, and a vegetated swale. The flow duration and water quality treatment basin will store and treat wet and dry weather flows using natural treatment processes. The outlet structure will be designed to direct low flows to a series of infiltration basins to take advantage of the infiltrative soils in the side canyons. Higher flows will be directed to a

vegetated swale that will connect to the main stem channel. The facility will be located to the extent feasible near the head end of the side canyons where depth to groundwater is greatest.

Golf Course Residences

Golf Course residences may be located on the ridge along the west side of the canyon, adjoining the similar type of development in Cañada Chiquita. The ridges contain substantial areas of hard pan caps, which combined with geotechnical considerations for slope stability, limit the feasibility of infiltration. To restrict infiltration, lined bioswales with an underdrain will be located along streets and driveways. The swale system will direct wet and dry weather flows to an engineered conduit that will carry water down the slope to the side canyons, or if required by grade considerations, to the main canyon floor. In the canyons, water will be directed to a combined control system. The combined control system will consist of three major elements: a FD/WQ basin, a separate infiltration basin or series of infiltration basins, and a vegetated bioinfiltration swale. The FD/WQ basin will store and treat wet and dry weather flows using natural treatment processes. The outlet structure will be designed to direct low flows to an infiltration basin to take advantage of the infiltrative soils in the side canyons and in the main canyon floor. Higher flows will be directed to a vegetated swale that will connect to the main stem of Chiquita Creek. Depending on topographic and grade considerations, the combined control system facilities will, to the extent feasible, be located near the head end of the side canyons where depth to groundwater is greatest.

4.4 WATER QUALITY MANAGEMENT PLAN FOR THE CENTRAL SAN JUAN AND TRAMPAS SUB-BASIN

4.4.1 Site Assessment

The Central San Juan and Trampas Canyon Sub-basin is divided into two main geographic areas: the Central San Juan subunit and the Trampas subunit (NCCP/ SAMP Working Group, 2003). The Central San Juan subunit includes the reach of San Juan Creek from just south of the confluence with Bell Creek to the east and the confluence with Gobernadora Creek to the west. The Central San Juan subunit extends north from San Juan Creek approximately 1.6 miles and encompasses a large north-south trending canyon through the center of the subunit. The Trampas Canyon subunit is characterized by the silica sand mining operation that dominates the canyon and the rugged terrain between Cristianitos Canyon and San Juan Creek. Planning areas that fall within the Central San Juan and Trampas Sub-basin include a portion of PA 3, a portion of PA 4, and most of PA 5 (Figure 4-5).

The Central San Juan and Trampas Sub-basin covers a 7.4 square mile area that contains several small tributary drainages which feed directly into the main stem of San Juan Creek. The central portion of the main stem of San Juan Creek, downstream of Bell, Lucas, and Verdugo Canyons, consists of a meandering river with several floodplain terraces in a wide valley bottom.

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The Central San Juan and Trampas Canyon drainage basin is underlain by bedrock of the Santiago, Silverado, and Williams formations. Bedding within the bedrock of the Santiago, Silverado, and Williams formations is near horizontal to gently dipping. Surficial geologic units within the project boundaries consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides. The majority of the sub-basin area is underlain by soils of hydrologic groups C (52.6 percent) and D (29.2 percent).

The middle reach of the main stem of San Juan Creek is a broad, meandering stream with several floodplain terraces (PCR et al, 2002). The creek supports a mosaic of southern willow riparian woodland, mule fat scrub, open water, and sand bars. The adjacent terraces support coast live oak woodland and southern sycamore riparian woodland. The creek has relatively coarse substrate and high topographic complexity, with a variety of secondary channels, pits, ponds, and bars. An abandoned aggregate mining pit has been filling in over the last several years and supports an open water and emergent marsh community. The central portion of San Juan functions as a sediment conduit between the major sediment-producing sub-basins and downstream areas.

The combination of predominant grasslands, erodible soils, and anthropogenic sources such as the Color Spot nurseries means that the sub-basins can be expected to generate relatively large nitrogen and phosphorus loadings for their size and may be a contributor to the increases in nutrient concentrations between Caspers Regional Park and La Novia that is evident in the Orange County PFRD monitoring program. However, some of the constituents may be sequestered (at least seasonally) within the permeable alluvial aquifers of San Juan Creek. High loads of fine sediment and particulates should favor the adsorbed phases of heavy metals and pesticides.

The central portion of San Juan Creek has intermittent to near perennial flow that is supported by alluvial groundwater that is near the surface, at least seasonally. The riparian habitats and pool and ponds depend on sufficient duration of shallow groundwater. This groundwater is recharged from sub-basins higher in the watershed and is conveyed in the alluvium through the central portion of San Juan Creek.

Existing Land Uses

Agricultural and developed lands cover approximately 12 percent of the land in this sub-basin. The Color Spot nursery is located on the north side of San Juan Creek in Catchments 21 and 26. Groundwater pumping supports local citrus orchards. Sand, hard rock, and minerals have been mined from Trampas Canyon over the last 50 years. An artificial lake used in the ongoing mining operation dominates this portion of the sub-basin.

Future Land Uses

The development alternatives in the Central San Juan and Trampas Sub-basin address approximately 4,800 acres in a portion of PA 3 and PA 4, and most of PA 5 (Figure 4-5, Figure

4-6, and Table 4-9). Under the B-10M Alternative, approximately 1,498 acres would remain as open space and 3,316 acres would be developed.

Table 4-9: Land Uses and Areas in the Central San Juan and Trampas Sub-basin

Alternative	Land Uses	Land Use Area within the Central San Juan and Trampas Sub-basin (acres)
B-10M	Proposed Development	3,316
	Open Space	1,498
	TOTAL	4,814

4.4.2 Planning Considerations and Planning Recommendations for the Central San Juan and Trampas Sub-basin

Specific hydrologic planning considerations for the Central San Juan and Trampas Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* include:

- The Central San Juan Sub-basin south of San Juan Creek is comprised of mainly silty-sandy terrains similar to those found in the Chiquita and Gobernadora Sub-basins. The eastern and western edges of this sub-basin have sharply different properties, discussed below.
- Clayey silts and sands that underlie smaller areas east of the Mission Viejo fault have a high propensity for shallow mudflows following periods of extended rainfall.
- The area along Radio Tower Road contains representative wetland types including riverine, alkali marsh, slope wetlands, vernal pools and lacustrine fringe wetlands. The slope wetlands appear to be associated with localized bedrock landslides from the San Onofre and Monterey formations that store groundwater discharge over a prolonged period. The vernal pools are also associated with landslides and support both the federally listed endangered San Diego and the Riversidean fairy shrimp. Manmade stock ponds support fringing lacustrine wetlands. Riverine reaches within this area are generally high-gradient, low-order streams characterized as steep canyons dominated by sycamore or willow riparian forest. Some areas appear to have perennial or near-perennial flow.
- Sand, hard rock and minerals have been mined for Trampas Canyon over the last 50 years. A artificial lake dominates this sub-basin. The lake is steep-sided, relatively deep and does not appear to support any aquatic resources of note. The surrounding uplands are dominated by ruderal vegetation with minimal habitat value.
- Runoff and base flow from Trampas Creek may contribute to supporting a small arroyo toad population near its confluence with San Juan Creek.

The selection and sizing of the facilities in the combined control systems for the Central San Juan and Trampas Sub-basin was guided by site conditions, the type of development land use, and incorporation of the planning recommendations. Table 4-10 lists the planning recommendations for the Central San Juan and Trampas Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* and how the recommendations affected the choice and configuration of the combined control systems.

Table 4-10: Incorporation of the *Planning Recommendations* into BMP Selection

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> • Trampas Canyon is suitable for development. 	<ul style="list-style-type: none"> • Planning Area 5 is located in the Trampas Canyon drainage area.
<ul style="list-style-type: none"> • The area along Radio Tower Road should be protected because it contains a diversity of wetland types and endangered fairy shrimp in close proximity to one another, thereby increasing the heterogeneity of the landscape from an aquatic resources perspective. 	<ul style="list-style-type: none"> • No development is planned along Radio Tower Road.
<ul style="list-style-type: none"> • Stormwater flows from Trampas Creek into San Juan Creek should be managed to provide flows comparable to existing conditions. 	<ul style="list-style-type: none"> • The combined control system for the Trampas drainage area is designed to emulate existing hydrologic conditions.

4.4.3 Combined Control System Elements by Planning Area

The following describes the proposed combined facilities for each of the proposed planning areas in the Central San Juan and Trampas Sub-basin for Alternative B-10M.

Planning Area 3

The Central San Juan Sub-basin includes a portion of Planning Area 3 (PA 3) north of the San Juan River. The proposed development within PA 3 is described as “general development” and includes a segment of proposed roadway. Runoff generated from these areas is discharged directly to segments of San Juan Creek that have been identified as arroyo toad habitat. To protect breeding habitat for arroyo toads within the San Juan Creek, flow duration controls will be incorporated and managed in a manner compatible to that for other sub-basins/catchments with flow duration control systems. The portions of Planning Area 3 within the Central San Juan Sub-basin can be hydraulically divided into three separate subcatchments. Runoff from each subcatchment will be treated by a combined control facility that includes a FD/WQ basin, and infiltration basin, and a vegetated swale that will connect to the tributary channel.

Planning Area 4

Planning Area 4 (PA 4) is located in the eastern portion of the Central San Juan Sub-basin, southeast of San Juan Creek. As with PA 3, flow duration controls are required to protect

breeding habitat for the arroyo toad. Runoff from PA 4 will be treated by a single combined control facility that includes a FD/WQ basin, and infiltration basin, and a vegetated swale that will connect to the tributary channel.

Planning Area 5

The southern portion of the Central San Juan and Trampas Sub-basin is the proposed location for Planning Area 5 (PA 5). PA 5 contains an existing sand mining and washing operation which is indicative of the highly infiltrative soils in the area. As with PA 3, PA 5 is primarily defined as “general development” and includes a segment of proposed roadway. PA 5 discharges to two separate tributaries of San Juan Creek: Trampas Creek and an unnamed creek west of Trampas. These tributaries provide habitat that is sensitive to hydrologic changes. Therefore, flows from PA 5 will be managed for flow duration control.

PA 5 has been divided into four separate catchments. Runoff from each catchment will be treated by a combined control facility that includes a FD/WQ basin, and infiltration basin, and a vegetated swale that will connect to the tributary channel (Unnamed Creek or Trampas Creek).

Currently, most of the area occupied by the sand mine and washing facilities does not contribute surface flows to Trampas Creek or any other tributary of San Juan Creek. All surface water runoff is discharged to a tailings pond onsite and is recycled for mining operations. The construction of PA 5 will replace the sand mine and discharges from the developed area will be routed to a water quality/flow duration facility. However, because the artificial lake does not discharge to Trampas Creek, the FD/WQ basin incorporated will be sized to match flows into Trampas Creek before the mine was constructed, with the objective to restore flows in Trampas Creek to the pre-mine hydrologic regime.

4.5 WATER QUALITY MANAGEMENT PLAN FOR THE CRISTIANITOS SUB-BASIN

4.5.1 Site Assessment

The Cristianitos Canyon drainage basin, upstream of the confluence with Gabino Creek, is located in the San Mateo Creek watershed approximately five miles from the Pacific Coast (Figure 4-7). The sub-basin area encompasses 3.7 square miles. The sub-watershed is aligned north-to-south and ranges in elevation from 280 ft (MSL) at the confluence of Cristianitos and Gabino Creeks to 1000 ft (MSL) at the head of Cristianitos Canyon.

The Cristianitos Sub-basin is underlain by bedrock of the Santiago and Silverado formations. Surficial geologic units within the project boundaries consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides (PCR et al, 2002). The majority of the Cristianitos Sub-basin is underlain by poorly infiltrating soils of hydrologic groups C (43.9 percent) and D (42.7 percent). However, compared to other sub-basins of the San Mateo watershed included in the WQMP, the upper Cristianitos Canyon also contains a relatively large portion of the better

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infiltrating soil group B (12.9 percent). The relatively high proportion of Type B soils and the minimal development in the sub-basin produce relatively high infiltration rates relative to the other sub-basins within the San Mateo watershed.

Soils west of Cristianitos Creek are characterized by erodible silty sands, while soils east of the creek generally are clays (NCCP/SAMP Workgroup, 2003b). However, the lower portion of Cristianitos Creek appears to be actively incising (PCR et al, 2002). Review of aerial photographs shows that prior to the extreme flow event of 1938, the reach of Cristianitos Creek upstream from the confluence of Gabino Creek was little more than a swale and seems to have incised 8 to 15 feet since that time. This portion of the creek is likely susceptible to further incision, and associated in-channel sediment generation, during extreme flow events.

As illustrated in Figure 4-8, the sub-basin is dominated by grasslands, a significant component of which is native grassland, and coastal sage scrub (NCCP/SAMP Workgroup, 2003b). The extent of grasslands in the sub-basin strongly suggests that nitrogen loading is currently high, while the high erosion potential indicates that the mobilization of phosphorus sources may be equally high. Metal loadings to the sub-basin are likely low at present and most metal transport can be expected in the particulate form.

Aquatic resources in the Cristianitos Sub-basin consist of both riverine and lacustrine (associated with abandoned clay pit mines and stockponds) systems (PCR et al, 2002). The upper portions of the sub-basin consist of a ridge or spine with canyons on both sides. These canyons are steep and narrow and contain well-developed, mature oak riparian woodland in a matrix of intact chaparral and coastal sage scrub. The structure, location in the headwaters, and juxtaposition with intact upland plant communities results in high functioning upland/wetland ecosystems. Cristianitos Creek, below an existing stockpond, is a meandering stream that contains alkali marsh communities mixed with willow and mule fat. However this reach is actively incising. Reaches just upstream of Gabino Creek have near-perennial flow, apparently supported by discrete loci of groundwater discharge. The persistent saturation has facilitated development of well-structured hydric soils, and as the gradient flattens, there is a moderate width floodplain associated with the stream. This area supports the highest diversity of wetland species of any of the San Mateo sub-basins studied.

There are several lacustrine wetlands in the sub-basin associated with abandoned clay pits or stockponds (PCR et al, 2002). In general, these areas appear to be functioning as intact wetlands. They contain a mix of open water and emergent marsh vegetation. Most are surrounded by a mix of sage scrub and grasslands. One of the stockponds on the lower end of Cristianitos Creek has a stream dominated by mule fat scrub draining into it. The ponds generally appear to have low turbidity and are being used by fish, invertebrates, amphibians, and birds. A large, abandoned clay pit exists near the southern boundary of the sub-basin. This pit is approximately 80 to 100 feet deep and dominated by open water with a narrow fringe of emergent marsh habitat. This large, abandoned pit is blue-green in color, and it does not appear to be functioning as a viable ecosystem.

Existing Land Uses

The Cristianitos Sub-basin is largely undeveloped, aside from roadways. There are several abandoned clay pits on the east side of the lower portion of the sub-basin. The Donna O’Neill Land Conservancy is located outside of the RMV boundary on the west side of the middle and lower portions of the sub-basin.

Future Land Uses

The development alternatives in the Cristianitos Sub-basin address approximately 1,275 acres within the RMV boundary in Planning Areas 6 and 7 (Figure 4-8 and Table 4-11). Under the B-10M Alternative, approximately 922 acres would remain as open space and 370 acres would be developed, including 61 acres of estates in PA 6 and 59 acres of estates and a 250 acre golf course in PA 7.

Table 4-11: Land Uses and Areas in the Cristianitos Sub-basin

Alternative	Land Uses	Land Use Area within the Cristianitos Sub-basin (acres)
B-10M	Estate	120
	Golf Course	250
	Proposed Development	0
	Open Space	922
	TOTAL	1,292

4.5.2 Planning Considerations and Planning Recommendations for the Cristianitos Sub-basin

Specific hydrologic planning considerations for the Cristianitos Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* include:

- Cristianitos Sub-basin has a less “flashy” hydrograph than other sub-basins of the western San Mateo Watershed due to its shape, infiltration characteristics, and drainage network.
- The terrains to the west of Cristianitos Creek are generally erodible silty sands while the terrains to the east of the Creek are generally less erodible clays (where not disturbed). Intact clayey terrains tend to seal and functionally become nearly impervious upon saturation, generating more rapid runoff than sandy terrains.
- Major riparian areas exist in the northeast and southwest portions of the sub-basin.
- The middle and lower areas to the east of the creek contain few riparian areas and include numerous former open clay pits that are eroding and are not self healing.

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- The middle portion of Cristianitos Creek supports alkaline wetlands. The hydrologic support of these wetlands in relation to the surface and subsurface hydrology of this portion of Cristianitos Creek is not fully understood; however, recently installed groundwater monitoring wells will help clarify this issue.
- The clay-rich soils to the east of the creek generate fine sediments, generally silts and clays, which contribute to turbidity in downstream waters (as contrasted with coarser sediments such as sands, silty sands, and cobbles contributed by Gabino and La Paz).
- A review of 1938 aerial photos indicates that the mainstem of Cristianitos Creek upstream from the confluence with Gabino Creek appears to have been deepening over the past 60 years.

The selection and sizing of the facilities in the combined control systems for the Cristianitos Sub-basin was guided by site conditions, the type of development land use, and incorporation of the planning recommendations. Table 4-12 lists the planning recommendations for the Cristianitos Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* and how the recommendations affected the choice and configuration of the combined control systems.

Table 4-12: Incorporation of the *Planning Recommendations* into BMP Selection

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> • The headwater area should be protected, with new impervious surfaces limited in extent within the headwater area. 	<ul style="list-style-type: none"> • No development planned for the headwaters in the East Branch of Cristianitos Creek. Development planned for the West Branch is estates, a land use with limited impervious surfaces.
<ul style="list-style-type: none"> • Where feasible, protected headwater areas should be targeted for restoration of native vegetation to reduce the generation of fine sediments from the clayey terrains and to promote infiltration, and to enhance the value of upland habitats adjacent to the streams. 	<ul style="list-style-type: none"> • Restoration is proposed in the headwater areas. Refer to the Habitat Restoration Plan.
<ul style="list-style-type: none"> • In order to mimic existing hydrologic conditions, development should focus on areas with clayey soils, which presently seal fairly quickly under storm conditions and have relatively high runoff rates. The overall goal should be to reduce the generation of fine sediments compared with existing conditions to reduce turbidity effects and other adverse impacts of fine sediments on downstream aquatic resources. Development in the middle and lower reach areas should be set back from the creek and should be located to the east of the creek where existing erosion could be concurrently addressed. 	<ul style="list-style-type: none"> • A major portion of proposed Alternative B-10M development will be located east of the creek in the middle and lower portions of the sub-basin in areas with clay soils and is set back from the creek.

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> Stream stabilization opportunities should be examined in Cristianitos Creek (above the confluence with Gabino Creek) in the context of longer-term geologic processes. 	<ul style="list-style-type: none"> Refer to the Habitat Restoration Plan.
<ul style="list-style-type: none"> The alkali wetlands within the middle portion of the sub-basin should be protected in conjunction with protection of the overall riparian system. 	<ul style="list-style-type: none"> The proposed Alternative B-10M development is set back from the creek.

4.5.3 Combined Control System Elements by Planning Area

The following describes the proposed combined facilities for each of the proposed planning areas within the Cristianitos Sub-basin for the B-10M Alternative.

Planning Area 6

Planning Area 6 (PA6) includes 61 acres of estates within the Cristianitos Sub-basin in Alternative B-10M and no development in the other alternatives. Given that the estate homes have less imperviousness and large areas of landscaping and natural vegetation, controls for the estates are most feasible if conducted onsite or in common areas. Controls will consist of site design, source control, and treatment practices, such as vegetated swales, bioretention areas, and planter boxes.

Planning Area 7

Planning Area 7 (PA 7) crosses the boundary of the Gabino Sub-basin and the Cristianitos Sub-basin. In the B-10M Alternative, PA 7 within the Cristianitos Sub-basin includes 250 acres of proposed golf course and 59 acres of estates adjacent to the golf course. Controls for the estates will be conducted either onsite, on the golf course, or in the wetpond located in the Gabino Sub-basin. Onsite controls will consist of site design, source control, and treatment practices, such as vegetated swales, bioretention areas, and planter boxes, located on the estate site or in common areas. Runoff from the estates adjacent to the golf course may be captured and stored as non-potable water for golf course irrigation, or may be treated in the golf course as feasible. The potential benefits of this concept include a reduction of runoff volumes typically associated with urban development and a reduction of water importation to meet irrigation demands. The storage facilities would additionally function as a wet pond for treatment of the stormwater, prior to use for irrigation. The main limitation is that runoff and peak irrigation demands are seasonally out of phase (runoff occurs in the wet season and peak irrigation demands are in the dry season). Where feasible, estates along the ridge top dividing the Cristianitos and Gabino Sub-basins may be graded to direct flows to the Gabino Sub-basin for treatment.

4.6 WATER QUALITY MANAGEMENT PLAN FOR THE GABINO PORTION OF THE GGABINO AND BLIND CANYON SUB-BASIN

4.6.1 Site Assessment

Because runoff management and water quality strategies for the B-10M Alternative link Blind Canyon and the Talega Sub-basin functionally, this section addresses only areas that drain to Gabino Creek. Gabino Canyon encompasses 8.3 square miles and is approximately 10 miles long (PCR et al, 2002). Along with Talega Canyon, it is the largest sub-basin in the upper San Mateo watershed. The Gabino Canyon Sub-basin is divided into three main planning subunits: the upper Gabino Canyon subunit, the middle Gabino subunit, and the lower Gabino subunit (NCCP/SAMP Working Group, 2003b). (The lower Gabino subunit includes Blind Canyon, which will be addressed in the Section 4.7 with the Talega Sub-basin). The upper Gabino subunit encompasses the open grasslands at the headwaters of Gabino Creek. A portion of Planning Area 9 is located in the upper Gabino subunit (Figure 4-9). The middle Gabino subunit is defined by the narrow, steep-sided canyon between upper Gabino Canyon and the confluence of Gabino and La Paz creeks. A portion of Planning Area 7 is located within the middle Gabino subunit. The lower Gabino subunit includes the portion of Gabino Canyon below its confluence with La Paz Creek and its confluence with Cristianitos Creek. This subunit includes a portion of Planning Area 7 and a portion of Planning Area 8.

Gabino Canyon is underlain primarily by bedrock of the Williams Formation (Pleasant sandstone and Schulz Ranch members), along with the Santiago, Silverado, Ladd (Baker Canyon member), and Trabuco formations (PCR et al, 2002). Surficial geologic units within the project boundaries consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides.

The Gabino Sub-basin is underlain by clayey and crystalline terrains that generally produce higher runoff volumes per unit area than sandier areas (PCR et al, 2002). However, compared to other crystalline terrains in the NCCP/SAMP study area, Gabino Canyon has the highest infiltration capacity of any of the analyzed sub-basins in the San Mateo watershed. Approximately 56 percent of the upper sub-basin is underlain by Type C soils, with 31 percent of the upper basin having the least permeable Type D soils. Infiltration capacity is somewhat lower in the lower portion of the sub-basin, with D-type soils being predominant.

Gabino Canyon was calculated to have the highest sediment yield and transport rate of any sub-basin analyzed in the San Mateo watershed (PCR et al, 2002). These high yields are partially attributable to the size of the sub-basin; however, the transport rate per unit area is also high, second only to the Cristianitos Sub-basin. Cobbles and other larger particles comprise the majority of sediment produced in this sub-basin; however, unlike La Paz, sand comprises a substantial portion of the sediment produced. The relatively high proportion of underlying sandy substrates (compared to the rest of the crystalline areas in the study area) likely contributes to the high sediment yield predicted for Gabino Canyon. Incision of the channel in the reaches just upstream of the confluence with La Paz also is a likely source of sediment. However, a significant portion of the sediment production is probably associated with erosion caused by

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historic grazing. Conversion of native habitat to non-native grassland, along with continued grazing, appears to have resulted in extensive gully formation adjacent to Gabino Creek and resultant increases in sediment delivery to downstream areas. A critical feature of the sediment transport characteristics of Gabino Canyon is that most of the sediment is mobilized during extreme episodic events, when the topography, unstable upland soils, and substrate types contribute to produce large quantities of sediment. The coarse sediment is probably very important to downstream channel structure and provides habitat for sensitive species in the middle and lower watershed.

The high proportion of grasslands in the upper watershed represents a potential source of high nitrogen loadings (PCR et al, 2002). Similarly phosphate loadings are expected to be moderate, mainly associated with erosion in the upper watershed. Incision in the upper reaches of Gabino Canyon and the naturally confined floodplain in the lower reaches mean that assimilation of nitrate and phosphate loadings are expected to be low to moderate within the riparian floodplain. Baseline metal loadings should be relatively low under existing conditions with most metals transported in particulate form.

The Gabino ground-water basin extends from near the confluence of La Paz and Gabino Creeks downstream to the canyon constriction just downstream of the Gabino/Cristianitos confluence, a valley distance of about 10,000 feet. The upper portion of the basin is cut into bedrock, but alluvial deposits get progressively deeper further downstream. Based on estimates of basin size and specific yield, the potential water-holding volume of the basin between the two confluences is about 400 acre-ft. It is fair to assume that the basin can assimilate about 0.2-0.3 cfs of summer flow, assuming that groundwater levels are sufficiently deep to inhibit establishment of riparian woodland.

The dominant habitat type in the upper portion of Gabino Canyon, above the confluence with La Paz Creek, is southern coast live oak riparian woodland (PCR et al, 2002). The adjacent uplands are primarily disturbed grasslands with sage scrub on the hillslopes. The upper watershed has been heavily grazed and is incised in places with vegetation that has been cropped or trampled. The riparian zone varies in width from relatively narrow to relatively wide and is well developed (depending on the intensity of grazing). Historically, the stream probably migrated through the floodplain, but now is confined by headcutting and incision processes. In some reaches this incision is in excess of ten feet and appears to have intercepted subsurface flow.

A manmade lake/stockpond in upper Gabino canyon, informally known as "Jerome's Pond," captures water from Gabino Creek and three unnamed tributaries (PCR et al, 2002). The pond can be characterized as a semi-marsh mix of open water and bulrush (*S. californicus*). Where Gabino creek flows into the stockpond, there is a delta dominated by mule fat scrub. The pond outlets into a tributary that supports willow riparian habitat and eventually joins the main flows of Gabino Creek. Above the pond, the tributaries are a mix of oak riparian and broad floodplain sycamore habitats. Portions of these tributaries exhibit slumping and erosion, probably resulting from grazing impacts, perhaps in conjunction with fires. A major unnamed tributary flows into Gabino Creek just upstream of its confluence with La Paz Creek. The natural drainage pattern of

this tributary has been substantially altered over time by mining activities, including the creation of a series of artificial ponds.

Lower Gabino Creek (below the confluence with La Paz), middle Gabino Creek, and La Paz Creek support structurally diverse, mature oak and southern sycamore riparian woodland with dense chaparral on the adjacent slopes (PCR et al, 2002). The center of the stream has a rock cobble substrate overlain by areas of shallow alluvial deposits that support mule fat scrub. The floodplain and riparian zones in the lower sub-basin are confined by the geology of the valley, but contain high topographic complexity (including bars and ponds that were inundated during our site visit), an abundance of coarse and fine woody debris, leaf litter, and a mosaic of plant communities. In many years, the creek flows through the late spring and seasonal pools persist in some locations, but seldom through the summer.

Existing Land Uses

The Gabino Sub-basin is largely undeveloped and is used for grazing. There is a manmade lake/stockpond in upper Gabino canyon and several abandoned clay pits on the west side of the lower portion of the sub-basin.

Future Land Uses

The development alternatives in the Gabino Sub-basin address approximately 4,280 acres within the RMV boundary in Planning Areas 7 and 9 (Figure 4-10 and Table 4-13). Under the B-10M Alternative, approximately 4,096 acres would remain as open space and 164 acres of estates would be located in PA 7 and 20 acres of estates would be located in PA 9.

Table 4-13: Land Uses and Areas in the Gabino Sub-basin

Alternative	Land Uses	Land Use Area within the Gabino Sub-basin (acres)
B-10M	Estate	184
	Proposed Development	0
	Open Space	4,096
	TOTAL	4,280

4.6.2 Planning Considerations and Planning Recommendations for the Gabino Sub-basin

Specific hydrologic planning considerations for the Gabino Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* include:

- Gabino and Talega Canyons are the largest sub-basins in the western San Mateo watershed.
- Gabino Canyon has the highest predicted absolute peak flow and runoff volume of the sub-basins studied in the western San Mateo watershed. This is due to its size, position

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high in the watershed, steep topography, and the narrow geologically confined nature of the middle and lower reaches of the sub-basin. Simulated hydrographs indicate a somewhat “flashy” runoff response in this sub-basin.

- Gabino Canyon has the highest predicted sediment yield and transport rate of any sub-basin analyzed in the western Sam Mateo sub-watersheds.
- Fine sediment generation in the upper sub-basin may exceed natural conditions due to extensive gully formation in the headwater areas.
- Terrains in the middle reaches are very steep, with high drainage densities and have very limited stormwater infiltration capacity.
- Sediments produced from the middle portion of the sub-basin are primarily coarse sediments, including sands and cobbles, which are mobilized and transported during extreme episodic events. These sediments are probably very important to downstream channel structure and provide geomorphologic elements of habitats for sensitive species found in the middle and lower reaches of Gabino Creek and further downstream.
- In wet years, the creek flows through the late spring and seasonal pools persist in some locations (probably associated with bedrock outcrops). However, these pools seldom if ever persist through the summer.
- Groundwater does not appear to be a significant element of the Creek’s hydrologic system, with the possible exception of the lower reaches (i.e., below the confluence with La Paz). It appears that the alluvium in this sub-basin is recharged during winter runoff events and once the limited aquifer storage has been seasonally depleted, little ongoing replenishment occurs until the next event.
- Along the lower reaches of the Creek, terrains to the north include clayey soils and a major unnamed side canyon that has been extensively modified by clay mining activities.
- The area south of Blind Canyon is comprised of a mesa top that has been grazed and is characterized by high gradient, coarse-bedded channel, and sycamore and oak riparian forest. The slopes of the canyon contain other significant habitat, including coast live oak.

The selection and sizing of the facilities in the combined control systems for the Gabino Sub-basin was guided by site conditions, the type of development land use, and incorporation of the planning recommendations. Table 4-14 lists the planning recommendations for the Gabino Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* and how the recommendations affected the choice and configuration of the combined control systems.

Table 4-14: Incorporation of the *Planning Recommendations* into BMP Selection

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> Limit new impervious surfaces in the headwater area to locations that will not adversely impact runoff patterns. 	<ul style="list-style-type: none"> Land use proposed for Upper Gabino in Alternative B-10M – estates – has limited impervious surfaces.
<ul style="list-style-type: none"> Protect the headwaters through restoration of existing gullies using a combination of slope stabilization, grazing management, and native grasslands and/or scrub restoration. To the extent feasible, restore native grasses to reduce sediment generation and promote infiltration of stormwater. 	<ul style="list-style-type: none"> Restoration is proposed in upper Gabino (Figure 4-10). Refer to the Habitat Restoration Plan. Under Alternative B-10M, soils stabilization would occur in conjunction with development.
<ul style="list-style-type: none"> Modify grazing management in the upper portion of the sub-basin to support restoration and vegetation management in the headwater areas. 	<ul style="list-style-type: none"> Refer to the Habitat Restoration Plan.
<ul style="list-style-type: none"> Minimize impacts to the steep side canyons in the middle portion of the sub-basin by limiting new impervious surfaces. 	<ul style="list-style-type: none"> No development is proposed for the steep side canyons in the middle sub-basin area.
<ul style="list-style-type: none"> To the extent feasible, focus development in the clayey soils and terrains in the lower portions of the sub-basin, where it could serve to reduce the generation of fine sediments and associated turbidity. 	<ul style="list-style-type: none"> Alternative B-10M proposes estates in the west side of the lower portion of the sub-basin on clayey soils.
<ul style="list-style-type: none"> To the extent feasible, utilize the side canyon currently degraded by past mining activities for natural water quality treatment systems. 	<ul style="list-style-type: none"> A clay mine pit would be used as a water quality treatment facility.
<ul style="list-style-type: none"> In the lower reach of the Creek, protect significant riparian habitats along the south side of the Creek and on proximate side canyon slopes. 	<ul style="list-style-type: none"> Riparian habitats along the south side of the Creek in the lower sub-basin and proximate side canyon slopes have been protected.
<ul style="list-style-type: none"> Protect the integrity of arroyo toad populations in lower Gabino Creek by maintaining hydrologic and sediment delivery processes, including maintaining the flow characteristics of episodic events in the sub-basin. Utilize natural water quality treatment systems to manage and treat runoff from any new land uses in areas adjacent to the lower creek. 	<ul style="list-style-type: none"> Although flows may be diverted into the lower Gabino Sub-basin from the Cristianitos Sub-basin in order to protect Cristianitos Creek and to utilize the ability of lower Cristianitos Creek to accept increased flows, the discharge point for the diverted flows from Cristianitos and the combined control system facilities in the lower Gabino Sub-basin is located as close as possible to the confluence with lower Cristianitos Creek in order to protect arroyo toad populations in lower Gabino Creek. The combined control system integrates natural treatment processes for water quality treatment.

4.6.3 Combined Control System Elements

The following describes the proposed combined facilities for each of the proposed planning areas within the Gabino Sub-basin for the B-10M Alternative.

Planning Area 7

Planning Area 7 (PA 7) is comprised of 223 acres of estates. It straddles the Cristianitos and Gabino Sub-basins and, where feasible, the grading plan will direct runoff from the Cristianitos Sub-basin to the Gabino Sub-basin to protect Cristianitos Creek. This is preferred because lower Gabino Creek, like San Juan Creek, is a relative large braided stream with coarse substrate that can accommodate increases in runoff without causing excessive erosion or inducing significant habitat changes. By comparison, increased runoff into Cristianitos Creek is considered likely to cause excessive erosion and possibly modify the existing alkaline wetland habitat. Additionally, the ability to route excess surface flows at the lower end of lower Gabino Creek allows the utilization of the functional capacity of lower Cristianitos Creek to accept increased flows.

Given that the estate homes have less imperviousness and large areas of landscaping and natural vegetation, controls for the estates are most feasible if conducted onsite or in common areas. Controls will consist of site design, source control, and treatment practices, such as vegetated swales, bioretention areas, and planter boxes.

Any excess flows generated in PA 7 within the Gabino Sub-basin will flow to an existing abandoned clay mine pit, which will be converted to a “wet” extended detention basin for treatment. A “wet” extended detention basin incorporates two pools: a permanent pool of water and a temporary water quality pool that is drawn down over 48 hours following a storm event. There is no pond outlet at this time, but an outlet structure would be provided to achieve the desired drain time. The pit is also hydraulically connected through the groundwater table to Gabino Creek so water that infiltrates into the pond will migrate as a subsurface flow into Gabino Creek. Enroute additional treatment will be achieved through filtration.

In the upper portion of the Gabino Sub-basin within Planning Area 9, the B-10M Alternative would include very low density estate homes. The very low density housing would be incorporated within the large area of surrounding open space. Controls for these estates will also be conducted onsite or in common areas and will consist of site design, source control, and treatment practices, such as vegetated swales, bioretention areas, and planter boxes.

4.7 WATER QUALITY MANAGEMENT PLAN FOR THE BLIND CANYON PORTION OF THE GABINO AND BLIND SUB-BASIN AND THE TALEGA SUB-BASIN

4.7.1 Site Assessment

Blind Canyon is a tributary watershed to Gabino that joins Gabino Creek just upstream of the confluence of Gabino Creek with lower Cristianitos Creek (Figure 4-11). Blind Canyon is a high

gradient, coarse substrate stream, dominated by sycamore and oak riparian gallery forest with a mule fat-dominated understory (PCR et al, 2002). The stream contains good topographic complexity, leaf litter, and coarse and fine woody debris. There are numerous high gradient, low order tributaries to Blind Canyon. Some contain scrub oak-dominated riparian forest, others are unvegetated swales. Several of the tributaries appear to pond seasonally at naturally occurring grade changes, but do not exhibit any features of slope wetlands. D-type soils are predominant in Blind Canyon.

Talega Canyon encompasses 8.3 square miles and straddles the boundary of Rancho Mission Viejo and Camp Pendleton (Figure 4-11). The Talega Canyon Sub-basin is extremely elongated, with the longest watercourse over 10.1 miles. Approximately one-third to one-half of the Talega Canyon drainage basin lies within the RMV boundary, most of which is occupied by the existing Northrup-Grummond facilities.

The Talega Sub-basin is underlain by bedrock of the Santiago, Silverado, Williams, and Trabuco formations and the Santiago Peak Volcanics (PCR et al, 2002). Within the boundaries of RMV, the underlying bedrock consists of the Santiago and Silverado formations and the Pleasants sandstone and Schulz Ranch members of the Williams formations. Surficial geologic units within the alternatives boundaries consist of alluvium, colluvium, nonmarine terrace deposits and a few landslides.

The majority of the sub-watershed is underlain by soils of hydrologic groups C (18.8 percent) and D (75.6 percent) (PCR et al, 2002). Talega Canyon has the highest proportion of poorer infiltrating Type D soils of any of the other sub-basins analyzed in the San Mateo watershed. The lack of available data and the fact that a significant portion of the basin is outside the study area (in Camp Pendleton) prevented analysis of sediment yield or transport rates for this sub-basin.

Nitrogen loading from the Talega Sub-basin should be relatively low given the existing land use and cover (PCR et al, 2002). However, the potential for generating large amounts of fine sediments indicates that Talega can be a significant source of phosphates. Historical aerial photography shows that a well-vegetated floodplain has often been absent, suggesting that the riparian corridor may play a relatively minor role in cycling of pollutants. However, some sequestration may occur in pockets where sandy substrates are found. Metal partitioning should heavily favor transport in the less biologically available particulate forms.

The riparian zones of Talega Creek are similar to those found in lower Cristianitos and Lower Gabino Creeks (PCR et al, 2002). Substrate is rock/cobble dominated with sandbars forming in depositional areas. The riparian habitat consists of dense stands of structurally diverse, mature coast live oak and southern sycamore riparian woodlands. Center portions of the creek support mule fat scrub and open sand bar habitat. The riparian zones are confined by the geology of the valley, but contain high topographic complexity, an abundance of coarse and fine woody debris, leaf litter, and a mosaic of understory plant communities. The creek contains shallow pools that

retain water into the late spring and early summer. Some of the highest concentrations of southwestern arroyo toad in the San Mateo watershed are located along Talega Creek.

Existing Land Uses

The Blind and Talega Sub-basins are largely undeveloped aside from the Northrop-Grumman (formerly know as TRW) facility. Areas in Blind Canyon are used for grazing.

Future Land Uses

The development alternatives in the Blind and Talega Sub-basins address approximately 2,055 acres within the RMV boundary in Planning Area 8 (Figure 4-12 and Table 4-15). Under the B-10M Alternative, approximately 1,093 acres would remain as open space and 963 acres would be developed, including 225 acres of golf course, 25 acres of resort area associated with the golf course, and 713 acres of general development, including residential, neighborhood center, and business park land uses.

Table 4-15: Land Uses and Areas in the Blind and Talega Sub-basins

Alternative	Land Uses	Land Use Area within the Blind and Talega Sub-basins (acres)
B-10M	Golf Course	225
	Golf Resort	25
	Proposed Development	713
	Open Space	1,093
	TOTAL	2,055

4.7.2 Planning Considerations and Planning Recommendations for the Blind Canyon Drainage Area and Talega Sub-basins

Specific planning considerations for the Blind Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* include:

- The slopes of Blind Canyon contain significant habitat including coast live oak.

Specific hydrologic planning considerations for the Talega Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* include:

- Talega Canyon straddles the boundary of RMV and Camp Pendleton, with at least a third of the upper watershed located outside of the SAMP and NCCP study areas in the San Mateo Wilderness Area. The existing TRW facilities are on the ridge above Talega Canyon, with runoff draining both to Talega Canyon and to Blind Canyon.
- Talega Canyon has the highest proportion of poorer infiltrating Type D soils of any of the other sub-basins analyzed in the San Mateo watershed and yield relatively high runoff

volumes. Although the simulated hydrographs for Talega Creek have a pronounced peak, they are relatively broad. The broader peaking is likely due to the elongated geometry of the sub-basin, which tends to attenuate flood movement as it travels through the sub-basin. Thus, runoff volumes are high but peak discharge rates are attenuated as stormwater travels downstream through the sub-basin.

- The headwaters of Talega Creek (which are outside of the SAMP and NCCP study areas) are in weathered granitic rocks that sustain a substantial density of springs. These springs help support a denser riparian corridor in the upper portion of the sub-basin, and may contribute to late season moisture in Talega Creek.
- Talega Creek supports one of the two largest populations of arroyo toads in the planning area. The creek substrate is rock/cobble with sandbars forming in depositional areas. Riparian habitat consists of dense stands of mature, structurally diverse coast live oak and southern sycamore riparian woodlands. Central reaches of the creek support mule fat scrub and open sand bar habitat. Riparian zones contain high topographic complexity, and abundance of coarse and woody debris, leaf litter and a mosaic of understory plant communities. The creek contains shallow pools that retain water into the late spring and early summer, a water supply likely to be of significance for arroyo toad breeding habitat, but does not appear to be sufficient to sustain steelhead.

The selection and sizing of the facilities in the combined control systems for the Blind Canyon drainage area and the Talega Sub-basin was guided by site conditions, the type of development land use, and incorporation of the planning recommendations. Table 4-16 lists the planning recommendations for the Blind and Talega Sub-basins set forth in the *Draft Watershed and Sub-basin Planning Principles* and how the recommendations affected the choice and configuration of the combined control systems.

Table 4-16: Incorporation of the Planning Recommendations into BMP Selection

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> • Limit development and other uses in Blind Canyon to the grazed areas on the mesa and away from the major oak woodlands in Blind Canyon. Direct to and treat stormwater runoff in areas that will not contribute to appreciable increases in water delivery/flow to the oak woodlands in the lower portion of the sub-basin. 	<ul style="list-style-type: none"> • Under the B-10M Alternative, proposed development areas in Blind Canyon are away from the major oak woodlands. • Runoff from Blind Canyon will be treated before being discharged to infiltration basins located near the confluence of Gabino Creek and Blind Creek.
<ul style="list-style-type: none"> • To the extent feasible, major stormwater flows from development areas in the Talega sub-basin should emulate current runoff patterns. Runoff during the dry season and high frequency/low magnitude storms (generally 1–2 year storm events) should be routed through natural water quality treatment systems and, where feasible, encouraged to flow generally away from arroyo 	<ul style="list-style-type: none"> • The proposed grading plan directs excess flows from areas once tributary to Talega Creek to Blind Creek. Excess flows are treated and diverted into infiltration basins located in Blind Canyon. Flow duration control is used to preserve the existing flows in Talega Creek.

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
toad habitat in Talega Canyon and toward Blind Canyon.	
<ul style="list-style-type: none"> Development should focus on the Talega Canyon ridge tops to avoid the canyon bottoms and preserve the steeper slopes. To the extent practical, development should generally be in the area of the existing TRW facilities and adjacent ridges to the east/northeast. 	<ul style="list-style-type: none"> The proposed development in Alternative B-10M is limited to the area of the Northrop-Grumman (formerly known as TRW) site and adjacent ridges to the east/northeast.
<ul style="list-style-type: none"> The timing of peak flows in Talega Creek should emulate the timing of flows under existing conditions. 	<ul style="list-style-type: none"> The combined control system will preserve the timing of existing flows in Talega Creek.

4.7.3 Combined Control System Elements by Planning Area – Alternative B-10M

The following describes the proposed combined facilities for Planning Area 8 within the Blind and Talega Sub-basins for Alternative B-10M.

Planning Area 8

Planning Area 8 (PA 8) proposed development includes 225 acres of golf course, 25 acres of golf resort, and 697 acres of general development within the Blind and Talega Sub-basins. The underlying soils are predominantly clay with moderate patches of sandy loam that limit the ability to infiltrate runoff.

Runoff from the general development in Blind Canyon will be treated and infiltrated in a combined control facilities. The control strategy for these areas includes the use of extended detention water quality treatment basins treating runoff from the general development. Treated and bypassed flows from the water quality basins will be directed to a lined vegetated swale that will discharge to infiltration basins located in patches of sandy loam in the lower elevations of Blind Canyon. In the neighborhood center and business park areas, roof runoff could be directed to stormwater planter areas or bioinfiltration swales, and landscaped areas could be used to treat runoff from parking and courtyard areas. Street runoff and excess roof/parking area runoff would be directed to the combined control system.

Runoff from the golf course will be captured and stored onsite as a source of non-potable water for golf course irrigation. The storage facilities would additionally function as a wetpond for treatment of the stormwater, prior to use irrigation. The methodology used to size the storage facility is discussed in Section 4.5.3 above.

Talega Creek is of particular concern in that it hosts a “major population” of arroyo toads and supports some of the highest quality riparian habitat in the NCCP/SAMP study area. To maintain existing flows to Talega Creek, flows generated from a portion of Catchment T-1 will be used to match the existing runoff conditions. This will incorporate the use of a single FD/WQ

basin, with a vegetated swale that will connect to the main stem of Talega Creek. The remainder of Catchment T-1 will flow to a water quality basin that will discharge to lower Cristianitos, which will allow for the utilization of the functional capacity of lower Cristianitos Creek to accept increased flows.

4.8 WATER QUALITY MANAGEMENT PLAN FOR THE VERDUGO SUB-BASIN

4.8.1 Site Assessment

The 4.8 square mile Verdugo Canyon Sub-basin has roughly an east-west orientation (Figure 4-13). Approximately one-half to two-thirds of the Verdugo Canyon Sub-basin lies within the RMV property boundary.

The sub-basin is underlain by bedrock of the Williams, Ladd, and Trabuco formations and the Santiago Peak Volcanics (PCR et al, 2002). Within the RMV boundary, the underlying bedrock consists of the Schulz Ranch and Starr members of the Williams formation, the Holz Shale and Baker Canyon members of the Ladd Formation, and the Trabuco formation. Surficial geologic units within the RMV boundary consist of alluvium, colluvium, nonmarine terrace, deposits and a few landslides of relatively limited areal extent.

Verdugo Canyon had one of the highest predicted infiltration rates of any of the sub-basins studied in the San Juan watershed (PCR et al, 2002). This results from the undeveloped condition of the sub-basin, the relatively high proportion of Type A (8.3 percent) soils (compared to other sub-basins), and relatively low proportion of Type D soils (28.6 percent) compared to other sub-basins in the watershed.

Verdugo Canyon, along with Lucas and Bell Canyons, constitute the more silty portions of the San Juan Creek watershed, with upper portions of the sub-basins containing crystalline terrains (PCR et al, 2002). These areas are characterized by coarser substrates, shallower soils, and steeper slopes than the Chiquita or Gobernadora Sub-basins. The combination of substrate type and slope results in Verdugo Canyon having the highest sediment transport rate per unit area of any of the sub-basins in San Juan Creek watershed. Sediment yield for Verdugo is second behind Bell Canyon. Like many of the steep silty and crystalline areas of the study area, much of the sediment in Verdugo is mobilized during episodic events and, when mobilized, has the potential to have substantial effect on sediment delivery and on the geomorphology of the downstream areas.

The large quantities of highly erodible soils in the Verdugo Sub-basin can be expected to provide a source of phosphorus loading to San Juan Creek (PCR et al, 2002). Nitrogen loading from the sub-basin is expected to be low given that only six percent of the watershed is covered with grasslands, there are limited anthropogenic sources, and little channel incision. The terrains and steep slope of Verdugo Canyon likely results in direct nutrient and pollutant pathways to surface waters. The existence of an intact riparian corridor implies that there is potential for sequestration of constituents of concern within floodplain terraces, with increased amounts of

organic carbon available to augment nitrogen cycling. Speciation is expected to favor the transport of metals and pesticides (were any to be present) in an adsorbed form.

The biological resources of Verdugo Canyon are also similar to those found in Bell or Lucas Canyon (PCR et al, 2002). The streams are predominantly coarse substrate with southern coast live oak riparian woodland, surrounded by sage scrub and chapparal. These areas are more similar to habitats found in the upper San Mateo watershed than to those found in the Chiquita and Gobernadora Sub-basins. Because groundwater is less prevalent than in Chiquita or Gobernadora, the habitats tolerate moderate moisture more than the willow riparian habitats found in those sub-basins. The narrowness of the canyon results in high biological interaction between the habitats of the floodplain and the adjacent uplands.

Existing Land Uses

The Verdugo Sub-basin is largely undeveloped.

Future Land Uses

The development alternative in the Verdugo Sub-basin addresses approximately 1,847 acres within the RMV boundary in Planning Area 4 and Planning Area 9 (Figure 4-14 and Table 4-17). Under the B-10M Alternative, approximately 1,368 acres would remain as open space and 479 acres would be developed. This proposed development is located in the lower portion of the sub-basin, adjacent to the Central San Juan Sub-basin.

Table 4-17: Land Uses and Areas in the Verdugo Sub-basin

Alternative	Land Uses	Land Use Area within the Verdugo Sub-basin (acres)
B-10M	Proposed Development	479
	Open Space	1,368
	TOTAL	1,847

4.8.2 Planning Considerations and Planning Recommendations for the Verdugo Sub-basin

Specific hydrologic planning considerations for the Verdugo Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* include:

- Verdugo Canyon has one of the highest soil infiltration rates of any of the sub-basins studies in the San Juan watershed.
- Substrate types and slope result in Verdugo Canyon having the highest sediment transport rate per unit area of any San Juan Creek watershed sub-basin, with sediment yield second behind Bell Canyon. Much of the sediment in Verdugo is mobilized during episodic

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events and, when mobilized, has the potential to have substantial effects on sediment delivery and on the geomorphology of downstream areas.

- The large quantities of highly erodible soils in the Verdugo Sub-basin are expected to provide a source of phosphorus loading to San Juan Creek.
- The upper portion of the Verdugo Sub-basin is underlain by the Trabuco and Ladd formations, which lack shallow groundwater and yield little base flow. Due to the relative absence of groundwater and the presence of the steep slopes, both upland and riparian habitats reflect drier conditions than in other sub-basins.
- The stream course has a predominantly coarse substrate and is strongly influenced by the narrowness of the canyon.

The selection and sizing of the facilities in the combined control systems for the Verdugo Sub-basin was guided by site conditions, the type of development land use, and incorporation of the planning recommendations. Table 4-18 lists the planning recommendations for the Verdugo Sub-basin set forth in the *Draft Watershed and Sub-basin Planning Principles* and how the recommendations affected the choice and configuration of the combined control systems.

Table 4-18: Incorporation of the *Planning Recommendations* into BMP Selection

Planning Recommendations	Site Planning and Treatment/Flow Control BMPs
<ul style="list-style-type: none"> • Development with impervious surfaces should be limited in extent in order to protect the generation and transport of sediment to downstream areas, and to protect Verdugo Canyon from excessive erosion. 	<ul style="list-style-type: none"> • 74% of the sub-basin is preserved as open space in the B-10M Alternative.
<ul style="list-style-type: none"> • Development should be set back from significant riparian habitat within the relatively narrow and geologically confined floodplain. 	<ul style="list-style-type: none"> • The proposed development is set back from significant riparian habitat.
<ul style="list-style-type: none"> • Infiltration functions should be protected through site design. Cumulative stormwater flows should be managed in such a way as to not change peak flows that under present conditions lag behind those of the main stem of San Juan Creek. The area adjacent to the mouth of Verdugo Canyon provides opportunities for infiltration and flow attenuation. 	<ul style="list-style-type: none"> • The combined control system will preserve the timing of existing flows in Verdugo Canyon Creek.

4.8.3 Combined Control System: Elements by Planning Area

The following describes the proposed combined facilities for the proposed planning area in the Verdugo Sub-basin for Alternative B-10M.

Planning Area 4

Planning Area 4 (PA 4) extends beyond the eastern boundaries of the Central San Juan Sub-basin and into the Verdugo Sub-basin. The proposed development within PA 4 is described as “general development” and includes multiple segments of proposed roadway. Runoff generated from PA 4 is discharged directly to Verdugo Creek, immediately upstream of the confluence with San Juan Creek. As previously stated, San Juan Creek has been identified as providing breeding habitat for the arroyo toad. To protect the arroyo toad habitat in San Juan Creek, flow duration controls will be incorporated. Runoff generated from all new development within the Verdugo Sub-basin will be treated by a single combined control facility that includes a FD/WQ basin, an onsite storage facility, an infiltration basin, and a vegetated swale that will connect to the tributary channel. Excess flows would be conveyed to Verdugo Creek through vegetated swales. Treated flows would be collected and stored onsite as a source of non-potable water supply. The storage facilities could be in the form of a wet pond or a structural tank. Treated flows that exceed the onsite storage capacity would be conveyed to an infiltration basin.

Facilities and Sizing

Table 4-21 presents the proposed combined control system for the Verdugo Sub-basin. To protect the arroyo toad population in San Juan Creek, flows generated from the proposed development will be treated in a combined control system consisting of a flow control/water quality basin, onsite storage facility, infiltration basin, and a lined bioswale.

Table 4-22 shows the estimated sizes of the components of the combined controlled system. The proposed development will be located on highly infiltrative soils (primarily sandy loam). Because of this, the majority of the runoff from developed conditions must be stored or infiltrated into the subsurface in order to match the natural flow regime in Verdugo Creek. The infiltration basins were sized to handle all flows out of the flow duration/water quality basin, providing adequate capacity in the event that the onsite storage facilities reach maximum capacity or are taken off-line.

Table 4-19: Combined Control System Requirements for the Verdugo Sub-basin-Alternative B-10M

Facility ID	Tributary Catchments	Combined Control System Components	Comments
Verdugo-1	120, 121a, 121b, 121c, 122, PA4-4, PA4-5	<ul style="list-style-type: none"> • FD/WQ Basin • Infiltration Basin • Lined Vegetated Swale 	Standard combined control system. Water is conveyed from flow duration basin to the infiltration basin through vegetated swales, allowing further water quality treatment. Bypassed flows are directed to Verdugo Creek.

Table 4-20: Combined Control System Facilities and Sizes the Verdugo Sub-basin- Alternative B-10M

Facility ID	Tributary Catchment	Facility Tributary Area ¹ (acre)	F.D./W.Q. Basin			Infiltration Basin ³	
			% Capture ²	Area (acres)	Volume (ac-ft)	Area (acres)	Volume (ac-ft)
Verdugo-1	120, 121a, 121b, 121c, 122, PA4-4, PA4-5	481	98	14.8	124.6	3.3	6.5

¹Tributary area includes project development within the catchment; open space and existing development are not included.

²Percent of average annual runoff volume predicted by the model that is captured in the basin.

³Infiltration basin sizes assume no infiltration occurs in vegetated swales. Infiltration areas and volumes may be divided between infiltration basin and swales in detailed design, with consideration of maintaining flow durations.

4.9 WATER QUALITY MANAGEMENT PLAN FOR THE NARROW AND LOWER SAN JUAN SUB-BASIN AND THE LOWER CRISTIANITOS SUB-BASIN

4.9.1 Narrow and Lower San Juan Sub-basin

Planning Area 1 (PA1) encompasses approximately 540 acres in the western portion of the Narrow Canyon and Lower San Juan Creek Sub-basin (Figure 4-15), east of the City of San Juan Capistrano in the vicinity of Antonia Parkway and Ortega Highway. Runoff from PA 1 would discharge via tributary streams into San Juan Creek. San Juan Creek in this sub-basin is similar to the Central San Juan Creek Sub-basin, with intermittent to near perennial flow in a highly braided channel. Existing land uses within this sub-basin are also similar to the Central San Juan and Trampas Sub-basin, and include general agriculture, nurseries, and orchards on the north and south sides of San Juan Creek in close proximity to the creek, as well as some commercial land use and roadway.

The proposed land uses within PA1 include 465 acres of general development (residential and urban activity center) and 75 acres of estates in the B-10M Alternative.

Given that the Narrow Canyon and Lower San Juan Creek Sub-basin is located on clayey terrain, and that hydrologic and geomorphic conditions in the receiving stream, San Juan Creek, are driven by large scale watershed processes, the focus of the WQMP elements for this sub-basin is on water quality treatment, rather than flow duration control. The combined control system facilities will therefore include extended detention water quality basins sized according to the WEF Method specified in the MS4 Permit, with the provision of a 48 hour draw down time.

4.9.2 Lower Cristianitos Sub-basin

The Lower Cristianitos Sub-basin is a small area encompassing approximately 287 acres located in the San Mateo Creek watershed south of the Cristianitos Sub-basin, southeast of the Donna O’Neill Conservancy at Rancho Mission Viejo, and west of the lower Gabino, Blind Canyon,

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and Talega Sub-basins (Figure 4-15). The dominant landscape feature in the area is lower Cristianitos Creek south of the confluence with Gabino Creek where it exits RMV property.

Soils in the main canyon are primarily sandy and soils on the uplands area adjacent to the Northrup-Grummond facility are erodible clays (NCC/SAMP Working Group, 2003). Elevations range from approximately 200 feet above MSL in the creek bottom to approximately 300 feet on the mesa east of the creek. Upland habitats are dominated by annual grassland and small patches of coastal sage scrub and southern cactus scrub. A small patch of native grassland is present in the northeast corner of the area that overlaps with native grasslands in the Gabino and Blind Canyon Sub-basins. Riparian habitats in lower Cristianitos Creek include southern coast live oak forest and woodland, southern sycamore riparian woodland, southern willow scrub, arroyo willow riparian forest, and mule fat scrub.

The sub-basin within the RMV boundary is mostly undeveloped, aside from a portion of the Northrup-Grummond facility and roadway. A significant amount of generally developed area exists within the sub-basin outside of the RMV boundary.

Alternative B-10M proposes 75 acres of general development and 214 acres of open space within the Lower Cristianitos Sub-basin. The general development land use is associated with Planning Area 8, which overlays the Lower Cristianitos, Gabino, Blind, and Talega Sub-basins.

The planning recommendations set forth in the *Draft Watershed and Sub-basin Planning Principles* for this sub-basin include protection of the integrity of arroyo toad populations in lower Cristianitos Creek by maintaining current hydrologic conditions. Under the B-10M Alternative, the developed area proposed within this sub-basin will drain to a combined control system similar to those proposed in the Blind and Talega Sub-basins, that include treatment in an extended detention basin followed by infiltration in the sandy soils in the main canyon. This system will mimic the current hydrologic conditions from this drainage area.

5 IMPACT ANALYSIS

This chapter evaluates the impacts of the proposed alternatives on pollutants of concern and hydrologic conditions of concern taking into account the WQMP elements described in Chapter 4. In the preceding chapter, the site design features, source control measures, and combined control system facilities were referred to as “BMPs” consistent with the Local WQMP. In this chapter, the BMPs associated with the Conceptual WQMP are referred to as “Project Design Features” (PDFs), which is consistent with the LIP’s CEQA guidance. The significance of impacts is evaluated based on significance criteria and thresholds described in Chapter 2.

Certain impacts are more conveniently addressed for the development alternatives as a whole, and are discussed in Section 5.1. Sub-basin specific impacts to hydrologic conditions of concern and other pollutants of concern are described in subsequent sections.

Hydrologic and water quality modeling for many of the planning areas was previously conducted for the Ranch Plan (Alternative B-4, provided in Appendix D). Modeling was also conducted for the B-9 Alternative for proposed development in PA 4 in the Central San Juan/Trampas sub-basin and the Verdugo sub-basin, and for proposed development in PA 8 within the Blind/Talega sub-basin. The impact analyses for the Blind/Talega and Central San Juan/Trampas sub-basins under Alternative B-9 are provided in Appendix E. Sub-basin specific impacts of the B-10M Alternative are primarily addressed through extrapolation of the B-4 and B-9 modeling results, literature information on the effects of urbanization on water quality, and professional judgment.

It should be noted that the hydrologic and water quality modeling only takes into account the structural facilities in the combined control system, including the detention and infiltration basins, the diversions, and the non-domestic water supply reservoirs. The modeling also takes into account anticipated irrigation controls. The models do not take into account site design and source control BMPs that will limit runoff and prevent the introduction of pollutants in the runoff. Such controls include litter programs, pesticide application management, street sweeping, and other maintenance operations. In this respect, the model predictions are likely to overestimate the effects of the proposed development on hydrology and water quality.

5.1 GENERALIZED IMPACTS

This section discusses those impacts that can be addressed for the proposed alternative as a whole, including impacts to certain pollutants of concern, groundwater impacts, and construction phase impacts. Discussion under general impacts also avoids replication of similar issues in subsequent sections.

5.1.1 Selected Pollutants of Concern

The assessment of impacts to solids, nutrients and trace metals was conducted with the aid of a water quality model. Necessary inputs to the model include statistically reliable and representative measured data that characterizes runoff water quality from a variety of land use

types, and characterizes the effectiveness of BMPs. Such data are not available for the entire suite of pollutants of concern. Consequently the assessment of impacts to other pollutants of concern, including bacteria, pesticides, hydrocarbons, and trash and debris, was analyzed qualitatively. The reasons that such data do not exist for each of these pollutants are discussed below.

- Actual human pathogens are usually not directly measured in stormwater monitoring programs because of the difficulty and expense involved. Rather, indicator bacteria such as fecal coliform are measured. Most indicators are not very reliable for stormwater conditions, in part because stormwater tends to mobilize pollutants from many sources, some of which contain non-pathogenic bacteria. For this reason, and because holding times for bacterial samples are necessarily short, stormwater programs collect single grab samples for pathogen indicators versus flow composite samples that potentially could produce more reliable estimates of averages.
- Various forms of hydrocarbons are common constituents associated with urban runoff; however, these constituents are difficult to measure because of laboratory interference effects, sample collection challenges (hydrocarbons tend to coat sample bottles), and they are typically measured with single grab samples, making it difficult to develop reliable Event Mean Concentrations (EMCs) based on collecting and analyzing flow composite samples.
- Pesticides in urban runoff are often at concentrations that are below detection limits for most commercial laboratories; and therefore there are limited statistically reliable data on pesticides in urban runoff.

Impacts to Pathogens

Pathogens are viruses, bacteria, and protozoa that can cause illness in humans. Identifying pathogens in water is difficult as the number of pathogens is exceedingly small, requiring sampling and filtering large volumes of water. Traditionally water managers have relied on measuring “pathogen indicators”, such as total and fecal coliform, as an indirect measure of the presence of pathogens. Although such indicators were considered reliable for sewage samples, indicator organisms are not necessarily reliable indicators of viable pathogenic viruses, bacteria, or protozoa in stormwater. One reason for this is that coliform bacteria, in addition to being found in the digestive systems of warm-blooded animals, are also found in plants and soil; and pathogen indicators can multiply in the environment if the substrate, temperature, moisture, and nutrient conditions are suitable.

There are numerous natural and anthropogenic sources of pathogen indicators. Natural sources include birds and other wildlife. Anthropogenic sources include domesticated animals and pets, and human sources that may be introduced via poorly functioning septic systems, cross-connections between sewer and storm drains, and the direct utilization of outdoor areas for human waste disposal.

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The Orange County Public Health Laboratory conducted a monitoring study in 1998 in the San Juan Creek watershed to help determine the sources of pathogen indicators during *dry weather conditions* (Moore et al., 2002). Monitoring stations were located in the ocean, in creeks in the San Juan Creek watershed, and in storm drains. One finding of the study was that “the highest concentrations of fecal coliforms and *Enterococcus* were found in the storm drains as compared to the creeks and ocean sampling sites. Samples taken from creek sites distant to human habitat also had low to moderate levels of bacteria, suggestive of fecal contamination by non-human sources.” Data obtained in San Juan Creek above the Ortega Highway (SJ30) indicated a log mean concentration for fecal coliform of about 300 colony forming units (CFUs) compared with a storm drain at La Novia Bridge (SJ07) where the concentration was about 1,400 CFUs.

Pathogen indicator concentrations during *wet weather* tend to be higher than during dry weather. The recent wet weather data collected by Wildermuth indicated that the geometric mean concentration of fecal coliform in San Juan Creek ranged from about 2,500 to 3,600 MPN/100mL. Geometric mean fecal coliform concentrations downstream of the Coto de Caza development in the Gobernadora Sub-basin were about 10,000 MPN/100 mL. The one dry weather fecal coliform sample taken below Coto De Caza was about 300 MPN/mL.

These data indicate that the development could potentially result in increased levels for pathogen indicators, especially during stormwater runoff conditions. The principal source of these pathogen indicators is likely pet wastes. Other sources of pathogens and pathogen indicators, such as cross connections between sanitary and storm sewers, are unlikely given modern sanitary sewer installation methods and inspection and maintenance practices.

The most effective means of controlling pet wastes as a source of pathogens is through source control, specifically education of pet owners, and providing products and disposal containers that encourage and facilitate cleaning up after pets.

The available data on the effectiveness of water quality basins for treating pathogens and pathogen indicators is limited. Caltrans has conducted some pathogen indicator monitoring of dry detention basins. These data indicate no statistically reliable reductions in effluent concentrations compared to influent concentrations. Therefore it is not assumed that levels of pathogen indicators during storm events will be reduced in the water quality basins.

However, the combined control system also includes an infiltration basin following the water quality basin. Infiltration is very effective in treating pathogens (DAMP Appendix E1), and therefore pathogens associated with dry weather flows, small storm flows, and the initial portion of large storm events will be effectively treated in the combined control system.

For those flows that bypass the infiltration basin, pathogen levels are not likely to meet the REC-1 standards (200 MPN/100 mL) for fecal coliform consistently. Meeting the REC-1 standard would require a level of treatment (e.g., disinfection) comparable to a municipal wastewater treatment plant which is considered beyond MEP for treating stormwater discharges.

The alternatives include a comprehensive list of source control BMPs for controlling pathogens that meet the Local WQMP and thus the MEP standard. Based on these considerations, the impact of the proposed alternatives on pathogens is considered a significant, unavoidable impact.

Impacts to Petroleum Hydrocarbons

The sources of oil, grease, and other petroleum hydrocarbons in urban areas include spillage and seepage of fossil fuels, discharge of domestic and industrial wastes, atmospheric deposition, and runoff (USEPA, 2002a). Runoff can be contaminated by leachate from asphalt roads, wearing of tires, deposition from automobile exhaust, and improper disposal of used oil and other auto-related fluids. Petroleum hydrocarbons, such as polycyclic aromatic hydrocarbons (PAHs), can accumulate in aquatic organisms from contaminated water, sediments, and food and are known to be toxic to aquatic life at low concentrations (USEPA, 2000a). Hydrocarbons can persist in sediments for long periods of time and result in adverse impacts on the diversity and abundance of benthic communities. Hydrocarbons can be measured as total petroleum hydrocarbons (TPH), oil and grease, or as individual groups of hydrocarbons, such as PAHs.

PAHs represent over 100 different chemicals and are found in coal tar, crude oil, creosote, and roofing tar; 16 PAHs have been placed on EPA's list of priority pollutants. Some PAHs are formed during the combustion of petroleum-based, wood, and paper products. The most likely sources of PAHs in stormwater runoff are vehicle combustion and leaks that could contribute PAHs in runoff from highways and parking lots. The majority of PAHs in stormwater adsorb to the organic carbon fraction of particulates in the runoff, including soot carbon generated from vehicle exhaust (Ribes et al, 2003). For example, a stormwater runoff study by Sharma et. al. (1997) found that the dissolved phase PAHs represented less than 11 percent of the total concentrations.

The median concentration of oil and grease summarized from a representative sample of NPDES MS4 monitoring programs nationwide was 3.1 mg/L for residential land use (Pitt et. al., 2003). The mean oil and grease value for three samples from high density single family residential land use reported in the Los Angeles County database was 1.3 mg/L; while TPH was also 1.3 mg/L in three samples (LA County, 2000). The reported mean oil and grease and TPH in four transportation land use samples was 3.1 mg/L. Oil and grease and TPH were not detected in 17 and 19 samples, respectively, out of a total of 21 samples taken of runoff from open space. These data indicate that hydrocarbons are only intermittently observed in runoff from residential areas, and when observed, the levels are relatively low. ***Dry weather*** discharges are primarily associated with illegal dumping, especially in areas where automobiles are maintained by homeowners that do not have a means of recycling used oil.

The Local WQMP rates detention basins and biofilters with a high or medium removal efficiency for oil and grease, and states that the effectiveness of infiltration basins and wetlands, according to the Local WQMP, is unknown. However, the California BMP Handbook attributes infiltration basins and constructed wetlands with high removal effectiveness for oil and grease, and medium effectiveness for extended detention basins and vegetated swales (CASQA, 2003). The proposed

combined control system, which is designed to treat pollutants through settling, adsorption, and biologically mediated processes in extended detention basins, wetlands, infiltration, and vegetated swales in series, should be very effective at treating PAHs and other petroleum hydrocarbons at the expected concentrations in runoff. On this basis, the effect of the proposed project on petroleum hydrocarbon levels is considered less than significant.

Impacts to Pesticides

Pesticides can be of concern from past as well as future activities. Where past farming practices involved the application of persistent pesticides such as DDT, there is the potential for mobilization during construction. Post-development application of pesticides for lawn, garden, and household use; common area landscaping; and golf courses may also introduce pesticides into the aquatic environment.

Wetlands Research Associates (WRA, 2002) identified pesticides and other toxic chemicals that could potentially impact endangered species known to be located within, downstream of, or adjacent to the RMV boundary - the arroyo toad and the southern steelhead. The following pesticides were identified as potential pollutants of concern: toxaphene, pentachlorophenol (PCP), and glyphosate. Toxaphene is an organochlorine pesticide that was very popular during the 1970s following the banning of DDT. It in turn was banned for all uses in 1990 (WRA, 2002). PCP is also a chlorinated pesticide that is primarily used as a preservative for wood products, and as a general herbicide. PCP is currently being phased out and is a Restricted Use Pesticide that can only be purchased and applied by certified applicators. Glyphosate is a broad-spectrum, non-selective systemic herbicide commonly formulated as Roundup. It tends to bound tightly with sediments, and is not very leachable by stormwater runoff. Its half life in pond water ranges from 12 days to 10 weeks (WRA, 2002).

Past and current agricultural practices consisted primarily of ranching, growing barley, and some nursery uses. In order to help identify the presence of legacy and other pesticides from these activities, Wildermuth analyzed stormwater runoff samples for organochlorine and organophosphate pesticides; the data has been provided in Appendix C. Six samples (one sample from six stations) for organochlorine pesticides were below detection. Detection values for most pesticides ranged between 0.1 to 0.6 µg/L. The detection limit for toxaphene was 1.3 µg/L, which is greater than the water quality criteria (0.73 µg/L). These data indicate that legacy pesticides are generally not present in stormwater runoff from the proposed development area; there is uncertainty, as in the case of toxaphene, as to whether the legacy pesticides are present at levels of concern due to the detection limit being greater than the water quality standard.

BMPs that will be implemented to address pesticides include non-structural and structural source control, low flow recycling, and treatment in the combined control system. EPA has recently banned the pesticides diazinon and chlorpyrifos (commonly used urban pesticides) for most urban applications (USEPA, 2002). These pesticides, as well as other banned pesticides, will not be used for landscape maintenance. Other source control measures include education

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programs for owners, occupants, and employees in the proper application, storage, and disposal of pesticides.

Pesticide discharges are of particular concern in golf courses. An Integrated Pest Management Plan (IPM) will be developed and implemented for the proposed golf courses. This plan will be the same or equivalent to the IPM for the approved Arroyo Trabuco Golf Course. Pesticides will be stored at the golf courses in an enclosure such as a cabinet, shed, or similar structure or will be stored on a paved surface and under cover and protected by secondary containment structures such as berms, dikes, or curbs. Dry weather flows and storm flows from the golf course will be treated in the combined control facilities, stored in non-domestic water storage reservoirs, and recycled for irrigation.

While some increase in pesticide use is likely to occur as the result of development due to maintenance of landscaped areas, particularly in the residential and golf portions of the development, careful selection, storage and application of these chemicals will help prevent water quality impacts from occurring. With appropriate management and storage of pesticides, no adverse impacts are expected to occur with development. Based on this combined source control and treatment strategy, potential impacts of pesticides on water quality are considered to be less than significant.

Impacts to Trash and Debris

Urban development tends to generate significant amounts of trash and debris. Trash refers to any human-derived materials including paper, plastics, metals, glass and cloth. Debris includes organic material transported by stormwater, including leaves, twigs, and grass clippings. Trash and debris is often characterized as material retained on a 5-mm mesh screen. It contributes to the degradation of receiving waters by imposing an oxygen demand, attracting pests, disturbing physical habitats, clogging storm drains and conveyance culverts and mobilizing nutrients, pathogens, metals, and other pollutants that may be attached to the surface. Sources of trash in developed areas can be both accidental and intentional. During wet weather events, gross debris deposited on paved surfaces can be transported to storm drains, where it is eventually discharged to receiving waters. Trash and debris can also be mobilized by wind and transported directly into waterways.

Urbanization could significantly increase trash and debris loads if left unchecked. However, the proposed BMPs, including source control and treatment BMPs, will minimize the adverse impacts of trash and debris. Source controls such as street sweeping, public education, fines for littering, and storm drain stenciling can be effective in reducing the amount of trash and debris that is available for mobilization during wet and dry weather events. Water quality basins are very effective at trapping trash and debris. Trash and debris are not expected to significantly impact receiving waters due to the implementation of PDFs.

Impacts to Chlorine

Chlorine is a potential pollutant of concern because the free form of chlorine is a strong oxidant and is therefore very toxic to aquatic life. With respect to new development, one dry weather concern is the emptying of swimming pools that have not been de-chlorinated into local streams. Municipal pools and private pools in areas served by a municipal sanitary system are generally required to be discharged into the sanitary system. Under these conditions, the impact of new development on beneficial uses of local receiving waters from chlorine discharges is considered less than significant.

5.1.2 Groundwater Impacts

Although geology and groundwater conditions vary depending on the terrain (Balance Hydrologics, 2001b), the impacts of the proposed development on groundwater quality are discussed in a general framework.

The approach taken by the WQMP to protect groundwater quality is multi-tiered: (1) site design and source control BMPs will be implemented to prevent the discharge of pollutants to the maximum extent practicable, (2) the proposed combined control system will incorporate infiltration only where there is at least a ten foot separation to groundwater, and (3) where infiltration is proposed, the water will be pretreated in a water quality treatment facility sized to meet MS4 Permit requirements.

Some incidental infiltration also will occur in the flow control/water quality basins upstream of the infiltration basins. However, in these basins, vegetation would be allowed to grow and decay, which will provide an adsorptive organic layer on the bottom of these basins that will assist in pollutants uptake and protect groundwater quality.

The only pollutant of concern for which there is a groundwater quality objective is nitrate. The water quality objective for nitrate-nitrogen is 10 mg/L; however, this level is much higher than observed concentrations of nitrate-nitrogen in urban runoff. For example, the range of observed nitrate-nitrogen concentrations from urban land uses in LA County are about 0.3 to 1.4 mg/L. Projected effluent concentrations from the FD/WQ basin would be about 0.3 mg/L. On this basis, the potential for adversely affecting groundwater quality for this pollutant of concern is considered less than significant.

5.1.3 Construction-Related Impacts

The potential impacts of construction on water quality focus primarily on sediments and turbidity and pollutants that might be associated with sediments (e.g., phosphorus). Construction-related activities that are primarily responsible for sediment releases are related to exposing soils to potential mobilization by rainfall/runoff and wind. Such activities include removal of vegetation from the site, grading of the site, and trenching for infrastructure improvements. Environmental factors that affect erosion include topographic, soil, and rainfall characteristics.

Construction impacts will be minimized through the development and implementation of erosion and sediment control BMPs that will meet or exceed measures required by the State Water Quality Control Board's NPDES General Construction Permit. Erosion control BMPs are designed to prevent erosion, whereas sediment controls are designed to trap sediment once it has been mobilized. A Stormwater Pollution Prevention Plan (SWPPP) will be developed as required by, and in compliance with, the General Construction Permit. This permit requires BMP selection, implementation, and maintenance during the construction phase of development.

The significance criteria during the construction phase is implementation of Best Management Practices consistent with Best Available Technology Economically Achievable and Best Conventional Pollutant Control Technology (BAT/BCT), as required by the Construction General Permit and Section 8 of the DAMP. Erosion and sediment transport and transport of other potential pollutants during the construction phase will be reduced or prevented through implementation of BAT/BCT in order to prevent or minimize environmental impacts during the construction phase.

5.1.4 Compliance with Plans, Policies, Regulations, and Permits

A key significance criterion that is applicable to the proposed alternatives as a whole is compliance with plans, policies, regulations and permits (Chapter 2). The following section specifically addresses compliance with this significance criterion.

Compliance with Plans and Policies

The Conceptual WQMP was developed to assess potential water quality, water balance, and hydromodification impacts of development that could occur within the development bubbles identified within the "B" Alternatives selected for review under the GPA/ZC, NCCP/MSAA/HCP, and SAMP and to recommend control measures to address those potential impacts. As discussed in Section 1, this Conceptual WQMP assesses potential water quality, water balance, and hydromodification impacts associated with the B-10M development alternative.

The WQMP elements were developed based on the general Local WQMP requirements and sub-basin specific water quality and hydrologic issues as identified in the *Draft Watershed and Sub-basin Planning Principles*. The selection and sizing of the facilities in the combined control systems for each sub-basin was guided by site conditions, the type of development land use, and incorporation of the planning recommendations also identified in the *Draft Watershed and Sub-basin Planning Principles*.

Compliance with Local WQMP and MS4 Permit Requirements

PDFs include site design, source control, and treatment control BMPs in compliance with the requirements of the Orange County Local WQMP and the Orange County NPDES Permit (Order No. R9-2002-0001). For most catchments, a combined control system consisting of a flow

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control/water quality basin, a separate infiltration basin, and a lined or unlined bioswale will be implemented. Recycling for irrigation and diversion of runoff to less sensitive areas are other strategies that are used depending on conditions. The site design, source control, and treatment control BMPs will work in concert to address all of the constituents of concern in runoff from the proposed development area.

The combined control system sizing meets or exceeds the NPDES Permit sizing requirement for treatment control BMPs. The FD/WQ lower basin volumes were sized according to meet sizing criteria option 2 for volume-based BMPs in the Local WQMP:

- *The volume of annual runoff produced by the 85th percentile, 24-hour rainfall event, determined as the maximized capture stormwater 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)*

The basins are sized with a draw-down time of 48 hours, which is satisfactory for treatment while minimizing mosquito problems.

Where vegetated bioinfiltration swales are proposed as stand alone treatment control BMPs, they will be sized to meet the Local WQMP sizing criteria below:

- *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, which 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.*

5.2 IMPACT ANALYSIS FOR THE CAÑADA CHIQUITA SUB-BASIN

This section evaluates the effectiveness of the WQMP for the Cañada Chiquita Sub-basin and evaluates the impacts of the proposed development on pollutants of concern and hydrologic conditions of concern.

The impact analysis for the Cañada Chiquita Sub-basin is based on extrapolation of hydrologic and water quality modeling results of a previously studied Ranch Plan Alternative (B-4 modeling results are presented Appendix D). Where the proposed development under the B-10M Alternative was similar to, or less than, the modeled alternative B-4, impacts were assessed qualitatively based on the modeling results. Where the proposed development under the B-10M Alternative is substantially different from the modeled alternative, a qualitative analysis was conducted based in part on the modeling results and additionally on our understanding of the sub-basin conditions and literature information on the effects of urbanization on hydrology and

water quality. All discussion of modeling results in this section specifically refers to the previously modeled development alternative B-4.

Figure 4-2 shows the proposed land uses in the B-10M Alternative. The land use areas of the modeled alternative B-4 and the proposed B-10M are compared in Table 5-1. Differences and similarities of the modeled alternative and the B-10M Alternative include the following:

- *Golf Course.* The modeled alternative included assessment of a golf course in the bottom of the main canyon and some side canyons in the middle reaches of Cañada Chiquita (see Appendix A). A slightly larger golf course is proposed in the B10-M Alternative.
- *Golf Residential.* Residential development area on the ridges overlooking the golf course is identical in the B-10M and the modeled alternative.
- *Proposed Development.* Development area in the B-10M Alternative is slightly smaller than the development area in the modeled alternative. A significant difference is that the modeled alternative included development area in the middle portion of Chiquita Canyon near the Tesoro High School which is not included in the B-10M Alternative. Proposed development areas in the B-10M are limited to the lower portion of the canyon, south of the water treatment plant.

Table 5-1: Cañada Chiquita Sub-basin Land Use Areas by Development Alternative

Land Uses	Land Use Area by Development Alternative (acres)	
	Modeled Alternative B-4 (Appendix D)	B-10M
Golf Course	113	158
Golf Residential	211	211
Proposed Development	339	326
Open Space	2068	2036
TOTAL	2731	2731

5.2.1 Impacts on Hydrologic Conditions of Concern

Impacts on hydrologic conditions of concern in Cañada Chiquita were evaluated based on the comparison of the pre- and post-development water balance results at the sub-basin scale and comparisons of pre- and post-development flow duration at the development bubble scale. These analyses are described in Section 3.5. The post-development condition reflects the effects of the combined control system for catchments affected by development, and in the case of the water balance assessments, reflects the additional effects of irrigating urban landscaping and the golf course and effects of vegetation changes on evapotranspiration.

Hydrologic Condition of Concern #1: Increased Stormwater Runoff Flow Rate, Volume, and Flow Duration

As described above, to address the effects of the proposed development on runoff flow rate, peak discharge, and flow duration were evaluated with two types of analyses: (1) flow duration analysis, and (2) water balance analysis. These analyses have already been performed for a former development alternative that is similar to the B-10M Alternative in terms of land use areas (Table 5-1). Results of the modeled alternative B-4 are extrapolated to the B-10M Alternative in the Chiquita sub-basin. All discussion of modeling results in this section specifically refers to this previously modeled development alternative. The modeling results and associated analyses are presented in Appendix D.

The results of the flow duration analysis were used to select and size combined flow duration control and infiltration facilities as depicted in Figure 3-6. The flow duration analysis was conducted at the “development bubble scale”, as this was the basis for sizing the facilities in the combined control system. An example of flow duration curves for the 53 year period of rainfall records is shown in Figure 5-1 for Chiquita Catchment 13. This figure shows the cumulative distribution of the duration of flows for the three development scenarios: pre-development discharge to the stream, post-development discharge to the stream, and post-development discharge with controls. The figure also shows the post-development 2 and 10 year peak flows, which is considered the approximate range of channel adjusting flows and are required to be analyzed by the Local WQMP. As indicated in the figure, the modeled control facility achieves good flow duration matching over the entire range of flows, including the 2 and 10 year peak flows.

Results of the flow duration analyses of the modeled alternative as displayed in Figure 5-1 show that matching pre-development flow duration is possible utilizing the combined control systems. Similar sizing of flow duration and infiltration facilities was conducted for all development bubbles that affect the hydrologic conditions in Chiquita Creek. The extent to which flow duration matching was achieved for each development bubble varied depending on conditions in each catchment. Areas where it was more difficult to achieve matching were balanced by “over matching” in neighboring areas where conditions were more favorable for matching.

Collectively, the flow duration analyses of the modeled alternative showed that the combined flow duration control and infiltration facilities could be designed and sized to manage the post-development runoff flow rate, peak discharge, and flow duration in a manner that reasonably matches the pre-development conditions in Chiquita Canyon. Because proposed land use areas in the B-10M Alternative are comparable or less than the modeled alternative land use areas, it follows that the hydrologic control facilities in the B-10M Alternative would be designed and sized to be equally effective at managing runoff. It is also possible that hydrologic control under the B-10M Alternative could be more effective than the modeled alternative, because the B-10M Alternative does not include residential development in the middle portion of the Chiquita Canyon.

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The second component of hydrologic studies was a monthly water balance analysis to assess the level of hydrologic control achieved with the combined control facilities. The water balance shows the effect of development on various hydrologic components of the water cycle. Example water balance results are shown in Figure 3-2. The water balance analysis considered the effects of water importation for irrigation supply. In addition the analysis was conducted for the following three climatic conditions:

- All Years in the Available Rainfall Record (WYs 1949 - 2001),
- Dry Years (WYs 1947 - 1977 and 1984 - 1990), and
- Wet Years (WYs 1978 - 1983 and 1991 - 2001).

The water balance analysis was conducted for a former development alternative. As shown in Table 5-1, the proposed land use in the B-10M Alternative is comparable to the modeled alternative. Therefore impacts from the B-10M Alternative will be similar to the modeled alternative. Findings of water balance analyses for the modeled alternative include:

- Importation of water for irrigation will add about 10 percent to the overall water balance for the sub-basin as a whole, most of which is required during the dry season. Most, if not all, of this water will be infiltrated and/or evapotranspired in the combined control system.
- For all years, which was the period used for sizing the control facilities, the surface runoff to Chiquita Creek is predicted to increase approximately 20 percent. These changes, in absolute terms, are less than changes associated with the natural variability in runoff. For example, the average annual runoff volume during wet periods is approximately 80 percent greater than the average annual runoff volume for all years of the rainfall record.
- Surface runoff from direct discharges to San Juan Creek increase significantly because runoff from development areas in bottom of the sub-basin is re-directed to San Juan Creek. The San Juan Creek channel in this area is made up of fairly coarse substrate including cobbles that is mobilized only under large events. The effect of increased runoff on San Juan Creek falls into three categories: the effect on channel stability, the effect on vegetation and habitat, and the effect on water supply. With respect to channel stability, the additional runoff volume will not result in increasing peak flows capable of mobilizing sediments, in part because the increase in peak flows from the development area will be small compared with peak flows in San Juan Creek, and in part because the peak flows from the development area have been shown to precede peak flows from the larger watershed (PCR et al., 2002). With respect to effects on habitat, much of the additional volume or runoff occurs in January through June, which corresponds to the arroyo toad breeding season, thereby providing water when it is a significant limiting factor to successful recruitment. With respect to water supply, much of the additional

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runoff volume will ultimately infiltrate into the wide San Juan Creek channel and will help to sustain the groundwater aquifer for downstream water supply users.

Hydrologic Condition of Concern #2: Decreased Infiltration and Groundwater Recharge

Results of water balance analyses for a former development alternative indicate that groundwater infiltration will increase modestly due to importation of water for irrigation and the use of infiltration basins to manage runoff. Proposed land use in the B-10M Alternative is comparable to the modeled alternative; therefore groundwater infiltration is expected to increase from development in B-10M Alternative.

With respect to this hydrologic condition of concern, the effect of the development is likely to increase infiltration and groundwater recharge; it is very unlikely that infiltration and groundwater recharge would be reduced.

Hydrologic Condition of Concern #3: Changed Base Flows

The increase in groundwater infiltration leads to increases in base flows. This additional base flow could be conveyed down Chiquita Creek to San Juan Creek, infiltrate in the stream channel, or enhance existing or support additional riparian vegetation. There is evidence that the quality of the existing riparian vegetation in lower Chiquita could benefit from additional water. The Restoration Ecologist, in consultation with the Reserve Owner/Manager, will assess the opportunities for enhancement of existing riparian vegetation and creation of new riparian/wetland vegetation that would yield the maximum benefit from the additional water.

The potential benefits of increased base flows obviously depend on a number of factors, including groundwater transport processes in the alluvial aquifer. Such processes will affect the location where base flow increases may occur and the magnitude of those increases. The proposed approach would be to adopt an adaptive management strategy that would try to take advantage of the additional anticipated water. If increased groundwater infiltration and increased base flows is determined to be beneficial to riparian habitats, no changes would be made to flow management. If it is determined that increased base flows are causing negative environmental effects, such as facilitating the invasion of exotic plant and wildlife species (e.g., bullfrogs), modifications in the flow management system to control these adverse effects will be evaluated and implemented. Such modifications could include additional routing of surface flows out of the sub-basin to San Juan Creek, or additional utilization of surface runoff for non-domestic water supply to decrease or offset increases in groundwater infiltration. A long-term adaptive management program is presented in Chapter 6.

5.2.2 Impacts on Pollutants of Concern – Alternative B-10M

A water quality model was used to assess the impacts of the proposed development on stormwater concentrations of sediments, nutrients, and trace metals. The modeling approach has been described in Chapter 3, and more technical details are provided in Appendix B. The

modeling results are in the form of mean annual loads and mean annual concentrations. Concentration is defined as the mass of pollutant contained in a unit volume of water in the runoff. A common measure of concentration in stormwater is the Event Mean Concentration (EMC), which is the average concentration during a runoff event. Load is the mass of pollutant associated with an event or series of events. The mean annual load is the mass of a given pollutant that on average is discharged annually. It is estimated in the water quality model as the average of the predicted annual loads over the 53 year simulation period. The mean annual concentration is the mean annual load divided by the mean annual runoff volume.

Water quality modeling and quantitative analyses were performed for the former development alternative B-4 that is comparable to the B-10M Alternative in terms of land use areas (Table 5-1). All discussion of modeling results in this section specifically refers to the previously modeled development alternative B-4. Results of the modeled alternative are extrapolated to the B-10M Alternative in the Chiquita sub-basin. The modeling results and associated analyses are presented in Appendix D.

TSS Loads and Concentrations

Mean annual loads and concentrations for TSS were estimated for a former development alternative. As shown in Table 5-1, the proposed land use in the B-10M Alternative is comparable to the modeled alternative. Therefore impacts from the B-10M Alternative will be similar to the modeled alternative. General results regarding TSS loads and concentrations include:

- Mean annual loads are highest during the wet years and lowest during dry years, and there is considerable difference in loads between wet and dry years. Under pre-development conditions, the average load during wet years is more than three times the average loads in dry years.
- Average TSS concentrations are also highest during the wet years and lowest during dry years. TSS concentrations vary depending on soil conditions, rainfall intensity, and runoff discharges. Under developed conditions concentrations will also vary depending on the relative contribution of open space areas, which have higher TSS, compared to urbanized areas where runoff tends to have lower TSS concentrations.
- The effect of development with PDFs on estimated mean annual TSS loads for the total sub-basin is small. There is a slight increase in loads (~ 10 percent) during dry years and a slight decrease in loads (~ five percent) during wet years. Ridge development on clay soils would contribute to a reduction of fine sediment. Also, it is important to note that open space areas in the sandy terrain of the canyon are likely to be important sources of coarse sediment supply that will be preserved.
- The estimated average TSS concentration decreases with development by approximately 45 percent. The combined control system is designed to treat by detention and

infiltration 80 to 90 percent of the runoff and would address urban particulates containing other pollutants. The estimated average TSS concentration from the total project area is in the lower end of the range of TSS concentrations observed at four San Juan Creek monitoring during storm events. Thus, estimated discharges to the stream are projected to have lower TSS concentrations than the stream.

Nutrient Loads and Concentrations

Mean annual loads and concentrations for nitrate-nitrogen, Total Kjeldahl Nitrogen (TKN), and total phosphorous were estimated for a former development alternative. TKN is a measure of the total organic nitrogen and ammonia-nitrogen, which is an inorganic form of nitrogen. Nitrate-nitrogen and ammonia-nitrogen are bio-available forms of nitrogen that can cause excessive algal growth in streams. Elevated ammonia is usually associated with wastewater and moreover, the nitrogen cycle in most aerobic streams tends to convert the nitrogen in ammonia to the nitrate form. Therefore nitrate-nitrogen tends to be the more important nitrogen nutrient form with regards to stimulating algal growth.

As shown in Table 5-1, the proposed land use in the B-10M Alternative is comparable to the modeled alternative. Therefore impacts from the B-10M Alternative are expected to be similar to the modeled alternative. General results regarding nutrient loads and concentrations include the following:

- Mean annual nitrate-nitrogen loads in stormwater flows from the entire sub-basin are estimated to increase moderately, by about 10 to 40 percent depending on climatic periods. Average nitrate concentrations in stormwater runoff are estimated to decrease with development. The estimated nitrate concentrations are within the range of observed concentrations at downstream monitoring stations (Table 5-2).
- Mean annual TKN loads in stormwater flows from the entire sub-basin are estimated to increase with development, by more than a factor of two. Average TKN concentrations are estimated to increase moderately, by about 20 to 30 percent depending on climatic periods. The estimated TKN concentrations are within the range of observed concentrations at downstream monitoring stations (Table 5-2).
- Mean annual total phosphorus loads in stormwater flows from the entire sub-basin are estimated to increase with development, by more than a factor of two. Average total phosphorus concentrations are estimated to increase moderately, by about 20 to 40 percent depending on climatic periods. The estimated total phosphorus concentrations are at the low end of the range of observed concentrations at downstream monitoring stations (Table 5-2).

The estimated increases for total phosphorous may be inflated because the existing runoff of total phosphorus, used as the baseline assumption for modeling purposes, is based on 0.27 mg/L derived from the vacant land use station in the Los Angeles County database. Projections of

phosphorous loads for vacant land use are affected significantly by local geology. Although no directly comparable local runoff data are available for the alternative area, in-stream data collected by Wildermuth indicates that the Los Angeles runoff data may be low. Also geologic information cited in Appendix B of the Baseline Water Quality Conditions report indicates that approximately 8 percent of the sub-basin is underlain by Monterey Shale bedrock and therefore “nitrogen and phosphorous loadings from this sub-basin are likely quite high” (Balance Hydrologics, 2001a). This evidence suggests that model predictions of the pre-development loads, especially phosphorous, may be underestimated, which would lead to an overestimate of changes associated with the proposed development.

Table 5-2: Comparison of Estimated Nutrient Concentrations with Observed In-Stream Concentrations the Chiquita Sub-basin

Nutrient	Estimated Average Annual Concentration ¹ (mg/L)			Observed Range of In-Stream Concentrations ² (mg/L)
	All Years	Dry Years	Wet Years	
Nitrate-nitrogen	0.60	0.53	0.7	0.15 – 1.5
TKN	1.6	1.7	1.6	None Detected – 3.0
Total Phosphorus	0.26	0.27	0.26	None Detected – 2.8

¹Estimated concentration for total project developed conditions with PDFs in the modeled alternative (Appendix D).

²Range of means observed at four San Juan watershed stations during the wet years.

The water quality concern with nutrients is excessive algal growth. The Basin Plan narrative objective is “Concentrations of nitrogen and phosphorous, by themselves or in combination with other nutrients, shall be maintained at levels below those which stimulate algae and emergent plant growth.” Given the geological sources of phosphorous, it would appear that nitrogen nutrients are the more limiting nutrients (PCR et al., 2002). Moreover, as discussed earlier, nitrate-nitrogen is the more important nitrogen form with regard to stimulating algal growth.

The combined control system, which incorporates wetlands, infiltration basins, and vegetated swales is specifically designed to treat nutrients. With respect to treatment effectiveness, constructed wetlands have been shown to be quite effective in reducing nitrates. Noteworthy examples in the region include Irvine Ranch Water District’s San Joaquin Marsh, used to treat water in San Diego Creek upstream of Newport Bay; and the Prado Wetlands which treat nutrients in reclaimed water entering Prado Reservoir and prior to being recharged in the downstream Santa Ana River recharge basins. Constructed wetlands and infiltration basins would be utilized as part of the combined control treatment system to treat low flows and small storm flows thereby reducing nutrient discharges to receiving streams.

Based on the water quality modeling and the choice of nutrient treating elements in the combined control system, the potential for discharges from the proposed project to stimulate algal growth in Chiquita Creek or San Juan Creek is limited.

Trace Metals

Mean annual loads and concentrations for aluminum, cadmium, copper, lead, and zinc were estimated for the former development alternative B-4 (Appendix D). Except for aluminum, the estimated concentrations are all in the dissolved form, which is the form of the California Toxics Rule (CTR) water quality criteria.

As shown in Table 5-1, the proposed development in the B-10M Alternative is comparable to the modeled alternative. Therefore, impacts from the B-10M Alternative are expected to be similar to the modeled alternative. General results regarding trace metal loads and concentrations include the following:

- Mean annual loads of dissolved cadmium are estimated to increase with development. Average dissolved cadmium concentrations are estimated to decrease in dry years, increase in wet years, and remain relatively unchanged for the long term average. The estimated dissolved cadmium concentrations are greater than the range of observed concentrations at downstream monitoring stations, but are well below the acute CTR criterion (Table 5-3).
- Mean annual loads and concentrations of dissolved copper are estimated to increase with development. The estimated dissolved copper concentrations are greater than the range of observed concentrations at downstream monitoring stations, but are below the acute CTR criterion.
- Mean annual loads and concentrations of dissolved lead are estimated to increase with development. The estimated dissolved lead concentrations are within than the range of observed concentrations at downstream monitoring stations, and are well below the acute CTR criterion.
- Mean annual loads of dissolved zinc are estimated to increase with development, and mean annual concentrations are estimated to decrease. The estimated dissolved zinc concentrations are greater than the range of observed concentrations at downstream monitoring stations, but are well below the acute CTR criterion.
- Mean annual loads of total aluminum are estimated to increase with development, and mean annual concentrations are estimated to decrease. The CTR does not include aluminum. Therefore, estimated total aluminum concentrations were compared to the National Ambient Water Quality Criteria (NAWQC) acute value for a pH range of 6.5 to 9.0. The range of pH values observed by Wildermuth within the San Juan Creek watershed was 8.1 – 8.6, which indicates that the NAWQC criteria is applicable to the

San Juan watershed. The estimated total aluminum concentration are less than the NAWQC acute criterion.

The estimated average runoff concentrations tend to be somewhat higher than the in-stream monitoring data (Table 5-3). This may be related to a combination of dilution effects and re-partitioning effects. The estimated average annual runoff concentrations for aluminum, cadmium, copper, lead, are below acute aquatic CTR and NAWQC criteria. In part this reflects the effects of elevated hardness which is typical of these stream systems.

Table 5-3: Comparison of Estimate Trace Metals Concentrations with Water Quality Criteria and Observed In-Stream Concentrations the Chiquita Sub-basin

Trace Metals	Predicted Average Annual Concentration ¹ (µg/L)			California Toxics Rule Criteria ² (µg/L)	Observed Range of In-Stream Concentrations ³ (µg/L)
	All Years	Dry Years	Wet Years		
Total Aluminum	576	571	582	750 ⁴	Not Monitored
Dissolved Cadmium	0.48	0.51	0.46	5.2	None Detected – 0.09
Dissolved Copper	12	12	11	15.9	2.1 – 4.0
Dissolved Lead	2.5	2.6	2.4	78.7	None Detected – 3.9
Dissolved Zinc	68	71	65	137	None Detected – 15.0

¹Estimated concentration for total project developed conditions with PDFs in the modeled alternative (Appendix D).

²Hardness = 120 mg/L, minimum value of monitoring data in San Juan Creek.

³Mean observed in San Juan watershed stations.

⁴NAWQC criteria for pH 6.5 – 9.0.

5.2.3 Findings of Significance

Hydrologic Conditions of Concern and Significance Thresholds

The following discusses the implications of the flow duration and water balance results on the hydrologic conditions of concern.

1. Increase Stormwater Runoff Volumes, Peak Discharges, and Flow Duration

Significance Threshold A: Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation.

The WQMP was designed specifically to preserve and protect the existing drainage patterns in the main stem of Chiquita Creek and in side canyon tributaries. Specifically, WQMP facilities will be located to the extent feasible in the upper ends of the side canyons and will be operated to mimic the current conditions in the tributary channels. Drainage patterns will be altered within

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the development bubble where drainage infrastructure will be provided; however, drainage swales or other more natural drainage features will be utilized to the extent feasible.

Significance Threshold B: Substantially increase the frequencies or duration of channel adjusting flows.

Flow duration and water balance analyses were conducted for a former development alternative. The results of these analyses show that flow duration control and infiltration facilities can be designed and sized to manage the post-development runoff flow rate, peak discharge, and flow duration in a manner that matches, to the extent feasible, the pre-development conditions in Chiquita Canyon. The proposed development in the B-10M Alternative is comparable or less than the development in the modeled alternative. Therefore, changes in the frequency and duration of channel adjusting flows would be effectively managed in the B-10M Alternative by incorporating flow duration controls in the design of the flow control and water quality basins. This design addresses a range of flows including the 2 and 10 year peak flow events required to be analyzed by the Local WQMP.

Based on these considerations, the effect of the proposed development in Cañada Chiquita on flow duration and volume within the range of channel adjusting flows is determined to be less than significant.

2. Decreased Infiltration and Groundwater Recharge

Significance Threshold A: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.

The significance threshold for this hydrologic condition of concern is a reduction in post-development infiltration volumes over pre-development infiltration volumes that would cause a significant reduction in groundwater recharge. Results of water balance analyses for a former development alternative indicates that infiltration volumes will likely increase over pre-development conditions, the extent of which will depend on whether it is a wet or dry cycle. Proposed land use in the B-10M Alternative is comparable to the modeled alternative, and therefore impacts from the B-10M Alternative will be similar to the modeled alternative. On this basis, the impact of the proposed project on decreasing infiltration and groundwater recharge is considered less than significant.

3. Change in Base Flow

Significance Criteria A: Substantially increase or decrease base flows as to negatively impact riparian habitat.

Results of water balance analyses for a former development alternative indicate that base flows will increase modestly due to importation of water for irrigation and the use of infiltration basins to manage runoff. This increase in base flows was determined to be potentially beneficial in

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terms of improving the health of existing vegetation or providing for additional riparian habitat. To the extent that such increases could affect San Juan Creek, additional water could potentially provide additional habitat for the arroyo toad during the sensitive breeding season. Proposed land use in the B-10M Alternative is comparable to the modeled alternative, and therefore impacts from the B-10M Alternative will be similar to the modeled alternative. On this basis, the impact of the proposed project on riparian habitat due to changes in base flows is considered less than significant.

Significance Threshold B: Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.

Sustaining high groundwater elevations are important where riparian vegetation depends upon ground water within two to ten feet of the ground surface, and where ground water is pumped for water supply. High ground water is particularly important where sustaining both uses, concurrently and conjunctively, as is the case in lower San Juan Creek. Results of water balance analyses for a former development alternative indicate that base flows will increase modestly due to importation of water for irrigation and the use of infiltration basins to manage runoff. The projected increases in base flow, although modest on the scale of the San Juan watershed, can add substantially to the reliability of recharge during dry years, helping to sustain riparian vegetation in areas where it is critical to bank stability within the cities of San Juan Capistrano and Capistrano Beach. Additionally, more reliable recharge and recharge earlier in the season will allow more effective development of ground water from the downstream alluvial aquifer of lower San Juan Creek by enabling pumping earlier in the winter, during drier years when recharge might otherwise be minimal, and by diluting with fresher recharge the concentrated salts introduced into the aquifer from leaching of local bedrock. Proposed land use in the B-10M Alternative is comparable to the modeled alternative, and therefore impacts from the B-10M Alternative will be similar to the modeled alternative. On this basis, the impact of the proposed project on groundwater elevations is considered less than significant.

Pollutants of Concern

The following are the conclusions regarding the significance of impacts for the pollutants of concern under wet and dry weather conditions.

Sediments: Mean total suspended solids concentrations are expected to be less in the post development condition than in the existing conditions because of the stabilization associated with urban landscaping and paving. In order to preserve the coarse sediment supply, the water treatment facilities are designed to capture and treat runoff from the developed areas, which would tend to generate finer solids, and to bypass larger flows that are more likely to carry coarser sediments needed to maintain a stable equilibrium in the main stem channel. On this basis the impact of the B-10M Alternative on suspended sediments is considered less than significant.

Nutrients (Nitrogen and Phosphorous): The local geology results in relatively high background phosphorous concentrations and suggests that the systems are likely to be nitrogen limited. Nitrate-nitrogen is the more bioavailable form of nitrogen and therefore is the more important form with regard to stimulating algal growth. Water quality modeling results of a former development alternative indicate that nitrate-nitrogen concentrations in stormwater runoff would decrease with development, largely due to the implementation of water quality controls that specifically address nitrate-nitrogen. Proposed land use in the B-10M Alternative is comparable to the modeled alternative, and therefore impacts from the B-10M Alternative will be similar to the modeled alternative. On this basis, the impact of the B-10M Alternative on nutrients and algal stimulation is considered less than significant.

Trace Metals: Water quality modeling results of a former development alternative indicate that average annual loads of total aluminum and dissolved cadmium, copper, lead, and zinc would increase with development. In most cases the average concentrations also expected to increase with development, but to a lesser extent. For some constituents and climatic regimes, the average concentrations are estimated to decrease with development. In all cases, estimated average concentrations of aluminum, cadmium, copper, lead, and zinc are below benchmark NAWQC and CTR criteria.

Proposed land use in the B-10M Alternative is comparable to the modeled alternative, and therefore impacts from the B-10M Alternative will be similar to the modeled alternative. On this basis, the impact of the B-10M Alternative on nutrients and algal stimulation is considered less than significant. On this basis, the impact of the B-10M Alternative on trace metals is less than significant.

5.3 IMPACT ANALYSIS FOR THE CAÑADA GOBERNADORA SUB-BASIN

This section evaluates the impacts of the proposed development in the Cañada Gobernadora Sub-basin on pollutants of concern and hydrologic conditions of concern. The method of analysis is similar to that described for Chiquita Canyon in Section 5.2. The impact analysis is based largely on extrapolation of hydrologic and water quality modeling results of the previously studied development alternative B-4 (all B-4 modeling results are presented in Appendix D).

Figure 4-4 shows the proposed land uses in the B-10M Alternative. The land use areas of the modeled alternative and the proposed B-10M are compared in Table 5-4. Differences and similarities of the modeled alternative and the B-10M Alternative include the following:

- *Estate.* The modeled alternative included assessment of estate housing in the upper portion of the Gobernadora sub-basin within the Ranch boundary. Under the B-10M Alternative there is no estate housing. General development in this area is reduced in scope to accommodate a larger wildlife movement corridor.
- *Golf Residential.* Residential development area on the ridges overlooking the golf course (in the Chiquita sub-basin) is identical in the B-10M and the modeled alternative.

- *Proposed Development.* Development area in the lower portion of the sub-basin under the B-10M Alternative is approximately 11 percent larger than the modeled alternative.

Table 5-4: Cañada Gobernadora Sub-basin Land Use Areas by Development Alternative

Land Uses	Land Use Area by Development Alternative (acres)	
	Modeled Alternative B-4 (Appendix D)	B-10M
Estate	140	0
Golf Residential	25	25
Proposed Development	933	1037
Open Space	1077	1113
TOTAL	2175	2175

5.3.1 Impacts on Hydrologic Conditions of Concern

The assessment approach is similar to the approach described for Chiquita Canyon in Section 5.2 and is not fully re-iterated here. The assessment is based on quantitative flow duration and water balance analyses of the former development alternative B-4 that is comparable to the B-10M Alternative in terms of land use areas (Table 5-4). All discussion of modeling results in this section specifically refers to the previously modeled development alternative B-4 (see Appendix D).

Hydrologic Condition of Concern #1: Increased Stormwater Runoff Flow Rate, Volume, and Flow Duration

Flow Duration Analysis

Flow duration matching was used to select and size combined flow duration control and infiltration facilities to manage the flow rate, volume, and duration of runoff from development areas in the Gobernadora sub-basin. The results of the flow duration analyses showed that matching pre-development flow duration up to the 10 year peak flows was possible utilizing the combined control system. The 2 to 10 year peak flow are considered the approximate range of channel adjusting flows and are required to be analyzed by the Local WQMP. The feasibility of the flow duration control facilities was quantified for all development areas in the Gobernadora sub-basin for the modeled alternative.

Water Balance Analysis

A water balance analysis was conducted to assess the level of hydrologic control achieved with the combined control facilities for the model alternative. General results of water balance analyses include the following:

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- Importation of water for irrigation will add about 10 percent to the overall water balance for the sub-basin as a whole, most of which is required during the dry season. Most, if not all, of this water will be infiltrated, evaporated and/or transpired in the combined control system.
- Surface runoff from RMV catchments below Cota de Caza would remain essentially unchanged with development, due to the effectiveness of the combined flow duration facilities.
- Water balances were prepared for both the entire Gobernadora sub-basin and for the RMV development areas in order to separate the effects of the existing development. Current annual average surface runoff from the entire Gobernadora sub-basin was estimated at 1,378 acre-ft compared to an estimated 258 acre-ft from the catchments below Coto de Caza. Thus, runoff from existing upstream development areas is estimated to contribute about 85 percent of the sub-basin surface flow for the existing and proposed land-uses of the modeled alternative.

The B-10M Alternative includes the Gobernadora Multi-purpose Basin near the upper end of the RMV boundary. This basin is intended to improve hydrologic and water quality conditions in Lower Gobernadora Creek and San Juan Creek through detention and diversion of excess runoff from existing upstream development. Balance Hydrologics developed a conceptual layout of the facility which calls for an approximately a 400 acre-foot detention capacity with a four day drain time. Water from the basin would be pumped to a non-domestic water supply reservoir for use as non-potable water.

The effect of the Multi-purpose Basin was quantified and analyzed as part of the assessment of the previously modeled alternative. Because the basin would only receive runoff from upstream development areas, the results of these analyses are applicable to the B-10M Alternative. The operation of the basin was modeled with the SWMM for a 53 year period of rainfall records to permit a water balance evaluation of the basin. Here it was assumed that demand for non-domestic water and reservoir capacity would not constrain pumping from the Multi-purpose Basin. A comparison of the water balance results for the existing conditions (no facility) and with the Multi-purpose Basin is shown in Table 5-5. The results indicate that the basin would reduce surface runoff to Lower Gobernadora from an estimated 3.4 inches (1378 acre-ft/yr) to 0.4 inches (161 acre-ft/yr) or approximately 90 percent.

Hydrologic Condition of Concern #2: Decreased Infiltration and Groundwater Recharge

Given the reliance on infiltration in the combined control system, changes to groundwater infiltration and outflow are more pronounced. Groundwater infiltration and outflows from the development in lower Gobernadora is expected to increase by about 35 percent for the all years condition. The corresponding increase for dry years is about 50 percent, and about 20 percent during the wet years. The largest effect is therefore during the dry years. It should be noted that

the increase in groundwater flows from development (for all years) is less than the variability in groundwater flows between dry years and wet years.

The expected increase in groundwater infiltration and outflows will not reduce recharge, but would instead increase recharge. However, groundwater levels are already high near the mouth of Cañada Gobernadora because of the apparent groundwater barrier. There is concern that existing groundwater levels could prevent groundwater infiltration in these areas. If this were the case, other options, such as diversion of excess runoff directly to San Juan Creek would be considered and would be provided for as part of the adaptive management program.

Hydrologic Condition of Concern #3: Changed Base Flows

The increase in infiltration and groundwater outflow leads to increases in base flows. As discussed above, the expected increase in base flows from development is in the range of 20 to 50 percent depending on the climatic trends. Analysis of vegetation in the GERA indicates that additional water could improve the condition of riparian vegetation in the GERA. The additional water could also possibly be used to increase the riparian habitat if the erosion effects caused by surface and subsurface flows from existing upstream development are reduced by the Gobernadora Multi-Purpose Basin as proposed under the B-10M Alternative.

If increases in base flows were determined to be detrimental, the proposed Gobernadora Multi-purpose Basin also could be used to reduce base flow contributions from Coto de Caza to offset increases in lower Gobernadora associated with the proposed development. A second alternative, as discussed above, would involve routing excess flows directly to San Juan Creek, thereby reducing or eliminating the need for infiltration, at least in those catchments in lower Gobernadora close to San Juan Creek. This option would also be a management measure that could be employed if the proposed Gobernadora Multi-purpose Basin were not constructed.

Impacts on hydrologic conditions of concern for the proposed development in the lower portion of Cañada Gobernadora would be similar to impacts identified for this area under the B-10M Alternative due to the close similarity of the development alternatives. Effective management of increased channel forming flows has been shown to be feasible using a combined flow duration and water quality treatment basin whose outlet structure is designed to mimic the pre-development runoff flow duration. This control includes the 2 and 10 year return period flows. Depending on location, excess flows would be infiltrated, thereby increasing recharge and base flows; diverted to San Juan Creek (i.e., Catchment 1 just east of Chiquadora Ridge); or stored in non-domestic water supply reservoirs for irrigation. Due to irrigation and the reliance on infiltration in the combined control system, groundwater infiltration and outflow is expected to increase with the proposed development. Increased base flows could be beneficial to existing habitat in the GERA and possibly for increased riparian habitat, assuming the Multi-purpose Basin is constructed to control excess surface runoff from existing development.

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Table 5-5: Effectiveness of Gobernadora Multi-purpose Basin (inches (acre-ft))

Climatic Period	Current Condition					Current Condition with Multi-purpose Basin					
	INFLOW	OUTFLOW				INFLOW	OUTFLOW				
	Precipitation	Runoff to Gobernadora Creek	GW Outflow	ET	Total	Precipitation	Withdrawal from Multi-purpose Basin	Runoff to Gobernadora (Bypass)	GW Outflow	ET	Total
All Years	14.9 (6108)	3.4 (1378)	3.2 (1302)	8.5 (3477)	15.1 (6157)	14.9 (6108)	3.0 (1232)	0.4 (161)	3.2 (1302)	8.5 (3485)	15.1 (6180)
Dry Years	12.5 (5119)	2.4 (972)	1.7 (708)	8.8 (3615)	12.9 (5295)	12.5 (5119)	2.2 (901)	0.1 (28)	1.7 (708)	8.9 (3622)	12.9 (5259)
Wet Years	20.1 (8203)	5.5 (2237)	6.3 (2561)	7.8 (3185)	19.5 (7983)	20.1 (8203)	4.7 (1933)	1.1 (443)	6.3 (2561)	7.8 (3185)	19.9 (8122)

5.3.2 Impacts on Pollutants of Concern

This section addresses the effects of stormwater runoff on sediments, nutrients, and trace metals. In order to isolate the effects of the proposed development, this assessment does not include the effects of existing development in Wagon Wheel and Coto de Caza. However, as indicated in the water balance discussion, the effect of runoff from existing upstream development is likely to dominate water quality conditions in Lower Gobernadora.

Water quality modeling and quantitative analyses were performed for a former development alternative that is comparable to the B-10M Alternative in terms of land use areas (Table 5-4). All discussion of modeling results in this section specifically refers to the previously modeled development alternative B-4 (Appendix D).

TSS Loads and Concentrations

Model results indicate that mean annual TSS loads and TSS concentrations will decrease with development. Decreases occur in all climatic regimes. The reduction in TSS loads is typical of development, which has the effect of stabilizing soils with vegetation and covering soils with impervious surfaces. The combined control systems are designed to detain and infiltrate 80 to 90 percent of the runoff, and therefore contribute to significant reductions in TSS loads and concentration. Reductions in TSS in these facilities will also contribute to reductions of other pollutants that are associated with urban particulates.

Mean annual TSS loads and concentrations are highest in wet years and lowest in dry years. This is true for both pre-development and post-development conditions. In fact, the variability in TSS loads and concentrations between dry and wet periods is greater than the estimated reduction resulting from development.

The criterion for TSS in the San Diego Basin Plan is narrative and states that “levels shall not cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.” The range of observed TSS concentrations compiled by Wildermuth at the four stations in the San Juan watershed was 368 to 1,372 mg/L. The estimated mean annual TSS concentration from the Gobernadora sub-basin with proposed development is about 90 mg/L. Thus, the projected mean TSS concentration in the runoff is less than the range of observed data.

Nutrient Loads and Concentrations

Model estimates indicate that mean annual loads and concentration of nitrate-nitrogen in the Gobernadora sub-basin (excluding existing upstream development) will decrease with development. Nitrate loads are estimated to decrease by about 25 percent and nitrate concentrations are estimated to decrease by about 70 percent. Conversely, mean annual loads and concentrations of TKN are expected to increase significantly with development, by about 180 and 80 percent, respectively. The estimated mean annual TKN concentrations, however, are

well within the range of observed concentrations at four monitoring locations on the San Juan Creek (see Table 5-6).

Model estimates also suggest significant increases in mean annual total phosphorus loads and concentrations from development. As with Cañada Chiquita (Section 5.2), these predicted increases may be inflated because the existing runoff of total phosphorus is based on relatively low concentration of 0.27 mg/L derived from the vacant land use station in the LA County database. Local geology suggests that concentrations in the runoff from undeveloped portions of the sub-basin could be higher. This is partially supported by limited RMV monitoring data collected upstream on the San Juan Creek at Caspers, which shows phosphorus levels between ND-3 mg/L (see Appendix C). Also, as shown in Table 5-6, the estimated total phosphorus concentrations are within, and near the low end, of the range of observed concentrations at four monitoring locations on the San Juan Creek.

The water quality concern with nutrients is excessive algal growth. The Basin Plan narrative objective states “concentrations of nitrogen and phosphorous, by themselves or in combination with other nutrients, shall be maintained at levels below those which stimulate algae and emergent plant growth.” Given the geological sources of phosphorous, it would appear that nitrogen nutrients are the more limiting nutrients (PCR et al., 2002). Moreover, nitrate-nitrogen is the more important nitrogen form with regard to stimulating algal growth.

The combined flow duration and water quality control system include constructed wetlands for treating dry weather flows and small storm flows. Runoff concentrations associated with larger events, that may only receive partial treatment, would benefit from dilution. Constructed wetlands are among the more effective methods for treating nitrate-nitrogen. Consequently, model estimates indicate that the mean annual nitrate-nitrogen is substantially smaller for the post-development condition, in comparison with the existing pre-development condition. Table 5-6 shows that estimated nitrate-nitrogen concentrations are well within the range of observed concentrations at monitoring locations on the San Juan Creek.

Table 5-6: Comparison of Predicted Nutrient Concentrations with Observed In-Stream Concentrations for the Gobernadora Sub-basin

Nutrient	Estimate Average Annual Concentration ¹ (mg/L)			Observed Range of In-Stream Concentrations ² (mg/L)
	All Years	Dry Years	Wet Years	
Nitrate	0.6	0.5	0.7	0.15 – 1.5
TKN	1.8	1.8	1.8	None Detected – 3.0
Total Phosphorus	0.3	0.3	0.3	None Detected – 2.8

¹ Estimated concentration for total project developed conditions with PDFs in the modeled alternative (Appendix D).

² Range of means observed at four San Juan watershed stations during the wet years.

Based on the water quality modeling results and the choice of nutrient treating elements in the combined control system, the potential for discharges from the proposed project to stimulate algal growth in Gobernadora Creek or San Juan Creek is limited.

Trace Metals

Mean annual loads and concentrations for aluminum, cadmium, copper, lead, and zinc were estimated for a former development alternative. Impacts from the B-10M Alternative are expected to be similar to the modeled alternative B-4 (Appendix D), based on the close similarity of the development areas (Table 5-4).

Water quality modeling results indicate that mean annual loads of total aluminum will increase with development (15-40 percent), and mean annual concentrations will decrease slightly by about 15 percent. The CTR does not include aluminum. Therefore, estimated total aluminum concentrations were compared to the National Ambient Water Quality Criteria (NAWQC) acute value for a pH range of 6.5 to 9.0. The range of pH values observed by Wildermuth within the San Juan Creek watershed was 8.1 – 8.6, which indicates that the NAWQC criteria is applicable to the San Juan watershed. As shown in Table 5-7, the NAWQC acute criterion is 750 mg/L. The estimated mean annual concentration for post-development conditions with PDFs is about 570 mg/L. This information would suggest that the mean aluminum concentration is likely not to exceed the NAWQA criterion in this sub-basin.

Water quality modeling results indicate that mean annual loads and concentrations of dissolved cadmium, copper, lead, and zinc will increase with development. Greatest increases, on a percentage basis, are for dissolved cadmium and lead. Smallest increases are estimated for dissolved zinc.

Table 5-7 shows a comparison of the estimated mean annual trace metals concentrations with the water quality criteria and observed data. The water quality criteria for metals vary with hardness. A hardness value of 120 mg/L was used in estimating the criteria, which corresponds to the minimum observed in-stream hardness reported by Wildermuth. Thus, the criteria are very conservative, i.e., likely represent a lower bound. Still the comparisons show that estimated trace metal concentrations are well below the CTR criteria. The estimated runoff concentrations are also somewhat higher than the monitored in-stream data. This may reflect the higher TSS levels in the stream, which can affect the geochemical partitioning between the dissolved and particulate phases. Specifically, higher TSS values may decrease the dissolved fraction of trace metals and increase the particulate fraction.

Table 5-7: Comparison of Predicted Trace Metals Concentrations with Water Quality Criteria and Observed In-Stream Concentrations for the Gobernadora Sub-basin

Trace Metals	Predicted Average Annual Concentration ¹ (µg/L)			California Toxics Rule Criteria ² (µg/L)	Observed Range of In-Stream Concentrations ³ (µg/L)
	All Years	Dry Years	Wet Years		
Total Aluminum	567	561	573	750 ⁴	Not Monitored
Dissolved Cadmium	0.33	0.34	0.33	5.2	None Detected – 0.09
Dissolved Copper	9.8	10.0	9.5	15.9	2.1 – 4.0
Dissolved Lead	2.9	2.9	2.9	78.7	None Detected – 3.9
Dissolved Zinc	40	39	40	137	None Detected – 15.0

¹ Estimated concentration for total project developed conditions with PDFs in the modeled alternative (Appendix D).

² Hardness = 120 mg/L, minimum value of monitoring data.

³ Range of means observed at four San Juan watershed stations during the wet years.

⁴ NAWQC criteria for pH 6.5 – 9.0.

5.3.3 Findings of Significance

Hydrologic Conditions of Concern and Significance Thresholds

The following discusses the implications of the water balance results on the hydrologic conditions of concern.

1. Increased Stormwater Runoff Flowrate, Volume and Flow Duration

Significance Threshold A: Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation.

The WQMP was designed specifically to preserve and protect the existing drainage patterns in the main stem of Gobernadora Creek and in side canyon tributaries. Specifically, WQMP facilities will be located to the extent feasible in the upper ends of the side canyons and will be operated to mimic the current conditions in the tributary channels. Drainage patterns will be altered within the development bubble where drainage infrastructure will be provided. However, drainage swales or other more natural drainage features will be utilized to the extent feasible.

Significance Threshold B: Substantially increase the frequencies and duration of channel adjusting flows.

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The EPA SWMM Model was used to analyze changes in the frequency and duration of flows for development bubbles similar to those in the B-10M Alternative. The analyses showed that flow control facilities can be sized and configured to match, to the extent possible, the pre-development flow durations over the entire range of predicted flows, including the 2 and 10 year peak flows. A water balance also was conducted that took into account the effects of anticipated irrigation and the operation of the BMPs. The results of the water balance indicated that surface water runoff volume to Gobernadora Creek would effectively match the pre-developed condition.

The water balance analysis also showed that existing upstream development in Cota de Caza and Wagonwheel contribute about 85 percent of the existing surface flow in the sub-basin. The B-10M Alternative includes the Gobernadora Multi-purpose Basin near the upper end of the RMV boundary. This basin is proposed to improve hydrologic and water quality conditions in Lower Gobernadora Creek and San Juan Creek through detention and diversion of excess runoff from existing upstream development. A water balance analysis of the Gobernadora Multi-purpose Basin indicates that the basin could reduce surface runoff to Lower Gobernadora by approximately 90 percent.

On this basis, the effect of the proposed development in Cañada Gobernadora on altering existing drainage or increasing the frequency and duration of channel adjusting flows is determined to be less than significant.

2. Decreased Infiltration and Groundwater Recharge

Significance Threshold A: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.

The water balance indicates that infiltration volumes will likely increase over pre-development conditions. Therefore groundwater levels, at least in the vicinity of the proposed infiltration basins, would increase rather than decrease. On this basis, the impact of the proposed project on decreasing infiltration and groundwater recharge is considered less than significant.

However, groundwater levels are already high near the mouth of Cañada Gobernadora because of the apparent groundwater barrier. There is concern that these levels would prevent groundwater infiltration in these areas. Because of this concern, excess runoff volume would be discharged directly to San Juan Creek, or diverted to a non-domestic water supply reservoir for recycling or the nearby WWTP for reclamation.

On this basis, the potential effect of the proposed development on infiltration and groundwater recharge is considered less than significant.

3. Changed Base Flows

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Significance Threshold A: Substantially increase or decrease base flows as to negatively impact riparian habitat.

The increase in infiltration and groundwater outflow leads to increases in base flows. Water balance results suggest that increases in base flows could be in the range of 20-50 percent, depending on climatic periods. Analysis of vegetation in the GERA indicates that additional water could provide a benefit to improving the condition of riparian vegetation. The additional water could also possibly be used to increase the riparian habitat, especially given that erosion effects caused by surface flows from existing upstream developed areas will likely be reduced by the Gobernadora Multi-purpose Basin.

If increases in base flows were determined to be detrimental, the Gobernadora Multi-purpose Basin could be used to reduce base flow contributions from Coto de Caza to offset increases in lower Gobernadora associated with the proposed development. Alternatively, excess flows could be routed directly to San Juan Creek thereby reducing or eliminating the need for infiltration, at least in those catchments in lower Gobernadora close to San Juan Creek. Excess base flows in San Juan Creek, especially between February and June, could improve breeding habitat for the arroyo toad and other sensitive aquatic species such as the southwestern pond turtle and arroyo chub.

Significance Threshold B: Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.

To the extent that the projected increase in base flows enter San Juan Creek, the effect could potentially raise the groundwater elevations downstream, which would be beneficial to local and downstream aquatic habitats and potentially to downstream water supply pumping operations.

Based on these considerations, the effect of the proposed development in altering base flows such as to adversely affect habitat or downstream groundwater levels for water supply purposes is considered less than significant.

Pollutants of Concern

The following are the conclusions regarding the significance of impacts for the pollutants of concern under wet conditions.

Sediments: Mean total suspended solids concentrations are estimated to be less in the post-development condition than in the existing condition. Sources of coarse sediments generated within the sandy soils of the main valley will be protected, while the development location will potentially reduce the generation of fine sediment from tributary drainage characterized by clay soils. On this basis the impact of the B-10M Alternative on suspended sediments is considered less than significant.

Nutrients (Nitrogen and Phosphorous): Given the geologic sources of phosphorus, the watershed appears to be nitrogen limited and the more bioavailable form of nitrogen nutrient is nitrate-nitrogen. The concentration and load of nitrate-nitrogen is estimated to decrease with development and will be within the range of observed in-stream concentrations in Gobernadora Creek. Moreover, the combined control system includes facilities such as constructed wetlands, which have been shown to be effective in treating nutrients. On this basis, the impact of the B-10M Alternative on nutrients is considered less than significant.

Trace Metals: Mean concentrations of total aluminum and dissolved cadmium, copper, lead, and zinc are estimated to increase with development. However, mean concentrations of aluminum, cadmium, copper, lead, and zinc are well below benchmark NAWQC and CTR criteria. On this basis, the impact of the B-10M Alternative on trace metals is less than significant.

5.4 IMPACT ANALYSIS FOR THE CENTRAL SAN JUAN AND TRAMPAS SUB-BASIN

This section evaluates the effectiveness of the WQMP for the Central San Juan and Trampas Sub-basin and evaluates the impacts of the proposed development on pollutants of concern and hydrologic conditions of concern.

A distinct feature in the Trampas Sub-basin is the existing Oglebay Norton sand mining and washing facilities that include an artificial lake that serves as a tailings reservoir, a desilting pond, and a temporary storage pond. This mining operation would be discontinued with the proposed project. The impact analysis considers conditions with and without the mine.

The impact analysis is based in part on extrapolation of hydrologic and water quality modeling results of two previously studied development alternatives. The modeling results for PA3 and PA5 are based on the modeled Alternative B-4 (results are presented in Appendix D). The modeling results for PA4 are based on the modeled Alternative B-9 (results presented in Appendix E). Figure 4-6 shows the proposed land uses in the B-10M Alternative, and the land use areas of the modeled alternatives and the proposed B-10M are compared in Table 5-8. Differences and similarities of the modeled alternative B-4 and the B-10M Alternative include the following:

- *Estate.* The modeled alternative B-4 included assessment of estate housing located in PA 4. Under the B-10M Alternative there is no estate housing in PA 4.
- *Proposed Development.* The modeled alternative B-4 included 2529 acres of proposed general development. Under the B-10M Alternative, the proposed general development is approximately 3300 acres, or 30 percent more. The increase in development area is located in PA 4 in the eastern portion of the sub-basin. The proposed development area within PA 3 north of San Juan Creek and within PA 5 to the south of San Juan Creek is approximately unchanged from the development area in the modeled alternative.

Table 5-8: Central San Juan & Trampas Sub-basin Land Use Areas by Development Alternative

Land Uses	Land Use Area by Development Alternative (acres)		
	B-10M	Modeled Alternative B-4 (Appendix D)	Modeled Alternative B-9 (Appendix E)
Estate	0	216	0
Proposed Development	3316	2529	3272
Open Space	1498	2099	1556
TOTAL	4814	4844	4828

The method of analysis is somewhat similar to that described for Chiquita Canyon in Section 5.2. In PA 3 and PA 5, where the proposed development under the B-10M Alternative is similar to the modeled alternative B-4, the impact analysis is based on extrapolation of hydrologic and water quality modeling results of a previously studied development alternative. All discussion of modeling results in PA 3 and PA 5 specifically refers to the previously modeled development alternative B-4 (see Appendix D).

In PA 4, the proposed development under the B-10M Alternative is greater than the modeled alternative B-4, but similar to alternative B-9. For this planning area, the impact analysis is based on a qualitative assessment of the modeled alternative B-9. All discussion of modeling results in PA 4 specifically refers to the previously modeled development alternative B-9 (see Appendix E).

5.4.1 Impacts on Hydrologic Conditions of Concern

The proposed development areas under the B-10M Alternative are approximately equivalent to the development areas under the B-9 Alternative in the Central San Juan/Trampas Sub-basin (see Table 5-8). Consequently, development impacts to hydrologic conditions of concern under the B-10M Alternative are expected to be similar to impacts under the former development alternative B-9, which is presented in Appendix E. The impact assessment below is based on results extrapolated from modeling the proposed development in PA 4 under the B-9 Alternative, and for the proposed development in the previously modeled alternative B-4 in PA 3 and PA 5.

Hydrologic Condition of Concern #1: Increased Stormwater Runoff Volume, Peak Discharge, and Flow Duration

Flow Duration Analysis

The flow duration analysis was conducted for each catchment affected by proposed development. The flow duration analysis results were used to select and size the combined control system facilities. The proposed control facilities generally achieve good flow duration matching over the entire range of flows, including the 2 and 10 year peak flows.

Water Balance Analysis

The water balance indicates that development will increase the net applied water (precipitation plus imported water) significantly, by approximately 40 to more than 100 percent, due to water importation for irrigation. Due to the effectiveness of the combined control facilities, the water balance indicates that development will cause minor increases in surface runoff to San Juan Creek, ranging from about one to ten percent. Greatest increases were in Trampas Canyon (PA 5). In this area, changes in surface runoff due to development are much less than the estimated variability in surface runoff between climatic periods. Thus, for all areas, the level of control provided by the combined control system is such that changes in surface water hydrology are minimal.

Hydrologic Condition of Concern #2: Decreased Infiltration and Groundwater Recharge

The water balance analyses indicate the volume of infiltration will increase substantially over pre-development conditions. Thus, development is projected to increase infiltration and groundwater recharge, at least in the areas near the infiltration basins.

Hydrologic Condition of Concern #3: Changed Base Flows

Projected increases in infiltration with development are expected to result in increases to base flows in San Juan Creek. The increased base flows would be utilized to support riparian vegetation, increase levels of the water table, or infiltrate into the channel bottom. Increased base flows in San Juan Creek may also support NCCP Guidelines recommendations addressing downstream aquatic habitat needs.

5.4.2 Impacts on Pollutants of Concern

As discussed previously, the proposed development areas under the B-10M Alternative are approximately equivalent to the development areas under the former development alternative B-9 (discussed in Appendix E) in the Central San Juan/Trampas Sub-basin, and therefore impacts to constituents of concern under the B-10M Alternative are expected to be similar to impacts under the B-9 Alternative. Thus, the impact assessment for the B-10M Alternative is based on modeling results discussed in Appendices D and E.

TSS Loads and Concentrations

TSS loads and concentrations estimated to decrease with proposed development in each planning area and for the total sub-basin area. Mean annual TSS loads and concentrations are highest in wet years and lowest in dry years. This is true for both pre-development and post-development conditions.

The criterion for TSS in the San Diego Basin Plan is narrative and states that “levels shall not cause a nuisance or adversely affect beneficial uses as a result of controllable water quality

factors.” The range of observed wet-weather TSS concentrations compiled by Wildermuth at the four stations is generally much greater than the estimated mean annual TSS concentrations with proposed development, and therefore will not likely cause a nuisance or adversely affect beneficial uses.

Nutrient Loads and Concentrations

Modeling results discussed in the previous section indicate that, in general, mean annual nitrate-nitrogen loads and concentrations will decrease with development, while mean annual loads and concentrations of TKN and total phosphorus will increase with development.

The water quality impact of concern here is excessive algal growth. The Basin Plan narrative objective is “Concentrations of nitrogen and phosphorous, by themselves or in combination with other nutrients, shall be maintained at levels below those which stimulate algae and emergent plant growth.” The estimated post-development runoff concentration for total phosphorous is generally less than that observed, where the observed data reflects the contribution from open areas and existing land uses. The higher observed nutrient data is consistent with the geologic information that indicates underlying bedrock may contribute high levels of phosphorous from open areas. Therefore, it is likely that nitrogen may be the limiting nutrient for excessive algae growth.

Nitrate-nitrogen is inorganic nitrogen and is considered more bio-available than TKN, which contains both organic and inorganic forms of nitrogen. The combined flow duration and water quality control system include constructed wetlands for treating dry weather flows and small storm flows. Constructed wetlands are among the more effective methods for treating nitrate-nitrogen, and consequently, model estimates indicate that mean annual nitrate-nitrogen loads and concentration will be reduced with development. These results would suggest that projected nutrient concentrations in runoff should not result in an increase in algae growth.

Trace Metals

Modeling results discussed in the previous section indicate that, in general, mean annual loads of aluminum, cadmium, and zinc from the entire sub-basin will decrease slightly with development, while mean annual loads of copper and lead loads will increase moderately. The highest loads are associated with aluminum, then in descending order zinc, copper, lead, and cadmium. Similarly, the mean annual concentrations for the entire sub-basin are estimated to decrease slightly for aluminum, cadmium, and zinc, and are estimated to increase for copper and lead. In all cases the estimated trace mean concentrations are well below benchmark NAWQC and CTR criteria.

5.4.3 Findings of Significance

Hydrologic Conditions of Concern and Significance Thresholds

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The following discusses the implications of the water balance results on the hydrologic conditions of concern.

1. Increased Stormwater Runoff Flowrate, Volume and Flow Duration

Significance Threshold A: Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation.

The WQMP was designed specifically to preserve and protect the existing drainage patterns, and sediment transport regime. Drainage patterns within the development bubbles will be modified by the installation of drainage infrastructure, but to the extent feasible (for example, in low density development areas) more natural swale type drainage will be considered. Drainage patterns will be modified in the Trampas Creek drainage by virtue of removing the sand mining operation; however, flow management is designed to mimic natural hydrologic conditions in Trampas Creek.

Significance Threshold B: Substantially increase the frequencies and duration of channel adjusting flows.

Changes in the frequency and duration of flows were analyzed for all development areas. The combined control system for these catchments was sized and configured to match, to the extent possible, the flow durations over the entire range of channel adjusting flows, including the 2 and 10 year peak flows. The results of water balance analyses show that combined control facilities would effectively control surface runoff to Trampas Creek, to the unnamed creek west of Trampas Creek, and to San Juan Creek to match the existing condition.

On this basis, the effect of the proposed development on altering existing drainage or increasing the frequency and duration of channel adjusting flows is determined to be less than significant.

2. *Decreased Infiltration and Groundwater Recharge*

Significance Threshold A: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.

The water balance indicates that infiltration volumes will likely increase over pre-development conditions, and therefore groundwater levels, particularly in and around San Juan Creek, would increase rather than decrease.

On this basis, the potential effect of the proposed development on infiltration and groundwater recharge are considered less than significant.

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Hydrologic Condition of Concern #3: Changed Base Flows

Significance Threshold A: Substantially increase or decrease base flows as to negatively impact riparian habitat.

The projected increase in infiltration and groundwater outflow is likely to lead to increases in base flows in Trampas Creek, the unnamed creek, and San Juan Creek. The magnitude of the increase is estimated to be about 1 cfs, which could potentially benefit arroyo toad habitat, especially during the breeding season when water is a significant factor affecting recruitment.

Significance Threshold B: Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.

To the extent that the projected increase in base flows enter San Juan Creek, the effect could potentially raise the groundwater elevations downstream which would be beneficial to downstream water supply pumping operations.

On this basis, the effect of the proposed development in altering base flows such as to adversely affect habitat or downstream groundwater levels for water supply purposes is considered less than significant.

Pollutants of Concern

The following are the conclusions regarding the significance of impacts for the pollutants of concern.

Sediments: Mean total suspended solids concentrations are estimated to be less in the post development condition than in the existing conditions.

Nutrients (Nitrogen and Phosphorous): Despite the predicted increases in TKN and total phosphorus loadings, the post-developed nutrient concentrations are either well below or within the observed range of in-stream concentrations, and therefore should not increase algal growth.

Trace Metals: Mean concentrations of total aluminum and dissolved cadmium and zinc are estimated to decrease with development, while mean concentrations of dissolved copper and lead are estimated to increase relative to estimated concentrations under existing conditions. However, mean concentrations of aluminum, cadmium, copper, lead, and zinc are well below benchmark NAWQC and CTR criteria.

On this basis, the impact of Alternative B-10M on sediments, nutrients, and trace metals is considered less than significant.

5.5 IMPACT ANALYSIS FOR THE CRISTIANITOS SUB-BASIN

This section evaluates the effectiveness of the WQMP for the Cristianitos Sub-basin. Impacts on pollutants of concern and hydrologic conditions of concern are evaluated for the B-10M Alternative. This sub-basin contains Planning Area 6 and 7.

Figure 4-8 shows the proposed land uses in the B-10M Alternative, and the land use areas of the modeled alternative B-4 and the proposed B-10M Alternative are compared in Table 5-9. The level of proposed development under the B-10M Alternative is considerably smaller than the modeled alternative. Differences and similarities of the modeled alternative and the B-10M Alternative include the following:

- *Estate.* The modeled alternative included no estate housing. Under the B-10M Alternative, estate housing is the only residential housing proposed in the Cristianitos Sub-basin. The estate housing is in both PA 6 and PA 7.
- *Golf Course.* The modeled alternative included assessment of a golf course and associated club house located in PA 6. Under the B-10M Alternative, the location of the golf course is moved to PA 7, and the size of the golf is increased by about 21 percent.
- *Proposed Development.* The modeled alternative included 535 acres of proposed general development. The B-10M Alternative eliminates all general development, which is partially replaced with estate housing.
- *Open Space.* Due to the reduction in general development under the B-10M Alternative, open space area is larger in comparison to the modeled alternative.

Table 5-9: Cristianitos Sub-basin Land Use Areas by Development Alternative

Land Uses	Land Use Area by Development Alternative (acres)	
	Modeled Alternative B-4 (Appendix D)	B-10M
Estate	0	120
Golf Course	206	250
Proposed Development	535	0
Open Space	553	922
TOTAL	1293	1292

A qualitative analysis is used to assess impacts of development. The analysis is based in part on the results and insights from quantitative analyses of the previously studied development alternative B-4. All discussion of modeling results in the Cristianitos sub-basin specifically refers to the previously modeled development alternative B-4 (Appendix D).

5.5.1 Impacts on Hydrologic Conditions of Concern

Hydrologic Condition of Concern #1: Increased Stormwater Runoff Volume, Peak Discharge, and Flow Duration

The proposed development in the Cristianitos Watershed includes a 250 acre golf course and 115 acres of low density Estate Housing. The past land use practices in this area include clay mining in Cristianitos and Gabino. This is an area with relatively poorly infiltrating soils, so that the pre-development runoff is high relative to areas having more infiltrative capacity.

A majority of the development in the Cristianitos watershed is the golf course and associated facilities. Much of the golf course is located in areas with poorly draining clayey soils. Irrigation controller will be used to limit potential over watering of the turf and landscape areas. For these reasons, runoff from the pervious portions of the golf course is not expected to be substantially different from the pre-development conditions.

Runoff from the impervious portions of the golf-course development (club house and associated roads and parking) and to the extent feasible from the estate areas in PA 7 within Cristianitos, will be captured and stored as non-potable water for golf course irrigation. The potential benefits of this concept include a reduction of runoff volumes and a reduction of water importation to meet irrigation demands. The storage facilities would also function as a wet pond for treatment of the stormwater, prior to use for irrigation and could potentially be integrated into the golf course design. Although runoff and peak irrigation demands are seasonally out of phase (runoff occurs in the wet season and peak irrigation demands are in the dry season), water balance analysis of the modeled alternative (Appendix D) showed that the concept of flow control using storage facilities is feasible in the Cristianitos sub-basin for average climatic conditions.

The estate homes are located in PA 6 and in the ridge areas in PA 7 in areas that have predominantly clayey soils. The increases in runoff with this type of low density urbanization in clayey terrains may not be substantial. Given that estate homes will be widely dispersed with extensive landscaping, low impact site design techniques will be feasible. Such controls would be conducted onsite or in common areas and will include treatment practices such as vegetated swales, planter boxes, and bioretention areas. Because of the clayey conditions, soil amendments and underdrains could be employed to encourage infiltration, soil soaking and ET. Additional measures can be undertaken for estate housing in PA 7. Here excess runoff can be directed to the golf course storage facilities for re-use as non-potable supplies. For estate housing on the ridge tops in PA 7, grading can be used, to the extent feasible, to direct excess runoff to the Gabino watershed which is considered less sensitive to increases in runoff.

In summary the following factors will help to limit runoff from proposed development in the Cristianitos sub-basin:

- Proposed estate and golf development is low density with considerable pervious areas

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- Proposed development is located in areas with clayey soils where pre-development runoff is relatively high
- On-site controls will be used to limit runoff by infiltration, soil soaking/retention, and ET
- Runoff can be stored in golf course storage areas for reuse as non-potable irrigation
- Development on ridge areas in PA 7 can be graded to direct runoff to the Gabino sub-basin.

Based on these considerations, it is likely that runoff from proposed development can be effectively managed to remain at predevelopment levels.

Hydrologic Condition of Concern #2: Decreased Infiltration and Groundwater Recharge

Water balance results for the previously modeled alternative (Appendix D) indicate development in the Cristianitos sub-basin will cause little to modest increases in the amounts of infiltration and groundwater outflow compared to the sub-basins analyzed in the San Juan watershed. The water balance indicated modest increase in infiltration for development areas that include the golf course, reflecting the effects of golf course irrigation. For the entire sub-basin, however, the water balance results showed that infiltration and groundwater flows were relatively unchanged. Similar results are expected for the B-10M Alternative, which includes a larger golf course with greater irrigation demand, but also less residential development and less associated landscape irrigation. Thus, infiltration and groundwater flows are expected to remain relatively unchanged or increase slightly with proposed development under the B-10M Alternative.

Hydrologic Condition of Concern #3: Changed Base Flows

The water balance results for the previously modeled alternative discussed above indicate that groundwater infiltration for average conditions (all years) will remain unchanged, as will base flows. During wet years, infiltration was estimated to decrease by 130 acre-ft/yr, which translates into a decrease in base flow of about 0.2 cfs on average. Conversely for dry years the estimated increase in base flows was only about 0.05 cfs. Moreover, the estimated change in infiltration and associated base flows was substantially smaller in magnitude than the variability between different climatic periods (wet years and dry years). Similar results are expected for proposed development under the B-10M Alternative due to the reduced scope of development. Any increase in base flows would be expected to be small, which could easily evaporate, infiltrate in the main stem channel, or be utilized by riparian vegetation in the immediate vicinity of PA 6 and PA 7.

5.5.2 Impacts on Pollutants of Concern

The section addresses impacts of stormwater runoff on sediments, nutrients, and trace metals. The modeling analysis has been described in Chapter 3. The impact assessment is partly based on water quality estimates of the previously modeled alternative B-4 (Appendix D).

Pollutant generation will be minimal given the low density of development. Irrigation controls and pesticide and fertilizer management educational programs would be provided to manage dry weather runoff and pollution. The on-site facilities will provide considerable opportunity for water quality control and treatment. These facilities include vegetated treatment areas such as swales, stormwater planter boxes and bioretention, which are all generally considered to be among the more effective treatment approaches. The density of housing is compatible with swales along the arterial roads, in contrast to traditional curb and gutter, which would effectively treat road runoff. In addition, the golf course storage facilities in PA 7 will be designed as wet ponds for water quality treatment. Wet ponds are also grouped among the more effective treatment approaches.

TSS Loads and Concentrations

Water quality modeling results for the previously modeled alternative indicates that TSS loads and concentrations will decrease with development. Similar results are expected for the B-10M Alternative, but to a lesser degree in magnitude due to the reduced scope of development area and density. The reduction in TSS loads and concentration is typical of development, which has the effect of stabilizing soils with vegetation and covering soils with impervious surfaces.

The criterion for TSS in the San Diego Basin Plan is narrative and states that “levels shall not cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.” The range of observed TSS data collected by Wildermuth at two stations in the San Mateo watershed was 3,900 to 9,400 mg/L, whereas the estimated mean annual TSS concentration in project area runoff is more than an order of magnitude smaller. Considering the elevated observed in-stream TSS levels, that development is likely to decrease TSS concentrations, and the use of an on-site treatment facility in the low density development area, it is unlikely that the proposed development will affect in-stream TSS levels.

Nutrient Loads and Concentrations

Water quality modeling results for the previously modeled alternative indicates that loads and concentrations of nitrate-nitrogen, TKN, and total phosphorus will be unchanged or decrease with development. Proposed development under the B-10M Alternative may likely have less impact than the modeled alternative due to the reduced size and density of development, as well as the use of effective treatment controls in the on-site estate areas and in the golf course.

Table 5-10 compares the estimated post-development concentrations with observed in-stream data. This table indicates that the estimated nutrient concentrations from the modeled alternative

are within the range of observed in-stream concentrations. As discussed above, the B-10M is likely to have less impact than the modeled alternative. Therefore, the proposed development is not expected to contribute to increases in the in-stream concentrations of nutrients.

Table 5-10: Comparison of Predicted Nutrient Concentrations with Observed In-Stream Concentrations for the Cristianitos Sub-basin

Nutrient	Estimated Average Annual Concentration ¹ (mg/L)			Observed Range of In-Stream Concentrations ² (mg/L)
	All Years	Dry Years	Wet Years	
Nitrate	0.79	0.80	0.79	0.29 – 1.1
TKN	1.05	0.89	1.17	0.39 – 1.2
Total Phosphorus	0.20	0.17	0.22	None Detected – 6.2

¹ Results from the previously modeled alternative B-4 for developed conditions with PDFs (see Appendix D).

² Range of means observed at two San Mateo watershed stations during the wet years.

Trace Metals

Water quality modeling results for the previously modeled alternative indicates that loads and concentrations for all metals except total aluminum tend to decrease with development. Concentrations and loads of total aluminum are estimated to increase by a modest amount (Appendix D). Proposed development under the B-10M Alternative may likely have less impact than the modeled alternative due to the reduced size and density of development, and the use of effective treatment controls in the on-site estate areas and in the golf course.

Table 5-11 compares the estimated post-development concentrations with applicable NAWQC or CTR criteria. A hardness of 140 mg/L has been used to estimate the CTR criteria for those metals whose criteria are hardness dependent. This value of hardness was the minimum hardness observed in the in-stream data collected by Wildermuth. Therefore the criteria may be viewed as a lower bound, and in this respect the comparison is conservative (i.e., more likely to indicate an exceedance). The table indicates that the projected mean concentrations are all less than the applicable criteria, and therefore the effects of metals on acute aquatic toxicity is not likely to be significant. Table 5-11 also compares the projected runoff concentrations with observed data. This comparison indicates that dissolved runoff concentrations are projected to be greater than dissolved in-stream concentrations. As discussed earlier, this situation may reflect the different dissolved-particulate equilibrium in the more sediment rich streams compared to the low sediment runoff.

Table 5-11: Comparison of Estimated Trace Metals Concentrations with Water Quality Criteria and Observed In-Stream Concentrations for the Cristianitos Sub-basin

Trace Metals	Predicted Average Annual Concentration ¹ (µg/L)			California Toxics Rule Criteria ² (µg/L)	Observed Range of In-Stream Concentrations ³ (µg/L)
	All Years	Dry Years	Wet Years		
Total Aluminum	527	518	537	750 ⁴	Not Monitored
Dissolved Cadmium	0.40	0.35	0.44	6.1	None Detected – 0.37
Dissolved Copper	6	5	7	18	1.3 – 4.7
Dissolved Lead	2.08	1.85	2.26	93	None Detected – 0.19
Dissolved Zinc	34	28	38	160	None Detected – 26

¹ Results from the previously modeled alternative for developed conditions with PDFs (see Appendix D).

² Hardness = 140 mg/L, minimum value of monitoring data.

³ Range of means observed at two San Mateo watershed stations during the wet years.

⁴ NAWQC criteria for pH 6.5 – 9.0.

5.5.3 Findings of Significance

Hydrologic Conditions of Concern and Significance Thresholds

The following discusses the implications of the water balance results on the hydrologic conditions of concern.

1. Increased Stormwater Runoff Flowrate, Volume and Flow Duration

Significance Threshold A: Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation.

The WQMP was designed specifically to preserve and protect the existing drainage patterns and the sediment transport regime. Drainage patterns within the development bubbles will be modified by the installation of drainage infrastructure, but to the extent feasible (for example, in low density development areas) more natural swale-like drainage will be considered.

Significance Threshold B: Substantially increase the frequencies and duration of channel adjusting flows.

- The proposed estate and golf development is low density with considerable pervious areas, and is generally located in areas that have clayey soils. For these areas pre-

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development runoff is comparatively high, and when combined with the low density of development, the increases in runoff due to development may not be excessive. The low density of urbanization also provides considerable opportunity to implement on-site source controls that limit runoff by infiltration, retention, and soil soaking and ET. These controls include routing of on-site runoff to vegetation areas such as swales, landscaped areas, planter boxes, and bioretention facilities. For development in PA 7, excess runoff may also be diverted to water features/basins on the golf course for storage and reuse as non-potable irrigation supply. Also in PA 7, proposed estate development on the ridges could be graded to direct any excess runoff to the Gabino watershed.

Based on these considerations, the effect of the proposed development on altering existing drainage or increasing the frequency and duration of channel adjusting flows is determined to be less than significant.

2. Decreased Infiltration and Groundwater Recharge

Significance Threshold A: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.

The geology of this sub-basin limits deep groundwater recharge and what infiltration does occur tends to contribute to shallow interflow into the stream. Water balance results suggest that infiltration volumes will likely mimic the existing condition. Similar results are expected for the B-10M Alternative based on the reduced scope of development in comparison to the modeled alternative.

On this basis, the potential effect of the proposed development on infiltration and groundwater recharge are considered less than significant.

3. Changed Base Flows

Significance Threshold A: Substantially increase or decrease base flows as to negatively impact riparian habitat.

Based on water analyses, base flows are estimated to be unchanged or will increase marginally with development. Any increase in base flows is expected to be insufficient to negatively impact habitat.

Significance Threshold B: Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.

As discussed above, the geology and soils of this sub-basin limit the groundwater resource to shallow interflow. Nonetheless, the water balance results indicate that proposed development is not likely to alter the groundwater balance.

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On this basis, the effect of the proposed development in altering base flows such as to adversely affect habitat or downstream groundwater levels for water supply purposes is considered less than significant.

Pollutants of Concern

The following are the conclusions regarding the significance of impacts for the pollutants of concern under wet and dry weather conditions.

Sediments: Mean total suspended solids loads and concentrations are estimated to be less in the post development condition than in the existing conditions, based on results from the previously modeled alternative.

Nutrients (Nitrogen and Phosphorous): Mean nutrient loads and concentrations are estimated to generally be less in the post-development condition than in the existing conditions, based on results from the previously modeled alternative. Proposed development under the B-10M Alternative is smaller in size and density compared with the modeled alternative. Low density development under the B-10M provides the opportunity to employ effective on-site treatment controls, such as swales and bioretention areas. Wet ponds will also be used to treat runoff that will be stored for non-potable water supply.

Trace Metals: Mean concentrations of dissolved cadmium, copper, lead, and zinc are estimated to decrease relative to predicted concentrations under existing conditions. The mean concentration of total aluminum is estimated to increase slightly with development. More significantly, mean concentrations of aluminum, cadmium, copper, lead, and zinc are well below benchmark NAWQC and CTR criteria.

On this basis, the impact of the B-10M Alternative on sediments, nutrients, and trace metals in the Cristianitos Sub-basin is considered less than significant.

5.6 IMPACT ANALYSIS FOR THE GABINO SUB-BASIN

This section evaluates the effectiveness of the WQMP for the Gabino Sub-basin.

The impact analysis focuses on planning areas 7 and 9 within the Gabino Sub-basin. Although Blind Canyon was considered along with Gabino in previous work such as the Baseline Conditions Report, we have chosen to discuss the impacts on Blind Canyon with those on Talega Canyon because proposed grading would direct runoff from the Northrop-Grumman area in the Talega Sub-basin into Blind Canyon.

The impact analysis is based in part on the results and insights from quantitative analyses of the previously studied development alternative B-4 (see Appendix D). However, quantitative analyses conducted for the previously modeled alternative were focused on proposed development in a lower portion of the Gabino watershed, in PA 7 and a small section of PA 8.

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Quantitative analyses did not include the proposed development in upper Gabino associated with PA 9, or the hydrologic contributions from existing open areas in middle and upper Gabino. Therefore, the impact analysis for proposed development under the B-10M Alternative is divided into two parts:

- Analysis of proposed development in lower Gabino associated with PA 7. This analysis is based in part on extrapolation of results from the previously modeled alternative. Any discussion of modeling results specifically refers to proposed development in lower Gabino under the previously modeled alternative B-4 in PA 7 (see Appendix D)
- A qualitative assessment of proposed development in PA 9 in the upper Gabino watershed

Figure 4-10 shows the proposed land uses in the B-10M Alternative. The land use areas of the modeled alternative and the B-10M Alternative are compared in Table 5-12. The level of proposed development under the B-10M Alternative is considerably smaller than the modeled alternative. Differences and similarities of the modeled alternative and the B-10M Alternative include the following:

- *Estate.* The modeled alternative included assessment of slightly less estate housing in PA 7 than the B-10M Alternative.
- *Proposed Development in PA 7.* The modeled alternative included 269 acres of proposed general development in PA 7. Under the B-10M Alternative there is no general development in PA 7, only estate housing and associated infrastructure.
- *PA 9 Development.* Proposed land use in the modeled alternative included a golf course and casitas in PA 9. Under the B-10M Alternative, there is no golf course or casitas, and development is limited to 20 acres of estate housing.
- *Open Space.* Due to the reduction in general development under the B10M Alternative, open space area is larger in comparison to the modeled alternative.

Table 5-12: Gabino Sub-basin Land Use Areas by Development Alternative

Land Uses	Land Use Area by Development Alternative (acres)	
	Modeled Alternative B-4 (Appendix D)	B-10M
Casitas	20	0
Estate	161	184
Golf Course	199	0
Golf Residential	0	0
Proposed Development	250	0
Open Space	3652	4096
TOTAL	4282	4280

5.6.1 Impacts on Hydrologic Conditions of Concern

Hydrologic Condition of Concern #1: Increased Stormwater Runoff Volume, Peak Discharge, and Flow Duration

Proposed development under the B-10M Alternative in PA 7 within the Gabino sub-basin is considerable smaller in size and density compared with the modeled alternative. The modeled alternative included 197 acres of estate housing and 269 acres of general development (single family residential housing), some of which was the result of proposed grading to divert excess runoff from Cristianitos. Under the B-10M Alternative, proposed development in lower Gabino is limited to 179 acres of low density estate housing. Consequently, impacts from development under the B-10M Alternative will be less than the impacts quantified for the previously modeled alternative.

The proposed estate housing is largely located on ridge top areas on clayey soils where pre-development runoff is comparatively high. Locating low density housing in areas with poorly draining soils is intended to limit the increases in runoff volume associated with development. Given that estate homes will be widely dispersed with extensive landscaping, low impact site design techniques will be feasible. Such controls would be conducted onsite or in common areas and will include treatment practices such as vegetated swales, planter boxes, and bioretention areas. Because of the clayey conditions, soil amendments and underdrains could be employed to encourage infiltration, soil soaking and ET.

Runoff from the estate areas in the Lower Gabino watershed would be stored and treated in the existing quarry ponds in the Lower Gabino. The existing quarry pond is an ideal location for storing and treating runoff. The pond is about two acres in size with significant storage capacity. The pond receives local runoff but there currently is no surface outlet. Data indicate that the pond is connected hydraulically to lower Gabino Creek through the groundwater. Water levels in the pond vary by 10-20 feet in response to local groundwater conditions. The quarry pond

would be retrofit as a water quality treatment facility by adding an outlet structure to allow the basin to operate as an extended detention wet pond. Surface water would exit the pond through the outlet into lower Gabino Creek.

Wet weather surface runoff to Gabino Creek may increase with development under the B-10M Alternative. However, any increase in runoff volume should be small to moderate given that development plans include only low density estate housing constructed in areas that primarily consist of low permeability clay soils that limit infiltration in the pre-development condition, and that a variety of on-site controls will be used to reduce runoff. Therefore, the increase in wet weather runoff is expected to be considerably less than the amount projected under the previously modeled alternative. Increases in wet weather flows in Lower Gabino is considered acceptable because Lower Gabino Creek, like San Juan Creek, is a relatively large, braided stream with coarse sized substrate that can accommodate increases in runoff without causing excessive erosion or inducing significant habitat changes.

Hydrologic Condition of Concern #2: Decreased Infiltration and Groundwater Recharge

As discussed earlier for Cristianitos Creek, the groundwater component of the water balance is smaller in these sub-basins in contrast to the sandy alluvial aquifers in the San Juan Creek watershed. Water balance results for the previously modeled alternative indicated that development would cause little to minor changes to infiltration and groundwater flows. These changes would be even less under the B-10M Alternative due to the reduced scope of development. Therefore, groundwater infiltration is not greatly affected by the proposed development in this sub-basin.

Hydrologic Condition of Concern #3: Changed Base Flow

As indicated above, projected groundwater infiltration and outflow is relatively small in these geologic conditions, resulting in intermittent stream systems, especially during dry years. During such years, the change in groundwater outflow is estimated to be on the order of 0.1 cfs or less, and would be even smaller under the B-10M Alternative. These projections would indicate that base flows will not be substantially altered by the proposed development.

5.6.2 Impacts on Pollutants of Concern

The section presents the water quality modeling results used to address impacts of stormwater runoff on sediments, nutrients, and trace metals.

Pollutant generation will be minimal given the low density of development. The on-site facilities will provide considerable opportunity for water quality control and treatment. These facilities include vegetated treatment areas such as swales, stormwater planter boxes and bioretention, which are all generally considered to be among the more effective treatment approaches. The density of housing is compatible with swales along the arterial roads, in contrast to traditional curb and gutter, which would effectively treat road runoff. In addition, the quarry pond will be

retrofit as a water quality treatment facility by adding an outlet structure to allow the basin to operate as an extended detention wet pond. Thus, any runoff that occurs from the development area will be treated in the quarry pond prior to discharge to Gabino Creek.

TSS Loads and Concentrations

Water quality modeling results for the previously modeled alternative indicate that estimated TSS concentrations will decrease with development, whereas the estimated TSS loads increase with development. For proposed development under the B-10M Alternative it is likely that TSS loads will be substantially smaller than the estimated loads, given the smaller scope of development. It is also possible that TSS loads could be reduced with development due to the effectiveness of on-site controls and treatment in the retrofitted quarry pond.

Observed in-stream TSS concentrations range from about 4,000 to 9,000 mg/L. This is considerably higher than the estimated mean annual concentration in project area runoff (44 mg/L). Thus, projected changes in TSS concentrations and loads due to proposed development are likely to be quite small compared to existing sediment transport in lower Gabino Creek.

Nutrient Loads and Concentrations

Water quality modeling results for the previously modeled alternative indicate that loads and concentrations of nitrate-nitrogen, TKN, and total phosphorus will increase with development, with the exception of nitrate concentrations which are estimated to decrease. For proposed development under the B-10M Alternative it is likely that changes in nutrient loads and concentrations will be substantially smaller than the estimated increases which are based on the previously modeled alternative. This is due to the considerably smaller size and density of the proposed development, as well as the good treatment performance that is expected with the on-site controls and with the retrofitted quarry pond.

Table 5-13 compares the estimated post-development concentrations with observed in-stream data. This table indicates that the predicted concentrations for nitrate-nitrogen are within the range of observed data, whereas the projected TKN concentrations are somewhat higher than in-stream concentrations. Given that these systems appear to be nitrogen limited and that nitrate-nitrogen is more bioavailable than TKN, changes in nitrate-nitrogen are the more important measure of the potential for discharges to stimulate algal growth. The estimated nitrate-nitrogen concentration is within the range of observed in-stream data. Moreover, as discussed earlier for Cristianitos Creek, intermittent streams run during the wet winter season when environmental conditions of light and temperature are less supportive of algal growth.

Table 5-13: Comparison of Predicted Nutrient Concentrations with Observed In-Stream Concentrations for the Gabino Sub-basin

Nutrient	Predicted Average Annual Concentration ¹ (mg/L)			Observed Range of In-Stream Concentrations ² (mg/L)
	All Years	Dry Years	Wet Years	
Nitrate-nitrogen	0.40	0.38	0.43	0.29 – 1.1
TKN	1.75	1.71	1.80	0.39 – 1.2
Total Phosphorus	0.28	0.28	0.28	None Detected – 6.2

¹ Results from the previously modeled alternative B-4 for developed conditions with PDFs (see Appendix D).

² Range of means observed at two San Mateo watershed stations during the wet years.

Trace Metals

Water quality modeling results for the previously modeled alternative indicate that mean annual loads for all metals will increase. The mean annual concentrations are estimated to increase for copper and leads, and are estimated to decrease for aluminum, cadmium, and zinc. As discussed previously, these projections are likely to be overstated for the proposed development under the B-10M Alternative, which has considerably less development and effective on-site and off-site hydrologic and water quality controls.

Table 5-14 compares the estimated post-development concentrations with applicable NAWQC or CTR criteria. A hardness of 140 mg/L has been used to estimate the CTR criteria for those metals whose criteria are hardness dependent. This value of hardness was the minimum hardness observed in the in-stream data collected by Wildermuth. Therefore the criteria may be viewed as a lower bound, and in this respect the comparison is conservative (i.e., more likely to indicate an exceedance). The table indicates that the projected mean concentrations are all less than the applicable criteria, and therefore the effects of metals on acute aquatic toxicity is not likely to be significant.

Table 5-14: Comparison of Predicted Trace Metals Concentrations with Water Quality Criteria and Observed In-Stream Concentrations for the Gabino Sub-basin

Trace Metals	Predicted Average Annual Concentration ¹ (µg/L)			California Toxics Rule Criteria ² (µg/L)	Observed Range of In-Stream Concentrations ³ (µg/L)
	All Years	Dry Years	Wet Years		
Total Aluminum	559	557	560	750 ⁴	Not Monitored
Dissolved Cadmium	0.52	0.52	0.52	6.1	None Detected – 0.37

Trace Metals	Predicted Average Annual Concentration ¹ (µg/L)			California Toxics Rule Criteria ² (µg/L)	Observed Range of In-Stream Concentrations ³ (µg/L)
	All Years	Dry Years	Wet Years		
Dissolved Copper	10.0	10.1	10	18	1.3 – 4.7
Dissolved Lead	2.87	2.80	2.96	93	None Detected – 0.19
Dissolved Zinc	37	37	37	160	None Detected – 26

¹ Results from the previously modeled alternative B-4 for developed conditions with PDFs (see Appendix D).

² Hardness = 140 mg/L, minimum value of monitoring data.

³ Range of means observed at two San Mateo watershed stations during the wet years.

⁴ NAWQC criteria for pH 6.5 – 9.0.

5.6.3 Findings of Significance

Hydrologic Conditions of Concern and Significance Thresholds

The following discusses the implications of the water balance results on the hydrologic conditions of concern.

1. Increased Stormwater Runoff Flowrate, Volume and Flow Duration

Significance Threshold A: Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation.

The WQMP was designed specifically to preserve and protect the existing drainage patterns and sediment transport regime. Development will alter existing drainage patterns in the side canyon above lower Gabino Creek in areas previously altered by prior mining activities and thus will not modify natural drainage patterns in these altered areas.

Significance Threshold B: Substantially increase the frequencies and duration of channel adjusting flows.

Runoff volume in lower Gabino may increase with the proposed development. However, any increase in runoff volume should be small to moderate given that development plans include only low density estate housing in areas that primarily consist of low permeability clay soils, and that a variety of on-site controls will be used to reduce runoff. Runoff from the development areas will be discharged into the large quarry pond in Lower Gabino, which is connected through the alluvial aquifer to nearby Gabino Creek. Gabino Creek is considered far more resistant to erosion than Cristianitos Creek.

On this basis, the effect of the proposed development on altering existing drainage or increasing the frequency and duration of channel adjusting flows is determined to be less than significant.

2. Decreased Infiltration and Groundwater Recharge

Significance Threshold A: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.

As discussed earlier for Cristianitos Creek, the groundwater component of the water balance is smaller in these sub-basins in contrast to the sandy alluvial aquifers in the San Juan Creek watershed. Water balance results for the previously modeled alternative indicated that development would cause little to minor changes to infiltration and groundwater flows. These changes would be even less under the B-10M Alternative due to the reduced scope of development.

On this basis, the potential effect of the proposed development on infiltration and groundwater recharge are considered less than significant.

3. Changed Base Flows

Significance Threshold A: Substantially increase or decrease base flows as to negatively impact riparian habitat.

As indicated above, projected groundwater infiltration and outflow is relatively small in these geologic conditions, resulting in intermittent stream systems, especially during dry years. During such years, the change in groundwater outflow based on water balance results is estimated to be on the order of 0.1 cfs or less, and would be even smaller under the B-10M Alternative. These projections would indicate that base flows will not be substantially altered by the proposed development.

The increased availability of groundwater could encourage non-native vegetation or additional vegetation that could adversely affect aquatic species. However it is likely that riparian vegetation in lower Gabino is influenced more by channel scour than by groundwater level. If elevated groundwater conditions in lower Gabino were to adversely affect habitat, adaptive management options could include pumping the aquifer down each year in order to manage base flows for the maximum habitat value.

Significance Threshold B: Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.

With the exception of the alluvial/terrace aquifers of Gabino, which are a part of this unit, the geology and soils of this sub-basin limit the groundwater resource to shallow interflow. Nonetheless the projected water balance results indicate the effect of the B-10M Alternative is

not likely to alter the groundwater balance and water table levels. If anything there may be a modest increase in groundwater levels during dry years.

On this basis, the effect of the proposed development in altering base flows such as to adversely affect habitat or groundwater levels is considered less than significant.

Pollutants of Concern

The following are the conclusions regarding the significance of impacts for the pollutants of concern under wet and dry weather conditions.

Sediments: Mean total suspended solids concentrations are predicted to be less in the post-development condition. Because development will be located in areas with clay soils that are currently disturbed and eroding, the generation of fine sediments that originate from erosion of these clay soils will be reduced; whereas the transport of coarser sediment and cobbles generated in middle Gabino and La Paz Canyon will be maintained to and through lower Gabino Creek.

Nutrients (Nitrogen and Phosphorous): Nitrate-nitrogen concentrations are projected to decrease with development; however, TKN and total phosphorus concentrations are projected to increase. Loads of all three nutrient species are projected to increase. Comparisons with observed in-stream data indicate runoff nitrate-nitrogen concentrations will be comparable to observed in-stream concentrations. Given that nitrate-nitrogen is the more important nutrient of concern, this comparison would suggest that runoff would not increase algal growth in Gabino Creek or impact arroyo toad habitat. Moreover, as discussed earlier for Cristianitos Creek, intermittent streams run during the wet winter and spring season when environmental conditions of light and temperature are less supportive of algal growth.

Trace Metals: Although trace metal loads are projected to increase, mean concentrations of cadmium, copper, lead, and zinc are well below the benchmark CTR criteria. Total aluminum is also less than the benchmark NAWQA criterion for all climatic conditions.

On this basis, the impact of the B-10M Alternative on sediments, nutrients, and trace metals in the Gabino Sub-basin is considered less than significant.

5.6.4 Impacts Associated with Proposed Development in Upper Gabino

The above discussion described the potential impacts associated with PA 7 on middle and lower Gabino. The B-10M Alternative also includes development in Upper Gabino consisting of 20 acres of estates. The effects of this proposed low density development were not modeled, but rather are addressed here qualitatively.

Impacts to Hydrologic Conditions of Concern

The proposed development is located in an area that has experienced extensive erosion because of natural erosive conditions coupled with past agricultural practices. Because of a combination

of erodible clays and sands, Upper Gabino is a source of fine as well as coarse sediment. The Gabino sub-basin is underlain by clayey and crystalline terrains that generally produce high runoff volumes. So in this case, urbanization, especially the low density urbanization that is proposed, may not substantially increase post-development runoff. With development, grading, landscaping, and the incorporation of flow control facilities including recycling of stormwater for golf course irrigation are all factors that would reduce runoff volumes and rates into middle and lower Gabino Creek.

Impacts to Pollutants of Concern

By siting the majority of the proposed development in an area that has suffered from past land use practices, the post-development sediment loads should decrease as a result of the development and urban landscaping that will tend to stabilize the soils. Low density development also will provide the opportunity to incorporate site design techniques that can provide for hydrologic as well as water quality control. Such techniques include directing roof and road runoff to bioinfiltration areas or swales. Given the clay conditions, soil amendments and underdrains could be employed to encourage infiltration. Runoff from low density development also exhibits better water quality than runoff from more dense development.

Based on these considerations, the impacts of the proposed development in upper Gabino on water quality are considered less than significant.

5.7 IMPACT ANALYSIS FOR THE BLIND AND TALEGA SUB-BASINS

This section evaluates the effectiveness of the WQMP for the Blind Canyon and Talega Canyon Sub-basins and evaluates the impacts of the proposed development on pollutants of concern and hydrologic conditions of concern.

In this section we evaluate the effects of runoff from PA 8 as it affects Talega and Blind Canyons. This area includes the Northrop-Grumman (formerly TRW) facilities. Because of concerns for arroyo toad habitat in Talega Creek, the proposed development plan is to grade PA 8 such that all excess runoff from PA 8 would discharge into either Blind Canyon to the north or lower Cristianitos to the west. The area of that portion of PA 8 that would be graded to discharge to Blind Canyon is approximately 473 acres. It is for this reason that the Blind and Talega Sub-basins are addressed in this section together.

In contrast to other sub-basins where entire sub-basins were modeled, the water balance and water quality modeling in these sub-basins were conducted for all the catchments in Blind Canyon and only for developed catchments in Talega Canyon. The decision to only model the developed portion of the Talega is reasonable given the grading plan. The impact assessment for the Blind and Talega sub-basins is based on the previously modeled alternative B-9 (Appendix E).

Figure 4-12 shows the proposed land uses in the B-10M Alternative. The land use areas for the B-10 Alternative and the previously modeled alternative B-9 are tabulated in Table 5-15.

Table 5-15: Blind and Talega Sub-basin Land Use Areas by Development Alternative

Land Uses	Land Use Area by Development Alternative (acres)	
	B-10M	Modeled Alternative B-9 (Appendix E)
Golf Course	225	225
Golf Resort	25	25
Proposed Development	713	660
Open Space	1093	1147
TOTAL	2055	2057

The assessment approach is based on hydrologic and water quality modeling of proposed land under the former development alternative B-9, presented in Appendix E. Modeling results and insights are used and extrapolated for the assessment of impacts under the B-10M Alternative. All discussion of modeling results in this section specifically refers to the previously modeled development alternative B-9 (see Appendix E).

5.7.1 Impacts on Hydrologic Conditions of Concern

Due to recent updates in the planning formulation, the drainage pattern of the B-10M Alternative is slightly different from the modeled alternative B-9 (Appendix E). The main difference is that with the B-10M Alternative, runoff from catchment T-1 (Figure 4-12) does not flow north to Blind Canyon, but instead drains westward to water quality basins in the lower Cristianitos sub-basin.

Benefits of reducing the surface runoff volume directed to Blind Canyon are: 1) required storage capacity for water quality treatment and flow duration matching in Blind Canyon would be reduced from the levels evaluated in the modeled alternative, and 2) there would be a reduction in the estimated increases in infiltration and associated base flows in Blind Canyon.

The treated runoff from catchment T-1 would be discharged directly to lower Cristianitos Creek. There would be no need for flow duration matching and infiltration facilities in this area because runoff volumes and flow rates associated with larger storm events are not expected to adversely affect the stability of Lower Cristianitos Creek given the size of the proposed development relative to the size of the overall San Mateo Creek watershed at the point of discharge.

The B-10M Alternative includes a water quality/flow duration basin in the upper portion of catchment T-1. This basin is intended to manage runoff volumes to Talega Creek such that pre-development volumes are matched to the extent feasible.

Hydrologic Condition of Concern #1: Increased Stormwater Runoff Volume, Peak Discharge, and Flow Duration

Flow Duration Analysis

Although the development area is slightly larger under the B-10M Alternative, the modeling results for the B-9 Alternative (Appendix E) show that flow duration control can be designed to effectively manage surface runoff from development in the Blind and Talega sub-basins. With controls, the runoff flows and durations will, to the extent feasible, match the pre-development condition. An outcome of this flow duration matching is that the 2 and 10 year peak flows are reduced to values consistent with the pre-development condition.

Water Balance Analysis

The water balance analysis for the modeled alternative B-9 (Appendix E) indicates that the flow duration controls in combination with the golf course storage facilities would effectively limit increases in surface runoff. Although the development area is slightly larger under the B-10M Alternative, due to the close similarity in proposed land use in the modeled alternative B-9 and the B-10M Alternative, it is reasonable for the flow durations facilities to achieve comparable levels of runoff volume control are feasible for the proposed land used under the B-10M Alternative. With similar levels of control, surface runoff to Talega would be approximately unchanged with development, and surface runoff to Blind Canyon could increase slightly.

Hydrologic Condition of Concern #2: Decreased Infiltration and Groundwater Recharge

Because of the heavy reliance on groundwater infiltration to manage potentially erosive flows, infiltration and groundwater flows to Blind Canyon increase substantially. The water balance analysis for the modeled alternative B-9 (Appendix E) indicates that infiltration will increase by more than 500 acre-ft per year, which is more than double the pre-development level. Similar, and perhaps smaller, increases would be expected with proposed development in the B-10M Alternative. Smaller increases in infiltration volume may occur in Blind Canyon because the volume of surface runoff directed to Blind Canyon is reduced under the B-10M Alternative. The effects of this infiltration would be to increase local groundwater table elevations, primarily in the lower portion of Blind Canyon.

As noted earlier, this analysis assumes that groundwater flows in the graded portion of Talega Canyon will approximately conform to the land surface. However, the direction of groundwater flows would more likely be influenced by subsurface geologic formations such as clay lenses. Therefore, irrigation associated with development in T-1 could result in small increases in infiltration and associated groundwater flows in the Talega sub-basin.

Hydrologic Condition of Concern #3: Changed Base Flow

The water balance analysis for the modeled alternative B-9 (Appendix E) indicates increases in groundwater infiltration and outflow into Blind Canyon is approximately 518 acre-ft/yr, which translates into an annual mean change in base flow of about 0.7 cfs. As discussed above, similar or slightly smaller increases would be expected for proposed development in the B-10M Alternative. This increase would occur near the mouth of Blind Creek and the effect could extend into lower Cristianitos Creek.

5.7.2 Impacts on Pollutants of Concern – B-10M

This section presents the water quality modeling results used to address impacts of stormwater runoff on sediments, nutrients, and trace metals for Alternative B-10M.

TSS Loads and Concentrations

The modeling results for the former development alternative B-9 (Appendix E) indicate quite low estimates for mean annual TSS concentration and loads in discharge to the Blind and Talega sub-basins. This effect reflects the relatively small areas proposed for development, soil stabilization achieved with urban landscaping, the increase in impervious cover, and the effect of treatment, and in particular, treatment by infiltration. The estimated mean TSS concentration is substantially smaller than observed in-stream concentrations.

Although the development area is slightly larger under the B-10M Alternative, due to the close similarity in proposed land use in the modeled alternative B-9 and the B-10M Alternative, it can be reasonably estimated that mean TSS loads and concentrations will be also be quite small under the B-10M Alternative. This is expected because of the close similarity in proposed land use in the modeled alternative B-9 and the B-10M Alternative, and because of the comparable levels of flow duration control. With similar levels of control, runoff from the proposed development area will not adversely affect TSS levels in receiving streams.

Under the B-10M Alternative, runoff from catchment T-1 is directed to lower Cristianitos sub-basin, instead of Blind Canyon. Thus, some of the TSS loads that are estimated in Blind Canyon, will instead be discharged directly to lower Cristianitos Creek. Surface runoff from T-1 will be treated in the water quality basin prior to discharge to lower Cristianitos Creek.

Nutrient Loads and Concentrations

The modeling results for the former development alternative B-9 (Appendix E) indicate that mean annual loads and concentrations of nitrate-nitrogen and TKN will decrease with development. Total phosphorus loads and concentrations are estimated to increase slightly. Similar trends are expected for proposed development in the B-10M Alternative, because of the similarity in land use and comparable levels of flow duration control.

Nitrate-nitrogen and ammonia-nitrogen (a portion of the TKN measurement) are important bio-available forms of nitrogen that can cause excessive algal growth in streams. TKN also contains

organic nitrogen which is considered less bioavailable, and in this respect nitrate-nitrogen is the more important nitrogen species when considering effects on algal growth. Based on the estimated reduction in nitrate-nitrogen concentration, and that estimated nitrate-nitrogen concentrations are within the range of observed concentrations, it is unlikely that nutrient concentrations in runoff from the proposed development would lead to excessive algal growth.

Trace Metals

The modeling results for the former development alternative B-9 (Appendix E) indicate that mean annual loads and concentrations for aluminum, cadmium, copper, lead, and zinc will decrease with the proposed development. The only exception is a small increase in the concentration of cadmium in runoff into Blind Canyon.

The important comparison with respect to potential effects on aquatic species is with the CTR criteria, and in the case of aluminum, the NAWQA criteria. Results for the modeled alternative B-9 showed that projected mean concentrations of all the metals are well below the benchmark criteria. Similar trends are expected for proposed development in the B-10M Alternative, because of the similarity in land use and the comparable levels of flow duration control.

5.7.3 Findings of Significance

Hydrologic Conditions of Concern and Significance Thresholds

The following discusses the implications of the water balance results on the hydrologic conditions of concern.

1. Increased Stormwater Runoff Flowrate, Volume and Flow Duration

Significance Threshold A: Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation.

The WQMP was designed specifically to preserve and protect the existing drainage patterns, and sediment transport regime. Drainage patterns within the development bubbles will be modified by the grading and installation of drainage infrastructure. Some of the grading is specifically designed to divert runoff from the more sensitive Talega Sub-basin to Blind Canyon and/or directly to lower Cristianitos, where stream conditions are considered more stable and resistant to the anticipated increase in flows.

Significance Threshold B: Substantially increase the frequencies and duration of channel adjusting flows.

Based on water balance results of the former development alternative B-9 (Appendix E), the increase in runoff volume in lower Blind Canyon is expected to be small, and is unlikely to affect channel stability.

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On this basis, the effect of the proposed development on altering existing drainage or increasing the frequency and duration of channel adjusting flows is determined to be less than significant.

2. Decreased Infiltration and Groundwater Recharge

Significance Threshold A: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.

Because of the reliance on infiltration as a volume control measure, groundwater infiltration is expected to increase in Blind Canyon and especially near the confluence with Gabino and lower Cristianitos Creeks. On this basis, the potential effect of the proposed development on infiltration and groundwater recharge is considered less than significant.

3. Changed Base Flows

Significance Threshold A: Substantially increase or decrease base flows as to negatively impact riparian habitat.

Groundwater outflow into lower Blind Canyon Creek is expected to increase significantly, on the order of 0.8 cfs or less. The effect would be mostly in lower Cristianitos Creek. Because of its size, substrate, and habitat, lower Cristianitos Creek is considered more suitable for accepting additional flows than Talega Creek. The base flow will decrease with distance downstream as some water will infiltrate into the stream bed and some water may be used to support riparian vegetation, especially in lower Cristianitos Creek which, in certain reaches, is heavily vegetated.

Significance Threshold B: Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.

As discussed above, the projected effect of the development would, if anything, increase base flows and local groundwater elevations. The effect would be most pronounced in lower Cristianitos Creek where existing habitat could potentially benefit from the additional water. On this basis, the effect of the proposed development in altering groundwater levels is considered less than significant.

Pollutants of Concern

The following are the conclusions regarding the significance of impacts for the pollutants of concern under wet and dry weather conditions.

Sediments: Mean total suspended solids loads and concentrations are estimated to be less in the post-development condition.

Nutrients (Nitrogen and Phosphorous): Post-developed nutrient loads are estimated to decrease and post-development concentrations are either well below or within the observed range of in-

stream concentrations. Moreover the treatment system will include constructed wetlands to treat dry weather and small storm flows. Wetland systems such as those at the San Joaquin Marsh and Prado Reservoir have been shown to be quite effective in treating nitrate-nitrogen. On this basis, the impact of the B-10M Alternative on nutrients is considered less than significant.

Trace Metals: Mean concentrations of total aluminum and dissolved cadmium, copper, lead, and zinc are predicted to decrease relative to predicted concentrations under existing conditions and are well below benchmark NAWQC and CTR criteria. On this basis, the impact of the B-10M Alternative on trace metals is less than significant.

5.8 IMPACT ANALYSIS FOR THE VERDUGO SUB-BASIN

This section evaluates the effectiveness of the WQMP for the Verdugo Sub-basin and evaluates the impacts of the proposed development on pollutants of concern and hydrologic conditions of concern.

Figure 4-14 shows the proposed land uses in the B-10M Alternative, and the land use areas for the modeled alternative B-9 and Alternative B-10M are tabulated in Table 5-16. This table shows that proposed land use areas in the two alternatives are almost identical. Therefore, the impact assessment is identical for the modeled alternative B-9 and Alternative B-10M in the Verdugo sub-basin. All discussion of modeling results in this section specifically refers to the previously modeled development alternative B-9 (see Appendix E).

Table 5-16: Verdugo Sub-basin Land Use Areas

Land Uses	Land Use Area by Development Alternative (acres)	
	Modeled Alternative B-9 (Appendix E)	B-10M
Proposed Development	479	479
Open Space	1370	1368
TOTAL	1849	1847

5.8.1 B-10M Alternative

In contrast to previous chapters where entire sub-basins were modeled, the modeling was conducted only for the lower Verdugo Sub-basin, defined as catchments 120 to 125, PA4-4, and PA4-5 (illustrated in Figure 4-14). The modeling does not include the hydrologic contributions from existing open areas in the upper portion of the sub-basin.

The decision to focus the analysis in Verdugo on the lower portion of the sub-basin is reasonable given that the proposed development is located in lower Verdugo. The results of the hydrologic and water quality analysis is therefore more of a relative comparison of pre- versus post-

development conditions for discharges into lower Verdugo Creek, as opposed to an absolute comparison of hydrologic conditions within the stream.

5.8.2 Impacts on Hydrologic Conditions of Concern

Hydrologic Condition of Concern #1: Increased Stormwater Runoff Volume, Peak Discharge, and Flow Duration

Flow Duration Analysis

One flow duration/water quality basin has been provided for the proposed development within the Verdugo Sub-basin. An example of the flow duration analysis results are presented in Figure 5-2. Also shown on the figure are the estimated 2 and 10 year return period post-development peak flows. These flows were estimated based on a frequency analysis of peak flows from the SWMM output for the 53 year rainfall record. The figure indicates that the flow controls effectively match the pre-development flow duration curve for a range of flows up to and beyond the 10 year peak flow. These results indicate that matching pre-development flow duration up to the 10 year peak flow was possible utilizing the combined control system in the Verdugo Sub-basin.

Water Balance Analysis

The water balance analysis results presented in Table 5-17 address the portion of PA 4 within the Verdugo Sub-basin. It is important to note that the pre-development catchments considered in the water balance total approximately 1,514 acres. However, because of the effects of the proposed grading, the total area of the post-development catchments is approximately 1,576 acres, an increase of about 62 acres.

Surface water runoff into Verdugo Creek is projected to increase on average (for all years) from about 28 acre-ft/yr to about 31 acre-ft/yr, or three acre-ft/yr. Increases during wet years would be slightly larger (4 acre-ft/yr), and increases during dry years would be slightly less (1 acre-ft/yr). These increases in surface runoff are minimal due to the effectiveness of the combined control system.

Hydrologic Condition of Concern #2: Decreased Infiltration and Groundwater Recharge

Groundwater outflow is projected to increase from 997 acre-ft/yr to 1,844 acre-ft/yr in all years, or approximately 85 percent, due to the use of infiltration and the added irrigation volumes.

These projected changes in groundwater outflow indicate that groundwater infiltration and groundwater recharge will not be decreased by the proposed development in this sub-basin.

Hydrologic Condition of Concern #3: Changed Base Flow

The water balance analysis indicates that post-development groundwater outflow will increase by about 847 acre-ft or 85 percent for all years and about 831 acre-ft (127 percent) during dry years. This groundwater outflow would ultimately increase base flows in Verdugo Creek, which would be utilized to support riparian vegetation, increase levels of the water table, or infiltrate into the channel bottom.

5.8.3 Impacts on Pollutants of Concern

The section presents the water quality modeling results used to address impacts of stormwater runoff on sediments, nutrients, and trace metals. Results are provided for the three development scenarios, for three climatic conditions.

TSS Loads and Concentrations

Table 5-18 shows that TSS loads are projected to decrease in all but dry years and concentrations are always predicted to decrease. Table 5-19 compares the projected mean annual TSS concentration in wet years (208 mg/L) to observed in-stream data that range up to 3,100 mg/L.

Table 5-17: Verdugo Sub-basin Average Annual Water Balance (Alternative B10M) (inches (acre-ft))

Climatic Period	Pre-Development ¹					Post-Development with PDFs ²						
	INFLOW	OUTFLOW				INFLOW			OUTFLOW			
	Precipitation	Runoff to Verdugo Creek	GW Outflow	ET	Total	Precipitation	Irrigation	Total	Runoff to Verdugo Creek	GW Outflow	ET	Total
All Years	17.2 (2173)	0.2 (28)	7.9 (997)	9.1 (1145)	17.2 (2171)	17.3 (2268)	7.4 (971)	24.7 (3239)	0.2 (31)	14.0 (1844)	10.3 (1358)	24.6 (3234)
Dry Years	14.4 (1822)	0.0 (6)	5.2 (654)	9.3 (1175)	14.5 (1834)	14.5 (1901)	7.4 (970)	21.9 (2871)	0.1 (7)	11.3 (1485)	10.5 (1380)	21.9 (2873)
Wet Years	23.1 (2916)	0.6 (77)	13.7 (1725)	8.6 (1083)	22.9 (2885)	23.2 (3045)	7.4 (973)	30.6 (4019)	0.6 (81)	19.8 (2606)	10.0 (1312)	30.4 (3998)

¹The pre-development catchments are 120-125. Pre-development area = 1514 acres.

²The post-development catchments are: 120 – 125, PA4-4, and PA4-5. Post-development area = 1576 acres.

Table 5-18: Predicted Average Annual TSS Loads and Concentrations for the Verdugo Sub-basin (Alternative B-10M)

Modeled Area	Site Condition	TSS Load (metric tons)			TSS Concentration (mg/L)		
		All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years
Verdugo Creek	Pre-Developed	7.8	1.5	21.1	224	224	224
	Developed	45	33	71	125	118	133
	Dev w/ PDFs	7.7	1.6	20.5	206	191	208
	Percent Change	-1	9	-3	-8	-15	-7

Table 5-19: Comparison of Predicted TSS Concentration with Water Quality Objectives and Observed In-Stream Concentrations for the Verdugo Sub-basin (Alternative B-10M)

Predicted Average Annual TSS Concentration ¹ (mg/L)	San Diego Basin Plan Water Quality Objectives	Range of Observed In-stream Concentrations ² (mg/L)
208	TSS levels shall not cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors	None Detected – 3,100

¹ Modeled concentration for developed conditions with PDFs in wet years.

² Range of concentrations observed at four San Juan watershed stations during storm events.

Nutrient Loads and Concentrations

Table 5-20 and Table 5-21 show the mean annual loads and concentrations for nitrate-nitrogen, TKN, and total phosphorus. Nitrate-nitrogen concentrations are projected to decrease slightly with development, but the additional projected runoff volume causes loads to increase slightly. TKN loads and concentrations are projected to increase by approximately 43 percent and 33 percent, respectively. Total phosphorus loads and concentrations are similarly projected to increase.

Table 5-22 compares post-development concentrations with observed in-stream data. This table indicates that the predicted concentrations for all of the nutrients are within the range of observed data.

Table 5-20: Predicted Average Annual Nutrient Loads for the Verdugo Sub-basin (Alternative B-10M) (lbs)

Modeled Area	Site Condition	Nitrate-N Loads			TKN Loads			Total P Loads		
		All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years
Verdugo Creek	Pre-Developed	89	17	242	75	14	203	9.5	1.8	25.8
	Developed	642	484	976	2181	1777	3037	302	247	419
	Dev w/ PDFs	91	20	241	107	29	272	14.1	3.9	35.6
	Percent Change	2	15	-0.3	43	104	34	48	115	38

Table 5-21: Predicted Average Annual Nutrient Concentrations for the Verdugo Sub-basin (Alternative B-10M) (mg/L)

Modeled Area	Site Condition	Nitrate-N Concentration			TKN Concentration			Total P Concentration		
		All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years
Verdugo Creek	Pre-Develop	1.16	1.16	1.16	0.98	0.98	0.98	0.12	0.12	0.12
	Developed	0.80	0.78	0.83	2.73	2.85	2.59	0.38	0.40	0.36
	Dev w/ PDFs	1.10	1.04	1.11	1.30	1.56	1.25	0.17	0.21	0.16
	Percent Change	-6	-10	-5	33	60	28	37	68	32

Table 5-22: Comparison of Predicted Nutrient Concentrations with Observed In-Stream Concentrations for the Verdugo Sub-basin (Alternative B-10M)

Nutrient	Predicted Average Annual Concentration ¹ (mg/L)			Observed Range of In-Stream Concentrations ² (mg/L)
	All Years	Dry Years	Wet Years	
Nitrate-nitrogen	1.10	1.04	1.11	0.15 – 1.5
TKN	1.30	1.56	1.25	None Detected – 3.0
Total Phosphorus	0.17	0.21	0.16	None Detected – 2.8

¹Modeled concentration for developed conditions with PDFs in wet years.

²Range of concentrations observed at four San Juan watershed stations during storm events.

Trace Metals

Table 5-23 and Table 5-24 show the predicted mean annual loads and mean annual concentrations for aluminum, cadmium, copper, lead, and zinc for the three development scenarios and for the three climatic conditions. Except for aluminum, the concentrations are all in the dissolved form, which is the form addressed in the California Toxics Rule.

Concentrations for aluminum and zinc are projected to essentially remain unchanged, while concentrations for dissolved cadmium, dissolved copper, and dissolved lead concentrations are projected to increase. Loads for all metals are projected to increase because of the increased runoff volumes.

The important comparison with respect to potential effects on aquatic species is with the benchmark CTR criteria, and in the case of aluminum, the NAWQA criteria. Table 5-25 compares the projected mean concentration for wet years with the CTR and NAWQA benchmark criteria. A hardness of 120 mg/L has been used to estimate the CTR criteria of those metals whose criteria are hardness dependent. This value of hardness was the minimum hardness observed in the in-stream data collected at the four monitoring stations in the San Juan Creek watershed by Wildermuth. Therefore the criteria may be viewed as a lower bound, and in this respect the comparison is conservative (i.e., more likely to indicate an exceedance). The table indicates that the projected mean concentrations of all the metals are well below the minimum criteria. In conclusion, concentrations of all trace metals are projected to be at lower concentrations than the benchmark criteria.

Table 5-23: Predicted Average Annual Trace Metal Loads for the Verdugo Sub-basin (Alternative B-10M)(lbs)

Modeled Area	Site Condition	Total Aluminum			Dissolved Cadmium			Dissolved Copper			Dissolved Lead			Dissolved Zinc		
		All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years
Verdugo Creek	Pre-Developed	52	10	141	0.04	0.01	0.10	0.38	0.07	1.04	0.10	0.02	0.26	2.8	0.5	7.6
	Developed	452	347	674	0.45	0.36	0.66	7.84	6.32	11.05	3.67	3.00	5.07	28.5	22.1	41.9
	Dev w/ PDFs	54	12	144	0.04	0.01	0.11	0.49	0.12	1.25	0.15	0.04	0.39	3.0	0.7	8.0
	Percent Change	4	21	2	10	33	7	27	69	20	60	141	48	7.1	26	4.2

Table 5-24: Predicted Average Annual Trace Metal Concentrations for the Verdugo Sub-basin (Alternative B-10M)(µg/L)

Modeled Area	Site Condition	Total Aluminum			Dissolved Cadmium			Dissolved Copper			Dissolved Lead			Dissolved Zinc		
		All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years	All Years	Dry Years	Wet Years
Verdugo Creek	Pre-Develop	679	679	679	0.50	0.50	0.50	5	5	5	1.25	1.25	1.25	36.7	36.7	36.7
	Developed	565	557	574	0.57	0.57	0.56	10	10	9	4.58	4.82	4.32	35.6	35.5	35.7
	Dev w/ PDFs	658	641	661	0.51	0.52	0.51	6	7	6	1.86	2.36	1.77	36.5	36.4	36.6
	Percent Change	-3	-6	-3	2	4	2	18	32	15	49	89	42	-0.6	-1.0	-0.5

Table 5-25: Comparison of Predicted Trace Metals Concentrations with Water Quality Criteria and Observed In-Stream Concentrations for the Gabino Sub-basin (Alternative B-10M)

Trace Metals	Predicted Average Annual Concentration ¹ (µg/L)			California Toxics Rule Criteria ² (µg/L)	Observed Range of In-Stream Concentrations ³ (µg/L)
	All Years	Dry Years	Wet Years		
Total Aluminum	658	641	661	750 ⁴	Not Monitored
Dissolved Cadmium	0.51	0.52	0.51	5.2	None Detected – 0.09
Dissolved Copper	6	7	6	15.9	2.1 – 4.0
Dissolved Lead	1.86	2.36	1.77	78.7	None Detected – 3.9
Dissolved Zinc	36.5	36.4	36.6	137	None Detected – 15.0

¹ Modeled concentration for developed conditions with PDFs.

² Hardness = 120 mg/L, minimum value of monitoring data.

³ Range of means observed at four San Juan watershed stations during storm events.

⁴ NAWQC criteria for pH 6.5 – 9.0.

5.8.4 Findings of Significance

Hydrologic Conditions of Concern and Significance Thresholds

The following discusses the implications of the water balance results on the hydrologic conditions of concern.

1. Increased Stormwater Runoff Flowrate, Volume and Flow Duration

Significance Threshold A: Substantially alter the existing drainage pattern of the site or area, including alteration of the course of a stream or river, in a manner that would cause substantial erosion or siltation.

The WQMP was designed specifically to preserve and protect the existing drainage patterns, and sediment transport regime.

Significance Threshold B: Substantially increase the frequencies and duration of channel adjusting flows.

Runoff volume in lower Verdugo is not projected to increase substantially with the proposed development, in large part because of the effectiveness of the combined control system.

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On this basis, the effect of the proposed development on altering existing drainage or increasing the frequency and duration of channel adjusting flows is determined to be less than significant.

2. Decreased Infiltration and Groundwater Recharge

Significance Threshold A: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge that would cause a net deficit in aquifer volumes or lowering of the local groundwater table.

Groundwater outflow is projected to increase approximately 85 percent due to the use of infiltration and the added irrigation volumes. These projected changes in groundwater outflow indicate that groundwater infiltration and groundwater recharge will not be decreased by the proposed development in this sub-basin.

On this basis, the potential effect of the proposed development on infiltration and groundwater recharge are considered less than significant.

3. Changed Base Flows

Significance Threshold A: Substantially increase or decrease base flows as to negatively impact riparian habitat.

The increased availability of groundwater could encourage non-native vegetation or additional vegetation that could adversely affect aquatic species. However it is likely that riparian vegetation in lower Verdugo is influenced more by channel scour than by groundwater level. If elevated groundwater conditions in lower Verdugo were to adversely affect habitat, adaptive management options could include pumping the aquifer down each year in order to manage base flows for the maximum habitat value.

Significance Threshold B: Substantially increase or decrease low flow estimates where high groundwater elevations are considered important.

The water balance analysis indicates that post-development groundwater outflow will increase by about 85 percent for all years and about 127 percent during dry years. This groundwater outflow would ultimately increase base flows in Verdugo Creek, which would be utilized to support riparian vegetation, increase levels of the water table, or infiltrate into the channel bottom.

On this basis, the effect of the proposed development in altering base flows such as to adversely affect habitat or groundwater levels is considered less than significant.

Pollutants of Concern

The following are the conclusions regarding the significance of impacts for the pollutants of concern under wet and dry weather conditions.

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Sediments: Mean total suspended solids concentrations and loads are predicted to be less in the post-development condition. Because development will be located in areas with clay soils, the generation of fine sediments that originate from erosion of these clay soils will be reduced, whereas the transport of coarser sediment and cobbles generated in upper Verdugo Canyon will be maintained to and through lower Verdugo Creek.

Nutrients (Nitrogen and Phosphorous): Nitrate-nitrogen concentrations are projected to decrease with development; however, TKN and total phosphorus concentrations are projected to increase. Loads of all three nutrient species are projected to increase. Comparisons with observed in-stream data indicate runoff nitrate-nitrogen concentrations will be comparable to observed in-stream concentrations. Also, as discussed earlier, the utilization of constructed wetlands for treatment has been shown to be effective in reducing nutrient concentrations. Given that nitrate-nitrogen is the more important nutrient of concern, this comparison would suggest that runoff would not increase algal growth in Verdugo Creek or impact arroyo toad habitat. Moreover, as also discussed earlier, intermittent streams run during the wet winter and spring season when environmental conditions of light and temperature are less supportive of algal growth.

Trace Metals: Although trace metal loads are projected to increase, mean concentrations of cadmium, copper, lead, and zinc are well below the benchmark CTR criteria. Total aluminum is also less than the benchmark NAWQA criterion for all climatic conditions.

On this basis, the impact of the proposed development on sediments, nutrients, and trace metals in the Verdugo Sub-basin is considered less than significant.

5.9 IMPACT ANALYSIS FOR THE NARROW AND LOWER CENTRAL SAN JUAN SUB-BASIN AND THE LOWER CRISTIANITOS SUB-BASIN

Hydrologic and water quality modeling was conducted for most of the planning areas and the results of this modeling was presented in the sections above. This modeling encompassed the range of terrains and proposed development types in the proposed alternative, and therefore it was not necessary to model all of the planning areas. The two remaining sub-basins that were not modeled were: (1) the Narrow and Lower Central San Juan Sub-basin (areas affected by PA 1), and lower Cristianitos Sub-basin, which would be affected by proposed development in the extreme western portion of the Northrop-Grumman area development (PA 8).

5.9.1 Narrow and Lower San Juan Sub-basin

Planning Area (PA) 1 is located in the western portion of Narrow Canyon within the Chiquita Sub-basin and in what is referred to herein as the Lower Central San Juan Sub-basin. The proposed development in the B-10M Alternative would encompass approximately 540 acres. The proposed development would include a mix of residential, urban activity center, business park, and open space uses. Runoff from PA 1 would discharge into San Juan Creek.

Impacts on Hydrologic Conditions of Concern

Effects on the hydrologic conditions of concern are associated with increased runoff volumes, peak flows, and durations taking into account the effect of terrains on stream channel characteristics and sediment supply. PA 1 is located in clayey terrain where shallow substrate is classified as less erodible clay. This terrain is also characterized as having lower infiltration capacity and therefore the effects of development on increasing runoff will be less pronounced than comparable development on sandy soils.

The receiving stream is San Juan Creek, a braided stream that drains a large tributary area. The system is braided because coarser sediments that originate in the steeper upland portions of the watershed tend to be deposited in the more gradual reach within PA 1. Given the small size of PA 1 compared to the San Juan Creek watershed, the discharges from PA 1 will in general be small relative to existing flow conditions in San Juan Creek. Also, given the proximity of the planning area to the creek and the tendency of urbanization to decrease the response time of catchments, the discharges from PA 1 will tend to precede peak flows in the larger watershed. For small storms, discharges into San Juan Creek may only originate from urbanized areas; however, such discharges will easily be accommodated within the channel and are not likely to be sufficient to mobilize stream sediments on a large scale.

With respect to significance criteria, discharges from the proposed development are not likely to adversely affect storm flows or base flows to the extent that the geomorphology and habitat values of central San Juan Creek will be adversely affected. Groundwater recharge also will not be significantly affected given the clayey terrain which limits existing infiltration.

Impacts on Pollutants of Concern

Impacts on pollutants for this development area are addressed based on available runoff data from similar land uses and data on BMP effectiveness. Table 5-26 shows the anticipated runoff water quality and effectiveness of the treatment BMPs based on literature values. The table is limited to solids, nutrients, and trace metals, as these categories of pollutants are most often measured in stormwater monitoring programs. Project impacts on pathogens, petroleum hydrocarbons, pesticides, trash and debris, and chlorine were addressed qualitatively in Section 5-1. Monitoring data from a nearby station in San Juan Creek are also provided, and, where applicable, available water quality criteria are given.

It is important to note that, as indicated in the table, the runoff data are regional data from LA and Ventura Counties, whereas the treatment data come from the EPA International BMP Database. Given the current availability of data, these are considered the two best sources of information for the project. However, using independent data sets can lead to minor inconsistencies. For example, in some cases effluent quality exceeds runoff water quality. Also within the ASCE/EPA data set, each constituent is not measured at all facilities and for all storms and this may lead to inconsistencies. For example, the dissolved copper concentration exceeds

the total copper value in the data set. These inconsistencies reflect the current availability of data, but are minor for our broader purposes here and do not affect our conclusions.

Dissolved metals data are all well below the CTR criteria based on hardness values observed in San Juan Creek. Also, note that dissolved concentrations observed in San Juan Creek are less than the effluent quality predictions. This reflects the much higher TSS concentrations in San Juan Creek, which tends to increase the fraction of metals adsorbed to particulates and decrease the fraction of metals in the dissolved state.

Although there are no numeric water quality criteria for nutrients, projected effluent concentrations of nutrients are all relatively low when compared to the range of observed concentrations. The projected effluent concentrations for the more biologically available forms of the nutrients, namely dissolved phosphorous and nitrate-nitrogen are below the observed range.

Total suspended solids are projected to be relatively low compared to the range of observed data, which reflects in part the high sediment concentrations that can be observed during large storm events in the San Juan Creek watershed. This comparison does not account for grain size, for which the terrains analysis would indicate that discharges from PA 1 will tend to be finer material such as clays and silts. In contrast, sediment supply and transport energy in the San Juan Creek watershed as a whole indicate that suspended sediments will largely be coarser materials, including sands.

With respect to significance criteria for water quality, these data indicate that, with implementation of the proposed WQMP, projected mean concentrations in the runoff discharged to San Juan Creek will not exceed water quality criteria, and will in general be less than observed in San Juan Creek. On this basis, the effects of discharges from PA 1 on water quality in San Juan Creek are considered less than significant.

Table 5-26: Projected Runoff Water Quality for Mixed Residential Land Uses in Planning Area 1

Pollutant of Concern	Units	Predicted Runoff Quality¹	Predicted Effluent Quality²	Range of Observed Concentrations³	CTR Criteria⁴
TSS	mg/L	72.9	33.7	13 – 3100	
Nitrate-Nitrogen	mg/L	0.59	0.29	0.46 - 1.5	
Total Kjeldahl Nitrogen	mg/L	2.2	1.6	0.56 – 2.8	
Dissolved Phosphorus	mg/L	0.23	0.15	0.54 - 0.76	
Total Phosphorus	mg/L	0.28	0.26	0.07 - 1.5	
Total Aluminum	µg/L	278	NA	NA	750

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Pollutant of Concern	Units	Predicted Runoff Quality¹	Predicted Effluent Quality²	Range of Observed Concentrations³	CTR Criteria⁴
Total Cadmium	µg/L	NA	0.93	ND ⁶ – 9.1	
Dissolved Cadmium	µg/L	0.12	0.52	ND - 0.088	7.6
Total Copper	µg/L	13.5	14.2	ND – 90	
Dissolved Copper	µg/L	8.60	16.2	3.4 - 3.7	22.2
Total Lead	µg/L	5.22	18.8	ND – 22	
Dissolved Lead	µg/L	1.60	2.58	ND	115
Total Zinc	µg/L	134	77.8	36 – 360	
Dissolved Zinc	µg/L	98.2	54.7	ND -13	184

¹Predicted mean runoff quality based on LA County EMC data for mixed residential land use type. Range of data points for monitored parameters is 49 to 56

²Predicted mean effluent quality based on ASCE/EPA International BMP Database for extended detention basin. Range of data points for monitored parameters is 12 to 104

³Range of observed concentrations at station SW1 (San Juan at Equestrian Site). Number of data points for monitored parameters is 2 to 5

⁴CTR Criteria were conservatively estimated based on minimum hardness value (170 mg/L as CaCO₃) observed at the station SW1 (San Juan at Equestrian Site)

⁵NA – Not Available

⁶ND – Non-Detect

5.9.2 Lower Cristianitos Sub-basin

Alternative B-10M proposes 75 acres of general development and 214 acres of open space within the Lower Cristianitos Sub-basin. The general development land use is associated with Planning Area 8, which overlays the Lower Cristianitos, Gabino, Blind, and Talega sub-basins. Grading plans for the B-10M Alternative would redirect runoff from approximately 276 acres in the Talega sub-basin to the Lower Cristianitos Sub-basin. Surface runoff would be treated prior to discharge to lower Cristianitos Creek. In addition, a combined flow duration and water quality basin in the Talega sub-basin would be designed to ensure that post-development surface runoff in Talega Creek matches the pre-development volume, to the extent feasible.

6 LONG TERM ADAPTIVE MANAGEMENT

This chapter presents the adaptive management approach that will be used to evaluate whether the WQMP elements are functioning as intended and to implement corrective procedures when needed. The issues addressed by this adaptive management approach are management considerations relating to “pollutants of concern” and “hydrologic conditions of concern”.

The adaptive management plan entails the following elements:

- *BMP Inspection and Performance Monitoring.* Routine inspection and monitoring of the combined control system components is required to establish that they are being properly maintained and are functioning as intended.
- *Hydrologic Monitoring and Streamcourse/Riparian System Monitoring.* Routine monitoring of the general hydrologic conditions is needed to ascertain if there are changes in the hydrologic regime and subsequent change to stream stability and geomorphology.
- *WQMP Review and Evaluation.* Annual review of the inspection and monitoring data will be conducted to determine if there is a need for corrective action, to evaluate impacts due to changes in watershed conditions on the hydrologic regime or BMP performance, and in general to evaluate if the WQMP is effective in meeting the planning objectives.
- *Corrective Measures.* Corrective measures will be undertaken for specific problems or conditions of concern identified in the review and evaluation. Depending on the nature of the problem, corrective measures could involve modification of the BMP design, operation, or maintenance, and/or implementation of additional BMPs. The effectiveness of the corrective measures will themselves be evaluated through continued inspection and monitoring. Thus, the management approach is adaptive to specific problems or conditions as they arise and are identified through ongoing inspection, monitoring, documentation, and evaluation.
- *Documentation and Reporting.* Documentation of all operation, maintenance, inspection, and monitoring activities will establish a continuous record of the condition of combined control system facilities and the health of the hydrologic regime. All records will be available to the public and regulatory and resource agencies.

The following sections expand on each of the adaptive management elements.

6.1 COMBINED CONTROL SYSTEM COMPONENT INSPECTION AND PERFORMANCE MONITORING

Routine and major operation and maintenance (O&M) activities of the combined control system facilities are described in Section 4.1.4. In conjunction with, or in addition to these O&M activities, performance monitoring of the structural BMPs will be conducted by the Home Owners

Association (HOA) or other designated entity. Details of the performance monitoring activities will be included in the subsequent level WQMPs. The following sections generally describe the monitoring activities that will be included in the subsequent level WQMPs.

6.1.1 Wet Weather Monitoring

Flow Duration Control and Water Quality Treatment (FD/WQ) Basins - Grab samples from influent and effluent flows during wet-weather conditions will provide information about the stormwater treatment performance of the FD/WQ basins. Of those WQ basins that discharge to surface receiving waters (as opposed to infiltration basins), grab samples will be collected for two to three storm events per year at representative basins selected on a rotating basis. Grab samples will be analyzed for TSS and possibly other constituents of concern (e.g., metals, nutrients, pathogens). Inlets and outlet areas of all of the FD/WQ basins will be visually inspected monthly during the wet season for signs of clogging, scouring, and sediment accumulation.

Infiltration Basins – Infiltration basins will be visually inspected monthly during the wet season, preferably during or soon after a rain event. Percolation rates in the infiltration basins will be determined by measuring the drop in water elevation over the sand bed with time during or after a storm event. Percolation rates will be determined following at least one storm event per year at each basin.

Swales – Swales will be visually inspected during wet-weather conditions to verify that there is sufficient capacity to convey storm flows, and to look for signs of scouring; clogging; and sediment, trash, and debris accumulation.

6.1.2 Dry Weather Monitoring

Flow Duration Control and Water Quality Treatment (FD/WQ) Basins – Field water quality measurements of influent and effluent dry weather flows will be collected at representative FD/WQ basins. Annual sediment and vegetation monitoring (see Section 4.1.4) will also provide an indication of pollutant removal occurring in the FD/WQ basins' low flow water quality wetlands. Collectively, this information will provide an ongoing record of wetland health and performance and indicate if any further chemical testing may be required at a particular site. Such testing would entail collection of grab samples and laboratory analyses for total nitrogen, coliform bacteria, and other pollutants of concern as warranted.

Infiltration Basins – Infiltration basins will be visually monitored to confirm that dry weather flows routed to the infiltration basins are percolating into the subsurface and that there are no dry weather discharges reaching the streams through the bioinfiltration swales.

6.2 HYDROLOGIC MONITORING

The WQMP proposes to undertake a “Stream Stabilization Program” to address potential downstream effects of discharges from the Combined Control System in accordance with the following Mitigation Measure (4.5-7) from the GPA/ZC Final Program EIR 589:

Stream Stabilization Program: Prior to the recording of a subdivision map, unless otherwise specified by the provisions of the applicable master area or planning area-specific ROMPs (as appropriate), the development applicant shall prepare a stream stabilization program, including funding, that will be implemented by the HOA or other responsible entity to mitigate anticipated limited local effects of erosion associated with drainage system outlets from the development or downstream of detention basins. These effects from erosion are to be addressed with non-structural biotechnical and geomorphic approaches aggressively at the first phase and if not effective then limited structural measures would be implemented. These approaches vary by terrain and the character of the channels:

1. Sandy and Silty-sandy terrain: Water quality and infiltration basins and ponds will be constructed along unnamed tributary channels and channel-less valleys. Appropriate energy dissipation will be installed downstream of each structure or control point. ‘Hungry water’ or potential downcutting will be controlled by a progressive sequence of:
 - a. establishment of hydrophytic vegetation, either turf-forming (such as salt grass or sedges) or with interpenetrating roots (such as willows); then
 - b. placement of turf-reinforced mats (TRM) or other flexible and biodegradable membrane to abet vegetative growth to stabilize the small drainages downstream of controls; then,
 - c. conventional erosion control fabrics and structures using techniques developed over the years to control gully- or small-channel incision.

In through-flowing named stream corridors, the potential scale of incision is larger, and is most reasonably addressed by a progressive sequence to include:

- a. Attempting to reduce runoff volumes and peaks from the watershed, by a combination of additional retarding of flow and use of (reconnecting, where needed) floodplains for flows of moderate to high recurrence.
- b. Reducing sediment yields from disturbed watershed upstream, such that avulsion (sudden channel changes, such as recently seen in Gobernadora Creek) can be minimized.
- c. Where the bed remains within the root zone of riparian vegetation, widening the riparian corridor, and managing its vegetation to promote dense interpenetrating

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- roots, such as naturally occurs along many reaches of these streams, perhaps in combination with reconfiguring the channel pattern to increase sinuosity to a stable thalweg length-to-channel slope value.
- d. Emplacing well-keyed structural grade control, with a wide variety of potential designs.
2. Clayey terrain: Differences between existing and future conditions will be the least in this terrain. Clayey terrains are also most resistant to incision, in most cases. Hence, biotechnical stabilization is most favored in this setting, especially for the smaller unnamed channels downstream from the small retarding and infiltration basins proposed at many locations. A progressive sequence of:
- a. Establishing hydrophytic or woody riparian vegetation, especially along the bases and crests of banks;
 - b. Installing turf-reinforcing mats and other shear-resistant soft structures;
 - c. Slight widening of channels where feasible without diminishing bank strength imparted by riparian vegetation, if significant; and
 - d. Engineering slopes using fabrics, or placing thoroughly-keyed structural controls, usually in combination with a., b., and c., above.

Hydrologic monitoring will be performed to determine if there are changes in the hydrologic regime and associated changes in stream stability and geomorphology. To minimize costs, visual observation of direct and indirect indicators will be used where practical. Hydrologic monitoring will include:

- *Groundwater levels* – Groundwater levels will be monitored quarterly at existing monitoring wells in the Cañada Gobernadora sub-basin, and at additional monitoring wells to be located in consultation with the management entity responsible for long-term adaptive management of protected habitat areas.
- *Base flows* – Dry weather base flows will be spot checked quarterly in sensitive areas through direct or estimated measurements.
- *Peak Discharges* – Stormwater peak flows will be estimated through stage measurements or measurements of high water marks. Stream channels will be surveyed annually for visual signs of down cutting or aggradation.

6.3 STREAMCOURSE/RIPARIAN SYSTEM MONITORING

In addition to the riparian systems monitoring provided through the Habitat Restoration Plan, the following riparian systems monitoring will be undertaken pursuant to the WQMP within riparian habitats potentially impacted by the operation of the Combined Control System facilities as required by GPA/ZC Final Program EIR Mitigation Measure 4.5-8.

Streamcourse Monitoring: Consistent with the provisions of the applicable master area or planning area-specific Runoff Management Plans (as appropriate), an area-specific stream monitoring program will be developed prior to the construction within the watershed, which will include reporting requirements, in order to observe changes in the natural alluvial stream system. The minimum program will include and address the following items:

- *Stream walks* – A geomorphologist or engineer familiar with both (a) flood conveyance estimation, and (b) the bed conditions required to meet habitat needs and conditions for species of concern will walk critical reaches of named channels within the project each year in late April. The stream-walker will note bed conditions, measure high-water marks, note new sources of sediment or bank distress along the channels, estimate Manning’s ‘n’ (roughness) at key locations, and assess whether bed and bank vegetation is suitable to meet conveyance and habitat objectives. Stream walks will occur during years 1, 2, 3, 4, 5 and 10 following substantial grading in a named-stream basin, and during any year within the first 10 seasons when six-hour rainfall intensities exceed the 5-year recurrence at a nearby pre-selected recording rainfall gauge. The stream-walker will also similarly canvass the lower two miles of Bell Canyon and the upper Chiquita watershed north of Oso Parkway, two stream segments with largely-intact and formally-preserved watersheds which can serve as control. Photographs showing key sites or problems will be taken. The individual conducting the walks shall be sufficiently senior and knowledgeable as to be registered as a geologist or engineer with the state. This individual will prepare an annual report by June 20 of the relevant year(s) specifying maintenance or repair measures needed to maintain suitable sediment transport and bed conditions.
- *Major stream cross-sections monitoring* – Monumented cross-sections will be established and surveyed on:
 - Lower Narrow Creek
 - Chiquita Creek (4 locations)
 - Gobernadora Creek (4 locations)
 - Bell Creek (2 locations)
 - Upper Cristianitos Canyon (3 locations)
 - Lower Gabino Creek (3 locations)
 - Gabino Creek within 0.5 mile of La Paz Creek
 - La Paz Creek within 0.6 mile of Gabino Creek

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Additional monitoring sections will also be provided on San Juan Creek and all monitoring locations will first be approved by the County of Orange before implementation. The cross-sections will be spaced approximately 0.6 to 1.2 miles apart and approved by the County. They will be surveyed to the nearest 0.05 feet vertical, and include notations of bed material encountered and qualitative descriptions of vegetation, and other observations conforming to geomorphic conventions, such as the International Hydrologic Vigil Network standards. The initial surveys will be conducted prior to grading, with resurveys during years 1, 3, 5, and 10 following initial grading or at frequencies determined by the County of Orange. Re-surveys will also be conducted during years when six-hour rainfall intensities exceed the five-year recurrence at a nearby pre-selected recording rainfall gauge or selected occurrences by the County of Orange. Results will be analyzed by the stream-walker, and included in the related report, recommending maintenance and restorative measures. The report will be submitted by May 20 of each year, to allow design and implementation (where needed) prior to the next winter.

- *Periodic aerial photography* – Aerial photographs of the entire project area will be taken during May or June following project approval, and during each subsequent May or June of years ending in a ‘5’ or ‘0’, until the project has been completed as defined by the County of Orange. Resolution of the photographs will be sufficient to prepare 200-foot scale maps with 2-foot (or 0.5-meter) contours. Contour maps will be prepared for the San Juan Creek channel corridor from the Verdugo Canyon confluence to 0.5 mile downstream of Antonio Parkway showing the topography of the bed and of the banks to elevations 15 feet above the adjoining bed. LIDAR (Light Detection and Ranging) or other technologies can be substituted for now-conventional photogrammetric methods. A qualified geomorphologist shall review the aerial photographs of the entire project area, identifying new upland sources of sediment, event-related or land-use disturbance, or evidence of channel change and instability. The geomorphologist will also assess discontinuities in sand transport throughout the project area, and will present an assessment of changes, if any, in the San Juan Creek corridor. Results will be presented in a report to be prepared by July 15 of each year, including recommendations for maintenance, repair, or other actions.
- *Evaluation of changes downstream of ponds and basins* – Longitudinal profiles and channel or drainage-way cross-sections will be established downstream of basins or ponds with capacities exceeding 1 acre foot, or which create a 4-foot elevation change in the energy grade line. Resurveys will occur whenever the stream-walker and/or the geomorphologist reviewing the aerial photos identify actual or incipient incision or erosion. Resurveys will be completed prior to July 1 when and where the need is identified in the May 20 report discussed above.
- *Supplemental assessments* – Adaptive management of channels means changing with the flow of time. Nothing in the program above precludes problem- or condition-related

investigations. Additional assessments may be conducted as deemed needed by the applicant to achieve the bed and bank conditions sought.

6.4 WATER QUALITY MANAGEMENT PLAN EVALUATION AND CORRECTIVE MEASURES

Annual review of the inspection and monitoring data will be conducted to: (1) evaluate if the structural BMPs are maintained and functioning properly, (2) to identify water quality concerns or issues, and (3) to identify hydrologic issues of concern and to evaluate whether the BMPs are functioning as intended in terms of hydromodification controls.

Table 6-1 lists general criteria that should be used in the annual review and evaluation. Additional criteria will likely be needed to address specific and unique circumstances as they arise.

BMP modifications and corrective measures will be undertaken to improve performance and remedy any problems that are identified. Selected actions and remedies will be unique to each situation, and in general should be based on a sound understanding of the possible causes and evaluation of alternatives. Table 6-1 identifies potential actions and corrective measures that may be considered.

Table 6-1: Criteria for Review and Evaluation of Monitoring and Inspection Data and Potential Actions and Corrective Measures

Evaluation Topics and Triggers	Potential Actions & Corrective Measures
<i>BMP Status and Sizing</i>	
<u>BMP Maintenance.</u> Are structural BMPs properly maintained?	<ul style="list-style-type: none"> • Correct maintenance practices and increase management oversight.
<u>BMP Sizing.</u> Are structural BMPs sufficient to address pollutants and hydrologic conditions of concern? Are there any unforeseen or unique changes in the watershed conditions that could potentially increase pollutant loads or runoff?	<ul style="list-style-type: none"> • Review and implement BMPs to address anticipated pollutant loads or runoff. • Continue and possibly increase watershed and BMP monitoring. • Implement additional source control and/or structural BMPs.
<i>Water Quality Treatment</i>	
<u>FD/WQ Basins.</u> Are the FD/WQ basins providing good water quality treatment performance? This would be evaluated with monitoring data for TSS and other constituents and comparisons with expected effluent quality as determined from information in the National BMP database.	<ul style="list-style-type: none"> • Review O&M history of the facility to determine if poor performance is related to inadequate maintenance. • Review monitoring information on sediment accumulation and removals, and influent TSS levels (if available) to evaluate if influent sediment levels are excessive. Review hydrologic monitoring to determine

Evaluation Topics and Triggers	Potential Actions & Corrective Measures
<p>Are low flow wetlands in FD/WQ basins healthy in appearance and providing a design level of water quality treatment for dry weather flows? This would be determined through field tests of basic water quality parameters, and possibly through laboratory analysis of grab samples.</p>	<p>if there are unique or temporary watershed conditions that could lead to excessive sediment loads (e.g. construction activities, fires).</p> <ul style="list-style-type: none"> • Potential corrective measures include: <ul style="list-style-type: none"> – Review and implement erosion control BMPs to reduce sediment loads – Continue and possibly increase BMP monitoring – Evaluate the facility design and modify if necessary • Evaluate possible causes of poor performance in the low flow water quality wetlands: <ul style="list-style-type: none"> – Review O&M history of the facility to verify proper maintenance of the facility – Verify adequacy of flows to maintain emergent wetland vegetation – Verify that water levels are not too high – Evaluate facilitate design in terms of flow paths and potential bypassing • Potential corrective measures for low flow wetland problems include: <ul style="list-style-type: none"> – Correct maintenance deficiencies – Adjust water levels or influent flows – Modify the facility design
<p><u>Infiltration Basins.</u> Are the infiltration basins functioning properly? i.e., are observed percolation rates equivalent to or in excess of the design rate?</p>	<ul style="list-style-type: none"> • Evaluate possible causes of poor performance: <ul style="list-style-type: none"> – Determine if there is sufficient groundwater capacity – Verify that the flow duration controls (orifices) are designed and functioning properly – Verify that there is adequate pre-treatment of sediments in the water quality basis and that there is no clogging or crusting in the infiltration basin – Review O&M history of the facility to determine if poor performance is related to inadequate maintenance • Potential corrective measures include: <ul style="list-style-type: none"> – Modify flow duration controls (orifices) in the FD/WQ basin – Correct maintenance deficiencies – Evaluate and modify the design of the infiltration basin – If groundwater capacity is insufficient, evaluate and implement alternative measures for recycling, infiltration, or diversion of excess flows.
<p><u>Swales.</u> Are swales functioning as designed? i.e., are wet weather flows properly directed through the swales, with no clogging or bypassing, and with adequate retention time?</p>	<ul style="list-style-type: none"> • Review O&M history of the facility to determine if poor performance is related to inadequate maintenance. • Evaluate sources of runoff and debris. If excessive,

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Evaluation Topics and Triggers	Potential Actions & Corrective Measures
	<p>evaluate and implement, if necessary, BMPs to reduce sources of runoff and debris.</p> <ul style="list-style-type: none"> • Evaluate the facility design and sizing. Modify as necessary and practical.
<i>Hydrologic Conditions</i>	
<p><u>Elevated Groundwater.</u> Are observed groundwater levels chronically elevated in comparison with pre-development levels? Are maximum groundwater levels maintained 10 ft below infiltration basins?</p>	<ul style="list-style-type: none"> • Adjust flow duration controls (orifices) to reduce diversions to the infiltration basins. • Look for additional opportunities to increase recycling, and/or ET of runoff. • Look for alternative or additional areas suitable for infiltration. • Divert excess flows to less-sensitive sub-basins or channels (e.g. San Juan Creek)
<p><u>Elevated Base Flows.</u> Are base flow discharges or seasonal duration chronically elevated in comparison with pre-development levels? Are changes in base flows having an undesirable effect on stream stabilization or riparian vegetation?</p>	<ul style="list-style-type: none"> • Review adequacy and maintenance of existing dry-weather source control measures. Correct deficiencies as necessary, and look for ways to improve performance of existing source controls. • Look for additional opportunities to reduce dry-weather flows, such as methods to increase ET and recycling. • Divert excess flows to less-sensitive sub-basins or channels (e.g. San Juan Creek)
<p><u>Elevated Peak Flows.</u> Are estimated peak flows significantly elevated in comparison with pre-development levels? Are wet-weather flows resulting in excessive channel down cutting?</p>	<ul style="list-style-type: none"> • Review adequacy and maintenance of existing wet-weather source control measures. Correct deficiencies as necessary, and look for ways to improve performance of existing source controls. • Look for additional opportunities for wet-weather source control BMPs. • Look for additional opportunities to store wet-weather runoff for non-potable water supplies. • Look for alternative or additional areas suitable for infiltration. • Divert excess flows to less-sensitive sub-basins or channels (e.g. Lower Cristianitos Creek)

Evaluation Topics and Triggers	Potential Actions & Corrective Measures
<i>Streamcourse/Riparian Systems</i>	
<p><u>Changes in Stream System.</u> Have bed conditions been altered significantly? Are bed and bank vegetation suitable to meet conveyance and habitat objectives? Have stream cross-sections altered significantly?</p>	<ul style="list-style-type: none"> • Perform stream maintenance or repair measures needed to maintain suitable sediment transport and bed conditions. • Also see potential actions and corrective measures under Elevated Peak Flows above, if wet-weather flows are resulting in excessive channel down cutting.

6.5 DOCUMENTATION AND REPORTING

An annual summary of all O&M and monitoring activities will be prepared. The summary report shall include:

- BMP construction and maintenance activities, including maintenance logs;
- All monitoring information, including watershed, hydrologic, and BMP performance monitoring data; and
- Findings of the annual evaluation and response, if any.

7 CUMULATIVE IMPACT ANALYSIS

This chapter addresses the cumulative effects of the proposed project in the San Juan Creek watershed and the San Mateo Creek watershed. As discussed in Section 3.2, the sub-basin impact analyses were conducted through a combination of qualitative and quantitative analyses, based on hydrologic and water quality modeling for portions of former development alternatives B-4 and B-9, described in Appendices D and E respectively. Model results and insights were extrapolated to the B-10M Alternative where proposed land-use was similar or less than the modeled alternative.

The analysis for cumulative impacts was similarly conducted by aggregating the sub-basin modeling results for the B-9 Alternative and for the B-4 Alternative as discussed in Section 3.2. For some planning areas the proposed development is much less than the modeled alternative. Also, modeling was not conducted for all planning areas in each alternative. For these cases, runoff and load estimates were made based on area-scaling of the modeled results from other representative planning areas.

7.1 SAN JUAN CREEK WATERSHED

The cumulative impacts of the proposed project in the San Juan Creek watershed were assessed by comparing the estimated increases in mean annual flows and pollutant loads generated by the project with the mean annual flows and loads calculated from monitoring data collected at the downstream gauging station at La Novia. The available monitoring data at this station is the most comprehensive of any downstream gauging station and therefore provides the best opportunity for assessing cumulative project effects on existing conditions.

It is important to note however that the gauging information only addresses the surface water component of the aquifer water balance and what flows past the gauges is a combination of (a) flow on the surface, (b) flow below the surface, and (c) what has been withdrawn from the alluvial aquifer upstream of the gauges. Although data on items (b) and (c) are limited, the importance of these elements of the overall water balance is discussed as it provides the appropriate context for the cumulative impact analysis.

7.1.1 Stormwater Runoff Volume

The La Novia gauging station is located about one mile downstream of RMV and just upstream of the I-5 freeway in the City of the San Juan Capistrano (Figure 1-6). The USGS maintains a stream flow gauging station at this location (Station No. 11046530) from which average daily discharge measurements for a period of 17 years (WY 1987-2002) were obtained. These data show that stream flows are ephemeral at this location, with frequent zero readings in late summer and early fall.

The daily discharge data were analyzed to estimate the mean annual stormwater runoff volumes for the 17 year record. A review of the data indicated that one cfs was an appropriate cutoff to

distinguish between dry weather base flows and stormwater flows. The average annual stormwater runoff volume for WY 1987-2002 is approximately 16,000 acre-ft/yr. Most of the available stream gauging data were collected during the wet period trend from WY 1991-2001, including the very wet years in 1995 and the El Nino water year 1998. Thus the data set is more representative of runoff during above average rainfall conditions.

Figure 7-1 illustrates the changes in the estimated annual stormwater runoff volumes from each sub-basin in the San Juan Creek watershed resulting from the proposed project. The total cumulative change in stormwater runoff volume along San Juan Creek is based on summing the sub-basin contributions. Note that the runoff contributions from the project do not include runoff from the existing developed areas in Coto de Caza and Wagon Wheel as this is an existing offsite condition. The effects of Coto de Caza, which was initially developed in the 1960's, on runoff are incorporated in the measured gauge flows at La Novia. The total cumulative runoff volume below RMV is compared with the estimated annual stormwater runoff at the La Novia Station in Table 7-1. This comparison shows that the increase in runoff volumes from the proposed alternative with PDFs is about two percent of the average annual storm runoff at La Novia.

Table 7-1: Comparison of Estimated Average Annual Stormwater Volumes at the La Novia Gauging Station and the Estimated With-Project Cumulative Increase in Flows Below RMV

Alternative	Period of Record of Measured Data at La Novia Gauge	Estimated Average Annual Stormwater Volume at La Novia based on Observations ¹ (acre-ft/yr)	Change in Annual Volume below RMV with Project ² (acre-ft/yr)	Change in Annual Stormwater Volume below RMV as % of Volume at La Novia
B-10M	WY 1987-2002	15982	312	2.0%

¹Estimated based on 17 years of measured daily flow data (WY 1987-2002).

²Estimated based on 53 year precipitation record and SWMM modeling (WY 1949-2001).

7.1.2 Stormwater Runoff Pollutant Loads and Concentrations

The OCPFRD has collected wet-weather water quality monitoring data at La Novia since 1991 (see Section 1.7.4). Average concentrations of stormwater monitoring data at the La Novia Station shown in Table 7-2 were used to estimate average annual stormwater loads at the La Novia Station.

Table 7-2: Average Stormwater Pollutant Concentrations from OCPFRD Monitoring at the La Novia Station used to Estimate Average Annual Pollutant Loads.

	TSS (mg/L)	Nitrate-N (mg/L)	Phosphate-P (mg/L)	Dissolved Copper (ug/L)	Dissolved Lead (ug/L)	Dissolved Zinc (ug/L)
Sample Years	1991-1999	1991-1999	1991-1999	2001-2002	2001-2002	2001-2002
No. of Samples	43	15	15	16	16	16
No. of Non-Detects	1	0	0	1*	16*	9*
Average Concentration	326	1.2	0.6	6.2	2.0	11.4

* The method detection limit (MDL) value was used for reported values below the MDL.

The estimated annual stormwater loads in the San Juan Watershed resulting from the proposed project are compared with the estimated average annual loads at the La Novia Station in Table 7-3 and Figure 7-2. Table 7-3 shows that the estimated average annual TSS and nitrate-nitrogen loads decrease by about two to three percent for the alternative. Total phosphorus loads are estimated to increase by less than two percent for the alternative.

Table 7-3: Average Annual Stormwater Loads and Concentrations at the La Novia Gauging Station and Cumulative Increase in Loads and Concentrations from Project Based on Modeling

Parameter	Estimated Loads			Estimated Concentration			
	Existing Average Annual Load at La Novia	Estimated Cumulative Change in Loads at La Novia	Change in Loads below RMV as % of Loads at La Novia	Existing Average Storm Concn. at La Novia	Average Storm Concn. at La Novia with Project	Estimated % Change in Storm Concn. with Project	CTR Criteria at hardness of 120 mg/L
TSS	7084 (tons)	-151 (tons)	-2.1%	326 (mg/L)	313 (mg/L)	-4.0%	
Nitrate-N	52151 (lbs)	-1444 (lbs)	-2.8%	1.2 (mg/L)	1.14 (mg/L)	-4.6%	
Phosphate-P	26076 (lbs)	412 (lbs)	1.6%	0.6 (mg/L)	0.60 (mg/L)	-0.3%	
Diss. Copper	270 (lbs)	17 (lbs)	6.3%	6.2 (ug/L)	6.5 (ug/L)	4.3%	15.9 (ug/L)
Diss. Lead	87 (lbs)	(lbs)	7.9%	2 (ug/L)	2.1 (ug/L)	5.9%	78.7 (ug/L)
Diss. Zinc	497 (lbs)	31 (lbs)	6.2%	11.4 (ug/L)	11.9 (ug/L)	4.2%	137 (ug/L)

Dissolved metal loads are estimated to increase by about four to six percent for Alternative B-10M. Average trace metal concentrations at La Novia are projected to increase only slightly and are well below the CTR criteria calculated at a hardness value of 400 mg/L (Table 7-4). Actual monitoring data at La Novia show hardness values consistently greater than 400 mg/L.

Table 7-4: Comparison of Estimated Average Trace Metal Concentrations Below RMV and at La Novia with the CTR Criteria.

Parameter	Units	Average Concentration At La Novia Without Project ¹	Average Concentration At La Novia With Project ²	CTR Criteria at hardness of 400 mg/L
Dissolved Copper	(ug/L)	6.2	8.9	50
Dissolved Lead	(ug/L)	2.0	3.1	280
Dissolved Zinc	(ug/L)	11.4	10.2	380

¹Estimated from available monitoring data (see Table 1-2)

²Estimated by added the incremental change in concentration below RMV to average concentrations from observed monitoring at La Novia

7.2 SAN MATEO CREEK WATERSHED

The cumulative impacts of the proposed project in the San Mateo Creek watershed were assessed by comparing the estimated flows and pollutant concentrations generated by the project with those calculated from available monitoring data in Lower Cristianitos Creek and San Mateo Creek.

7.2.1 Stormwater Runoff Volumes

Average daily discharge data downstream of RMV are available from three USGS gauging stations. Table 7-5 summarizes the estimated average annual runoff at these stations based on the daily flow information. As in the San Juan Creek watershed, only flows above one cfs were assumed to be stormwater related. Two of the stations were located on Cristianitos Creek not far downstream of RMV. The third station is located on the main stem of San Mateo Creek near I-5 and the coast. The periods of record for the data at each gauge vary and the records reflect either dry or wet periods as indicated in the table. Most of the available stream gauging data at the Cristianitos Creek below Talega Gauge and San Mateo Creek gauge was collected during periods of below average rainfall (dry periods) as defined in Figure 1-4, resulting in relatively low runoff volumes. The lower station on Cristianitos Creek was in operation during extremely wet years in 1995 and 1998 and consequently this gauge shows higher runoff than the downstream San Mateo Creek gauge. For the purpose of developing a benchmark condition representative of a mix of dry and wet years, annual estimates of runoff from the two gauges in Lower Cristianitos Creek were pooled to provide an approximate estimate of average runoff of 2,000 acre-ft/yr.

Review of the gauging data indicted that during certain conditions the flow at the San Mateo Creek gauge was actually less than the corresponding flow at the upstream Cristianitos gauge. This occurs because the alluvial aquifer system is pumped to irrigate crops on leased lands along San Mateo and Cristianitos Creek and for water supply for Camp Pendleton. The volumes of

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water utilized by agriculture and Camp Pendleton are uncertain, however, based on the area under cultivation, agricultural pumpage is probably in the low thousands of acre feet per year.

Table 7-5: Average Annual Stormwater Runoff Volumes at USGS Gauging Stations in the San Mateo Watershed.

USGS Gauge Number	Gauge Location	Drainage Area (square miles)	Period of Record	Dry / Wet Period Data	Average Annual Stormwater Flows (AF/yr)
11046350	Cristianitos Crk Below Talega	29	WY 1951-67	Dry	1100
11046360	Cristianitos Crk Above San Mateo	31.6	WY1994-2002	Wet	3580
11046370	San Mateo Crk at I-5	132	WY 1947-67, WY1984-85	Dry	2830

The estimated increase in the mean annual stormwater runoff volumes in the San Mateo Creek watershed resulting from the proposed project are shown in the form of “stick diagrams” for the B-10M Alternative in Figure 7-3. The values are in acre-ft and reflect the estimated increase in runoff from each sub-basin. The increases in runoff volume from each sub-basin are accumulated along the main stem of Cristianitos Creek. These values then represent the cumulative increase in mean annual runoff volume in acre-ft.

Table 7-6 compares the existing runoff volume based on the USGS data with the estimated cumulative increase in runoff volumes from the proposed project. The USGS data used in the table is for the Cristianitos Creek data only. The B-10M Alternative is estimated to increase runoff volumes in lower Cristianitos Creek by about 480 acre-ft/yr or 24 percent. The primary contributing sub-basin to this increase is the Talega Sub-basin (Figure 7-3). However, as discussed above, this volume is small compared to the annual volumes of water extracted from the aquifer for water supply purposes. Therefore the increased surface water flows are considered a benefit to providing additional surface flows in a system that is heavily pumped.

Table 7-6: Estimated Project Effects on Average Annual Stormwater Runoff Volumes

Alternative	Period of Record of Measured Data at Lower Cristianitos Creek Gauges	Estimated Average Annual Stormwater Volume based on Observations ¹ (acre-ft/yr)	Change in Annual Volume below RMV with Project ² (acre-ft/yr)	Change in Annual Stormwater Volume below RMV as % of Volume at Lower Cristianitos
B-10M	WY 1951-1967 WY 1994-2002	2000	480	24%

¹Based on pooled USGS monitoring data at 2 Lower Cristianitos Creek gauges (see Table 7-5).

²Based on modeling results for 53 year period of record (WY 1949-2001).

7.2.2 Stormwater Runoff Pollutant Loads and Concentrations

There is very little stormwater quality monitoring data available in the San Mateo Creek watershed. RMV has recently initiated stormwater monitoring, and the limited data are described in Section 1.7.4. One of the RMV stations (SW-8) is located on Cristianitos Creek, below Gabino Creek and above Talega Creek. Water quality monitoring data from this station were used to assess impacts of the proposed project.

The estimated increases in average annual stormwater pollutant loads in the San Mateo Creek watershed resulting from the proposed project are shown in Figure 8-4. The cumulative increases along the main stem of Lower Gabino Creek and Lower Cristianitos Creek are also shown. The B-10M Alternative exhibits relatively small estimated increases in cumulative pollutant loads, and in some cases reductions in cumulative pollutant loads. This occurs because of the use of infiltration BMPs and runoff recycling where feasible, both of which effectively reduce pollutant loads. Also, there is a moderate amount of existing development in Blind Canyon and Talega Canyon (Northrop Grumman), which was modeled as a light industrial land-use. Pollutant concentrations from light industrial development are greater than from residential development (based on LA County monitoring information), and therefore the modeled land use type changes in these areas result in reduced loads under post-development.

Table 7-7 compares the estimated existing loads at SW-8, based on RMV monitoring information, with the estimated cumulative increase in loads from the proposed project based on the modeling. Under the B-10M Alternative, TSS are estimated to decrease slightly and nutrient loads in Lower Cristianitos Creek are estimated to increase slightly. The TSS and nutrient concentrations are estimated to decrease due to dilution with increased runoff volumes. Metal loads are estimated to increase by about 20 to 80 percent. However, concentrations in Lower Cristianitos Creek exhibit small increases, and in all cases are well below the CTR criteria calculated at a conservative hardness value of 120 mg/L.

Table 7-7: Estimated Changes in Pollutant Loads and Concentrations at SW-8.

Parameter	Estimated Loads			Estimated Concentrations			
	Existing Annual Load at SW-8	Estimated Cumulative Change in Loads at SW-8	Change in Loads below RMV as % of Loads at SW-8	Existing Average Concentr. at SW-8	Average Concentr. at SW-8 with Project	Estimated % Change in Concentr. with Project	CTR Criteria at hardness of 120 mg/L
ALTERNATIVE B-10M							
TSS	12963 (tons)	-2 (tons)	0%	4767 (mg/L)	3852 (mg/L)	-19.2%	
Nitrate-N	3263 (lbs)	385 (lbs)	12%	0.6 (mg/L)	0.54 (mg/L)	-10%	
Phosphate-P	3481 (lbs)	339 (lbs)	10%	0.64 (mg/L)	0.57 (mg/L)	-12%	
Dissolved Copper	35 (lbs)	11 (lbs)	31%	6.5	6.8 (ug/L)	6%	15.9 (ug/L)
Dissolved Lead	3.2 (lbs)	2.6 (lbs)	81%	0.58	0.9 (ug/L)	46.6%	78.7 (ug/L)

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Dissolved Zinc	63 (lbs)	11 (lbs)	16%	11.5	11 (ug/L)	-5.3%	137 (ug/L)
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Collectively, analyses described above indicate that regional treatment BMPs would limit cumulative increases in runoff volumes to moderate levels (about 20 to 30 percent) and would effectively control pollutant loads and concentrations.

7.3 FINDINGS OF SIGNIFICANCE

The following are the findings of significance with regard to the cumulative impacts of Alternative B-10M in the San Juan Creek watershed and the San Mateo Creek watershed.

7.3.1 San Juan Creek Watershed

In the San Juan Creek watershed, the projected increase in mean annual runoff at the La Novia bridge is about two percent for the B-10M Alternative. This increase does not take into account the runoff from existing upland development in Coto de Caza and Wagon Wheel, and would be less if these areas were included in the analysis. The additional stormwater flows, although modest, along with the dry weather base flow contributions would benefit the system by replenishing the aquifer, especially during dry years, and would help support arroyo toads breeding downstream of the “key location”. On this basis, the cumulative impact of the proposed development under the B-10M Alternative on flows in San Juan Creek is considered less than significant.

Projected changes in pollutant loads in the San Juan Creek watershed vary depending on pollutant. For TSS, pollutant loads are projected to decrease by about two percent for the B-10M Alternative. For nutrients, nitrate-nitrogen loads are projected to decrease by about three percent, whereas phosphate loads are projected to increase by about two percent. Nutrient concentrations are projected to decrease and therefore algal growth should not be stimulated with development. Trace metal loads are projected to increase by about four to six percent depending on constituent and the alternative. Trace metal concentrations however are well below CTR criteria. On this basis, the cumulative effect of the proposed development under the B-10M Alternative is considered less than significant.

7.3.2 San Mateo Creek Watershed

In the San Mateo Creek watershed, the projected increase in mean annual runoff at the Lower Cristianitos gauges is about 480 acre-ft/yr or 24 percent for the B-10M. The increase is caused by the projected excess flows from the Talega Sub-basin associated with Planning Area 8. This increase does not take into account the fact that the Lower Cristianitos/San Mateo system is a “losing system” in which surface water runoff infiltrates into the stream bed and becomes part of the sub-surface flow system. The primary cause of this effect is the extensive groundwater pumping conducted at Camp Pendleton. This de-watering of the San Mateo system also has

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adversely impacted the arroyo toad habitat in the affected reaches. Additional runoff flows from the proposed development would augment in-stream flows and potentially improve arroyo toad habitat in this area. On this basis, the cumulative impact of the proposed development under the B-10M Alternative on flows in San Mateo Creek is considered less than significant.

Projected changes in pollutant loads in Lower Cristianitos Creek at sampling station SW-8 vary depending on pollutant and alternative. For TSS, pollutant loads are projected to remain approximately unchanged under the B-10M Alternative. For nutrients, nitrate-nitrogen and phosphate loads are projected to increase by about 10 percent under the B-10M Alternative. Nutrient concentrations are projected to essentially remain unchanged, and therefore the potential for stimulating algal growth is limited. Trace metal loads are projected to increase by about 30 percent to 80 percent for the B-10M Alternative. Trace metal concentrations however are well below CTR criteria. On this basis, the cumulative effect of the proposed development under the B-10M Alternative is considered less than significant.

8 GLOSSARY

Aggradation: The deposition and accumulation of sediment that was eroded and transported from the upstream watershed, resulting in an elevated streambed.

Alluvium: Silt, sand and gravel deposited by flowing water.

Base Flow: The normal day-to-day flow in the channel of a watershed from groundwater and spring contributions [Viessman et al., 1977].

Clay: Hydrous aluminum silicate minerals with platy structure, typically less than 1/256-mm in diameter.

Colluvium: Material deposited by gravity at the foot of a slope.

Best Management Practices (BMPs)*: BMPs are defined in 40 CFS 122.2 as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. In the case of municipal storm water permits, BMPs are typically used in place of numeric effluent limits.

Bioaccumulate*: The progressive accumulation of contaminants in the tissues of organisms through any route including respiration, ingestion, or direct contact with contaminated water, sediment, pore water or dredged material to a higher concentration than in the surrounding environment. Bioaccumulation occurs with exposure and is independent of the trophic level.

Clean Water Act Section 402(p)*: is the federal statute requiring municipal and industrial dischargers to obtain NPDES permits for their discharges of storm water.

Clean Water Act Section 303(d) Water Body*: An impaired water in which water quality does not meet applicable water quality standards and/or is not expected to meet water quality standards, even after the application of technology based pollution controls required by the CWA. The discharge of urban runoff to these water bodies by the co-permittees is significant because these discharges can cause or contribute to violations of applicable water quality standards.

Dry season: April 1 to September 30.

Dry weather flow: In general, dry weather flows are flows in stream channels and storm drain systems that do not originate from precipitation events, such as flows generated from urban activities (car washing, landscape irrigation, draining of swimming pools) and from natural base flow sources, primarily groundwater discharge.

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Erosion*: When land is diminished or worn away due to wind, water, or glacial ice. Often the eroded debris (silt or sediment) becomes a pollutant via storm water runoff. Erosion occurs naturally but can be intensified by land clearing activities such as farming, development, road building, and timber harvesting.

Geomorphology: The study of forms and characteristics of the earth's surface and the physical and chemical processes that affect landforms. Weathering, erosion and transport are the fundamental geomorphic processes that break down mountains and supply sediment to stream channels.

Hardpan: A layer of hard subsoil or clay.

Hydrology: The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hydrologic processes: The extent to which precipitation is intercepted by vegetation, infiltrates into the ground, or results in overland flow, influencing the rate and magnitude of stream flows.

Hydromodification: The change in the natural watershed hydrologic processes and runoff characteristics (i.e., interception, infiltration, overland flow, interflow and groundwater flow) caused by urbanization or other land use changes that result in increased stream flows and sediment transport.

Impervious surfaces: A hard surface area that either prevents or retards the entry of water into the soil mantle. A hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include: roofs, roadways, walkways, driveways, parking lots, patios, concrete or asphalt paving, gravel roads, and packed earthen material.

Incision: The hydrologic processes of stream flow that exceeds the available sediment load and erodes streambeds, resulting in a deepening channel.

Knickpoint: The point of a stream bed where there is an abrupt change in slope, governed by regimen and by the structure and composition of the bed and bank materials of the river.

Load: the amount of pollutant, usually expressed in mass, such as pounds or tons, that is discharged to a receiving water body during a specified period of time. Examples of typical load units are lbs/day (pounds per day) and tons/year (tons per year).

Loam: Soil composed of a mixture of sand, clay, silt, and organic matter.

Municipal Separate Storm Sewer System (MS4)*: A Municipal Separate Storm Sewer System is a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, natural drainage features or channels, modified natural channels man-made channels, or storm drains): (i) Owned or operated by the State, city town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other waters, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or designated and approved management agency under Section 208 of the CWA that discharges to waters of the United States; (ii) Designated or used for collecting or conveying storm water; (iii) Which is not a combined sewer; (iv) Which is not part of the Publicly Owned Treatment Works as defined at 40 CFR 122.2.

Historic and current developments make use of natural drainage patterns and features as conveyances for urban runoff. Urban streams used in this manner are part of the municipalities MS4 regardless of whether they are natural, man-made, or partially modified features. In these cases, the urban stream is both an MS4 and a receiving water.

National Pollution Discharge Elimination System (NPDES)*: These permits pertain to the discharge of waste to surface waters only. All State and Federal NPDES permits are also WDRs.

Non Point Source (NPS)*: Non point sources refers to diffuse, widespread sources of pollution. These sources may be large or small, but are generally numerous throughout a watershed. Non Point sources include but are not limited to urban, agricultural, or industrial areas, roads, highways, construction sites, communities served by septic systems, recreational boating activities, timber harvesting mining, livestock grazing, as well as physical changes to stream channels, and habitat degradation. NPS pollution can occur year round and time rainfall snowmelt, irrigation, or any other source of water runs over land or through the ground, picks up pollutants from these numerous, diffuse sources and deposits them into rivers, lakes, and coastal waters or introduces them into ground water.

Non-Storm Water*: Non-storm water consists of all discharges to and from a stormwater conveyance system that do not originate from precipitation events (i.e. all discharges from a conveyance system other than storm water).

Nuisance Flows: Persistent low flows in the dry season, originating from urban and agricultural activities.

Pollutant*: A pollutant is broadly defined as any agent that may cause or contribute to the degradation of water quality such that a condition of pollution or contamination is created or aggravated.

Sediment*: Soil, sand, and minerals washed from land into water. Sediment resulting from anthropogenic sources (i.e. human induced land disturbance activities) is considered a

pollutant. The NPDES permit regulates only the discharges of sediment from anthropogenic sources and does not regulate naturally occurring sources of sediment. Sediment can destroy fish-nesting areas, clog animal habitats, and cloud waters so that sunlight does not reach aquatic plants.

Silt: particles with diameters between 0.75 and 0.002-mm.

Siltation: The settling of soil and sedimentary particles in lakes, rivers and streams.

Small storm events: Storm flow runoff from about 1-inch of precipitation or less.

Stormwater* : Urban runoff and snowmelt runoff consisting only of discharges that originate from precipitation events. Stormwater is that portion of precipitation that flows across a surface to the storm drain system or receiving waters. Examples of this phenomenon include: the water that flows off a building's roof when it rains (runoff from an impervious surface); and the water that flows from a vegetated surface when rainfall is in excess of the rate at which it can infiltrate into the underlying soil (runoff from a pervious surface). When all factors are equal, runoff increases as the perviousness of a surface decreases. During precipitation events in urban areas, rain water picks up and transports pollutants through stormwater conveyance systems, and ultimately to water of the United States.

Sub-basin: The catchment area of a stream tributary or series of stream tributaries.

Total Maximum Daily Load (TMDL)*: The TMDL is the maximum amount of a pollutant that can be discharged into a water body from all sources (point and non-point) and still maintain water quality standards. Under Clean Water Act section 303(d), TMDLs must be developed for all water bodies that do not meet water quality standards after application of technology-based controls.

Tributary: A stream or river flowing into a larger body of water.

Urbanization: The transformation of land into residential, commercial, and industrial properties and associated infrastructure such as drainages, roads, and sewers.

Urban Runoff*: Urban runoff is defined as all flows in a storm water conveyance system and consists of the following components: (1) storm water (wet weather flows) and (2) non-storm water illicit discharges (dry weather flows).

Water Quality Objective* : Numerical or narrative limits on constituents or characteristics of water designated to protect designated beneficial uses of the water. [California Water Code Section 13050(h)]. California's water quality objectives are established by the State and Regional Water Boards in the Water Quality Control Plans. Water quality objectives are also called water quality criteria in the Clean Water Act.

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Water Quality Standards*: Are defined as the beneficial uses (e.g., swimming, fishing, municipal drinking water supply, etc.) of water and the water quality objectives necessary to protect those uses.

Watershed* : The geographical area which drains to a specified point on a water course, usually a confluence of streams or rivers (also known as drainage area, catchment, or river basin).

Water Year: October 1 to September 30.

Wet season: October 1 to March 31.

* Definitions that are denoted with an asterisk were obtained from the San Diego Regional Water Quality Control Board, Orange County NPDES Permit (SDRWQCB, February 2002).

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