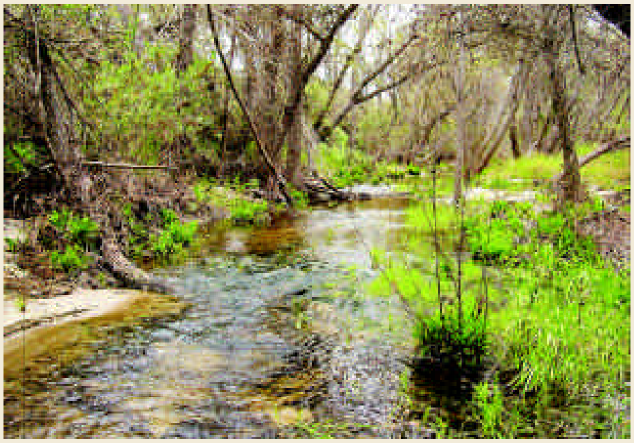
Hydrologic Comparison of Baseline & Alternative Land Use Conditions for the San Juan and San Mateo Watersheds

Prepared for:

Rancho Mission Viejo

March 2004



Prepared by:

PWA

Philip Williams & Associates, Ltd.

Consultants in Hydrology

Alternatives Analysis:

Hydrologic Comparison of Baseline and Alternative Land Use Conditions for San Juan and San Mateo Watersheds

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March 30, 2004

PWA Ref. # 1393.01, 1393.02

March 30, 2004

Laura Coley Eisenberg
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RE: **San Juan & San Mateo Watershed Hydrology Report**
PWA Ref. # 1393.01, 1393.02

Dear Laura:

Enclosed is our revised Alternatives report, which incorporates your March 29 comments and discussion.

This revised report is submitted to you in support of the San Juan/San Mateo Special Area Management Plan, the Southern Sub Region National Communities Conservation Plan/Habitat Conservation Plan, the Comprehensive Point and Non-Point Source Pollution Control Program and the EIR process.

PWA is available to discuss the results of the study and their implications, as needed.

Please contact either myself or Jeff Haltiner with any questions or comments.

Sincerely

Amy Stewart, Ph.D.
Associate

Cc: Tom Staley, RMV

Services provided pursuant to this Agreement are intended to meet the needs of the Rancho Mission Viejo. The services, opinions, recommendations, plans, or specifications provided by PWA to the Rancho Mission Viejo do not apply to other sites, and should be used solely for the Rancho Mission Viejo.

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1. INTRODUCTION AND WATERSHED ENVIRONMENTAL SETTING

1.1 ROLE OF THE HYDROLOGY ALTERNATIVES ANALYSIS IN THE COORDINATED PLANNING PROCESS

This Alternatives Analysis: Hydrologic Comparison of Baseline and Alternatives Land Use Conditions for San Juan and San Mateo Watersheds ("Hydrology Alternatives Analysis") was developed by Rancho Mission Viejo (RMV) to support planning efforts for RMV lands in the San Juan Creek and western San Mateo Creek watersheds involved in the coordinated planning process comprising:

- Southern NCCP/HCP. The Southern Natural Community Conservation Plan/Habitat Conservation Plan (Southern NCCP/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/MSAA. A Special Area Management Plan (SAMP) and Master Streambed Alteration Agreement (MSAA) is being prepared jointly by the U.S. Army Corps of Engineers (USACE) and CDFG and covers generally those portions of the San Juan Creek and San Mateo Creek watersheds located within the Southern NCCP/HCP subregion. As in the case of the NCCP/HCP, the SAMP/ MSAA is a voluntary process. The purpose of the SAMP/MSAA is to provide for the protection and long-term management of sensitive aquatic resources (biological and hydrological) on a landscape level. The SAMP/MSAA 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.

- County of Orange/Rancho Mission Viejo GPA/ZC. Rancho Mission Viejo has submitted an application to the County of Orange which includes a request for a General Plan Amendment and Zone Change (GPA/ZC). The GPA/ZC application would provide 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 proposed GPA/ZC constitute a central focus of the Southern NCCP/HCP and SAMP/MSAA planning programs because these lands comprise 90 percent of the remaining privately owned lands in the Southern NCCP/HCP and SAMP/MSAA planning areas (Figure 1-1) and over 98 percent of the privately owned lands actively involved in the NCCP/HCP and SAMP/MSAA that are not already developed or approved for development.

The public agencies (CDFG, USFWS, USACE and County of Orange) and participating landowners involved in the coordinated planning process believe that the opportunity to coordinate the proposed NCCP/HCP, SAMP/MSAA and GPA/ZC will further the ability of all participants to comprehensively address the need for both large-scale conservation planning and certainty with respect to long-term economic development in the respective planning areas. The geomorphic, hydrologic, and biological resources addressed under the SAMP/MSAA are also essential elements of the habitat systems of the NCCP planning area. In turn, the geomorphic, hydrologic, and biological resources addressed by the coordinated NCCP/HCP and SAMP/MSAA principles are central environmental planning considerations for the GPA/ZC.

Although there is every intent to complete all three planning elements of the coordinated process (the NCCP/HCP, SAMP/MSAA and GPA/ZC), there is no way to ensure this result. Accordingly the Hydrology Alternatives Analysis has employed and addressed applicable SAMP/MSAA Guidelines and Principles at both the watershed and sub-basin scale. In this way, species, habitat, hydrologic and geomorphic considerations identified through the coordinated planning process have been fully integrated into the analysis. The elements of the coordinated planning process are summarized in Table 1-1.

1.2 WATERSHED PLANNING

Watershed planning embraces a wide array of planning considerations including 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").

1.2.1 SAMP

Recognizing the need for more comprehensive planning in 1998, a resolution by the United States House of Representatives' Committee on Pubic 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/MSAA process is being coordinated with the NCCP/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.

Table 1-1: Elements of the Coordinated Planning Process for Southern Orange County

Programs	NCCP/HCP	SAMP/MSAA	GPA/Zone Change
Lead Agencies	US Fish & Wildlife Service County of Orange	US Army Corps of Engineers California Dept. of Fish and Game	County of Orange
Purpose	Protect and conserve species and their habitats	Avoid and minimize impacts to aquatic and riparian areas and protect water quality and hydrologic functions	Amend General Plan and Zoning Ordinances – identify locations, types, and intensities of land uses
Authority	Federal ESA, State ESA, and NCCP Act	Federal CWA and State 1600 Program	General Plan and zoning law
Products	• Habitat Reserve System • Adaptive Management Program • Species Coverage • Implementing Agreement • Funding Assurances • Monitoring Program • Record of Decision /Section 10 Permits • NCCP Management Agreement and Sec 2835 Permits	• Aquatic Resource Restoration/Management Program • Record of Decision • Section 404 Permits • Master Streambed Alteration Agreement	• Amendments to General Plan elements: · Land Use · Resources · Recreation · Transportation • Zone Change • Water Quality Program

Adapted from: http://pdsd.oc.ca.gov/rp_2.htm

1.2.1.1 Watershed and Sub-Basin Planning Principles

The USACE, Los Angeles District, and the CDFG previously prepared a set of general watershed tenets (planning framework) that was presented at the public workshops on December 13, 2001 and May 15, 2002 (see Chapter 1, Section 1.2.2). 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/MSAA planning effort and provide valuable guidance during preparation of the Southern NCCP/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/MSAA 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/MSAA and NCCP/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 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" (Science Advisors, May 1997).

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

- Southern SAMP/MSAA 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 (BH), PCR Services Corporation (PCR) and Philip Williams & Associates, Ltd. (PWA) for RMV.
- Reserve Design Principles (1997) prepared by the Science Advisors for the Southern NCCP/HCP.
- Southern Subregion databases.

The Watershed Planning Principles provide a key link between the SAMP/MSAA and the NCCP/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/HCP and SAMP/MSAA. For each sub-basin, the important hydrologic and geomorphic processes and aquatic/riparian resources are identified and reviewed under the heading of "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 Hydrology Alternatives Analysis assures that hydrologic related considerations have been addressed.

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 documents prepared for the "coordinated planning process," the NCCP/HCP and SAMP/MSAA have a goal of preparing a Habitat Reserve and associated long-term management program that addresses the objectives of both the NCCP/HCP and the SAMP/MSAA.

1.3 OBJECTIVES

The goal of this report is to assess, on a planning level, the hydrologic conditions within the San Juan and western San Mateo watersheds (Figure 1-1) for the existing "baseline" conditions, for the proposed GPA/ZC Project "The Ranch Plan," and also for multiple alternative development plans within Rancho Mission Viejo. The purpose of the alternatives analyses is to ensure that impacts to aquatic resources are avoided, minimized, and mitigated to the maximum extent practicable. In particular, results of the rainfall-runoff hydrographic analysis will be used to analyze potential effects of proposed development on flood events.

1.4 RELATION TO PREVIOUS BASELINE REPORT

This report complements and updates the baseline hydrology described in the PWA 2001 Technical Appendix A, *Baseline Hydrologic Conditions: San Juan & Upper San Mateo Watersheds*. Baseline, or existing, development increased in the SAMP project area between years 2000 and 2003, as illustrated in Figure 1-2. Specific land use categories on these recently developed areas were obtained from EDAW and used to parameterize inputs to the hydrologic model. Details about existing land use assumptions are discussed later in this document. Infiltration parameters, such as low loss fractions and maximum loss rates, were updated in 2003 to reflect recent land use practices.

In addition to the baseline hydrologic study, this report extends the analysis to include the proposed GPA/ZC for the Ranch Plan (aka B-4 Alternative) and six alternatives for further development within the Rancho Mission Viejo (RMV) boundaries. Each planning alternative addresses a separate development focus:

- Proposed GPA/ZC Project (B4 Alternative,"The Ranch Plan"): The Ranch Plan proposes land use reallocation within 13 designated Planning Areas of the RMV. Development is allowed in Planning Areas 1, 2, 3, 4, 5, 6, 7, 8, and 9. Five open-space planning areas are located outside of the proposed development.

- B5 Alternative: The purpose of Alternative B-5 is to locate all future development within the San Juan Creek Watershed. This avoids future development within the San Mateo Creek Watershed.

- B6 Alternative: Alternative B-6 concentrates development in the San Juan Creek Watershed and previously disturbed regions of the San Mateo Watershed. It avoids future development within the Chiquita and Verdugo sub-basins.

- B8 Alternative: Alternative B-8 allows new development in the western portion of RMV adjacent to Ortega Highway, and in the previously disturbed regions within the Trampas and Gobernadora sub-basins. It avoids future development in the Chiquita sub-basin and the San Mateo Watershed.

- B9 Alternative: Alternative B9 allows development in the lower portion of the Chiquita sub-basin, and in the Gobernadora, Verdugo, Central San Juan and Trampas sub-basins. Development also is proposed in the Blind Canyon and Talega sub-basins of the San Mateo watershed. Plan B9 allows for more development in the San Juan watershed, while significantly limiting development in the San Mateo watershed. It avoids future development in the Cristianitos, Gabino and La Paz sub-basins in the San Juan watershed.

- B10 Alternative (County Environmental Plan): The County Environmental Alternative allows for development in the San Juan Creek and San Mateo Watersheds. The alternative allows for reduced development in the Cristianitos and Upper Chiquita sub-basins. It avoids future development in the Upper Gabino and La Paz Canyons. The alternative proposes open space in the Upper Verdugo, Upper Cañada Chiquita and Upper Gobernadora sub-basins.

- B11 Alternative (County Regional Housing Plan): The County Regional Housing Alternative allows for development in the San Juan Creek and San Mateo Watersheds. The alternative avoids future development in the Upper Gabino and La Paz Canyon sub-basins. This plan proposes open space in the Upper Verdugo, Upper Cañada Chiquita and Upper Gobernadora sub-basins. Additionally, the plan allows for the potential avoidance of development in the Middle and Lower

Cañada Chiquita sub-basin and the San Mateo watershed under a Planning Reserve designation. Development is avoided in the northwestern portion of Cristianitos sub-basin.

Results from the hydrologic analyses for the alternatives are discussed and compared with existing baseline hydrology in Section 4. This comprehensive technical and planning effort allows early identification of impacts; enabling habitat mitigation and flood hazard reduction to be integrated early in the development process.

1.5 REPORT ORGANIZATION

Following this introduction, this report includes four additional technical sections. In Section 2, the methodology and approach used for the hydrology analysis are described. In Section 3, baseline hydrology within the San Juan and San Mateo watersheds is compared with hydrology from the proposed Ranch Plan land use. Details on the six alternatives are provided in Section 4. Potential impacts on sediment transport as a result of the changing hydrology are presented in Section 5. In Section 6, potential impacts are identified and preliminary mitigation strategies discussed. A list of participating PWA staff and references are offered in Sections 7 and 8 respectively.

2. METHODOLOGY

2.1 INTRODUCTION

The magnitude, frequency, and pattern of surface flow through uplands and within stream channels are likely the most deterministic factors of the integrity and distribution of wetlands and riparian habitat. Changes in the magnitude or frequency of peak flows for more frequent events (i.e., 2-year return interval), more moderate events (i.e., 10-year return interval) or extreme events (i.e., 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 baseflow (i.e., perennialization of historically intermittent or ephemeral streams) 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. As such, a careful analysis of hydrologic conditions of the San Juan and San Mateo Watersheds was conducted. This analysis is used to evaluate hydrologic impacts of land-use alternatives. This chapter includes descriptions of the techniques utilized in the stream network analysis and in the hydrology analysis. For details on the parameter values used within each simulation, refer to the relevant sub-sections of Section 3 (Baseline and Ranch Plan Models).

2.2 APPROACH

2.2.1 Rainfall-Runoff Analysis

2.2.1.1 Overview and Methods

As measured streamflow rates are available at few locations in the project area, computer models, which relate precipitation events to predicted runoff, were used to assess flow conditions. The Army Corps of Engineers HEC-1 flood hydrograph model was utilized with input parameters as specified by the Orange County Hydrology Manual (OCHM, 1986) for 2-, 10- and 100-year flood events. To facilitate the use of OCHM methodology, LAPRE-1 was used in combination with Visual HEC-1. LAPRE-1 is a Los Angeles District USACE pre-processor for HEC-1, customized for hydrologic analysis of southern California watersheds. A watershed GIS database was created to generate and evaluate various input parameters to LAPRE-1 and Visual HEC-1, including sub-basin area, basin roughness, channel lengths, area rainfall distributions, and SCS runoff curve numbers. Numbered sub-basins used in this analysis are presented in Figure 1-3. Data generated from the GIS is provided in the 2001 PWA Technical Appendix. Hydrologic parameters that were altered from the 2001 Baseline Conditions are described in following sections.

2.2.1.2 Precipitation Parameters

Precipitation parameters were calculated according to OCHM methods. For each sub-basin, PWA calculated point precipitation depth data for the modeled return intervals (2-year, 10-year, and 100-year) and the durations specified in the OCHM (5-minute, 30-minute, 1-hour, 3-hour, 6-hour, and 24-hour durations). The HEC-1 model tends to over-estimate flows from smaller events, such as the 2-year storm, due to a relatively simple approach used to analyze rainfall, infiltration, and runoff. This approach does not reflect the true complexities of these processes. To address this limitation of HEC-1 for the 2-year event discharges, PWA followed the Orange County Hydrology Manual Addendum #1 (1995) and adjusted standard 2-year point rainfall amounts by a factor of 0.7. According to the Addendum, this adjustment yields runoff results that are "expected" values (50% confidence interval). Expected values were also computed for the 10- and 100-year events in accordance with the Addendum, which states that *"Expected value (50% confidence interval) discharges should be used for …Calculating incremental increases in peak discharge for purposes of implementing development mitigation requirements…(and) Estimates of water resources related variables such as sedimentation and water quality."*

Point precipitation amounts were adjusted to account for non-mountainous and mountainous areas in the watersheds. Values were also adjusted to reflect expected values. As specified in the OCHM, different point precipitation values were used for sub-basins below elevation 2,000 feet (610 m) and sub-basins above elevation 2,000 feet ("mountainous areas"). Area averaging was used to calculate appropriate point precipitation values for sub-basins with both mountainous and non-mountainous areas. Calculated point precipitation depths are shown in Table 2-1.

Table 2-1 Point Precipitation Values

Duration	Point Precipitation (inches)					
	Non-Mountainous Areas			Mountainous Areas		
	2-year	10-year	100-year	2-year	10-year	100-year
5 minutes	0.13	0.26	0.40	0.18	0.40	0.63
30 minutes	0.28	0.59	0.87	0.32	0.68	1.04
1 hour	0.37	0.78	1.15	0.46	0.99	1.51
3 hours	0.62	1.31	1.94	0.94	2.01	3.08
6 hours	0.85	1.81	2.71	1.46	3.14	4.81
24 hours	1.44	3.03	4.49	2.67	5.71	8.76

Source: OCHM, 1986, and OCHM Addendum No. 1.

Point precipitation depth data were input to LAPRE-1, the Los Angeles Army Corps of Engineers HEC-1 pre-processor, which scaled the data according to sub-basin area to obtain precipitation depths, and then formulated a 24-hour design rainstorm for each sub-basin according to OCHM methods (OCHM, 1986, B-11).

2.2.1.3 Infiltration Parameters

Infiltration is the process by which surface water percolates into the sub-surface soil and groundwater column. Infiltration is an important hydrologic process because it governs groundwater recharge, soil moisture storage, and surface water runoff. As modeled by HEC-1, infiltration is one of several processes represented by a withdrawal of a portion of total storm precipitation that could generate surface runoff. Other processes that subtract precipitation from storm runoff (cumulatively referred to as "losses" in HEC-1) include vegetation interception, surface depression storage, and evapotranspiration. Losses are subtracted from actual precipitation to yield effective precipitation, the amount of precipitation available for runoff. According to OCHM methods, losses are computed using two parameters: the low loss fraction (Y-bar), and the maximum loss rate (Fm). Losses are computed as proportional to the low loss fraction and precipitation intensity (Y-bar x Precipitation Intensity) unless they exceed the maximum loss rate. If computed losses exceed the maximum loss rate, losses are assumed to equal Fm. Hydrologic soil type, vegetation cover, land-use classification, and percent impervious conditions are considered in determining Y-bar and Fm. Following OCHM methods, and as detailed in the 2001 Technical Appendix, maximum loss rates (Fm) and low loss fractions (Y-bar) were calculated for each sub-basin.

Soils were classified according to standard USDA descriptions that reflect estimated runoff potential based on soil properties. Soils are grouped according to infiltration rates measured when the soils are thoroughly wet. Soils are classified into four hydrologic soil groups (A, B, C, or D), such that A-type soils have the highest infiltration rates and D-type soils have the lowest infiltration potential. Maps of the hydrologic soil groups are provided in the 2001 Technical Appendix A. Updated vegetation, land-use and resulting Natural Resource Conservation Service (NRCS) runoff indices (curve numbers) are discussed for baseline conditions and for each development scenario in Sections 3 and 4. Table 2-2 provides a cross-reference for the land use / soil type / curve number computations.

2.2.1.4 Synthetic Unit Hydrograph Parameters

The unit hydrograph method is a means of calculating the time distribution of runoff during a rainfall event. In calculating a unit hydrograph, the watershed factors affected the time distribution of runoff (watershed area, shape, slope and land use) are assumed to be constant for a given watershed. LAPRE-1 provides a useful means of calculating an event-based unit hydrograph for a given watershed, based on OCHM methods. Input parameters required by LAPRE-1 include basin factor (n), length of the longest watercourse, length from the watercourse to the centroid of the watershed, average watershed slope, and S-graph type (mountain, foothill, developed valley or undeveloped valley). For details on PWA unit hydrograph computations, refer to the 2001 Technical Appendix. Generally, the methodology utilized to calculate sub-basin unit hydrographs follow OCHM standards.

2.2.1.5 Routing and Hydraulic Structure Parameters

A multiple sub-basin approach was required to model the large San Juan and San Mateo Watersheds. Routing reaches in the HEC-1 model were utilized to represent portions of certain channels. For the developed western portion of the San Juan Watershed (along Oso Creek), it was also necessary to simulate several hydraulic structures, including reservoirs and detention basins. Figures 2-1 and 2-2 illustrate the HEC-1 node networks for the modeled San Juan and San Mateo creek watersheds. Sub-basins in Figures 2-1 and 2-2 can be geographically cross-referenced with the sub-basin delineations of Figure 1-3.

In the San Juan Watershed, where surveyed cross-sectional data was available from a HEC-RAS hydraulics model (SLA, 1999), the Muskingum-Cunge routing method was used. In the areas of the San Juan Watershed where HEC-RAS model data was not available, the Muskingum routing method was used. Muskingum routing was also used for the entire San Mateo Watershed HEC-1 model. Routing parameters for the sub-basins are detailed in the 2001 PWA Technical Appendix.

Table 2-2 PWA Land Use / Vegetation Cover Classification, Curve Numbers and Basin n-values

PWA Category and Sub-categories			PWA Code	Examples from WES Description	OCHM Source Cover Type(s)	Curve Number for Soil Types				Baisn n value
						A	B	C	D	
Natural (1)	Dunes (101)	General Dunes	10101	Dune Habitats; S. Coastal Foredunes; S. Dune Scrub	Open Brush - good	41	63	75	81	0.03
	Sage Scrub (102)	General Sage Scrub	10201	Scrub Habitats; Southern Coastal Bluff Scrub; Maritime Succulent Scrub; Venturan-Diegan Transitional Sage Scrub; Southern Catus Scrub; Chenopod Scrub; Riveridian Coastal Sage Scrub; Flood Plain Sage Scrub	Open Brush - average fair and good	44	65	76	82	0.03
		Sage Scrub - Grassland Transition	10202	Sage Scrub-Grassland Ecotone; Mixed Sage Scrub - Grassland	average Open Brush - fair and Grass - fair	48	68	78	84	0.03
	Chaparral (103)	General Chaparral	10301	Chaparral Habitats; Southern Mixed Chaparral; Mixed Montane Chaparral; Nolina Chaparral; Toyon-Sumac	average Broadleaf Chaparral - fair and Narrowleaf Chaparral - fair	48	68	78	84	0.03
		Chaparral - Sage Scrub Transition	10302	Coastal Sage-Chaparral Scrub Ecotone	Chaparral and Sage	45	66	77	83	0.03
		Broadleaf Chaparral	10303	Ceanothus Chaparral; Scrub Oak Chaparral; Manzanita Chaparral	Broadleaf Chaparral - average fair and good	36	60	73	80	0.035
		Broadleaf Chaparral and Sage	10304	Scrub Oak-Sagebrush; Scrub Oak-Sage Scrub	average Open Brush - fair and Broadleaf Chaparral - fair	43	65	76	82	0.035
		Narrowleaf Chaparral	10305	Chamise Chaparral	Narrowleaf Chaparral - fair	55	72	81	86	0.03
		Narrowleaf Chaparral and Sage	10306	Chamise-Sagebrush; Chamise-Sage Scrub; Maritime Chaparral-Sagebrush; Maritime Chaparral-Sage Scrub; S. Maritime Chaparral	average Open Brush - fair and Narrowleaf Chaparral - fair	51	69	79	85	0.03
		Live Oak Chaparral	10307	Interior Live Oak Chaparral	average Broadleaf Chaparral - fair and Woodland/Grass - fair	42	64	76	82	0.04
	Grassland (104)	General Grassland	10401	Grassland Habitats; Annual Grass; Elymus Grassland; Souther Coastal Needlegrass; Mixed Perennial Grass; Ruderal; Deergrass	Grass - average fair and good	44	65	77	82	0.04
		Sumac Savanna	10402	Sumac Savanna	average Grass - fair and Broadleaf Chaparral - fair	45	66	77	83	0.04
		Live Oak Savanna	10403	Coast Live Oak Savanna	Average Grass - fair and Woodland/Grass - fair	47	67	78	83	0.04
	Woodland and Forest (105)	Woodland and Riparian Habitat	10501	Riparian Habitats; Riparian Herb; S. Sycamore; S. Coast Live Oak; S. Arroyo Willow; S. Black Willow; S. Cottonwood-Willow; White Alder; Canyon Live Oak; Woodland Habitats	Woodland - average fair and good	31	58	72	78	0.05
		Riparian Willow	10502	Southern Willow Scrub; Mulfat Scrub	Average Open Brush - fair and Woodland - fair	41	63	75	81	0.05
		Forest	10503	Forest Habitats	Woodland/Grass - average fair and good	39	62	75	81	0.05
	Wetlands and Watercourses (106)	Meadow and Marsh	10601	Vernal Pools, Seeps and Wet Meadows; Marsh Habitats	Meadows/Cienegas - good	30	58	71	78	0.04
		Streams and Creeks	10602	Intermittent Streams; Ephemeral Drainages	verage Open Brush - fair and Grass - fa	48	68	78	84	0.03
		Lakes and Open Water	99991	Perennial Water Bodies		30	58	71	78	0
		Fluctuating Shoreline	99992			30	58	71	78	0
		Flood Control Channels	10603	Flood Control Channels	average Open Brush - fair and Grass - fair with 50% impervious	73	83	88	91	0.02
	Cliff and Rock Habitats (107)	Cliff and Rocks	10701	Cliff and Rock Outcrops	Barren	78	86	91	93	0.05
		Rock with Plants	10702	Vascular Plants in Rock Habitats	average Barren and Open Brush - fair	62	76	84	88	0.05
Agricultural (2)	General Agriculture (201)	General Agriculture	20101	Agriculture; Other Agriculture	average Fallow, Legumes/Close Seeded, Row Crops, Small Grains	67	78	85	89	0.2
	Row Crops (202)	Row Crops	20201	Dryland Field Crops	average Pasture/Dryland - fair and Small Grains	59	73	82	86	0.2
		Irrigated Row Crops	20202	Irrigated Row and Field Crops	average Pasture/Irrigated - fair and Row Crops and Small Grains	62	75	83	87	0.2
	Dairy and Cattle or Fallow (203)	General Dairy, Cattle or Fallow	20301	Dairies/Stockyards/Stables	Fallow	77	86	91	94	0.03
	Orchards (204)	General Orchards	20401	Vineyards and Orchards	Orchards/Evergreen - average fair and good	39	62	75	81	0.1
	Nurseries (205)	General Nurseries	20501	Nurseries	Orchard/Evergreen - good with 15% impervious	43	64	76	82	0.025
	Pastures (206)	General Pastures	20601		average Pasture/Dryland - fair and Pasture Irrigated - fair	47	67	78	83	0.03
Developed (3)	General Developed Areas (301)	General Developed Areas	30101	Developed Areas; Non-urban industrial/commercial/institutional; Other Developed Areas	Residential/Commercial with 50% impervious	65	77	84	87	0.02
		Residential / Commercial	30102			32	56	69	75	0.02
		Impervious Areas	30103			98	98	98	98	0.01
	Residential (302)	Rural Residential	30201	Rural residential	Chaparral and Sage with 10% impervious	50	69	79	84	0.025
		Single Family Residential	30202		Residential/Commercial with 40% impervious	58	73	81	85	0.025
		Multiple Family Residential	30203		Residential/Commercial with 75% impervious	82	88	91	92	0.02
	Urban Commercial and Industrial (303)	General Urban Commercial and Industrial	30301	Urban	Residential/Commercial with 90% impervious	91	94	95	96	0.015
	Transportation (304)	General Transportation	30401	Transportation	Residential/Commercial with 95% impervious	95	96	97	97	0.015
	Parks (305)	General Parks	30501	Parks and Ornamental Plantings	Turf - fair with 15% impervious	52	70	80	84	0.025
Other (9)	Disturbed Areas (901)	General Disturbed Areas	90101	Disturbed Areas	Barren	78	86	91	93	0.04
		Disturbed Wetlands	90102		average Meadows/Cienegas - fair and Barren	65	78	86	89	0.03

NOTES:
1) Basin n-values revised 8th September 2000

The OCHM specifies that streamflow routing calculations, when necessary, should be performed using the convex routing technique. However, it also states that other routing techniques may be acceptable if results of these techniques are comparable to those obtained using convex routing. Since convex routing is not available in the HEC-1 program, PWA used Muskingum and Muskingum-Cunge routing techniques, as previously described. To satisfy the requirements of the OCHM, PWA applied the convex routing technique to several routing reaches in the San Juan Creek watershed model for 100-year conditions and compared the results with Muskingum routing results. This comparison is detailed in the Baseline Hydrologic Conditions Report, Technical Appendix A (PWA 2001). The comparison between the Muskingum and Convex routing methods indicates that the two techniques produce very similar results and that PWA's selected routing methods represent a reasonable alternative to the convex method.

In addition to the routing reaches described, four detention facilities were modeled on Oso Creek in the San Juan Watershed: Oso Reservoir, Portola Basin, O'Neil Basin, and the Galivan Basin. Data to model these four facilities in HEC-1 was obtained from SLA (1999) and are further discussed in the 2001 PWA Appendix.

2.2.2 Sediment Transport Analysis

The in-channel sediment transport processes were evaluated for both the existing conditions and the Ranch Plan for nine sub-basins in the San Mateo and San Juan Creek watersheds. SAMWin was used to calculate peak sediment transport rates and sediment yields during 2-, 10-, and 100-year flow events for several channel reaches in the San Juan and San Mateo watersheds (for reach locations, refer to the descriptions in Section 5 of this report). Peak sediment transport rate is expressed in mass per time (tons/day) and is the capacity of the channel to pass its sediment load. In this analysis, we calculated the transport capacity for the peak discharge. Sediment yield is expressed in mass units (tons) and is the total sediment outflow from a basin over a specified time period (duration of 2-year, 10-year, and 100-year flow events in the current analysis).

The SAMWin program consists of three computational modules: SAMhyd, SAMsed, and SAMyld. SAMhyd uses channel input data (discharge, cross section geometry, roughness, and energy slope) from a representative cross-section to calculate hydraulic parameters for a given reach. The resulting hydraulic parameters, along with sediment gradation data, are input into SAMsed to calculate transport rates for given discharge values. Within SAMyld, the transport rate is combined with a storm event hydrograph to produce a sediment yield for that event.

SAMWin model requires streamflow data, channel geometry information, channel hydraulic parameters (including roughness and energy slope), sediment particle-size distributions by reach, and the selection of an appropriate sediment transport function. In support of the 2001 Baseline Report (Technical Appendix A) PWA created input files for each of the study reaches. The channels were divided into reaches by classifying the main channels based on similar geometry and sediment characteristics. The input parameters from the previous analysis were used, but the streamflows (2-, 10-, and 100-year flows) obtained from the HEC-1 model were updated in the input files. The existing HEC-2 hydraulic model of the San Juan Creek (SLA, 1999) was updated to HEC-RAS, which was rerun to reflect the updated hydrology. The average hydraulic conditions obtained from the HEC-RAS model were used to estimate the sediment transport capacity and event sediment yields along the San Juan Creek. Chapter 4 of the PWA Technical Appendix A (PWA, 2001) provides more details on the input data.

SAMWin has a variety of sediment transport functions available for estiamating transport rates. We used the same sediment transport equation as the previous analysis; the Laursen Madden equation (1995) sediment transport function. Please refer to Section 4.5 of the PWA Technical Appendix A (2001) for the rationale for selecting the appropriate sediment transport equation. Section 4.5 of the PWA Technical Appendix A (2001) also includes a comparison of results to several previously published studies (including SLA (1999), Vanoni et al. (1980), and Kroll and Porterfield (1969)) and a sensitivity analysis.

3. POTENTIAL HYDROLOGIC IMPACTS OF THE RANCH PLAN

3.1 OVERVIEW OF EXISTING HYDROLOGIC CONDITIONS

Baseline hydrology, representing existing conditions, was updated from the 2001 PWA Technical Appendix. As previously discussed and illustrated in Figure 1-2, developed regions have increased within the watersheds. Therefore, the 2001 HEC-1 model was updated to incorporate current land use and development.

3.1.1 Model Parameterization

The San Juan and San Mateo Watershed rainfall/runoff models were parameterized according to the methods described in Section 2 of this report and also within the 2001 PWA Technical Appendix.

3.1.2 Infiltration

In HEC-1, infiltration rates are computed based on the NRCS runoff index method, incorporating soil characteristics, land use, vegetation, impervious cover and antecedent moisture conditions to estimate loss rates. Tables 3-1 and 3-2 list physical characteristics, including drainage area and soil types, for all sub-basins within the San Juan and San Mateo Watersheds.

Much of the San Juan watershed is currently undeveloped (73%), while approximately 21% of the watershed is developed. Most of the development is concentrated in the Oso and Trabuco tributaries of the western watershed, and the northern half of the Cañada Gobernadora sub-basin. A high percentage of the land surface of these urbanized regions is impervious to runoff. Overall, approximately 15% of the entire San Juan watershed is impervious surface area. Various agricultural land uses occur mostly in Cañada Chiquita, southern Cañada Gobernadora, and the central San Juan catchments. Agriculture represents 4% of the total watershed area. The predominant vegetation communities in the San Juan watershed are coastal sage scrub, chaparral and grassland with corridors of riparian vegetation occurring along the primary creek paths. Figure 3-1 illustrates baseline land uses and soil types within the RMV boundaries. Land use information and soil types are primary influences in determination of rainfall runoff.

Based on the OCHM methods, SCS runoff curve numbers were used in hydrologic modeling of the San Juan watershed to synthesize the effect of soil type, land-use, vegetation, and infiltration processes and provide an integrated overall "loss" rate. Assigned runoff curve numbers range from 30 to 97 (as seen in Figure 3-1). 92% of the watershed has curve numbers in the range of 70-97. For modeling purposes, higher curve numbers result in a greater proportion of rainfall becoming surface runoff. Lower curve numbers represent regions with potentially high infiltration rates, resulting in decreased volumes of runoff. As apparent in Figure 3-1, regions of high infiltration occur mostly along riparian corridors and alluvial valley floors.

Table 3-1 Hydrologic Parameters for the San Juan Creek Watershed, Baseline Condition

GIS Sub-basin	HEC-1 Node	Areas				Soils									Watercourse Lengths				Slope	Sub-basin Roughness n-value	Lag Time (hrs)	Average Curve Number (AMC II)	LAPRE-1
		Sub-basin		Upstream Drainage		Percentage Area in Soil Group				Low Loss Fraction			Maximum Loss Rate (in/hr)		Longest		To Centroid						
		(mi^2)	(acres)	(mi^2)	(acres)	A	B	C	D	2-year	10-year	100-year	2-year	10-year & 100-year	(mi)	(ft)	(mi)	(ft)	(ft/mi)				S-graph Type
1	SJ1	5.12	3,276	5.12	3,277	2	0	9	89	0.592	0.367	0.094	0.600	0.208	5.47	28,862	2.68	14,154	605.0	0.050	0.99	82.2	Mountain
2	SJ2	6.18	3,955	6.18	3,955	0	8	70	22	0.675	0.433	0.118	0.600	0.243	6.23	32,898	2.26	11,921	280.1	0.045	1.01	77.4	Mountain
3	SJ3	7.17	4,586	50.11	32,070	4	0	49	48	0.727	0.492	0.149	0.599	0.231	7.99	42,179	4.35	22,963	324.4	0.049	1.52	78.8	Mountain
4	TC4	4.67	2,987	30.38	19,443	2	39	22	36	0.685	0.483	0.157	0.391	0.166	7.07	37,324	3.42	18,039	130.9	0.036	1.15	82.5	Valley Undeveloped
5	SJ5	1.70	1,086	51.81	33,158	10	9	41	40	0.860	0.653	0.255	0.591	0.245	2.84	14,994	1.29	6,809	321.2	0.040	0.52	74.3	Foothill
6	TC6	11.04	7,067	16.51	10,566	3	2	20	74	0.641	0.413	0.116	0.597	0.218	8.87	46,859	6.13	32,348	528.6	0.050	1.66	80.3	Mountain
7	SJ7	2.99	1,912	2.99	1,914	3	35	54	7	0.734	0.544	0.199	0.424	0.190	3.17	16,737	1.35	7,148	183.2	0.025	0.39	79.3	Valley Undeveloped
8	SJ8	4.66	2,982	104.91	67,142	3	15	32	50	0.812	0.587	0.197	0.575	0.227	3.82	20,193	1.70	8,958	131.2	0.063	1.21	78.6	Valley Undeveloped
9	SJ9	4.80	3,069	56.61	36,230	8	1	62	29	0.843	0.627	0.234	0.600	0.249	6.02	31,810	2.88	15,200	353.4	0.050	1.16	74.8	Mountain
10	SJ10	4.39	2,812	4.39	2,810	0	3	45	52	0.598	0.369	0.093	0.599	0.226	5.21	27,518	2.81	14,816	448.2	0.049	1.01	80.8	Mountain
11	OC11	2.00	1,280	16.28	10,419	8	18	0	74	0.609	0.427	0.142	0.353	0.137	3.68	19,405	1.74	9,182	87.5	0.025	0.52	84.3	Valley Developed
12	OC12	0.73	467	14.29	9,146	9	11	1	80	0.460	0.286	0.064	0.213	0.081	1.51	7,974	0.59	3,140	193.4	0.020	0.17	90.9	Valley Developed
13	SJ13	7.42	4,747	84.59	54,138	6	12	53	29	0.856	0.645	0.239	0.586	0.244	4.48	23,649	1.84	9,718	148.0	0.040	0.84	75.4	Valley Undeveloped
14	OC14	1.00	642	13.56	8,678	0	19	0	81	0.488	0.311	0.076	0.237	0.086	1.36	7,172	0.49	2,566	256.0	0.020	0.14	89.9	Valley Developed
15	OC15	1.41	905	8.98	5,747	3	12	34	52	0.442	0.280	0.070	0.182	0.071	2.99	15,808	1.65	8,727	141.4	0.020	0.34	90.7	Valley Undeveloped
16	TC16	2.53	1,618	32.91	21,062	9	6	13	73	0.690	0.490	0.178	0.410	0.157	2.96	15,628	1.31	6,898	162.9	0.027	0.41	81.1	Valley Undeveloped
17	TC17	1.70	1,090	54.79	35,066	13	47	0	40	0.596	0.413	0.134	0.305	0.139	2.98	15,713	1.38	7,271	131.2	0.025	0.41	85.0	Valley Developed
18	SJ18	5.34	3,418	175.97	112,621	8	25	6	61	0.541	0.354	0.093	0.280	0.114	4.52	23,865	2.31	12,205	129.2	0.025	0.57	88.2	Valley Developed
19	OC19	3.57	2,287	12.55	8,032	0	14	11	75	0.427	0.261	0.055	0.170	0.062	4.76	25,117	2.58	13,610	112.4	0.024	0.62	91.8	Valley Developed
20	SJ20	4.81	3,075	4.81	3,078	0	16	2	82	0.668	0.440	0.113	0.352	0.127	6.33	33,429	3.37	17,815	130.1	0.032	0.97	85.7	Valley Undeveloped
21	SJ21	4.59	2,940	109.50	70,080	4	16	7	73	0.677	0.467	0.142	0.449	0.170	4.37	23,076	1.81	9,556	240.2	0.040	0.74	83.6	Valley Developed
22	OC22	3.95	2,531	7.56	4,838	0	21	8	71	0.390	0.237	0.050	0.140	0.053	4.13	21,806	1.62	8,530	174.0	0.021	0.40	92.5	Valley Undeveloped
23	SJ23	7.83	5,013	27.29	17,466	2	1	41	56	0.700	0.460	0.130	0.600	0.225	5.99	31,606	2.73	14,413	385.9	0.050	1.11	80.0	Mountain
24	SJ24	8.88	5,685	19.46	12,454	1	3	43	54	0.640	0.405	0.107	0.599	0.226	4.48	23,651	1.59	8,374	426.3	0.049	0.79	80.0	Mountain
25	SJ25	1.53	981	115.84	74,138	5	21	1	73	0.710	0.503	0.164	0.468	0.180	2.46	12,991	1.26	6,656	297.4	0.030	0.37	81.8	Valley Developed
26	TC26	8.30	5,315	24.81	15,878	6	20	22	52	0.741	0.531	0.185	0.463	0.187	6.98	36,831	4.08	21,549	226.2	0.037	1.12	79.6	Mountain
27	0C27	1.16	742	3.61	2,310	3	37	32	28	0.515	0.357	0.120	0.222	0.096	1.72	9,070	0.78	4,138	185.3	0.020	0.20	86.7	Valley Developed
28	SJ28	4.01	2,565	42.95	27,488	13	3	44	39	0.864	0.664	0.276	0.590	0.248	4.36	23,001	2.23	11,768	274.9	0.050	0.97	72.8	Mountain
29	SJ29	2.17	1,391	38.94	24,922	5	0	53	42	0.760	0.529	0.171	0.599	0.236	5.08	26,835	2.22	11,738	519.6	0.050	0.92	78.0	Mountain
30	TC30	5.46	3,497	5.46	3,494	1	1	37	61	0.608	0.379	0.099	0.600	0.222	4.49	23,716	2.27	12,006	545.6	0.050	0.88	80.2	Mountain
31	SJ31	4.58	2,928	4.58	2,931	0	37	42	22	0.840	0.614	0.206	0.586	0.251	5.59	29,538	2.46	12,966	144.9	0.046	1.16	77.7	Foothill
32	TC32	0.90	576	25.71	16,454	17	14	17	51	0.762	0.589	0.282	0.482	0.207	2.48	13,082	1.23	6,500	136.4	0.029	0.42	73.4	Valley Undeveloped
33	OC33	0.20	128	1.35	864	1	26	0	73	0.485	0.312	0.079	0.208	0.079	0.60	3,187	0.32	1,687	255.4	0.025	0.11	89.7	Valley Undeveloped
34	SJ34	9.10	5,823	14.22	9,101	3	3	43	50	0.763	0.540	0.179	0.556	0.214	6.86	36,241	3.48	18,360	360.9	0.050	1.30	78.8	Mountain
35	SJ35	2.93	1,872	5.91	3,782	7	28	61	4	0.801	0.598	0.225	0.485	0.221	4.31	22,731	2.10	11,109	153.2	0.040	0.85	76.9	Valley Undeveloped
36	SJ36	1.77	1,133	7.68	4,915	1	31	63	6	0.865	0.659	0.247	0.562	0.247	3.49	18,441	1.86	9,844	192.6	0.043	0.78	74.8	Foothill
37	OC37	1.15	735	1.15	736	0	22	3	76	0.795	0.578	0.196	0.533	0.198	2.29	12,092	0.95	5,038	257.9	0.029	0.32	78.9	Mountain
58	SJ58	9.48	6,066	36.77	23,533	2	5	31	62	0.649	0.419	0.118	0.600	0.225	8.45	44,605	4.64	24,521	404.7	0.049	1.53	80.2	Mountain
59	OC59	1.10	706	2.45	1,568	4	36	6	54	0.448	0.284	0.073	0.156	0.064	2.17	11,463	0.91	4,810	255.4	0.020	0.22	90.5	Valley Developed
60	SJ60	6.35	4,066	20.57	13,165	8	6	46	40	0.855	0.642	0.252	0.600	0.245	8.86	46,766	4.75	25,102	231.1	0.049	1.75	74.0	Mountain
63	SJ63	3.40	2,173	11.08	7,091	4	20	39	37	0.814	0.590	0.197	0.598	0.247	4.01	21,151	2.33	12,277	141.7	0.064	1.41	78.6	Foothill
64	TC64	3.90	2,495	36.80	23,552	18	10	5	66	0.646	0.462	0.172	0.395	0.164	5.57	29,409	2.53	13,343	99.0	0.035	0.95	82.0	Foothill

Table 3-2 Hydrologic Parameters for the San Mateo Creek Watershed, Baseline Condition

GIS Sub-basin	HEC-1 Node	Areas				Soils									Watercourse Lengths				Slope	Sub-basin Roughness n-value	Lag Time (hrs)	Average Curve Number (AMC II)	LAPRE-1
		Sub-basin		Upstream Drainage		Percentage Area in Soil Group				Low Loss Fraction			Maximum Loss Rate (in/hr)		Longest		To Centroid						
		(mi^2)	(acres)	(mi^2)	(acres)	A	B	C	D	2-year	10-year	100-year	2-year	10-year & 100-year	(mi)	(ft)	(mi)	(ft)	(ft/mi)				S-graph Type
38	SM38	4.29	2,748	4.29	2,748	0	14	72	14	0.556	0.333	0.077	0.323	0.135	3.85	20,335	1.65	8,737	119.3	0.030	0.59	82.9	Valley Developed
39	SM39	2.72	1,739	20.65	13,213	2	24	50	24	0.718	0.482	0.146	0.600	0.252	3.37	17,810	1.47	7,753	393.9	0.050	0.71	77.1	Mountain
40	SM40	5.99	3,833	26.64	17,047	1	5	82	12	0.673	0.432	0.118	0.600	0.248	5.54	29,276	2.71	14,334	366.3	0.045	0.99	78.0	Mountain
41	SM41	5.28	3,382	55.64	35,612	2	3	70	25	0.774	0.534	0.164	0.600	0.242	4.66	24,590	1.95	10,282	450.9	0.050	0.87	78.1	Mountain
42	SM42	5.16	3,300	50.36	32,230	0	1	34	65	0.651	0.411	0.105	0.600	0.218	5.26	27,776	2.67	14,111	602.5	0.050	0.97	81.5	Mountain
43	CC43	4.56	2,916	32.18	20,593	2	8	8	82	0.774	0.543	0.168	0.556	0.199	4.39	23,180	2.10	11,066	141.2	0.040	0.87	80.9	Valley Undeveloped
44	SM44	16.46	10,535	80.65	51,616	1	6	72	20	0.734	0.491	0.144	0.600	0.245	9.48	50,077	4.78	25,237	207.9	0.050	1.85	77.8	Mountain
45	CC45	3.67	2,347	19.24	12,313	1	13	44	43	0.848	0.625	0.214	0.600	0.236	3.69	19,501	1.64	8,666	196.3	0.040	0.70	77.1	Valley Undeveloped
46	SM46	4.65	2,977	133.28	85,300	2	22	4	72	0.784	0.552	0.171	0.568	0.216	4.60	24,288	2.26	11,939	129.8	0.035	0.81	80.6	Valley Undeveloped
47	CC47	8.38	5,363	27.62	17,677	3	3	19	76	0.777	0.542	0.172	0.597	0.217	10.08	53,235	5.34	28,198	224.2	0.040	1.56	79.3	Mountain
48	CC48	3.28	2,102	15.57	9,966	3	3	34	60	0.820	0.593	0.201	0.590	0.223	4.02	21,250	1.51	7,957	190.8	0.040	0.70	78.3	Valley Undeveloped
49	CC49	5.03	3,221	5.03	3,221	6	8	56	31	0.864	0.649	0.243	0.600	0.247	5.82	30,740	2.68	14,145	255.3	0.045	1.06	75.1	Mountain
50	SM50	3.50	2,240	64.19	41,082	3	0	40	56	0.769	0.532	0.162	0.600	0.227	4.30	22,692	1.91	10,071	418.3	0.050	0.85	79.9	Mountain
51	CC51	7.25	4,643	7.25	4,643	7	2	44	48	0.821	0.597	0.208	0.600	0.237	6.80	35,893	3.46	18,266	303.1	0.045	1.21	77.0	Mountain
52	SM52	3.70	2,365	3.70	2,365	0	24	45	30	0.630	0.397	0.105	0.488	0.201	3.86	20,356	2.04	10,784	143.0	0.035	0.72	79.1	Valley Developed
53	SM53	6.84	4,380	45.20	28,930	1	16	68	15	0.734	0.495	0.151	0.600	0.252	5.54	29,244	2.79	14,746	255.9	0.040	0.95	76.3	Valley Undeveloped
54	SM54	5.05	3,230	60.69	38,842	0	0	53	47	0.662	0.422	0.111	0.600	0.226	5.70	30,116	3.10	16,355	354.3	0.050	1.17	80.3	Mountain
55	SM55	1.64	1,048	9.63	6,161	0	2	83	14	0.686	0.443	0.121	0.600	0.245	3.48	18,371	1.88	9,922	316.8	0.035	0.57	78.8	Mountain
56	SM56	8.30	5,312	17.93	11,474	1	14	82	3	0.683	0.442	0.125	0.565	0.242	5.92	31,283	3.22	16,976	274.7	0.040	1.01	77.0	Mountain
57	SM57	4.55	2,914	38.36	24,550	3	5	46	46	0.705	0.468	0.135	0.600	0.234	3.75	19,823	1.12	5,917	446.5	0.050	0.65	79.5	Mountain
61	SM61	15.80	10,114	96.45	61,730	3	1	3	93	0.791	0.555	0.174	0.596	0.208	9.93	52,445	4.97	26,216	172.1	0.040	1.59	80.4	Valley Undeveloped
62	SM62	7.17	4,590	33.81	21,636	1	9	76	15	0.670	0.428	0.116	0.600	0.248	5.82	30,752	2.97	15,686	359.9	0.050	1.16	77.9	Mountain

Overall, infiltration in the San Juan watershed is relatively low due to the prominence of poorly infiltrating soils and the significant proportion of development in the western watershed, primarily outside the RMV boundary. However, there are significant pockets of the watershed, particularly in the central watershed, which do have more permeable soils and offer better infiltration.

The majority of the San Mateo watershed is undeveloped (92%); a small fraction is developed (6%) or used for agriculture (1%). Agricultural lands occur mostly in the lower Cristianitos and San Mateo stream valleys. Developed areas include some light industrial and residential areas both inside and outside of the MCB Camp Pendleton in the lower watershed. Much of the watershed is covered in sage, chaparral, grassland, or woodland. Overall, only about 3% of the entire San Mateo watershed is impervious to runoff.

The majority of the San Mateo Creek watershed (93%) is characterized by higher SCS runoff curve numbers between 70 and 97. Higher curve numbers result in a greater proportion of rainfall becoming surface runoff. Based on a spatial GIS analysis of the runoff curve numbers, loss rates were calculated for the San Juan and San Mateo watersheds and incorporated into the HEC-1 model.

Overall, infiltration in the San Mateo watershed is relatively low due to the prevalence of poorly infiltrating soils. However, there are pockets of the watershed, particularly in the upper western watershed, which do have more permeable soils and offer higher infiltration. Tables 3-1 and 3-2 detail calculated hydrologic parameters for the San Juan Creek and San Mateo Creek Watershed sub-basins, respectively.

3.2 POTENTIAL HYDROLOGIC IMPACTS OF THE RANCH PLAN: OVERVIEW

3.2.1 Thresholds of significance

Thresholds of significance for hydrology have been developed by Orange County 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.

- 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.

- 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.

- 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/MSAA Planning Principles

3.2.2 Ranch Plan Description

The Ranch Plan (B-4 Alternative) identifies 13 Planning Areas within the RMV Boundary. The Planning Areas are comprised of development zones within the Ortega Gateway (PA 1), Chiquita Canyon (PA 2), Cañada Gobernadora (PA 3), East Ortega (PA4), Trampas (PA 5), Cristianitos Meadows (PA 6), Cristianitos Canyon (PA 7), and Talega Canyon (PA 8). O'Neill Ranch (PA9) includes limited developed land uses in an open space setting. Four open space Planning Areas are planned outside of the development zones. Figure 3-2 illustrates the location of these areas. Planning Areas 1-5, and 10-13 are located within the San Juan Watershed. Planning Areas 6-9 are located in the San Mateo Watershed. Table 3-3 provides a comparison of sub-basin land uses under Existing Conditions and the Ranch Plan.

3.2.3 Model Parameterization

The proposed Ranch Plan land uses are illustrated in Figure 3-3. Within LAPRE-1 and the resulting HEC-1 model, basin n values, low loss fractions and maximum loss rates were changed to account for the developing landscape and grading changes. Figure 3-4 illustrates the changing sub-basin delineations due to grading within the Planning Areas. Tables 3-4 and 3-5 summarize hydrologic parameters used in the model, such as infiltration parameters and lag times. Values in Tables 3-4 and 3-5 may be compared with the values in Tables 3-1 and 3-2. Sub-basins in which the Ranch Plan altered hydrologic parameters are highlighted in Table 3-4 and 3-5. Channel slopes and length of primary watercourse were retained from the baseline.

Table 3-3 Land Use Allocations Within Sub-Basins, Existing Conditions and Ranch Plan

		Percent of Sub-Basin Area									
		Existing Conditions					**Ranch Plan (Alternative B4)**				
Subbasin	Hec-Node	Undeveloped	Agricultural	Developed	Disturbed Area	Open Water	Undeveloped	Agricultural	Developed	Disturbed Area	Open Water
1	SJ1	99.9	0.0	0.0	0.1	0.0	99.9	0.0	0.0	0.1	0.0
2	SJ2	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
3	SJ3	98.5	0.0	0.4	1.1	0.0	98.5	0.0	0.4	1.1	0.0
4	**TC4**	**34.8**	**6.8**	**51.8**	**6.3**	**0.3**	**34.4**	**6.9**	**52.2**	**6.3**	**0.3**
5	**SJ5**	**98.2**	**0.0**	**1.8**	**0.0**	**0.0**	**98.4**	**0.0**	**1.6**	**0.0**	**0.0**
6	TC6	96.9	1.3	0.9	0.8	0.0	96.9	1.3	0.9	0.8	0.0
7	**SJ7**	**46.6**	**1.8**	**48.3**	**2.3**	**1.1**	**46.7**	**1.8**	**48.1**	**2.4**	**1.1**
8	**SJ8**	**61.4**	**31.1**	**7.5**	**0.0**	**0.1**	**59.6**	**6.9**	**33.5**	**0.0**	**0.0**
9	**SJ9**	**99.8**	**0.0**	**0.1**	**0.1**	**0.0**	**97.8**	**0.0**	**2.1**	**0.1**	**0.0**
10	SJ10	98.5	0.0	1.0	0.4	0.0	98.5	0.0	1.0	0.4	0.0
11	OC11	35.0	8.8	55.1	1.0	0.0	35.0	8.8	55.1	1.0	0.0
12	OC12	16.8	0.0	79.4	3.8	0.0	16.8	0.0	79.4	3.8	0.0
13	**SJ13**	**83.5**	**6.2**	**4.2**	**3.4**	**2.8**	**41.0**	**2.7**	**54.7**	**0.2**	**1.4**
14	OC14	11.8	0.0	84.0	4.2	0.0	11.8	0.0	84.0	4.2	0.0
15	OC15	5.4	0.0	94.2	0.2	0.2	5.4	0.0	94.2	0.2	0.2
16	**TC16**	**43.9**	**0.6**	**51.3**	**4.2**	**0.0**	**44.0**	**0.6**	**51.1**	**4.2**	**0.0**
17	TC17	26.1	9.6	63.6	0.6	0.0	26.1	9.6	63.6	0.6	0.0
18	SJ18	28.7	4.1	66.2	1.0	0.0	28.7	4.1	66.2	1.0	0.0
19	OC19	6.0	0.0	93.5	0.5	0.0	6.0	0.0	93.5	0.5	0.0
20	**SJ20**	**15.4**	**5.3**	**78.8**	**0.4**	**0.1**	**15.4**	**4.6**	**79.5**	**0.4**	**0.1**
21	**SJ21**	**61.5**	**4.2**	**34.0**	**0.4**	**0.0**	**58.5**	**2.4**	**38.7**	**0.4**	**0.0**
22	OC22	6.8	0.1	92.7	0.3	0.1	6.8	0.1	92.7	0.3	0.1
23	SJ23	99.9	0.0	0.0	0.0	0.0	99.9	0.0	0.0	0.0	0.0
24	SJ24	99.5	0.0	0.5	0.0	0.0	99.5	0.0	0.5	0.0	0.0
25	SJ25	58.6	0.0	39.6	1.8	0.1	58.6	0.0	39.6	1.8	0.1
26	TC26	62.1	0.0	37.6	0.2	0.2	62.1	0.0	37.6	0.2	0.2
27	OC27	2.8	0.0	80.1	1.4	15.7	2.8	0.0	80.1	1.4	15.7
28	SJ28	97.4	0.0	2.4	0.2	0.0	97.4	0.0	2.4	0.2	0.0
29	SJ29	99.8	0.0	0.1	0.0	0.0	99.8	0.0	0.1	0.0	0.0
30	TC30	99.9	0.0	0.0	0.1	0.0	99.9	0.0	0.0	0.1	0.0
31	**SJ31**	**50.4**	**45.0**	**4.4**	**0.2**	**0.0**	**56.7**	**28.3**	**14.7**	**0.3**	**0.0**
32	TC32	69.0	0.0	29.1	1.7	0.2	69.0	0.0	29.1	1.7	0.2
33	OC33	12.6	0.0	86.2	0.0	1.2	12.6	0.0	86.2	0.0	1.2
34	SJ34	86.7	0.0	10.5	2.4	0.3	86.7	0.0	10.5	2.4	0.3
35	**SJ35**	**49.8**	**17.5**	**29.3**	**3.0**	**0.4**	**50.8**	**17.6**	**28.2**	**3.0**	**0.4**
36	**SJ36**	**80.6**	**2.8**	**11.1**	**5.4**	**0.0**	**80.8**	**1.7**	**12.1**	**5.4**	**0.0**
37	OC37	63.7	8.3	18.1	0.0	9.8	63.7	8.3	18.1	0.0	9.8
38	SM38	7.8	0.0	92.2	0.0	0.0	7.8	0.0	92.2	0.0	0.0
39	SM39	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
40	SM40	99.9	0.0	0.0	0.1	0.0	99.9	0.0	0.0	0.1	0.0
41	SM41	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
42	SM42	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
43	**CC43**	**80.3**	**0.0**	**15.0**	**4.7**	**0.0**	**79.7**	**0.0**	**15.3**	**4.9**	**0.0**
44	SM44	99.5	0.4	0.1	0.0	0.0	99.5	0.4	0.1	0.0	0.0
45	**CC45**	**97.2**	**0.0**	**0.0**	**2.8**	**0.0**	**69.0**	**0.0**	**29.8**	**1.2**	**0.0**
46	SM46	59.5	21.6	10.8	8.1	0.0	59.5	21.6	10.8	8.1	0.0
47	**CC47**	**98.9**	**0.0**	**1.1**	**0.0**	**0.0**	**86.8**	**0.0**	**13.2**	**0.0**	**0.0**
48	**CC48**	**93.0**	**0.0**	**3.3**	**3.5**	**0.1**	**56.2**	**0.0**	**42.4**	**1.4**	**0.1**
49	**CC49**	**99.9**	**0.0**	**0.0**	**0.1**	**0.0**	**91.4**	**0.0**	**8.6**	**0.1**	**0.0**
50	SM50	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
51	**CC51**	**99.6**	**0.1**	**0.3**	**0.0**	**0.0**	**99.3**	**0.1**	**0.7**	**0.0**	**0.0**
52	SM52	61.0	0.0	37.4	1.6	0.0	61.0	0.0	37.4	1.6	0.0
53	SM53	99.7	0.0	0.2	0.1	0.0	99.7	0.0	0.2	0.1	0.0
54	SM54	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
55	SM55	97.2	0.0	0.0	2.8	0.0	97.2	0.0	0.0	2.8	0.0
56	SM56	87.1	0.5	11.6	0.8	0.0	87.1	0.5	11.6	0.8	0.0
57	SM57	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
58	SJ58	99.8	0.0	0.1	0.1	0.0	99.8	0.0	0.1	0.1	0.0
59	OC59	5.2	0.0	94.4	0.4	0.0	5.2	0.0	94.4	0.4	0.0
60	SJ60	99.9	0.0	0.1	0.0	0.0	99.9	0.0	0.0	0.0	0.0
61	SM61	98.5	0.2	1.3	0.1	0.0	98.5	0.2	1.3	0.1	0.0
62	SM62	94.4	5.6	0.0	0.0	0.0	94.4	5.6	0.0	0.0	0.0
63	**SJ63**	**58.5**	**29.4**	**0.1**	**12.0**	**0.0**	**29.5**	**10.6**	**50.0**	**9.9**	**0.0**
64	TC64	41.1	6.3	45.2	6.6	0.9	41.1	6.3	45.2	6.6	0.9

	Percent of Watershed Area									
	Existing Conditions					**Ranch Plan (Alternative B4)**				
	Undeveloped	Agricultural	Developed	Disturbed Area	Open Water	Undeveloped	Agricultural	Developed	Disturbed Area	Open Water
San Juan Watershed	72.9	4.2	21.2	1.3	0.4	70.4	2.6	25.5	1.1	0.3
San Mateo Watershed	91.9	1.2	6.1	0.8	0.1	89.1	1.2	8.9	0.7	0.1

Note: Sub-basins in bold indicate that land use conditions were changed between Existing Conditions and the Ranch Plan

Table 3-4 Hydrologic Parameters for the San Juan Creek Watershed, Ranch Plan Alternative

GIS Sub-basin	HEC-1 Node	Areas				Soils					Watercourse Lengths				Slope	Sub-basin Roughness n-value	Lag Time (hrs)	Average Curve Number (AMC II)	LAPRE-1
		Sub-basin		Upstream Drainage		Low Loss Fraction			Maximum Loss Rate (in/hr)		Longest		To Centroid						
		(mi^2)	(acres)	(mi^2)	(acres)	2-year	10-year	100-year	2-year	10-year & 100-year	(mi)	(ft)	(mi)	(ft)	(ft/mi)				S-graph Type
1	SJ1	5.12	3,276	5.12	3,276	0.592	0.367	0.094	0.600	0.208	5.47	28,862	2.68	14,154	605.0	0.050	0.99	82.2	Mountain
2	SJ2	6.18	3,955	6.18	3,955	0.675	0.433	0.118	0.600	0.243	6.23	32,898	2.26	11,921	280.1	0.045	1.01	77.4	Mountain
3	SJ3	7.17	4,586	50.11	32,073	0.727	0.492	0.149	0.599	0.231	7.99	42,179	4.35	22,963	324.4	0.049	1.52	78.8	Mountain
4	*TC4*	*4.63*	*2,966*	*30.34*	*19,420*	*0.683*	*0.481*	*0.157*	*0.389*	*0.165*	*7.07*	*37,324*	*3.42*	*18,039*	*130.9*	*0.036*	*1.15*	*82.6*	*Valley Undeveloped*
5	*SJ5*	*1.69*	*1,079*	*51.80*	*33,152*	*0.860*	*0.653*	*0.254*	*0.592*	*0.245*	*2.84*	*14,994*	*1.29*	*6,809*	*321.2*	*0.040*	*0.52*	*74.4*	*Foothill*
6	TC6	11.04	7,067	16.51	10,564	0.641	0.413	0.116	0.597	0.218	8.87	46,859	6.13	32,348	528.6	0.050	1.66	80.3	Mountain
7	*SJ7*	*3.00*	*1,922*	*3.00*	*1,922*	*0.734*	*0.544*	*0.199*	*0.425*	*0.191*	*3.17*	*16,737*	*1.35*	*7,148*	*183.2*	*0.025*	*0.39*	*79.3*	*Valley Undeveloped*
8	*SJ8*	*4.80*	*3,072*	*105.13*	*67,286*	*0.779*	*0.557*	*0.183*	*0.492*	*0.195*	*3.82*	*20,193*	*1.70*	*8,958*	*131.2*	*0.050*	*0.97*	*79.9*	*Valley Undeveloped*
9	*SJ9*	*4.75*	*3,042*	*56.55*	*36,194*	*0.841*	*0.623*	*0.230*	*0.595*	*0.246*	*6.02*	*31,810*	*2.88*	*15,200*	*353.4*	*0.049*	*1.14*	*75.1*	*Mountain*
10	SJ10	4.39	2,812	4.39	2,812	0.598	0.369	0.093	0.599	0.226	5.21	27,518	2.81	14,816	448.2	0.049	1.01	80.8	Mountain
11	OC11	2.00	1,280	16.28	10,422	0.609	0.427	0.142	0.353	0.137	3.68	19,405	1.74	9,182	87.5	0.025	0.52	84.3	Valley Developed
12	OC12	0.73	467	14.29	9,143	0.460	0.286	0.064	0.213	0.081	1.51	7,974	0.59	3,140	193.4	0.020	0.17	90.9	Valley Developed
13	*SJ13*	*7.68*	*4,915*	*84.71*	*54,215*	*0.743*	*0.533*	*0.182*	*0.405*	*0.169*	*4.48*	*23,649*	*1.84*	*9,718*	*148.0*	*0.030*	*0.62*	*80.4*	*Valley Developed*
14	OC14	1.00	642	13.56	8,675	0.488	0.311	0.076	0.237	0.086	1.36	7,172	0.49	2,566	256.0	0.020	0.14	89.9	Valley Developed
15	OC15	1.41	905	8.98	5,747	0.442	0.280	0.070	0.182	0.071	2.99	15,808	1.65	8,727	141.4	0.020	0.34	90.7	Valley Undeveloped
16	*TC16*	*2.54*	*1,623*	*32.88*	*21,044*	*0.691*	*0.490*	*0.178*	*0.410*	*0.157*	*2.96*	*15,628*	*1.31*	*6,898*	*162.9*	*0.027*	*0.41*	*81.1*	*Valley Undeveloped*
17	TC17	1.70	1,090	54.77	35,051	0.596	0.413	0.134	0.305	0.139	2.98	15,713	1.38	7,271	131.2	0.025	0.41	85.0	Valley Developed
18	SJ18	5.34	3,418	175.98	112,630	0.541	0.354	0.093	0.280	0.114	4.52	23,865	2.31	12,205	129.2	0.025	0.57	88.2	Valley Developed
19	OC19	3.57	2,287	12.55	8,034	0.427	0.261	0.055	0.170	0.062	4.76	25,117	2.58	13,610	112.4	0.024	0.62	91.8	Valley Developed
20	*SJ20*	*4.82*	*3,085*	*4.82*	*3,085*	*0.670*	*0.442*	*0.114*	*0.350*	*0.127*	*6.33*	*33,429*	*3.37*	*17,815*	*130.1*	*0.032*	*0.97*	*85.6*	*Valley Developed*
21	*SJ21*	*4.39*	*2,810*	*109.52*	*70,095*	*0.665*	*0.456*	*0.136*	*0.436*	*0.165*	*4.37*	*23,076*	*1.81*	*9,556*	*240.2*	*0.039*	*0.73*	*84.1*	*Valley Developed*
22	OC22	3.95	2,531	7.56	4,841	0.390	0.237	0.050	0.140	0.053	4.13	21,806	1.62	8,530	174.0	0.021	0.40	92.5	Valley Undeveloped
23	SJ23	7.83	5,013	27.29	17,466	0.700	0.460	0.130	0.600	0.225	5.99	31,606	2.73	14,413	385.9	0.050	1.11	80.0	Mountain
24	SJ24	8.88	5,685	19.46	12,453	0.640	0.405	0.107	0.599	0.226	4.48	23,651	1.59	8,374	426.3	0.049	0.79	80.0	Mountain
25	SJ25	1.53	981	115.88	74,161	0.710	0.503	0.164	0.468	0.180	2.46	12,991	1.26	6,656	297.4	0.030	0.37	81.8	Valley Developed
26	TC26	8.30	5,315	24.81	15,879	0.741	0.531	0.185	0.463	0.187	6.98	36,831	4.08	21,549	226.2	0.037	1.12	79.6	Mountain
27	0C27	1.16	742	3.61	2,311	0.515	0.357	0.120	0.222	0.096	1.72	9,070	0.78	4,138	185.3	0.020	0.20	86.7	Valley Developed
28	SJ28	4.01	2,565	42.95	27,487	0.864	0.664	0.276	0.590	0.248	4.36	23,001	2.23	11,768	274.9	0.050	0.97	72.8	Mountain
29	SJ29	2.17	1,391	38.94	24,923	0.760	0.528	0.171	0.599	0.236	5.08	26,835	2.22	11,738	519.6	0.050	0.92	78.0	Mountain
30	TC30	5.46	3,497	5.46	3,497	0.608	0.379	0.099	0.600	0.222	4.49	23,716	2.27	12,006	545.6	0.050	0.88	80.2	Mountain
31	*SJ31*	*4.62*	*2,959*	*4.62*	*2,959*	*0.858*	*0.636*	*0.221*	*0.575*	*0.247*	*5.59*	*29,538*	*2.46*	*12,966*	*144.9*	*0.043*	*1.09*	*76.6*	*Foothill*
32	TC32	0.90	576	25.71	16,455	0.762	0.589	0.282	0.482	0.207	2.48	13,082	1.23	6,500	136.4	0.029	0.42	73.4	Valley Undeveloped
33	OC33	0.20	128	1.35	862	0.485	0.312	0.079	0.208	0.079	0.60	3,187	0.32	1,687	255.4	0.025	0.11	89.7	Valley Undeveloped
34	*SJ34*	*9.09*	*5,817*	*14.21*	*9,092*	*0.762*	*0.540*	*0.179*	*0.556*	*0.214*	*6.86*	*36,241*	*3.48*	*18,360*	*360.9*	*0.050*	*1.30*	*78.8*	*Mountain*
35	*SJ35*	*3.04*	*1,947*	*6.05*	*3,869*	*0.803*	*0.599*	*0.225*	*0.489*	*0.222*	*4.31*	*22,731*	*2.10*	*11,109*	*153.2*	*0.041*	*0.87*	*76.9*	*Valley Undeveloped*
36	*SJ36*	*1.62*	*1,038*	*7.67*	*4,907*	*0.867*	*0.662*	*0.250*	*0.559*	*0.246*	*3.49*	*18,441*	*1.86*	*9,844*	*192.6*	*0.043*	*0.78*	*74.6*	*Foothill*
37	OC37	1.15	735	1.15	735	0.795	0.578	0.196	0.533	0.198	2.29	12,092	0.95	5,038	257.9	0.029	0.32	78.9	Mountain
58	SJ58	9.48	6,066	36.77	23,532	0.648	0.419	0.118	0.600	0.225	8.45	44,605	4.64	24,521	404.7	0.049	1.53	80.2	Mountain
59	OC59	1.10	706	2.45	1,569	0.448	0.284	0.073	0.156	0.064	2.17	11,463	0.91	4,810	255.4	0.020	0.22	90.5	Valley Developed
60	*SJ60*	*6.27*	*4,013*	*20.48*	*13,106*	*0.855*	*0.642*	*0.251*	*0.600*	*0.245*	*8.86*	*46,766*	*4.75*	*25,102*	*231.1*	*0.049*	*1.75*	*74.0*	*Mountain*
63	*SJ63*	*3.33*	*2,132*	*11.00*	*7,039*	*0.776*	*0.549*	*0.173*	*0.471*	*0.195*	*4.01*	*21,151*	*2.33*	*12,277*	*141.7*	*0.043*	*0.93*	*80.6*	*Foothill*
64	TC64	3.90	2,495	36.78	23,538	0.646	0.462	0.172	0.395	0.164	5.57	29,409	2.53	13,343	99.0	0.035	0.95	82.0	Foothill

Note: Rows in italics have changed from Baseline Conditions

Table 3-5 Hydrologic Parameters for the San Mateo Creek Watershed, Ranch Plan Alternative

GIS Sub-basin	HEC-1 Node	Areas				Soils					Watercourse Lengths				Slope	Sub-basin Roughness n-value	Lag Time (hrs)	Average Curve Number (AMC II)	LAPRE-1
		Sub-basin		Upstream Drainage		Low Loss Fraction			Maximum Loss Rate (in/hr)		Longest		To Centroid						
		(mi^2)	(acres)	(mi^2)	(acres)	2-year	10-year	100-year	2-year	10-year & 100-year	(mi)	(ft)	(mi)	(ft)	(ft/mi)				S-graph Type
38	SM38	4.29	2,748	4.29	2,748	0.556	0.333	0.077	0.323	0.135	3.85	20,335	1.65	8,737	119.3	0.030	0.59	82.9	Valley Developed
39	SM39	2.72	1,739	20.65	13,213	0.718	0.482	0.146	0.600	0.252	3.37	17,810	1.47	7,753	393.9	0.050	0.71	77.1	Mountain
40	SM40	5.99	3,833	26.64	17,047	0.673	0.432	0.118	0.600	0.248	5.54	29,276	2.71	14,334	366.3	0.045	0.99	78.0	Mountain
41	SM41	5.28	3,382	55.64	35,612	0.774	0.534	0.164	0.600	0.242	4.66	24,590	1.95	10,282	450.9	0.050	0.87	78.1	Mountain
42	SM42	5.16	3,300	50.36	32,230	0.650	0.411	0.105	0.600	0.218	5.26	27,776	2.67	14,111	602.5	0.050	0.97	81.5	Mountain
43	*CC43*	*4.30*	*2,753*	*32.12*	*20,556*	*0.774*	*0.543*	*0.169*	*0.555*	*0.200*	*4.39*	*23,180*	*2.10*	*11,066*	*141.2*	*0.040*	*0.87*	*80.9*	*Valley Undeveloped*
44	SM44	16.46	10,535	80.65	51,616	0.734	0.492	0.144	0.600	0.245	9.48	50,077	4.78	25,237	207.9	0.050	1.85	77.8	Mountain
45	*CC45*	*3.61*	*2,309*	*19.10*	*12,222*	*0.834*	*0.609*	*0.205*	*0.546*	*0.215*	*3.69*	*19,501*	*1.64*	*8,666*	*196.3*	*0.036*	*0.62*	*77.9*	*Valley Undeveloped*
46	SM46	4.65	2,977	133.22	85,263	0.784	0.552	0.171	0.568	0.216	4.60	24,288	2.26	11,939	129.8	0.035	0.81	80.6	Valley Undeveloped
47	*CC47*	*8.72*	*5,581*	*27.82*	*17,803*	*0.769*	*0.533*	*0.166*	*0.570*	*0.207*	*10.08*	*53,235*	*5.34*	*28,198*	*224.2*	*0.038*	*1.48*	*79.8*	*Mountain*
48	*CC48*	*3.26*	*2,084*	*15.49*	*9,913*	*0.806*	*0.576*	*0.189*	*0.542*	*0.205*	*4.02*	*21,250*	*1.51*	*7,957*	*190.8*	*0.034*	*0.59*	*79.2*	*Valley Undeveloped*
49	*CC49*	*5.07*	*3,245*	*5.07*	*3,245*	*0.860*	*0.644*	*0.237*	*0.591*	*0.243*	*5.82*	*30,740*	*2.68*	*14,145*	*255.3*	*0.043*	*1.02*	*75.5*	*Mountain*
50	SM50	3.50	2,240	64.19	41,082	0.768	0.532	0.162	0.600	0.227	4.30	22,692	1.91	10,071	418.3	0.050	0.85	79.9	Mountain
51	*CC51*	*7.16*	*4,585*	*7.16*	*4,585*	*0.821*	*0.597*	*0.208*	*0.599*	*0.237*	*6.80*	*35,893*	*3.46*	*18,266*	*303.1*	*0.045*	*1.21*	*77.0*	*Mountain*
52	SM52	3.70	2,365	3.70	2,365	0.630	0.397	0.105	0.488	0.201	3.86	20,356	2.04	10,784	143.0	0.035	0.72	79.1	Valley Developed
53	SM53	6.84	4,380	45.20	28,930	0.734	0.495	0.151	0.600	0.252	5.54	29,244	2.79	14,746	255.9	0.040	0.95	76.3	Valley Undeveloped
54	SM54	5.05	3,230	60.69	38,841	0.662	0.422	0.110	0.600	0.226	5.70	30,116	3.10	16,355	354.3	0.050	1.17	80.3	Mountain
55	SM55	1.64	1,048	9.63	6,161	0.686	0.444	0.121	0.600	0.245	3.48	18,371	1.88	9,922	316.8	0.035	0.57	78.8	Mountain
56	SM56	8.30	5,312	17.93	11,474	0.683	0.442	0.124	0.565	0.242	5.92	31,283	3.22	16,976	274.7	0.040	1.01	77.0	Mountain
57	SM57	4.55	2,914	38.36	24,550	0.705	0.467	0.134	0.600	0.234	3.75	19,823	1.12	5,917	446.5	0.050	0.65	79.5	Mountain
61	SM61	15.80	10,114	96.45	61,730	0.791	0.555	0.174	0.596	0.208	9.93	52,445	4.97	26,216	172.1	0.040	1.59	80.4	Valley Undeveloped
62	SM62	7.17	4,590	33.81	21,636	0.670	0.428	0.116	0.600	0.248	5.82	30,752	2.97	15,686	359.9	0.050	1.16	77.9	Mountain

Note: Rows in italics have changed from Baseline Conditions

3.2.4 Storm Event Runoff

The 2-year, 10-year, and 100-year storm events were analyzed the constructed HEC-1 watershed models. Figures 3-5 through 3-10 show predicted San Juan and San Mateo hydrographs for the 2-, 10-, and 100-year events at the Pacific Ocean river mouth. Hydrographs are shown for baseline (existing) conditions of development and for the Ranch Plan. As seen in the figures, model results suggest that the proposed development does not significantly impact hydrographs at the downstream confluence (the Pacific Ocean). Total runoff volumes at the Pacific Ocean outlet of the San Juan and San Mateo watersheds are provided for the Baseline and Ranch Plan land use conditions under the three modeled storm events in Table 3-10. The influence of development is most apparent during the smaller, more frequent events (i.e. the 2-year event). As seen in Table 3-9, peak discharge at the mouth of the San Juan Creek increases by 6% for the 2-year event and 1% for the 100-year event. Runoff volume increases by 2% for the 2-year event and 0.3% for the 100-year event (Table 3-9).

The Ranch Plan focuses development along the main branch of the San Juan Creek in the San Juan Watershed, and along Cristianitos Creek in the San Mateo Watershed. Table 3-6 provides peak discharges at key locations along the creeks. Tables 3-7 and 3-8 indicated the times at which peak flows exited the sub-basins for simulated Existing Conditions and the Ranch Plan, respectively. Times along the main San Juan Creek and Cristianitos Creek, at the confluence with the various sub-basins, are also provided for reference. Since all of the proposed development and open space in the Rancho Mission Viejo is within the Cristianitos Creek watershed, comparative peak times along the main San Mateo Creek channel are not examined. Peak discharge from the listed San Juan canyons experienced their peak flow rates prior to the passing of peak flow along the main San Juan Creek under Existing Conditions and also under the proposed Ranch Plan. Within the San Mateo Watershed, sub-basin peaks also occurred prior to the passing of the mainstem Cristianitos Creek peak discharge.

3.3 POTENTIAL IMPACT OF THE RANCH PLAN ON INDIVIDUAL SUB-BASINS

Proposed development is focused in distinct Planning Areas, limited to specific sub-basins. Therefore, analysis of discharge hydrographs from individual sub-basins provides a useful analysis tool. The remainder of this section provides a brief overview of individual sub-basins in which land use would be altered under the Ranch Plan. Within the San Juan Watershed, sub-basins discussed include Verdugo Canyon, Canada Gobernadora, Canada Chiquita, the Central San Juan Catchments and the Horno Creek Canyon. Within the San Mateo Watershed, sub-basins of interest include La Paz Canyon, Upper and Lower Gabino Canyon, Upper Cristianitos Canyon and Talega Canyon. More detailed sub-basin descriptions are provided in the 2001 PWA Technical Appendix.

3.3.1 Verdugo Canyon

The Verdugo Canyon (4.80 mi^2) sub-basin is located in the eastern central portion of the San Juan basin, just south of the Lucas Canyon basin. This canyon is represented by sub-basin 9 in Figure 1-3 and node SJ9 in the HEC-1 network of Figure 2-1.

Table 3-6 Peak Discharge on San Juan Creek and Cristianitos Creek

	HEC-1 node	Peak Discharge, cfs					
		Existing Conditions			Ranch Plan		
SAN JUAN CREEK		***2-Year***	***10-Year***	***100-Year***	***2-Year***	***10-Year***	***100-Year***
D/S of Long Canyon	CSJ10	1,106	3,720	7,103	1,106	3,720	7,103
D/S of Lion Canyon	cSJ24	1,380	4,949	10,430	1,380	4,949	10,430
D/S of Lucas Canyon	CSJ3	1,806	7,348	17,622	1,806	7,348	17,622
U/S of Bell Canyon at Verdugo	cSJ9	1,832	7,531	18,420	1,832	7,532	18,447
at confluence w/central SJ catchments	cSJ13	2,441	10,145	25,304	2,453	10,110	25,153
D/S of Canada Gobernadora	CSJ63	2,502	11,131	28,059	2,515	11,344	28,272
U/S of Canada Chiquita	ERSJ8	2,499	11,111	28,011	2,514	11,236	28,080
D/S of Horno Creek	CSJ20	2,786	13,332	33,190	2,629	13,754	33,755
U/S of Trabuco Creek	LRSJ25	2,782	13,339	33,397	2,838	13,853	34,041
San Juan at Pacific Ocean	cSJ18	3,978	17,614	49,085	4,217	18,421	49,741
CRISTIANITOS CREEK							
upper Gabino	CCC49	534	2,461	4,836	548	2,485	4,882
D/S of Gabino Canyon	CCC45	583	2,900	6,444	596	2,929	6,482
D/S of Talega Canyon	cCC47	711	3,634	8,556	732	3,672	8,612
U/S of San Mateo Creek confluence	cCC43	729	3,868	9,370	751	3,935	9,471
San Mateo at Pacific Ocean	cSM46	2,980	13,155	33,228	2,984	13,149	33,190

Table 3-7 Peak Flow Timing, Baseline Conditions

Sub-basin	GIS	Peak Flow Time in Sub-basin (DAY # HH:MM from beginning of model)			GIS	Peak Flow Time on Main Stem @ Sub-basin Confluence (DAY # HH:MM)			Sub-basin Peak Timing Relative to Main Stem (Hours)		
		2-year	10-year	100-year		2-year	10-year	100-year	2-year	10-year	100-year
VERDUGO	SJ9	Day 1 16:50	Day 1 16:40	Day 1 16:40	LRSJ9	Day 1 22:00	Day 1 20:20	Day 1 19:10	-5.17	-3.67	-2.50
GOBERNADORA	cSJ63	Day 1 17:20	Day 1 17:10	Day 1 17:10	cSJ13	Day 1 22:00	Day 1 19:10	Day 1 18:40	-4.67	-2.00	-1.50
CHIQUITA	SJ31 + SJ8	Day 1 17:10	Day 1 17:10	Day 1 17:10	ERSJ8	Day 1 22:10	Day 1 17:20	Day 1 17:20	-5.00	-0.17	-0.17
CENTRAL SJ	SJ13	Day 1 16:50	Day 1 16:50	Day 1 16:50	RSJ13	Day 1 22:00	Day 1 19:20	Day 1 18:50	-5.17	-2.50	-2.00
SAN JUAN @ PACIFIC	cSJ18	Day 1 18:00	Day 1 18:00	Day 1 18:00							
CRISTIANITOS	CC45	Day 1 16:40	Day 1 16:40	Day 1 16:40							
LA PAZ	CC51	Day 1 16:50	Day 1 16:40	Day 1 16:50							
GABINO	cCC48	Day 1 17:40	Day 1 17:20	Day 1 17:20							
TALEGA	CC47	Day 1 17:00	Day 1 17:00	Day 1 17:00							
SAN MATEO @ PACIFIC	cSM46	Day 2 2:50	Day 2 0:00	Day 1 21:40							

Table 3-8 Peak Flow Timing, Ranch Plan

Sub-basin	GIS	Peak Flow Time in Sub-basin (DAY # HH:MM from beginning of model)			GIS	Peak Flow Time on Main Stem @ Sub-basin Confluence (DAY # HH:MM)			Sub-basin Peak Timing Relative to Main Stem (Hours)		
		2-year	10-year	100-year		2-year	10-year	100-year	2-year	10-year	100-year
VERDUGO	SJ9	Day 1 16:40	Day 1 16:40	Day 1 16:40	LRSJ9	Day 1 22:00	Day 1 20:20	Day 1 19:10	-5.33	-3.67	-2.50
GOBERNADORA	cSJ63	Day 1 17:30	Day 1 17:00	Day 1 17:00	cSJ13	Day 1 22:00	Day 1 19:10	Day 1 18:30	-4.50	-2.17	-1.50
CHIQUITA	SJ31 + SJ8	Day 1 17:10	Day 1 17:00	Day 1 17:00	ERSJ8	Day 1 17:10	Day 1 17:20	Day 1 17:10	0.00	-0.33	-0.17
CENTRAL SJ	SJ13	Day 1 16:40	Day 1 16:40	Day 1 16:40	RSJ13	Day 1 22:00	Day 1 19:20	Day 1 17:10	-5.33	-2.67	-0.50
SAN JUAN @ PACIFIC	cSJ18	Day 1 18:00	Day 1 17:50	Day 1 17:50							
CRISTIANITOS	CC45	Day 1 16:30	Day 1 16:30	Day 1 16:30							
LA PAZ	CC51	Day 1 16:50	Day 1 16:40	Day 1 16:50							
GABINO	cCC48	Day 1 17:40	Day 1 17:20	Day 1 17:10							
TALEGA	CC47	Day 1 17:00	Day 1 17:00	Day 1 17:00							
SAN MATEO @ PACIFIC	cSM46	Day 2 2:40	Day 2 0:00	Day 1 21:40							

Table 3-9 Peak Discharges Within the San Juan and San Mateo Creek Watersheds - Baseline, Ranch Plan & Alt B9

	Sub-basin Name		Peak Discharge, cfs															
			Baseline Conditions			Alternative B4 (The Ranch Plan)						Alternative B9					
	GIS	HEC-1	2-year event	10-year event	100-year event	2-year event	percent increase 2-year	10-year event	percent increase 10-year	100-year event	percent increase 100-year	2-year event	percent increase 2-year	10-year event	percent increase 10-year	100-year event	percent increase 100-year
SAN JUAN WATERSHED																	
Lucas Canyon	3	SJ3	224	1,025	2,291	224	0	1,025	0	2,291	0	224	0	1,025	0	2,291	0
Verdugo Canyon	9	SJ9	79	510	1,242	80	1	522	2	1,263	2	98	24	576	13	1,329	7
Bell Canyon	1	SJ1	545	1,777	3,303	545	0	1,777	0	3,303	0	545	0	1,777	0	3,303	0
	34	SJ34	403	1,641	3,325	403	0	1,641	0	3,325	0	403	0	1,640	0	3,325	0
		cSJ60	597	2,575	6,026	597	0	2,575	0	6,026	0	597	0	2,574	0	6,026	0
Canada Gobernadora	7	SJ7	391	1,397	2,299	391	0	1,388	-1	2,299	0	392	0	1,388	-1	2,299	0
	35	SJ35	179	738	1,369	177	-1	727	-1	1,352	-1	177	-1	727	-1	1,352	-1
(Wagon Wheel Canyon)	36	SJ36	127	528	988	123	-3	527	0	987	0	123	-3	527	0	987	0
		cSJ63	767	3,157	5,700	749	-2	3,209	2	5,962	5	749	-2	3,244	3	6,004	5
Canada Chiquita	31	SJ31	320	1,298	2,447	266	-17	1,242	-4	2,340	-4	320	0	1,290	-1	2,448	0
	8	SJ8	81	432	1,087	102	25	493	14	1,174	8	91	12	477	10	1,163	7
		SJ8+SJ31	401	1,730	3,530	364	-9	1,728	0	3,514	0	409	2	1,737	0	3,581	1
Central San Juan Catchments	13	SJ13	111	748	1,918	227	105	1,124	50	2,291	19	196	77	1,156	54	2,355	23
San Juan Creek at the Pacific Ocean		cSJ18	3,978	17,614	49,085	4,217	6	18,421	5	49,741	1	4,191	5	18,416	5	49,715	1
SAN MATEO WATERSHED																	
La Paz Canyon	51	CC51	323	1,386	2,784	323	0	1,386	0	2,784	0	323	0	1,386	0	2,784	0
Upper Gabino Canyon	49	CC49	229	1,075	2,085	243	6	1,100	2	2,131	2	231	1	1,085	1	2,104	1
Lower Gabino Canyon with Blind Canyon	48	CC48	156	742	1,458	184	18	853	15	1,591	9	184	18	841	13	1,566	7
Upper Cristianitos Canyon	45	CC45	146	758	1,542	166	13	839	11	1,616	5	146	0	758	0	1,541	0
Talega Canyon	47	CC47	238	1,160	2,540	256	8	1,188	2	2,577	1	254	7	1,185	2	2,577	1
San Mateo Creek at the Pacific Ocean		cSM46	2,980	13,155	33,228	2,984	0	13,149	0	33,190	0	2,983	0	13,155	0	33,211	0

Note: Percent increase refers to percent increase in peak discharge as compared with Baseline Conditions. A negative value indicates that the Baseline Conditions had a higher peak flow. Values are rounded to the nearest percent.

Table 3-10 Runoff Volumes Within the San Juan and San Mateo Creek Watersheds - Baseline, Ranch Plan & Alt B9

	Sub-basin Name		Runoff Volume, acre-feet														
			Baseline Conditions			Alternative B4 (The Ranch Plan)						Alternative B9					
	GIS	HEC-1	2-year event	10-year event	100-year event	2-year event	percent increase 2-year	10-year event	percent increase 10-year	100-year event	percent increase 100-year	2-year event	percent increase 2-year	10-year event	percent increase 10-year	100-year event	percent increase 100-year
SAN JUAN WATERSHED																	
Lucas Canyon	3	SJ3	191	783	1,936	191	0	783	0	1,936	0	191	0	783	0	1,936	0
Verdugo Canyon	9	SJ9	59	309	907	59	0	312	1	913	1	69	17	332	7	926	2
Bell Canyon		cSJ60	548	2,130	5,106	548	0	2,130	0	5,106	0	548	0	2,130	0	5,106	0
Wagon Wheel Canyon	36	SJ36	23	115	323	22	-3	114	-1	322	0	22	-4	114	-1	322	0
Canada Gobernadora		cSJ63	195	835	2,105	207	6	856	3	2,122	1	207	6	860	3	2,126	1
Canada Chiquita	8 & 31	SJ31+SJ8	130	630	1,715	136	4	635	1	1,715	0	135	4	640	2	1,728	1
Central San Juan Catchments	13	SJ13	75	415	1,273	138	84	554	33	1368	7	115	53	534	29	1,368	7
San Juan Creek at the Pacific Ocean		cSJ18	5,298	19,317	44,880	5,386	2	19,492	1	45,002	0	5,372	1	19,498	1	45,031	0
SAN MATEO WATERSHED																	
La Paz Canyon	51	CC51	120	565	1,474	120	0	565	0	1,474	0	120	0	565	0	1,474	0
Upper Gabino Canyon	49	CC49	64	341	928	67	4	343	1	934	1	64	0	341	0	928	0
Lower Gabino Canyon with Blind Canyon	48	CC48	49	235	623	53	7	245	4	632	1	56	14	252	7	637	2
Upper Cristianitos Canyon	45	CC45	47	242	682	51	8	254	5	690	1	47	0	242	0	682	0
Talega Canyon	47	CC47	156	710	1,818	165	6	724	2	1,832	1	165	6	724	2	1,832	1
San Mateo Creek at the Pacific Ocean		cSM46	3,808	15,227	36,967	3,827	0	15,265	0	37,003	0	3,823	0	15,258	0	36,995	0

Note: Percent increase refers to percent increase in runoff volume as compared with Baseline Conditions. A negative percent increase implies that Baseline Conditions resulted in higher volumes of flow.

Existing land use within the canyon is primarily natural consisting of sage scrub and chaparral. As seen in Table 3-3, 99.8% of the sub-basin is currently undeveloped. The Ranch Plan will develop approximately 2% of the sub-basin. The impact of the land use changes on sub-basin hydrologic parameters and runoff is minimal. The assumed soil moisture condition (Antecedent Moisture Condition (AMC) II) curve number increases from 74.8 to 75.1. Higher curve numbers imply that a larger percentage of the precipitation volume will appear as runoff, and not infiltrate.

Low loss fractions and maximum loss rates slightly decrease with implementation of the Ranch Plan. The model indicates that peak discharges increase less than 3% (Table 3-9) and discharge volumes increase less than 1% (Table 3-10).

3.3.2 Cañada Gobernadora

The Cañada Gobernadora subarea is represented by sub-basins 7, 35, and 63 in Figure 1-3 and nodes SJ7, SJ35, and SJ63 in the HEC-1 network of Figure 2-1. The Wagon Wheel Canyon tributary to Cañada Gobernadora is represented by sub-basin 36 and HEC-1 node SJ36.

The predominant vegetation types in the existing non-developed or non-agricultural portions of the sub-basin are sage and chaparral. In terms of hydrologic parameters, Cañada Gobernadora is interesting and complex in that it contains both the largest existing developed area (located in the upper reaches of the watershed, within sub-basins 7 and 35) and some of the highest infiltrating soils in the project sub-basins. The Ranch Plan proposes residential development in sub-basin 63 (Table 3-4). As a result of the development increase, runoff curve numbers increase from 78.6 (Existing Conditions) to 80.6 in sub-basin 63.

Simulated discharge for the Baseline and Ranch Plan land use conditions are given in Table 3-9 at the HEC-1 node cSJ63, which is located in the downstream reaches of Gobernadora, prior to the confluence with San Juan Creek. As seen in Table 3-9, the model predicts that the peak discharge will actually decrease for the Ranch Plan 2-year simulations, due to runoff exiting the sub-basin more quickly than for the Baseline simulation. However the total volume of flow is increased by 6 % (Table 3-10).

3.3.3 Cañada Chiquita

Cañada Chiquita is represented by sub-basins 8 and 31 (SJ8 and SJ31 in the HEC-1 model), which also include the Narrow Canyon area. The combined drainage area of sub-basins 31 and 8 is 9.24 mi^2. Existing land use consists of primarily agricultural and undeveloped regions (Table 3-3). The Ranch Plan proposes residential and urban commercial uses.

Similar to the 2-year event at Cañada Gobernadora, peak flows are predicted to decrease under the Ranch Plan. The peak decrease is due to the faster arrival of runoff at the sub-basin confluence. Discharge volumes for the Ranch Plan are consistently larger (up to about 2% higher) than existing volumes (Table 3-10). The Ranch Plan hydrographs are of similar shape as Existing Conditions hydrographs, consisting of a quick rise to peak flow.

3.3.4 Central San Juan Catchments

These Central San Juan catchments are collectively represented by sub-basin 13 in Figure 1-3 and node SJ13 in the HEC-1 network in Figure 2-1. The tributaries of the Central San Juan catchments enter San Juan Creek at various locations along the 19,617 ft reach through this sub-basin. However, the HEC-1 hydrology model approximates this by assuming that the tributaries all meet San Juan Creek at the downstream end of this sub-basin. This type of spatial averaging, or "bulk" runoff generation method of HEC-1 was used for all of the sub-basins analyzed in this study. It is required to allow aggregating the detailed location/function of numerous tributaries into a reasonable number of watershed subbasins for computation. The other studied sub-basins considered in this report typically consist of a single canyon whose discharge joins the San Juan Creek at a single confluence. The effects of the discharge on San Juan Creek occur primarily at the canyon-creek confluence point. By contrast, within the Central San Juan Catchments, the effects of surface runoff will be distributed along the reach of the main San Juan Creek channel. For this reason, the following results that characterize the sub-basin runoff and the effect of this runoff upon the flows in San Juan Creek should be interpreted cautiously. However, while this required regionalization results in some loss of detail, it does not greatly alter the ability of the model to assess the project impacts or to compare various alternatives to the baseline conditions.

Currently, the predominant vegetation types in the non-developed and non-agricultural lands of the sub-basin are sage, chaparral, and woodland. Existing development (4.2% of the sub-basin, Table 3-3) occurs primarily near the San Juan Creek. The East Ortega, Gobernadora and Trampas Planning Areas will be developed under the Ranch Plan, resulting in creation of residential zones and commercial/industrial developments, located primarily in regions of already existing development. Over 54% of the Catchments will be developed under the Ranch Plan (Table 3-3).

The proposed development significantly impacts runoff from storm events, increasing peak discharge by 105%, 50%, and 19% for the 2-, 10- and 100-year events, respectively (Table 3-9). Runoff is increased by 84%, 33% and 7% for those same events (Table 3-10).

3.3.5 Horno Creek Canyon

Horno Canyon is represented in the San Juan model as node SJ20 (Figure 2-1) and is identified as sub-basin 20 within Figure 1-3. Sub-basin 20 is approximately 4.8 mi^2 in area. The Horno Creek basin is 78.8% developed and 5.3% agricultural (Table 3-3) in the Existing Condition. The Ranch Plan will increase development to 79.5% with the addition of residential zones in Planning Area 1. Due to the small increase in development, storm event runoff volume did not change appreciably. Runoff peaks, however, increase by 15% under the Ranch Plan (for the 2-year event). The discharge increases are mitigated by the recently developed Ladera Ranch Horno Creek Basin, which was not included in the HEC-1 model.

3.3.6 La Paz Canyon

The La Paz Canyon, in the San Mateo Watershed, is represented by sub-basin 51 in Figure 1-3 and node CC51 in the San Mateo HEC-1 network in Figure 2-2. La Paz Canyon is nearly entirely undeveloped (99.6%). Agricultural and developed lands (mostly roads) cover approximately 0.4% of the sub-basin.

The predominant vegetation types in the sub-basin are sage, chaparral, and grassland. The Ranch Plan does not significantly alter the landscape, increasing developed zones from 0.3% (Existing Conditions) to 0.7% (with the Ranch Plan). The sub-basin will remain 99.3% undeveloped (Table 3-3).

As seen Tables 3-9 and 3-10, the Ranch Plan model does not indicate peak or volumetric increase.

3.3.7 Upper Gabino Canyon

The hydrology of Gabino Canyon was analyzed as part of the San Mateo watershed HEC-1 model. Upper Gabino Canyon was represented by hydrologic sub-basin 49 in Figure 1-3 and node CC49 in the San Mateo HEC-1 network in Figure 2-2. The area of Upper Gabino is 5 mi^2. Existing land use consists primarily of grassland. 99.9% of the sub-basin is undeveloped under Existing Conditions (Table 3-3). Under the Ranch Plan, undeveloped lands will decrease to 91.4% of the sub-basin area. 8.5% of the sub-basin will be developed. Planned development is low-impact rural residential and a golf course, therefore hydrologic parameters do not change significantly. The average sub-basin curve-number increases only slightly from 75.1 to 75.5.

Storm runoff was calculated for upper Gabino Canyon under Existing and Ranch Plan land use conditions. Peak flows increase by 6% for the 2-year event and event volumes increase by 4% for the same event.

3.3.8 Lower Gabino with Blind Canyon

They hydrology of the lower Gabino canyons were evaluated as part of the San Mateo watershed HEC-1 model. The 3.3 mi^2 sub-area is represented by sub-basin 48 in Figure 1-3 and node CC48 in the Figure 2-2 HEC-1 network. Under existing conditions, this region is primarily (93%) undeveloped (Table 3-3). The Ranch Plan increases developed areas from 3.3% (under Existing Conditions) to 42.4% of the sub-basin (under the Ranch Plan). A majority of the development occurs as Rural and Single Family Residential. Average basin curve numbers increase only slightly from 78.3 to 79.2.

Peak runoff increases by 7% for the 2-year event (see Table 3-10) and 1% for the 100-year event. Discharge volumes increase by 18%, 15% and 9% for the 2-, 10- and 100-year events, respectively.

3.3.9 Upper Cristianitos Canyon

The hydrology of Cristianitos Canyon was analyzed as part of the San Mateo watershed HEC-1 model. This 3.5 mi^2 canyon is represented by sub-basin 45 in Figure 1-3 and node CC45 in the HEC-1 network in Figure 2-2. Under existing conditions, the predominant vegetation types in the sub-basin are grassland and sage. 97.2% of the sub-basin is currently undeveloped. The Ranch Plan reduces the undeveloped regions to 69% of the sub-basin area and increases developed regions from 0% to 30% of the basin (Table 3-3). The development focuses on low-impact residential and creation of open spaces. Therefore the resulting impact on basin hydrology is minimal.

Similar to the other sub-basins, the 2-year event runoff is affected to the largest extent. Peak discharge is increased by 13% (Table 3-9) and basin runoff is increased by 8% (Table 3-10).

3.3.10 Talega Canyon

The hydrology of Talega Canyon was analyzed as part of the San Mateo watershed HEC-1 model. This area is approximately 8.4 mi^2 and is represented by sub-basin 47 in Figure 1-3 and node CC47 in the HEC-1 network in Figure 2-2. As with much of the San Mateo watershed, Talega Canyon is primarily undeveloped (98.9%) with 1.1% of developed area (Table 3-3). The predominant vegetation is sage scrub. Single family, rural residential, and a golf course/resort zone will be created under the Ranch Plan, increasing development to 13% of the sub-basin.

A comparison of 2-year, 10-year and 100-year discharge peaks and volumes are presented in Tables 3-9 and 3-10, respectively. Ranch plan peak discharges are 8% higher than Existing Conditions, for the 2-year event. For the same event, discharge volume increased by 6%.

4. HYDROLOGIC ANALYSIS OF OTHER LAND USE ALTERNATIVES

4.1 PLAN DESCRIPTIONS

In addition to the Ranch Plan, six other land use alternatives were included in the hydrologic analysis. Brief summaries of each plan are included within this section.

•Plan B5: The purpose of Alternative B-5 is to avoid new development within the San Mateo Creek Watershed and to locate all new development with the San Juan Creek Watershed. Figure 4-1 illustrates the land uses for this plan.

•Plan B6: Alternative B-6 avoids new development with the Chiquita and Verdugo sub-basins. The plan concentrates development in the San Juan watershed and previously disturbed regions of the San Mateo watershed (Figure 4-2)

•Plan B8: The intent of Alternative B-8 is to avoid new development in Chiquita sub-basin and the San Mateo watershed (Figure 4-3). Development is allowed adjacent to Ortega Highway and previously disturbed regions within Trampas and Gobernadora sub-basins.

•Plan B9: Alternative B9 avoids new development in the Cristianitos, Gabino and La Paz sub-basins in the San Juan watershed. The plan allows development in the lower Chiquita sub-basin, Gobernadora, Verdugo, Central San Juan and Trampas sub-basins. Development also is planned in Blind Canyon and Talega sub-basin of the San Mateo watershed. Plan B9 focuses on development in the San Juan watershed, while significantly limiting development in the San Mateo watershed. Land use for Plan B9 is illustrated in Figure 4-4.

•County Housing Plan: The County Housing Plan avoids new development in the Upper Gabino and La Paz Canyon sub-basins (Figure 4-5). This plan provides for protected open space in Upper Verdugo, Upper Cañada Chiquita and Upper Gobernadora sub-basins. Additionally, the plan allows for the potential avoidance of development in the Middle and Lower Cañada Chiquita sub-basin and the San Mateo watershed under a Planning Reserve designation. Development is avoided in the northwestern portion of Cristianitos sub-basin.

•County Constraints Plan: The County Constraints Alternative avoids new development in the Upper Gabino and La Paz Canyons. Minimized development is allowed in the Cristianitos and Upper Chiquita sub-basins (Figure 4-6). The plan provides for protected open space in Upper Verdugo, Upper Cañada Chiquita and Upper Gobernadora sub-basins.

4.1.1 Level of Analysis

A detailed map of proposed land use was available for the proposed Ranch Plan. However, land use maps for the other alternatives were more general, and do not contain the level of refinement of the Ranch Plan.

The alternatives may be divided in three groups based on the level of detail available during model parameterization. The most detailed land use and grading maps were available for the Existing Conditions model and for the Ranch Plan (refer to Figures 3-1 and 3-2). Alternatives B5, B6, and B8 had an intermediate amount of detail available (Figures 4-1 through 4-3). Information was available regarding zones of proposed development, and within those zones, the acreages of certain land uses (i.e. Agriculture, Single Family Residential, Industrial). Using the Ranch Plan as a template, and via communication with EDAW, placement of specific land uses (for example, schools) was incorporated into GIS layers. Alternatives B9 and the two County Alternatives had the least land use detail available. Within these plans, only approximate zoning was available (Figures 4-4 through 4-6). Grading plans were provided for the East Ortega Planning Area for Alternative B9.

Rainfall-runoff models were created for Existing Conditions and the Ranch Plan (as presented in Section 3) and also for Alternative B9 (although available land use is not as detailed). Other alternatives are compared qualitatively to the detailed simulations by comparing land use within the Planning Areas and utilizing associated average curve numbers (Table 2-2) to predict the extent of runoff. The different levels of zoning detail within the alternatives make a direct comparison somewhat difficult. However, the overall nature and scale of impact can be assessed qualitatively.

4.2 HYDROLOGIC ANALYSIS OF ALTERNATIVE B9

The Rancho has identified 13 Planning Areas. These development bubbles were previously presented in Figure 3-2. Each proposed alternative focused development within a subset of the Planning Areas (1, 2, 3, 4, 5, 6, 7, 8, and 9). Qualitative descriptions of the remaining alternatives and the likely impact on rainfall runoff can be found in Section 4.3 (It should be recognized that these potential impacts do not include the effect of mitigation measures proposed to reduce the potential runoff impacts to a less than significant level).

4.2.1 Alternative B9 Proposed Land Use

Table 4-1 details land use within each of the Planning Areas, as proposed for the Ranch Plan and for Alternative B9. As seen in the table, Alternative B9 generally avoids development within the San Mateo watershed, aside from Planning Area 8. Within the San Juan Watershed, a higher concentration of Business Parks would exist under Alternative B9, compared to the Ranch Plan. The Business Parks are located in Planning Areas 1, 2, 3 and 8 in Alternative B9, resulting in 240 gross acres. Under the Ranch Plan, 80 acres of Business Park are proposed. Business Parks are associated with an increased imperviousness and therefore runoff may be expected to increase in these areas.

Alternative B9 allocates a larger fraction of the Ranch to Open Space (16,233 acres for B9, 15,121 acres for the Ranch Plan), a majority of which is located in the San Mateo Watershed. 7,293 acres are allocated for Residential Development under the Ranch Plan, 6,176 acres are proposed for Alternative B9. A majority of the Residential Development occurs within the San Juan Watershed, under both alternatives. Within the allocated Residential areas, Alternative B9 has a slightly higher density of Residential Units than the Ranch Plan.

Table 4-1 Land Use Comparison: Ranch Plan and Alternative B9

	The Ranch Plan													Alternative B9													
	Residential		Urban Activity Center		Neighborhood Center		Business Park		Golf Resort	Open Space Use			Planning Area Totals	Residential		Urban Activity Center		Neighborhood Center		Business Park		Golf Resort	Open Space Use			Planning Area Totals
Planning Area	Gross Acres	Maximum Dwelling Units	Gross Acres	Maximum Square Footage	Gross Acres	Maximum Square Footage	Gross Acres	Maximum Square Footage	Gross Acres	Internal Open Space Acres	Open Space Acres	Rancho Mission Viejo Regional Park Acres	Gross Acres	Gross Acres	Maximum Dwelling Units	Gross Acres	Maximum Square Footage	Gross Acres	Maximum Square Footage	Gross Acres	Maximum Square Footage	Gross Acres	Internal Open Space Acres	Open Space Acres	Rancho Mission Viejo Regional Park Acres	Gross Acres
1	451	1,020	89	1,190,000							148	122	810	453	1,020	47	560,000			40	610,000					540
2	985	1,550	40	610,000	5	50,000				650			1,680	565	1,290			10	100,000	40	610,000					615
3	1,957	5,630	122	1,680,000	10	100,000				149	115		2,353	1,908	5,630	44	480,000	10	100,000	80	1,220,000		129			2,171
4	211	150			5	50,000							216	1,241	2,000			10	100,000				49			1,300
5	1,181	2,440			10	100,000				159			1,350	1,181	2,440			10	100,000							1,191
6	263	110								45			308													0
7	843	1,480			10	100,000				497	92		1,442													0
8	982	1,400			10	100,000	80	1,220,000	20	172			1,264	828	1,220			10	100,000	80	1,220,000	25	350			1,293
9	420	220									8,852		9,272													0
10											845		845											15,705		15,705
11											1,015		1,015													
12											1,348		1,348													
13												912	912													
TOTAL	7,293		251		50		80		20	1,672	12,415	1,034	22,815	6,176		91		50		240		25	528	15,705	0	22,815

Source: EDAW, 3/29/04

4.2.2 Model Parameterization

The proposed land uses are illustrated in Figure 4-4. Within LAPRE-1 and the resulting HEC-1 model, the model parameters that describe rainfall runoff processes (curve #, basin n values, low loss fractions and maximum loss rates) were changed to account for the differences between existing and proposed conditions. For example, representation of the land use in the hydrologic models for each of the various planning alternatives is accomplished by assigning a "runoff curve number" to the particular development area. The method for assigning curve numbers, (which are used to estimate how much rainfall flows directly to the streams, and how much is infiltrated into the soil) is described in the OCHM (Table 2-2). A model curve number is assigned by combining the land use category with the local soil type in any given area (Figure 3-1). Tables 4-2 and 4-3 summarize hydrologic parameters used in the model, such as infiltration parameters and lag times. Values in Tables 4-2 and 4-3 may be compared with the values for Existing Conditions in Tables 3-1 and 3-2 and for the Ranch Plan (Tables 3-4 and 3-5). Sub-basins in which Alternative B9 altered hydrologic parameters from Existing Conditions are highlighted with italics in Tables 4-2 and 4-3. Watershed geometry was changed between the Existing Conditions and Alternative B9 to reflect plan grading. Grading plans were provided for the East Ortega bubble; other basin delineations were adapted from the Ranch Plan grading and from relevant Existing Conditions. Channel slopes and length of primary watercourse were retained from the baseline.

4.2.3 Model Results

The 2-year, 10-year, and 100-year storm events were analyzed using the constructed HEC-1 watershed models. Alternative B9 peak discharges are presented in Figures 4-8 through 4-13 for each canyon and each storm event. Baseline Conditions and the Ranch Plan are also shown for comparison. When comparing the land use scenarios, it is important to bear in mind that the level of land use detail available for model parameterization was quite different. Within Figures 4-8 through 4-13, the Baseline simulations had the highest level of detail. The Ranch Plan also had high detail available (refer to Figure 3-3). In general, results from the B9 simulations are comparable to those computed from the Ranch Plan and Baseline Conditions. Peak discharge values and runoff volumes are presented in Tables 3-9 and 3-10.

Table 4-2 Hydrologic Parameters for the San Juan Creek Watershed, Alternative B9

GIS Sub-basin	HEC-1 Node	Areas				Soils					Watercourse Lengths				Slope	Sub-basin Roughness n-value	Lag Time (hrs)	Average Curve Number (AMC II)	LAPRE-1
		Sub-basin		Upstream Drainage		Low Loss Fraction			Maximum Loss Rate (in/hr)		Longest		To Centroid						
		(mi^2)	(acres)	(mi^2)	(acres)	2-year	10-year	100-year	2-year	10-year & 100-year	(mi)	(ft)	(mi)	(ft)	(ft/mi)				S-graph Type
1	SJ1	5.12	3,276	5.12	3,276	0.592	0.367	0.094	0.600	0.208	5.47	28,862	2.68	14,154	605.0	0.050	0.99	82.2	Mountain
2	SJ2	6.18	3,955	6.18	3,955	0.675	0.433	0.118	0.600	0.243	6.23	32,898	2.26	11,921	280.1	0.045	1.01	77.4	Mountain
3	SJ3	7.17	4,586	50.11	32,073	0.727	0.492	0.149	0.599	0.231	7.99	42,179	4.35	22,963	324.4	0.049	1.52	78.8	Mountain
4	*TC4*	*4.63*	*2,966*	*30.34*	*19,420*	*0.683*	*0.481*	*0.157*	*0.389*	*0.165*	*7.07*	*37,324*	*3.42*	*18,039*	*130.9*	*0.036*	*1.15*	*82.6*	*Valley Undeveloped*
5	*SJ5*	*1.70*	*1,086*	*51.81*	*33,159*	*0.860*	*0.653*	*0.255*	*0.591*	*0.245*	*2.84*	*14,994*	*1.29*	*6,809*	*321.2*	*0.040*	*0.52*	*74.3*	*Foothill*
6	TC6	11.04	7,067	16.51	10,564	0.641	0.413	0.116	0.597	0.218	8.87	46,859	6.13	32,348	528.6	0.050	1.66	80.3	Mountain
7	*SJ7*	*3.00*	*1,922*	*3.00*	*1,922*	*0.734*	*0.544*	*0.199*	*0.425*	*0.191*	*3.17*	*16,737*	*1.35*	*7,148*	*183.2*	*0.025*	*0.39*	*79.3*	*Valley Undeveloped*
8	*SJ8*	*4.85*	*3,103*	*105.18*	*67,315*	*0.798*	*0.570*	*0.185*	*0.507*	*0.201*	*3.82*	*20,193*	*1.70*	*8,958*	*131.2*	*0.052*	*1.01*	*79.6*	*Valley Undeveloped*
9	*SJ9*	*4.77*	*3,052*	*56.58*	*36,211*	*0.818*	*0.599*	*0.219*	*0.553*	*0.230*	*6.02*	*31,810*	*2.88*	*15,200*	*353.4*	*0.045*	*1.05*	*76.1*	*Mountain*
10	SJ10	4.39	2,812	4.39	2,812	0.598	0.369	0.093	0.599	0.226	5.21	27,518	2.81	14,816	448.2	0.049	1.01	80.8	Mountain
11	OC11	2.00	1,280	16.28	10,422	0.609	0.427	0.142	0.353	0.137	3.68	19,405	1.74	9,182	87.5	0.025	0.52	84.3	Valley Developed
12	OC12	0.73	467	14.29	9,143	0.460	0.286	0.064	0.213	0.081	1.51	7,974	0.59	3,140	193.4	0.020	0.17	90.9	Valley Developed
13	*SJ13*	*7.63*	*4,884*	*84.72*	*54,221*	*0.786*	*0.560*	*0.182*	*0.398*	*0.166*	*4.48*	*23,649*	*1.84*	*9,718*	*148.0*	*0.027*	*0.56*	*79.9*	*Valley Developed*
14	OC14	1.00	642	13.56	8,675	0.488	0.311	0.076	0.237	0.086	1.36	7,172	0.49	2,566	256.0	0.020	0.14	89.9	Valley Developed
15	OC15	1.41	905	8.98	5,747	0.442	0.280	0.070	0.182	0.071	2.99	15,808	1.65	8,727	141.4	0.020	0.34	90.7	Valley Undeveloped
16	*TC16*	*2.54*	*1,623*	*32.88*	*21,044*	*0.691*	*0.490*	*0.178*	*0.410*	*0.157*	*2.96*	*15,628*	*1.31*	*6,898*	*162.9*	*0.027*	*0.41*	*81.1*	*Valley Undeveloped*
17	TC17	1.70	1,090	54.77	35,051	0.596	0.413	0.134	0.305	0.139	2.98	15,713	1.38	7,271	131.2	0.025	0.41	85.0	Valley Developed
18	SJ18	5.34	3,418	175.99	112,631	0.541	0.354	0.093	0.280	0.114	4.52	23,865	2.31	12,205	129.2	0.025	0.57	88.2	Valley Developed
19	OC19	3.57	2,287	12.55	8,034	0.427	0.261	0.055	0.170	0.062	4.76	25,117	2.58	13,610	112.4	0.024	0.62	91.8	Valley Developed
20	*SJ20*	*4.78*	*3,061*	*4.78*	*3,061*	*0.669*	*0.441*	*0.114*	*0.350*	*0.127*	*6.33*	*33,429*	*3.37*	*17,815*	*130.1*	*0.032*	*0.97*	*85.6*	*Valley Developed*
21	*SJ21*	*4.38*	*2,806*	*109.56*	*70,121*	*0.668*	*0.459*	*0.137*	*0.433*	*0.164*	*4.37*	*23,076*	*1.81*	*9,556*	*240.2*	*0.039*	*0.73*	*84.0*	*Valley Developed*
22	OC22	3.95	2,531	7.56	4,841	0.390	0.237	0.050	0.140	0.053	4.13	21,806	1.62	8,530	174.0	0.021	0.40	92.5	Valley Undeveloped
23	SJ23	7.83	5,013	27.29	17,466	0.700	0.460	0.130	0.600	0.225	5.99	31,606	2.73	14,413	385.9	0.050	1.11	80.0	Mountain
24	SJ24	8.88	5,685	19.46	12,453	0.640	0.405	0.107	0.599	0.226	4.48	23,651	1.59	8,374	426.3	0.049	0.79	80.0	Mountain
25	SJ25	1.53	981	115.88	74,162	0.710	0.503	0.164	0.468	0.180	2.46	12,991	1.26	6,656	297.4	0.030	0.37	81.8	Valley Developed
26	TC26	8.30	5,315	24.81	15,879	0.741	0.531	0.185	0.463	0.187	6.98	36,831	4.08	21,549	226.2	0.037	1.12	79.6	Mountain
27	0C27	1.16	742	3.61	2,311	0.515	0.357	0.120	0.222	0.096	1.72	9,070	0.78	4,138	185.3	0.020	0.20	86.7	Valley Developed
28	SJ28	4.01	2,565	42.95	27,487	0.864	0.664	0.276	0.590	0.248	4.36	23,001	2.23	11,768	274.9	0.050	0.97	72.8	Mountain
29	SJ29	2.17	1,391	38.94	24,923	0.760	0.528	0.171	0.599	0.236	5.08	26,835	2.22	11,738	519.6	0.050	0.92	78.0	Mountain
30	TC30	5.46	3,497	5.46	3,497	0.608	0.379	0.099	0.600	0.222	4.49	23,716	2.27	12,006	545.6	0.050	0.88	80.2	Mountain
31	*SJ31*	*4.58*	*2,929*	*4.58*	*2,929*	*0.841*	*0.615*	*0.206*	*0.586*	*0.252*	*5.59*	*29,538*	*2.46*	*12,966*	*144.9*	*0.046*	*1.16*	*77.7*	*Foothill*
32	TC32	0.90	576	25.71	16,455	0.762	0.589	0.282	0.482	0.207	2.48	13,082	1.23	6,500	136.4	0.029	0.42	73.4	Valley Undeveloped
33	OC33	0.20	128	1.35	862	0.485	0.312	0.079	0.208	0.079	0.60	3,187	0.32	1,687	255.4	0.025	0.11	89.7	Valley Undeveloped
34	*SJ34*	*9.09*	*5,817*	*14.21*	*9,092*	*0.762*	*0.540*	*0.179*	*0.556*	*0.214*	*6.86*	*36,241*	*3.48*	*18,360*	*360.9*	*0.050*	*1.30*	*78.8*	*Mountain*
35	*SJ35*	*3.04*	*1,947*	*6.05*	*3,869*	*0.803*	*0.599*	*0.225*	*0.489*	*0.222*	*4.31*	*22,731*	*2.10*	*11,109*	*153.2*	*0.041*	*0.87*	*76.9*	*Valley Undeveloped*
36	*SJ36*	*1.64*	*1,051*	*7.69*	*4,920*	*0.867*	*0.662*	*0.250*	*0.560*	*0.246*	*3.49*	*18,441*	*1.86*	*9,844*	*192.6*	*0.043*	*0.78*	*74.6*	*Foothill*
37	OC37	1.15	735	1.15	735	0.795	0.578	0.196	0.533	0.198	2.29	12,092	0.95	5,038	257.9	0.029	0.32	78.9	Mountain
58	SJ58	9.48	6,066	36.77	23,532	0.648	0.419	0.118	0.600	0.225	8.45	44,605	4.64	24,521	404.7	0.049	1.53	80.2	Mountain
59	OC59	1.10	706	2.45	1,569	0.448	0.284	0.073	0.156	0.064	2.17	11,463	0.91	4,810	255.4	0.020	0.22	90.5	Valley Developed
60	*SJ60*	*6.30*	*4,034*	*20.51*	*13,126*	*0.855*	*0.643*	*0.252*	*0.600*	*0.245*	*8.86*	*46,766*	*4.75*	*25,102*	*231.1*	*0.049*	*1.75*	*74.0*	*Mountain*
63	*SJ63*	*3.35*	*2,142*	*11.03*	*7,062*	*0.774*	*0.543*	*0.168*	*0.459*	*0.190*	*4.01*	*21,151*	*2.33*	*12,277*	*141.7*	*0.044*	*0.95*	*80.9*	*Foothill*
64	TC64	3.90	2,495	36.78	23,538	0.646	0.462	0.172	0.395	0.164	5.57	29,409	2.53	13,343	99.0	0.035	0.95	82.0	Foothill

Note: Rows in italics have changed from Baseline Conditions

Table 4-3 Hydrologic Parameters for the San Mateo Creek Watershed, Alternative B9

GIS Sub-basin	HEC-1 Node	Areas				Soils					Watercourse Lengths				Slope	Sub-basin Roughness n-value	Lag Time (hrs)	Average Curve Number (AMC II)	LAPRE-1
		Sub-basin		Upstream Drainage		Low Loss Fraction			Maximum Loss Rate (in/hr)		Longest		To Centroid						
		(mi^2)	(acres)	(mi^2)	(acres)	2-year	10-year	100-year	2-year	10-year & 100-year	(mi)	(ft)	(mi)	(ft)	(ft/mi)				S-graph Type
38	SM38	4.29	2,748	4.29	2,748	0.556	0.333	0.077	0.323	0.135	3.85	20,335	1.65	8,737	119.3	0.030	0.59	82.9	Valley Developed
39	SM39	2.72	1,739	20.65	13,213	0.718	0.482	0.146	0.600	0.252	3.37	17,810	1.47	7,753	393.9	0.050	0.71	77.1	Mountain
40	SM40	5.99	3,833	26.64	17,047	0.673	0.432	0.118	0.600	0.248	5.54	29,276	2.71	14,334	366.3	0.045	0.99	78.0	Mountain
41	SM41	5.28	3,382	55.64	35,612	0.774	0.534	0.164	0.600	0.242	4.66	24,590	1.95	10,282	450.9	0.050	0.87	78.1	Mountain
42	SM42	5.16	3,300	50.36	32,230	0.650	0.411	0.105	0.600	0.218	5.26	27,776	2.67	14,111	602.5	0.050	0.97	81.5	Mountain
43	*CC43*	*4.33*	*2,771*	*32.11*	*20,549*	*0.775*	*0.544*	*0.170*	*0.556*	*0.200*	*4.39*	*23,180*	*2.10*	*11,066*	*141.2*	*0.040*	*0.87*	*80.8*	*Valley Undeveloped*
44	SM44	16.46	10,535	80.65	51,616	0.734	0.492	0.144	0.600	0.245	9.48	50,077	4.78	25,237	207.9	0.050	1.85	77.8	Mountain
45	*CC45*	*3.61*	*2,309*	*19.06*	*12,196*	*0.848*	*0.624*	*0.214*	*0.600*	*0.236*	*3.69*	*19,501*	*1.64*	*8,666*	*196.3*	*0.040*	*0.70*	*77.1*	*Valley Undeveloped*
46	SM46	4.65	2,977	133.21	85,256	0.784	0.552	0.171	0.568	0.216	4.60	24,288	2.26	11,939	129.8	0.035	0.81	80.6	Valley Undeveloped
47	*CC47*	*8.72*	*5,582*	*27.78*	*17,778*	*0.769*	*0.533*	*0.167*	*0.580*	*0.210*	*10.08*	*53,235*	*5.34*	*28,198*	*224.2*	*0.038*	*1.50*	*79.7*	*Mountain*
48	*CC48*	*3.22*	*2,058*	*15.45*	*9,888*	*0.791*	*0.562*	*0.182*	*0.533*	*0.202*	*4.02*	*21,250*	*1.51*	*7,957*	*190.8*	*0.035*	*0.61*	*79.8*	*Valley Undeveloped*
49	*CC49*	*5.06*	*3,239*	*5.06*	*3,239*	*0.863*	*0.648*	*0.242*	*0.600*	*0.246*	*5.82*	*30,740*	*2.68*	*14,145*	*255.3*	*0.044*	*1.06*	*75.1*	*Mountain*
50	SM50	3.50	2,240	64.19	41,082	0.768	0.532	0.162	0.600	0.227	4.30	22,692	1.91	10,071	418.3	0.050	0.85	79.9	Mountain
51	*CC51*	*7.17*	*4,591*	*7.17*	*4,591*	*0.821*	*0.597*	*0.208*	*0.600*	*0.237*	*6.80*	*35,893*	*3.46*	*18,266*	*303.1*	*0.045*	*1.21*	*77.0*	*Mountain*
52	SM52	3.70	2,365	3.70	2,365	0.630	0.397	0.105	0.488	0.201	3.86	20,356	2.04	10,784	143.0	0.035	0.72	79.1	Valley Developed
53	SM53	6.84	4,380	45.20	28,930	0.734	0.495	0.151	0.600	0.252	5.54	29,244	2.79	14,746	255.9	0.040	0.95	76.3	Valley Undeveloped
54	SM54	5.05	3,230	60.69	38,841	0.662	0.422	0.110	0.600	0.226	5.70	30,116	3.10	16,355	354.3	0.050	1.17	80.3	Mountain
55	SM55	1.64	1,048	9.63	6,161	0.686	0.444	0.121	0.600	0.245	3.48	18,371	1.88	9,922	316.8	0.035	0.57	78.8	Mountain
56	SM56	8.30	5,312	17.93	11,474	0.683	0.442	0.124	0.565	0.242	5.92	31,283	3.22	16,976	274.7	0.040	1.01	77.0	Mountain
57	SM57	4.55	2,914	38.36	24,550	0.705	0.467	0.134	0.600	0.234	3.75	19,823	1.12	5,917	446.5	0.050	0.65	79.5	Mountain
61	SM61	15.80	10,114	96.45	61,730	0.791	0.555	0.174	0.596	0.208	9.93	52,445	4.97	26,216	172.1	0.040	1.59	80.4	Valley Undeveloped
62	SM62	7.17	4,590	33.81	21,636	0.670	0.428	0.116	0.600	0.248	5.82	30,752	2.97	15,686	359.9	0.050	1.16	77.9	Mountain

Note: Rows in italics have changed from Baseline Conditions

4.3 QUALITATIVE COMPARISON OF ALTERNATIVE LAND USE PLANS

Proposed land uses for Alternatives B5, B6, B8, B10 and B11 are presented in Table 4-4. The total planning area for each alternative is the same, however the distribution of open space to traditional development differs within each alternative. The RMV is relatively undeveloped under Existing Conditions, therefore, runoff is expected to increase with increasing development and a greater percentage of imperivous area. Of the land uses presented in Table 4-4, Business Parks and high density Residential Areas will contribute higher runoff than will allocated open spaces and golf resorts. Based on acreages of developed land, the Alternatives expected to increase runoff by the greatest percentage include The Ranch Plan and Alternatives B10, and B11. The Alternatives that are expected to produce the least total runoff include Alternatives B8 and B9.

4.3.1 Alternative B5

Development in Planning Area 1 (Ortega Gateway, Figure 3-2) replaces existing Open Space and agriculture. Single Family Residential homes comprise most of the development in this area for Alternative B5. The hydrologic effect of this type of development is expected to be similar to the Multiple Family Residential homes proposed for the Ranch Plan. While both types of land use produce high runoff rates, the development areas are relatively small compared with the development bubbles in other planning areas.

Planning Area 2 (Chiquita, Figure 3-2) is larger in Alternative B5 than in any of the other alternatives. The majority of the development in this area is designated as Single Family Residential homes, and there are three, smaller areas designated as Urban, Commercial, and Industrial. When compared to the existing agriculture, these types of development are expected to increase the rainfall runoff, and the larger size of Planning Area 2 for Alternative B5 also is expected to contribute to more runoff in this area than for the rest of the alternatives.

Planning Area 3 (Gobernadora, Figure 3-2) also is designated primarily as Single Family Residential homes, with smaller areas designated as Urban, Commercial, and Industrial. The gross acreage of this Planning Area is slightly larger in Alternative B5 than in the Ranch Plan. With similar development types in Planning Area 3 for both Alternative B5 and the Ranch Plan, the larger size of the Planning Area is expected to create more runoff in Alternative B5.

Planning Area 4 (East Ortega, Figure 3-2) is larger in Alternative B5 than in any of the other alternatives. A majority of this development is designated as Single Family Residential homes with the exception of a small area designated as Urban, Commercial, and Industrial. When compared to the existing agriculture, these types of development are expected to increase rainfall runoff, and the larger size of Planning Area 2 for Alternative B5 is expected to contribute to more runoff in this area than for the rest of the alternatives.

Planning Area 5 (Trampas, Figure 3-2) is designated almost entirely as Single Family Residential homes, with a small development area designated as Urban, Commercial, and Industrial. When compared to the

Table 4-4 Land Use Comparison of Other Alternatives

Alternative B5

Planning Area	Residential Gross Acres	Residential Maximum Dwelling Units	Urban Activity Center Gross Acres	Urban Activity Center Maximum Square Footage	Neighborhood Center Gross Acres	Neighborhood Center Maximum Square Footage	Business Park Gross Acres	Business Park Maximum Square Footage	Golf Resort Gross Acres	Open Space Use Internal Open Space Acres	Open Space Use Open Space Acres	Open Space Use Rancho Mission Viejo Regional Park Acres	Planning Area Totals Gross Acres
1	457	950	43	490,000			40	610,000					540
2	1,630	2,660			10	100,000	100	1,525,000					1,740
3	2,327	6,360	58	650,000	10	100,000	125	1,905,000					2,520
4	1,005	980			10	100,000							1,015
5	1,345	3,050			10	100,000							1,355
6													0
7													0
8													0
9													0
10											15,645		15,645
11													
12													
13													
TOTAL	6,764		101		40		265				15,645		22,815

Alternative B6

Planning Area	Residential Gross Acres	Residential Maximum Dwelling Units	Urban Activity Center Gross Acres	Urban Activity Center Maximum Square Footage	Neighborhood Center Gross Acres	Neighborhood Center Maximum Square Footage	Business Park Gross Acres	Business Park Maximum Square Footage	Golf Resort Gross Acres	Open Space Use Internal Open Space Acres	Open Space Use Open Space Acres	Open Space Use Rancho Mission Viejo Regional Park Acres	Planning Area Totals Gross Acres
1	462	1,000	38	440,000			40	610,000					540
2													0
3	2,332	6,650	53	600,000	10	100,000	125	1,905,000					2,520
4	490	500			5	50,000							495
5	1,345	3,100			10	100,000							1,355
6													0
7	650	1,200			10	100,000							660
8	480	900			10	100,000	100	1,525,000					590
9	575	650			5	50,000							580
10											16,075		16,075
11													
12													
13													
TOTAL	6,334		91		50		265				16,075		22,815

Alternative B8

Planning Area	Residential Gross Acres	Residential Maximum Dwelling Units	Urban Activity Center Gross Acres	Urban Activity Center Maximum Square Footage	Neighborhood Center Gross Acres	Neighborhood Center Maximum Square Footage	Business Park Gross Acres	Business Park Maximum Square Footage	Golf Resort Gross Acres	Open Space Use Internal Open Space Acres	Open Space Use Open Space Acres	Open Space Use Rancho Mission Viejo Regional Park Acres	Planning Area Totals Gross Acres
1	470	950	40	450,000			30	458,000					540
2													0
3	1,837	5,075	42	465,000	10	100,000	60	915,000					1,949
4													0
5	1,181	2,375			10	100,000							1,191
6													0
7													0
8													0
9													0
10											19,135		19,135
11													
12													
13													
TOTAL	3,488		82		20		90				19,135		22,815

Alternative B10

Planning Area	Residential Gross Acres	Residential Maximum Dwelling Units	Urban Activity Center Gross Acres	Urban Activity Center Maximum Square Footage	Neighborhood Center Gross Acres	Neighborhood Center Maximum Square Footage	Business Park Gross Acres	Business Park Maximum Square Footage	Golf Resort Gross Acres	Open Space Use Internal Open Space Acres	Open Space Use Wilderness Park Acres	Open Space Use Open Space Acres	Planning Area Totals Gross Acres
1	450	1,020	50	590,000			40	610,000					540
2	959	1,392			10	100,000	40	610,000		622			1,631
3	1,916	5,630	45	490,000	10	100,000	100	1,525,000		100			2,171
4	1,256	2,000			10	100,000				265			1,531
5	1,181	2,440			10	100,000							1,191
6	61	122								214			275
7	468	446			5	50,000				877			1,350
8	901	1,400			10	100,000	80	1,220,000	25	333			1,349
9													0
10											903		903
11											1,211		1,211
12												10,663	10,663
13													
TOTAL	7,192		95		55		260		25	2,411	2,114	10,663	22,815

Alternative B11

Planning Area	Residential Gross Acres	Residential Maximum Dwelling Units	Urban Activity Center Gross Acres	Urban Activity Center Maximum Square Footage	Neighborhood Center Gross Acres	Neighborhood Center Maximum Square Footage	Business Park Gross Acres	Business Park Maximum Square Footage	Golf Resort Gross Acres	Open Space Use Internal Open Space Acres	Open Space Use Wilderness Park Acres	Open Space Use Open Space Acres	Planning Area Totals Gross Acres
1	496	1,040	44	500,000									540
2	1,126	3,700			10	100,000				495			1,631
3	1,976	5,180	50	550,000	10	100,000	35	540,000		100			2,171
4	1,250	2,340	6	80,000	10	100,000				265			1,531
5	1,181	2,300			10	100,000							1,191
6													0
7	1,340	2,200			10	100,000							1,350
8	884	2,440	12	150,000	10	100,000	80	1,220,000	25	338			1,349
9													0
10											903		903
11											1,211		1,211
12												10,938	10,938
13													
TOTAL	8,253		112		60		115		25	1,198	2,114	10,938	22,815

Source: EDAW, 3/29/04

existing Open Space, these types of development are expected to increase rainfall runoff. As Planning Area 5 is larger for Alternative B5 than for the Ranch Plan, more runoff is expected in this area than in the Ranch Plan.

There are no development areas in Cristianitos Meadows, Cristianitos Canyon, O'Neill Ranch, or TRW for Alternative B5.

4.3.2 Alternative B6

Development in Planning Area 1 (Ortega Gateway, Figure 3-2) replaces existing Open Space and agriculture. Single Family Residential homes comprise most of the development in this area for Alternative B6. The hydrologic effect of this type of development is expected to be similar to the Multiple Family Residential homes proposed for the Ranch Plan. While both types of land use produce high runoff rates, the development areas are relatively small compared with the development bubbles in other planning areas.

Planning Area 3 (Gobernadora, Figure 3-2) also is designated primarily as Single Family Residential homes, with smaller areas designated as Urban, Commercial, and Industrial. The gross acreage of this Planning Area is slightly larger in Alternative B6 than in the Ranch Plan. With similar development types in Planning Area 3 for both Alternative B6 and the Ranch Plan, the larger size of the Planning Area is expected to create more runoff in Alternative B5.

Planning Area 4 (East Ortega, Figure 3-2) is larger in Alternative B6 than in any of the other alternatives, except for Alternative B5. A majority of this development is designated as Single Family Residential homes with the exception of a small area designated as Urban, Commercial, and Industrial. When compared to the existing agriculture, these types of development are expected to increase rainfall runoff, and the larger size of Planning Area 2 for Alternative B6 is expected to contribute to more runoff in this area than for the rest of the alternatives, with the exception of Alternative B5.

Planning Area 5 (Trampas, Figure 3-2) is designated almost entirely as Single Family Residential homes, with one small development area designated as Urban, Commercial, and Industrial. When compared to the existing Open Space, these types of development are expected to increase rainfall runoff, and since Planning Area 5 is larger for Alternative B6 than for the Ranch Plan, more runoff is expected in this area than in the Ranch Plan.

Planning Area 7 (Cristianitos Canyon, Figure 3-2) also is comprised almost entirely of Single Family Residential homes, with one small area designated as Urban, Commercial, and Industrial and one small area designated as NUD. The Single Family Residential homes are expected to cause more runoff than the existing open space. Since Planning Area 5 is larger for Alternative B6 than for the Ranch Plan, more runoff is expected in this area than in the Ranch Plan.

Development in Planning Area 8 (TRW, Figure 3-2) replaces limited, existing development and large Open Space areas. The development bubble is similar in size for Alternative B6 and the Ranch Plan. Alternative B6 is largely designated as Single Family Residential homes, but also contains a large area designated as Urban, Commercial, and Industrial. The Ranch Plan includes Single Family and Rural Residential homes. Runoff increases are expected to be similar between the two plans, and represent a moderate increase over existing conditions.

Planning Area 9 (O'Neill Ranch, Figure 3-2) is designated almost entirely of Single Family Residential homes, with one small area designated as Urban, Commercial, and Industrial. This type of development is expected to cause more runoff than the Parks and Golf Courses slated for the Ranch Plan, and the existing open space.

There are no development bubbles in Cristianitos Meadows, or Chiquita for Alternative B6.

4.3.3 Alternative B8

Development in Planning Area 1 (Ortega Gateway, Figure 3-2) replaces existing Open Space and agriculture. Single Family Residential homes comprise most of the development in this area for Alternative B8. The hydrologic effect of this type of development is expected to be similar to the Multiple Family Residential homes proposed for the Ranch Plan. While both types of land use produce high runoff rates, the development areas are relatively small compared with the development bubbles in other planning areas.

Planning Area 3 (Gobernadora, Figure 3-2) also is designated primarily as Single Family Residential homes, with smaller areas designated as Urban, Commercial, and Industrial. The gross acreage of this Planning Area is similar in Alternative B8 than in the Ranch Plan. With similar development types in Planning Area 3 for both Alternative B8 and the Ranch Plan, runoff increases are expected to be similar between the two plans

The development bubble in Planning Area 5 (Trampas, Figure 3-2) is nearly identical in size for both Alternative B8 and the Ranch Plan. In Alternative B8, Single Family Residential homes as well as Urban, Commercial and Industrial development are proposed, whereas the Ranch Plan consists of Multiple Family and Single Family Residential homes. Because the Trampas area is primarily Open Space at present, a relatively larger percentage increase in runoff is expected for both Alternative B8 and the Ranch Plan in Planning Area 5 than the other Planning Areas.

There are no development bubbles in Chiquita, East Ortega, Cristianitos Meadows, Cristianitos Canyon, O'Neill Ranch, or TRW for Alternative B8.

4.3.4 Alternative B10 (County Environmental Plan)

Development in Planning Area 1 (Ortega Gateway, Figure 3-2) replaces existing Open Space and agriculture. Approximately the same acreage and density of residential development is proposed for the Ranch Plan and for Alternative B10 in Planning Area 1. The hydrologic effects of Ranch Plan and Alternative B10 proposed development are expected to be very similar. While both types of land use produce high runoff rates, the development areas are relatively small compared with the development bubbles in other planning areas.

Planning Area 2 is similar for the Ranch Plan and for Alternative B10. The Ranch Plan has slightly higher gross acreages of development, however Alternative B10 includes a Business Park which will increase the area of impervious coverage. Therefore the hydrologic response is expected to be comparable for the 2 plans.

The Ranch Plan and Alternative B10 are expected to produce similar runoff within Planning Area 3.

The development in Planning Area 4 (East Ortega, Figure 3-2) replaces small areas of existing agriculture and open space. For Alternative B10, the development bubble in this area is considerably larger than in the Ranch Plan, and therefore, Alternative B10 is expected to produce significantly greater runoff.

The development bubble in Planning Area 5 (Trampas, Figure 3-2) is nearly identical in size for both Alternative B10 and the Ranch Plan. Within both plans, a majority of the proposed development area consists of Residential use. . Therefore, runoff is expected to be similar for Alternative B10 and for the Ranch Plan in Planning Area 5.

There are small areas of Rural Residential homes in Planning Area 6 (Cristianitos Meadows, Figure 3-2) for Alternative B10. These Rural Residential homes are expected to create less runoff than the larger development bubble of Rural Residential homes, and Parks and Golf Courses in the Ranch Plan.

The Cristianitos Canyon development bubble (Planning Area 7) is comprised entirely of Rural Residential homes and Golf Courses. These types of development represent a moderate increase in runoff over existing conditions. The larger development area for the Ranch Plan containing Single Family Residential homesis expected to create more runoff than does the development in Alternative B10.

Development in Planning Area 8 (TRW, Figure 3-2) replaces limited, existing development and large Open Space areas. The development bubble is similar in size for Alternative B10 and the Ranch Plan. The Ranch Plan and Alternative B10 both includeSingle Family and Rural Residential homes. Runoff increases are expected to be similar between the two plans, and represent a moderate increase over existing conditions.

There are no development bubbles in Cristianitos Meadows, or O'Neill Ranch for the Alternative B10

4.3.5 Alternative B11 (County Regional Housing Plan)

Development in Planning Area 1 (Ortega Gateway, Figure 3-2) replaces existing Open Space and agriculture. The hydrologic effects of the development, primarily residential, are expected to be very similar.

The proposed area of Residential development within Planning Area 2 in is greater and more dense for Alternative B11. The Ranch Plan allocates a greater percentage of the planning area to open space. Runoff is, therefore, expected to be slightly higher for Alternative B11 when compared with the Ranch Plan.

In Alternative B11, Planning Area 3 consists of a slightly smaller developed area than is proposed underr the Ranch Plan. In both alternatives, the majority of the development is Multiple Family and Single Family Residential. Overall, more runoff would be expected from the Ranch Plan in Planning Area 3.
The development in Planning Area 4 (East Ortega, Figure 3-2) replaces small areas of existing agriculture, and open space. For Alternative B11, the development bubble (primarily residential development) in this area is considerably larger than in the Ranch Plan, and therefore, Alternative B11 is expected to produce greater runoff.

The development bubble in Planning Area 5 (Trampas, Figure 3-2) is nearly identical in size for both Alternative B11 and the Ranch Plan, although the Residential DU density is slightly higher under the Ranch Plan. Because the Trampas area is primarily Open Space at present, a relatively larger percentage increase in runoff is expected for both Alternative B11 and the Ranch Plan. The two alternatives are expected to produce similar volumes of runoff.

Planning Area 7 (Cristianitos Canyon, Figure 3-2) is comprised almost entirely of Residential land uses, with the inclusion of a Golf Course. As Planning Area 5 is larger for Alternative B11 than for the Ranch Plan, more runoff is expected in this area under B11 than under the Ranch Plan.

Development in Planning Area 8 (TRW, Figure 3-2) replaces limited, existing development and large Open Space areas. The development bubble is similar in size for Alternative B11 and the Ranch Plan. The Ranch Plan includes Single Family and Rural Residential homes. The Alternative B11 also includes urban centers, Business Parks and a golf course in Planning Area 8. Runoff is expected to be similar between the two plans, although slightly higher for Alternative B11.

There are no development areas in the O'Neill Ranch and Cristianitos Meadows Planning Areas for Alternative B11.

5. IN-CHANNEL SEDIMENT TRANSPORT ANALYSIS

5.1 OVERVIEW

PWA previously assessed sediment transport conditions in the San Juan and San Mateo watersheds and reported on the details and results of sediment transport analysis for baseline conditions (PWA 2001). However, land use conditions have changed in the project area due to increased development between the years 2000 and 2003. Therefore, the existing baseline hydrologic conditions were revised to reflect these watershed changes and the hydrologic model was updated. In addition, the analysis was extended to include potential plans for further development within the Rancho Mission Viejo (RMV) boundaries. The current sediment transport analysis updates the in-channel sediment transport conditions in the study area for the modified baseline conditions. The analysis also assesses sediment transport conditions under two of the potential development plans, namely the "Ranch Plan" and "Alternative B9". As described in chapter 4, the results from the other alternatives on sediment transport are expected to be similar.

PWA modeled in-channel sediment transport processes in nine of the ten studied sub-basins in the San Mateo and San Juan Creek watersheds (Figure 5-1). Data on channel geometry and sediment characteristics was not available for Talega Canyon, therefore the effects of the development plans on the sediment transport conditions within Talega Canyon were qualitatively evaluated based on the predicted changes in the hydrologic regime, as described by peak flows and volumes. This approach is adequate for the current planning level analysis. A more detailed and quantitative analysis of sediment transport characteristics in Talega Canyon, as well as in the other studies sub-basins, will be included in future studies as the preferred alternative is selected, and level of design is refined.

PWA selected the USACOE computer model, the Hydraulic Design Package for Channels (SAM), to evaluate in-channel sediment processes at the planning level. SAM allows the computation of both sediment transport capacity and sediment yield for a given flood event. Due to limited data availability and other constraints, SAM is an appropriate choice for this study to establish a preliminary overview of sediment transport conditions in the canyons under the baseline conditions and the Ranch Plan, to assess the *magnitude and direction* of change in sediment transport capacity (i.e. erosion and sedimentation), and to compare the effects of the Ranch Plan on the sediment regime.

The information on modeling procedures, input parameters and assumptions, data sources, and sensitivity analysis described in PWA's report (2001), as well as a comparison of results with other sediment studies in the San Juan Creek. The sensitivity analysis was conducted to evaluate the sensitivity of sediment transport results to channel geometry, sediment distribution, and transport function. PWA performed a series of comparative SAM model runs where these input parameters were altered, resulting changes in sediment transport were reported, and impacts of each parameter on the transport results were evaluated. Please refer to Section 4.5 of PWA (2001) for a discussion on sensitivity analysis and comparison to other studies.

5.2 GEOMORPHIC CONTEXT

The entrainment, transport, and deposition of sediment in watersheds of coastal southern California occurs according to a cascading system involving upland hillslopes, alluvial stream channels, estuaries, and the coast. These different geomorphic zones within the cascading system variably supply, transport, or store sediment. As the principal conduit of sediment transport, the stream channel system dynamically responds to changes in hydrologic conditions across the watershed. Increases or decreases in runoff and sediment delivery to specific reaches can result in shifts in erosional and depositional patterns throughout the drainage network. Additionally, changes in sediment storage functions within the channel create feedbacks, which further alter stream geometry and slope and may affect stability.

5.3 APPROACH

The in-channel sediment transport processes were evaluated for both the existing conditions and the development alternatives for the sub-basins in the San Mateo and San Juan Creek watersheds (Figure 5-1). PWA used the recent Windows version of SAM, SAMWin, to evaluate in-channel sediment processes. SAMWin is the modified DOS-based SAM model to be used as a Windows application. SAMWin allows the computation of both sediment transport capacity and sediment yield for a given flood event.

SAMWin is appropriate for the purposes of the current planning level analysis and in supporting the coordinated planning process. SAMWin analysis allows establishing a preliminary overview of sediment transport conditions and comparing the effects of the Ranch Plan and Alternative B9 on the existing conditions sediment system. We used the SAMWin model to assess the magnitude and direction of change in sediment transport capacity. Calculating sediment transport capacity is difficult. The results of the sediment transport capacity and yield estimates provide an assessment of change over the existing conditions rather than absolute estimates.

5.4 RESULTS FOR SEDIMENT TRANSPORT CAPACITY MODELING

Using the SAMWIN model, peak sediment transport rates were calculated for the 2-, 10-, and 100-year discharge events for each of the sub-basins. The Laursen (Madden) sediment transport function was used within the SAMWin application. Peak transport rates per unit area were also calculated for each of the sub-basins.

There are a number of important points that should be noted in evaluating the sediment transport analysis results:

1. The estimated sediment transport capacity is based on the flow regime, the sediment characteristics and the channel characteristics. In this analysis, the latter two (sediment and channel) characteristics are assumed the same for the baseline and proposed development conditions. The development has been designed to avoid changes to the stream channels, so the hydraulic regime will remain unchanged. The development siting will allow continued supply of the coarser sediments, which are the determinants in the adjustment of river channel form and key

elements in the sediment transport analysis. Fine-grained clay sediments are generally a problem during the construction process, and a comprehensive sediment control program will be implemented during this phase. Following completion of the construction process and the growth of vegetation in the developed areas, the production of fine-grain sediments is expected to revert to pre-project levels. Thus, the change in estimated sediment transport regime is solely a function of the predicted hydrologic regime, as described by the flow analysis. Therefore, in the sub-basins showing greater hydrologic change, the sediment transport regime will show greater change. When hydrologic effects are predicted to be minimal, sediment transport will also show little change.

At present, to support the coordinated planning efforts, hydrologic assessment has been conducted at the sub-basin scale. This is appropriate for the level of detail available in the proposed development alternatives. Future assessments at the design level will be done at the development bubble scale to insure that the mitigation measures described in Chapter 6 preclude any significant increase or decrease in sediment transport.

2. Sediment transport modeling is inherently difficult, and generally recognized to be less accurate than hydrologic and hydraulic modeling. The SAM methodology used in this analysis provides a planning level estimate of potential impacts resulting from the proposed development plans. At the design phase, more detailed (HEC-6) sediment modeling will be conducted on critical reaches.

3. The rates presented below represent the capacity for the system to transport sediment and may not describe actual sediment transport rates. Actual sediment transport for channels are determined by both transport capacity and sediment input. For instance, where the sediment transport capacity is increased and sediment input remains relatively constant, the channel (or a specific reach) will become either more erosive or less depositional. If sediment transport capacity is reduced and sediment input remains similar, then either more deposition or less erosion will occur.

4. An increase in sediment transport *capacity* does not automatically mean an increase in erosion and sediment volume. Erosion requires both excess sediment transport capacity and excess shear stress (erosive energy minus resistance from channel materials). Where the channel is more resistant (for example due to the presence of riparian vegetation) erosion will not occur.

5. The changes in sediment transport rates described below for the Ranch Plan represent potential impacts without mitigation. In chapter 6, we describe the hydrologic mitigation approach and the level of significance of impacts following the application of mitigation measures.

5.4.1 Lucas Canyon

Lucas Canyon, in the San Juan Watershed, was divided into three reaches for the sediment transport analysis (Figure 5-1). Results of the sediment transport capacity analysis are shown in Table 5-1. Under both the Ranch Plan and Alternative B9, the hydrologic assessment shows no change in the peak discharges of the three flow events and consequently no change in sediment transport capacities.

Table 5-1 Peak Sediment Transport Capacities Within the San Juan and San Mateo Creek Watersheds - Baseline, Ranch Plan, and Alternative B9

			Peak Transport Capacity (tons/day)														
	Reach	HEC-1	Baseline Conditions			The Ranch Plan						Alternative B9					
			2-year event	10-year event	100-year event	2-year event	percent increase 2-year	10-year event	percent increase 10-year	100-year event	percent increase 100-year	2-year event	percent increase 2-year	10-year event	percent increase 10-year	100-year event	percent increase 100-year
SAN JUAN WATERSHED																	
Lucas Canyon (LU)	1	SJ3	21,267	107,134	253,410	21,267	0.0	107,134	0.0	253,410	0.0	21267	0.0	107134	0.0	253,410	0.0
	2	SJ3	52,479	268,855	622,270	52,479	0.0	268,855	0.0	622,270	0.0	52,479	0.0	268,855	0.0	622,270	0.0
	3	SJ3	1,479	13,683	43,165	1,479	0.0	13,683	0.0	43,165	0.0	1,479	0.0	13,683	0.0	43,165	0.0
Verdugo Canyon (VD)	1	SJ9	14,105	99,881	257,735	14,310	1.5	102,472	2.6	261,760	1.6	17,654	25.2	113,519	13.7	277,027	7.5
	2	SJ9	22,445	164,386	418,747	22,866	1.9	168,431	2.5	425,886	1.7	28,272	26.0	187,258	13.9	448,253	7.0
	3	SJ9	5,403	38,315	98,513	5,485	1.5	39,306	2.6	100,253	1.8	6,735	24.7	43,832	14.4	105,594	7.2
	4	SJ9	1,410	23,439	76,255	1,439	2.0	24,243	3.4	78,163	2.5	1,980	40.4	27,914	19.1	83,142	9.0
Bell Canyon (BE)	1	cSJ60	53,348	260,364	654,498	53,348	0.0	260,364	0.0	654,498	0.0	53,348	0.0	260,364	0.0	654,498	0.0
	2	cSJ60	62,109	295,125	733,281	62,109	0.0	294,922	-0.1	733,281	0.0	62,109	0.0	294,922	-0.1	733,281	0.0
	3	cSJ60	61,691	295,304	731,353	61,691	0.0	295,304	0.0	731,353	0.0	61,691	0.0	295,304	0.0	731,353	0.0
	4	cSJ34	75,232	319,087	726,507	71,482	-5.0	319,087	0.0	726,507	0.0	71,482	-5.0	318,678	-0.1	726,507	0.0
	5	cSJ34	126,341	524,524	1,192,630	119,771	-5.2	524,524	0.0	1,192,630	0.0	119,771	-5.2	524,524	0.0	1,192,630	0.0
	6	cSJ34	262,890	1,042,890	2,274,920	249,871	-5.0	1,042,890	0.0	2,274,920	0.0	249,871	-5.0	1,040,440	-0.2	2,274,920	0.0
Canada Gobernadora (GO)	1	cSJ63	122,075	564,986	1,055,190	118,990	-2.5	574,309	1.7	1,104,850	4.7	118,990	-2.5	581,209	2.9	1,113,940	5.6
	2	cSJ63	119,470	557,525	1,050,860	116,379	-2.6	567,335	1.8	1,100,410	4.7	116,379	-2.6	573,805	2.9	1,106,950	5.3
	3	cSJ63	80,325	388,872	736,988	78,418	-2.4	395,236	1.6	773,565	5.0	78,418	-2.4	400,954	3.1	779,197	5.7
	4	cSJ63	88,416	402,616	753,238	85,853	-2.9	409,417	1.7	791,359	5.1	85,853	-2.9	414,651	3.0	795,783	5.6
	5	cSJ63	100,724	465,868	872,052	98,271	-2.4	474,497	1.9	915,838	5.0	98,271	-2.4	479,530	2.9	921,412	5.7
	6	cSJ63	93,227	421,053	792,264	91,069	-2.3	428,727	1.8	830,392	4.8	91,069	-2.3	433,408	2.9	837,604	5.7
	7	cSJ35	69,233	272,780	489,922	69,072	-0.2	270,213	-0.9	488,709	-0.2	69,072	-0.2	270,213	-0.9	488,709	-0.2
	8	cSJ35	81,326	327,833	596,446	81,055	-0.3	326,073	-0.5	594,294	-0.4	81,055	-0.3	326,073	-0.5	594,294	-0.4
	9	SJ7	155,358	587,350	973,558	155,770	0.3	582,396	-0.8	973,558	0.0	155,358	0.0	582,396	-0.8	973,558	0.0
Canada Chiquita (CH)	1	SJ8+SJ31	71,701	336,479	722,063	65,067	-9.3	336,140	-0.1	718,216	-0.5	73,389	2.4	338,462	0.6	732,747	1.5
	2	SJ8+SJ31	20,355	103,063	222,885	18,297	-10.1	102,620	-0.4	221,745	-0.5	20,830	2.3	103,285	0.2	226,477	1.6
	3	SJ8+SJ31	50,588	237,552	492,271	45,354	-10.3	237,552	0.0	489,799	-0.5	51,553	1.9	238,908	0.6	499,841	1.5
	4	SJ31	14,424	66,414	132,073	11,792	-18.2	63,156	-4.9	125,657	-4.9	14,424	0.0	65,847	-0.9	132,073	0.0
	5	SJ32	134,655	595,175	1,144,480	110,947	-17.6	569,702	-4.3	1,092,090	-4.6	134,655	0.0	592,509	-0.4	1,144,480	0.0
	6	SJ33	39,527	178,235	354,047	32,350	-18.2	170,140	-4.5	337,436	-4.7	39,527	0.0	177,126	-0.6	354,047	0.0
Central San Juan Catchments																	
Cental San Juan (SJ)	1	cSJ8	39,504	248,711	712,636	39,805	0.8	270,048	8.6	716,249	0.5	40,078	1.5	267,059	7.4	715,287	0.4
	2	CSJ63	28,968	161,917	559,635	29,111	0.5	165,643	2.3	578,034	3.3	29,231	0.9	164,090	1.3	558,609	-0.2
	3	cSJ13	27,566	219,005	526,488	27,707	0.5	219,468	0.2	535,143	1.6	27,674	0.4	216,490	-1.1	520,010	-1.2
	4	CSJ60	48,147	227,343	865,426	48,436	0.6	226,872	-0.2	865,482	0.0	48,402	0.5	226,859	-0.2	866,700	0.1
Trampas (TR)	1	23% SJ13	18,368	130,735	338,824	38,462	109.4	196,863	50.6	406,121	19.9	33,194	80.7	203,442	55.6	418,394	23.5
	2	23% SJ13	288	3,593	11,350	766	165.9	5,935	65.2	14,095	24.2	632	119.4	6,095	69.6	14,532	28.0
	3	23% SJ13	14,397	106,225	273,223	30,719	113.4	160,265	50.9	328,510	20.2	26,261	82.4	164,865	55.2	337,854	23.7
Norteast (NE)	1	11% SJ13	5,840	44,536	120,330	12,888	120.7	69,257	55.5	145,322	20.8	11,293	93.4	71,014	59.5	149,742	24.4
	2	11% SJ13	5,429	40,285	112,400	11,310	108.3	63,448	57.5	136,241	21.2	9,804	80.6	65,055	61.5	140,090	24.6
Northwest (NW)	1	9% SJ13	3,346	24,345	66,130	6,891	105.9	37,374	53.5	79,356	20.0	6,151	83.8	38,765	59.2	81,529	23.3
	2	9% SJ13	4,759	35,154	94,085	10,159	113.5	54,112	53.9	112,502	19.6	8,911	87.2	55,052	56.6	115,934	23.2
Southwest (SW)	1	4% SJ13	483	4,353	11,828	1,177	143.5	6,733	54.7	14,231	20.3	1,044	116.0	6,847	57.3	14,575	23.2
	2	4% SJ13	822	7,322	20,236	1,973	140.1	11,528	57.4	24,514	21.1	1,734	111.1	11,768	60.7	24,986	23.5
SAN MATEO WATERSHED																	
La Paz Canyon (LP)	1	CC51	28,568	131,578	275,397	28,568	0.0	131,578	0.0	275,397	0.0	28,568	0.0	131,578	0.0	275,796	0.1
	2	CC51	95,910	450,655	934,420	95,910	0.0	450,655	0.0	934,420	0.0	95,910	0.0	450,655	0.0	934,420	0.0
	3	CC51	279,504	1,229,760	2,487,010	279,504	0.0	1,229,760	0.0	2,487,010	0.0	279,504	0.0	1,229,760	0.0	2,492,780	0.2
Gabino Canyon (GA)	1	cCC48	61,789	342,687	771,693	63,242	2.4	345,885	0.9	775,381	0.5	62,818	1.7	345,556	0.8	772,212	0.1
	2	cCC48	45,638	240,372	546,740	46,656	2.2	242,691	1.0	549,888	0.6	46,241	1.3	242,437	0.9	546,740	0.0
	3	CC49	40,186	217,402	445,256	42,756	6.4	223,543	2.8	454,822	2.1	40,485	0.7	219,865	1.1	448,848	0.8
	4	CC49	75,207	398,996	805,317	79,941	6.3	407,959	2.2	824,143	2.3	75,556	0.5	402,619	0.9	813,145	1.0
	5	CC49	103,487	499,847	985,049	110,206	6.5	511,959	2.4	1,005,350	2.1	104,738	1.2	504,535	0.9	992,508	0.8
Cristianitos Canyon (CR)	1	CC45	29,090	173,940	372,593	33,458	15.0	194,126	11.6	391,983	5.2	29,090	0.0	173,940	0.0	372,593	0.0
	2	CC45	4,217	24,596	52,719	4,842	14.8	27,360	11.2	55,424	5.1	4,217	0.0	24,596	0.0	52,719	0.0
	3	CC45	8,335	49,224	103,952	9,599	15.2	54,958	11.6	109,017	4.9	8,335	0.0	49,224	0.0	103,952	0.0

Note: Percent increase refers to percent increase in peak transport capacity as compared with Baseline Conditions. A negative value indicates that the Baseline Conditions had a higher peak transport capacity.

Within Lucas Canyon, Reach 2 has the highest transport capacity for all three modeled flood events. This may be due to a greater percentage of smaller, more transportable sediment in Reach 2 (Table 5-1). Reach 3 upstream tends to have the lowest transport capacity while the capacity of Reach 1 is intermediate between 2 and 3. The sediment transport trends across reaches will not be altered under the development plans.

5.4.2 Verdugo Canyon

Verdugo Canyon, in the San Juan Watershed, was divided into four reaches for the sediment transport analysis (Figure 5-1). Results of the sediment transport capacity analysis are shown in Table 5-1 and Figure 5-2.

The results indicate that under the Baseline Conditions, the Ranch Plan, and Alternative B9 Reach 2 produced the highest peak sediment transport rates, followed by Reach 1. Results for reaches 3 and 4 were significantly lower than for reaches 1 and 2.

Under the Ranch Plan, the peak sediment transport capacity of the Verdugo Canyon is predicted to increase by between 1.5% and 2% for the 2-year flow, 2.5% and 3.5% for the 10-year flow, and 1.5% and 2.5% for the 100-year flow along its length (Figure 5-2). The largest increases in peak sediment transport capacity occur during the 10-year event. The most upstream reach, Reach 4, has the largest increase in predicted peak sediment transport capacity for all three modeled events.

Under Alternative B9, the peak sediment transport capacity along the Verdugo Canyon is predicted to increase significantly by between 25% and 40% for the 2-year flow, 14% and 19% for the 10-year flow, and 7% and 9% for the 100-year flow along its length (Figure 5-2). The largest increases in peak sediment transport capacity occur during the 2-year event. Reach 4, has the largest increase in predicted peak sediment transport capacity for all three modeled events.

Alternative B9 resulted in significantly larger increases in sediment transport capacity over the Baseline Conditions compared to the Ranch Plan for all three modeled flow events.

5.4.3 Canada Gobernadora

Cañada Gobernadora, in the San Juan Watershed, was divided into nine reaches for the sediment transport analysis (Figure 5-1). Results of the peak sediment transport capacity analysis are shown in Table 5-1 and Figure 5-3.

Under the Baseline Conditions, within Cañada Gobernadora, Reach 9, the most upstream reach, has the highest transport capacity for the 2-year and 10-year flows, followed by Reach 1 and Reach 2 for both events. During the 100-year event, while Reaches 1 and 2 have the highest transport capacities, Reach 9 has the third highest capacity. Runoff rates in Reach 9 are the lowest of the Gobernadora reaches, showing the importance of slopes in generating the high sediment transport rates.

The sediment transport capacity trends across reaches are the same as the Baseline Conditions under the Ranch Plan. Figure 5-3 shows the percent change in predicted sediment transport capacity over the Baseline Conditions. While the 2-year flow results in decreased transport capacities for Reaches 1 through 6, 10-year and 100-year flows results in increased peak transport capacities for the same reaches. During the 2-year flow, predicted peak transport capacities decreases by 0.2% to 3%. During the 10-year flow, there is an increase in sediment transport capacity of approximately 2% for Reaches 1 through 6, reducing to approximately 0% for reaches 7 through 9. The increases in predicted peak transport capacities are the largest during the 100-year flow event with similar trends to the 10-year flow. Under the 100-year flow, Canada Gobernadora will undergo a predicted increase in peak transport capacity of approximately 5% for Reaches 1 through 6, recovering approximately to zero change along Reaches 7 to 9.

The sediment transport capacity trends under Alternative B9 are also the same as the Baseline Conditions and the Ranch Plan. Figure 5-3 illustrates the percent change in predicted sediment transport capacity over the Baseline Conditions and compares it to the Ranch Plan. While the 2-year flow results in decreased transport capacities for Reaches 1 through 6, 10-year and 100-year flows results in increased peak transport capacities for the same reaches. During the 2-year flow, predicted peak transport capacities decrease by 2.3% to 2.9% along Reaches 1 through 6 and remain approximately the same for Reaches 7 through 9. The increases in peak transport capacities are the highest for the 10- and 100-year flows along Reaches 1 through 6 under both development plans. During the 10-year flow, there is an increase in sediment transport capacity of approximately 3% for Reaches 1 through 6, reducing to approximately 1% for reaches 7 through 9. The increases in predicted peak transport capacities are the largest during the 100-year flow event with similar trends to the 10-year flow. Under the 100-year flow, Canada Gobernadora will undergo a predicted increase in peak transport capacity of approximately 5.5% for Reaches 1 through 6, recovering approximately to zero change along Reaches 7 to 9.

While the Ranch Plan and Alternative B9 have the same impacts on the peak transport capacities during the 2-year flow, the latter results in slightly larger increases in peak transport capacities during the 10- and 100-year events compared to the Ranch Plan.

5.4.4 Canada Chiquita

Cañada Chiquita, in the San Juan Watershed, was divided into six reaches for the sediment transport analysis (Figure 5-1). Results of the sediment transport analysis are shown in Table 5-1 and Figure 5-4.

Generally, the sediment transport trends within Cañada Chiquita are the same for all three events. Results indicate that sediment transport capacity is highest in Reach 5 under all three modeled events. The Ranch Plan results in significant changes in peak transport capacities during the 2-year event (Figure 5-4). Under the 2-year flow, the peak sediment transport capacities decrease by approximately 10% along Reaches 1 through 3, decreasing down to approximately 18% for Reaches 4 to 6. The 10-year and the 100-year flows have almost no effect on peak transport capacities for Reaches 1 through 3. However, along Reaches 4 through 6, there is a decrease in predicted peak transport capacities by approximately 5% during both flow events.

Alternative B9 results in similar sediment transport trends to the Baseline Conditions within Cañada Chiquita. In the upstream portion of Canada Chiquita, along Reaches 4 through 6, peak sediment transport capacities under Alternative B9 remain approximately the same compared to the Baseline Conditions. Along the downstream portion of the canyon, through Reaches 1 to 3, Alternative B9 results in slight changes in peak transport capacities during all three modeled events (Figure 5-4). While the predicted peak transport capacities increase by approximately 0.5% during the 10-year event, the peak sediment transport capacities increase by approximately 2.3% and 1.5% during the 2-year and 100-year events, respectively.

Alternative B9 does not result in significant changes in peak transport capacities in Canada Chiquita over the Baseline Conditions. The Ranch Plan has a larger impact on the existing sediment regime compared to Alternative B9.

5.4.5 Central San Juan Catchments

The San Juan Creek sub-basin was divided into 11 reaches from four small sub-basin tributaries that directly enter San Juan Creek (Figure 5-1). The sub-basins include the Trampas, San Juan Northeast (SJNE), San Juan Northwest (SJNW), and San Juan Southwest (SJSW) tributaries. As discussed in Section 3.3.4 of this report, the Central San Juan Catchments (as represented in the HEC-1 model) represent a bulk averaging of the multiple tributaries. Results of the sediment transport analysis for the tributaries are shown in Table 5-1 and Figures 5.5 through 5.8. The results for the mainstem Central San Juan are shown in Table 5-1 and Figure 5-9.

Along the mainstem San Juan, Reach 4 has the highest transport capacities, followed by Reach 3 under all three modeled events. Transport rates for the main San Juan channel are higher than the tributaries due to larger flows and channel size. The Ranch Plan results in negligible to moderate changes during the modeled flow events (Figure 5-9). During 2-year flow, the peak transport capacities are approximately the same as the Baseline Conditions. Both under the Ranch Plan and Alternative B9, positive increases in transport capacities are expected for all three events, for Reaches 3 and 4. However, Alternative B9 results in larger increases in peak transport capacities along Reaches 3 and 4. Both development plans result in decreases in peak transport capacities along Reach 2, while having very little effect along Reach 1.

Among the Central San Juan tributaries, Trampas Canyon has the highest sediment transport rates. Trampas Canyon is a very steep headwater tributary and has higher flow rates than the other tributaries. The peak sediment transport capacities increase very significantly under both the Ranch Plan and Alternative B9 for all three modeled events. 2-year flow is the most affected event under both of the development plans. During the 2-year flow, the Ranch plan results in larger increases in peak transport capacities compared to Alternative B9. While the increases in peak transport capacities under the Ranch Plan range between 110% and 165%, the increases under Alternative B9 range between 81% and 119% during the 2-year flow. The most significantly affected reach is Reach 2 under both plans. While the 10-year flow results in increases in peak transport capacities of between 50% and 65%, the 100-year flow results in increases in peak transport capacities of approximately 20% under the Ranch Plan (Figure 5-6). Alternative B9 have similar effects on the 10- and 100-year flow peak transport capacities. The predicted peak sediment transport capacities increase by between 55% and 70% during the 10-year flow and by between 24% and 28% during the 100-year flow event.

The peak sediment transport capacities of the other tributaries to Central San Juan are much smaller than the Trampas and the mainstem Central San Juan capacities due to the smaller basin size of the tributaries. However, because these basins are small and would include extensive development, the potential to sediment increase is high. These tributaries will undergo very significant increases in percent transport capacities under both the Ranch Plan and Alternative B9.

Under the Ranch Plan, The SJNW tributary experiences a 113% increase in transport rate during the 2-year event (Figure 5-7). The 10- and 100-year flows result in 54% and 20% increases in peak transport, respectively. Along the SJSW, the Ranch Plan results in increases in peak transport capacities of approximately 140%, 55%, and 20% during the 2-, 10-, and 100-year flows, respectively (Figure 5-8). Under the Ranch Plan, predicted peak transport capacities increase by approximately 110%, 55%, and 20% along the SJNE during the 2-, 10-, and 100-year flows, respectively (Figure 5-5).

Under Alternative B9, the SJNW tributary experiences an increase of approximately 85% in peak transport rate during the 2-year event (Figure 5-7). The 10- and 100-year flows result in 59% and 23% increases in peak transport, respectively. Along the SJSW, Alternative B9 results in increases in peak transport capacities of approximately 116%, 61%, and 23% during the 2-, 10-, and 100-year flows, respectively (Figure 5-8). Predicted peak transport capacities increase by approximately 93%, 62%, and 25% along the SJNE during the 2-, 10-, and 100-year flows, respectively (Figure 5-5).

In Central San Juan tributaries, the Ranch Plan results in larger increases in peak transport capacities during the 2-year flow compared to Alternative B9. However, the increases in peak transport capacities within Central San Juan tributaries over the Baseline Conditions are larger under Alternative B9 during the 10- and 100-year events.

5.4.6 La Paz Canyon

La Paz Canyon, in the San Mateo Watershed, was divided into three reaches for the sediment transport analysis (Figure 5-1). Results of the sediment transport analysis for La Paz Canyon are shown in Table 5-1. Under both the Ranch Plan and Alternative B9, the hydrologic assessment shows no change in the peak discharges of the three flow events and consequently no change in sediment transport capacities.

Within La Paz Canyon, Reach 3, the most upstream reach, has the highest transport capacity for all three modeled flow events. Sediment transport capacity is lower in Reach 2 and is the lowest in Reach 1. This decrease in transport capacity from upstream to downstream is likely a reflection of decreasing channel slopes. The sediment transport trends across reaches are preserved under the Ranch Plan.

5.4.7 Gabino Canyon

Gabino Canyon, in the San Mateo Watershed, was divided into five reaches for the sediment transport analysis (Figure 5-1). Results of the sediment transport analysis are shown in Table 5-1 and Figure 5-10.

Within Gabino Canyon, Reach 5, the most upstream reach, has the highest predicted peak transport capacity for all three flow events. High transport capacities in Reach 5 are likely due to high channel slopes in this reach. Sediment transport capacity is also comparatively high in Reaches 4 and 1, with significantly lower transport capacities in Reaches 2 and 3. The larger size of the channel and the greater proportion of small sediment sizes may explain the relatively high transport rate in Reach 1. Sediment transport capacity trends across the modeled reaches are the same under the Ranch Plan.

Figure 5-10 shows the increases in predicted peak transport capacities along the channel for all modeled events. During the 2-year event, the Ranch Plan results in a 2% increase in peak sediment transport capacity Reaches 1 and 2, increasing to approximately 6.5% for Reaches 3 to 5. The increases in predicted peak transport capacities under the Ranch Plan during the 10-year and 100-year flows are relatively similar, changing between 1% and 3%, peaking at Reach 3.

Alternative B9 results in negligible increases in peak transport capacities, ranging between 0.5% and 1.5% for the modeled events. The Ranch Plan results in slightly larger increases in peak transport capacities over the Baseline Conditions compared to Alternative B9.

5.4.8 Upper Cristianitos Canyon

Upper Cristianitos Creek, in the San Mateo Watershed, was divided into three reaches for the sediment transport analysis (Figure 5-1). Results of the sediment transport analysis are shown in Table 5-1 and Figure 5-11.

The peak transport capacities are predicted to be the highest in Reach 1 for all three modeled events. This result may reflect the larger (yet still transportable) bed-material size and larger channel width exhibited by Reach 1. The bed-material distribution for Reach 1 has a larger proportion of sand and gravel than the other two reaches. Under all three events, the most upstream reach, Reach 3, has the second highest transport capacities and Reach 2 has the lowest. The sediment transport capacity trends across reaches are the same under the Ranch Plan.

The Ranch Plan results in significant potential increases in peak sediment transport capacities, the 2-year flow having the largest impact. The peak transport capacities increase by approximately 15%, 12%, and 5% during the 2-year, 10-year, and 100-year flows, respectively.

Under Alternative B9, the hydrologic assessment shows no change in the peak discharges of the three flow events and consequently no change in sediment transport capacities. The Ranch Plan has significantly larger impacts on the existing sediment transport conditions compared to Alternative B9.

5.4.9 Talega Canyon

The hydrologic assessments for the Ranch Plan and Alternative B9 show similar effects on the peak discharges during the 2-, 10-, and 100-year flows within Talega Canyon (Table 3-9). Consequently, both plans will have similar effects on the predicted peak sediment transport capacities during all three modeled events. Table 3-9 illustrates that the largest increases in peak discharges occur during the 2-year event under both development plans, suggesting that the most significant changes in peak transport capacities will occur during the 2-year event. During the 10- and 100-year flows, peak discharges do not change significantly under the modeled development plans. Therefore, the Ranch Plan and Alternative B9 are not expected to have significant impacts on predicted peak sediment transport capacities during the modeled events.

5.4.10 Conclusion and Impact Discussion

Unmitigated development plans would alter the in-channel sediment transport processes by altering the hydrologic and hydraulic regime of the San Juan and San Mateo channel systems. Altered flow regimes could potentially induce bed and/or bank instability, or contribute to any existing instabilities. The potential impacts are considered to be potentially significant at the local scale (i.e, on the streams in the local canyons such as Chiquita, Gobernadora, Cristianitos, etc.) and will be mitigated via the hydrologic mitigation measures. By preventing increases in peak flows, channels will not be subject to significantly altered sediment transport characteristics and the impacts of the proposed development plans will be reduced to a level that is less than significant. The channel stability and adjustment to the proposed plans will be monitored. Monitoring will allow an adaptive management approach through which additional mitigation measures could be added.

More detailed site investigations and modeling will be needed in future studies as the level of design increases. These will be needed to develop appropriate mitigation measures for individual locations.

5.5 RESULTS FOR SEDIMENT YIELD MODELING

SAMWin model was used to estimate sediment yields during the 2-year, 10-year, and 100-year flow events under both the Baseline Conditions and the development alternatives by combining the respective hydrographs and sediment rating curves (sediment transport in tons/day versus discharge in cfs). The complete results of the analysis including the yields from all reaches are presented in Table 5-2. The discussion below focuses only on the sediment yields at the most downstream reaches of each canyon under the Baseline Conditions, the Ranch Plan, and Alternative B9 since this would represent the load to the mainstem San Juan and San Mateo Creeks. Please refer to Table 5-2 for the details of sediment yields along each canyon.

The impacts of the Ranch Plan and Alternative B9 on sediment yields during the 2-year, 10-year, and 100-year flows are summarized in Figures 5-21, and 5-22. Figures 5-21 and 5-22 illustrate the increases in predicted sediment yields at canyon mouths for all three modeled events under the Ranch Plan and Alternative B9, respectively. Following the predicted hydrologic changes and the transport discussions in the previous section, neither the Ranch Plan nor Alternative B9 results in significant predicted changes in Bell, Lucas and La Paz Canyons.

Under the Ranch Plan, the largest increases in predicted sediment yields at canyon mouths occur during the 2-year flow for all canyons with the exception of the mainstem Central San Juan, which undergoes the largest increase in sediment yield during the 10-year flow event. All of the Central San Juan tributaries (i.e. Trampas, SJNE, SJNW, and SJSW) are predicted to undergo significant increases in predicted sediment yields. The sediment yields are predicted to increase by between 111% and 118% during the 2-year flow at the mouths of Trampas, SJNW, and SJNE. The sediment yields at the mouths of Trampas, SJNW, and SJNE during the 10-year and 100-year flows vary slightly around 30% and 8%, respectively (Figure 5-20). The increases in sediment yields at SJSW under the Ranch Plan are predicted to be 59%, 36%, and 8% for the 2-, 10-, and 100-year flows, respectively. Within the San Mateo watershed, Cristianitos Canyon is predicted to undergo the largest increase in sediment yield under the Ranch Plan during the 2-year flow. The Ranch Plan does not result in any significant increases in sediment yields in Gabino and Verdugo Canyons.

Under Alternative B9, the largest increases in predicted sediment yields at canyon mouths occur during the 2-year flow for all canyons with the exception of the mainstem Central San Juan, which undergoes the largest increase in sediment yield during the 10-year flow event. All of the Central San Juan tributaries (i.e. Trampas, SJNE, SJNW, and SJSW) are predicted to undergo significant increases in predicted sediment yields. The sediment yields are predicted to increase by between 32% and 73% during the 2-year flow at the mouths of Trampas, SJNW, and SJNE. The sediment yields at the mouths of Trampas, SJNW, and SJNE during the 10-year and 100-year flows vary slightly around 31% and 8%, respectively (Figure 5-20). The increases in sediment yields in SJSW under Alternative B9 are predicted to be 32%, 31%, and 8% for the 2-, 10-, and 100-year flows, respectively. Under Alternative B9, the hydrologic assessment of the Cristianitos Canyon shows no change in the peak discharges and volumes of the three flow events and consequently no change in sediment transport capacities and sediment yields. Within the San Mateo watershed, Alternative B9 does not result in any significant increases in sediment yields in Gabino and Chiquita Canyons.

Figures 5-12 through 5-14 show the sediment yields for the 2-, 10-, and 100-year flows under the Baseline Conditions, the Ranch Plan, and Alternative B9, respectively. The sediment yields per unit area for each canyon under both the Baseline Conditions and the two development plans are presented in Figures 5-15 through 5-17 for the 2-year, 10-year, and 100-year flows, respectively. Figures 5-18, 5-19,

Table 5-2 Reach Sediment Yields Within the San Juan and San Mateo Creek Watersheds - Baseline, Ranch Plan, and Alternative B9

	Reach	HEC-1	Sediment Yield (tons)														
			Baseline Conditions			The Ranch Plan						Alternative B9					
			2-year event	10-year event	100-year event	2-year event	percent increase 2-year	10-year event	percent increase 10-year	100-year event	percent increase 100-year	2-year event	percent increase 2-year	10-year event	percent increase 10-year	100-year event	percent increase 100-year
SAN JUAN WATERSHED																	
Lucas Canyon (LU)	1	SJ3	**8,392**	**38,596**	**101,405**	**8,392**	**0.0**	**38,596**	**0.0**	**101,405**	**0.0**	**8,392**	**0.0**	**38,596**	**0.0**	**101,405**	**0.0**
	2	SJ3	20,728	95,793	251,937	20,728	0.0	95,793	0.0	251,937	0.0	20,728	0.0	95,793	0.0	251,937	0.0
	3	SJ3	416	3,500	13,011	441	6.0	3,526	0.7	12,993	-0.1	416	0.0	3,500	0.0	13,011	0.0
Verdugo Canyon (VD)	1	SJ9	**4,596**	**28,571**	**89,353**	**4,600**	**0.1**	**28,842**	**0.9**	**89,909**	**0.6**	**5,546**	**20.7**	**30,908**	**8.2**	**91,392**	**2.3**
	2	SJ9	7,402	46,374	146,096	7,415	0.2	46,856	1.0	146,932	0.6	8,914	20.4	50,238	8.3	149,388	2.3
	3	SJ9	1,878	10,984	34,280	1,880	0.1	11,089	1.0	34,500	0.6	2,241	19.3	11,878	8.1	35,091	2.4
	4	SJ9	356	4,425	20,584	357	0.3	4,489	1.4	20,795	1.0	461	29.5	5,002	13.0	21,398	4.0
Bell Canyon (BE)	1	cSJ60	**21,195**	**99,851**	**259,892**	**21,195**	**0.0**	**99,859**	**0.0**	**259,902**	**0.0**	**21,196**	**0.0**	**99,859**	**0.0**	**259,902**	**0.0**
	2	cSJ60	24,954	114,930	294,587	24,954	0.0	114,923	0.0	294,581	0.0	24,954	0.0	114,923	0.0	294,581	0.0
	3	cSJ60	25,065	114,591	293,643	25,065	0.0	114,601	0.0	293,654	0.0	25,065	0.0	114,601	0.0	293,654	0.0
	4	cSJ34	24,326	106,149	262,347	24,712	1.6	106,674	0.5	262,684	0.1	24,712	1.6	106,667	0.5	262,659	0.1
	5	cSJ34	41,890	177,179	433,247	42,612	1.7	178,005	0.5	433,643	0.1	42,612	1.7	178,010	0.5	433,664	0.1
	6	cSJ34	91,914	364,291	860,444	92,553	0.7	365,085	0.2	860,919	0.1	92,553	0.7	365,020	0.2	860,681	0.0
Canada Gobernadora (GO)	1	cSJ63	**13,277**	**65,581**	**176,869**	**14,247**	**7.3**	**67,396**	**2.8**	**178,416**	**0.9**	**14,268**	**7.5**	**67,751**	**3.3**	**178,839**	**1.1**
	2	cSJ63	12,841	64,408	174,025	13,792	7.4	66,196	2.8	175,582	0.9	13,813	7.6	66,540	3.3	175,952	1.1
	3	cSJ63	7,979	42,070	118,194	8,590	7.7	43,350	3.0	119,438	1.1	8,605	7.8	43,605	3.6	119,759	1.3
	4	cSJ63	9,613	47,193	127,140	10,295	7.1	48,441	2.6	128,156	0.8	10,311	7.3	48,703	3.2	128,453	1.0
	5	cSJ63	10,626	54,057	146,235	11,432	7.6	55,603	2.9	147,657	1.0	11,450	7.8	55,887	3.4	147,959	1.2
	6	cSJ63	10,124	50,090	133,811	10,882	7.5	51,500	2.8	135,082	0.9	10,898	7.6	51,762	3.3	135,387	1.2
	7	cSJ35	5,760	27,515	70,881	5,765	0.1	27,421	-0.3	70,889	0.0	5,765	0.1	27,421	-0.3	70,889	0.0
	8	cSJ35	7,510	32,890	84,511	7,518	0.1	32,792	-0.3	84,547	0.0	7,518	0.1	32,792	-0.3	84,547	0.0
	9	SJ7	9,205	45,125	114,611	9,206	0.0	44,787	-0.7	114,592	0.0	9,206	0.0	44,789	-0.7	114,596	0.0
Canada Chiquita (CH)	1	SJ8+SJ31	**10,036**	**56,323**	**162,686**	**10,608**	**5.7**	**57,232**	**1.6**	**163,500**	**0.5**	**10,494**	**4.6**	**57,367**	**1.9**	**164,217**	**0.9**
	2	SJ8+SJ31	2,399	15,891	48,424	2,558	6.6	16,173	1.8	48,675	0.5	2,523	5.2	16,199	1.9	48,880	0.9
	3	SJ8+SJ31	6,590	39,340	114,477	6,974	5.8	39,910	1.4	114,848	0.3	6,960	5.6	40,097	1.9	115,424	0.8
	4	SJ31	1,129	7,085	20,779	1,012	-10.4	6,811	-3.9	20,530	-1.2	1,129	0.0	7,026	-0.8	20,773	0.0
	5	SJ32	12,150	68,002	191,068	10,913	-10.2	65,393	-3.8	188,724	-1.2	12,147	0.0	67,470	-0.8	191,130	0.0
	6	SJ33	3,302	19,582	56,528	2,966	-10.2	18,831	-3.8	55,869	-1.2	3,301	0.0	19,424	-0.8	56,532	0.0
Central San Juan Catchments																	
Cental San Juan (SJ)	1	cSJ8	**20,330**	**102,481**	**289,539**	**20,640**	**1.5**	**107,782**	**5.2**	**298,208**	**3.0**	**20,543**	**1.0**	**107,862**	**5.3**	**298,353**	**3.0**
	2	CSJ63	14,898	67,776	200,228	15,394	3.3	69,063	1.9	203,875	1.8	15,261	2.4	68,671	1.3	200,261	0.0
	3	cSJ13	11,407	82,499	236,560	11,678	2.4	84,264	2.1	240,744	1.8	11,655	2.2	83,635	1.4	236,538	0.0
	4	CSJ60	23,495	100,905	305,391	23,500	0.0	101,051	0.1	307,094	0.6	23,597	0.4	101,363	0.5	251,694	-17.6
Trampas (TR)	1	23% SJ13	**4,791**	**34,888**	**111,229**	**10,440**	**117.9**	**47,245**	**35.4**	**120,063**	**7.9**	**8,289**	**73.0**	**45,640**	**30.8**	**120,816**	**8.6**
	2	23% SJ13	46	724	3,069	140	204.3	1,081	49.3	3,408	11.0	100	117.4	1,041	43.8	3,407	11.0
	3	23% SJ13	3,850	28,081	90,157	8,391	117.9	38,180	36.0	97,401	8.0	6,646	72.6	36,763	30.9	97,410	8.0
Norteast (NE)	1	11% SJ13	**1,488**	**11,633**	**38,273**	**3,233**	**117.3**	**15,978**	**37.4**	**41,569**	**8.6**	**2,569**	**72.6**	**15,409**	**32.5**	**41,594**	**8.7**
	2	11% SJ13	1,148	10,487	34,848	2,684	133.8	14,425	37.6	37,810	8.5	2,095	82.5	13,867	32.2	37,790	8.4
Northwest (NW)	1	9% SJ13	**522**	**6,263**	**20,961**	**1,104**	**111.5**	**7,915**	**26.4**	**22,666**	**8.1**	**830**	**59.0**	**7,707**	**23.1**	**22,694**	**8.3**
	2	9% SJ13	851	9,021	29,928	1,814	113.2	11,712	29.8	32,574	8.8	1,367	60.6	11,289	25.1	32,438	8.4
Southwest (SW)	1	4% SJ13	**219**	**1,123**	**3,709**	**349**	**59.4**	**1,523**	**35.6**	**3,998**	**7.8**	**289**	**32.0**	**1,468**	**30.7**	**3,998**	**7.8**
	2	4% SJ13	351	1,883	6,284	566	61.3	2,567	36.3	6,815	8.5	464	32.2	2,471	31.2	6,812	8.4
SAN MATEO WATERSHED																	
La Paz Canyon (LP)	1	CC51	**4,434**	**24,718**	**68,285**	**4,434**	**0.0**	**24,718**	**0.0**	**68,285**	**0.0**	**4,434**	**0.0**	**24,718**	**0.0**	**68,292**	**0.0**
	2	CC51	15,464	84,040	232,250	15,464	0.0	84,040	0.0	232,252	0.0	15,464	0.0	84,040	0.0	232,252	0.0
	3	CC51	41,885	238,609	646,079	41,884	0.0	238,610	0.0	646,081	0.0	41,885	0.0	238,610	0.0	646,178	0.0
Gabino Canyon (GA)	1	cCC48	**11,430**	**69,061**	**199,972**	**11,792**	**3.2**	**69,957**	**1.3**	**201,041**	**0.5**	**11,847**	**3.6**	**70,287**	**1.8**	**201,063**	**0.5**
	2	cCC48	9,138	50,644	142,758	9,409	3.0	51,273	1.2	143,525	0.5	9,442	3.3	51,461	1.6	143,454	0.5
	3	CC49	4,413	29,253	88,417	4,606	4.4	29,458	0.7	88,963	0.6	4,411	0.0	29,245	0.0	88,408	0.0
	4	CC49	8,378	54,647	163,423	8,739	4.3	54,977	0.6	164,306	0.5	8,358	-0.2	54,536	-0.2	163,301	-0.1
	5	CC49	5,422	61,548	205,153	5,676	4.7	61,514	-0.1	205,955	0.4	5,439	0.3	61,619	0.1	205,350	0.1
Cristianitos Canyon (CR)	1	CC45	**3,787**	**24,277**	**75,167**	**4,155**	**9.7**	**25,609**	**5.5**	**76,136**	**1.3**	**3,787**	**0.0**	**24,276**	**0.0**	**75,189**	**0.0**
	2	CC45	579	3,514	10,716	632	9.2	3,701	5.3	10,847	1.2	579	0.0	3,514	0.0	10,717	0.0
	3	CC45	1,176	7,000	21,297	1,283	9.1	7,381	5.4	21,583	1.3	1,176	0.0	7,000	0.0	21,306	0.0

Notes:
1. Percent increase refers to percent increase in reach sediment yield as compared with Baseline Conditions. A negative value indicates that the Baseline Conditions had a higher sediment yield.
2. Sediment yields at the most downstream reaches are highlighted in bold text and represent sediment yields from canyons delivered to San Juan and Cristianitos Creeks

and 5-20 illustrate the sediment yields per unit area under the Baseline Conditions, the Ranch Plan, and Alternative B9, respectively.

5.5.1 Lucas Canyon

Under both the Ranch Plan and Alternative B9, the hydrologic assessment shows no change in the peak discharges and volumes of the 2-, 10-, and 100-year events over Baseline Conditions in Lucas Canyon. Therefore, the Ranch Plan and Alternative B9 do not have any impact on predicted sediment transport capacities and sediment yields.

5.5.2 Verdugo Canyon

Verdugo Canyon has significant sediment yield per unit area compared to the other San Juan sub-basins, with the exception of small Central San Juan tributaries (Table 5-2, and Figures 5-15 through 5-17).

Predicted sediment yields in Verdugo Canyon increases negligibly by 0.1% to 1% under the Ranch Plan (Figure 5-21). The largest increase in sediment yield under the Ranch Plan occurs during the 10-year flow event.

Under Alternative B9, predicted sediment yields in Verdugo Canyon increase significantly by 2% to 20% over the Baseline Conditions (Figure 5-22). The largest increase in sediment yield under this alternative occurs during the 2-year flow event.

Alternative B9 resulted in significantly larger increases in sediment yield over the Existing Conditions compared to the Ranch Plan for all three modeled flow events.

5.5.3 Canada Gobernadora

Canada Gobernadora has moderate sediment yield per unit area compared to the other San Juan sub-basins, with the exception of small Central San Juan tributaries (Table 5-2, and Figures 5-15 through 5-17).

There are moderate to low increases in predicted sediment yields of Canada Gobernadora under the Ranch Plan. Predicted sediment yields increase by 7.3%, 2.8%, and 1% for the 2-, 10-, and 100-year flows, respectively (Figure 5-21).

Under Alternative B9, predicted sediment yields increase by 7.3%, 2.8%, and 1% for the 2-, 10-, and 100-year flows, respectively (Figure 5-22), over existing conditions.

Alternative B9 and the Ranch Plan have similar results on the sediment regime of Canada Gobernadora.

5.5.4 Canada Chiquita

With similar sediment yields per unit area to Canada Gobernadora Canyon, Canada Chiquita also has moderate sediment yields per unit area under all three modeled events (Table 5-2, and Figures 5-15 through 5-17).

The Ranch Plan results in increases in predicted sediment yields in Canada Chiquita, with the largest increase occurring during the 2-year flow. Predicted sediment yields increase by 5.7%, 1.6%, and 1% during the 2-, 10-, and 100-year flows, respectively (Figure 5-21).

Alternative B9 results in increases in predicted sediment yields in Canada Chiquita, with the largest increase occurring during the 2-year flow. Predicted sediment yields increase by 4.6%, 1.9%, and 1% during the 2-, 10-, and 100-year flows, respectively (Figure 5-22).

While the Ranch Plan has a greater impact on the sediment yield during the 2-year flow than Alternative B9, the latter results in slightly larger increases in sediment yield during the 10- and 100-year events compared to the Ranch Plan. Both plans represent an increase in sediment yield over Existing Conditions.

5.5.5 Central San Juan Catchments

The Central San Juan Catchments, excluding the main-stem Central San Juan, have the largest sediment yields per unit area among all the modeled basins for all three flow events, which are significantly larger than all other canyon yields (Table 5-2, and Figures 5-15 through 5-17).

While the predicted event sediment yields do not change significantly in the mainstem Central San Juan under the Ranch Plan, the tributary catchments to Central San Juan, including Trampas, San Juan Northeast (SJNE), San Juan Northwest (SJNW), and San Juan Southwest (SJSW), are predicted to undergo very significant to moderate increases in sediment yield. The mainstem Central San Juan is predicted to have yield increases of 1.5%, 5.2%, and 3% during the 2-, 10-, and 100-year flows, respectively (Figure 5-21).

While the predicted event sediment yields do not change significantly in the mainstem Central San Juan under Alternative B9, the tributary catchments to Central San Juan, including Trampas, San Juan Northeast (SJNE), San Juan Northwest (SJNW), and San Juan Southwest (SJSW), are predicted to undergo very significant to moderate increases in sediment yield. The mainstem Central San Juan is predicted to have yield increases of 1%, 5.3%, and 3% during the 2-, 10-, and 100-year flows, respectively (Figure 5-22).

The largest increases are predicted in Trampas Canyon, with the most significant increase occurring during the 2-year flow. While, the Ranch Plan results in increases in predicted sediment yields of 118%, 35%, and 8% for the 2-, 10-, and 100-year flows, Alternative B9 results in increases in predicted sediment yields of 73%, 31%, and 9% for the 2-, 10-, and 100-year flows, respectively.

The three small sub-basins within the Central San Juan watershed (SJNE, SJNW, and SJSW) also undergo significant increase in predicted sediment yields under the Ranch Plan. The increases during the 2-year flow are the most significant and are 117%, 111% and 59% for SJNE, SJNW, and SJSW, respectively. In the same subbasins, predicted sediment yields increase by 37%, 26%, and 36% during the 10-year flow event. The increases in sediment yield are similar for all three subbasins during the 2-year flow event and are approximately 8%.

The three small sub-basins within the Central San Juan watershed (SJNE, SJNW, and SJSW) also undergo significant increase in predicted sediment yields under the Alternative B9. The increases during the 2-year flow are the most significant and are 73%, 60% and 32% for SJNE, SJNW, and SJSW, respectively. In the same sub-basins, predicted sediment yields increase by 37%, 26%, and 36% during the 10-year flow event. The increases in sediment yield are similar for all three sub-basins during the 100-year flow event and are between 8 and 9%.

Within Central San Juan watersheds, the Ranch Plan results in larger increases in sediment yield during the 2- and 10-year flow compared to Alternative B9. However, the increases in sediment yield over the Baseline Conditions during the 100-year event are slightly larger under Alternative B9.

5.5.6 La Paz Canyon

La Paz Canyon has the lowest sediment yields per unit area among the San Mateo sub-basins for all three flow events (Table 5-2, and Figures 5-15 through 5-17). There is no change in peak flows and in volumes of the 2-, 10-, and 100-year events under the Ranch Plan and Alternative B9 over Baseline Conditions in La Paz Canyon. Therefore, the development plans do not have any impact on predicted sediment transport capacities and sediment yields.

5.5.7 Gabino Canyon

Gabino Canyon has moderate sediment yields per unit area for all modeled events (Table 1-4, Figures 5-15 through 5-17). Gabino Canyon is not subject to significant increases in predicted sediment yields under the Ranch Plan. During the 2-, 10-, and 100-year flows, predicted sediment yield increases by 3.2%, 1.3%, and 1%, respectively (Figure 5-21).

Under Alternative B9, predicted sediment yield increases by 3.7%, 1.8%, and 1% during the 2-, 10-, and 100-year flows, respectively (Figure 5-22).

Alternative B9 results in slightly larger increases in sediment yield over the Baseline Conditions compared to the Ranch Plan.

5.5.8 Upper Cristianitos Canyon

There is no change in peak flows and in volumes of the 2-, 10-, and 100-year events under Alternative B9 over Baseline Conditions in Upper Cristianitos Canyon. The Ranch Plan results in comparatively higher increases in sediment transport capacity and yield compared to Alternative B9.

5.5.9 Talega Canyon

The hydrologic assessments for the Ranch Plan and Alternative B9 show that they both have similar effects on the peak discharges and runoff volumes during the 2-, 10-, and 100-year flows within Talega Canyon (Table 3-9 and Table 3-10). Therefore, both plans are likely to have similar effects on the sediment yields during all three modeled events. Tables 3-9 and 3-10 illustrate that the largest increases in peak discharges and runoff volumes occur during the 2-year event under both development plans, suggesting that the most significant changes in sediment yields will occur during the 2-year event.

During the 10- and 100-year flows, runoff volumes are not predicted to change significantly under the development plans. Therefore, the Ranch Plan and Alternative B9 are not expected to have significant impacts on sediment yields during the modeled events.

5.5.10 Conclusion and Impact Discussion

If unmitigated, the proposed development plans would alter the in-channel sediment transport processes by altering the hydrologic and hydraulic regime of the San Juan and San Mateo channel systems. Altered flow regime could potentially induce bed and/or bank instability, or contribute to any existing instabilities. The potential impacts would be locally significant.

Potential channel impacts are directly correlated to the hydrologic regime associated with each land use alternative. Peak flows and the volume and duration of flow within the channel will influence sediment transport and yield. Therefore, as discussed in Section 4.3, the greatest (unmitigated) impacts are expected from the Ranch Plan and from Alternatives B10 and B11. However, by mitigating the hydrologic impacts and by preserving the existing flow regime, adverse sediment transport impacts may be reduced. By preventing increases in durations of high velocity events and reducing flow volume increases, the channels will not be subject to significantly altered sediment transport characteristics and the impacts of the proposed development plans will be reduced to a level that is less than significant. The channel stability and adjustment to the proposed plans will be monitored. Monitoring will allow an adaptive management approach through which additional mitigation measures could be added.

More detailed site investigations and modeling will be needed in future studies as the level of design increases. These will be needed to develop appropriate mitigation measures for individual locations.

6. POTENTIAL IMPACTS SUMMARY AND MITIGATION STRATEGY

This chapter summarizes the nature of potential impacts, the criteria for evaluating these impacts, and proposed mitigation approaches and criteria. While it focuses on the Ranch Plan, the overall approach is applicable to each of the alternatives.

6.1 OVERVIEW

The proposed development will alter the land surface cover in portions of the San Juan and San Mateo Creek subwatersheds. This in turn will alter the rainfall-runoff processes such that the development may increase the rate and volume of surface runoff directed to the creeks and drainages, and reduce the amount of rainfall that infiltrates to the groundwater table or is evaporated back to the atmosphere. These potential increases in streamflow could in turn alter the sediment transport capacity of the channels, resulting in erosion or sedimentation of the channels, and conveyance of additional sediment off-site. The previous chapters provide an assessment of the existing hydrologic and sediment transport characteristics of the development areas (and off-site areas within the watersheds, both up- and downstream of the development zone). In addition, they provide a planning level assessment of potential alterations to the hydrologic and sediment regimes for the various alternatives. In particular, for rainfall runoff conditions, they provide estimates of:

- The potential change in peak flow rate (ie, the maximum flow rate that may occur during a flood event of a given size)
- The potential change in timing of the arrival of peak flows
- The potential change in volume of runoff from a particular flood event

The sediment transport capacity of the various channel reaches, is a function of the predicted channel flows, channel characteristics, and the distribution of sediment sizes. For sediment transport assessment, the SAM computer model results (described in Section 5) provide an estimate of the sediment to be transported. The modeling was done to characterize existing conditions, and estimate potential changes in transport capacity that may result from the various development alternatives. In general, significant flow increases would be expected to increase erosion in steeper channel reaches, and deposit this sediment downstream in flatter or wider areas. It should be noted that this assessment focuses only on the sediment transport capacity of the channel reaches. Prior studies by Balance Hydrologics characterize the geomorphic characteristics of the channel system, and provide insight into the existing channel stability and susceptibility to changes in the flow regime or sediment supply. The project layout has been developed to minimize development on the coarser sandy soil areas. These are expected to continue to supply coarser sediments to the stream channels and will not result in the reduction of the beneficial sediment to the channel.

Potential hydrologic impacts are minimized by a combination of development location, flood management strategies described below, and the water quality management program described in the Geosyntec report. The hydrologic management features of the water quality program will also provide significant benefits in maintaining the existing hydrologic regime.

6.2 CRITERIA FOR SIGNIFICANT IMPACTS

Proposed significance criteria relevant to the regional hydrology studies (as established by Orange County) for hydrology and water quality are as follows:

Significant water resources impacts would occur if the proposed project 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.

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

- Substantially increase the frequencies and duration of channel adjusting flows

- 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.

- Conflict with applicable San Juan Creek Watershed/Western San Mateo Creek Watershed SAMP/MSAA Planning Principles. Principles relevant to this study include:

- 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 (including, but not limited to, changes in hydrologic response to major episodic storm events, potential changes in sediment supply, and potential changes in the infiltration of surface/soil water to groundwater)

- Principle 4 – Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks.

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

These can be summarized into the following impact criteria and planning principles:

6.2.1 Impact Criteria

1. Increase flood hazards (on- or off-site) by substantially increasing the rate or amount of surface runoff.
2. Destabilize channels by substantially altering the flow regime
3. Produce erosion or deposition of sediment by altering the course of the streams

6.2.2 Planning Principles

1. Emulate the existing runoff and infiltration patterns
2. Minimize alterations during major floods, changes in sediment regime, and changes in the annual water balance.
3. Minimize changes in the timing of flows in the local drainages, in relation to the flows in the San Juan and San Mateo systems.
4. Minimize changes to the sediment regime in the main channels

6.3 PROPOSED MITIGATION STRATEGIES

As discussed in Chapter 3, the total development envelope represents a relatively small percentage of the overall San Juan and San Mateo watersheds (less than 5% of each, as shown in Table 3-3). As such, the nature of potential increases in flow or sediment from the various development alternatives will be comparably small in comparison to the existing hydrologic and sediment regimes of these two major watersheds. Thus, the potential impacts of the proposed RMV developments on downstream, off-site areas would be cumulative in nature. Changes from the natural hydrologic regime result from the aggregated effects of all the existing development in the watersheds with the RMV development potentially adding small but cumulative impacts.. While the proposed development represents a small portion of the San Juan and San Mateo watersheds, it represents a larger percentage of the local subwatersheds (Chiquita, Gobernadora, Cristianitos, Gabino, and Talega). Thus, the potential for impacts is greater in for the creeks in these local canyons compared with the San Juan and San Mateo Channels. While the predicted scale of changes in runoff (and consequently, in sediment transport/yield) are small, there are channel erosion and flood hazard issues downstream of the ranch boundary. As such, even the small increases predicted are considered potentially significant. RMV is proposing a mitigation program that will prevent increases in flood peaks from a wide variety of storms ranging from the 2-year to the 100-year event. In addition, the hydrologic management plan will prevent increases in runoff volume from events up to the 2-year storm. These smaller storms have the primary "channel-forming role" (that is, have the major effect on channel stability).

The goal of the RMV mitigation strategy is manage all of the potential hydrologic and sediment impacts from the development through a combination of land use planning and a series of on-site facilities that will reduce these impacts to a less-than-significant level, both on- and off-site for all of the subwatersheds as well as the San Juan and San Mateo systems. This represents an integrated approach to managing flood control issues, pollutants of concern, and addressing the hydrologic conditions of concern. It is designed to provide a comprehensive solution to protect stream courses, riparian habitats, provide water quality treatment and flood hazard management.

The overall hydrologic mitigation strategy initially focused on the identification of preferred locations for siting development. Disturbed areas and zones with lower infiltration properties (rock outcroppings and clay soils) were preferentially selected for development, while areas with higher infiltration (sandy and loamy soils) were avoided. This results in relatively small predicted differences in runoff between existing conditions and the proposed project. Mitigation of the runoff increases that do occur will combine localized infiltration facilities, small detention ponds (golf courses etc), dry season evaporation and some flow diversion strategies, distributed throughout the developed planning areas, with a series of larger, sub-regional flood detention basins located at the downstream end of each of the major development areas..

The distributed "infiltration" facilities are intended to provide both water quality management and flow management during small to medium rainstorms. In addition to water quality management, they are designed to mimic the annual water balance, maintain groundwater infiltration, and reduce artificial dry season streamflow during smaller more frequent rainstorm events (generally less than 2 year frequency). They will also provide some peak flow rate and flow volume reduction during larger (2- to 100-yr) design events. These facilities are described in the Geosyntec report (Geosyntec, 2004).

During more severe flood events (2- to 100-year events), excess runoff will be temporarily stored in larger detention facilities, and released at lower flow rates to prevent flow peak increases to local or regional channel systems. These larger basins will also provide water quality benefits by trapping additional sediment and pollutants prior to discharge into the local and regional streams. This is considered an additional benefit, as the existing water quality management facilities have been designed to provide the required level of treatment. While the water quality and flood management elements will be designed to function as an integral system, they will be considered separately for management and maintenance. The flood facilities will be designed and maintained in accordance with the county flood program directions on sizing, design and maintenance. The water quality facilities will be designed in accordance with RWQCB requirements, and those of the county water quality program.

The primary mitigation approach for sediment transport/channel stability issues is to manage the hydrologic regime. By minimizing the alteration of channel-forming flow events (up to the 2-year event), preventing an increase in peak flows, and reducing volume increases, the channels will not be subject to significantly altered sediment transport characteristics.

6.4 DETENTION FACILITIES

Detention facilities will be located at the lower end of each of the major developed planning areas as necessary within the RMV project. While the specific design and characteristics of each basin will be refined during the project design process, planning level information is provided in this section to characterize the facilities and their functions.

Initial basin locations are shown on Figure 6-1 for the Ranch Plan. While the specific number, size and locations of the basins will vary between alternatives, and will be refined during the design process, these locations have been field identified regarding initial feasibility and spatial availability. Table 6-1 provides in initial estimate of the range of storage volumes that may be required in each of the major planning areas. These initial estimates cover a range obtained from the Geosyntec report (detention volumes required to match the flow-duration curve for a wide variety of storm events), rainfall-runoff modeling, and based on the detention volumes required in the adjacent Ladera development. In this development, the Horno basin was sized based on the OCHM criteria to provide flood hazard reduction from a wide range of storms (2- to 100-year events). The ratio of development area to required detention basin volume in Ladera provides a useful initial estimate of the volumes that may be required in the RMV development areas. The RMV team will work closely with the OC flood control program during the subsequent project phases to refine the location, number, size and design of these basins throughout the development areas as the preferred development alternative is selected and finalized. Depending on the alternative grading plan, there may be a single larger basin in some planning areas, or a series of smaller basins. The basin design, in conjunction with the water quality runoff management plan will provide mitigation to reduce flow peaks to existing levels, and flow volumes to a level that prevents stream channel instability.

Table 6-1 Approximate Detention Basin Volumes

	Sub-basin Name		Proposed Detention Basin Volume, acre-feet
	GIS	HEC-1	
SAN JUAN WATERSHED			
Canada Gobernadora*	7, 35, 36, & 63	cSJ63	50-250
Canada Chiquita	8 & 31	SJ31+SJ8	25-150
Central San Juan Catchments	13	SJ13	200-500
SAN MATEO WATERSHED			
Gabino Canyon with Blind Canyon**	48	CC48	25-150
Upper Cristianitos Canyon	45	CC45	50-175
Talega Canyon***	47	CC47	50-175

*- Includes Wagon Wheel
**- Includes Upper and Lower Gabino and Blind
***- Talega only

The basins will be designed as "off-line" from most of the major stream channels. That is, they will be located within the development area, and will not require damming or diversion from the major drainage channels (ie, Chiquita Ck). The Gobernadora detention basin would be located within the channel and designed as a flow through basin. Flow from the development will be routed through the basins prior to discharge either to the mainstem stream channels. In general, flow from undeveloped areas will not be routed through the basins, but will follow existing drainages directly to the main channels.

The basins will be designed to include an initial forebay area for trapping of sediment, floating debris etc (Figure 6-2 provides a schematic depiction of a typical detention facility). The sediment forebay will be designed for easy maintenance, with an elongated shape maximize the opportunity for sediment (and pollutants adsorbed to the sediment particles) to settle out, and to allow easy sediment removal by an excavator on the access road. Maintenance standards will be established for maximum depth of accumulated sediment in the forebay basins prior to removal. An overflow weir will connect the forebay to the main detention facility. This larger facility will include the entrance zone, the main storage area and the outlet structure. The basin will have sloped, vegetated sides, a perimeter access road, and a ramp access to the basin floor. The entire detention facility will be fenced to preclude public access. The floor of the basin will likely be colonized by emergent vegetation. This can provide additional water quality improvement of urban runoff, and evaporation potential during the dry season. In addition, this vegetation will provide incidental avian and wildlife habitat. However, the primary intent of the structures is to provide sediment trapping in the forebay, and flood detention in the main basin. As such, maintenance protocol and regulatory permits should be established during the design process to facilitate the required periodic sediment removal and facility maintenance.

The outlet structure will be configured to control a wide range of flows, providing flow management from the 2- to 100-year flow event. It will also include an overflow spillway, designed to safely convey floods in excess of the outlet structure capacity directly to the stream. A subdrain will be provided to insure complete drainage within several days following a flow event.

A key element in the long-term effectiveness of the detention facilities is the establishment of an on-going maintenance and monitoring program. RMV will establish both a management entity and a funding source to insure the implementation of a program to accomplish the following goals:

- Monitoring: the monitoring program will track the performance of the detention facilities as well as the stability of the various stream channels within the RMV project. The monitoring will serve to identify the regular maintenance needs of the facilities (this program will be integrated with the monitoring of the water quality facilities, described in the Geosyntec report) as well as track any emerging problems with erosion or sedimentation in the stream channels.
- Detention basin maintenance will include:
    - Identifying the rate of sediment buildup in the forebay or in the main facility and provision for sediment removal when the accumulated sediment reaches a specified depth (the initial sizing criteria for basin volume will include provision for this loss of storage during the period of sediment accumulation)
    - Emergent Vegetation management: A vegetation management plan will be specified for all of the structure elements of the flood detention system. RMV will work with the

county to identify elements of the detention basin that can accommodate some vegetation (for example if water quality ponds are included in the facility, vegetation criteria will be developed for these). Based on county recommendations, vegetation will be precluded from the active flood detention basins to facilitate sediment removal activities.

- Vector/nuisance management: The design and maintenance of the basins will include prevention of vector problems such as mosquitos, rodents, algal blooms etc.
- Structural components: the basin inlet and outlet structures will require periodic maintenance to remove accumulated debris and replacement of damaged or aging elements. If the basins include a water recovery program (ie, use of detained or infiltrated water for irrigation), the pumps and associated facilities (screens, pipes, valves) will require ongoing monitoring/maintenance.
- Facility Appearance/landscaping: The detention basins will be large elements situated at visible locations within the developments. As such their design and maintenance are important from an aesthetic perspective. The perimeter fencing, access roads and landscaping, on the basin side slopes will require ongoing irrigation and upkeep to insure that the basins represent visually appealing facilities.

6.5 LEVEL OF SIGNIFICANCE AFTER MITIGATION

The flow mitigation program will be refined during the design process. At present, combined infiltration and detention facilities have been proposed to maintain the flow regime and prevent significant changes during a full range of flow events.

Regarding the specific hydrologic criteria:

- 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.

The proposed detention facilities, in conjunction with the infiltration approach, will reduce post-project flow peaks to the pre-project level. There is adequate area within the development areas to refine the size of the detention facilities to comply with County criteria. As such, the project with mitigation will have a less than significant impact on both on- and off-site flood hazards.

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

The project is being designed to avoid direct alteration of the major stream channels. During the project design phases, any required alteration to smaller drainages will be done in a way to maintain channel stability. This will include drainage system design attributes, as well as routing flows within the development areas through the Infiltration/Sedimentation and Detention basin facilities. The project will have a less than significant effect on channel erosion/siltation due to alteration of the channel system.

- Substantially increase the frequencies and duration of channel adjusting flows

The combined infiltration/detention system is designed to provide flow management for a full range of future hydrologic events, ranging from the frequent winter rainstorms, to the moderate (1.5- to 5-yr) events, and including the major flood events (10-year to 100-year). The goal is maintain the existing flow regime, especially for the more frequent and channel forming (approximately 2-yr events). For larger events, flow peaks will not increase. Based on this, the impact is considered to be less than significant.

- 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.

The project detention facilities will be designed to comply with all applicable county and other agency design/safety criteria. In general, the basins are typically located at the lower end of the development bubbles, relatively near the major watercourses. The facilities will be designed with adequate spillway systems to safely convey water in excess of the pond capacity, or in the event of outlet structure blockage. Implementation of this will reduce potential safety impacts to a less than significant level.

- Conflict with applicable San Juan Creek Watershed/Western San Mateo Creek Watershed SAMP/MSAA Planning Principles. Principles relevant to this study include:

    - 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 (including, but not limited to, changes in hydrologic response to major episodic storm events, potential changes in sediment supply, and potential changes in the infiltration of surface/soil water to groundwater)
    - Principle 4 – Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks.
    - Principle 6 – Maintain coarse sediment yields, storage and transport processes.

Development and compliance with the Planning Principles has been an integral part of the planning of the RMV development. The overall project layout, including development bubble locations has included maintenance of the hydrologic regime as an integral component. This will allow coarse (sandy) sediment supply to the stream systems. In addition, the infiltration facilities will insure that the changes to the hydrologic regime are minimized. Finally, provision of the detention/sediment facilities will insure that flood flows are not increased, and prevent the excessive discharge of fine (silt/clay) particles from the development bubbles. Implementation of these measures/facilities represents compliance with the SAMP planning principles and will reduce impacts to a less than significant level.

7. LIST OF PREPARERS

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Brad Evans	Graphics

8. REFERENCES

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"San Juan Creek Watershed Management Study F3 Feasibility Phase Appendices – Hydraulic and Sedimentation Documentation." Prepared by Simons, Li & Associates for the U.S. Army Corps of Engineers, Los Angeles District, July 1999.

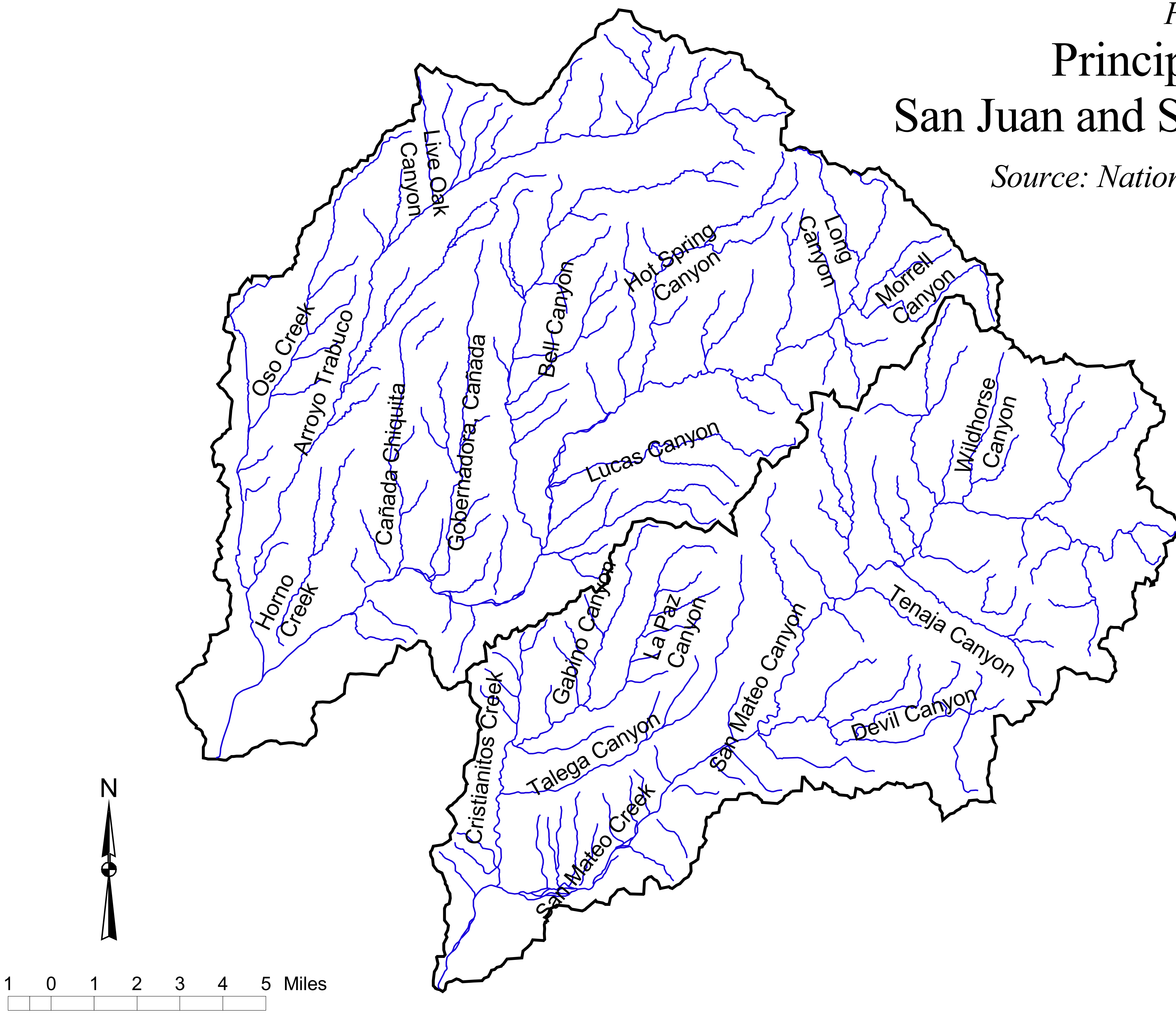
"Technical Appendix A: Baseline Hydrologic Conditions, San Juan and Upper San Mateo Watersheds." Philip Williams & Associates, Ltd. Prepared for Rancho Mission Viejo. May 2001

9. FIGURES

Figure 1-1

Principal Streams
San Juan and San Mateo Watersheds

Source: National Hydrography Dataset



Light border - San Juan Basin
Dark border - San Mateo Basin

PWA

figure 1-2

Increase in Existing Developed Area Within the San Juan & San Mateo Watersheds (2000 and 2003)

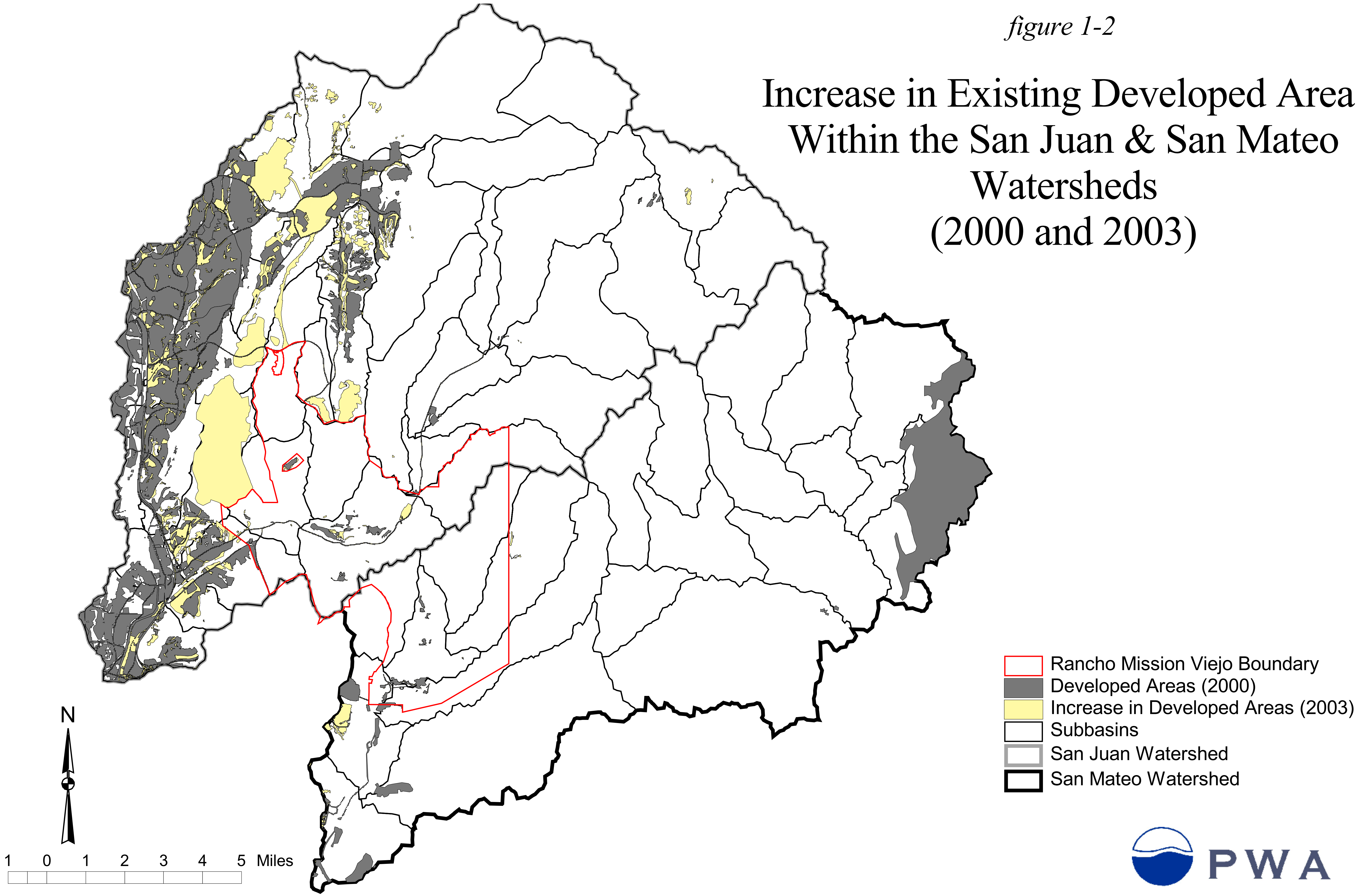
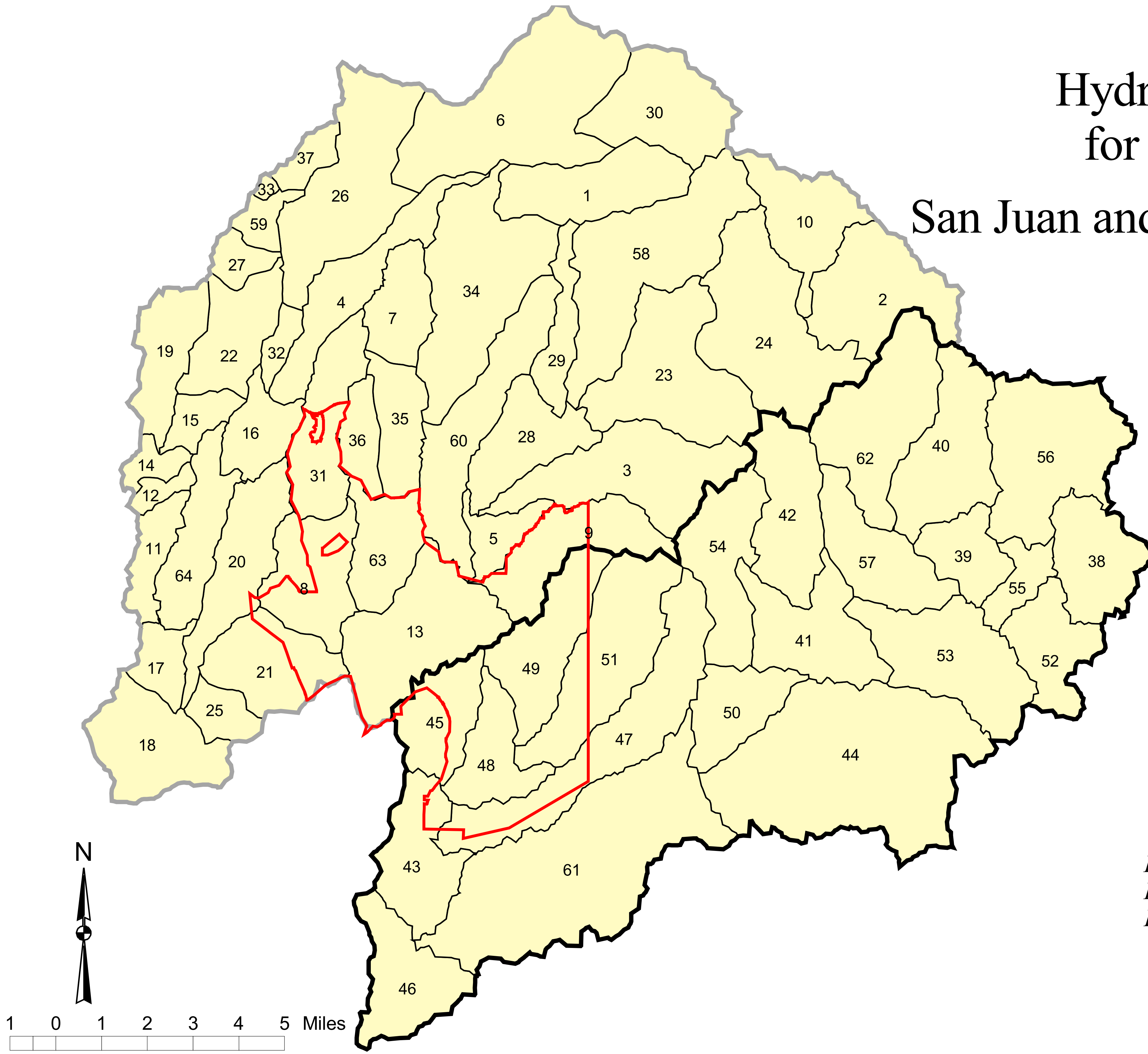


figure 1-3

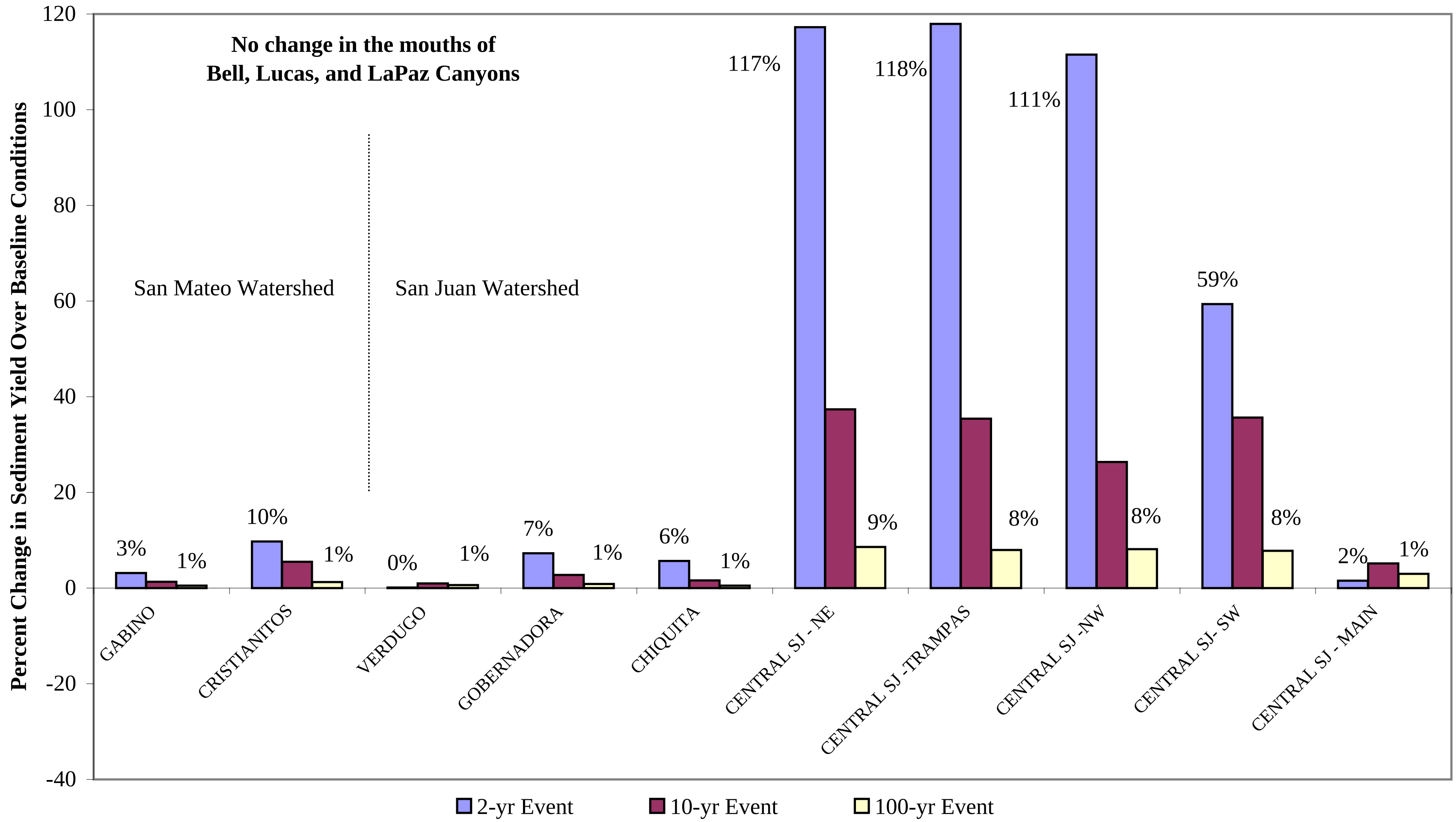
Hydrologic Sub-basins for Runoff Analysis

San Juan and San Mateo Watersheds



Light border - San Juan Basin
Dark border - San Mateo Basin
Red border - Rancho Mission Viejo Boundary

PWA



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are for the most downstream reaches.

figure 1-4

San Juan and San Mateo Watersheds Sediment Transport Analysis

Percent Change in Sediment Yield Over Baseline Conditions (at Canyon Mouths)

PWA

PWA #:1393-02

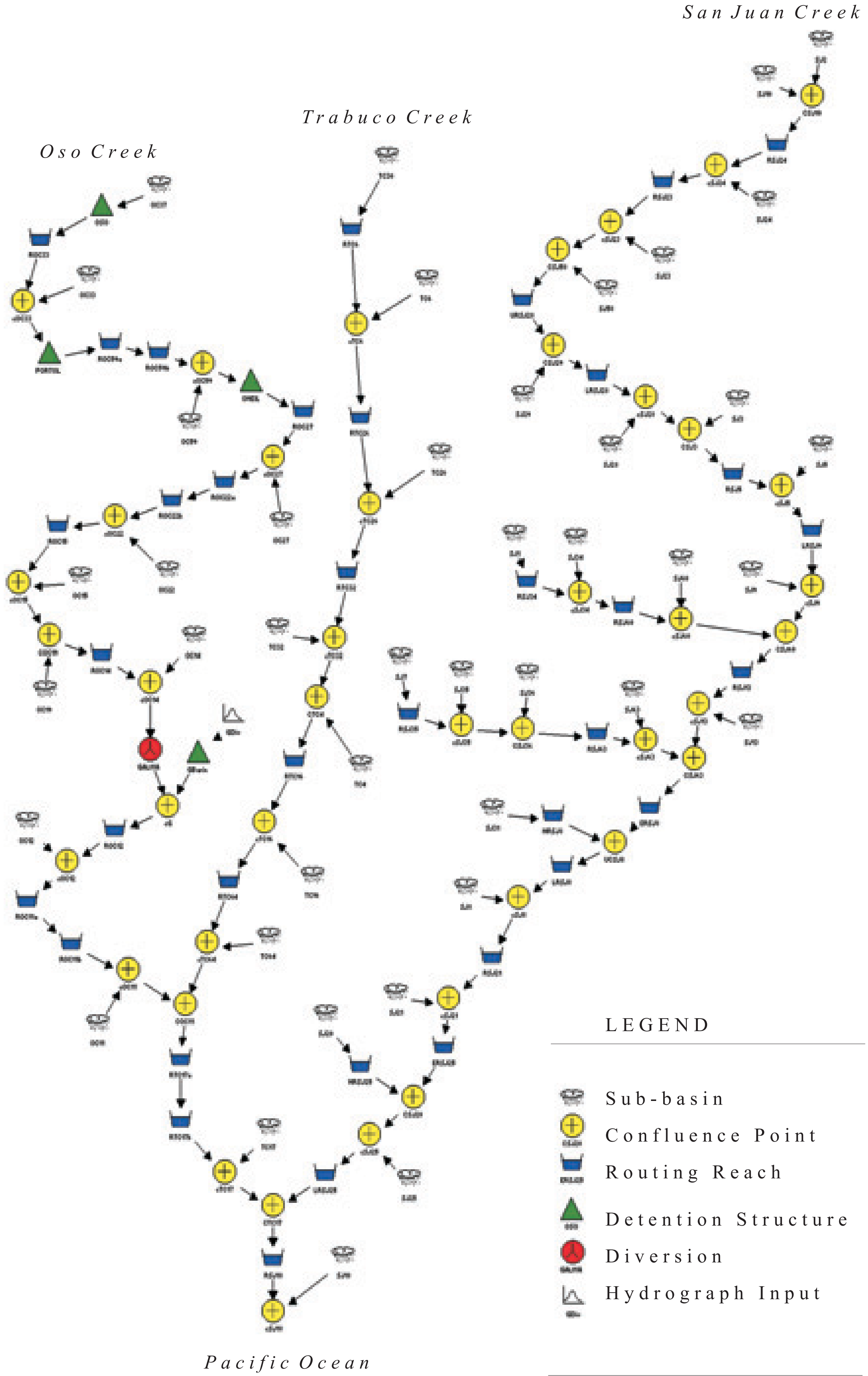
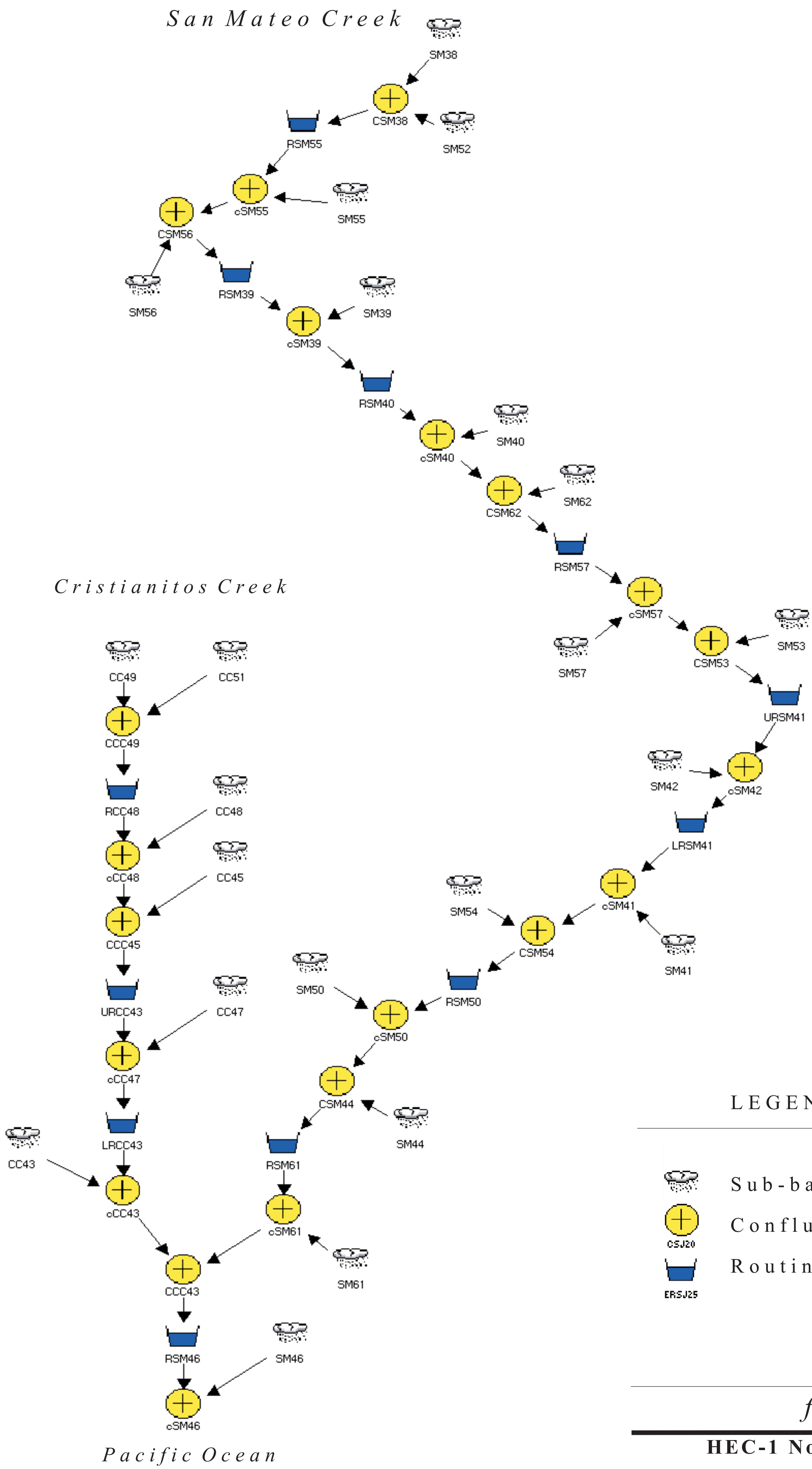


figure **2-1**

HEC-1 Node Network
San Juan Watershed



LEGEND

Sub-basin

CSJ20 ConfluencePoint

ERSJ25 RoutingReach

figure **2-2**

HEC-1 Node Network

San Mateo Watershed

1393 SAMP San Mateo.cdr

PWA

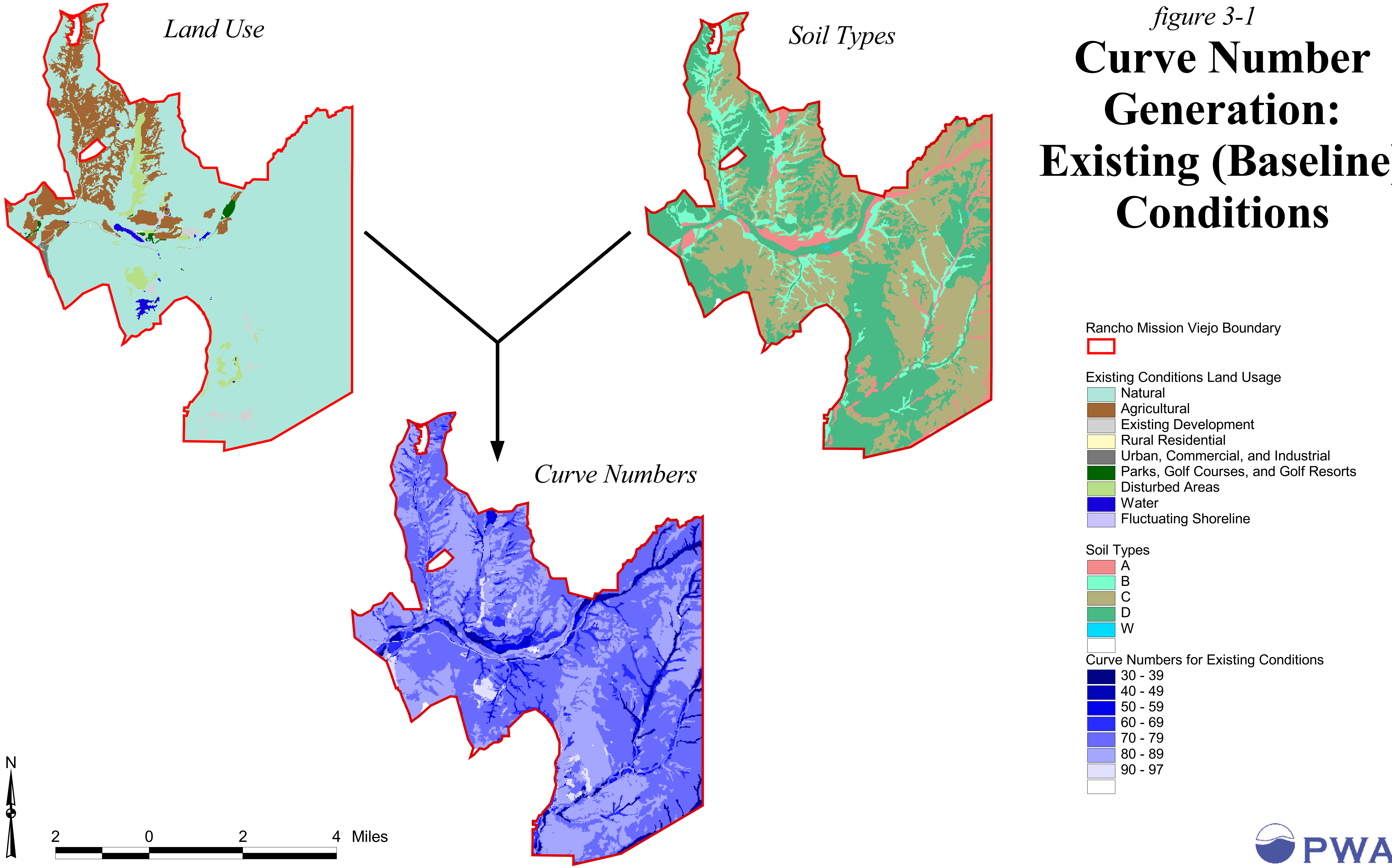
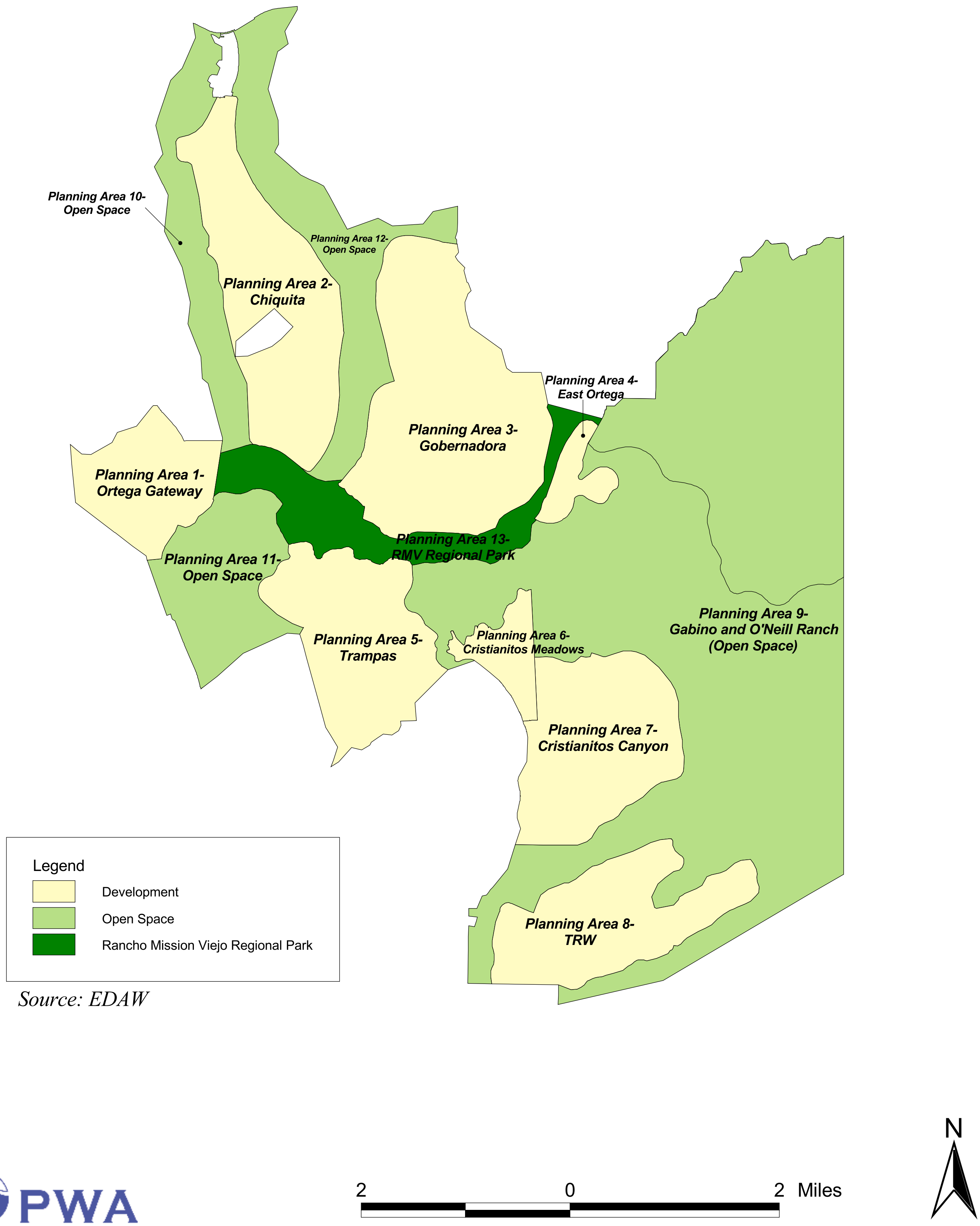


figure 3-1

Curve Number Generation: Existing (Baseline) Conditions

figure 3-2

RMV Planning Areas

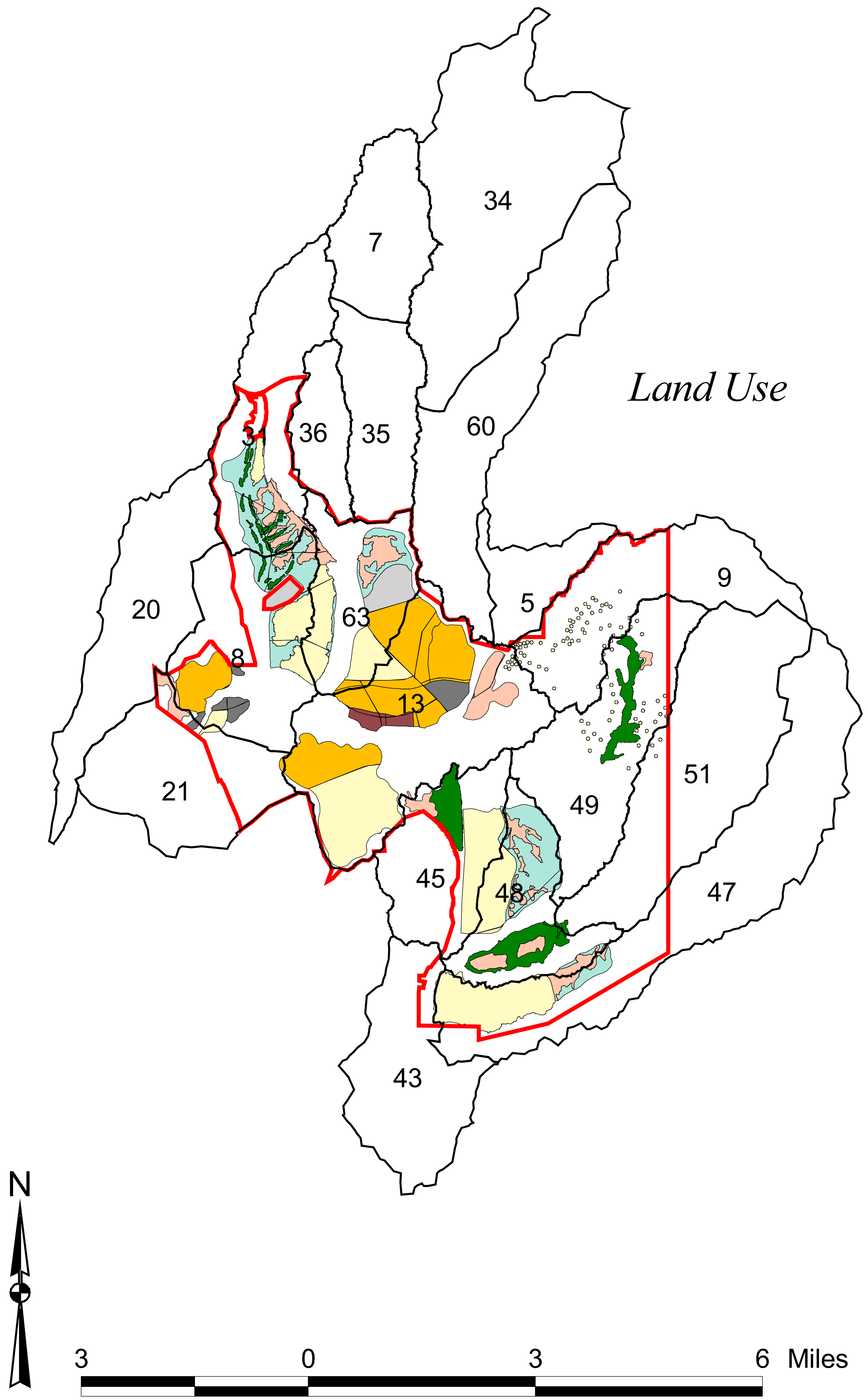


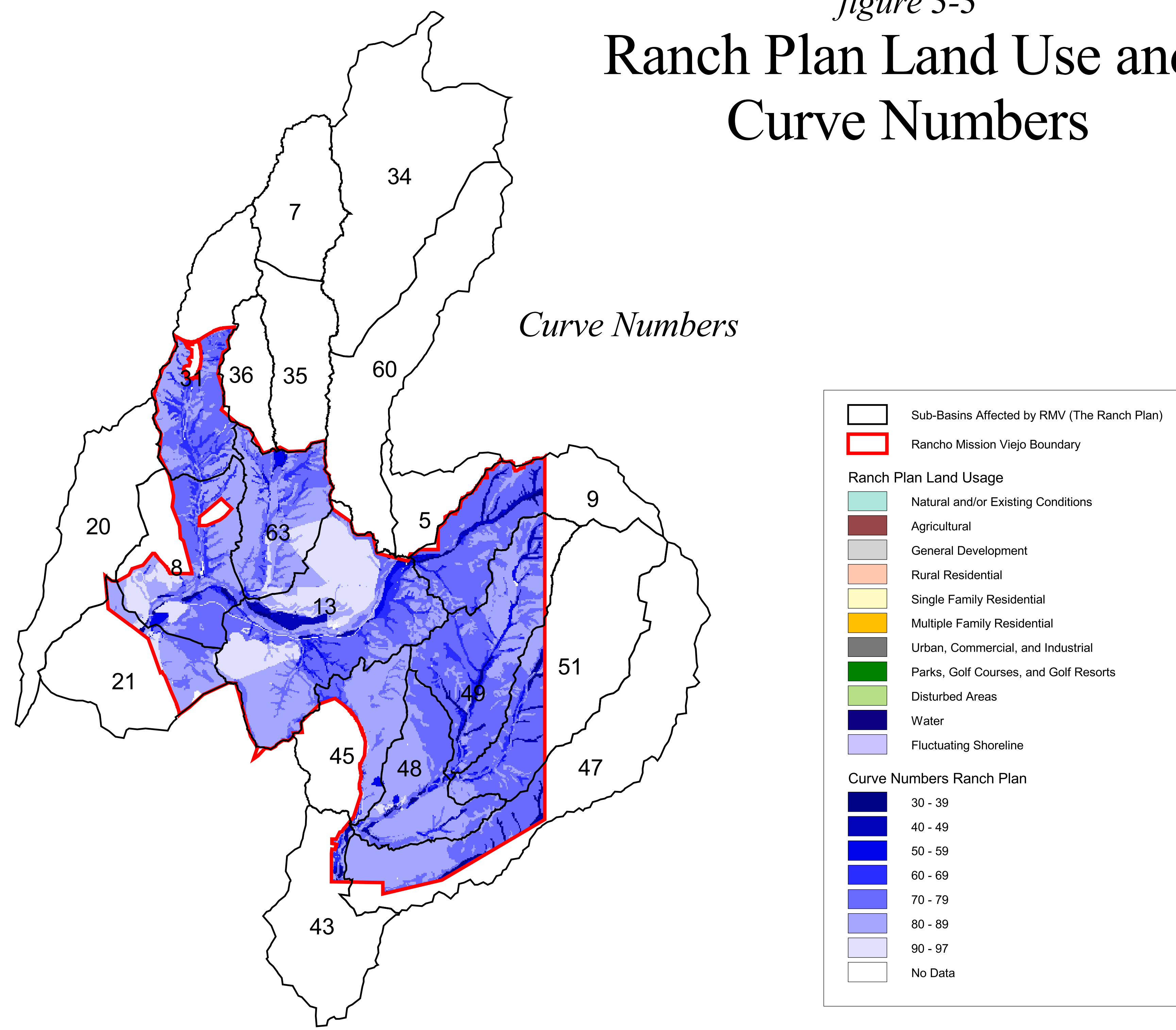
Source: EDAW

PWA

figure 3-3

Ranch Plan Land Use and Curve Numbers

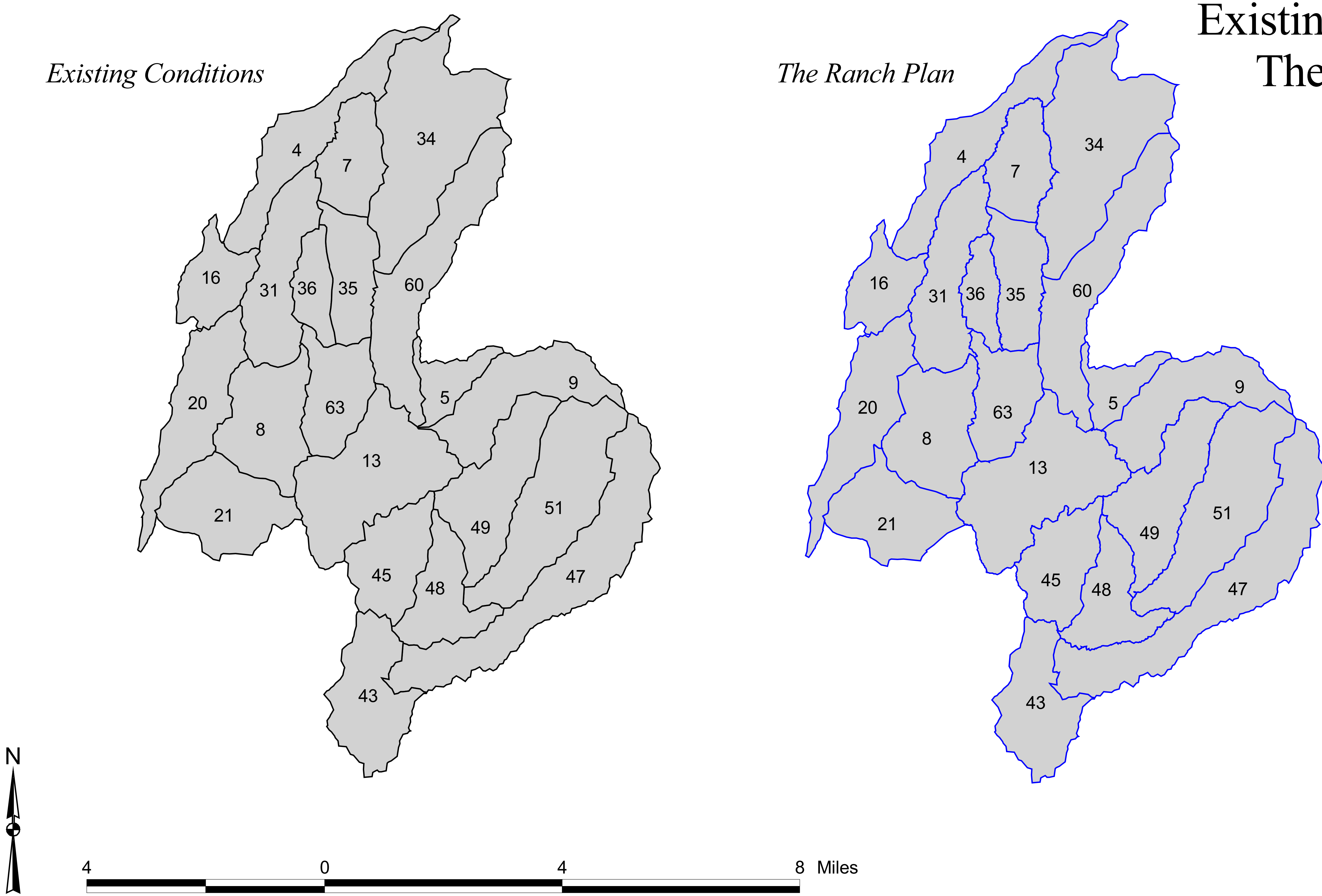




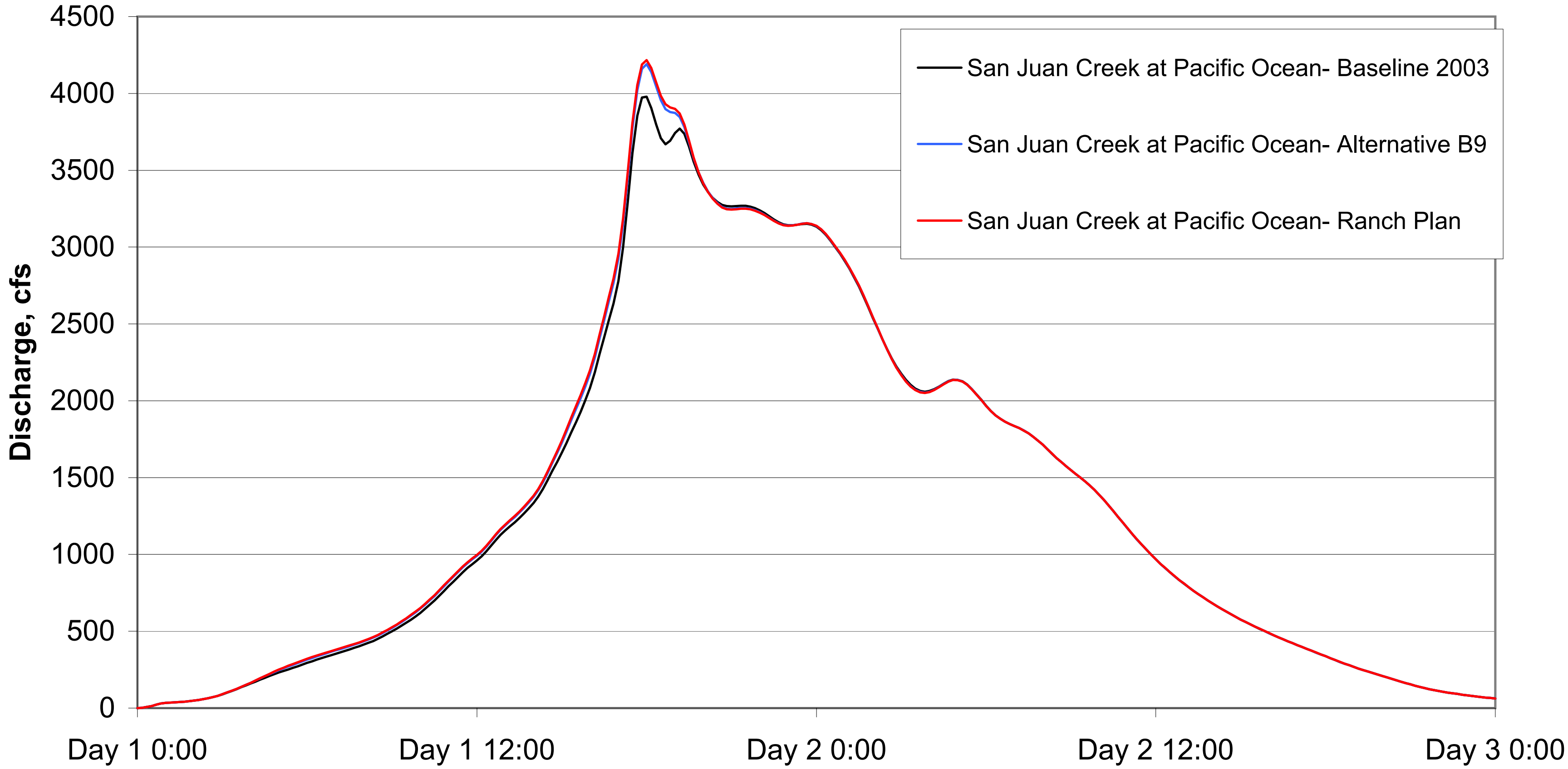
PWA

figure 3-4

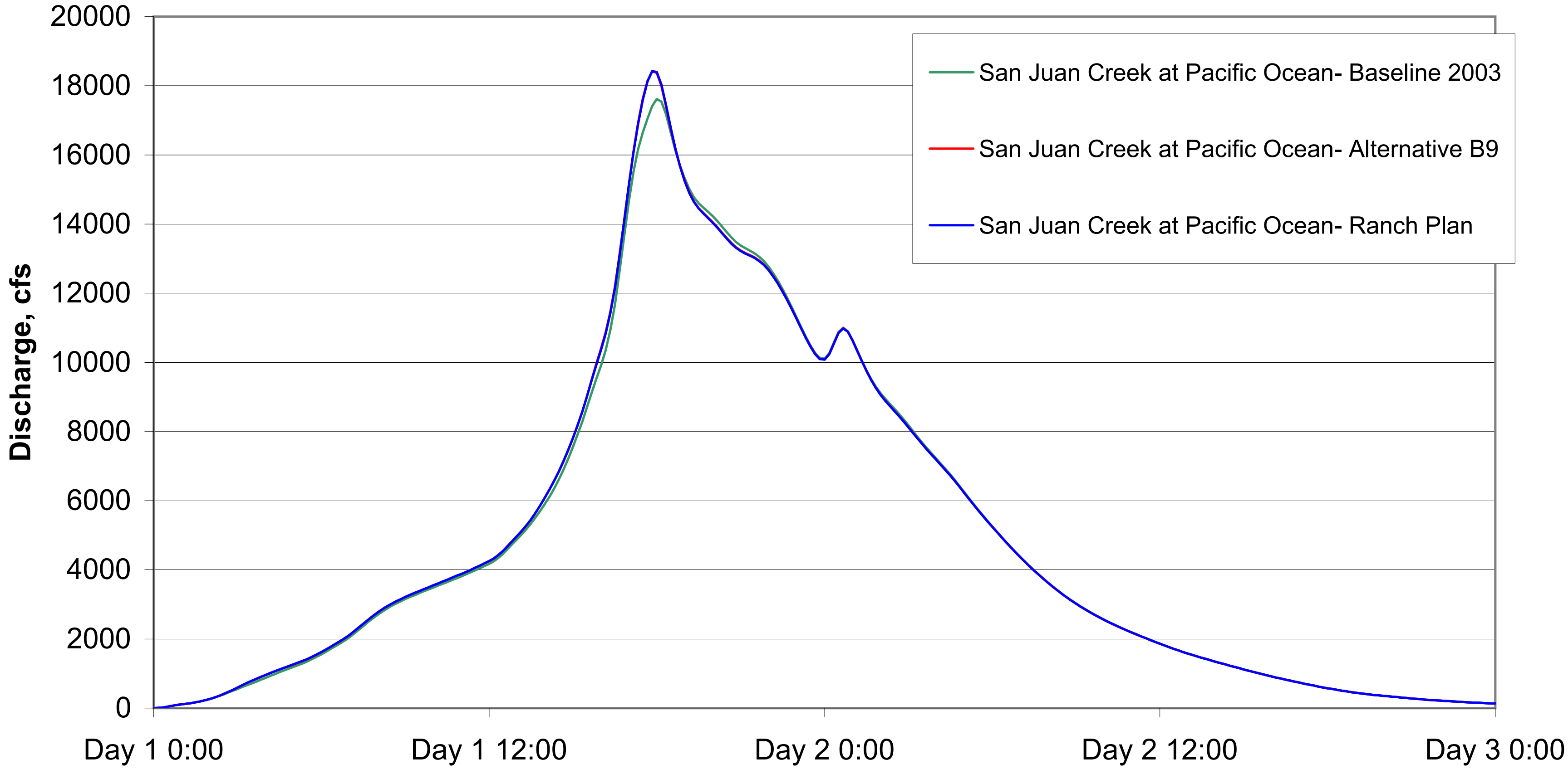
Sub-Basin Delineations: Existing Conditions & The Ranch Plan



PWA



Source: PWA HEC-1 2003 Analysis- cSJ18	*figure* 3-5 2-year Event Hydrographs San Juan Creek Watershed PWA Ref 1393.02 PWA



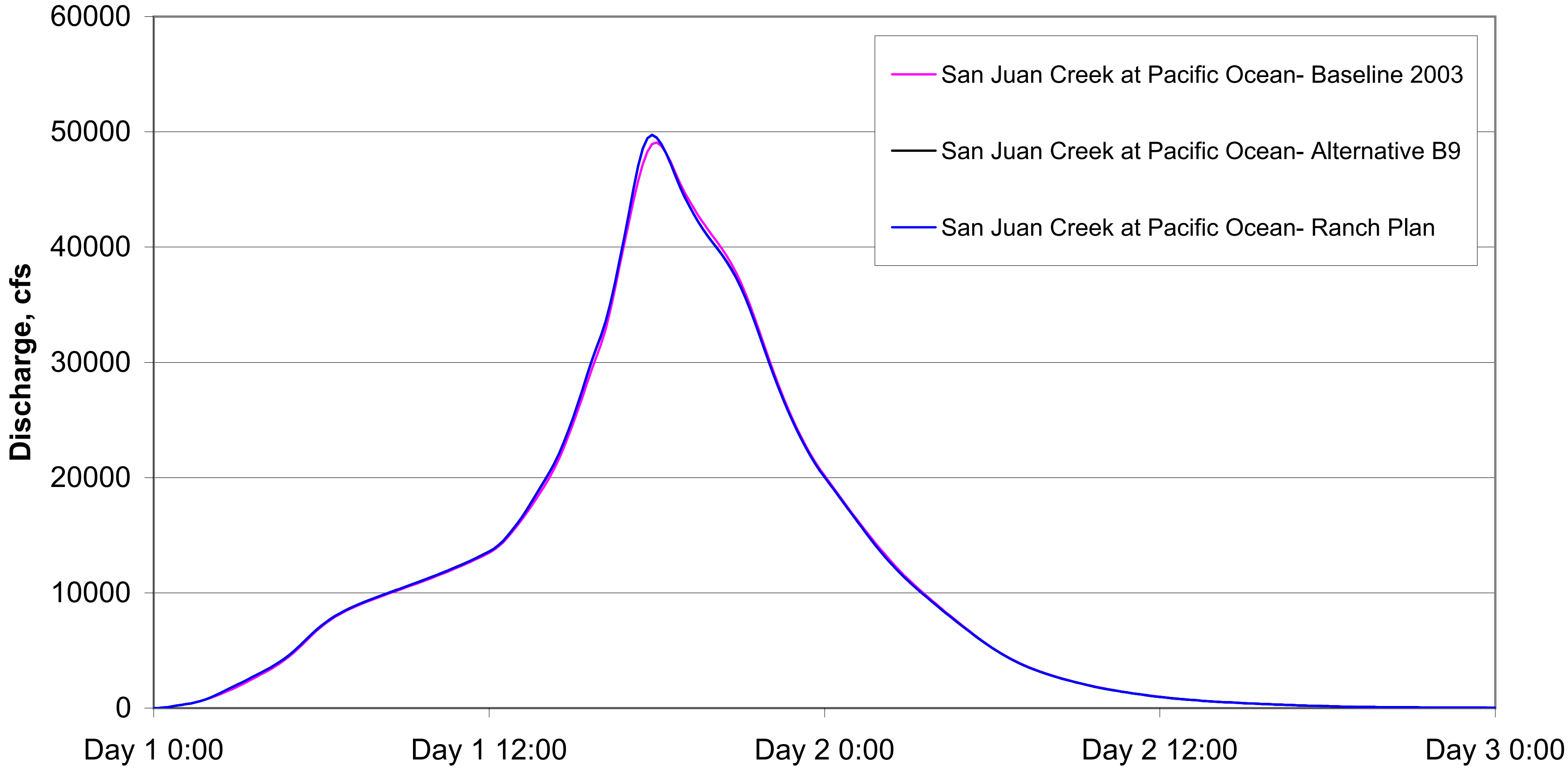
Source: PWA HEC-1 2003 Analysis; cSJ18

figure 3-6

10-year Event Hydrographs San Juan Creek Watershed

PWA Ref 1393.02

PWA



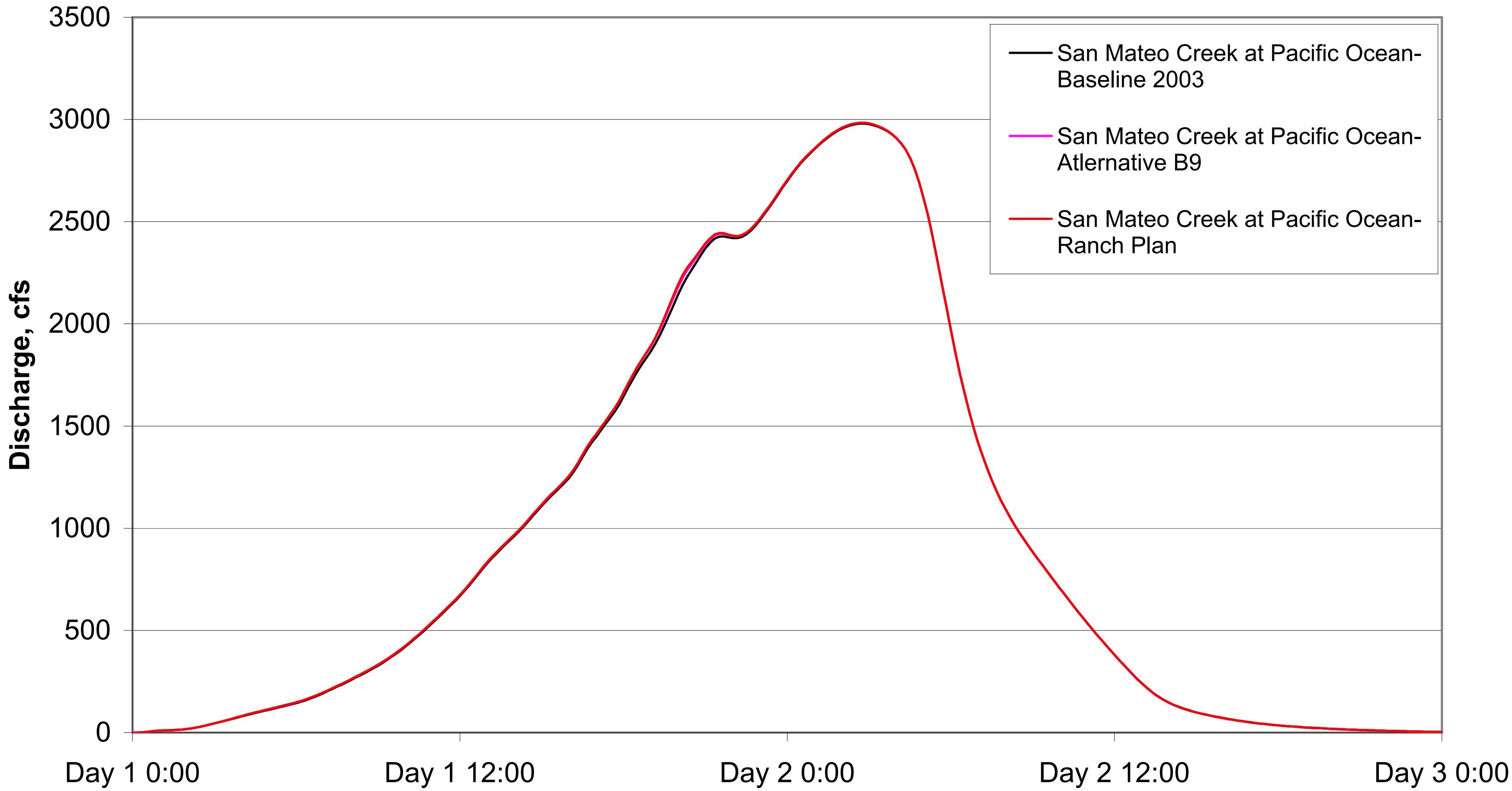
Source: PWA HEC-1 2003 Analysis; cSJ18

figure 3-7

100-year Event Hydrographs San Juan Creek Watershed

PWA Ref 1393.02

PWA

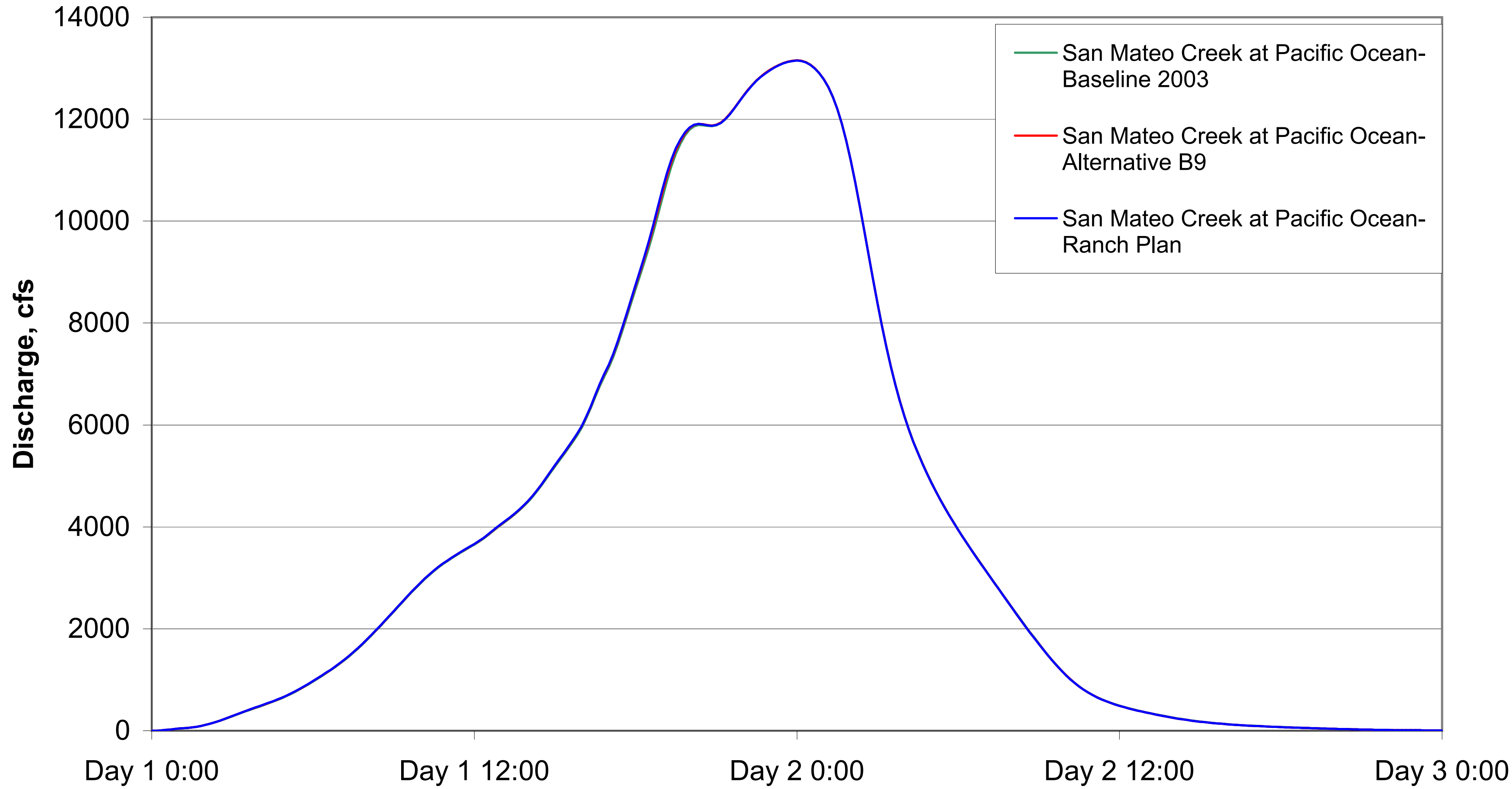


Source: PWA HEC-1 2003 Analysis; cSM46

figure 3-8

2-year Event Hydrographs, San Mateo Creek Watershed

PWA Ref 1393.02



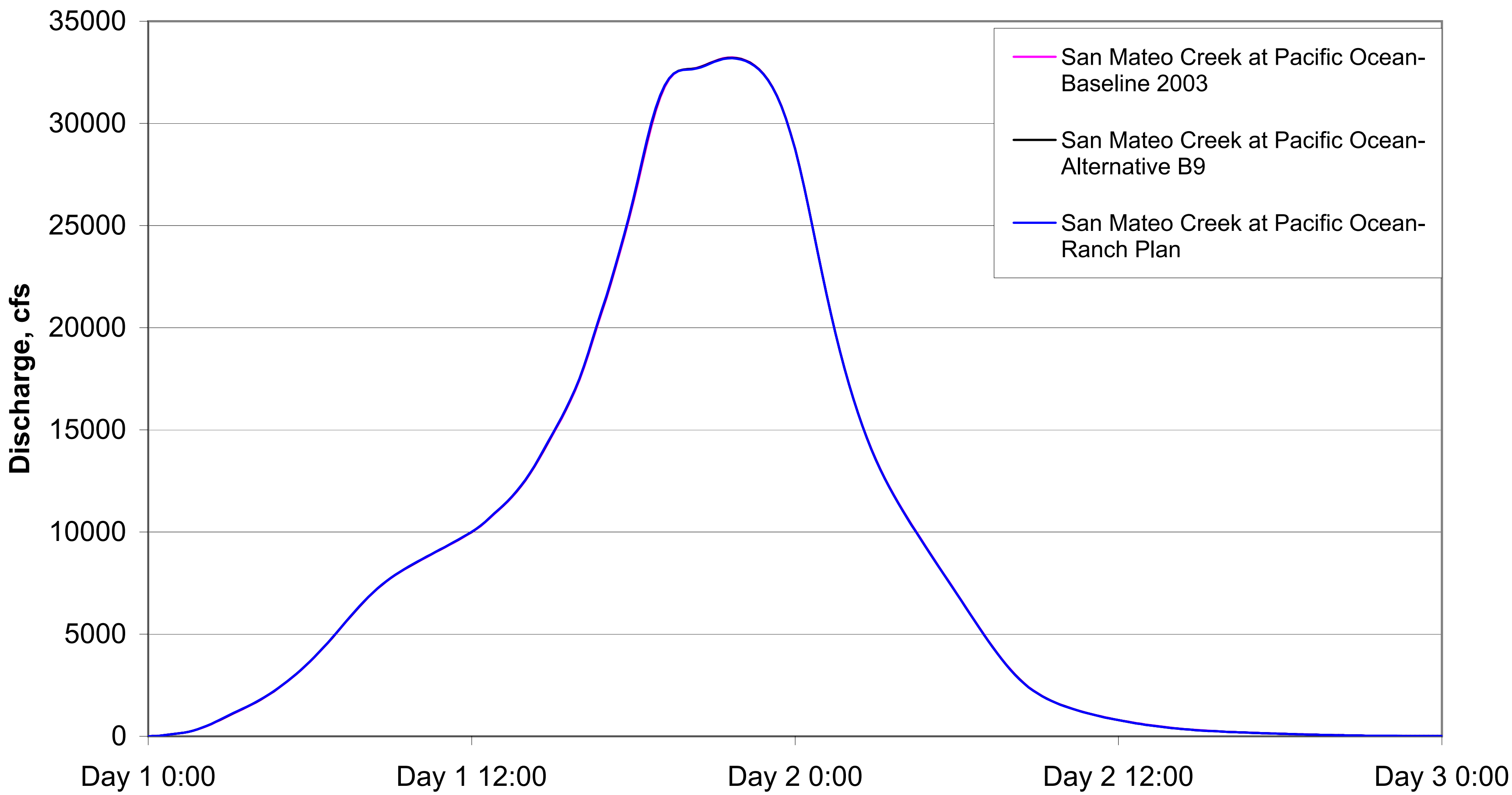
Source: PWA HEC-1 2003 Analysis; cSM46

figure 3-9

10-year Event Hydrographs, San Mateo Creek Watershed

PWA Ref 1393.02

PWA



Source: PWA HEC-1 2003 Analysis; cSM46

figure 3-10

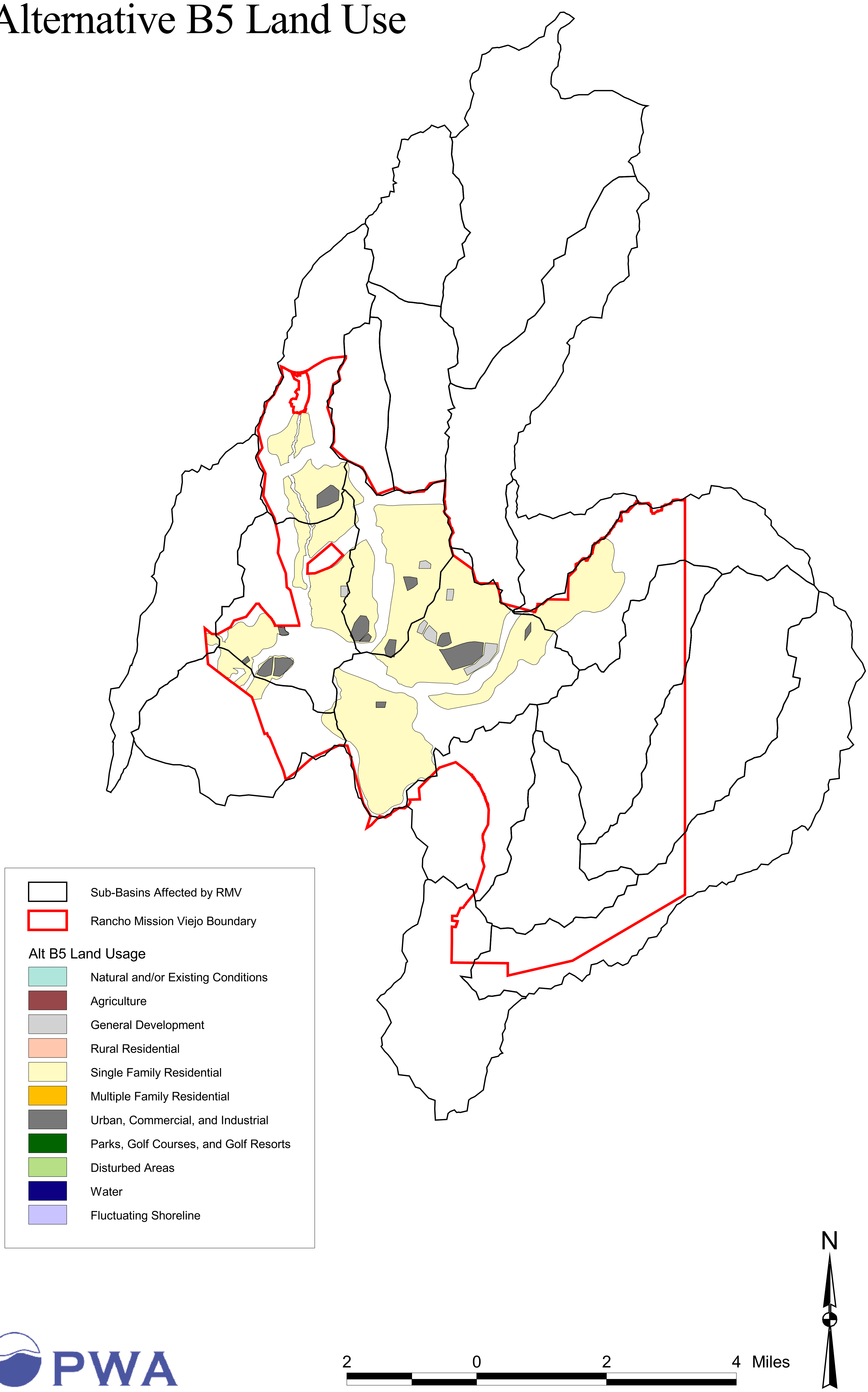
100-year Event Hydrographs, San Mateo Creek Watershed

PWA REF 1393.02

PWA

figure 4-1

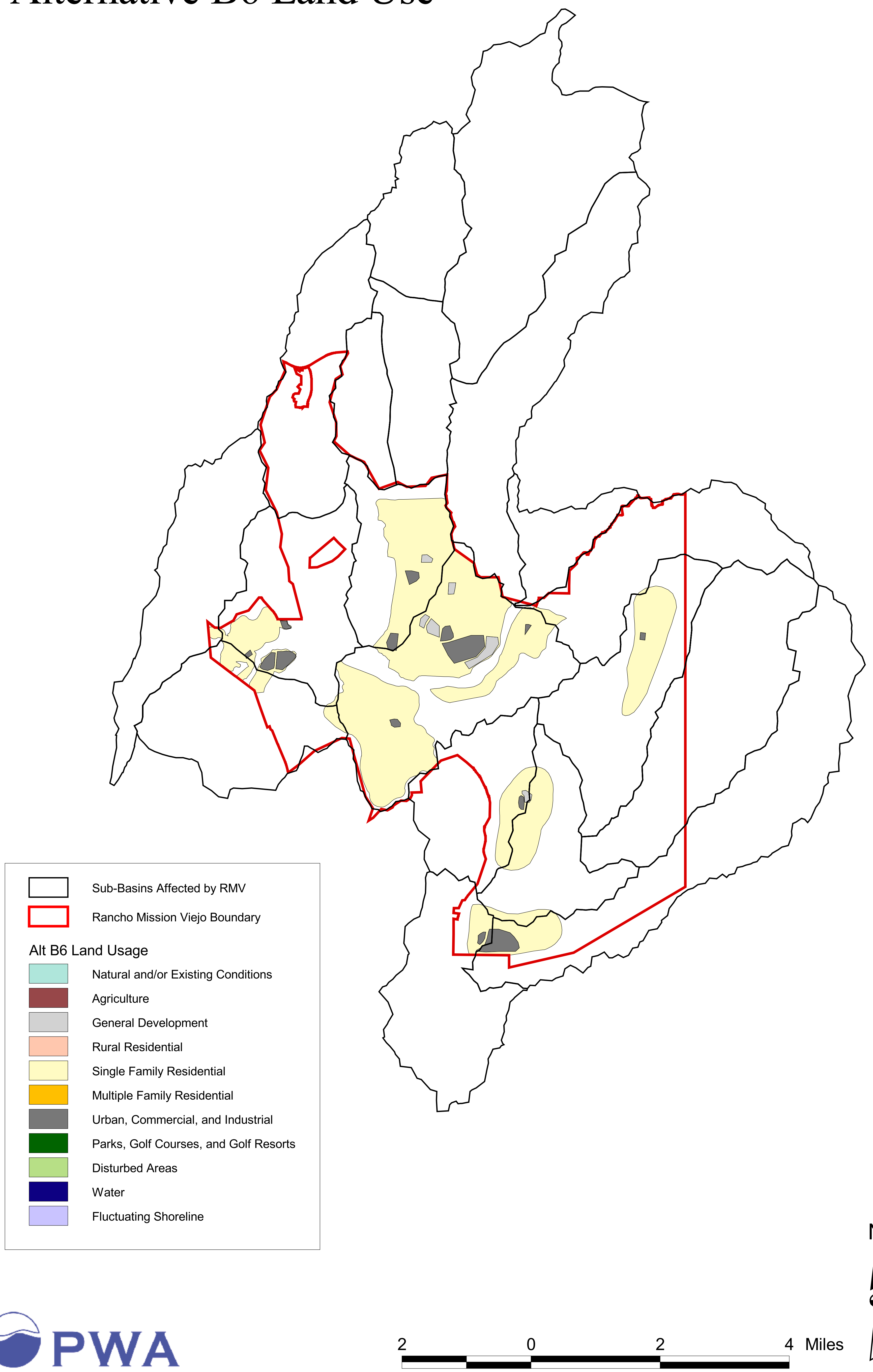
Alternative B5 Land Use



PWA

figure 4-2

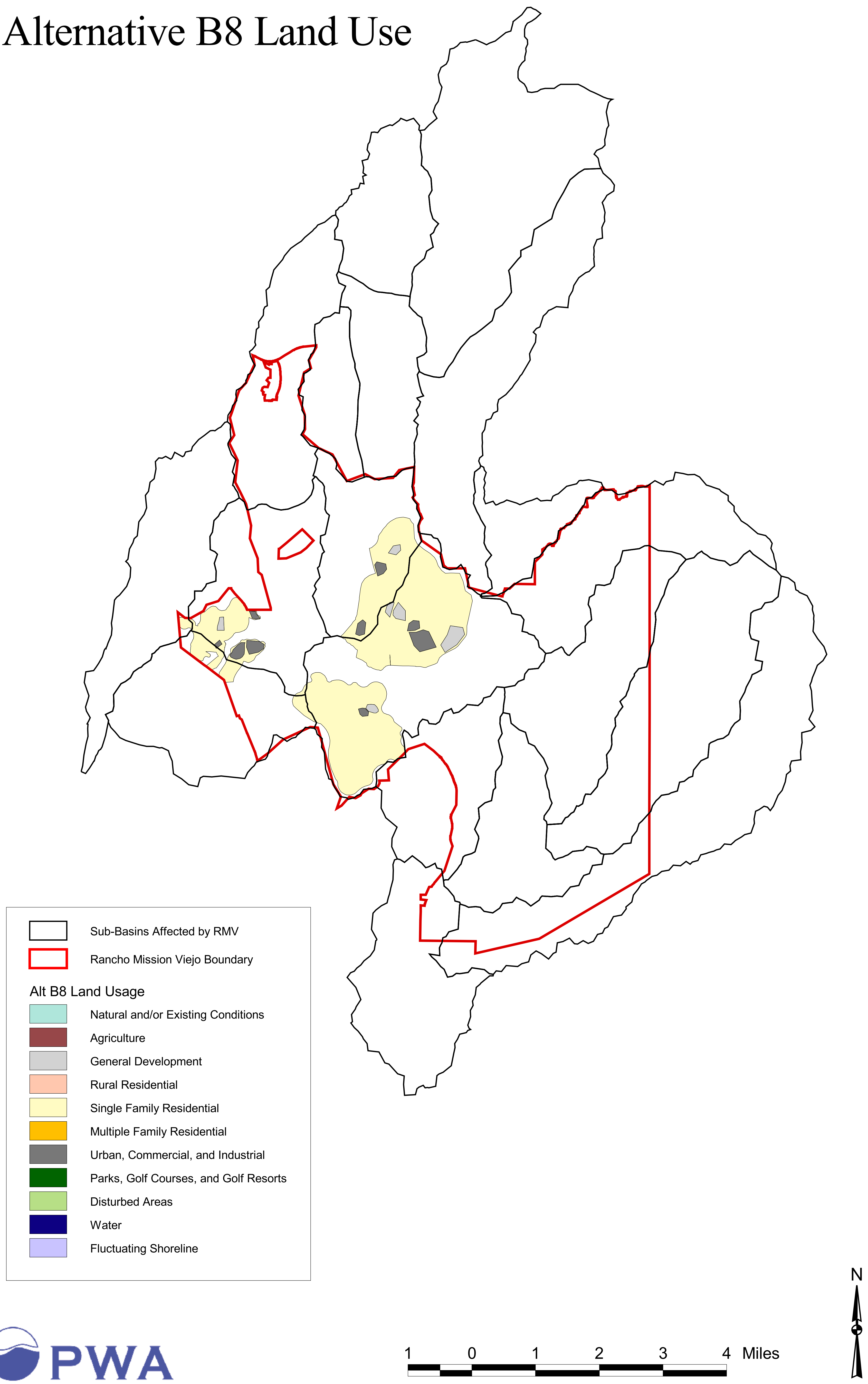
Alternative B6 Land Use



PWA

figure 4-3

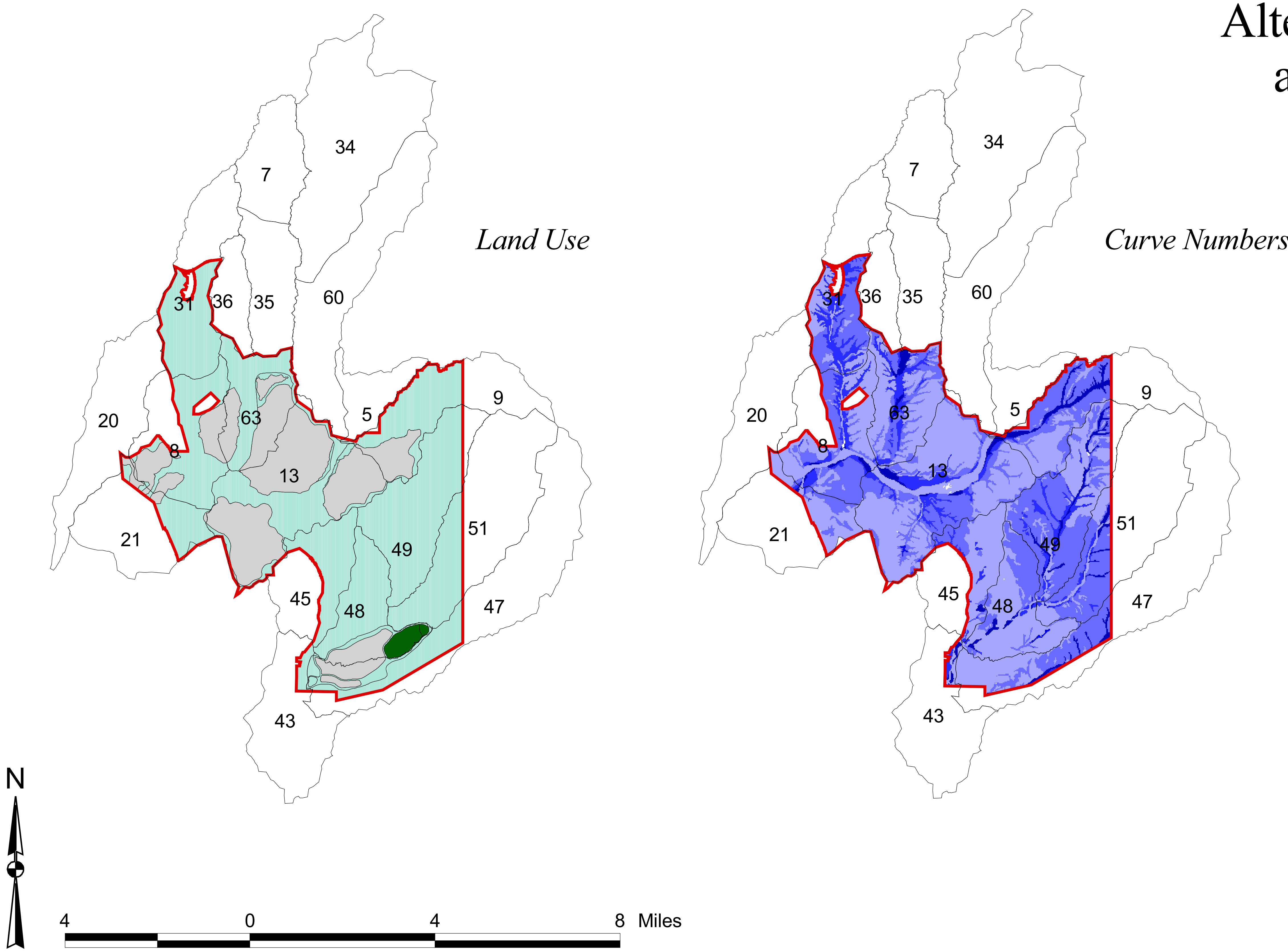
Alternative B8 Land Use

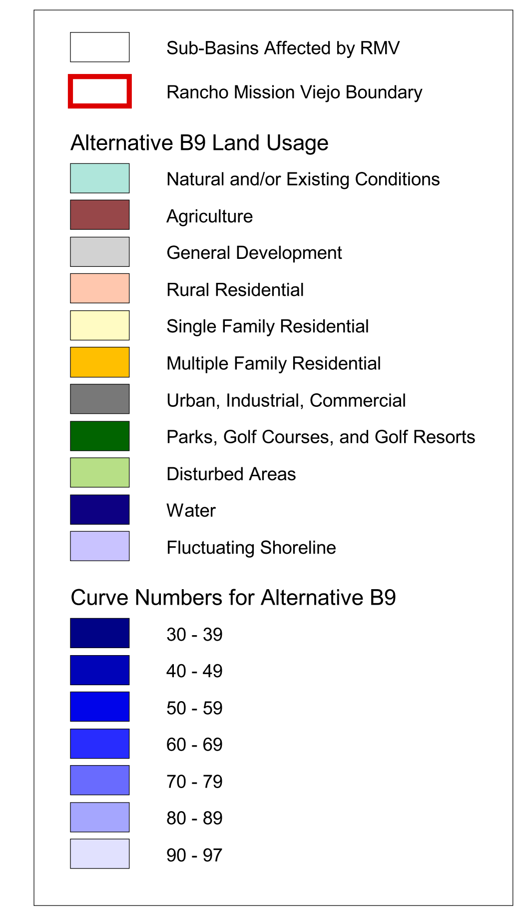


PWA

figure 4-4

Alternative B9 Land Use and Curve Numbers

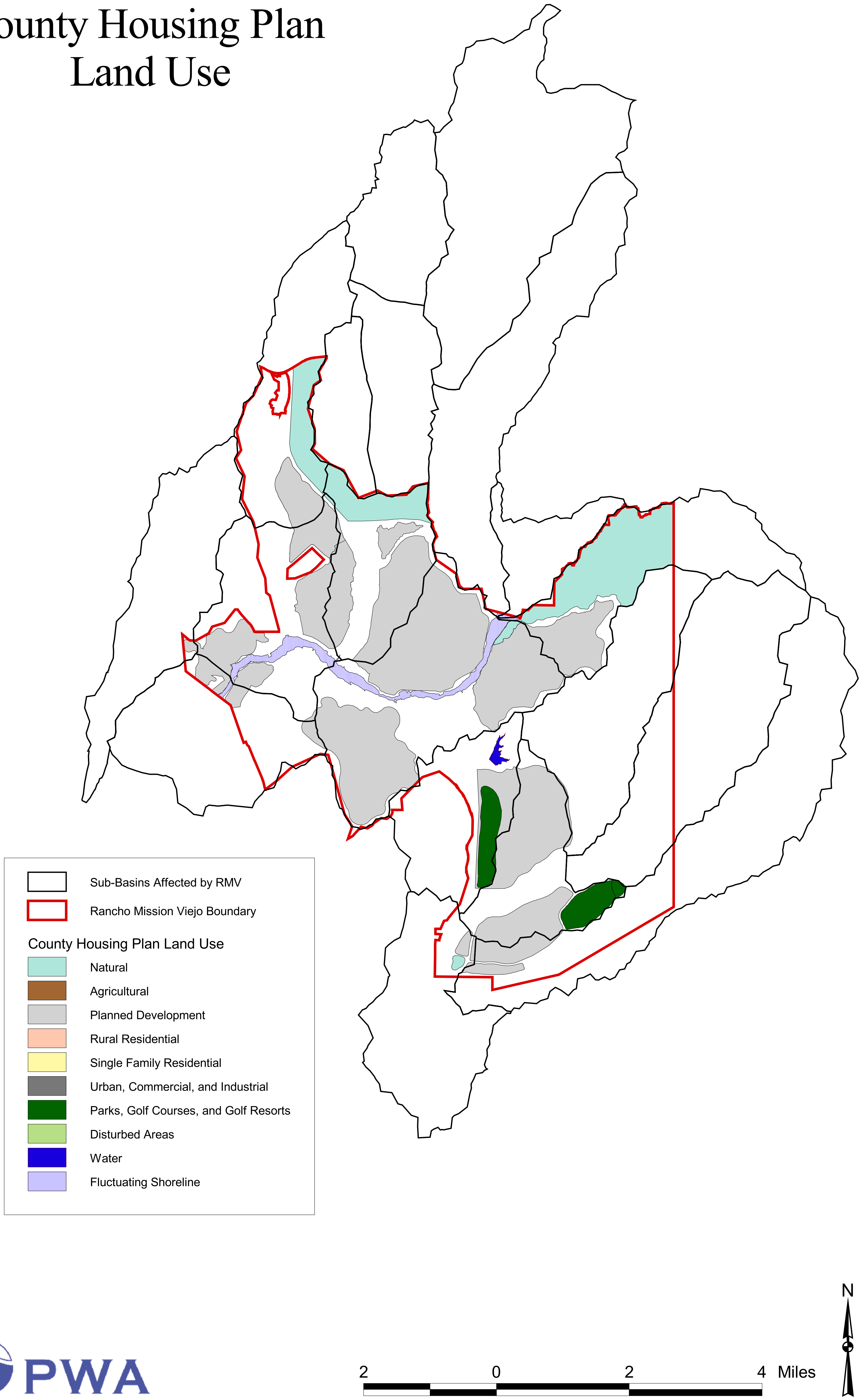




PWA

figure 4-5

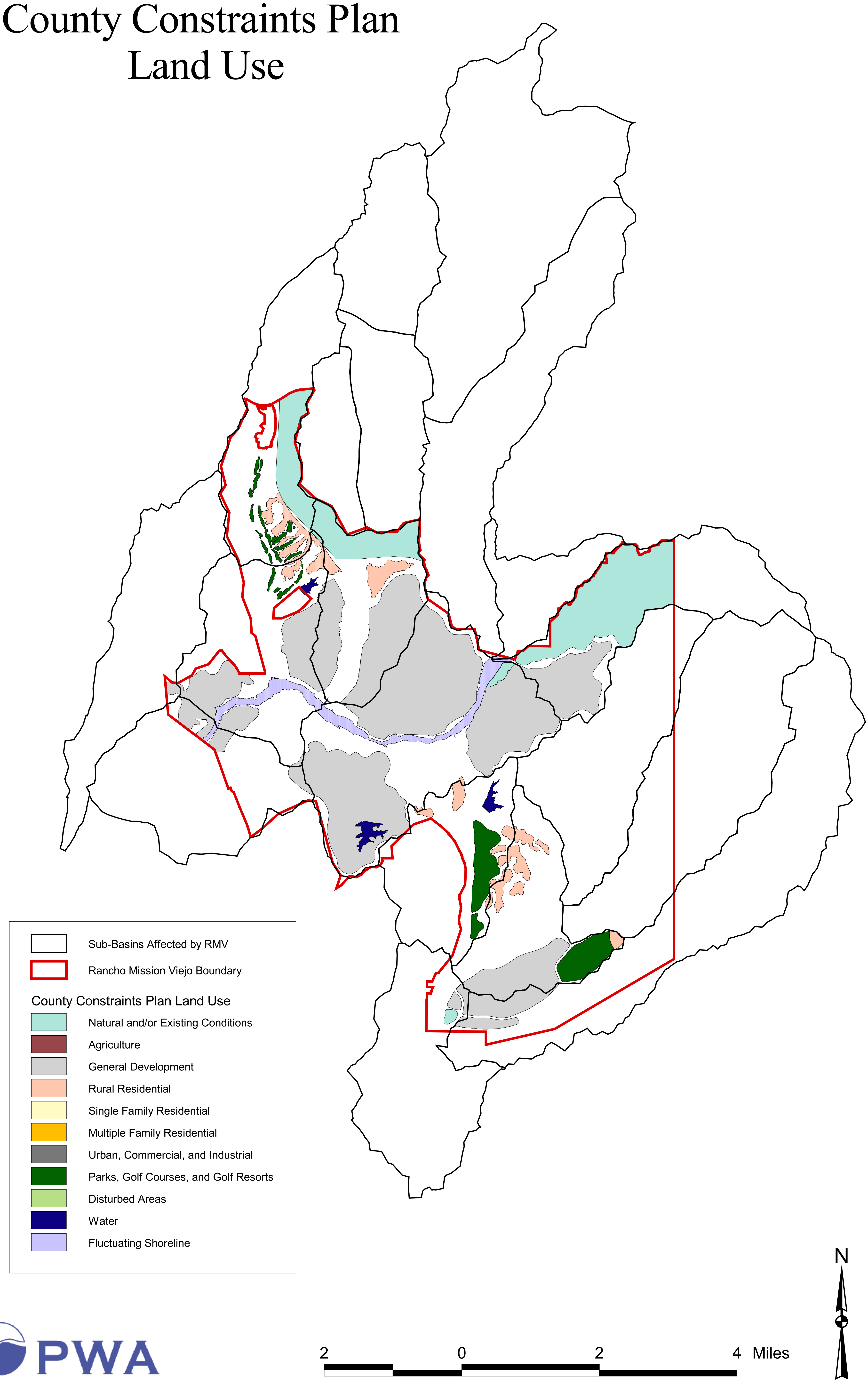
County Housing Plan Land Use



PWA

figure 4-6

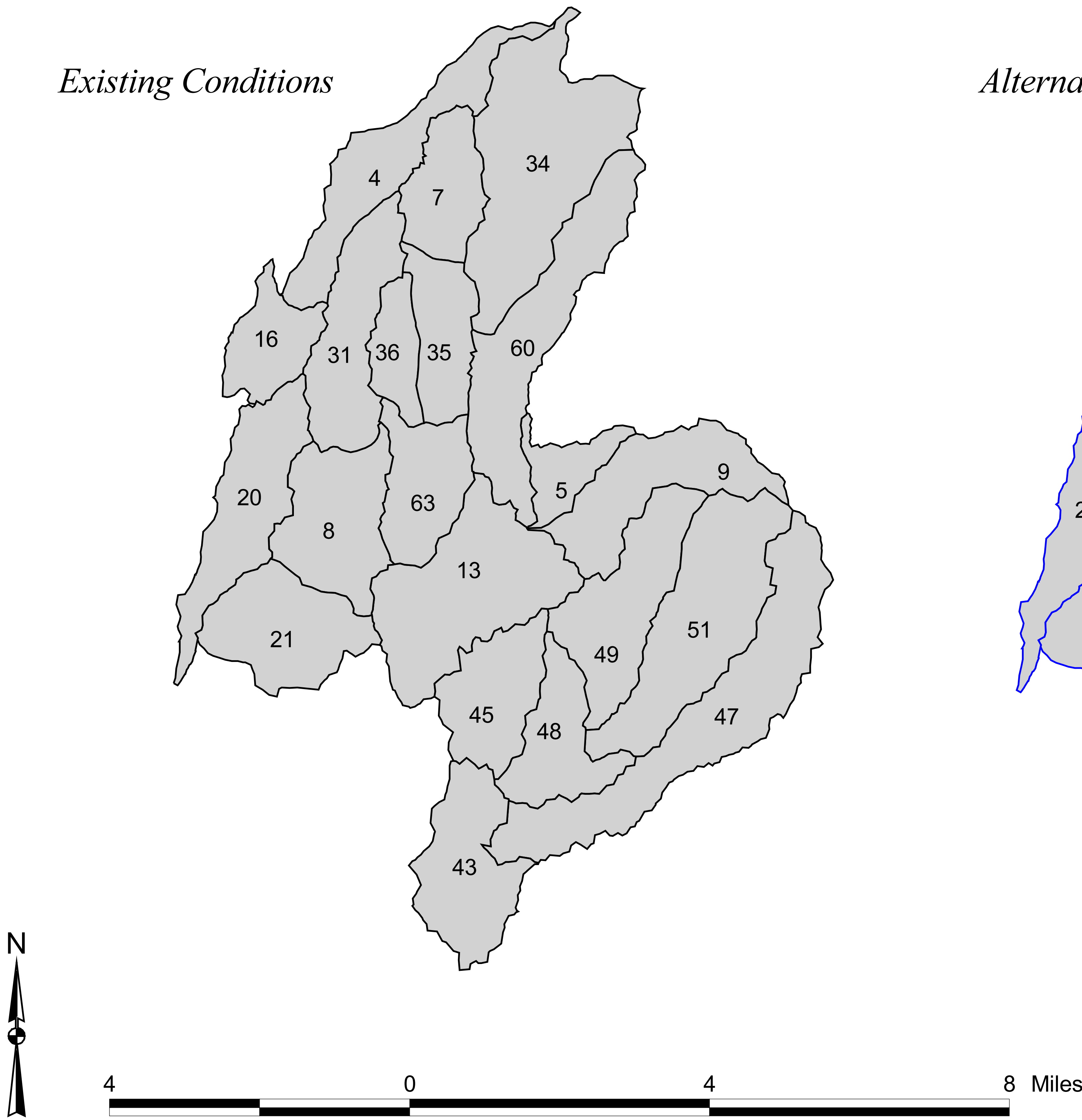
County Constraints Plan Land Use

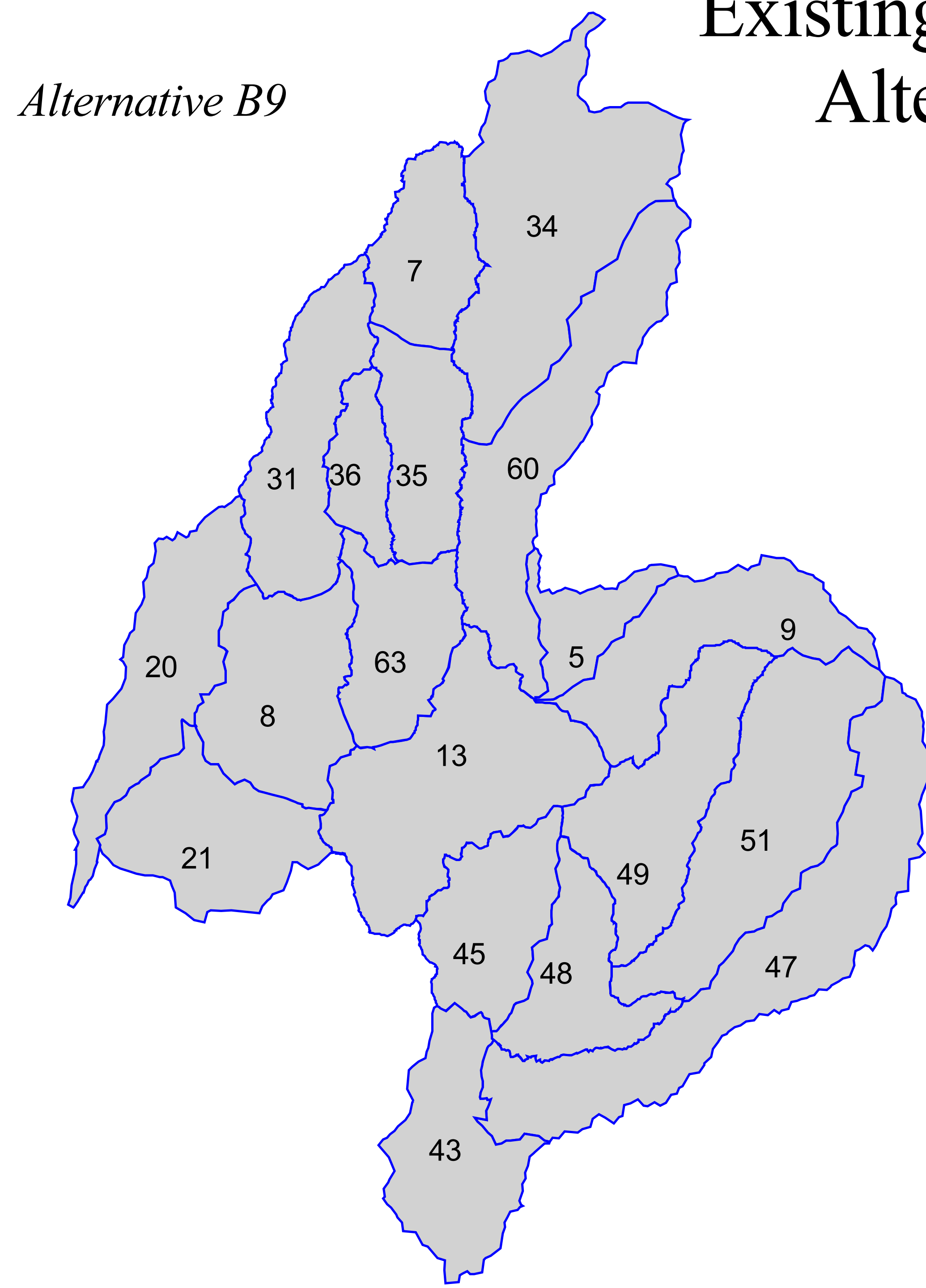


PWA

figure 4-7

Sub-Basin Delineations: Existing Conditions & Alternative B9





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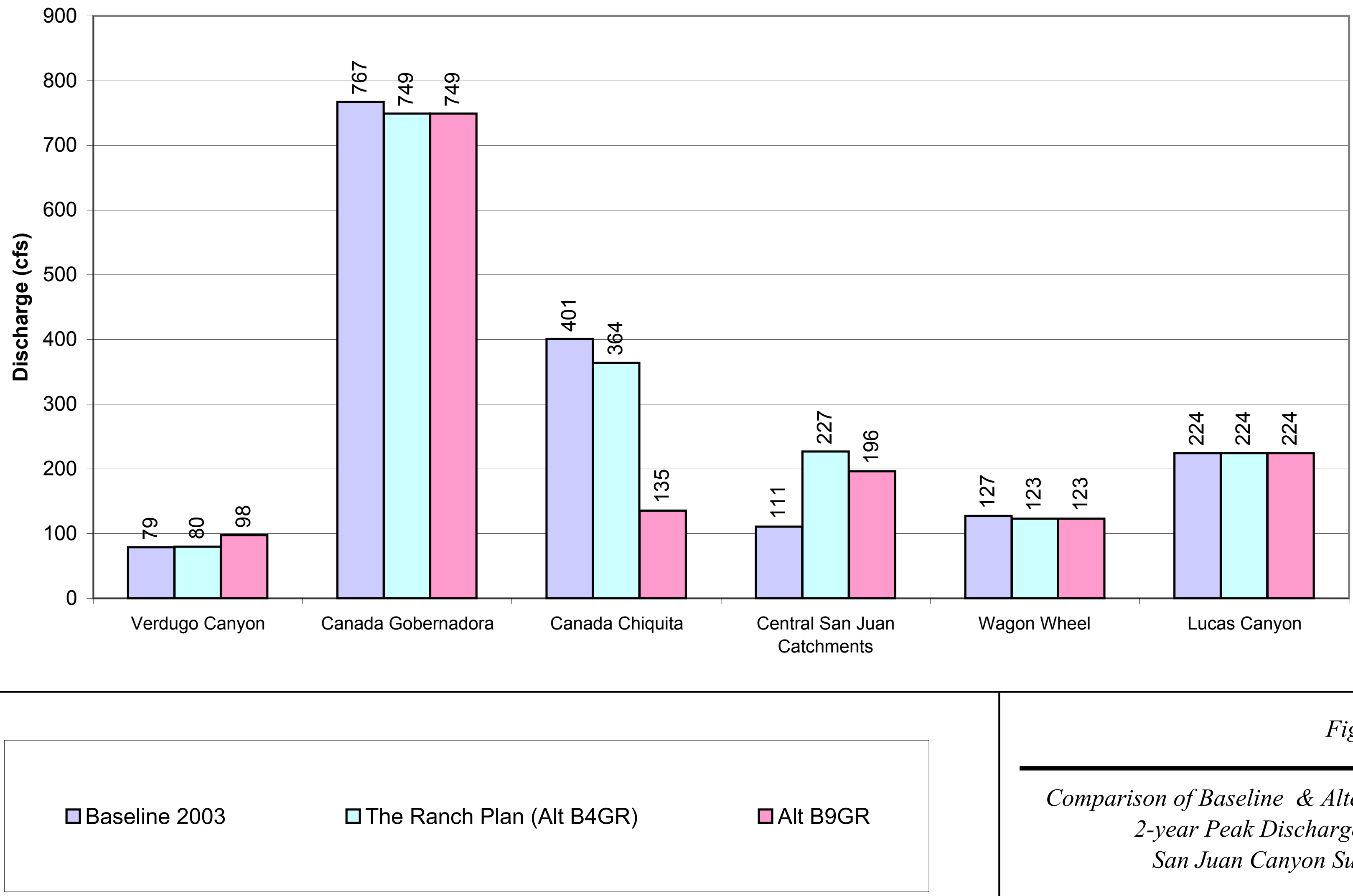


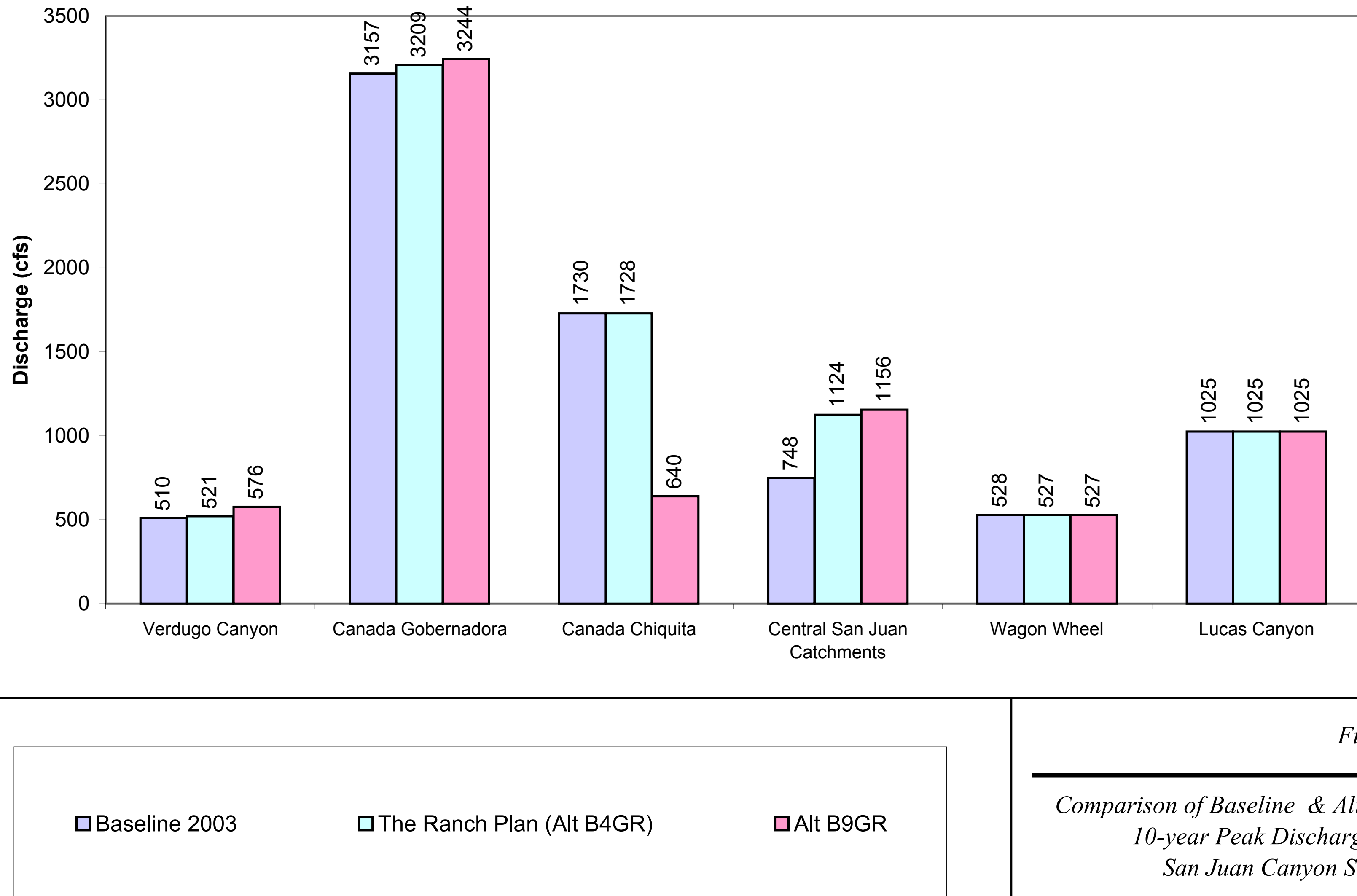
HEC-1 nodes include:
SJ9, cCSJ63, SJ8+Sj31 and SJ13

Figure 4-8

Comparison of Baseline & Alternatives
2-year Peak Discharge Results
San Juan Canyon Sub-basins

PWA

PWA#:
1393.02



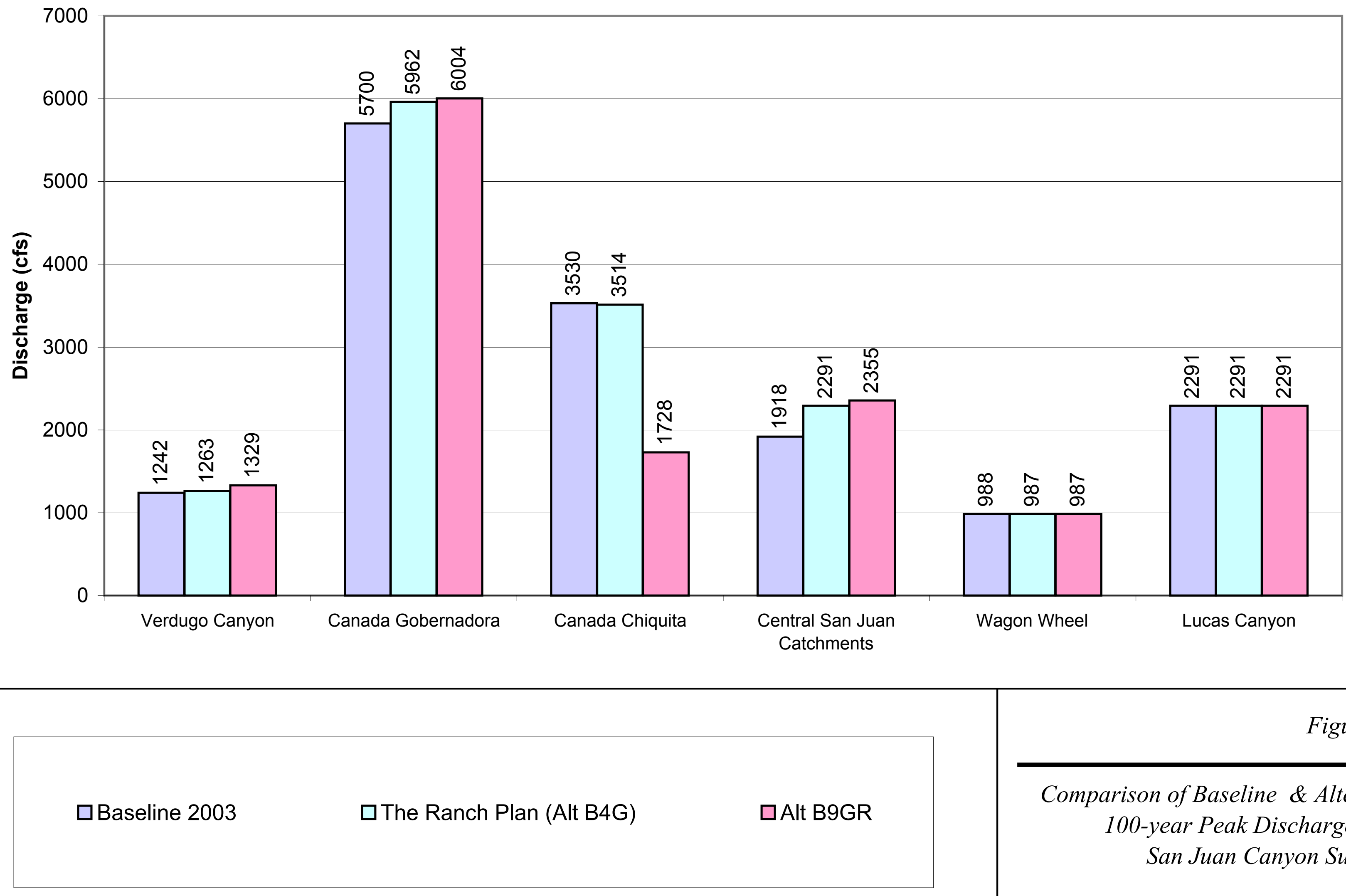
HEC-1 nodes include:
SJ9, cCSJ63, SJ8+Sj31 and SJ13

Figure 4-9

Comparison of Baseline & Alternatives
10-year Peak Discharge Results
San Juan Canyon Sub-basins

PWA

PWA#:
1393.02



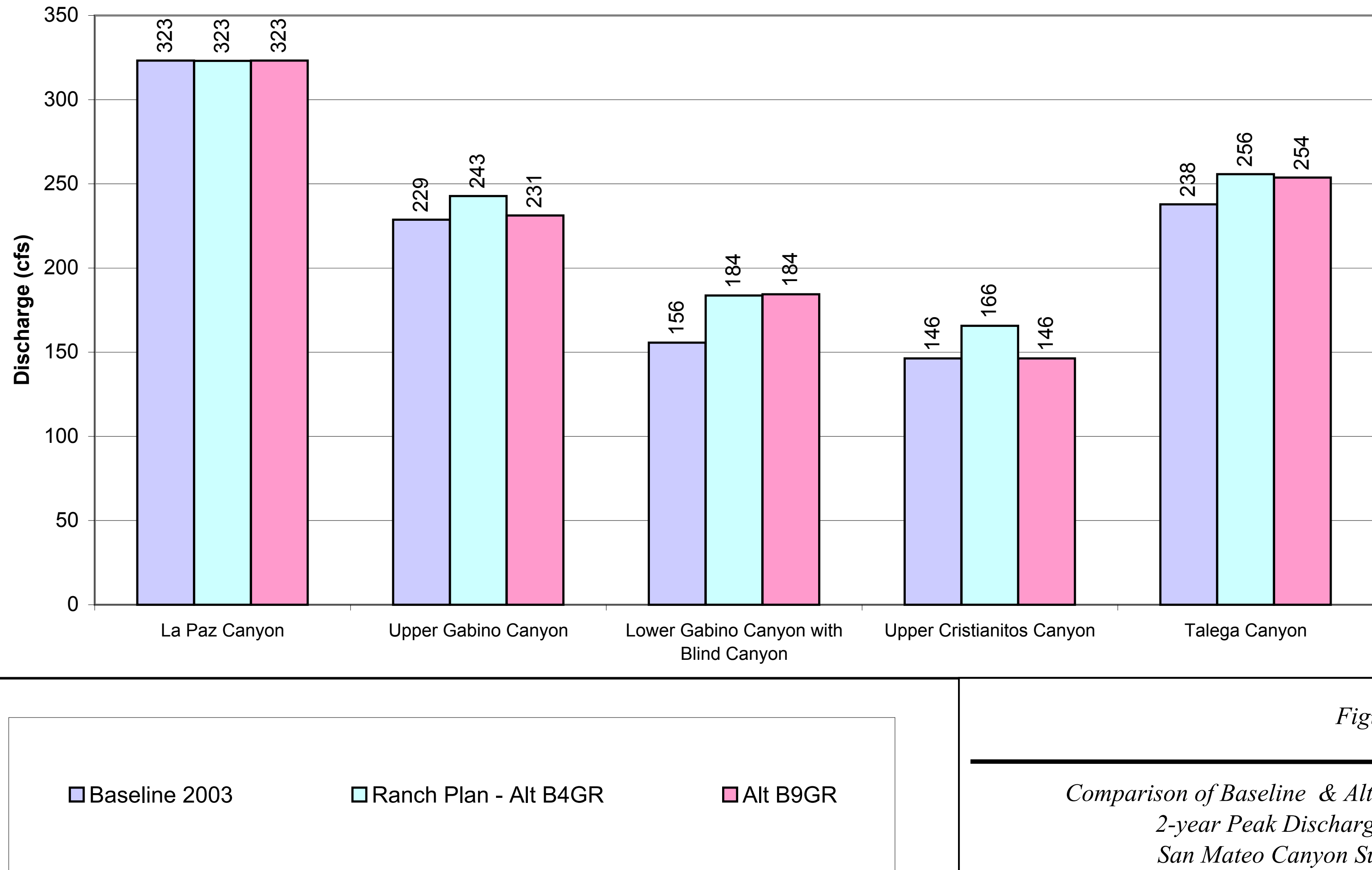
HEC-1 nodes include:
SJ9, cCSJ63, SJ8+Sj31 and SJ13

Figure 4-10

Comparison of Baseline & Alternatives
100-year Peak Discharge Results
San Juan Canyon Sub-basins

PWA

PWA#:
1393.02



HEC-1 nodes include:
CC45, CC47, CC48, CC49 and CC51

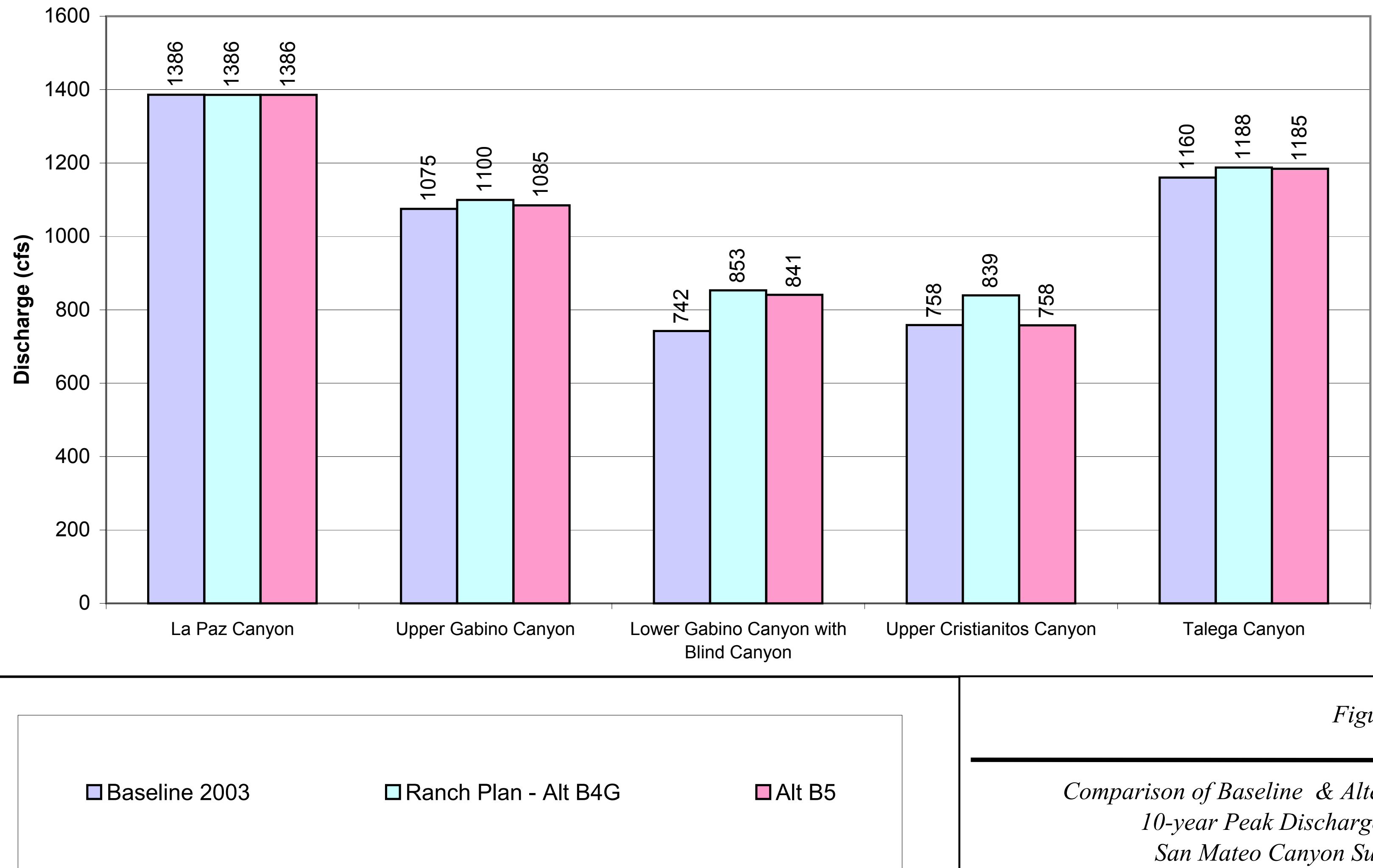
Figure 4-11

Comparison of Baseline & Alternatives
2-year Peak Discharge Results
San Mateo Canyon Sub-basins

PWA

PWA#:
1393.02

139302_results_compSM_2604, fig -- 2



HEC-1 nodes include:
CC45, CC47, CC48, CC49 and CC51

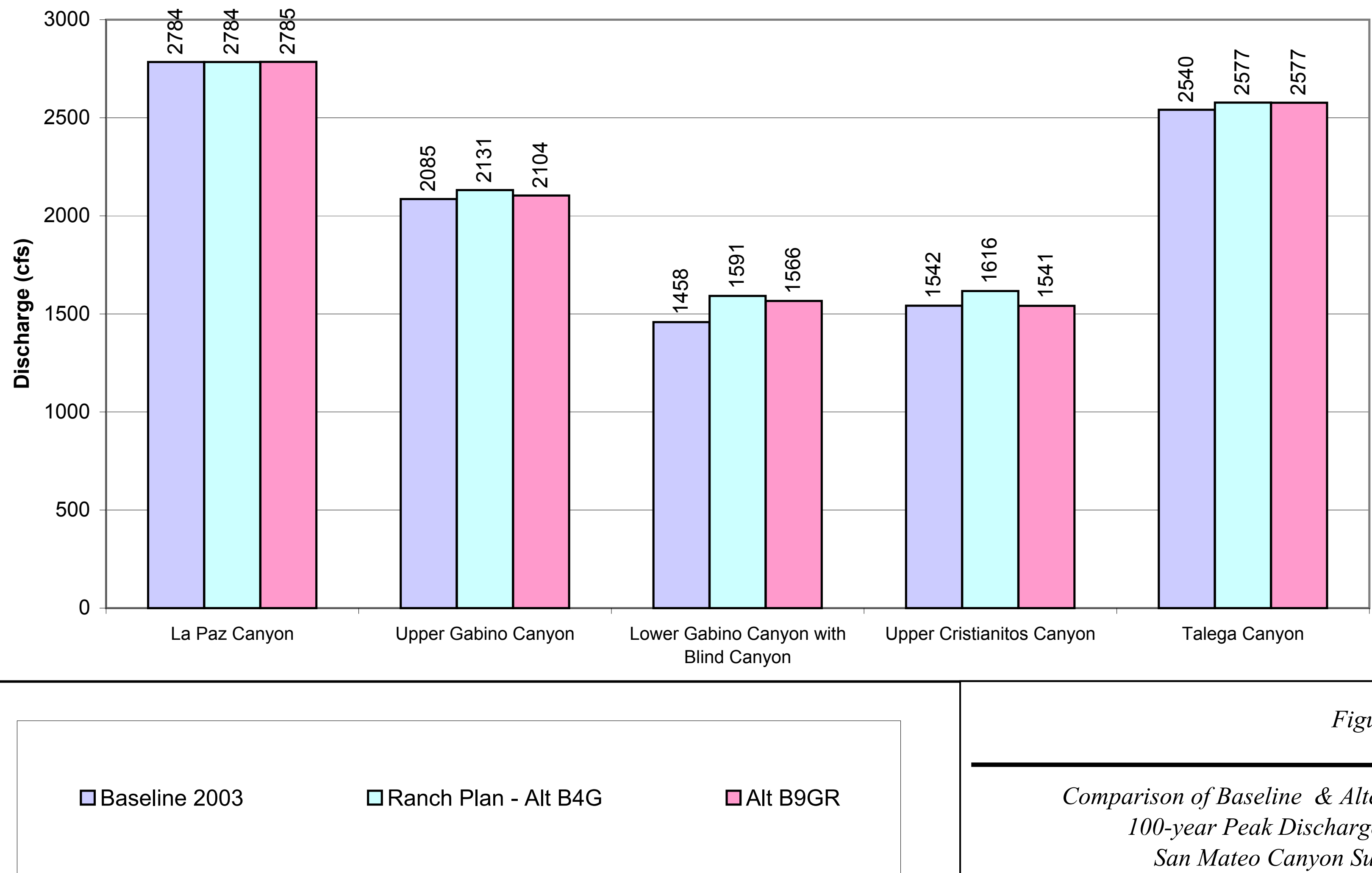
Figure 4-12

Comparison of Baseline & Alternatives
10-year Peak Discharge Results
San Mateo Canyon Sub-basins

PWA

PWA#:
1393.02

139302_results_compSM_2604, fig -- 10



HEC-1 nodes include:
CC45, CC47, CC48, CC49 and CC51

Figure 4-13

Comparison of Baseline & Alternatives
100-year Peak Discharge Results
San Mateo Canyon Sub-basins

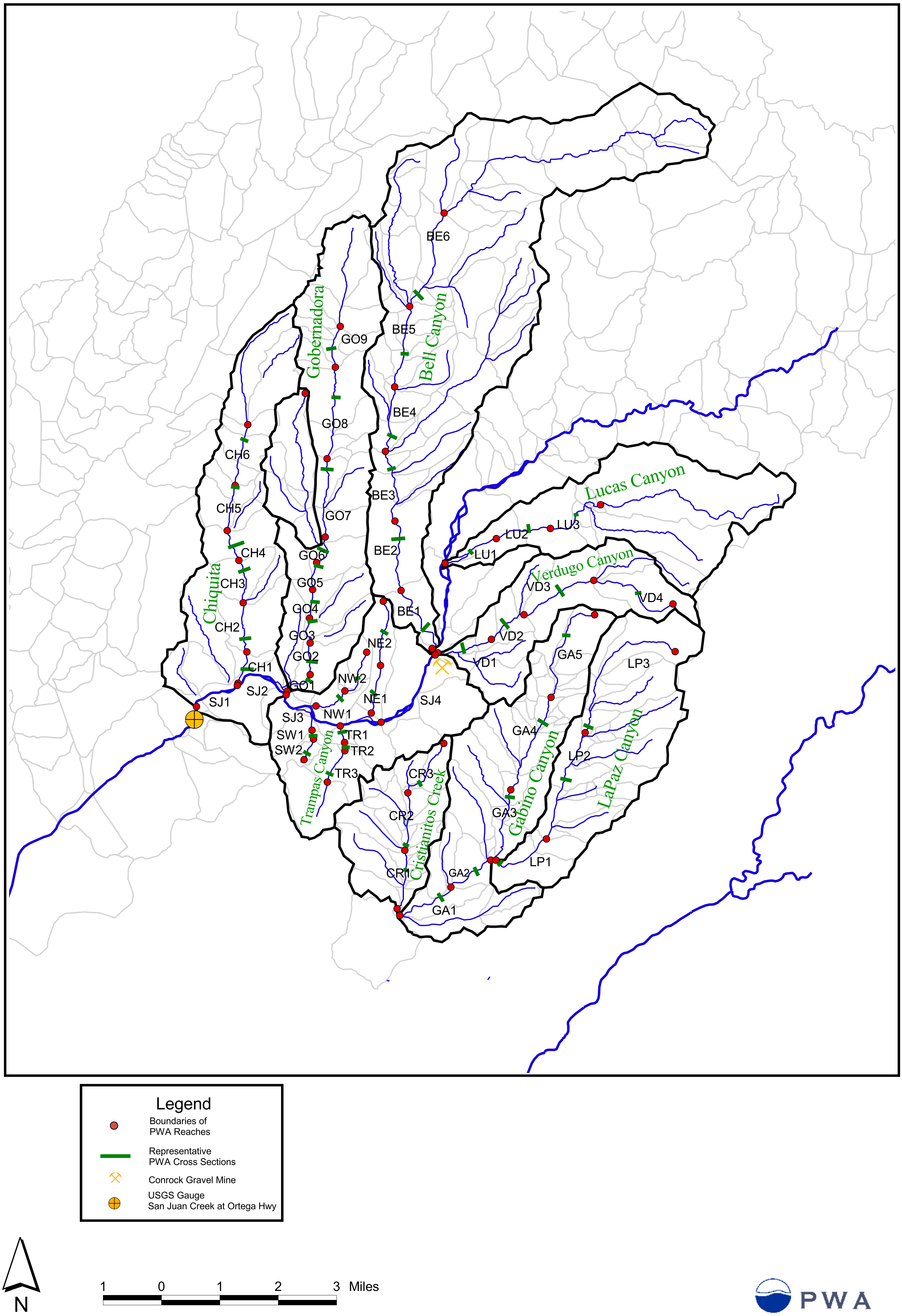
PWA

PWA#:
1393.02

139302_results_compSM_2604, fig -- 100

figure 5-1

Sediment Transport Reaches
in Hydrologic Sub-basins



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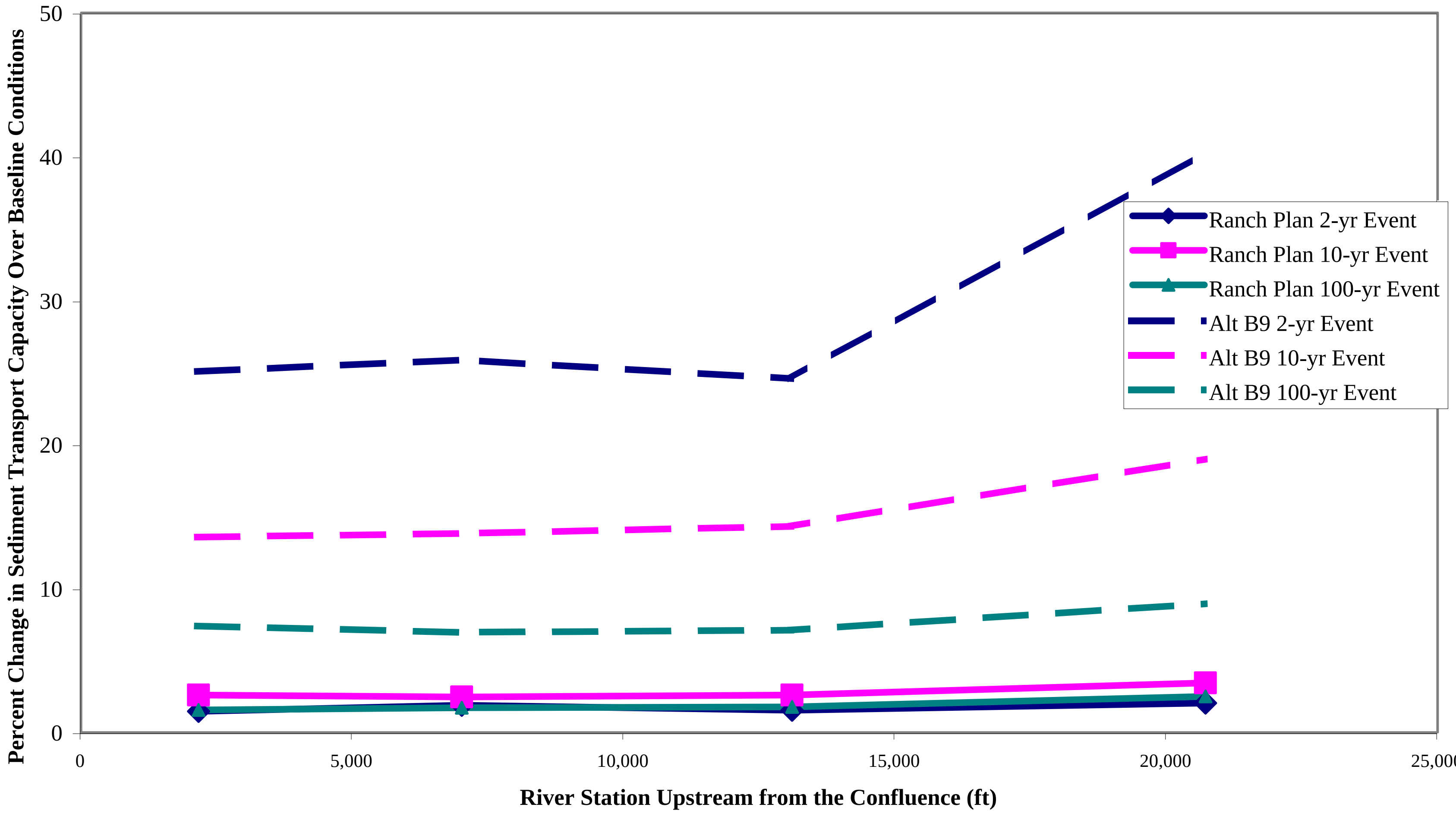


Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for VD1 through VD4 from downstream to upstream order (left to right).

figure 5-2

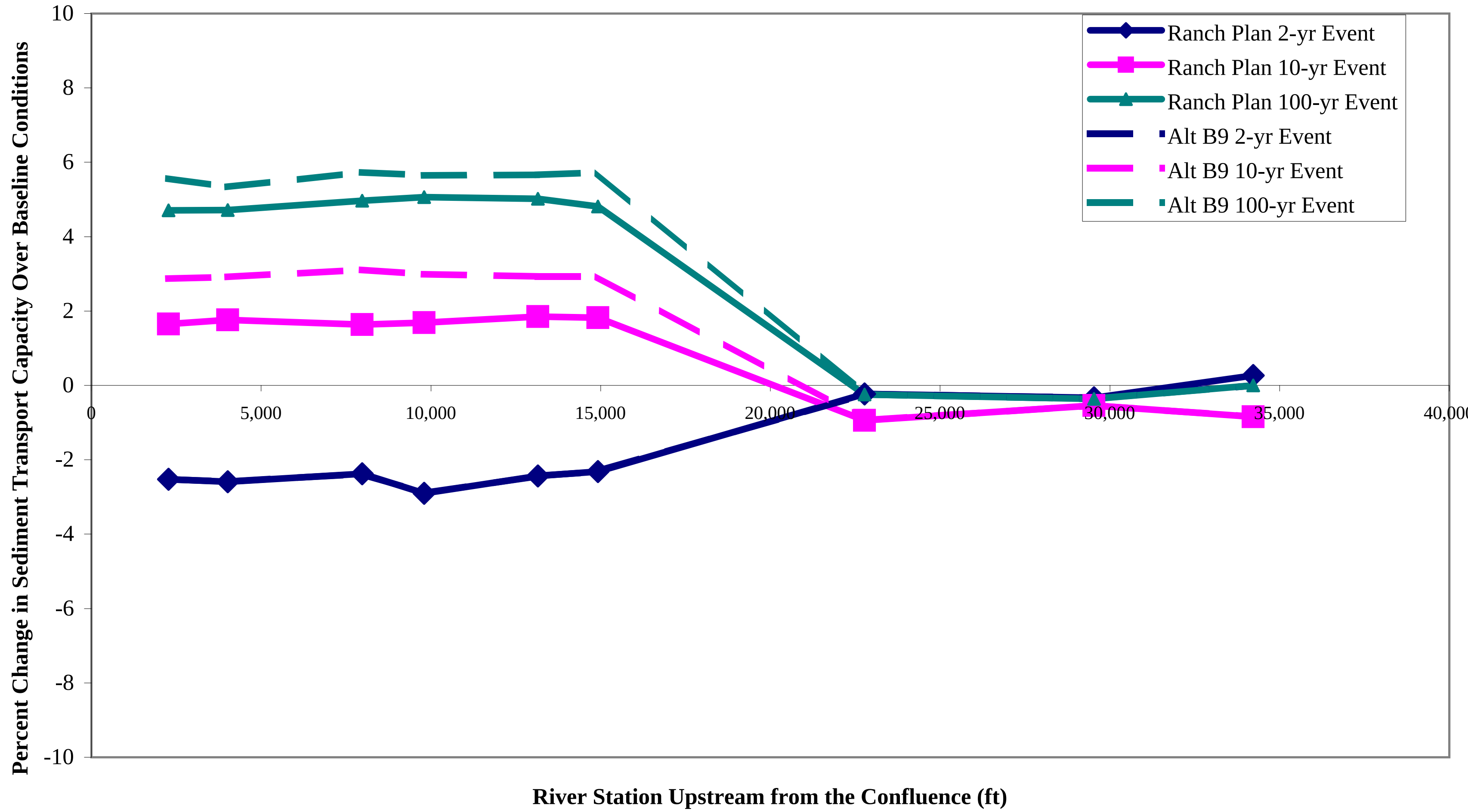
San Juan and San Mateo Watersheds Sediment Transport Analysis

Verdugo Canyon

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.

Notes:

1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for GO1 through GO9 from downstream to upstream order (left to right).

figure 5-3

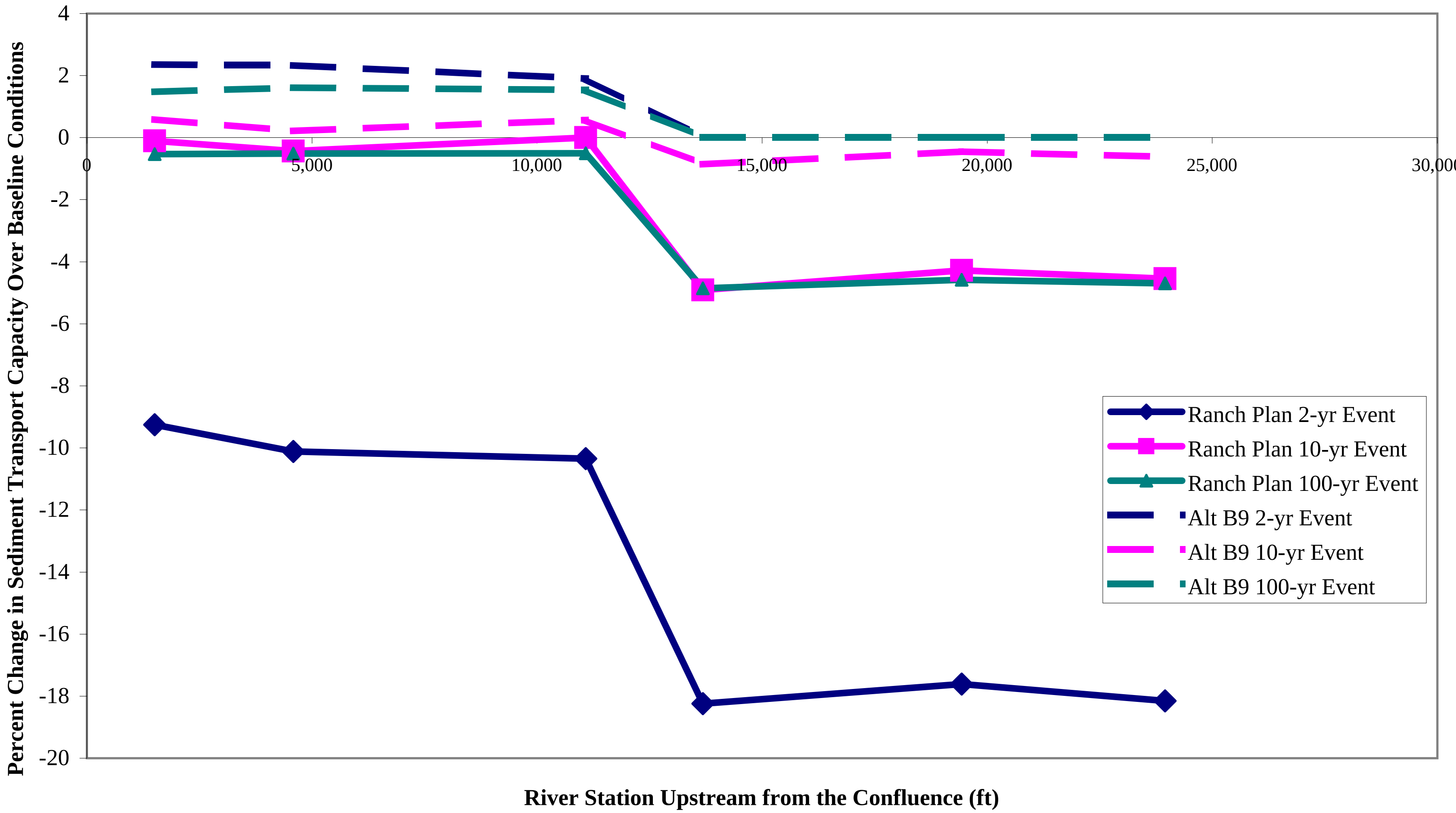
San Juan and San Mateo Watersheds Sediment Transport Analysis

Canada Gobernadora

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for CH1 through CH6 from downstream to upstream order (left to right).

figure 5-4

San Juan and San Mateo Watersheds Sediment Transport Analysis

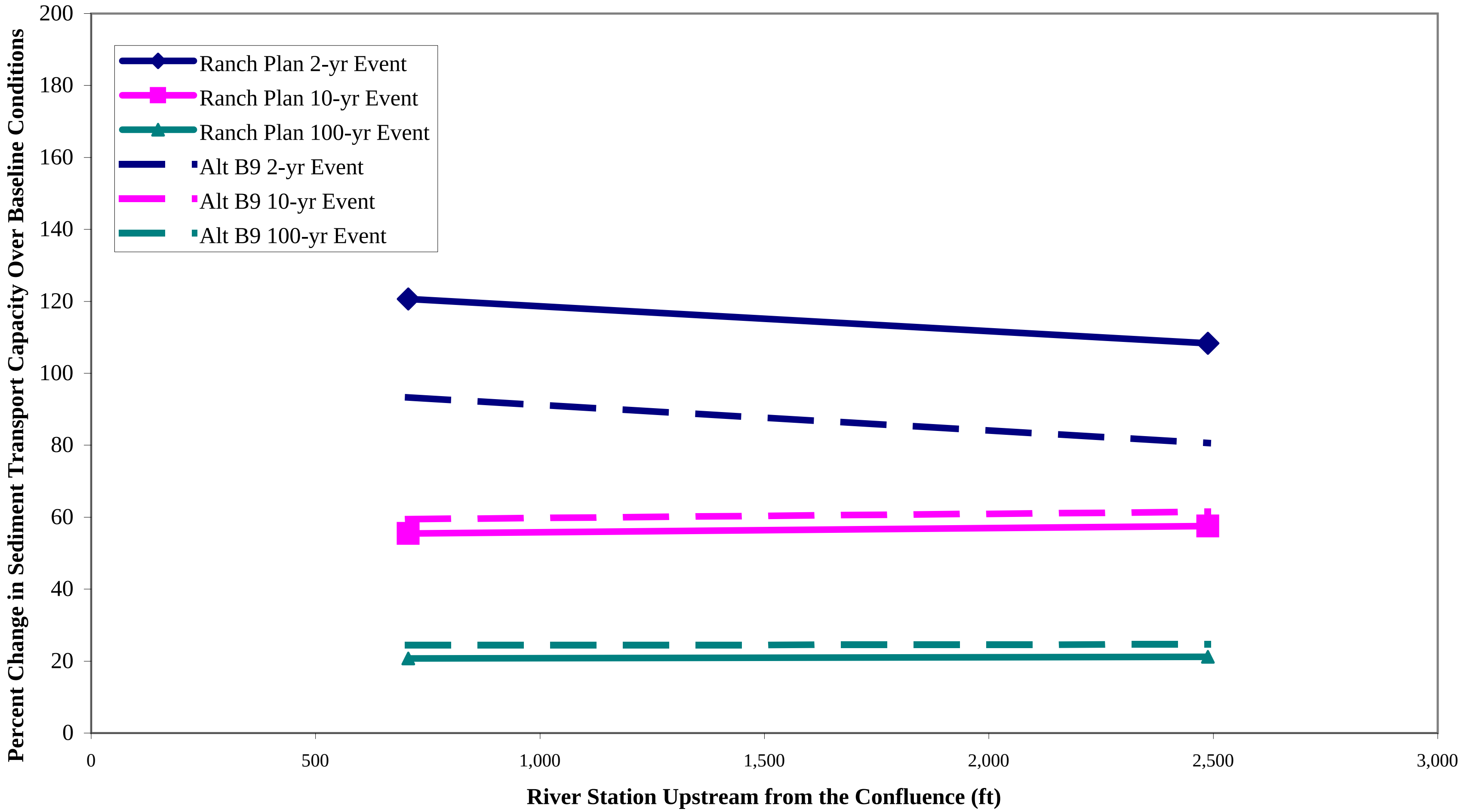
Canada Chiquita

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02

Capacity_Comparison_Results.xls Chiquita 3/30/2004



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for NE1 and NE2 from downstream to upstream order (left to right).

figure 5-5

San Juan and San Mateo Watersheds Sediment Transport Analysis

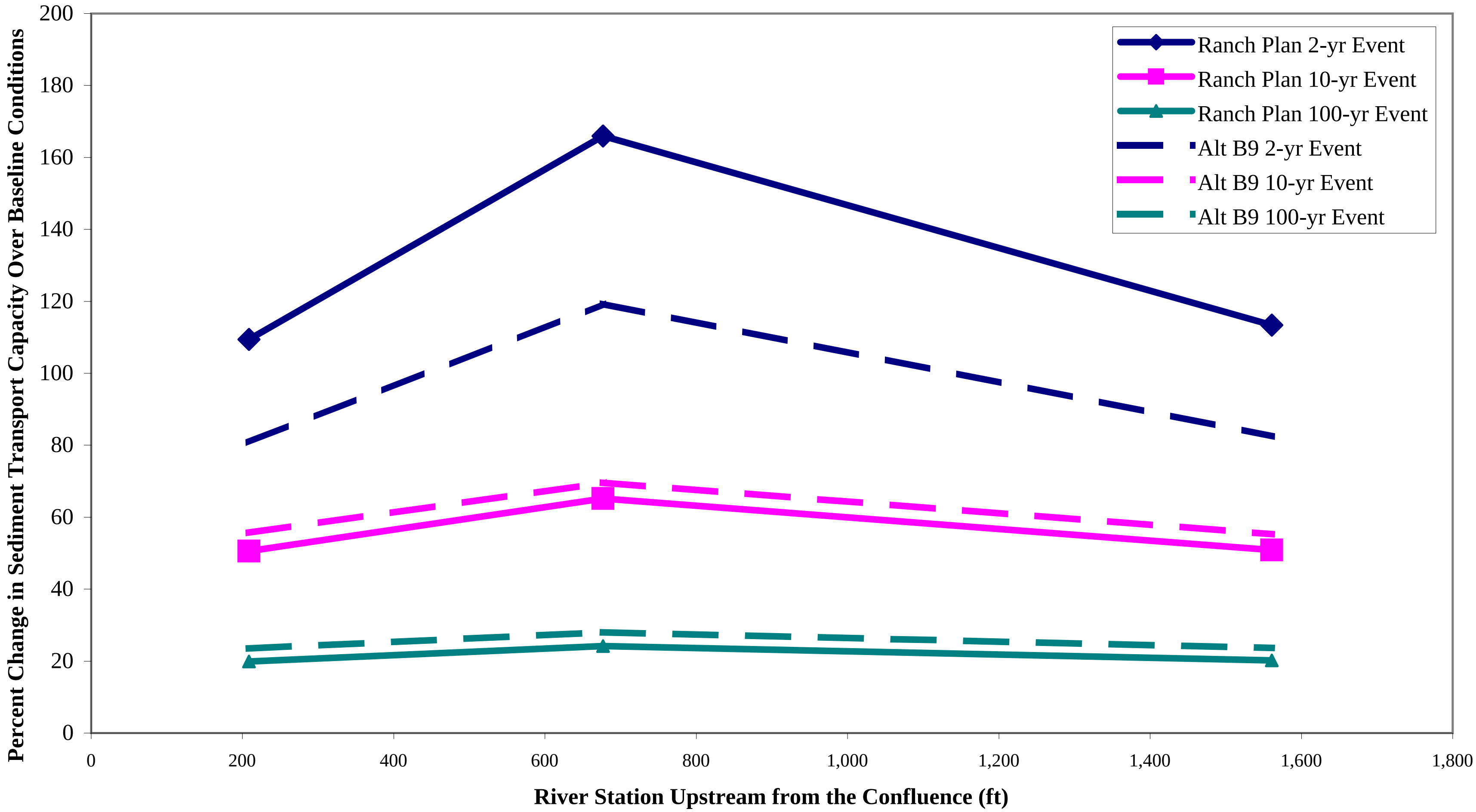
San Juan Creek Northeast Canyon

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02

Capacity_Comparison_Results.xls NE 3/30/2004



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for TR1 through TR3 from downstream to upstream order (left to right).

figure 5-6

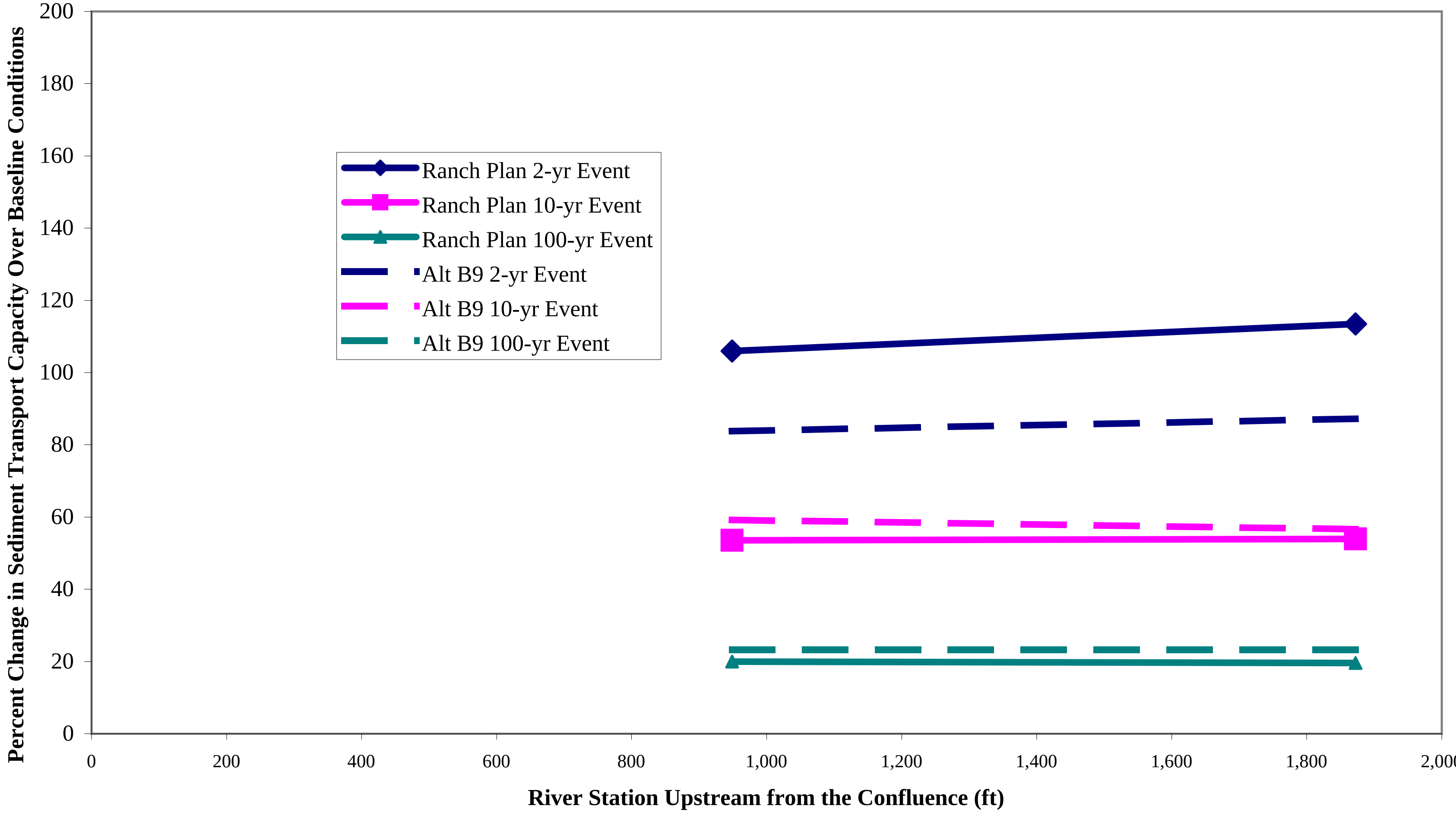
San Juan and San Mateo Watersheds Sediment Transport Analysis

Trampas Canyon

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for NW1 and NW2 from downstream to upstream order (left to right).

figure 5-7

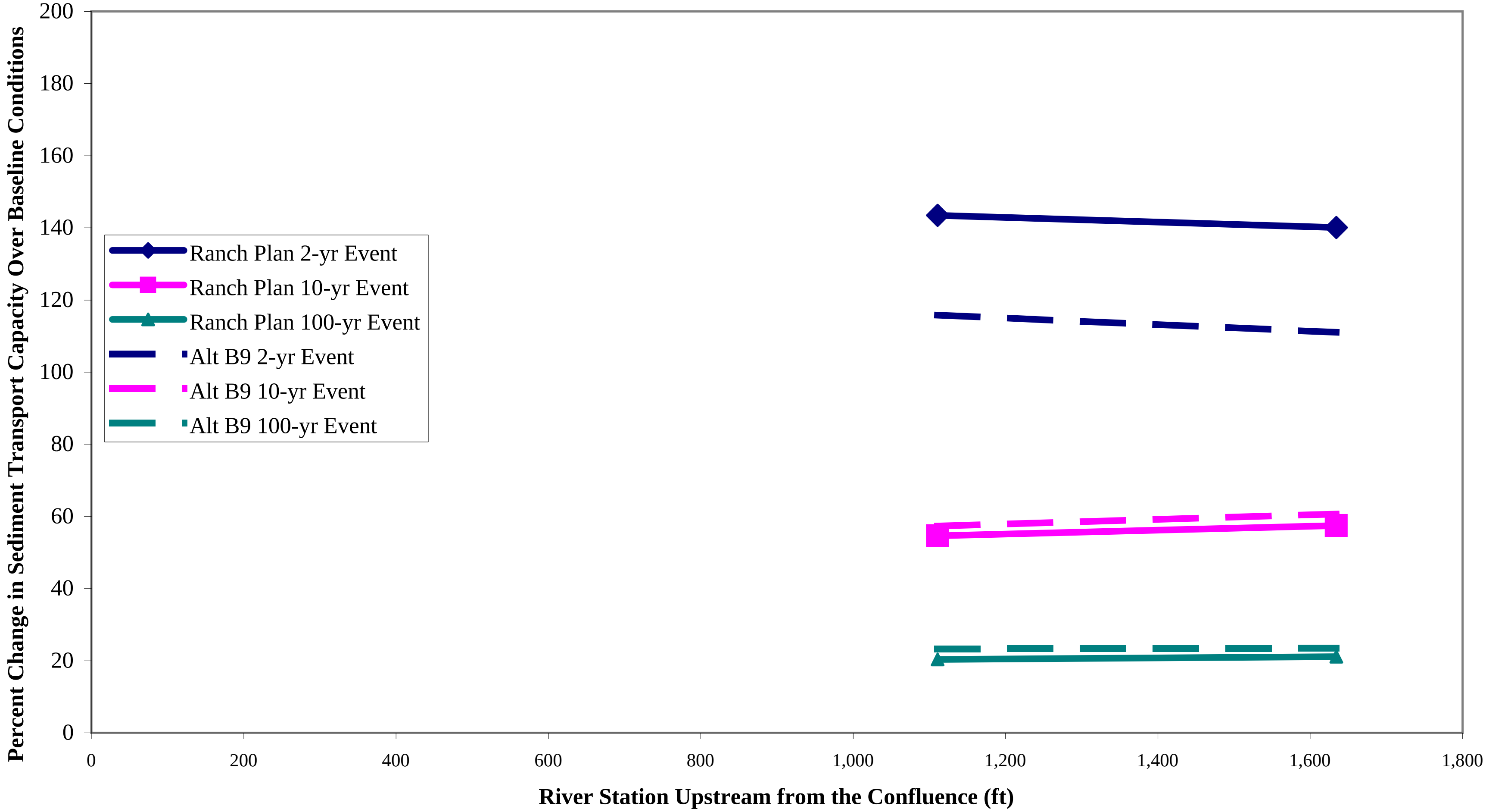
San Juan and San Mateo Watersheds Sediment Transport Analysis

San Juan Creek Northwest Canyon

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for SW1 and SW2 from downstream to upstream order (left to right).

figure 5-8

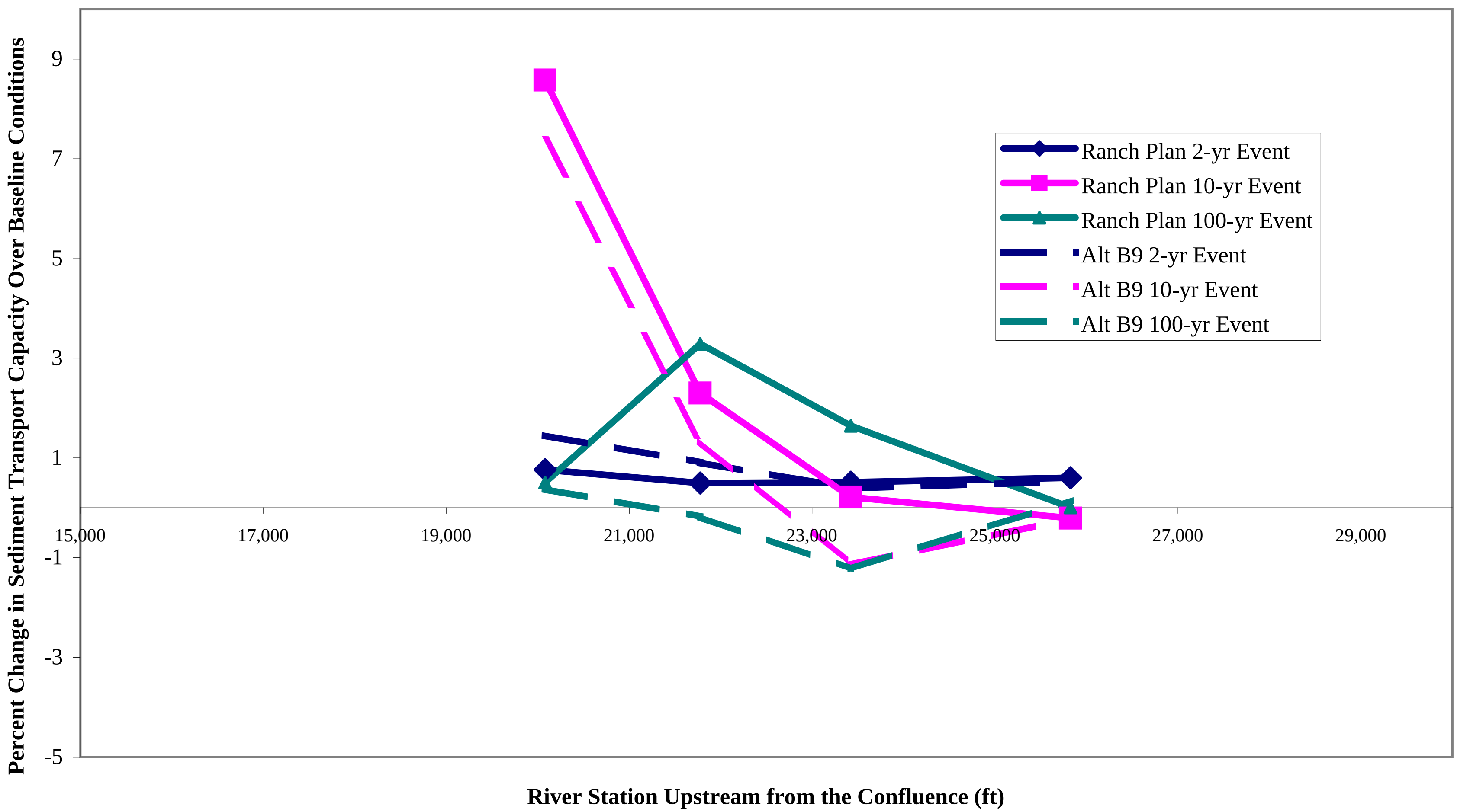
San Juan and San Mateo Watersheds Sediment Transport Analysis

San Juan Creek Southwest Canyon

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for SJ1 through SJ4 from downstream to upstream order (left to right).

figure 5-9

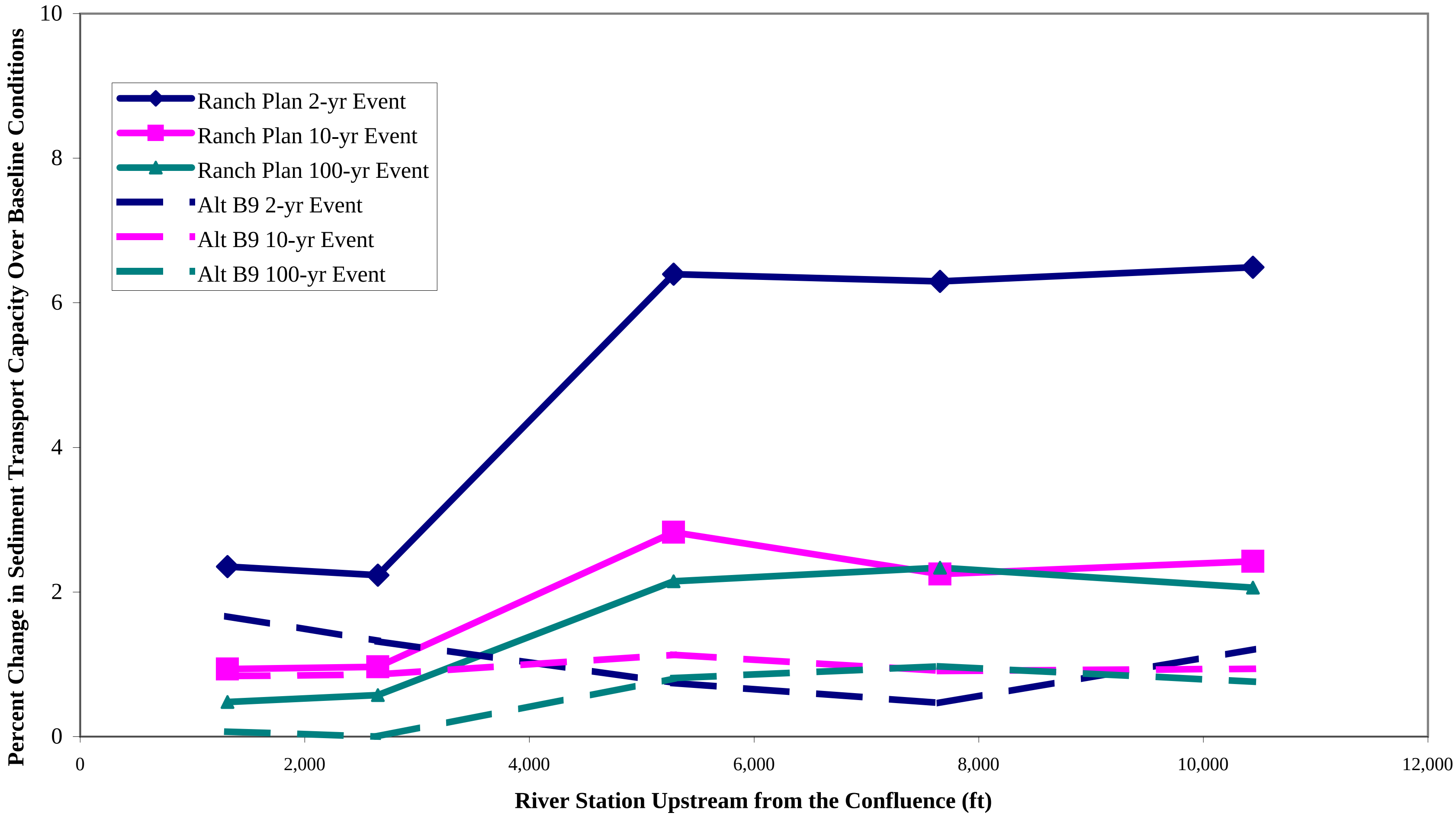
San Juan and San Mateo Watersheds Sediment Transport Analysis

Central San Juan Mainstem

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for GA1 through GA5 from downstream to upstream order (left to right).

figure 5-10

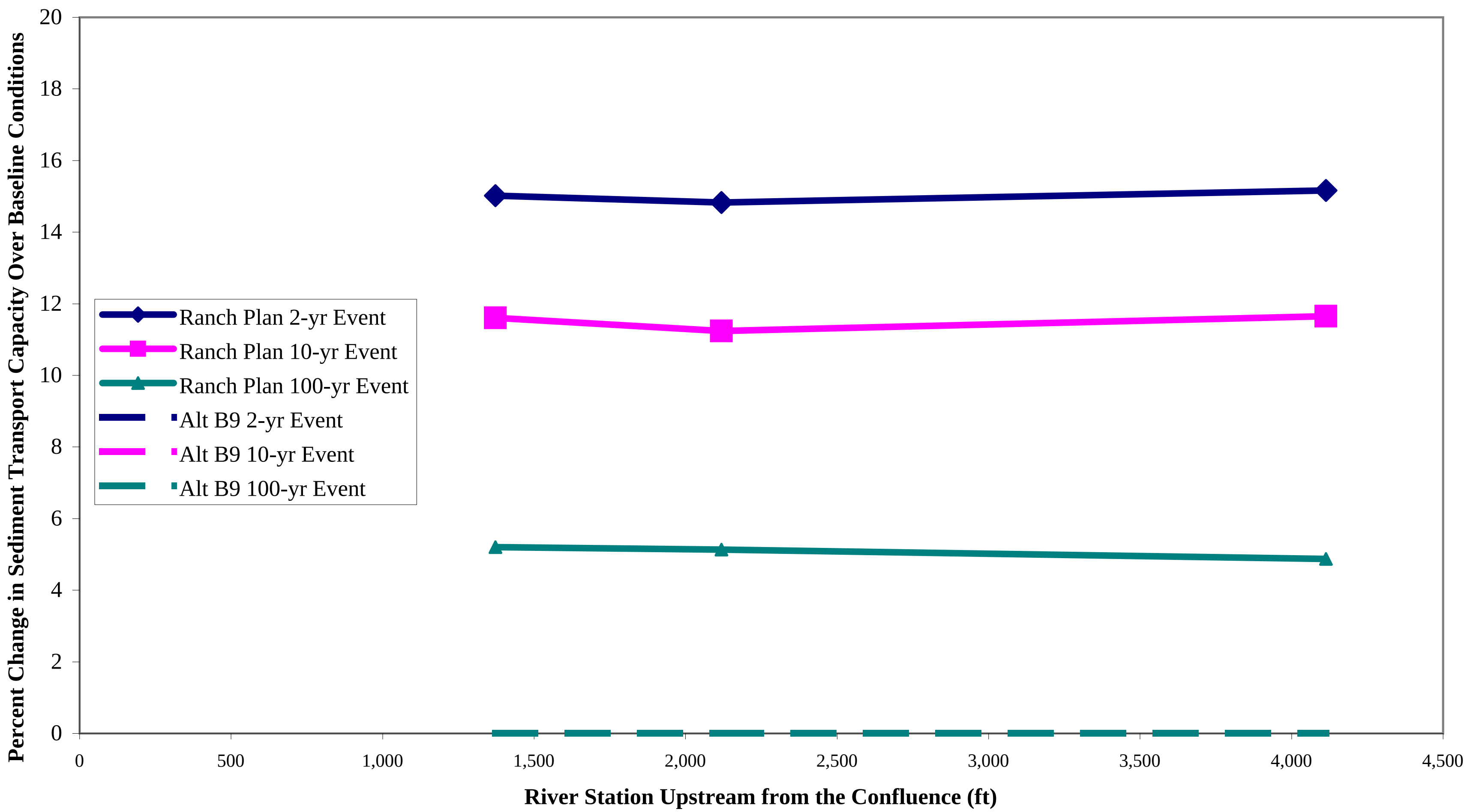
San Juan and San Mateo Watersheds Sediment Transport Analysis

Gabino Canyon

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. Values shown for CR1 through CR3 from downstream to upstream order (left to right).

figure 5-11

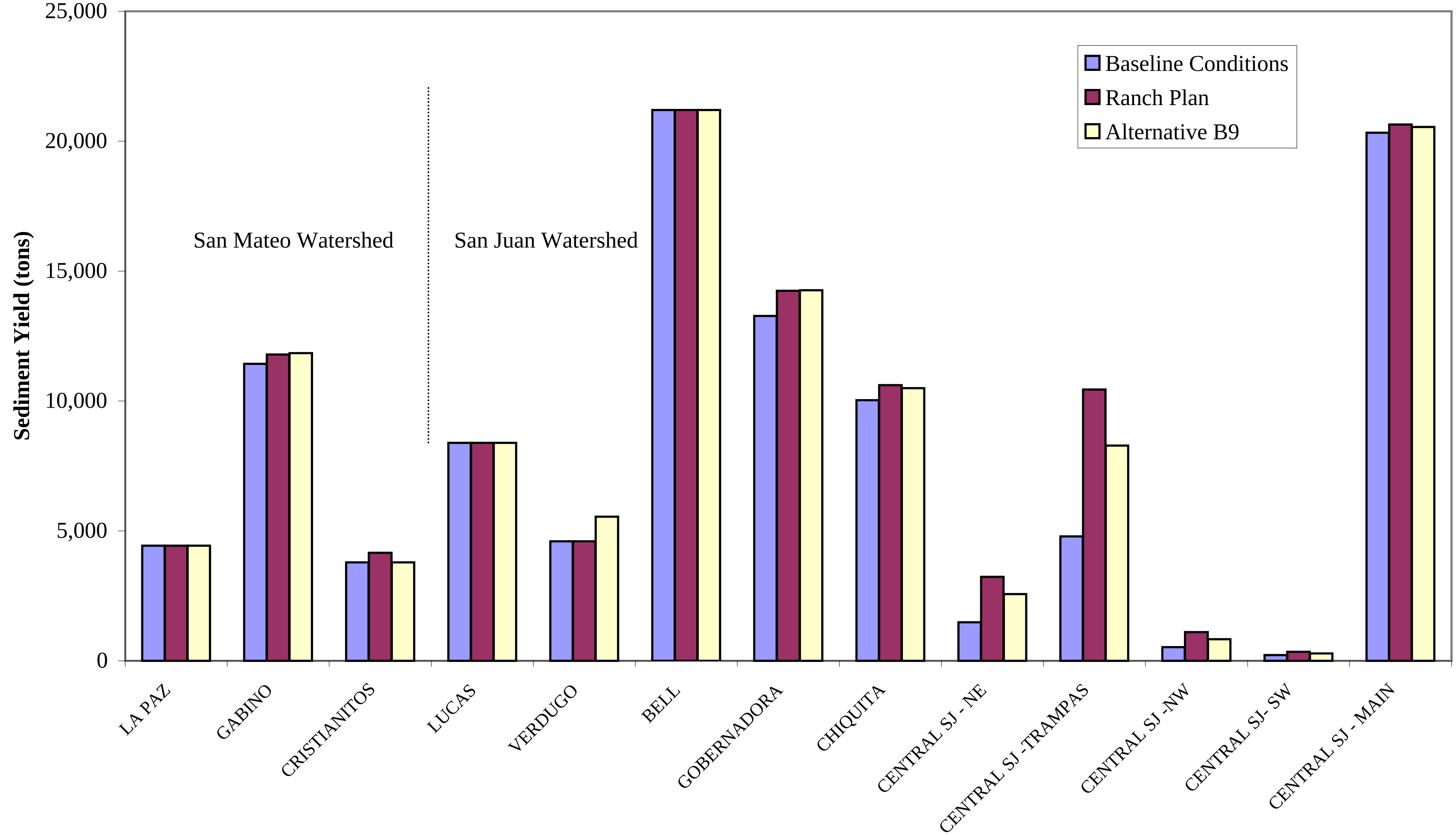
San Juan and San Mateo Watersheds Sediment Transport Analysis

Cristianitos Canyon

Percent Change in Transport Capacity Over Baseline Conditions

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.

Notes:

1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

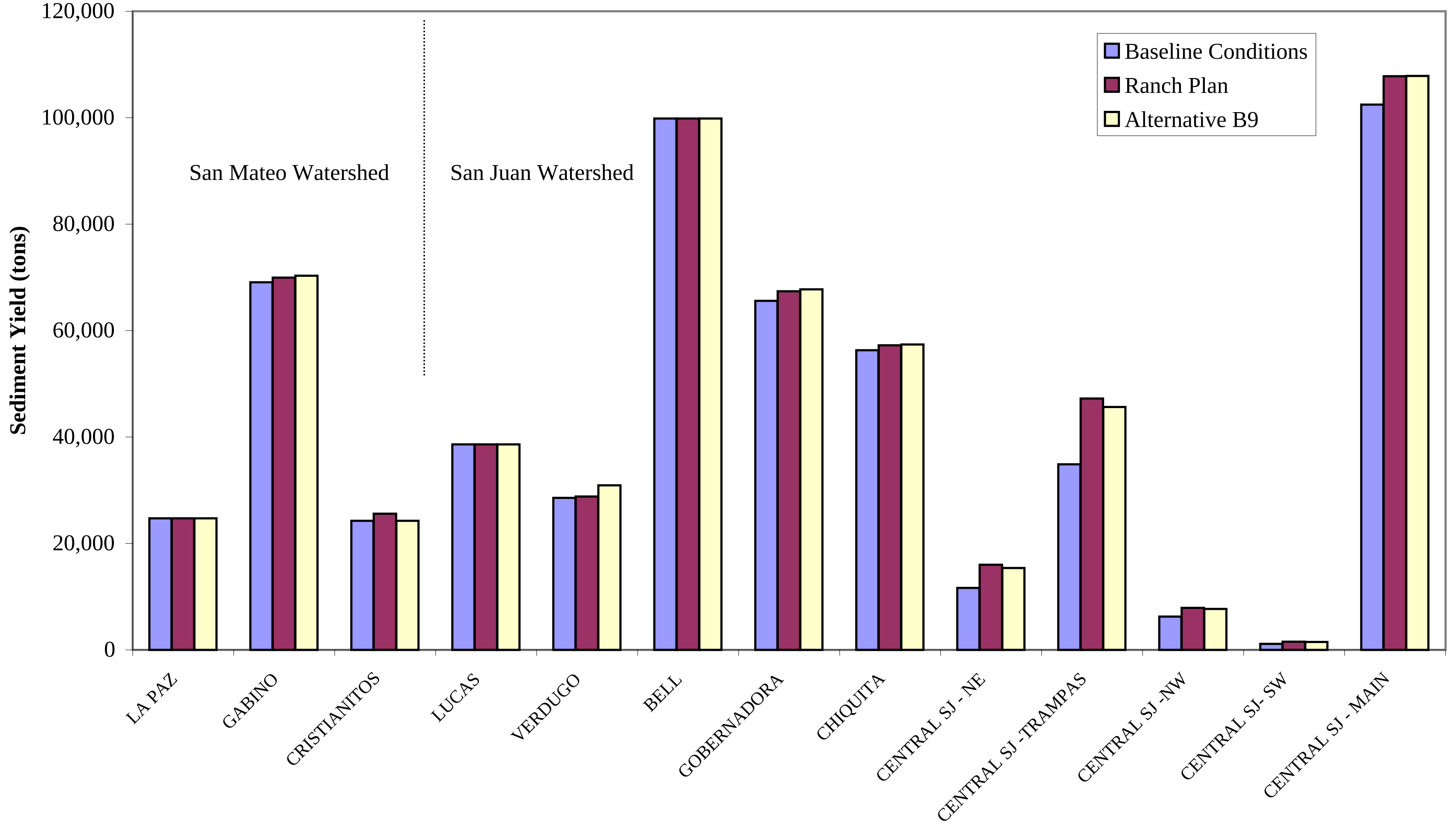
figure 5-12

San Juan and San Mateo Watersheds Sediment Transport Analysis

2-yr Event Sediment Yield at Canyon Mouths

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

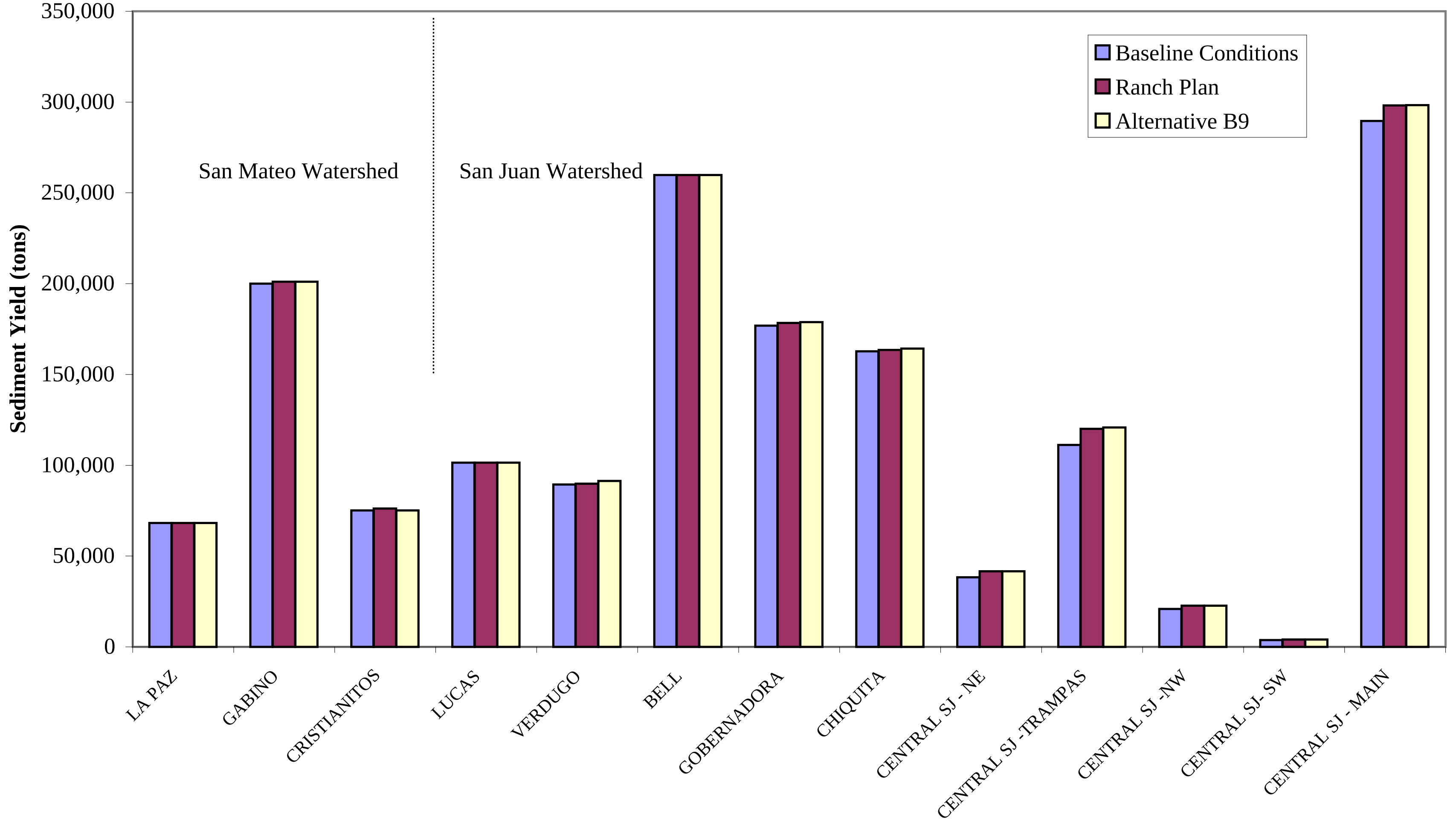
figure 5-13

San Juan and San Mateo Watersheds Sediment Transport Analysis

10-yr Event Sediment Yield at Canyon Mouth

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.

Notes:

1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

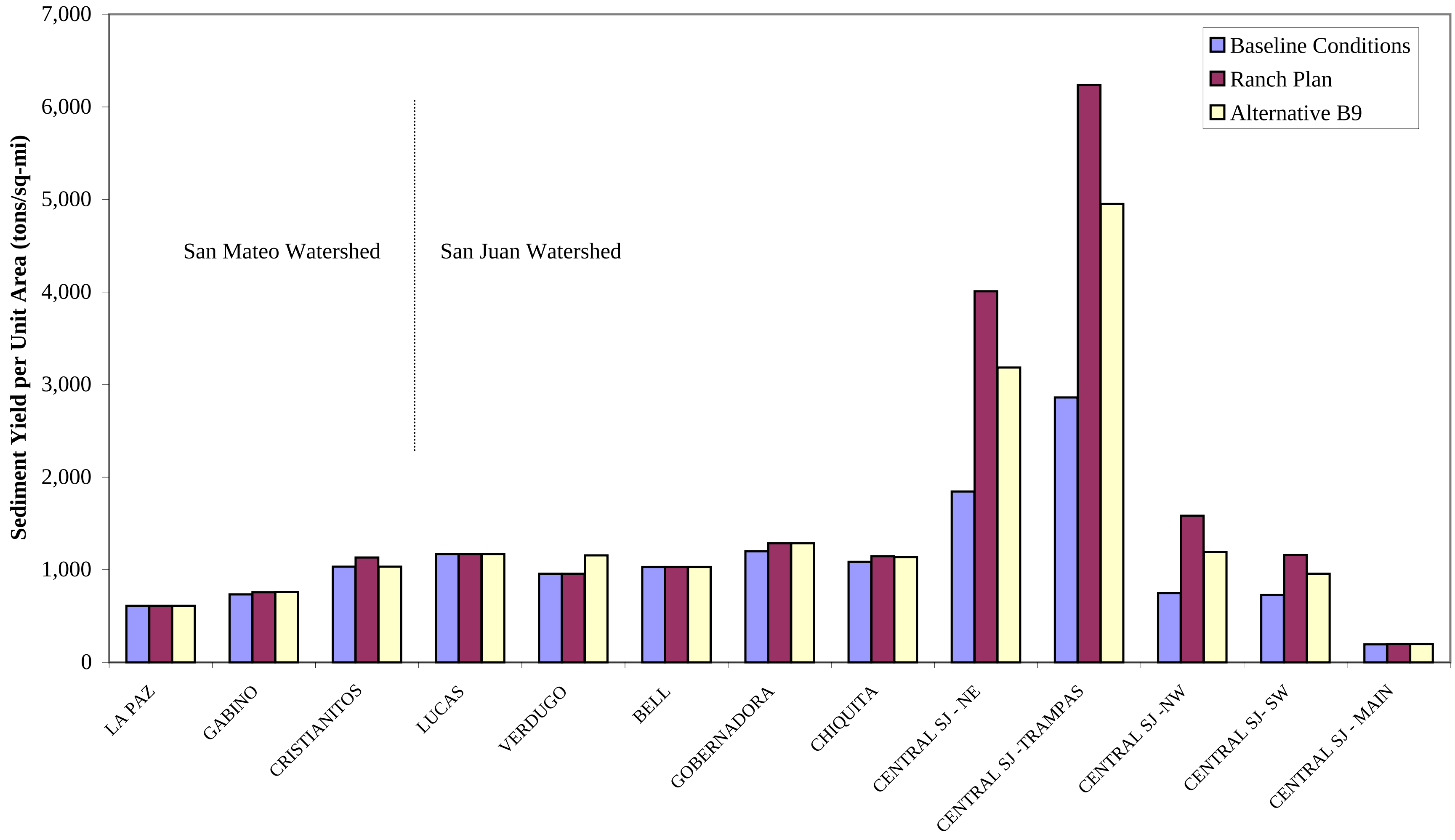
figure 5-14

San Juan and San Mateo Watersheds Sediment Transport Analysis

100-yr Event Sediment Yield at Canyon Mouth

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

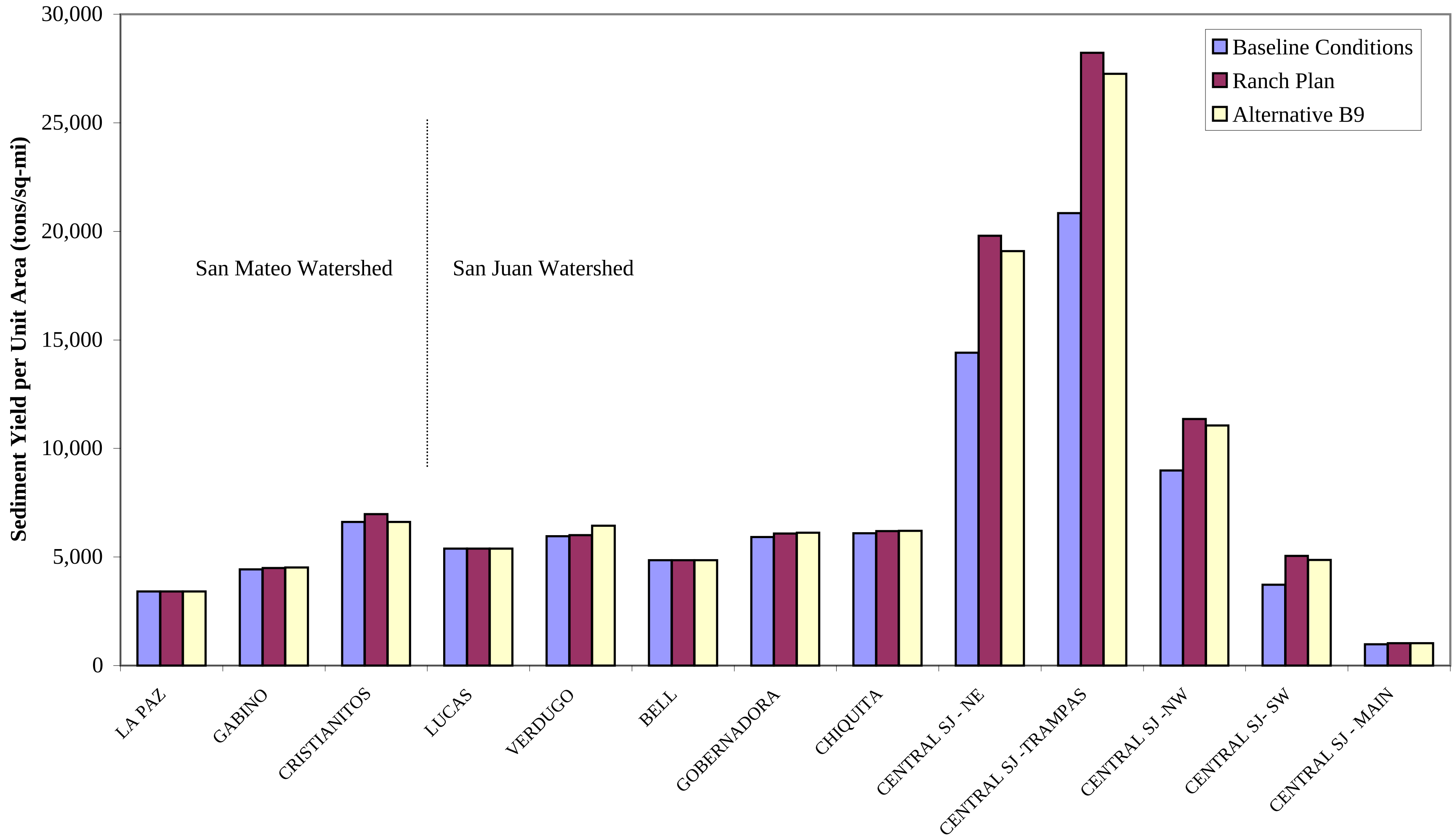
figure 5-15

San Juan and San Mateo Watersheds Sediment Transport Analysis

2-yr Event Sediment Yield per Unit Area at Canyon Mouths

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

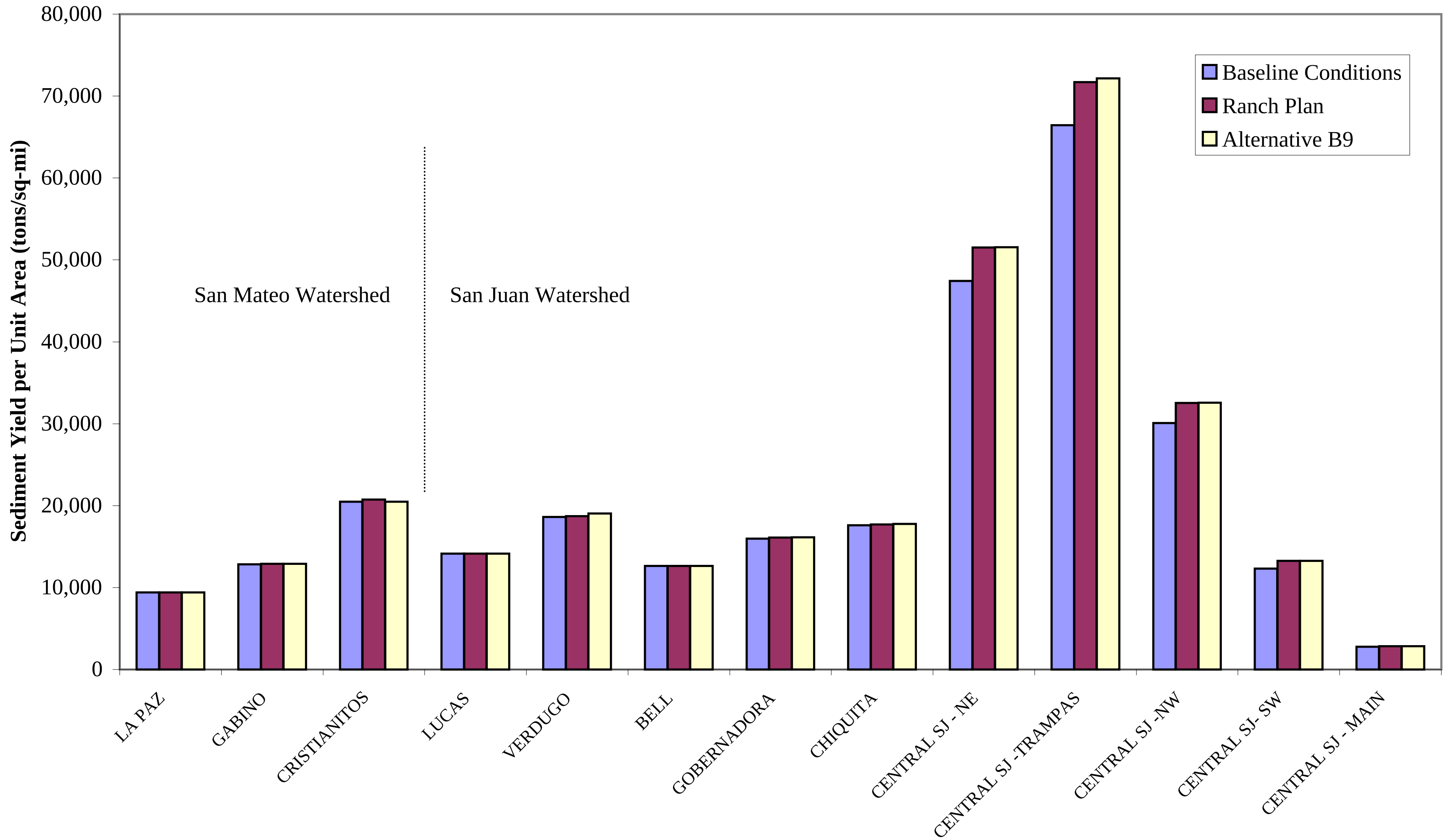
figure 5-16

San Juan and San Mateo Watersheds Sediment Transport Analysis

10-yr Event Sediment Yield per Unit Area at Canyon Mouth

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.

Notes:

1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

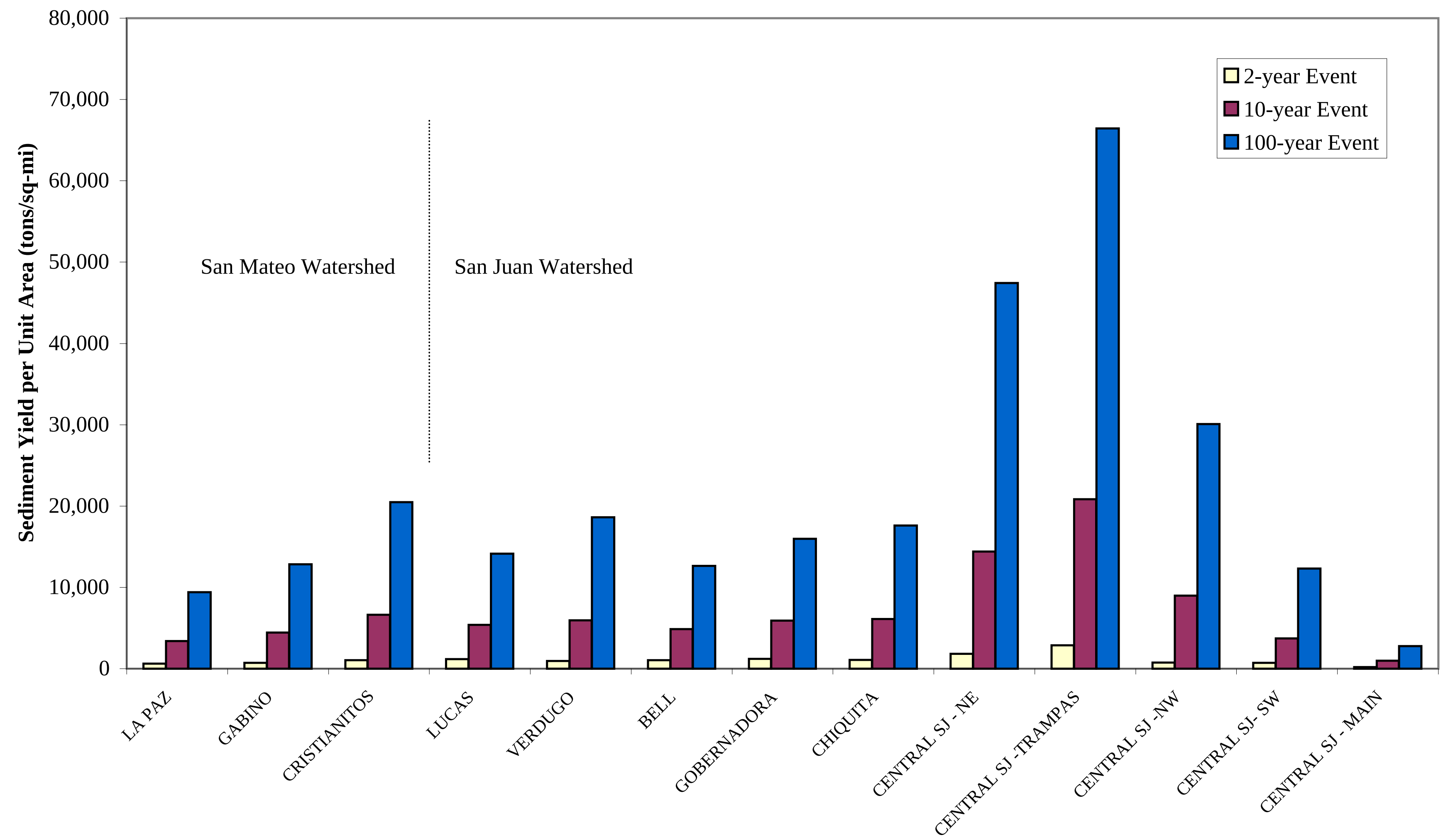
figure 5-17

San Juan and San Mateo Watersheds Sediment Transport Analysis

100-yr Event Sediment Yield per Unit Area at Canyon Mouth

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.

Notes:

1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

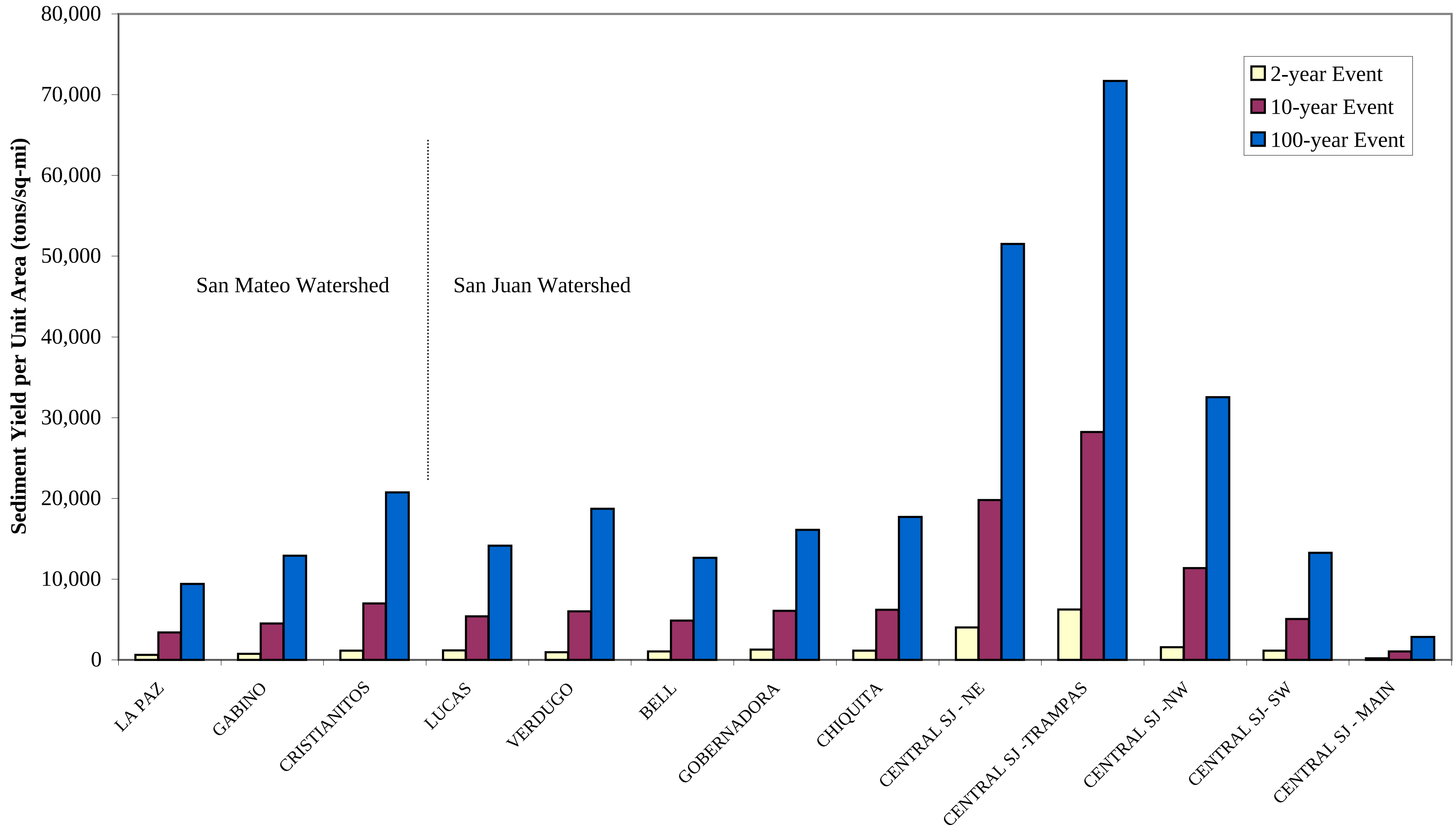
figure 5-18

San Juan and San Mateo Watersheds Sediment Transport Analysis

Sediment Yield per Unit Area at Canyon Mouths Under Baseline Conditions for All Modeled Events

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

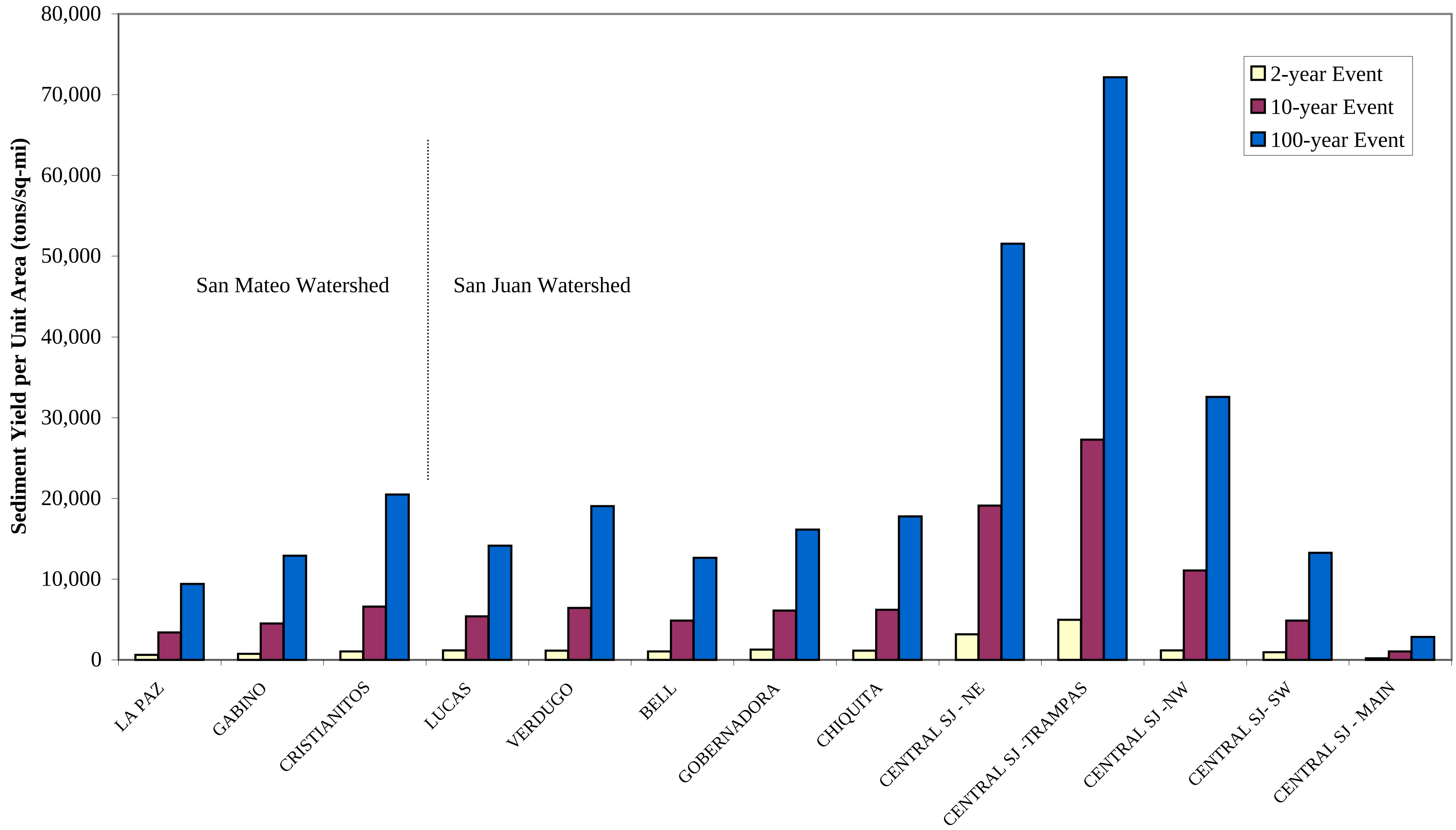
figure 5-19

San Juan and San Mateo Watersheds Sediment Transport Analysis

Sediment Yield per Unit Area at Canyon Mouths Under Ranch Plan for All Modeled Events

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.

Notes:

1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are shown for the most downstream reaches.

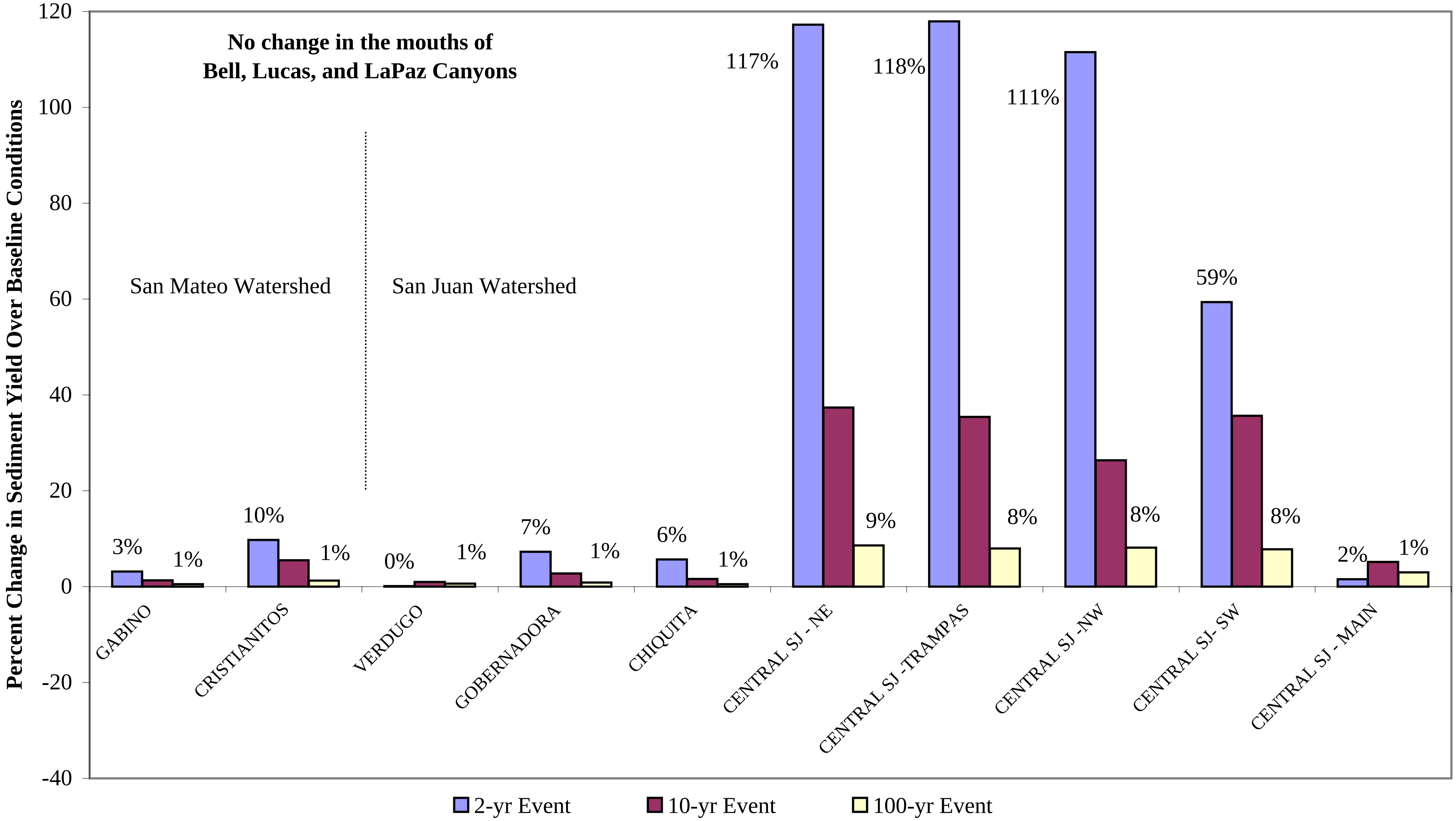
figure 5-20

San Juan and San Mateo Watersheds Sediment Transport Analysis

Sediment Yield per Unit Area at Canyon Mouths Under Alternative B9 for All Modeled Events

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.
Notes:
1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are for the most downstream reaches.

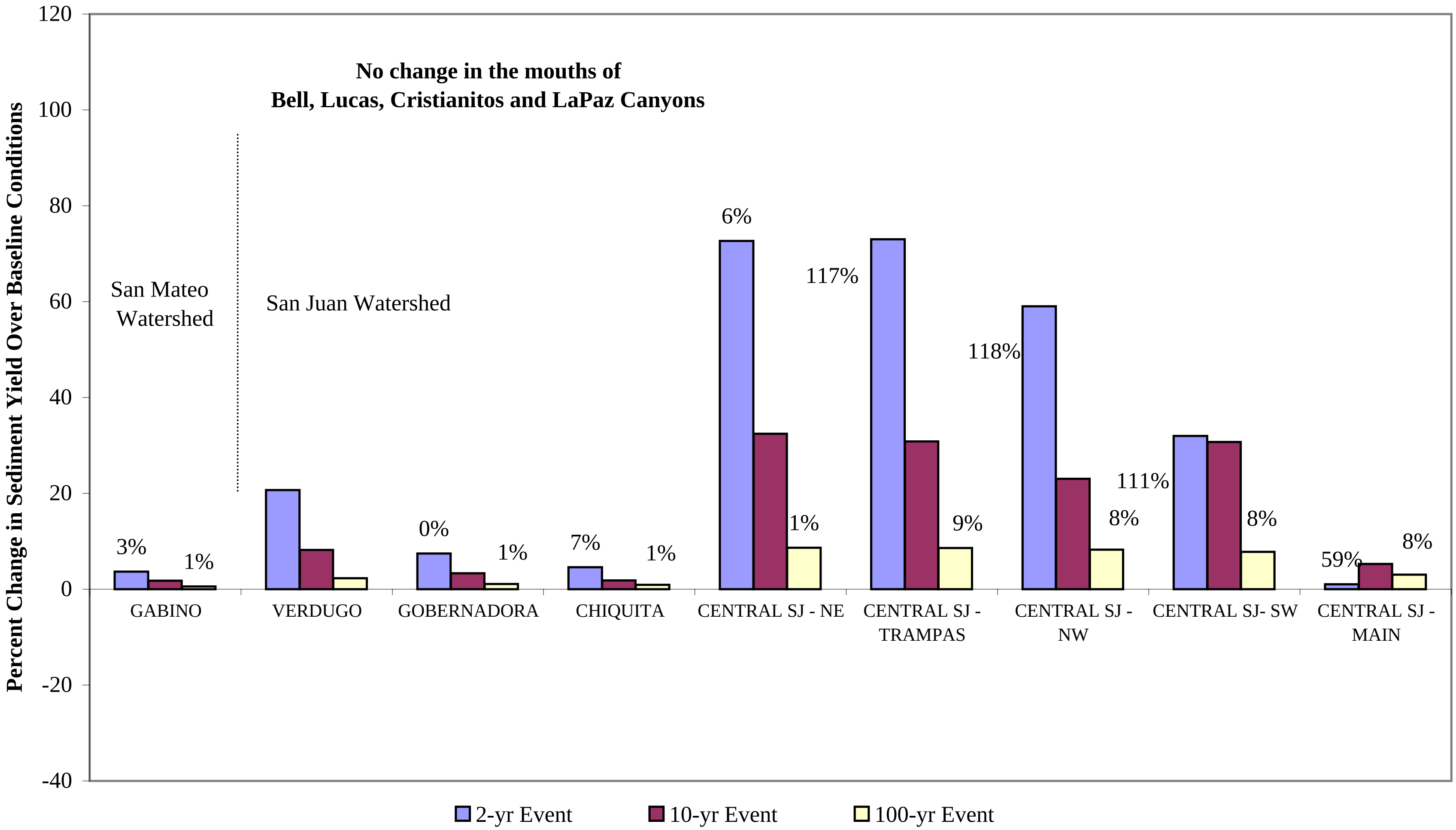
figure 5-21

San Juan and San Mateo Watersheds Sediment Transport Analysis

Percent Change in Sediment Yield Over Baseline Conditions under the Ranch Plan (at Canyon Mouths)

PWA

PWA #:1393-02



Source: PWA (2004) Sediment Transport Analysis.

Notes:

1. SAMwin model (developed by USACE and Ayres Associates) was used in the analysis.
2. Laursen(Madden) (1985) sediment transport equation was employed.
3. The results are for the most downstream reaches.

figure 5-22

San Juan and San Mateo Watersheds Sediment Transport Analysis

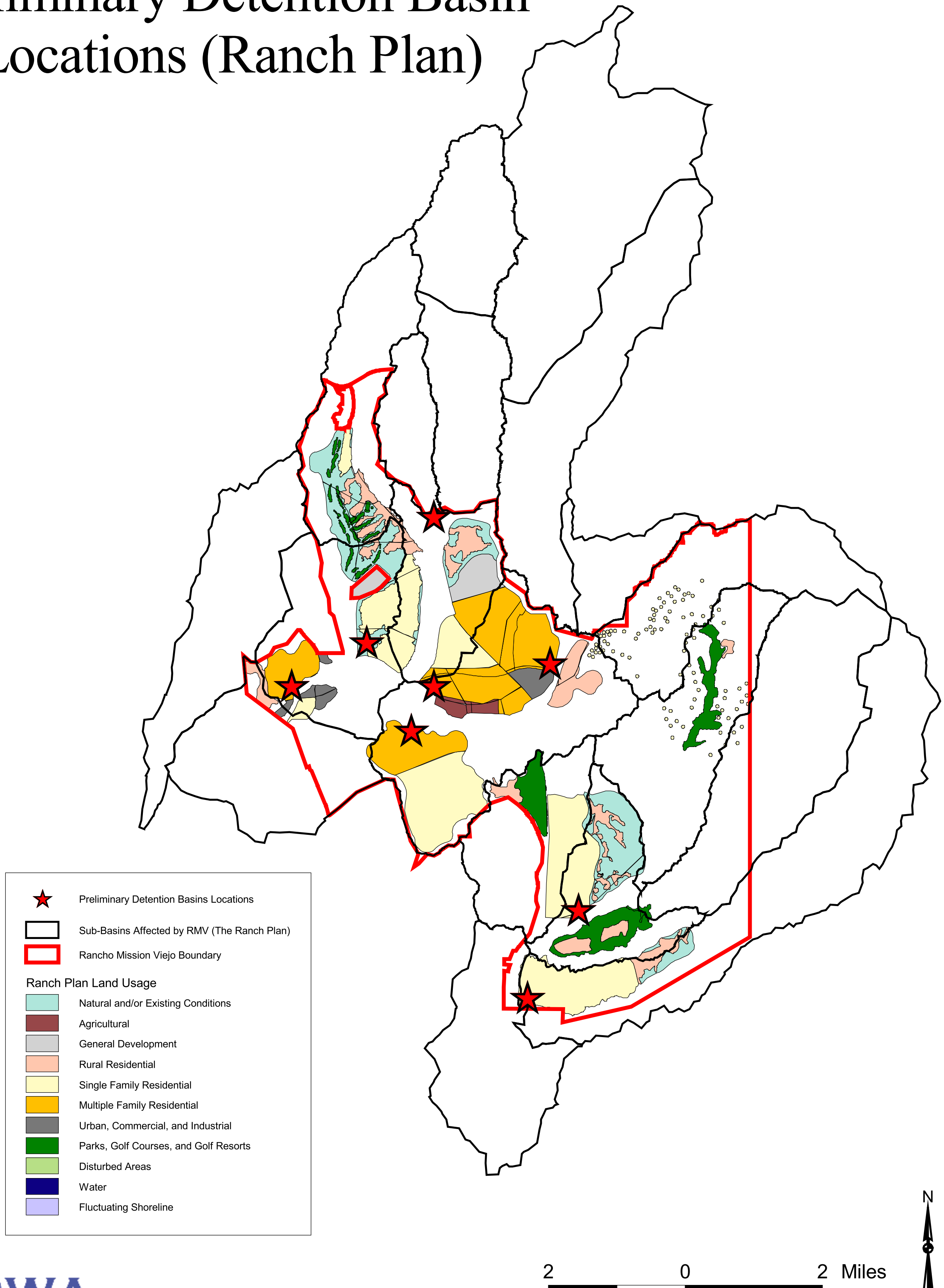
Percent Change in Sediment Yield Over Baseline Conditions under Alternative B9 (at Canyon Mouths)

PWA

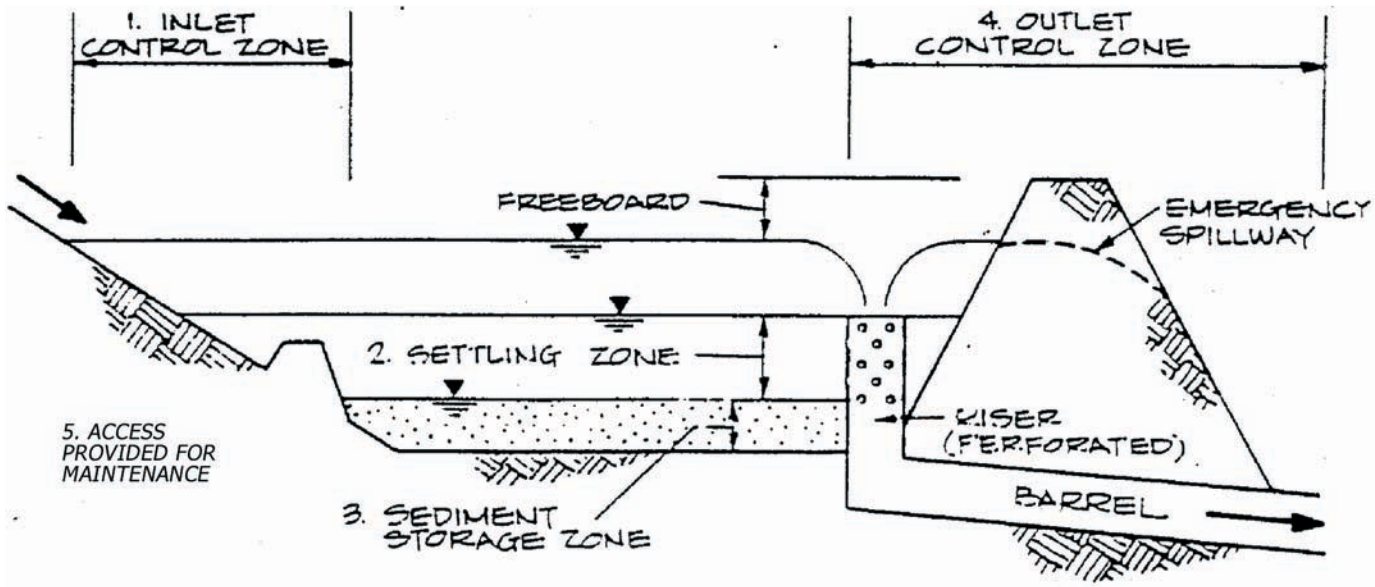
PWA #:1393-02

figure 6-1

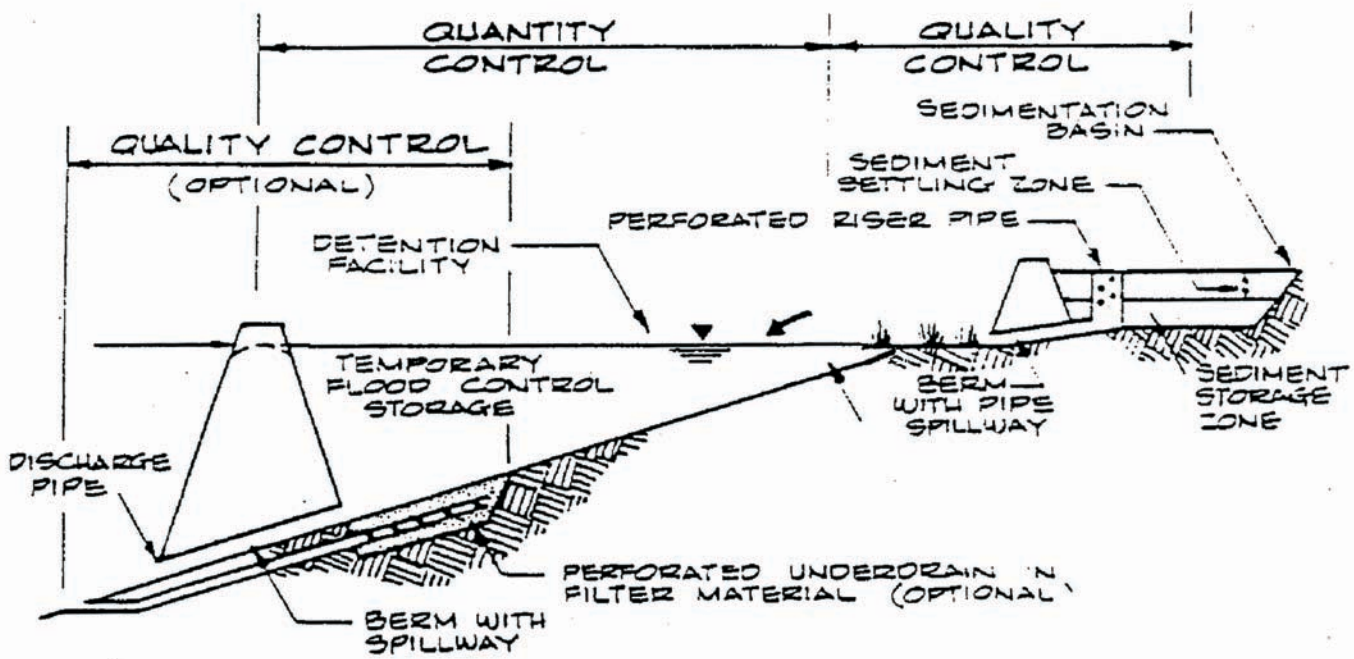
Preliminary Detention Basin Locations (Ranch Plan)



PWA



SEDIMENTATION BASIN COMPONENTS



COMBINED SEDIMENTATION BASIN - DETENTION FACILITY

from Walesh, 1989

figure **6.2**

Orange County SAMP

Detention / Sediment Basin

PROJ REF# 1393-02

PWA

1393-02/Report/1393-02Figs/Detntn_SedBasin.cdr

PWA
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SFO@PWA-LTD.COM

MEMORANDUM

DATE: May 21, 2004

TO: Tom Staley, Laura Coley Eisenberg, Richard Broming

COMPANY: RANCHO MISSION VIEJO

FROM: Amy Stewart, Setenay Bozkurt, Jeff Haltiner

COPY TO: Bruce Phillips (PACE), Barry Hecht (Balance), Peter Mangarella (Geosyntec)

RE: RMV Sediment Yield

PWA Ref. #: 1393.02 SAMP

Introduction

This memo summarizes sediment yield calculations for existing conditions, the construction-phase and post-project land use conditions, focusing on sub-basins that are proposed for development (Figure 1) under the Ranch Plan (Alternative B4). The sediment yield study has been completed in response to the April 20, 2004 comments on the PWA Alternatives Analysis (March 2004) by Bruce Phillips (PACE, on behalf of Orange County).

Sediment Yield represents the volume (or mass) of soil that is eroded from the hillsides of a watershed, as a result of the rill and sheet erosion processes that may affect developing areas. A portion of this sediment is deposited further down slope in the watershed, and over time, some of this is delivered to the channel via overland flow type processes. PWA utilized the Modified Universal Soil Loss Equation (MUSLE) to estimate event-based sediment yield from subwatersheds in the San Juan and San Mateo watersheds. Sediment yields were calculated for existing conditions, for conditions representing the construction phase, and for developed (Ranch Plan) conditions. Yield calculations were modified using a Sediment Delivery Ratio to estimate sediment mobilization that actually reaches the stream channel. The MUSLE method represents an estimate of total sediment transport, for all size fractions of sediment. We further differentiate the sediment transport into fine (clay and silt size particles) and coarse material (sand size and larger).

Method

The Modified Universal Soil Loss Equation, MUSLE (Williams, 1981) was used to estimate event sediment yield occurring as a result of sheet and rill erosion. The 2- and 100-year flow events were analyzed for sediment yield. MUSLE is an event-based empirical model that was derived from the widely used sediment yield estimation method, Universal Soil Loss Equation (USLE) (Wischmeier and Smith, 1965). The MUSLE is a standard method of estimating sediment yield in developing areas. The equation has been previously applied within Orange County in studies such as the Newport Bay/San

Diego Creek Watershed Study (Chang, 2000) and the San Juan watershed assessment documented in Simons, Li & Associates, 1999. MUSLE was recommended by the County reviewer as an appropriate method of yield computation for this study.

The MUSLE represents sediment yield as:

$$Y = 95(Q * q_p)^{0.56} KCPLS \qquad \text{(Eq. 1)}$$

such that:

- Y = sediment yield from an individual storm (tons)
- Q = storm runoff volume (acre-feet)
- q_p = peak runoff rate (cfs)
- K = soil erodibility factor
- C = crop management factor
- P = erosion control practice factor
- LS = slope length and gradient factor

Parameter Estimation

Storm event peaks and volumes were obtained for each sub-basin from the PWA HEC-1 rainfall/runoff model (PWA, 2004). Table 1 lists the sub-basin peaks and volumes from the existing conditions simulations and also from the Ranch Plan simulations. To focus on the effect of land use cover on the yield of sediment from the basins, the same hydrologic conditions (Q and q_p) were assumed for the existing and construction phase conditions.

The erodibility of a soil is a quantitative measure of its susceptibility to erosion and is determined from long-term measurements at standard soil plots. It is an integrated average annual value that quantifies the cohesive bonding character of the soil and ability of the soil to resist detachment and transport during a rainfall event (Renard et al., 1997). We obtained soil erodibility values from SSURGO soil data prepared by the National Resources Conservation Service. SSURGO is the most detailed level of soil mapping done by the NRCS and duplicates the original soil survey maps (http://www.ftw.nrcs.usda.gov/ssur_data.html). Table 1 lists the sub-basin erodibility factors as calculated from an area-weighted average of the sub-basin erodibility. Figure 2 presents the spatial distribution of K-values. K values (which represent a fundamental soil parameter) were assumed to be the same for existing conditions, the construction phase, and for project conditions.

Crop management factors (C) describe the ground cover over the soil. These may vary from agricultural cover (hence, the origin of the name) as well as various urban or commercial designations. In vegetated areas, they are a function of crop type, canopy cover, undergrowth cover, and life-stage of the vegetation.

C is the ratio of sediment loss from zones with specific crops and cover to the loss from a tilled fallow. C values were collected from appropriate literature (Dunne & Leopold, 1978; Wischmeier, W.H. & D.D. Smith (1965); NRCS (1998); and Cornell Univeristy). Sub-basin C factors change between exiting conditions, the construction phase and for the ranch plan, reflecting the different land covers. Sub-basin land use is presented for each scenario in Figure 3. Table 1 summarizes the sub-basin C-factors.

The slope length and steepness factors are represented as a combined topographic factor, the LS factor. The LS factor, as originally formulated in the USLE, is based on the slope gradient and length of the standard field plot. This methodology is not suited to work with digital elevation data. In addition, at the basin scale, the slope length approach is difficult to use. Therefore, to incorporate the impact of flow convergence and the shapes of hillslopes (such as convex versus concave), the slope length factor was replaced by upslope contributing area (Moore and Burch, 1986; Mitasova *et al*., 1996). Above every point, the contributing (or upstream) area rather than slope length is the key-determining factor (Moore *et. al*, 1993; Desmet & Govers, 1996).

A procedure for estimating the LS factor using contributing area is provided by Moore *et a*l. (1993).

$$LS = (m+1)\left[\frac{A_S}{22.13}\right]^m \left[\frac{\sin\beta}{0.0896}\right]^n \quad \text{(Eq.2)}$$

such that:

LS = slope length factor
β= local slope gradient (degrees)
m, n = parameters representing prevailing flow type
A_s = upslope contributing area per unit contour width.

The length and the slope of the standard USLE plot are 72.6 feet (22.13 meters) and 9 percent (5.16 degrees), respectively. The typical values for m and n are 0.4-0.6 and 1.0-1.4, respectively, depending on the prevailing type of flow, where higher values are for rill-dominated areas. Lower values for m and n should be used for areas with prevailing dispersed flow, such as areas well covered with vegetation. Higher values should be used for areas with a more turbulent type of flow caused by existing rills or disturbed areas. For the RMV sub-basins, m and n values were chosen as 0.6 and 1.3, respectively.

Due to sub-basin grading, slope length factors differ between existing conditions and project conditions. Construction phase slope-length factors are estimated to be the same as for project conditions. Sub-basin slope length factors are presented in Table 1.

The erosion control practice factor, P, represents the ratio of sediment loss for various erosion control practices (for example terracing crops) to sediment loss from straight-row farming down the hillslope. In accordance with the 1995 Hydrologic Engineering Center Training Document No. 36, P is assumed to be 1 for all sub-basins and all land use scenarios.

Results

Incorporating the parameters into the MUSLE (Eq. 1) results in event-based sediment yield estimates, as presented in Table 2-A. During the construction phase of the project, sediment yields may potentially increase between 21-635% for the 2-year and 100-year events (when compared to existing conditions). The relative increases between the construction phase and the existing conditions are identical for the 2- and 100-year events as the existing condition hydrology was used for both scenarios. The largest increases are expected in sub-basin 48 (representing lower Gabino and Blind Canyons). The smallest percentage increase in sediment yield occurs in sub-basin 49 (upper Gabino Canyon).

Post-construction, and subsequent to completion of the Ranch Plan development, sediment yield is predicted to decrease below existing conditions. The decrease in sediment yield would result from the establishment of mature landscaping in the developed areas, and the increased imperviousness of the sub-basins that prevents erosion of the underlying soil (represented by decreasing C-factors as seen in Table 1). The MUSLE indicates that for the discrete events, the largest changes in sediment production are within sub-basin 8 (lower Chiquita Canyon) and within sub-basin 13 (Central San Juan Catchments). The sub-basins least influenced include sub-basins 21 (at the downstream RMV boundary) and Verdugo Canyon (sub-basin 9). Within the RMV, the change in sediment yield ranges from a 1% increase to a 51% decrease for the 2-year event. For the 100-year event, the maximum potential change is 70% (in sub-basin 13).

The calculated sediment yield results represent potential increases in the sediment eroded from a developing area as a result of sheet and rill erosion. The amount of sediment actually conveyed off the hillslope to stream channels would be considerably less, since much of the sediment is trapped on site and conveyed more slowly over extended periods. This rate of delivery is episodic, depending on the frequency of large rainstorms, watershed disturbance by fire, etc. The sediment production (yields) were converted to estimates of sediment conveyed to the streams, using a Sediment Delivery Ratio (SDR). Use of a SDR aids in estimation of actual mobilization of sediments. The SDR may be determined utilizing a number of different methods. We used the USDA Slope Continuity Method which is based on watershed slope steepness (assumes that the sediment delivery to the streams is dependent on the watershed steepness). Representative cross-sections were drawn across the individual sub-basins. Regions of the cross-sections with slopes greater than 10% were hypothesized to be areas in which sediment is likely to mobilize. The cumulative length of “sediment producing” areas were divided by the cumulative length of the sub-basin cross-sections to obtain the sub-basin SDR. Within the RMV, SDRs ranged from 46-73%. MUSLE results were multiplied by the SDR to obtain the scaled results provided in Table 2-B.

Simons, Li & Associates utilized MUSLE to estimate sediment yield in their 1999 study of the San Juan Watershed. However, results from the PWA and SLA studies cannot be directly compared as the locations for yield computation are not equivalent. To provide a range of sediment yields within the study area, Table 3 presents sediment yield per unit acre from the SLA and PWA computations. PWA yield estimates (Table 3-A) include the range resulting from scaled and non-scaled MUSLE results. SLA and PWA yield estimates are developed at different locations within the watershed and also utilize different discretization of MUSLE parameters. For example, SLA used 3 factors to represent land use: natural conditions (C=0.2), existing urban conditions (C=0.02) and future urban conditions (C=0.01). In contrast, PWA used 38 categories of land use, each with a representative C-factor.

Sediment Management

Two phases of sediment management are proposed to provide mitigation for the potential impacts resulting from this project. The first phase of mitigation should address the increased sediment yield due to construction. Construction mitigation will be addressed through the development of a comprehensive Storm Water Pollution Prevention (SWPP) Program. This will be a County-approved plan to prevent excess sediment generation and transport to the stream channel from development areas. It will include protection of graded areas during the rainy season, conveyance of runoff to sedimentation basins prior to discharge to the stream channel, and an active revegetation plan.

Phase two mitigation includes sediment management practices to mitigate for the completed development. The project water quality management plan is designed to maintain the existing hydrologic regime in terms of runoff peaks and duration, and minimize runoff volume changes. As discussed within the RMV Planning Principles, post-project hillslope sediment transport is minimized by the development locations. A majority of the development is sited on crystalline or fine, less erodible, sediments. PWA calculations of fine sediment percentage beneath the planned development bubbles (including planned parks and golf courses) are presented in Table 4. Fine sediments were, conservatively, considered to be sediments capable of passing through a #200 sieve (less than 0.075 mm). As seen in the table, the percentage of fines beneath the planned development ranges from 27-54% of the development footprint.

From a watershed sediment yield perspective, it is most important to maintain the coarse sediment supply to the channels, as this provides the primary channel bed material, and ultimately provides the material needed to maintain the beaches along the shoreline. Sub-basin delivery of coarse sediment was computed using the scaled sediment delivery estimates of Table 2-B and the calculated percents of fine and coarse sediments. Key assumptions for this analysis are that the MUSLE results, calculated for the sub-basin as a whole, may be scaled to the development bubble level and also that the yield ratio of coarse to fine sediments is closely related to the ratio of coarse/fine sediments in the development footprint.

Coarse sediment yield will be maintained by project layout, with development focused on crystalline and clayey soils, and avoiding main channel modifications during the development process. Although the project is designed to avoid channel impacts, one area of potential concern is the area of channel downstream of detention basin discharges. A monitoring program will be implemented to document the pre-project (existing) channel morphology and track any post-project channel erosion. The program will include establishment of monumented cross-section and a longitudinal profile along the channel, with repeat surveys to assess any channel changes. If channel erosion does occur, a response plan will be developed to address localized erosion problems.

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Table 1: MUSLE parameters

A

Existing Conditions

Sub-Basin #		Soil Erodibility, K	2-year Runoff Volume, Q (ac-ft)	100-year Runoff Volume, Q (ac-ft)	2-year Peak runoff, q_p (cfs)	100-year Peak runoff, q_p (cfs)	Cover Management Factor, C	Length-Slope Factor, LS
Chiquita Canyon	8	0.32	62	837	81	1087	0.860	3.34
	31	0.31	68	878	320	2447	0.132	1.89
Gobernadora	63	0.34	52	652	165	1487	0.162	2.5
Central SJ	13	0.30	75	1273	111	1918	0.076	3.11
	21	0.28	105	879	156	1304	0.030	2.08
Verdugo Canyon	9	0.33	59	907	79	1242	0.071	5.22
Cristianitos Canyon	45	0.25	47	682	146	1542	0.048	1.85
Talega Canyon	47	0.26	156	1818	238	2540	0.065	4
Gabino w/Blind Canyon	48	0.24	49	623	156	1458	0.038	2.09
Upper Gabino	49	0.30	64	928	229	2085	0.058	2.96

B

Construction Phase

Sub-Basin #		Soil Erodibility, K	2-year Runoff Volume, Q (ac-ft)	100-year Runoff Volume, Q (ac-ft)	2-year Peak runoff, q_p (cfs)	100-year Peak runoff, q_p (cfs)	Cover Management Factor, C	Length-Slope Factor, LS
Chiquita Canyon	8	0.32	62	837	81	1087	0.295	3.13
	31	0.31	68	878	320	2447	0.183	1.9
Gobernadora	63	0.34	52	652	165	1487	0.590	2.05
Central SJ	13	0.30	75	1273	111	1918	0.561	2.72
	21	0.28	105	879	156	1304	0.051	2.47
Verdugo Canyon	9	0.33	59	907	79	1242	0.090	5.21
Cristianitos Canyon	45	0.25	47	682	146	1542	0.244	1.76
Talega Canyon	47	0.26	156	1818	238	2540	0.186	3.52
Gabino w/Blind Canyon	48	0.24	49	623	156	1458	0.309	1.89
Upper Gabino	49	0.30	64	928	229	2085	0.074	2.81

C

Ranch Plan Project Conditions

Sub-Basin #		Soil Erodibility, K	2-year Runoff Volume, Q (ac-ft)	100-year Runoff Volume, Q (ac-ft)	2-year Peak runoff, q_p (cfs)	100-year Peak runoff, q_p (cfs)	Cover Management Factor, C	Length-Slope Factor, LS
Chiquita Canyon	8	0.32	75	852	102	1174	0.036	3.13
	31	0.31	61	863	266	2340	0.110	1.9
Gobernadora	63	0.34	65	670	244	1718	0.095	2.05
Central SJ	13	0.30	138	1368	227	2291	0.023	2.72
	21	0.28	110	884	165	1325	0.024	2.47
Verdugo Canyon	9	0.33	59	913	80	1263	0.070	5.21
Cristianitos Canyon	45	0.25	51	690	166	1616	0.037	1.76
Talega Canyon	47	0.26	165	1832	256	2577	0.060	3.52
Gabino w/Blind Canyon	48	0.24	53	632	184	1591	0.026	1.89
Upper Gabino	49	0.30	67	934	243	2131	0.057	2.81

Table 2: Sediment Yield Results

A

Sub-Basin #		*Sediment Yield From MUSLE*									
		Existing Conditions		**Construction Phase**				**Ranch Plan Project Conditions**			
		2-year Sediment Yield	100-year Sediment Yield	2-year Sediment Yield	Change Over Existing Conditions	100-year Sediment Yield	Change Over Existing Conditions	2-year Sediment Yield	Change Over Existing Conditions	100-year Sediment Yield	Change Over Existing Conditions
		(tons)	(tons)	(tons)	(percent)	(tons)	(percent)	(tons)	(percent)	(tons)	(percent)
Chiquita Canyon	8	1,033	18,975	3,320	221	60,997	221	511	-51	7,849	-59
	31	1,978	25,830	2,757	39	36,000	39	1,403	-29	20,901	-19
Gobernadora	63	2,099	29,441	6,268	199	87,922	199	1,418	-32	15,587	-47
Central SJ	13	1,056	25,440	6,820	546	164,239	546	587	-44	7,744	-70
	21	380	4,105	772	103	8,327	103	383	1	3,948	-4
Verdugo Canyon	9	1,317	28,453	1,666	27	35,999	27	1,305	-1	28,368	0
Cristianitos Canyon	45	297	4,970	1,435	383	24,033	384	245	-17	3,766	-24
Talega Canyon	47	2,327	34,654	5,858	152	87,263	152	2,031	-13	28,501	-18
Gabino w/Blind Canyon	48	271	3,931	1,991	635	28,905	635	192	-29	2,575	-34
Upper Gabino	49	1,053	16,221	1,276	21	19,648	21	1,042	-1	15,375	-5

B

Sub-Basin #		Sediment Delivery Ratio	*Sediment Delivered (Yield Scaled with Sub-Basin Specific SDR)*					
			Scaled Existing Conditions		**Scaled Construction Phase**		**Scaled Ranch Plan**	
			2-year Sediment Yield	100-year Sediment Yield	2-year Sediment Yield	100-year Sediment Yield	2-year Sediment Yield	100-year Sediment Yield
		(percent)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)
Chiquita Canyon	8	57.4	593	10,886	1,905	34,995	293	4,503
	31	57.1	1,129	14,744	1,574	20,549	801	11,930
Gobernadora	63	54.4	1,142	16,018	3,410	47,838	772	8,481
Central SJ	13	51.0	539	12,971	3,477	83,739	299	3,948
	21	46.6	177	1,914	360	3,884	179	1,841
Verdugo Canyon	9	71.3	939	20,296	1,188	25,678	931	20,235
Cristianitos Canyon	45	59.8	178	2,973	858	14,376	147	2,253
Talega Canyon	47	73.7	1,714	25,528	4,315	64,284	1,496	20,996
Gabino w/Blind Canyon	48	49.5	134	1,944	985	14,295	95	1,273
Upper Gabino	49	70.7	745	11,470	902	13,893	737	10,872

MUSLE_Results_Tables v3.xls

Table 3: Comparison of Watershed Sediment Yield

A

Sub-Basin Name & Node #		drainage area acres	PWA Sub-basin sediment yield range in tons/acre					
			Existing Conditions		Construction Phase		Ranch Plan	
			2-year event	100-year event	2-year event	100-year event	2-year event	100-year event
Chiquita Canyon	8	2,982	0.20-0.35	3.65-6.36	0.64-1.11	11.73-20.45	0.10-1.17	1.51-2.63
	31	2,928	0.39-0.68	5.04-8.82	0.54-1.94	7.02-12.29	0.27-0.48	4.07-7.14
Gobernadora	63	2,173	0.53-0.97	7.37-13.55	1.57-2.88	22.01-40.46	0.36-0.65	3.9-7.17
Central SJ	13	4,747	0.11-0.22	2.73-5.36	0.73-1.44	17.64-34.6	0.06-0.12	0.83-1.63
	21	2,940	0.06-0.13	0.65-1.4	0.12-0.26	1.32-2.83	0.06-0.13	0.63-1.34
Verdugo Canyon	9	3,069	0.31-0.43	6.61-9.27	0.39-0.54	8.37-11.73	0.3-0.43	6.59-9.24
Cristianitos Canyon	45	2,347	0.08-0.13	1.27-2.12	0.37-0.61	6.12-10.24	0.06-0.1	0.96-1.6
Talega Canyon	47	5,363	0.32-0.43	4.76-6.46	0.80-1.09	11.99-16.27	0.28-0.38	3.91-5.31
Gabino w/Blind Canyon	48	2,102	0.06-0.13	0.92-1.87	0.47-0.95	6.8-13.75	0.05-0.09	0.61-1.22
Upper Gabino	49	3,221	0.23-0.33	3.56-5.04	0.28-0.4	4.31-6.1	0.23-0.32	3.38-4.77

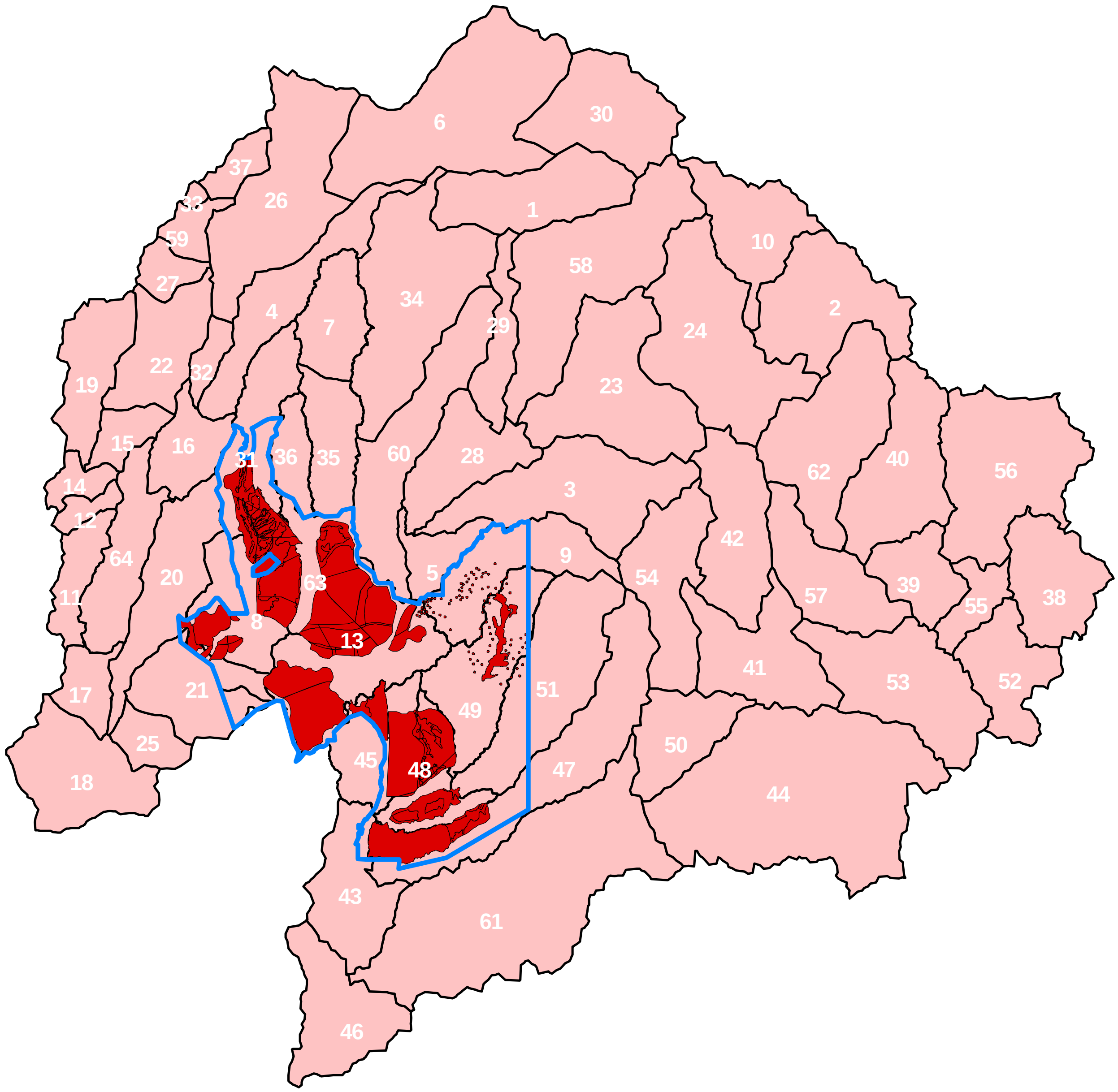
B

Sub-Basin Name & Node #		drainage area acres	SLA Sub-basin sediment yield in tons/acre			
			Existing Conditions		Project Conditions	
			2-year event	100-year event	2-year event	100-year event
San Juan Ck upstream of Bell and Verdugo	SJ2	49,920	0.11	12.04	0.11	12.04
Trabuco Creek at Tijeras	TB3t	19,200	0.33	13.96	0.58	14.69
Oso Creek at La Paz	OS4t	7,680	0.14	0.53	0.07	0.27
Gobernadora at Wagon Wheel	CG2t	5,120	0.02	0.63	0.02	0.36

Source: SLA, 1999

Table 4: Delivery of Coarse Sediment

Sub-Basin #		Percent Fines in Development Footprint	*Coarse Sediment Delivered (greater than 0.075 mm)*					
			Existing Conditions		**Construction Phase**		**Ranch Plan**	
			2-year Sediment Yield	100-year Sediment Yield	2-year Sediment Yield	100-year Sediment Yield	2-year Sediment Yield	100-year Sediment Yield
		(percent)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)
Chiquita Canyon	8	35.7	381	7,004	1,225	22,514	189	2,897
	31	54.5	514	6,708	716	9,349	364	5,428
Gobernadora	63	29.3	807	11,325	2,411	33,821	545	5,996
Central SJ	13	30.3	376	9,045	2,425	58,397	209	2,753
	21	32.8	119	1,286	242	2,608	120	1,237
Verdugo Canyon	9	27.1	685	14,799	867	18,724	679	14,755
Cristianitos Canyon	45	32.4	120	2,008	580	9,712	99	1,522
Talega Canyon	47	40.6	1,019	15,175	2,565	38,214	889	12,481
Gabino w/Blind Canyon	48	39.4	81	1,178	597	8,662	58	772
Upper Gabino	49	37.9	462	7,123	560	8,627	458	6,751



Ranch Boundary
Ranch Plan Development
San Juan/San Mateo Watersheds

Figure 1

N

Ranch Plan Development in the San Juan and San Mateo Watersheds

SAMP MUSLE Computations

PWA Ref #: 1393.02

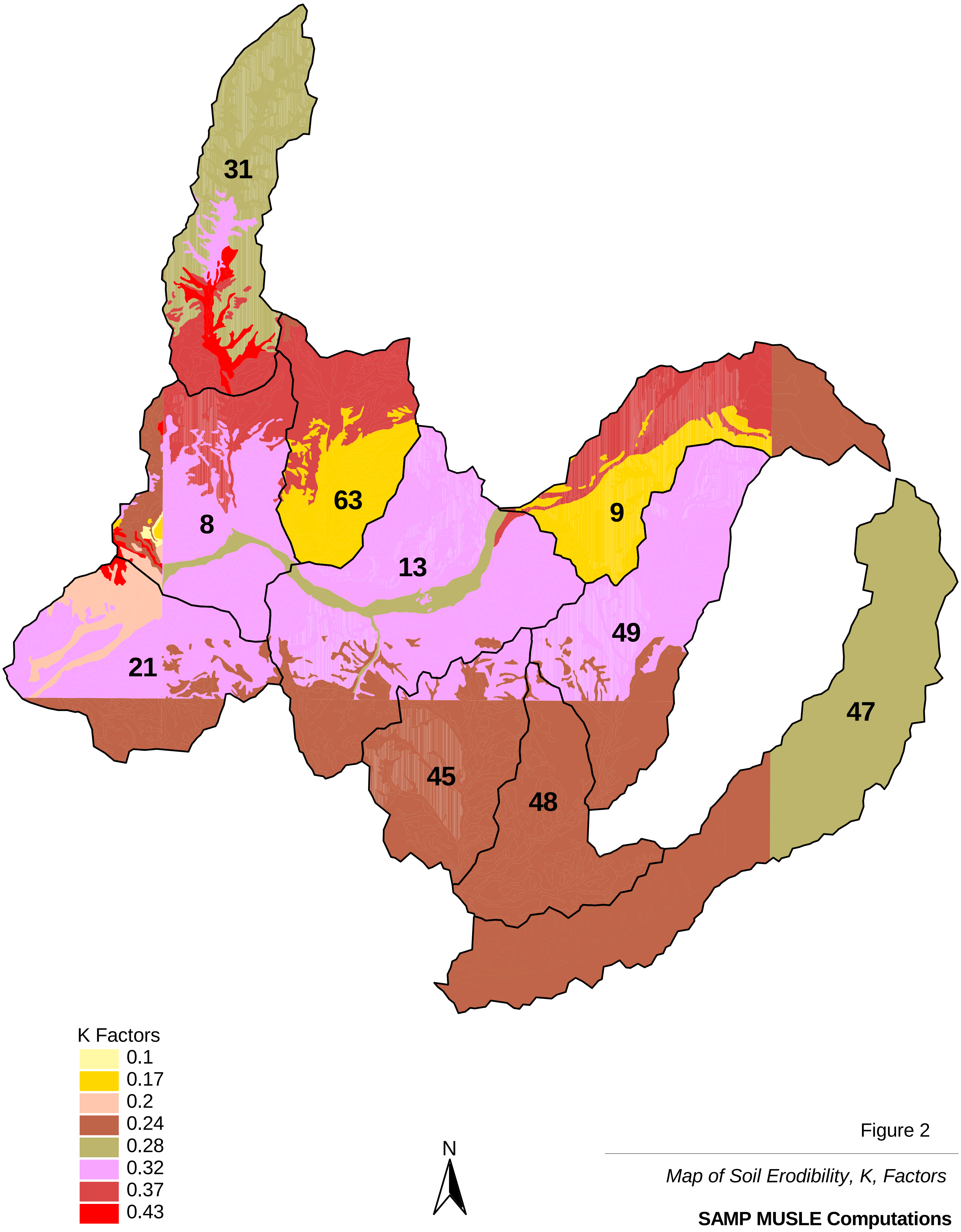
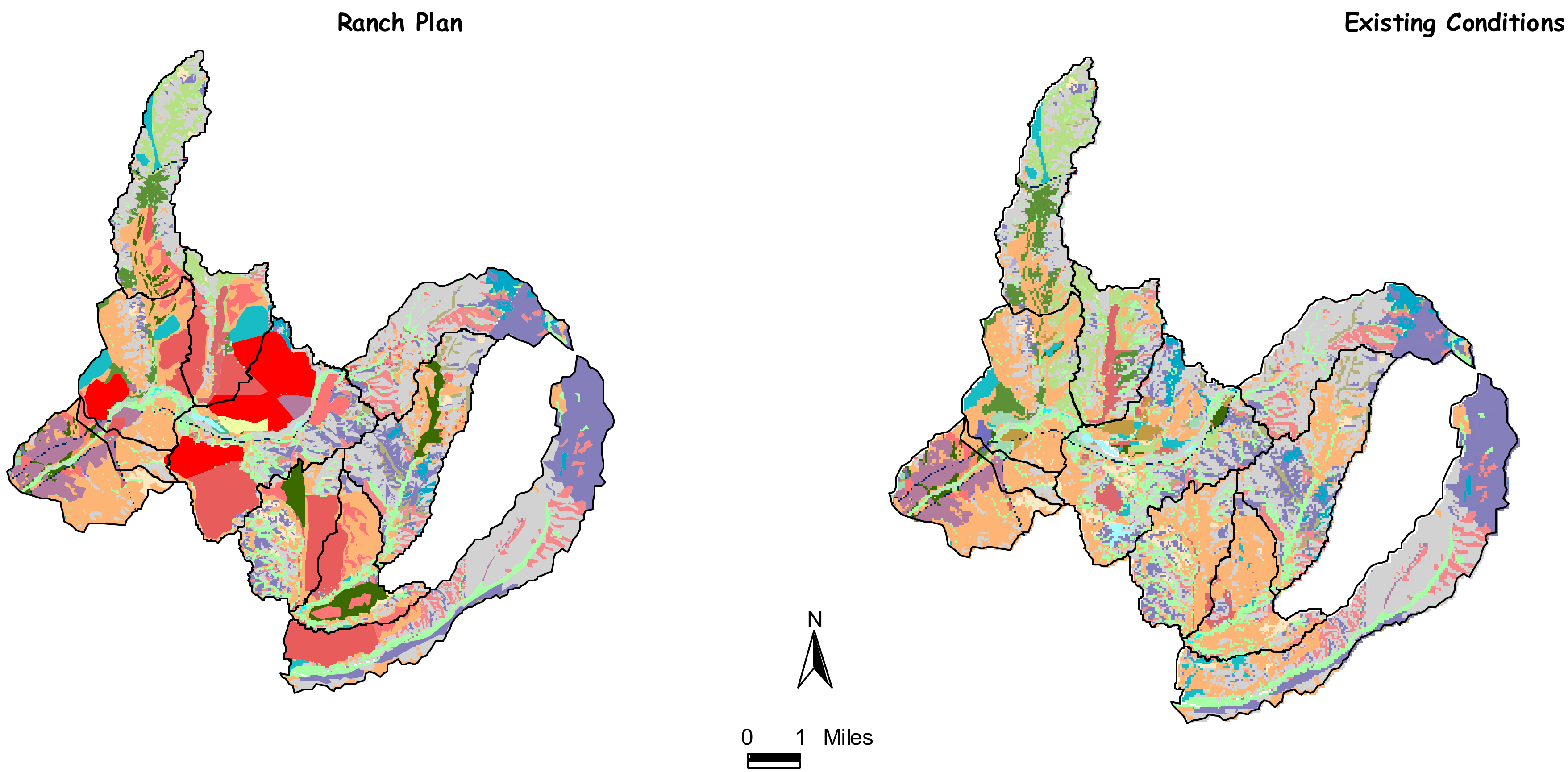


Figure 2

Map of Soil Erodibility, K, Factors

SAMP MUSLE Computations

PWA Ref #: 1393.02



Land Cover Categories

- Broadleaf Chaparral
- Broadleaf Chaparral and Sage
- Chaparral - Sage Scrub Transition
- Fluctuating Shoreline
- General Agriculture
- General Chaparral
- General Dairy, Cattle or Fallow
- General Developed Areas
- General Disturbed Areas
- General Grassland
- General Nurseries
- General Orchards
- General Parks
- General Pastures
- General Sage Scrub
- General Transportation
- General Urban Commercial and Industrial
- Irrigated Row Crops
- Lakes / Open Water
- Meadow and Marsh
- Multiple Family Residential
- Narrowleaf Chaparral
- Narrowleaf Chaparral and Sage
- Riparian Willow
- Rock with Plants
- Row Crops
- Rural Residential
- Sage Scrub - Grassland Transition
- Single Family Residential
- Streams and Creeks
- Woodland and Riparian Habitat

Figure 3

Map of Land Cover Distributions

SAMP MUSLE Computations

PWA Ref #: 1393.02

PWA