Final

San Pasqual Valley Groundwater Basin

Groundwater Sustainability Plan

Volume 1: Plan

September 2021

Prepared by

WOODARD & CURRAN

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San Pasqual Valley Groundwater Basin Groundwater Sustainability Plan

Prepared by

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No. 6967
STATE OF CALIFORNIA

Adopted by

City of San Diego on December 17, 2021

and

County of San Diego on January 12, 2022

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ACKNOWLEDGEMENTS

The San Pasqual Valley Groundwater Sustainability Agency (GSA) appreciates and acknowledges the funding contribution from the California Department of Water Resources (DWR). Funding for this San Pasqual Valley Groundwater Sustainability Plan (GSP) has been provided in part by the Water Quality, Supply, and Infrastructure Improvement Act of 2014 through an agreement with DWR.

San Pasqual Valley GSA

The City of San Diego and the County of San Diego comprise the San Pasqual Valley GSA.

San Pasqual Valley GSP Advisory Committee

- Carole Burkhard – Small Landowner
- David L. Toler – San Pasqual Tribe
- Eric Larson – San Diego County Farm Bureau
- Frank Konyn – Agricultural/Animal (City Lessee)
- Lisa Peterson – San Diego Zoo Safari Park
- Mark Dederian – San Pasqual Academy
- Matt Witman – Agricultural/Crop (City Lessee
- Rikki Schroeder – Rancho Guejito (Large Landowner)
- Trish Boaz – San Dieguito River Valley Conservancy

San Pasqual Valley GSP Technical Peer Review

- Matt Wiedlin – Wiedlin & Associates
- Will Halligan – Luhdorff & Scalmanini
- Peter Quinlan – Dudek

San Pasqual Valley GSP Consulting Team

Lead Consultant – Prime contractor responsible for GSP development, groundwater conditions and hydrogeologic conceptual model, undesirable results and sustainability criteria, projects/management actions and implementation plan.

Modeling – Subcontractor responsible for development of numerical flow model and incorporating climate change into modeling. Lead author for water budgets, depletions of interconnected surface waters, and model documentation.

Geology - Subcontractor responsible for preparing cross sections provided in hydrogeologic conceptual model.

Technical Advisor - Subcontractor responsible for providing professional independent technical review and input on GSP development.

Wiedlin & Associates

Technical Advisor - Subcontractor responsible for providing professional independent technical review and input on GSP development.

Stakeholder Outreach - Subcontractor responsible for AC and TPR meeting facilitation.

Technical Editing – Subcontractor responsible for technical editing.

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Acronyms and Abbreviations

Term	Abbreviation
AB	Assembly Bill
AFY	acre-feet per year
amsl	above mean sea level
APN	assessor's parcel number
BCM	California Basin Characterization Model
bgs	below ground surface
BMP	best management practice
CalETa	California Actual Evapotranspiration Model
CalRecycle	California Department of Resources Recycling and Recovery
CanESM2	Canadian Earth System Model version 2
CASGEM Program	California Statewide Groundwater Elevation Monitoring Program
CCR	California Code of Regulations
CCTAG	Climate Change Technical Advisory Group
CDC	California Department of Conservation
CDPR	California Department of Pesticide Regulation
CEQA	California Environmental Quality Act
CNRM-CM5	Centre National de Recherches Météorologiques version 5
COVID-19	coronavirus disease 2019
CWC	California Water Code
DMS	Data Management System
DWR	California Department of Water Resources
EPA	U.S. Environmental Protection Agency
Formation	Formation Environmental
GAMA Program	Groundwater Ambient Monitoring and Assessment
GCM	global climate model
GDE	groundwater-dependent ecosystem
GIS	geographic information system
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HadGEM2	Hadley Centre Global Environment Model version 2
HCM	hydrogeologic conceptual model
InSAR	interferometric synthetic aperture radar
IPCC	International Panel on Climate Change
IRWM	Integrated Regional Water Management
LEA	San Diego County Solid Waste Local Enforcement Agency
MAP	mean annual precipitation
MCL	maximum contaminant level
mg/L	milligrams per liter
MIROC5	Model for Interdisciplinary Research on Climate version 5
MOU	Memorandum of Understanding

Acronyms and Abbreviations

Term	**Abbreviation**
NCCAG	Natural Communities Commonly Associated with Groundwater
NWIS	National Water Information System
NWQMC	National Water Quality Monitoring Council
PRISM	Parameter-Elevation Relationships on Independent Slopes Model
RCP	representative concentration pathway
RWQCB	Regional Water Quality Control Board
SAGBI	Soil Agricultural Groundwater Banking Index
SB	Senate Bill
SGMA	Sustainable Groundwater Management Act
SPGMP	San Pasqual Groundwater Management Plan
SPV	San Pasqual Valley
SPV SNMP	San Pasqual Valley Groundwater Basin Salt and Nutrient Management Plan
SWIS	Solid Waste Information System
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TDS	total dissolved solids
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UWMP	Urban Water Management Plan
WDL	Water Data Library
WQIP	San Dieguito River Watershed Management Area Water Quality Improvement Plan (2021 Update)
WY	water year

EXECUTIVE SUMMARY

The San Pasqual Valley Groundwater Sustainability Agency (SPV GSA), which comprises the City of San Diego (City) and the County of San Diego (County), developed this Groundwater Sustainability Plan (GSP) to comply with California's Sustainable Groundwater Management Act (SGMA) and its requirement to sustainably manage the San Pasqual Valley Groundwater Basin (Basin). SGMA, which became effective January 1, 2015, provides a framework to regulate groundwater for the first time in California's history by requiring local agencies to form GSAs and providing those GSAs with the necessary tools to manage groundwater use (California Water Code [CWC] Section 10720, et seq.).

The overarching aim of SGMA is to establish and achieve the "sustainability goal" for the Basin through the development and implementation of a GSP. SGMA defines sustainable groundwater management as "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results" (CWC Section 10721). The GSP is required to include measures to achieve sustainable conditions by 2042.

The City Council and the County Board of Supervisors each adopted the *Memorandum of Understanding: Development of a Groundwater Sustainability Plan for the San Pasqual Valley Groundwater Basin* establishing the SPV GSA as the single multi-agency GSA for the Basin. The Memorandum of Understanding further clarified the collaborative approach to developing and implementing the GSP with stakeholders' input. SGMA requires both the County and City to adopt this GSP by January 31, 2022. Similarly, future GSP amendments must be adopted by both the City Council and County Board of Supervisors.

While groundwater use in the Basin is currently sustainable, this GSP includes monitoring requirements, established thresholds, and projects and management actions that, once implemented, would ensure the sustainable management of groundwater resources in perpetuity.

Introduction and Agency Information

This section of the GSP contains background information such as contact and authority information, and a summary of outreach efforts performed during GSP development.

The GSA consists of the City, which has land use and water supply authority, and owns the land within its jurisdiction; and the County, which has land use responsibilities and implements the County's Groundwater Ordinance outside of the City's jurisdiction in the Basin. While the City will implement the GSP within City jurisdiction (90 percent of the Basin), and the County will implement the GSP within County-only areas (10 percent of the Basin), the City and County remain committed to collaboratively implementing a single GSP for the entire Basin. A "Core Team" comprised of GSA staff are responsible for developing and implementing the GSP for the Basin.

SGMA mandates that steps be taken to ensure the broadest possible public participation in the GSP development process. From its inception, the GSA has been focused on soliciting and receiving input from stakeholders in the Basin. In order to consider the interests of all beneficial uses and users of groundwater, the GSA formed an Advisory Committee comprised of nine representatives and groundwater users in the Basin to provide input to GSA staff on key components of the GSP. The GSA also formed a Technical Peer Review Group comprised of three technical experts, to aid in the preparation of a scientifically sound GSP. From June 2019 to July 2021, these groups met approximately quarterly in meetings open to the public, and provided feedback to the GSA in the development of the planning and policy recommendations contained in this GSP.

Plan Area

This section describes jurisdictions of the GSA and a description of existing planning and monitoring programs in the Basin.

The Plan Area for this GSP and the jurisdictional boundary of the GSA are coterminous with DWR's Bulletin 118 boundary for the Basin (Basin No. 9.010). The Basin (Figure ES-1) is located approximately 25 miles northeast of downtown San Diego within the San Pasqual Valley. Approximately 90 percent of the Basin is City-owned and designated and managed as an agricultural preserve as documented in City of San Diego Council Policy 600-45. The Basin underlies portions of Cloverdale Canyon, Rockwood Canyon, and Bandy Canyon along Highway 78. The San Pasqual Valley is sparsely populated and includes row crop, orchard, nursery, and dairy operations. Guejito Creek flows into Santa Ysabel Creek and Santa Maria and Ysabel Creeks coincide with the start of the San Dieguito River, which flows southwest into Hodges Reservoir.

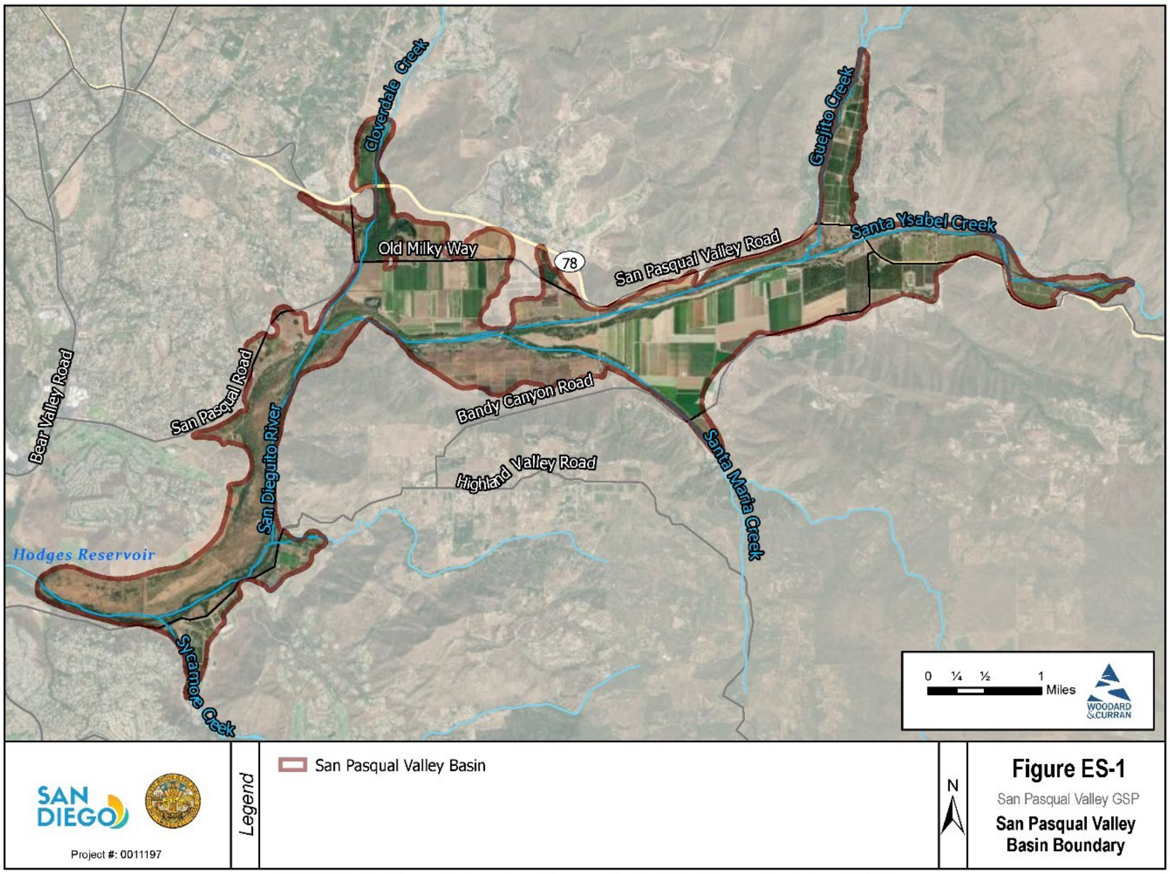


Figure ES-1. San Pasqual Valley Basin Boundary

Hydrogeologic Conceptual Model

This section describes the Hydrogeologic Conceptual Model, which includes the Basin's physical geology, regional structural settings, and Basin boundaries. This section was developed using information from Section 4, *Groundwater Conditions*, and in Section 5, *Water Budgets*. This is an important tool to clearly communicate an understanding of Basin conditions.

The 5.5-square mile Basin is comprised of Quaternary Deposits and is underlain by discontinuous Residuum. The Quaternary Deposits range in thickness from 75 to 250 feet thick and consist mainly of sand and gravel. The residuum ranges from 10 to 110 feet thick where it is present and consists of decomposed bedrock. Fractured crystalline igneous rocks underly the Basin and comprise the hills around the Basin and are present underneath the Quaternary Deposits and Residuum. The Basin has one principal aquifer composed of Quaternary Deposits and Residuum.

Groundwater Conditions

This section describes the amount and movement of groundwater through the Basin, changes in historical levels, contour maps, and groundwater quality. The interconnection of rivers and streams to groundwater and potential groundwater-dependent ecosystems are also discussed.

Groundwater levels in the Basin have been monitored for over 15 years and are generally deeper and fluctuate in the eastern portion of the Basin in response to dry and wet periods. Groundwater levels in the western portion of the Basin are shallower and less prone to significant fluctuations.

Groundwater quality analysis indicates constituent concentrations are correlated and likely highly dependent on the quality of surface water flowing into the Basin. Historically, total dissolved solids and nitrates have been the primary constituents of concern, with evidence suggesting that nitrate levels are tied to evapoconcentration and fertilizer use both within the Basin and contributions from streamflows that originate in the watershed upstream from the Basin.

Water Budgets

This section provides information about the amount of water moving through the Basin historically. It also provides projections of water movement through the Basin, based on sets of assumed future climate and operational conditions. Water budgets help quantify the volumetric rate of water entering and leaving the Basin through the surface water system, land system, and groundwater systems via processes such as precipitation, streamflow, pumping and groundwater recharge from irrigation.

Water budgets were quantified with the aid of the SPV GSP Integrated Groundwater/Surface Water Flow Model (SPV GSP Model), which is a numerical model that builds off the hydrogeologic conceptual model and incorporates future climate change, as required by SGMA regulations. Historical groundwater pumping in the Basin between 2005 and 2019 was estimated to range from 4,740 to 6,741 acre-feet per year (AFY). Groundwater levels during this historical period were deemed to be sustainable, and the Basin's sustainable yield is expected to be more than historical groundwater pumping.

Given inherent uncertainties in groundwater models, the SPV GSP Model is not being used to predict the Basin's sustainability. Groundwater level monitoring data will be used to confirm Basin conditions and inform the GSA as to whether or not implementing management actions is needed. During the GSP implementation period, the sustainable yield will be reevaluated and updated as additional data are analyzed and as knowledge of the hydrogeologic conceptual model evolves.

Undesirable Results

This section describes the GSP's sustainability goal, which is to avoid undesirable results while providing a sustainable groundwater resource for beneficial users in the Basin. To guide the establishment of a monitoring network and sustainability thresholds, undesirable results statements are included. Additionally, this section concludes that no undesirable results are currently occurring in the Basin.

The four out of six undesirable results applicable to this Basin include:

- Reduction of groundwater storage
- Chronic lowering of groundwater levels
- Degraded water quality
- Depletions of interconnected surface water

Seawater intrusion and land subsidence were both found not applicable to this Basin.

Monitoring Networks

This section describes the rationale for selecting/designing the monitoring networks, and how the proposed networks would support the SPV GSA in determining whether undesirable results are present in the future. The areas of potential improvement to the GSP's data collection and monitoring networks are also summarized. The GSP includes one monitoring network to detect changes in groundwater levels with 15 representative wells and another monitoring network with 10 representative wells to detect changes in groundwater quality. While improvements to the monitoring networks could be made, the SPV GSA has not identified any data gaps that would affect the ability to monitor groundwater conditions and assess sustainability for the Basin.

Minimum Thresholds and Measurable Objectives

This section describes the established thresholds that link monitoring network data to the determination of undesirable results and associated need to implement management measures. Minimum thresholds were established for groundwater elevations at levels protective of well infrastructure. Groundwater quality thresholds were established for both total dissolved solids and nitrate (as NO_3N) in the Basin, and take into consideration of local water users, drinking water standards, and concentrations of these constituents flowing into the Basin. If a certain percentage of the sites in the monitoring networks exceed the minimum threshold for a specified duration, an undesirable result may occur. Measurable objectives are established for groundwater levels and groundwater quality as the targets for basin management.

This GSP uses a non-regulatory threshold to assist the GSA with planning project and management action implementation by creating a planning threshold. A planning threshold acts as an early warning system that allows the GSA to implement management actions in an attempt to avoid threshold exceedances.

Projects and Management Actions

This section describes the GSP-related projects and management actions considered by the GSA and identifies and analyzes which projects or actions may be selected for implementation. The GSA has designated a City management area and a County management area in the Basin (Figure ES-2). Projects and management actions occurring in these management areas would be overseen by the GSA according to their respective management area jurisdictions.

The Basin is currently sustainably managed, and no projects or management actions are needed to achieve sustainability. However, projects and management actions can enhance management capability and improve understanding of the groundwater system to maintain sustainability into the future.

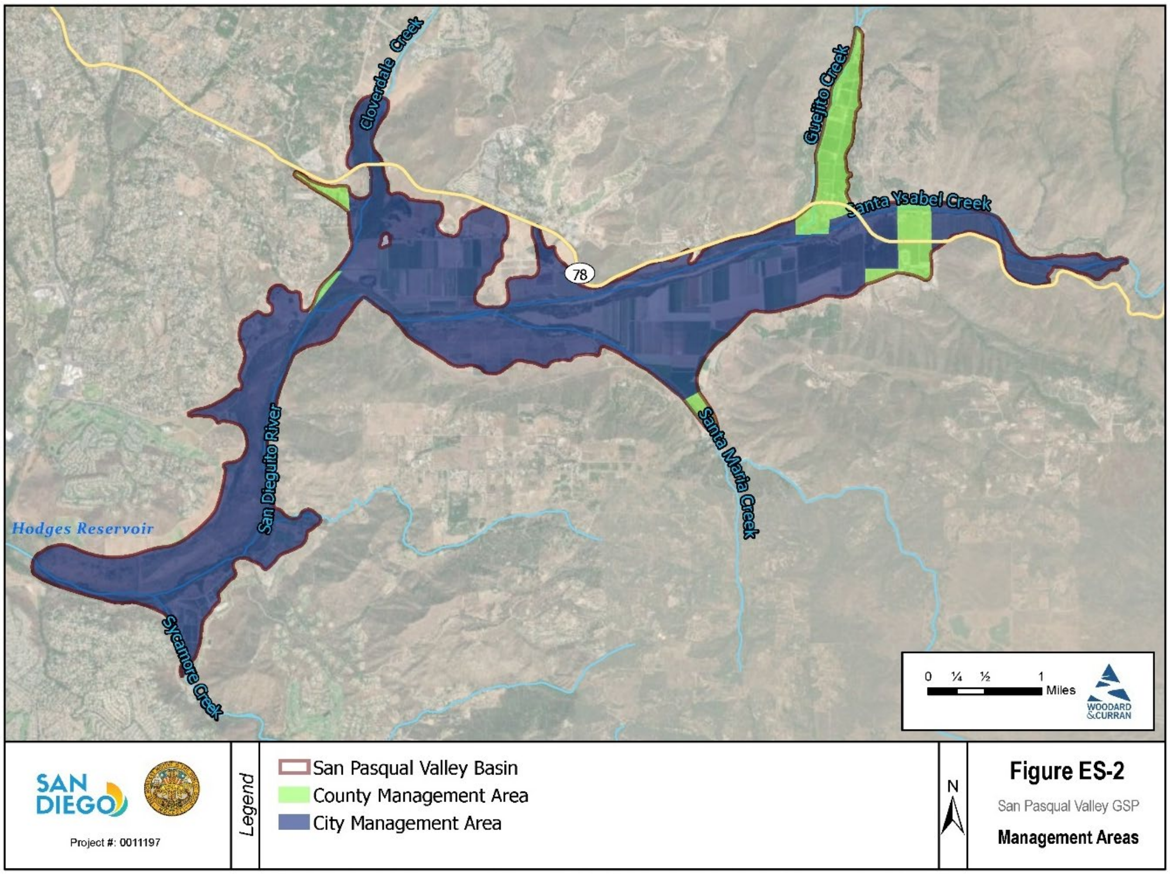
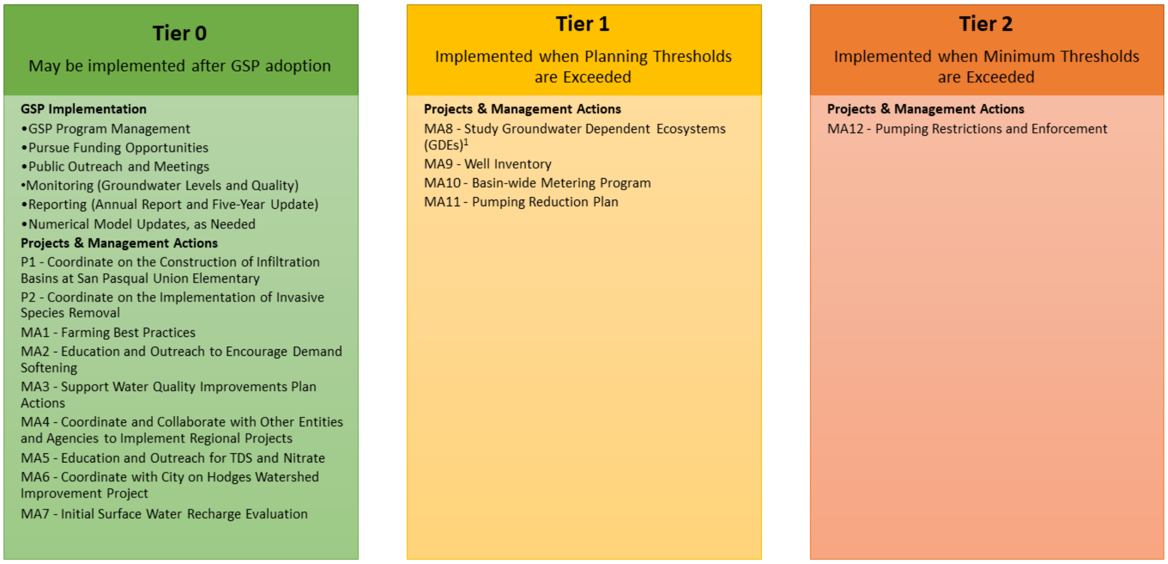


Figure ES-2. Management Areas

The projects and management actions (PMAs) are grouped into tiers (Figure ES-3) that correlate with different Basin conditions and thresholds for implementation (Figure ES-4) to help keep the Basin sustainable.

- Tier 0 PMAs could be implemented at any time upon adoption of the GSP and include, for example, groundwater monitoring, and education and outreach activities for water quality.
- Tier 1 PMAs could be implemented if planning thresholds for groundwater levels are exceeded as described in Section 8, *Minimum Thresholds and Measurable Objectives*. Tier 1 PMAs include a study of potential groundwater dependent ecosystems, a well inventory, a basin-wide metering program, and the development of a pumping reduction program.
- Tier 2 PMAs could be initiated if minimum thresholds for groundwater levels are exceeded and Tier 1 PMAs have been considered. Tier 2 PMAs include implementation of the pumping reduction program developed in Tier 1.



[1] Study GDEs has separate thresholds as described in *Section 8, Minimum Thresholds and Measurable Objectives*

Figure ES-3. Project and Management Action Tiers

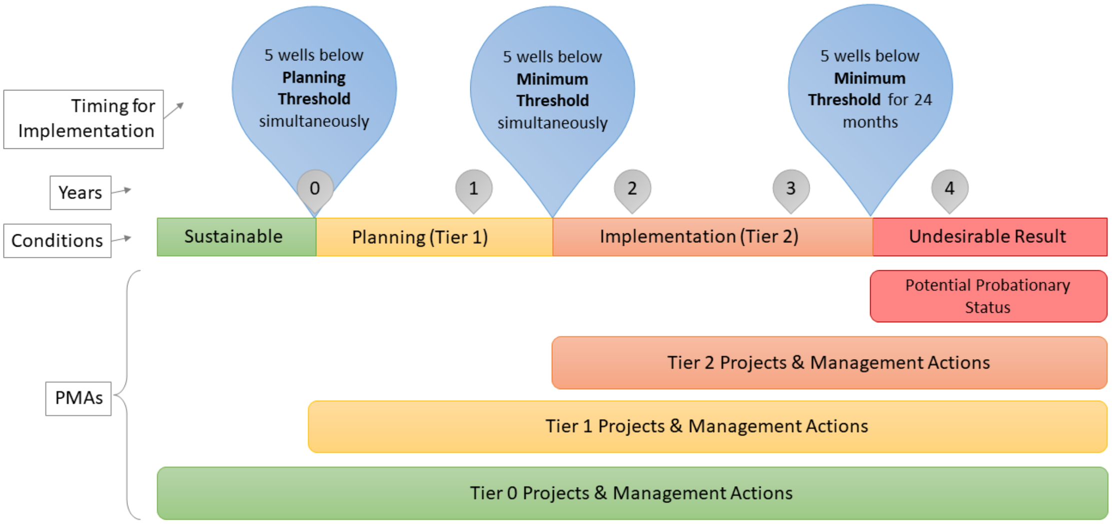


Figure ES-4. Relationship between Project and Management Actions and Basin Conditions

Plan Implementation

This section includes a schedule of GSA operations activities, a table of PMAs, anticipated costs to be incurred by the GSA during implementation, and how implementation costs will be funded by the GSA.

Since the Basin is currently sustainable, the GSA will continue monitoring groundwater conditions and implement the GSP, as necessary, to maintain sustainable groundwater conditions. The GSA will submit annual and more detailed 5-year evaluation reports to DWR by April 1. The annual reports will document new data being collected to track groundwater conditions within the Basin and monitor progress on implementation of PMAs. The 5-year evaluation reports provide the GSA an opportunity to evaluate the success and/or challenges in GSP implementation. If knowledge of Basin conditions changes based on updated data, if management criteria (e.g., sustainable yield or minimum thresholds) need to be modified, or if projects and management actions need to be modified or added, the GSP may be updated.

The total estimated GSP implementation cost for the anticipated 20-year implementation period is expected to range from about $5.9 to $11.3 million. Actual costs are subject to change, depending on Basin conditions and detailed scoping information. This estimate includes management, administration, and monitoring costs; annual and 5-year evaluation reports; and projects and management actions. In general, the GSA may fund GSP implementation using a combination of existing City/County funds, administrative pumping fees, assessments/parcel taxes, and/or grants.

The GSA intends to continue public outreach and provide opportunities for engagement during GSP implementation. This will include providing opportunities for public participation (including beneficial users) at public meetings, and providing access to GSP information online on the SPV GSP website.

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Section 1. INTRODUCTION AND AGENCY INFORMATION

This section describes the San Pasqual Valley (SPV) Groundwater Sustainability Agency (GSA), its authority in relation to the Sustainable Groundwater Management Act (SGMA), and the purpose of this Groundwater Sustainability Plan (GSP).

1.1 General Information and Background

In 2014, in response to continued overdraft of many of California's groundwater basins, the State of California enacted SGMA to provide local agencies the authority to sustainably manage groundwater. The SPV Groundwater Basin (Basin) is subject to SGMA as it is one of 127 basins and subbasins identified in 2014 by the California Department of Water Resources (DWR) as being medium- or high-priority, based on components such as population and groundwater use. Under SGMA, high- and medium-priority basins not identified as critically overdrafted must be managed via a GSP by January 31, 2022. DWR has identified the Basin as a medium-priority basin (DWR, 2019). For each of these basins and subbasins, SGMA requires preparation of a GSP to reach sustainability within 20 years of implementing a GSP. Within the framework of SGMA, sustainable groundwater management is defined as the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

This GSP meets the regulatory requirements established by DWR as demonstrated in the completed *Preparation Checklist for GSP Submittal* (Appendix A).

1.2 Purpose of this Groundwater Sustainability Plan

The purpose of this GSP is to understand and describe the conditions needed to implement sustainable groundwater management in the Basin to comply with SGMA requirements. SGMA's requirements are set forth in a three-bill legislative package: Assembly Bill (AB) 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley). SGMA is codified as California Water Code (CWC) Sections 10720–10737.8.

GSPs are prepared and implemented by GSAs that are newly formed from local agencies or a combination of local agencies. A GSP must address six specific sustainability indicators listed below. Sustainability indicators are effects that may be caused by groundwater conditions occurring throughout a basin.

	Chronic lowering of groundwater levels, indicating a significant and unreasonable depletion of supply.
	Significant and unreasonable **reduction of groundwater storage**.
	Significant and unreasonable **seawater intrusion**.
	Significant and unreasonable **degraded water quality**.
	Significant and unreasonable **land subsidence**.
	Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

A GSP's planning and implementation horizon is defined by SGMA as a "50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield." As the western-most edge of the Basin is approximately 12 miles away from the Pacific Ocean, seawater intrusion is not a realistic factor. There are also no existing saline water lakes. For these reasons, this GSP does not consider saline intrusion as a sustainability indicator. Similarly, the Basin is not prone to land subsidence because of its geology, as discussed in Section 3, *Hydrogeologic Conceptual Model*.

1.3 Agency Information

This section provides information about the GSA, how it was formed, and how it is managed. Discussion includes information about the GSA's committees and how the GSA makes final decisions.

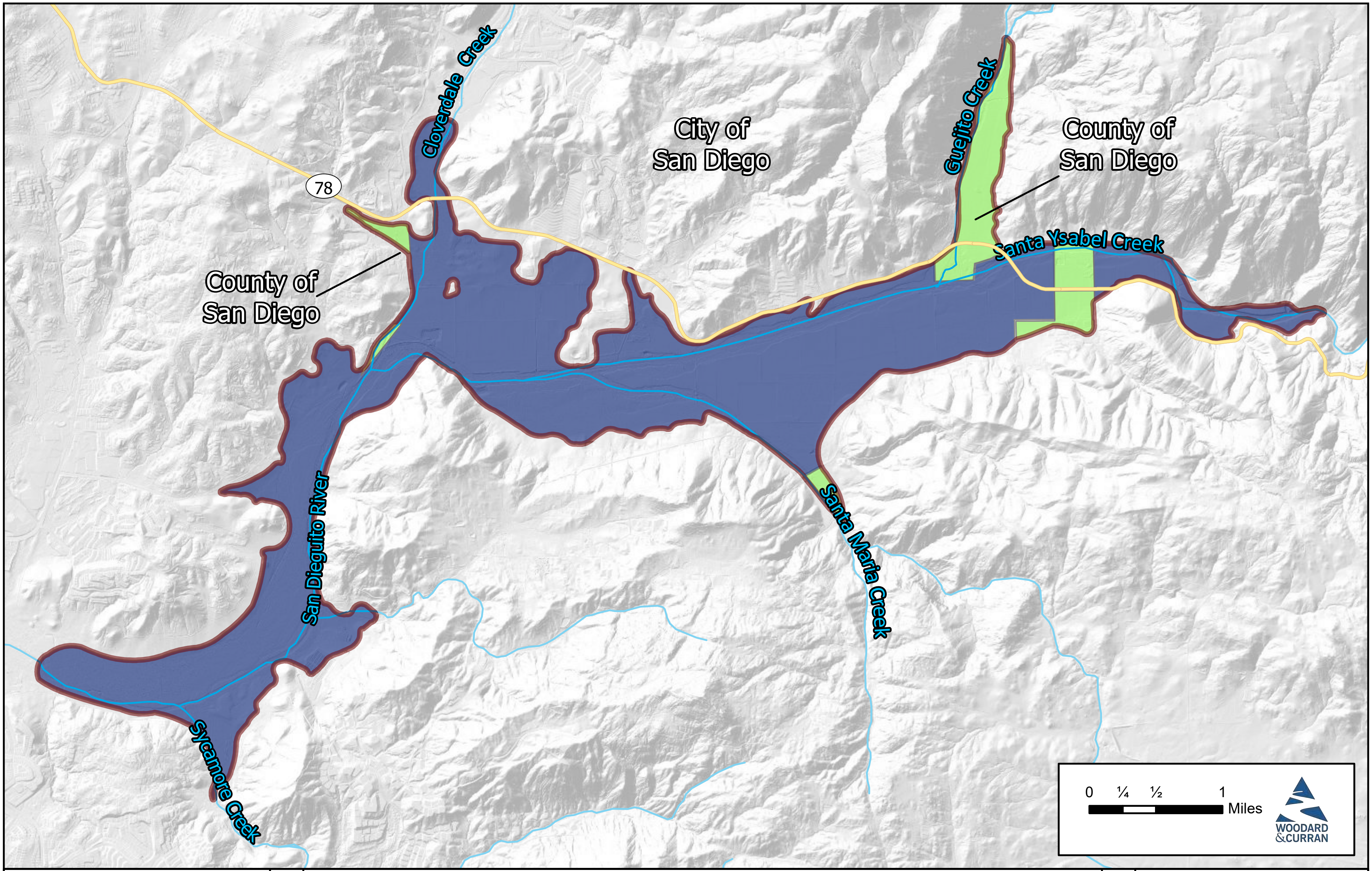
1.3.1 SPV GSA Memorandum of Understanding

On June 29, 2017, the City of San Diego (City) and County of San Diego (County) entered into a Memorandum of Understanding (MOU) to create the multi-agency SPV GSA (Appendix B). The MOU eliminated overlapping jurisdictions and established an agreement to cooperatively develop a single GSP for the Basin that would be implemented in accordance with the City's and County's respective jurisdictions. The City's jurisdiction includes approximately 90 percent of the 5.5-square mile Basin (Figure 1-1). Although the County jurisdiction includes the entire Basin, for the purposes of SGMA implementation, the County will manage the 10 percent of the Basin that is outside of the City's jurisdiction.

The County approved the MOU on June 21, 2017, and the City approved the MOU on June 27, 2017. Pursuant to CWC Section 10723.8, notice of formation of the SPV GSA was provided to DWR on June 28, 2017 (Appendix C). The SPV GSA covers 100 percent of the Basin and is designated by DWR as an exclusive multi-agency GSA. Per DWR's *California's Groundwater Bulletin 118—Update 2003* (Bulletin 118) (Appendix D), the Basin is designated Groundwater Basin 9-10. The notice of intent to develop a GSP was provided to DWR on January 7, 2019 (City, 2019a).

1.3.2 SPV GSA Management Structure

City and County representatives who comprise the SPV GSA Core Team and Executive Group collaboratively guided the GSP development process. Consultant costs for this GSP's development are proportionately distributed based on the jurisdictional area of each agency in the Basin. Each agency will implement the GSP in accordance with their jurisdictional boundaries.



Project #: 0011197

Legend

- San Pasqual Valley Basin
- County of San Diego
- City of San Diego

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Figure 1-1

San Pasqual Valley GSP

Basin Jurisdictional Boundaries

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** DWR.

Core Team

The Core Team consists of City and County staff that are responsible for developing a coordinated GSP. City staff was designated to lead the effort in hiring the consultant and developing the GSP in collaboration with the County (City of San Diego and County of San Diego, 2017). The GSP Core Team responsibilities include the following:

- Creating a detailed breakdown of City and County responsibilities for GSP implementation
- Calculating anticipated costs of implementing the GSP
- Recommending cost recovery mechanisms (if necessary)

The Core Team also appointed a representative from the City to be the main point of contact with DWR throughout development of the GSP. This representative is responsible for communicating actions conducted under the MOU (City of San Diego and County of San Diego, 2017).

Executive Group

The Executive Group consists of City and County representatives (typically directors, general managers, and chief executives). This group is responsible for providing information, direction, and oversight to the Core Team on matters, such as:

- Progress on meeting goals and objectives
- Progress on implementing actions undertaken pursuant to the MOU and resolving issues related to those actions
- Measures to increase efficiency reaching the MOU's goals

Prior to GSP development, the Executive Group developed and approved guiding principles that established a foundation for collaborative discussion, planning, establishing operational values, and mutual understandings among members of the Core Team. The Executive Group is coordinated by a City representative (City of San Diego and County of San Diego, 2017).

City of San Diego

The City has operated under the Strong Mayor Form of Governance since the approval of Proposition D on June 8, 2010. This newer form of governance removed the Mayor from the City's legislative body and recognized the Mayor as having the following roles:

- Serving as official head of the City for all ceremonial purposes
- Being the entity for serving civil process as recognized by the courts
- Having the authority to sign all legal instruments and documents on behalf of the City
- Having local authority as recognized by the Governor of California for military purposes

Proposition D also installed a Council President to chair the City Council, which operates as the legislative branch of government, and provides checks and balances to the Mayor (City, 2010). There are currently nine City Council members, each representing one of nine City districts. Officeholders (including councilmembers, Mayor, and City Attorney) serve 4-year terms and are limited to two successive terms of office (City, 2020). Portions of the SPV Basin are located in City Council District 5.

Prior to consideration for GSP adoption by the City Council, the GSA will request a recommendation from the City Environment Committee. After review by the City Environment Committee, the City Council will consider adoption of this GSP. The San Diego City Council meets weekly on Tuesdays and has the legal authority to adopt the GSP.

County of San Diego

The County government is composed of a Board of Supervisors, a Chief Administrative Officer, and County departments that are organized into the Public Safety Group, Health and Human Services Agency, Land Use and Environmental Group, and Finance and General Government Group. Elected officials within these county departments include the District Attorney, Sheriff, Assessor, Recorder, County Clerk, Treasurer, and Tax Collector (County, 2020). The five-member Board of Supervisors operates as the legislative branch of government for the County and will consider adoption of this GSP. The Board of Supervisors typically meets four times every month and has legal authority to adopt the GSP. Portions of the SPV Basin are located in County Board of Supervisor Districts 2, 3, and 5.

1.3.3 SPV GSA Legal Authority

The SPV GSA is a multi-agency GSA comprised of the City and County. Since each governing body retains full authority to approve, amend, or reject a proposed GSP, and this GSP will need to be adopted by each respective governing body. The City and County each also have their own legal authorities under SGMA as a local agency. SGMA defines a local agency as "a local public agency that has water supply, water management, or land use responsibilities within a groundwater basin (Water Code § 10721(n))" (DWR, 2019). Any local agency or combination of local agencies overlying a groundwater basin is eligible to become a GSA for that basin. Pursuant to CWC Section 10723.8, the notice of intent to manage groundwater resources as the SPV GSA was provided to DWR on June 28, 2017 (Appendix C).

1.3.4 SPV GSA Contact Information

Table 1-1 lists SPV GSA member contact names and mailing addresses.

Table 1-1. SPV GSA Member Contact Information

Local Agency	Primary Representative
City of San Diego	Staci Domasco (Plan Manager) Public Utility Department Engineering & Program Management 9192 Topaz Way San Diego, CA 92123 sdomasco@sandiego.gov
County of San Diego	James Bennett Planning & Development Services Water Resources Manager 5510 Overland Avenue, Third Floor, San Diego, CA 92123 Jim.Bennett@sdcounty.ca.gov

1.4 Notice and Communication

This section describes how the GSP has been developed with input from the public, as well as how the public was notified of these opportunities, including the notice of intent to develop a GSP, GSP development meetings, discussion about opportunities for public engagement and how public input was used, how meetings were held, and other documentation of public engagement activities.

1.4.1 Notice of Intent to Develop a GSP

The City prepared a notice of intent to develop a GSP for the Basin on January 7, 2019, and submitted the notice to DWR's Sustainable Groundwater Section Chief, Trevor Joseph (Appendix C).

1.4.2 GSP Development Meetings

The Core Team meets regularly to discuss GSP development and implementation activities, assignments and consultant management, milestones, and ongoing work progress. Periodic Executive Group meetings are held to discuss, review, and resolve details and issues brought forward from the Core Team regarding the development of the GSP. Other staff or consultants may attend these meetings to ensure appropriate expertise is available (City of San Diego and County of San Diego, 2017).

In addition to regular internal GSP development meetings, the Core Team is also responsible for scheduling public meetings to coordinate development and implementation of the GSP (City of San Diego and County of San Diego, 2017).

1.4.3 Opportunities for Public Engagement and How Public Input Was Used

As the best way to communicate with and consider the interests of all beneficial uses and users of groundwater in the Basin, the SPV GSA established a public website: https://www.sandiegocounty.gov/content/sdc/pds/SGMA/san-pasqual-valley.html (Figure 1-2).

The website provides information to stakeholders during GSP development and implementation (City, 2019a). From the website, stakeholders can sign up to receive email updates about GSP development and implementation. GSP-related meetings held by the City Council, County Board of Supervisors, Technical Peer Review Group, and Advisory Committee are open to the public. Meeting agendas and materials prepared for the Technical Peer Review Group and Advisory Committee are posted on the website in advance of each meeting.

At each Technical Peer Review Group and Advisory Committee meeting, members of the public are invited to provide input and comments on GSP development materials. The Core Team also accepts written comments on GSP development materials for approximately 2 weeks following each Technical Peer Review Group and Advisory Committee meeting.

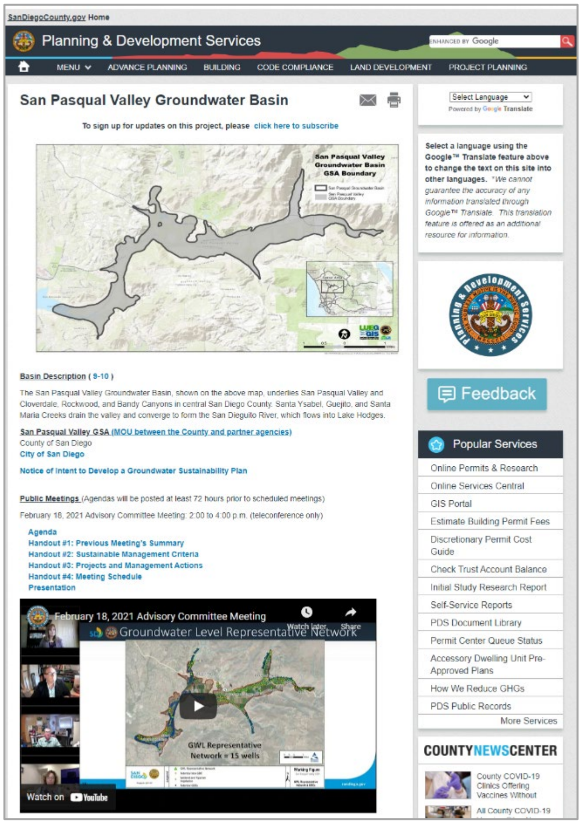

Figure 1-2. SPV GSA Website, March 2021

1.4.4 How the GSA Encourages Active Involvement

To engage interested stakeholders in the GSP process, the GSA invited the public to apply for positions on the Advisory Committee and Technical Peer Review Group. These groups were formed in 2019 to help develop the GSP and to provide input to GSA staff during GSP development. GSA staff also provide periodic updates to the City Council and County Board of Supervisors.

1.4.5 Advisory Committee

The purpose of the SPV GSP Advisory Committee was to provide input and feedback on GSP development. The SPV GSA invited all stakeholders and interested parties to participate in the Advisory Committee, either as a designated member or through its public meetings. The Advisory Committee is composed of the following nine member types as approved by the SPV GSA, and represent four stakeholder categories (Table 1-2).

Table 1-2. Advisory Committee Stakeholder Categories and Members

Stakeholder Category	Member Type
Groundwater User	San Pasqual Academy
	Rancho Guejito (Large Landowner)
	Aggregate Group (Small Landowner)
	San Diego Zoo Safari Park
Agricultural User	Agricultural/Crop (City Lessee)
	Agricultural/Animal (City Lessee)
	Aggregate Group/San Diego County Farm Bureau
Environmental User	San Dieguito River Valley Conservancy
Native American Tribe	San Pasqual Tribe

The GSA held eight Advisory Committee meetings throughout the planning process, from October 2019 through July 2021 (see Table 1-4). During GSP development, Advisory Committee meetings were held quarterly and were open to the public. Advisory Committee members were invited to speak during the meeting presentations or activities; and members of the public were invited to speak during the public comment portion of the agenda. Multiple Advisory Committee members asked questions and provided input and feedback at every meeting.

The Core Team circulated Advisory Committee meeting announcements to all stakeholders via its interested parties email list. Advisory Committee meeting agendas and materials were uploaded to the website in advance of meetings. During closure of government facilities due to the coronavirus disease 2019 (COVID-19) pandemic, Advisory Committee meetings were held virtually and recorded for later upload to the website.

1.4.6 Technical Peer Review

The Technical Peer Review Group provided expert review and recommendations to help prepare a scientifically sound GSP for the Basin. The Technical Peer Review Group was composed of the GSP consultant, two qualified independent reviewers, and any technical experts hired or appointed by members of the Advisory Committee. Technical experts must either be a professional geologist in the United States, a professional engineer in the United States, or have a PhD in hydrogeology, hydrology, geology, or a related field.

The Technical Peer Review Group was composed of the following three members as appointed by the GSAs and Advisory Committee members (see Table 1-3).

Table 1-3. Technical Peer Review Group Members

Member Type	Entity
Appointed by GSAs	Wiedlin & Associates
Appointed by GSAs	Luhdorff & Scalmanini
Appointed by Rancho Guejito (Large Landowner)	Dudek

The GSA held seven Technical Peer Review Group meetings throughout the planning process, from November 2019 through January 2021 (see Table 1-4). During GSP development, Technical Peer Review Group meetings were held quarterly on the same day as the Advisory Committee meetings and were open to the public. Technical Peer Review Group members were invited to speak up at any point during the meeting presentations or activities; Advisory Committee members could weigh in after each agenda item; and members of the public were invited to speak during the public comment portion of the agenda. All Technical Peer Review Group members and multiple Advisory Committee members asked questions and provided input and feedback during meetings.

The Core Team circulated Technical Peer Review Group meeting announcements to all stakeholders via its interested parties email list. Meeting agendas and materials were uploaded to the website in advance of meetings. During closure of government facilities due to COVID-19, Technical Peer Review Group meetings were held virtually and recorded for later upload to the website.

1.4.7 Method of Informing the Public

Notices about upcoming public meetings are provided on the website and are physically posted at two public locations: the Escondido Public Library and the San Diego County Farm Bureau (Farm Bureau). Email notices about meetings and other GSP-related announcements (such as release of the plan for public review) are sent to those who subscribed for email updates (i.e., interested parties; this list is maintained by the GSA).

Written comments regarding Advisory Committee or Technical Peer Review Group meetings, or communications about GSP development or implementation, can also be submitted to Staci Domasco, GSP Plan Manager, via telephone at (858) 292-6409 or via email to sdomasco@sandiego.gov.

List of Public Meetings Where the GSP Was Discussed

Table 1-4 lists the schedule for both previously held and anticipated GSP development meetings. Meeting agendas and minutes from public meetings already held are provided in Appendix E. As study and GSP development began, all Advisory Committee meetings were anticipated to be held in the afternoon from 2:00 to 4:00 p.m. at the Farm Bureau Offices located at 420 South Broadway in Escondido, California. Similarly, all Technical Peer Review Group meetings were anticipated to be held in the morning from 9:00 to 11:00 am on the same day as the Advisory Committee meetings at the County of San Diego's offices at 5510 Overland Avenue in San Diego, California. However, due to local and state restrictions during the COVID-19 pandemic, in-person meetings were changed to videoconferences beginning May 14, 2020.

Table 1-4. GSP Development Meetings

Meeting Group/Type	Meeting Date or Proposed Date	Meeting Topics
City Council	October 19, 2016	SGMA overview and implementation.
City Council and County Board of Supervisors	March 16, 2017	SGMA overview, San Pasqual GSA filing, GSP Chapters, stakeholder engagement.
County Board of Supervisors	June 21, 2017	MOU, stakeholder engagement, GSP components.
County Board of Supervisors	October 11, 2017	Not applicable.
City Council and County Board of Supervisors	May 24, 2018	GSP development, stakeholder engagement goals, Advisory Committee composition.
Advisory Committee	June 6, 2019	SGMA/GSP introduction, Brown Act, bylaws, future meeting dates.
Advisory Committee	October 10, 2019	Introduce the consulting team, initiate data collection efforts, review GSP development process, review communications plan.
Technical Peer Review Group	November 7, 2019	Technical Peer Review Group meeting schedule, data collection, HCM, groundwater conditions.
Advisory Committee/ Technical Peer Review Group	January 9, 2020	Introduction HCM, groundwater conditions, undesirable results groundwater model approach.
Advisory Committee/ Technical Peer Review Group	May 14, 2020	Undesirable results, groundwater model, overview sustainable management criteria, groundwater model update, review field program.
Advisory Committee/ Technical Peer Review Group	July 9, 2020	Groundwater model update, sustainable management criteria, projects and management actions, water budgets.
Technical Peer Review Group	December 17, 2020	Groundwater model update.
Advisory Committee/ Technical Peer Review Group	January 14, 2021	Sustainable management criteria, water budgets, projects and management actions, plan implementation.
Advisory Committee	February 18, 2021	Groundwater model update, water budgets, sustainable management criteria, projects and management actions.
Advisory Committee	July 8, 2021	Present Public Review draft GSP to the Advisory Committee.
County Board of Supervisors	*Anticipated* November 3, 2021	GSP Adoption.
City Council	*Anticipated* November 16, 2021	GSP Adoption.
--	January 31, 2022	Final GSP submitted to DWR.
Notes: HCM = hydrogeologic conceptual model Specific meeting topics are subject to change.		

1.4.8 Summary of Comments and Responses During GSP Development

Comments from stakeholders, Advisory Committee, and Technical Peer Review Group members were sent directly to the GSP Plan Manager via email. In addition, the GSA received comments from the public regarding the Draft GSP during the public review period held from June 14, 2021 to August 13, 2021. The comments received were transferred into a tracking matrix, which was organized by Advisory Committee, Technical Peer Review Group, or Public Review and the commenter's name. Comments were then reviewed by consulting staff and the Core Team for consideration during GSP development. For comments received during Advisory Committee or Technical Peer Review meetings, responses were discussed with participants as part of the next meeting's agenda. For comments received during public review of the Draft GSP, responses are provided in the tracking matrix. All comments received are included in Appendix F.

1.5 GSP Organization

This GSP is structured and ordered to allow for efficient review by DWR by aligning with the SGMA preparation checklist (Appendix A). Each GSP section provides adequate information and context for future readers to fully understand Basin conditions and management strategy established by the GSA. The GSP is structured as follows:

- **Executive Summary—**The Executive Summary is a high-level description of the GSP's overall contents.
- **Section 1, *Introduction and Agency Information***—This section contains background information such as contact and authority information, and a summary outreach efforts performed during GSP development.
- **Section 2, *Plan Area*—**This section describes surficial and jurisdictional conditions in the GSA, a description of existing planning programs in the Basin, and a description of existing monitoring programs in the Basin.
- **Section 3, *Hydrogeologic Conceptual Model*—**This section describes the Basin's physical geology, regional structural settings, and Basin boundaries. This section can be used when interpreting informaiton in Section 4, *Groundwater Conditions*, and in Section 5, *Water Budgets*.
- **Section 4, *Groundwater Conditions*—**This section describes the amount and movement of groundwater through the Basin, changes in historical levels, contour maps, groundwater quality, and potential for land subsidence. This section also evaluates the interconnection of rivers and streams to groundwater, and identifies groundwater-dependent ecosystems (GDEs).
- **Section 5, *Water Budgets*—**This section provides information about the amount of water moving through the Basin historically, currently, and potentially in the future. Inflows, outflows, and consumptive uses such as evapotranspiration (ET_0), groundwater pumping, are simulated.
- **Section 6, *Undesirable Results*—**This section describes the GSP's sustainability goal, which is to avoid undesirable results while providing a sustainble groundwater resource for beneficial users in the Basin. This section also includes undesirable results statements, which guide establishment of a monitoring network and sustainability thresholds. Additionally, this section provides an overview of whether undesirable results are currently occurring in the Basin.

- **Section 7, *Monitoring Networks*—**This section describes the rationale for selection/design of the monitoring network, and how the proposed network could detect undesirable results. This section also summarized areas of potential improvement to the GSP's data collection and monitoring network.
- **Section 8, *Minimum Thresholds and Measureable Objectives*—**This section describes the established thresholds that link monitoring network results to undesirable results and implementation measures.
- **Section 9, *Projects and Management Actions*—**This section describes projects and actions considered by the GSA, identifies and analyzes which projects or actions may be selected for implementationand provides brief analysis for each project or management action.
- **Section 10, *Plan Implementation*—**This section includes a schedule of GSA operations activities, a schedule of projects and management actions, anticipated costs to be incurred by the GSA during implementation, and how implementation costs will be funded by the GSA.
- **Appendices**—This section is a collection of appending/supporting GSP infomation.

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Section 2. PLAN AREA

This section describes the SPV Basin Plan Area and existing water management plans. The review of existing water management plans summarized here describes current surface water and groundwater monitoring programs, land use and water management programs, and general plans in the Basin. Information contained in this section has been collected from publicly available sources; it may not reflect all information used during GSP technical analysis.

2.1 Plan Area Description

This section describes the Plan Area along with the major streams, land uses, and locations of groundwater wells inside the Plan Area. Information about the surrounding watershed have also been included. This section further describes existing surface water monitoring programs, groundwater monitoring programs, and data libraries used to support preparation of this GSP.

2.1.1 Plan Area Definition

The Plan Area corresponds to the lateral boundaries of the Basin, which underlies the SPV and portions of Cloverdale, Rockwood, Bandy, and Sycamore Creek Canyons. According to DWR's Bulletin 118 (Appendix D), the Basin (defined as Basin 9-10 in Bulletin 118) is bounded by Hodges Reservoir to the west and otherwise by non-water bearing rocks of the Peninsular Ranges. The Basin's water-bearing units, according to Bulletin 118, are alluvium and residuum.

In 2016, DWR revised the Basin boundary to correct a previous error and correctly match the location of the Basin. The boundary previously had been offset due to a projection error. This was remedied concurrent with DWR's basin reprioritization efforts. The reprioritization kept the Basin as a medium-priority and corrected the associated geographic information system (GIS) shapefiles available that describe the Basin's location and extent.

Bottom of the Basin Boundary

The SPV Basin is defined in Bulletin 118 (Appendix D), and includes Quaternary Deposits and Residuum. Fractured bedrock underlies the Residuum. As summarized in Section 5, *Water Budgets*, some groundwater interaction of groundwater between fractured bedrock beneath the Quaternary Deposits and the Residuum is accounted for in the water budget analysis; however, the degree of this interaction is not well understood and represents an area of potential improvement that may be investigated by the GSA to further the understanding of the Basin and the interaction of groundwater pumping in and around the Basin.

2.1.2 Local Demographics

Approximately 90 percent of the SPV Basin has been designated as an agricultural preserve by the City of San Diego to preserve the rural and agricultural character of the Valley (see Section 2.2 below for more detail). Most of the Basin is comprised of riparian vegetation along the San Dieguito River and agricultural parcels, including avocados, citrus, cut flowers, dairy, cattle grazing, grapevines, greenhouses, and nurseries. Residential land uses include the San Pasqual Academy, a residential high school for foster youth, and a small number of residential homes within the Basin. The SPV GSP Model estimated Basin population at less than 70 residents based on the number of household septic systems. According to the DWR's Disadvantaged Communities mapping tool (DWR, 2021), there are no Disadvantaged Communities located within the Basin. Although there are no tribal reservation lands in the Basin, the San Pasqual Tribe has cultural interests in the Basin.

2.1.3 Plan Area Setting

This section contains figures showing the Plan Area's setting in different contexts. Figures are described below.

Figure 2-1 shows the Basin and its key geographic features. The Basin is located approximately 25 miles northeast of downtown San Diego within the SPV. Approximately 90 percent of the Basin is designated as a City-owned and managed agricultural preserve. The SPV is sparsely populated and includes row crop, orchard, nursery, and dairy operations (City, 2016). Santa Ysabel, Guejito, Cloverdale Creek, and Santa Maria Creeks drain the Basin and converge to form the San Dieguito River, which flows into Hodges Reservoir to the west (DWR, 2004).

Figure 2-2 shows the GSA boundary. The GSA covers the entire Basin, leaving no unmanaged areas. The GSA was formed on June 29, 2017 by execution of the MOU between the City and the County. The SGMA adjudication areas are from *Trussell v. City of San Diego* (1959) 172 Cal.App.2nd 593 and are depicted in very rough approximation on Figure 2-2.

Figure 2-3 shows the Basin and neighboring groundwater basins. The Basin is in the South Coast Hydrologic Region within the San Dieguito Drainage Basin, which starts in the Volcan Mountain at the headwaters of the Santa Ysabel Creek and flows west-southwest to the Pacific Ocean. The Basin is not directly adjacent to any other Bulletin 118-identified basin. Therefore, the Basin is not required to coordinate with other basins during GSP development and implementation.

Figure 2-4 shows that the Basin is located entirely within San Diego County. Much of the Basin is in the northern portion of the City of San Diego's jurisdiction, approximately 5 miles southwest of the City of Escondido.

Figure 2-5 shows the Basin's jurisdictional boundaries. The City's jurisdiction includes approximately 90 percent of the 5.5-square mile Basin; the City leases much of the land for agricultural and residential uses (City, 2015). Although the County jurisdiction includes the entire Basin, for the purposes of SGMA implementation, the County will implement the GSP in the remaining 10 percent of the Basin outside City's jurisdiction.

Figure 2-6 and Figure 2-7 show the agricultural and residential land uses in the Basin in 2005 and 2018. The data in these figures were compiled during model construction for this GSP, and include land use data compiled from DWR, the City, local stakeholders, and publically available aerial imagery for the 2005 and 2018 time periods. These figures show that the two primary land uses in the Basin are riparian vegetation and agriculture. Agricultural crops in the Basin include avocados, citrus, cut flowers, dairy, cattle grazing, grapevines, greenhouses, nurseries, summar forage, truck crops, sod, and winter forage. Water use in the Basin is supplied almost entirely from groundwater. Locally diverted surface water is not used in the Basin, but imported water is used locally for irrigation. Imported water is used on the hillsides surrounding portions of the Basin for avocado groves and the San Diego Zoo Safari Park, which are both on the north side of the Basin. Imported water is also used in dense residential areas to the north, west, and south that are served by the City of Escondido, Rincon Del Diablo Municipal Water District, and Ramona Municipal Water District. There is also a small area of land in the Basin that receives imported water from the City of Escondido, located west of Cloverdale Creek between Old San Pasqual Road and San Pasqual Valley Road (Highway 78).

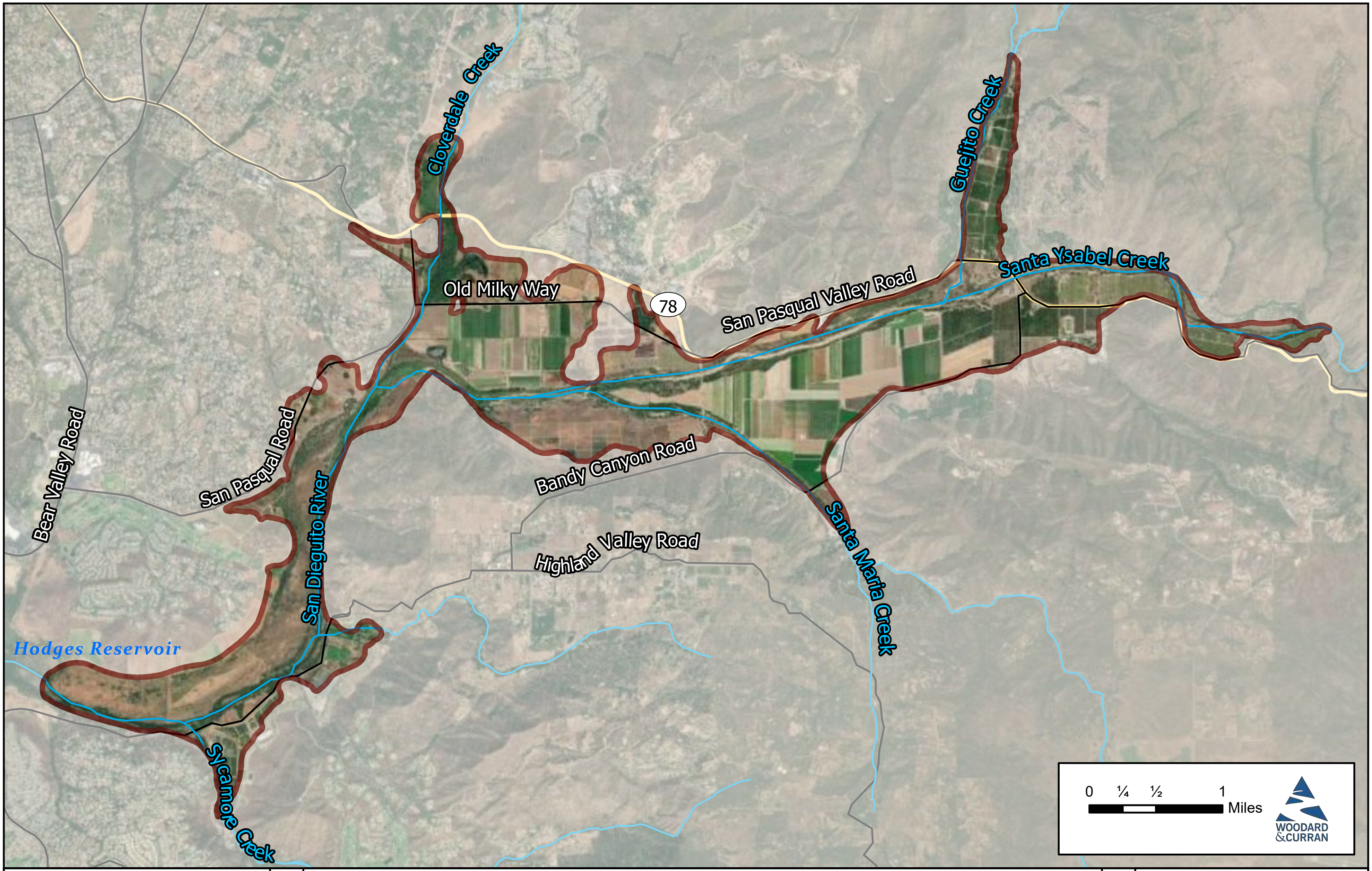
Figure 2-8 shows the density of domestic wells per square mile in and around the Basin, based well completion reports available in DWR's well completion database (DWR, 2019). DWR categorizes wells into three primary categories: domestic, production, and public. Domestic wells are those that provide private, non-commercial water. Production wells are usually for commercial purposes such as industry or agriculture. Public wells are those that supply water to public water distribution systems. There are 57 domestic wells in the geographic area of the Basin and surrounding areas, inclusive of wells completed in the alluvium, residuum, and underlying bedrock. The reported well completion depths range from 20 to 1,310 feet below ground surface (bgs). The highest density of domestic wells is in the northeast portion of the Basin near Guejito Creek and in the southwestern corner of the Basin near Hodges Reservoir.

Figure 2-9 shows the density of production wells per square mile in and around the Basin. There are 131 production wells in the geographic area of the Basin and surrounding areas, inclusive of wells completed in the alluvium, residuum, and underlying bedrock. The reported well completion depths ranging from 21 to 1,510 feet bgs. Production wells are reported throughout the Basin, with the highest density near Cloverdale and Santa Ysabel Creeks near the confluence with Guejito Creek.

Figure 2-10 shows the density of public wells per square mile in and around the Basin. There are five public wells in the geographic area of the Basin and surrounding areas, inclusive of wells completed in the alluvium, residuum, and underlying bedrock. The reported well completion depths range from 180 to 612 feet bgs. The Public wells in the Basin are located along Santa Ysabel Creek near the confluence with the Guejito Creek.

Figure 2-11 shows public lands in and around the Basin. The public lands in the Basin consist of City- and County-owned properties. There are no state, federal, or tribal lands in the Basin. The San Pasqual Tribe, however, has cultural interests in the Basin and has participated in GSP development as a member of the SPV GSP Advisory Committee.

Figure 2-12 shows the Basin's location within the San Dieguito River Drainage Basin. The San Dieguito River Drainage Basin is the fourth largest drainage basin in the County (City, 2016). The headwaters of the drainage basin are in the Volcan Mountains, and the discharge area is the Pacific Ocean to the west-southwest. The Basin receives surface water from Santa Ysabel, Santa Maria, Guejito, and Cloverdale Creeks, along with other small creeks. Flows in Santa Ysabel upstream of the Basin are regulated by releases Sutherland Reservoir. Surface water leaves the Basin via the San Dieguito River and is impounded in Hodges Reservoir. If the reservoir's level exceeds reservoir capacity during extreme storm events, water may be transferred into Olivenhain Reservoir or released via a gage in the reservoir dam, and continue west along the San Dieguito River Valley before it flows into the Pacific Ocean.



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Project #: 0011197

Legend

San Pasqual Valley Basin

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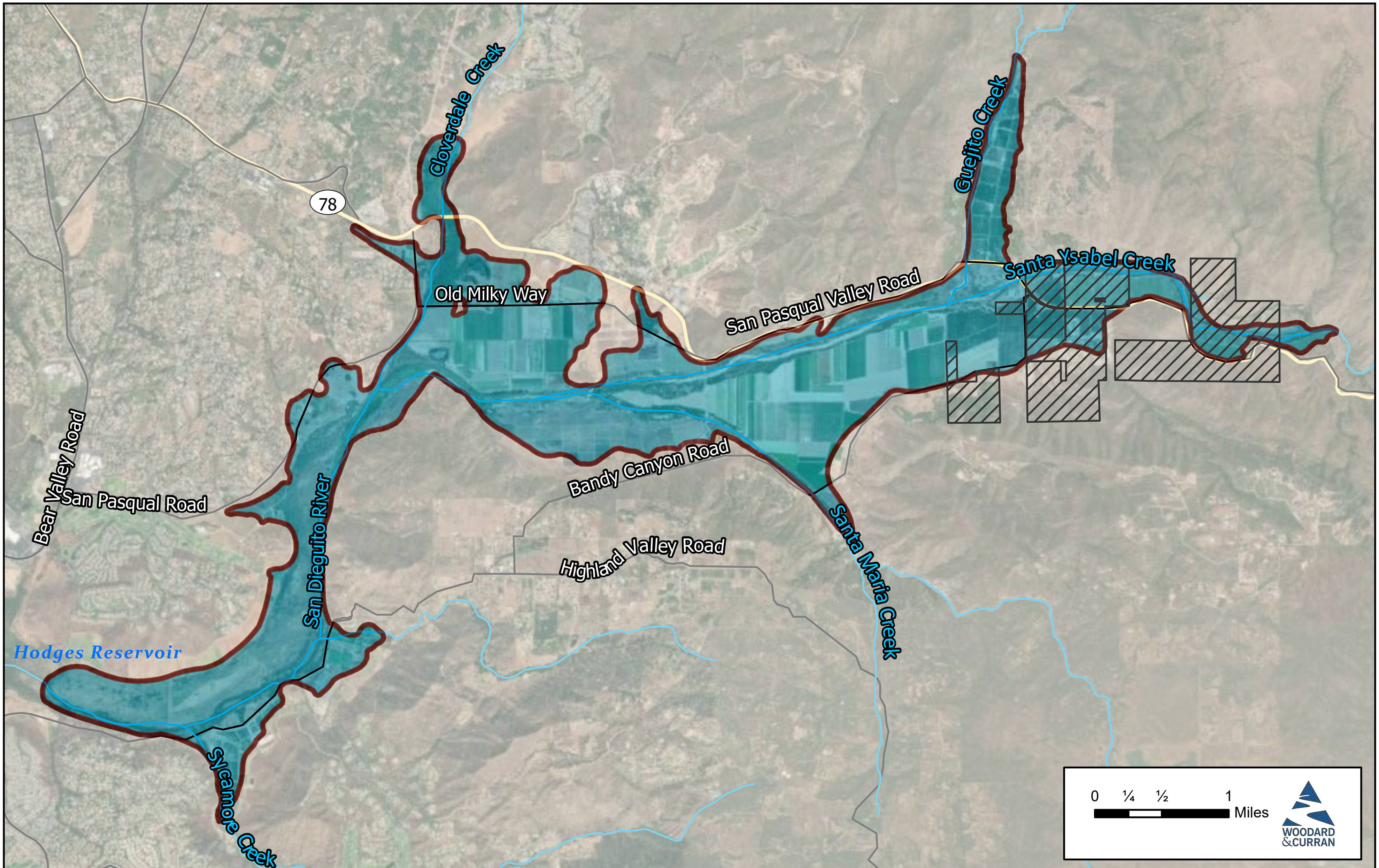
Figure 2-1

San Pasqual Valley GSP

Basin Boundaries and Key Geographic Features

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** DWR SGMA Data Viewer.



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- San Pasqual Valley Basin
- San Pasqual Valley GSA
- SGMA Adjudication Areas

Disclaimer: The SGMA adjudication areas are from Trussell v. City of San Diego (1959) 172 Cal.App.2nd 593. The SGMA adjudication areas depicted are a very rough approximation and a more detailed parcel-level analysis is required to fully identify the area. These areas are subject to change.

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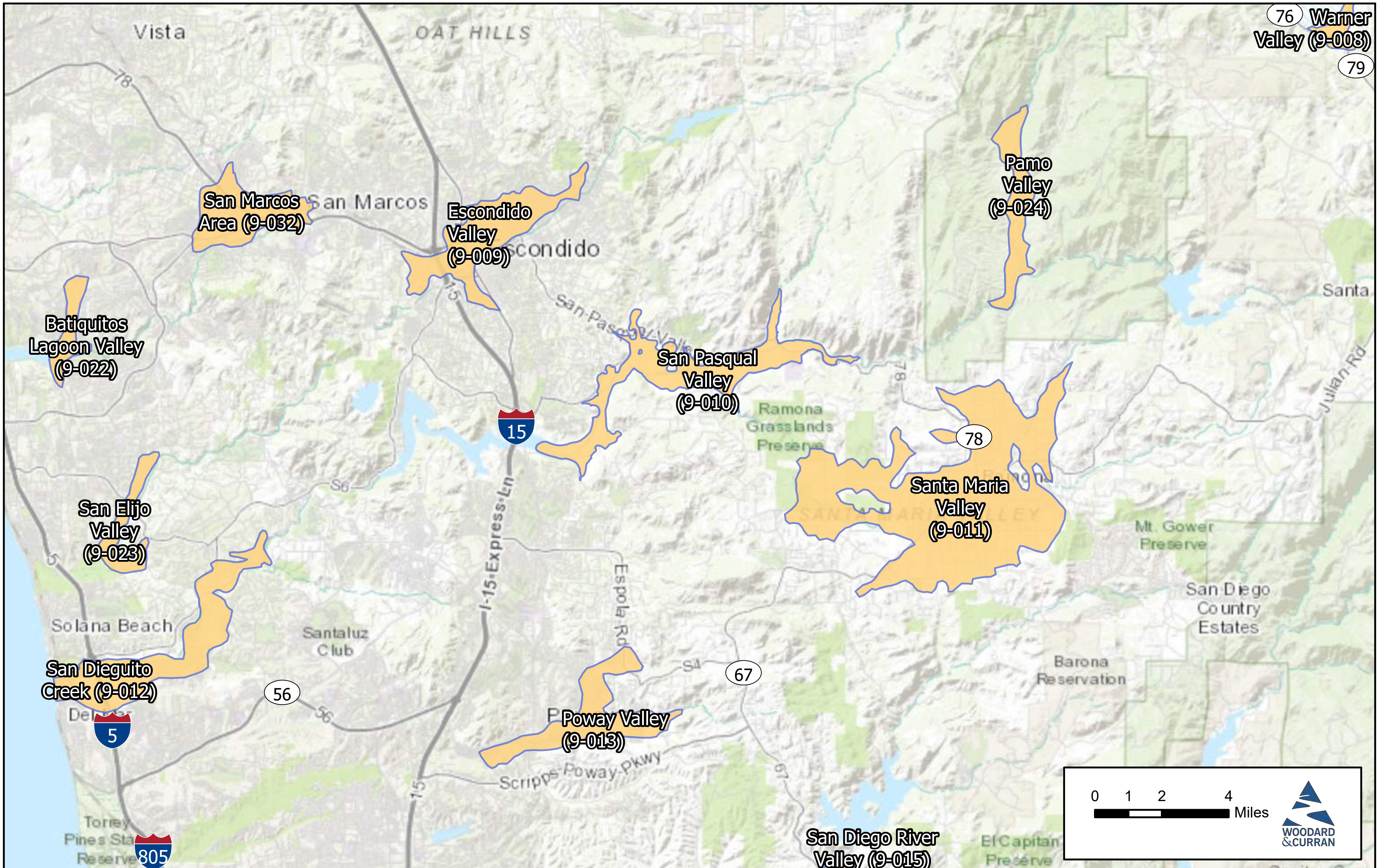
Figure 2-2

San Pasqual Valley GSP

San Pasqual Valley GSA Boundary

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** DWR SGMA Data Viewer.



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Bulletin 118 Basins

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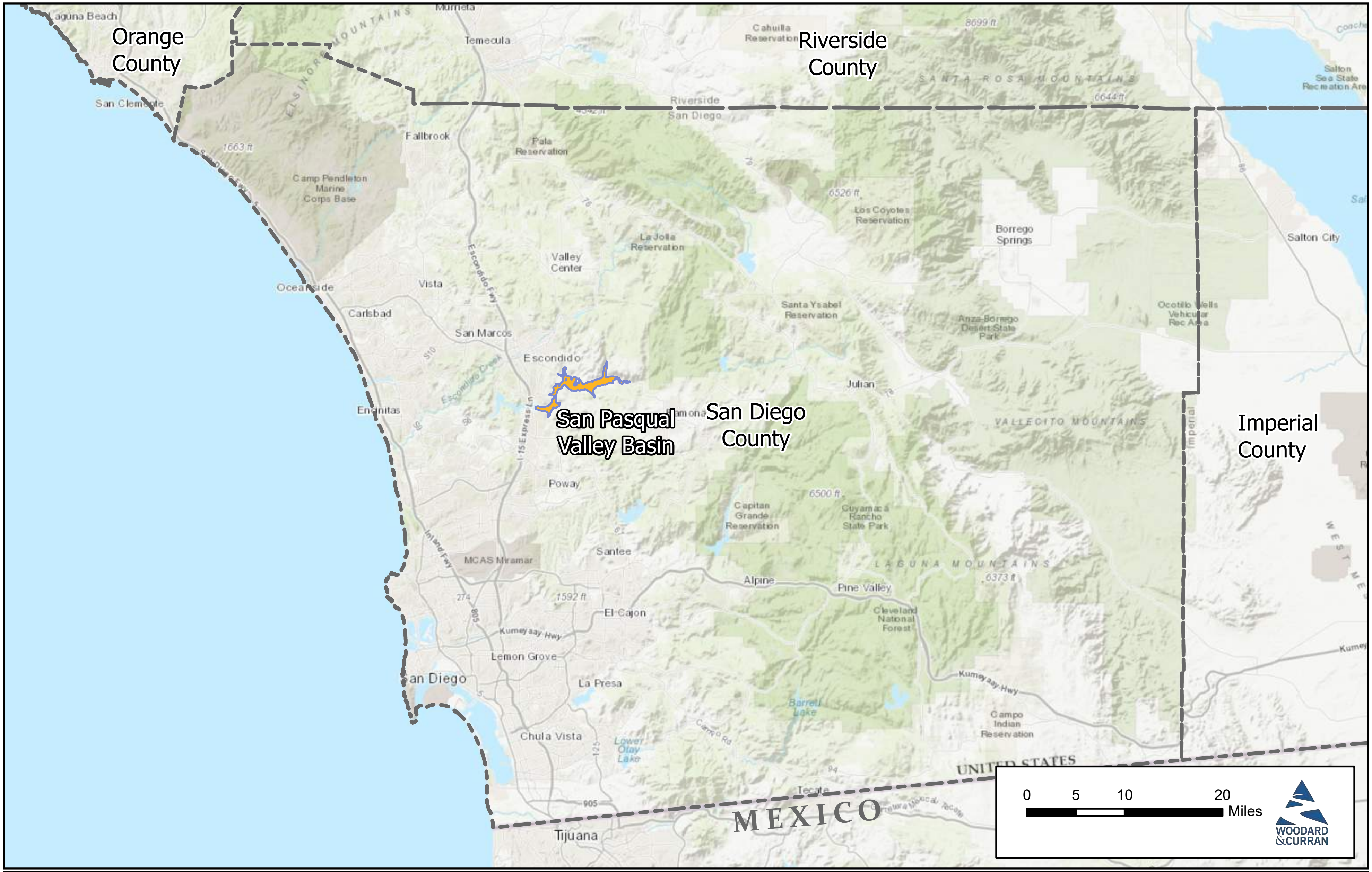
Figure 2-3

San Pasqual Valley GSP

San Pasqual Valley Neighboring Basins



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San Diego County

San Pasqual Valley Basin

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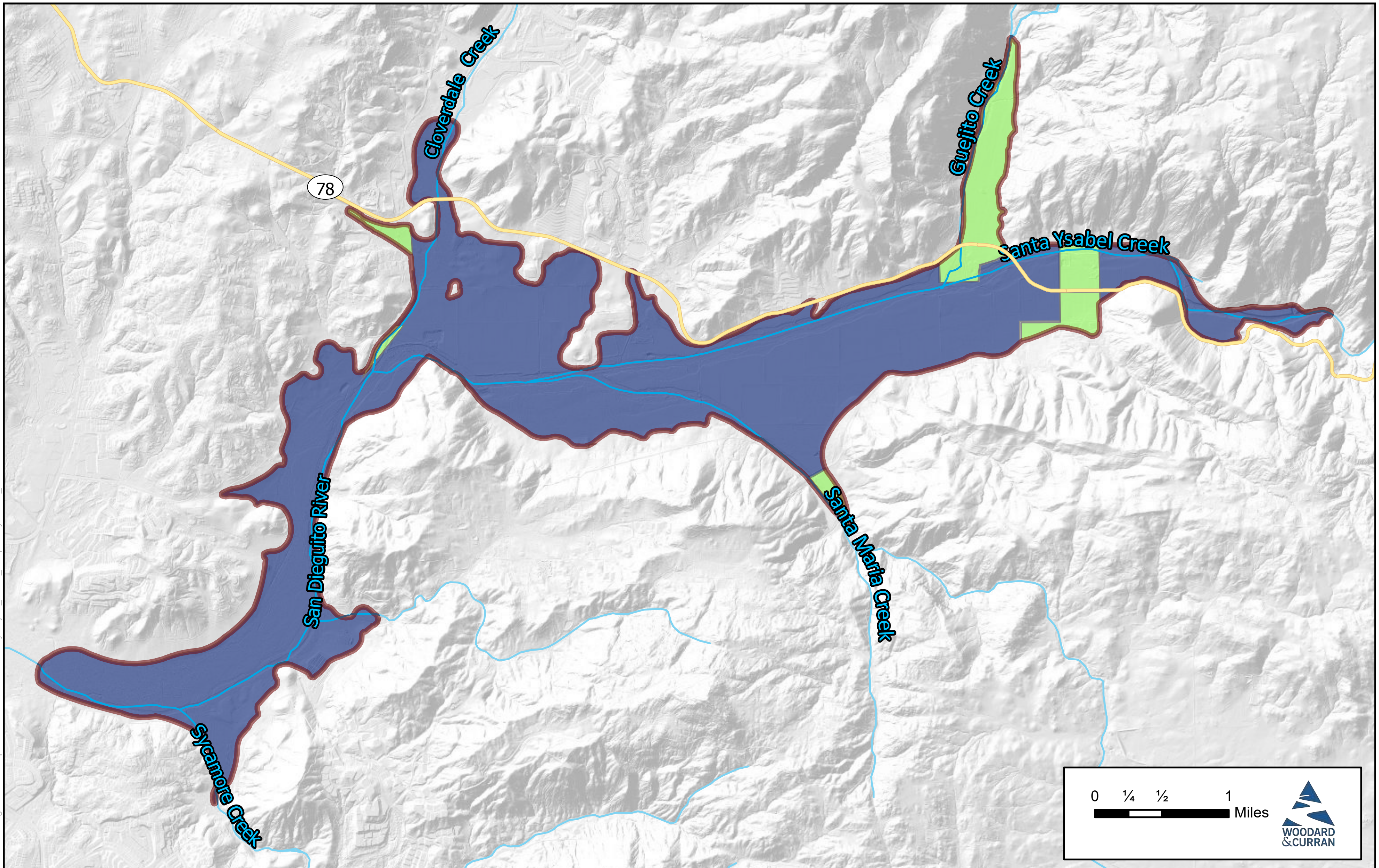
Figure 2-4

San Pasqual Valley GSP

San Pasqual Valley Position in County

Project #: 0011197

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** DWR



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- San Pasqual Valley Basin
- County of San Diego
- City of San Diego

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Figure 2-5

San Pasqual Valley GSP

Basin Jurisdictional Boundaries

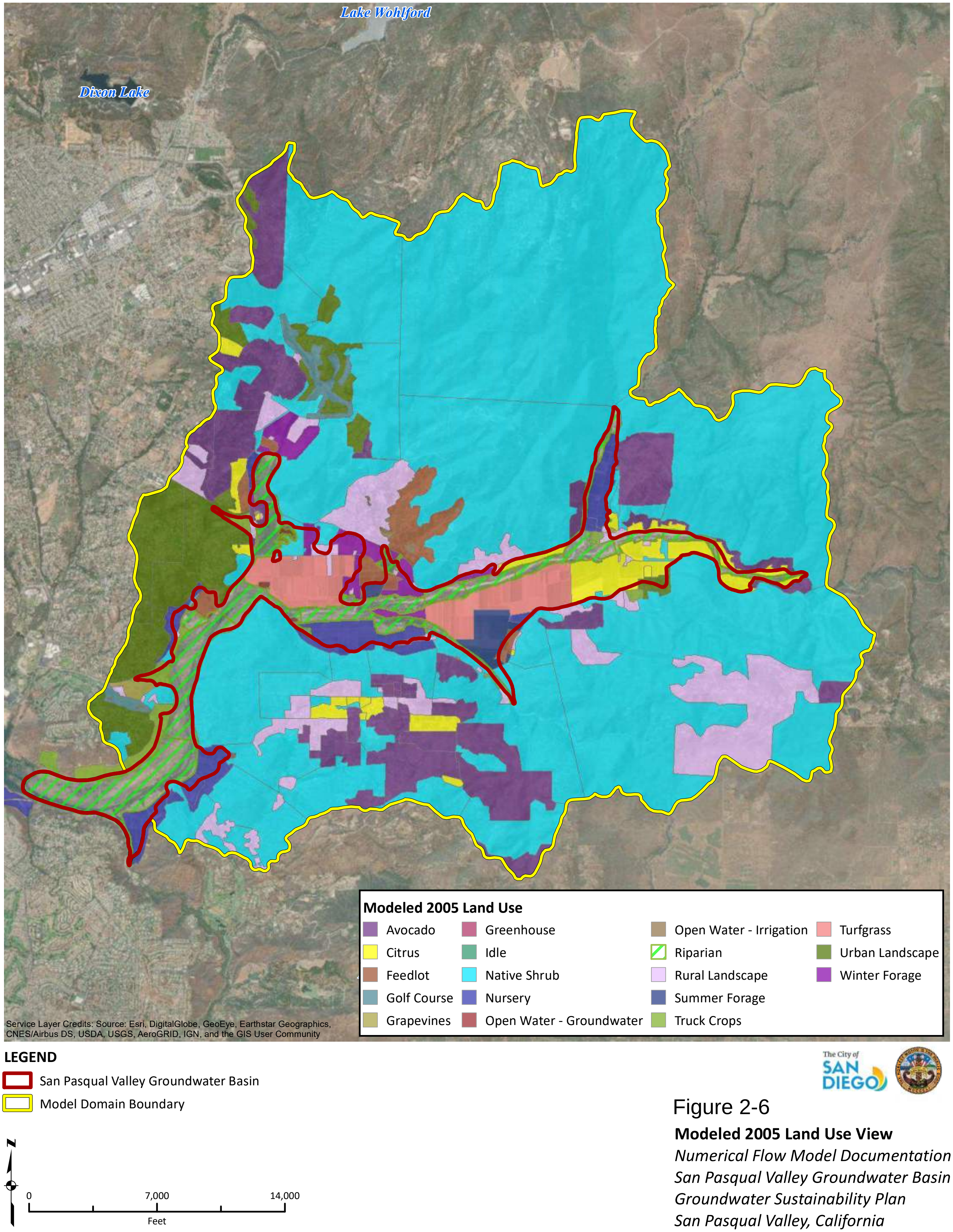


Figure 2-6

Modeled 2005 Land Use View

Numerical Flow Model Documentation
San Pasqual Valley Groundwater Basin
Groundwater Sustainability Plan
San Pasqual Valley, California

Jacobs

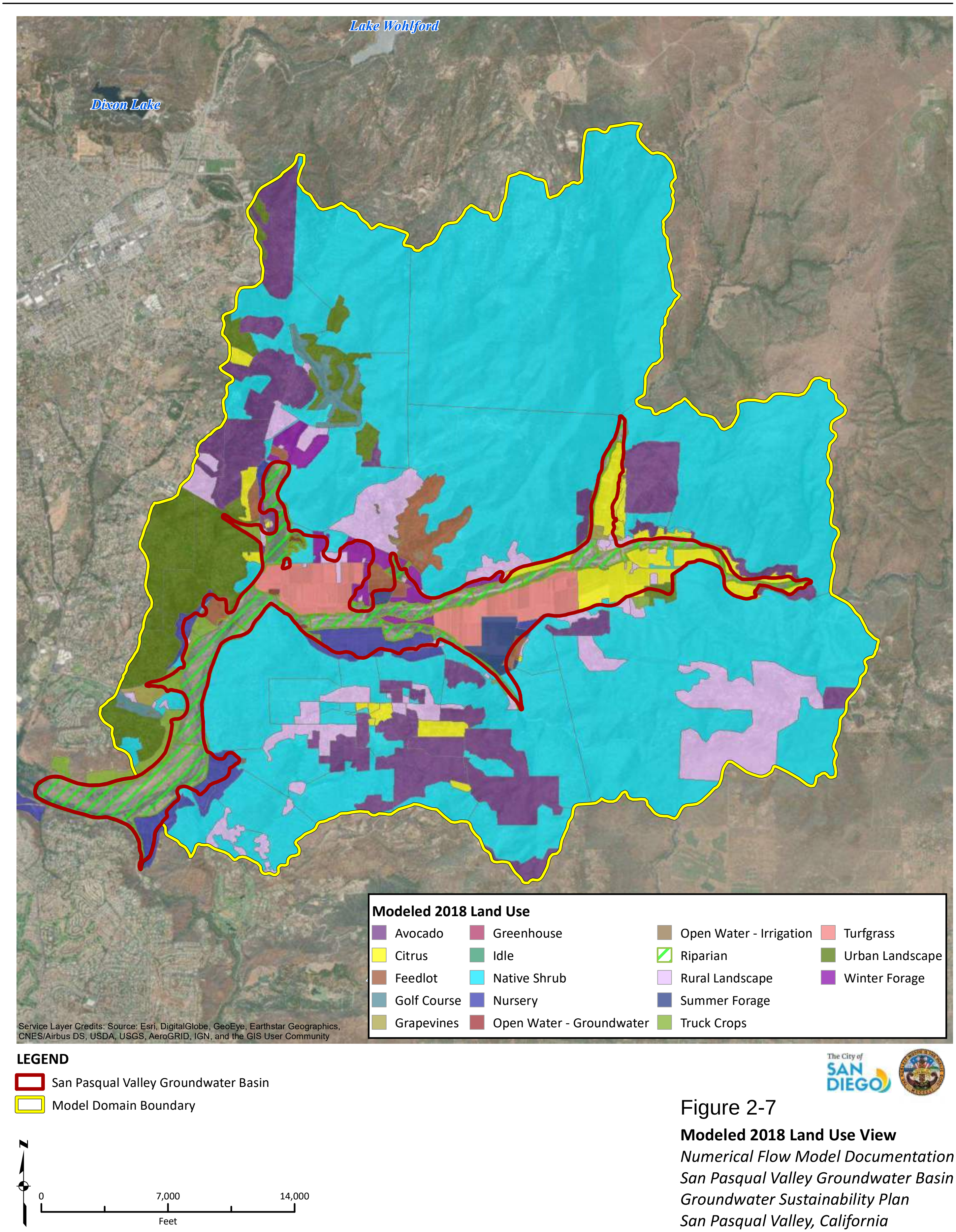
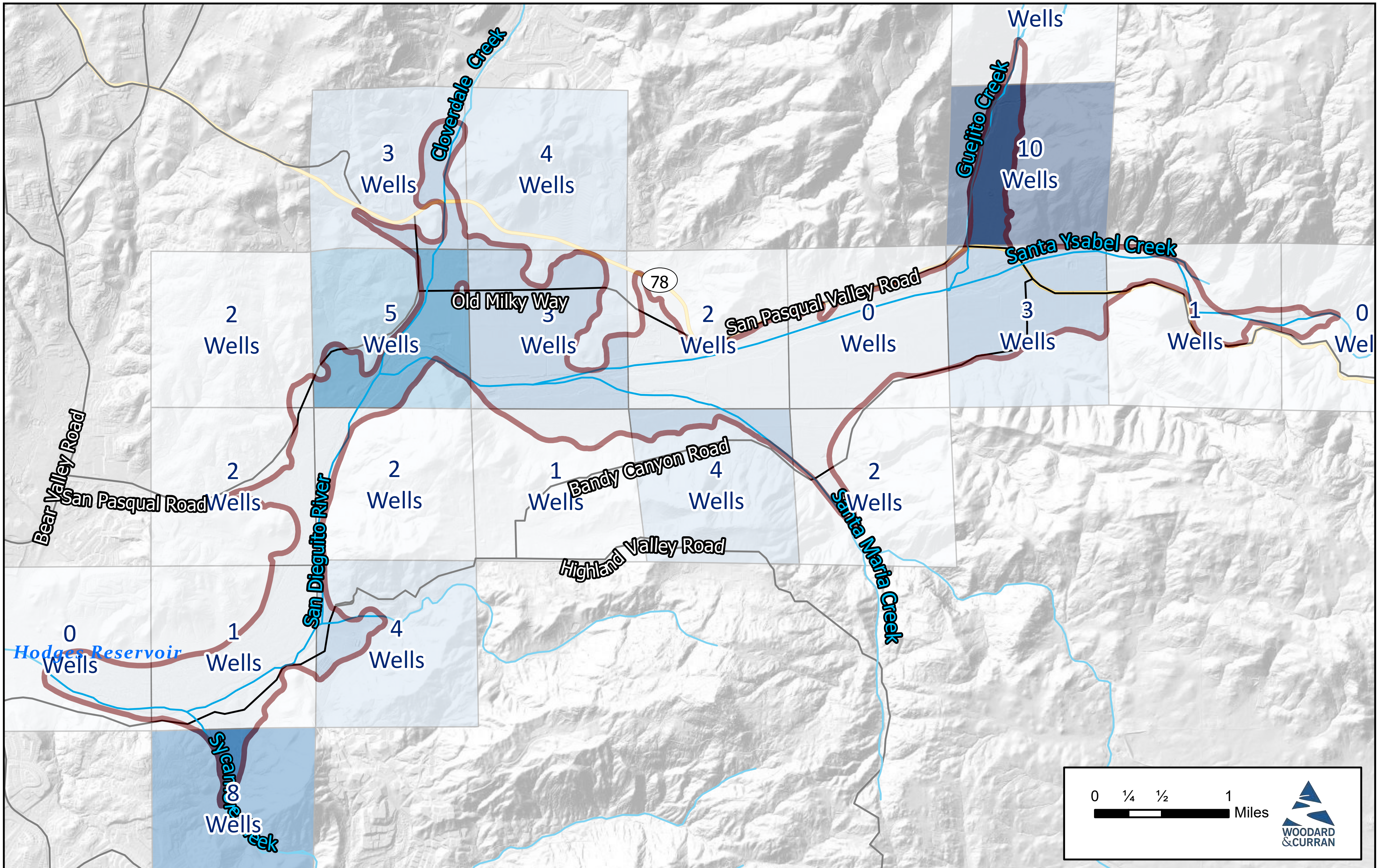


Figure 2-7

Modeled 2018 Land Use View

Numerical Flow Model Documentation
San Pasqual Valley Groundwater Basin
Groundwater Sustainability Plan
San Pasqual Valley, California



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San Pasqual Valley Basin

Domestic Wells by Section
- 0 to 2
- 3 to 4
- 5 to 6
- 7 to 8
- 9 to 10

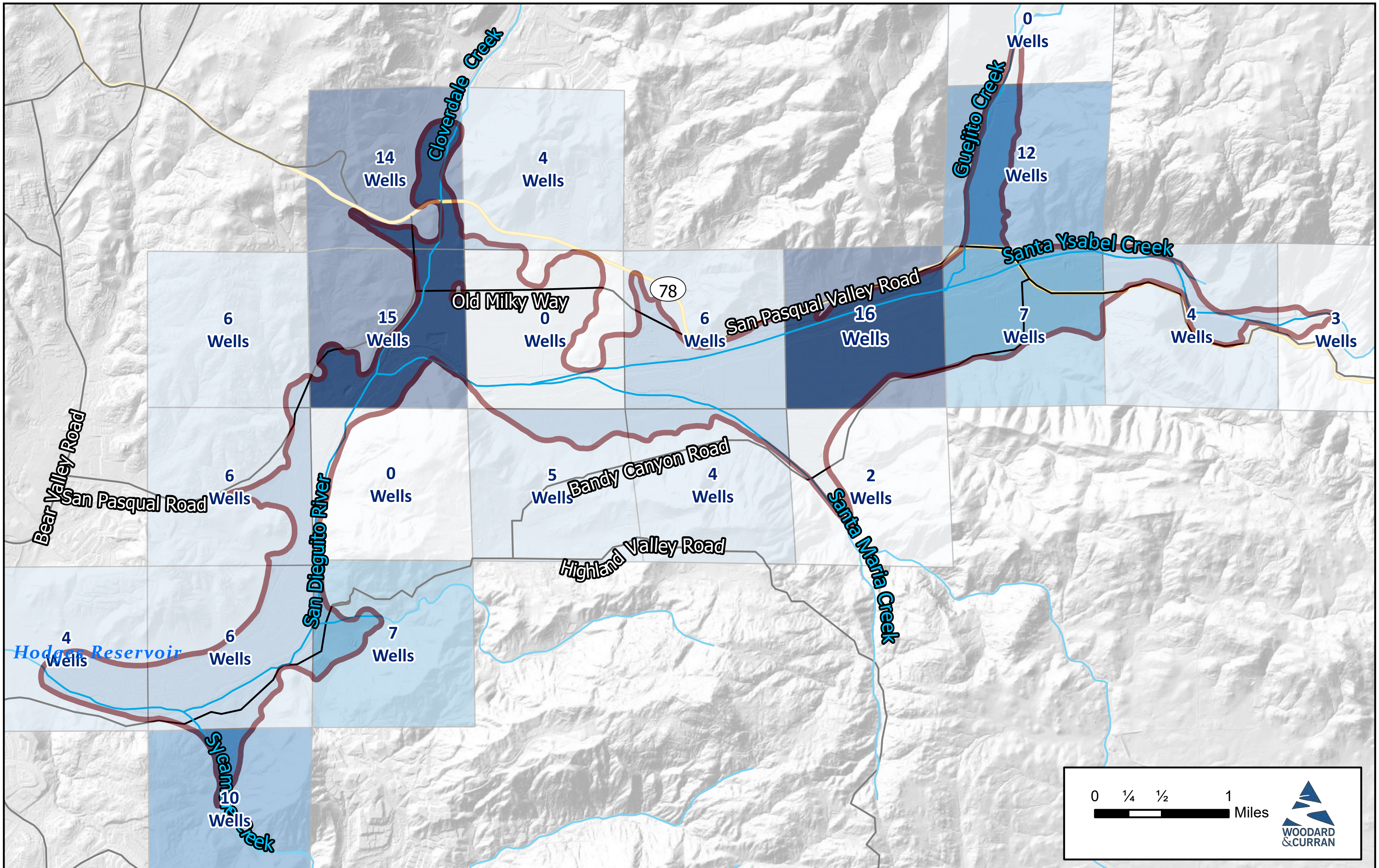
*All wells are within the San Pasqual Valley, but some may be completed outside of the Basin.

N

Figure 2-8

San Pasqual Valley GSP

San Pasqual Valley Domestic Wells



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San Pasqual Valley Basin

Production Wells by Section

0 to 3

4 to 6

7 to 9

10 to 12

13 to 16

*All wells are within the San Pasqual Valley, but some may be completed outside of the Basin.

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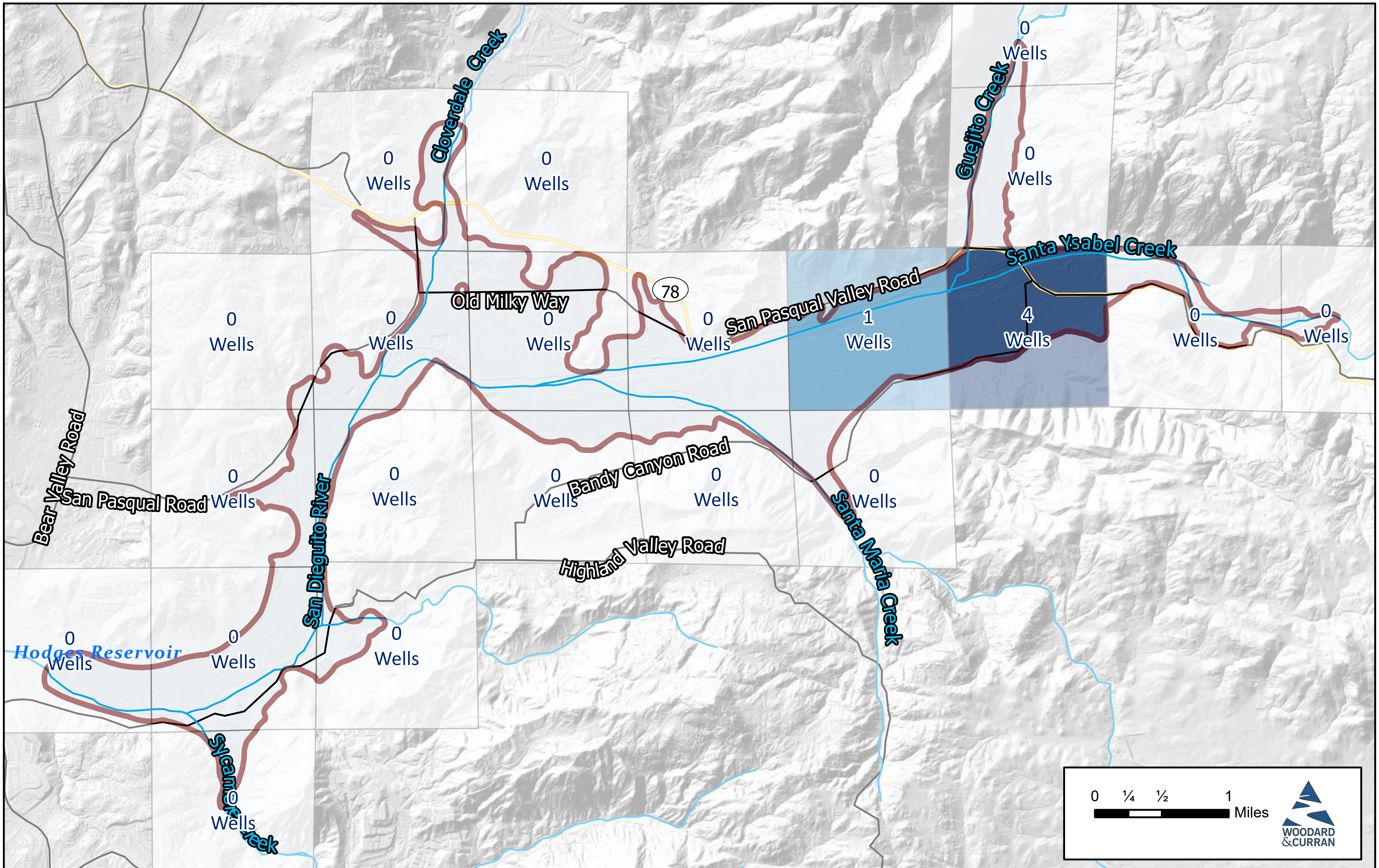
Figure 2-9

San Pasqual Valley GSP

San Pasqual Valley Production Wells



Project #: 0011197

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San Pasqual Valley Basin

Public Wells by Section

- 0
- 1 to 2
- 3 to 4

*All wells are within the San Pasqual Valley, but some may be completed outside of the Basin.

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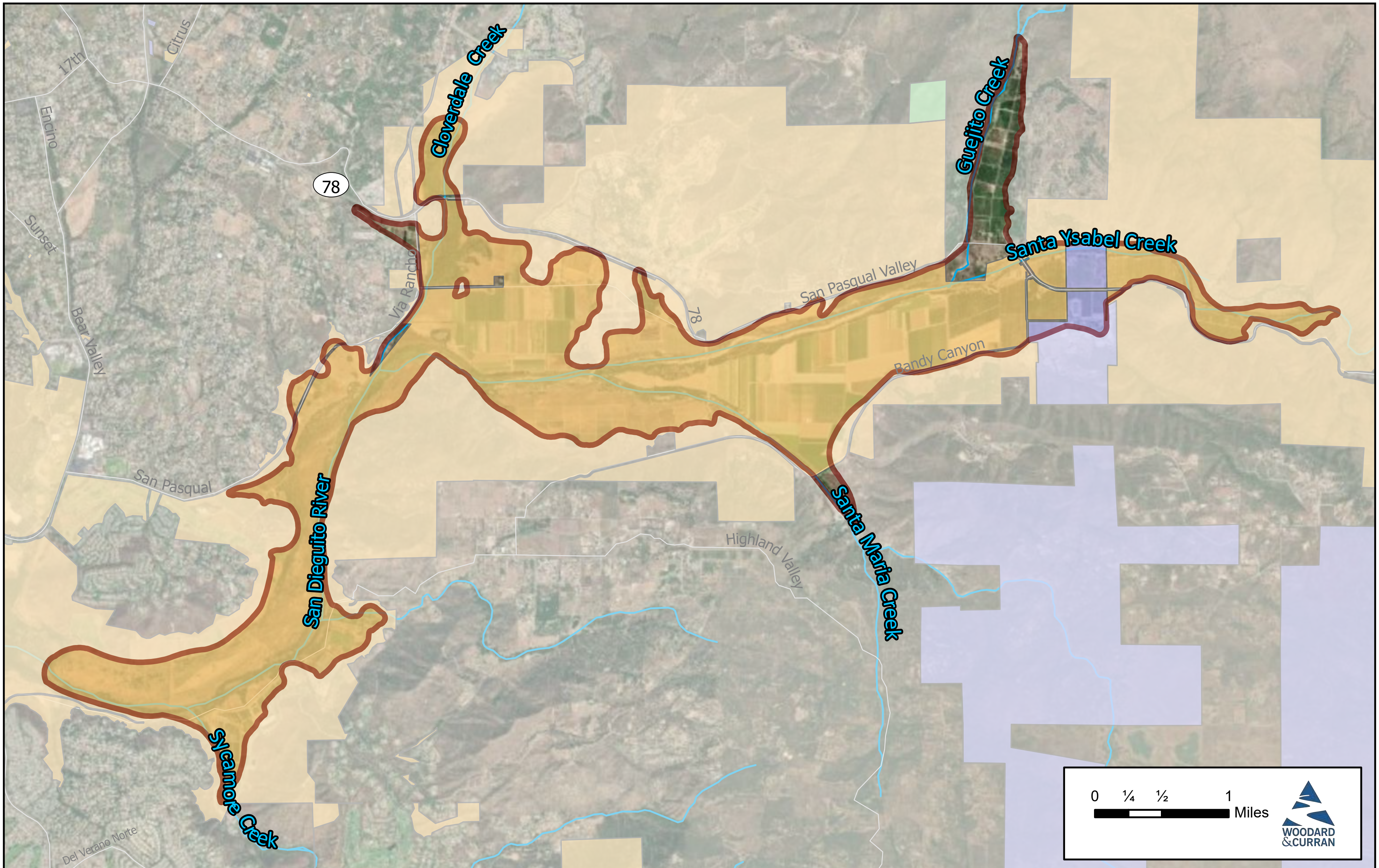
Figure 2-10

San Pasqual Valley GSP

San Pasqual Valley Public Wells

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source** DWR.



Project #: 0011197

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San Pasqual Valley Basin

Public Landowner

Bureau of Land Management

City of San Diego

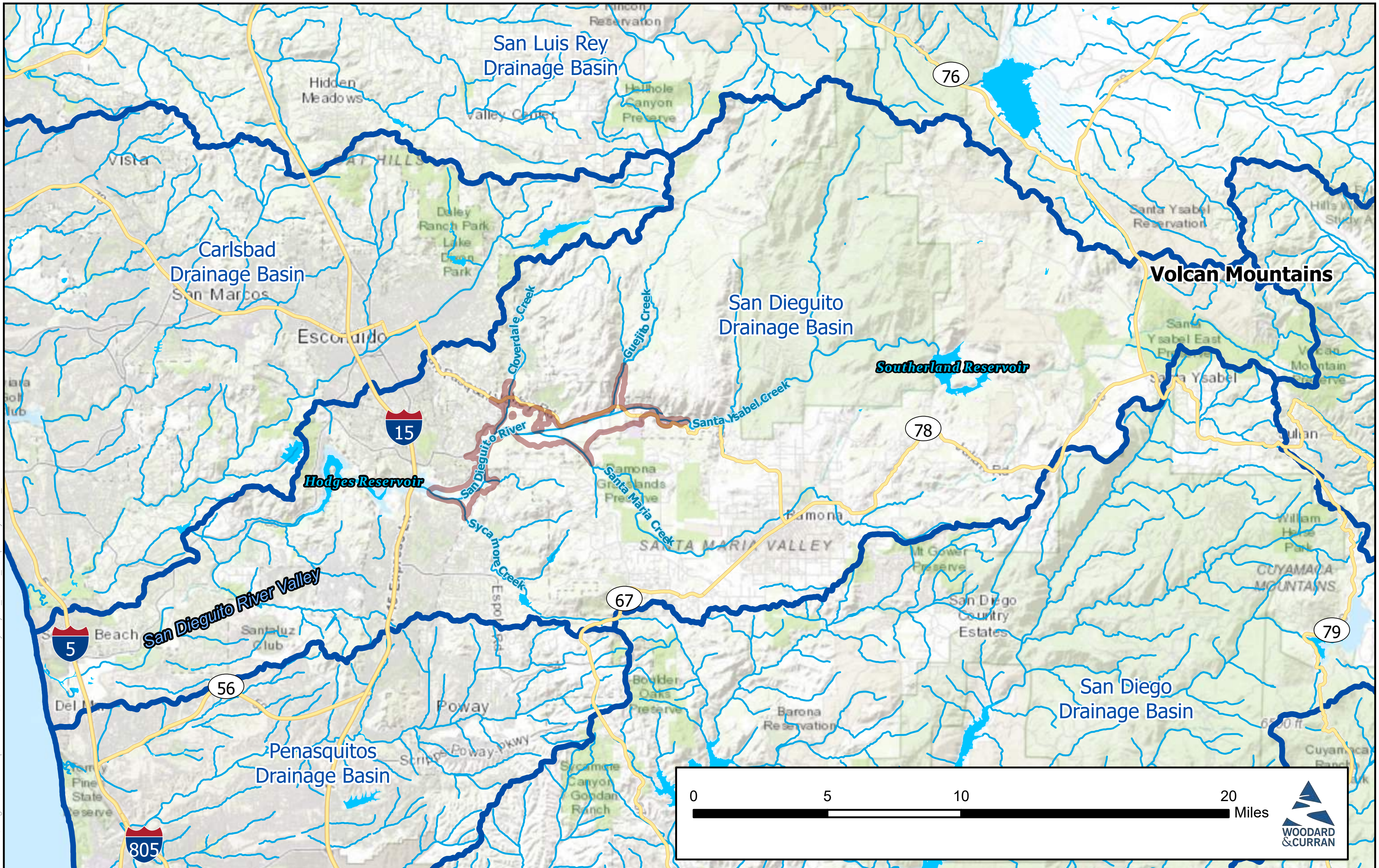
County of San Diego

N

Figure 2-11

San Pasqual Valley GSP

San Pasqual Valley Public Land



Project #: 0011197

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- San Pasqual Valley Basin
- Drainage Basins
- Streams

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Figure 2-12

San Pasqual Valley GSP

San Pasqual Valley Basin Location

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Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** DWR, SanDAG/SanGIS.

2.1.4 Historical Santa Ysabel Creek Riparian Rights

Riparian rights to the surface and subsurface flows of Santa Ysabel Creek were addressed in *Trussell v. City of San Diego* (1959) 172 Cal.App.2nd 593. Plaintiffs alleged that the City had injured their riparian water rights by constructing Sutherland Dam and preventing flows in Santa Ysabel Creek from reaching their land in the San Pasqual Valley. The trial court issued a judgment, which the appellate court upheld, finding that the plaintiff landowners held both riparian rights to Santa Ysabel Creek as well as overlying rights to San Pasqual Valley Basin supplies fed by Santa Ysabel Creek, and that these rights were prior and paramount to the City's appropriative right to store Santa Ysabel Creek water behind Sutherland Dam. The trial court further found that construction of Sutherland Dam caused the water levels in plaintiffs wells to drop below the average static levels that existed prior to construction of Sutherland Dam. The trial court ultimately held that plaintiffs had a right to a static water level of no lower than 20 feet below ground level, and that the City may not withhold or store the natural flow of Santa Ysabel Creek when the average static water level falls below this level. The judgment applied to a limited area of the San Pasqual Valley and was based on hydrologic information available at the time.

2.1.5 Existing Groundwater Water Monitoring

Groundwater elevation and groundwater water quality in the Basin are currently monitored by the City. Historical and current groundwater elevation and quality monitoring in the Basin are described below.

- **City of San Diego Groundwater Elevation Monitoring**. The City collects groundwater levels data from a network of 12 monitoring wells in the Basin every quarter and contracts with USGS to collect groundwater level data in three active cluster wells and one active single well in the Basin. Refer to Section 7.3.1 for additional information on groundwater level monitoring.
- **City of San Diego Groundwater Quality Monitoring**. Over the last 20 years, the City has collected groundwater samples from a network of 11 monitoring wells throughout the Basin. Since 2020, the samples have been collected semi-annually and analyzed for nitrate, nitrite, TDS, turbidity, phosphate (ortho), bromide, iron, manganese, mercury, total organic carbon pH, and bacteria. Prior to 2020, the samples were analyzed for a broad suite of organic and inorganic compounds. Additional information regarding existing groundwater monitoring is provided in Section 7.3.3.

2.1.6 Existing Surface Water Monitoring

Surface water flow and water quality in the Basin are currently monitored by the City. Historical and current surface water flow and quality monitoring in the Basin are described below.

- **City of San Diego Surface Water Flow Monitoring**. The City contracts with the U.S. Geological Survey (USGS) to collect streamflow data at three stream gages in the Basin's watershed, upstream of the Basin. Stream discharges are monitored continuously at these gages. In addition, the City has installed four new stream gages within the Basin that City monitors during wet-weather flows. Refer to Section 7.3.4 of this GSP for additional information on surface water monitoring.
- **City of San Diego Surface Water Quality Monitoring**. Since 2000, City personnel have monitored surface water quality at five locations within the Basin. The monitoring is conducted semiannually and includes analysis for temperature, dissolved oxygen, pH, electrical conductivity, and oxidation-reduction potential. Additional information regarding the active stream gages and existing surface water monitoring is provided in Section 7.3.4.

2.1.7 Data Libraries

The following data libraries are an overview of relevant datasets that provide groundwater and surface water-related data; these data were evaluated and reviewed during GSP preparation. Refer to Section 7, *Monitoring Networks,* for additional discussion of relevant data from these data sources.

DWR—WDL

DWR's WDL database contains groundwater elevation measurements for more than 35,000 wells throughout California. There are six active wells and one inactive well in the Basin that report periodic groundwater measurements to the WDL. The City submits data to DWR's WDL. Data provided to the WDL are available for the time periods from either 2011 or 2013 through 2020.

DWR's WDL database also contains data about chemical and physical parameters found in drinking water, groundwater, and surface water throughout the state collected via discrete, grab-type water quality sampling stations. The Basin has 20 inactive groundwater quality stations. These wells are not sampled in regular intervals, and most of the wells only have one or two days of recorded measurements with large temporal gaps between results. Constituents most frequently sampled include TDS and nitrates (DWR, 2020b).

DWR—CASGEM Program

DWR's CASGEM Program collects monitoring data on seasonal and long-term groundwater elevation trends in collaboration with local monitoring entities. There are six CASGEM Program wells and one additional voluntary well in the Basin. Data provided to the CASGEM Program are available for the time period from 2011 through 2020. The City is the designated CASGEM Program agency for the Basin and is responsible for submitting groundwater elevation data to the CASGEM Program semi-annually (DWR, 2019a).

SWRCB—Groundwater Ambient Monitoring and Assessment Program

SWRCB's Groundwater Ambient Monitoring and Assessment (GAMA) Program was established in 2000 to create a comprehensive groundwater monitoring program throughout California. The GAMA Program was also charged with providing increased public availability and access to groundwater quality and contamination information (SWRCB, 2019). A total of 47 wells in the Basin report data to the GAMA Program.

SWRCB—GeoTracker

SWRCB's GeoTracker database contains records for sites that impact, or have the potential to impact, groundwater quality. These records indicate there are no open status sites, no leaking underground storage tank sites or active cleanup program sites in the Basin (SWRCB, 2020).

USGS— National Water Information System

The USGS National Water Information System (NWIS) monitors groundwater for chemical, physical, and biological properties across the United States and uploads these data to GeoTracker on a quarterly basis. USGS tracks groundwater quality and levels at the three active cluster wells and one active single well in the Basin. All data collected by USGS is stored in the NWIS.

CDPR—Well Inventory Dataset

The CDPR Well Inventory Dataset is used to monitor pesticide levels and compile sample data as part of its Groundwater Protection Program. The goal of this program is to improve understanding of environmental impacts and behavior of pesticides in relation to groundwater, as well as to develop pesticide-use best practices that reduce threats to groundwater. There are three wells in the Basin with data reported for the time period from 1985 through 2012 (CDPR, 2020).

County Department of Environmental Health and Quality—Solid Waste Local Enforcement Agency

The County's Solid Waste Local Enforcement Agency (LEA) is certified by the California Department of Resources Recycling and Recovery (CalRecycle) to enforce State solid waste laws and regulations in the County, excluding the City. The LEA has primary responsibility for ensuring the proper operation, permitting and closure of solid waste facilities, their operations and solid waste disposal sites. The LEA is also responsible for ensuring the review and approval of post-closure land use activities at closed solid waste disposal sites. The LEA works to protect public health, safety and the wellbeing of the local community and environment from the impacts of solid waste management/recycling and disposal (County Department of Environmental Health and Quality—LEA, 2020).

Data pertaining to active and closed solid waste sites are recorded in the CalRecycle Solid Waste Information System (SWIS), which was reviewed during the development of this GSP. There is currently one active site and one closed site in the Basin, which were taken into consideration when reviewing groundwater quality conditions. However, but recorded inspections of these sites do not include data for inclusion into the GSA's Data Management System (DMS) (CalRecycle, 2020).

County Department of Environmental Health and Quality—Small Drinking Water Systems (San Pasqual Academy)

The County's Small Drinking Water Systems program protects public health by helping water system owners and operators to provide pure and safe drinking water by preventing waterborne diseases, identifying risks of bacteriological, chemical and/or radiological contamination, conducting inspections, providing technical assistance, and working in partnership with the small drinking water systems in the County. The San Diego County Department of Environmental Health has an agreement with the SWRCB's Division of Drinking Water for administration and enforcement of federal and state statutes and regulations for any water systems under 200 service connections (County Department of Environmental Health and Quality—Small Drinking Water Systems, 2020).

A review of the California Water Boards' *Drinking Water—Public Water System Information* online shows one Small Drinking Water System at the San Pasqual Academy (California Water Boards, 2020). Data from the well that supplies the San Pasqual Academy was evaluated and included in the GSA's DMS, and special considerations were made during the development of the sustainability thresholds included in this GSP (refer to Section 8, *Minimum Thresholds and Measurable Objectives* for more information).

Hazardous Materials Division Permits

The County of San Diego Department of Environmental Health and Quality—Hazardous Materials Division was formed to protect human health and the environment by ensuring that hazardous materials, hazardous waste, medical waste, and underground storage tanks are properly managed. All businesses that meet set criteria are required by law to obtain and maintain a valid Unified Program Facility Permit through the California Environmental Reporting System (County Department of Environmental Health and Quality—Hazardous Materials Division, 2020). A search of the California Environmental Reporting System was performed during development of this GSP; no sites are within the Basin.

2.2 Existing Land Use and Water Management Programs

This section describes past and current land use and water management plans and programs in the region that may interact with the SPV GSP, and describes how they may impact one another.

2.2.1 San Pasqual Valley Community Plan

The *San Pasqual Valley Plan* (Community Plan) was adopted by the City in 1995, and later amended in 1996 and 2005 (City, 1995). The Community Plan establishes a pattern of land use that serves to optimize water quality and quantity in the Basin and in downstream Hodges Reservoir, preserve the rural and agricultural character of the SPV, protect riparian and sensitive upland habitats, and create an open space park compatible with agricultural and habitat preservation (City, 1995). The Community Plan addressed water resources, flood control, and sand mining operations in the SPV, along with open space and archeological resource protection.

The sustainability goals and thresholds established in this GSP support the Community Plan's goals to protect land uses that promote water quality and quantity goals within the Basin. Adaptive management strategies in this GSP also support Community Plans effort to preserve rural and agricultural characteristics of the SPV, and protect riparian and sensitive habitats. The Community Plan also complements this GSP's sustainability goal.

Implementation of this GSP is not expected to negatively affect implementation of the Community Plan, nor is the Community Plan expected to negatively affect the GSA's ability to maintain sustainability over the implementation horizon.

2.2.2 San Pasqual Vision Plan

The *San Pasqual Vision Plan* (Vision Plan) was developed by the City in May 2004 to provide a comprehensive long-term vision for City-owned lands in the SPV (City of San Diego Planning Department, 2005). The Vision Plan is designed to influence and guide the City's land use and development decisions and serves to provide resources related to potential concepts, projects, and monitoring strategies that were incorporated in the SPV since it was written. The Vision Plan contains 10 directives that address various issues facing the SPV; its intent is to protect water resources, sustainable agricultural opportunities, rural character, cultural and historical resources, and low-impact recreational opportunities in the SPV.

Implementation of this GSP is not expected to negatively affect implementation of the Vision Plan, nor is the Vision Plan expected to negatively affect the GSA's ability to maintain sustainability over the implementation horizon.

2.2.3 San Pasqual Groundwater Management Plan

In November 2007, the City Council adopted the *San Pasqual Groundwater Management Plan* (SPGMP), which defines an adaptive groundwater management plan for the Basin (City of San Diego Water Department, 2016). As stated in the SPGMP, the goal is to "understand and enhance the long-term sustainability and quality of groundwater within the Basin, and protect this groundwater resource for beneficial uses including water supply, agriculture, and the environment." The SPGMP serves as the initial framework for coordinating the management activities into a cohesive set of basin management objectives and related actions to improve management of groundwater resources in the SPV. The City has been actively managing and implementing SPGMP recommendations in cooperation with the local community and agricultural groups (City, 2016). This GSP will supersede the SPGMP once it is adopted by the GSA. Because of this, the SPGMP will not affect GSP implementation or the ability to reach sustainability over the GSP's implementation horizon.

2.2.4 San Pasqual Groundwater Management State of the Basin Report

The City's *State of the Basin Report* (City, 2015) documents groundwater management activities performed by the City from July 2010 through 2014. The State of the Basin Report documents hydrologic conditions, as well as activities undertaken to manage long-term sustainability of the Basin's groundwater resources. It also documents ongoing implementation of the SPGMP and planned groundwater management implementation activities (City, 2015). The State of the Basin Report provides valuable resources related to potential concepts, projects, and monitoring strategies that can be incorporated into the GSP.

The State of the Basin Report is not expected to negatively affect the GSA's ability to maintain sustainability over the GSP implementation horizon. Many of its components were used to develop this GSP. Additionally, because the State of the Basin Report is primarily a status update on Basin conditions, implementation of the GSP is not expected to contradict the State of the Basin Report or its assumptions.

2.2.5 San Pasqual Valley Groundwater Basin Salt and Nutrient Management Plan

The SWRCB's *Recycled Water Policy* required Salt and Nutrient Management Plan (SNMPs) to be developed for all groundwater basins in California by May 2014. SNMPs help manage salts, nutrients, and other chemical compounds in groundwater. Development of the *San Pasqual Valley Groundwater Basin Salt and Nutrient Management Plan* (SPV SNMP) (City, 2014) involved stakeholder outreach, groundwater basin characterization, identification and quantification of salinity sources, supplemental monitoring, and assessment of salinity and nutrient management strategies.

The San Diego Regional Water Quality Control Board (RWQCB) developed guidelines for developing SNMPs in the San Diego region; these were based on characteristics such as basin storage, yield, water quality, and municipal use. The San Diego RWQCB then designated regional basins into Tiers A through E. SPV was identified as a Tier A basin (San Diego RWQCB, 2010).

The SPV SNMP provides resources related to potential concepts, projects, and monitoring strategies that could be incorporated into the GSP.

Implementation of this GSP is not expected to negatively affect the implementation of the SPV SNMP, nor is the SPV SNMP expected to negatively affect the GSA's ability to maintain sustainability over the implementation horizon.

2.2.6 San Diego County General Plan

The *County of San Diego General Plan* (General Plan), adopted in 2011, provides a framework for the future growth and development of the unincorporated areas of the County (County Land Use and Environment Group—Planning & Development Services, 2018). The General Plan is based on a set of guiding principles designed to protect the County's unique and diverse natural resources and maintain the character of its rural, semi-rural, and village communities. It describes the County's goals of taking an environmentally sustainable approach to plan and balance the need for adequate infrastructure, housing, and economic vitality, while maintaining and preserving each unique community within the County, agricultural areas, and extensive open space. The General Plan also provides resources related to potential concepts, projects, and monitoring strategies that have been incorporated into the GSP during development.

Lands in unincorporated County jurisdiction that are groundwater dependent (outside the boundary of the San Diego County Water Authority and/or a water district) in the Basin are limited to (1) nearly 200 acres in Rockwood Canyon including a few parcels south of Rockwood Canyon, (2) less than 25 acres of land in Bandy Canyon, and (3) the County owned San Pasqual Academy. The Rockwood Canyon and Bandy Canyon have a Rural Lands (RL-40) General Plan Land Use

Designation, which allows a maximum of one single-family dwelling per 40 acres. The San Pasqual Academy has a Public/Semi-Public Facilities General Plan Land Use Designation. There are three single-family residences in the Rockwood Canyon area (including the few parcels south of Rockwood Canyon). There is a nearly 150-acre portion that is not developed north of SR-78 that could potentially be subdivided to have a maximum buildout of three residential dwelling units in the Basin. Bandy Canyon has less than 25 acres of land which could potentially support a maximum of one residential dwelling unit. San Pasqual Academy is a public facility and would not be subject to future residential subdivision. Given there are only three single-family residences in the basin and very limited residential development potential that would be reliant on groundwater, implementation of this GSP is not expected to negatively affect the implementation of the General Plan, nor is the General Plan expected to negatively affect the GSA's ability to maintain sustainability over the implementation horizon.

2.2.7 City Urban Water Management Plan

DWR requires Urban Water Management Plans (UWMPs) to be prepared by urban water suppliers every 5 years to ensure that adequate water supplies are available to meet existing and projected water needs. In their respective UWMPs, urban water suppliers must assess the reliability of water sources over a 20-year planning time frame. The *City of San Diego 2015 Urban Water Management Plan* (2015 UWMP) (City Public Utilities Department [PUD], 2016) is described here; the 2020 UWMP is currently under development.

The 2015 UWMP details the City's water system, water demands, sources of water supplies, water conservation efforts, climate change impacts, energy intensity, water shortage contingency planning, and projected water supply reliability during normal, dry, and multi-year drought conditions (City PUD, 2016). The 2015 UWMP was developed not only to meet regulatory requirements, but also to serve as an overarching water resources planning document for the City's residents, businesses, interest groups, and public officials. The 2015 UWMP's objective is to ensure adequate water supplies are available to meet existing and future water demands, which directly complement GSP objectives. The 2015 UWMP promotes efficient use of the water supply and strengthens GSP goals of providing a long-term sustainable supply of groundwater for beneficial uses. Implementation of this GSP is not expected to negatively affect implementation of the 2020 UWMP or the 2015 UWMP, nor is the UWMP expected to negatively affect the GSA's ability to maintain sustainability over the implementation horizon.

2.2.8 San Diego Integrated Regional Water Management Plan

The *2019 San Diego Integrated Regional Water Management Plan* (2019 IRWM Plan) (Regional Water Management Group, 2019) is an integrated, regional water plan for the San Diego region. The 2019 IRWM Plan identifies regionally and locally focused projects that help achieve regional objectives and address water management including water supply reliability, improving water quality, and protecting natural resources. It also provides resources related to potential concepts, projects, and monitoring strategies that can be incorporated into the GSP.

Implementation of this GSP is not expected to negatively affect the implementation of the 2019 IRWM Plan, nor is the 2019 IRWM Plan expected to negatively affect the GSA's ability to maintain sustainability over the implementation horizon.

2.3 Plan Elements from California Water Code Section 10727.4

Table 2-1 below lists plan elements from CWC Section 10727.4, and their location in this GSP if the element is managed under this GSP.

Table 2-1. Plan Elements from CWC Section 10727.4

Element	Location
Control of saline water intrusion	Not applicable.
Wellhead protection areas and recharge areas	Not included; this is a County authority.
Migration of contaminated groundwater	Section 9, *Projects and Management Actions*
A well abandonment and well destruction program	Not included; this is a County authority.
Replenishment of groundwater extractions	Further evaluation of replenishment opportunities is included in Section 9, *Projects and Management Actions*
Activities implementing, opportunities for, and removing impediments to, conjunctive use or underground storage.	Not included.
Well construction policies.	Not included; this is a County authority.
Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects.	Section 9, *Projects and Management Actions*, and coordination with the City, County, and/or RWQCB.
Efficient water management practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use.	Section 9, *Projects and Management Actions*, and coordination with the City, County, and/or RWQCB.
Efforts to develop relationships with state and federal regulatory agencies.	Section 9, *Projects and Management Actions*, and coordination with the City, County, and/or RWQCB.
Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity.	Not included; land use planning is under City and County jurisdictions.
Impacts on groundwater dependent ecosystems.	Section 4, *Groundwater Conditions*, and Section 9, *Projects and Management Actions*

Section 3. HYDROGEOLOGIC CONCEPTUAL MODEL

This section describes the SPV Basin's hydrogeologic conceptual model (HCM). As defined in DWR's *Best Management Practices for the Sustainable Management of Groundwater—Hydrogeologic Conceptual Model* (HCM BMP) (DWR, 2016), the Basin's HCM provides the following:

- An understanding of the general physical characteristics related to the regional hydrology, land use, geologic structure, water quality, principal aquifers, and principal aquitards of the Basin setting
- The context to develop water budgets, mathematical models, and monitoring networks
- A tool for stakeholder outreach and communication.

This section discusses topography, surface waters, recharge, and soils in the Basin. It also describes the Basin's geologic history and setting, discusses geologic formations present in and around the Basin, and identifies the primary aquifer and its characteristics.

The Basin is in the Peninsular Ranges Geomorphic Province, and is located in the foothills west of the Peninsular Range and east of the coastal plain. The Basin, which is narrow and curved, is approximately 9 miles long and bounded on all sides by hills composed primarily of Cretaceous-aged granitic rocks (i.e., tonalite, monzogranite, and granodiorite). The hills surrounding the Basin are 200 to 1,000 feet higher than the Basin's level.

3.1 Topography, Surface Water Bodies, and Recharge

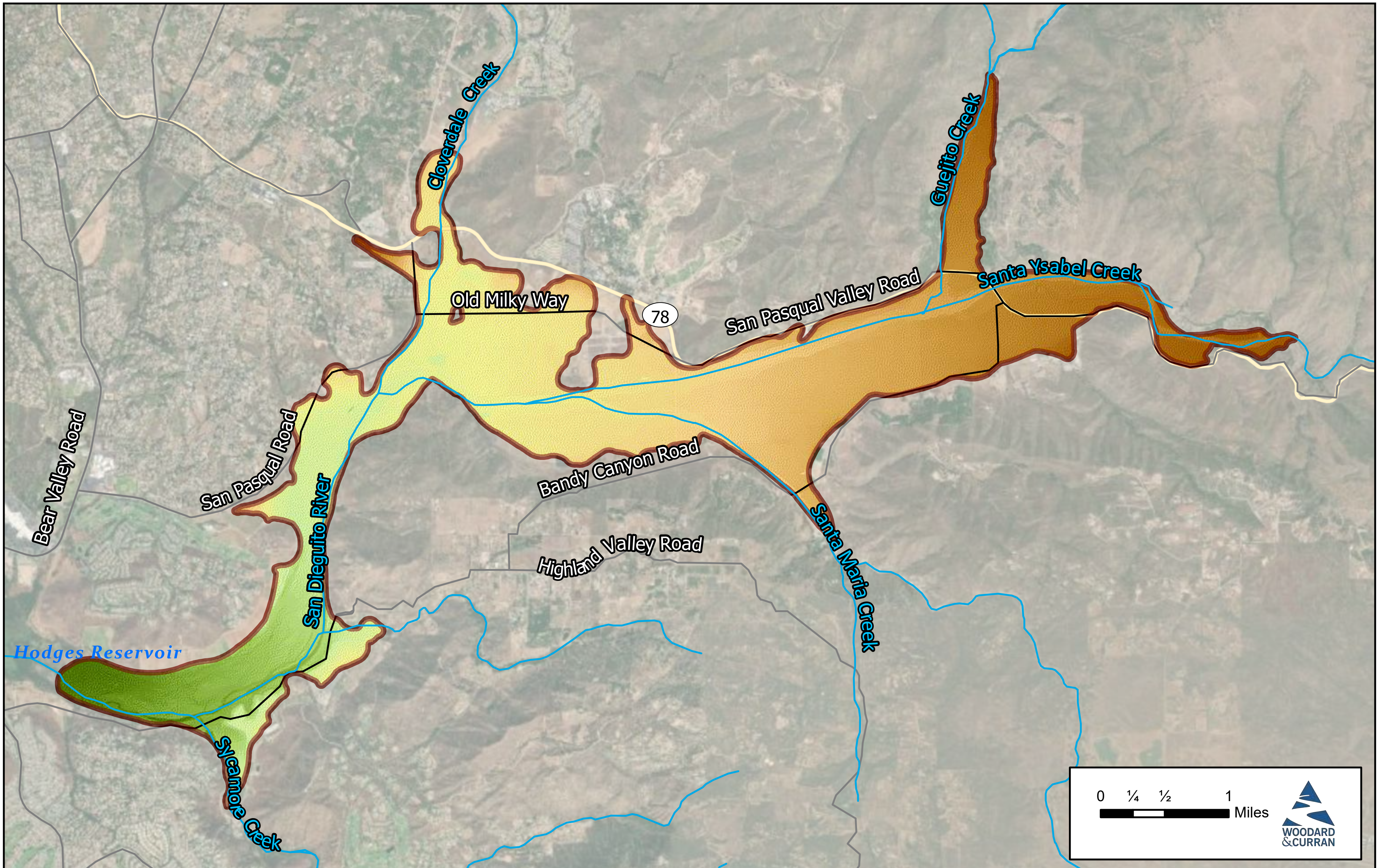
This section describes the topography, surface water, soils, and groundwater recharge potential in the Basin.

3.1.1 Topography

Figure 3-1 shows the Basin's topography. The topography of the Basin can be characterized as gently sloping with an overall topographic gradient of 0.003 feet per foot toward the west. The tributaries entering the Basin from the north and south are of a similar gradient. Surface elevations range from approximately 500 feet above mean sea level (the North American Vertical Datum of 1988) where Santa Ysabel Creek enters the SPV through a narrow canyon in the eastern portion of the Basin to approximately 320 feet above mean sea level in the west where the Basin discharges to Hodges Reservoir.

3.1.2 Surface Water Bodies

Surface water bodies in the Basin are limited to streams. These streams are generally ephemeral in nature and typically only flow in response to rain events primarily in winter or during years of above-average precipitation. Guejito Creek flows into Santa Ysabel Creek and the confluence of Santa Maria and Santa Ysabel Creeks coincides with the start of the San Dieguito River, which flows southwest into Hodges Reservoir. Cloverdale and Sycamore Creeks from the north and south flow into the San Dieguito River, while Santa Ysabel Creek enters the Basin from the east. Figure 3-2 shows the locations of streams in the Basin.



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San Pasqual Valley Basin

Elevation (ft)

500

300

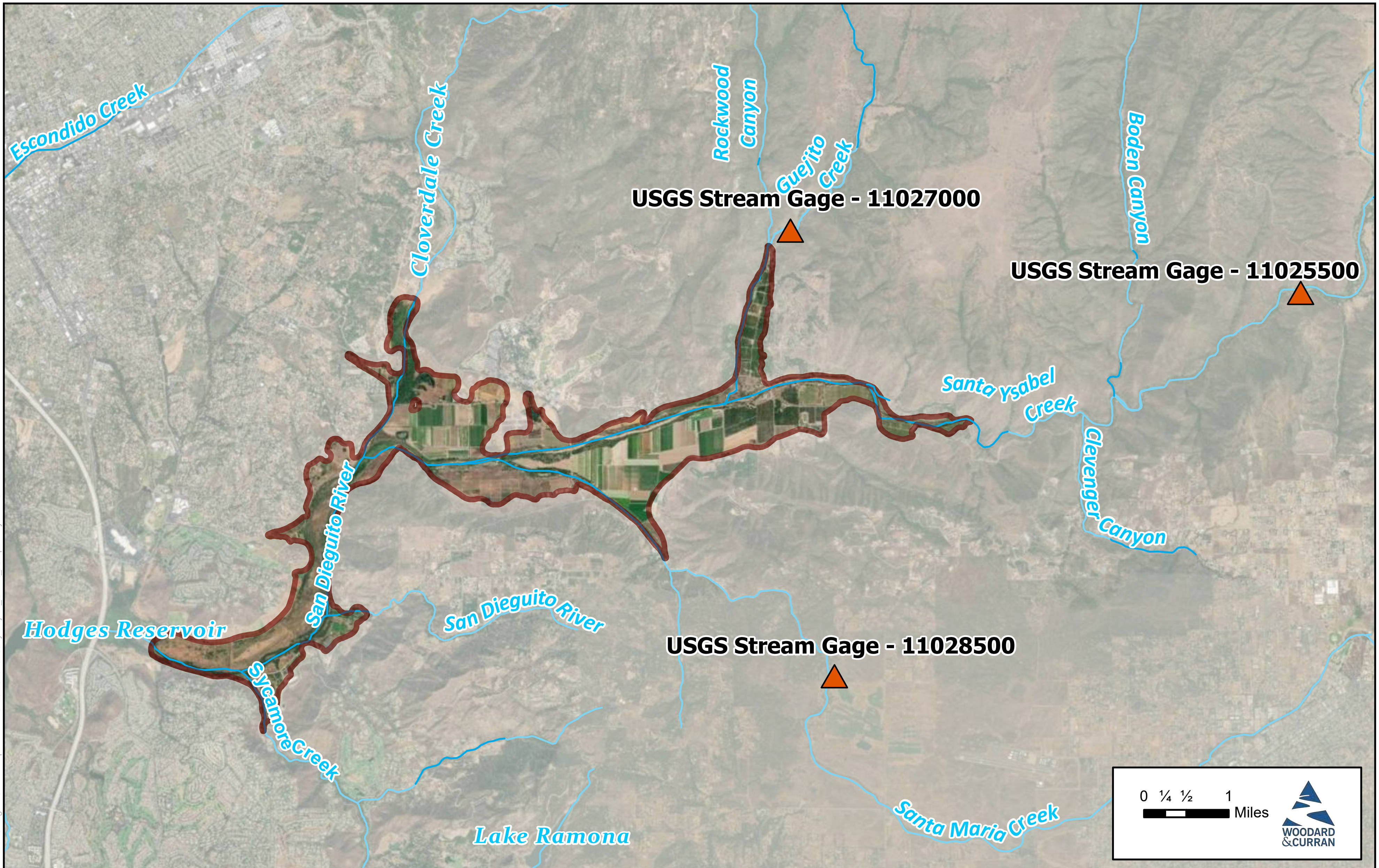
*Vertical datum is NAVD88

N

Figure 3-1

San Pasqual Valley GSP

Topography



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- San Pasqual Valley Basin
- Active USGS Stream Gage Station
- Streams

N

Figure 3-2

San Pasqual Valley GSP

Surface Water Bodies

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Figure Exported: 9/20/2021 By: gvalenzuela Using: D:\San Pasqual From GIS3 20201013\MyProject_GSP2_v3.aprx Layout: F3-2 - Surface Waters

Santa Ysabel Creek, regulated by Sutherland Dam upstream of the Basin, flows approximately 100 days during the year with an average annual discharge of 510 acre-feet per year (AFY). Guejito Creek flows, unregulated, roughly 145 days per year with an average annual discharge of 290 AFY. Santa Maria Creek has a median discharge of 145 AFY and flows about 50 days per year; although some years it does not flow at all. Cloverdale Creek flows perennially owing to irrigation runoff from avocado groves on the surrounding hillside (USGS, 1983).

The creeks' average annual discharges are much greater than their median annual discharge by an order of magnitude, suggesting that much of the flow through the drainages occurs from infrequent high flows due to storms and that the base flow during much of the year is low or nonexistent.

Figure 3-2 shows the location of USGS stream gages. Figure 3-3 through Figure 3-5 show the flow rates of Guejito, Santa Maria, and Santa Ysabel Creeks. Stream gage data show that substantial flows only occur during the winter and spring months, as is common in Mediterranean climates, and that most stream reaches do not flow during drought periods (e.g., 2014 to 2015).

3.1.3 Areas of Recharge, Potential Recharge, and Groundwater Discharge

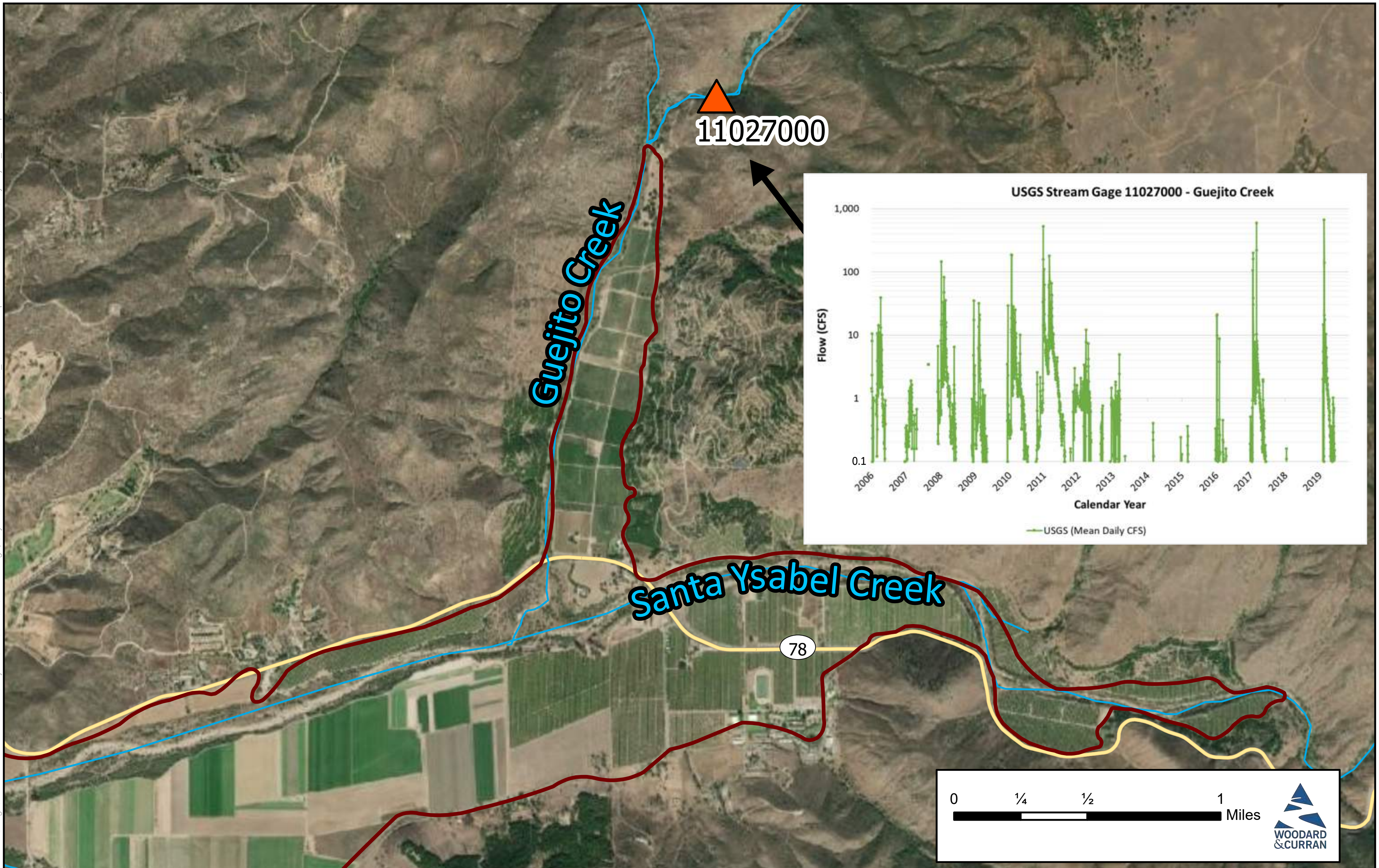
Recharge to the Basin comes in the form of infiltration from precipitation, recharge of applied water, and infiltration of surface flow from Santa Ysabel Creek and the tributary streams of Guejito, Santa Maria, and Cloverdale Creeks. Additionally, groundwater flow from the surrounding bedrock into the Basin likely contributes some amount of recharge into the Basin. Section 5, *Water Budgets*, provides further discission of these recharge components.

Areas in the Basin with the highest potential recharge include margins where bedrock meets unconsolidated materials at the edge of the Basin. When rainfall occurs over bedrock, much of the water is unable to infiltrate, and flows downslope until it reaches unconsolidated material at the edge of the Basin where infiltration rates are higher. Where more permeable materials overlie bedrock around the Basin, rainfall infiltrates these permeable materials, and much of the water flows along the bedrock contact until it reaches the Basin's unconsolidated materials.

Additional areas of potential recharge are located where the soils overlying the Basin have high infiltration capacities. Figure 3-6 shows the distribution of soil infiltration capacities in the Basin. Most of the Basin has soils with high infiltration capacities (i.e., 10–100 micrometer [μm]/second), with only the western edge of the Basin near Hodges Reservoir having very low (i.e., 0–0.01 μm/second) infiltration capacities.

The Soil Agricultural Groundwater Banking Index (SAGBI) is another indicator of recharge potential. The SAGBI is a measure of the suitability of agricultural lands for groundwater recharge. Figure 3-7 shows the distribution of the SAGBI in the Basin. Most agricultural land the Basin is rated excellent for groundwater recharge.

Groundwater discharges in the Basin occur though pumping, shallow groundwater uptake from plants, and discharge to streams in gaining reaches, and to a lesser extent, subsurface outflow to Hodges Reservoir. Groundwater also discharges from the alluvium and residuum to fractured bedrock where downward hydraulic gradients occur. Groundwater discharge to streams occurs primarily in the western end of the Basin where the water table intersects the streambeds. Groundwater discharge to vegetation on the land surface also occurs, such as at the marsh area near the intersection of Bandy Canyon and Ysabel Creek Roads. Section 5, *Water Budgets*, provides further discission of these discharge components.



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San Pasqual Valley Basin

Lakes/Reservoirs

USGS Active Gaging Station

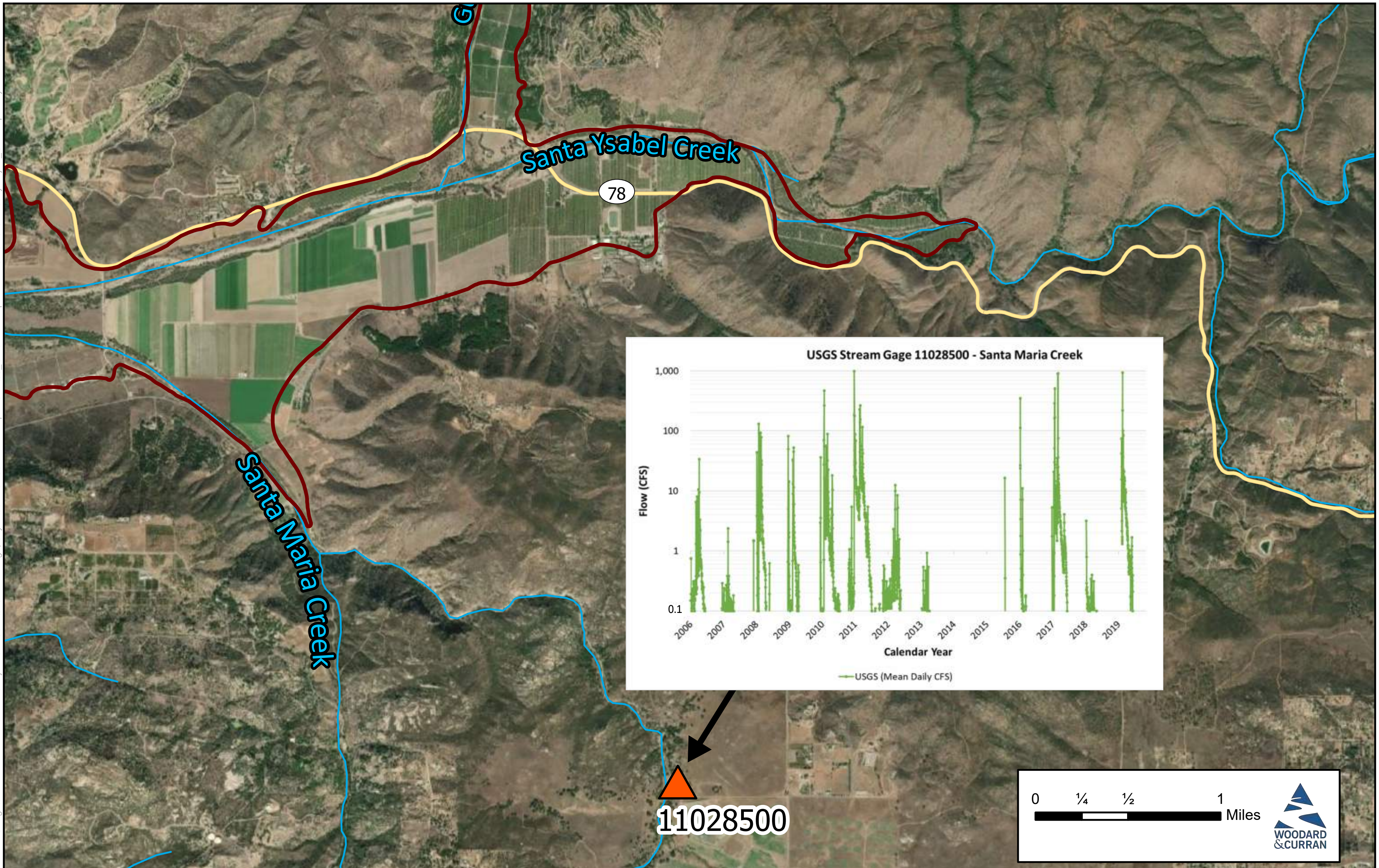
CFS = cubic feet per second

N

Figure 3-3

San Pasqual Valley GSP

USGS Stream Gage 11027000-Guejito Creek



SAN DIEGO

Project #: 0011197

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San Pasqual Valley Basin

Lakes/Reservoirs

USGS Active Gaging Station

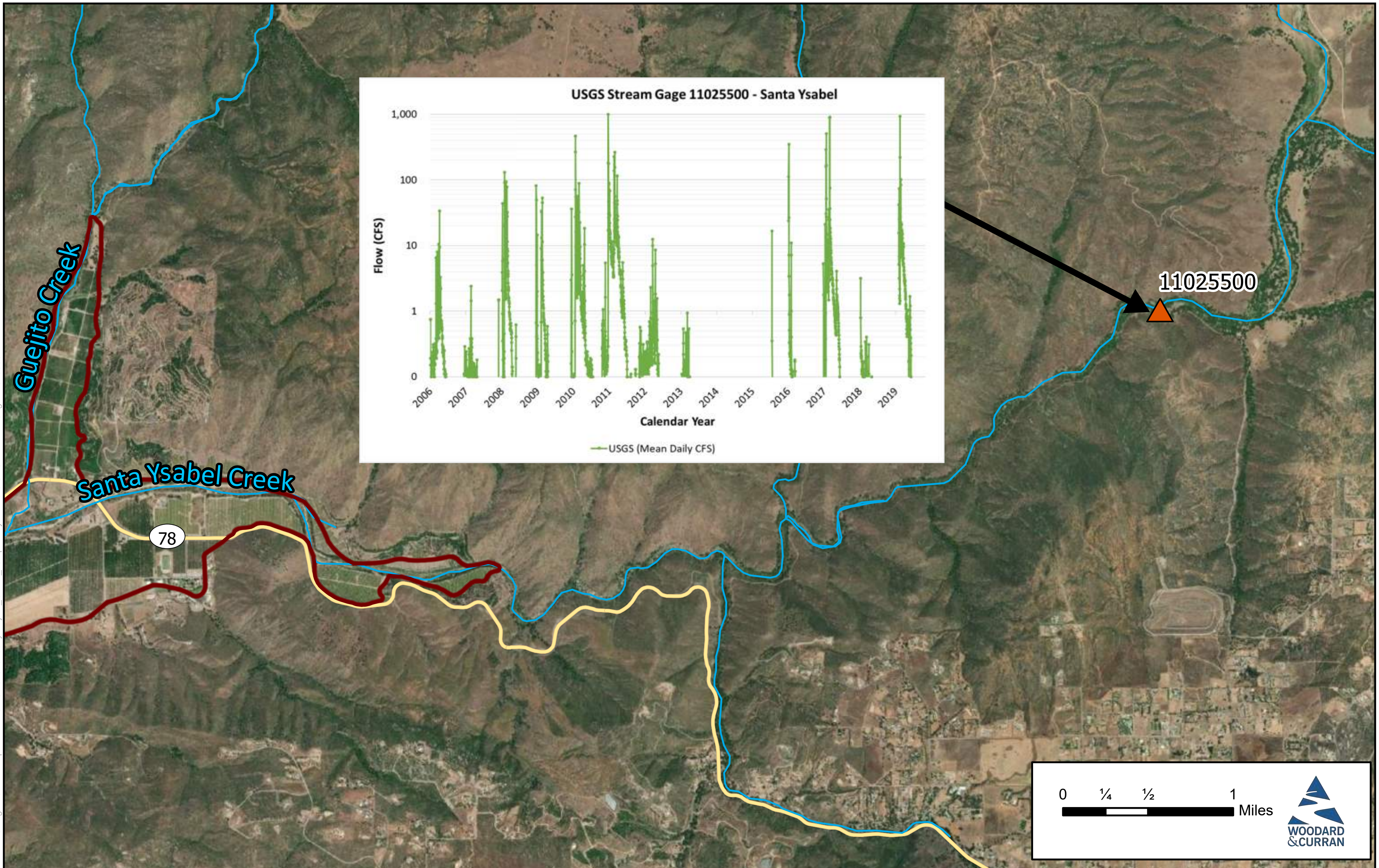
CFS = cubic feet per second

N

Figure 3-4

San Pasqual Valley GSP

USGS Stream Gage 11028500-Santa Maria Creek



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Legend

- San Pasqual Valley Basin
- Lakes/Reservoirs
- USGS Active Gaging Station

CFS = cubic feet per second

N

Figure 3-5

San Pasqual Valley GSA

USGS Stream Gage
11025500-Santa Ysabel Creek

Figure Exported: 9/21/2021 By: gvalenzuela Using: D:\San Pasqual From GIS3 20201013\MyProject_GSP2_v3.aprx Layout: F3-5 USGS Stream Gage 11025500—Santa Ysabel Creek

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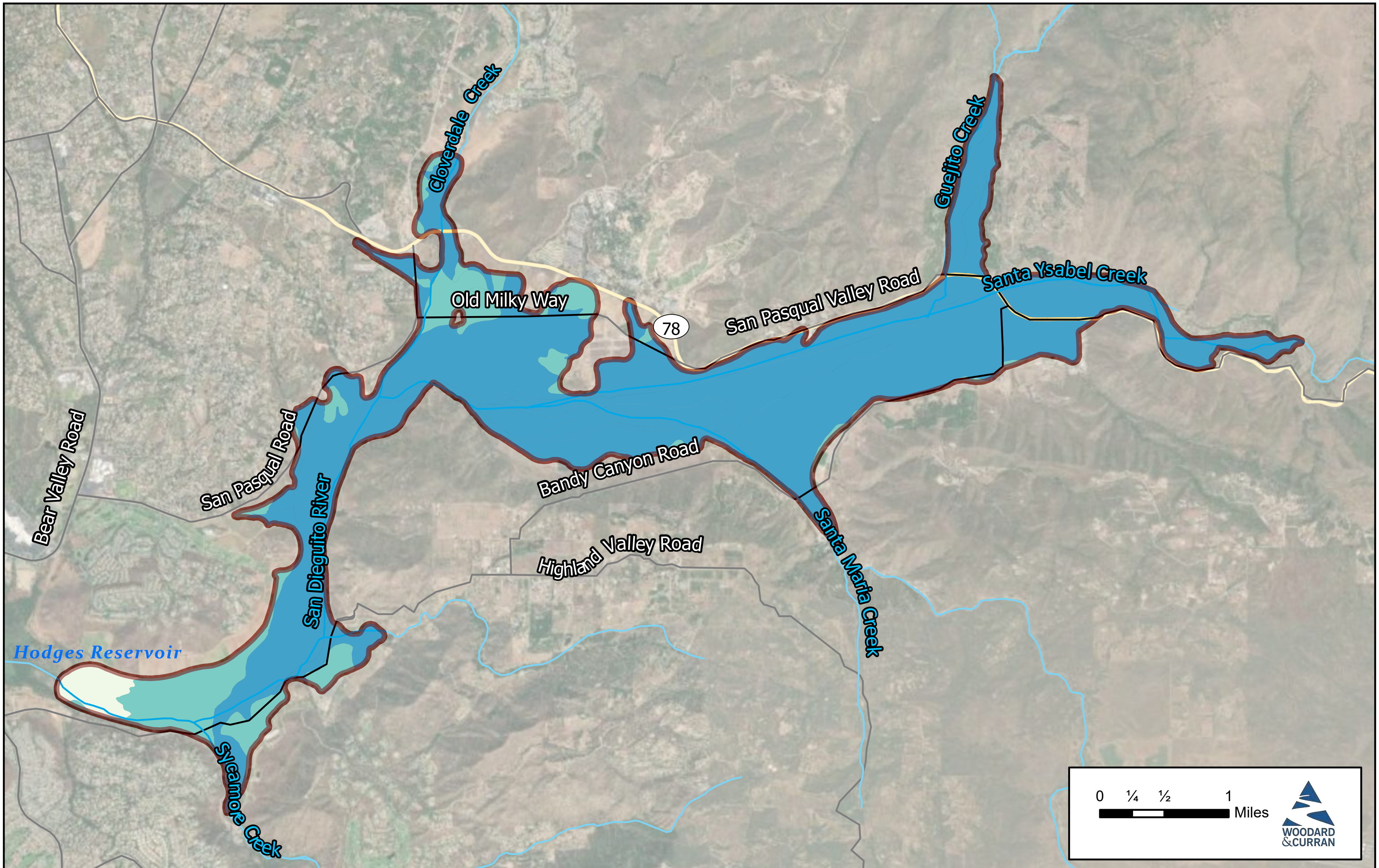

SAN DIEGO

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Legend

San Pasqual Valley Basin

Infiltration Capacity (micrometer per second)

- Very Low: 0-0.01
- Low: 0.01-0.1
- Moderately Low: 0.1-1
- Moderately High: 1-10
- High: 10-100
- Very High: 100+

N

Figure 3-6

San Pasqual Valley GSP

Soil Infiltration Capacities

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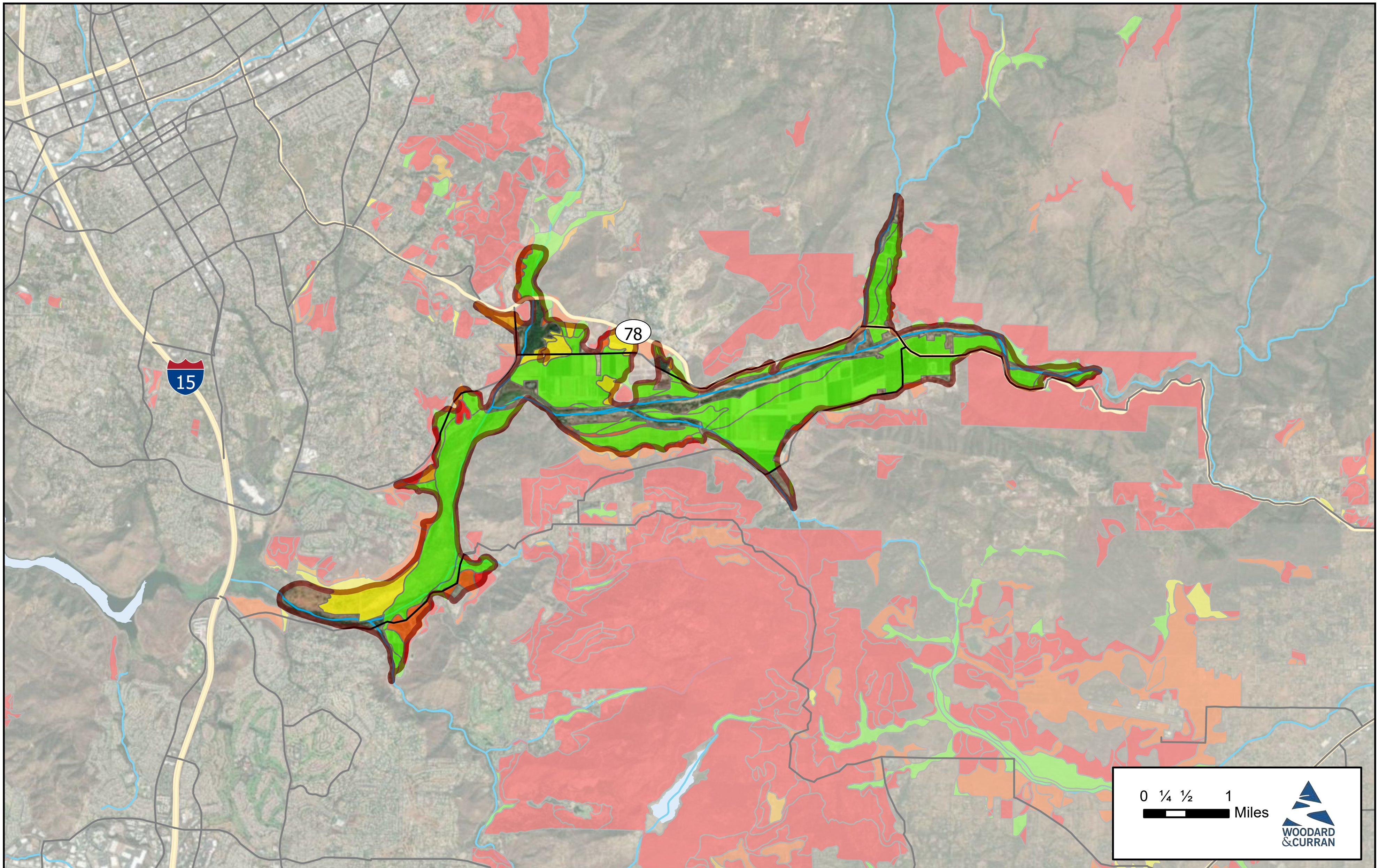

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Legend

San Pasqual Valley Basin

Soil Agricultural Groundwater Banking Index (SAGBI) Rating Group

- Excellent
- Good
- Moderately Good
- Moderately Poor
- Poor
- Very Poor

N

Figure 3-7

San Pasqual Valley GSP

Soil Agricultural Groundwater Banking Index (SAGBI)

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3.1.4 Soils

Soil types are shown in Figure 3-8, and the key for the soil map is shown in Figure 3-9. Soil in the Basin consists of primarily Visalia-Tujunga soils with a small proportion (i.e., less than 5 percent) of Ramona soils in the area where Cloverdale Creek enters the main part of the Basin. The Visalia-Tujunga soils present in the Basin and have a high infiltration capacity (i.e., 2 to 6.3 inches per hour for Visalia, and greater than 20 inches per hour for Tujunga soils) and are relatively thick (i.e., greater than 5 feet). The Ramona soils are atypical for this area and are thick (i.e., 5 feet or greater) but have low infiltration capacities (i.e., 0.2 to 0.6 inches per hour).

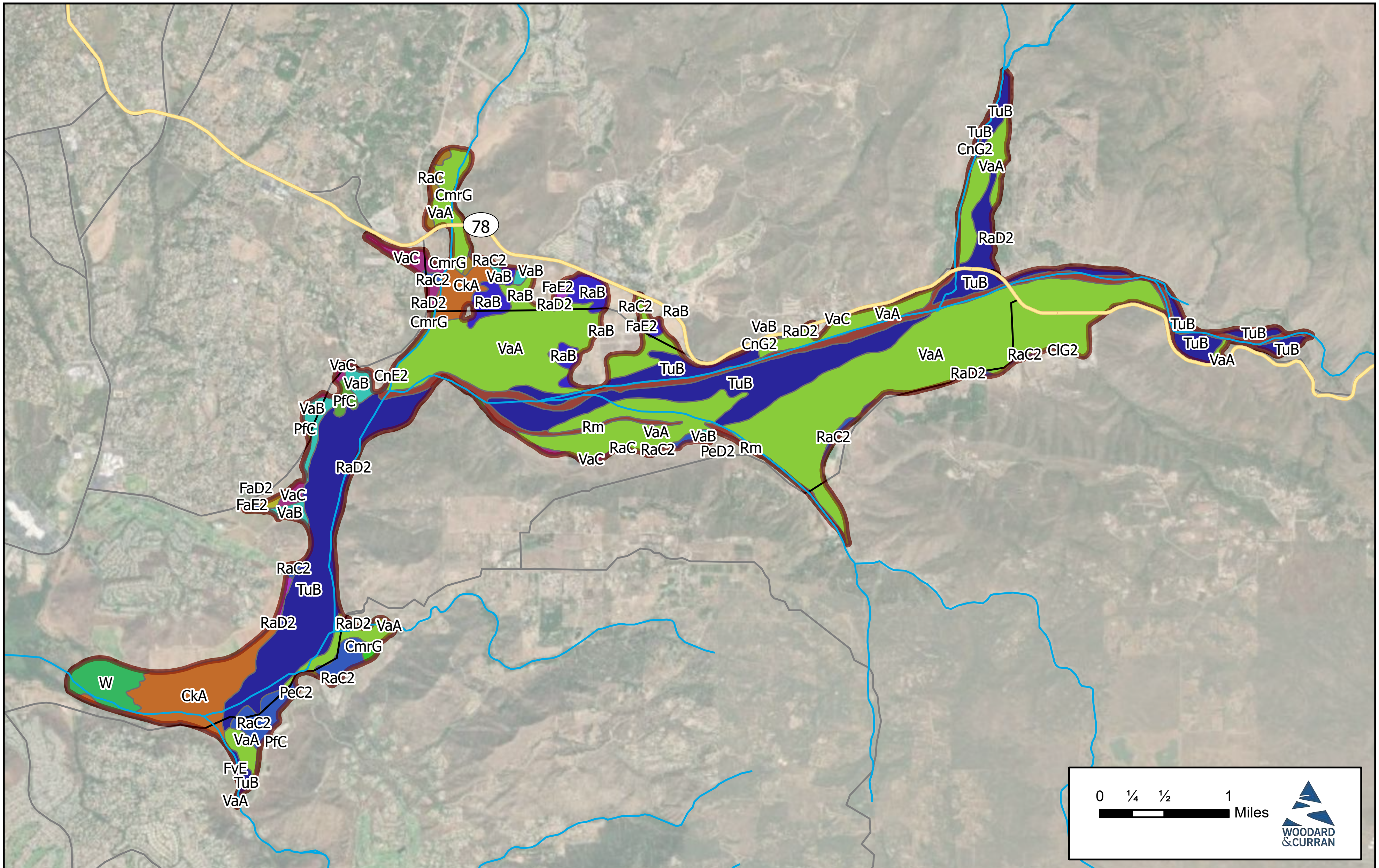
3.2 Geologic History

The Basin is located in Peninsular Ranges geomorpic providence of southern California. The Peninsular Ranges are characterized by steep mountain highlands draining to intermontane basins, valleys, and rivers. Cretaceous intrusive rocks of the Peninsular Range batholith form the highlands areas. Uplift, combined with lower sea levels during the Quaternary, caused further erosion and incision of rivers and streams into the intrusive bedrock bounding the Basin. Alluvium and colluvium derived from the weathered intrusive rocks in the surrounding watershed were subsequently deposited within the valley forming the Basin.

3.3 Geologic Formations

DWR, in their report *San Pasqual Valley Groundwater Basin Groundwater Monitoring Network Assessment and Recommendations* (DWR, 2011), summarizes three geologic groupings in the vicinity of the Basin: Quaternary Deposits, Residuum, and Crystalline Rock. Figure 3-10 shows the surficial extent of the Quaternary Deposits, Residuum, and Crystalline Rock as grouped by DWR and USGS (USGS, 1983). The three groupings are summarized below.

- **Quaternary Deposits—**Quaternary Deposits, which are referred to as “alluvial aquifer” in USGS’s Evaluation of the San Dieguito, San Elijo, and San Pasqual Hydrologic Subareas for Reclaimed Water Use, San Diego County, California (USGS, 1983) and are commonly referred to as “Alluvium” include geologic units that were deposited by streams and processes during Quaternary time. These deposits include stream bed deposits, flood deposits, and active creek beds, called wash deposits. They also include sands and gravels with minor amounts of silt and clay. Some clay layers are found interbedded with sand and gravel deposits, but the clay layers do not appear to be continuous throughout the Basin (DWR, 2011). This grouping also includes older (Pleistocene) fluvial and colluvial deposits.
- **Residuum—**Residuum, which is referred to as “residual aquifer” in USGS’ 1983 report, includes variably weathered crystalline rocks, which generally underlie the Quaternary Deposits and overlie the Crystalline Rock. In general, Residuum is comprised of weathered Crystalline Rock that has not been extensively reworked by streams.
- **Crystalline Rock—**Crystalline Rock includes the igneous rocks rocks of the Southern California Batholith, which locally consist primarily of granodiorite, tonalite, and monzogranite.



San Pasqual Valley Basin

See Figure 3-9 for key to soil units in this map

Legend

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Project #: 0011197

Figure 3-8

San Pasqual Valley GSP

Soil Units

Unit Symbol

- CkA-Chino silt loam, saline, 0 to 2 percent slopes
- CmrG-Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes
- ClG2-Cieneba coarse sandy loam, 30 to 65 percent slopes, eroded
- CnE2-Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent slopes, eroded
- CnG2-Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent slopes, eroded
- FaD2-Fallbrook sandy loam, 9 to 15 percent slopes, eroded
- FaE2-Fallbrook sandy loam, 15 to 30 percent slopes, eroded
- FvE-Fallbrook-Vista sandy loams, 15 to 30 percent slopes
- PeC2-Placentia sandy loam, 5 to 9 percent slopes, eroded
- PeD2-Placentia sandy loam, 9 to 15 percent slopes, eroded
- PfC-Placentia sandy loam, thick surface, 2 to 9 percent slo pes
- RaB-Ramona sandy loam, 2 to 5 percent slopes
- RaC-Ramona sandy loam, 5 to 9 percent slopes
- RaC2-Ramona sandy loam, 5 to 9 percent slopes, eroded
- RaD2-Ramona sandy loam, 9 to 15 percent slopes, eroded
- Rm-Riverwash
- TuB-Tujunga sand, 0 to 5 percent slopes
- VaA-Visalia sandy loam, 0 to 2 percent slopes
- VaB-Visalia sandy loam, 2 to 5 percent slopes
- VaC-Visalia sandy loam, 5 to 9 percent slopes
- VvE-Vista rocky coarse sandy loam, 15 to 30 percent slopes
- W-Water

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Legend

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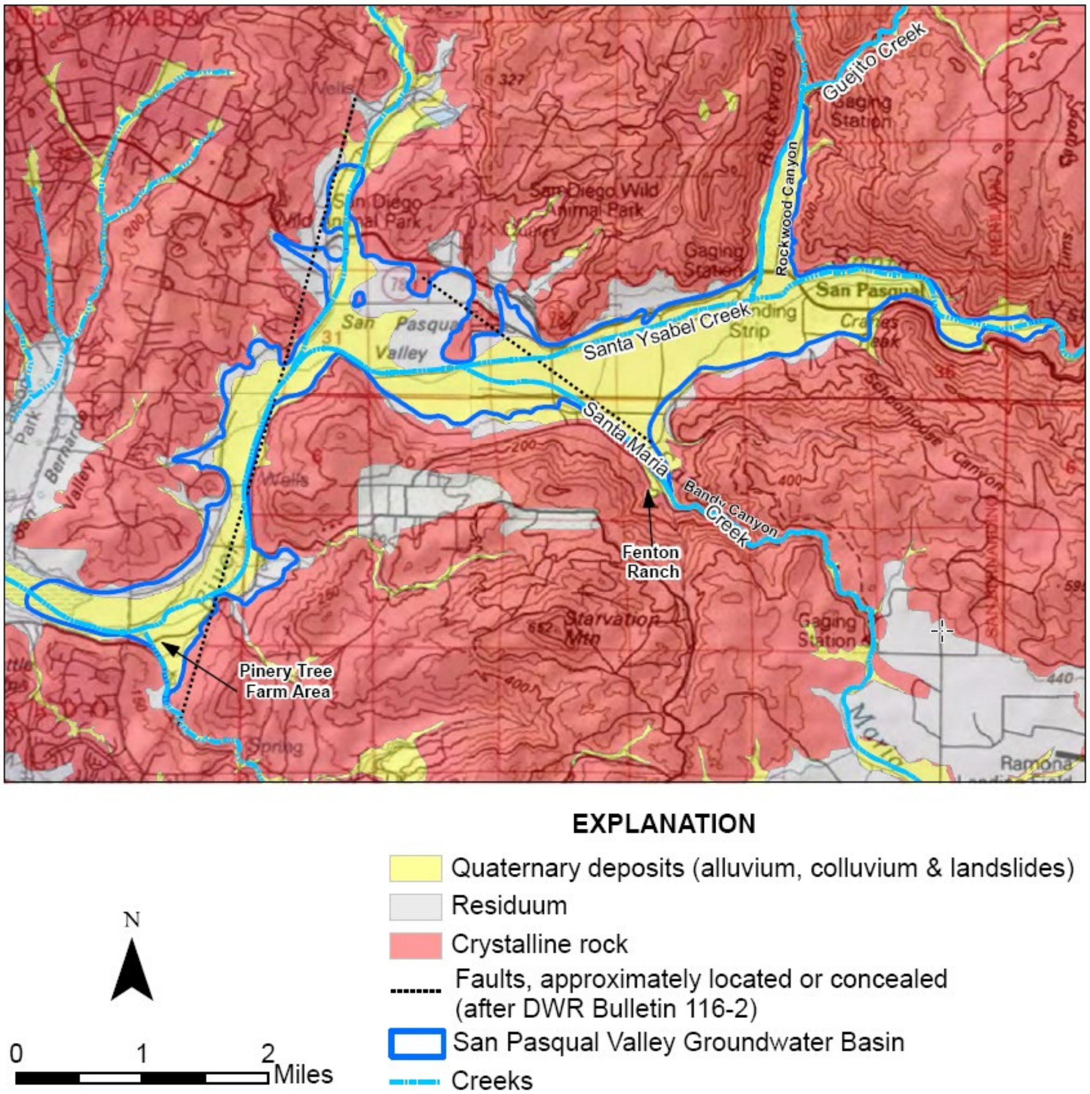
Figure 3-9

San Pasqual Valley GSP

Key for Figure 3-8



Source: DWR, 2011

Figure 3-10. Simplified Geologic Map and Faults

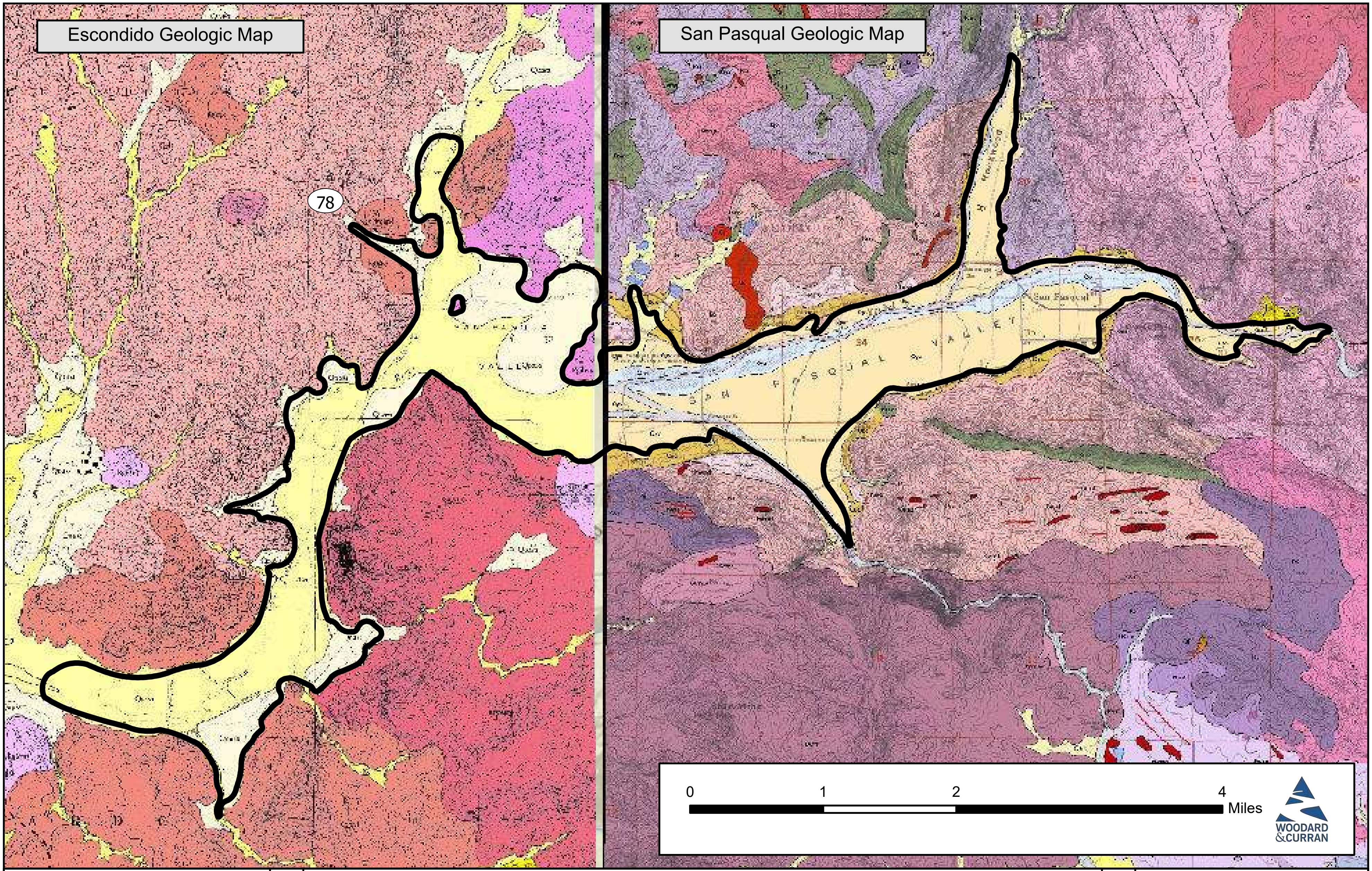
Two detailed geologic maps prepared by USGS and California Department of Conservation (CDC) cover the SPV Basin. These two maps cover the Escondido Quadrangle (USGS and CDC, 1999) and the San Pasqual Quadrangle (USGS and CDC, 2007). Figure 3-11 shows the extents of the two geologic maps where they cover the SPV Basin, and Figure 3-12 shows the map key from the Escondido Quadrangle geologic map. Figure 3-13 through Figure 3-15 provide the map key from the San Pasqual Quadrangle. These two quadrangle scale maps were prepared by different cartographers, and align in the locations of the alluvium and crystalline rocks. However, they disagree on some interpretations of specific formation details. A correlation of the major groupings and the units identified in the three maps is shown in Table 3-1.

3.4 Geologic Faults

There are two known geologic faults in the Basin. One fault trends approximately north through San Pasqual Narrows and into Cloverdale Canyon. The second fault trends northwest from Bandy Canyon through the central part of the Basin. These faults do not affect groundwater flow or well yields in the area (DWR, 2011). Neither of the faults is considered active. Figure 3-10 (above) shows the locations of the two faults.

Table 3-1. Correlation of Units in Geologic Maps

Grouping Name (DWR 2011)	Grouping Name (USGS 1983)	Quadrangle Map	Geologic Age	Unit Name
Quaternary Deposits	Alluvial Aquifer	DWR, 2011	Holocene to Pleistocene	Quaternary Deposits
		USGS and CDC, 1999	Holocene	Younger alluvial flood plain deposits
				Younger colluvial and stream deposits
		USGS and CDC, 2007		Young alluvial valley deposits
				Wash deposits
		USGS and CDC, 1999	Pleistocene	Older alluvial river deposits
		USGS and CDC, 2007		Old colluvial deposits
Residuum	Residual Aquifer	DWR, 2011	Holocene to Tertiary(?)	Residuum
Crystalline Rock	Crystalline Rocks	DWR, 2011	Cretaceous	Crystalline Rock
		USGS and CDC, 1999		Miscellaneous granodiorite
				Escondido Creek Leucogranodiorite
				Woodson Mountain Granodiorite
				Lake Wolford Leucogranodiorite
				Green Valley Tonalite
				San Marcos Gabbro
		USGS and CDC, 2007		Cuyamaca Gabbro
				Corte Madera Monzogranite
				Woodson Mountain Granodiorite
				Lake Wolford Granodiorite
				Tonalite of Alpine
				Japatul Valley Tonalite
				Las Bancas Tonalite



Legend

San Pasqual Valley Basin

See following figures for geologic keys of each Quadrant

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Figure 3-11

San Pasqual Valley GSP

Geologic Map

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions.
Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** CDC CGS/USGS.

DESCRIPTION OF MAP UNITS

Qlsc	Active (Holocene) lake (lacustrine) deposits; mostly submerged and manmade; sc – silty clay with sand and gravel.
Qyasa	Younger (Holocene, not active) alluvial flood plain deposit; unconsolidated sediments; sa – silty sand with clay.
Qycsa	Younger (Holocene, not active) colluvial (slope wash) and stream deposits; along small drainage courses; sa – silty sand with clay and gravel.
Qls	Landslide (Pleistocene to Holocene) deposits; subject to renewed slope failure. Querried where existence is questionable.
Qoasa	Older (Pleistocene, younger than 500,000 years) alluvial river deposits; moderately consolidated sediments; sa – siltly sand with gravel and clay.
Qofag	Older (Pleistocene, younger than 500,000 years) alluvial fan, debris flow and talus deposits; ag – sandy gravel with silt and clay.
Tmv	Mission Valley Formation (late Eocene) - Friable, light olive gray, fine to medium grained sandstone with interbeds and tongues of dark greenish-gray sandy claystone and cobble conglomerate. The conglomerate represent tongues of the Stadium conglomerate and comprise up to 30 percent of the section in the easternmost exposures but less than 1 percent in the westernmost exposures. Includes the Sweetwater Formation.
Tst	Stadium Conglomerate (middle-Eocene) - Massive cobble conglomerate with a dark yellowish-brown coarse-grained sandstone matrix.
Tf	Friars Formation (middle and late Eocene) - Massive, yellowish gray, medium grained, poorly indurated sandstone interlayered with dark greenish-gray sandy claystone.
Kgd	Miscellaneous granodiorite: undifferentiated types of granodiorite with minor tonalite.
Kg(e)	Escondido Creek leucogranodiorite: fine-grained light-colored rocks ranging from leucogranodiorite to leucotonalite, with minor granodiorite and tonalite.
Kg(wm)	Woodson Mountain granodiorite: coarse-grained light-colored granodiorite with some finer-grained granodiorites and minor tonalite.
Kg(lw)	Lake Wolford leucogranodiorite: fine-grained light-colored granodiorite with some coarser-grained granodiorite and minor tonalite.
Kg(gv)	Green Valley tonalite: medium-grained gray tonalite with minor granodiorite, gabbro and other basic igneous rocks.
Kg(sm)	San Marcos gabbro: fine to coarse-grained rocks ranging from troctolite to quartz norite, with minor tonalite.
KJI	Intrusive rocks of the Santiago Peak Volcanics: fine-grained granodiorite and related rocks, with minor amounts of rocks listed under KJsp and KJm.
KJsp	Undifferentiated Santiago Peak Volcanics: mildly metamorphosed volcanic and volcaniclastic rocks. Volcanic rocks range from basalt to rhyolite, but are predominantly andesite. It also contains rocks listed under KJi and KJm.
KJm	Undifferentiated Metasedimentary rocks: quartzite with some mildly metamorphosed rocks (schist, argilite, slate, phyllite, etc.). It also contains rocks listed under KJsp and KJi.

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Figure 3-12

San Pasqual Valley GSP

Key for Escondido Geologic Map

af **Artificial fill (late Holocene)** - Includes earth dam structure at Lake Ramona, and engineered fill, asphalt and concrete paving at Ramona Airport airstrip.

Qw_2 **Wash deposits (late Holocene)** - Unconsolidated sand and gravel deposited in active washes. Consists of light brownish-gray (2.5Y 6/2) to grayish-brown (10YR 5/2), fine- to medium-grained sand, silt, and coarse sand to fine gravel. Sand is angular to sub-angular, micaceous, and is primarily derived from local bedrock. Subject to localized reworking and new sediment deposition during winter storms.

Qw_1 **Wash deposits (late Holocene)** - Unconsolidated sand and gravel deposited in intermittently active washes. Consists of light brownish-gray (2.5Y 6/2), fine- to medium-grained sand, silt, and coarse sand to fine gravel. Sand is angular to sub-angular, micaceous, and is primarily derived from local bedrock. Subject to periodic flooding of bordering Qw_2 wash deposits.

Qa **Axial channel deposits (late Holocene)** – Unconsolidated sand, gravel, silt and clay deposited in active and recently active canyon and valley drainages. Consists of grayish-brown (10YR 5/2) sand, gravel, silt and clay.

Qls **Landslide deposits (Holocene to Pleistocene)** – Slope-failure deposits consisting of poorly to moderately consolidated, poorly sorted rock fragments and soil material. May be susceptible to renewed slope movements. Question mark indicates landslide is questionable.

Qds **Debris slide deposits (Holocene to Pleistocene)** – Shallow slope-failure deposits consisting of soil material and poorly sorted rock fragments. May be susceptible to renewed slope movements.

Qya **Young axial channel deposits (Holocene to late Pleistocene)** - Unconsolidated to slightly consolidated sand and gravel deposited in marginal parts of active washes. Consists of light olive-brown (2.5Y 5/3) to grayish-brown (2.5Y 5/2), fluvial deposits of fine- to coarse-grained sand with minor silt, and minor fine to coarse gravel and cobbles. Gravel and cobbles are sub-rounded to rounded. In most areas, unit is slightly elevated above the active younger wash deposits.

Qyv **Young alluvial valley deposits (Holocene to late Pleistocene)** –Unconsolidated to moderately consolidated gently sloping fluvial deposits within broad valleys. Consists of grayish-brown (2.5Y 5/2) to dark grayish-brown (10YR 4/2) fine- to medium-grained sand, silt, and fine gravel.

Qoc **Old colluvial deposits (late to middle Pleistocene)** - Unconsolidated to well-consolidated deposits of sediment, rock fragments and soil material deposited by creep and slope wash. Consists of brown (7.5YR 4/3) to (7.5YR 5/4), fine- to coarse-grained sand, clay, silt, and minor fine gravel. Mapped where thick enough to obscure underlying bedrock. Forms aprons along the base of slopes.

QTf / QTf-l **Fanglomerate (Quaternary or Tertiary?)** - Moderately to well-indurated, massively bedded, poorly sorted to unsorted, micaceous, silty, fine- to medium-grained, brown (10YR 5/3) arkosic sandstone. Matrix-supported angular (0.5 to 3 cm) clasts of locally derived pegmatitic rock common. Near its base, the deposit contains abundant clasts of angular pegmatitic material as much as 20 cm in maximum dimension; rare broken Poway-type metavolcanic and quartzite cobble clasts up to 25 cm; and rounded, "rotten" granitic boulders. Boulders average 30 cm in diameter and can exceed one meter in maximum dimension. Fossiliferous, fossils consist of root casts and other unidentified casts and debris. Occurs as debris flow and fan deposits at base of slopes and in small drainages. Poorly exposed, usually only observed in roadcuts and gullies. Desiccation cracks common. Queried Tertiary age assignment based on degree of induration, and stratigraphic position above crystalline basement and below deeply weathered, eroded, unindurated colluvium. May include deposits related to the Ballena River system, e.g. cobble lag deposits 1 km south of the Ramona Airport, shown on the map as **QTf-l**.

Klp **Tonalite of La Posta (Cretaceous)** – Rocks tentatively correlated with La Posta-type plutons of the eastern zone of the Peninsular Ranges batholith. Consists of homogeneous, idiomorphic medium- and coarse-grained hornblende-biotite tonalite, trondhjemite (leucotonalite), and leucogranodiorite. The unit is in part equivalent to the La Posta Quartz Diorite of Miller (1935). La Posta rocks contain abundant white-weathering plagioclase and a low color index (C.I.), which together, impart a white color to the low platy outcrops of the unit. Also characteristic are: 1) light-gray quartz grains up to 1+ cm of bipyramidal to ovoid shape, 2) euhedral, barrel-shaped biotite books (0.5 to 1 cm across by 1.5 cm in length), and 3) scattered 2- to 5-cm-long K-feldspar oikocrysts that appear as glassy reflective cleavages on weathered rock surfaces. Commonly visible in hand sample, are grains of pale-yellow euhedral sphene. The La Posta unit consists of plagioclase, quartz, biotite ± hornblende ± K-feldspar; in granodiorite and monzogranite, where K-feldspar equals or exceeds biotite. In the San Pasqual quadrangle, the tonalite of La Posta is mapped along the east central map boundary and the northeast map corner. These small La Posta bodies represent the western portion of the outer pluton of the Ramona ring-dike structure located in the central portion of the Ramona quadrangle immediately to the east. Medium-grained leucotonalite and tonalite/granodiorite of this pluton display idiomorphic texture (due to hornblende and biotite phenocrysts), are quartz-rich, and contain K-feldspar oikocrysts and visible sphene. The Klp pluton in the ring dike structure in the Ramona quadrangle is petrographically similar to the La Posta-type pluton south of the town of Alpine, which is the westernmost exposure of the unit in the El Cajon 1:100,000-scale quadrangle. The Klp pluton of the Ramona ring-dike structure appears to be the origin of numerous large pegmatite dikes that intrude the northeast quarter of the quadrangle.

Kcp / Kcp-w **Chiquito Peak Monzogranite (Cretaceous)** -This unit is grayish-white weathering, medium to coarse-grained hornblende-biotite leucomonzogranite and granodiorite, with lesser tonalite, granite, alaskite and pegmatite. Biotite content is greater than hornblende in most outcrops. In thin section, biotite contains opaque oxide rimmed by secondary sphene and is altered to very fine grained sphene. Large euhedral to subhedral plagioclase grains are present along with quartz grains larger than feldspars, and most recrystallized into subgrains. Most K-feldspar is poikilitic, and some perthitic. Texture is generally magmatic with minor subsolidus effects. Chiquito Peak monzogranite has mutually intrusive contacts with the tonalite of Las Bancas. Named Chiquito Peak by Todd (1977), for its location in the northeast part of the Viejas Mountain quadrangle in San Diego County. U-Pb zircon dating of the Chiquito Peak pluton gave an age of about 113 Ma (Todd, 2004). Deeply weathered Kcp unit is shown on the map as **Kcp-w**.

Kc / Kc-w **Cuyamaca Gabbro (Cretaceous)** - The Cuyamaca Gabbro (Everhart, 1951), is the name given to large gabbro plutons, smaller gabbro bodies, and gabbroic dikes in central and southern San Diego County. Most of the gabbro in the San Pasqual quadrangle occurs in small discontinuous bodies and dikes within granitic rocks, regionally associated with the Ramona ring-dike structure. These rocks are fine- to coarse-grained and dark grayish-green colored on fresh surfaces, but typically weather to form a reddish soil with sparse outcrop. Textures are magmatic with slight recrystallization, and includes strong foliation due to recrystallized mafic minerals. Most outcrops are foliated and flow banding is present near contact zones. Unit has abundant fine-grained anhedral orthopyroxene with scarce subhedral phenocrysts. Hornblende is poikilitic and interstitial. Plagioclase typically occurs as subhedral laths. A more leucocratic variety of gabbro occurs either interlayered with, or gradational to the more common mafic variety. This rock has less abundant mafic minerals and may have fine-grained interstitial quartz. Conventional K-Ar analysis of hornblende from two gabbro plutons southeast of the San Pasqual quadrangle yielded cooling ages of 108 and 104 Ma (Hoggatt and Todd, unpublished data) . An U-Pb zircon age of 107± 2 Ma for the gabbro pluton that underlies Poser Mountain in the Viejas Mountain quadrangle is essentially the same as that of the Ka pluton at its nearby type locality (Ortega-Rivera, 2003). Deeply weathered Kc unit is shown on the map as **Kc-w**.

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Figure 3-13

San Pasqual Valley GSP

Key for San Pasqual Geologic Map (1 of 3)

Kcm

Corte Madera Monzogranite (Cretaceous) - Consists of medium- to coarse-grained biotite leucomonzogranite, leucogranodiorite, and syenogranite as well as abundant dikes of leucogranite, alaskite, pegmatite, and aplite. Outcrops of the unit weather white with a pinkish-orange (peach) hue. Scarce mafic grains in Corte Madera rocks form lenticular aggregates whose wide (0.5 to 2 cm) spacing imparts a distinctive spotted appearance to rock surfaces. Foliation fabrics in Kcm rocks range from weak magmatic to strong synmagmatic or post-magmatic (subsolidus). Monzogranite of the Kcm unit is composed of subequal quartz and plagioclase with lesser K-feldspar and biotite; about half of the petrographic samples contain small relict hornblendes. Granodiorite consists of plagioclase, quartz, K-feldspar, and biotite. Major minerals of the syenogranite phase of the Kcm unit are K-feldspar, quartz, plagioclase, and biotite. Characteristically, quartz in all facies of the unit occurs as subequant to lenticular grains as long as 1 cm; in moderately strained rocks, quartz phenocrysts are partly recrystallized to subgrains, whereas in highly strained rocks, quartz occurs in lenticular multi-grain aggregates and ribbons >1 cm long. Corte Madera plutons typically comprise the most centrally located and latest intrusions in Cretaceous zoned plutonic complexes in the western zone of the Peninsular Ranges batholith (Todd and others, 2003). In the southeastern part of the San Pasqual quadrangle, Kcm forms small bodies and dikes in the Japatul Valley tonalite. An U-Pb zircon age of 111 ± 2 Ma was reported for the central Corte Madera-type pluton that underlies El Cajon Mountain (Ortega-Rivera, 2003). Conventional K-Ar hornblende cooling ages of 105 and 102 Ma were determined for two additional plutons of the unit (Hoggatt and Todd, unpublished data).

Kwmd, Kwm, Kwm-w

Woodson Mountain Granodiorite (Cretaceous) - Light-tan to pale brownish-gray, medium- to coarse-grained granodiorite. Named for characteristic large boulder outcrops at Mount Woodson, the type locality (Miller, 1937), in the southwest corner of the San Pasqual quadrangle, and is present in many large masses in the southwest map area. Unit locally intrudes Japatul Valley and earlier Cretaceous plutons. Small scale dark, fine-grained inclusions are widespread, but not as numerous as tonalites, with some crude gneissic structure. Typical granodiorite unit is coarse-grained, with more than 30% quartz and 30% plagioclase, with rectangular crystals showing albite twinning. Biotite is approximately 5%, and is chief ferromagnesian, forming well-distributed unoriented flakes, grouped occasionally with primary sphene, and allanite. Hornblende may be absent, to up to 2%. Accessory minerals include sphene, zircon, and apatite. Outcrops form bold ledge-like ridges. Unit weathers to fine- to coarse–grained grus. Deeply weathered Kwm unit is shown on the map as **Kwm-w**. Woodson Mountain aplite dikes (map symbol **Kwmd**) form resistant small northwest and west-trending outcrops, and intrude both Kjv and Ka/Kjv unit. K-Ar apparent ages on biotite from Mount Woodson location are 104 Ma and 89 Ma near Mount Laguna, in San Diego County (Krummenacher and others, 1975). Also mapped as Kcp - Chiquito Peak monzogranite by Todd (2004) in the El Cajon 1:100,000-scale quadrangle to the south.

Klw, Klw-gr, Kld

Lake Wolford Granodiorite (Cretaceous) – Lake Wolford granodiorite is primarily a fine-grained, light-gray leucogranodiorite. It likely comprises several closely related plutons, with some hybrid zones. In the northwest part of the San Pasqual quadrangle, the Lake Wolford granodiorite is exposed as a possible chilled-margin facies with the Kmv unit. Small bodies of fine-grained leucogranite related to the Lake Wolford pluton show a marginal facies (map symbol **Klw-gr**), and may be the source of leucocratic dikes (map symbol **Kld**) that intrude into the Kjv unit and metavolcanic unit, Kmv. Large hybrid areas are formed by streaking and intermixing of granodiorite, quartz monzonite, and metamorphics (chiefly quartzites or feldspathic quartzites) (Miller, 1937). The Lake Wolford unit is distinguished by low percent of dark minerals (Larsen, 1948). Dark fine-grained inclusions are widespread, but not as numerous as tonalites. The Lake Wolford granodiorite is exposed as broad, flat outcrops that are commonly aplitic.

Ka, Ka-w

Tonalite of Alpine (Cretaceous) - Consists of medium- to coarse-grained biotite-hornblende tonalite, quartz diorite, and minor diorite. In addition to abundant mafic inclusions, Alpine rocks contain 2- to 3-cm-long concentrations of mafic minerals. In thin section, these dark concentrations consist of intergrown, partly recrystallized mafic minerals. Poikilitic biotite and/or hornblende grains, 1- to 2-cm-long, are commonly present. As a result of variably sized mafic constituents, the tonalite of Alpine tends to be heterogeneous in outcrop and hand sample. Foliation is well developed due to parallel alignment of (l) magmatic phenocrysts, (2) recrystallized minerals (subsolidus recrystallization), and (3) mafic aggregates and inclusions. The tonalite of Alpine consists of plagioclase, quartz, subequal hornblende and biotite, and pyroxene. Rarely, rocks contain interstitial K-feldspar, in a few cases enough to produce borderline granodiorite/tonalite compositions. In the San Pasqual quadrangle, the tonalite of Alpine interfingers with, and grades into, the Japatul Valley tonalite in the northwest corner of the map, and is shown as map unit Ka/Kjv. The Alpine and Japatul Valley units are genetically related based on: progressively less mafic compositions of these two tonalite units, abundant mafic inclusions in both, hornblende and biotite as chief mafic minerals, gradational contacts, and similar geochemical characteristics. Todd and others (2003) proposed that both units fractionated from a single mafic parental magma. U-Pb zircon analysis of a sample from the Alpine type locality yielded an age of 108 ± 2 Ma (Ortega-Rivera, 2003). A conventional K-Ar hornblende cooling age of 107 Ma was obtained for tonalite collected near this site; other K-Ar hornblende ages for the Alpine unit range from 102 to 97 Ma (Hoggatt and Todd, unpublished data). Deeply weathered Ka unit is shown on the map as **Ka-w**.

Kjv, Kjv-w

Japatul Valley Tonalite (Cretaceous) - Consists of biotite-hornblende tonalite, hornblende-biotite tonalite, and borderline tonalite/granodiorite that grades to granodiorite. Japatul Valley rocks are medium- to coarse-grained, equigranular, and moderately to strongly foliated. Weathered color ranges from light-gray to grayish-white, and the abundant mafic inclusions commonly weather out in relief. The Japatul Valley unit is composed of plagioclase, quartz, biotite, hornblende, and K-feldspar. Plagioclase in tonalite samples is zoned from labradorite cores to sodic oligoclase rims, and in granodiorite, from sodic andesine to sodic oligoclase. Plagioclase has undergone variable degrees of subsolidus strain and recrystallization. Roughly one-half of Japatul Valley samples are strongly foliated, and in these rocks, plagioclase igneous shapes and zoning are almost obliterated. In mylonitic gneiss, plagioclase occurs as porphyroclasts containing solid-state inclusions of hornblende, biotite, epidote, and quartz, and in recrystallized folia. The Japatul Valley tonalite underlies a large portion of the San Pasqual quadrangle, and is one of the Ramona ring-dike units to the east. Japatul Valley tonalite underlies most of the Santa Maria Valley and is extensively exposed in the northwest map area. In the southeastern map area, the tonalite contains Kmv inclusions, and is cut by numerous dikes of the Corte Madera monzogranite (Kcm), many of which are too small to show at map scale. In the west and northern Santa Maria Valley, Japatul Valley rocks are also cut by Woodson Mountain Granodiorite dikes. This area is part of the northern outermost zone of the El Cajon Mountain plutonic complex to the south, in which Kcm dikes that fringe a central Corte Madera pluton intrude Kmv screens and Kjv tonalite (Todd, 2004). The Kjv unit has not been dated by U-Pb method. South of the San Pasqual quadrangle, conventional K-Ar hornblende ages of six samples range from 109 to 94 Ma (Hoggatt and Todd, unpublished data), and $^{40}Ar/^{39}Ar$ minimum emplacement ages of 112 and 104 Ma were also determined (Todd and others, 2003). Deeply weathered Kjv unit is shown on the map as **Kjv-w**.

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Figure 3-14

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Key for San Pasqual Geologic Map (2 of 3)

Klb / Klb-w

Las Bancas Tonalite (Cretaceous) – Las Bancas tonalite is a homogeneous, mafic inclusion-free hypersthene-biotite tonalite with lesser quartz diorite, granodiorite, diorite, and quartz norite. Locally, Las Bancas tonalite is interlayered on a fine scale with gabbro. On fresh surfaces of average Klb, mafic minerals and clear plagioclase grains give the rock a dark-gray to black color. The unit weathers to large subrounded residual boulders with a reddish-gray to tan color. The Las Bancas rock is typically medium-grained, equigranular, and generally has a steep foliation due to the preferred alignment of mineral grains. Plagioclase and mafic minerals of Klb plutons retain euhedral/subhedral grain shapes except near pluton margins where protoclastic textures may be developed. Characteristic of the unit are scattered large (0.5 to 2.5 cm) poikilitic biotite grains (oikocrysts) that enclose early crystallized mafic minerals and appear as reflective cleavages on weathered rock faces. Plagioclase (labradorite to sodic andesine) is the most abundant modal mineral. Although locally recrystallized, the largest plagioclase grains (up to 6 mm long) commonly retain delicate euhedral oscillatory zoning. In the most mafic Las Bancas rocks, which contain abundant hypersthene and less than 10% quartz, plagioclase is labradorite to bytownite. This mafic rock may contain indistinct, 2-cm-thick planar concentrations of felsic and mafic minerals oriented parallel to mineral foliation (cumulate layering). The layered rocks also contain pale-weathering lenticular basaltic inclusions as long as 10 cm. In the San Pasqual quadrangle, the Las Bancas tonalite forms most of the highland areas in the north half of the map area. The Las Bancas-type pluton south of the town of Mount Laguna has an U-Pb zircon age of 104 Ma (L.T. Silver, oral communication to V.R. Todd, 1979) and the pluton south of the town of Descanso (unit type locality) has an age of 109 ± 2 Ma (Ortega-Rivera, 2003). Conventional K-Ar hornblende cooling ages of 107, 101, and 96 Ma were determined for the Las Bancas unit (Hoggatt and Todd, unpublished data). Deeply weathered Klb unit is shown on the map as **Klb-w**.

Kmv

Western metavolcanic rocks (Cretaceous) - In the southern part of the San Pasqual quadrangle, several small hills are underlain by metamorphosed silicic and intermediate volcanic rocks that are intruded and surrounded by the Japatul Valley tonalite. Minor pelitic schist, feldspathic metaquartzite, and plutonic-cobble metaconglomerate are interlayered with tuff, tuff-breccia, and flows of andesitic, rhyolitic, and basaltic composition. These rocks were metamorphosed to amphibolite facies and based on lithology, have been assigned to the Early Cretaceous-Late Jurassic Santiago Peak Volcanics by most workers. These outcrops are spatially continuous in a north- northwest structural trend across the map area, with similar rocks mapped as Kmv in the El Cajon 1:100,000-scale quadrangle by Todd (2004) to the south where tonalite magma apparently assimilated marginal parts of the metavolcanic inclusions producing a variety of hybrid migmatites.

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Figure 3-15

San Pasqual Valley GSP

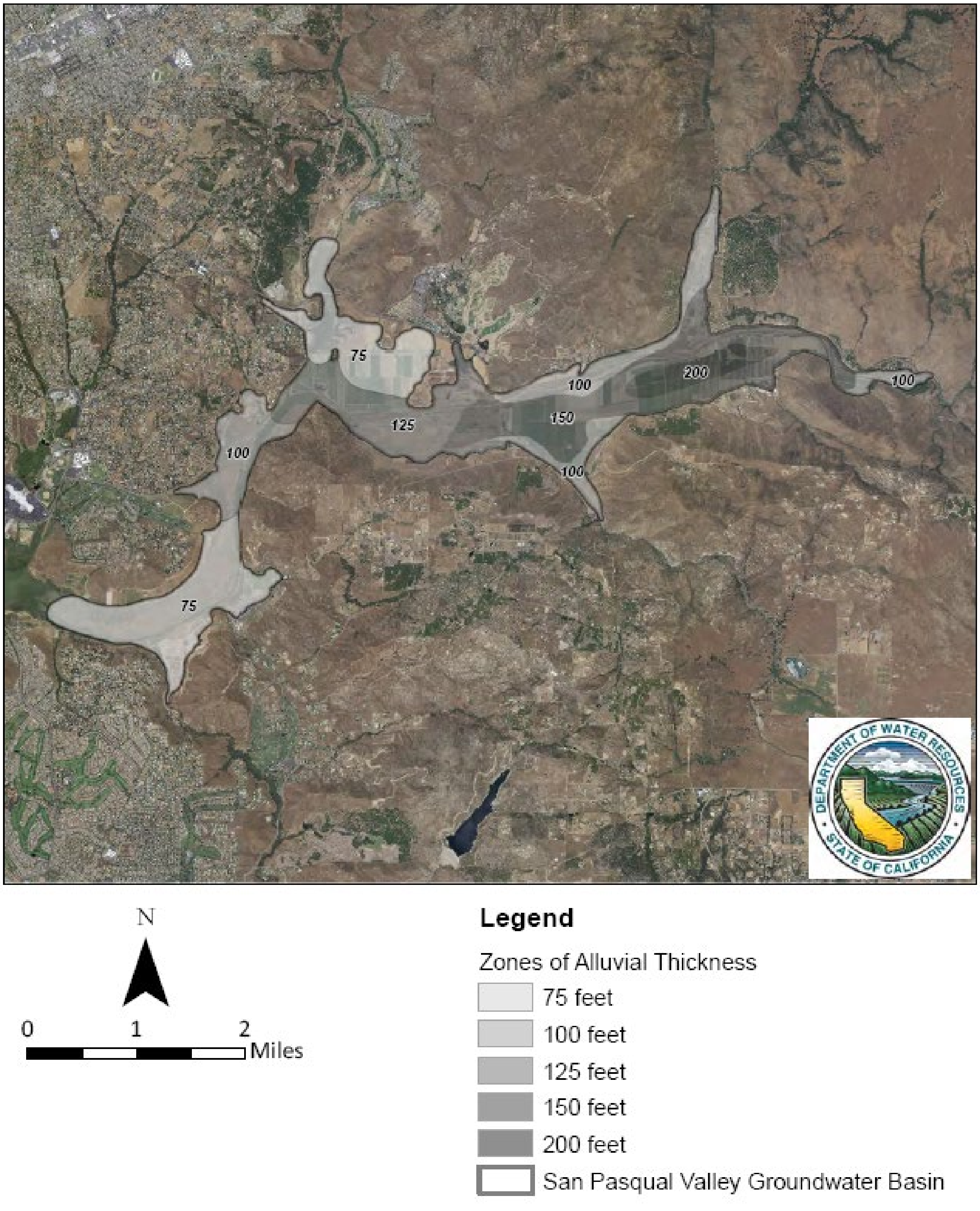
Key for San Pasqual Geologic Map (3 of 3)

3.5 Structural Setting

This section discusses the structural setting of the three main geologic groupings (i.e., Quaternary Deposits, Residuum, and Crystalline Rock). Figure 3-10 shows the locations of these geologic groupings. Crystalline Rock forms the basement, hills, and ridgetops in the area surrounding the Basin. Specifically, Woodson Mountain Granodiorite forms the basement beneath most of the Basin. The Residuum overlies Crystalline Rock, and is typically thicker in flat and valley bottom areas of the Basin, and thinner or absent in the steeper upland areas. Thicker layers of Residuum develop in crystalline formations that are more susceptible to weathering and where faulting and highly fractured rocks occur. Green Valley Tonalite, which is exposed in the hills outside the Basin, is more susceptible to weathering than the Woodson Mountain Granodiorite and consequently, thicker layers of Residuum likely occur in those areas. Quaternary Deposits overlie the Residuum and Crystalline Rock and occur at ground surface throughout the Basin. The Quaternary Deposits are generally undeformed and its thickness ranges between 75 feet near Hodges Reservoir to over 200 feet in the eastern part of the Basin. Figure 3-16 shows the estimated thickness of deposits in the Basin (DWR, 2011).

Geologic cross sections were prepared for this GSP using data from well completion reports collected from DWR, the City, the County, and local landowners. Figure 3-17 shows the cross section transects and identifies the well completion reports used to prepare the cross sections. Figure 3-18 and Figure 3-19 show cross sections for the Basin. All four cross sections include information about the depths and screened intervals of the wells; they also show the formation materials recorded on well completion reports, grouped by generally coarse-grained or generally fine-grained material, Residuum, or fractured rock. This information was used to correlate approximate locations of Quaternary Deposits, Residuum, and Crystalline Rock across the Basin. The cross sections are described below.

- Cross section A-A’ is located down the long axis of the Basin, starting near Hodges Reservoir in the west, and ending at the eastern end of the Basin. This cross section depicts the general thickening of alluvium (Quaternary Deposits) from west to east in the Basin.
- Cross section B-B’ shows the north end to the left, and depicts a thickening of alluvium (Quaternary Deposits) to the south toward the main portion of the Basin.
- Cross section C-C’ runs north to south from left to right, and depicts thicker intervals of Quaternary Deposits (approximately 170 feet thick) and Residuum (approximately 90 feet thick) in the eastern part of the Basin.
- Cross section D-D’ shows materials in Rockwood Canyon from north to south. This cross section indicates a rise of Crystalline Rock at the southern end of the canyon.
- In general, the well completion reports characterize the alluvium as coarse-grained (e.g., sand and gravel). Although these reports do indicate that some localized and isolated layers of finer-grain materials (e.g., silt and clay) occur, no laterally-extensive fine grained units were identified based on review of this information. The well completion reports used to prepare the cross sections are included in Appendix G.



Source: DWR, 2015

Figure 3-16. Thickness of Alluvium

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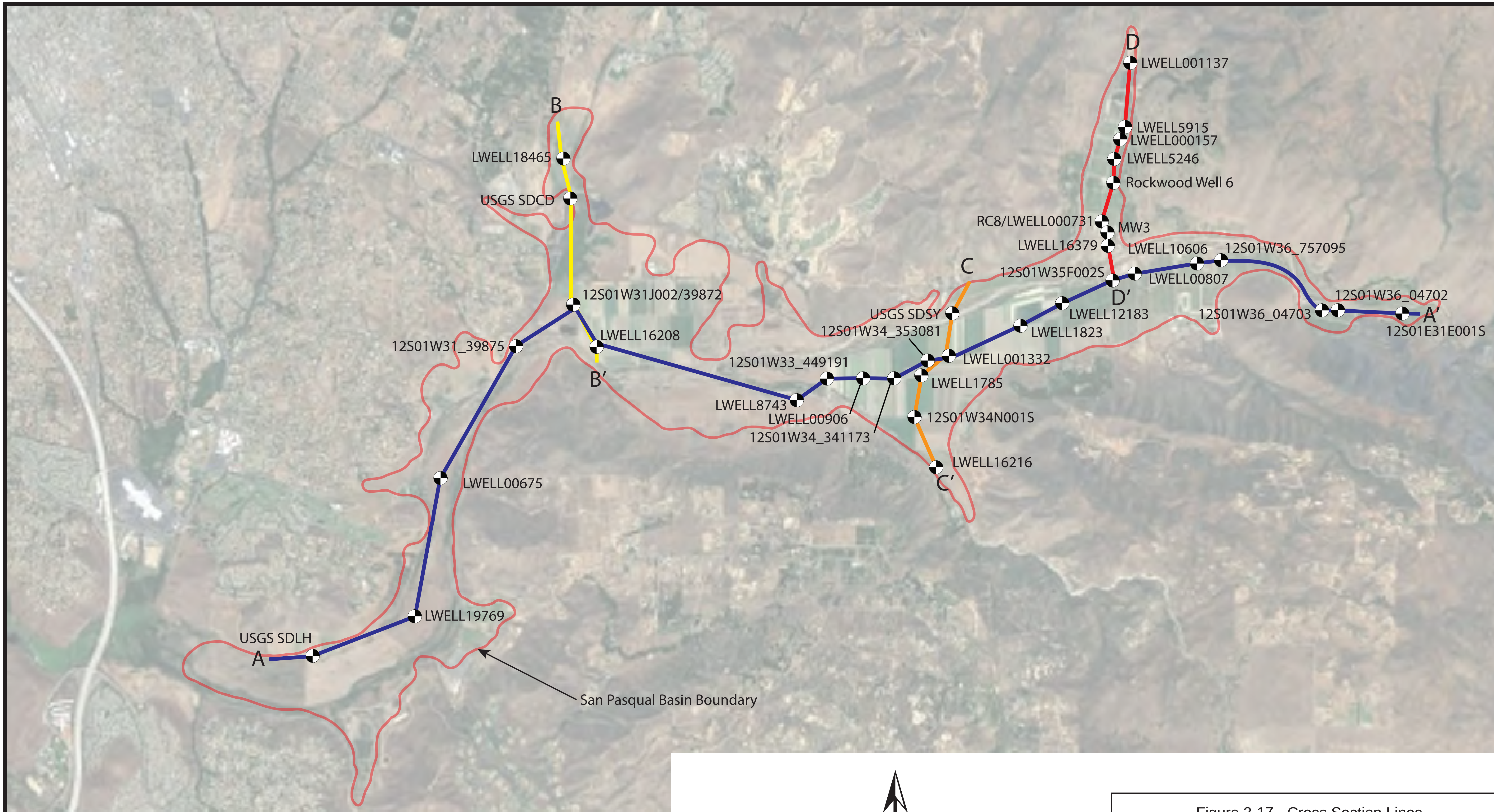


LEGEND/NOTES

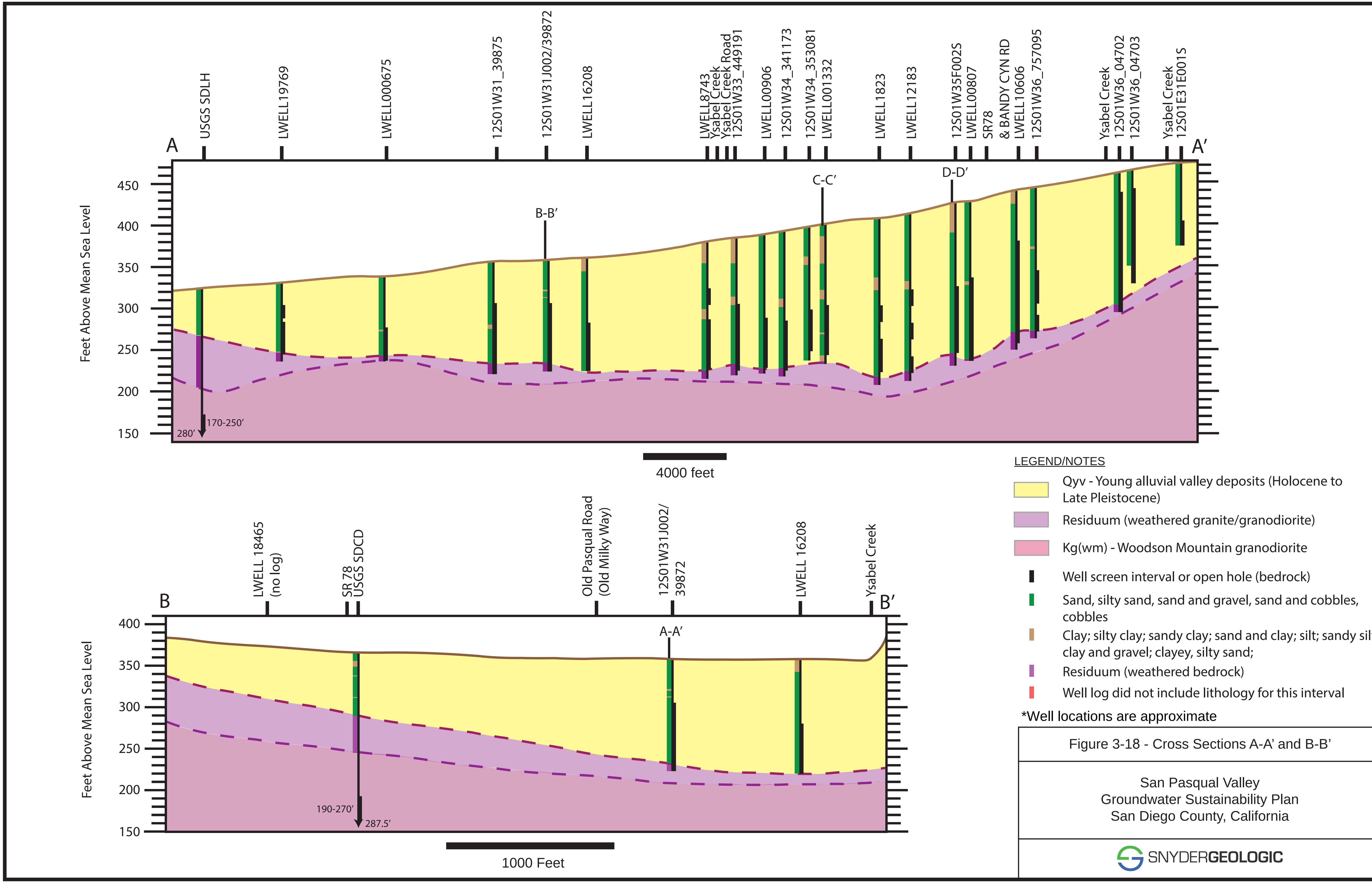
Well - locations are approximate

Base Map Source: Google Earth, 2020

Figure 3-17 - Cross Section Lines

San Pasqual Valley
Groundwater Sustainability Plan
San Diego County, California

SNYDERGEOLOGIC


A
A′
USGS SDLH
LWELL19769
LWELL000675
12S01W31_39875
12S01W31J002/39872
LWELL16208
LWELL8743
Ysabel Creek
Ysabel Creek Road
12S01W33_449191
LWELL00906
12S01W34_341173
12S01W34_353081
LWELL001332
LWELL1823
LWELL12183
12S01W35F002S
LWELL00807
SR78
& BANDY CYN RD
LWELL10606
12S01W36_757095
Ysabel Creek
12S01W36_04702
12S01W36_04703
Ysabel Creek
12S01E31E001S
B-B′
C-C′
D-D′
Feet Above Mean Sea Level
450
400
350
300
250
200
150
170-250′
280′
4000 feet
B
B′
LWELL 18465
(no log)
SR 78
USGS SDCD
Old Pasqual Road
(Old Milky Way)
12S01W31J002/
39872
LWELL 16208
Ysabel Creek
A-A′
Feet Above Mean Sea Level
400
350
300
250
200
150
190-270′
287.5′
1000 Feet
LEGEND/NOTES
Qyv - Young alluvial valley deposits (Holocene to Late Pleistocene)
Residuum (weathered granite/granodiorite)
Kg(wm) - Woodson Mountain granodiorite
Well screen interval or open hole (bedrock)
Sand, silty sand, sand and gravel, sand and cobbles, cobbles
Clay; silty clay; sandy clay; sand and clay; silt; sandy silt clay and gravel; clayey, silty sand;
Residuum (weathered bedrock)
Well log did not include lithology for this interval
*Well locations are approximate
Figure 3-18 - Cross Sections A-A′ and B-B′
San Pasqual Valley
Groundwater Sustainability Plan
San Diego County, California
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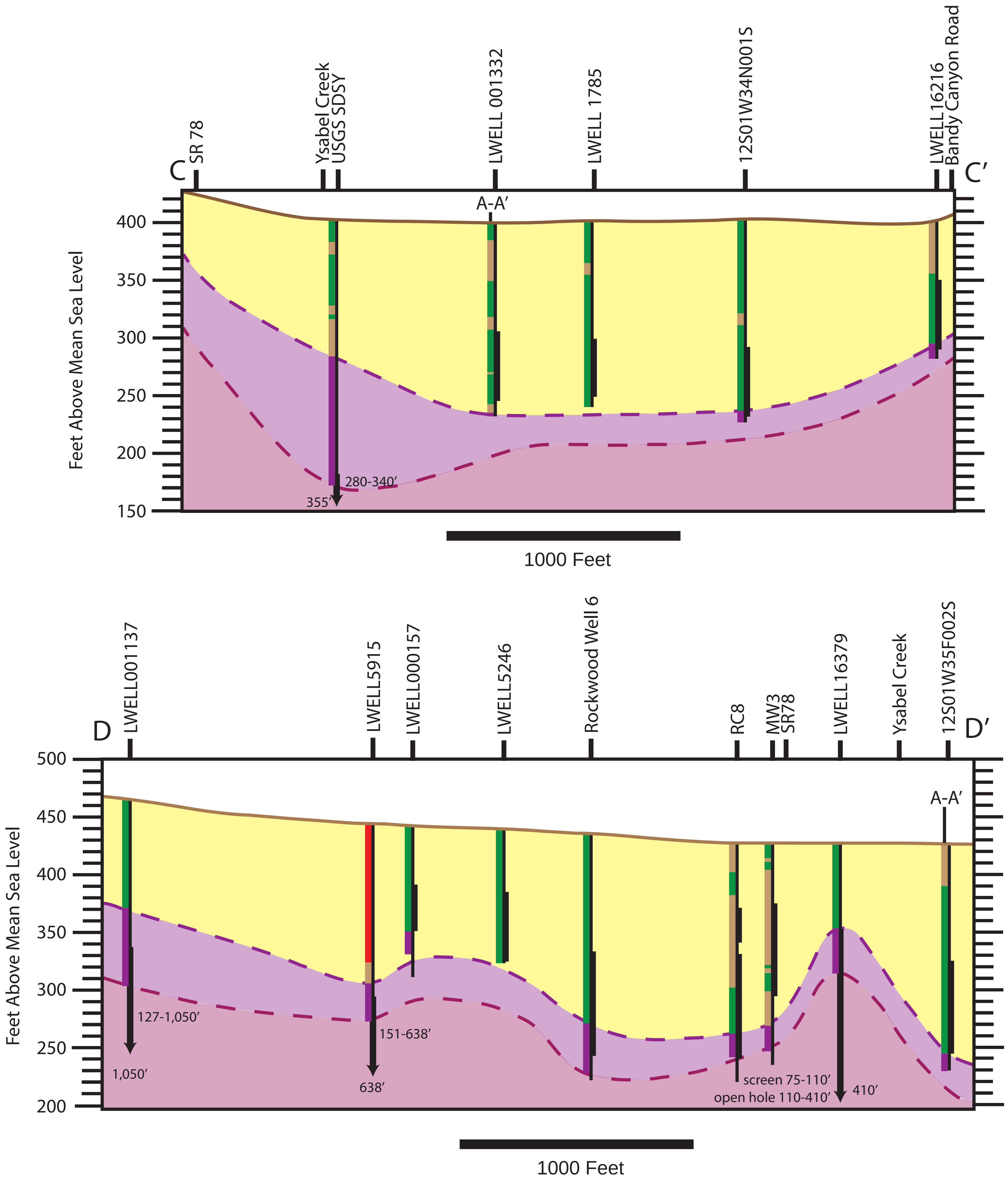

LEGEND/NOTES

- Qyv - Young alluvial valley deposits (Holocene to Late Pleistocene)
- Residuum (weathered granite/granodiorite)
- Kg(wm) - Woodson Mountain granodiorite
- Well screen interval or open hole (bedrock)
- Sand, silty sand, sand and gravel, sand and cobbles, cobbles
- Clay; silty clay; sandy clay; sand and clay; silt; sandy silt clay and gravel; clayey, silty sand;
- Residuum (weathered bedrock)
- Well log did not include lithology for this interval

*Well locations are approximate

Figure 3-19 - Cross Sections C-C' and D-D'

San Pasqual Valley
Groundwater Sustainability Plan
San Diego County, California

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3.6 Basin Boundaries

This section discusses the defined boundaries of the Basin. Boundaries are either lateral, at the surface of the earth, or at depth, at the bottom of the Basin.

3.6.1 Lateral Boundaries

The lateral boundary is generally coincident with the change in topographic slope, which occurs at the contact between Quaternary Deposits and Crystalline Rock comprising the hills that surround the Basin. The downgradient boundary on the Basin's western side is the highwater level of Hodges Reservoir. The upgradient boundary on the eastern side of the Basin is where Santa Ysabel Creek enters the SPV from the narrow bedrock canyon upstream. DWR's Bulletin-118 (Appendix D) identifies the types of lateral basin boundaries that were used to delineate basins and subbasins. There are two types of lateral basin boundaries that apply to the SPV Basin, which are described below.

- **Impermeable Bedrock—**Impermeable bedrock with lower water yielding capacity. These include consolidated rocks. This boundary applies to the majority of the Basin where Quaternary Deposits meet Crystalline Bedrock.
- **Constrictions in Permeable Materials—**A lower-permeability material, even with openings that are filled with more permeable stream channel materials, generally forms a basin boundary for practical purposes. While groundwater may flow through the sediment-filled gaps, the flow is restricted to those gaps. This boundary applies at the inlet of Santa Ysabel Creek and near Hodges Reservoir.

3.6.2 Boundaries with Neighboring Basins

There are no neighboring subbasins that are hydraulically connected to the Basin.

3.6.3 Bottom of the Basin Boundary

The SPV Basin is defined in Bulletin-118 (Appendix D), and includes Quaternary Deposits and Residuum. Fractured bedrock underlies the Residuum. As summarized in Section 5, *Water Budgets*, some groundwater interaction of groundwater between fractured bedrock beneath the Quaternary Deposits and the Residuum is accounted for in the water budget analysis; however, the degree of this interaction is not well understood and represents an area of potential improvement that may be investigated by the GSA to further the understanding of the Basin and the interaction of groundwater pumping in and around the Basin.

3.7 Principal Aquifer

There is a single principal aquifer in the Basin that is composed of the Quaternary Deposits and Residuum geologic groupings. DWR's *Water Basics Glossary* (DWR, 2021) defines an aquifer as "a body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells and springs." Most of the water pumped in the Basin is contained in Quaternary Deposits, with lesser amounts coming from the Residuum. The amount of water contributed to the Quaternary Deposits and Residuum from Crystalline Rock near the Basin is not fully known and may be investigated further by the GSA.

The alluvium in the Basin is primarily coarse-grained, and no laterally extensive fine-grained units that could function as regional aquitards were identified based on review of the available well completion reports (Section 3.5). Consequently, the Basin's principal aquifer is continuous and unconfined with some localized areas of less permeable materials that may result in semiconfined conditions. This conclusion is consistent with DWR's 2011 report, as well as USGS's 1983 report:

> *"Based on our evaluations of the lithology and the depths to first water and to static water reported on the well logs, groundwater in the Basin is interpreted to be unconfined"* (DWR, 2011).
>
> *"The alluvial fill is a water-table aquifer, and ground water is not confined"* (USGS, 1983)

The following subsections describe aquifer properties and other characteristics of the Quaternary Deposits and Residuum.

3.7.1 Quaternary Deposits

Quaternary Deposits in the Basin range in thickness from approximately 75 to 200 feet (Figure 3-16) and consist of sand, silt, clay, gravel, and boulders. Specific yield was estimated at 16 percent (USGS, 1983). Groundwater modeling, as described in Appendix I, has resulted in a specific yield estimate of 10 percent for the Quaternary Deposits. Well yields can exceed 1,500 gallons per minute (Appendix G). Specific capacity generally ranges from 15 to 75 gallons per minute per foot of drawdown with some wells exceeding 100 gallons per minute per foot of drawdown (Appendix G). Hydraulic conductivity and transmissivity vary across the basin, and have been estimated as part of several reports, as described below.

- The calibrated hydraulic conductivity for alluvium (Quaternaty Deposits) used in the groundwater flow model for this GSP ranges from approximately 40 to 100 feet per day (Appendix I).
- Geoscience Support Services, Inc. conducted an aquifer test in 2008 for the San Pasqual Temporary Desalination Demonstration Facility at well BH-4B near the western end of the Basin. According to the aquifer test results, the aquifer has a calculated transmissivity of 52,400 square feet per day, a hydraulic conductivity 639 feet per day, and a storativity of 0.007
- USGS' Evaluation of the San Dieguito, San Elijo, and San Pasqual Hydrologic Subareas for Reclaimed Water Use, San Diego County, California (USGS,1983) estimated an average specific yield of 16 percent and transmissivity between 4,000 and 25,000 square feet per day for the Quaternary Deposits geologic grouping.
- DWR's *Groundwater Basin Storage Capacity and Safe Yield* report (DWR, 2015) examined lithologic logs to estimate a weighted average specific yield for the Basin that ranged from 10 to 20 percent, and calculated a total storage capacity of 61,700 acre feet.
- The City's *Well Construction Report–Orfila Well* (City, 2002) reports specific capacity ranging from 12.78 to 13.43 gallons per minute per foot during step testing, and a transmissivity between 4,827 to 4,963 square feet per day.

3.7.2 Residuum

Residuum consists of weathered granitic Crystalline Rock that surround and underlies the Quaternary Deposits. Based on review of well completion logs, the thickness of the Residuum ranges from approximately 20 to 110 feet where wells have penetrated its full thickness; however, most of the wells in the Basin were not advanced through the Residuum into Crystalline Rock (Figures 3-18 and 3-19). The calibrated hydraulic conductivity for the Residuum used in the groundwater flow model for this GSP ranges from approximately 2 to 10 feet per day (Appendix I), with an estimated specific yield of 5 percent for the Residuum.

3.8 Areas of Potential Improvement

The following are areas of potential improvement have been identified during analysis:

- The degree of interaction of groundwater between Crystalline Rock and the Basin is uncertain.
- The depth to Crystalline Rock in the Basin is not fully known because most wells were completed when they reached Residuum, and were not drilled to Crystalline Rock.
- Estimates of aquifer properties such as hydraulic conductivity, transmissivity, and storativity for Residuum have not been determined by field testing.

3.9 Plan to Increase Data

Further evaluation of information related to areas of potential improvement as identified above is not necessary to implement the GSP and sustainably manage the Basin but may be investigated by the GSA. Refer to Section 9, *Projects and Management Actions*, for more information about areas where additional information would improve the understanding of the Basin.

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Section 4. GROUNDWATER CONDITIONS

This GSP section satisfies Title 23 CCR Section 354.16 (i.e., the SGMA regulations) and describes the Basin's historical and current groundwater conditions. As defined by the SGMA regulations, this section does the following:

- Summarizes historical groundwater conditions based on existing studies
- Defines current and historical groundwater conditions in the Basin
- Describes the distribution, availability, and quality of groundwater in the Basin
- Identifies interactions between groundwater, surface water, GDEs, and subsidence
- Establishes a baseline of groundwater quality and quantity conditions that will be used to monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds
- Provides information to be used for defining measurable objectives to maintain or improve specified groundwater conditions
- Supports development of a monitoring network to demonstrate that the SPV GSA is achieving Basin sustainability goals.

The groundwater conditions described in this section are intended to convey past and present groundwater levels, groundwater quality, and other conditions related to groundwater. Information in this section is used elsewhere in this GSP to define measurable objectives, identify sustainability indicators, and establish undesirable results.

4.1 Historical Groundwater Conditions

This section presents information and analysis from selected sources that discuss historical groundwater conditions in the Basin. Historically, the Basin shows the following characteristics:

- Groundwater levels are consistently shallow with little fluctuation in the western portion of the Basin
- Groundwater levels fluctuate in the eastern portion of the Basin in response to drier and wetter periods, and generally recover to pre-drought levels quickly
- TDS concentrations in the Basin have generally increased from the years 1950 to 2000, but have stopped increasing in most areas and have fluctuated after 2000
- Nitrate concentrations in the Basin have generally increased from the years 1960 to 2000 and have generally declined or stablized in most wells since 2000
- TDS concentrations in the Santa Maria and Cloverdale Creeks were high and have likely contributed to TDS loading in the Basin for over 40 years

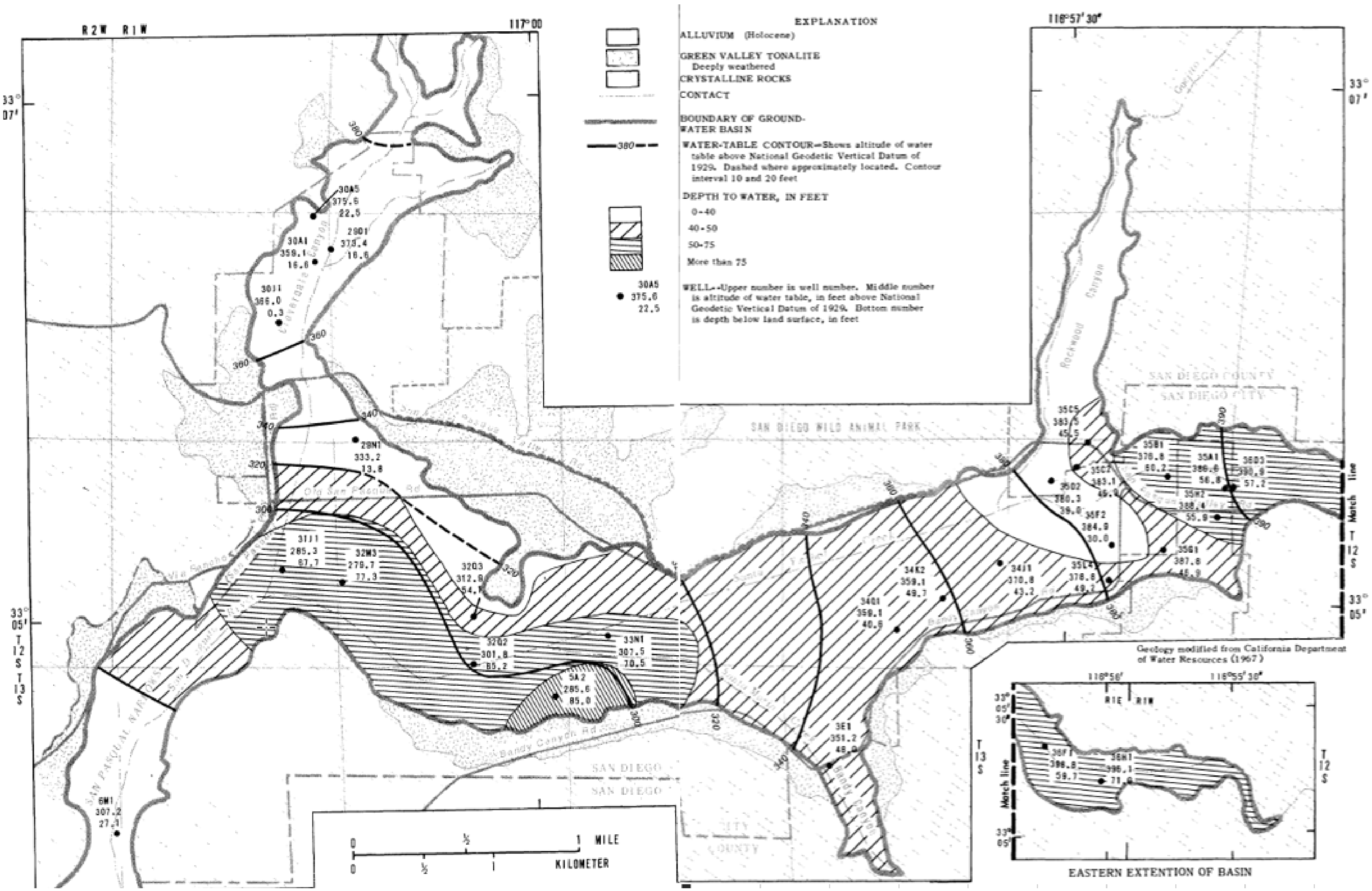
4.1.1 Evaluation of the San Dieguito, San Elijo, and San Pasqual Hydrologic Subareas for Reclaimed Water Use, San Diego County, California, 1983

USGS' report *Evaluation of the San Dieguito, San Elijo, and San Pasqual Hydrologic Subareas for Reclaimed Water Use, San Diego County, California* (USGS, 1983) evaluated groundwater flow conditions and groundwater quality in the Basin.

This report indicates that groundwater moves from east to west generally following the topography of the Basin. Before groundwater development, groundwater levels were near the land surface throughout much of the alluvial aquifer. These levels began to decline in the 1940s, and reached the lowest levels seen prior to 1983 in 1965 and 1977 (USGS, 1983).

Figure 4-1 is a water-level contour map for spring 1977. At that time, water levels in the San Pasqual alluvium were the lowest ever recorded prior to the beginning of an irrigation season. The hydraulic gradient through San Pasqual Narrows was reversed, and ground water was moving into the Basin from outside the hydrologic subarea to the southwest. The only discharge from the Basin was groundwater pumping and evapotranspiration of agricultural crops. Depth to water was greater than 40 feet throughout most of the alluvial aquifer and exceeded 80 feet in some places. Water levels rose rapidly in 1978 in response to a wet year. The alluvial aquifer filled, and groundwater movement returned to normal (USGS, 1983).

In the Basin alluvium, TDS concentrations in groundwater in 1981 and 1982, as estimated from specific conductance, were as high as 1,430 mg/L, with a median concentration of 1,040 mg/L. In the residuum, total dissolved solids concentrations in groundwater (as reflected by specific conductance) tended to be higher downgradient from agricultural land (USGS, 1983).



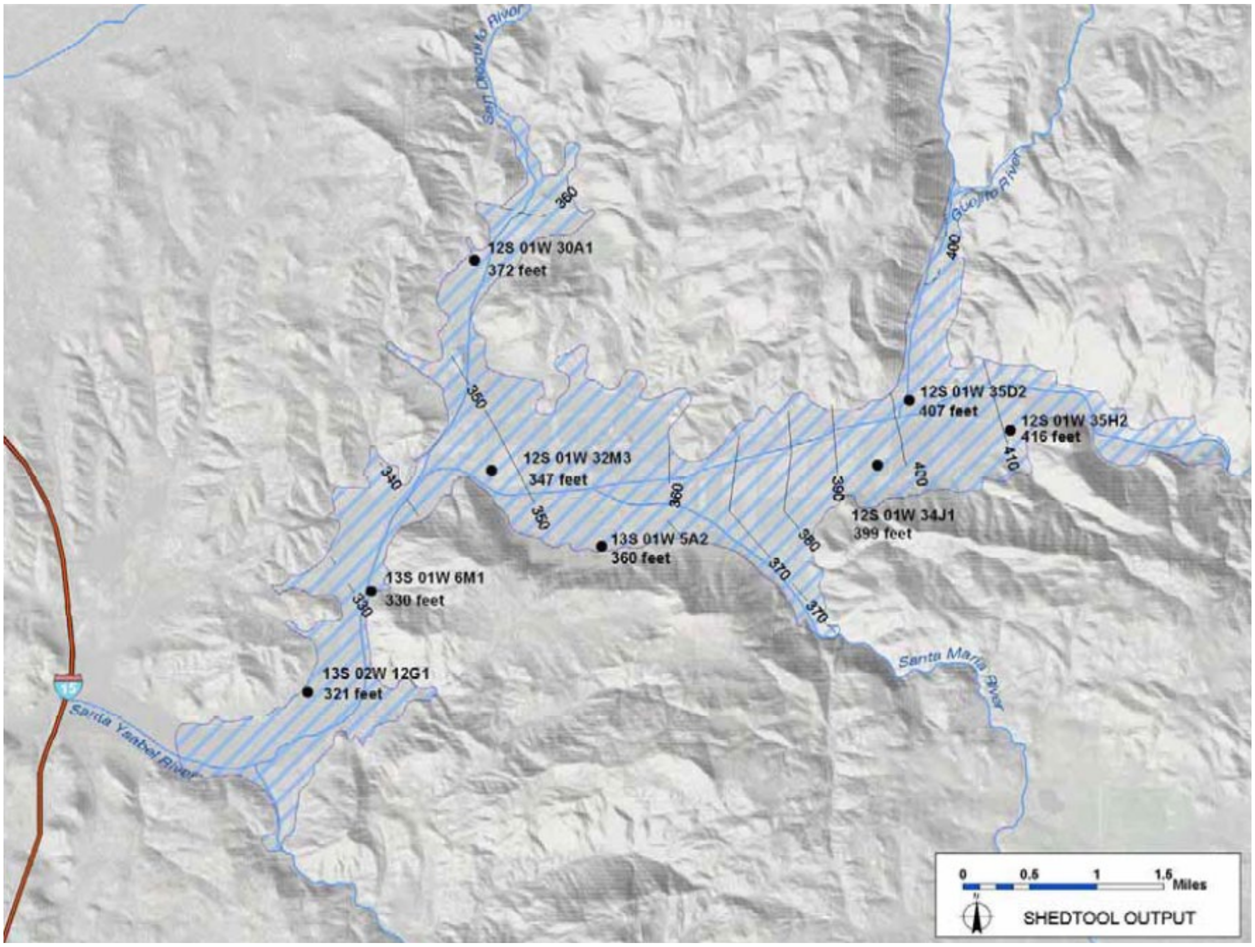
Source: USGS, 1983

Figure 4-1. USGS 1983—Groundwater Elevation Contour Map, Spring 1977

4.1.2 San Pasqual Groundwater Management Plan, 2007

The SPGMP (City of San Diego Water Department, 2007) included descriptions of groundwater occurrence, movement, and quality.

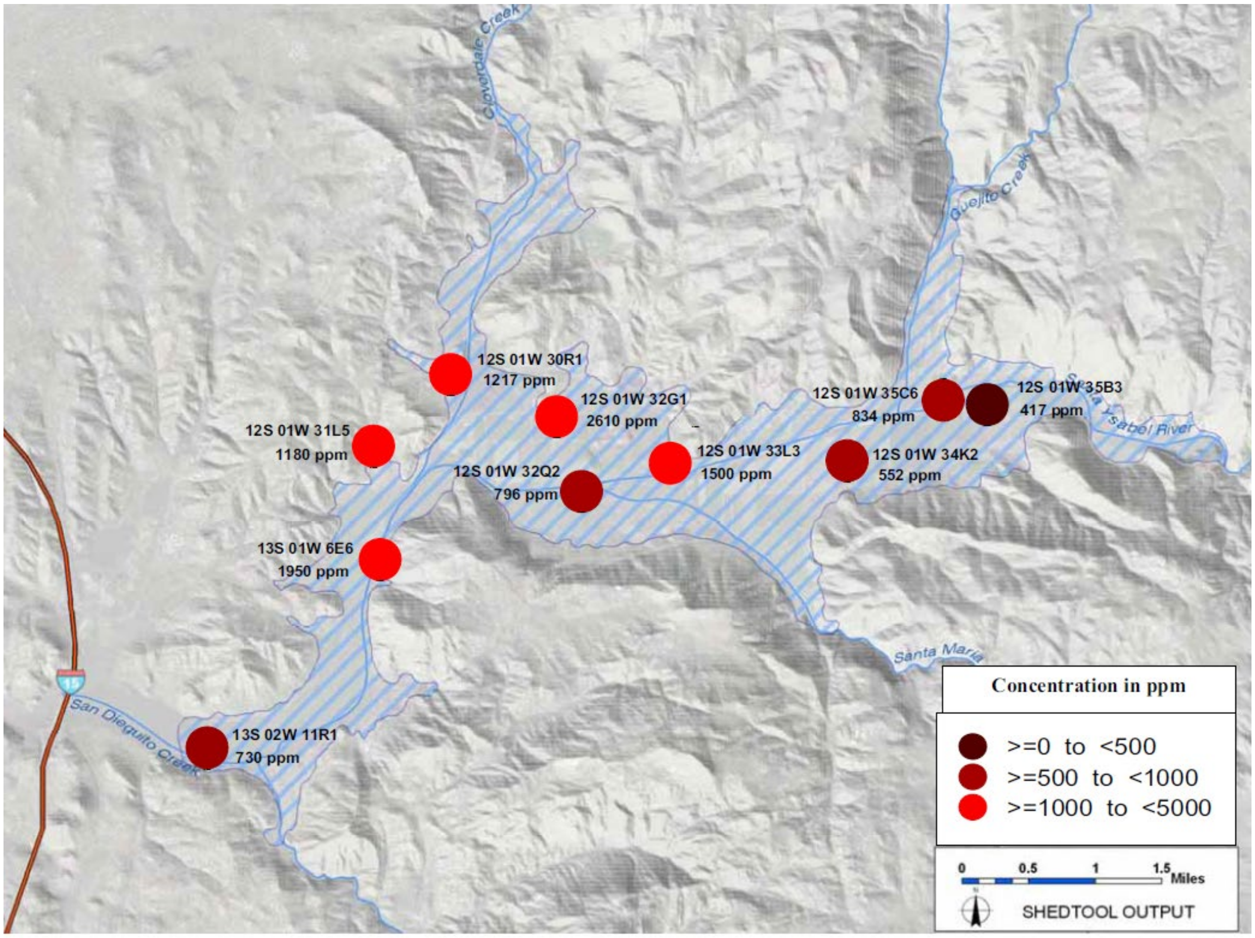
Figure 4-2 illustrates averaged Basin groundwater elevation contours from February 7, 1995 to February 7, 1996 from the SPGMP, based on data from eight wells. Generally, groundwater was deeper in the eastern portion of the Basin and was shallowest on the western edge near Hodges Reservoir in 1995. Over the distance evaluated in the SPGMP, the groundwater elevation difference between the eastern and western portions of the Basin was approximately 96 feet, and the average groundwater gradient across the entire Basin during 1995 was 0.003 feet per foot toward the west.



Source: City of San Diego, 2007
Note: the names of the surface water features in the source file used for this figure are mislabeled. Please refer to Figure 4-3 for the correct names of the surface water features.

Figure 4-2. City of San Diego Public Utilities Department 2007—Groundwater Elevations from February 1995 to February 1996

As shown in Figure 4-3, the SPGMP evaluated TDS concentrations from 2001 to 2006, and found that 1) TDS concentrations often exceeded the recommended (or secondary) MCL of 500 mg/L throughout the Basin, and 2) TDS concentrations on average were highest in the western and central portions of the Basin. TDS concentrations averaged 1,254 and 722 mg/L in the western and eastern portion of the Basin, respectively. Across the entire Basin, TDS concentrations ranged between approximately 58 and 4,400 mg/L. TDS average values exceeded the secondary MCL, which is a recommended or non-mandatory water quality standard. Figure 4-4 illustrates TDS concentrations over the time for wells in the western and eastern portions of the Basin. Results based on the time series data presented indicate TDS concentrations in the Basin's western portion have generally increased since 1950, and TDS concentrations in the Basin's eastern portion have shown little significant change.

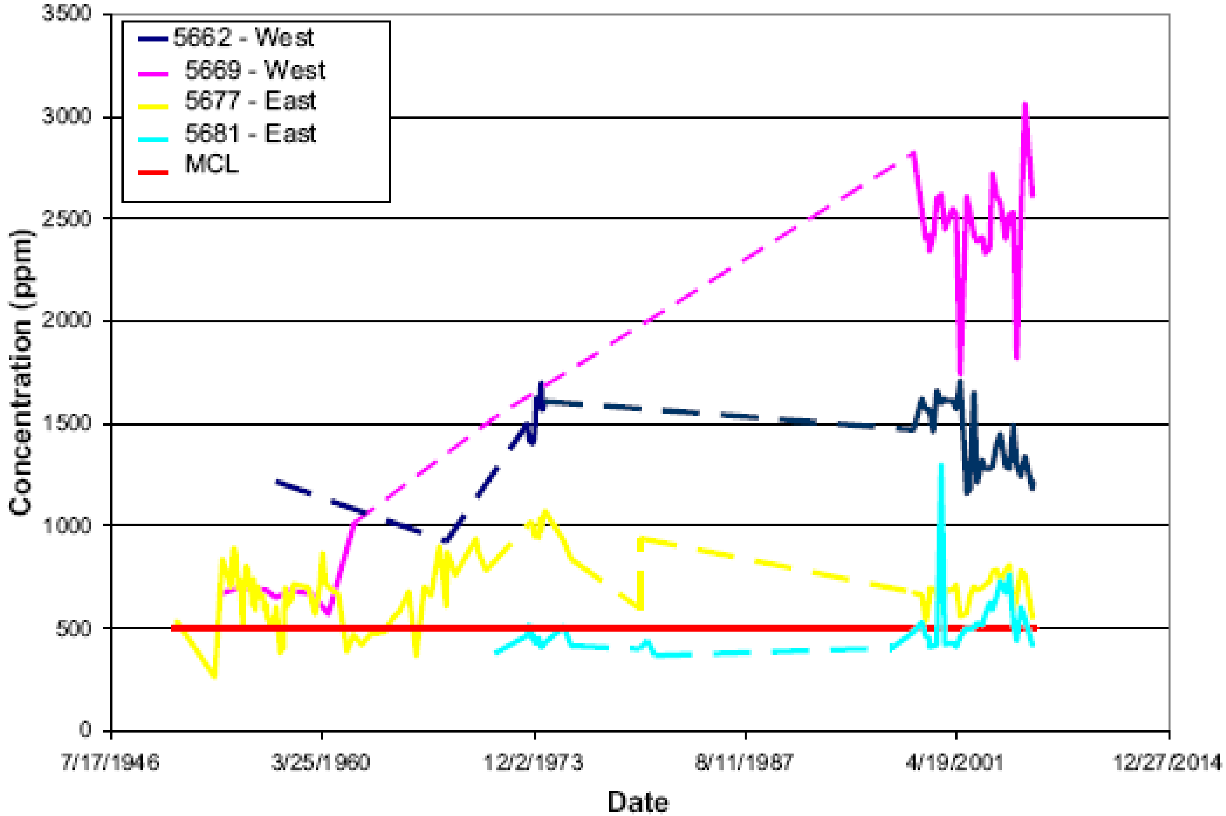


Source: City of San Diego, 2007

Figure 4-3. City of San Diego Public Utilities Department 2007—Mean Total Dissolved Solids Concentrations, 2001 to 2006

The SPGMP also noted TDS concentrations varied from 2001 to 2006 (Figure 4-4) (City of San Diego Water Department, 2007):

> *"However, in recent years more frequent measurements have shown that TDS has varied significantly in the west-central portion of the basin (well 5669 (12S/01W-32G1)). The results from well 5662 (12S/01W-30R1), located farther west than well 5669, shows a decreasing trend in TDS the most recent years."*

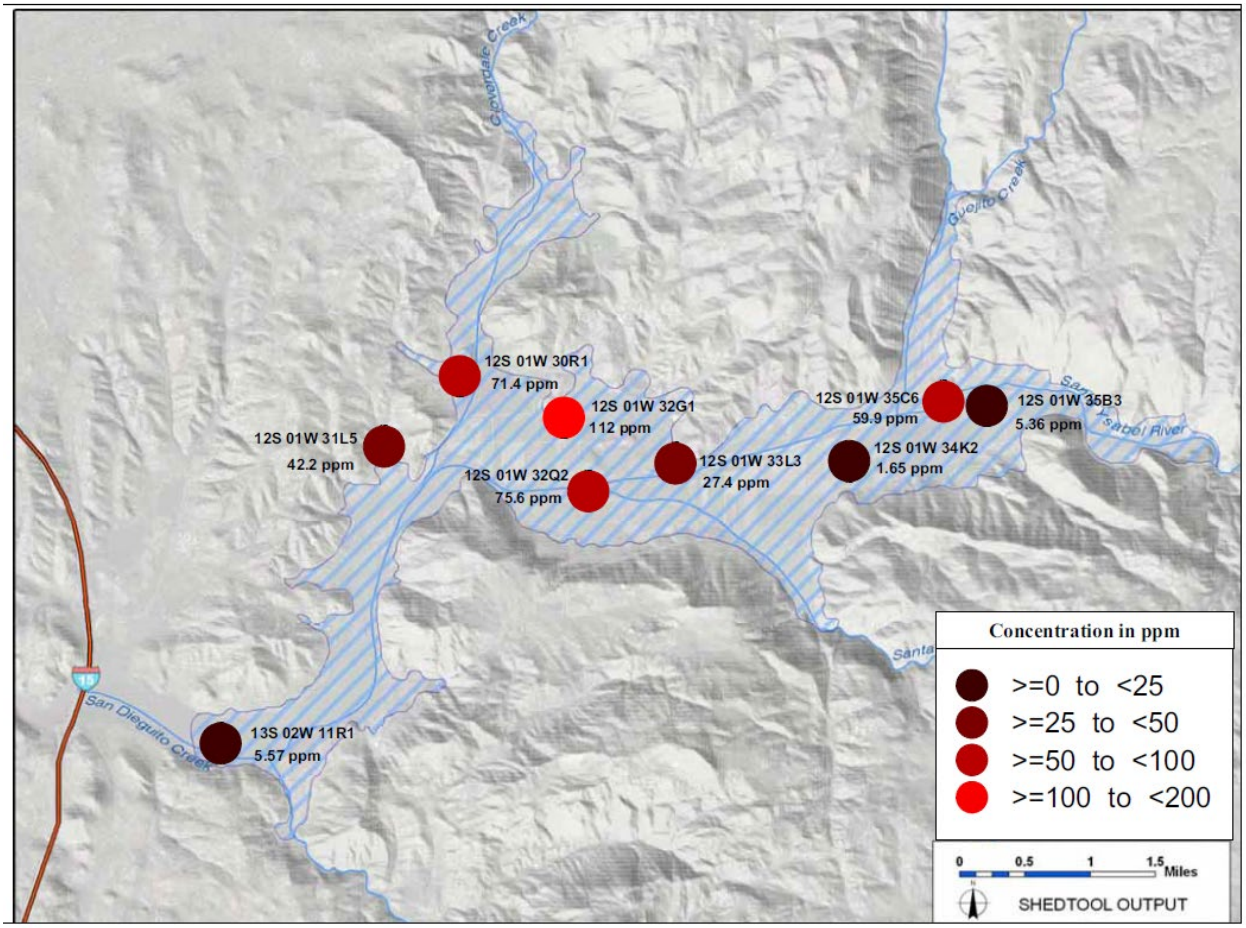


Source: City of San Diego, 2007

Figure 4-4. City of San Diego Public Utilities Department 2007—Total Dissolved Solids Concentrations 1946 to 2006

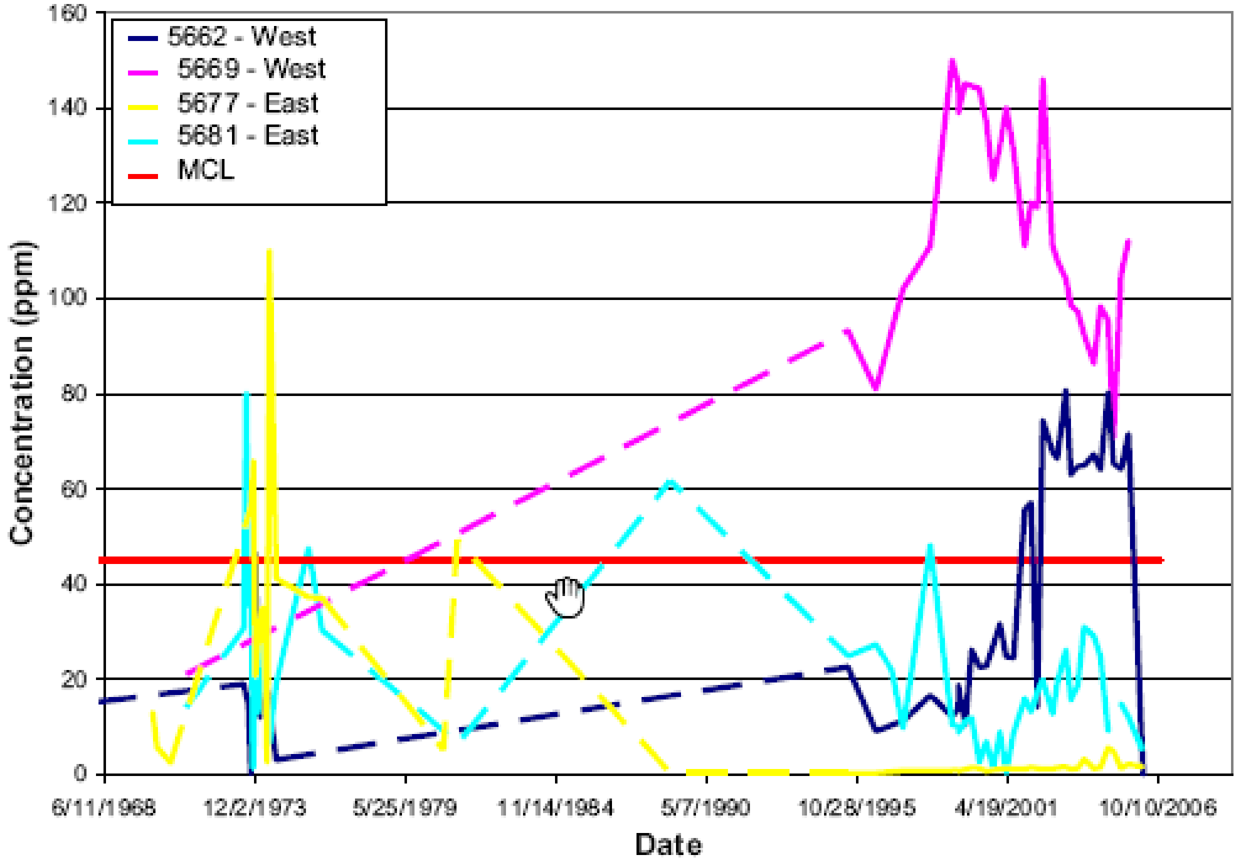
Figure 4-5 shows nitrate concentrations (as NO_3) averaged just less than the primary MCL of 45 mg/L in both the western and eastern portions of the Basin from 2003 to 2006. The SPGMP also evaluated a collection of records from 1968 and 1970. These records indicate the highest levels of nitrate (as NO_3) in the Basin were in the central-western portion. The SPGMP also noted the following, as illustrated in Figure 4-6, below:

> *"Nitrate has varied significantly in well 5669 (12S01W32G1), located in the west central portion of the basin. The results from well 5662 (12S01W30R1), located farther west than well 5669 shows a significant increase from the early 1970s, but the most recent measurement showed a significant decrease in the nitrate concentration. The wells in the eastern portion of the basin have shown fluctuations in the nitrate concentration for the period of record. The variability in nitrate concentrations over the period of record is potentially due to the slow migration of nitrate through the vadose zone during dry periods, and the fast migration of nitrates into the groundwater during wet periods when the groundwater level rises."*



Source: City of San Diego, 2007

Figure 4-5. City of San Diego Public Utilities Department 2007—Mean Nitrate as NO_3 Concentrations 2001 to 2006



Source: City of San Diego, 2007

Figure 4-6. City of San Diego Public Utilities Department 2007—Nitrate as NO_3 Concentrations 1968 to 2006

The SPGMP also evaluated surface water quality and noted that Santa Ysabel and Guejito Creeks had good water quality, with TDS below the secondary MCL and nitrate (as NO_3) below the primary MCL. Surface water quality in Santa Maria and Cloverdale Creeks and the San Dieguito River was measured in 1982; Santa Maria Creek had a TDS concentration of 714 mg/L, while Cloverdale Creek had a TDS concentration of 945 mg/L. San Dieguito River had a TDS concentration of 945 mg/L, indicating that inflows on these two creeks have been contributing to TDS loading in the Basin for decades.

4.1.3 San Pasqual Valley Groundwater Basin Groundwater Monitoring Network Assessment and Recommendations, 2011

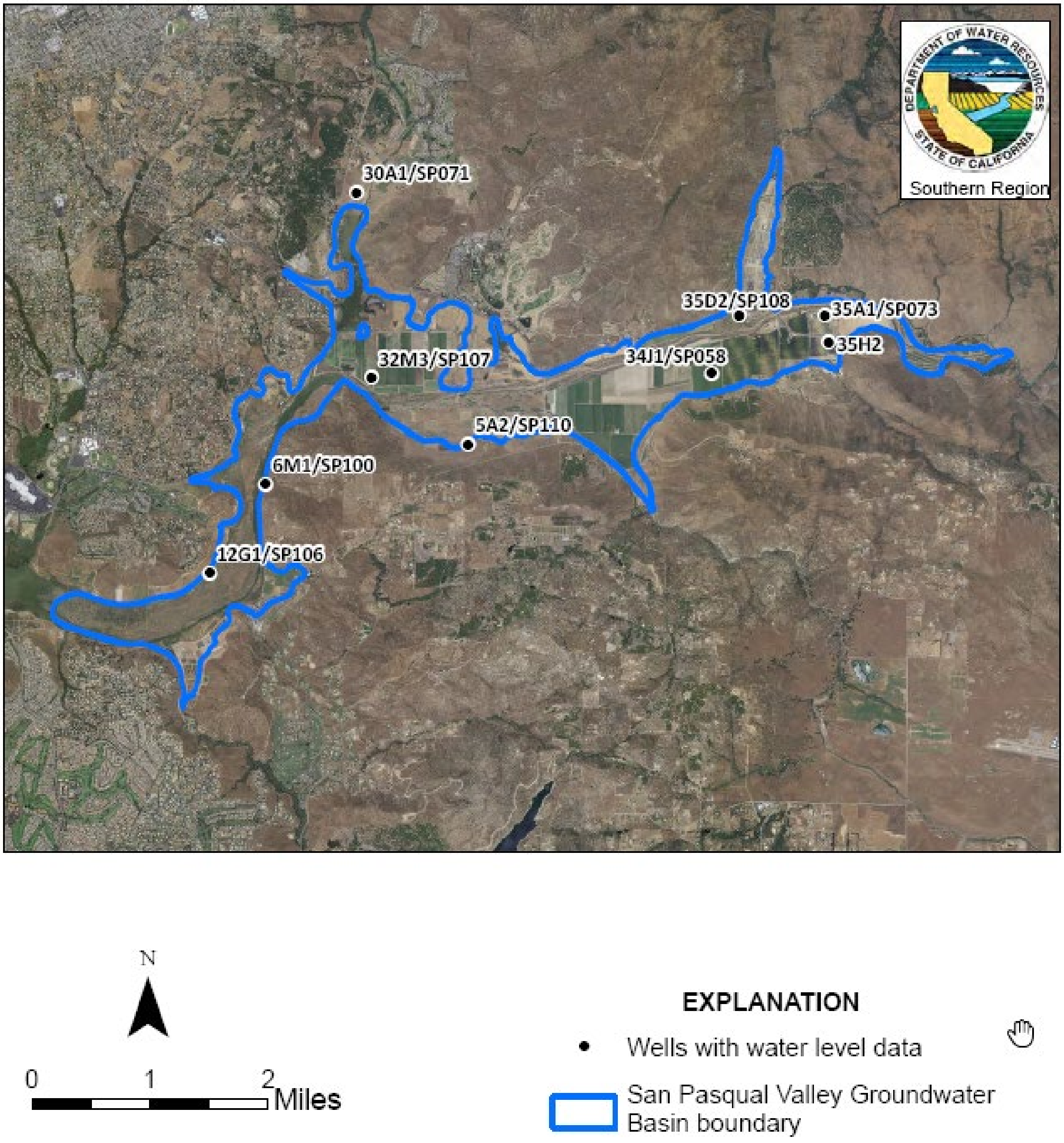
DWR's *San Pasqual Valley Groundwater Basin Groundwater Monitoring Network Assessment and Recommendations* (DWR, 2011) reviewed groundwater level conditions. This report interpreted groundwater information to determine whether the Basin's groundwater was unconfined.

Figure 4-7 shows well locations with long, continuous records of water level measurements through 2000. Figure 4-8 shows graphs of water level measurements taken during the early 1970s through the late 1990s at the wells shown in Figure 4-7. The graphs of water level fluctuations for the wells in the eastern part of the Basin tend to show similar patterns, and the graphs for the wells in the western part of the Basin also tend to show similar patterns of water level fluctuations. The graphs of measurements show patterns of water level fluctuation in the wells in the eastern part of the Basin that are distinct from the patterns seen in the wells in the western part of the Basin, and show that, while the eastern portion of the Basin experiences declines in groundwater elevation during drought periods, elevations recover to pre-drought conditions quickly.

Figure 4-9 shows groundwater elevation contours made with water level measurements taken in 12 wells in December 2008. Elevation of the groundwater table is highest in the eastern part of the Basin, and it is gradually lower toward the west. Groundwater moves westward in the eastern part of the Basin and southwestward in the western part of the Basin. The groundwater flow direction appears to generally follow the slope of the surface drainage.

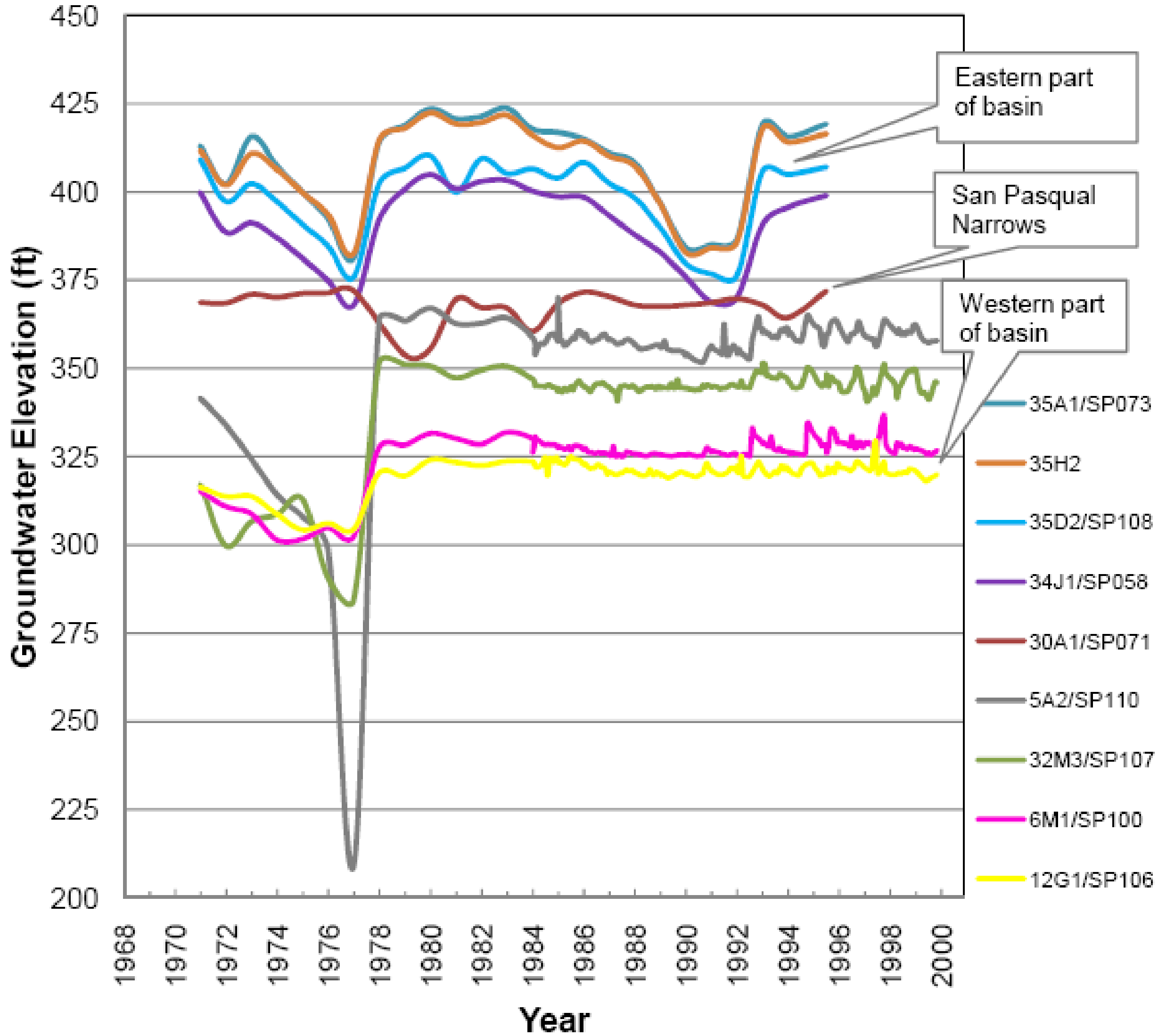
Over a distance of 6.42 miles, the groundwater elevation difference between the eastern and western portions of the Basin was 82.31 feet in 2008. This report calculated the average groundwater gradient across the length of the Basin at 0.0024 feet per foot toward the west (DWR, 2011).

This report also identified that the pattern of water level fluctuations in the eastern portion of the Basin has been different than the patterns in the central and western portions of the Basin. A significant drop in water levels in the eastern portion of the Basin occurred in 1977 and again in the early 1990s; however, water levels recovered after both occurrences. Water levels also dropped in the western portion of the Basin around 1977 and then recovered (DWR, 2011).



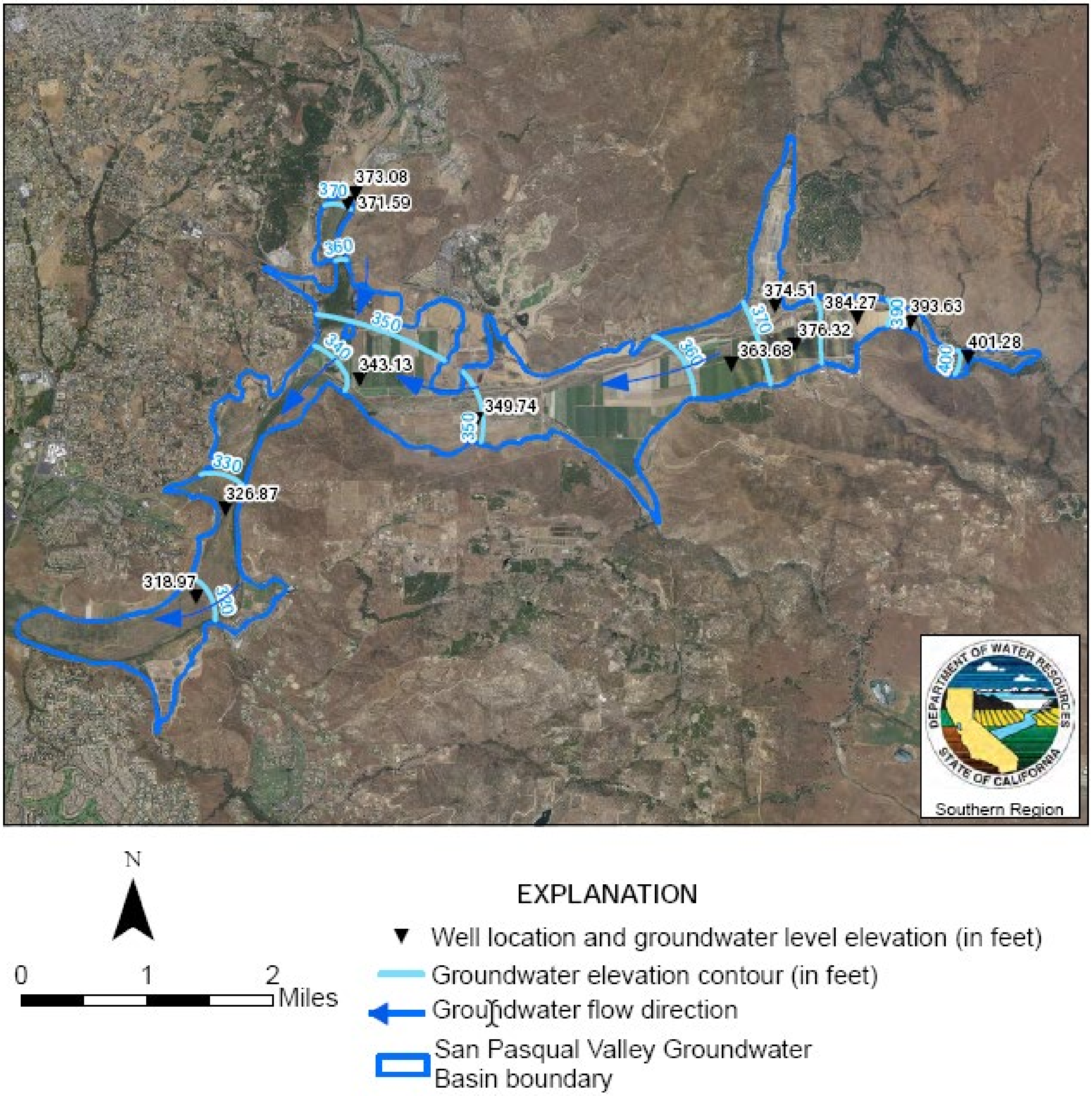
Source: DWR, 2011

Figure 4-7. DWR 2011—Wells with Water Level Data Map



Source: DWR, 2011

Figure 4-8. DWR 2011—Hydrograph Showing Long-Term Groundwater Level Trends



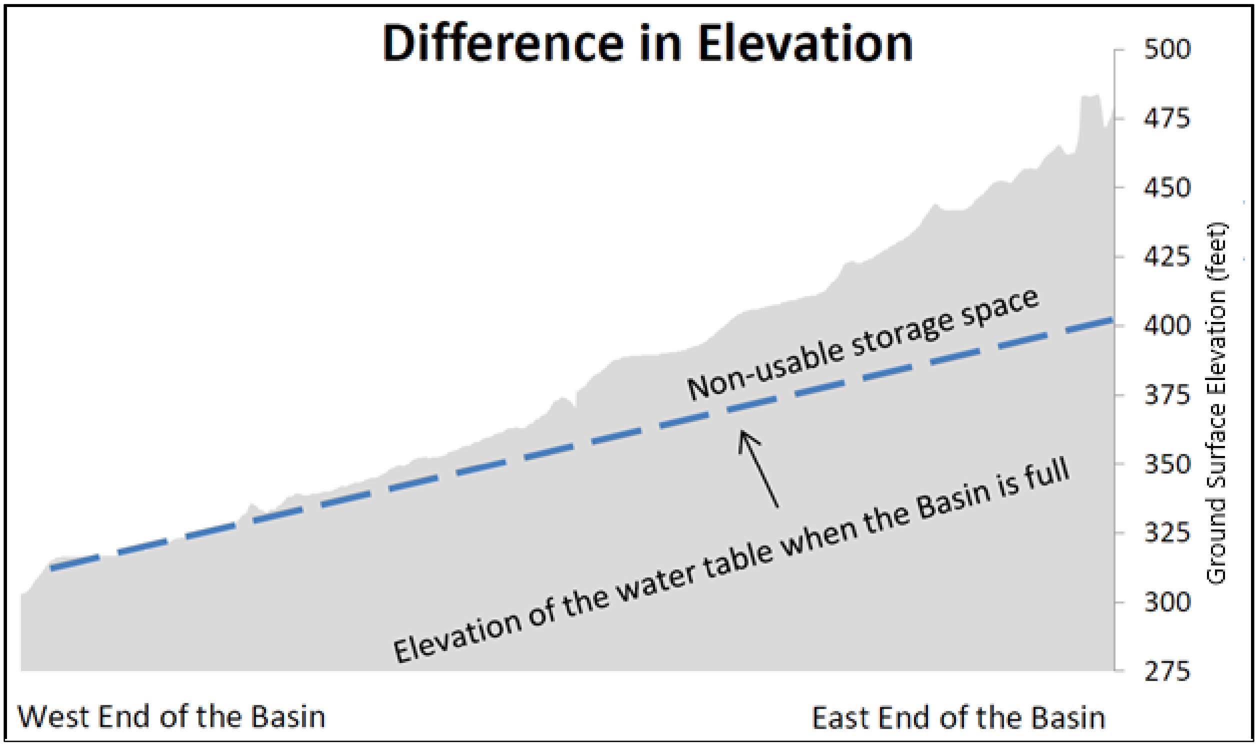
Source: DWR, 2011

Figure 4-9. DWR 2011—Hydrograph Showing Long-Term Groundwater Level Trends for December, 2008

4.1.4 Groundwater Basin Storage Capacity and Safe Yield, San Pasqual Valley Groundwater Basin, 2015

DWR's *Groundwater Basin Storage Capacity and Safe Yield, San Pasqual Valley Groundwater Basin* (DWR, 2015) described the Basin's ability to store groundwater. This report identified several factors that may limit the maximum amount of water that could be stored in the Basin, and found the specific limiting factor in the case of the Basin was its shape and configuration.

Figure 4-10 shows a Basin cross section showing the ground-surface gradient, the water table elevation when the Basin is full, and the Basin's non-usable storage space. The ground-surface gradient is westward and the difference in elevation from east to west is more than 160 feet. The eastern part of the Basin has storage space available when the western part of the Basin is full because of the lower surface elevation in the western than eastern portion of the basin. This additional storage space available in the eastern part of the Basin is non-usable storage space (DWR, 2015).



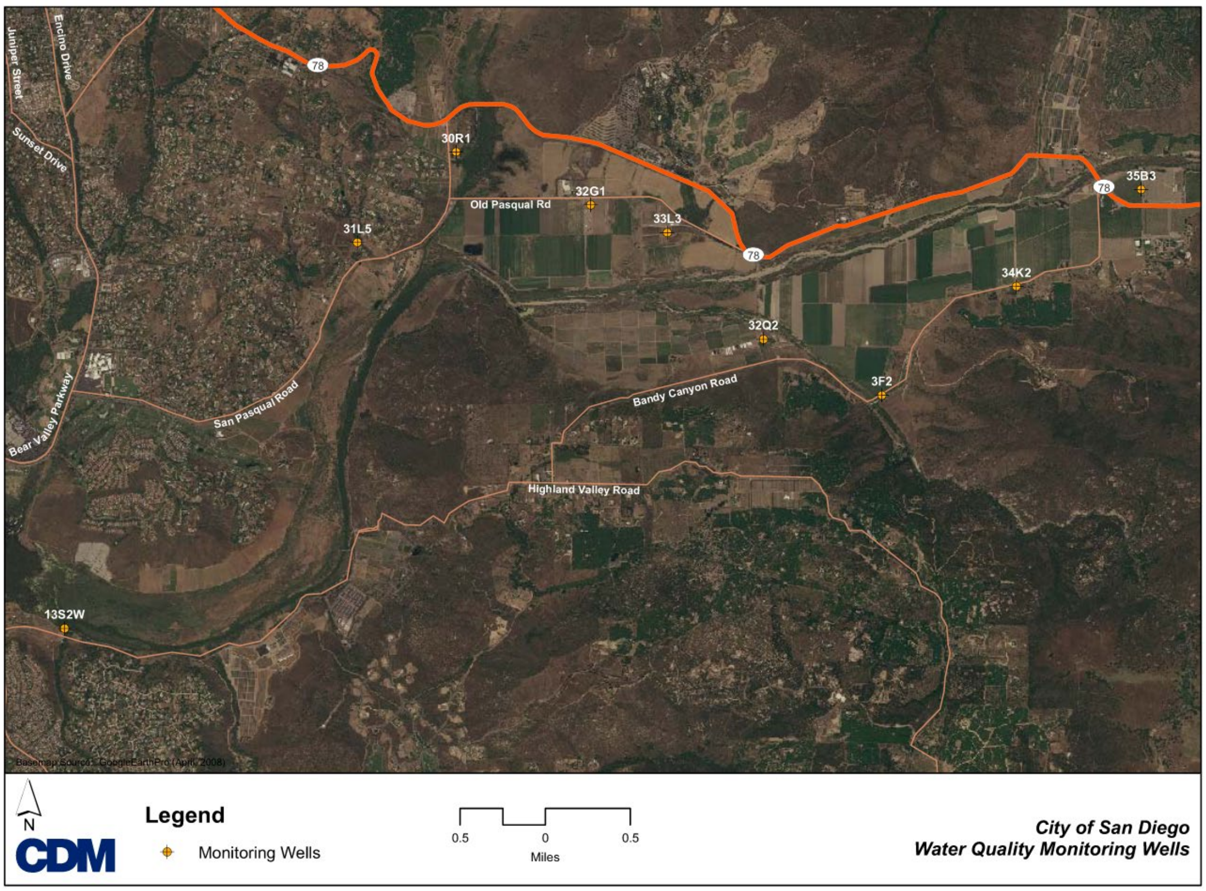
Source: DWR, 2015

Figure 4-10. DWR 2015—Relationship Between Ground Surface Elevation and Storage

4.1.5 San Pasqual Groundwater Conjunctive Use Study, 2010

The City's *San Pasqual Groundwater Conjunctive Use Study* (City of San Diego, 2010) evaluated potential conjunctive use opportunities in the Basin. This study determined that the Basin reached a full condition in 1954, from 1980 to 1988, and from 1993 to 1999. Declines in groundwater levels due to ongoing groundwater pumping combined with drought occurred and were followed by groundwater levels recovering to full Basin conditions (City of San Diego, 2010).

This study also reported groundwater quality monitoring information. Figure 4-11 shows the locations of wells with groundwater quality monitoring data evaluated in this study's report. Figure 4-12 and Figure 4-13 are tables from the report that show monitoring results from 2004 to 2007, and show that TDS measurements exceeded the secondary MCL and nitrate (as NO_3) measurements exceeded the primary MCL during that time in a number of locations. This study also describes groundwater quality conditions in the Basin prior to 2015.



Source: City of San Diego, 2010

Figure 4-11. City of San Diego 2010—Groundwater Quality Monitoring Wells Map

Table 2-5 City Water Quality Monitoring Data TDS Measurements (mg/L)									
Sample Date	Monitoring Well Identification								
	13S2W	31L5	30R1	32G1	33L3	32Q2	3F2	34K2	35B3
Dec 2007	NA	1,240	1,280	1,700	1,340	NA	1,250	**699**	**495**
Mar 2007	781	1,220	1,140	1,960	1,370	962	1,290	**712**	**473**
Oct 2006	951	1,130	1,170	2,770	1,460	927	1,900	**627**	**441**
Sept 2005	919	1,300	1,340	3,060	1,500	1,040	1,290	**760**	**547**
July 2005	879	1,300	1,240	2,500	1,450	1,110	1,360	**781**	**604**
Mar 2005	59	1,260	1,300	1,820	4,400	951	1,350	**654**	**439**
Dec 2004	784	1,140	1,490	2,530	1,350	591	1,350	**588**	**533**
Sept 2004	907	1,220	1,280	2,520	1,340	804	1,330	**809**	**763**
June 2004	913	1,320	1,290	2,400	1,350	814	1,500	**782**	**673**
Feb 2004	764	1,410	1,450	2,580	1,500	842	1,450	**719**	**730**
Average	**773**	**1,256**	**1,300**	**2,460**	**1,747**	**893**	**1,424**	**715**	**578**
NA – Not Available									

Source: City of San Diego, 2010

Figure 4-12. City Water Quality Monitoring Data TDS Measurements (mg/L)

Table 2-6 City Water Quality Monitoring Data Nitrate (mg/L) as NO_3									
Sample Date	Monitoring Well Identification								
	13S2W	31L5	30R1	32G1	33L3	32Q2	3F2	34K2	35B3
Dec 2007	NA	32	27.1	102	26.1	87.8	15.3	**1.31**	**7.97**
Mar 2007	6.06	43.1	62.3	95.6	31.9	110	24.8	**2.15**	**10.7**
Oct 2006	13.7	33.4	51.6	117	32.1	40	40	**3.86**	**10.9**
Sept 2005	4.2	42.2	71.4	112	29.1	75.6	15.2	**2.13**	**12.1**
July 2005	4.55	39.6	64.1	105	42.1	76.6	16.3	**1.37**	**14.8**
Mar 2005	5.61	44.6	65.3	70.7	21.4	83.2	11.3	**4.79**	**NA**
Dec 2004	5.06	37.4	80.1	95.3	21	28.1	11.6	**5.51**	**9.16**
Sept 2004	3.38	40.1	64	98.3	22.9	65.3	10.8	**1.45**	**24.8**
June 2004	3.21	27.1	67.2	86.3	23.9	77.7	52.9	**1.27**	**29**
Feb 2004	6.59	36.9	64.9	92.4	26.8	68.3	13	**3.16**	**30.9**
Average	**6**	**38**	**66**	**97**	**28**	**69**	**22**	**3**	**18**
NA – Not Available									

Source: City of San Diego, 2010

Figure 4-13. City Water Quality Monitoring Data Nitrate (mg/L) as NO_3

4.1.6 San Pasqual Valley Groundwater Basin Salt and Nutrient Management Plan, 2014

The SPV SNMP (City of San Diego, 2014) evaluated groundwater quality in the Basin. The SNMP reported that Santa Ysabel Creek had low concentrations of nitrate and TDS, and that Guejito Creek also had low concentrations of nitrate and TDS. Santa Maria Creek had low concentration of nitrate, but elevated levels of TDS.

Cloverdale, Kit Carson, and Sycamore Creeks had TDS levels that exceed RWQCB water quality objectives, likely due to increased human activity and urban stormwater runoff. These areas are surrounded by agricultural and residential land uses, which may be contributors to the high levels of TDS. The SNMP also provided an assessment of sources and loads for salts and nutrients as follows:

- More salts were entering the aquifer than were being removed, which has resulted in an overall increase in groundwater concentrations of TDS over time. The SNMP estimated a net increase in TDS mass that is stored in water-bearing formations of approximately 8,000 U.S. tons annually.
- Surface water inflows and imported water used for irrigation contribute 29 and 16 percent respectively to the total Basin salt load. The majority of the surface water salt load is contributed by Cloverdale and Santa Maria Creeks, which account for approximately one-third of Basin inflows from major stream drainages.
- The single largest contributing source of nitrogen is commercial crop fertilizer use, at 56 percent of the Basin total, followed by landscape fertilizer use at 14 percent.
- Nitrogen loading associated with in-Basin manure applications at Frank Konyn Dairy Inc. and the San Diego Zoo Safari Park, represents a combined 21 percent of the Basin total, with other nonregulated small animal facilities comprising 2 percent of the Basin total.
- The SNMP estimated it would take more than a decade in some areas of the Basin for surface constituents to reach the water table, and lateral groundwater movement of constituents through the aquifer occurs over multiple decades (City of San Diego, 2014):

> *"It may take several years to decades after implementing salt and nutrient management strategies before there would be noticeable changes in TDS and nitrate concentrations in groundwater in some portions of the Basin."*

The SNMP also estimated conditions with reductions to nitrate loading, and concluded that even a near total reduction of nitrate loading would not improve conditions so that nitrate would be above the water quality objective (City of San Diego, 2014):

> *"Modeling results suggest that even an unrealistic reduction of 95 percent of the nitrate concentrations associated with nitrogen loading from fertilizer and manure management would not decrease the footprint area where nitrate concentrations exceed the nitrate groundwater water quality objective, however implementation of a 25 percent reduction in nitrate loading from fertilizer and manure management is projected to curb further increases in nitrate mass in the Basin alluvial aquifer over time."*

The SNMP concluded that improvements could be made in TDS for different subareas of the Basin, but the overall forecast suggests only limited improvements would occur within 50 years of implementation.

4.2 Groundwater Movement and Ocurrence

This section describes the movement and occurrence of groundwater in the Basin based on data collected from the City of San Diego, County of San Diego, and private landowners. Collected data that was used in this section is described in Section 7, *Monitoring Networks*.

4.2.1 Groundwater Levels

Hydrographs show that groundwater levels have remained fairly constant in the western portion of the Basin and have declined over the 2011-2016 drought in the eastern portion of the Basin, with partial recovery from 2017–2018. Figure 4-14 shows selected hydrographs in the Basin. Appendix L includes larger versions of the hydrographs shown in Figure 4-14.

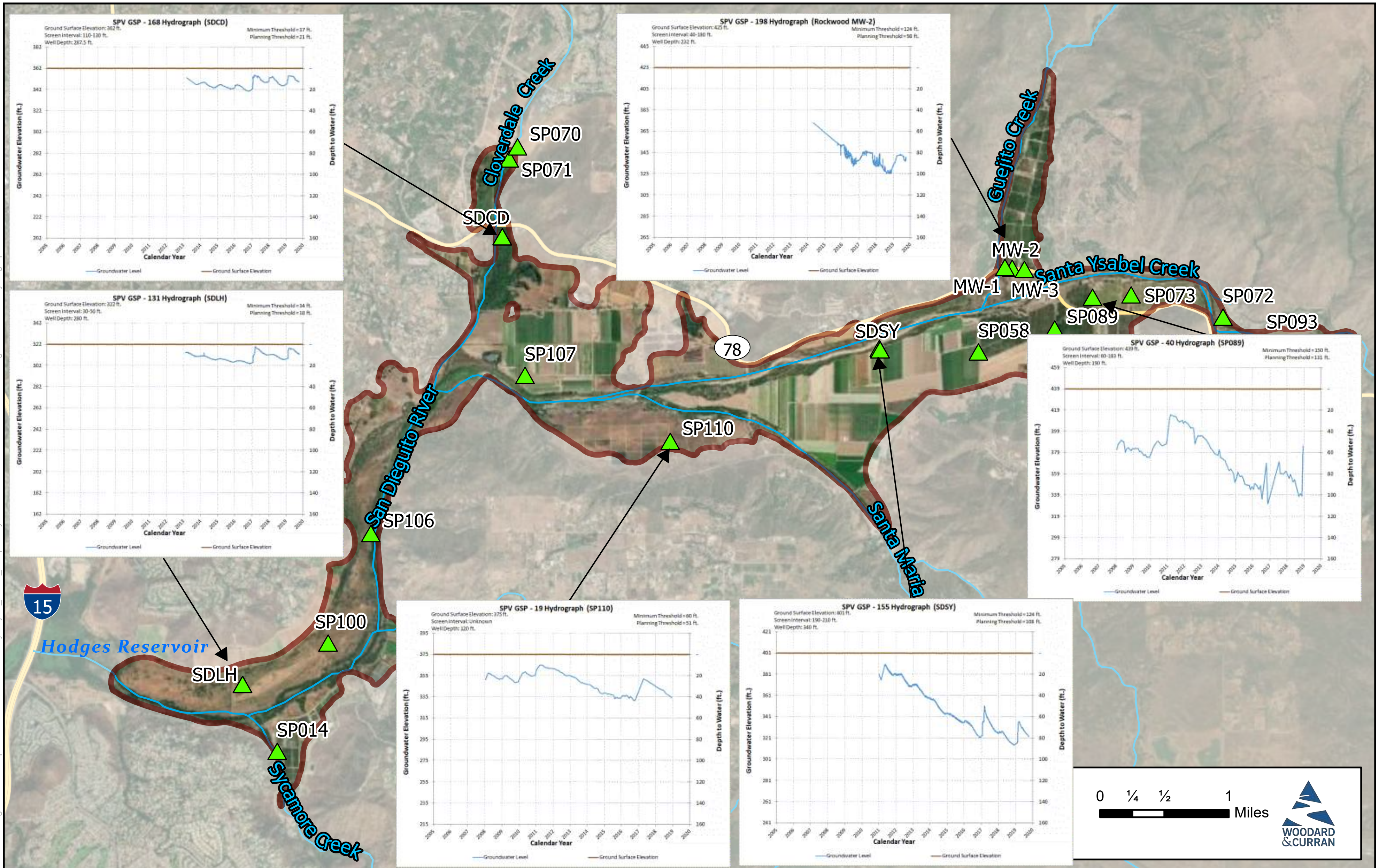
For this GSP, analysts prepared groundwater contour maps to improve understanding of recent groundwater trends in the Basin. A contour map shows changes in groundwater elevations by interpolating groundwater elevations between monitoring sites. Elevations are shown on these maps with contour lines, which indicate a constant groundwater elevation along the contour line. There are two versions of contour maps used in this section. One shows groundwater elevation above mean sea level; this information can be used to infer groundwater horizontal gradients. The second contour map shows contours of depth to water, which is the distance from ground surface to the water level measured in a well; this information can identify areas of shallow or deep groundwater.

Depth to water contours help analysts understand groundwater levels at the planning level across the Basin and help to promote an understanding of regional groundwater level trends. These contour maps are not indicative of exact values across the Basin because groundwater contour maps approximate conditions between measurement points.

Figure 4-15 shows groundwater elevation contours for groundwater elevations in spring of 2015; the contours shown indicate that groundwater flows mimic topography, and groundwater flowed from east to west through the Basin during this time.

Figure 4-16 shows groundwater elevation contours for groundwater elevations in fall of 2018. More groundwater elevation data were available in fall of 2018, and Figure 4-16 shows more detail than those of spring 2015. Groundwater elevations are similar to fall of 2015 overall, with the Basin's western portion having groundwater elevations ranging from 5 to 10 feet higher, and the eastern portion of the Basin having similar groundwater elevations. Groundwater moved from east to west, with groundwater directly south of Rockwood Canyon having a small northward gradient from operation of wells in that area.

Figure 4-17 shows depth to groundwater contours for spring of 2018, and shows groundwater was within 20 feet bgs in the Basin's western portion. The figure also shows depth to water is up to 87 feet bgs in the Basin's eastern portion. The groundwater directly south of Rockwood Canyon no longer had a small northward gradient, but had reversed toward the south.



SAN DIEGO

Project #: 0011197

Legend

- San Pasqual Valley Basin
- Groundwater Levels Monitoring Network
- Streams

Vertical datum is NAVD88; Groundwater depths are relative to ground surface

N

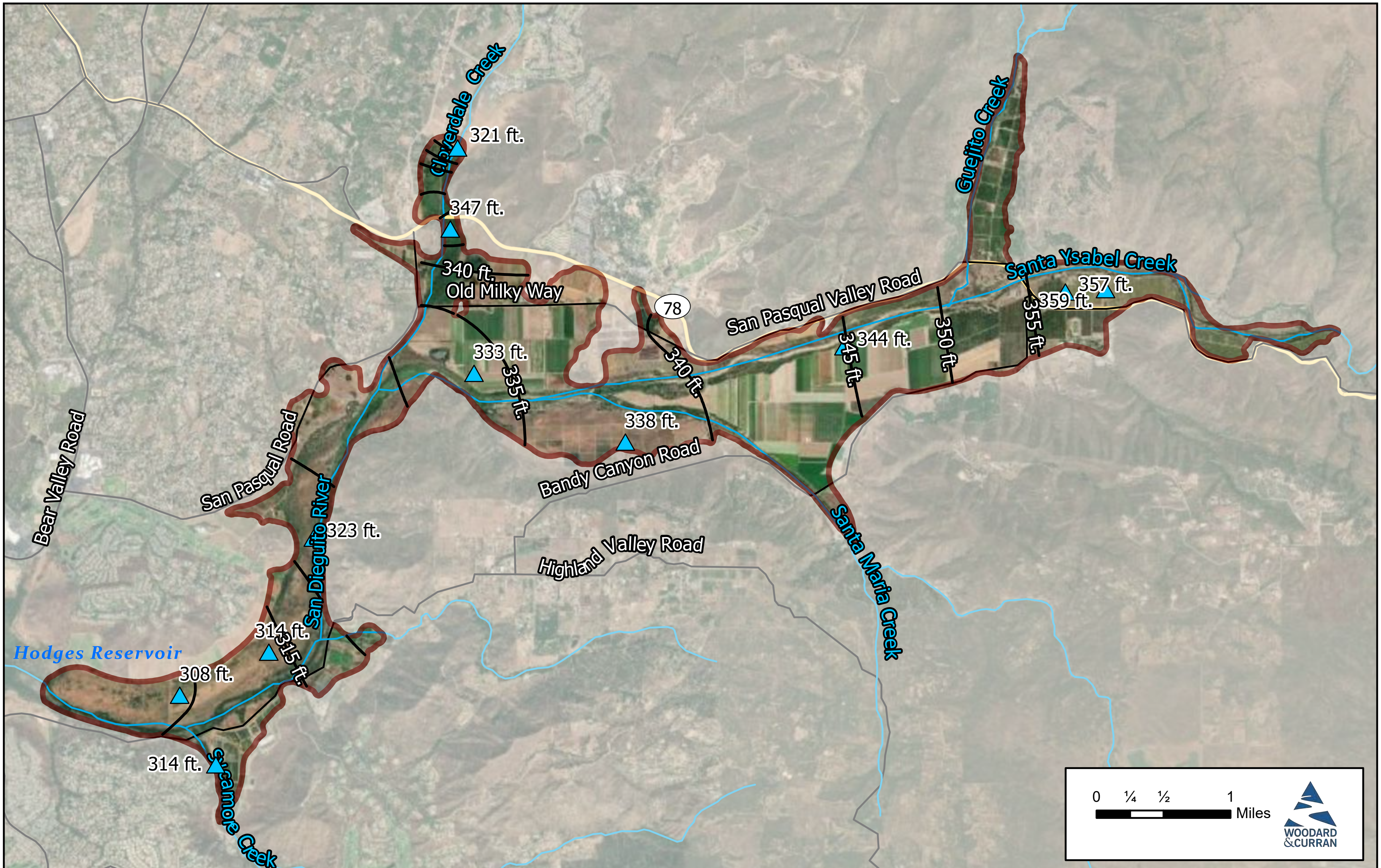
Figure 4-14

San Pasqual Valley GSP

Groundwater Hydrographs

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** SanDAG/SanGIS.

Figure Exported: 9/21/2021 By: gvalenzuela Using: D:\San Pasqual From GIS3 20201013\MyProject_GSP2_v3.aprx Layout: F7-14 Groundwater Level Monitoring Network with hydrographs



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Project #: 0011197

Legend

- ▲ Monitoring Wells (Spring 2015 GWE ft.)
- San Pasqual Valley Basin
- Contour (5 ft.)

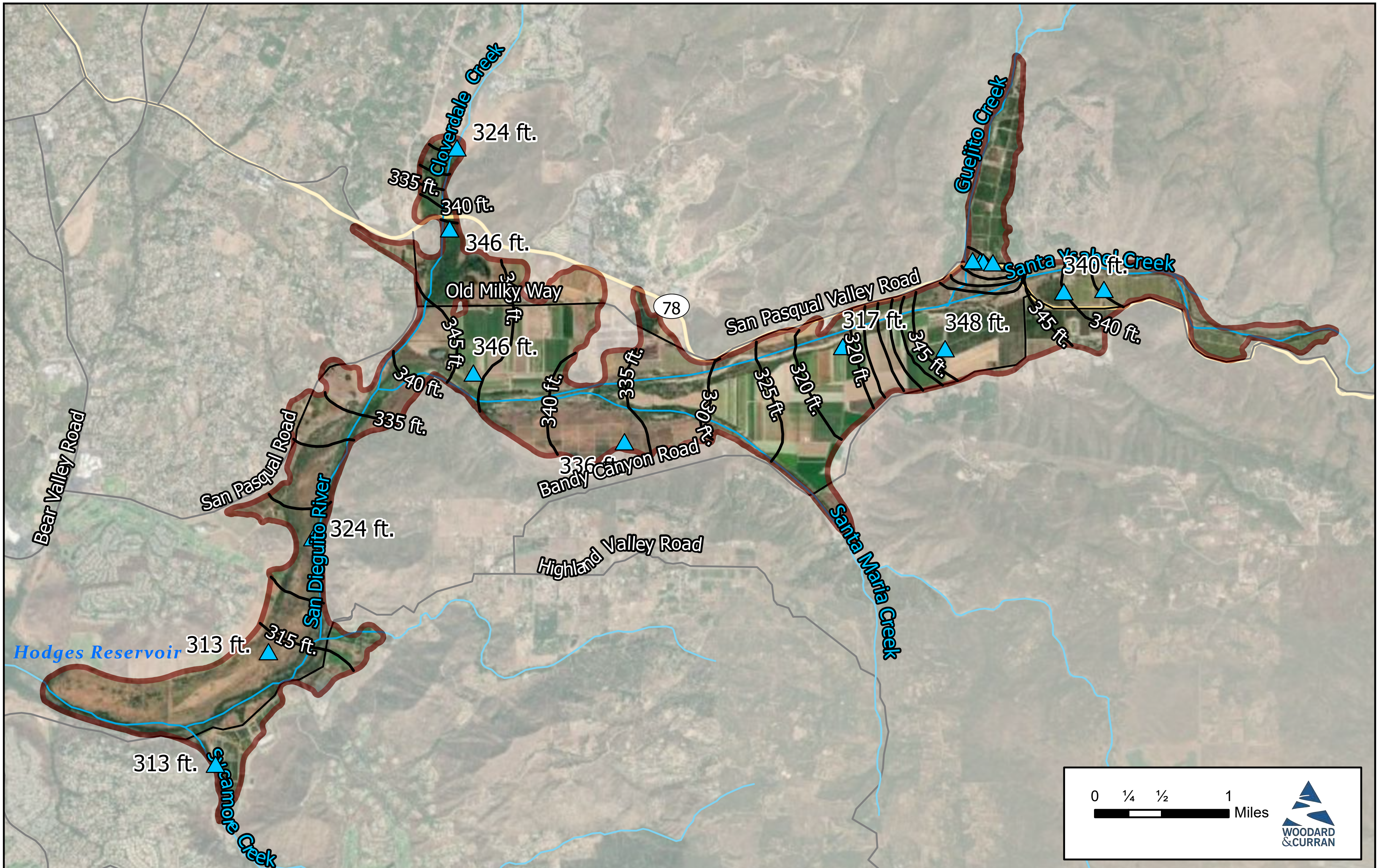
*Vertical datum is NAVD88

N

Figure 4-15

San Pasqual Valley GSP

Groundwater Elevation Contours - Spring 2015



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Project #: 0011197

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San Pasqual Valley Basin

Monitoring Wells (Fall 2018 GWE ft.)

Groundwater Elevation Contour (ft.)

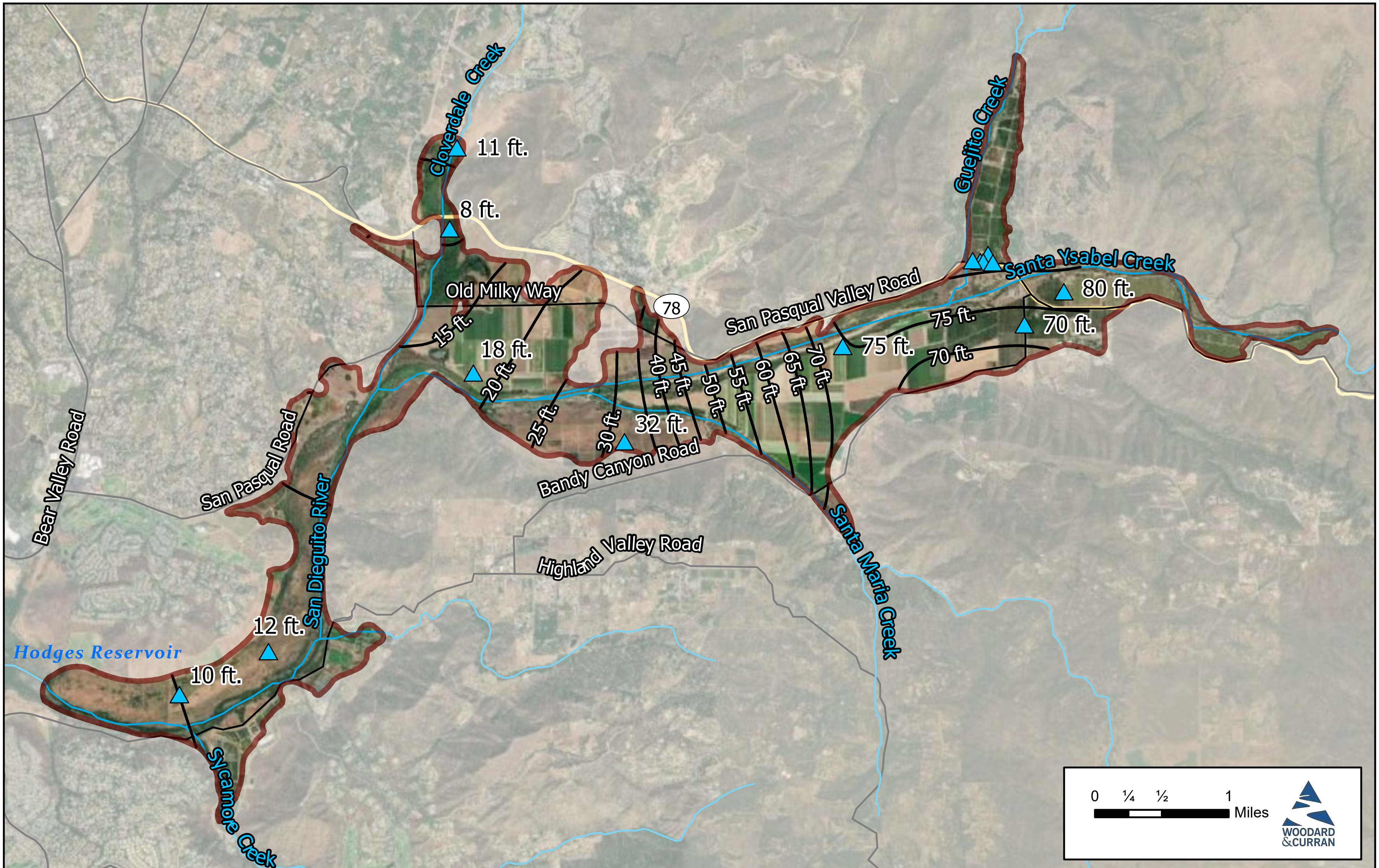
*Vertical datum is NAVD88

N

Figure 4-16

San Pasqual Valley GSP

Groundwater Elevation Contours - Fall 2018



SAN DIEGO

Project #: 0011197

Legend

San Pasqual Valley Basin

Monitoring Wells (Spring 2018 DTW ft.)

Depth to Groundwater Contour (ft. bgs)

ft. bgs: feet below ground surface

N

Figure 4-17

San Pasqual Valley GSP

Depth to Water Contours - Spring 2018

4.2.2 Vertical Hydraulic Gradients

A vertical hydraulic gradient describes the potential for movement of groundwater perpendicular to the ground surface. A vertical hydraulic gradient is typically computed by comparing the elevations of groundwater in a nested well (i.e., a well with multiple completions that are of different depth intervals) or wells within close proximity of one another screened at different depths. If groundwater elevations in the well's shallower completions are higher than those in the deeper completions, the vertical hydraulic gradient is identified as a downward gradient. A downward gradient is one where groundwater has the potential to move downward in elevation. If groundwater elevations in the shallower completions are lower than in the deeper completions, the gradient is identified as an upward gradient. An upward gradient is one where groundwater trends upward toward the ground surface. If groundwater elevations are the same across a well's completions, that would indicate a vertical hydraulic gradient of zero, which would indicate no potential for vertical movement of groundwater at that location. An understanding of the Basin's vertical gradients throughout the Basin is required per SGMA regulations Section 354.16(a), and this understanding further describes the potential for groundwater movement in the Basin.

There are three multiple-completion (nested) wells in the Basin. A nested well includes perforations at multiple intervals; as a result, it provides information at multiple depths in the well. Figure 4-18 shows the locations of the nested wells in the Basin, which are at the bottom end of the Basin near Hodges Reservoir (well SDLH), near Highway 78 and Cloverdale Creek (well SDCD), and further up the Basin near Santa Ysabel Creek (well SDSY).

Figure 4-19 shows a combined hydrograph for nested well SDSY and additional USGS well 330514116582801 that is within 50 feet of well SDSY. Well SDSY has three completions, each at different depths. Additional USGS well 330514116582801 is screened above all three well SDSY completions and provides additional vertical flow data, which is why it is included in the hydrograph. Data about all four completions at these two wells are as follows:

- Completion SDSY-1 is the deepest completion in well SDSY, with a screened interval from 280 to 340 feet bgs
- Completion SDSY-2 is the middle completion in well SDSY, with a screened interval from 190 to 210 feet bgs
- Completion SDSY-3 is the shallowest completion in well SDSY with a screened interval from 70 to 90 feet bgs
- USGS well 330514116582801 (i.e., the additional well near well SDSY) has a screen interval from 50 to 60 feet bgs

Figure 4-19 shows water levels are close to the same elevation at each completion throughout spring and fall seasons, and throughout the period of record. Notably, the shallowest well (shown in green) went dry below 60 feet bgs; measurements from 2015 and later are shown individually.

Figure 4-20 shows a combined hydrograph for nested well SDLH, which was installed by USGS. SDLH has of three completions, each at different depths as follows:

- Completion SDLH-1 is the deepest completion with a screened interval from 170 to 270 feet bgs
- Completion SDLH-2 is the middle completion with a screened interval from 90 to 110 feet bgs
- Completion SDLH-3 is the shallowest completion with a screened interval from 30 to 50 feet bgs

Figure 4-20 shows that the deepest completion is lower than the shallower completions by as much as 10 feet during summer and fall months. This indicates that during the irrigation season, the deeper portions of the aquifer are likely to be where pumping occurs, which induces a downward gradient. This pumping removes water from the deeper portion of the aquifer, creating a downward vertical gradient during the summer and fall. By spring, enough water has moved down or horizontally to replace removed water, and the downward vertical gradient is significantly smaller at this location in the spring measurements.

Figure 4-21 shows a combined hydrograph for nested well SDCD, which was installed by the USGS. Well SDCD has three completions, each at different depths as follows:

- Completion SDCD-1 is the deepest completion with a screened interval from 190 to 270 feet bgs
- Completion SDCD-2 is the middle completion with a screened interval from 110 to 130 feet bgs
- Completion SDCD-3 is the shallowest completion with a screened interval from 30 to 50 feet bgs

Figure 4-21 shows that the deepest completion is slightly lower than the shallower completions. This indicates a small downward vertical gradient is present at this location in the spring measurements.

The lack of strong vertical gradients within the Basin is expected given the lack of continuous aquitards in the subsurface, and the primary aquifer is generally connected from Basin's surface to the bottom.

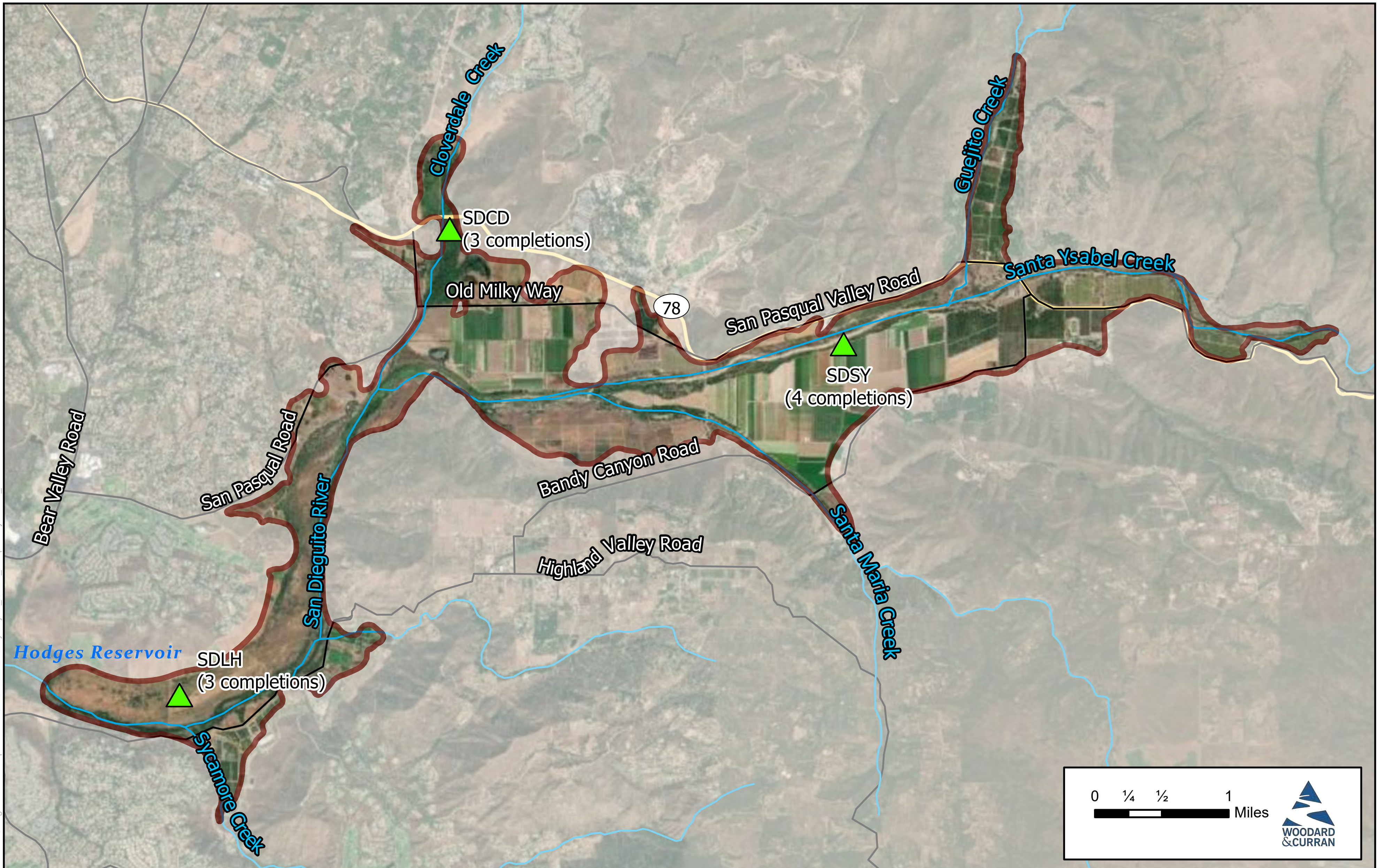


Figure Exported: 9/21/2021 By: gvalenzuela Using: D:\San Pasqual From GIS3 20201013\MyProject_GSP2_v3.aprx Layout: F2_1 - Basin

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Project #: 0011197

Legend

San Pasqual Valley Basin

Nested Groundwater Level Monitoring Wells

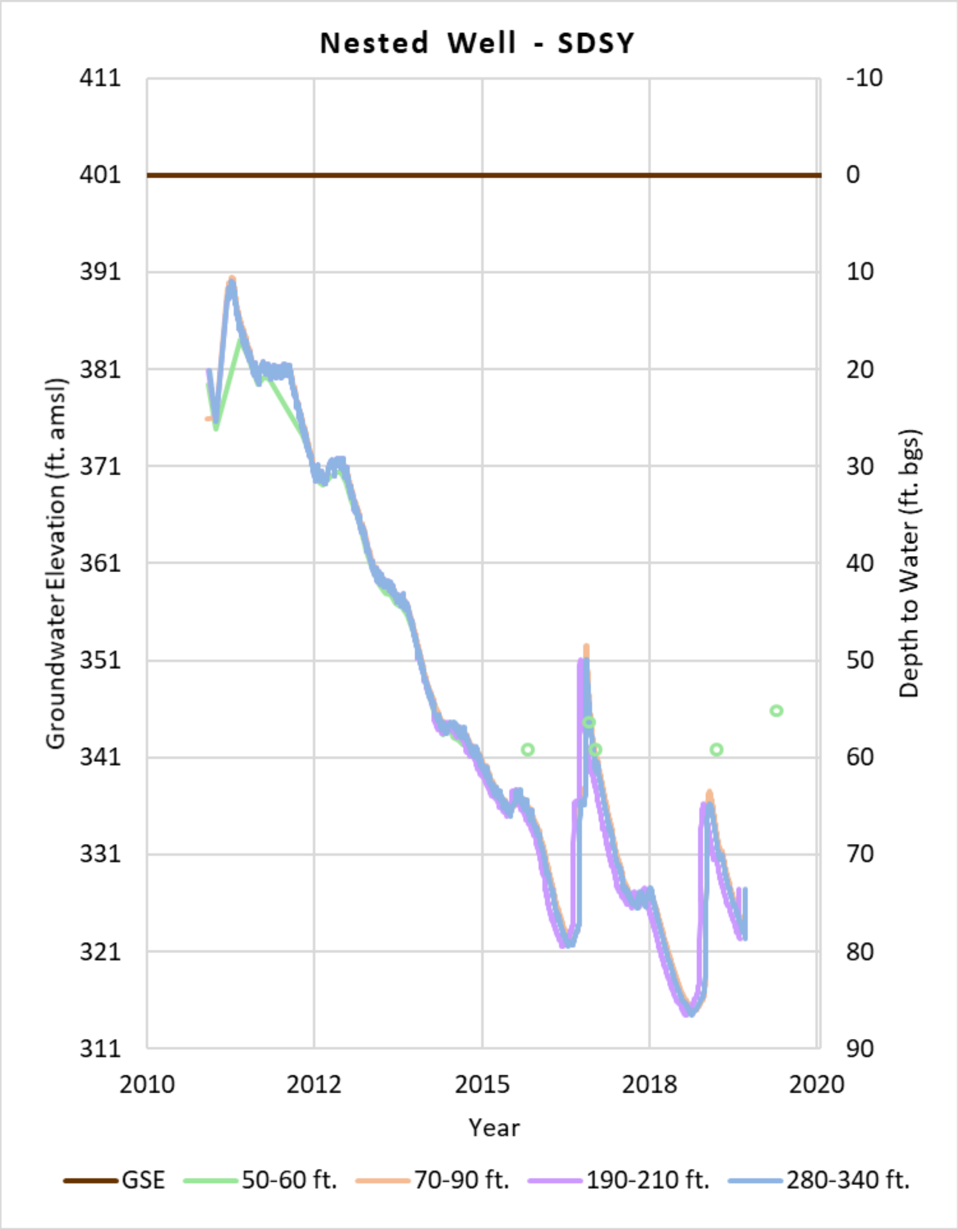
Streams

N

Figure 4-18

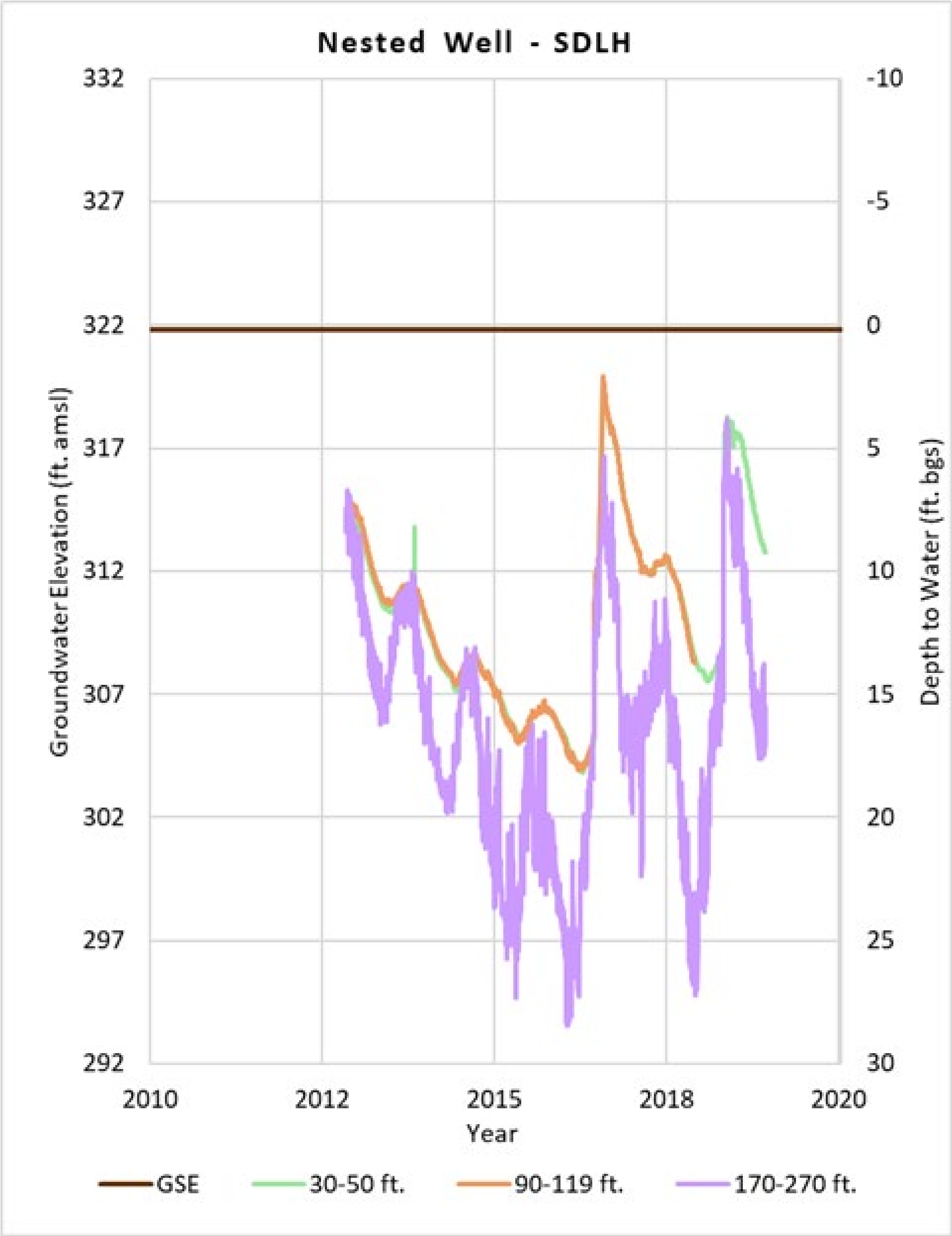
San Pasqual Valley GSP

Location of Nested Groundwater Level Monitoring Wells



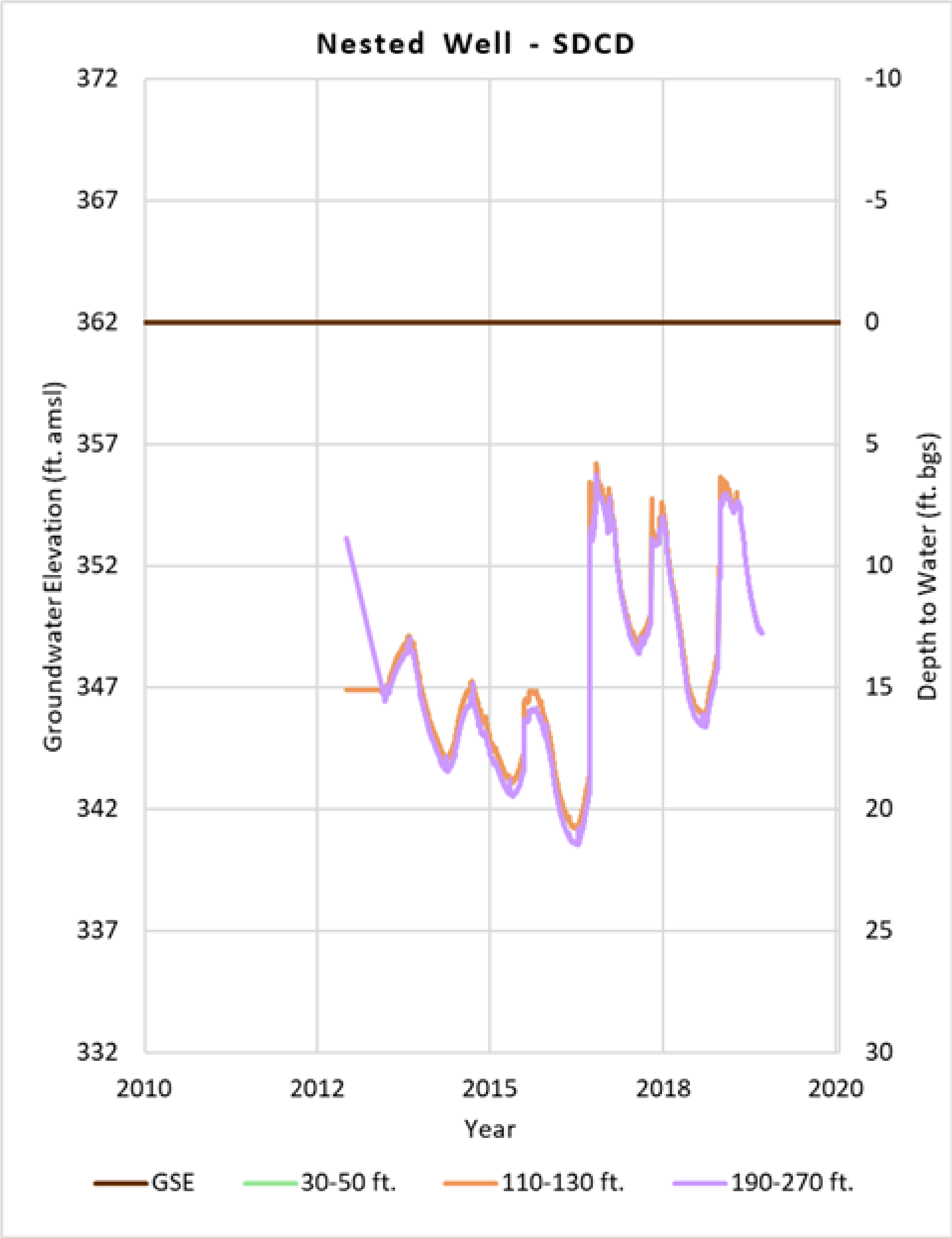
Note: Vertical datum is NAVD88, and depths are relative to ground surface.

Figure 4-19. Nested Well SDSY Hydrograph



Note: Vertical datum is NAVD88, and depths are relative to ground surface.

Figure 4-20. Nested Well SDLH Hydrograph



Note: Vertical datum is NAVD88, and depths are relative to ground surface.

Figure 4-21. Nested Well SDCD Hydrograph

4.2.3 Change in Groundwater Storage

The Basin's maximum groundwater in storage for the Alluvium is generally considered to be 58,000 acre-feet, with Residuum storage estimated at 5,000 acre-feet or less (USGS, 1983).

Historical change in Basin groundwater storage has shown a decline during dry periods and recovery during wet periods. Figure 4-22 shows change in Basin groundwater storage by year, water year type, and cumulative water volume over the last 15 years. Change in groundwater storage was calculated using the SPV GSP Model (Appendix I). Average annual change in groundwater storage over the 15-year period was -245 acre-feet. In Figure 4-22, the bar color correlates with a water year type defined by Basin precipitation. Change in groundwater storage was negative in dry, critically dry, and some normal years, and was positive in wet, above normal, and some normal years. Hydrological water year types are based on a local precipitation ranking, and uses the following classifications:

- W—Wet
- AN—Above normal
- N—Normal
- D—Dry
- C—Critically dry

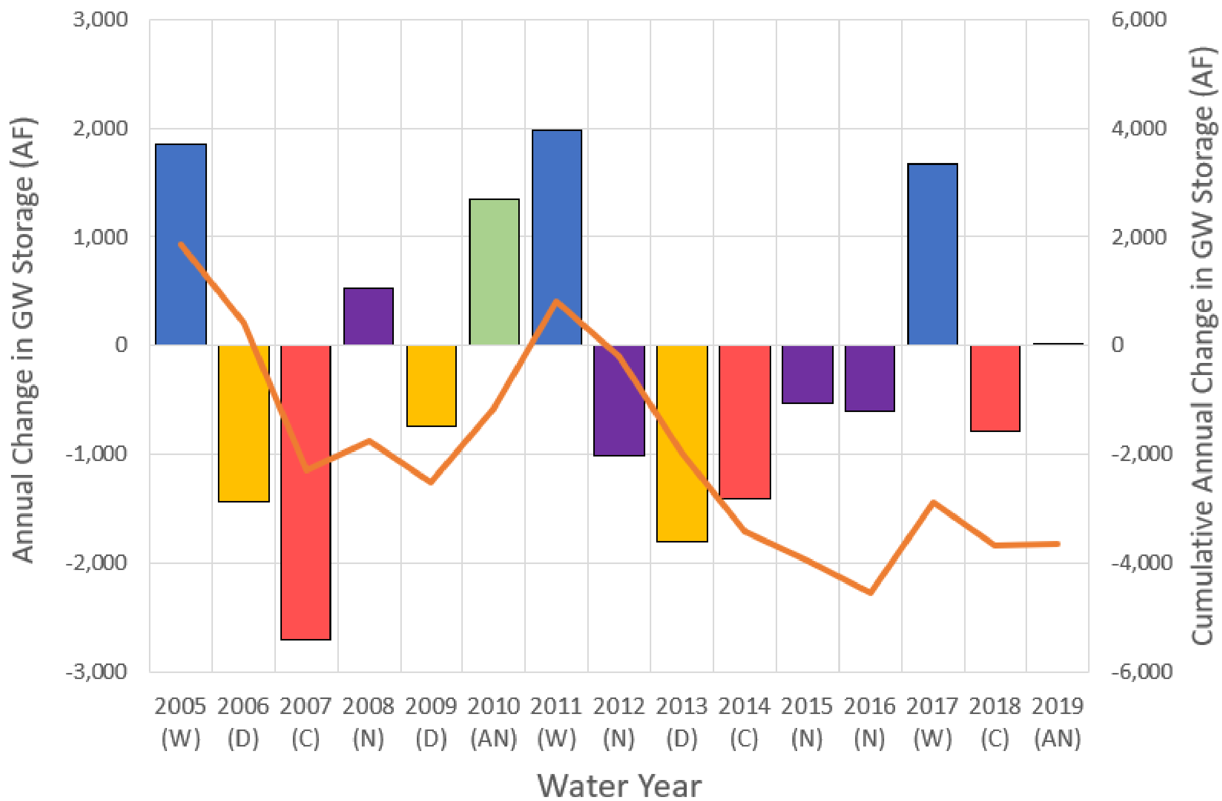


Figure 4-22. Basin Storage by Year, Water Year Type, and Cumulative Water Volume

4.3 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator in the Basin because seawater intrusion is not present and will not occur due to the Basin's elevation and lateral distance to the Pacific Ocean, bays, deltas, and inlets.

4.4 Groundwater Quality

This section presents Basin groundwater quality related conditions. The constituents of concern in the Basin are TDS and nitrate.

4.4.1 Groundwater Quality Summary

Information about Basin groundwater quality was summarized in the SNMP (City of San Diego, 2014). The SNMP summarized water quality monitoring for a wide variety of constituents, and identified TDS and nitrate as the constituents of concern in the Basin. Figure 4-23 and Figure 4-24 are summary tables describing groundwater quality in the Basin from 1950 through 2006, as detailed in the SNMP. Figure 4-25 and Figure 4-26 also summarize groundwater quality in the Basin from 2007 through 2013. Other water quality constituents that were both monitored and summarized in the SNMP have not been measured at levels that are higher than the MCLs since 2013. Iron and manganese were detected at above the MCL after 2013, but are naturally occurring, do not have primary MCLs, and are not directly associated with groundwater quality management.

4.4.2 Total Dissolved Solids

Figure 4-27 shows selected chemographs (that is, constituent concentrations through time) of TDS concentrations in surface waters both in and next to the Basin. TDS measurements have been below 1,000 mg/L for Guejito and Santa Ysabel Creeks, with an increase in TDS following winter in 2011. TDS measurements for Santa Maria Creek peaked at approximately 1,000 mg/L in 2011. TDS levels in measurements for Cloverdale and Sycamore Creeks were higher than the upper secondary MCL for TDS of 1,000 mg/L, with Cloverdale Creek TDS concentrations increasing from 2006 to 2011 reaching up to 4,160 mg/L, and Sycamore Creek TDS concentrations reaching approximately 1,500 mg/L. Kit Carson Creek does not flow into the Basin, but drains an area near it, and has had TDS measurements as high as 2,830 mg/L. The TDS concentrations in creeks that flow into the Basin indicate that surface water flowing into the Basin is a contributor of TDS loading to groundwater in the Basin.

Figure 4-28 shows TDS chemographs for selected groundwater wells in the Basin. Appendix H includes lager versions of these chemographs. The TDS concentrations for Wells SP089 and SP061, located in the eastern portion of the Basin, have remained relatively near 500 mg/L stable throughout the measurement period. Higher TDS concentrations have been reported for (i.e., 1,100 to 3,500 mg/L). These two wells are in the northwestern portion of the Basin. Well SP003 has had TDS concentrations that fluctuate each year and have been approximately 900 mg/L on average.

Groundwater Quality Summary, 1950 through 2006

San Pasqual Valley Groundwater Basin Salt and Nutrient Management Plan

					Groundwater Results							
					Western Portion of Basin			Eastern Portion of Basin				
Constituent	Primary MCL[h]	Secondary MCL[h]	Regional Board Groundwater WQO[c]	Units	Maximum	Minimum	Average[g]	Maximum	Minimum	Average[g]	Exceeds Primary or Secondary MCL[a]	Exceeds Regional Board Groundwater WQO[a]
General Mineral												
Calcium	--	--	--	mg/L	352	11	140	274	21	85	NA[b]	NA[b]
Chloride	--	250/500/600[f]	400[d]	mg/L	1,618	72	270	324	0.3	100	Yes	Yes
Fluoride	2	--	1.0[d]	mg/L	2	< 0.03	0.5	62.1	< 0.03	0.6	Yes	Yes
Hardness (as $CaCo_3$)	--	--	--	mg/L	1,390	50	500	997	127	347	NA[b]	NA[b]
Magnesium	--	--	--	mg/L	170	< 3	60	121	4.6	35	NA[b]	NA[b]
Nitrate (as NO_3)	45	--	10[d]	mg/L	174	<0.2	40	141.5	<0.2	20	Yes	Yes
Potassium	--	--	--	mg/L	28	0.604	3.5	12	<0.5	3	NA[b]	NA[b]
Sodium	--	--	--	mg/L	540	3.11	185	204	34	83	NA[b]	NA[b]
Sodium Percent	--	--	60[e]	%	42%	19%	40%	27%	51%	33%	NA[b]	No
Sulfate	--	250/500/600[f]	500[d]	mg/L	1,063	3.9	310	519	10	100	Yes	Yes
Alkalinity (total)	--	--	--	mg/L	408	89.2	270	384	20	200	NA[b]	NA[b]
General Physical												
Total Dissolved Solids	--	500/1000/1500[f]	1000[d]	mg/L	3060	58	1300	4400	262	722	Yes	Yes
Inorganics												
Aluminum	1	0.2	--	mg/L	0.387	0.00205	0.0179	0.27	0.00136	0.0184	Yes	NA[b]
Antimony	0.006	--	--	mg/L	0.00587	0.00145	0.0039	<0.0005	<0.0005	<0.0005	No	NA[b]
Arsenic	0.01	--	--	mg/L	0.009	0.00102	0.0030	0.007	0.00075	0.0024	No	NA[b]
Barium	2	--	--	mg/L	0.135	0.00131	0.0576	0.294	0.00239	0.1280	No	NA[b]
Beryllium	0.004	--	--	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	No	NA[b]
Boron	--	--	0.75[d]	mg/L	0.194	<0.0005	0.060	0.148	<0.0005	0.0400	NA[b]	No
Cadmium	0.005	--	--	mg/L	0.02	0.00115	0.004	0.003	0.00108	0.0030	Yes	NA[b]
Chromium	0.05	--	--	mg/L	0.0114	0.00101	0.004	0.0105	0.00101	0.0034	No	NA[b]
Copper	--	1	--	mg/L	0.05	0.00133	0.007	0.351	0.00101	0.0101	No	NA[b]

Source: City of San Diego, 2014 – See Figure 4-24 (next page) for footnote legend.

Figure 4-23. Groundwater Quality Summary, 1950 through 2006—Part 1

Groundwater Quality Summary, 1950 through 2006
San Pasqual Valley Groundwater Basin Salt and Nutrient Management Plan

Constituent	Primary MCL[h]	Secondary MCL[h]	Regional Board Groundwater WQO[c]	Units	Groundwater Results						Exceeds Primary or Secondary MCL[a]	Exceeds Regional Board Groundwater WQO[a]
					Western Portion of Basin			Eastern Portion of Basin				
					Maximum	Minimum	Average[g]	Maximum	Minimum	Average[g]		
Iron	--	0.3	0.3 [d]	mg/L	35.6	0.0266	2.060	4	0.01	0.3000	Yes	Yes
Lead	0.015	--	--	mg/L	0.05	0.000561	0.021	0.05	0.000844	0.0180	No	NA[b]
Manganese	--	0.05	0.05 [d]	mg/L	2.7	0.0002	0.300	5.67	0.0002	0.2000	Yes	Yes
Mercury	0.002	--	--	mg/L	0.00037	0.0002	0.0	0.0004	0.0002	0.0002	No	NA[b]
Nickel	0.1	--	--	mg/L	0.0687	0.00056	0.005	0.0858	0.0005	0.0040	No	NA[b]
Perchlorate	--	--	--	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA[b]	NA[b]
Selenium	0.05	--	--	mg/L	0.012	0.001	0.0060	0.057	0.00137	0.0120	Yes	NA[b]
Silver	--	0.1	--	mg/L	0.01	0.00075	0.0092	0.01	0.01	0.0100	No	NA[b]
Thallium	0.002	--	--	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	No	NA[b]
Vanadium	--	--	--	mg/L	0.0253	0.00506	0.0126	0.0709	0.00301	0.0115	NA[b]	NA[b]
Zinc	--	5.0	--	mg/L	0.303	0.00201	0.0452	5.02	0.0023	0.0960	Yes	NA[b]
Organics												
Volatile Organic Compounds (Drinking Water)	-- [i]	-- [i]	-- [i]	mg/L	0.00284	<0.00001	-- [i]	0.00456	<0.00001	-- [i]	-- [i]	NA[b]

Notes:
[a]Indicates that at least one or more reported concentration exceeds the primary or secondary MCL or Regional Board groundwater WQO.
[b]To date, MCLs and groundwater WQOs have not been identified for this constituent.
[c]These values represent the Regional Board groundwater WQOs for the Basin.
[d]Detailed salt balance studies are recommended for this area to determine limiting mineral concentration levels for discharge. On the basis of existing data, the tabulated objectives would probably be maintained in most areas. Upon completion of the salt balance studies, significant WQO revisions may be necessary. In the interim, projects of groundwater recharge with water quality inferior to the tabulated numerical values may be permitted following individual review and approval by the Regional Board if such projects do not degrade existing ground water quality to the aquifers affected by the recharge.
[e]Na is measured as the % Na = (Na / (Na + Ca + Mg + K)) * 100%, where Na, Ca, Mg, and K are expressed in milliequivalent per liter (meq/L)
[f]Secondary MCLs limits presented in order of Recommended/Upper/Short Term.
[g]Average was calculated using detections recorded above the reporting limit. Therefore, nondetect or less than the detection limit values were not factored into the average calculation.
[h]The lowest respective U.S. Environmental Protection Agency or California Department of Health Services constituent MCL value is presented.
[i]Because multiple constituents are represented as volatile organic compounds, MCLs and average concentrations are not provided.

Key:
-- = Not Applicable
NA = not available

Source: City of San Diego, 2014

Figure 4-24. Groundwater Quality Summary, 1950 through 2006—Part 2

Groundwater Quality Summary, 2007 through 2013
San Pasqual Valley Groundwater Basin Salt and Nutrient Management Plan

					Groundwater Results							
					Western Portion of Basin			Eastern Portion of Basin				
Constituent	Primary MCL[h]	Secondary MCL[h]	Regional Board Groundwater WQO[c]	Units	Maximum	Minimum	Average[g]	Maximum	Minimum	Average[g]	Exceeds Primary or Secondary MCL[a]	Exceeds Regional Board Groundwater WQO[a]
General Mineral												
Calcium	--	--	--	mg/L	256	66	142	206	83	111	NA[b]	NA[b]
Chloride	--	250/500/600[f]	400[d]	mg/L	558	125	267	318	131	162	Yes	Yes
Fluoride	2	--	1.0[d]	mg/L	0.97	0.06	0.35	0.35	0.21	0.24	No	No
Hardness (as $CaCo_3$)	--	--	--	mg/L	989	207	598	616	360	412	NA[b]	NA[b]
Magnesium	--	--	--	mg/L	127	2	57	72	11	35	NA[b]	NA[b]
Nitrate (as NO_3)	45	--	10[d]	mg/L	110	4	40	25	<0.2	7	Yes	Yes
Potassium	--	--	--	mg/L	9	<0.5	3	5	3	3	NA[b]	NA[b]
Sodium	--	--	--	mg/L	539	86	191	197	91	105	NA[b]	NA[b]
Sodium Percent	--	--	60[e]	%	59%	36%	49%	52%	38%	42%	NA[b]	No
Sulfate	--	250/500/600[f]	500[d]	mg/L	596	99	323	558	164	210	Yes	Yes
Alkalinity (total)	--	--	--	mg/L	375	106	244	276	172	191	NA[b]	NA[b]
General Physical												
Total Dissolved Solids	--	500/1000/1500[f]	1000[d]	mg/L	2160	10	1282	1410	720	827	Yes	Yes
Inorganics												
Aluminum	1	0.2	--	mg/L	2.8300	<0.0015	0.9519	0.0212	<0.0015	0.0205	Yes	NA[b]
Antimony	0.006	--	--	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	No	NA[b]
Arsenic	0.01	--	--	mg/L	0.0043	<0.0002	0.0032	0.0245	<0.0002	0.0243	Yes	NA[b]
Barium	2	--	--	mg/L	0.2760	<0.001	0.0761	0.1270	0.0001	0.0960	No	NA[b]
Beryllium	0.004	--	--	mg/L	<0.0002	<0.0002	<0.0002	0.0239	<0.0002	0.0223	Yes	NA[b]
Boron	--	--	0.75[d]	mg/L	0.2030	0.0510	0.1090	0.1190	<0.001	0.0655	NA[b]	No
Cadmium	0.005	--	--	mg/L	<0.0001	<0.0001	<0.0001	0.0242	<0.0001	0.0240	Yes	NA[b]
Chromium	0.05	--	--	mg/L	0.0043	<0.0001	0.0014	0.0208	<0.0001	0.0204	No	NA[b]
Copper	--	1	--	mg/L	0.452	0.003	0.025	0.028	<0.0005	0.012	No	NA[b]
Iron	--	0.3	0.3[d]	mg/L	0.1140	<0.005	0.0822	0.2420	<0.005	0.1257	No	No

Source: City of San Diego, 2014 – See Figure 4-26 (next page) for footnote legend.

Figure 4-25. Groundwater Quality Summary, 2007 through 2013—Part 1

Groundwater Quality Summary, 1950 through 2006

San Pasqual Valley Groundwater Basin Salt and Nutrient Management Plan

					Groundwater Results							
					Western Portion of Basin			Eastern Portion of Basin				
Constituent	Primary MCL[h]	Secondary MCL[h]	Regional Board Groundwater WQO[c]	Units	Maximum	Minimum	Average[g]	Maximum	Minimum	Average[g]	Exceeds Primary or Secondary MCL[a]	Exceeds Regional Board Groundwater WQO[a]
Iron	--	0.3	0.3 [d]	mg/L	35.6	0.0266	2.060	4	0.01	0.3000	Yes	Yes
Lead	0.015	--	--	mg/L	0.05	0.000561	0.021	0.05	0.000844	0.0180	No	NA[b]
Manganese	--	0.05	0.05 [d]	mg/L	2.7	0.0002	0.300	5.67	0.0002	0.2000	Yes	Yes
Mercury	0.002	--	--	mg/L	0.00037	0.0002	0.0	0.0004	0.0002	0.0002	No	NA[b]
Nickel	0.1	--	--	mg/L	0.0687	0.00056	0.005	0.0858	0.0005	0.0040	No	NA[b]
Perchlorate	--	--	--	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA[b]	NA[b]
Selenium	0.05	--	--	mg/L	0.012	0.001	0.0060	0.057	0.00137	0.0120	Yes	NA[b]
Silver	--	0.1	--	mg/L	0.01	0.00075	0.0092	0.01	0.01	0.0100	No	NA[b]
Thallium	0.002	--	--	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	No	NA[b]
Vanadium	--	--	--	mg/L	0.0253	0.00506	0.0126	0.0709	0.00301	0.0115	NA[b]	NA[b]
Zinc	--	5.0	--	mg/L	0.303	0.00201	0.0452	5.02	0.0023	0.0960	Yes	NA[b]
Organics												
Volatile Organic Compounds (Drinking Water)	-- [i]	-- [i]	-- [i]	mg/L	0.00284	<0.00001	-- [i]	0.00456	<0.00001	-- [i]	-- [i]	NA[b]

Notes:

[a]Indicates that at least one or more reported concentration exceeds the primary or secondary MCL or Regional Board groundwater WQO.

[b]To date, MCLs and groundwater WQOs have not been identified for this constituent.

[c]These values represent the Regional Board groundwater WQOs for the Basin.

[d]Detailed salt balance studies are recommended for this area to determine limiting mineral concentration levels for discharge. On the basis of existing data, the tabulated objectives would probably be maintained in most areas. Upon completion of the salt balance studies, significant WQO revisions may be necessary. In the interim, projects of groundwater recharge with water quality inferior to the tabulated numerical values may be permitted following individual review and approval by the Regional Board if such projects do not degrade existing ground water quality to the aquifers affected by the recharge.

[e]Na is measured as the % Na = (Na / (Na + Ca + Mg + K)) * 100%, where Na, Ca, Mg, and K are expressed in milliequivalent per liter (meq/L)

[f]Secondary MCLs limits presented in order of Recommended/Upper/Short Term.

[g]Average was calculated using detections recorded above the reporting limit. Therefore, nondetect or less than the detection limit values were not factored into the average calculation.

[h]The lowest respective U.S. Environmental Protection Agency or California Department of Health Services constituent MCL value is presented.

[i]Because multiple constituents are represented as volatile organic compounds, MCLs and average concentrations are not provided.

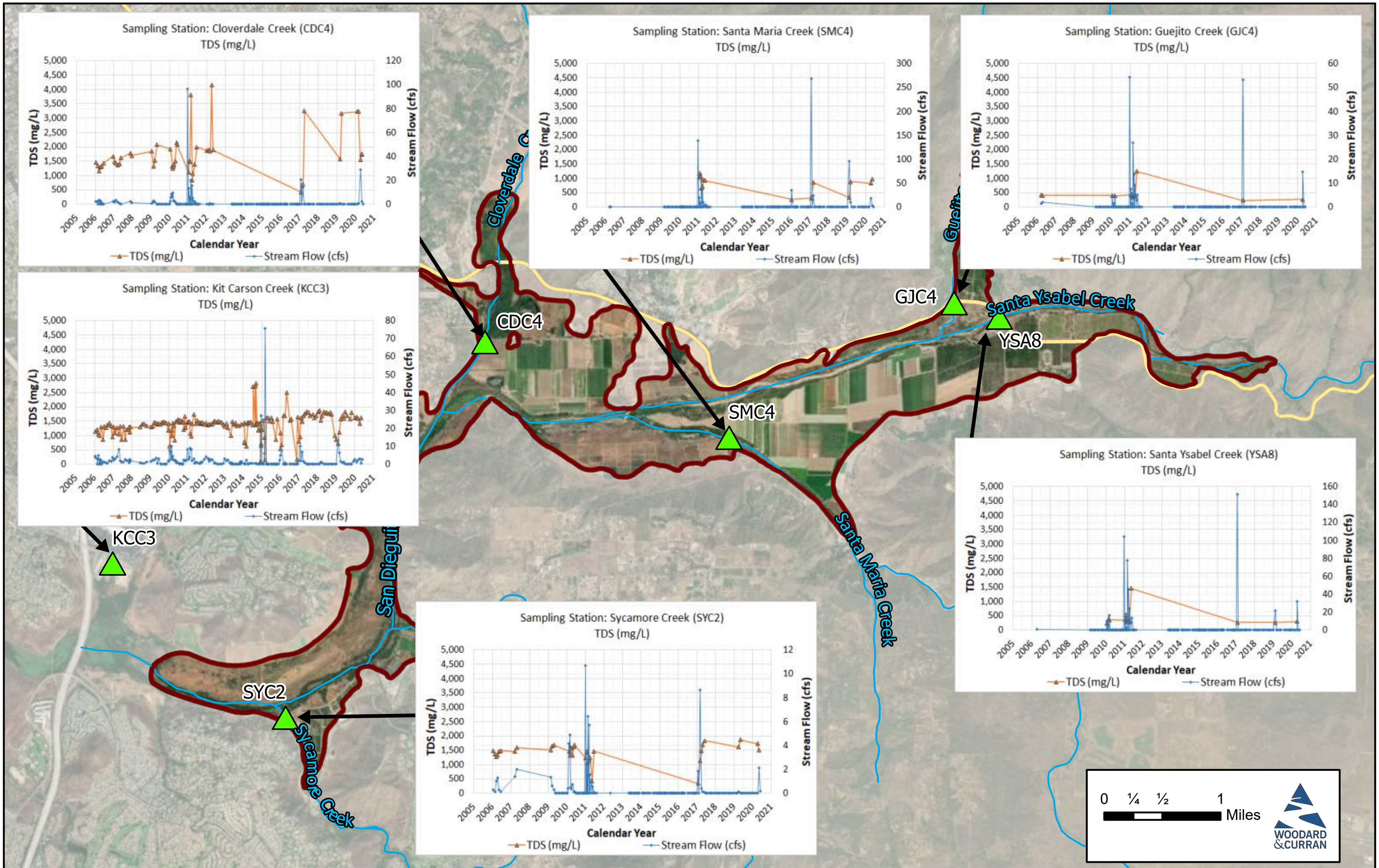
Key:

-- = Not Applicable

NA = not available

Source: City of San Diego, 2014

Figure 4-26. Groundwater Quality Summary, 2007 through 2013—Part 2



Project #: 0011197

Legend

San Pasqual Valley Basin

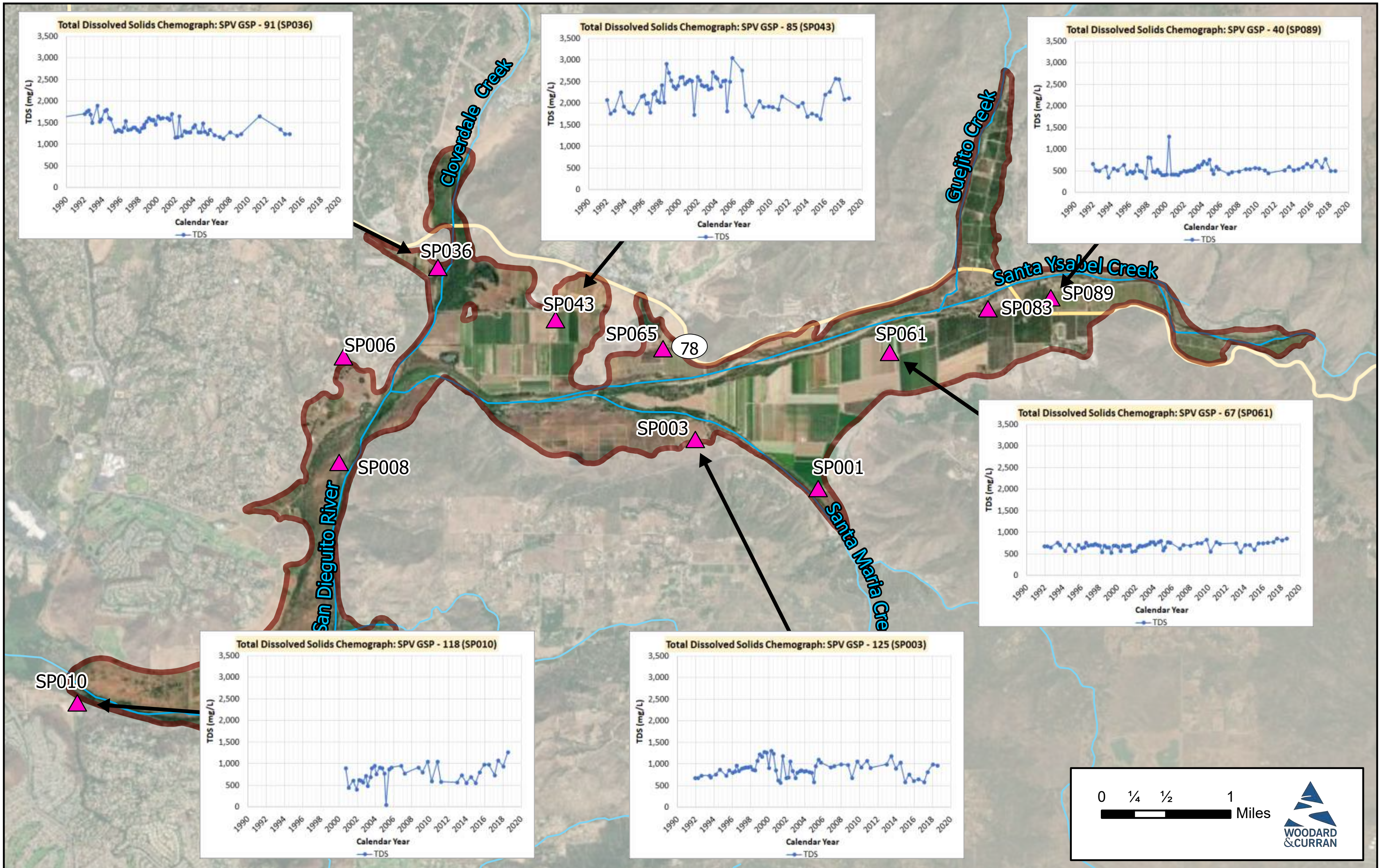
City of San Diego Surface Water Quality Station

cfs = cubic feet per second
mg/L = milligrams per liter
TDS = total dissolved solids

Figure 4-27

San Pasqual Valley GSP

Chemographs of Total Dissolved Solids Concentrations in Surface Water



Project #: 0011197

Legend

San Pasqual Valley Basin

Groundwater Quality Monitoring Network

mg/L = milligrams per liter
TDS = total dissolved solids

N

Figure 4-28

San Pasqual Valley GSP

Chemographs of Total Dissolved Solids Concentrations in Groundwater

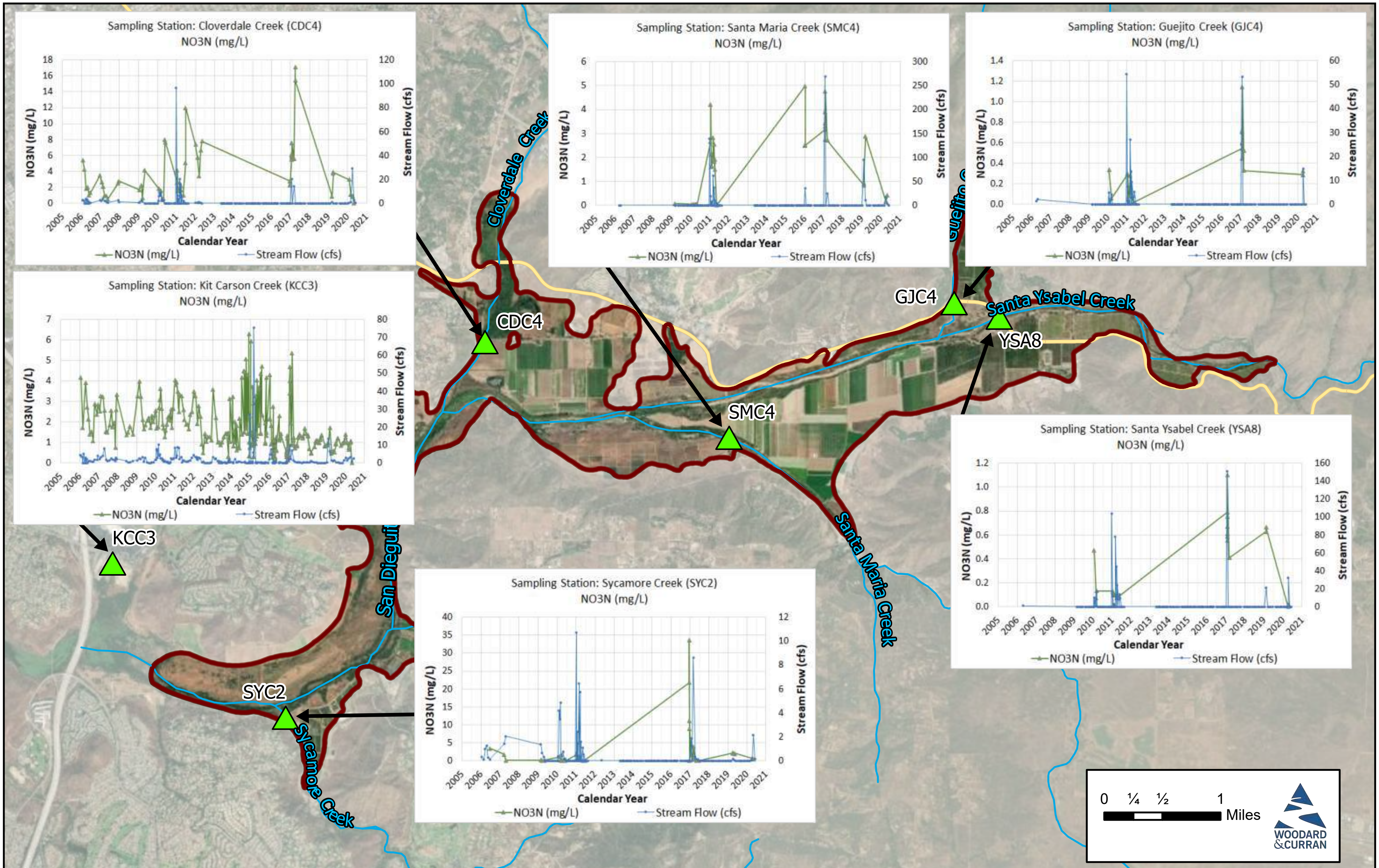
4.4.3 Nitrate

Figure 4-29 shows selected chemographs of nitrate concentrations as nitrogen (NO_3N) in surface waters in and next to the Basin. Nitrate concentrations have been below 1 mg/L (as NO_3N) for Guejito and Santa Ysabel Creeks. Nitrate concentrations for Santa Maria Creek ranged from 1 to 4 mg/L (as NO_3N) in 2011 and were detected at 5 mg/L in 2016. Nitrate concentrations for Cloverdale Creek have b exceeded the MCL for nitrate (10 mg/L as NO_3N). Nitrate concentrations for Cloverdale Creek have ranged from <1 to 18 mg/L (as NO_3N). for Sycamore Creek have ranged from near detection limits to 34 mg/L (as NO_3N). Kit Carson Creek does not flow into the Basin, but drains an area near the Basin, and has had nitrate concentrations as high as 6 mg/L (as NO_3N). The nitrate concentrations measured in that creeks that flow in the Basin indicate that surface water is contributor of nitrate loading to groundwater in the Basin.

Figure 4-30 shows nitrate chemographs for selected groundwater wells in the Basin. Appendix H includes lager versions of these chemographs. The nitrate concentrations for Wells SP089 and SP061, located in the eastern portion of the Basin, have remained near detection limits for the period of measurement. Nitrate concentrations have ranged from non-detect to as high as 19 mg/L (as NO_3N) in well SP036, and have ranged from near detection limits to as high as 34 mg/L (as NO_3N) in well SP043. Well SP003 has had nitrate concentrations that range from 5 to 39 mg/L (as NO_3N).

4.4.4 Anthropogenic Contaminants

Figure 4-31 shows the results of a query using the RWQCB's GeoTracker website. GeoTracker documents contaminant concerns and mitigation projects. As shown in the figure, most GeoTracker sites are Irrigated Lands Regulatory Sites or closed Leaking Underground Storage Tank Cleanup Sites. These sites are localized concerns, but do not pose a threat to the Basin's overall groundwater quality.



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Legend

San Pasqual Valley Basin

City of San Diego Surface Water Quality Station

cfs= cubic feet per second
mg/L = milligrams per liter
NO3N= Nitrate concentration as nitrogen (N)

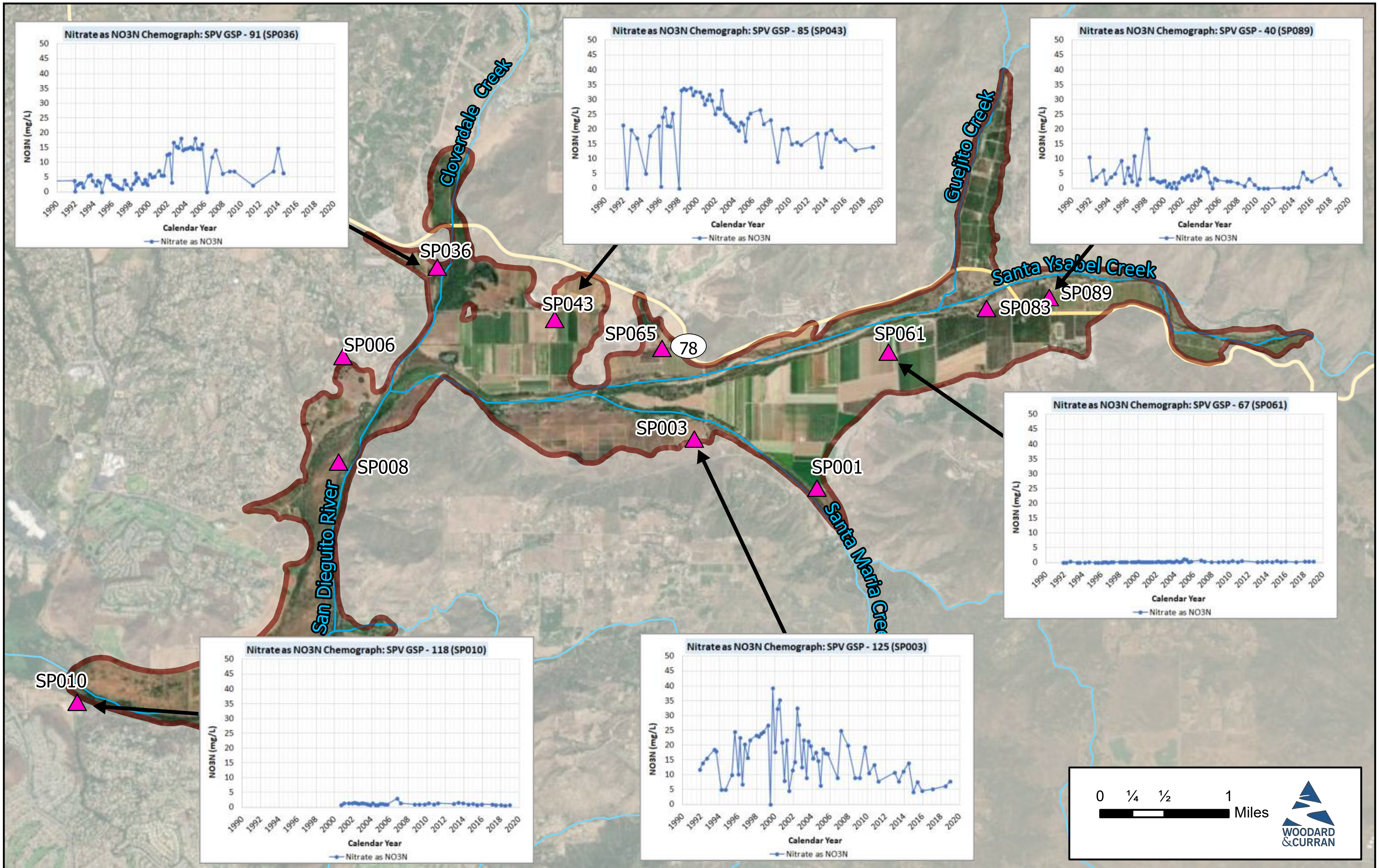
N

Figure 4-29

San Pasqual Valley GSP

Chemographs of Nitrate Concentrations in Surface Water

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** SanDAG/SanGIS, USGS, DWR.



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Project #: 0011197

Legend

San Pasqual Valley Basin

Groundwater Quality Monitoring Network

mg/L = milligrams per liter

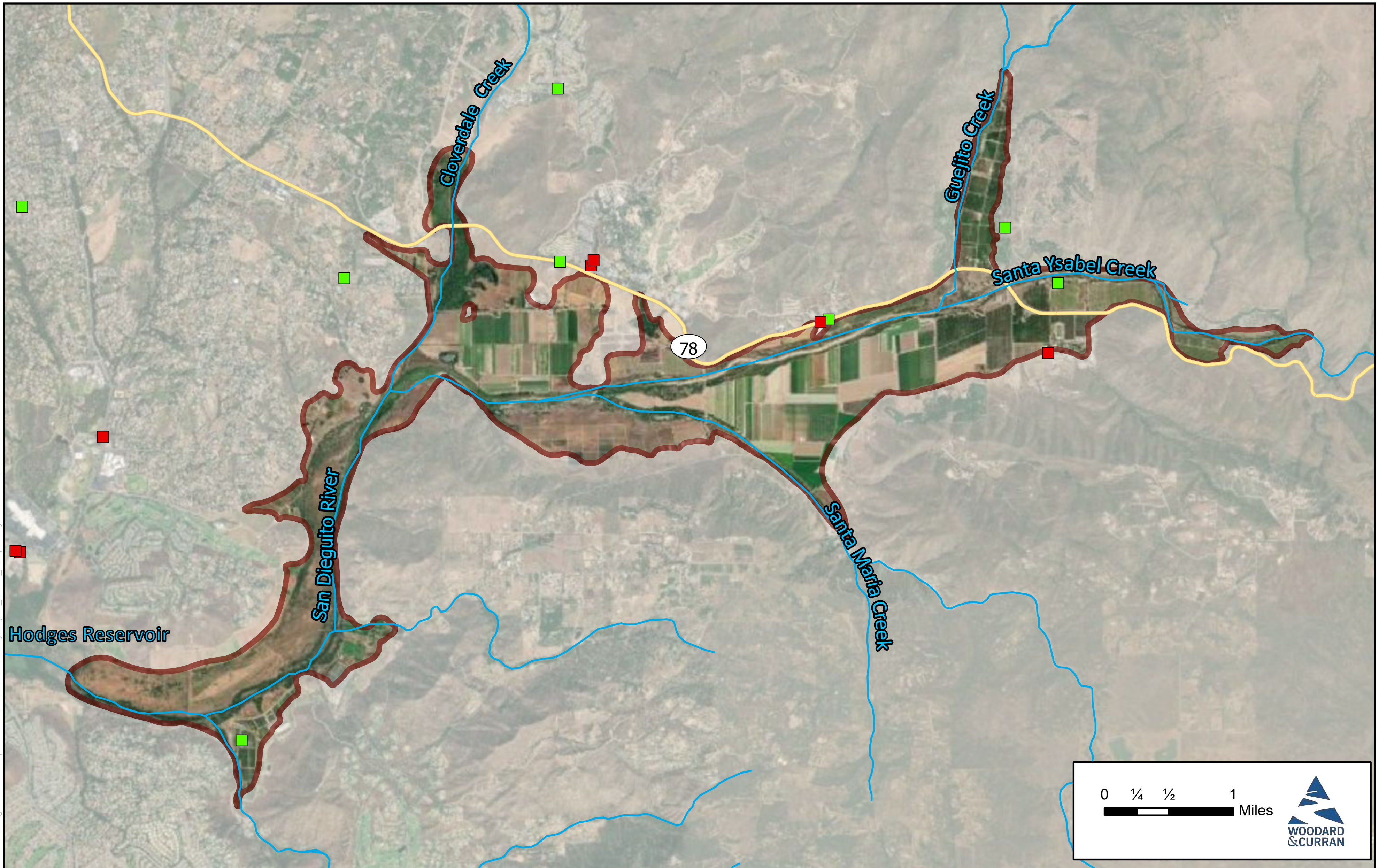
NO3N= Nitrate concentration as nitrogen (N)

N

Figure 4-30

San Pasqual Valley GSP

Chemographs of Nitrate Concentrations in Groundwater



Project #: 0011197

Legend
San Pasqual Valley Basin
Cleanup Program Site
LUST Cleanup Site

N

Figure 4-31
San Pasqual Valley GSP
GeoTracker Sites

Figure Exported: 9/21/2021 By: gvalenzuela Using: D:\San Pasqual From GIS3 20201013\MyProject_GSP2_v3.aprx Layout: F4-27 GeoTracker Sites

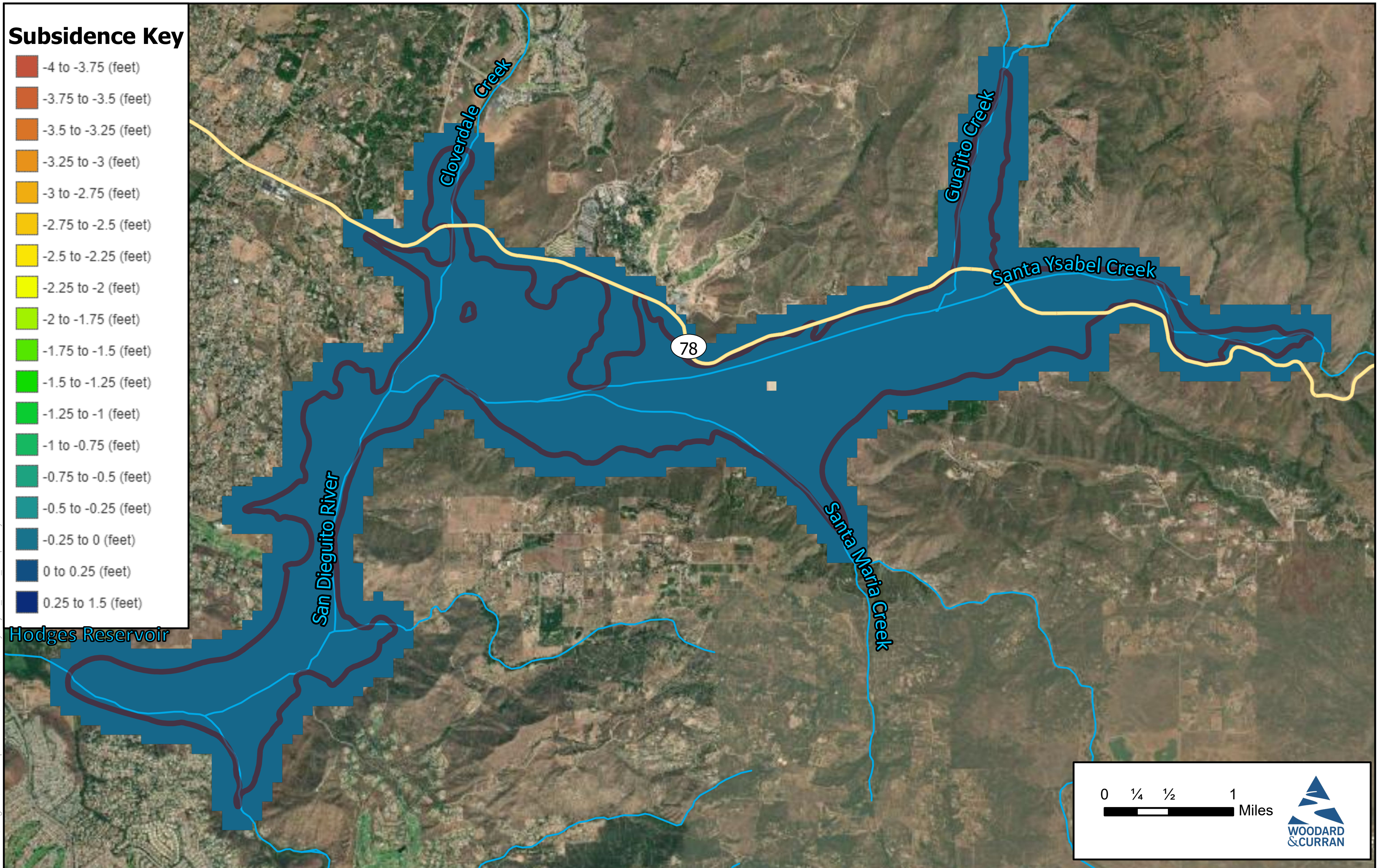
4.5 Land Subsidence

In assessing land surface subsidence due to groundwater extraction, two types of subsidence are considered: elastic and inelastic. Elastic subsidence is caused by compaction of unconsolidated sands and gravels due to groundwater withdrawal and a resulting reduction in pore fluid pressure. Typically, as groundwater is recharged and/or pumping is reduced or ceased, pore fluid pressures increase and the subsidence rebounds. Inelastic subsidence occurs when pore fluid pressures in fine-grained sediments such as silt and clay are reduced and the sediments collapse, which is most problematic in aquitards or other thick units of fine-grained material. When groundwater recharges and water levels rise, the pore water pressures do not rebound in the collapsed silts and clays due to permanently reduced pore space in the compacted fine-grained units.

Literature reviews during preparation of this GSP revealed no existing subsidence issues or concerns for the SPV. A review of available subsidence data revealed no extensometers or continuous GPS stations in or immediately adjacent to the Basin, and the only available subsidence data were available from DWR as InSAR data. The measurement period of DWR's InSAR data was from June 2015 through October 2020. As shown in Figure 4-32, the Basin experienced between 0 and 0.25 feet of subsidence during the 5-year period. Review of individual data points in the Basin suggests that cumulative subsidence has been in the range of 0.03 to 0.1 feet during this period, corresponding to subsidence rates of approximately 0.006 to 0.02 feet per year. The accuracy of the InSAR data is 18 millimeters, or approximately 0.059 feet, for this period (Towell, 2021). Thus, the reported cumulative InSAR displacements at some locations are less than the accuracy of the of the InSAR method. In addition, the InSAR data at individual locations in the Basin, both positive (i.e., upward travel) and negative (i.e., downward travel) vertical displacement occurred in the during this period, suggesting that the observed subsidence may be elastic rather than inelastic subsidence.

Subsidence due to groundwater withdrawal is not a significant concern in the Basin for the following reasons:

- Subsurface materials that make up the Basin are generally coarse grained and not (refer to Section 3, *Hydrogeologic Conceptual Model*), so the Basin is not particularly susceptible to ineslastic land subsidence.
- Available InSAR data indicate that minor cumulative subsidence has occurred between June 2015 through October 2020.



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Project #: 0011197

Legend

San Pasqual Valley Basin

N

Figure 4-32

San Pasqual Valley GSP

Total Subsidence - June 2015 to October 2020

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** SanDAG/SanGIS, USGS, DWR.

Figure Exported: 9/23/2021 By: gvalenzuela Using: D:\San Pasqual From GIS3 20201013\MyProject_GSP2_v3.aprx Layout: F4-28 Subsidence from June 2015 to Oct 2020

4.6 Interconnected Surface Water Systems

The primary surface water features in the SPV include the San Dieguito River and its major tributary streams. Figure 4-33 shows the streams that were evaluated as part of this GSP, which include: Cloverdale, Guejito, Sycamore, and Santa Maria Creeks; the Safari Park Outlet; two reaches of Santa Ysabel Creek (from the upstream end of the Basin to San Pasqual Narrows); and two reaches of San Dieguito River (from San Pasqual Narrows to Hodges Reservoir).

Their general characteristics are summarized below.

- **Cloverdale Creek** drains 18 square miles and has become perennial since approximately the late 1970s due to groundwater recharge from imported water used for irrigation of avocado groves along the hillsides surrounding, but outside of, the Basin. Streamflows into the Basin are unregulated and ungaged. Groundwater recharge from irrigation in Cloverdale Canyon was sufficient to turn Cloverdale Creek into a perennial stream and maintain groundwater levels near ground surface in 1977, while the remainder of the Basin was experiencing record low water levels due to extreme drought, in some cases 40 to 80 feet bgs in other parts of the Basin.
- **Guejito Creek** drains 22 square miles. It enters the Basin in Rockwood Canyon near the northeastern portion of the Basin before flowing into Santa Ysabel Creek.
- **Santa Maria Creek** drains 58 square miles and flows into the central portion of the Basin. The creek flows northwest after traveling through Ramona (a census designated place) and the Ramona Grasslands County Preserve before contributing to Santa Ysabel Creek.
- **Santa Ysabel Creek** drains 128 square miles and flows primarily east to west. It discharges into the Basin and is regulated by Sutherland Reservoir upstream.
- **San Dieguito River** begins at the confluence of Santa Ysabel and Santa Maria Creeks upstream from the San Pasqual Narrows. The San Dieguito River flows out of the Basin and into Hodges Reservoir. The river continues downstream from Hodges Reservoir where it flows into the Pacific Ocean.
- **Sycamore Creek** drains less than 10 square miles and enters the Basin in the southwestern portion of the Basin before flowing into San Dieguito River.
- **Safari Park Outlet** flows primarily north to south through the Safari Park property entering the central portion of the Basin and flows into Santa Ysabel Creek upstream of the confluence with Santa Maria Creek.

4.6.1 Location of Interconnected Steams

Streams that are hydraulicly connected to the underlying aquifer are designated as interconnected streams. This occurs when the groundwater elevation in the aquifer beneath the stream is greater than or equal to the elevation of the streambed. Where streams are interconnected, groundwater elevations in the aquifer can influence stream flows.

The groundwater model described in Appendix I was used to analyze interactions between surface water flows and groundwater in the Basin and to assess locations of stream reaches that may be interconnected. Potentially interconnected reaches were identified where modeled average monthly groundwater levels intersected the modeled stream bottoms (Appendix I). The potentially interconnected reaches in Basin are:

- San Dieguito River (East and West reaches)
- Cloverdale Creek
- Sycamore Creek

These reaches are in the western portion of the Basin (Figure 4-33). The average depth to groundwater in these areas has generally been less than 30 feet bgs.

Stream–aquifer interconnection in these reaches is likely transient based on interactions among streamflow, precipitation, groundwater recharge, and pumping. Portions of the interconnected reaches may be gaining (groundwater discharge to the stream) or losing (stream discharge to groundwater), and the locations of the gaining or losing portions of the streams may vary over time. Model simulations indicate that Cloverdale Creek, Sycamore Creek, and eastern reach of the San Dieguito River (between confluences of Cloverdale and Santa Maria Creeks) are net gaining streams (Appendix I). The western reach of the San Dieguito River (downstream of the confluence of Cloverdale Creek) changes from net gaining during wet years to net losing during dry years, but it is net gaining on average for the simulation period (92 AFY for 2005-2019, Appendix I).

Guejito Creek, Santa Maria Creek, and Santa Ysabel Creek in the eastern portion of the Basin (Figure 4-33) are designated as disconnected streams because measured groundwater levels in nearby wells and the simulated groundwater levels do not intersect the streambed in these reaches. These streams are losing streams and can recharge groundwater when surface flows are available.

4.6.2 Estimates of Streamflow Depletion

As described in Appendix I, the SPV GSP Model was used to estimate streamflow depletion caused by pumping for the period of 2005 to 2019. Simulated streamflows for each reach were compared for two model runs: 1) with pumping and groundwater applied as irrigation and 2) without pumping and applied groundwater. The difference between the two is an estimate of the streamflow depletion caused by pumping. Table 4-1 shows the annual stream depletions associated with groundwater pumping for each reach. The steam depletion for the San Dieguito River West reach is an appropriate estimate of overall streamflow depletion for the Basin because it is the final (farthest downstream) reach in the modeled system. The average streamflow depletion for the San Dieguito River West reach is approximately 3,500 AFY for the simulation period (Table 4-1). The average groundwater pumping during this period was approximately 5,900 AFY (Appendix I). Although the model suggests that 59 percent of pumping is supplied by surface streamflow depletion, there are limitations to any model given the various input parameters that could be used.

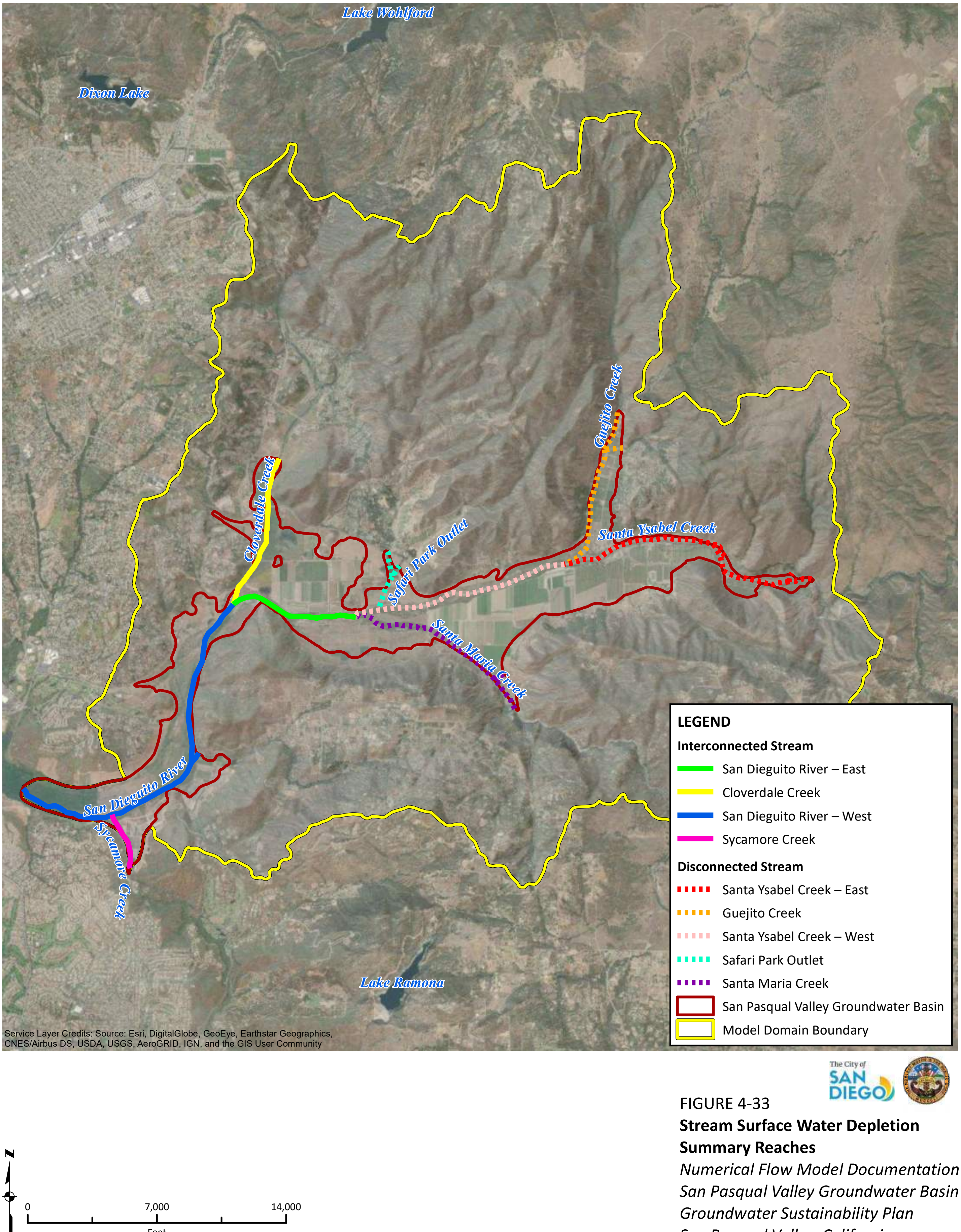

FIGURE 4-33

Stream Surface Water Depletion Summary Reaches

Numerical Flow Model Documentation
San Pasqual Valley Groundwater Basin Groundwater Sustainability Plan
San Pasqual Valley, California

Jacobs

Table 4-1. Stream Depletion by Reach

Year (Water Year)[a]	Disconnected Streams (AF)					Interconnected Streams (AF)			
	Santa Ysabel Creek—East	Guejito Creek	Santa Ysabel Creek—West	Safari Park Outlet	Santa Maria Creek	San Dieguito River—East	Cloverdale Creek	Sycamore Creek	San Dieguito River—West
2005 (W)	1,367	121	2,843	5	661	3,860	47	13	4,295
2006 (D)	560	34	1,433	1	609	2,522	43	2	2,698
2007 (C)	91	8	456	1	453	1,517	47	0	1,626
2008 (N)	816	60	2,270	3	752	3,715	70	5	4,093
2009 (D)	619	50	1,698	3	706	3,067	65	4	3,306
2010 (AN)	991	92	2,601	4	945	4,183	81	8	4,550
2011 (W)	1,620	174	3,597	7	917	4,913	50	7	5,259
2012 (N)	638	59	1,674	1	689	2,778	51	1	3,014
2013 (D)	364	38	1,073	2	683	2,314	66	1	2,521
2014 (C)	289	38	797	2	687	2,160	87	1	2,423
2015 (N)	407	41	1,058	2	694	2,526	106	1	2,810
2016 (N)	543	58	1,432	2	764	2,957	98	1	3,132
2017 (W)	1,267	131	3,316	11	1,177	5,125	83	6	5,470
2018 (C)	690	58	1,913	5	849	3,391	64	3	3,629
2019 (AN)	929	64	2,378	4	930	3,942	63	4	4,144
2005–2019 Annual Average	746	68	1,903	4	768	3,265	68	4	3,531

[a]W=wet year, AN=above normal year, N=normal year, D=dry year, and C=critically dry year

4.7 Groundwater-Dependent Ecosystems

A GDE is defined in the SGMA regulations as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." SGMA regulations Section 354.16(g) requires identification of GDEs in a basin using data available from DWR, or by using the best available information. DWR provides the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset through the SGMA data portal.0F[1] For this GSP, the NCCAG dataset used for identification of GDEs in the Basin. Once downloaded, the data were compiled using a set of six pre-existing dataset sources; this process is explained in detail on DWR's Natural Communities Dataset Viewer website.1F[2] Figure 4-34 shows NCCAG-identified locations from the dataset. Because DWR's NCCAG dataset was not verified prior to public distribution, DWR recommends verification of NCCAG-identified locations by a licensed biologist.

A Woodard & Curran licensed wetlands biologist verified the NCCAG dataset using remote sensing techniques supported by in-person field verification. Appendix J contains the technical memorandum describing analysis performed by the licensed wetlands biologist. The wetlands biologist first performed a desktop assessment using publicly available statewide and regional data layers to evaluate the NCCAG dataset in the Basin and identified locations for in-person field verification. The wetlands biologist then conducted a field study at 15 Basin locations from March 2 to 4, 2020 (Appendix J). Upon completion of the in-person field verification, the wetlands biologist refined the preliminary desktop GDE assessment data and revised the mapping for potential-GDEs and potential non-GDEs based on field observations and further research. The assessment considered the depth to groundwater to help determine GDE status. The Nature Conservancy (TNC) has developed guidance documents for identifying potential GDEs (TNC, 2019). One of the primary factors that the TNC guidance considers is the depth to groundwater and how it relates to rooting depths of phreatophyte vegetation. Depths to groundwater within 30 feet of ground surface are generally accepted as a proxy to indicate that the suspected GDE vegetation is supported by groundwater.

Analysis was performed by groupings, and the results of the analysis are shown in Figure 4-35. Of the 72 NCCAG-mapped polygons (i.e., 53 GDE wetland polygons and 19 GDE vegetation polygons), the combined desktop and field assessment yielded 64 potential GDEs and eight potential non-GDEs. Also, during desktop assessment, the wetlands biologist viewed 1,062 individual Basin locations and determined potential GDE status. Of the 1,062 assessment locations:

- 285 points in the Basin were determined to be potential GDEs,
- 197 points were determined to be potential non-GDEs, and
- 580 points were determined to be wetland and/or riparian communities.

[1] https://gis.water.ca.gov/app/NCDatasetViewer/
[2] https://gis.water.ca.gov/app/NCDatasetViewer/sitedocs/#

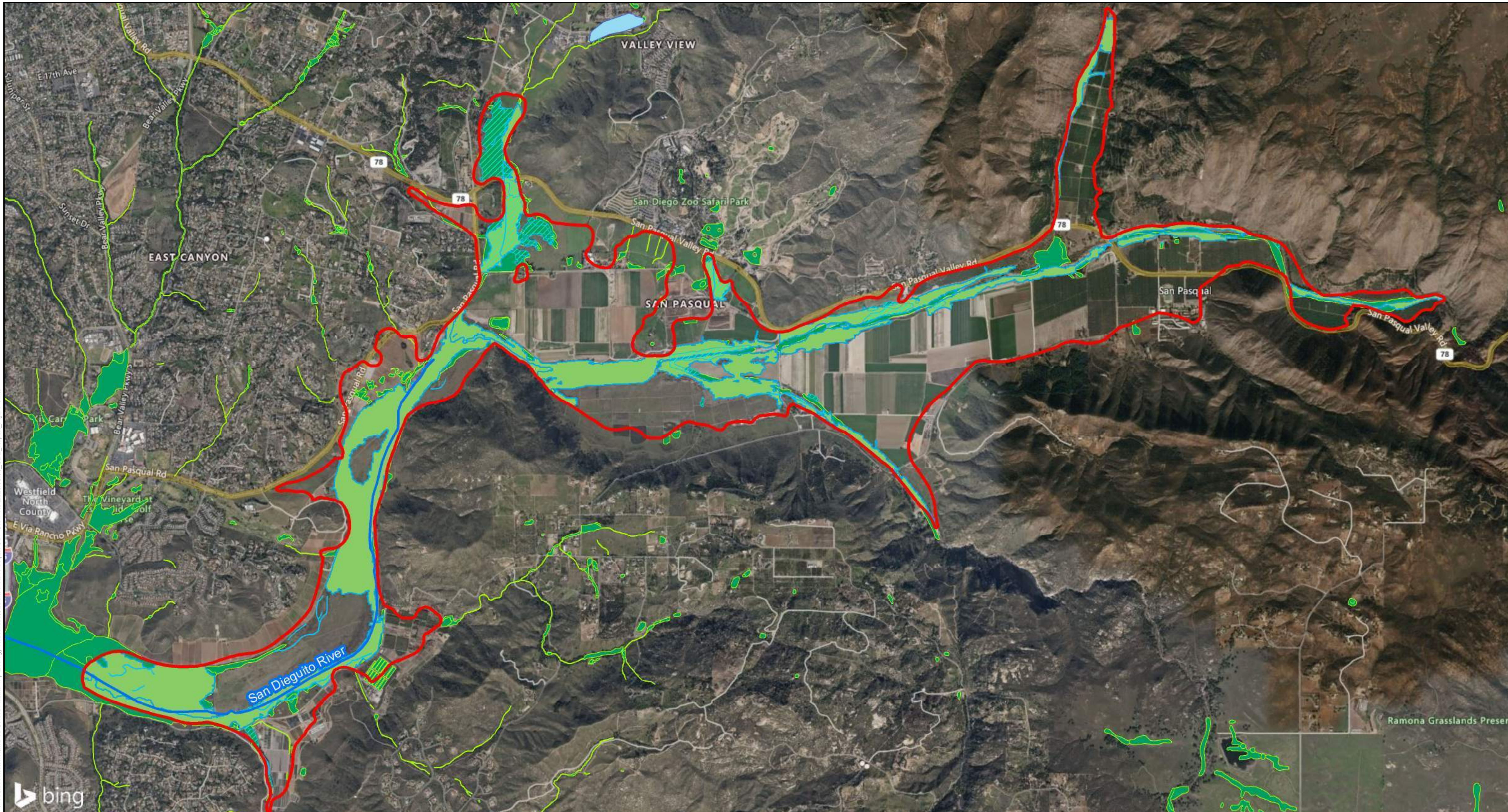

Figure 4-34

San Pasqual Valley GSP

Natural Communities Commonly Associated with Groundwater Dataset

Legend

- San Pasqual Valley Groundwater Basin
- USGS National Hydrography Data
- CA DWR Lakes Data
- NCCAG Wetlands (San Pasqual Valley)
- NCCAG Vegetation (San Pasqual Valley)
- USFWS National Wetlands Inventory

0 1,750 3,500 7,000 Feet

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WOODARD & CURRAN

Project #: 0011197.00

Map Created: May 2020

Figure 4-35

San Pasqual Valley GSP

Probable and Non-Probable GDEs Based on Analysis

Legend

- San Pasqual Valley Groundwater Basin
- NCCAG Wetlands (San Pasqual Valley)
- NCCAG Vegetation (San Pasqual Valley)
- Groundwater Contours
- Potential GDE
- Potential Non-GDE
- Wetland & Riparian Vegetation

0 1,750 3,500 7,000 Feet

N

Project #: 0011197.00
Map Created: August 2020

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions.
Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources: Bing Maps Hybrid; CA DWR Natural Communities Commonly Associated with Groundwater.**

Potential GDEs largely consisted of dense riparian and wetland communities along mapped drainage systems where monitoring well data showed the average depth to groundwater at 30 feet or less relative to the ground surface. Many of the potential GDEs observed appear to rely on surface flows or stormwater runoff, as well as groundwater, to influence soil moisture requirements. The potential non-GDEs largely consisted of dry upland areas dominated by shallow-rooted grasses and/or invasive species. Areas that consisted of wetland and/or riparian phreatophytes (i.e., deep-rooted plant species) along drainageways where the average depth to groundwater was greater than 30 feet were classified as wetland and riparian communities. Both the potential GDEs and the wetland and riparian communities may support habitat for state and federal protected species (Appendix J).

4.8 Data Gaps

The GSA did not identify any data gaps at this time.

4.9 Areas of Potential Improvement

The GSA did identify one area of improvement for the Basin that may be needed during GSP implementation. The interaction between Bulletin-118 identified Basin formations (i.e., Alluvium and Residuum) and the fractured granitic bedrock is not well understood at the time of GSP preparation. Understanding of this interaction may be evaluated through aquifer testing involving observation wells that monitor Basin water levels using nearby pumping wells that are screened in fractured bedrock.

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Section 5. WATER BUDGETS

This section describes the historical, current and projected water budgets for the Basin. As defined by SGMA regulations (i.e., Title 23 CCR Sections 350—358), this section quantifies the following:

- Total surface water entering and leaving the Basin by water source type
- Inflow to the groundwater system by water source type
- Outflows from the groundwater system by water use sector
- Change in the annual volume of groundwater in storage between seasonal high conditions
- If overdraft conditions occur, a quantification of overdraft over a period of years during which water year (WY) [3] and water supply conditions approximate average conditions
- WY type associated with the annual supply, demand, and change in groundwater stored
- Estimate of sustainable yield for the Basin

The water budgets described in this section have been developed in accordance with the guidelines in DWR's *Best Management Practices for the Sustainable Management of Groundwater—Water Budget* (Water Budget BMP) (DWR, 2016). These guidelines served as the basis for quantifying the volumetric rate of water entering and leaving the Basin. Water enters and leaves the Basin naturally, such as through precipitation and streamflow, and through human activities, such as pumping and groundwater recharge from irrigation.

Separate historical, current, and projected water budgets have been developed for three different Basin systems: a land system, a surface water system, and a groundwater system. Figure 5-1 illustrates how these different systems relate to each other; Table 5-1 lists the water budget components for each system.

As shown in Figure 5-1 and Table 5-1, an outflow from one system can be an inflow to another system (e.g., groundwater recharge from streams is an inflow to the groundwater system, but an outflow from the surface water system). The water budgets for these systems have been quantified with the aid of the SPV GSP Integrated Groundwater/Surface Water Flow Model (SPV GSP Model), which simulates flow processes in the Basin and in portions of the underlying bedrock and contributing subcatchments surrounding the Basin. The SPV GSP Model simulates the major hydrologic processes affecting groundwater and surface water flow in and surrounding the Basin.

There is unavoidable uncertainty associated with water budget estimates, which is inherent in any numerical flow model. Further, these water budget estimates are subject to change as the understanding of Basin conditions evolves during implementation of the GSP. AppendixI contains additional information regarding water budget development and the SPV GSP Model.

[3] DWR's *Water Basics Glossary* defines a water year as "the continuous 12-month period for which hydrologic records are compiled and summarized." Typically, this period is from October 1 through September 30 of the following year.

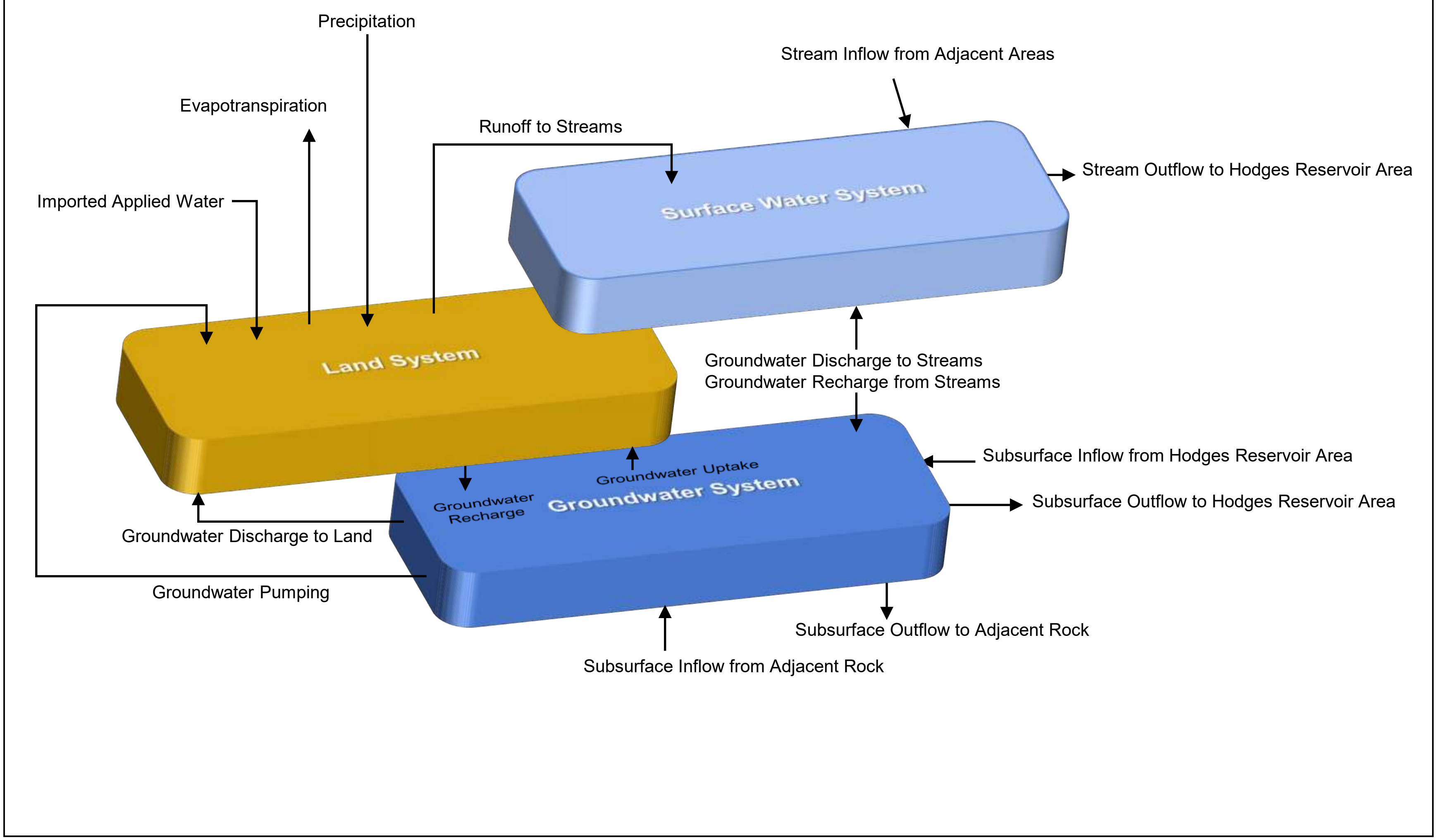

Figure 5-1. Generalized Water Budget Diagram

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Table 5-1. Land, Surface Water, and Groundwater Systems Water Budget Components

Land System Inflow Components	Land System Outflow Components
Precipitation	Runoff to Streams
Imported Applied Water[a]	ET of Precipitation
Groundwater Deliveries for Irrigation	ET of Shallow Groundwater
Shallow Groundwater Uptake	ET of Applied Water
Groundwater Discharge to Land Surface	Groundwater Recharge from Precipitation, Applied Water, and Septic Systems
Surface Water System Inflow Components	**Surface Water System Outflow Components**
Runoff to Streams	Stream Outflow to Hodges Reservoir Area
Stream Inflow from Adjacent Areas	Groundwater Recharge from Streams
Groundwater Discharge to Streams	
Groundwater System Inflow Components	**Groundwater System Outflow Components**
Groundwater Recharge from Precipitation, Applied Water, and Septic Systems	Shallow Groundwater Uptake (ET of Shallow Groundwater)
Groundwater Recharge from Streams	Groundwater Discharge to Streams
Subsurface Inflow from Hodges Reservoir Area	Groundwater Pumping
Subsurface Inflow from Adjacent Rock	Subsurface Outflow to Hodges Reservoir Area
	Subsurface Outflow to Adjacent Rock
	Groundwater Discharge to Land Surface

[a] A small portion of the Basin receives imported water from the City of Escondido as well as from groundwater pumping wells outside of the SPV GSP Model domain (City of San Diego, 2014).

5.1 Approach for Selecting Hydrologic Periods

SGMA regulations (Title 23 CCR Section 354.18) requires the GSA to develop historical, current, and projected water budgets for the Basin. The historical water budget must include infromation from at least the last 10 years. After consideration of historical hydrologic variability and availability of historical land and water use data (refer to Section 5.2.1, *Historical and Current Periods*), a 15-year period including WYs 2005 through WY 2019 (i.e., October 2004 through September 2019) was selected for the historical model calibration and water budget period. The last 5 years of this historical period, including WYs 2015 through 2019 were used to establish an averaging period to develop the current water budget.

SGMA regulations requires projected water budgets to span 50 years from 2022, which is the year by which a GSA of a medium-priority groundwater basin must submit its first GSP to DWR. Thus, a 52-year period including WYs 2020 through 2071 was established to develop the Basin's projected water budget. This provides a continuous model simulation from WY 2005 through 2071, and enables a projection simulation to WY 2072 (i.e., 50 years after the first SPV GSP submittal in 2022). Section 5.2.1 describes modeled climate conditions for both the historical and current periods.

SGMA regulations also requires projected water budgets to incorporate assumptions regarding climate change. However, these regulations do not require any particular climate change approach, as long as the chosen approach is based on the best available science and is technically defensible. Two climate change approaches were considered for developing projected water budgets for this GSP. The first approach considered is based on a time-period analysis as offered by DWR. With this approach, 50 years of historical monthly precipitation and reference evapotranspiration (ET_0) data are selected by the modeler and then processed through a DWR tool that adjusts these datasets to account for climate change. The second approach considered is based on a transient analysis. With this approach, precipitation and air temperature projections from a global climate model (GCM) are used along with a rainfall-runoff model to establish projected precipitation and ET_0 datasets. Available GCMs include projected climate conditions out to the year 2100 under a variety of climatic and greenhouse gas-emission assumptions made by atmospheric scientists (e.g., the Climate Change Technical Advisory Group [CCTAG], 2015; Pierce et al., 2018).

The transient analysis approach was selected for Basin projection simulations based on the following rationale:

- Climate projections indicate that climatic patterns occurring over the last several decades may not necessarily be reliable indicators of future climatic patterns. As a result, and although SGMA regulations (i.e., Title 23 CCR Section 354.18) indicate that the projected water budget must be based on 50 years of historical hydrology to reflect long-term hydrologic conditions, selecting an appropriate historical hydrologic period on which to base climate change factors is not a straightforward process.
- Considerable research on climate change has been and will continue to be undertaken by dedicated atmospheric scientists with appropriate technical backgrounds. Thus, the GCMs developed by these specialists are based on the best available science and are technically defensible. As a result, these GCMs comply with the intent of SGMA regulations (i.e., Title 23 CCR Section 354.18).
- The transient analysis approach allowed the GSP technical team to maintain consistency among modeling tools, in assumptions, and in workflow associated with developing the historical, current, and projected water budgets.

Section 5.2.2 of this GSP describes modeled climate conditions for the projected period. Appendix I provides additional detail regarding the approach for incorporating climate change with model projections used to develop the projected water budget.

5.2 Modeled Climate Conditions

5.2.1 Historical and Current Periods

Figure 5-2a presents the annual precipitation totals for the Basin for a 40-year period, including WYs 1980 through 2019. The Parameter-Elevation Relationships on Independent Slopes Model (PRISM) (PRISM Climate Group, 2020) interpolation method was used to develop data sets that reflected, as closely as possible, the current state of knowledge of spatial climate patterns in the Basin and surrounding vicinity. The precipitation data presented in Figure 5-2a represent the spatial averages of PRISM precipitation grid values in the SPV GSP Model domain. The mean annual precipitation (MAP) over the 40-year period is 14.57 inches. This historical period was considered when establishing a historical model calibration period, which also serves the historical water budget period. After considering climatic variability and the available data regarding land use, water use, and groundwater levels, a 15-year period including WYs 2005 through 2019 was selected for historical model calibration and for the water budget period. A MAP of 13.80 inches for WYs 2005 through 2019 is about 5 percent lower than the WYs 1980 through 2019 MAP of 14.57 inches. The

WYs 2005 through 2019 MAP of 13.8 inches is significant as it relates to the historical water budget period (i.e., 2015–2019).

Annual departures from the WYs 2005 through 2019 MAP are displayed as yellow bars in Figure 5-2a and are calculated by subtracting the MAP value of 13.80 inches from each annual precipitation value. Above normal (AN) and wet (W) WYs have positive annual departure values above the dashed line, while normal (N), dry (D), and critically dry (C) years have negative annual departure values below the dashed line. The cumulative departure from the WYs 2005 through 2019 MAP is also provided in Figure 5-2a (shown as the black solid line) and is computed by accumulating the annual departures (i.e., the yellow bars) from WY 2005 forward in time. The annual departures and cumulative departure data indicate a reasonable balance of wet, normal, and dry conditions for model calibration. Additionally, because the availability and reliability of hydrologic and water budget data are more favorable for this recent period as compared with earlier periods, the recent 15-year period was selected for model and water budget development. The current water budget was developed using the last 5 years of this historical period, including WYs 2015 through 2019.

5.2.2 Projection Period

As part of the California Fourth Climate Change Assessment (Pierce et al., 2018), a suite of 10 GCMs previously identified by CCTAG (2015) was reduced to four GCMs representing warm/dry, average, and cool/wet conditions, and a complement (identified as a diversity scenario). The remaining four GCMs replicated California's historical climate. Through this process, the following four GCMs were identified to represent potential climate variability in California:

- Hadley Centre Global Environment Model version 2 (HadGEM2)-ES—warm/dry
- Canadian Earth System Model (CanESM2)—average
- Model for Interdisciplinary Research On Climate (MIROC5)—complement
- Centre National de Recherches Météorologiques (CNRM-CM5)—cool/wet

Each of these GCMs also considers representative concentration pathway (RCP) scenarios that describe potential greenhouse gas and aerosol emission conditions (Intergovernmental Panel on Climate Change [IPCC], 2013). Two RCP scenarios have been analyzed using RCP 4.5, representing a medium scenario in which a reduction in greenhouse gas emissions is considered, versus RCP 8.5, which assumes a "business as usual" emissions scenario (Pierce et al., 2018). A recent study conducted by Schwalm et al. (2020) identified that the RCP 8.5 emissions scenario closely tracks historical total cumulative carbon dioxide emissions and is the best match for mid-century projections of greenhouse-gas emissions, based on current and stated policies. Thus, annual precipitation projections were processed for the SPV GSP Model domain using the four GCMs identified by Pierce et al. (2018) and the RCP 8.5 emissions scenario to review how these projections compare, and to recommend a GCM as an appropriate climate-change scenario for the SPV GSP.

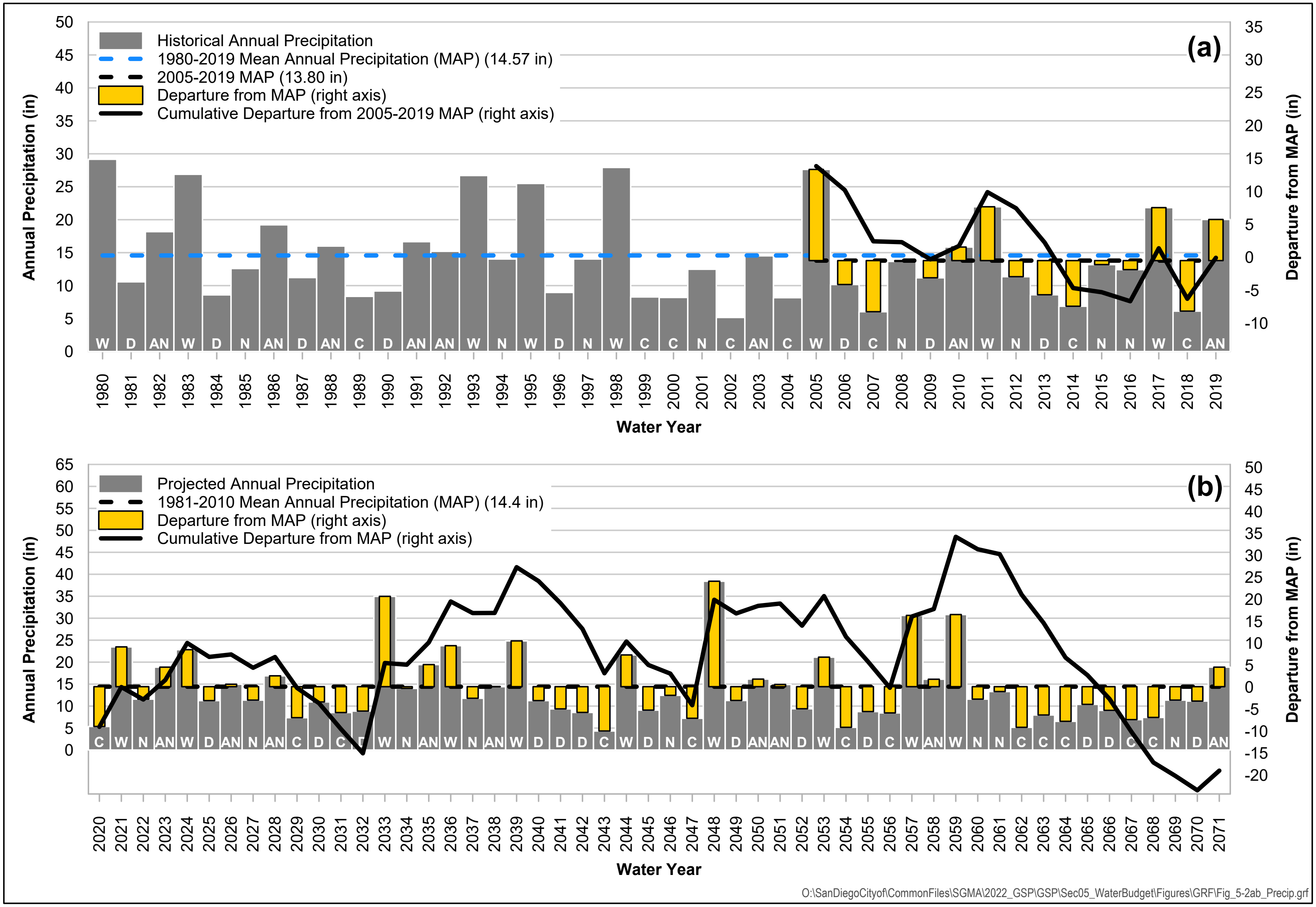

Figure 5-2. (a) Historical Annual Precipitation and (b) Projected Annual Precipitation

Jacobs

The HadGEM2-ES, RCP 8.5 (IPCC, 2013) scenario was used to develop projected water budgets for the GSP planning period (see Appendix I for additional details). This dataset assumes "business as usual" greenhouse gas emissions and climatic conditions that plot within the range of the ensemble, but on the drier side of the four California-specific GCMs (Pierce et al., 2018). While within the range of climate change projections, this dataset was selected as a potentially conservative scenario for water budget development. Figure 5-2b presents the annual precipitation totals for the Basin for the 52-year projection period, including WYs 2020 through 2071, along with annual and cumulative departures from the MAP of the most recent historical precipitation normal of of WYs 1981 through 2010.

Projected precipitation for this particular GCM includes two 4-year droughts in WYs 2029 through 2032, and WYs 2040 through 2043; one 3-year drought in WYs 2054 through 2056; and one 9-year drought in WYs 2062 through 2070. More substantial wet years are projected to occur only one to two times every 10 to 20 years in this particular GCM. The projected precipitation and departure data indicate a variety of wet, normal, and dry conditions that are suitable for aiding the GSP planning process.

5.3 Model Use and Associated Data for Water Budget Development

The SPV GSP Model, which was used to develop the water budgets, was developed in consultation with the Technical Peer Review Group, which includes three independent groundwater practitioners with expertise in technical groundwater evaluations. The GSA hosted seven public Technical Peer Review Group meetings (Table 1-3) during development of the GSP and SPV GSP Model. These meetings provided opportunities for Technical Peer Review Group members, Advisory Committee members, and the public to review and comment on major aspects of model and GSP development.

The SPV GSP Model integrates the three-dimensional groundwater and surface water systems, land surface processes, and operations. The SPV GSP Model was calibrated for the 15-year hydrologic period, including WYs 2005 though 2019, to groundwater levels measured at monitoring wells located throughout the Basin during that time period. The SPV GSP Model also simulates potential future conditions for a 52-year hydrologic period, including WYs 2020 through 2071. Additionally, the SPV GSP Model simulates monthly hydrologic and operational conditions over the 15-year historical period and 52-year projection period.

Developing the SPV GSP Model entailed assimilating information about land use, water infrastructure, hydrogeologic conditions, agricultural water demands and supplies, and population. The SPV GSP Model was built upon an existing numerical groundwater flow and transport model developed as part of the SPV SNMP (City, 2014). The SPV GSP Model is based on the best available data and information as of January 2020. It is expected that the SPV GSP Model will be updated as additional monitoring data are collected and analyzed, and as knowledge of the HCM evolves during implementation of the GSP. Future model updates could result in changes to the estimated water budgets described in this section. Additional information about the construction, calibration, and use of the SPV GSP Model is included in Appendix I.

5.4 Water Budget Definitions and Assumptions

This section defines water budget components and the assumptions used during water budget development.

5.4.1 Historical and Current Water Budget Assumptions

The Basin's historical water budget evaluates the availability and reliability of past surface water supplies and agricultural demands relative to WY type. The 15-year hydrologic period of WYs 2005 through 2019 was selected for developing the historical water budget. This period includes a sequence of representative hydrology while also capturing recent Basin operation conditions. Table 5-2 lists the assumptions for information incorporated into the SPV GSP Model for the historical and current water budgets.

The current water budget evaluates the availability and reliability of more recent surface water supplies and agricultural demands relative to WY type. The 5-year hydrologic period of WYs 2015 through 2019 was selected for developing the current water budget. This period includes recent hydrology and Basin operation conditions since 2015, which is the WY coinciding with the January 1, 2015 effective date of SGMA regulations (i.e., Title 23 CCR Sections 350—358). Appendix J contains additional information about the construction, calibration, and use of the SPV GSP Model as it relates to historical and current water budgets.

5.4.2 Projected Water Budget Assumptions

The projected water budget forecasts the availability and reliability of recent land use, population, and water use over a future sequence of hydrology that incorporates the effects of climate change. The 52-year hydrologic period of WYs 2020 through 2071 was selected for developing the projected water budget; this period also captures recent Basin operations under 2018 land use conditions. Table 5-2 lists the assumptions for project water budget assumptions incorporated into the SPV GSP Model. Appendix I contains additional information about the construction, calibration, and use of the SPV GSP Model.

Table 5-2. Water Budget Assumptions

Water Budget Item	Assumption/Basis for Historical and Current Water Budgets	Assumption/Basis for Projected Water Budgets
Hydrologic Period	• Historical: WYs 2005 through 2019 • Current: WYs 2015 through 2019 • Monthly time intervals	• WYs 2020 through 2071 • Monthly time intervals
Precipitation	• Downscaled PRISM (PRISM Climate Group, 2020) precipitation dataset, as processed using the BCM (Flint et al., 2013)	• Downscaled PRISM (PRISM Climate Group, 2020) precipitation dataset that incorporates climate change based on the HadGEM2-ES, RCP 8.5 (IPCC, 2013) GCM, as process using the BCM (Flint et al., 2013)
Reference Evapotranspiration (ET_0)[a]	• California Irrigation Management Information System Station 153 in the SPV	• Downscaled PRISM (PRISM Climate Group, 2020) air temperature dataset that incorporates climate change based on the HadGEM2-ES, RCP 8.5 (IPCC, 2013) GCM, as processed using the BCM (Flint et al., 2013) • ET_0 is computed using the BCM (Flint et al., 2013) based on air temperature projections

Table 5-2. Water Budget Assumptions

Water Budget Item	Assumption/Basis for Historical and Current Water Budgets	Assumption/Basis for Projected Water Budgets
Stream Inflows	• Guejito Creek USGS stream gage 11027000 • Santa Ysabel Creek USGS stream gage 11025500 • Santa Maria Creek USGS stream gage 11028500 • Inflows for ungaged streams are based runoff estimates computed by the BCM (Flint et al., 2013) and bias corrected by Jacobs	• Runoff projections computed by the BCM (Flint et al., 2013) based on the HadGEM2-ES, RCP 8.5 (IPCC, 2013) GCM and bias corrected by Jacobs
Subsurface Inflows	• 25 percent of the groundwater recharge in contributing catchments as computed by the BCM (Flint et al., 2013)	• 25 percent of the groundwater recharge in contributing catchments as computed by the BCM (Flint et al, 2013) based on the HadGEM2-ES, RCP 8.5 (IPCC, 2013) GCM
Land Use/Cropping	• Built upon land use dataset developed for the SNMP (City, 2014) • Updated based on 2014 and 2016 DWR land use datasets, Google Earth™ imagery, and stakeholder input	• Built upon land use dataset developed for the SNMP (City, 2014) • Updated based on 2014 and 2016 DWR land use datasets, Google Earth™ imagery, and stakeholder input • Held constant at 2018 conditions based on low likelihood of future changes in land use
Well Infrastructure	• Stakeholder input for WYs 2005 through 2019	• Stakeholder input for 2020 conditions
Evapotranspiration (ET)	• CalETa (Formation, 2020) dataset provides actual monthly crop ET values for calendar years 2005, 2010 through 2017, and 2019	• 2018 land use and crop coefficients and projected ET_0 computed by the BCM (Flint et al, 2013) that incorporates climate change based on the HadGEM2-ES, RCP 8.5 (IPCC, 2013) GCM
Domestic Water Use	• Stakeholder input and census data	• Held constant at 2020 conditions based on stakeholder input and 2018 land use and population characteristics • Given the desire to maintain the SPV as an agricultural preserve, the population has not experienced much growth historically and anticipated SPV population growth is negligible

Notes:
BCM = California Basin Characterization Model
Formation = Formation Environmental
CalETa = California Actual Evapotranspiration
[a]The crop associated with the reference evapotranspiration is grass.

5.5 Historical, Current, and Projected Water Budgets

Figure 5-3 presents three sets of charts showing historical, current, and projected water budgets. The top, middle, and bottom charts show the land system, surface water system, and groundwater system water budget summaries, respectively. Figure 5-4 presents three sets of charts, one for each Basin water budget system, with the annual time series of the historical, current, and projected water budgets. The colors of the water budget components in Figure 5-3 and Figure 5-4 have been standardized to facilitate comparison across figures. Water budget estimates are described below; these budgets are subject to change in future GSP updates as understanding of Basin conditions evolves during GSP implementation.

5.5.1 Land System Water Budgets

Table 5-3 and Figure 5-3a present averages of the individual historical, current, and projected land system budgets, whereas Figure 5-4a presents the annual time series of the historical, current, and projected land system budgets.

According to SPV GSP Model results, the Basin received an average of about 9,900 AFY of land inflows and outflows during the 15-year historical period mostly from groundwater deliveries for irrigation, followed by precipitation, and shallow groundwater uptake by vegetation. During this same period, the largest outflow from the land system was ET_o of applied water (3,600 AFY) followed by groundwater recharge from precipitation, applied water, and septic system flows that recharged the underlying Basin aquifer.

Because SPV GSP Model projections assume a similar water demand, the projected time series land system water budget looks similar to the historical land system estimates. Although there is a greater projected amount of groundwater deliveries for irrigation as compared to historical amounts, these amounts are not enough to offset a reduction of other land system inflow terms.

In the SPV GSP Model, the hierarchy of inflows and outflows under current conditions is the same as those under the historical period. That is, the relative order of the most dominant land system water budget components is identical during the 15-year and the most recent 5-year averaging periods. Total inflows and outflows under current conditions are about 4 percent higher than total inflows and outflows under historical conditions.

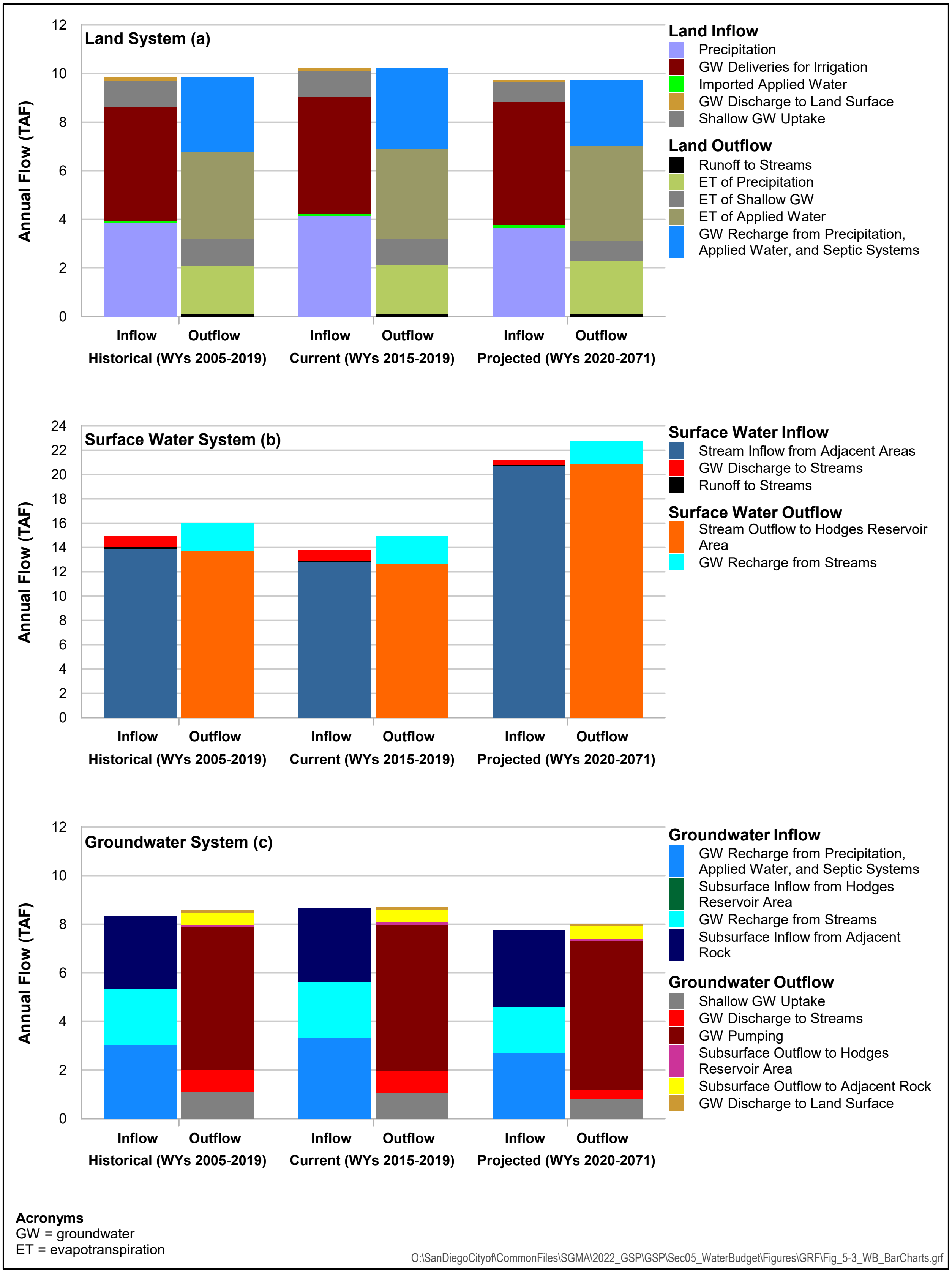

Figure 5-3. Average Annual Water Budgets

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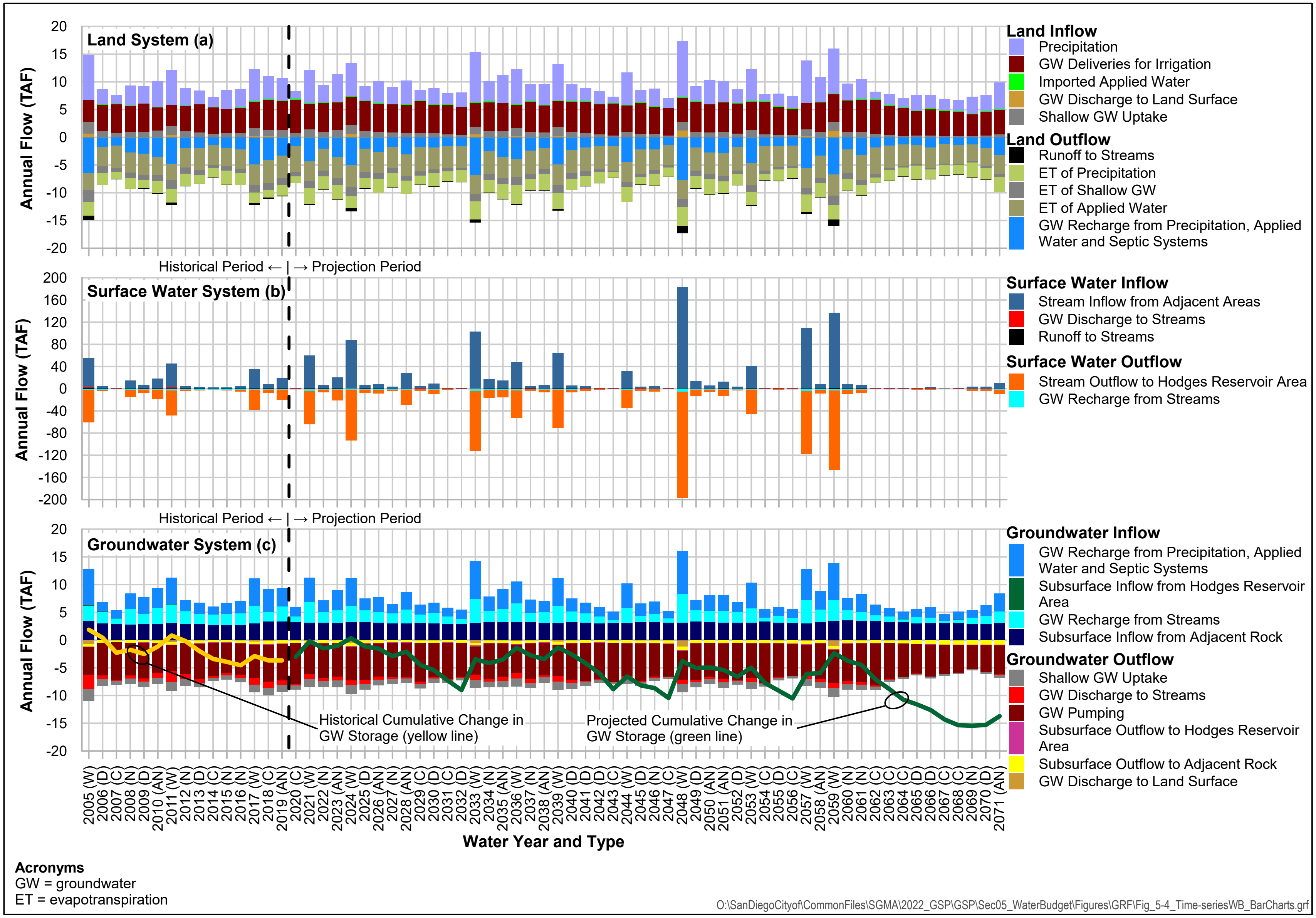

Figure 5-4. Time-series Annual Water Budgets

Jacobs

Table 5-3. Average Annual Land System Water Budgets[a]

Water Budget Component	Historical Average Annual Flow (AFY) WYs 2005–2019	Current Average Annual Flow (AFY) WYs 2015–2019	GSP Implementation Period Average Annual Flow (AFY) WYs 2020-2042	Projected Average Annual Flow (AFY) WYs 2020–2071
Inflows				
Precipitation	3,864	4,126	3,872	3,638
Imported Applied Water	76	92	128	135
Groundwater Deliveries for Irrigation	4,679	4,818	5,145	5,162
Shallow Groundwater Uptake	1,107	1,088	1,079	887
Groundwater Discharge to Land Surface	119	102	120	119
Total Inflow	9,845	10,226	10,344	9,941
Outflows				
Runoff to Streams	130	115	130	128
ET of Precipitation	1,974	2,000	2,301	2,182
ET of Shallow Groundwater	1,107	1,088	1,079	887
ET of Applied Water	3,583	3,704	3,975	3,985
Groundwater Recharge from Precipitation, Applied Water, and Septic Systems	3,052	3,320	2,861	2,759
Total Outflow	9,846	10,227	10,346	9,941

(a) Native vegetation (that is, native shrubs plus riparian vegetation) water demand is assumed to be met through precipitation and shallow groundwater uptake. The ET of native vegetation is a portion of the sum of the ET of precipitation and the ET of shallow groundwater. The ET of native vegetation alone within the Basin averages 2,328 to 2,556 AFY during the four averaging periods indicated.

5.5.2 Surface Water System Water Budgets

Table 5-4 and Figure 5-3b present averages of individual Basin historical, current, and projected surface water system budgets, whereas Figure 5-4b presents an annual time series of the historical, current, and projected surface water system budgets.

According to SPV GSP Model results, the Basin experienced an average of about 15,000 AFY of surface water inflows during the 15-year historical period; most stream inflow is from contributing subcatchments north, east, and south of the Basin. During this same period, approximately 14,000 AFY of streamflow in the San Dieguito River exited the Basin and flowed toward Hodges Reservoir. Model projections for WYs 2020-2071 indicate larger average stream inflows and outflows than historical averages; however, as shown in Figure 5-4b, the larger projected averages are influenced by relatively fewer extreme wet years.

Table 5-4. Average Annual Surface Water System Water Budgets

Water Budget Component	Historical Average Annual Flow (AFY) WYs 2005–2019	Current Average Annual Flow (AFY) WYs 2015–2019	GSP Implementation Period Average Annual Flow (AFY) WYs 2020-2042	Projected Average Annual Flow (AFY) WYs 2020–2071
Inflows				
Runoff to Streams	130	115	130	128
Stream Inflow from Adjacent Areas	13,907	12,796	24,752	23,537
Groundwater Discharge to Streams	921	861	590	438
Total Inflow	14,958	13,772	25,472	24,103
Outflows				
Stream Outflow to Hodges Reservoir Area	13,714	12,641	24,656	23,506
Groundwater Recharge from Streams	2,276	2,303	2,431	2,169
Total Outflow	15,990	14,944	27,086	25,675

5.5.3 Groundwater System Water Budgets

Table 5-5 and Figure 5-3c present averages of the historical, current, and projected groundwater system budgets, whereas Figure 5-4c presents the annual time series of the historical, current, and projected groundwater system budgets.

According to SPV GSP Model results, the Basin experienced an average of about 8,300 AFY of groundwater inflows during the 15-year historical period, most of which was in the form groundwater recharge from precipitation, applied water, septic systems, subsurface inflow from adjacent rock, and groundwater recharge from streams. During this same period, the largest outflow from the groundwater system was groundwater pumping, which serves as the primary source for irrigation in the Basin with pumping rates totalling approximately 5,900 AFY.

Because SPV GSP Model projections assume a similar water demand, the projected time series groundwater system water budget looks similar to the historical groundwater system estimates (Figure 5-4**c**).

SPV GSP Model results indicate that the total projected groundwater inflows could be slightly lower than historical groundwater inflows due to less groundwater recharge from precipitation and applied water, and less groundwater recharge from streams. This is because hydrology under modeled climate change conditions during the projection period is generally drier as compared to the last few decades. Although there is more projected subsurface inflow from adjacent rock compared with historical rates, this inflow is not enough to offset the projected reduction in groundwater recharge terms.

The historical, current, and projected groundwater system budgets all indicate an average deficit in cumulative change in groundwater storage ranging from -53 AFY under current conditions up to -248 AFY under projected conditions. The projected deficit is a result of lower groundwater recharge rates and lower groundwater levels (equating to reduced groundwater uptake) and increased ET_0 under climate change conditions. These conditions exacerbate the need for increased groundwater pumping to meet future water demands.

Thus, even with little to no change in cropping patterns or population, reductions in precipitation and groundwater uptake and increases in ET_0 under climate change conditions could result in greater reliance on groundwater pumping and/or imported water. This deficit range represents 0.6 to 3.0 percent of the average of the groundwater inflows and outflows, and is within the uncertainty of these water budget estimates. This means small changes to individual water budget estimates could potentially result in no deficit in cumulative change to groundwater storage. Further, given the uncertainty associated with climate projections using drier than average projected values, it is possible that future climate conditions could be different than those inherent in the GCM selected for use in the SPV GSP Model.

DWR’s Water Budget BMP indicates that reductions of groundwater storage in wet and above normal years could be an indication of overdraft conditions. As discussed in Section 5.5.4 and shown in Table 5-6, the average changes in stored groundwater during historical, current, and projected years are positive numbers under wet and above normal WY types. It is also common for outflows to exceed inflows during drought conditions; for example, WYs 2012 through 2014 coincide with a substantial drought. Thus, it would be premature to identify a small deficit in the cumulative change in groundwater storage over WYs 2005 through 2019 as overdraft. Additional years of groundwater level data are needed to develop a more definitive statement about whether the Basin is in a long-term overdraft condition. The water budgets described here will be revaluated during GSP implementation.

Table 5-5. Average Annual Groundwater System Water Budgets

Water Budget Component	Historical Average Annual Flow (AFY) WYs 2005-2019	Current Average Annual Flow (AFY) WYs 2015-2019	GSP Implementation Period Average Annual Flow (AFY) WYs 2020-2042	Projected Average Annual Flow (AFY) WYs 2020-2071
Inflows				
Groundwater Recharge from Precipitation, Applied Water, and Septic Systems	3,052	3,320	2,861	2,759
Groundwater Recharge from Streams	2,276	2,303	2,431	2,169
Subsurface Inflow from Hodges Reservoir Area	18	0	0	0
Subsurface Inflow from Adjacent Rock	2,983	3,031	3,110	3,145
Total Inflow	8,329	8,654	8,402	8,073
Outflows				
Shallow Groundwater Uptake (ET of Shallow Groundwater)	1,107	1,088	1,079	887
Groundwater Discharge to Streams	921	861	590	438
Groundwater Pumping	5,861	6,021	6,198	6,233
Subsurface Outflow to Hodges Reservoir Area	98	149	112	99
Subsurface Outflow to Adjacent Rock	468	486	500	545
Groundwater Discharge to Land Surface	119	102	120	119
Totals				
Total Outflow	8,574	8,707	8,600	8,321
Average of Total Inflows and Outflows	8,452	8,681	8,501	8,197
Change in Groundwater Storage	-245	-53	-199	-248
Change in Groundwater Storage as a Percent of the Average of Total Inflows and Outflows	2.9%	0.60%	2.3%	3.0%

5.5.4 Water Supply and Demand

Table 5-6 summarizes annual average supply and demand by WY type within the Basin for the historical, current, and projected water budgets. Groundwater is the dominant supply source in the Basin, placing a higher demand on pumping during critically dry and dry WYs due to less precipitation. Although surface water flowing through the system is not generally used directly for irrigation, surface water does provide an important source of groundwater recharge to the Basin (refer to groundwater recharge from streams Figure 5-3 and 5-4), making water potentially available to help meet agricultural pumping demands. Annual applied water demands are highest during critically dry and dry WYs due to a lack of precipitation, lower groundwater levels (and therefore less groundwater uptake), and the need for irrigation to sustain agriculture in the Basin. Changes in groundwater storage vary between WY types, with increases in groundwater storage during wet and above normal years and decreases in groundwater storage during normal, dry, and critically dry years.

Observations of current supply and demand are consistent with those of the 15-year historical period, except that a dry WY did not occur in WYs 2015 through 2019 (Table 5-6). As with the historical and current groundwater conditions, projected groundwater pumping serves as the dominant supply source in the Basin, with a higher demand on pumping required under critically dry and dry WYs due to less precipitation (Table 5-6). Projections indicate that surface water and imported water will be increasingly important sources of supply to meet projected agricultural demands in the Basin. Annual applied water demands are projected to be highest under critically dry and dry years due to the lack of precipitation, lower groundwater levels (and therefore less groundwater uptake), and the need to irrigate to sustain agriculture in the Basin. Changes in groundwater storage vary between WY types, with increases during wet and above normal years and decreases during normal, dry, and critically dry years. Overall, the positive and negative changes in groundwater storage are projected to be greater during the projected period compared to the current period, suggesting the possibility of more dramatic changes in groundwater levels in the future (Table 5-6). More dramatic changes in future modeled groundwater levels and groundwater storage are the result of future sequencing and magnitudes of wetter and drier WYs as compared to historical conditions.

5.6 Sustainable Yield Estimates

Table 5-7 presents annual agricultural groundwater pumping from the historical groundwater system water budget. According to the SPV GSP Model, agricultural pumping ranged from 4,740 AFY in the wet WY of 2011 to 6,741 AFY in the critically dry WY of 2007. Year-to-year variability plays an important role in the health of the Basin. Sustainable yield is defined in the SGMA regulations as follows:

> *"…the maximum quantity of water calculated over a base period representative of long-term conditions in a basin, including any temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result."*

As described in Section 8, *Minimum Thresholds and Measurable Objectives,* groundwater levels will be used as a proxy to determine whether an undesirable result has occurred for both chronic lowering of groundwater levels and depletion of groundwater storage. Groundwater levels during the historical water budget period (i.e., WYs 2005 through 2019) do not indicate an undesirable result based on the sustainable management criteria described in Section 8. Therefore, the Basin's sustainable yield is at least higher than historical agricultural pumping (i.e., above the average of the modeled historical pumping rate in the Basin; see statistical summaries at the bottom of Table 5-7).

Table 5-6. Supply and Demand by WY Type Summary

Water Budget Component	Wet (AFY)	Above Normal (AFY)	Normal (AFY)	Dry (AFY)	Critically Dry (AFY)
Historical Period (WYs 2005–2019)					
Annual Groundwater Supply	5,199	5,904	5,618	6,237	6,428
Annual Imported Applied Water	67	68	69	65	87
Annual Surface Water Supply	1,110	1,886	1,653	1,269	933
Annual Total Supply	6,376	7,858	7,340	7,571	7,448
Annual Applied Water Demand	3,760	4,223	4,018	4,415	4,570
Change in Stored Groundwater	1,835	683	-405	-1,332	-1,639
Current Period (WYs 2015–2019)					
Annual Groundwater Supply	5,934	6,521	5,484	N/A	6,669
Annual Imported Applied Water	79	114	68	N/A	67
Annual Surface Water Supply	1,864	1,877	1,476	N/A	519
Annual Total Supply	7,877	8,512	7,028	N/A	7,255
Annual Applied Water Demand	4,294	4,686	3,933	N/A	4,834
Change in Stored Groundwater	1,664	18	-573	N/A	-790
Projection Period (WYs 2020–2071)					
Annual Groundwater Supply	5,603	6,047	6,235	6,413	6,694
Annual Imported Applied Water	127	137	134	141	139
Annual Surface Water Supply	2,942	1,972	1,551	1,517	894
Annual Total Supply	8,672	8,156	7,920	8,071	7,727
Annual Applied Water Demand	4,243	4,616	4,886	5,088	5,464
Change in Stored Groundwater	3,276	398	-831	-1,234	-2,211

N/A = Not applicable because no dry year occurred during the current period
Annual Groundwater Supply = groundwater pumped from the Basin
Annual Imported Water = water imported to the Basin used to meet applied water demand
Annual Surface Water Supply = the net groundwater recharge from streams in the Basin
Annual Total Supply = sum of the groundwater, imported applied water, and surface water supply
Annual Applied Water Demand = the applied water demand within the Basin

Table 5-7. Historical Agricultural Pumping Summary

Water Year	Water Year Type	Agricultural Groundwater Pumping (AFY)
2005	Wet	4,925
2006	Dry	5,875
2007	Critically Dry	6,741
2008	Normal	5,933
2009	Dry	6,480
2010	Above Normal	5,287
2011	Wet	4,740
2012	Normal	5,569
2013	Dry	6,356
2014	Critically Dry	5,875
2015	Normal	5,403
2016	Normal	5,565
2017	Wet	5,934
2018	Critically Dry	6,669
2019	Above Normal	6,521
2005–2019 Minimum	N/A	4,740
2005–2019 Average	N/A	5,858
2005–2019 Median	N/A	5,875
2005–2019 Maximum	N/A	6,741

The SPV GSP Model is only one line of analysis being used to help the GSA develop its GSP. Detailed information about the SPV GSP Model is in Appendix I.

The SPV GSP Model does not and will not ultimately decide whether the Basin is being managed sustainably. Field data collection, reporting, and analysis during GSP implementation will be used in conjunction with the established sustainable management criteria to establish a more definitive sustainable yield for the Basin.

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Section 6. UNDESIRABLE RESULTS

This section describes SGMA's sustainability indicators, sustainability goals, and undesirable results for the SPV Basin, and are defined as follows:

- **Sustainability Indicators—**These indicators are defined in DWR's *Draft Best Management Practices for the Sustainable Management of Groundwater—Sustainable Management Criteria* (Sustainable Management Criteria BMP) (DWR, 2017), and are summarized below.
- **Sustainability Goal—**A sustainability goal qualitatively describes a basin's overall objectives and desired conditions.
- **Undesirable Results—**Undesirable results statements are developed to describe the conditions under which each applicable sustainability indicator (listed below) would become significant and unreasonably negative to beneficial uses in a basin.

6.1 Sustainability Indicators

As briefly discussed in Section 1.2, SGMA defines sustainability indicators as one of six effects caused by groundwater conditions that, when significant and unreasonable, could potentially cause undesirable results. The six sustainability indicators are described by DWR as shown below.

	Chronic lowering of groundwater levels, indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
	Significant and unreasonable **reduction of groundwater storage**.
	Significant and unreasonable **seawater intrusion**.
	Significant and unreasonable **degraded water quality**, including the migration of contaminant plumes that impair water supplies.
	Significant and unreasonable **land subsidence** that substantially interferes with land uses.
	Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

6.2 Sustainability Goal

A sustainability goal is a qualitative description of the objectives and desired conditions in a basin. It is supported by locally defined undesirable results, monitoring networks (Section 7, *Monitoring Networks*), and sustainable management criteria (Section 8, *Minimum Thresholds and Measurable Objectives*) including minimum thresholds, measurable objectives, and interim milestones.

The Basin's sustainability goal is as follows:

> *To maintain a locally managed, economically viable, sustainable groundwater resource for existing and future beneficial use in the San Pasqual Valley Groundwater Basin by managing groundwater to avoid the occurrence of undesirable results.*

6.2.1 Discussion of Measures to Operate within Sustainable Yield

The water budget for the Basin (Section 5, *Water Budgets*), indicates the Basin has been operated within its sustainable yield. Conditions in the Basin may change in the future, and the SPV GSP includes projects and management actions that the GSA may undertake if conditions change, and additional management is necessary to maintain sustainability.

6.2.2 Achieving Sustainability within 20 Years

As the historical, current, projected, and projected with climate change model results indicate (Section 5, *Water Budgets*), the Basin has been operating sustainably and is likely to continue to be sustainable over this GSP's implementation period.

6.3 Undesirable Results

This section describes the Basin-specific undesirable results for each sustainability criterion. SGMA defines undesirable results as one or more significant and unreasonable effects caused by groundwater conditions occurring in a basin. These undesirable results are based on the six sustainability indicators described above. DWR's BMPs and Guidance Documents (DWR, 2021) state that "Undesirable results will be defined by minimum threshold exceedances."

On January 9, 2020, the GSA hosted an Advisory Committee meeting during which sustainability and undesirable outcomes were discussed in small breakout group format. Input from Advisory Committee members and stakeholders on what would constitute an undesirable result was tabulated, and input was correlated to the most relevant GSP sustainability criteria. The tabulated workshop results (Appendix K) guided creation of the GSA's undesirable results statements.

6.3.1 Chronic Lowering of Groundwater Levels

This section provides a statement describing the undesirable results for the chronic lowering of groundwater levels. This statement is then supported by descriptions of potential causes of the undesirable result, the potential effects of that undesirable result, how to identify the undesirable result, and an evaluation to determine if the undesirable result is currently present in the Basin.

Description of Undesirable Results

The undesirable result for the chronic lowering of groundwater levels is a result that causes significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP. The undesirable results would involve lowering water levels to depths not accessible by supply wells or levels that substantially limit water availability for GDEs.

Potential Causes of Undesirable Results

Potential causes of undesirable results for the chronic lowering of groundwater levels are sustained groundwater pumping that exceeds the average sustainable yield in the Basin, greater consumptive use on a regular basis, changes in precipitation, reduction in surface and subsurface flows, and/or increases in evapotranspiration in the SPV watershed and other contributing watersheds in the future. Potential local impacts to groundwater levels could be caused by one or more of the following:

- Increases in the consumptive use of water due to increases in agricultural productivity
- Reductions in the amount of stream flows that reach the Basin due to changes in conditions upstream from the Basin

Potential Effects of Undesirable Results

If there is a continued lowering of groundwater levels indicating that undesirable results are occurring, effects could include the following:

- Dewatering of a subset of the existing groundwater infrastructure, starting with the shallowest wells or those completed at the highest topographic elevations
- Increased costs to pump groundwater
- Adverse effects on GDEs to the extent connected with the principal aquifer, including increased difficulty for plants to access groundwater
- Changes in irrigation practices and crops grown due to decreased water availability
- Adverse effects to property values and the regional economy

Identification of Undesirable Results

As described in more detail in Section 7, *Monitoring Networks*, the groundwater level monitoring network consists of 15 representative wells located throughout the Basin. Minimum threshold exceedances in five of these wells is considered indicative of a widespread decline in groundwater levels, as opposed to a more localized groundwater level decline (e.g., minimum threshold exceedances in one monitoring well), which could be associated with pumping concentrated in a particular area of the Basin. Furthermore, groundwater levels in areas of the Basin fluctuate over a wide range in response to changes in conditions (see Section 4, *Groundwater Conditions*). Therefore, sustained exceedances of minimum thresholds are more significant than short-term exceedances from a basin management perspective. Based on this, the undesirable result for the chronic lowering of groundwater levels is considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., 5 of 15 wells) fall below their minimum groundwater elevation thresholds for two consecutive years.

Evaluation of the Presence of Undesirable Results

Section 8, *Minimum Thresholds and Measurable Objectives* discusses how minimum thresholds were selected. Appendix L presents hydrographs of groundwater levels through 2019 and the established depth of the minimum threshold for each monitoring site. Of the 15 representative monitoring wells, none had groundwater levels that were below the minimum threshold in the latest measurement in 2019, indicating that the Basin does not currently exceed the requirements for an undesirable condition for the chronic lowering of groundwater levels.

6.3.2 Reduction of Groundwater Storage

This section provides a statement describing the undesirable results for a reduction in groundwater storage. This statement is then supported by descriptions of potential causes of the undesirable result, the potential effects of that undesirable result, how to identify the undesirable result, and an evaluation to determine if the undesirable result is currently present in the Basin.

Description of Undesirable Results

The undesirable result for the reduction in groundwater storage is a result that causes significant and unreasonable reduction in the viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP. The undesirable results would involve insufficient groundwater availability to support these beneficial uses.

Justification of Groundwater Levels as a Proxy

As stated in DWR's BMPs and Guidance Documents, the metric for reductions in groundwater storage is a volume of groundwater that can be withdrawn from a basin or management area, based on measurements from multiple representative monitoring sites, without leading to undesirable results. As described in Section 7, *Monitoring Network,* the groundwater level monitoring network consists of 15 representative monitoring wells. The network has good spatial coverage across the Basin, so the groundwater level information from this network is expected to correlate well to the overall storage conditions. The minimum groundwater level thresholds for these wells were established to be above most nearby supply wells including all known domestic wells (see Section 8, *Minimum Thresholds and Measurable Objectives*) and are therefore protective of effective groundwater storage. In addition, planning thresholds and measurable objectives for groundwater levels were also established for each representative well considering a 5-year decline to allow for drought storage. Thus, the overall approach for groundwater level thresholds is also protective of groundwater storage conditions in the Basin, and the use of groundwater levels is therefore appropriate as a proxy metric for the groundwater storage sustainability indicator

Potential Causes of Undesirable Results

Reductions in groundwater storage occur when groundwater withdrawals exceed inflows. Potential causes of undesirable results for a reduction in groundwater storage include:

- Groundwater pumping that exceeds the average sustainable yield in the Basin
- Decreases in precipitation and/or potential increases in evapotranspirationin the SPV watershed and contributing watersheds in the future

Potential Effects of Undesirable Results

The overarching effect of undesirable results for groundwater storage would be reduced access to groundwater supply for beneficial uses. In addition, other effects associated with chronic lowering of groundwater levels may also occur, including the following:

- Dewatering of existing groundwater infrastructure
- Increased costs to pump groundwater
- Adverse effects to GDEs and property values
- Changes in irrigation practices and crops grown due to decreased water availability
- Adverse effects to domestic and irrigation uses and users that rely on groundwater in the Basin

Identification of Undesirable Results

Of the 15 representative monitoring wells, none had groundwater levels that were below the minimum threshold in the latest measurement in 2019, indicating that the Basin does not currently exceed the requirements for an undesirable condition for groundwater storage.

Evaluation of the Presence of Undesirable Results

Because measurements show that levels are not in an undesirable condition, reduction of groundwater storage is not identified to be in an undesirable condition.

6.3.3 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator in the Basin because seawater intrusion is not present and not likely to occur given its distance from the Pacific Ocean, bays, deltas, or inlets. Therefore, there is no possibility of an undesirable result due to seawater intrusion.

6.3.4 Degraded Water Quality

This section provides a statement describing the undesirable results for degraded water quality. This statement is then supported by descriptions of potential causes of the undesirable result, the potential effects of that undesirable result, how to identify the undesirable result, and an evaluation to determine if the undesirable result is currently present in the Basin.

Description of Undesirable Results

For degraded water quality to be characterized as an undesirable result, it must be associated with groundwater-management activities and the impacts those activities have on water quality. If those activities cause a significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP; that would be considered an undesirable result for degraded water quality.

This direct relationship underscores that undesirable results for water quality must be associated with groundwater pumping and other groundwater-related activities. Existing water quality impacts prior to 2015, and future water quality impacts caused by land use practices, surface water quality issues, or other issues not associated with groundwater management may be undesirable results for degraded water quality that are not the responsibility of the GSA because they are outside of GSA authorities. Nevertheless, the GSA intends to implement *Management Action 3 – Support WQIP Actions,* which details actions six local jurisdictions in the San Dieguito River Watershed Management Area would initiate to address discharges of nutrients and other pollutants through activities in their jurisdictions, including the SPV Basin.

Potential Causes of Undesirable Results

The SPV SNMP (City, 2014) identified estimated contributions of nitrogen and TDS in the Basin, and estimated that 70 percent of nitrogen contribution was derived from commercial and landscape fertilizer use. The SPV SNMP also evaluated contributions of TDS to groundwater in the Basin as follows:

- Surface water inflows, 29 percent
- Imported water, 16 percent
- Evapotranspiration in riparian areas, 19 percent
- Evapoconcentration from irrigation, 29 percent

Continued loading of TDS and nitrate from these sources may lead to increased nitrate and TDS concentrations in groundwater and potentially undesirable results.

Potential Effects of Undesirable Results

If groundwater quality degraded enough to reach undesirable results, the effects could potentially cause the following:

- Reduced availability of potable groundwater for beneficial uses, with domestic wells being most vulnerable due to increased treatment costs or more limited access to alternate supplies
- High salinity impacting drinking water needs, as there are drinking water standards associated with aesthetics (i.e., taste, color, and odor) for drinking water
- Reduced quality of groundwater used for irrigation, impacting crop health
- Increased salinity levels have the potential to impact GDEs and surface water quality during times when streams have gaining reaches
- Adverse effects to property values from lower quality groundwater

Identification of Undesirable Results

The monitoring network for groundwater quality consists of 10 monitoring wells located throughout the Basin (see Section 7, *Monitoring Networks*). Analogous to groundwater levels, exceedances of minimum thresholds for groundwater quality in multiple wells are more representative of basin-wide conditions than exceedances in a single well. Additionally, the concentrations of TDS and nitrate have fluctuated year-to-year over a wide range in some wells (see Section 4, *Groundwater Conditions*) and therefore, sustained exceedances of minimum thresholds are considered more indicative of basin-scale water quality issues than a one-time exceedance or anomalous occurrence. Based on this rationale, undesirable results for degraded water quality are considered to occur during GSP implementation when 30 percent of the representative monitoring wells (i.e., 3 of 10 wells) for water quality exceed the minimum threshold for a constituent for two consecutive years.

Evaluation of the Presence of Undesirable Results

Section 7, *Monitoring Networks* provides the monitoring network for groundwater quality, and Section 8, *Minimum Thresholds and Measurable Objectives* provides the sustainability thresholds for groundwater quality. Appendix H includes chemographs for the water quality monitoring network. Nitrate (as NO_3N) concentrations exceed minimum thresholds in two of the representative monitoring wells (SP006 and SP043) and have exceeded this threshold for more than two years since 2015 (Appendix H). TDS concentrations in two of the representative monitoring wells (SP010 and SP008) have been reported at maximum concentrations (minimum thresholds) since 2015, but not for two consecutive years. The Basin is not experiencing an undesirable result for degraded groundwater quality because neither nitrate nor TDS concentrations have exceeded their respective minimum thresholds in three representative monitoring wells for two consecutive years.

6.3.5 Land Subsidence

Land subsidence occurs when groundwater levels are reduced through pumping, resulting in dewatering and compaction of compressible clays in the subsurface, which causes the land surface to subside. Undesirable results associated with subsidence can include differential subsidence that impacts the grade of and drainage of water conveyance, roads, and rail lines, among other impacts. Basins susceptible to permanent (inelastic) land subsidence are typically underlain by thick sequences of alluvium containing abundant or thick layers of clay. The SPV Basin does not have these characteristics, and there have been no known reports of subsidence-related impacts in the Basin.

As discussed in Section 3, *Hydrogeologic Conceptual Model*, and in the 2007 SPGMP, the Basin is comprised of mostly coarse-grained alluvium ranging from approximately 120 to 200 feet in thickness, and clay layers are uncommon and where present are generally thin with limited continuity. Given the relatively small size of the Basin, limited saturated thickness in the Basin, and the coarse-grained nature of alluvial materials, inelastic land surface subsidence is considered unlikely to occur in the Basin. This also contributed to the decision to refrain from installing subsidence monitoring locations throughout the Basin during SPGMP implementation (City, 2007). As discussed in Section 4, *Groundwater Conditions*, recent interferometric synthetic aperture radar (InSAR) data show that only nominal subsidence occurred in the Basin during the measured period, and the observed subsidence may be elastic rather than inelastic subsidence.

Since subsidence has not caused undesirable results in the Basin and is not anticipated to cause undesirable results in the foreseeable future, including over the planning horizon of this GSP, establishing minimum thresholds and measurable objectives is not required in the Basin pursuant to Title 23 CCR Section 354.26(d).

6.3.6 Depletions of Interconnected Surface Water

This section provides a statement describing the undesirable results for depletions of interconnected surface water. This statement is then supported by descriptions of potential causes of the undesirable result, the potential effects of that undesirable result, how to identify the undesirable result, and an evaluation to determine if the undesirable result is currently present in the Basin.

Description of Undesirable Results

Surface water features (streams) that are hydraulically connected to the underlying aquifer are designated as interconnected streams. This implies that the groundwater elevation in the aquifer beneath the stream is greater than the elevation of the stream bed. Pumping that causes lower groundwater levels in the vicinity of the stream that induce steeper gradients away from the stream can increase seepage from the steam, or during times when streams have gaining reaches, reduce groundwater discharge (baseflow) to the stream. Stream–aquifer interconnection in these areas may be transient based on a complex interaction among streamflow, precipitation, groundwater recharge, and pumping. In the Basin, the interconnected streams occur in the western portion of the basin where groundwater conditions are shallow (see Figure 4-33). Based on previous studies for San Pasqual Valley, no surface water flow leaves the Valley in a typical year. In wet years and during floods, enough surface water is available to provide flow in the San Dieguito River at San Pasqual Narrows at the discharge point of the Basin (DWR, 2015).

The undesirable result for depletions of interconnected surface water is a result that causes significant and unreasonable adverse effects on beneficial uses of interconnected surface water over the planning and implementation horizon of this GSP. In the SPV Basin, surface water exits the Basin during intense storms and extended wet periods and discharges to Hodges Reservoir. There are no known diverters of surface water within the Basin. The primary beneficial use of interconnected streams is water availability to support GDEs. Undesirable results can be associated with a substantial decrease in available groundwater that supports GDEs.

Potential GDEs in the Basin largely consist of dense riparian and wetland communities along streams located in the western portion of the Basin (see Figure 4-35). The potential GDEs may support habitat for multiple state and federal protected species (Appendix J). Given that potential GDEs are located along mapped drainage systems, surface flows or stormwater runoff may satisfy the soil moisture requirements for these vegetative communities. Undesirable results would occur if pumping-induced streamflow depletion causes significant and unreasonable impacts to these potential GDEs, if supported by *Management Action 8 – Study Groundwater Dependent Ecosystems*.

Justification of Groundwater Elevations as a Proxy

DWR defines, in their Sustainable Management Criteria BMP (DWR, 2017) that "the minimum threshold metric for depletion of interconnected surface waters shall be a rate or volume of surface water depletion." Volumes of surface water depletions are discussed in Section 4, *Groundwater Conditions* and estimated using the SPV GSP Model, which developed those estimates using stream flow and groundwater level information (Appendix I).

The rates and volumes of surface water depletion can be estimated by calculation or modeling and are impractical metrics for thresholds for streamflow depletion. As described above, the primary beneficial use of interconnected steams is water availability to support potential GDEs. Groundwater levels are an important factor for the availability of interconnected groundwater to support potential GDEs. Therefore, this GSP uses groundwater levels as a proxy to monitor for surface water depletions.

A subset of the groundwater level monitoring wells will be used to monitor for depletion of interconnected groundwater (See Section 7, *Monitoring Networks*). This interconnected surface waters monitoring network consist of six representative monitoring wells and are in the western portion of the Basin where potential GDEs are known to occur. Thresholds for the monitoring network are established for surface water depletions in Section 8, *Minimum Thresholds and Measurable Objectives*.

Potential Causes of Undesirable Results

Potential causes of undesirable results for depletions of interconnected surface water are likely tied to groundwater production that could result in lowering of groundwater elevations in shallow aquifers near surface water courses. This could change the hydraulic gradient between the water surface elevation in the surface water course and the groundwater elevation, resulting in an increase in depletion of surface water.

Potential Effects of Undesirable Results

The cause of undesirable results for depletions of interconnected surface water would need to be associated with magnitudes of groundwater pumping that result in lower shallow groundwater levels near interconnected surface waters enough to cause significant and unreasonable adverse effects on beneficial uses of interconnected surface water over the planning and implementation horizon of this GSP. Groundwater pumping can influence the hydraulic gradient between the surface water elevation and the water table, resulting in less streamflow from increased stream leakage, decreased groundwater discharge to the stream, or some combination thereof.

Identification of Undesirable Results

The undesirable result for depletion of interconnected surface water is monitored by proxy using groundwater levels. The representative monitoring network consist of six monitoring wells in the western portion of the Basin and generally spans the area of the Basin where interconnected streams and potential GDEs may occur. Threshold exceedances in multiple wells are considered more representative of basin-scale impacts than an exceedance in an individual well, which could be caused by localized pumping. Likewise, sustained threshold exceedances are considered more significant than short-term exceedances because water levels in this area of the Basin do fluctuate in response to changes in conditions. Undesirable results are considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., two of six wells) fall below their minimum groundwater elevation thresholds for two consecutive years, if *Management Action 8 – Study Groundwater Dependent Ecosystems* supports this conclusion.

Evaluation of the Presence of Undesirable Results

Groundwater levels are and have been above the minimum threshold for the six monitoring wells used to monitor stream depletions. As such, an undesirable result is not present in the SPV Basin for depletions of surface water. Monitoring for surface water depletions is shown in Section 7, *Monitoring Networks*, and the thresholds on the monitoring network are established for surface water depletions in Section 8, *Minimum Thresholds and Measurable Objectives*.

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Section 7. MONITORING NETWORKS

This section describes the SPV GSP monitoring network and how existing monitoring programs were incorporated into this GSP's monitoring network. This section also explains how the monitoring network can detect undesirable results, summarizes current monitoring, discusses data gaps, and discusses areas for potential improvement.

7.1 Useful Terms

This section uses terms related to groundwater wells, water quality measurements, subsidence stations, and other related monitoring components. Terms typically used to describe groundwater near wells are listed below.

- **Ground Surface Elevation—**This is the elevation in feet above mean sea level of the ground surface at the well location.
- **Total Well Depth—**This is the depth to which a well is installed. This depth can be deeper than the bottom of the screened interval.
- **Depth to Water—**This is the distance from the ground surface to where water is encountered inside the well.
- **Water Surface Elevation—**This is the elevation above mean sea level that water is encountered inside the well.
- **Screened Interval**—This is the portion of a well casing that is screened to allow water from the surrounding soil into the well. There can be several screened intervals in the same well. A screened interval is usually reported in feet bsg.
- **Top of Perforation—**This is the distance to (depth of) the top of the perforation in the well from the ground surface elevation, typically reported in feet bgs.
- **Bottom of Perforation—**This is the distance to (depth of) the bottom of the perforated screen in the well from the ground surface elevation, typically reported in feet bgs.

Figure 7-1 is a schematic of a typical monitoring well.

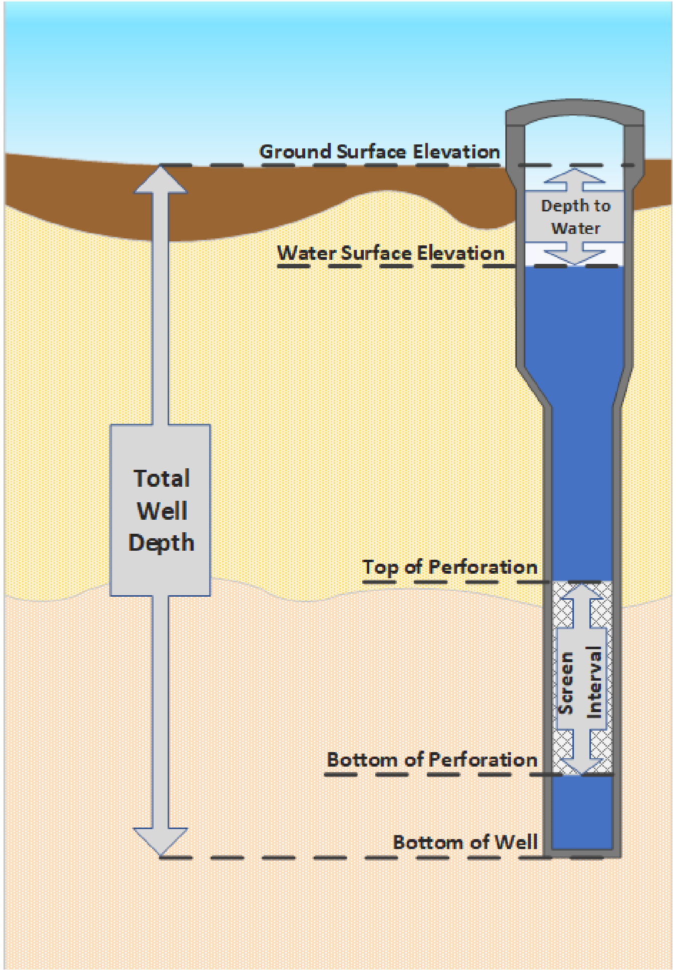


Figure 7-1. Basin Well Completion Diagram

7.2 Monitoring Network Objectives

This section describes the Basin's monitoring network for the six sustainability indicators (refer to Section 6.1, *Sustainability Indicators*, for more information). The objective of the SPV GSP's monitoring network is to provide access to monitor groundwater conditions to enable an assessment of whether undesirable results as described in Section 6, *Undesirable Results*. The monitoring network described in this section will detect changes in groundwater conditions relative to the following sustainability indicators:

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Degraded water quality
- Depletions of interconnected surface water

The sustainability indicators associated with seawater intrusion and land subsidence have been deemed not applicable to the Basin by the SPV GSA (see Section 6.3 for details).

7.2.1 Basin Conditions Relevant to Measurement Density and Frequency

This section summarizes key Basin conditions that influenced selection of monitoring wells for inclusion in each of the monitoring networks. These key conditions include hydrogeologic considerations, land use considerations, and historical groundwater conditions.

The Basin, as described in Section 3, *Hydrogeological Conceptual Model*, is one principal aquifer composed of two primary geologic groups: Quaternary Deposits and Residuum. There are no continuous aquitards in the Basin that act as barriers to vertical groundwater movement, nor are there faults in the Basin that have created known barriers to horizontal groundwater movement.

The largest groundwater use in the Basin is irrigation for agriculture. Section 3, *Hydrogeological Conceptual Model* describes the extent of land used for irrigated agriculture in the Basin.

Section 4, *Groundwater Conditions*, presents information about historical groundwater conditions in the Basin. Section 4 also provides hydrographs and groundwater contour maps that show groundwater generally flows from east to west toward Hodges Reservoir in the Basin, and tends to be shallower in the western portion of the Basin as it passes through San Pasqual Narrows and approaches Hodges Reservoir.

7.3 Existing Monitoring

This section describes existing monitoring for groundwater levels, water quality, and surface water flows. The monitoring networks described in this section were designed by evaluating data provided by DWR, USGS, the County, the City, and other stakeholders.

7.3.1 Groundwater Level Monitoring

This subsection describes groundwater level monitoring conducted by agencies and private landowners in the Basin.

CASGEM Program

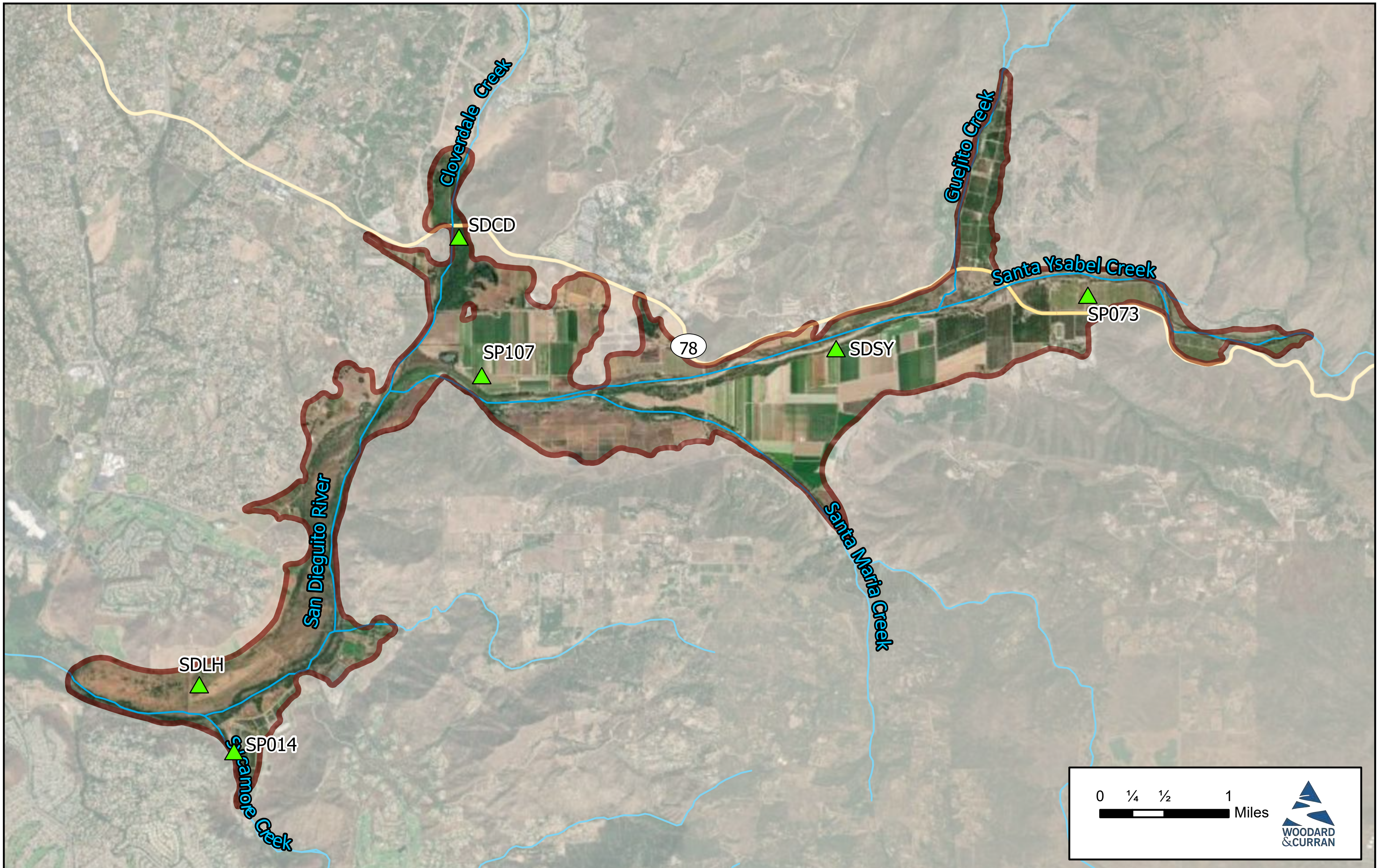
The State maintains groundwater elevation data in one master database maintained by DWR, which is managed under the CASGEM Program.

The CASGEM Program tracks seasonal and long-term groundwater elevation trends in groundwater basins throughout the State. In 2009, Senate Bill x7-6 created a framework for collaboration between local monitoring entities and DWR, establishing the CASGEM Program.

The CASGEM Program allows local agencies to be designated as CASGEM Program monitoring entities for groundwater basins through the state. CASGEM Program monitoring entities can measure groundwater elevations directly or compile data from other agencies to fulfill a monitoring plan, with each entity responsible for submitting that data to DWR.

The CASGEM Program's data include six CASGEM wells in the Basin. Figure 7-2 shows the location of these wells for which the City sends groundwater well elevation data to the DWR CASGEM program twice per year. Summary information regarding the CASGEM monitoring is provided below.

- Total number of wells monitored by the CASGEM Program: Six
- Composition: Three single completion wells and three cluster wells with three well completions each
- Earliest measurement date: January 15, 2008
- Longest period of record: 11 years
- Median period of record: 8 years



Project #: 0011197

Legend

- San Pasqual Valley Basin
- DWR/CASGEM Wells
- Streams

N

Figure 7-2

San Pasqual Valley GSP

Wells with Monitoring Data Provided to DWR CASGEM

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USGS

USGS performs continuous monitoring on three cluster well locations in the Basin under a contract with the City. USGS provides groundwater level monitoring data via their online portals for the National Ground-Water Monitoring Network, and the NWIS.

USGS' online data portals provide both approved and provisional data. Approved data are data that have been quality-assured and deemed fit for USGS publication. The portals also provide provisional data that are unverified by USGS and are potentially subject to revision. The GSA used USGS' URL generation tool to download all provisional and approved data about the Basin for analysis.

Within each of the three USGS cluster wells are three wells, each screened at a different level, for a total of 9 wells with one location having an additional well completion making a total of four wells in that cluster. Summary information regarding the USGS monitoring in the Basin is listed below.

- Total number of wells monitored by USGS: 10
- Composition: One single completion and three cluster wells with three wells each
- Earliest measurement date: December 28, 2010
- Longest period of record: 9 years
- Median period of record: 7 years

Figure 7-3 shows well locations included in the USGS dataset. The three cluster wells are monitored continuously at three different depths. A well from each of the three clusters also reports data within the CASGEM Program and WDL data sets. Table 7-1 provides additional information about the active USGS groundwater level monitoring wells.

Table 7-1. USGS Groundwater Level Monitoring Wells

SPV GSP Well Number	City Well Name	Site Code	Site Name	Well Depth (feet bgs)	Period of Record
SPV GSP-182	SDSY	330514116582801	012S001W34L005S	60	2011-2019
Cluster Well 1					
SPV GSP-154	SDSY	330514116582903	012S001W34L004S	90	2010-2019
SPV GSP-155	SDSY	330514116582902	012S001W34L003S	210	2011-2019
SPV GSP-156	SDSY	330514116582901	012S001W34L002S	340	2011-2019
Cluster Well 2					
SPV GSP-169	SDCD	330555117010103	012S001W30J005S	50	2013-2019
SPV GSP-168	SDCD	330555117010102	012S001W30J004S	130	2013-2019
SPV GSP-167	SDCD	330555117010101	012S001W30J003S	270	2013-2019
Cluster Well 3					
SPV GSP-131	SDLH	330320117024703	013S002W12M003S	50	2013-2019
SPV GSP-132	SDLH	330320117024702	013S002W12M002S	110	2013-2018
SPV GSP-133	SDLH	330320117024701	013S002W12M001S	270	2013-2019
Note: *bgs = below ground surface*					

Figure 7-3. USGS Groundwater Monitoring Wells

City of San Diego

The has City monitored 12 wells in the Basin on a quarterly basis for groundwater levels. In the winter of 2020, the City Public Utilities Department (PUD) constructed two new multilevel or cluster wells, SP128 and SP129, to add to their monitoring network. SP128 has three wells screened at different levels inside a single borehole. SP129 has two wells screened at different levels inside one borehole. No monitoring data from SP128 and SP129 were available for analysis in this GSP; future data may be used in the annual reports or 5-year evaluation reports. Figure 7-4 shows the locations of the City monitoring wells. Summary information regarding the City's groundwater level network is listed below.

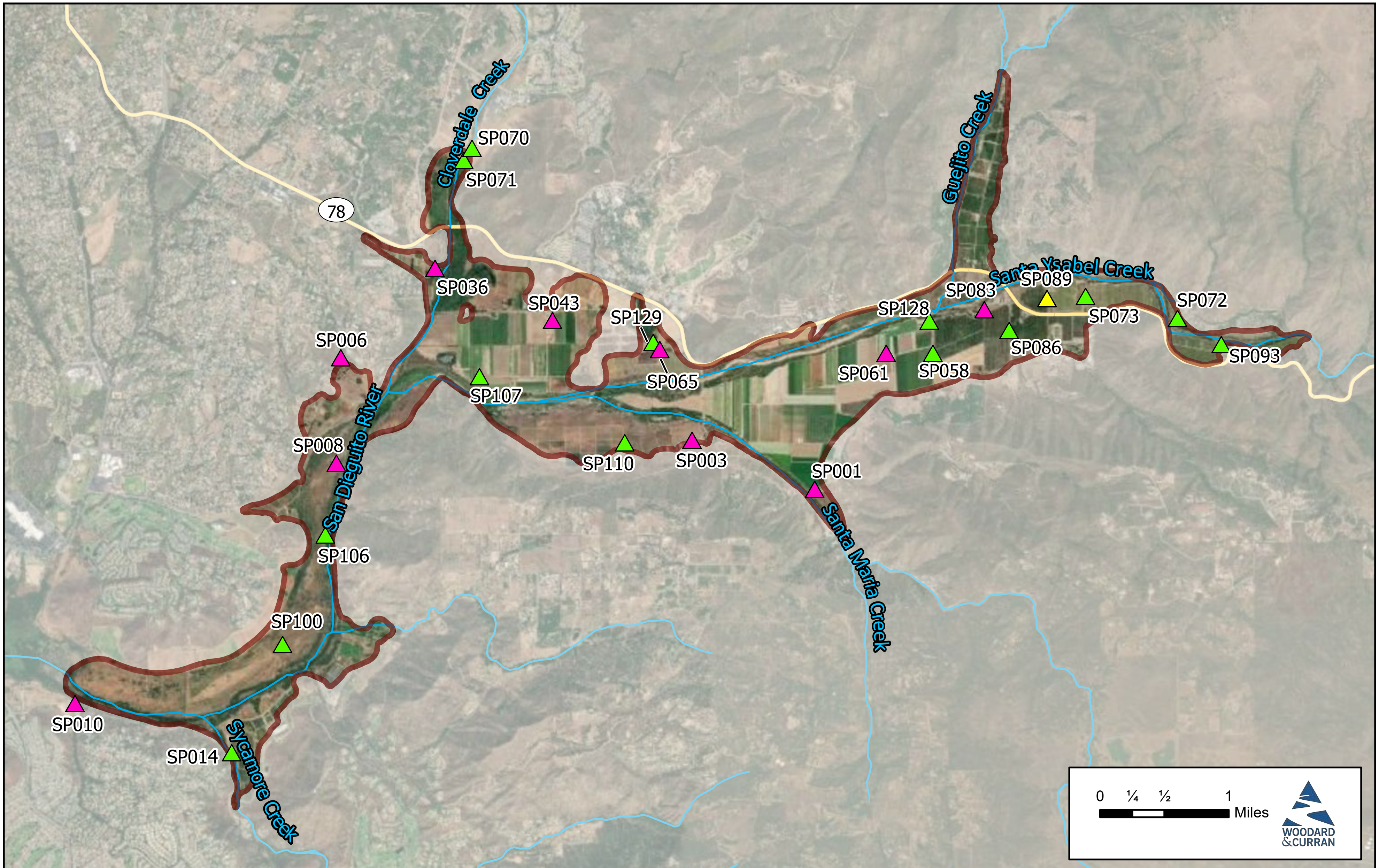
- Total number of Monitoring Wells Owned by the City of San Diego: 12
- Composition: 12 single completion
- Earliest measurement date: January 15, 2008
- Longest period of record: 11 years
- Median period of record: 11 years

Table 7-2 provides additional information regarding the City's groundwater level monitoring wells.

Table 7-2. City of San Diego Groundwater Level Monitoring Wells

SPV GSP Well Number	City Well Name	Monitoring Entity	Period of Record	Well Depth (feet bgs)	Reported to CASGEM Program
SPV GSP-40	SP089	City Public Utilities Department	2008–2018	190	No
SPV GSP-19	SP110	City Public Utilities Department	2008–2018	120	No
SPV GSP-70	SP058	City Public Utilities Department	2008–2018	Unknown	No
SPV GSP-43	SP086	City Public Utilities Department	2008–2018	Unknown	No
SPV GSP-36	SP093	City Public Utilities Department	2008–2018	Unknown	No
SPV GSP-29	SP100	City Public Utilities Department	2008–2018	Unknown	No
SPV GSP-23	SP106	City Public Utilities Department	2008–2018	Unknown	No
SPV GSP-22	SP107	City Public Utilities Department	2008–2019	43	Yes
SPV GSP-58	SP071	City Public Utilities Department	2008–2018	Unknown	No
SPV GSP-56	SP073	City Public Utilities Department	2008–2019	192	Yes
SPV GSP-59	SP070	City Public Utilities Department	2008–2018	Unknown	No
SPV GSP-57	SP072	City Public Utilities Department	2008–2013	70	No
SPV GSP-015	SP014	City Public Utilities Department	2011-2019	43	Yes
N/A	SP128(S) SP128(M) SP128(D)	City Public Utilities Department	Installed 02/2020	165 200 300	No
N/A	SP129(S) SP129(D)	City Public Utilities Department	Installed 02/2020	105 215	No

Note:
bgs = below ground surface



Project #: 0011197

Legend

- San Pasqual Valley Basin
- City of San Diego Groundwater Level Monitoring Wells
- City of San Diego Groundwater Quality Monitoring Wells
- City of San Diego Groundwater Level and Quality Monitoring Well

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Figure 7-4

San Pasqual Valley GSP

Wells with Monitoring Data Provided by the City of San Diego

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Private Landowners

A private landowner in Rockwood Canyon provided information for three wells that are monitored for groundwater levels. These data have been incorporated into the GSA's DMS. The locations of these wells are shown on Figure 7-5. A summary of the information available for these monitoring wells is listed below.

- Total number of monitoring wells operated by private landowner: Three
- Composition: Single completion wells
- Earliest measurement date: September 28, 2015
- Longest period of record: 4 years
- Median period of record: 4 years

Table 7-3 provides additional information regarding the private landowner monitoring wells.

Table 7-3. Private Landowner Groundwater Level Monitoring Wells

SPV GSP Well Number	City Well Name	Monitoring Entity	Period of Record	Well Depth (feet bgs)
SPV GSP-198	Rockwood MW-2	Private Landowner	2015–2019	200
SPV GSP-205	Rockwood MW-3	Private Landowner	2015–2019	150
SPV GSP-212	Rockwood MW-1	Private Landowner	2015–2019	150

Note:
bgs = below ground surface

7.3.2 Overlapping and Duplicative Data

Some of the data used to compile and create the Basin database contained duplicate entries for wells, metadata, groundwater level measurements, and groundwater quality measurements. Duplicative entries were removed by comparing specific information fields from each data source such as state well number, master identifier codes, USGS identification names, and local names. Analysts identified duplicates and removed or combined entries for partial duplicates. After duplicates were removed, analysts assigned each unique well an identifier code that served as its primary identification number for all other processes and mapping exercises.

7.3.3 Groundwater Quality Monitoring

This section discusses existing groundwater quality monitoring programs in the Basin.

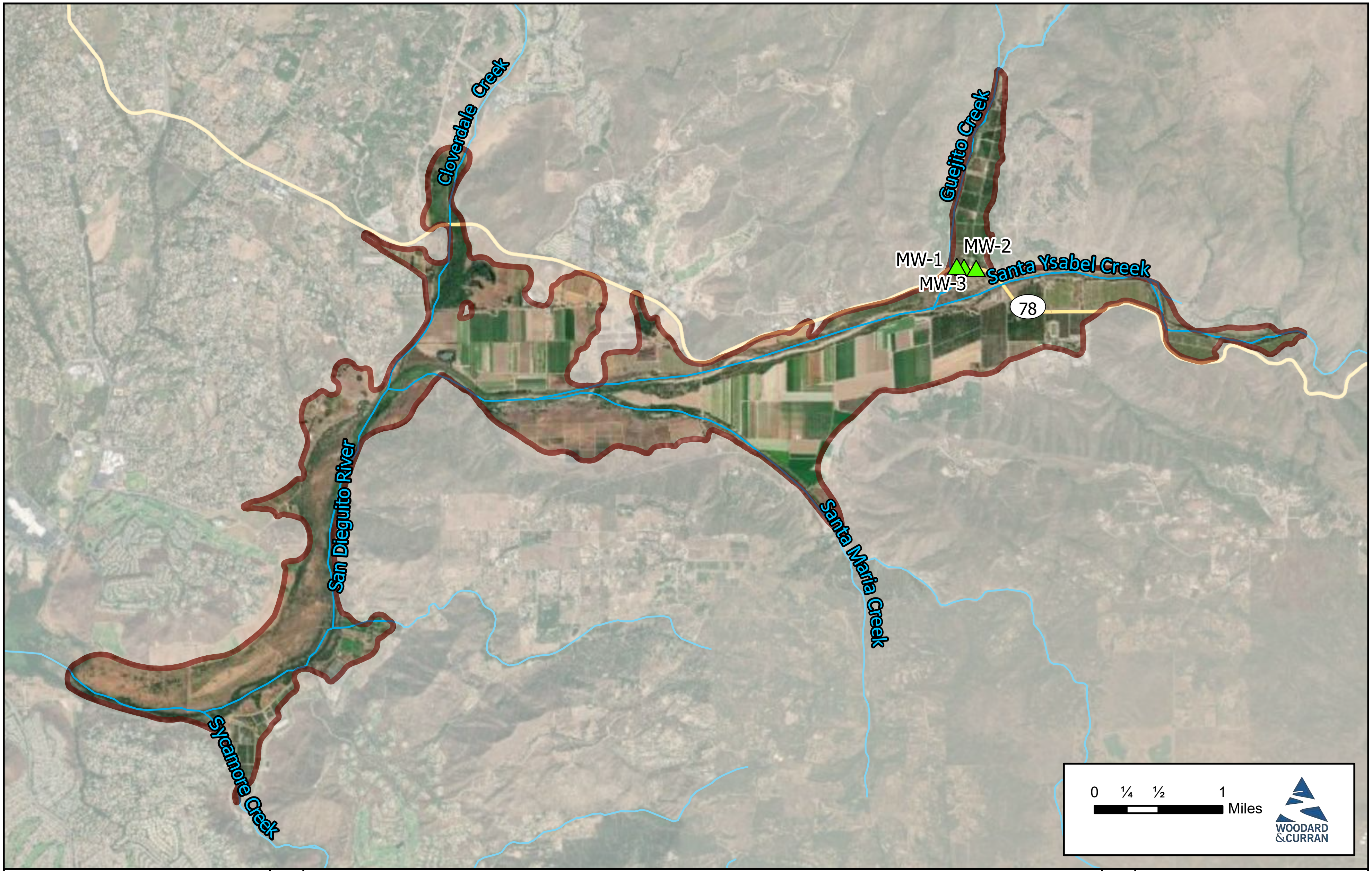
National Water Quality Monitoring Council

The National Water Quality Monitoring Council (NWQMC) was created in 1997 to provide a collaborative, comparable, and cost-effective approach for monitoring and assessing water quality in the United States. Several organizations have contributed to the database, including the Advisory Committee on Water Information, the U.S. Department of Agriculture (USDA) Agricultural Research Service, the U.S. Environmental Protection Agency (EPA), and USGS (NWQMC, 2021).

A single online portal provides access to data from the contributing agencies. Data are included from the USGS NWIS, the EPA Storage and Retrieval Data Warehouse, and USDA's Agricultural Research Program, Sustaining the Earth's Watersheds—Agricultural Research Database System. Water quality data for the Basin was downloaded through NWQMC and included data associated with USGS monitoring. The NWQMC database also provides TDS data for four water quality monitoring sites. Summary information regarding the NWQMC monitoring is listed below.

- Total number of NWQMC measurement sites: Six
- Composition: Three nested well locations with three wells each
- Earliest measurement date year: 2010
- Longest period of record: 10 years
- Median period of record: 7 years

The water quality monitoring sites included in the NWQMC database are the three USGS sites that were discussed in the previous section.



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Project #: 0011197

Legend

San Pasqual Valley Basin

Private Monitoring Wells

N

Figure 7-5

San Pasqual Valley GSP

Wells with Monitoring Data Provided by Private Landowners

City of San Diego

The City conducts groundwater sampling for water quality at 11 locations throughout the Basin (Figure 7-4). Water samples are collected at these wells semi-annually. The City had been analyzing samples for approximately 140 different water quality constituents including TDS, nitrates, fluoride, phosphates, sulfate, various metals, and additional analytes. Summary information regarding the City's groundwater quality monitoring program is provided below.

- Number of sampling sites: 11
- Composition: Single completion wells
- Earliest measurement date year: 1957
- Longest period of record: 57 years
- Median period of record: 12 years

Table 7-4 provides additional information regarding the City's groundwater quality monitoring wells.

Table 7-4. City of San Diego Groundwater Quality Monitoring Wells

SPV GSP Well Number	City Well Name	Monitoring Entity	Period of Record	Well Depth (feet bgs)
SPV GSP-127	SP001	City Public Utilities Department	1991-2018	120
SPV GSP-125	SP003	City Public Utilities Department	1991-2018	106
SPV GSP-122	SP006	City Public Utilities Department	1991-2018	Unknown
SPV GSP-120	SP008	City Public Utilities Department	1992-2018	200
SPV GSP-118	SP010	City Public Utilities Department	2000-2019	Unknown
SPV GSP-91	SP036	City Public Utilities Department	1957-2014	Unknown
SPV GSP-85	SP043	City Public Utilities Department	1991-2018	100
SPV GSP-67	SP061	City Public Utilities Department	1991-2018	Unknown
SPV GSP-64	SP065	City Public Utilities Department	1991-2018	80
SPV GSP-46	SP083	City Public Utilities Department	1999-2003	Unknown
SPV GSP-40	SP089	City Public Utilities Department	1991-2018	190
Note: bgs = below ground surface				

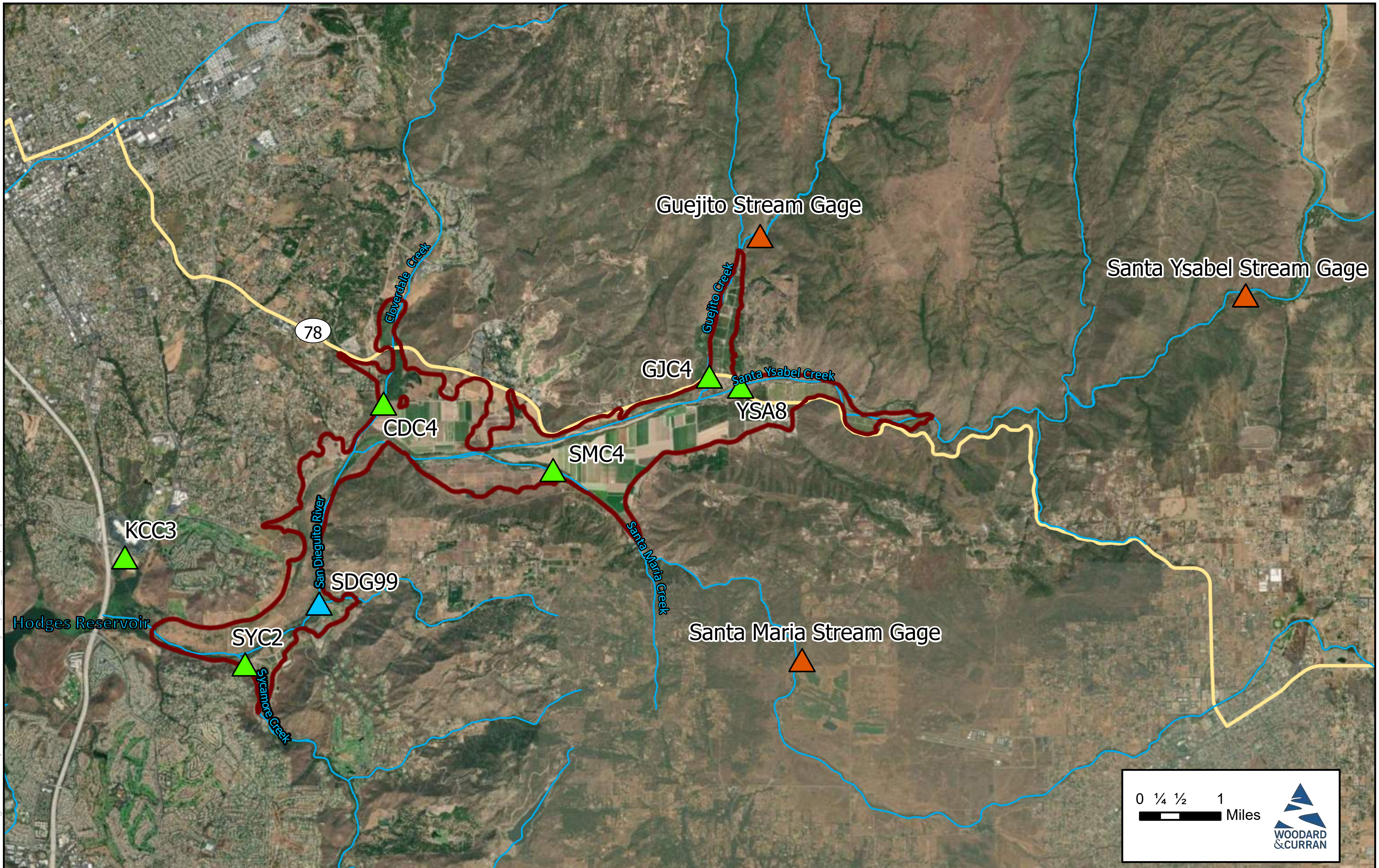
7.3.4 Surface Water Monitoring

City of San Diego Surface Water Flow Monitoring

Streamflow monitoring is conducted at stream flow gages. The City contracts with USGS to measure streamflow at three different stream gages in the Basin's watershed upstream of the Basin. These gages are located along Guejito Creek (11027000) just north of Rockwood Canyon, Santa Ysabel Creek (11025500) east of the Basin, and Santa Maria Creek (11028500) south of the Basin. The Basin itself does not have continuous stream gages along its creeks, but the City has recently installed new streamflow gages within the Basin that the City monitors during wet-weather flow. In addition, Hodges Reservoir is located just west of the Basin. Hodges Reservoir is operated and monitored by the City for lake levels, and those levels are reported to the California Environmental Data Exchange Network. Table 7-5 shows the location of the stream gages and Hodges Reservoir. Additional information regarding the stream gages is provided in Table 7-5.

Table 7-5. Active Streamflow Gages

Gage	Monitoring Agency	Location	Within Basin	Years of Record
11028500	USGS	Santa Maria Creek, south of the Basin	No	1912–2020
11025500	USGS	Santa Ysabel Creek, near Ramona	No	1912–2019
11027000	USGS	Guejito Creek, immediately north of Basin	No	1947–2020
SYC2	City of San Diego	Sycamore Creek	Yes	Installed in 2020
SDG99	City of San Diego	San Dieguito River, between confluences of Cloverdale and Sycamore Creeks	Yes	Installed in 2020
CDC4	City of San Diego	Guejito Creek, immediately upstream from the confluence with Santa Ysabel Creek	Yes	Installed in 2020
GJC4	City of San Diego	Cloverdale Creek, immediately upstream from the confluence with San Dieguito River	Yes	Installed in 2020
KCC3	City of San Diego	Kit Carson Creek (downstream of the basin)	No	Installed in 2020



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Project #: 0011197

Legend

- San Pasqual Valley Basin
- City of San Diego Stream Gage or Surface Water Quality Station
- Active USGS Stream Gage Station
- City of San Diego Stream Gage Station

N

Figure 7-6

San Pasqual Valley GSP

Stream Gages and Surface Water Quality Stations

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City of San Diego Surface Water Quality Monitoring

In addition to streamflow monitoring, City personnel have monitored surface water quality on a semi-annual basis at stations on Santa Maria, Santa Ysabel, Cloverdale, Guejito, Sycamore, and Kit Carson Creeks. Water quality data collected include information about temperature, dissolved oxygen, pH, electrical conductivity, and oxidation-reduction potential. Currently, PUD completes grab sample collections during storm water events and monthly during non-storm water conditions. Figure 7-6 shows the locations of the six surface water quality stations (five of which are in the Basin, and one is downstream of the Basin). Information regarding these sampling locations is provided in Table 7-6.

Table 7-6. City of San Diego Surface Water Quality Stations

Station	Location	Within Basin	Status	Period of Record
SMC4	Santa Maria Creek, immediately upstream from the confluence with Santa Ysabel Creek	Yes	Active	2006–2020
YSA8	Santa Ysabel Creek, east side of the Basin	Yes	Active	2010–2020
CDC4	Cloverdale Creek, immediately upstream from the confluence with San Dieguito River	Yes	Active	2006–2020
GJC4	Guejito Creek, immediately upstream from the confluence with Santa Ysabel Creek	Yes	Active	2006–2020
SYC2	Sycamore Creek	Yes	Active	2006–2020
KCC3	Kit Carson Creek (downstream of the basin)	No	Active	2006–2020

7.4 Operational Flexibility of Integrating Existing Monitoring Programs

Existing monitoring and management programs do not limit operational flexibility in the Basin because they are guidance programs.

7.5 Monitoring Rationales

This section describes the rationale for selecting sites for the monitoring network. Monitoring networks in the Basin were developed to enable assessment of changes in Basin conditions so the GSA can manage the Basin during GSP implementation, meet its the sustainability goal, and prevent undesirable results.

The monitoring networks and monitoring frequencies were selected to detect short-term, seasonal, and long-term trends in groundwater levels and storage with a temporal frequency and spatial density that is needed to evaluate both project effectiveness and the effectiveness of any management actions undertaken by the GSA.

Section 9, *Projects and Management Actions,* describes how the GSA will undertake monitoring as part of GSP implementation. The schedule and costs associated with GSP implementation are also discussed in Section 9.

7.6 Groundwater Level Monitoring Network

This section provides information about management areas, the criteria for selecting representative wells, monitoring frequency, spatial density, and summary protocols.

7.6.1 Management Areas

The Basin has been separated into two management areas based on City and County jurisdiction, as discussed in Section 2, *Plan Area*. These areas correspond to lands within the City and those that lie only within the unincorporated County. Although there are two jurisdictional management areas, a single groundwater level monitoring network will be used for the entire Basin.

7.6.2 Monitoring Frequency

This section describes the monitoring frequency and schedule for the representative monitoring network for groundwater levels. This GSP's groundwater levels monitoring network follows guidance published by DWR in its *Best Management Practices for the Sustainable Management of Groundwater—Monitoring Networks and Identification of Data Gaps* (Monitoring Networks BMP) (DWR, 2016). This document provides guidance about monitoring frequency based on the discussion presented in *National Framework for Groundwater Monitoring in the United States* (Advisory Committee on Water Information, 2013). This analysis and discussion suggest a monitoring frequency that is based on aquifer properties and degree of use.

DWR's guidance recommends that initial characterization of monitoring locations use frequent measurements to establish the dynamic range at each monitoring site and to identify external stresses affecting groundwater levels. According to this guidance, an understanding of these conditions based on professional judgment should be reached before more typical monitoring frequencies are implemented.

As described in Section 5.4.1, the Basin received an average of 14.57 inches of rainfall per year groundwater recharge from precipitation is likely low. Groundwater recharge from precipitation and applied water for WYs 2005 through 2019 averaged approximately 3,050 AFY (see the summary rows at the end of Attachment 5 in Appendix I). With a Basin area of about 3,500 acres, the areal groundwater recharge from precipitation and applied water would therefore have been approximately 10.5 inches per year on average. The SPV GSP Model does not separate out the groundwater recharge from precipitation as a separate term, but given the low annual rainfall of 14.57 inches, the groundwater recharge from applied water is likely responsible for most of the 10.5 inches per year of groundwater recharge. Groundwater recharge from precipitation alone is likely low. According to the guidelines shown in Table 7-7, and as provided by DWR Monitoring Networks BMP, the Basin's groundwater levels monitoring frequency should be quarterly, based on low groundwater recharge from precipitation for the unconfined aquifer. The monitoring network should be monitored simultaneously to gain a snapshot of groundwater conditions at each measurement across the Basin. As simultaneous measurements are not physically possible, monitoring of the level network should be conducted within the span of one week for each measurement period (DWR, 2016).

Table 7-7. Monitoring Frequency for Groundwater Level Monitoring Based on Aquifer Properties and Degree of Use

Aquifer Type	Nearby Long-term Aquifer Withdrawals		
	Small Withdrawals	Moderate Withdrawals	Large Withdrawals
Unconfined Aquifer			
Low recharge (<5 inches/year)	Quarterly	Quarterly	Monthly
High recharge (>5 inches/year)	Quarterly	Monthly	Daily
Confined Aquifer			
Low hydraulic conductivity (<200 feet/year)	Quarterly	Quarterly	Monthly
High hydraulic conductivity (>200 feet/year)	Quarterly	Monthly	Daily

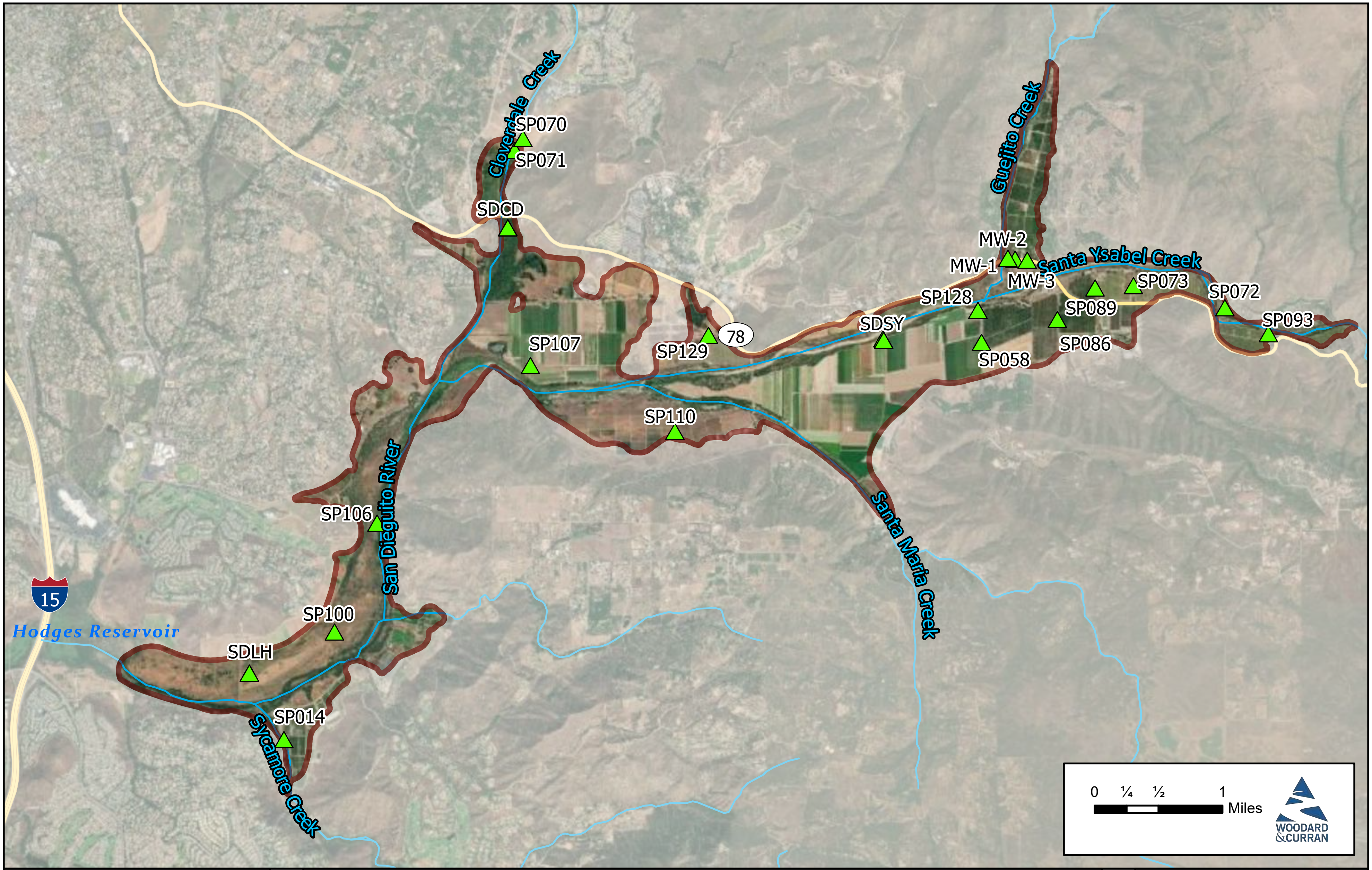
7.6.3 Spatial Density

Spatial density of the monitoring network was considered both during selection of the entire monitoring network and selection of representative wells. The goal of the groundwater level monitoring network is to provide adequate coverage across the entire Basin aquifer. Adequate coverage allows the ability to monitor and identify groundwater changes across the Basin over time. Consideration of monitoring well locations included proximity to other monitoring wells, and ensured adequate coverage near the other prominent features such as faults or production wells. In the Basin, monitoring wells in close proximity to active pumping wells could be influenced by groundwater withdrawals, which could skew groundwater level interpretations.

DWR's Monitoring Networks BMP (DWR, 2016) provides guidance about monitoring well density by citing a variety of sources and condition-dependent densities to guide monitoring network implementation. These recommended monitoring well densities range from 4 to 10 monitoring wells per 100 square miles. While these estimates may provide guidance for monitoring well spatial densities in a larger basin, this guidance does not apply in the SPV Basin, which is a relatively small, alluvium-filled valley with an aerial extent of about 5.5 square miles. Therefore, monitoring well selection was primarily influenced by local geology, groundwater use, sustainability criteria, and professional judgment.

7.6.4 Monitoring Network for Groundwater Levels

The SPV GSP's monitoring network for groundwater levels includes City, USGS, and private landowner wells. A total of 21 monitoring wells with a combined 31 well completions will be monitored. Figure 7-7 shows the well locations. The monitoring network provides adequate coverage of the principal aquifer in the Basin and will be useful for determining flow directions and hydraulic gradients, as well as changes in groundwater storage. Table 7-9 summarizes available well construction information and groundwater level data for the monitoring network. The proposed monitoring frequency is quarterly (Section 7.6.2). This monitoring frequency will capture short-term, seasonal, and long-term trends in groundwater levels. This network will continue to be monitored by current monitoring entities, and data collected from this network will be used to improve understanding of Basin conditions during GSP implementation.



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Legend

San Pasqual Valley Basin

Groundwater Levels Monitoring Network

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Figure 7-7

San Pasqual Valley GSP

Groundwater Levels Monitoring Network

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7.6.5 Representative Monitoring Network for Groundwater Levels

The representative monitoring network wells serve to represent groundwater level conditions in the Basin and are set in locations that allow monitoring to indicate long-term, Basin changes. Representative monitoring wells also have sustainable management criteria assigned to them. Representative groundwater level sites in the Basin were selected using several criteria, including the following:

- **Adequate Spatial Distribution**—Representative monitoring network for groundwater levels does not require the use of all wells that are spatially grouped together in a portion of the Basin. Inclusion of tightly grouped wells as representative monitoring wells would result in collection of redundant data. Adequately spaced wells will provide greater Basin coverage with fewer monitoring sites.
- **Robust and Extensive Historical Data**—Representative monitoring network sites for groundwater levels with longer and more robust collections of historical data provide insight into long-term trends; these trends can provide information about groundwater conditions through varying climatic periods, such as droughts and wet periods. Historical data may also show changes in groundwater conditions from anthropogenic activities. While some sites chosen for the network may not have extensive historical data, they may still be selected because there are no other wells nearby with longer data records.
- **Professional Judgment**—Professional judgment is employed to make a final decision about each monitoring well, particularly when more than one suitable well exists in an area of interest.

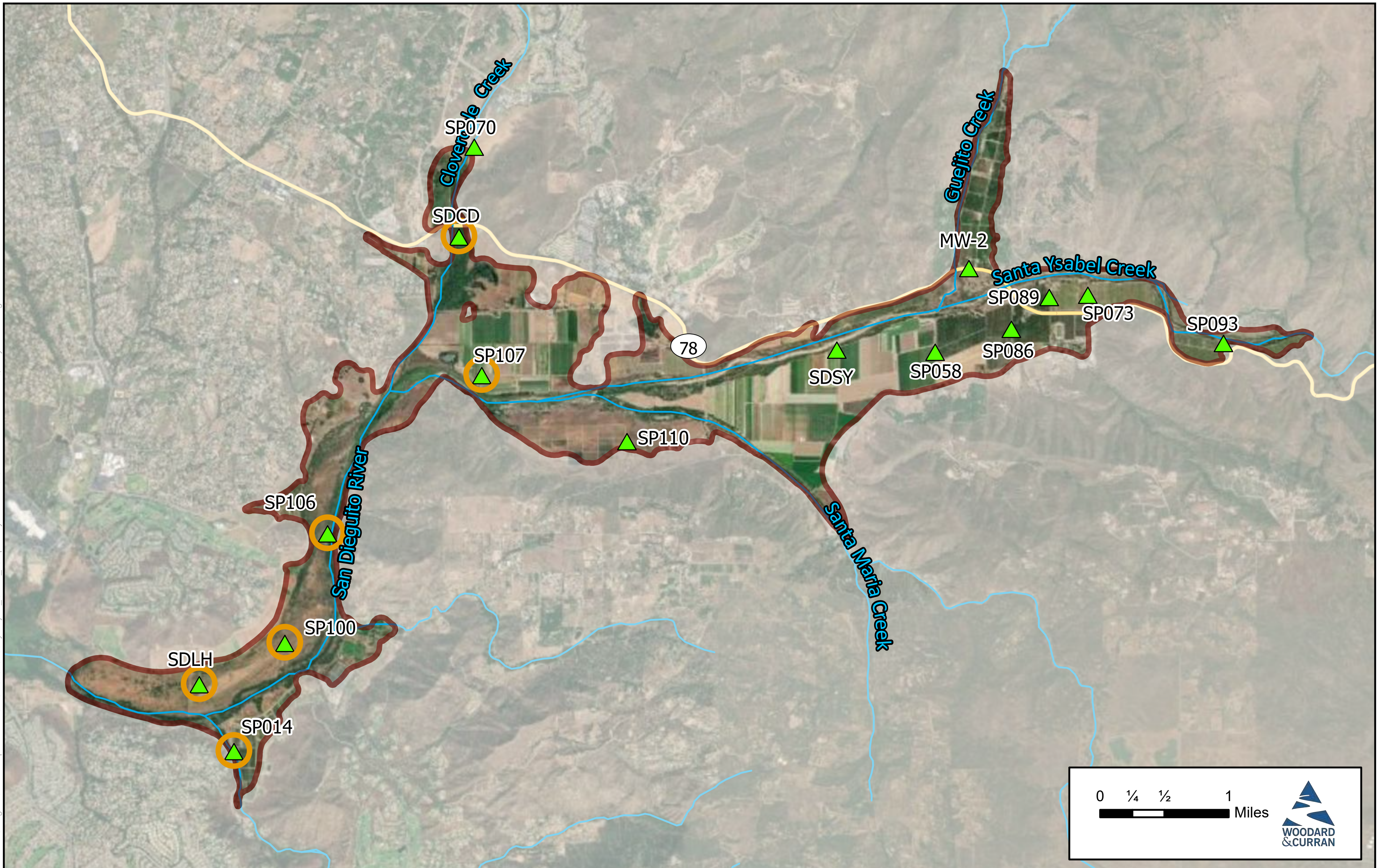
Of the available 31 monitoring well completions in the GSP's monitoring network, 15 wells were selected to make up the GSP's representative network for groundwater levels. Figure 7-8 shows the GSP's representative monitoring network well locations for groundwater levels and interconnected surface waters (described in Section 7.11, *Depletions of Interconnected Surface Waters*). Section 8.2, *Chronic Lowering of Groundwater Levels* explains the thresholds the SPV GSA will use to evaluate monitoring data from the representative network wells. Table 7-8 identifies the wells that will be used for representative monitoring and provides information regarding their construction details.

7.6.6 Monitoring Protocols

The GSA will use the *Best Management Practices for the Sustainable Management of Groundwater—Monitoring Protocols, Standards, and Sites* (Monitoring Protocols BMP) (Appendix M) for monitoring protocols.

7.6.7 Data Gaps

The SPV monitoring network exceeds density requirements outlined in DWR's Monitoring Networks BMP (DWR, 2016) for monitoring protocols and has sufficient historical data. The SPV GSA has not identified any data gaps that would affect its ability to achieve the sustainability goal for the Basin.



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Project #: 0011197

Legend

- San Pasqual Valley Basin
- Groundwater Levels Representative Network Wells
- Depletion of Interconnected Surface Waters Representative Network Wells

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Figure 7-8

San Pasqual Valley GSP

Groundwater Levels Representative Monitoring Network

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Table 7-8. Representative Monitoring Network and Other Wells for Groundwater Levels

SPV GSP Well Name	Representative Well	State Well Number	USGS Site Code	City Well Name	Well Construction Year	Well Depth (feet bgs)	Screen Interval (feet bgs)	Well Elevation (feet NAVD88)	First Measurement Date	Last Measurement Date	Measurement Period (Years)	Measurement Count
Representative Monitoring Network for Groundwater Levels												
SPV GSP-19	Yes	13S001W04D	-	SP110	Unknown	120	Unknown	375.3	1/15/2008	12/15/2018	10	110
SPV GSP-22	Yes	-	-	SP107	Unknown	43	Unknown	357.8	1/15/2008	4/22/2019	11	125
SPV GSP-23	Yes	-	-	SP106	Unknown	Unknown	Unknown	335.9	1/15/2008	12/15/2018	10	105
SPV GSP-29	Yes	-	-	SP100	Unknown	Unknown	Unknown	327.3	1/15/2008	12/15/2018	10	112
SPV GSP-36	Yes	-	-	SP093	Unknown	Unknown	Unknown	468.2	1/15/2008	12/15/2018	10	64
SPV GSP-40	Yes	12S001W35B001S	-	SP089	1984	190	60–183	438.7	1/15/2008	12/15/2018	10	107
SPV GSP-43	Yes	-	-	SP086	Unknown	Unknown	Unknown	431.4	1/15/2008	12/15/2018	10	109
SPV GSP-56	Yes	-	-	SP073	Unknown	192	Unknown	446.0	1/15/2008	4/22/2019	11	115
SPV GSP-59	Yes	-	-	SP070	1991	190	Unknown	381.5	1/15/2008	12/15/2018	10	109
SPV GSP-70	Yes	-	-	SP058	1991	190	80–100, 120–189	415.5	1/15/2008	10/15/2018	10	72
SPV GSP-155	Yes	12S001W34L003S	330514116582902	SDSY	2010	340	190–210	401.4	1/4/2011	10/14/2019	8	3,040
SPV GSP-168	Yes	12S001W30J004S	330555117010102	SDCD	2013	130	110–130	362.1	3/13/2013	10/10/2019	6	2,206
SPV GSP-131	Yes	13S002W12M003S	330320117024703	SDLH	2012	280	30–50	321.8	2/13/2013	10/15/2019	6	2,421
SPV GSP-114	Yes	-	-	SP014	Unknown	43	Unknown	330.0	12/21/2011	4/22/2019	8	16
SPV GSP-198	Yes	-	-	Rockwood MW-2	2014	200	40–180	424.6	9/28/2015	10/2/2019	4	1,444
Other Monitoring Wells for Groundwater Levels in the Basin												
SPV GSP-57	No	-	-	SP072	Unknown	70	Unknown	458.1	1/15/2008	9/15/2013	5	59
SPV GSP-58	No	-	-	SP071	Unknown	Unknown	Unknown	374.4	1/15/2008	12/15/2018	10	109
N/A	No	-	-	SP128(S) SP128 (M) SP128 (D)	2020	165 200 300	145-165 190-200 225-300	414.46 414.39 414.45	Recently Installed	-	-	-
N/A	No	-	-	SP129(S) SP129(D)	2020	105 215	95-105 130-215	382.69 382.67	Recently Installed	-	-	-
SPV GSP- 182	No	12S001W34L005S	330514116582801	SDSY	2010	60	50-60	398.3	1/4/2011	4/21/2020	9	42
SPV GSP-154	No	12S001W34L004S	330514116582903	SDSY	2010	90	70–90	401.2	12/28/2010	10/14/2019	9	3,081
SPV GSP-156	No	12S001W34L002S	330514116582901	SDSY	2010	340	280–340	401.4	1/6/2011	10/14/2019	8	3,004
SPV GSP-167	No	12S001W30J003S	330555117010101	SDCD	2013	270	190–270	362.1	3/13/2013	10/10/2019	6	2,199
SPV GSP-169	No	12S001W30J005S	330555117010103	SDCD	2013	50	?–50	362.1	3/13/2013	5/21/2019	6	2,064
SPV GSP-132	No	13S002W12M002S	330320117024702	SDLH	2012	280	?–110	321.8	2/15/2013	8/30/2018	5	2,004
SPV GSP-133	No	13S002W12M001S	330320117024701	SDLH	2012	280	?–270	321.8	2/13/2013	10/15/2019	6	2,384
SPV GSP-205	No	-	-	Rockwood MW-3	2014	150	50–130	426.2	9/28/2015	10/2/2019	4	1,326
SPV GSP-212	No	-	-	Rockwood MW-1	2014	150	50–130	425.3	9/28/2015	10/2/2019	4	1,444

Note:
bgs = below ground surface
NAVD88 = North American Vertical Datum of 1988

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7.6.8 Areas of Potential Improvement

The groundwater level monitoring network exceeds density requirements and will provide sufficient data for sustainably managing the Basin. However, there are areas in the Basin that are considered areas for potential improvement to refine the monitoring network. These areas have been identified either because of their relative isolation in the Basin, or because of their proximity to areas of potential surface water and groundwater interaction. Additional data from these areas may be helpful for future GSP implementation activities but are not considered data gaps since they do not limit the GSA's ability to sustainably manage the Basin. Areas of potential improvement for the groundwater level monitoring network are shown in Figure 7-9.

7.7 Groundwater Storage Monitoring Network

Groundwater storage is monitored by proxy through the measurement of groundwater levels. Therefore, representative wells used for groundwater levels will also be used to monitor groundwater storage. Thresholds for groundwater storage are discussed in Section 8, *Minimum Thresholds and Measurable Objectives*.

7.8 Seawater Intrusion Monitoring Network

The Basin is geographically isolated from the Pacific Ocean and any other large source of saline water. As a result, the Basin is not at risk for seawater intrusion. Salinity (i.e., TDS) is monitored as part of the groundwater quality network, but seawater intrusion is not a concern for the Basin.

7.9 Degraded Groundwater Quality Monitoring Network

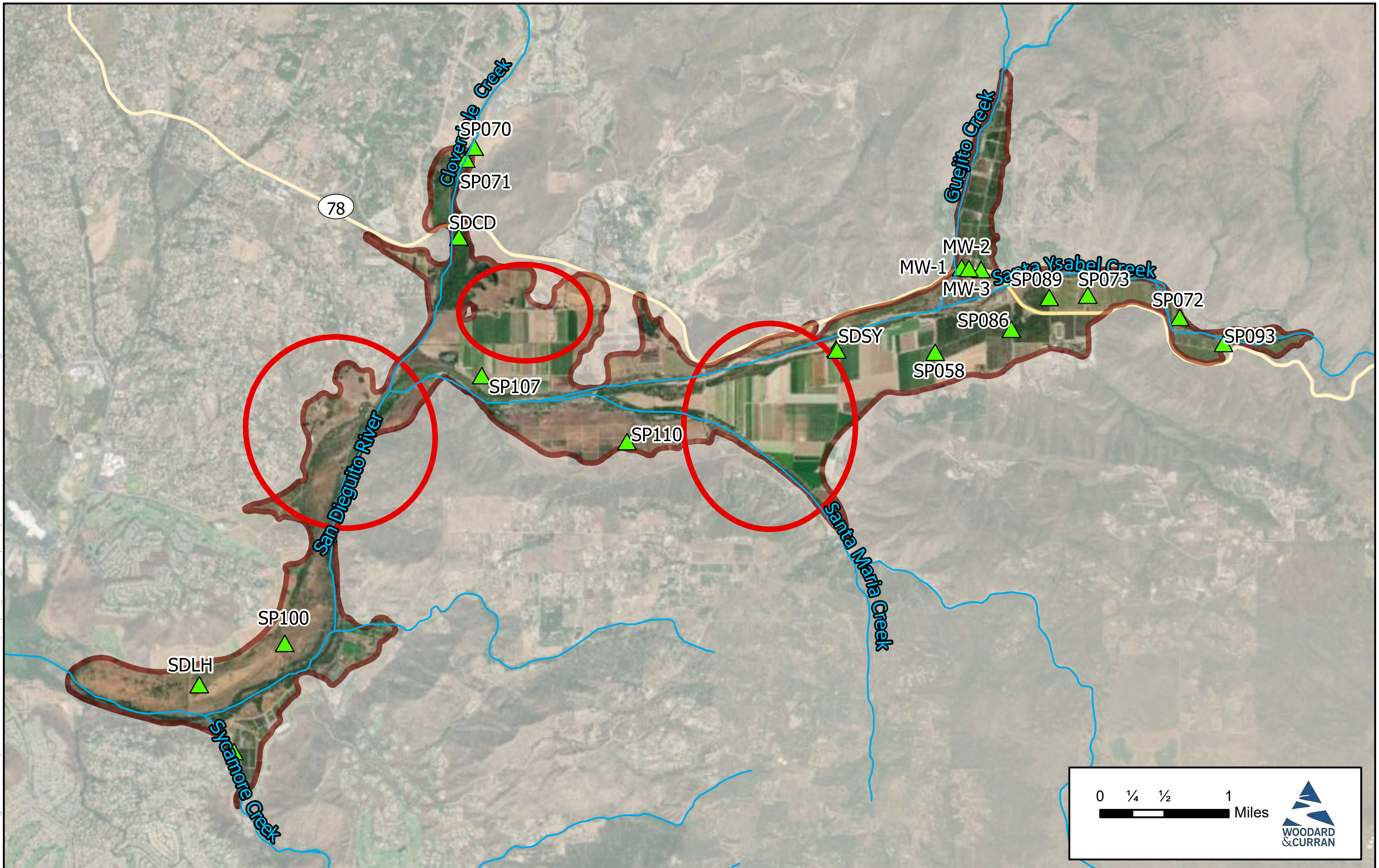
GSP implementation will include groundwater quality monitoring. This section describes the criteria for selecting representative wells for monitoring groundwater quality; monitoring frequency; spatial density; summary protocols; and identification strategies to fill data gaps, if any. After evaluating the historical presence of constituents in the Basin's groundwater (refer to Section 4, *Groundwater Conditions*), the SPV GSA has determined that TDS and nitrate are the two constituents that must be monitored to support sustainable management. Therefore, the monitoring network for groundwater quality will include sampling and analysis of TDS and nitrate.

7.9.1 Management Areas

The Basin has been separated into two management areas based on jurisdiction, as discussed in Section 2, *Plan Area*. These areas correspond to lands within the City and those that lie only within the unincorporated County. Although there are two jurisdictional management areas, a single groundwater quality monitoring network will be used for the entire Basin.

7.9.2 Monitoring Sites Selected for Monitoring Network

All 11 of the City's water quality wells were chosen to be included in the groundwater quality monitoring network (Figure 7-4). The wells are located throughout the Basin and provide adequate spatial coverage for groundwater quality monitoring. Table 7-4 provides available well construction information and period of record for the monitoring network. The water quality monitoring conducted by the USGS and DWR are conducted neither frequently nor consistently enough to be suitable for inclusion in the GSP monitoring network.



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Legend

- San Pasqual Valley Basin
- Areas of Potential Improvement
- Groundwater Levels Monitoring Network

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Figure 7-9

San Pasqual Valley GSP

Groundwater Levels Monitoring Network Areas of Potential Improvement

7.9.3 Monitoring Frequency

Although DWR does not provide specific recommendations on the frequency of monitoring in relationship to the described groundwater characteristics, the GSA and will conduct water quality sampling semi-annually. The GSA will analyze the samples for nitrate and TDS. The City will additionally analyze samples for the following water quality constituents: nitrite, turbidity, phosphate (ortho), bromide, iron, manganese, mercury, total organic carbon, pH, and bacteria.

7.9.4 Spatial Density

DWR's Monitoring Networks BMP (DWR, 2016) states "The spatial distribution must be adequate to map or supplement mapping of known contaminants." Using this guidance, professional judgment was used to identify representative wells in the Basin. The full monitoring network is comprised of 11 wells. However, Well SP083 has not been sampled since 2003 and has been eliminated from the representative monitoring network because of the lack of recent data. In addition, Wells SP061 and SP089, located west and east of SP083, respectively, provide adequate spatial coverage for groundwater quality monitoring in the eastern portion of the Basin (Figure 7-10).

7.9.5 Groundwater Quality Monitoring and Representative Monitoring Networks

The representative monitoring network for groundwater quality consists of 10 monitoring wells. Figure 7-10 shows their locations. Table 7-9 presents available well construction information and summarizes the water quality data available for the representative monitoring network.

7.9.6 Monitoring Protocols

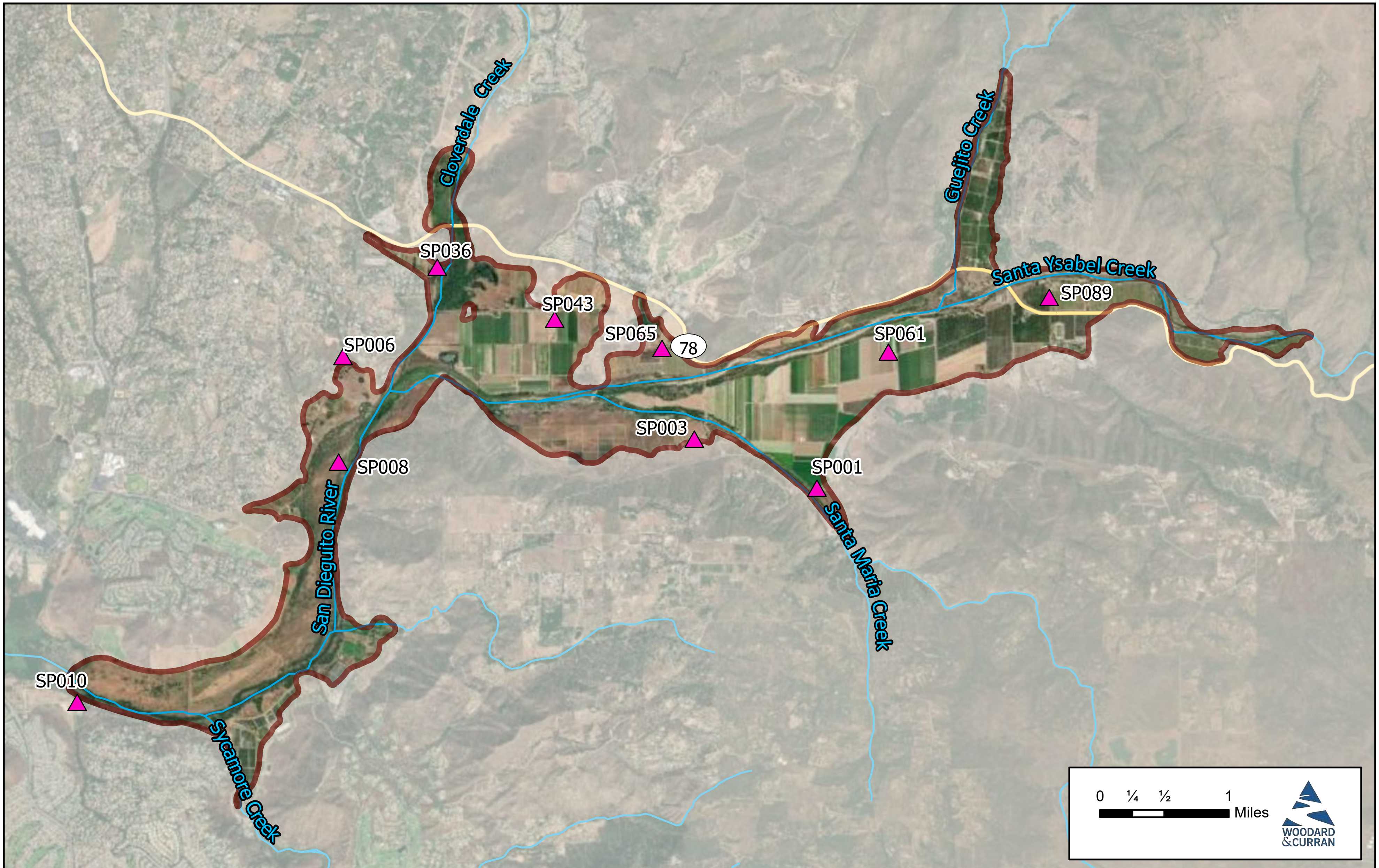
The GSA will use the monitoring protocols described in DWR's Monitoring Protocols BMP (Appendix M).

7.9.7 Data Gaps

The SPV groundwater quality monitoring network meets density requirements as outlined in DWR's Monitoring Networks BMP (DWR, 2016) for monitoring protocols and has sufficient historical data. The GSA has not identified any data gaps that would affect the ability to achieve the sustainability goal for the Basin.

7.9.8 Areas for Potential Improvement

The SPV groundwater quality monitoring network may need periodic updates and improvement as the sites that are monitored by the GSA change over time. One potential improvement could include replacing old wells in the existing network.



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San Pasqual Valley Basin

Groundwater Quality Monitoring Network

Figure 7-10

San Pasqual Valley GSP

Representative Monitoring Network Wells for Groundwater Quality

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** SanDAG/SanGIS.

Table 7-9. Representative Monitoring Network for Groundwater Quality

SPV GSP Well Name	Representative Well	State Well Number	City Well Name	Well Construction Year	Well Depth (feet)	Screen Interval	Well Elevation (feet NAVD88)	First Measurement Date	Last Measurement Date	Measurement Period (Years)	Measurement Count (Nitrate/TDS)
SPV GSP-127	Yes	-	SP001	Unknown	120	Unknown	401.7	11/18/1991	7/16/2018	27	71/76
SPV GSP-125	Yes	13S001W04C	SP003	Unknown	106	Unknown	383.0	11/18/1991	7/16/2018	27	64/70
SPV GSP-122	Yes	-	SP006	Unknown	Unknown	Unknown	393.8	12/10/1991	7/16/2018	27	59/66
SPV GSP-120	Yes	-	SP008	Unknown	200	Unknown	341.0	5/14/1992	7/16/2018	26	32/40
SPV GSP-118	Yes	-	SP010	Unknown	Unknown	Unknown	321.3	9/11/2000	7/16/2018	18	41/39
SPV GSP-91	Yes	12S001W30R001S	SP036	Unknown	Unknown	Unknown	365.3	3/26/1957	6/25/2014	57	70/67
SPV GSP-85	Yes	-	SP043	Unknown	100	Unknown	364.0	12/10/1991	7/16/2018	27	60/68
SPV GSP-67	Yes	12S001W34K003S	SP061	Unknown	Unknown	Unknown	407.2	11/18/1991	7/16/2018	27	65/69
SPV GSP-64	Yes	12S001W33M001S	SP065	Unknown	80	Unknown	379.8	12/10/1991	7/16/2018	27	63/66
SPV GSP-40	Yes	12S001W35B001S	SP089	Unknown	190	60-183	438.7	11/18/1991	7/16/2018	27	67/70

Note:
bgs = below ground surface
NAVD88 = North American Vertical Datum of 1988
TDS = Total dissolved solids

Table 7-10. Representative Monitoring Network for Depletion of Interconnected Surface Waters

SPV GSP Well Name	Representative Well	State Well Number	USGS Site Code	City Well Name	Well Construction Year	Well Depth (feet bgs)	Screen Interval (feet bgs)	Well Elevation (feet NAVD88)	First Measurement Date	Last Measurement Date	Measurement Period (Years)	Measurement Count
SPV GSP-22	Yes	-	-	SP107	Unknown	43	Unknown	357.8	1/15/2008	4/22/2019	11	125
SPV GSP-23	Yes	-	-	SP106	Unknown	Unknown	Unknown	335.9	1/15/2008	12/15/2018	10	105
SPV GSP-29	Yes	-	-	SP100	Unknown	Unknown	Unknown	327.3	1/15/2008	12/15/2018	10	112
SPV GSP-169	Yes	12S001W30J005S	330555117010103	SDCD	2013	50	?–50	362.1	3/13/2013	5/21/2019	6	2,064
SPV GSP-131	Yes	13S002W12M003S	330320117024703	SDLH	2013	280	30–50	321.8	2/13/2013	10/15/2019	6	2,421
SPV GSP-114	Yes	-	-	SP014	Unknown	43	Unknown	330.0	12/21/2011	4/22/2019	8	16

Note:
bgs = below ground surface
NAVD88 = North American Vertical Datum of 1988

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7.10 Land Subsidence Monitoring

As described in Section 6.3.5, *Land Subsidence*, the GSA has determined that subsidence has not caused undesirable results in the Basin and is not anticipated to cause undesirable results in the foreseeable future, including over the planning horizon of this GSP. Consequently, establishing minimum thresholds and measurable objectives and monitoring for these thresholds is not required for the Basin.

7.11 Depletions of Interconnected Surface Water Monitoring Network

The SGMA regulations (i.e., Title 23 CCR Section 354.28 (c)(6)) states that "The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following: (A) The location, quantity, and timing of depletions of interconnected surface water, and (B) A description of the groundwater and surface water model used to quantify surface water depletion."

These regulations require a numerical model to estimate the depletions of interconnected surface water from groundwater pumping. However, this is not a measured value and there is no functional way for a monitoring network to directly measure depletions of interconnected surface water from groundwater pumping.

Monitoring for depletions of interconnected surface water uses groundwater levels as a proxy for determining sustainability, as permitted by Title 23 CCR Section 354.36 (b). Additionally, there are currently no state, federal, or local standards that regulate depletions of interconnected surface water. Therefore, the GSA will use groundwater levels as a proxy metric for monitoring and for use in evaluating sustainable management criteria for depletions of interconnected surface water.

Table 7-10 (prior page) shows information about the representative monitoring wells in the depletion of interconnected surface waters monitoring network. These six wells, which are shown on Figure 7-8, are located within the portion of the Basin where the GSA has determined there are potential GDEs.

7.11.1 Data Gaps

There are no data gaps for this sustainability indicator because it is monitored by proxy.

7.11.2 Areas of Potential Improvement

Numerical model estimates of surface water depletions from groundwater pumping can benefit from additional stream gage data. Additional continuous stream flow monitoring inside the Basin would provide additional clarity about surface water depletions in the Basin, and the GSA may pursue installation of additional stream gages as is strategically viable.

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Section 8. MINIMUM THRESHOLDS AND MEASURABLE OBJECTIVES

This section provides the minimum thresholds, planning thresholds, measurable objectives for groundwater levels and groundwater quality for the Basin. Other sustainability indicators will be monitored by proxy using groundwater levels. Management areas, rationales, and justifications for the thresholds selected are also discussed.

8.1 Thresholds

This section describes the thresholds used to prevent undesirable results in the Basin described in Section 6, *Undesirable Results*.

8.1.1 Minimum Thresholds

A minimum threshold is defined in the SGMA regulations as a numeric value for each sustainability indicator used to define undesirable results (refer to Section 6, *Undesirable Results*). The SGMA regulations require a GSA to establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each representative monitoring site. If a GSA-defined percentage of those monitoring sites exceed the minimum threshold for a specified duration, then an undesirable result would be present.

8.1.2 Planning Threshold

A planning threshold is a non-regulatory threshold created by the SPV GSA for use during the implementation of this GSP. A planning threshold acts as an early warning system that allows the GSA to implement management actions and avoid minimum threshold exceedances.

8.1.3 Measurable Objective

A measurable objective is defined in the SGMA regulations as the specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted GSP to achieve a basin's sustainability goal. A measurable objective is used to help guide the GSA as it continues sustainable groundwater management over a GSP's planning and implementation horizon.

8.2 Chronic Lowering of Groundwater Levels

As described in Section 6, *Undesirable Results*, the undesirable result of chronic lowering of groundwater levels causes significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses throughout the planning and implementation horizon of this GSP.

As discussed in Section 4, *Groundwater Conditions*, groundwater conditions vary across the Basin. Changes in groundwater conditions are influenced by climatic cycles and overlying land uses.

8.2.1 Minimum Threshold

The minimum threshold for groundwater levels in the Basin was established to assess whether undesirable results are present during GSP implementation.

Undesirable results are prevented by setting a minimum threshold that has the following characteristics:

- Responsive to local well conditions
- Set above the Bulletin 118-defined bottom of the basin (Appendix D)
- Protective of at least 80 percent of nearby well infrastructure
- Protective of all known domestic wells in the eastern portion of the Basin

The minimum threshold for groundwater levels in representative wells in the Basin was calculated using a two-step determination process, as shown in Figure 8-1, and described below. Figure 8-2 shows the location of the wells in the representative monitoring network for groundwater levels and the locations of potential GDEs.

- If a representative well is within 2,000 feet of a potential GDE as described in Section 4, *Groundwater Conditions*, then the minimum threshold is calculated as 100 percent of the historical range of groundwater measurements below the historical minimum groundwater level. These representative wells are in the western portion of the Basin. The depth to groundwater in the western portion of the Basin is generally 30 feet or less and has tended to fluctuate over a smaller range than the depth to groundwater in the eastern portion of the Basin (see Section 4, *Groundwater Conditions*). The minimum thresholds of these wells in the western portion of the Basin reflect these smaller level fluctuation conditions. When used appropriately with the Planning Threshold (described in subsection 8.7), applying the full range of historical fluctuations to the historical lows allows for some operational flexibility while also establishing minimum thresholds that are protective of potential GDEs.

Or

- As illustrated in Figure 8-1, if a representative well is farther than 2,000 feet from a potential GDE as described in Section 4, *Groundwater Conditions* then the minimum threshold is calculated as 50 percent of the historical range of groundwater measurements below the historical minimum groundwater level. These representative wells are in the eastern portion of the Basin. The depth to groundwater in the eastern portion of the Basin is deeper and has historically fluctuated over a wider range than the GDEs in the west (see Section 4, *Groundwater Conditions*). Consequently, minimum thresholds are set deeper in the eastern part of the Basin. Applying half the range of the historical fluctuations to the historical lows allows for operational flexibility while establishing minimum thresholds that are protective of supply wells and basin storage.

Minimum thresholds that were calculated for each representative well were compared to estimates of the bottom of the Basin and to nearby well infrastructure. Minimum thresholds at all representative network sites were also compared to collected well completion reports for the square mile (as determined using the Public Land Survey System) near the monitoring sites. All minimum thresholds were set at levels that were at least 80 percent of nearby well depths to ensure local well infrastructure is protected. This approach allows for the possibility that some of the shallowest wells may be impacted if groundwater levels exceed the minimum thresholds. Table 8-1 includes the proposed thresholds for each representative monitoring well. Potential impacts to domestic wells were specifically evaluated when assigning thresholds. Minimum thresholds were set to ensure all known domestic wells within the eastern portion of Basin historically subject to the largest fluctuation of groundwater levels are protected (Table 8-2).

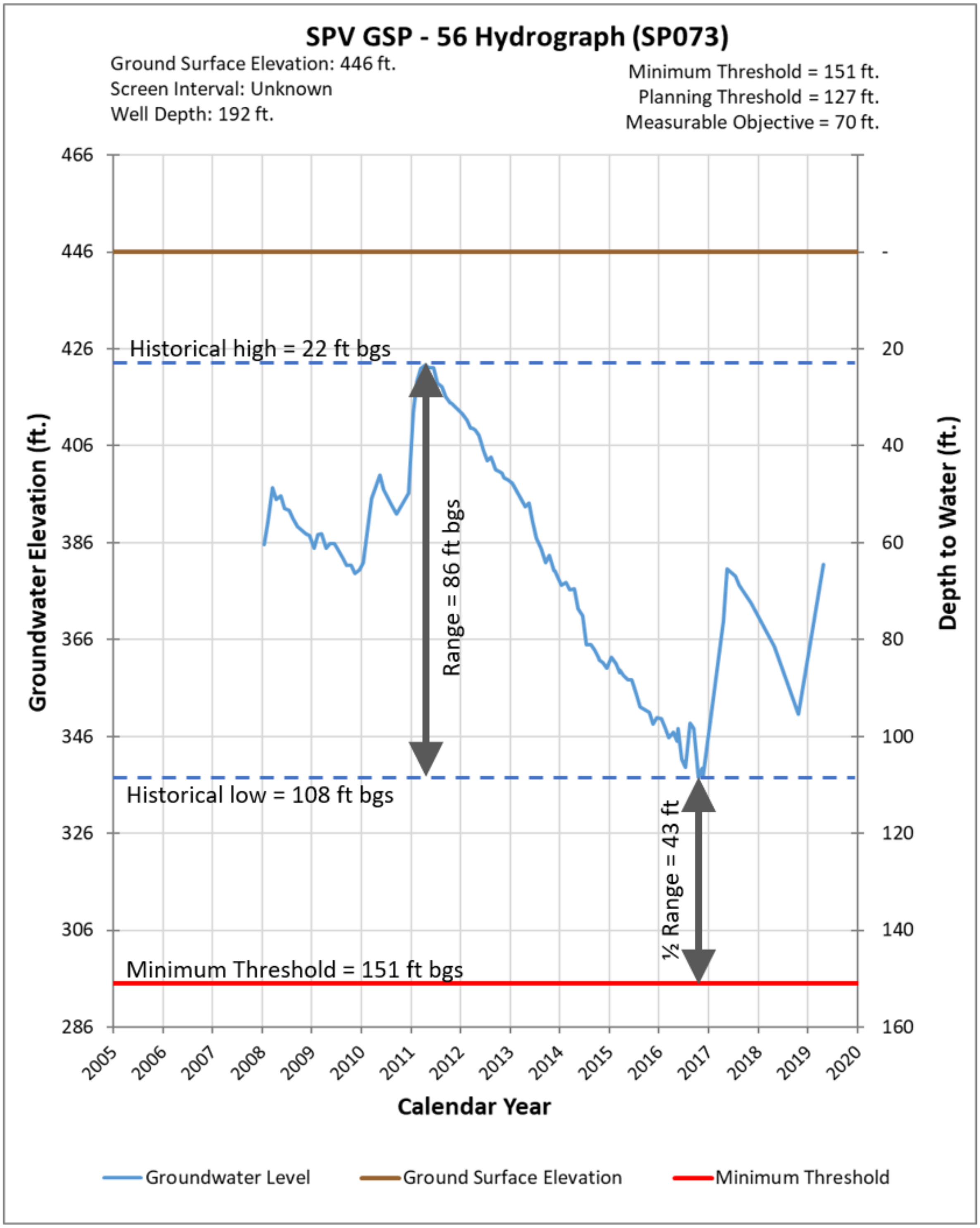
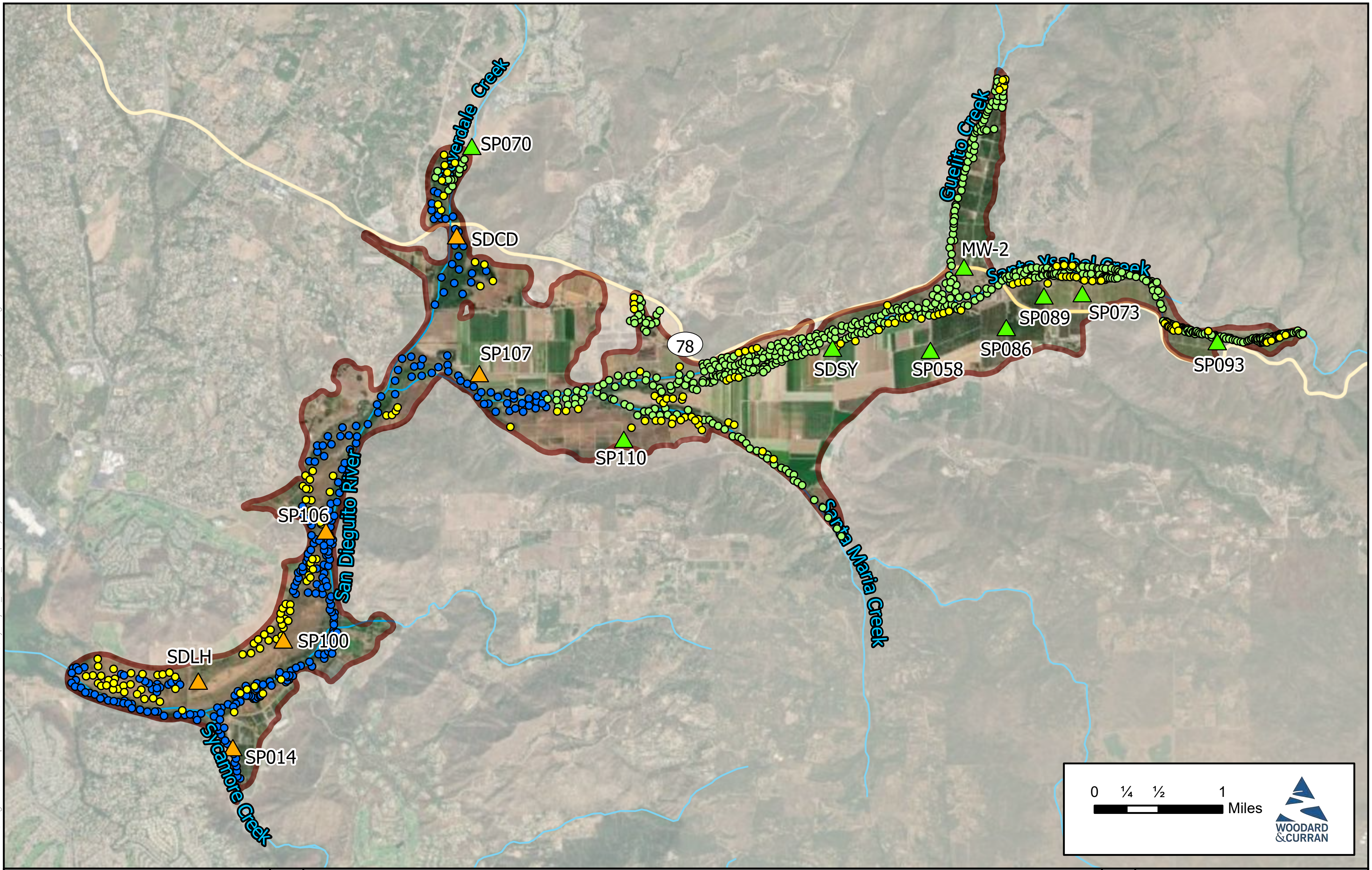


Figure 8-1. Basin Minimum Threshold Calculation



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- San Pasqual Valley Basin
- Groundwater Levels Representative Network Wells
- Groundwater Levels and Interconnected Surface Water Representative Network Wells
- Potential Non GDE
- Wetland and Riparian Vegetation
- Potential GDEs

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Figure 8-2

San Pasqual Valley GSP

Groundwater Levels Representative Monitoring Network

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Source:** SanDAG/SanGIS.

Table 8-1. Sustainable Management Criteria for Groundwater Levels

City Well Name	SPV GSP Well Number	Near GDE?	Minimum Threshold (feet bgs)	Planning Threshold (feet bgs)	Measurable Objective (feet bgs)	GSE (feet)
SP110	SPV GSP–19	No	60	51	30	375.3
SP107	SPV GSP–22	Yes	61	32	10	357.8
SP106	SPV GSP–23	Yes	32	17	10	335.9
SP100	SPV GSP–29	Yes	39	20	10	327.3
SP093	SPV GSP–36	No	100	75	15	468.2
SP089	SPV GSP–40	No	150	131	85	438.7
SP086	SPV GSP–43	No	99	84	51	431.4
SP073	SPV GSP–56	No	151	127	70	446
SP070	SPV GSP–59	No	38	19	10	381.5
SP058	SPV GSP–70	No	135	122	93	415.5
SDSY 330514116582902	SPV GSP–155	No	124	108	68	401.4
SDCD 330555117010102	SPV GSP–168	Yes	37	21	10	362.1
SDLH 330320117024703	SPV GSP–131	Yes	34	18	10	321.8
SP014	SPV GSP–114	Yes	35	20	10	330
Rockwood MW-2	SPV GSP–198	No	124	98	36	424.6

Notes
bgs = below ground surface
GSA = groundwater sustainability agency
GSE = ground surface elevation, datum is NAVD88
GDE = groundwater dependent ecosystem

Well construction details for all representative wells are not known; if groundwater levels fall below the depths of the representative monitoring wells during GSP implementation, the GSA may install replacement wells at these locations.

Table 8-2. Comparison of Domestic Production Well Depths in the Eastern Portion of Basin to Minimum Thresholds

Assessor's Parcel Number	Address	Well Use	Well Depth (feet bgs)	Nearest Representative Monitoring Well	Minimum Threshold (feet bgs)	Planning Threshold (feet bgs)	Measurable Objective (feet bgs)
242-110-13-00	17141 San Pasqual Valley Rd	Domestic - Single Family Residence	200	Rockwood-MW2	124	98	36
242-110-10-00	17331 San Pasqual Valley Rd	Domestic - Single Family Residence	410				
242-070-07-00	17224 San Pasqual Valley Rd	Domestic - Single Family Residence	549				
242-131-06-00	17701 San Pasqual Valley Rd	Community - San Pasqual Academy	180 232	SP073	151	127	70
242-131-08-00	18117, 18123, 18125, & 18165 Bandy Canyon Rd	Domestic - Single Family Residences	unknown	SP086	99	84	51

Notes
bgs = below ground surface

8.2.2 Planning Threshold

The planning threshold was established for groundwater levels considering the following:

- Shallower than minimum thresholds and deeper than measurable objectives
- Closer to minimum threshold than measurable objective
- Responsive to local well conditions
- Provides an estimated 18 months to plan prior to reaching minimum threshold during drought conditions

The planning threshold for representative wells in the Basin was calculated using the same method for all wells. The calculation used 30 percent of a 5-year drought decline as described below in Section 8.2.3, *Measurable Objective.* A 5-year drought is 60 months long; 0.3 multiplied by 60 is 18 months. This slope was projected above the minimum threshold to establish the planning threshold and gives the GSA 18 months to plan prior to reaching the minimum threshold.

As described in Section 6.3.6, *Depletions of Interconnected Surface Water*, the GSP proposes to use groundwater levels as a proxy for monitoring of interconnected surface water. Planning thresholds have also been established based on groundwater levels for interconnected surface water and potential GDEs. Those planning thresholds are presented in Section 8.7, *Depletions of Interconnected Surface Water.*

8.2.3 Measurable Objective

The measurable objective was established for groundwater levels considering the following:

- Objective set at a level appropriate for areas with potential GDEs, or
- For areas without potential GDEs, objective is representative of enough storage above the minimum threshold to provide 5 years of drought storage

The methodology used to set the measurable objective was selected using the two-step determination process described below:

- If the well is within 2,000 feet of a potential GDE as described in Section 4, *Groundwater Conditions* the measurable objective is set at 10 feet below ground surface. This depth is within the range of current and historical fluctuations in groundwater levels. Based on a review of historical groundwater level trends in each well, this provides more than a 5-year drought buffer.

Or

- If the well is farther than 2,000 feet from a potential GDE as described in Section 4, *Groundwater Conditions* a 5-year drought buffer was calculated by selecting a period representative of a drought decline between June 2011 and June 2016 and determining the slope of that decline over time for each representative network well. Some representative wells did not have a full 5-year period of record for the drought decline. This required extrapolating the slope of the decline to determine a full 5-year period. This second method allows for a 5-year margin of operational flexibility for drought storage in portions of the Basin with deeper groundwater levels.

Figure 8-3 shows an example of how the 5-year drought buffer was calculated for representative well SP073.

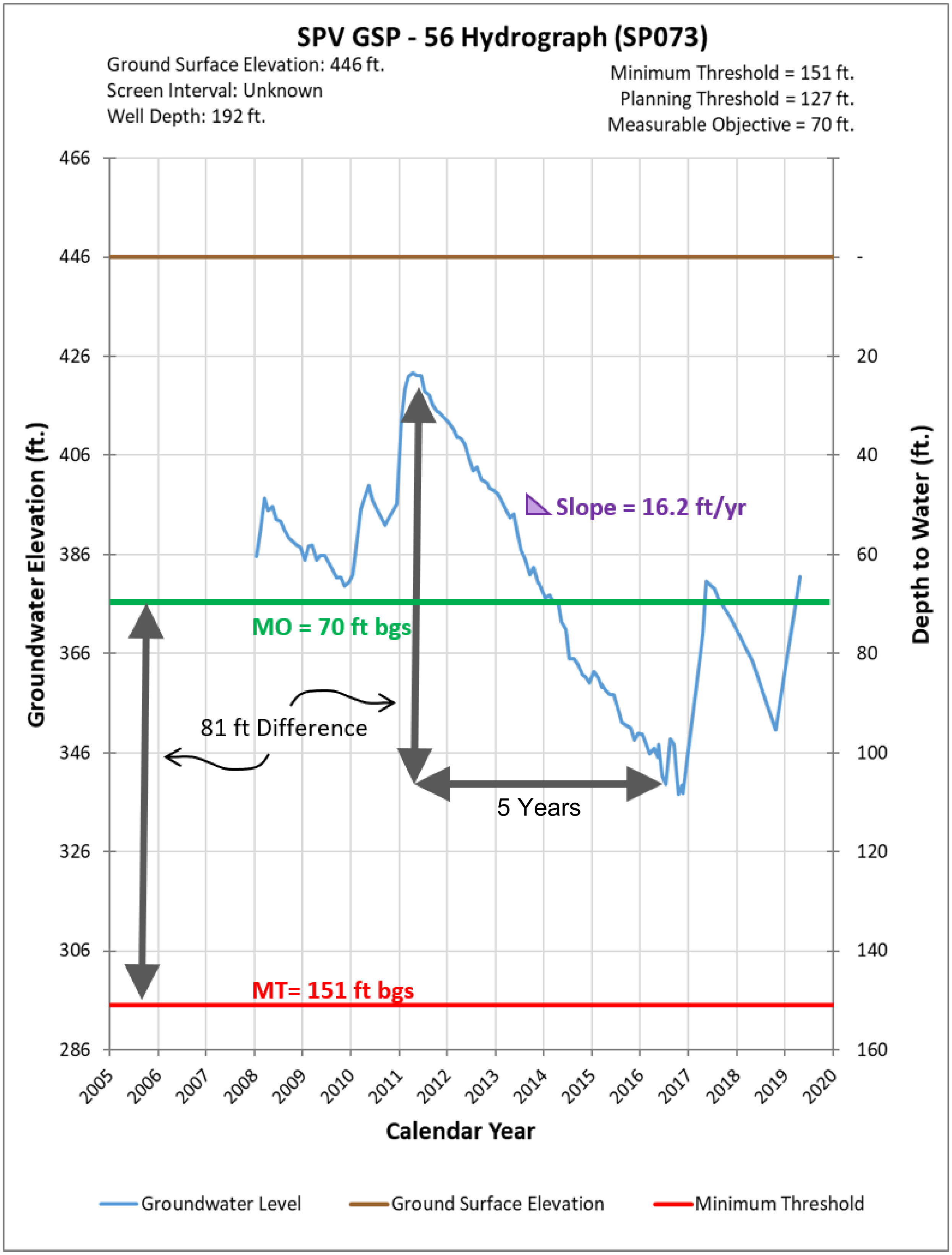


Figure 8-3. Example of Margin of Operational Flexibility Calculation

8.2.4 Margin of Operational Flexibility

The Basin's margin of operational flexibility is the difference between the measurable objective and the minimum threshold for each well. The margin of operational flexibility was selected to provide at least a 5-year drought buffer above the minimum threshold for each representative monitoring well.

8.2.5 Interim Milestones

Since the Basin is currently sustainable, and because interim milestones are intended to show the GSA's progress toward sustainability, interim milestones are not needed.

8.2.6 Sample Hydrographs and Thresholds for Groundwater Levels

Figures 8-4 and 8-5 are hydrographs of two representative wells in the Basin, one in the western portion (Figure 8-4) and one in the eastern portion (Figure 8-5). In these figures, the Basin's minimum threshold, planning threshold, and measurable objective are shown on the hydrographs.

The left axis on each figure shows the elevation above mean sea level, and the right axis shows depth to water below ground surface; time in years is shown along the bottom axis.

Appendix L includes hydrographs for the 15 representative well sites for groundwater levels in the Basin with their accompanying minimum thresholds, planning thresholds, and measurable objectives.

Table 8-1 (above) lists wells in the representative monitoring network and the numerical values for the minimum threshold, planning threshold, and measurable objective.

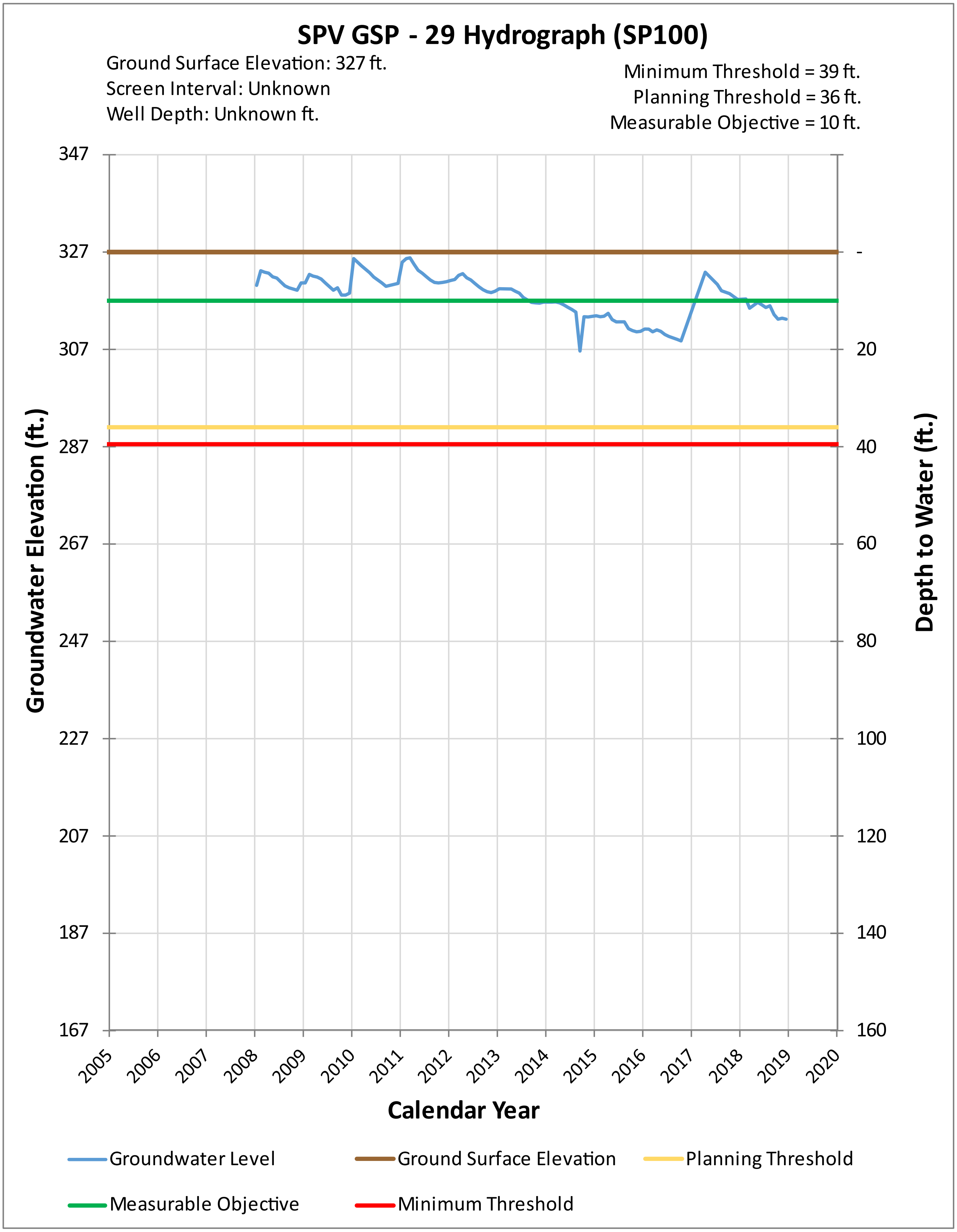


Figure 8-4. Example Hydrograph from the Western Portion of the Basin

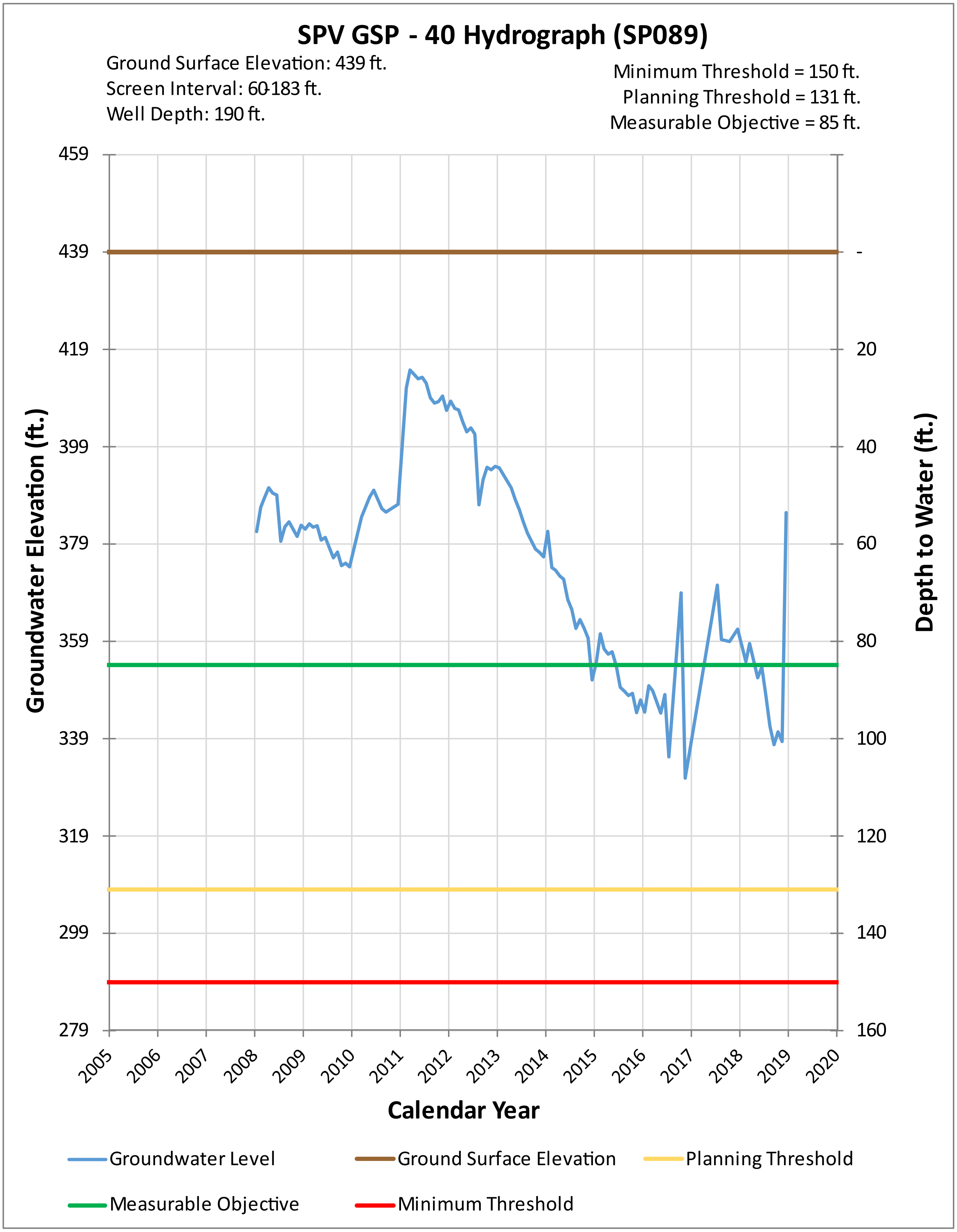


Figure 8-5. Example Hydrograph from Eastern Portion of the Basin

8.3 Reduction of Groundwater Storage

The undesirable result for a reduction in groundwater storage is a result that causes significant and unreasonable reduction in the viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP. Any benefits to groundwater storage are expected to coincide with groundwater level management. Therefore, monitoring for a reduction of groundwater storage in the Basin uses groundwater levels as a proxy for determining sustainability, as permitted by Title 23 CCR Section 354.28 (d). The undesirable results, measurable objectives, and planning thresholds for Chronic Lowering of Groundwater Levels (Table 8-2) also apply to reduction in groundwater storage.

8.4 Seawater Intrusion

Due to the geographic location of the Basin, which is approximately 19 miles inland from the Pacific Ocean, seawater intrusion does not apply as a sustainability indicator. Establishing criteria for undesirable results because of seawater intrusion is not required pursuant to Title 23 CCR Section 354.26(d).

8.5 Degraded Water Quality

SGMA regulations specify that "minimum thresholds for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results." For degraded water quality to be characterized as an undesirable result, it must be associated with groundwater-management activities and the impacts those activities have on water quality. If those activities cause a significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP; that would be considered an undesirable result for degraded water quality. Salinity (measured as TDS) and nitrates have been identified as potentially being of concern for water quality in the Basin, as identified in Section 4; however, TDS and nitrate concentrations in the Basin are the result of several factors that are beyond direct GSA control. Figure 8-6 shows the groundwater quality representative monitoring network.

8.5.1 Minimum Thresholds

Minimum thresholds for the 10 representative monitoring wells for groundwater quality in the Basin were developed for nitrate and TDS as follows:

- Nitrate (as NO_3N) minimum threshold: 10 mg/L, which is the maximum contaminant level (MCL) established by the U.S. Environmental Protection Agency through its Safe Drinking Water Act drinking water standards (i.e., Titles 17 and 22 CCR).
- TDS minimum threshold: The historical high measured concentration for the well, or 1,000 mg/L (which is the upper secondary MCL for TDS[4]), whichever is higher in concentration. Establishing the minimum threshold based on the maximum reported TDS concentrations reflects the existing water quality conditions in the Basin. The secondary MCL for TDS is an aesthetic limit for potable water and exceedances are not associated with toxicity or health risks.

As described in Section 4, *Groundwater Conditions*, nitrate and TDS concentrations have locally exceeded the primary and upper secondary MCL, respectively, in the Basin. Despite these

[4] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/ddw_secondary_standards.pdf

exceedances in localized areas, groundwater of adequate quality has and continues to be used for agricultural and domestic supply in the Basin.

8.5.2 Measurable Objectives

Measurable objectives for the 10 representative monitoring wells for groundwater quality in the Basin were developed for nitrate and TDS as follows:

- Nitrate (as NO_3N) measurable objective: 5 mg/L, which is half the MCL of 10 mg/L.
- TDS measurable objective: 1,000 mg/L for wells that have historical concentrations above 1,000 mg/L; 1,000 mg/L is the upper MCL for TDS[1] and is the water quality objective established in the SPV SNMP (City, 2014). A measurable objective of 500 mg/L, which is the recommended secondary MCL for TDS for wells with historical concentrations generally below 1,000 mg/L.

8.5.3 Interim Milestones

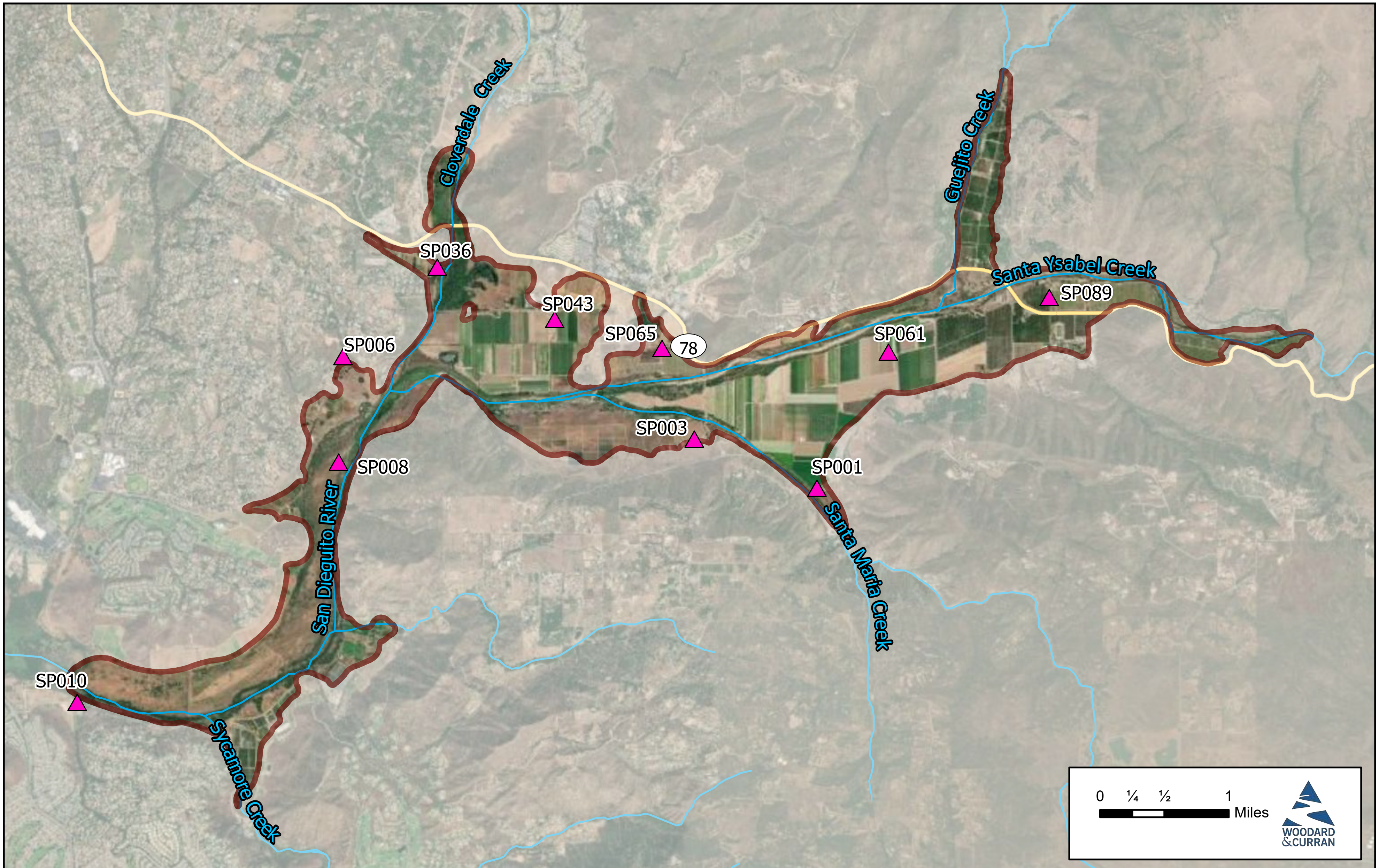
Interim milestones are not needed for the Basin's groundwater quality representative monitoring network because current groundwater quality conditions do not exceed minimum thresholds and the Basin is not experiencing an undesirable result. In addition, education and outreach for water quality is anticipated to occur once the GSP is adopted to help maintain sustainable groundwater quality conditions in the Basin.

8.5.4 Sample Chemographs and Thresholds for Water Quality

Table 8-3 summarizes minimum thresholds and measurable objectives for all the representative wells in the Basin. Figures 8-7 and 8-8 show chemographs for well SP098 for nitrate and TDS. In these figures, the Basin's minimum threshold and measurable objective for each constituent are shown.

Table 8-3. Minimum Thresholds and Measurable Objectives for Groundwater Quality Representative Sites

City Well Name	SPV GSP Well Number	Well Depth (feet below GSE)	Nitrate as NO3N		Total Dissolved Solids (TDS)	
			Measurable Objective (mg/L)	Minimum Threshold (mg/L)	Measurable Objective (mg/L)	Minimum Threshold (mg/L)
SP001	SPV GSP–127	120	5	10	1,000	1,900
SP003	SPV GSP–125	106	5	10	500	1,310
SP006	SPV GSP–122	Unknown	5	10	1,000	1,680
SP008	SPV GSP–120	200	5	10	1,000	2,170
SP010	SPV GSP–118	Unknown	5	10	500	1,270
SP036	SPV GSP–91	Unknown	5	10	1,000	1,900
SP043	SPV GSP–85	100	5	10	1,000	3,060
SP061	SPV GSP–67	Unknown	5	10	500	1,000
SP065	SPV GSP–64	80	5	10	1,000	1,750
SP089	SPV GSP–40	190	5	10	500	1,300



Project #: 0011197

Legend

San Pasqual Valley Basin

Groundwater Quality Monitoring Network

N

Figure 8-6

San Pasqual Valley GSP

Representative Monitoring Network Wells for Groundwater Quality

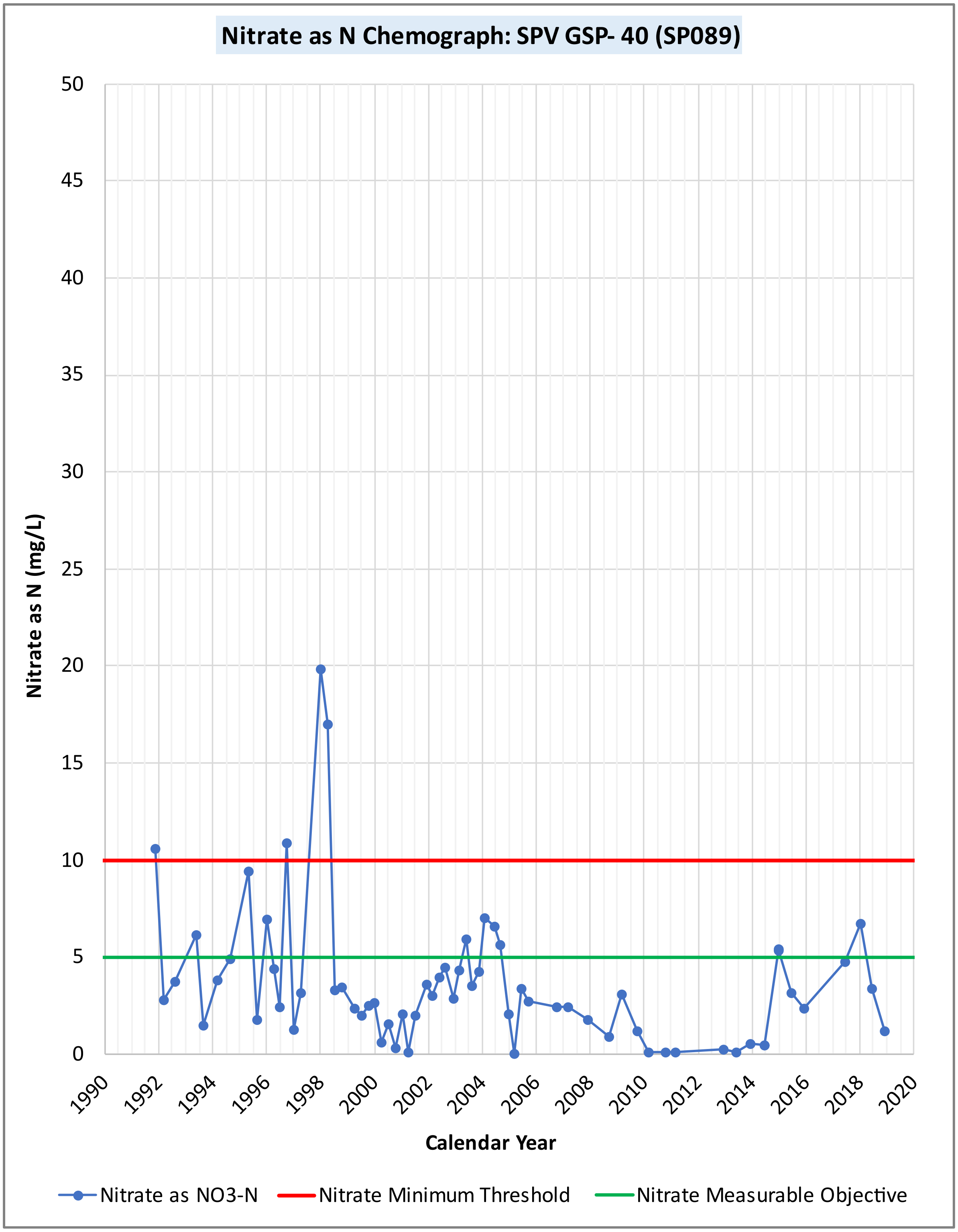


Figure 8-7. Example Nitrate Chemograph—SP089

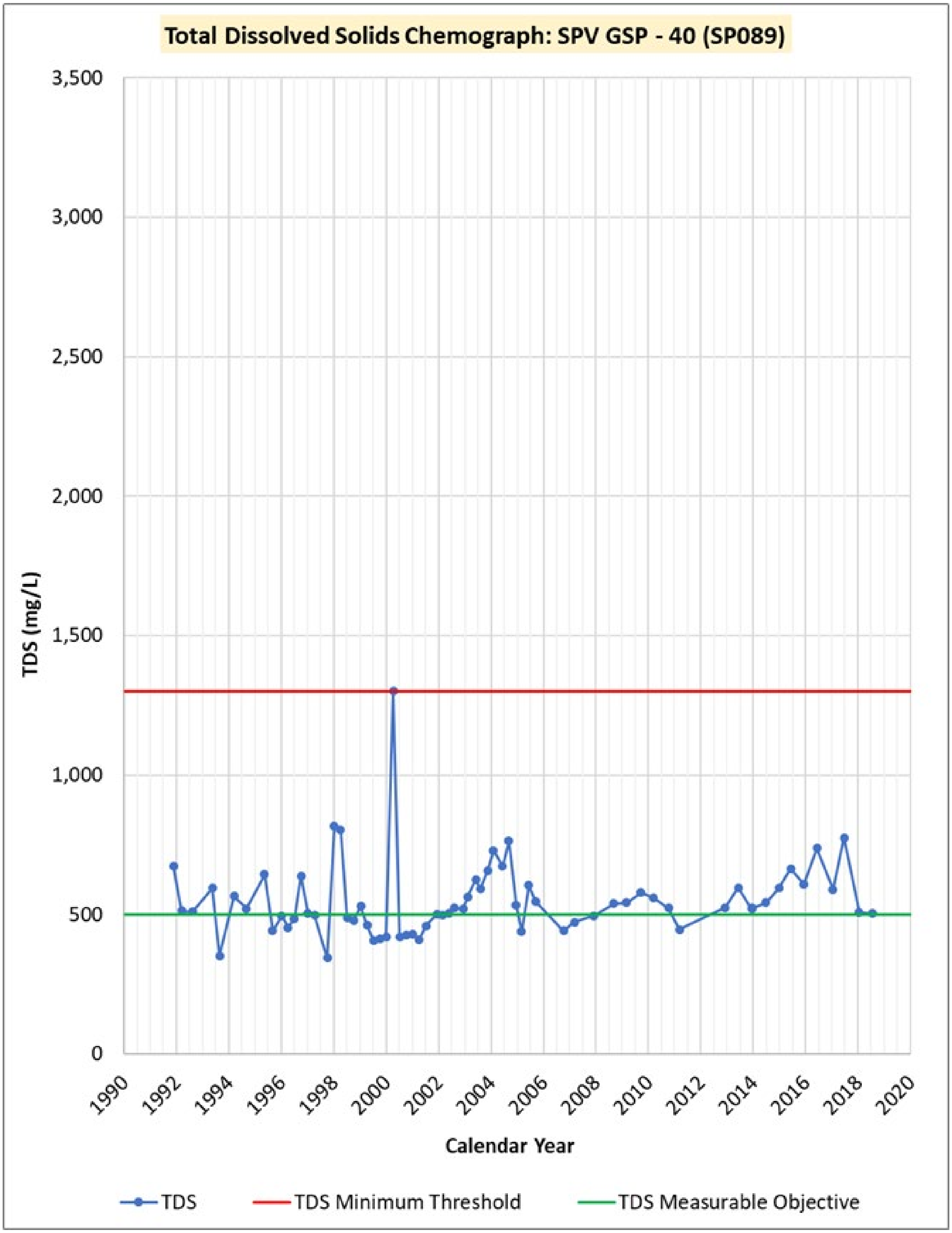


Figure 8-8. Example TDS Chemograph—SP089

8.6 Subsidence

As described in Section 6.3.5, *Land Subsidence*, the GSP has determined that subsidence has not caused undesirable results in the Basin and is not anticipated to cause undesirable results in the foreseeable future, including over the planning horizon of this GSP. Consequently, establishing minimum thresholds and measurable objectives and monitoring for these thresholds is not required for the Basin pursuant to Title 23 CCR Section 354.26(d).

8.7 Depletions of Interconnected Surface Water

SGMA regulations define the minimum threshold for interconnected surface water as "…the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on the beneficial uses of the surface water and may lead to undesirable results." The undesirable result for depletions of interconnected surface water is a result that causes significant and unreasonable reductions in the viability of GDEs in the Basin over the planning and implementation horizon of this GSP.

The riparian and wetland habitats throughout the Basin likely receive soil moisture from stormwater, surface flow, or return flow from adjacent agricultural areas. As discussed in Section 4, *Groundwater Conditions,* streams in the eastern portion of the Basin are not connected to the regional aquifer, and changes in groundwater levels will not increase stream depletions in this portion of the Basin. In the western portion of the Basin, where potential GDEs are located, the depth to water has been consistently shallower than the rest of the Basin and within the average rooting depth of many GDEs. This suggests that, in addition to receiving soil moisture from surface flows, the potential GDEs in the western portion of the Basin may also be supported by groundwater. The GSA has selected monitoring by proxy for the depletions of interconnected surface water (Section 6.3.6, *Depletions of Interconnected Surface Water*).

8.7.1 Minimum Thresholds

Depletions of interconnected surface water will be monitored using groundwater levels in the six monitoring wells in the western portion of the Basin that are within 2,000 feet of a potential GDE. Figure 8-2 shows the locations of potential GDEs in the Basin and the location of representative monitoring wells for groundwater level monitoring. The minimum thresholds and monitoring objectives for these wells incorporate objectives for both chronic lowering of water levels and interconnected surface water, as discussed in Section 8.2*, Chronic Lowering of Water Levels* and repeated below: Table 8-2 summarizes the thresholds and monitoring objectives.

- If a representative well is within 2,000 feet of a potential GDE as described in Section 4, , *Groundwater Conditions*, then the minimum threshold is calculated as 100 percent of the historical range of groundwater measurements below the historical minimum groundwater level. These representative wells are in the western portion of the Basin. The depth to groundwater in the western portion of the Basin is generally 30 feet or less and has tended to fluctuate over a smaller range than the depth to groundwater in the eastern portion of the Basin (see Section 4, *Groundwater Conditions*). The minimum thresholds of these wells in the western portion of the Basin reflect these smaller level fluctuation conditions.

Table 8-1 summarizes the thresholds and measurable objectives.

8.7.2 Planning Thresholds

A different approach for the planning thresholds was implemented for depletion of interconnected surface water than for chronic lowering of water levels. Whereas the planning thresholds for groundwater levels and storage were based on an 18-month duration for the GSA to act before the minimum thresholds (refer to Section 8.2), a more conservative approach was taken for the interconnected surface water planning thresholds. The interconnected surface water planning threshold is defined as the historical low groundwater elevation in each of the six wells, which is substantially shallower than the minimum thresholds for these wells (Table 8-2). These depths represent groundwater levels in which potential GDE's remained viable within the Basin during historically low groundwater level periods, and would likely remain viable if those levels are maintained. Groundwater levels that exceed the Planning Threshold do not necessarily indicator potential GDE degradation, rather conditions that have not yet been measured at each representative monitoring well site.

For interconnected surface water, the GSA has determined that if 30 percent of the six wells (i.e., two of the six wells) in the western portion of the Basin within 2,000 feet of a potential GDE fall below the planning threshold simultaneously, the GSA will consider conducting a study to determine the extent and locations of GDEs in the Basin, and will determine if additional potential projects and management actions are needed to address the protection of GDEs. A GDE study is discussed in Section 9, *Projects and Management Actions*.

8.7.3 Measurable Objectives

The measurable objective established for wells adjacent to potential GDEs are described in Section 8.2.3 and repeated below:

- If the well is within 2,000 feet of a potential GDE as described in Section 4, *Groundwater Conditions* the measurable objective is set at 10 feet below ground surface. This depth is within the range of current and historical fluctuations in groundwater levels. Based on a review of historical groundwater level trends in each well, this provides more than a 5-year drought buffer.

8.7.4 Interim Milestones

Since the Basin is currently sustainable, and because interim milestones are intended to show the GSA's progress toward sustainability, interim milestones are not needed.

Section 9. PROJECTS AND MANAGEMENT ACTIONS

9.1 Introduction

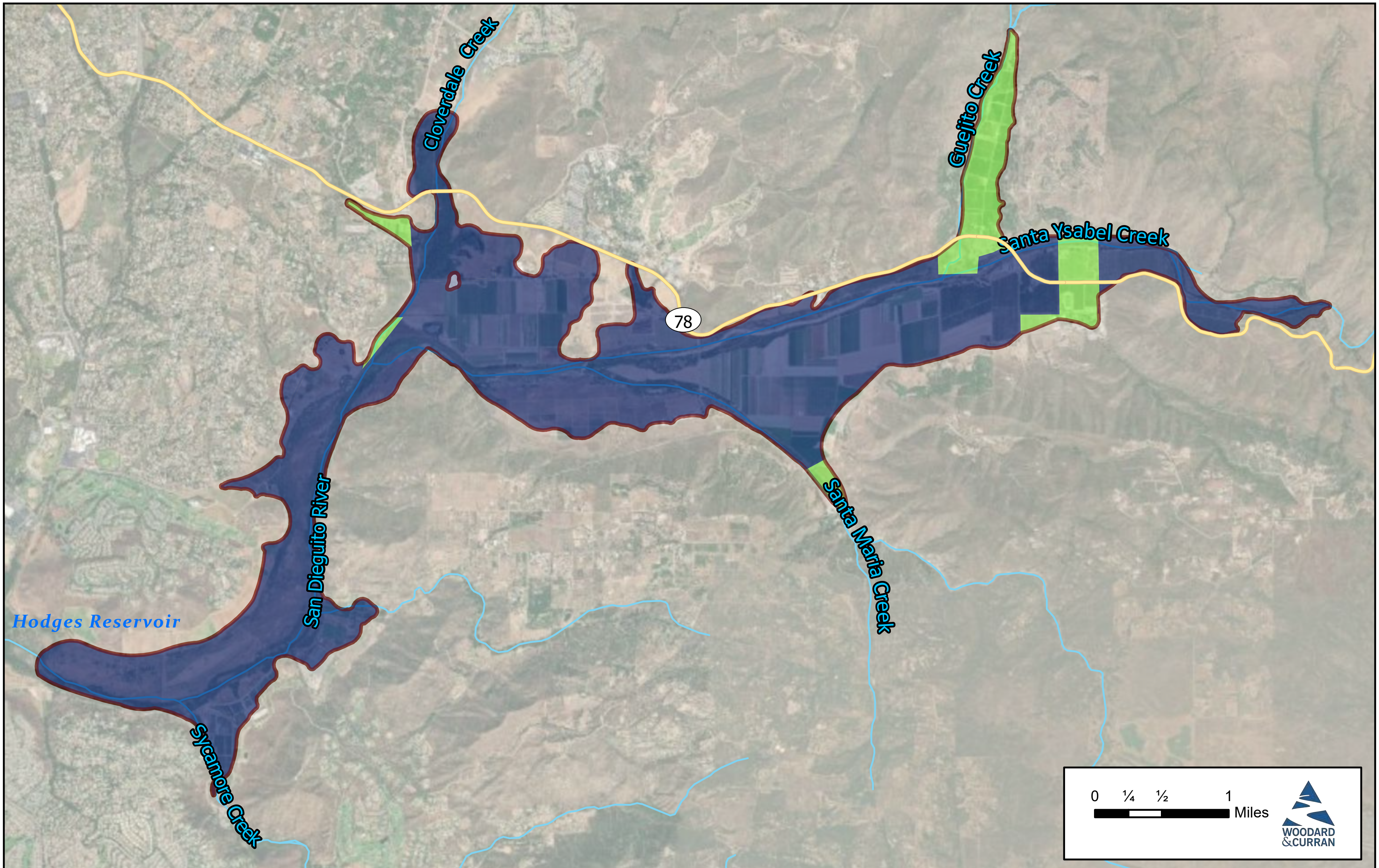
This section describes the projects and management actions that satisfy Sections 354.42 and 354.44 of the SGMA regulations.4F[5] These projects and management actions create opportunities for sustainable groundwater management in the Basin that respond to changing conditions and help prevent undesirable results. This section also describes the following:

- Management areas
- GSP implementation approach
- Screening process for selecting projects and management actions
- Proposed projects and management actions

9.2 Management Areas

As described in Section 2, *Plan Area,* the City's jurisdiction includes approximately 90 percent of the 5.5-square mile Basin. Per the City's Community Plan (City of San Diego Planning Department, 2015) and City Council Resolution R-286043, the City leases all its jurisdictional land for "preservation and conservation of open space land and natural resources." Although the County underlies the entire Basin, for the purposes of SGMA implementation, the County manages the remaining 10 percent of the Basin that is outside of the City's jurisdiction. As such, the GSA has designated a City management area and a County management area in the Basin. Figure 9-1 shows the boundaries of these two management areas. Management actions and projects occurring in these management areas would be overseen by the GSA according to their respective management area jurisdictions consistent with the MOU agreement (Appendix B) between the City and County.

[5] https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I74F39D13C76F497DB40E93C75FC716AA&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)



Project #: 0011197

Legend

- San Pasqual Valley Basin
- County Management Area
- City Management Area

N

Figure 9-1

San Pasqual Valley GSP

Management Areas

9.3 Approach for Implementation of Projects and Management Actions

The Basin is currently sustainably managed; no projects or management actions are needed to achieve sustainability. However, projects and management actions can enhance management capability and improve understanding of the groundwater system to maintain sustainability into the future. The projects and management actions identified in this section are a menu of options that could be implemented to both maintain sustainable groundwater conditions and allow the GSA to respond to changing groundwater conditions.

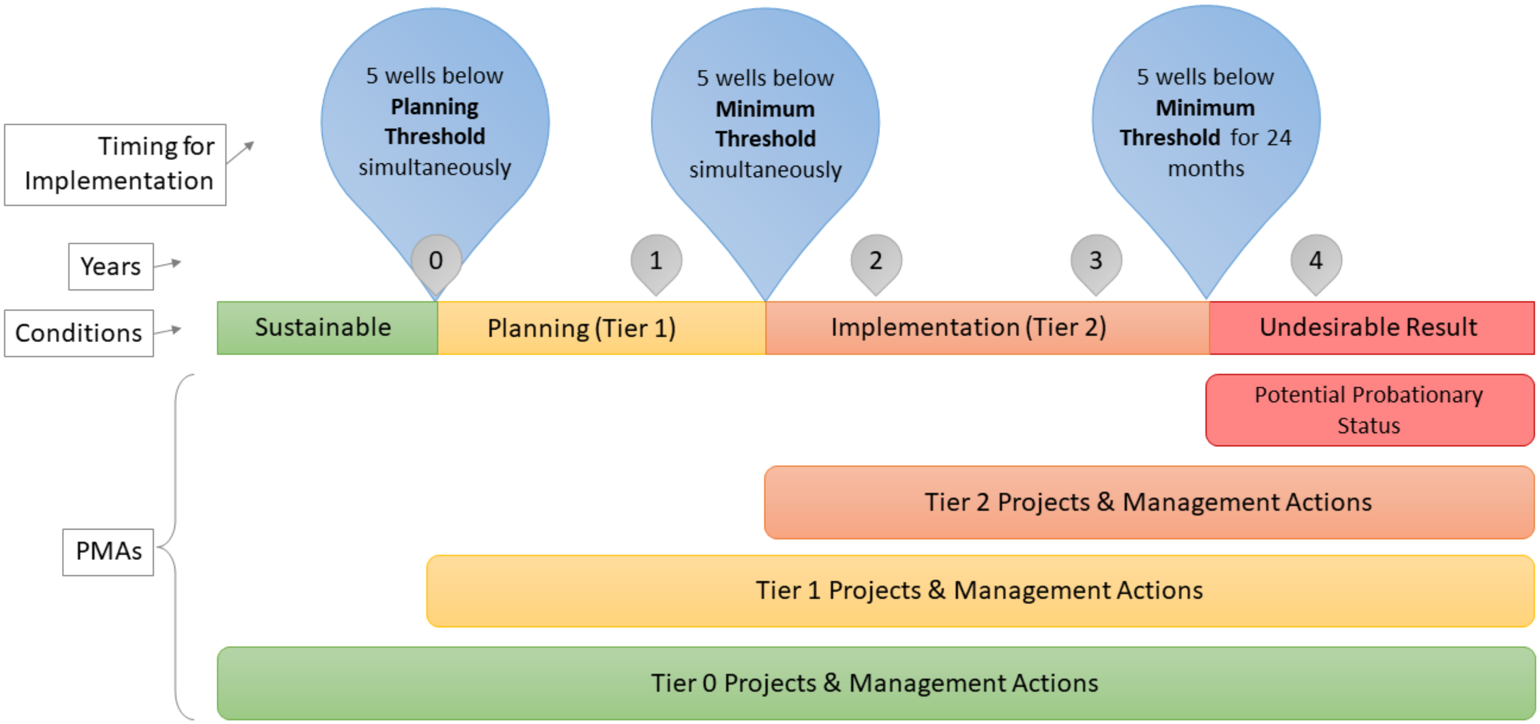
The projects and management actions are grouped into tiers (Figure 9-2, described below) that correlate with different Basin conditions and thresholds for implementation (Figure 9-3):

- **Tier 0—**These projects and management actions could be implemented by the GSA at any time after GSP adoption.
- Tier 1—These projects and management actions could be implemented if planning thresholds for groundwater levels (described in Section 8, Minimum Thresholds and Measurable Objectives) are exceeded. Tier 1 actions can potentially be initiated when at least five wells in the Basin exceed their planning threshold. Potential Tier 1 management actions include creating a well inventory, developing a Pumping Restrictions and Enforcement Plan, and a basin-wide metering program. Separately, a management action to study GDEs could be implemented when the interconnected surface water proxy monitoring network falls below the planning threshold, as defined in Section 8.7.
- **Tier 2—**These projects and management actions could be implemented if minimum thresholds for groundwater levels (described in Section 8) are exceeded. Tier 2 actions could potentially be initiated when at least five wells in the Basin exceed their minimum threshold. The only potential Tier 2 management action currently included in the GSP is implementation of the Pumping Restrictions and Enforcement Plan.

The following section describes when Tier 1 and Tier 2 management actions would be implemented.

[1] Study GDEs has separate thresholds as described in *Section 8, Minimum Thresholds and Measurable Objectives*

Figure 9-2. Tiers for GSP Projects and Management Actions



Note: Timeline conservatively assumes a sustained drought in which no actions have occurred to curtail pumping.

Figure 9-3. Relationship between Project and Management Actions and Basin Conditions and Management Thresholds

9.4 Implementation of Tier 1 and Tier 2 Projects

The process for implementation of Tier 1 and Tier 2 projects in the Basin is both iterative and cyclical, and would be initiated when designated thresholds for Basin groundwater levels are exceeded. This allows projects and management actions to address potential exceedances of sustainability thresholds on an as-needed basis.

This approach allows the GSA to do the following:

- Take necessary action to investigate the cause of potential exceedances of the planning threshold
- Provide a framework for responding to such exceedances in order to prevent reaching the minimum threshold
- Provide a framework for responding to an exceedance of the planning thresholds in the depletions of interconnected surface water monitoring network

Figure 9-4 is a schematic of the process for implementation; the steps of this process are described below.

9.4.1 Step 1—Continue SGMA Monitoring

The GSA will continue their ongoing existing monitoring programs to assess groundwater levels. The GSA will continue with the monitoring programs described in Section 7, *Monitoring Networks* to track conditions for the applicable sustainability indicators discussed in Section 8, *Minimum Thresholds and Measurable Objectives*. This GSP uses planning thresholds to guide implementation of Tier 1 and Tier 2 management actions.

Monitoring network data will be collected and used to determine whether Tier 1 or Tier 2 projects should be implemented. The GSP monitoring networks will use existing monitoring program data for future monitoring efforts, which will continue to characterize the Basin's groundwater status.

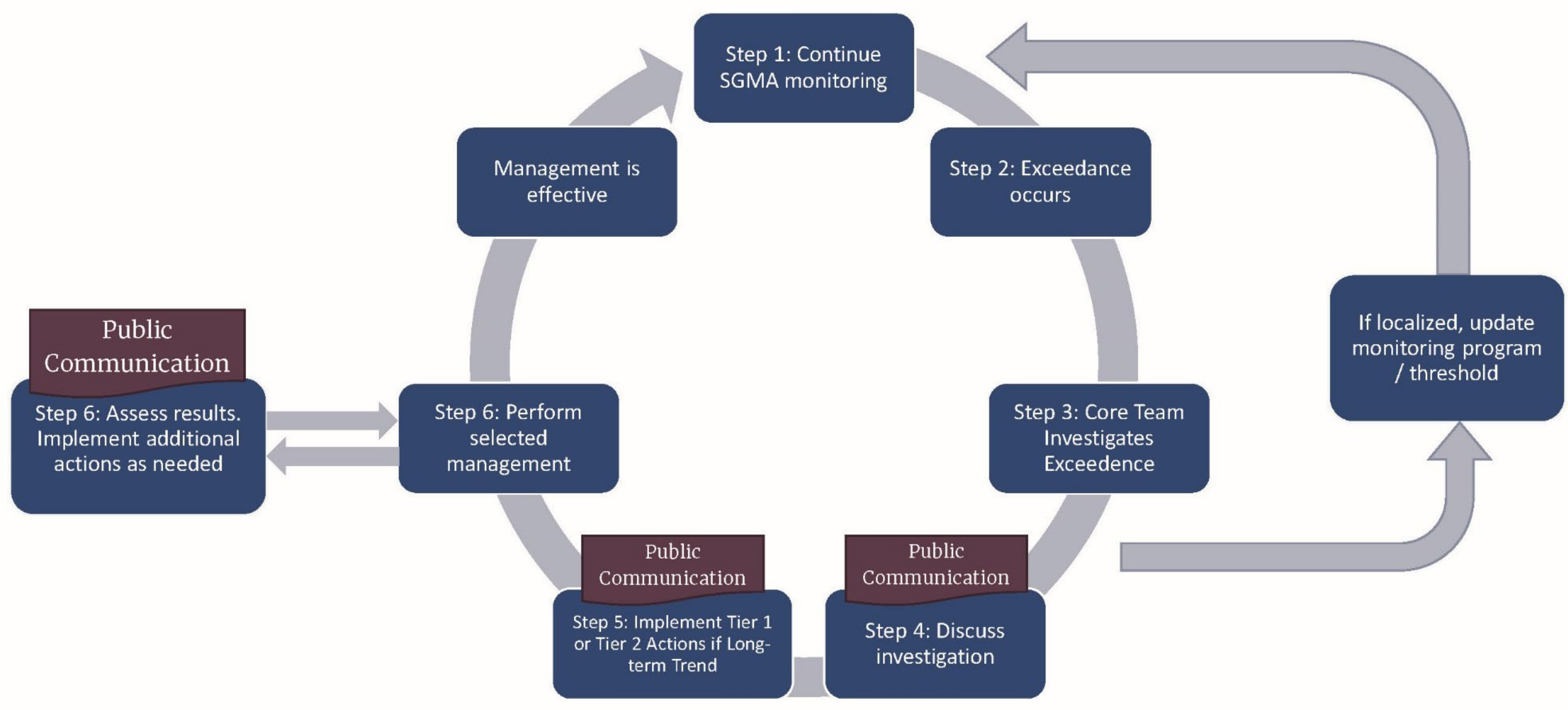


Figure 9-4. Implementation Process for Tier 1 and 2 Management Actions

9.4.2 Step 2—Determine Whether an Exceedance Occurs

The thresholds for determining an exceedance that might require implementing management actions are called planning and minimum thresholds. Planning thresholds differ from the minimum thresholds in that they are designed to be initiated at shallower depths than minimum thresholds; however, planning thresholds are still at deeper depths than measurable objectives. Planning thresholds allow the GSA to respond to local monitoring well conditions before minimum thresholds are exceeded. Tier 1 management actions could potentially be initiated if at least five wells in the Basin exceed their planning threshold, while Tier 2 management actions could potentially be initiated if at least five wells in the Basin exceed their minimum threshold.

As conditions change in the Basin, groundwater levels at representative monitoring wells may fall below the planning thresholds. If a representative monitoring well's groundwater level exceeds either the planning or minimum thresholds for groundwater levels, the GSA may determine that an investigation will be initiated to determine the cause of the exceedance and whether or not implementation of Tier 1 or Tier 2 management actions will be required.

9.4.3 Step 3—GSA Core Team Investigates Exceedance

If any planning or minimum threshold is exceeded for groundwater levels, the GSA Core Team (composed of City and County representatives) would discuss and consider developing an approach for investigation, if the GSA determined an investigation was necessary.

The primary goal of an investigation would be to determine whether the planning or minimum threshold exceedance is a locally driven change in conditions, such as an erroneous measurement, a well collapse, or change in local land use or pumping patterns, or whether it represents a long-term, Basin or regional change in conditions. Figure 9-4 illustrates the investigation process. The investigation would include steps such as analyzing well logs and inspecting the surrounding City leaseholders' production wells or interviewing well owners in City or County jurisdiction to determine if any recent changes occurred that may have affected groundwater levels. The GSA might also investigate nearby land use changes, whether any new wells have been installed, precipitation and drought periods, or other factors as necessary.

If at least five wells are confirmed through the investigation process to have exceeded the planning threshold, then the process would move on to Step 4 to notify the public and Step 5 to consider potential Tier 1 management actions. Similarly, if at least five wells are confirmed through the investigation process to have exceeded the minimum threshold, then the process moves on from Step 4 to notify the public and Step 5 to consider potential Tier 2 management actions.

9.4.4 Step 4—Discuss Investigation with Public

If investigation determined that at least five wells exceeded either planning or minimum thresholds, the GSA would notify the public (Figure 9-4). Exceedance information and investigation results would be provided to the public, and the GSA Core Team would report whether the exceedances demonstrated a locally driven change or a long-term regional change. The GSA Core Team might also suggest expanded investigation or a conclusion of the investigation if appropriate. The GSA Core Team may also consider recommendations provided by the public for further action. If the GSA determines an exceedance demonstrated a locally driven change, the GSA would document this decision and adjust the monitoring network and thresholds as needed for the localized groundwater condition that changed.

However, if investigation determines exceedances in at least five wells (i.e., below the planning threshold) that indicate a long-term regional trend, the investigation would move on to implementation of Tier 1 management action(s) to address the issue. Additionally, any exceedances relative to minimum thresholds and status compared to the other sustainable management criteria would be reported to DWR via annual reports as part of this GSP, which would be publicly available following submission to DWR.

9.4.5 Step 5—Implement Tier 1 or Tier 2 Management Actions if Exceedances Are Confirmed in Five Wells

To address a long-term regional trend that may cause undesirable results in at least five wells, the GSA may need to implement Tier 1 management actions; if these actions are not enough to address the trend, then these can be followed by Tier 2 management actions that would address declining groundwater levels. As noted above, Tier 1 management actions may be implemented if planning thresholds are exceeded in five or more wells, and after additional Tier 0 management actions have been considered. If Tier 0 and Tier 1 management actions have been implemented, but groundwater levels continue to decline so that minimum thresholds are exceeded in five or more wells, then Tier 2 management actions can be implemented as well.

9.4.6 Step 6—Perform Selected Management and Assess Results

Following implementation of Tier 1 and Tier 2 management actions, SGMA monitoring will continue and will be used to assess how conditions change.

If monitoring indicates that conditions have been restored to sustainable conditions (i.e., those above the minimum threshold), implementation of Tier 1 and Tier 2 management action(s) would be deemed successful. If the exceedance is not addressed within one year of Tier 2 implementation, the GSA Core Team will perform additional investigation and potentially revise implementation of Tier 2 management actions to avoid undesirable results. Once management of the issue is deemed effective, monitoring would continue as described in the GSP.

9.5 Screening of Projects and Management Actions

The GSA performed a screening analysis to evaluate a range of potential projects and management actions to help move the Basin toward sustainability, if necessary, in the future. Screening analysis results are described in Appendix N. In summary, the screening analysis resulted in a list of potential projects and management actions that would be available for implementation if needed. Table 9-1 lists potential projects the GSA considered, but screened out for various reasons.

Table 9-1. Projects and Management Actions Screened Out During Analysis

Activity Name	Reason for Screening
Limitations on new well construction: limiting the installation of new wells over a certain size or capacity unless they are replacing an existing well	Well construction permits are an existing County function and not a GSA authority.
Surface water or stormwater capture and storage: capture surface water or stormwater flows in the eastern end of the Basin and use the water to recharge groundwater levels.	Environmental permitting requirements are high, and cost is high relative to the amount of water gained.
Discharge excess advanced treated reclaimed water, available in nonpeak growing season and winter months, from Hogback Reservoir to Cloverdale Creek	High cost and uncertain benefit.
Recharge excess reclaimed water from Hogback Reservoir to the eastern portion of the Basin	High cost.
Recharge basin with advanced treated recycled water from a new San Pasqual Water Reclamation Facility in the West Basin	High cost.
Recharge basin with Advanced treated recycled water from New San Pasqual Water Reclamation Facility in the East Basin	High cost.
Recharge with raw water from Ramona Mutual Water District	Ramona is discontinuing its raw water services at the end of 2021.
Recharge with City of San Diego recycled water	High cost.
Pump-and-treat system for nitrate	High cost.
Hodges Reservoir natural treatment system: wetlands and detention basins to treat discharge before entering to Hodges	High cost and uncertain benefit.
Household water treatment for domestic users	Infeasible implementation due to regulations.

Table 9-2 lists the potential projects and activities deemed feasible for implementation in the Basin, along with their GSP implementation tier, current status, and potential timing.

The sections following this table provide a detailed description of each proposed project and management action.

Table 9-2. Potential Projects and Management Actions for Implementation

Project/Management Action	Implementation Tier	Current Status[a]	Anticipated Timing
Project 1—Coordinate with City on Construction of Infiltration Basins at San Pasqual Union Elementary	0	Not yet begun	4 to 6.5 years for planning and construction
Project 2—Coordinate on the Implementation of Invasive Species Removal	0	Ongoing	Ongoing
Management Action 1—Farming Best Practices	0	Not yet begun	Ongoing
Management Action 2—Education and Outreach to Encourage Demand Softening	0	Not yet begun	Ongoing
Management Action 3—Support Water Quality Improvement Project Actions	0	Not yet begun	Ongoing
Management Action 4—Coordinate and Collaborate Regionally with Other Entities to Perform Monitoring and Implement Regional Projects	0	Not yet begun	Ongoing
Management Action 5—Education and Outreach about TDS and Nitrate	0	Not yet begun	Ongoing
Management Action 6—Coordinate with City on Hodges Watershed Improvement Project	0	Began in 2021	2-3-year implementation and 2-year monitoring required
Management Action 7—Initial Surface Water Recharge Evaluation	0	Not yet begun	1- to 2-year evaluation to identify potential recharge projects that warrant further analysis
Management Action 8—Study GDEs	1	Not yet begun	6 months to 1 year implementation
Management Action 9—Well Inventory	1	Not yet begun	1- to 3-year implementation
Management Action 10—Basinwide Metering Program	1	Not yet begun	1-to 2-year implementation
Management Action 11—Develop Pumping Reduction Plan	1	Not yet begun	1-to 2-year implementation
Management Action 12—Pumping Restrictions and Enforcement	2	Not yet begun	Ongoing

Notes
[a] The Basin is currently sustainable. Projects and management actions would only be implemented as necessary.
GDE = groundwater dependent ecosystem

9.6 Addressing Sustainability Indicators

If implemented, proposed projects and management actions would contribute toward protecting the Basin from undesirable results and maintaining sustainable conditions. The sustainability indicators would be measured directly for water quality or by proxy using groundwater elevation data. Table 9-3 summarizes how projects and management actions would address the applicable sustainability indicators for the Basin; as noted previously, seawater intrusion is not a concern due to the Basin's distance from the Pacific Ocean. Similarly, based on the geology of the Basin and lack of identifiable symptoms, land subsidence is not anticipated to be a concern. The physical benefits of projects and management actions are also described under each project and action below.

9.6.1 Overdraft Mitigation

Overdraft occurs when long-term groundwater outflows from a basin exceed the long-term groundwater inflows to the basin. The historical groundwater system budget indicates an average deficit in cumulative change in groundwater storage of -245 AFY between WYs 2005 through 2019. This deficit represents less than 3 percent of the average groundwater budget over that period, and is within the uncertainty of these water budget estimates (refer to Section 5, *Water Budgets*). As such, it would be premature to identify a small deficit in the cumulative change in groundwater storage over WYs 2005 through 2019 as overdraft. The Basin's lack of undesirable results suggests the Basin is not in a condition of overdraft. Also, the SPV GSP Model uses a potentially conservative climate forecast approach that may underestimate the amount of available groundwater. In other words, since the Basin is currently considered sustainable, no overdraft mitigation efforts are proposed at this time.

The proposed projects and management actions for implementation would support maintenance of groundwater levels above planning and minimum thresholds through demand management or reductions in pumping. These projects and management actions depend on the GSA determining whether action is necessary.

9.6.2 Water Balance Management for Drought Preparedness

Domestic and irrigation water users in the Basin rely on groundwater to meet water needs. Management actions might be implemented as needed by the GSA as either an ongoing or temporary action during drought periods. Management actions that support groundwater levels through increased recharge help protect groundwater resources for use during future drought; they also help protect the Basin from the impacts of drought on groundwater storage.

Management actions that would reduce pumping (and by extension, would increase drought preparedness) in the Basin are as follows:

- Reducing demand both before and during drought periods
- Supporting groundwater levels through increased recharge in non-drought years
- Decreasing impacts of drought on users
- Reducing the need for increased pumping when precipitation levels are low

Table 9-3. How Projects and Management Actions Address Sustainability Indicators

Management Action or Project	Sustainability Indicator			
	Chronic Lowering of Groundwater Levels	Reduction of Groundwater Storage	Degraded Water Quality	Depletions of Interconnected Surface Water
Implementation Tier 0				
Project 1— Coordinate with City on Construction of Infiltration Basins at San Pasqual Union Elementary	Would increase recharge in the Basin, directly contributing to groundwater levels.	Would increase recharge in the Basin, directly contributing to groundwater storage.	Infiltration basins would filter pollutants prior to entering the Basin, improving groundwater quality.	Infiltration basins would improve water quality entering Cloverdale Creek. It may also reduce the potential for groundwater levels to decline and negatively impact surface water flows.
Project 2— Coordinate on the Implementation of Invasive Species Removal	Would reduce groundwater use by invasive species, directly contributing to groundwater levels.	Would reduce groundwater use by invasive species, directly contributing to groundwater storage.	Reducing groundwater pumping could potentially reduce evapoconcentration effect from decreased ET.	Reduced groundwater use would help protect groundwater levels, thereby reducing the potential for negative impacts to surface water flows associated with lowering groundwater levels.
Management Action 1— Farming Best practices	Would reduce groundwater pumping through increased efficiency of agricultural use.	Reducing groundwater pumping would increase groundwater storage.	Would improve groundwater quality through actions such as tillage techniques or pest management.	Reduced groundwater pumping would help protect groundwater levels, thereby reducing the potential for negative impacts to surface water flows associated with lowering groundwater levels.
Management Action 2— Education and Outreach to Encourage Demand Softening	Voluntary demand softening would reduce groundwater pumping.	Reducing groundwater pumping would increase groundwater storage.	Reducing groundwater pumping would help alleviate groundwater quality degradation associated with lowering of groundwater levels.	Reduced groundwater pumping would help protect groundwater levels, thereby reducing the potential for negative impacts to surface water flows associated with lowering groundwater levels.
Management Action 3— Support WQIP Actions	Coordination to support strategies implemented in existing plans and documents will benefit the region. Benefits depend on the implemented actions.			
Management Action 4— Coordinate and Collaborate Regionally with Other Entities to Perform Monitoring and Implement Regional Projects	Coordination to support improved monitoring and regional collaboration may result in shared relevant data and improved Basin conditions.			
Management Action 5— Education and Outreach about TDS and Nitrate	This project does not address this sustainability indicator.	This project does not address this sustainability indicator.	Would improve access to potable water through education of alternatives.	This project does not address this sustainability indicator.
Management Action 6—Hodges Watershed Improvement Project	This project has the potential to increase recharge in the basin.	Would potentially increase recharge in the Basin, directly contributing to groundwater storage.	Would improve water quality by reducing sediment and nutrient loading to the Basin.	When completed, this project would improve water quality throughout the San Dieguito Watershed.
Management Action 7— Initial Surface Water Recharge Evaluation	Groundwater replenishment through surface water recharge would increase groundwater levels and protect the basin from chronic lowering.	Groundwater replenishment through surface water recharge would improve groundwater storage.	Groundwater replenishment through surface water recharge could potentially improve groundwater quality.	Replenishment would protect groundwater levels, thereby reducing the potential for negative impacts to surface water flows associated with lowering groundwater levels.
Implementation Tier 1				
Management Action 8— Study GDEs	This project does not address this sustainability indicator.	This project does not address this sustainability indicator.	This project does not address this sustainability indicator.	Understanding the locations of GDEs will improve understanding of potential impacts from depletions of interconnected surface water.
Management Action 9— Well Inventory	An inventory of wells in the Basin would specifically determine which wells are within Basin boundaries and impact basin conditions, such as the chronic lowering of groundwater levels.	An inventory of wells in the Basin would determine which wells are located within Basin boundaries and impact basin conditions, such as the chronic lowering of groundwater levels and the accompanying contribution to groundwater storage.	An inventory of wells in the Basin would specifically determine which wells are located within Basin boundaries and impact basin conditions, such as degraded water quality.	This management action does not address this sustainability indicator.

Table 9-3. How Projects and Management Actions Address Sustainability Indicators

Management Action or Project	Sustainability Indicator			
	Chronic Lowering of Groundwater Levels	Reduction of Groundwater Storage	Degraded Water Quality	Depletions of Interconnected Surface Water
Management Action 10—Basinwide Metering Program	Further improvement of monitoring network to better understand Basin conditions.	Further improvement of monitoring network to support analysis related to other sustainability indicators.	Further improvement of monitoring network to support analysis related to other sustainability indicators.	Further improvement of monitoring network to support analysis related to other sustainability indicators.
Management Action 11—Pumping Reduction Plan	Develops the details of a pumping restriction and enforcement program so that the program is ready to implement if Tier 2 conditions are reached.	Reducing groundwater pumping would help decrease the reduction of groundwater storage associated with high levels of pumping.	Reducing groundwater pumping would help alleviate groundwater degradation associated with lowering of groundwater levels.	Reduced groundwater pumping would help protect groundwater levels, thereby reducing the potential for negative impacts to surface water flows associated with lowering groundwater levels.
Implementation Tier 2				
Management Action 12—Pumping Restrictions and Enforcement	Would limit groundwater pumping, with restriction decreasing over time until groundwater pumping reaches sustainability.	Reducing groundwater pumping would help decrease the reduction of groundwater storage associated with high levels of pumping.	Reducing groundwater pumping would help alleviate groundwater degradation associated with lowering of groundwater levels.	Reduced groundwater pumping would help protect groundwater levels, thereby reducing the potential for negative impacts to surface water flows associated with lowering groundwater levels.

Notes
GDE = groundwater dependent ecosystem
WQIP = San Dieguito River Watershed Management Area Water Quality Improvement Plan (2021 Update) (Wood, 2020)

9.7 Projects

This section describes two projects selected for inclusion in the GSP that could be implemented *at any time* to help maintain Basin sustainability. All of the projects included in the GSP are in Tier 0, which means that they could potentially be implemented by the GSA regardless of sustainability conditions in the Basin.

Other projects were also considered for inclusion in this GSP as part of a project screening process. However, given the cost and potential challenges implementing these other projects, the GSA removed these projects from further consideration (Appendix N).

9.7.1 Project 1—Coordinate with the City on Constructing Infiltration Basins at San Pasqual Union Elementary School (Tier 0)

The draft *San Dieguito River Watershed Management Area Water Quality Improvement Plan (2021 Update)* (WQIP) (Wood, 2020) was released in September 2020. The WQIP lists several potential jurisdictional strategies. One of the identified projects involves constructing infiltration and detention basins at San Pasqual Union Elementary School, sited directly north of the Basin adjacent to Cloverdale Creek. If this project were initiated and implemented by the City's Stormwater Department through the WQIP, the GSA Core Team would support its implementation.

This project would construct, operate, and maintain an infiltration basin that would treat a total drainage area of 5,818 acres on 19 acres of available space (on assessor's parcel number [APN] 241-060-11-00). According to the WQIP, the exact location of the infiltration basin would be determined via a detailed site assessment.

As described in the WQIP, this project may only be initiated and implemented if all the following conditions are met:

- WQIP interim load reduction goals are not met
- Funding to address municipal separate storm sewer system discharges is identified and secured
- City staff resources are identified and secured

Public Notice and Outreach

If this project were initiated and implemented through the WQIP, public notice and outreach would not be required beyond what is necessary for approval at a City Council meeting or through applicable California Environmental Quality Act (CEQA) requirements. Public notice and outreach would be completed by the City's Internal Departments.

Permitting and Regulatory Process

The City's Internal Departments would be responsible for project implementation and for securing any required permits for the project. The GSA would not be responsible for project implementation.

Project Benefits

Constructing infiltration basins near San Pasqual Union Elementary School could improve groundwater quality through additional infiltration prior to reaching the Basin. Specifically, the western portion of the Basin historically has high concentration of TDS and nitrate; the new infiltration basins would help reduce bacteria, nitrate, metals, trash, and sediment prior to entering this area of the Basin. Through coordination with the City's Internal Departments, Basin groundwater quality would be improved.

Project Implementation

If initiated via the WQIP, the following resources, funds, time, and steps are needed for the City's Internal Departments to implement this strategy:

- Identify project locations (3 to 6 months)
- Secure funds in the form of general funds, bonds, or grants (6 months to 2 years)
- Obtain City Council approval of capital improvement projects budget (occurs annually in May)
- Initiate preliminary engineering to narrow project scope (6 months; approximately $30,000 per capital improvement project)
- Hire design consultant to develop detailed construction plans and construction cost estimates (2 years; approximately $500,000 per capital improvement project)
- Complete construction contractor bid and award process for construction phase (6 months)
- Construct project (4 months to 1 year; project construction costs must be determined)
- Operation and maintenance in perpetuity. Funds and staff resources for this function must be approved by City Council as part of the City's annual budget.

Supply Reliability

This project would improve supply reliability through increased groundwater recharge via construction of an infiltration basin.

Legal Authority

Implementation of this project would require coordination with the City's Internal Departments.

Project Costs

The GSA would not contribute funds for the implementation of this project. It is expected that the municipal separate storm sewer system and WQIP co-permittees would fund this project.

Technical Justification

The infiltration basin would be designed and constructed in compliance with applicable standards and regulations. If implementation of this project was initiated via the WQIP, an engineering report would be developed to support project benefits in the Basin.

Basin Uncertainty

Implementation of this project could improve groundwater quality in the Basin. It would help address uncertainty in the Basin by maintaining communication among regional entities and by using existing forums for information sharing. This would help the GSA better understand, anticipate, and address uncertain conditions in the Basin.

CEQA Considerations

Constructing an infiltration basin is subject to CEQA regulation. The City's Internal Departments would be responsible for complying with CEQA for the project.

9.7.2 Project 2—Coordinate on the Implementation of Invasive Species Removal (Tier 0)

The primary and overarching objective for management of land in SPV is the protection of water resources. Beyond this, and in cooperation with other entities and partners, the City strives to protect all of the Valley's natural resource and community values. As part of this effort, the City's PUD has multiple on-going Invasive Species Removal projects and multiple partners. The City PUD has partnered with the San Dieguito River Valley Conservancy (a member of the GSP Advisory Committee) and the San Dieguito River Park Joint Powers Authority (JPA). The City PUD has found by working together to pool resources, the result is the best possible outcome for the SPV Basin.

The WQIP includes information about the Northern San Diego County Invasive Non-Native Species Control Program. This Program, funded by the San Diego Integrated Regional Water Management (IRWM) Program and the San Diego Association of Governments, began in 2012 and is located in the SPV. The Program is implemented through partnerships with the City's Public Utilities Department (PUD), the Mission Resource Conservation District, and the San Diego County Water Authority (Water Authority). As this Program continues to be implemented, the GSA Core Team would coordinate with existing partners to support invasive non-native plant removal in the SPV Basin.

The San Pasqual Valley Integrated Weed Management Plan (City, 2013) is an adaptive, comprehensive plan that locates, identifies, quantifies, prioritizes, and provides recommendations for invasive weed species management within the approximately 7,405-acre San Pasqual Valley Weed Management Area (WMA). The SPV Basin boundary is entirely inside the WMA. The City PUD would continue to implement the Plan throughout the WMA.

Additionally, the San Diego Association of Governments (SANDAG) began the TransNet Environmental Mitigation Program (EPM) Land Management Grant Program in 2013. The grant is allocated and distributed through a competitive process to maintain the integrity of existing regional habitat preserves through enhanced land management. The City PUD applied for and was awarded funding for the San Pasqual Cactus Wren Project. The City's San Pasqual Cactus Wren Project is ongoing and would enhance and restore approximately 100 acres of habitat for the endangered Coastal cactus wren along the north side of San Pasqual Valley.

The GSA Core Team would not be responsible for project implementation and would coordinate with existing partners on the project, including the San Dieguito River Valley Conservancy and the San Dieguito River Park Joint Powers Authority, through the City's PUD.

Public Notice and Outreach

As an ongoing project, partner agencies including the City and the County plus the Cities of Del Mar, Escondido, Poway, and Solana Beach, working directly with local, state, federal and private landowners to obtain right-of-entry permission for invasive species removal. The GSA Core Team would coordinate with existing partners to continue to maximize stakeholder and community involvement and stewardship.

Permitting and Regulatory Process

The GSA Core Team would not be responsible for project implementation and would coordinate with existing partners on the project (i.e., City's PUD, Mission Resource Conservation District, and the Water Authority).

Project Benefits

Invasive non-native plant removal protects and enhances habitat, conserves water resources, protects water delivery and storage systems by reducing flood risk and damage, improves water quality by reducing erosion, and reduces risk of fire. Reducing wildfire fuels would reduce the likelihood of needing to use precious water for wildfire suppression. Giant reed (*Arundo donax*) and pampas grass (*Cortaderia selloana*) in particular are large water users. Eradication of these invasive species in SPV will reduce groundwater use and increase groundwater supply.

Project Implementation

The GSA Core Team would coordinate with existing project partners on project implementation.

Supply Reliability

This project would improve supply reliability through reduced groundwater use of invasive non-native plants, making more water available in the Basin.

Legal Authority

Implementation of this project would require coordination with existing partners.

Project Costs

This project has been ongoing in the Basin since 2012. Project costs for the Proposition 50, San Diego IRWM grant totaled to approximately $3.3 million to eradicate 374 acres of invasive non-native plant species. The project currently monitors and re-treats invasive non-native plants at project sites primarily using regional Natural Community Conservation Planning funds dispersed through the San Diego Association of Governments TransNet program. The GSA would not contribute funds for the implementation of this project.

Technical Justification

This project would increase water supply reliability in the Basin.

Basin Uncertainty

This project would address uncertainty by working towards eliminating invasive non-native plant groundwater usage in the Basin.

CEQA Considerations

Invasive species removal may be subject to CEQA regulations. Existing partners would be responsible for CEQA compliance.

9.8 Management Actions

This section describes the management actions selected for inclusion in this GSP. The majority of these management actions are in Tier 0, which means that they could potentially be implemented by the GSA at any time after the GSP is adopted. There are four Tier 1 management actions, which could potentially be implemented if wells exceed planning thresholds as described in Section 8, *Minimum Thresholds and Measurable Objectives*. There is one Tier 2 management action that could potentially be implemented if five or more wells exceed the minimum thresholds. Tier 1 and Tier 2 management actions would be implemented using the implementation process as described above and shown in Figure 9-4.

Management actions are administrative in nature and are based on locally implemented actions that the GSA could take to affect groundwater sustainability. Most management actions do not require outside approvals, nor do they involve capital projects.

9.8.1 Management Action 1—Farming Best Management Practices (Tier 0)

The GSA would support changes in irrigation practices to encourage sustainability, including irrigation efficiency or sustainable agriculture practices to reduce groundwater quality impacts. Sustainable agriculture practices may include crop rotation, planting cover crops, reducing or eliminating tillage, applying integrated pest management, or adopting agroforestry practices. Because the GSA has limited authority to implement these best management practices (BMPs), the GSA would encourage use of BMPs through education and outreach or encourage collaboration with other entities in the region, including the Farm Bureau and the Water Authority as needed. Participation in the program would be optional.

As an example, the Water Authority recently received a San Diego IRWM grant to implement an agricultural efficiency program in the region. The Agricultural Irrigation Efficiency Program offers agricultural incentives to growers that invest in improving irrigation system efficiency. The Agricultural Irrigation Efficiency Program provides farmers with technical assistance and cost-sharing as reimbursement for recommended irrigation system equipment retrofits that improve distribution uniformity and efficiency. The SPV GSP website will share resources for these types of regional programs to encourage water use efficiency.

Public Notice and Outreach

This management action is an education and outreach program to encourage use of BMPs. Ultimately, participation in this type of program would be voluntary. Success of a program like this would depend on cooperation from water users and would require extensive outreach to agricultural stakeholders.

Permitting and Regulatory Process

Permitting would not be required; this management action would be a voluntary outreach program.

Management Action Benefits

Land use changes would positively impact groundwater use, improve irrigation efficiency, and potentially reduce salt and nutrient loads through manure/fertilizer management. Through partnering with existing programs, the GSA could encourage participation in regional programs that would directly benefit the Basin.

Management Action Implementation

This education and outreach program to encourage farming BMPs would be ongoing. Resources that provide more information about existing programs in the region and that offer rebates or other support would be available on the SPV GSP website. The GSA would coordinate with the Farm Bureau and the Water Authority, which both have existing outreach programs in place to create a successful program tailored to the Basin. Additional grant funding could be pursued to expand the scope and/or extend the length of time a farm BMPs program is implemented.

Supply Reliability

This management action would not rely on water supplies from outside the Basin, as it is a planning effort that will result in conservation. This management action would support overall supply reliability by reducing groundwater pumping in the Basin through education and outreach promoting voluntary farming BMPs.

Legal Authority

Implementing irrigation efficiency upgrades or retrofits would be a voluntary program and specified legal authority would not be required. Individual users would be encouraged to participate in such a program.

Management Action Costs

Cost to the GSA is estimated to be from $40,000 to $50,000 per year. However, the cost to stakeholders to implement various BMPs would range in cost. The GSA would refer stakeholders to existing BMP programs to encourage water use efficiency, and would research local, state, and federal funding opportunities that might be used in complement with the outreach program to lower the barrier to entry for stakeholders.

Technical Justification

Outreach and education surrounding irrigation practices would encourage efficiency, including irrigation efficiency or sustainable agriculture practices. These practices include proper tillage or the using of grass filter strips, as well as integrated pest management. These practices directly impact groundwater supply through reducing groundwater pumping and directly improve groundwater quality through modified agricultural practices.

Basin Uncertainty

Implementing agricultural efficiency and farming BMPs would help increase groundwater supply in the Basin through reduced pumping. If groundwater extraction causes an undesirable result, the availability of reliable groundwater supplies would become increasingly uncertain.

CEQA Considerations

CEQA compliance is not required for an education and outreach program encouraging use of BMPs.

9.8.2 Management Action 2—Education and Outreach to Encourage Demand Softening (Tier 0)

To encourage water-use efficiency in the Basin, the GSA would conduct education and outreach to water users in the Basin. The outreach program would encourage landowners to reduce acreage of permanent crops, or encourage converting high water use crops to low water use crops. Participation in the program would be voluntary. The GSA would coordinate with the Farm Bureau and the Water Authority, which has existing outreach programs in place.

Public Notice and Outreach

This management action is an education and outreach program. This voluntary program would aim to reduce groundwater extraction in the Basin without implementing pumping restrictions or enforcement (i.e., Management Action 11—Pumping Restrictions and Enforcement). The success of this voluntary program would depend on cooperation among water users and would require extensive outreach to agricultural stakeholders.

Permitting and Regulatory Process

Permitting would not be required for this management action, which is a voluntary education and outreach program.

Management Action Benefits

This voluntary education and outreach program has the potential to reduce total agricultural water use by encouraging reduction in the amount of high water use crops in the Basin. Benefits would be measured by the change in total AFY of groundwater savings. This would depend on crop type and would vary by individual user.

Management Action Implementation

This education and outreach program would be ongoing. Resources that provide more information about reducing acreage of permanent crops or changing high water use crops to low water use crops would be available on the SPV GSP website. The GSA would coordinate with the Farm Bureau and the Water Authority, which has outreach programs in place that could help create a successful program tailored to the Basin.

Supply Reliability

Because it is a planning effort that would result in conservation, this education and outreach program does not rely on water supplies from outside the Basin. This education and outreach program would support overall supply reliability by reducing overdraft in the Basin and by moving the Basin toward sustainability.

Legal Authority

Implementing an education and outreach program in the Basin does not require additional specified legal authority.

Management Action Costs

Estimated cost for an education and outreach program would be from $10,000 to $15,000 per year. However, the cost to encourage or incentivize stakeholders to participate in a voluntary program may be substantially higher. The GSA would research local, state, and federal funding opportunities that could complement/support this program.

Technical Justification

A change in crop type and reduction of high-water intensive crops would directly impact groundwater supply through reduced groundwater pumping.

Basin Uncertainty

The Basin is currently considered sustainable. However, this management action would provide an opportunity to reduce groundwater pumping through voluntary reduction if the Basin were approaching undesirable results. Pumping restrictions and enforcement would be avoided if users voluntarily reduced groundwater use to avoid undesirable results. If groundwater extraction causes an undesirable result, the availability of reliable groundwater supplies may become increasingly uncertain.

CEQA Considerations

CEQA compliance would not be required for education and outreach.

9.8.3 Management Action 3—Support WQIP Actions (Tier 0)

The WQIP includes example strategies that the City could use to address discharges of nutrients and other pollutants through activities in its jurisdiction, including in the GSA's area. One example strategy listed in the WQIP is agricultural lease renewals. This strategy incorporates nutrient-focused Best Management Practices (BMPs). Another strategy that the WQIP lists is implementing an enhanced residential drive-by inspection such that Residential Management Areas in the upper San Dieguito River WMA are inspected at a higher frequency than is required by the Municipal permit (which is at least once every 5 years). In addition to identifying illicit connections, illegal discharges, and other potential pollutant discharges, inspectors also look for evidence of improper

BMP implementation related to manure management in rural residential areas with equestrian and livestock activities.

Public Notice and Outreach

Public notice and outreach would be completed by the City's Internal Departments as needed.

Permitting and Regulatory Process

The GSA is not responsible for the implementation of this project. The City's Internal Departments would be responsible for following the proper regulatory and permitting process for any implemented actions.

Management Action Benefits

This strategy may be implemented through the City's WQIP to improve and protect water quality. Through coordination with the City's Internal Departments, the GSA would also experience benefits in the Basin without direct cost.

Management Action Implementation

The agricultural lease renewal strategy listed in the WQIP is only an example. Therefore, the implementation process is unknown.

Supply Reliability

Implementation of this management action does not impact supply reliability.

Legal Authority

Implementation of this project would require coordination with the implementing agency (i.e., the City's Internal Departments).

Management Action Costs

The GSA would not contribute funds toward implementation of this management action. City's Internal Departments and WQIP co-permittees would fund these efforts.

Technical Justification

Any actions or strategies implemented through the WQIP would be further analyzed by the implementing agency.

Basin Uncertainty

Implementation of this project could improve Basin groundwater quality. It would help address uncertainty in the Basin water supply by maintaining communication among regional entities by using existing forums for information sharing. This would also help the GSA better understand, anticipate, and address uncertain conditions in the Basin.

CEQA Considerations

CEQA compliance may be required for these project actions.

9.8.4 Management Action 4—Coordinate and Collaborate Regionally with Other Entities to Perform Monitoring and Implement Regional Projects (Tier 0)

Collaboration with other entities in the region would benefit the Basin. This management action would involve coordinating with other monitoring entities or encouraging the implementation of regional projects.

To encourage collaboration and implement regional projects in the watershed, the GSA may collaborate with regional entities such as the San Diego IRWM Program. The San Diego IRWM Program is an interdisciplinary effort led by water retailers, wastewater agencies, stormwater and flood managers, watershed groups, the business community, Native American tribes, the agricultural community, and nonprofit stakeholders to improve water resources planning in the San Diego IRWM Region. IRWM as a practice is aimed at developing long-term water supply reliability, improving water quality, and protecting natural resources. Both the City and County staff serve on the San Diego IRWM Regional Advisory Committee. Through collaboration among participating agencies, the GSA could encourage regional projects that would improve Basin conditions.

Public Notice and Outreach

This management action consists of coordination among the GSA and with other entities in the region. Public participation would be determined on a case-by-case basis.

Permitting and Regulatory Process

This management action involves coordination meetings and would not require permits or regulatory approvals to implement. If collaboration leads to the recommendations of any regional projects or improvements to the monitoring network, project implementation would be subject to the appropriate permitting and regulatory processes.

Management Action Benefits

This management action leverages the efforts of other monitoring and regional entities for increased benefits to the GSA's area. Improved coordination could leverage the efforts of other monitoring entities and improve knowledge of the Basin.

Management Action Implementation

This management action would be implemented as the opportunity arises.

Supply Reliability

If collaboration with entities in the region led to the implementation of a project that increased groundwater levels in the Basin, then this management action would increase supply reliability.

Legal Authority

Coordination and collaboration with other agencies do not require specific legal authority conferred by SGMA.

Management Action Costs

Estimated cost to the GSA ranges from $10,000 to $15,000 per year in staff time.

Technical Justification

Regional collaboration increases the efficiency of regional water management as all organization reach for a common goal.

Basin Uncertainty

Implementation of this project could improve Basin groundwater quality or groundwater levels. It could also help address uncertainty in the Basin by maintaining communication among regional entities and using existing forums for information sharing. This would help the GSA better understand, anticipate, and address uncertain conditions in the Basin.

CEQA Considerations

Any projects resulting from increased collaboration with regional and monitoring entities would be designed and constructed in compliance with applicable standards and regulations. CEQA compliance may be required depending on the created project.

9.8.5 Management Action 5—Education and Outreach for TDS and Nitrate (Tier 0)

As discussed in Section 8.5, degraded water quality from TDS and nitrate concentrations is the result of a number of factors that are beyond GSA control. However, residents in the Basin who rely upon groundwater for their potable supply would benefit from increased information about potential water quality issues in the Basin. The GSA would conduct outreach and education to water users in the Basin to provide an update on water quality monitoring results and to provide a forum to discuss potential water quality issues and options. The GSA intends on utilizing components of the *Framework for a Drinking Water Well Impact Mitigation Program* (Self-Help Enterprises et al., undated) to guide GSA outreach activities and potential corrective action recommendations.

Public Notice and Outreach

This management action is an education and outreach program. This program would aim to educate about Basin conditions, communicate the importance of water quality testing, and discuss potential options and implications of degraded water quality for TDS and nitrate.

Permitting and Regulatory Process

Permitting would not be required for this management action, which is an education and outreach program.

Management Action Benefits

This education and outreach program has the potential to provide information to Basin residents, particularly domestic users, about the potability of their wells. Benefits would be measured by stakeholder participation in the Basin.

Management Action Implementation

This education and outreach program would be ongoing. Resources that provide more information about water quality issues would be available on the SPV GSP website.

Supply Reliability

Implementation of this management action does not impact supply reliability.

Legal Authority

Implementing an education and outreach program in the Basin does not require additional specified legal authority.

Management Action Costs

Estimated cost for an education and outreach program would be from $10,000 to $15,000 per year.

Technical Justification

Increased education would allow stakeholders to make informed decisions regarding their potable water supply.

Basin Uncertainty

Implementation of this program could improve potable water supply for Basin residents.

CEQA Considerations

CEQA compliance would not be required for education and outreach.

9.8.6 Management Action 6— Coordinate with City on Hodges Watershed Improvement Project (Tier 0)

The Hodges Watershed Improvement Project consists of two subprojects 1) a San Pasqual Valley Resource Management Plan (SPVRMP) and associated BMP implementation, and 2) San Dieguito Watershed Habitat Restoration (SDWHR) for ecosystem enhancement. The primary benefit of the SPVRMP is the implementation of a minimum of five (5) BMPs. The primary benefit of the SDWHR project is the restoration of a minimum of 17 acres of habitat. This management action would use habitat restoration and BMPs to improve water quality and reduce soil salinity by removing invasive salt cedar and reducing sediment and nutrient loading in Basin and downstream in Hodges Reservoir.

- *Subproject 1*: The SPVRMP would include guidance for agricultural lessees, non-agricultural lessees, and the City to prioritize, select, and implement BMPs to reduce stormwater runoff from agricultural and non- agricultural sites. Implementation of the SPVRMP would result in the reduction of erosion from agricultural and non-agricultural sites and an improvement to downstream water quality through the implementation of self-selected BMPs by the City and agricultural lessees. A minimum of 5 BMPs would be implemented.
- *Subproject 2*: The SDWHR would consist of habitat restoration in the San Dieguito Watershed above Hodges Reservoir. Habitat restoration would involve the removal of invasive species and replanting with native species, where appropriate. Restoration would primarily occur in the eastern portion of San Pasqual Valley and would focus on the removal of salt cedar (Tamarix sp.), gum tree (Eucalyptus sp.), and giant reed (Arundo donax). Removal of invasive species reduces water uptake by notorious water consumptive species. Enhanced native vegetation would uptake nutrients that would otherwise reach the Basin and the reservoir waters. Other ecosystem services that are expected to be enhanced include improved habitat for wildlife and erosion control. A minimum of 17 acres would be restored.

The Hodges Watershed Improvement Project is being managed by the City's PUD as part of an IRWM grant in coordination with the Water Authority.

Public Notice and Outreach

Public notice and outreach would be completed by the City's PUD as needed. A stakeholder workshop to gather feedback on drafts of the SPVRMP and the SDWHR's conceptual habitat restoration plan is planned for late 2021.

Permitting and Regulatory Process

The GSA is not responsible for the implementation of this project. The City's PUD would be responsible for following the proper regulatory and permitting process for any BMPs or restoration actions through the Hodges Watershed Improvement Project.

Management Action Benefits

The Hodges Watershed Improvement Project would improve and protect water quality. Through coordination with the City's PUD, the GSA would also experience benefits in the Basin without direct cost.

Management Action Implementation

The BMPs listed in the SPVRMP are still being implemented.

Supply Reliability

Implementation of this management action does not impact supply reliability.

Legal Authority

Implementation of this project would require coordination with the City's PUD and does not require additional specified legal authority.

Management Action Costs

The GSA would not contribute funds toward implementation of this management action. The City's PUD and the Water Authority would fund these efforts.

Technical Justification

Any actions or strategies implemented through the Hodges Watershed Improvement Project would be further analyzed by the implementing agency.

Basin Uncertainty

Implementation of this project would improve Basin groundwater quality by removing invasive salt cedar and reducing sediment and nutrient loading. It would help address uncertainty in the Basin by producing a SPVRMP that is accessible to the public and by maintaining communication among regional entities through the use of forums for information sharing. This would also help the GSA better understand, anticipate, and address uncertain conditions in the Basin.

CEQA Considerations

Any necessary CEQA compliance required for various sub projects in the Hodges Watershed Improvement Project would be completed as necessary by the City's PUD.

9.8.7 Management Action 7—Initial Surface Water Recharge Evaluation (Tier 0)

This management action involves completing an initial investigation to identify potential surface water recharge projects that warrant further analysis, and a preliminary feasibility analysis study.

If benefits and feasibility for a recharge project are determined to be acceptable by the GSA, the GSP will be updated to identify next steps and associated Tier 0, Tier 1, and/or Tier 2 management actions. To the extent that the GSA identifies a recharge project that relies on a surface water supply controlled by a third-party (including the City or neighboring jurisdictions), the third-party must agree that the project is feasible and consent to implementation of the project. A preliminary assessment (see Appendix N) of Sutherland Reservoir as surface water supply was conducted as part of the development of this management action.

Public Notice and Outreach

Public outreach will include posted notices, email announcements, or public workshops/meetings to engage stakeholders in the investigation of surface water recharge options. The Initial Surface Water Recharge Evaluation for Sutherland or any other surface water supply would be circulated for public comment before it was finalized and approved by the GSA.

Permitting and Regulatory Process

Completing an Initial Surface Water Recharge Evaluation would not require any permitting, but would require consideration of existing water rights associated with potential surface water supplies, water use, and applicable agreements, in addition to any regulations associated with groundwater replenishment in the Basin.

Management Action Benefits

An Initial Surface Water Recharge Evaluation would help the Basin achieve desired groundwater levels, groundwater storage, groundwater quality, and reductions in negative impacts to surface water flows through direct replenishment.

Management Action Implementation

The Initial Surface Water Recharge Evaluation would involve completing a feasibility study to identify and evaluate options for surface water recharge. Developing an Initial Surface Water Recharge Evaluation is estimated to take one to two years. The GSA will use the Initial Surface Water Recharge Evaluation to determine the benefits to the Basin, and feasibility of implementation, of a potential recharge project, including but not limited to feasibility related to the avoidance of the unreasonable waste of water. In addition, potential impacts to existing users of this water source would be evaluated. Based on an assessment of these factors, if the GSA determines that a project warrants inclusion in the GSP, the GSP may be updated to identify next steps and include associated Tier 0, Tier 1, and/or Tier 2 management actions. The GSA does not presently possess the information and science requisite to fully assess the benefits and feasibility of any potential resulting management actions, but any identified management actions will be supported by the best available information and science.

The City would be responsible for public outreach, costs, and coordination with necessary agencies and/or departments related to the Initial Surface Water Recharge Evaluation.

Supply Reliability

Completing an Initial Surface Water Recharge Evaluation relies on water supplies from outside the Basin for implementation. An Initial Surface Water Recharge Evaluation would identify groundwater replenishment sources to support overall supply reliability and maintenance of Basin sustainability.

Legal Authority

The GSA has the authority to conduct an investigation for the purposes of SGMA, and acquire surface water and import surface water into the Basin to carry out the provisions of SGMA, including percolating water into the soil (CWC Section 10725.4(a), 10726.2(b). As the owner/operator of upstream Sutherland Reservoir and a member of the SPV GSA, the City of San Diego has the authority to explore surface water recharge options that may involve Sutherland Reservoir releases.

Management Action Costs

Developing an Initial Surface Water Recharge Evaluation is estimated to cost approximately $300,000-$500,000. It is anticipated the City would fund this management action.

Technical Justification

Surface water recharge involving reservoir releases from Sutherland Reservoir upstream of the Basin would directly increase groundwater replenishment. Analysis and modeling would need to justify use of reservoir releases to benefit groundwater storage in the Basin without unreasonable supply losses to ET and basin outflows. According to a preliminary assessment (see Appendix N), some of the groundwater recharge from additional Sutherland Reservoir releases would cause increases in groundwater discharge to streams and the land surface, ET, and basin outflows. A more comprehensive evaluation would need to be completed to better understand the cost-benefit and operational feasibility of surface water recharge projects. Such an evaluation would need to consider operational rules and priority setting to balance competing demands of Sutherland Reservoir.

Basin Uncertainty

Developing an Initial Surface Water Recharge Evaluation would provide an opportunity to reduce overdraft-related uncertainty in the Basin by ensuring groundwater replenishment.

CEQA Considerations

Development of an Initial Surface Water Recharge Evaluation is not subject to CEQA. Should a surface water recharge project be proposed for implementation, CEQA analysis will be completed at that time.

9.8.8 Management Action 8—Study Groundwater Dependent Ecosystems (Tier 1)

GDEs are defined in the SGMA regulations as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." SGMA does not require establishing additional sustainable management criteria to specifically manage GDEs, but rather includes GDEs as a beneficial user of water to be considered when developing other sustainable management criteria. As described in Section 8.7, the planning thresholds defined for interconnected surface water are used to identify when a detailed study of GDEs would be needed. Once the planning thresholds are reached, the GSAs will conduct a desk-top study or aerial map review of the Basin to investigate the areas of concern. This investigation will determine the detailed scope of the GDEs Study, if warranted.

Because GDEs are considered a potential beneficial user of groundwater in the Basin, it is important to confirm the presence of GDEs and understand trends in plant health related to groundwater conditions. This management action would entail developing a detailed GDEs Study for this purpose. As discussed in Section 2, Plan Area, the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset is used to estimate GDE location. Because the NCCAG dataset includes a number of estimates, DWR recommends that a biologist verify NCCAG-identified locations. For this study, a wetland biologist would identify locations from the NCCAG dataset and GDEs Technical Memorandum prepared for this plan (see Appendix J) using remote sensing techniques, and would then verify the GDE locations in the field. The GDEs Study would evaluate access to groundwater supplies based on depth to groundwater, subsurface flows, and adjacency to agricultural return flows; and will integrate remote sensing indices of the plant health to assess potential adverse effects of declining groundwater levels on the potential GDEs, which may be then incorporated into future GSP monitoring plans.

Public Notice and Outreach

Although specific public notice and outreach is not required to conduct a GDE study, study results would be included in the GSA's annual or 5-year evaluation report and made available to stakeholders when completed.

Permitting and Regulatory Processes

No permits or regulatory approvals would be required to complete this study.

Management Action Benefits

This management action would not provide direct benefits as related to water supply or groundwater sustainability. It would provide information for the GSA Core Team to consider regarding future groundwater management in focused GDE locations. This expanded understanding of GDEs could help reduce the potential for adverse impacts to GDEs by improving understanding of their location and rooting depths.

Management Action Implementation

Initial desk-top study to investigate areas of concern would be completed within 6 months to 1 year. If warranted, full-scale study to assess the location and health of GDEs within the Basin would be completed in an additional 1 year once initiated.

Supply Reliability

The implementation of this management action does not impact supply reliability.

Legal Authority

CWC Section 10725.4 authorizes the GSA to conduct investigations of this type to determine the need for groundwater management in the Basin.

Management Action Costs

Based on an estimate of fees for a biologist and expenses required to complete the study, it is estimated a GDE study could cost between $100,000 to $200,000.

Technical Justification

SGMA requires the identification of GDEs to avoid adverse impacts to habitat and wildlife resulting from the potential depletion of interconnected surface water.

Basin Uncertainty

The purpose of this management action is to reduce uncertainty surrounding the location of GDEs in the Basin.

CEQA Considerations

This management action is exempt from CEQA, per CEQA Guidelines Section 15306.

9.8.9 Management Action 9—Well Inventory (Tier 1)

This management action may be initiated following the exceedance of the planning thresholds in at least five wells (refer to Section 8, *Minimum Thresholds and Measurable Objectives*). The GSA would inventory wells that may produce more than two-acre feet of water per year (i.e., non-de minimis extraction wells) and are potentially in the Basin, to improve its ability to manage the Basin. The well inventory would identify and compile information about wells that are potentially located in the Basin. Additional studies may be completed to help further the understanding of the Basin. Compilation of the well inventory may include the following:

- Review records to obtain well construction information
- Coordinate with landowners/leaseholders
- Complete field visits to verify well location and size
- Conduct video logging of selected wells with unknown well construction
- Determine which wells are in the Basin
- Investigate well interaction with surface water in the Basin
- Compile estimates or meter readings of water pumped

Public Notice and Outreach

Completion of this management action would require cooperation from water users, landowners, and leaseholders to identify all wells and determine if the wells are within Basin boundaries. Implementation of this management action would require extensive coordination with well owners and cooperation on water use.

Permitting and Regulatory Processes

No permits or regulatory approvals would be required to complete a well inventory.

Management Action Benefits

The purpose of delineating which wells are located in the Basin would be to improve the accuracy of monitoring and pumping measurement, and to develop a better understanding of which wells are pumping water from the Basin. Completion of this management action would be needed before Management Action 9—Basinwide Metering Program, and Management Action 11—Pumping Restrictions and Enforcement, can be implemented.

Management Action Implementation

The GSA would complete the well inventory. This management action may take from 1 to 3 years depending on availability of well information and level of cooperation among existing groundwater users.

Supply Reliability

Implementation of this management action does not impact supply reliability. However, by determining which wells are located within the Basin, the GSA gains a better understanding of groundwater use and users, which would contribute to maintaining supply reliability.

Legal Authority

Pursuant to CWC Section 10725.4, the GSA has the legal authority to conduct an investigation to determine the need for groundwater management in the Basin.

Management Action Costs

A well inventory may cost between $100,000 and $200,000 depending on the need for field surveys and/or additional analysis.

Technical Justification

To investigate the cause of an any planning threshold exceedance, the GSA would have to determine which wells are located within the Basin and contribute to Basin conditions.

Basin Uncertainty

The purpose of this management action would be to reduce uncertainty about which wells are located within the Basin, and impacting Basin conditions. Without an accurate understanding of wells in the Basin, uncertainty may hinder the GSA from managing groundwater use in the Basin.

CEQA Considerations

Completion of a well inventory is exempt from CEQA, per CEQA Guidelines Section 15306.

9.8.10 Management Action 10—Basinwide Metering Program (Tier 1)

This management action may be initiated following the exceedance of the planning thresholds in at least five wells (refer to Section 8, *Minimum Thresholds and Measurable Objectives*). To improve measurement of groundwater use and to improve the GSA's understanding of pumping in the Basin, this management action would install meters on non-de minimis extraction wells. Installed meters could be upgraded meters with encoder receiver transmitters if needed. The encoder receiver transmitters and new meters would allow for remote reading of flow via a radio signal to a radio receiver inside a vehicle or at a fixed location.

Public Notice and Outreach

The implementation of this management action would require extensive coordination with well owners and the GSA will reach out directly to impacted stakeholders.

Permitting and Regulatory Process

There are no permitting or regulatory requirements for a basinwide metering project at this time.

Management Action Benefits

This management action addresses chronic lowering of groundwater levels by enhancing water conservation through increased understanding of groundwater pumping. Individual meters on Basin groundwater extraction wells would provide pumping data for each well, improving understanding of the Basin overall.

Management Action Implementation

It is estimated meter installation could be completed over the span of one to two years. Successful implementation of this management action would require the completion of Management Action 8—Well Inventory.

Supply Reliability

This management action would improve supply reliability through an improved understanding of groundwater extraction in the Basin.

Legal Authority

Pursuant to CWC Section 10725.8, the GSA has authority to require meters on production wells in the Basin.

Management Action Costs

Implementation may range in cost from $50,000 to $200,000. Implementation of this management action would need to be preceded by Management Action 8—Well Inventory, which would determine the number of extraction wells in the Basin that are not metered. Approximately ninety percent of the leaseholder wells within the City's jurisdiction are metered. The City initiated a phased metering program approximately ten years ago and has been adding new meters every spring when funding is available.

Technical Justification

To investigate the cause of a planning threshold exceedance, the GSA must have a detailed understanding of groundwater pumping in the Basin. Installing meters on non-de minimis wells would provide the data necessary to make management decisions that would maintain sustainable use.

Basin Uncertainty

Meters on individual non-de minimis extraction wells would provide a more detailed understanding of groundwater pumping in the Basin, reducing uncertainty about which wells impact Basin conditions.

CEQA Considerations

This management action is not subject to CEQA compliance; installing meters would be exempt under CEQA Guidelines Section 15303.

9.8.11 Management Action 11—Pumping Reduction Plan (Tier 1)

This management action may be initiated following the exceedance of planning thresholds in at least five wells (refer to Section 8, *Minimum Thresholds and Measurable Objectives*). A plan for implementation of pumping reductions would be developed as the GSA continues to monitor groundwater levels below the planning thresholds as follows:

- Evaluate current and historic groundwater use for each non-de minimis groundwater user in the Basin
- Evaluate area(s) in the Basin that may benefit from focused reductions or limits on increased groundwater use
- Develop recommended reductions or limits
- Develop implementing rules and regulations
- Develop a timetable for implementation

As the Basin is sustainable at current pumping levels, it is expected that users would not be required to reduce pumping over time, but may be limited in how much pumping could be increased in the future.

Public Notice and Outreach

Developing a Pumping Reduction Plan would require substantial public input to help inform the GSA about the potential impacts of pumping restrictions on groundwater users in the Basin. Public outreach could include posted notices, email announcements, and public workshops/meetings.

Permitting and Regulatory Process

Developing a Pumping Reduction Plan would not require any permitting, but would require consideration of existing water use and applicable permits in addition to any regulations associated with groundwater pumping in the Basin. The Pumping Reduction Plan may require adoption by City Council and County Board.

Management Action Benefits

A Pumping Reduction Plan would help the Basin achieve sustainable pumping levels through direct reductions in groundwater overdraft.

Management Action Implementation

Successful completion of this management action may first require completing Management Action 9—Well Inventory, and Management Action 10—Basinwide Metering Program for an accurate pumping quantification.

Developing a Pumping Reduction Plan would be based on identifying unsustainable groundwater pumping practices in the Basin. Currently, the Basin is considered sustainable; however, if there is an extended drought or if groundwater pumping increased in the future causing the Basin to approach undesirable results, then the GSA could implement a Pumping Reduction Plan to directly reduce or limit groundwater pumping. Developing a Pumping Reduction Plan is estimated to take two to three years, with restrictions implemented the following year, if needed.

Supply Reliability

Developing a Pumping Reduction Plan does not rely on water supplies from outside the Basin, as it is a planning effort that would result in conservation. A Pumping Reduction Plan would support overall supply reliability by maintaining Basin sustainability.

Legal Authority

Pursuant to CWC Section 10726.4, the GSA has the authority to develop a Pumping Reduction Plan. The Pumping Reduction Plan is expected to require adoption by City Council and County Board after development.

Management Action Costs

Developing a Pumping Reduction Plan is estimated to cost approximately $100,000 to $200,000 to conduct the analysis, set up the measurement and tracking system, and conduct outreach.

Technical Justification

Pumping reductions would directly reduce groundwater pumping. A Pumping Reduction Plan would develop allocations that clearly describe both the methodology used and justification for the methodology when establishing pumping reductions or limits.

Basin Uncertainty

Developing a Pumping Reduction Plan would provide an opportunity to reduce overdraft-related uncertainty in the Basin by ensuring long-term sustainability of groundwater use.

CEQA Considerations

Development of a Pumping Reduction Plan may be subject to CEQA.

9.8.12 Management Action 12—Pumping Restrictions and Enforcement (Tier 2)

This management action may be initiated following the exceedance of minimum thresholds in at least five wells (refer to Section 8, *Minimum Thresholds and Measurable Objectives*). A plan for implementation of this action would first be developed following the exceedance of planning thresholds in at least five wells (refer to Management Action 11—Pumping Reduction Plan). Under this action, the GSA could implement pumping restrictions to limit groundwater use in accordance with the Pumping Reduction Plan. Enforcement would be through fee assessments and/or penalties.

Public Notice and Outreach

Implementing pumping restrictions would require substantial public input to help communicate the need for reductions/limitations and to notify groundwater users of specific restrictions.

Permitting and Regulatory Process

Implementation of pumping restrictions is unlikely to require permitting. The GSA will adhere to necessary regulatory requirements prior to assessing fees or implementing penalties (e.g., CWC Section 10730).

Management Action Benefits

Implementation and enforcement of a pumping reduction plan would directly reduce groundwater pumping. Benefits would be measured by the change in total volume of groundwater pumped from the Basin.

Management Action Implementation

Successful completion of this management action would first require completing Management Action 10—Pumping Reduction Plan.

Successful implementation would require cooperation from groundwater users in the Basin. The GSA would be responsible for public outreach and plan enforcement. Mechanisms for enforcement would be outlined in the Pumping Reduction Plan. Enforcement may include levying fees, assessments, or penalties.

Supply Reliability

Reduced pumping would support overall supply reliability and moving the Basin toward sustainability.

Legal Authority

Pursuant to CWC Section 10726.4, the GSA has the authority to implement a Pumping Reduction Plan. The Pumping Reduction Plan is expected to require adoption by City Council and County Board prior to implementation.

Management Action Costs

Costs to implement pumping reductions would depend on the level of enforcement and outreach required to achieve allocation targets. A Pumping Reduction Plan would include a cost estimate for enforcement and implementation. Costs are estimated to be approximately $50,000 to $100,000 per year for implementation/O&M.

Technical Justification

Pumping reductions would directly reduce groundwater pumping. A Pumping Reduction Plan would clearly describe both the methodology used and justification for the methodology when establishing pumping reductions.

Basin Uncertainty

The Basin is currently considered sustainable. However, this management action would provide an opportunity to reduce groundwater level declines if the Basin were approaching undesirable results. If groundwater extraction causes an undesirable result, the availability of reliable groundwater supplies would become increasingly uncertain. Reduced pumping would provide an opportunity to reduce uncertainty in the Basin water supply to ensure sustainable management of groundwater.

CEQA Considerations

Pumping reductions may be subject to CEQA.

Section 10. IMPLEMENTATION

While groundwater use in the Basin is currently sustainable, the GSA will implement the SPV GSP as required by SGMA to ensure the sustainable management of groundwater resources in perpetuity. The SPV GSP includes the following tasks:

- Conduct outreach and meetings including public meetings, GSA Core Team meetings, website maintenance, and education and outreach related to basin management.
- Implement a monitoring program including continued groundwater level and quality monitoring, and the completion of groundwater monitoring improvements.
- Pursue funding opportunities.
- Develop annual reports.
- Develop the required 5-year evaluation reports for the GSP, including numerical model updates and an annual land use inventory.
- Implement projects and management actions on an as-needed basis as described in Section 9, *Projects and Management Actions.*

This section describes the contents of both an annual and a 5-year evaluation report; these reports must be provided to DWR as required by SGMA regulations and describe SGMA implementation activities and related projects.

10.1 Implementation Schedule

Figure 10-1 illustrates the GSP's implementation schedule. Additional details about activities included in the schedule have been described in Section 9, *Projects and Management Actions*. The GSA's schedule for GSP implementation spans from 2022 to 2042; the schedule below highlights high-level activities anticipated for each 5-year period. Because the Basin is currently considered sustainable, projects and management actions would only be implemented on an as-needed basis, and they are not currently included in the schedule.

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ID	Task Name	Duration	Start	Finish
1	**San Pasqual Valley Basin GSP Implementation**	**5458 days?**	**Mon 1/31/22**	**Wed 12/31/42**
2	**Program Management and Reports**	**5458 days**	**Mon 1/31/22**	**Wed 12/31/42**
3	Plan submittal to the State	1 day	Mon 1/31/22	Mon 1/31/22
4	GSA Administration	5457 days	Tue 2/1/22	Wed 12/31/42
5	**Annual Reports**	**5218 days**	**Fri 4/1/22**	**Tue 4/1/42**
27	Numerical Model Updates 1	500 days	Wed 1/1/25	Tue 12/1/26
28	Annual Land Use Inventory 1	500 days	Wed 1/1/25	Tue 12/1/26
29	Five Year Report/Interim Target Evaluation 1	0 days	Fri 1/29/27	Fri 1/29/27
30	Numerical Model Updates 2	500 days	Tue 1/1/30	Mon 12/1/31
31	Annual Land Use Inventory 2	500 days	Tue 1/1/30	Mon 12/1/31
32	Five Year Report/Interim Target Evaluation 2	0 days	Fri 1/30/32	Fri 1/30/32
33	Numerical Model Updates 3	500 days	Mon 1/1/35	Fri 11/28/36
34	Annual Land Use Inventory 3	500 days	Mon 1/1/35	Fri 11/28/36
35	Five Year Report/Interim Target Evaluation 3	0 days	Fri 1/30/37	Fri 1/30/37
36	Plan Updates (as needed)	4152 days	Sun 1/31/27	Mon 12/29/42
37	**Public Outreach and Meetings**	**5457 days?**	**Tue 2/1/22**	**Wed 12/31/42**
38	Public Outreach and Meetings	5457 days	Tue 2/1/22	Wed 12/31/42
39	GSA Core Team Meetings			
40	Outreach and Website Maintenance	5457 days	Tue 2/1/22	Wed 12/31/42
41	**GSA Core Team Meetings**	**5218 days**	**Fri 7/1/22**	**Tue 7/1/42**
62	**Public Workshops**	**5218 days**	**Thu 9/1/22**	**Mon 9/1/42**
83	**Monitoring Programs**	**5457 days?**	**Tue 2/1/22**	**Wed 12/31/42**
84	Groundwater level and groundwater quality monitoring	5457 days	Tue 2/1/22	Wed 12/31/42
85	Complete groundwater monitoring improvements	979 days?	Tue 2/1/22	Fri 10/31/25
86	**Projects and Management Action Implementation**	**5400 days**	**Mon 1/31/22**	**Fri 10/10/42**
87	Evaluate monitoring reports to ensure no threshold exceedances have occured	270 mons	Mon 1/31/22	Fri 10/10/42
88	Evaluate Projects and Management Actions as needed	270 mons	Mon 1/31/22	Fri 10/10/42

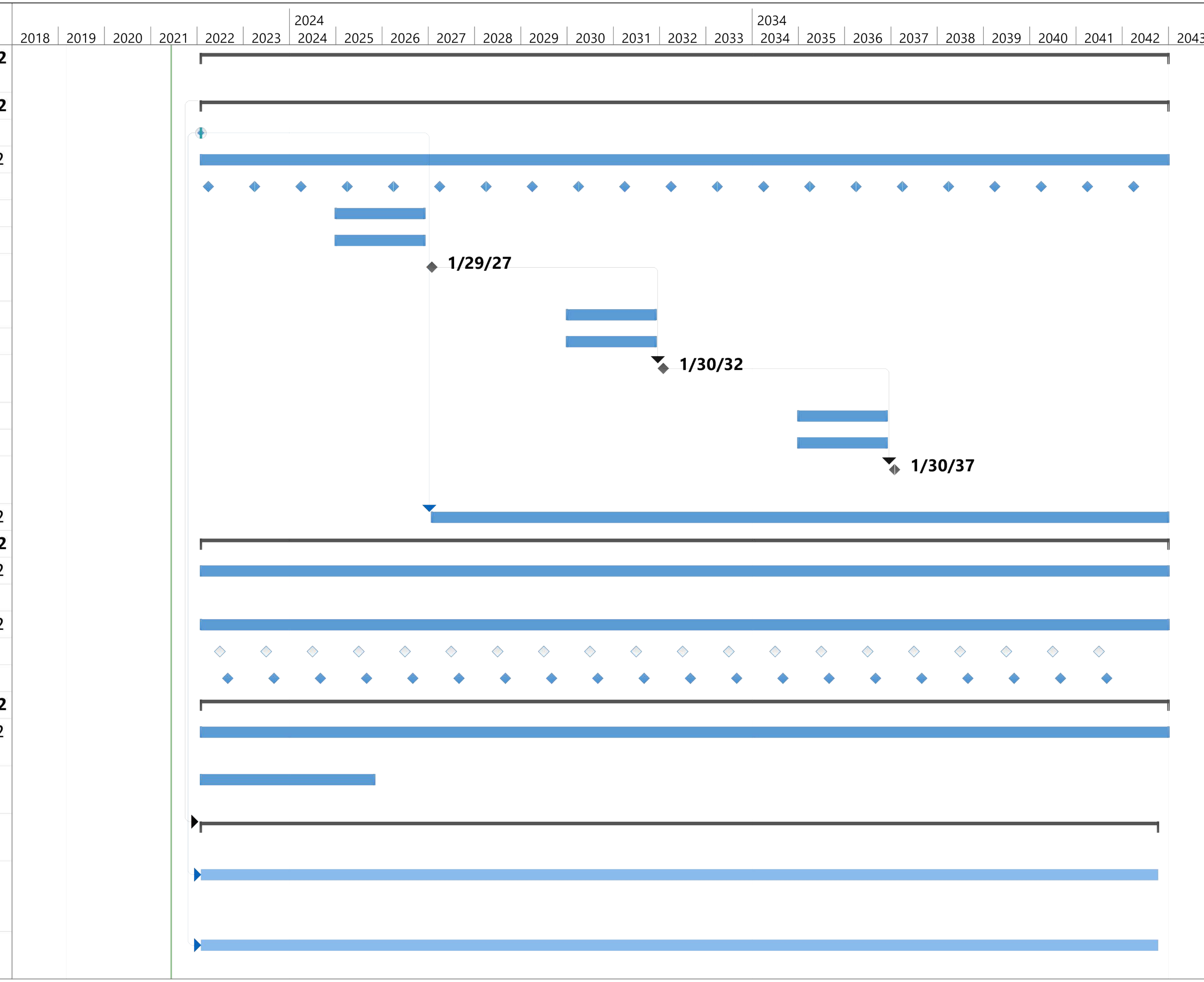

Figure 10-1

San Pasqual Valley GSP

GSP Implementation Schedule

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10.2 Implementation Costs and Funding Sources

GSA operations and GSP implementation will incur costs, which will require funding by the GSA. The four primary activities that will incur costs are listed below.

- Implementing GSP-related projects and management actions as-needed
- GSA Core Team operations and program management
- Developing annual reports
- Developing 5-year evaluation reports

Table 10-1 lists the estimated budgets for these activities. These estimates will be refined during GSP implementation and as more information becomes available. The total estimated GSP implementation cost for the anticipated 20-year implementation period is expected to range from about $5.9 to $11.3 million.

Table 10-1. San Pasqual Valley GSA and GSP Implementation Costs

Activity	Estimated Cost
GSP Program Management	
Oversight and coordination	$40,000–60,000 per year
Pursue funding opportunities	By application type: State: $45,000–$60,000 Federal: $50,000+
Public Outreach and Meetings	
Public Meetings	$15,000–$30,000 per year
GSA Core Team Meetings	$20,000–$40,000 per year
Outreach and Website Maintenance	$5,000–$15,000 per year
Monitoring Programs	
Groundwater level monitoring	$20,000–$30,000 per year
Groundwater quality monitoring	$20,000–$30,000 per year
Maintain digital management system (DMS)	$20,000 per year
Optional groundwater monitoring improvements	$150,000–$200,000 per new well construction
Annual Reports	
Develop Annual Reports	$40,000–$65,000 per year
Annual Land Use Inventory	$10,000-$20,000 per year
5-Year Evaluation Reports	
Develop 5-year Evaluation Reports	$100,000–$300,000
As-Needed Numerical Model Updates	$75,000–$300,000
Land Use Inventory	$10,000–$20,000
Projects and Management Actions (Tier 0)	
Project 1—Coordinate with the City of San Diego on the Construction of Infiltration Basins at San Pasqual Union Elementary	No cost to the GSA
Project 2—Coordinate on the Implementation of Invasive Species Removal	No cost to the GSA

Table 10-1. San Pasqual Valley GSA and GSP Implementation Costs

Activity	Estimated Cost
Management Action 1—Farming Best Practices	$40,000–$50,000 per year dependent on BMP
Management Action 2—Education and Outreach to Encourage Demand Softening	$10,000–$15,000 per year
Management Action 3—Support Water Quality Improvement Project Actions	No cost to the GSA
Management Action 4—Coordinate and Collaborate with Other Entities to Perform Monitoring and Implement Regional Projects	$10,000–$15,000 per year
Management Action 5—Education and Outreach about TDS and Nitrate	$10,000-$15,000 per year
Management Action 6—Coordinate with City on Hodges Watershed Improvement Project	No cost to the GSA
Management Action 7—Initial Surface Water Recharge Evaluation	$300,000-$500,000
Projects and Management Actions (Tier 1)	
Management Action 8—Study GDEs	$100,000-$200,000
Management Action 9—Well Inventory	$100,000-$200,000
Management Action 10—Basinwide Metering Program	$50,000-$200,000
Management Action 11—Pumping Reduction Plan	$100,000-$200,000
Projects and Management Actions (Tier 2)	
Management Action 12—Pumping Restrictions and Enforcement	Implementation/O&M: $50,000-$100,000 per year

Notes
Cost estimates are for planning purposes and costs for a project may be higher when implemented due to potential changes in conditions and detailed project information.

10.2.1 GSP Program Management

GSP Program Management will primarily consist of general GSA administration and oversight of ongoing GSA monitoring and reporting, public outreach and engagement, and any implementation of the projects and management actions as necessary. This includes coordination of technical activities associated with GSP implementation tasks. GSP Program Management would also include preparing grant applications and grant administration.

GSP administration will include the joint coordination activities of the GSA as necessary to implement the GSP. The GSA Core Team guided development of this GSP and will continue to meet on an as-needed basis during the GSP implementation period to guide implementation. GSP administrative activities include oversight of consultants or contractors that may be retained by the GSA in support of joint GSP activities. This includes monitoring, annual reporting, and GSP updates. Activities under the GSP Program Management also include public outreach and meetings, described in more detail in Section 10.3.

10.2.2 Funding Sources

Funding options for the projects and management actions are presented in Table 10-2. The GSA will meet cost obligations using a combination of funding options. Anticipated funding for implementation may be pursued as appropriate grant opportunities arise. Grant and loan programs that the GSA may pursue for implementation of proposed projects and management actions include the IRWM grant program and the Sustainable Groundwater Management (SGM) grant program (both administered by DWR), along with the Drinking Water State Revolving Fund (DWSRF; administered by SWRCB). Grant funding will likely not cover all GSP implementation costs due to implementation timing and some tasks being ineligible for grant funding; therefore, GSP implementation may rely on GSA operating funds as applicable. Additionally, in accordance with CWC Section 10730, the GSA has the ability to impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of SGMA implementation.

Table 10-2. Funding Options for Proposed Projects and Management Actions

Activity	Potential Funding Options
Project 1—Coordinate with the City on Constructing Infiltration Basins at San Pasqual Union Elementary School	Not applicable
Project 2—Coordinate on the Implementation of Invasive Species Removal	Not applicable
Management Action 1—Farming Best Practices	IRWM Program grant; SGM Program grant; GSA operating funds
Management Action 2—Education and Outreach to Encourage Demand Softening	IRWM Program grant; GSA operating funds
Management Action 3—Support Water Quality Improvement Plan Actions	Not applicable
Management Action 4—Coordinate and Collaborate with Other Entities to Perform Monitoring and Implement Regional Projects	GSA operating funds
Management Action 5—Education and Outreach about TDS and Nitrate	GSA operating funds; SGM Program grant
Management Action 6—Coordinate with City on Hodges Watershed Improvement Project	Not applicable
Management Action 7—Initial Surface Water Recharge Evaluation	City to fund initial evaluation
Management Action 8—Study GDEs	GSA operating funds
Management Action 9—Well Inventory	GSA operating funds; SGM Program grant
Management Action 10—Basinwide Metering Program	GSA operating funds; SGM Program grant; DWSRF loan
Management Action 11—Pumping Reduction Plan	GSA operating funds
Management Action 12—Pumping Restrictions and Enforcement	GSA operating funds

10.3 Public Outreach and Meetings

During GSP development, the SPV GSA used multiple forms of public outreach to communicate SGMA-related information and solicit input. The GSA intends to continue public outreach and provide opportunities for engagement during GSP implementation. This will include providing opportunities for public participation (including beneficial users) at public meetings and providing access to GSP information online via the SPV GSP website5F[6]. The GSA will continue to maintain a stakeholder email list with all community members and entities who have expressed interest in GSP activities. Announcements will continue to be distributed via email prior to public meetings. Public meetings/workshops will be held as needed to provide an opportunity for stakeholders and members of the public to learn about, discuss, and provide input on basin conditions, GSP activities, and the SGMA program. The GSA Core Team will meet to discuss the implementation activities of the GSP, as necessary, and regularly update the SPV GSP website with meeting agendas and materials, reports, and other program information as applicable.

10.4 Monitoring Programs

This GSP identifies the need for ongoing monitoring, which is a critical element of GSP implementation. The GSA intends to implement the monitoring programs described in Section 7, *Monitoring Program* to track conditions for the applicable sustainability indicators. The GSP has identified monitoring networks for groundwater levels and water quality; representative monitoring sites have been selected and minimum thresholds have been established. Monitoring network data will be collected and used to do the following:

- Better characterize Basin conditions
- Identify groundwater trends
- Determine whether undesirable results are occurring
- Determine if project and management action implementation is necessary

Monitoring data will be managed and reported to stakeholders using the SPV Data Management System (DMS). The GSP monitoring networks make use of existing monitoring programs and develop further monitoring to continue characterization of the Basin. As described in Section 7, *Monitoring Program*, the implementation of monitoring network activities for the SPV GSP will continue groundwater level and groundwater quality monitoring through its existing network. The monitoring program for groundwater levels will also use existing CASGEM, USGS, and City well monitoring data in the Basin. The water quality monitoring program for this GSP will also use data from existing programs, such as the National Water Quality Monitoring Council, GAMA, and data from City monitoring wells.

The SPV monitoring network has provided sufficient historical data and meets and/or exceeds data density requirements outlined in DWR's *Monitoring Networks and Identification of Data Gaps BMP* (DWR, 2016) for monitoring protocols. However, the GSA can benefit from increased data and improve upon information used to characterize the Basin.

As such, the GSA may implement optional groundwater monitoring improvements. The GSA may assess the monitoring network and install additional monitoring wells and/or expand the monitoring network in other ways (i.e., through adding continuous measurement devices). The cost

[6] The SPV GSP website can be accessed here: https://www.sandiegocounty.gov/content/sdc/pds/SGMA/san-pasqual-valley.html