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# Paso Robles Subbasin Groundwater Sustainability Plan VOLUME 1


**Chapter 1. Introduction to Paso Robles Subbasin Groundwater Sustainability Plan**

**Chapter 2. Agencies' Information**

**Chapter 3. Description of Plan Area**

**Chapter 4. Hydrogeologic Conceptual Model**

**Chapter 5. Groundwater Conditions**

**Chapter 6. Water Budgets**




*Prepared for:*

*Paso Robles Subbasin Cooperative Committee and the Groundwater Sustainability Agencies*

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| $/AF | dollar per acre-foot |
| $/AF-benefit | dollar per acre-foot of basin benefit |
| Act (or SGMA) | Sustainable Groundwater Management Act |
| AF | acre-feet |
| AFY | acre-feet per year |
| AMWC | Atascadero Mutual Water Company |
| Basin Plan | Water Quality Control Plan for the Central Coast Basin |
| BPs | Best Water Use Practices |
| BMPs | Best Management Practices |
| C&E | Communications and Engagement |
| CASGEM | California Statewide Groundwater Elevation Monitoring |
| CCR | California Code of Regulations |
| CCRWQCB | Central Coast Regional Water Quality Control Board |
| CGPS | Continuous GPS |
| CIMIS | California Irrigation Management Information System |
| City | City of Paso Robles |
| Cooperative Committee | Paso Basin Cooperative Committee |
| County | San Luis Obispo County |
| CSA16 | Community Service Area 16 |
| CSD | Community Services District |
| CWWCP | Countywide Water Conservation Program |
| DAIv2 | Data Archive Interface |
| DDW | Division of Drinking Water |
| DMS | Paso Robles Subbasin Data Management System |
| DWR | Department of Water Resources |
| EPA | Environmental Protection Agency |
| ET (or ETo) | evapotranspiration |
| ft/day | feet per day |
| ft2/day | square feet per day |
| ft msl | feet above mean sea level |
| GAMA | Groundwater Ambient Monitoring and Assessment |
| GDE | Groundwater-Dependent Ecosystem |
| GMP | Groundwater Management Plan |
| gpd/ft | gallons per day per foot |
| gpm | gallons per minute |
| GSA | Groundwater Sustainability Agency |
| GSI | GSI Water Solutions, Inc. |
| GSP (or the Plan) | Groundwater Sustainability Plan |
| GSSI | Geoscience Support Services, Inc. |

| | |
|---|---|
| hp | horsepower |
| ILRP | Irrigated Lands Regulatory Program |
| InSAR | Interferometric Synthetic Aperture Radar |
| IRWMP | Integrated Regional Water Management Program |
| LID | Low Impact Development |
| LOS | Level of Severity |
| LUCE | Land Use and Circulation Element |
| MCL | Maximum Contaminant Limit (or Maximum Contaminant Levels) |
| MO | measurable objectives |
| MOA | Memorandum of Agreement |
| mg/L | milligram per liter |
| msl | mean sea level |
| MT | minimum thresholds |
| MWR | Master Water Report |
| NCCAG | Natural Communities Commonly Associated with Groundwater |
| NDMC | National Drought Mitigation Center |
| NHD | National Hydrology Dataset |
| NRCS | USGS National Resources Conservation Service |
| NWIS | National Water Information System |
| NWP | Nacimiento Water Project |
| O&M | operations and maintenance |
| OSWCR | DWR Online System for Well Completion Reports |
| pCi/L | picocuries per liter |
| PWIS | CA Water Boards Public Water Information System |
| RW | recycled water |
| SAGBI | Soil Agricultural Groundwater Banking Index |
| SB | Senate Bill |
| SGMA (or Act) | Sustainable Groundwater Management Act |
| SGMA Regulations | CCR Subchapter 2. Groundwater Sustainability Plans |
| SLO County | San Luis Obispo County |
| SLOFCWCD | San Luis Obispo County Flood Control and Water Conservation District |
| SMC | Sustainable Management Criteria |
| SMCL | Secondary Maximum Contaminant Limit |
| SMCSD | San Miguel Community Services District |
| SNMP | Salt and Nutrient Management Plan |
| SPI | Standardized Precipitation Index |
| SSURGO | Soil Survey Geographic Database |
| Subbasin | Paso Robles Area Subbasin of the Salinas Valley Groundwater Basin |
| SWP | State Water Project |
| SWRCB | State Water Resources Control Board |

| | |
|---|---|
| SWRP | San Luis Obispo Stormwater Resource Plan |
| TDS | total dissolved solids |
| TMDLs | Total Maximum Daily Load |
| UNAVCO | University NAVSTAR Consorium |
| USACE | United States Army Corps of Engineers |
| USGS | United States Geologic Survey |
| USDA | United States Department of Agriculture |
| UWMP | Urban Water Management Plan |
| Water Board | State Water Resources Control Board |
| WPA | Water Planning Areas |
| WRAC | Water Resources Advisory Committee |
| WY | Water Year |

# REGULATIONS CHECKLIST FOR GSP SUBMITTAL

| GSP Regulations Section | Requirement | Description | Section Number, or other location as indicated in the GSP |
|---|---|---|---|
| **Article 3. Technical and Reporting Standards** | | | |
| 352.2 | Monitoring Protocols | Monitoring protocols adopted by the GSA for data collection and management | 7.8 |
| | | Monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin | Chapter 7, including Appendix F |
| **Article 5. Plan Contents, Subarticle 1. Administrative Information** | | | |
| 354.4 | General Information | Executive Summary | Executive Summary |
| | | List of references and technical studies | References Cited |
| 354.6 | Agency Information | GSA mailing address | 2.1 |
| | | Organization and management structure | 2.2 |
| | | Contact information of Plan Manager | 2.4 |
| | | Legal authority of GSA | 2.3 |
| | | Estimate of implementation costs | 10.2, Table 10-1 |
| 354.8(a) | Map(s) | Area covered by GSP | 3.1 (Figure 3-1) |
| | | Adjudicated areas, other agencies within the basin, and areas covered by an Alternative | Not applicable |
| | | Jurisdictional boundaries of federal or State land | Figure 3-2 |
| | | Existing land use designations | Figure 3-4 |
| | | Density of wells per square mile | Figures 3-7, 3-8, 3-9 |
| 354.8(b) | Description of the Plan Area | Summary of jurisdictional areas and other features | 3.2, 3.3 |
| 354.8(c)<br>354.8(d)<br>354.8(e) | Water Resource Monitoring and Management Programs | Description of water resources monitoring and management programs | 3.6, 3.7, 3.8 |
| | | Description of how the monitoring networks of those plans will be incorporated into the GSP | 3.9.1 |
| | | Description of how those plans may limit operational flexibility in the basin | 3.9.2 |
| | | Description of conjunctive use programs | 3.9.3, not applicable |
| 354.8(f) | Land Use Elements or Topic Categories of Applicable General Plans | Summary of general plans and other land use plans | 3.10 |
| | | Description of how implementation of the GSP may change water demands or affect achievement of sustainability and how the GSP addresses those effects | 3.10.4 |
| | | Description of how implementation of the GSP may affect the water supply assumptions of relevant land use plans | 10.3, 10.4 |
| | | Summary of the process for permitting new or replacement wells in the basin | 2.3.1.2 and 3.8.6 |

| | | | |
|---|---|---|---|
| | | Information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management | 3.10.4 |
| 354.8(g) | Additional GSP Contents (optional items) | Description of Actions related to:<br>Control of saline water intrusion | Not applicable |
| | | Wellhead protection | Not applicable |
| | | Migration of contaminated groundwater | 5.6.3 |
| | | Well abandonment and well destruction program | Not applicable |
| | | Replenishment of groundwater extractions | Not applicable |
| | | Conjunctive use and underground storage | 3.9.3 |
| | | Well construction policies | 2.3.1.2 and 3.8.6 |
| | | Addressing groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects | Not applicable |
| | | Efficient water management practices | 9.3.2 |
| | | Relationships with State and federal regulatory agencies | 3.3.1, 3.3.3 |
| | | Review of land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity | 3.10 |
| | | Impacts on groundwater dependent ecosystems | 4.7.2, Appendix C |
| 354.10 | Notice and Communication | Description of beneficial uses and users | Appendix G, including Section G.3 |
| | | List of public meetings | Table 11-2 |
| | | GSP comments and responses | Appendix M |
| | | Decision-making process | Appendix G, including Section G.4 |
| | | Public engagement | Appendix G |
| | | Encouraging active involvement | Appendix G, including Sections G.7, 8, 9 and Appendices H, I, and J |
| | | Informing the public on GSP implementation progress | Appendix G, including Section G. 7 |
| **Article 5. Plan Contents, Subarticle 2. Basin Setting** | | | |
| 354.14 | Hydrogeologic Conceptual Model | Description of the Hydrogeologic Conceptual Model | Chapter 4, inclusive |
| | | Two scaled cross-sections | Figures 4-12, 4-13, 4-14, 4-15 |
| | | Map(s) of physical characteristics: topographic information, surficial geology, soil characteristics, surface water bodies, source and point of delivery for imported water supplies | Figures 4-1, 4-2, 4-3, 4-4, 4-19, 3-5 |
| 354.14(c)(4) | Map of Recharge Areas | Map delineating existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas | Figures 4-16, 4-17 |
| | Recharge Areas | Description of how recharge areas identified in the plan substantially contribute to the replenishment of the basin | 4.7.1, Figure 4-16; 6.1 |
| 354.16 | Current and Historical Groundwater Conditions | Groundwater elevation data | 5.1 |
| | | Estimate of groundwater storage | 5.2 |
| | | Seawater intrusion conditions | 5.3, not applicable |

| | | | |
|---|---|---|---|
| | | Groundwater quality issues | 5.6 |
| | | Land subsidence conditions | 5.4 |
| | | Identification of interconnected surface water systems | 5.5 |
| | | Identification of groundwater-dependent ecosystems | 4.7.2 |
| 354.18 | Water Budget Information | Description of inflows, outflows, and change in storage | 6.2.1, Appendix E |
| | | Quantification of overdraft | Chapter 6 |
| | | Estimate of sustainable yield | Chapter 6 |
| | | Quantification of current, historical, and projected water budgets | Chapter 6 |
| | Surface Water Supply | Description of surface water supply used or available for use for groundwater recharge or in-lieu use | 3.4.1, Figure 3-5; Appendix I |
| 354.20 | Management Areas | Reason for creation of each management area | 8.10.1 |
| | | Minimum thresholds and measurable objectives for each management area | 8.10.2 |
| | | Level of monitoring and analysis | 8.10.3 |
| | | Explanation of how management of management areas will not cause undesirable results outside the management area | 8.10.4 |
| | | Description of management areas | 8.10 |
| **Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria** | | | |
| 354.24 | Sustainability Goal | Description of the sustainability goal | 8.2 |
| 354.26 | Undesirable Results | Description of undesirable results | 8.4.5, 8.5.4, 8.7.4, 8.8.4, 8.9.4 |
| | | Cause of groundwater conditions that would lead to undesirable results | 8.4.5.2, 8.5.4.2, 8.7.4.2, 8.8.4.2, , 8.9.4 |
| | | Criteria used to define undesirable results for each sustainability indicator | 8.4.5.1, 8.5.4.1, 8.7.4.1, 8.8.4.1, , 8.9.4 |
| | | Potential effects of undesirable results on beneficial uses and users of groundwater | 8.4.5.3, 8.5.4.3, 8.7.4.3, 8.8.4.3, 8.9.4 |
| 354.28 | Minimum Thresholds | Description of each minimum threshold and how they were established for each sustainability indicator | 8.4.4, 8.5.2, 8.7.2, 8.8.2, 8.9.2 |
| | | Relationship for each sustainability indicator | 8.4.4.4, 8.5.2.2, 8.7.2.4, 8.8.2.2, 8.9.2 |
| | | Description of how selection of the minimum threshold may affect beneficial uses and users of groundwater | 8.4.4.6, 8.5.2.4, 8.7.2.6, 8.8.2.4, 8.9.2 |
| | | Standards related to sustainability indicators | 8.4.4.7, 8.5.2.5, 8.7.2.7, 8.8.2.5, 8.9.2 |
| | | How each minimum threshold will be quantitatively measured | 8.4.4.8, 8.5.2.6, 8.7.2.8, 8.8.2.6, 8.9.2 |
| 354.30 | Measureable Objectives | Description of establishment of the measureable objectives for each sustainability indicator | 8.4.3, 8.5.3, 8.7.3, 8.8.3, 8.9.3 |
| | | Description of how a reasonable margin of safety was established for each measureable objective | 8.4.3, 8.5.3, 8.7.3, 8.8.3, 8.9.3 |
| | | Description of a reasonable path to achieve and maintain the sustainability goal, including a description of interim milestones | 8.4.3, 8.5.3.2, 8.7.3.4, 8.8.3.2, 8.9.3 |
| **Article 5. Plan Contents, Subarticle 4. Monitoring Networks** | | | |

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|---|---|---|---|
| 354.34 | Monitoring Networks | Description of monitoring network | Chapter 7, including 7.2. through 7.6 |
| | | Description of monitoring network objectives | 7.1 |
| | | Description of how the monitoring network is designed to: demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features; estimate the change in annual groundwater in storage; monitor seawater intrusion; determine groundwater quality trends; identify the rate and extent of land subsidence; and calculate depletions of surface water caused by groundwater extractions | Chapter 7, including 7.2. through 7.6 |
| | | Description of how the monitoring network provides adequate coverage of Sustainability Indicators | Chapter 7, including 7.2. through 7.6 |
| | | Density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends | Chapter 7, including 7.2. through 7.6 |
| | | Scientific rational (or reason) for site selection | Chapter 7, including 7.2. through 7.6 |
| | | Consistency with data and reporting standards | Chapter 7, including 7.2. through 7.6 |
| | | Corresponding sustainability indicator, minimum threshold, measureable objective, and interim milestone | Chapter 7, including 7.2. through 7.6; Chapter 8 Tables 8-1 through 8-10 |
| | | Location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used<br>Description of technical standards, data collection methods, and other procedures or protocols to ensure comparable data and methodologies | Chapter 7, including 7.2. through 7.6 |
| 354.36 | Representative Monitoring | Description of representative sites | 7.7 |
| | | Demonstration of adequacy of using groundwater elevations as proxy for other sustainability indicators | 8.5.2 |
| | | Adequate evidence demonstrating site reflects general conditions in the area | 7.7 |
| 354.38 | Assessment and Improvement of Monitoring Network | Review and evaluation of the monitoring network | Chapter 10 |
| | | Identification and description of data gaps | Chapter 7, including 7.2.1, 7.3.1, 7.4.1, 7.5.1, 7.6.1 |
| | | Description of steps to fill data gaps | Chapter 10 |
| | | Description of monitoring frequency and density of sites | Chapter 7, including 7.2. through 7.6 |
| **Article 5. Plan Contents, Subarticle 5. Projects and Management Actions** | | | |
| 354.44 | Projects and Management Actions | Description of projects and management actions that will help achieve the basin's sustainability goal | Chapter 9 |
| | | Measureable objective that is expected to benefit from each project and management action | |
| | | Circumstances for implementation | |
| | | Public noticing | |
| | | Permitting and regulatory process | |

| | | | |
|---|---|---|---|
| | | Time-table for initiation and completion, and the accrual of expected benefits | |
| | | Expected benefits and how they will be evaluated | |
| | | How the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included. | |
| | | Legal authority required | |
| | | Estimated costs and plans to meet those costs | |
| | | Management of groundwater extractions and recharge | |
| 354.44(b)(2) | | Overdraft mitigation projects and management actions | |
| **Article 8. Interagency Agreements** | | | |
| 357.4 | Coordination Agreements - Shall be submitted to the Department together with the GSPs for the basin and, if approved, shall become part of the GSP for each participating Agency. | Coordination Agreements shall describe the following: A point of contact | Not applicable |
| | | Responsibilities of each Agency | |
| | | Procedures for the timely exchange of information between Agencies | |
| | | Procedures for resolving conflicts between Agencies | |
| | | How the Agencies have used the same data and methodologies to coordinate GSPs | |
| | | How the GSPs implemented together satisfy the requirements of SGMA | |
| | | Process for submitting all Plans, Plan amendments, supporting information, all monitoring data and other pertinent information, along with annual reports and periodic evaluations | |
| | | A coordinated data management system for the basin | |
| | | Coordination agreements shall identify adjudicated areas within the basin, and any local agencies that have adopted an Alternative that has been accepted by the Department | |

# DEFINITIONS

## California Water Code

Sec. 10721

Unless the context otherwise requires, the following definitions govern the construction of this part:

(a) Adjudication action means an action filed in the superior or federal district court to determine the rights to extract groundwater from a basin or store water within a basin, including, but not limited to, actions to quiet title respecting rights to extract or store groundwater or an action brought to impose a physical solution on a basin.

(b) Basin means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Chapter 3 (commencing with Section 10722).

(c) Bulletin 118 means the department's report entitled California's Groundwater: Bulletin 118 updated in 2003, as it may be subsequently updated or revised in accordance with Section 12924.

(d) Coordination agreement means a legal agreement adopted between two or more groundwater sustainability agencies that provides the basis for coordinating multiple agencies or groundwater sustainability plans within a basin pursuant to this part.

(e) De minimis extractor means a person who extracts, for domestic purposes, two acre-feet or less per year.

(f) Governing body means the legislative body of a groundwater sustainability agency.

(g) Groundwater means water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water that flows in known and definite channels.

(h) Groundwater extraction facility means a device or method for extracting groundwater from within a basin.

(i) Groundwater recharge or recharge means the augmentation of groundwater, by natural or artificial means.

(j) Groundwater sustainability agency means one or more local agencies that implement the provisions of this part. For purposes of imposing fees pursuant to Chapter 8 (commencing with Section 10730) or taking action to enforce a groundwater sustainability plan,

groundwater sustainability agency also means each local agency comprising the groundwater sustainability agency if the plan authorizes separate agency action.

(k) Groundwater sustainability plan or plan means a plan of a groundwater sustainability agency proposed or adopted pursuant to this part.

(l) Groundwater sustainability program means a coordinated and ongoing activity undertaken to benefit a basin, pursuant to a groundwater sustainability plan.

(m) In-lieu use means the use of surface water by persons that could otherwise extract groundwater in order to leave groundwater in the basin.

(n) Local agency means a local public agency that has water supply, water management, or land use responsibilities within a groundwater basin.

(o) Operator means a person operating a groundwater extraction facility. The owner of a groundwater extraction facility shall be conclusively presumed to be the operator unless a satisfactory showing is made to the governing body of the groundwater sustainability agency that the groundwater extraction facility actually is operated by some other person.

(p) Owner means a person owning a groundwater extraction facility or an interest in a groundwater extraction facility other than a lien to secure the payment of a debt or other obligation.

(q) Personal information has the same meaning as defined in Section 1798.3 of the Civil Code.

(r) Planning and implementation horizon means 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.

(s) Public water system has the same meaning as defined in Section 116275 of the Health and Safety Code.

(t) Recharge area means the area that supplies water to an aquifer in a groundwater basin.

(u) Sustainability goal means the existence and implementation of one or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin is operated within its sustainable yield.

(v) Sustainable groundwater management means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

(w) Sustainable yield means the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result.

(x) Undesirable result means one or more of the following effects caused by groundwater conditions occurring throughout the basin:

(1) 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.

(2) Significant and unreasonable reduction of groundwater storage.

(3) Significant and unreasonable seawater intrusion.

(4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

(5) Significant and unreasonable land subsidence that substantially interferes with surface land uses.

(6) Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

(y) Water budget means an accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.

(z) Watermaster means a watermaster appointed by a court or pursuant to other law.

(aa) Water year means the period from October 1 through the following September 30, inclusive.

(ab) Wellhead protection area means the surface and subsurface area surrounding a water well or well field that supplies a public water system through which contaminants are reasonably likely to migrate toward the water well or well field.

## Official California Code of Regulations

Title 23. Waters
Division 2. Department of Water Resources
Chapter 1.5. Groundwater Management
Subchapter 2. Groundwater Sustainability Plans
Article 2. Definitions
23 CCR § 351
§ 351. Definitions.

The definitions in the Sustainable Groundwater Management Act, Bulletin 118, and Subchapter 1 of this Chapter, shall apply to these regulations. In the event of conflicting definitions, the definitions in the Act govern the meanings in this Subchapter. In addition, the following terms used in this Subchapter have the following meanings:

(a) "Agency" refers to a groundwater sustainability agency as defined in the Act.

(b) "Agricultural water management plan" refers to a plan adopted pursuant to the Agricultural Water Management Planning Act as described in Part 2.8 of Division 6 of the Water Code, commencing with Section 10800 et seq.

(c) "Alternative" refers to an alternative to a Plan described in Water Code Section 10733.6.

(d) "Annual report" refers to the report required by Water Code Section 10728.

(e) "Baseline" or "baseline conditions" refer to historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin.

(f) "Basin" means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Water Code 10722 et seq.

(g) "Basin setting" refers to the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.

(h) "Best available science" refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.

(i) "Best management practice" refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.

(j) "Board" refers to the State Water Resources Control Board.

(k) "CASGEM" refers to the California Statewide Groundwater Elevation Monitoring Program developed by the Department pursuant to Water Code Section 10920 et seq., or as amended.

(l) "Data gap" refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed.

(m) "Groundwater dependent ecosystem" refers to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.

(n) "Groundwater flow" refers to the volume and direction of groundwater movement into, out of, or throughout a basin.

(o) "Interconnected surface water" refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.

(p) "Interested parties" refers to persons and entities on the list of interested persons established by the Agency pursuant to Water Code Section 10723.4.

(q) "Interim milestone" refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

(r) "Management area" refers to an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors.

(s) "Measurable objectives" refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin.

(t) "Minimum threshold" refers to a numeric value for each sustainability indicator used to define undesirable results.

(u) "NAD83" refers to the North American Datum of 1983 computed by the National Geodetic Survey, or as modified.

(v) "NAVD88" refers to the North American Vertical Datum of 1988 computed by the National Geodetic Survey, or as modified.

(w) "Plain language" means language that the intended audience can readily understand and use because that language is concise, well-organized, uses simple vocabulary, avoids excessive acronyms and technical language, and follows other best practices of plain language writing.

(x) "Plan" refers to a groundwater sustainability plan as defined in the Act.

(y) "Plan implementation" refers to an Agency's exercise of the powers and authorities described in the Act, which commences after an Agency adopts and submits a Plan or Alternative to the Department and begins exercising such powers and authorities.

(z) "Plan manager" is an employee or authorized representative of an Agency, or Agencies, appointed through a coordination agreement or other agreement, who has been delegated management authority for submitting the Plan and serving as the point of contact between the Agency and the Department.

(aa) "Principal aquifers" refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

(ab) "Reference point" refers to a permanent, stationary and readily identifiable mark or point on a well, such as the top of casing, from which groundwater level measurements are taken, or other monitoring site.

(ac) "Representative monitoring" refers to a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

(ad) "Seasonal high" refers to the highest annual static groundwater elevation that is typically measured in the Spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand.

(ae) "Seasonal low" refers to the lowest annual static groundwater elevation that is typically measured in the Summer or Fall, and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

(af) "Seawater intrusion" refers to the advancement of seawater into a groundwater supply that results in degradation of water quality in the basin, and includes seawater from any source.

(ag) "Statutory deadline" refers to the date by which an Agency must be managing a basin pursuant to an adopted Plan, as described in Water Code Sections 10720.7 or 10722.4.

(ah) "Sustainability indicator" refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).

(ai) "Uncertainty" refers to a lack of understanding of the basin setting that significantly affects an Agency's ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

(aj) "Urban water management plan" refers to a plan adopted pursuant to the Urban Water Management Planning Act as described in Part 2.6 of Division 6 of the Water Code, commencing with Section 10610 et seq.

(ak) "Water source type" represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.

(al) "Water use sector" refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

(am) "Water year" refers to the period from October 1 through the following September 30, inclusive, as defined in the Act.

(an) "Water year type" refers to the classification provided by the Department to assess the amount of annual precipitation in a basin.

# 1 INTRODUCTION TO PASO ROBLES SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

## 1.1 Purpose of the Groundwater Sustainability Plan

In 2014, the State of California enacted the Sustainable Groundwater Management Act (SGMA). This law requires groundwater basins in California that are designated as medium or high priority be managed sustainably. Satisfying the requirements of SGMA generally requires four basic activities:

1. Forming one or multiple Groundwater Sustainability Agency(s) (GSAs) to fully cover a basin;
2. Developing one or multiple Groundwater Sustainability Plan(s) (GSPs) that fully cover the basin;
3. Implementing the GSP and managing to achieve quantifiable objectives; and
4. Regular reporting to the California Department of Water Resources (DWR).

This document fulfills the GSP requirement for the Paso Robles Area Subbasin of the Salinas Valley Groundwater Basin (Paso Robles Subbasin or Subbasin). This GSP describes the Paso Robles Subbasin, develops quantifiable management objectives that account for the interests of the Subbasin's beneficial groundwater uses and users, and identifies a group of projects and management actions that will allow the Subbasin to achieve sustainability within 20 years of plan adoption.

The GSP was developed specifically to comply with SGMA's statutory and regulatory requirements. As such, the GSP uses the terminology set forth in these requirements (see e.g. Water Code Section 10721 and 23 CCR Section 351) which is oftentimes different from the terminology utilized in other contexts (e.g. past reports or studies, past analyses, judicial rules or findings). The definitions from the relevant statutes and regulations are attached to this report for reference.

## 1.2 Description of Paso Robles Subbasin

The Paso Robles Subbasin is identified by DWR in Bulletin 118 as Subbasin No. 3-004.06 (DWR, 2016). The Subbasin is part of the greater Salinas Valley Basin in the Central Coastal region of California. The Subbasin as defined in this GSP encompasses an area of approximately 436,240 acres, or 681 square miles and is entirely within San Luis Obispo County. The Subbasin boundaries delineate the groundwater basin; the watershed includes the area that drains the surface water to the Subbasin, and encompasses a much larger area.

The Subbasin as originally defined by DWR (2003) was in both Monterey and San Luis Obispo Counties. On February 11, 2019, DWR released the Final 2018 Basin Boundary Modifications approving two revisions to the Subbasin boundary. One revision made the northern boundary of the Paso Basin coincident with the Monterey and San Luis Obispo County line, placing the Paso Basin entirely within San Luis Obispo County and making formal coordination with Salinas Valley Basin GSA optional. The other revision removed the basin area underlying Heritage Ranch Community Services District GSA, making them no longer subject to SGMA or required to develop a GSP. A basin boundary modification was approved by DWR that moved the northern boundary of the Paso Robles Area Subbasin to the Monterey/San Luis Obispo county line. A subsequent basin boundary adjustment was approved by DWR in 2019 to remove the land covered by Heritage Ranch Community Services District from the Subbasin. Heritage Ranch Community Services District was originally an active GSA in the Subbasin. The Plan has been modified to take out Heritage Ranch Community Services District and the land it overlies after the boundary adjustment was approved. The final basin boundary is shown on Figure 1-1.

The Subbasin is bounded by two groundwater basins and two subbasins, as shown on Figure 1-1.

- The Atascadero Area Subbasin (3-004-11) is located southwest of the Paso Robles Subbasin. The boundary with the Subbasin is the Rinconada Fault zone which is a leaky barrier to groundwater flow.
- The Upper Valley Aquifer Subbasin of the Salinas Valley Groundwater Basin is located north of the Paso Robles Subbasin. Its aquifers are in hydraulic continuity with those in the Subbasin.
- The Cholame Valley (3-005) groundwater basin is located east of the Paso Robles Subbasin. Its western boundary is the San Andreas Fault that is a barrier to groundwater flow.
- The Carrizo Plain (3-019) groundwater basin is located southeast of the Paso Robles Subbasin. The Carrizo Plain boundary with the Subbasin is a topographic high with sediments in hydraulic continuity with the Basin.

The Atascadero, Carrizo Plain and Cholame Valley groundwater basins are designated as very low priority and therefore not required to submit GSPs. Although not required to develop a GSP, the Atascadero Area Subbasin is planning to prepare and adopt a GSP. The Paso Robles Subbasin and Salinas Valley Upper Valley Aquifer Subbasin are subject to SGMA and are required to develop GSPs.

The Subbasin includes the incorporated City of Paso Robles. The Subbasin additionally includes the unincorporated census-designated places of Cholame, Creston, San Miguel, Shandon, and Whitley Gardens (Figure 1-1).

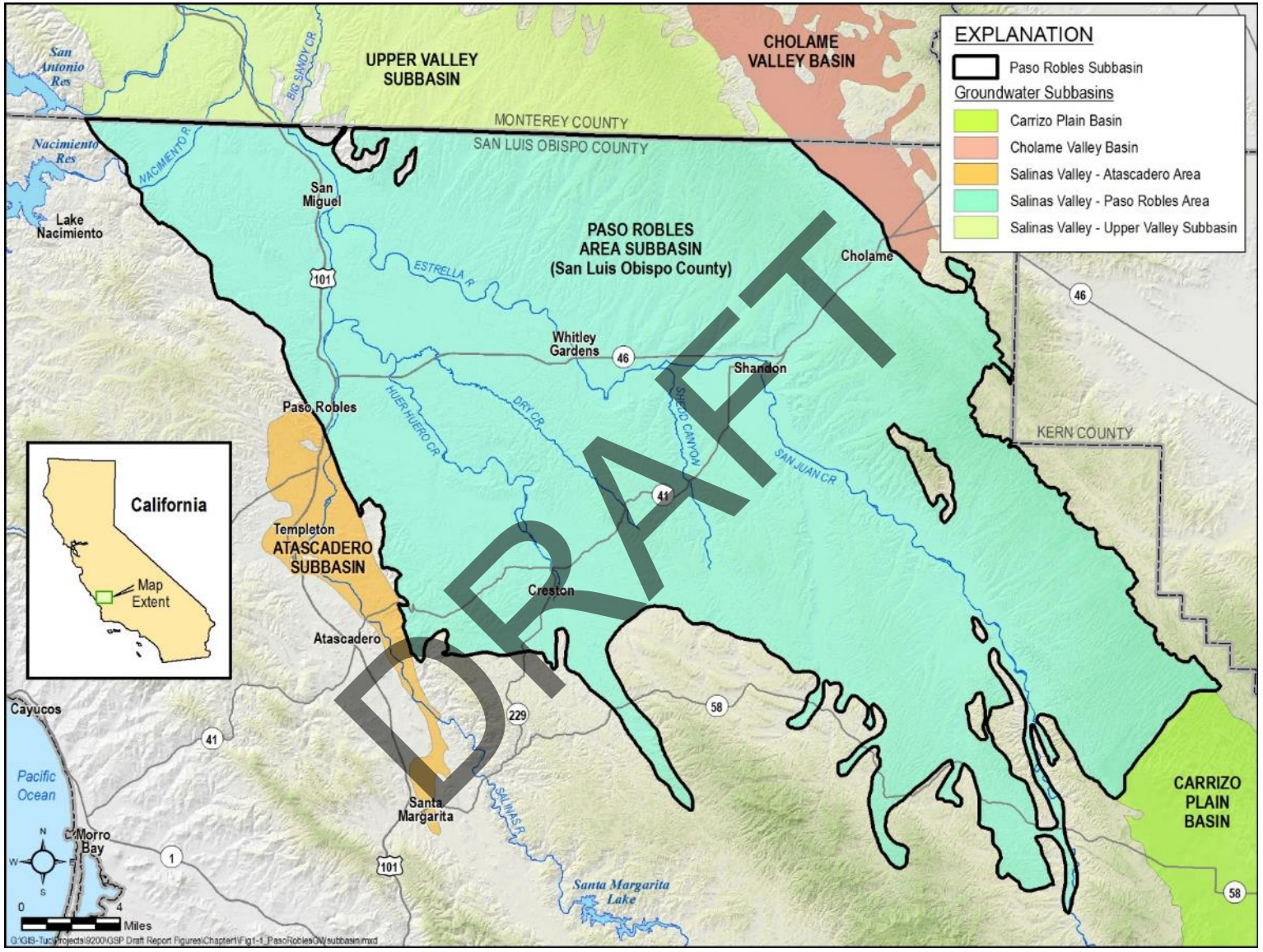



Figure 1-1. Paso Robles Subbasin and Surrounding Subbasins

# 2 AGENCIES' INFORMATION

The Paso Robles Subbasin GSP has been jointly developed by four GSAs:

- City of Paso Robles
- Paso Basin - County of San Luis Obispo GSA
- San Miguel Community Services District (CSD)
- Shandon - San Juan GSA

## 2.1 Agencies' Names and Mailing Addresses

The following contact information is provided for each GSA pursuant to California Water Code § 10723.8.

City of Paso Robles GSA
1000 Spring Street
City of Paso Robles, CA 93635

Paso Basin - County of San Luis Obispo GSA
C/O County of San Luis Obispo Department of Public Works - Water Resources
County Government Center, Room 206
San Luis Obispo, CA 93408

San Miguel Community Services District GSA
P.O. Box 180
San Miguel, CA 93451

Shandon - San Juan GSA
P.O. Box 150
Shandon, CA 93461

## 2.2 Agencies' Organization and Management Structure

The organization and management structures of each of the four subbasin GSAs are described below. Each of the GSAs appoints a representative to a Cooperative Committee that is further described in Section 2.3.2. The Cooperative Committee coordinates activities among all the GSAs during the GSP development phase.

### 2.2.1 City of Paso Robles GSA

The City of Paso Robles is an incorporated city that operates under a Council-Manager general law form of government. The City Council consists of five members elected at-large, on a non-partisan basis. Council members serve four-year overlapping terms. The mayor is directly elected and serves a two-year term. Decisions on all GSA-related matters require an affirmative vote of a majority of the five-member City Council. One member from the City Council sits on the Cooperative Committee that coordinates activities among all GSAs in accordance with the Memorandum of Agreement (MOA) further described in section 2.3.1.5 and included in Appendix A. The City of Paso Robles GSA's activities are staffed through the City's Department of Public Works.

### 2.2.2 Paso Basin - County of San Luis Obispo GSA

The County of San Luis Obispo is governed by a five-member Board of Supervisors. Board members are elected to staggered four-year terms. Decisions on all GSA-related matters require an affirmative vote of a majority of the Board. One member from the Board of Supervisors sits on the Cooperative Committee that coordinates activities among all GSAs in accordance with the MOA further described in section 2.3.1.5 and included in Appendix A. The Paso Basin - County of San Luis Obispo GSA's activities are staffed through the County's Department of Public Works.

### 2.2.3 San Miguel Community Services District GSA

San Miguel CSD is governed by a five-member Board of Directors. Directors are elected to four-year terms. Decisions on all GSA-related matters require an affirmative vote of a majority of the five Board of Directors members. One member from the San Miguel CSD Board of Directors sits on the Cooperative Committee that coordinates activities among all in accordance with the MOA further described in section 2.3.1.5 and included in Appendix A. The San Miguel CSD GSA's activities are staffed by the CSD's staff engineer.

### 2.2.4 Shandon - San Juan GSA

The Shandon-San Juan Water District is governed by a five-member Board of Directors elected to staggered four year terms. The District elected to serve as the exclusive GSA for the portion of

the Subbasin situated within the boundaries of the District, and therefore also functions as the Shandon-San Juan GSA. Decisions on all GSA-related matter require an affirmative vote of a majority of the five-member Board of Directors. One member from the Shandon - San Juan GSA Board of Directors sits on the Cooperative Committee that coordinates activities among all in accordance with the Memorandum of Agreement (MOA) further described in section 2.3.1.5 and included in Appendix A. The Shandon - San Juan GSA's activities are staffed by members of the Water District or their representatives and by contracted professional engineers.

## 2.3 Authority of Agencies

Each of the GSAs developing this coordinated GSP is formed in accordance with the requirements of California Water Code § 10723 *et seq*. The resolutions of formation for all GSAs are included in Appendix A. The specific authorities for forming a GSA and implementing the GSP for each of the agencies that formed GSAs are listed below.

### 2.3.1 Individual GSAs

#### 2.3.1.1 City of Paso Robles GSA

The City of Paso Robles is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents. The City is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA. Upon establishing itself as a GSA, the City obtains all the rights and authorities provided to GSAs under California Water Code § 10725 *et seq.* subject to the terms and conditions set forth therein. In addition, the City retains its ability to manage groundwater pursuant to its police powers and well permitting authority.

#### 2.3.1.2 Paso Basin - County of San Luis Obispo GSA

The County of San Luis Obispo has land use authority over the unincorporated areas of the County, including areas overlying the Paso Robles Subbasin. The County of San Luis Obispo is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA. Upon establishing itself as a GSA, the County obtains all the rights and authorities provided to GSAs under California Water Code § 10725 *et seq*. subject to the terms and conditions set forth therein. In addition, the County retains its ability to manage groundwater and the construction of wells pursuant to its police powers.

#### 2.3.1.3 San Miguel Community Services District GSA

San Miguel CSD is a local public agency of the State of California, organized and operating under the Community Services District Law, Government Code § 6100 *et seq*. San Miguel CSD provides water and sewer services to its residents. San Miguel CSD is therefore a local agency

under California Water Code § 10721 with the authority to establish itself as a GSA. Upon establishing itself as a GSA, San Miguel CSD obtains all the rights and authorities provided to GSAs under California Water Code § 10725 *et seq*. subject to the terms and conditions set forth therein.

#### 2.3.1.4 Shandon - San Juan GSA

The Shandon - San Juan Water District was formed in accordance with California's Water District Law, California Water Code § 34000 *et seq*. In accordance with California's Water District Law, the Shandon - San Juan Water District obtains the water supply and management authorities included in California Water Code § 35300 *et seq.*, with the exception of the ability to export groundwater beyond the boundaries of the Paso Robles subbasin. The Shandon - San Juan Water District is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA. Upon establishing itself as a GSA, the District obtains all the rights and authorities provided to GSAs under California Water Code § 10725 *et seq*. subject to the terms and conditions set forth therein.

#### 2.3.1.5 Memorandum of Agreement for GSP Development

The five GSAs overlying the original Subbasin entered into a Memorandum of Agreement (MOA) in September 2017. Heritage Ranch CSD was an original party to the MOA. With the basin boundary modification approval by DWR in 2019, Heritage Ranch is no longer part of the Subbasin. A copy of the MOA is included in Appendix A.

The purpose of the MOA is to establish a committee to develop a single GSP for the entire Paso Robles Subbasin. The single GSP developed under this MOA will be considered for adoption by each individual GSA and subsequently submitted to DWR for approval. Per §12.2 of the MOA, the MOA shall automatically terminate upon DWR's approval of the adopted GSP. The GSAs may decide to enter into a new agreement to coordinate GSP implementation at that time.

The MOA establishes the Paso Basin Cooperative Committee (Cooperative Committee) consisting of one member and one alternate from each of the GSAs. The Cooperative Committee conducts activities related to GSP development and SGMA implementation. The full list of activities the Cooperative Committee is authorized to undertake is included in the MOA in Appendix A; highlights include:

- Developing a GSP that achieves the goals and objectives outlined in SGMA;
- Reviewing and participating in the selection of consultants related to Cooperative Committee efforts;
- Developing annual budgets and additional funding needs;
- Developing a stakeholder participation plan; and

The MOA sets forth each GSAs' weighted voting percentages and the votes needed to implement certain actions or make certain recommendations to the individual GSAs. In particular, the MOA states that the Cooperative Committee must unanimously vote to recommend that the GSAs adopt the final GSP, though the MOA provides that each GSA may adopt the GSP for its jurisdiction without the Cooperative Committee's recommendation. Any vote to recommend changes to the MOA requires unanimous approval by the Cooperative Committee Members.

### 2.3.2 Memorandum of Agreement for GSP Implementation

Pursuant to Section 1 of the MOA, the GSAs intend to use the current MOA as a basis for continued cooperation in the management of the Subbasin during the period between adoption of the GSP by each GSA and approval of the GSP by DWR.

### 2.3.3 Coordination Agreements

The single GSP developed by the GSAs completely covers the entire Paso Robles Subbasin. Therefore, no coordination agreements with other GSAs are necessary.

### 2.3.4 Legal Authority to Implement SGMA Throughout the Plan Area

Figure 2-1 shows the extent of the GSP plan area, along with the jurisdictional boundary of each of the exclusive GSAs cooperating on this GSP. This figure shows that the entire plan area is covered by the exclusive GSAs, and no portion of the Subbasin is covered by a non-exclusive GSA. Therefore, the combination of the GSAs provides the legal authority to implement this GSP throughout the entire plan area. No authority is needed from any other GSA to implement this plan.

## 2.4 Contact Information for Plan Manager

This section will be completed prior to submittal of the GSP.

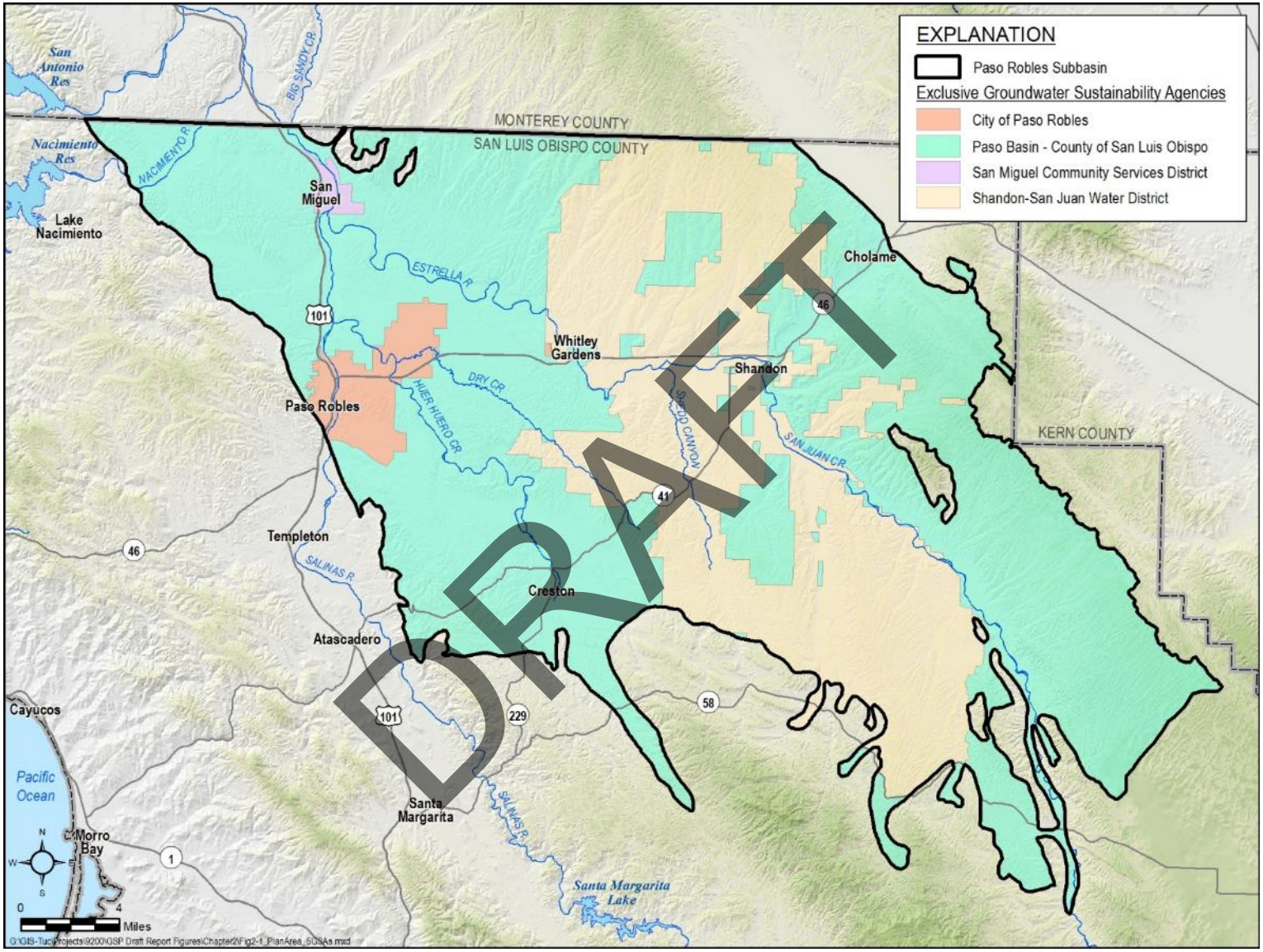



Figure 2-1. Extent of GSP Plan Area and Exclusive Groundwater Sustainability Agencies

# 3 DESCRIPTION OF PLAN AREA

## 3.1 Paso Robles Subbasin Introduction

This GSP covers the entire Paso Robles Subbasin. The Subbasin lies in the northern portion of San Luis Obispo County. The majority of the Subbasin comprises gentle flatlands near the Salinas River Valley, ranging in elevation from approximately 445 to 2,387 feet above mean sea level. The Subbasin is drained by the Salinas River. Tributaries to the Salinas River include the Estrella River, Huer Huero Creek, and San Juan Creek. Communities in the Subbasin are the City of Paso Robles and the communities of San Miguel, Creston, and Shandon. Highway 101 is the most significant north-south highway in the Subbasin, with Highways 41 and 46 running east-west across the Subbasin. Figure 3-1 shows the extent of the plan area as well as the significant water bodies, communities, and highways.

## 3.2 Adjudicated Areas, Other GSAs, and Alternative Plans

As of the date that this GSP was completed and submitted to DWR for evaluation: (1) No part of the Subbasin nor any surrounding subbasin is identified in SGMA (Water Code § 10720.8) as an adjudicated area and no part of the Subbasin nor any surrounding subbasin has been the subject of a comprehensive common law groundwater adjudication or comprehensive adjudication as described in Code of Civil Procedure Section 830 *et seq.*; (2) No other GSAs exist within the Subbasin; and (3) No alternative plans have been submitted for any part of the Subbasin, nor for any surrounding subbasin. Consequently, no map is included in the GSP for adjudicated areas, other GSAs or alternative plans.

## 3.3 Other Jurisdictional Areas

In addition to the GSAs, there are several federal, state, and local agencies that have some degree of water management authority in the Subbasin. Each agency or organization is discussed below. A map of the jurisdictional extent of the Federal and State agencies within the Subbasin is shown on Figure 3-2. The source of this information is the DWR SGMA data viewer, available on the DWR SGMA website. A map showing the jurisdictional extent of city and local jurisdictions within the Subbasin is shown on Figure 3-3, though boundaries are unknown, and therefore not included in the map, for other entities with water management/supply responsibilities (mutual water companies, small water systems, etc.).

### 3.3.1 Federal Jurisdictions

Federal agencies with land holdings in the Subbasin include the National Forest Service and the Bureau of Land Management. A portion of the Los Padres National Forest covers a small area

near the southern boundary of the Subbasin. The Bureau of Land Management owns two small parcels in the Red Hills area that partially overlie the Subbasin.

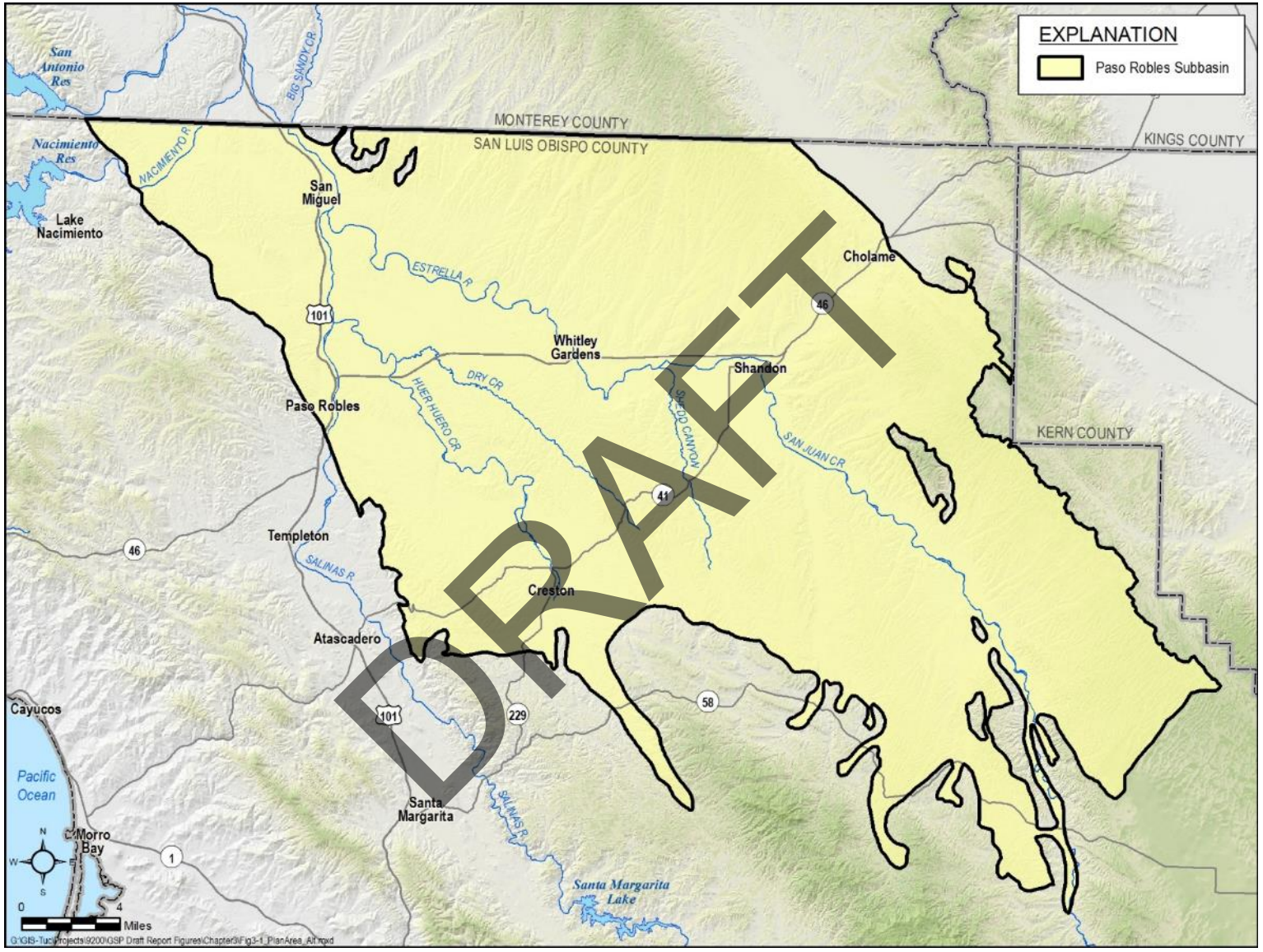



Figure 3-1. Area Covered by GSP

### 3.3.2 Tribal Jurisdiction

The two prominent Native American Tribes in San Luis Obispo County are the Salinan and Northern Chumash Indian tribes. These two tribes do not have any recognized tribal land in the Subbasin.

### 3.3.3 State Jurisdictions

State agencies in the Subbasin include the California National Guard and the California Department of Fish and Wildlife. The California National Guard occupies Camp Roberts at the north end of the Subbasin. The California Department of Fish and Wildlife oversees an area along the Salinas River near Camp Roberts. The Department of Fish and Wildlife additionally has three conservation easements that partially overlie the eastern boundary of the Subbasin.

### 3.3.4 County Jurisdiction

The County of San Luis Obispo and the associated San Luis Obispo County Flood Control and Water Conservation District (SLOFCWCD) have jurisdiction over the entire Subbasin. Land owned or managed by the County in the Subbasin includes a conservation easement south of the City of Paso Robles operated by the Land Conservancy of San Luis Obispo County; CW Clark Park in Shandon; and Wolf Property Natural Area in San Miguel.

### 3.3.5 City and Local Jurisdictions

The City of Paso Robles lies on the west side of the Subbasin. The City has water management authority over its incorporated area and manages a number of parks and recreational sites. One community service district exists in the Subbasin: the San Miguel CSD. Two primarily agricultural water districts exist in the Subbasin: the Shandon - San Juan Water District and the Estrella-El Pomar-Creston Water District.

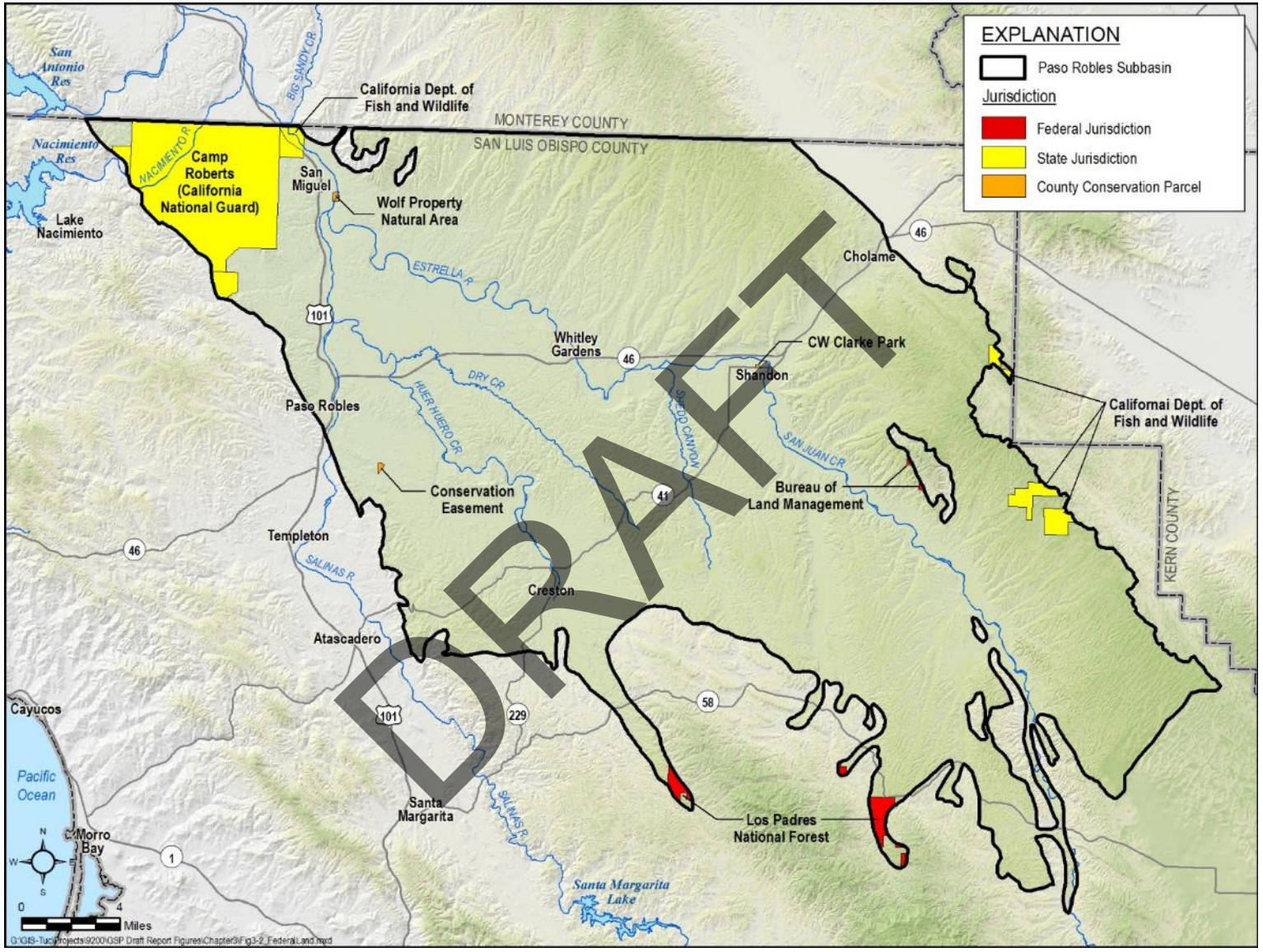



Figure 3-2. Map of Federal Jurisdictional Areas, State Jurisdictional Areas and County Conservation Parcels

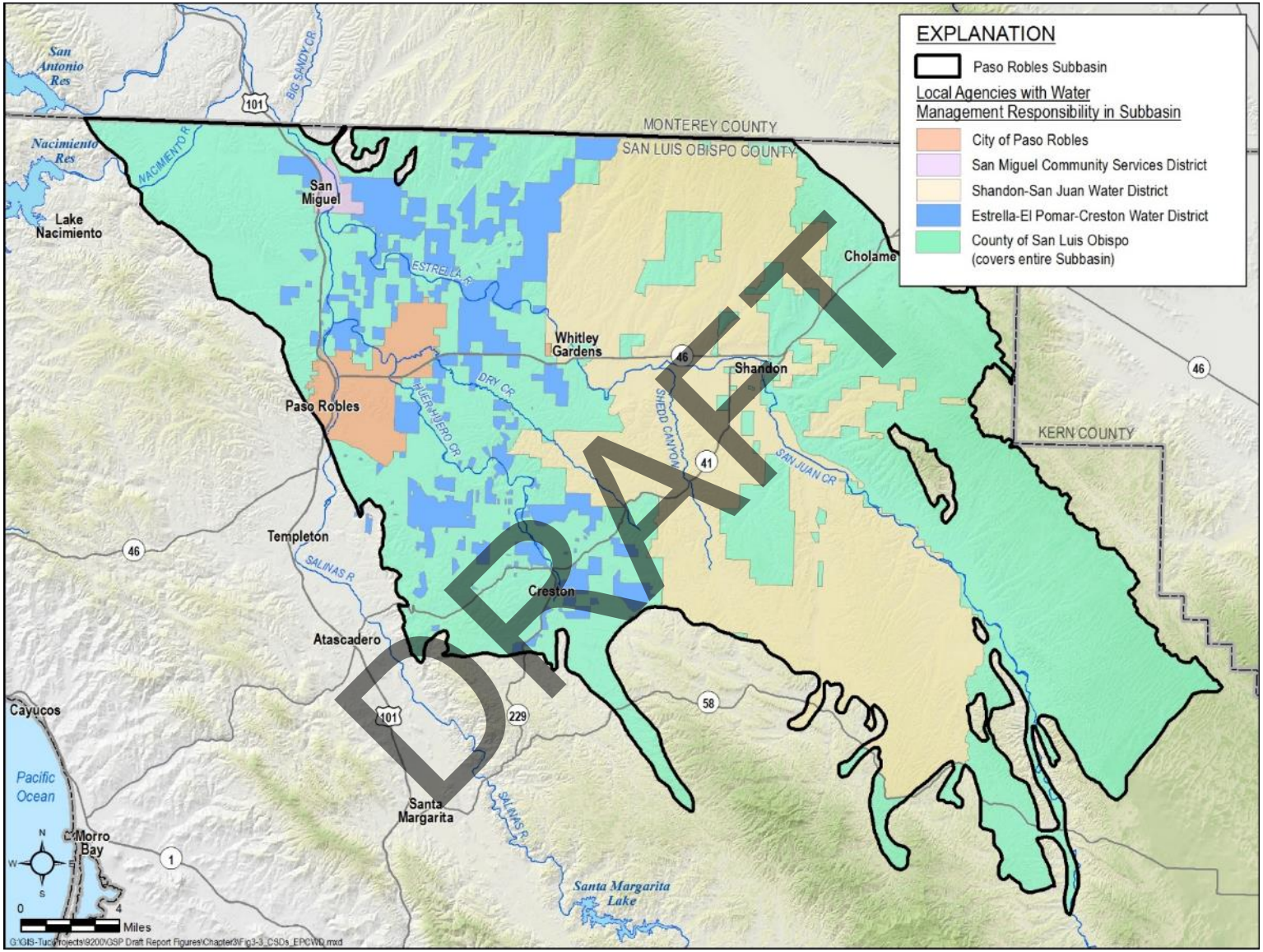



Figure 3-3. Map of City, CSD, and Water District Jurisdictional Areas

## 3.4 Land Use

Land use planning authority in the Subbasin is the responsibility of the City of Paso Robles (within its boundary) and of the County of San Luis Obispo (within all other areas of the Subbasin). Current land use in the Subbasin is shown on Figure 3-4 and is summarized by group in Table 3-1. The urban land use category is provided by DWR based on data compiled by Land IQ from 2014 (LandIQ, 2017). The agricultural land use categories and acreage is provided by the County of San Luis Obispo's Agricultural Commissioner's Offices (SLO County ACO) (2016). The balance of the 436,240 acres in the GSP Plan Area is classified as native vegetation and could include dry farmed land.

Table 3-1. Land Use Summary

| Land Use Category | Acres |
|---|---|
| Citrus | 397 |
| Deciduous | 471 |
| Alfalfa | 1,590 |
| Nursery | 63 |
| Pasture | 667 |
| Vegetable | 1,691 |
| Vineyard | 35,349 |
| Native vegetation | 387,435 |
| Urban | 8,577 |
| Total | **436,240** |

Sources: Department of Water Resources and County of San Luis Obispo's Agricultural Commissioner Offices

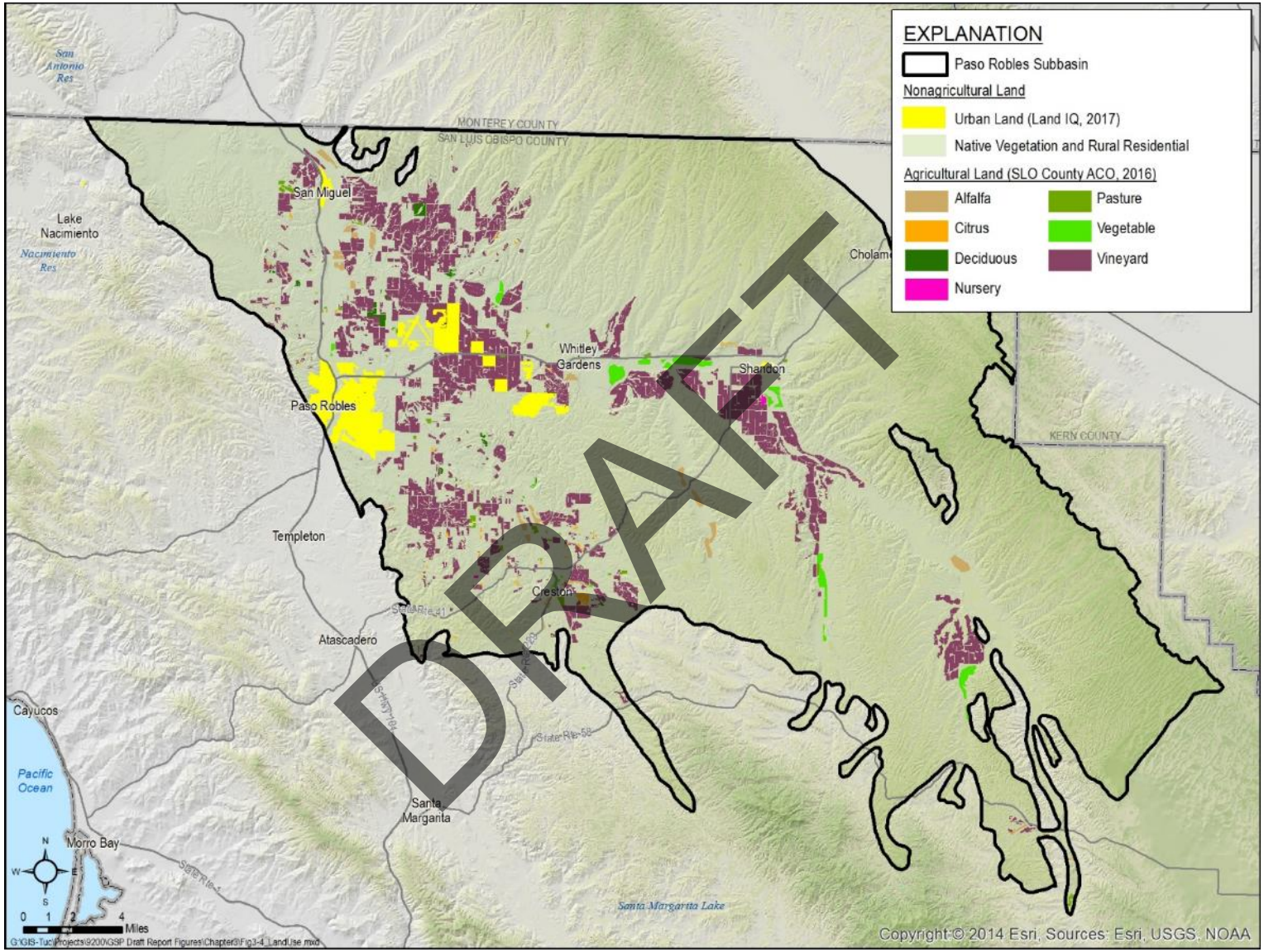



Figure 3-4. Existing Land Use Designations

### 3.4.1 Water Source Types

The Subbasin has three water source types: groundwater, surface water, and recycled water. Until 2015, all water demands in the Subbasin were met with groundwater. Figure 3-5 shows the communities, defined as cities and census-designated places that depend on groundwater as the source of water.

The City of Paso Robles began using Nacimiento Project Water in 2015. (Todd Groundwater, 2016). The City has a contractual entitlement to 6,488 acre-feet per year (AFY). Community Service Area 16 (CSA16), surrounding the community of Shandon, has a State Water Project (SWP) contract entitlement to 100 AFY from the Coastal Branch of the SWP. In 2017, CSA16 took delivery of 99 AF of water, which was the first delivery of SWP water. The locations of the pipelines supplying these water sources are shown on Figure 3-5, along with the land areas supplied by these surface water sources.

Historically, recycled water has not been used as a source of water in the Subbasin. The City of Paso Robles, San Miguel CSD, and Camp Roberts operate wastewater treatment plants. The City of Paso Robles is currently upgrading its water treatment system and plans to use its treated wastewater for irrigation and other non-potable uses. San Miguel CSD is also investigating non-potable use of wastewater. Currently, there is no land using wastewater as a water source type.

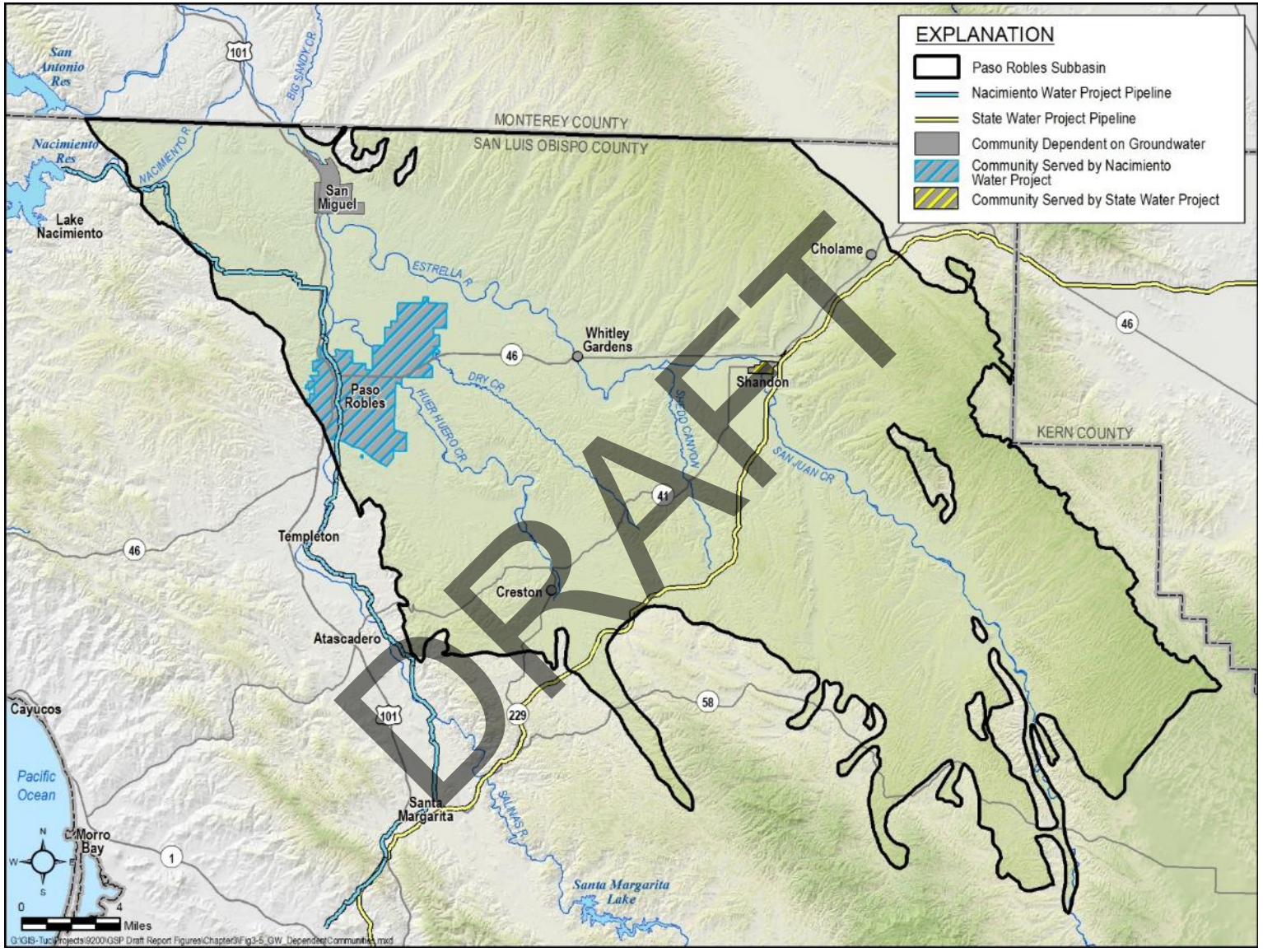



Figure 3-5. Communities Dependent on Groundwater and With Access to Surface Water

## 3.4.2 Water Use Sectors

Water demands in the Basin are organized into the six water use sectors identified in the SGMA Regulations. The urban, agricultural, and native vegetation areas are the same as the land use categories that were defined in Figure 3-4 and Table 3-1. These are:

- **Urban**. Urban water use is assigned to non-agricultural water uses in the cities and census-designated places. Domestic use outside of census-designated places is not considered urban use.
- **Industrial**. There is limited industrial use in the Subbasin. DWR does not have any records of wells in the subbasin that are categorized as for industrial use. Most industrial use is associated with agriculture and is lumped into the agricultural water use sector.
- **Agricultural**. This is the largest water use sector in the Subbasin by water use.
- **Managed wetlands**. There are no managed wetlands in the Subbasin.
- **Managed recharge**. There is no managed recharge in the Subbasin. Recycled water discharge to ponds is included in the urban water use sector
- **Native vegetation.** This is the largest water use sector in the Subbasin by land area. This sector, required by the SGMA Regulations, includes rural residential areas. Native vegetation is the term used in the SGMA Regulations for all other unmanaged and non-irrigated land use sectors.

Figure 3-6 shows the distribution of the water use sectors in the Subbasin.

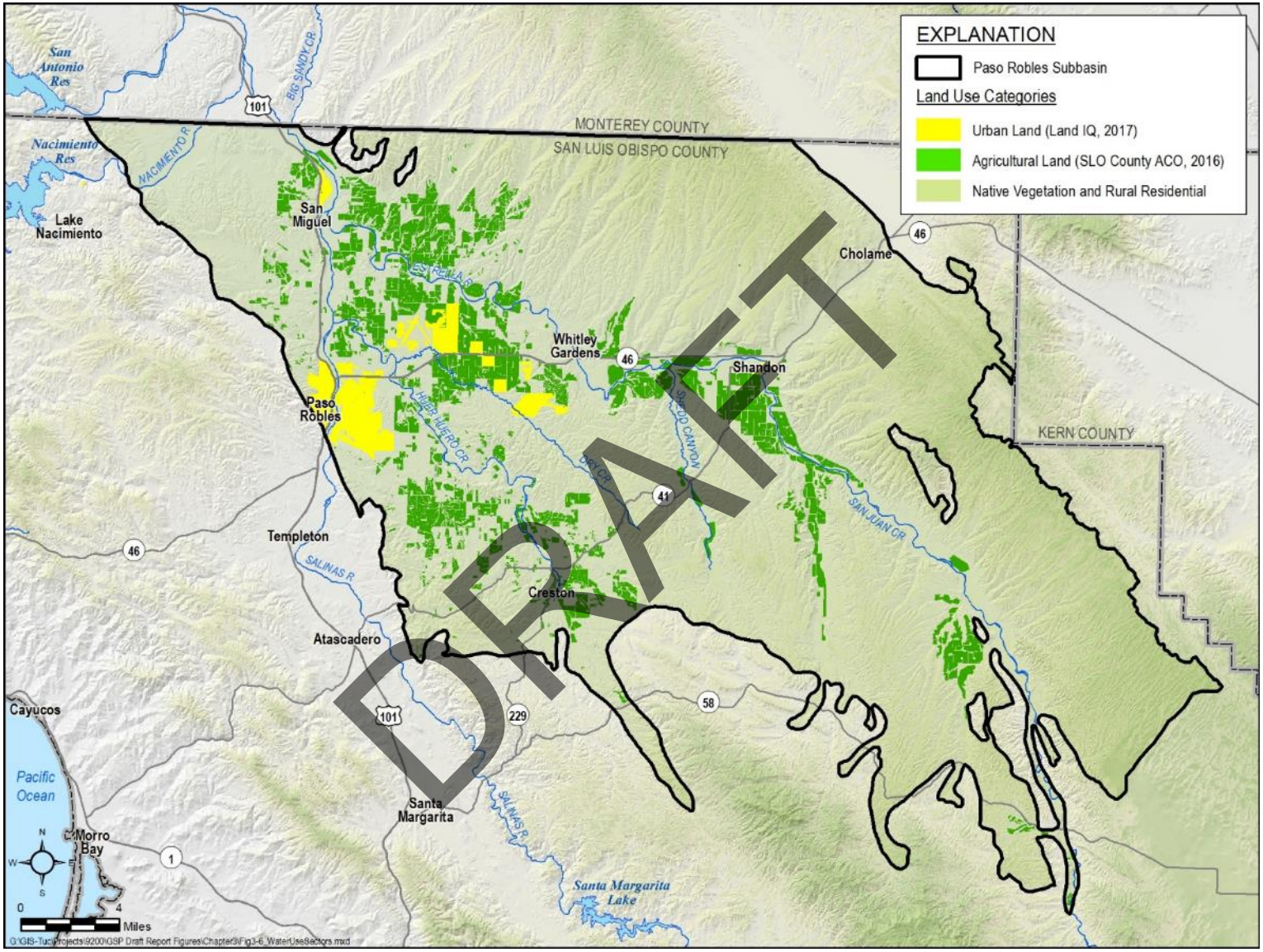



Figure 3-6. Water Use Sectors

## 3.5 Existing Well Types, Numbers, and Density

The total number of existing and active wells is not known. Well types, well depth, and well distribution data were downloaded from DWR's well completion report map application. (DWR, 2018). DWR provided this information specifically for developing GSPs. DWR categorizes wells in this mapping application as either domestic, production, or public supply. These categories are based on the well use information submitted with the well logs to DWR. The majority of the wells categorized on well logs as production wells are used for agriculture. Most of the wells in the Subbasin are used for domestic purposes.

Figure 3-7 through Figure 3-9 show the density of these DWR wells in the Subbasin by their types of use. These DWR data used to develop these maps are not the same set of well data from other sources listed below. DWR data were used to develop maps of well densities because they are organized for easy mapping of well density per square mile. These maps should be considered representative of well distributions, but not definitive.

In addition to DWR datasets, described above, other well information is available from other public databases. Many wells in these databases may have been destroyed or abandoned. Some wells are located in more than one database. Additionally, it is possible that some wells exist in multiple sources listed below due to multiple well naming conventions. The number of wells in each database are listed below. These numbers are updated as of June 12, 2019 and contain duplicates (i.e. each well was included in the count for every source the well was found):

- Online System for Well Completion Reports (OSWCR): 5,854 wells
- SGMA Data Viewer: 20 wells
- SLO County Public Data: 41wells
- SLO County Confidential Data: 193 wells
- SLO County Public Health Department Data Request: 207 wells
- City of Paso Robles: 1 well
- CASGEM: 9 wells

Finally, the County of SLO Public Health Department has a well inventory database of wells permitted between 1965 and the present. The database is based on the best available historical data compiled from the Environmental Health Services well construction permit application process. Of the 5,164 wells documented in the subbasin, most are domestic wells, and approximately 600 are irrigation wells (County of SLO Public Health Department, June 2019).

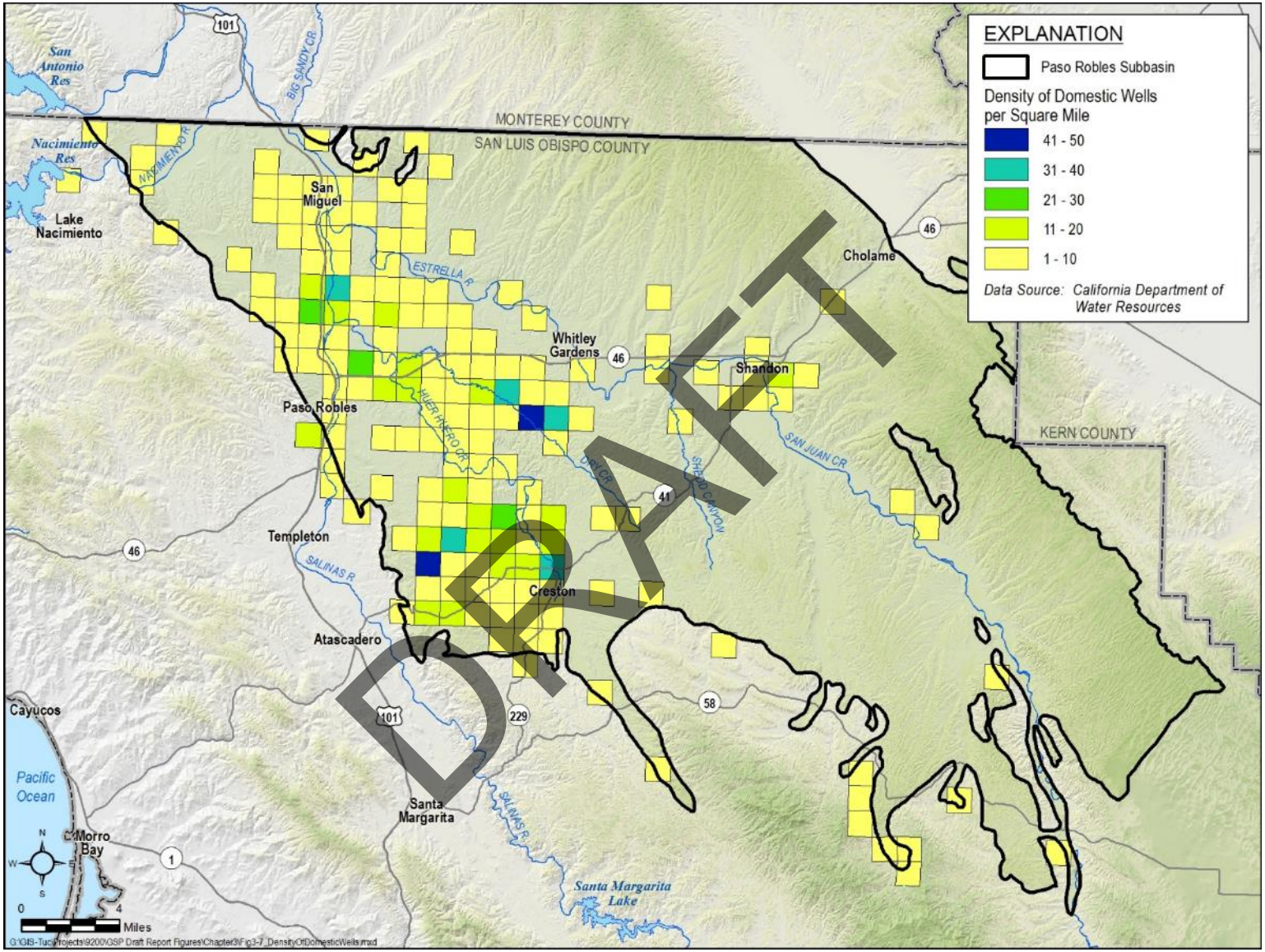



Figure 3-7. Density of Domestic Wells per Square Mile

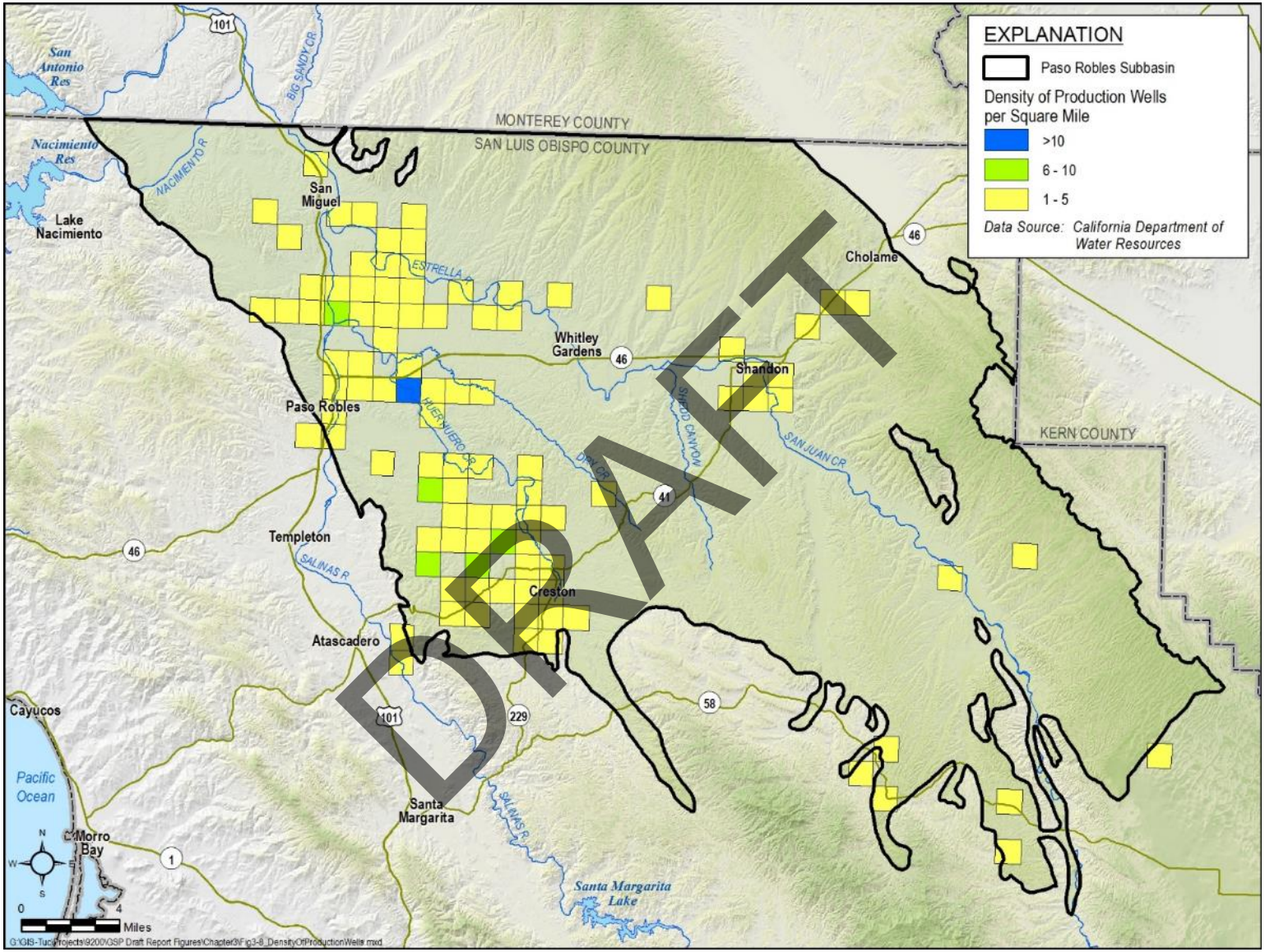



Figure 3-8. Density of Production Wells per Square Mile

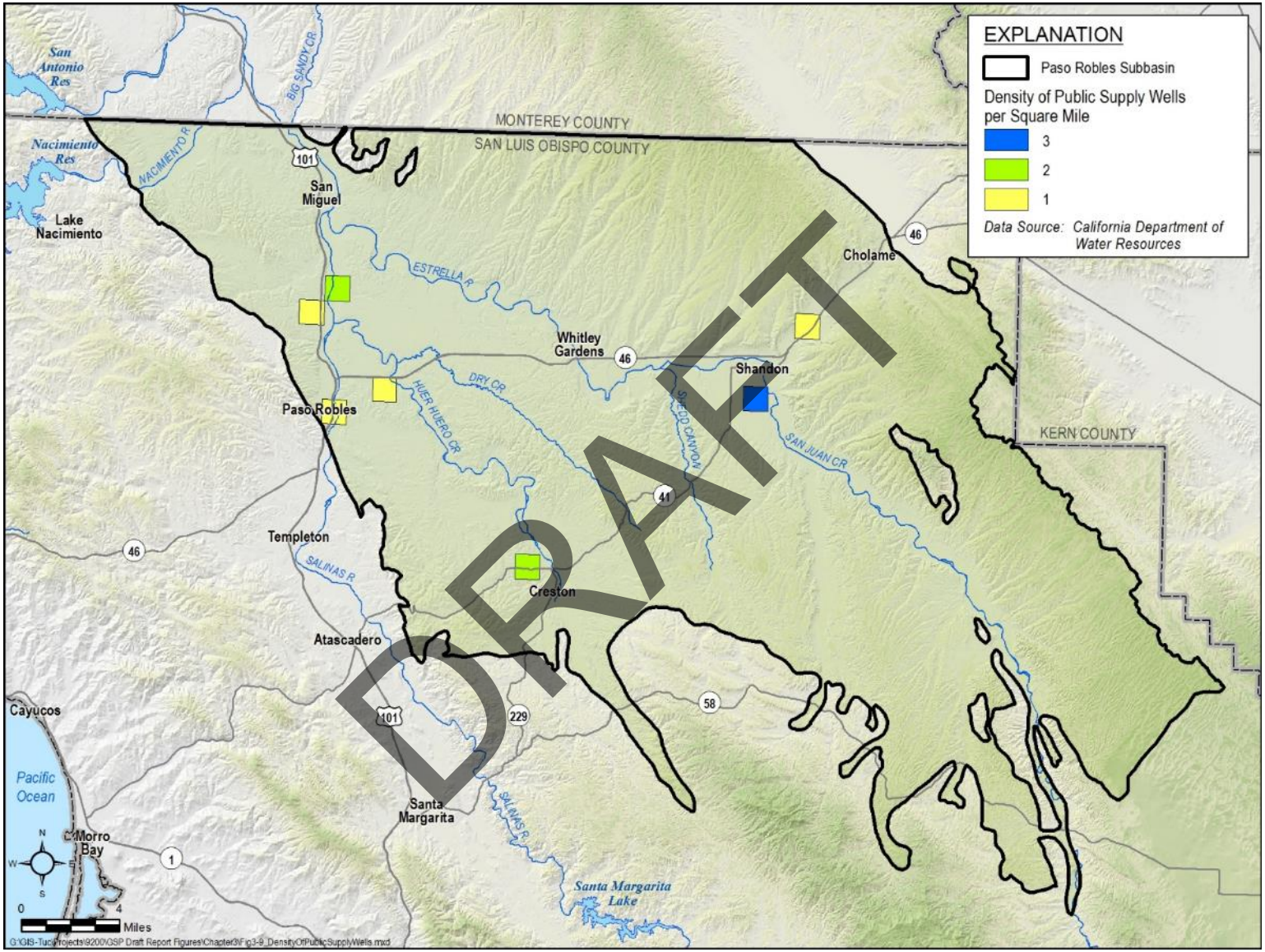



Figure 3-9. Density of Public Water Supply Wells per Square Mile

## 3.6 Existing Monitoring Programs

### 3.6.1 Groundwater Level Monitoring

The SLOFCWCD has been monitoring groundwater levels county-wide on a semi-annual basis for more than 50 years to support general planning and for engineering purposes. Groundwater level measurements are taken once in the spring and once in the fall. The monitoring takes place from a voluntary network of wells. The voluntary monitoring network has changed over time as access to wells has been lost or new wells have been added to the network.

The U.S. Geological Survey (USGS) monitors groundwater levels at two monitoring wells in the Basin. The two wells in the Paso Robles Subbasin only have one measurement, collected in November 2017. The frequency for monitoring is given as "periodic" so the frequency is unknown at this time.

Routine monitoring of groundwater levels is conducted in the Subbasin by County Staff through the SLOFCWCD program. Figure 3-10 shows the locations of monitoring wells in the SLOFCWCD's database that are designated as public and the locations of monitoring wells reported to the state's California Statewide Groundwater Elevation Monitoring (CASGEM) system. The monitoring network also includes a number of other wells in the Plan Area that are not shown on this map as the data was gathered under confidentiality agreements between monitoring network participants and SLOFCWCD. Additional evaluation of the current monitoring program was conducted for the GSP to establish a representative monitoring network of wells with public data that will be used during plan implementation to track groundwater elevations and ensure that minimum thresholds, described in Chapter 8, Sustainable Management Criteria, have not been exceeded.

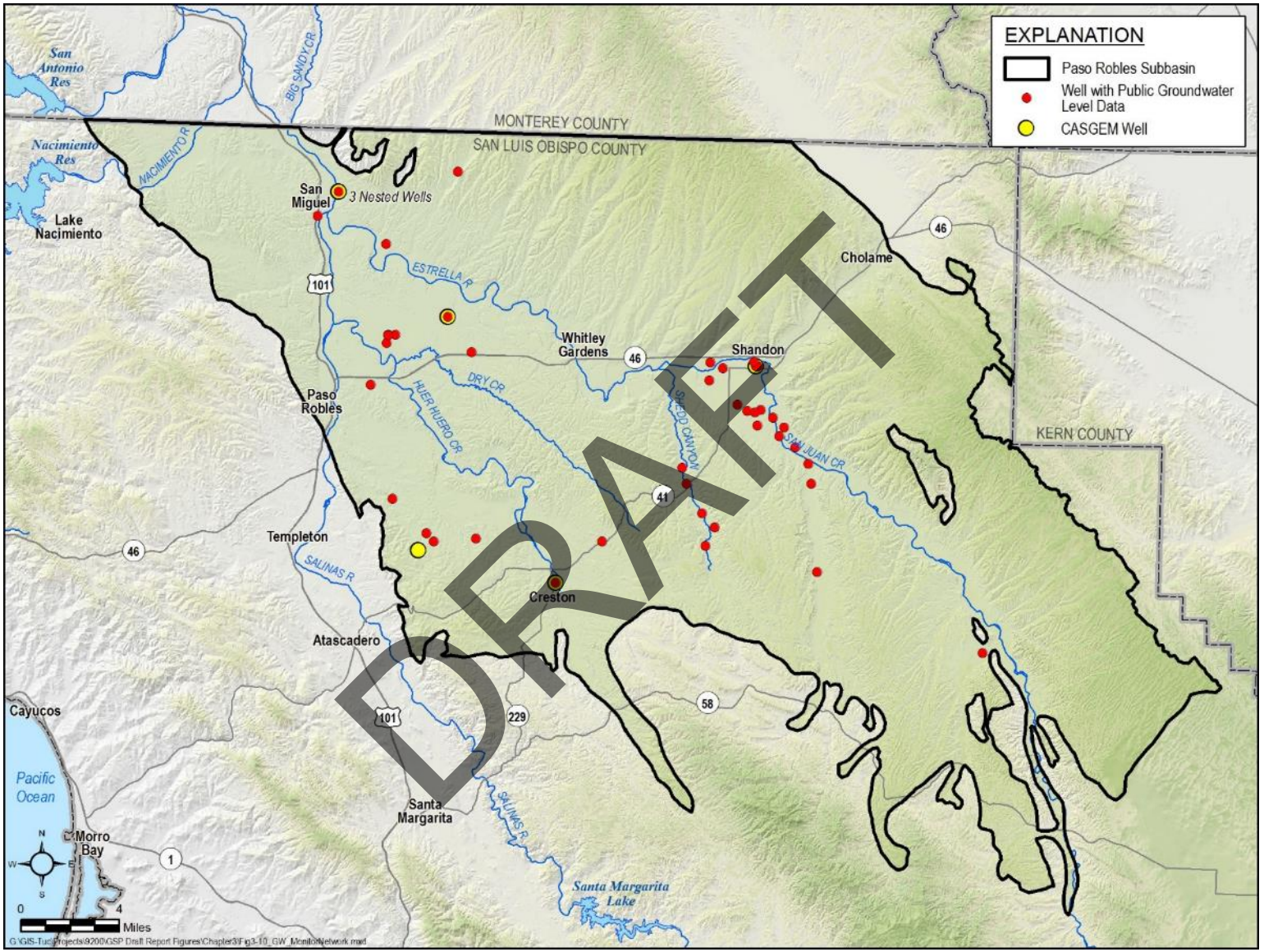



Figure 3-10. Wells with Publicly Available Groundwater Level Data

## 3.6.2 Groundwater Quality Monitoring

Groundwater quality is monitored under several different programs and by different agencies including:

- Municipal and community water purveyors must collect water quality samples on a routine basis for compliance monitoring and reporting to the California Division of Drinking Water.
- The USGS collects water quality data on a routine basis under the Groundwater Ambient Monitoring and Assessment (GAMA) program. These data are stored in the State's GAMA/Geotracker system.
- The State Water Resources Control Board's 2009 Recycled Water Policy required the development of Salt Nutrient Management Plans for groundwater basins in California. This plan was developed in 2015 for the Paso Robles Subbasin (RMC, 2015).
- There are multiple sites that are monitoring groundwater quality as part of investigation or compliance monitoring programs through the Central Coast Regional Water Quality Control Board.

Figure 3-11 shows the location of wells in the State's GAMA Geotracker database. The USGS monitors groundwater quality at two monitoring wells in the Subbasin. Only one sample has been collected (in 2017) from each of the wells. The monitoring frequency is unknown.

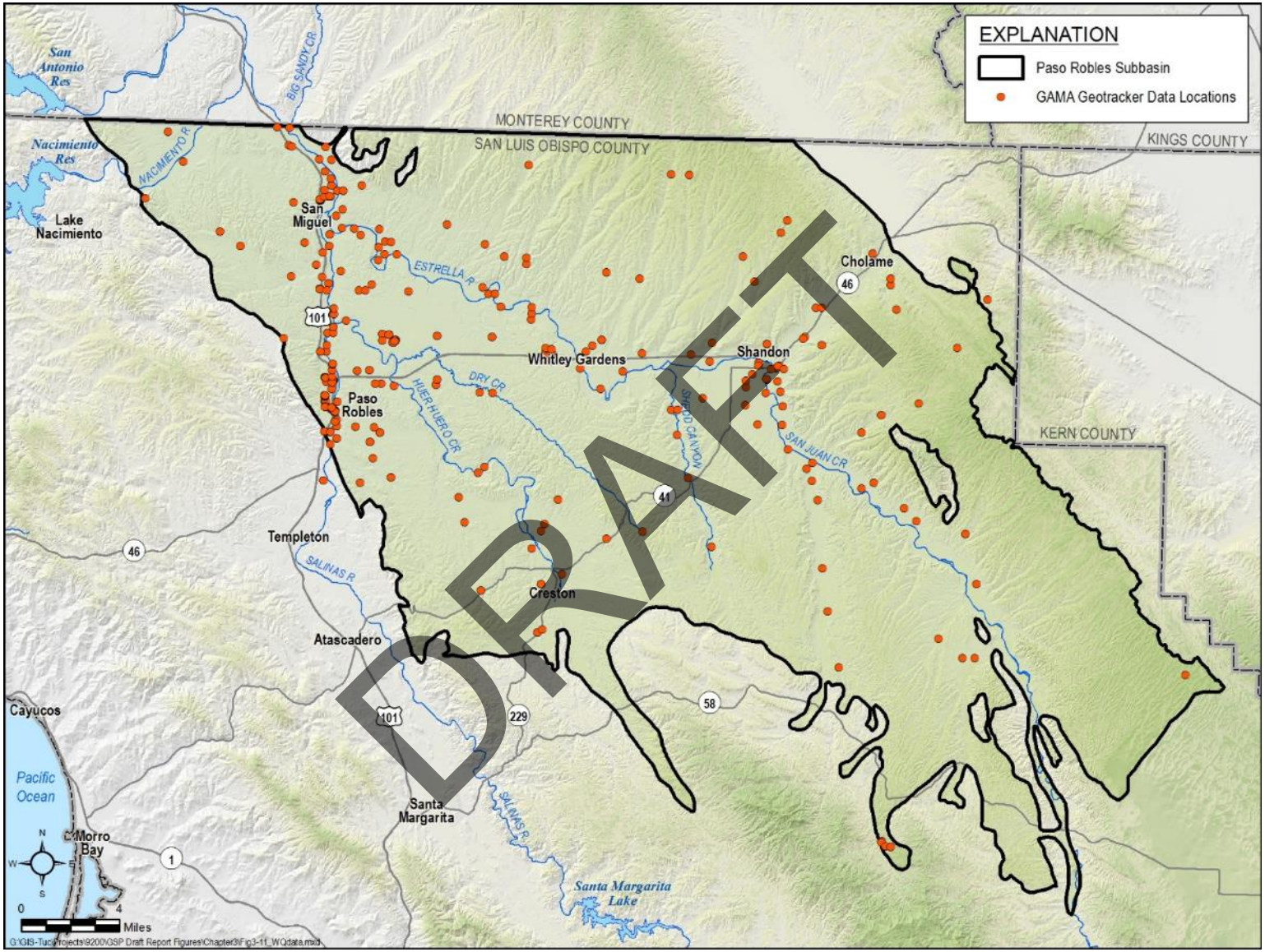



Figure 3-11. Groundwater Quality Monitoring Well Locations

### 3.6.3 Surface Water Monitoring

Stream gauges have historically been maintained and monitored by the USGS and the SLOFCWCD. Data are stored electronically in National Water Information System (NWIS) files and are retrievable from the USGS Water Resources Internet site.

The SLOFCWCD also stores electronic stream gauge data. There are various SLOFCWCD stream gauges surrounding the Subbasin, but no SLOFCWCD stream gauges lie within the Subbasin. Of the USGS stream gauges with historical data, only three gauges are currently active in the Subbasin:

- Salinas River above the City of Paso Robles,
- Estrella River near Estrella,
- Nacimiento River below the Nacimiento Dam near Bradley

A fourth stream gauge, the Salinas River gauge, lies at the base of Santa Margarita dam upstream of the Subbasin. This gauge is important for this GSP because it provides estimates of the streamflow released towards the Subbasin. Figure 3-12 shows the locations of the three active stream gauges in the Subbasin and the one SLOFCWCD gauge upstream of the Subbasin. These three stream gauges in the study area report daily average stream flows.

### 3.6.4 Climate Monitoring

Climate data are measured at seven stations located in the Subbasin. Data from these seven stations were obtained from the SLOFCWCD. The locations of the stations are shown on Figure 3-13. A discussion of climate will be provided in another chapter of the GSP (Chapter 6 – Water Budgets).

Figure 3-13 displays the long-term precipitation record at the Paso Robles station.

The Paso Robles precipitation station measures daily temperatures in addition to rainfall. The California Irrigation Management Information System (CIMIS) station number 163 in Atascadero measures a number of climatic factors that allow a calculation of daily reference evapotranspiration (ETo) for the area. Table 3-2 provides a summary of average monthly rainfall, temperature, and reference ETo for the Basin.

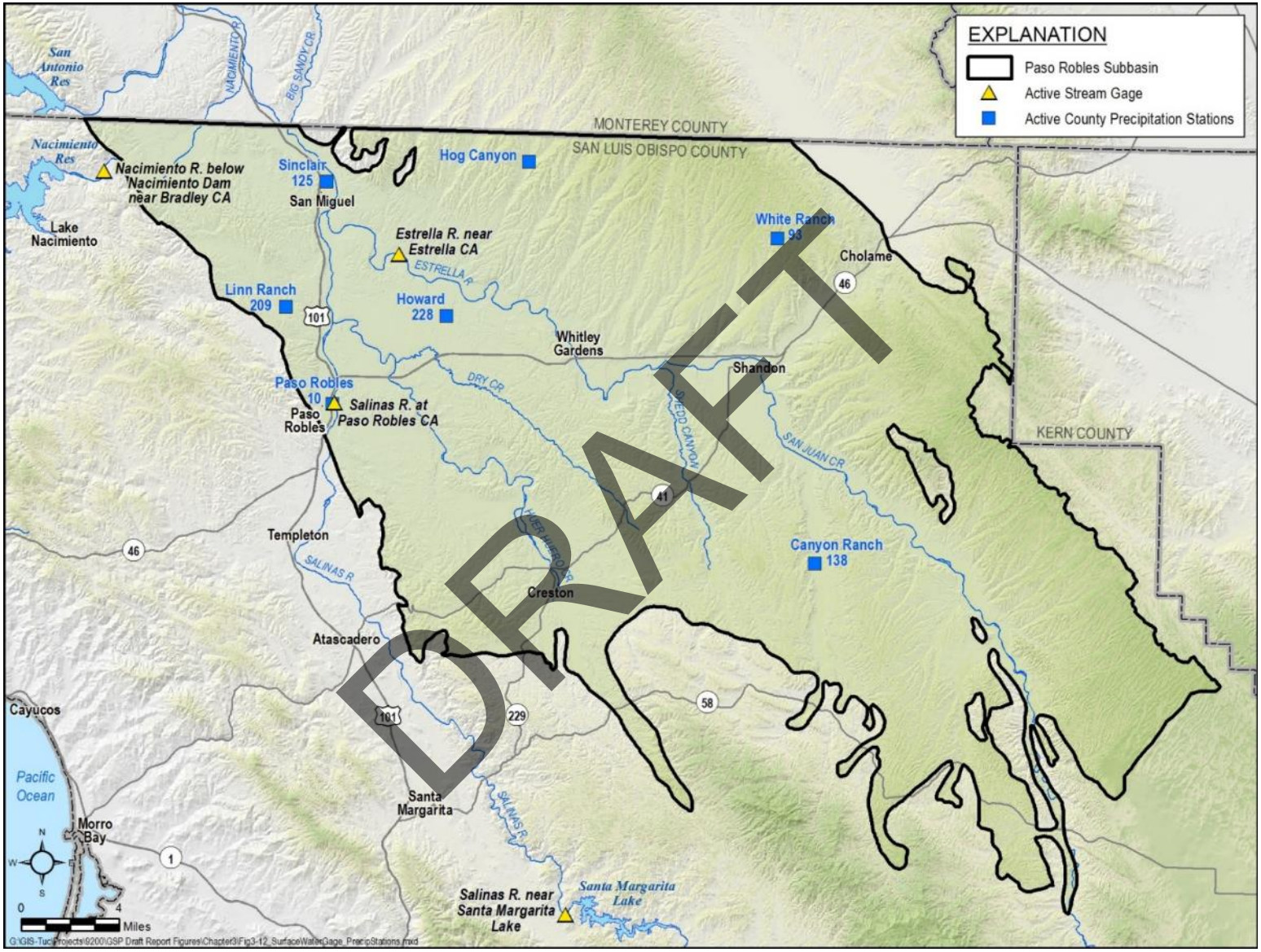



Figure 3-12. Surface Water Gauging and Precipitation Stations

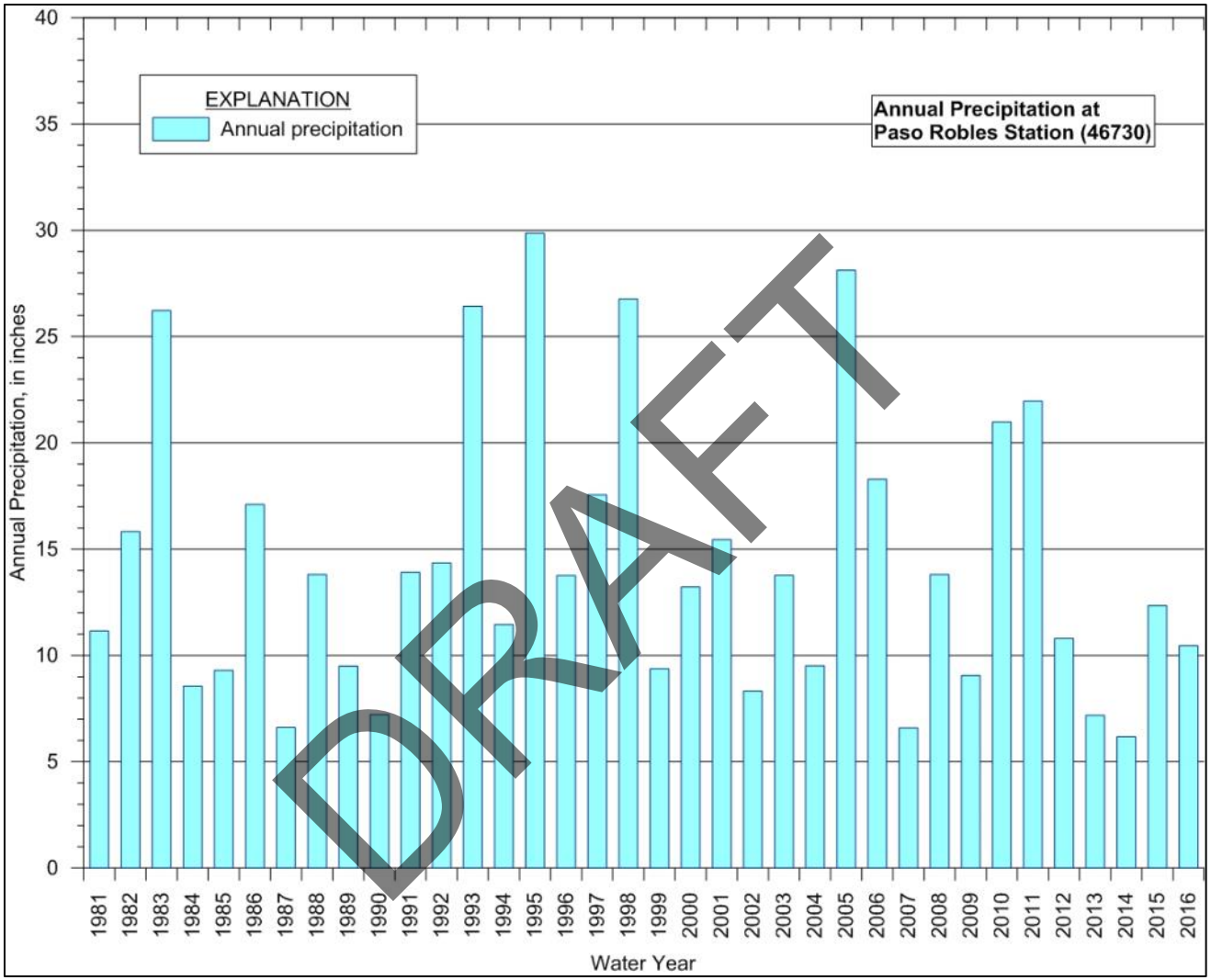



Figure 3-13. Annual Precipitation at the Paso Robles Station

Table 3-2. Average Monthly Climate Summary

| Month | Average Rainfall (inches)[a] | Average $ET_o$ (inches)[b] | Average Daily Temperature (F°)[c] |
|---|---|---|---|
| January | 3.4 | 1.7 | 46.7 |
| February | 3.1 | 2.1 | 49.6 |
| March | 2.6 | 3.6 | 54.0 |
| April | 0.8 | 4.7 | 57.4 |
| May | 0.4 | 6.5 | 61.5 |
| June | 0.0 | 7.5 | 68.6 |
| July | 0.1 | 8.0 | 70.8 |
| August | 0.0 | 7.2 | 70.5 |
| September | 0.2 | 5.6 | 68.4 |
| October | 0.9 | 3.7 | 60.9 |
| November | 1.0 | 2.3 | 51.2 |
| December | 2.4 | 1.4 | 45.2 |
| Monthly Average | 1.2 | 4.5 | - |
| Average Calendar Year[d] | 15.0 | 54.5 | 58.7 |

[a] Average of monthly precipitation at Paso Robles Station 046730 for Jan 1989-Dec 2017 (NOAA NCDC).

[b] ETo = Average of monthly evapotranspiration at Paso Robles Station PR-1 for Jan 1989 through Dec 2017. PR-1 is operated by Western Weather Group. Data prior to Jan 2010 was compiled by Geoscience Support Services, Inc.

[c] Average daily temperature at Paso Robles Station (PR-1) for Jan 2010 through Dec 2017.

[d] Average Calendar Year is not the sum of monthly averages, but rather a historical annual average over the period of record.



### 3.6.4.1 Incorporating Existing Monitoring Programs into the GSP

The SLOFCWCD, the City of Paso Robles, and the City of San Miguel's monitoring programs provide a foundation of groundwater level data to develop the GSP. Chapter 7 of this GSP describes the long-term GSP Monitoring Program, including its relationship to the existing SLOFCWCD program.

The current water quality monitoring program for the production wells will be incorporated into this GSP to demonstrate that groundwater quality undesirable results do not occur based on data from a representative number of production wells. The existing stream gauges will also be incorporated into this GSP monitoring plan.

#### 3.6.4.2 Limits to Operational Flexibility

The existing monitoring programs are not anticipated to limit the operational flexibility of this GSP.

## 3.7 Existing Management Plans

There are multiple groundwater and water management plans that cover the Subbasin. These plans are described in the following subsections, along with brief descriptions of how they relate to the management of current water supply, projected water supplies, and land use.

### 3.7.1 Groundwater Management Plan (2011)

The City of Paso Robles, having authority to manage the groundwater resources within their city limits, and SLOFCWCD, having authority to prepare a groundwater management plan within the unincorporated portions of the Paso Basin within San Luis Obispo County, developed a Groundwater Management Plan (GMP) (GEI, 2011) that is compliant with AB3030 and SB1938 legislation. The plan covered both the Atascadero and Paso Robles Subbasins but excluded the area between the San Juan and San Andreas Faults.

The GMP included a list of 73 groundwater management activities that could be implemented in the Subbasin. The groundwater management activities were grouped into various categories including stakeholder involvement, monitoring and data collection, resource protection, sustainability, and water management. The plan included an implementation schedule and a requirement for periodic updates.

### 3.7.2 San Luis Obispo County Master Water Report (2012)

The Master Water Report (MWR) (Carollo, 2012) is a compilation of the current and future water resource management activities being undertaken by various entities within San Luis Obispo County and is organized by Water Planning Areas (WPA). The MWR explores how these activities interrelate, analyzes current and future supplies and demands, identifies future water management strategies and ways to optimize existing strategies, and documents the role of the MWR in supporting other water resource planning efforts. The MWR evaluates and compares the available water supplies to the water demands for the different water planning areas. This was accomplished by reviewing or developing the following:

- Current water supplies and demands based on available information
- Forecast water demands and water supplies available in the future under current land use policies and designations
- Criteria under which there is a shortfall when looking at supplies versus demands

- Criteria for analyzing potential water resource management strategies, projects, programs, or policies
- Potential water resource management strategies, projects, programs, or policies to resolve potential supply deficiencies.

### 3.7.3 San Luis Obispo County Region Integrated Regional Water Management Plan (2014)

The San Luis Obispo County Integrated Regional Water Management Plan (IRWMP) was initially developed and adopted by the SLOFCWCD in 2005 (GEI Consultants, 2005), and has been updated several times. The 2014 IRWMP (San Luis Obispo County, 2014) included goals and objectives that provide the basis for decision-making and are used to evaluate project benefits. The goals and objectives reflect input from interested stakeholders on the region's major water resources issues.

The SLOFCWCD, in cooperation with the SLOFCWCD's Water Resources Advisory Committee (WRAC), prepared the IRWMP to align the region's water resources management planning efforts with the State's planning efforts. The IRWMP is used to support the Region's water resource management planning and submittal of grant applications to fund these efforts. The IRWMP integrated 19 different water management strategies that have or will have a role in protecting the region's water supply reliability, water quality, ecosystems, groundwater, and flood management objectives. The integration of these strategies resulted in a list of action items (projects, programs, and studies) needed to implement the IRWMP. The IRWMP is currently being updated, with a DWR submittal target date of October 2019.

### 3.7.4 Salt and Nutrient Management Plan for the Paso Robles Groundwater Basin (2015)

The City of Paso Robles, along with the City of Atascadero, San Miguel CSD, Templeton CSD, Heritage Ranch CSD, County of San Luis Obispo, and Camp Roberts, prepared a Salt and Nutrient Management Plan (SNMP) for the Subbasin in accordance with the State's 2009 Recycled Water Policy (RMC, 2015).

In the SNMP, baseline groundwater quality conditions were established as a framework under which salt and nutrient issues can be managed, and to streamline the permitting process of new recycled water projects while meeting water quality objectives and protecting beneficial uses. The SNMP will eventually be used by the Central Coast Regional Water Quality Control Board (CCRWQCB) to aid in the management of basin groundwater quality.

### 3.7.5 City of Paso Robles Urban Water Management Plan (2016)

The Urban Water Management Plan (UWMP) (Todd Groundwater, 2016) describes the City's current and future water demands, identifies current water supply sources, and assesses supply reliability for the City. The UWMP describes the City's reliance on groundwater and its support for efforts to mitigate or avoid conditions of overdraft by developing additional sources. The UWMP provides a forecast of future growth, water demand and water sources for the City through 2035. These sources include water conservation, surface water from Lake Nacimiento, and the use of recycled water for irrigation. The UWMP identifies beneficial impacts to groundwater quality through the use of these sources.

## 3.8 Existing Groundwater Regulatory Programs

There are several water-related regulatory programs in the Subbasin.

### 3.8.1 Salinas River Live Stream Agreement (SWRCB, 1972)

In 1972, the State Water Resources Control Board (SWRCB) issued a decision regarding the storage of water at Salinas Reservoir in order to protect vested downstream rights. The decision presumed that downstream rights would be met if a visible surface flow (i.e., a "live" stream) existed in the Salinas River between the Salinas Reservoir and the confluence with the Nacimiento River. If there was no live stream, then total daily inflow to the Salinas Reservoir was to be released to pass downstream.

The Live Stream Agreement was first implemented in 1972 using flow at the stream gauge on the Salinas River near the City of Paso Robles as an indicator of "live" stream conditions. In 1976, a set of six observation points was established to determine "visible surface flow". A seventh observation point, located immediately upstream of the Graves Creek confluence, was added in 1978. It is this seventh point that has always been the first point to go dry, triggering the live stream release period.

### 3.8.2 Groundwater Export Ordinance (2015)

In 2015, the County of San Luis Obispo passed an Exportation of Groundwater ordinance that requires a permit for the export of groundwater out of a groundwater basin or out of the County. An export permit is only approved if the Department of Public Works Director or his/her designee finds that moving the water would not have any adverse impacts to groundwater resources, such as causing aquifer levels to drop, disrupting the flow of neighboring wells or resulting in seawater intrusion. Export permits are only valid for one year.

### 3.8.3 County of San Luis Obispo Water Demand Offset Ordinance (2015)

In October 2015, the Board of Supervisors adopted the Ordinance and Resolution 2015-288. The Ordinance limited new or expanded irrigated agriculture in areas within the Subbasin except by offset of existing irrigated agriculture either on the same property or on a different property in the Subbasin. The Ordinance also identified areas of severe decline in groundwater elevation and properties overlying these areas would be further restricted from planting new or expanded irrigated agriculture except for those converting irrigated agriculture on the same property into a different crop type. Resolution 2015-288 established the Countywide Water Conservation Program (CWWCP). The CWWCP helps to substantially reduce increases in groundwater extraction in areas that have been certified Level of Severity (LOS) III.

In June 2019, the Board of Supervisors directed the County of San Luis Obispo Department of Planning and Building to develop recommendations for extending the Ordinance such that there is no gap between the expiration of the Ordinance and any pumping restrictions or controls that may be implemented as part of this GSP. The Department of Planning and Building is developing a two-phase extension. It is anticipated that the first phase will be presented to the Board of Supervisors in November, 2019, and will include a time extension as well as additions to the Ordinance that do not trigger significant review under CEQA. The second phase will likely be presented to the Board of Supervisors sometime in 2020, and will include Ordinance additions that may trigger more significant CEQA review.

### 3.8.4 Agricultural Order (RWQCB, 2017)

In 2017 the CCRWQCB issued Agricultural Order No. R3-2017-0002, a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Order). The permit requires that growers implement practices to reduce nitrate leaching into groundwater and improve surface receiving water quality. Specific requirements for individual growers are structured into three tiers based on the relative risk their operations pose to water quality.

Growers must enroll, pay fees, and meet various monitoring and reporting requirements according to the tier to which they are assigned. All growers are required to implement groundwater monitoring, either individually or as part of a cooperative regional monitoring program. Growers electing to implement individual monitoring (i.e., not participating in the regional monitoring program implemented by the Central Coast Groundwater Coalition or CCGC) are required to test all on-farm domestic wells and the primary irrigation supply well for nitrate or nitrate plus nitrite, and general minerals, including, but not limited to, total dissolved solids (TDS), sodium, chloride and sulfate.

### 3.8.5 Water Quality Control Plan for the Central Coast Basins (SWRCB, 2017)

The Water Quality Control Plan for the Central Coastal Basin (Basin Plan) was most recently updated in September 2017. The objective of the Basin Plan is to outline how the quality of the surface water and groundwater in the Central Coast Region should be managed to provide the highest water quality reasonably possible.

The Basin Plan lists beneficial users, describes the water quality which must be maintained to allow those uses, provides an implementation plan, details SWRCB and CCRWQCB plans and policies to protect water quality and a statewide surveillance and monitoring program as well as regional surveillance and monitoring programs.

Present and potential future beneficial uses for inland waters in the Basin are: surface water and groundwater as municipal supply (water for community, military or individual water supplies); agricultural; groundwater recharge; recreational water contact and non-contact; sport fishing; warm fresh water habitat; wildlife habitat; rare, threatened or endangered species; and, spawning, reproduction, and/or early development of fish.

Water Quality Objectives for both groundwater (drinking water and irrigation) and surface water are provided in the Basin Plan.

Total Maximum Daily Load (TMDLs) requirements have been developed for Fecal Indicator Bacteria and Alternative Implementation Program for the Cholame Creek Watershed and Lower San Antonio River Subwatershed in San Luis Obispo and Monterey Counties. A TMDL for boron in the Estrella River Subwatershed, San Luis Obispo and Monterey Counties has also been developed. A TDML for to the Upper Salinas River has not been developed.

The Basin Plan identified actions to be implemented in the Basin, including:

- Dischargers along the Salinas River should remain as separate treatment facilities with land disposal to evaporation/percolation systems and land application (irrigation) systems where possible. Disposal should be managed to provide maximum nitrogen reduction (e.g., through crop irrigation or wet and dry cycle percolation).
- The City of Paso Robles owns and operates a nominal 5 mgd secondary wastewater treatment plant. Treated wastewater is discharged to the Salinas River channel. Beneficial use of reclaimed water should be investigated and implemented, if feasible.
- The City of Paso Robles also owns and operates the wastewater facility serving the California Youth Authority and Paso Robles Airport. Wastewater from the California Youth Authority is currently treated at the City of Paso Robles' WWTP. This wastewater is part of the Recycled Water project that is currently in construction.

### 3.8.6 Requirements for New Wells

In October, 2017, Governor Brown signed Senate Bill (SB) 252 which became effective on January 1, 2018. SB 252 requires well permitting authorities to request certain information, such as depth of the proposed well, identification of existing wells on the property, the planned category of water use and the estimated cumulative extraction volume before January 1, 2020, from a well permit applicant to construct a new well within a critically overdrafted basin and to post the information provided. The law is subject to certain exceptions, such as the applicant would be a *de minimis* extractor, the proposed well is a replacement well that would not result in an increase in extraction, or the proposed well is located within an area subject to a GSP. The requirements set forth in SB 252 become inoperative on January 30, 2020.

### 3.8.7 Title 22 Drinking Water Program (SWRCB)

The SWRCB Division of Drinking Water (DDW) regulates public water systems in the State to ensure the delivery of safe drinking water to the public. A public water system is defined as a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. Private domestic wells, wells associated with drinking water systems with less than 15 residential service connections, industrial and irrigation wells are not regulated by the DDW. County of SLO Environmental Health has primacy and regulates smaller community systems less than 200 connections.

The SWRCB-DDW enforces the monitoring requirements established in Title 22 of the California Code of Regulations (CCR) for public water system wells, and all the data collected must be reported to the DDW. Title 22 also designates the regulatory limits (known as maximum contaminant levels [MCLs]) for various waterborne contaminants, including volatile organic compounds, non-volatile synthetic organic compounds, inorganic chemicals, radionuclides, disinfection byproducts, general physical constituents, and other parameters.



## 3.9 Monitoring and Management Programs with GSP

### 3.9.1 Incorporation into GSP

Information in these plans have been incorporated into this GSP and used during the preparation of Sustainability Goals, when setting Minimum Thresholds and Measurable Objectives, and were considered during development of Projects and Management Actions. This GSP specifically incorporates the following plans and programs, described above:

- The Salt and Nutrient Management Plan for the Paso Robles Groundwater Basin is incorporated into the existing conditions and the Sustainable Management Criteria

- The County of San Luis Obispo Water Demand Offset Ordinance is acknowledged as an important tool for controlling new land uses dependent on groundwater until groundwater management controls can be finalized as part of GSP implementation.
- The Salinas River Live Stream Agreement requirements are incorporated in the Sustainable Management Criteria and projects as a restriction on surface water use
- The Groundwater Export Ordinance is incorporated as a limitation on groundwater use in the Projects and Management Actions
- Agricultural Order (CCRWQCB, 2017) is incorporated into the monitoring plan and Sustainable Management Criteria as monitoring locations for agricultural water quality

### 3.9.2 Limits to Operational Flexibility

Some of the existing management plans and ordinances will limit operational flexibility. These limits to operational flexibility have already been incorporated into the sustainability projects and programs included in this GSP. Examples of limits on operational flexibility include:

- The Groundwater Export Ordinance prevents export of water out of the Subbasin. This is likely not a significant limitation because exporting water out of the Subbasin hinders sustainability.
- The Basin Plan and the Title 22 Drinking Water Program restrict the quality of water that can be recharged into the Subbasin.

### 3.9.3 Conjunctive Use Programs

There are no active conjunctive use programs currently operating within the Subbasin.

## 3.10 Land Use Plans

The County of San Luis Obispo, the City of Paso Robles and Camp Roberts have land use authority. The GSAs do not have land use authority by virtue of being GSAs. Land use is an important factor in water management as described below. The following sections provide a general description of these land use plans and how implementation may affect groundwater. Per statute, when there is a substantial amendment to a city or county's general plan, the planning agency must review and consider the GSP.

### 3.10.1 City of Paso Robles General Plan (2011)

The City of Paso Robles General Plan is the fundamental land use policy document of the City of Paso Robles. The City's General Plan was developed to address several areas within the City's Planning Area; which includes areas defined as City Limits, the Sphere of Influence, and the

Planning Impact Area. The City's General Plan defines the framework by which the City's physical and economic resources are to be managed and used in the future. This City General Plan has a planning horizon of 2025.

Present City policy recommends that residential growth be managed toward a target population of 44,000 in 2025. Most growth is anticipated to occur within the existing City limits where services and public facilities are available. Additional growth is likely to occur in the urban area east of the Salinas River, but minor annexations to the City would be necessary in order to fully develop at the densities recommended in the City's General Plan.

### 3.10.2 San Luis Obispo County General Plan (2014)

The County of San Luis Obispo General Plan contains three pertinent elements that are related to land use and water supply. Pertinent sections include:

- Land Use Element
- Agricultural Element
- Inland Area Plans Element

The County General Plan also contains programs which are specific, non-mandatory actions or policies recommended by the Land Use and Circulation Element (LUCE) to achieve community or area wide objectives. Implementing each LUCE program is the responsibility of the County or other public agency that is identified in the program. Because programs are recommended actions rather than mandatory requirements, implementation of any program by the County should be based on consideration of community needs and substantial community support for the program and its related cost.

The LUCE, adopted in 2014, consolidates and reorganizes the former Adelaida, El Pomar-Estrella, Las Pilitas, Nacimiento, and Salinas River planning areas, and the northern portions of the Los Padres and Shandon-Carrizo planning areas, into a single watershed-based planning area called the North County planning area. The Planning Area does not conform to the Subbasin boundaries but does provide a general representation of the land use in the area.

Article 9 and Article 10 of the LUCE incorporates a number of community plans that were developed for the communities in the Subbasin. These include the Creston Village Plan, the North County Villages Plan, the San Miguel Community Plan, and the Shandon Community Plan.

The County General Plan identifies land use types and acres within the North County planning area. The data from the 2014 update are summarized on Table 3-3.

Table 3-3. Land Use Acreage

| Land Use Category | Adelaida | El Pomar-Estrella | Las Pilitas | Los Padres North | Nacimiento | Salinas River | Shandon[2] | Total |
|---|---|---|---|---|---|---|---|---|
| Agriculture | 152,715 | 104,762 | 21,270 | 11,613 | 36,049 | 52,954 | 348,569 | **727,932** |
| Rural Lands | 26,711 | 14,613 | 3,528 | 21,133 | 31,334 | 7,945 | 3,941 | **109,205** |
| Recreation | 277 | 0 | 460 | 0 | 2,725 | 664 | 0 | **4,126** |
| Open Space | 1,352 | 0 | 3,520 | 74,943 | 9,954 | 13,630 | 1,421 | **104,820** |
| Residential Rural | 77 | 11,816 | 625 | 0 | 2,363 | 5,530 | 170 | **20,581** |
| Residential Suburban | 0 | 363 | 0 | 0 | 0 | 82 | 0 | **445** |
| Residential Single Family | 0 | 0 | 0 | 0 | 0 | 22 | 0 | **22** |
| Residential Multi-Family | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Commercial Retail | 0 | 0 | 8 | 0 | 0 | 5 | 3 | **16** |
| Commercial Service | 0 | 0 | 0 | 0 | 0 | 87 | 3 | **90** |
| Industrial | 0 | 0 | 0 | 0 | 0 | 20 | 0 | **20** |
| Public Facilities | 26,146 | 2 | 0 | 0 | 0 | 86 | 0 | **26,234** |
| Dalidio Ranch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Total** | **207,278** | **131,556** | **29,411** | **107,689** | **82,425** | **81,025** | **354,107** | **993,491** |

[1]Acreage quantities are current as of the last major update to each of the former North County area plans (refer to Table 1-1).
[2]Northern half of the former Shandon-Carrizo planning area.



Projected growth in the planning subareas in the Subbasin as defined in the County General Plan includes:

- The City of Paso Robles population in 1995 was estimated to be 21,539, or 15.9 percent above the population of 18,138 in 1990, increasing at an average annual growth rate of 3.1 percent.
- Population in the Adelaida sub-area has been steadily increasing, but slower than the county as a whole. This pattern will likely continue, declining slightly as countywide growth also declines.
- The Las Pilitas sub-area's present population is estimated to be 1,101. Since the sub- area contains no urban areas, a large population increase is not expected. Population growth in the Las Pilitas sub-area has been slightly less than 2 percent per year and is expected to slowly decline as the countywide growth rate also declines.

The SLO County Planning Department estimated potential water demands from rural residential areas in the County. They assumed that a reasonable ultimate build-out equates to development

of 75 percent of all possible parcels currently zoned for rural residential areas. This would result in a rural residential demand of just over 37,000 AFY. This estimate includes small community water systems. If ultimate build-out occurred by 2025, the annual growth rate would be an unrealistic 12.8 percent. In order to determine the demand in 2025, a growth rate of 2.3 percent per year was assumed. As a result, the County estimated rural residential pumping in 2025 will be 16,504 AF, which is 44 percent of ultimate build-out.

An overarching assumption in this plan is that any future increases in groundwater use within the Subbasin will be offset by equal reductions in groundwater use in other parts of the Subbasin, or in other words, groundwater neutral through implementation of the GSP.

In addition, in 1990, the County created the Resource Management System (RMS) with the purpose of establishing a process whereby development could be sustained through planned resource management. The RMS focuses on collecting data, identifying issues and recommending solutions with respect to a number of resources, including water and sewage disposal. As part of the RMS, the County Planning and Building Department produces Biannual Resource Summary Reports (RSRs) and, under certain circumstances, Resource Capacity Studies (RCSs). When a resource deficiency becomes apparent, efforts are made to determine how the resource capacity might be expanded, where conservation measures could be introduced to extend the availability of the unused capacity, or where development should be limited or redirected to areas with remaining resource capacity.

The RMS uses resource-related data and analyses to classify resource deficiencies using three alert levels known as levels of severity (LOS). The criteria for each LOS in the context of water supply are as follows:

- LOS I is reached when water demand projected over 20 years equals or exceeds the estimated dependable supply.
- LOS II occurs when water demand projected over 15-20 years (or other lead time determined by an RCS) equals or exceeds the estimated dependable supply.
- LOS III is reached when water demand projected over 15 years (or other lead time determined by an RCS) equals or exceeds the estimated dependable supply or the time required to correct the problem is longer than the time available before the dependable supply is reached.

In 2007, the County Board of Supervisors directed staff to prepare an RCS for the water supply in the Paso Basin. The RCS addresses the state of the Paso Basin based on work already completed, which included:

- Paso Robles Groundwater Basin Study (Fugro, 2002)

- Paso Robles Groundwater Basin Study Phase II - Numerical Model Development, Calibration, and Application (Fugro, 2005)
- Evaluation of Paso Robles Groundwater Basin Pumping- Water Year 2006 (Todd, 2009)
- Paso Robles Groundwater Basin Water Balance Review and Update (Fugro, 2010)

These studies have calculated the water use by major water use sectors (agriculture, rural land uses, small commercial uses, municipal systems, and small community systems). These studies show that outflows exceed inflows on an average annual basis.

In February 2011, the County Board of Supervisors adopted the RCS, which recommended an LOS III for the Paso Basin and an LOS I for the Atascadero Basin. The RCS also recommended actions to include:

- Water conservation measures that will lead to more efficient water use.
- Land use controls that will reduce conflicts over the limited groundwater resource.

The RCS recognized various decision-making constraints that complicated potential actions by the County at that time, such as the limited regulatory role over water use throughout the entire basin. However, SGMA "…declares that it is vital that there be close coordination and consultation between California's water supply or management agencies and California's land use approval agencies to ensure that proper water supply and management planning occurs to accommodate projects that will result in increased demands on water supplies or impact water resource management." (Government Code 653525). Therefore it will be important to coordinate the County's land use authority with the planning and actions necessary to achieve the sustainability goals identified in local GSPs.



## 3.10.3 Camp Roberts Joint Land Use Study

Located north of the City of Paso Robles and spanning nearly 43,000 acres, Camp Roberts is one of the state's three main training bases for the California National Guard and trains more than 15,000 guardsmen in a typical year. Most of the base is in San Luis Obispo County, within the Subbasin, with the remainder in Monterey County. The Camp Roberts Joint Land Use Study was developed to improve communication between the installation and local communities about land use regulation and conservation decisions as well as natural resource management issues (Matrix Design Group, 2013).

The plan acknowledges groundwater supply planning must be coordinated to ensure viable water resources: "Groundwater supply is of great concern for San Luis Obispo and Monterey Counties. The increases in well drilling for development—residential, commercial, and agriculture—causes more concern in maintaining adequate levels of the Paso Robles Groundwater Basin.

Camp Roberts is a minimal user of the Basin, but development must be strategically planned to avoid unnecessary draws on the Basin."

The plan outlines the following monitoring activities related to water:

- Monitor surface water quality on Camp Roberts and throughout the watershed. Focus studies on the relationship between surface water and groundwater resources. Camp Roberts should allow collection of water samples on Camp Roberts by other agencies, if needed.

- Coordinate with local, regional and state water supply providers and permitting agencies to ensure continued availability of adequate potable water supplies. Identify primary users and anticipated needs through a future time period. Develop plans to sustain and manage water resources more efficiently and update plans regularly.

### 3.10.4 Land Use Plans Outside of Basin

The stakeholders submitting this GSP have not included information regarding the implementation of land use plans outside the Subbasin, as these adjacent subbasins are also required to implement SGMA and their GSPs will require them to achieve sustainable groundwater management.

# 4 HYDROGEOLOGIC CONCEPTUAL MODEL

This chapter describes the hydrogeologic conceptual model of the Paso Robles Subbasin, including the Subbasin boundaries, geologic formations and structures, and principal aquifer units. The chapter also summarizes general Subbasin water quality, the conceptual interaction between groundwater and surface water, and generalized groundwater recharge and discharge areas. This chapter draws upon previously published studies, primarily hydrogeologic and geologic investigations by Fugro Consultants Inc. completed for SLOFCWCD in 2002 and 2005. Subsequent groundwater model updates (GSSI 2014 and 2016), relied upon the original geologic interpretations (Fugro, 2002 and 2005), with the exception of the basin boundaries that are defined in accordance with Bulletin 118 (DWR 2003 and 2016). The Hydrogeologic Conceptual Model presented in this chapter is a summary of aspects of the Subbasin hydrogeology that influence groundwater sustainability based on available information. The basin understanding will be adapted as hydrogeology are better understood in the future. Detailed information can be found in the original reports (Fugro, 2002 and 2005). This chapter, along with Chapter 3 – Description of Plan Area, sets the framework for subsequent chapters on groundwater conditions and water budgets.

## 4.1 Subbasin Topography and Boundaries

The Subbasin is a structural northwest-trending trough filled with sediments that have been folded and faulted by regional tectonics. The top of the Subbasin is the ground surface. The elevation of the Subbasin ranges from approximately 2,000 feet above mean sea level (msl) at the southeastern corner to approximately 600 feet above msl in the northwest where the Salinas River exits the Subbasin.

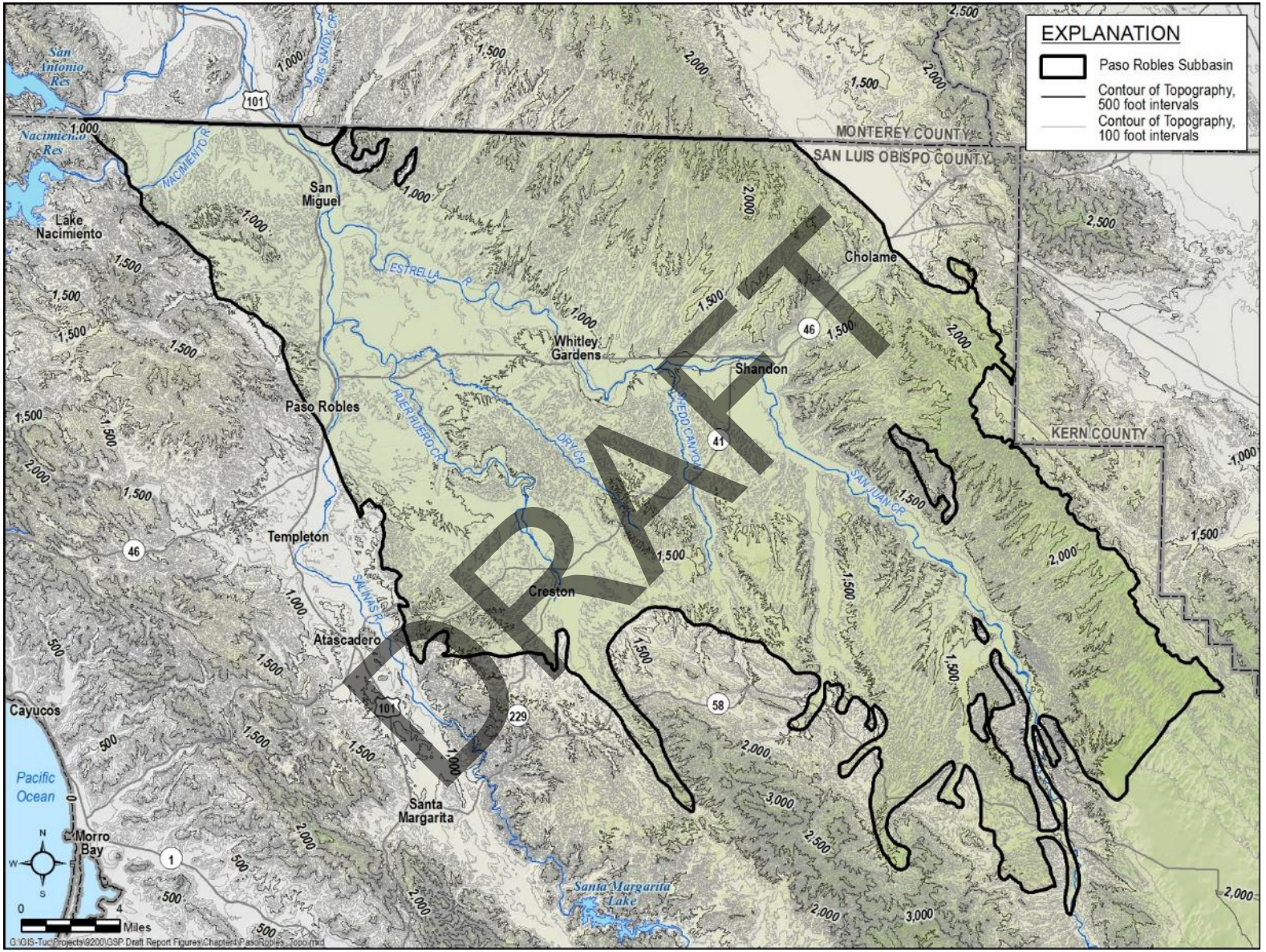



Figure 4-1. Paso Robles Subbasin Topography

Figure 4-1 shows the topography of the Subbasin using 100-foot contour intervals. The Subbasin is bounded by sediments with low permeability, sediments with poor groundwater quality, rock, and structural faults. In some areas the sediments of the Subbasin are continuous with adjacent subbasins.

The bottom of the Subbasin is generally defined as the base of the Paso Robles Formation, an irregular surface formed as the result of folding, faulting, and erosion (Fugro, 2002). The Subbasin bottom is not considered an absolute barrier to flow because some of the geologic units underlying the Paso Robles Formation produce sufficient quantities of water, but the water is generally of poor quality and therefore, is not considered part of the Subbasin. Figure 4-2 shows the lateral boundaries of the Subbasin and the approximate depth to the bottom of Paso Robles Formation in areas where it is saturated.

The Subbasin lateral boundaries are as follows:

- The western boundary of the Subbasin is defined by the contact between the sediments in the Subbasin and the sediments of the Santa Lucia Range. An additional section of the western boundary is defined by the San Marcos-Rinconada fault system which separates the Paso Robles Subbasin from the Atascadero Subbasin.
- The northern boundary of the Subbasin is defined by the county line between San Luis Obispo County and Monterey County. This boundary is not defined by a physical barrier to groundwater flow; water-bearing sediments are continuous with the Salinas Valley Upper Valley Subbasin in Monterey County.
- The eastern boundary of the Subbasin is defined by the contact between the sediments in the Subbasin and the sediments of the Temblor Range. The San Andreas Fault generally forms the northeastern Subbasin boundary, although the basin boundary was identified in the groundwater model as further west, in the area of the White Canyon/Red Hills/San Juan faults (Fugro, 2002).
- The southern boundary of the Subbasin is defined by the contact between the sediments in the Subbasin and the sediments of the La Panza Range. To the southeast, a watershed divide separates the Subbasin from the adjacent Carrizo Plain Basin; sedimentary layers are likely continuous across this divide.

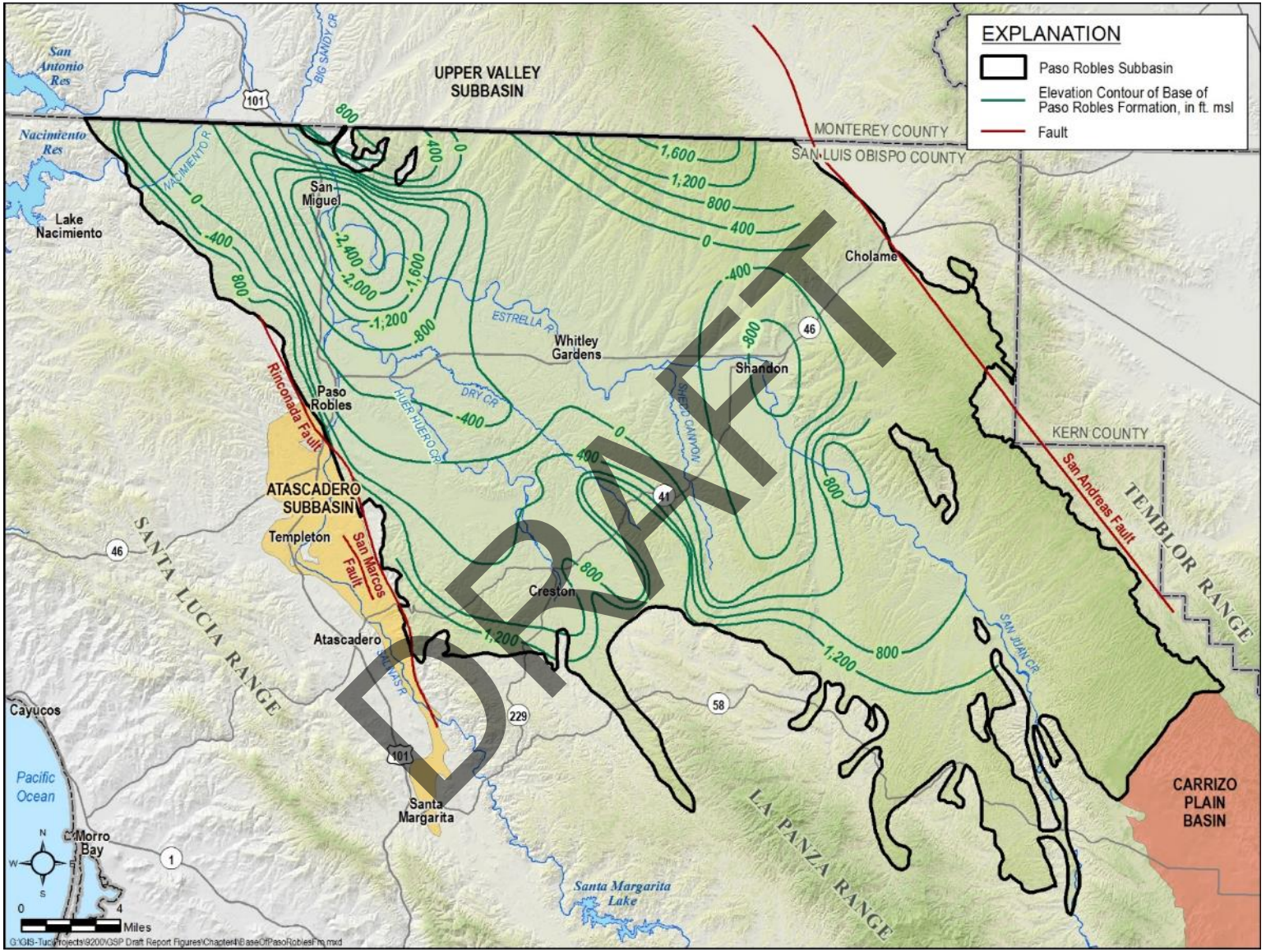



Figure 4-2. Base of Subbasin as Defined by the Base of the Paso Robles Formation

## 4.2 Soils Infiltration Potential

Saturated hydraulic conductivity of surficial soils is a good indicator of the soil's infiltration potential. Soil data from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (USDA NRCS, 2018) is shown by the four hydrologic groups on Figure 4-3. The soil hydrologic group is an assessment of soil infiltration rates that is determined by the water transmitting properties of the soil, which includes hydraulic conductivity and percentage of clays in the soil, relative to sands and gravels. The hydrologic soil group is "determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity and depth to any layer that is more or less water impermeable or depth to a water table" (USDA NRCS, 2007).The groups are defined based on characteristics within 100 centimeters (40 inches) of the surface as:

- Group A – High Infiltration Rate: water is transmitted freely through the soil; soils typically less than 10 percent clay and more than 90 percent sand or gravel
- Group B – Moderate Infiltration Rate: water transmission through the soil is unimpeded; soils typically have between 10 and 20 percent clay and 50 to 90 percent sand
- Group C – Slow Infiltration Rate: water transmission through the soil is somewhat restricted; soils typically have between 20 and 40 percent clay and less than 50 percent sand
- Group D – Very Slow Infiltration Rate: water movement through the soil is restricted or very restricted; soil typically have greater than 40 percent clay, less than 50 percent sand

The hydrologic group of the soil generally correlates with the hydraulic conductivity of underlying geologic units, with lower soil hydraulic conductivity zones correlating to areas underlain by clayey portions of the Paso Robles Formation. The higher soil hydraulic conductivity zones correspond to areas underlain by alluvium or areas of coarser sediments within the Paso Robles Formation.

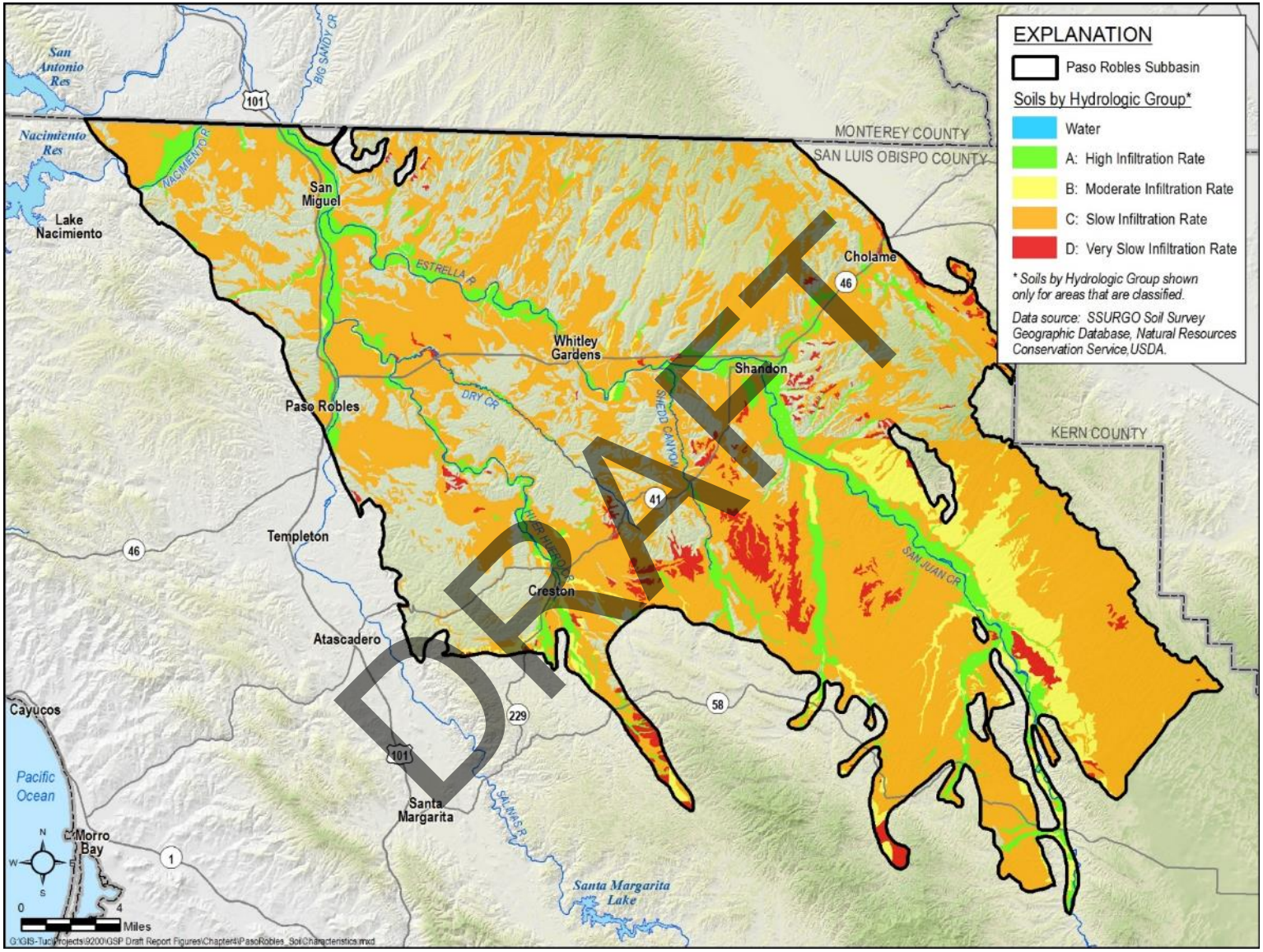



Figure 4-3. Paso Robles Subbasin Soil Characteristics

## 4.3 Regional Geology

This section provides a description of the geologic formations in the Subbasin. These descriptions are summarized from previously published reports by Fugro (2002 and 2005). Figure 4-4 shows the surficial geology and geologic structures of the Subbasin (County of SLO, 2007). .Figure 4-5 provides the location of the geologic cross-sections shown on Figure 4-6 through Figure 4-10. The selected geologic cross-sections illustrate the relationship of the geologic formations that constitute the Subbasin and the geologic formations that underlie and surround the Subbasin based on lithologic data from wells. The cross-sections are from different reports so the format differs but the geologic units are consistent. Likewise, the cross sections were created from base maps that are not included in this report but the general geologic units and structures are the same as represented in Figure 4-4. Figure 4-6 through Figure 4-8 are from Fugro (2002). Figure 4-9 and Figure 4-10 are from Fugro (2005), which also label the various layers from the groundwater model that was developed at this time. The groundwater model was subsequently updated (GSSI, 2016) and is presented in Chapter 6.

### 4.3.1 Regional Geologic Structures

The base of the Subbasin is locally divided by two semi-parallel bedrock ridges: the San Miguel Dome and the Creston Anticlinorium (Figure 4-4). These two bedrock ridges are often not exposed at the ground surface, but are apparent in the east – west subsurface cross-sections, which show subsurface expression of the bedrock. Cross sections Figure 4-6 and Figure 4-8 show these areas where bedrock (generally consisting of the Pancho Rico Formation, the Santa Margarita Formation, or the Monterey Formation) is shallow or exposed at the surface. The shallow bedrock ridge does not appear to be present between San Miguel and Creston (Figure 4-7).

The deepest portion of the Subbasin is west of the San Miguel Dome and north of Paso Robles, with over 3,000 feet of sediments (Fugro, 2005). This deep trough extends through the Paso Robles area and shallows progressively to the south. As shown on Figure 4-6, the sediments are generally relatively thin on the order of a few hundred feet in the Creston area. East of the San Miguel Dome and near the community of Shandon the Paso Robles Formation is over 2,000 feet thick.

The faults within and along the borders of the Subbasin boundaries are shown on Figure 4-6 and are based on the basin boundaries defined by the State's Bulletin 118 – 2003 Update (DWR, 2003). The predominant fault near the western side of the Subbasin is the San Marcos-Rinconada fault system. The predominant fault near the eastern side of the Subbasin is the San Andreas Fault. Within the Subbasin and sub-parallel to the San Andreas Fault are the Red Hill, San Juan, and White Canyon faults, but it is unknown to what degree these faults are barriers to groundwater flow. These faults could create compartments in the sediments and limit the ability

of groundwater to move within the Subbasin. The Paso Robles Formation is either not present or not saturated east of the San Juan fault system; there is very little well data in this portion of the Subbasin.

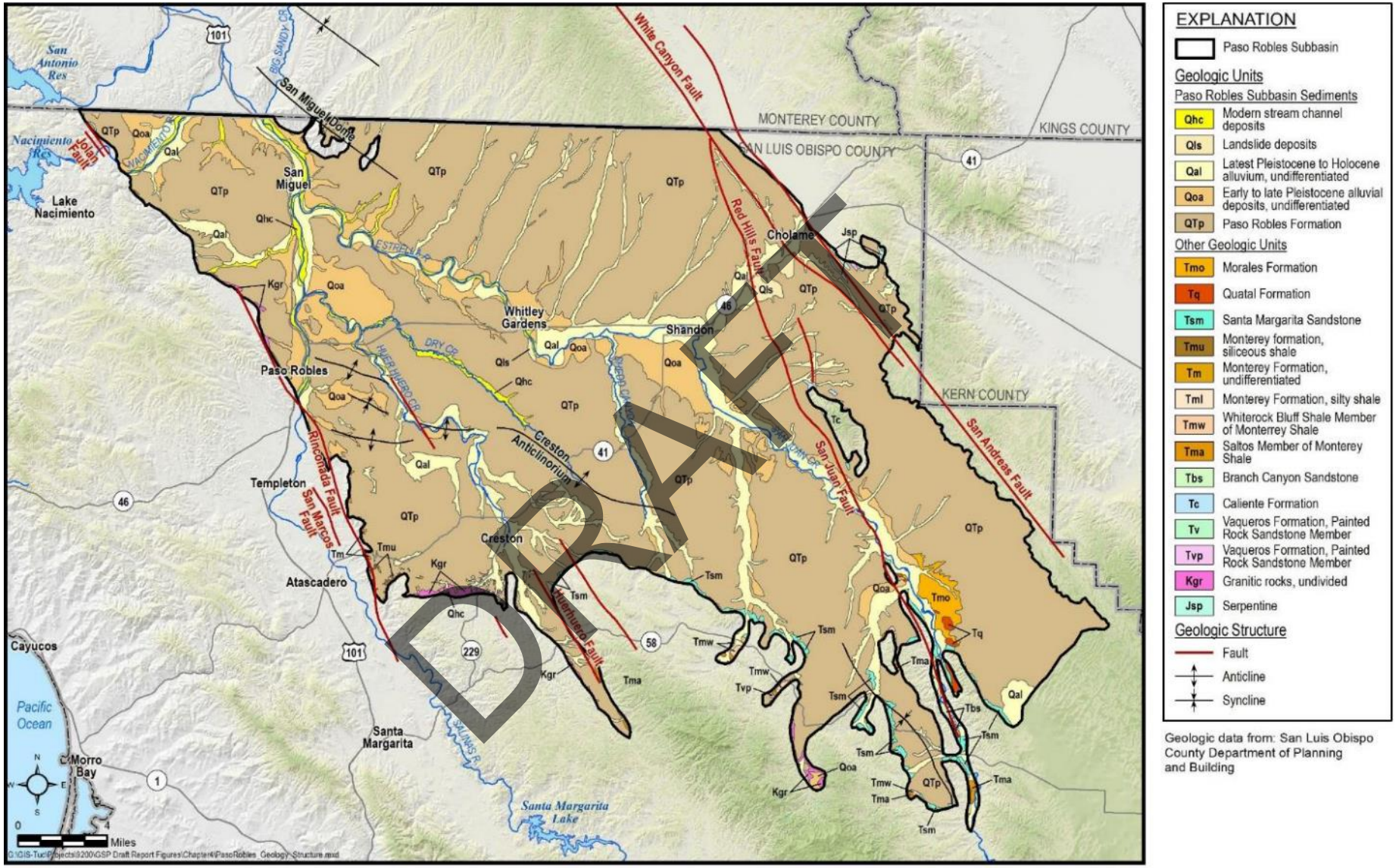



Figure 4-4. Surficial Geology and Geologic Structures

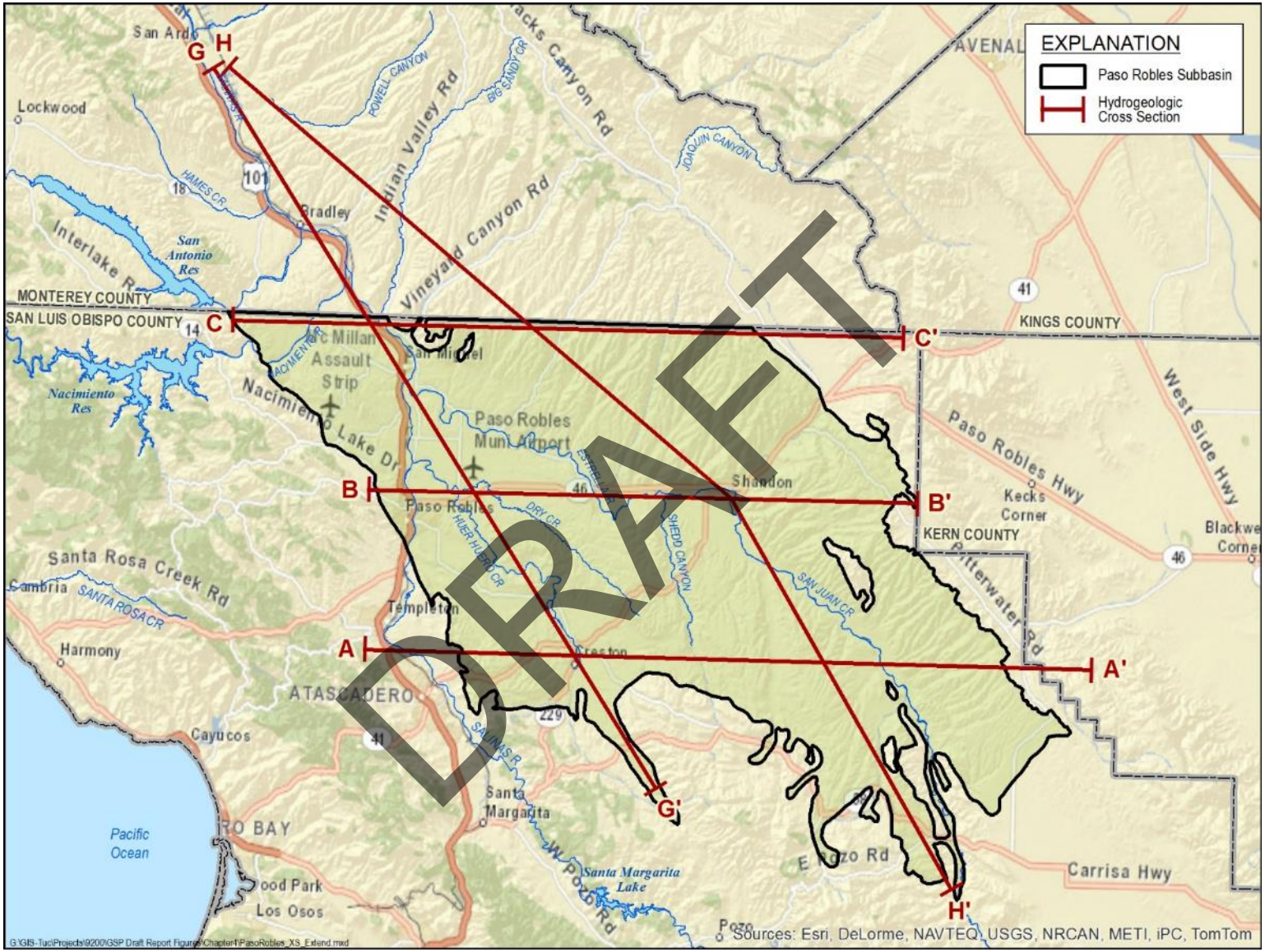
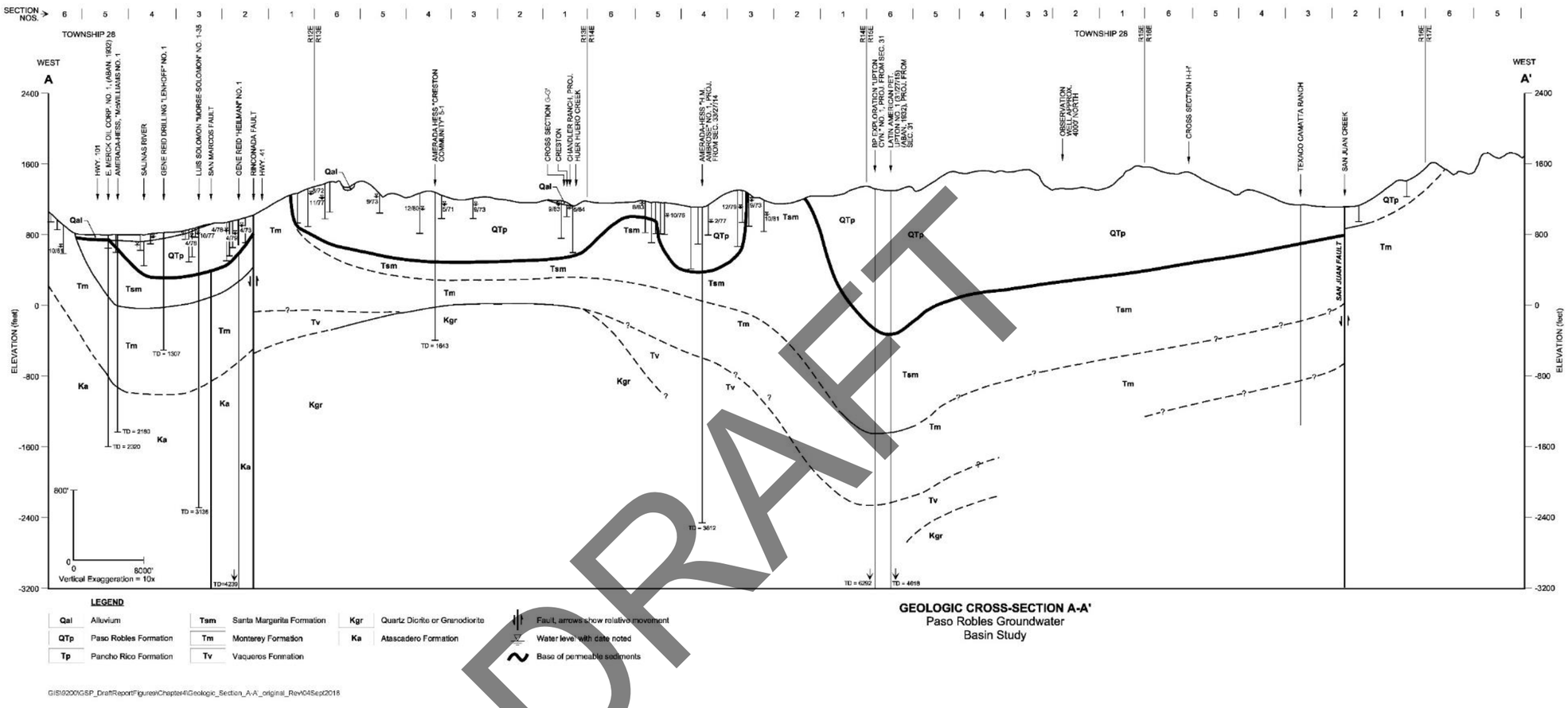



Figure 4-5. Cross Sections Locations

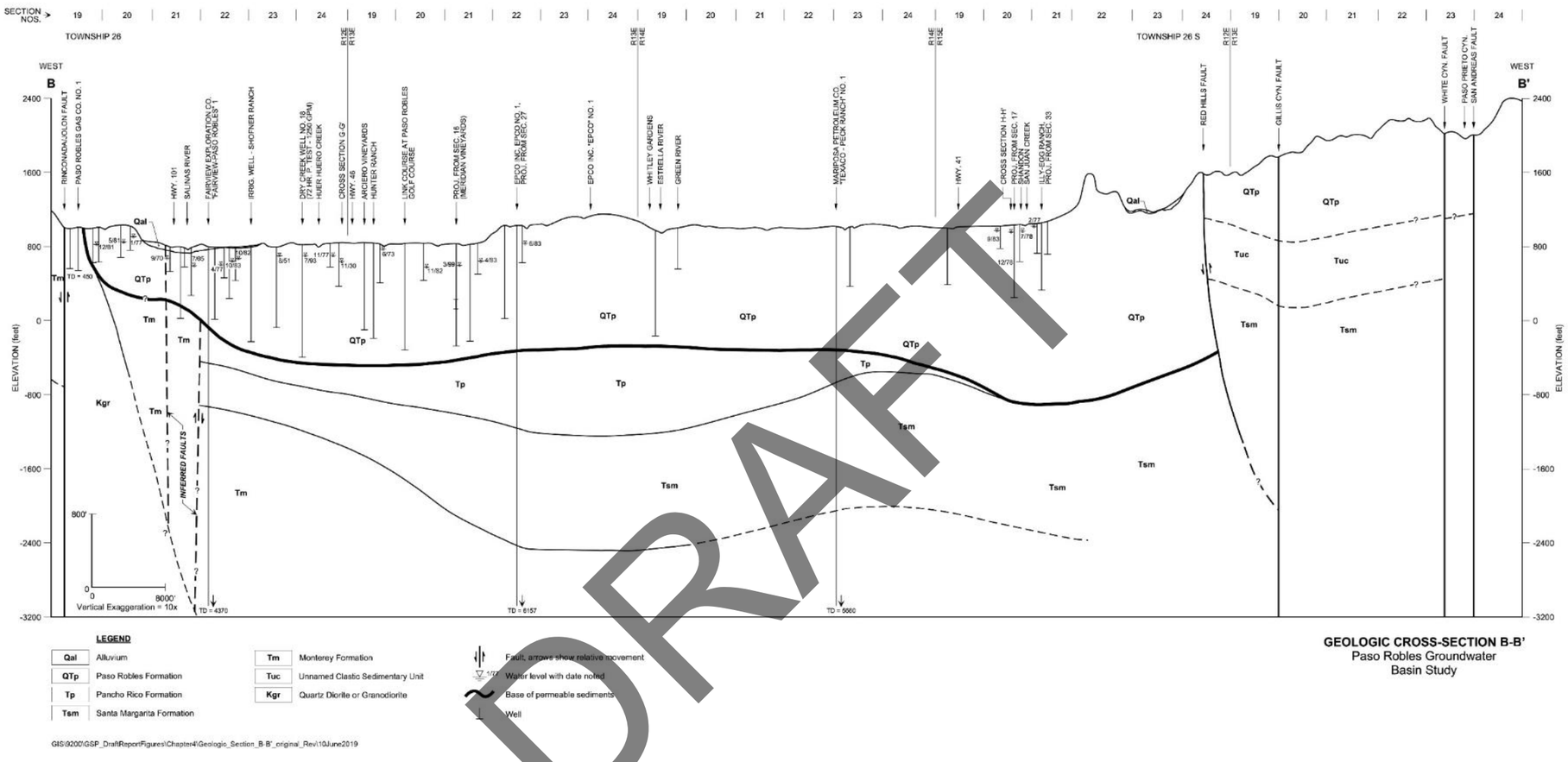



**GEOLOGIC CROSS-SECTION A-A'**
Paso Robles Groundwater
Basin Study



Source: Modified from Fugro (2002)

Figure 4-6. Geologic Section A-A'






Source: Modified from Fugro (2002)

Figure 4-7. Geologic Section B-B'

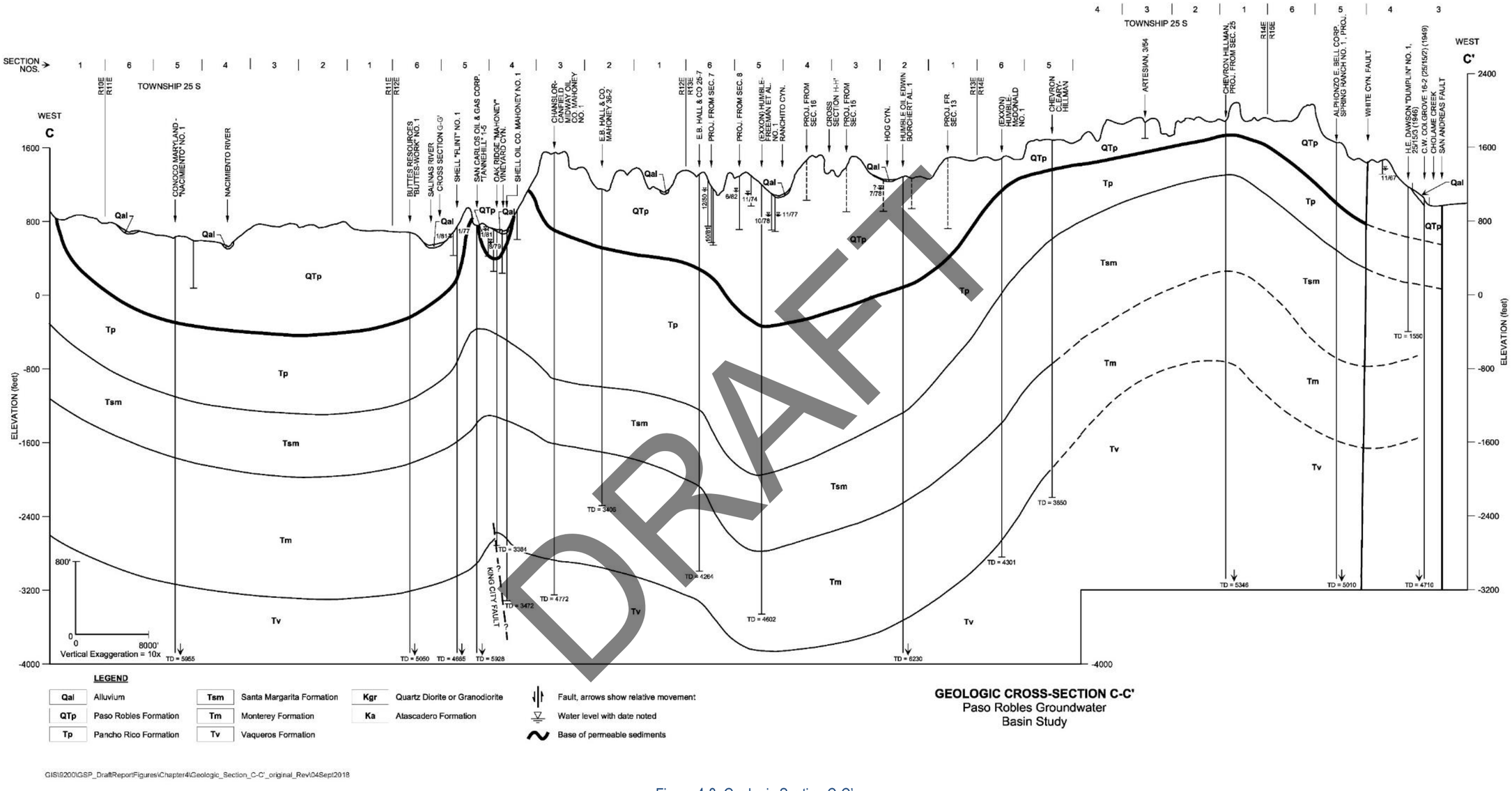





Figure 4-8. Geologic Section C-C'

Source: Modified from Fugro (2002)

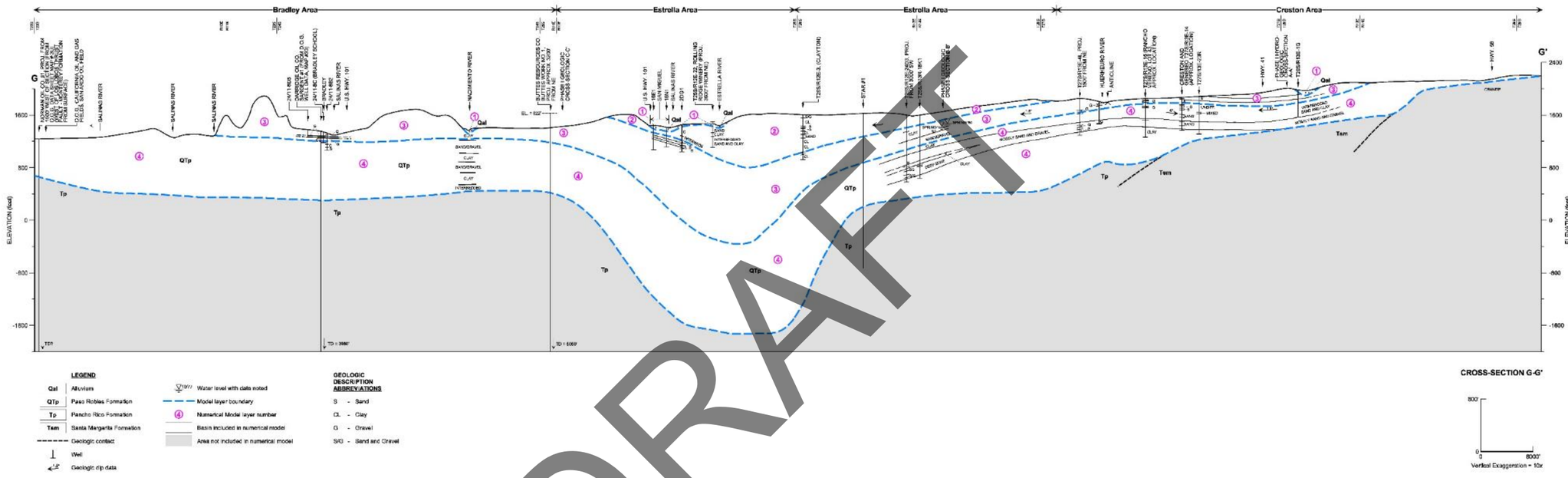



Figure 4-9. Geologic Section G-G'

Source: Modified from Fugro (2005)

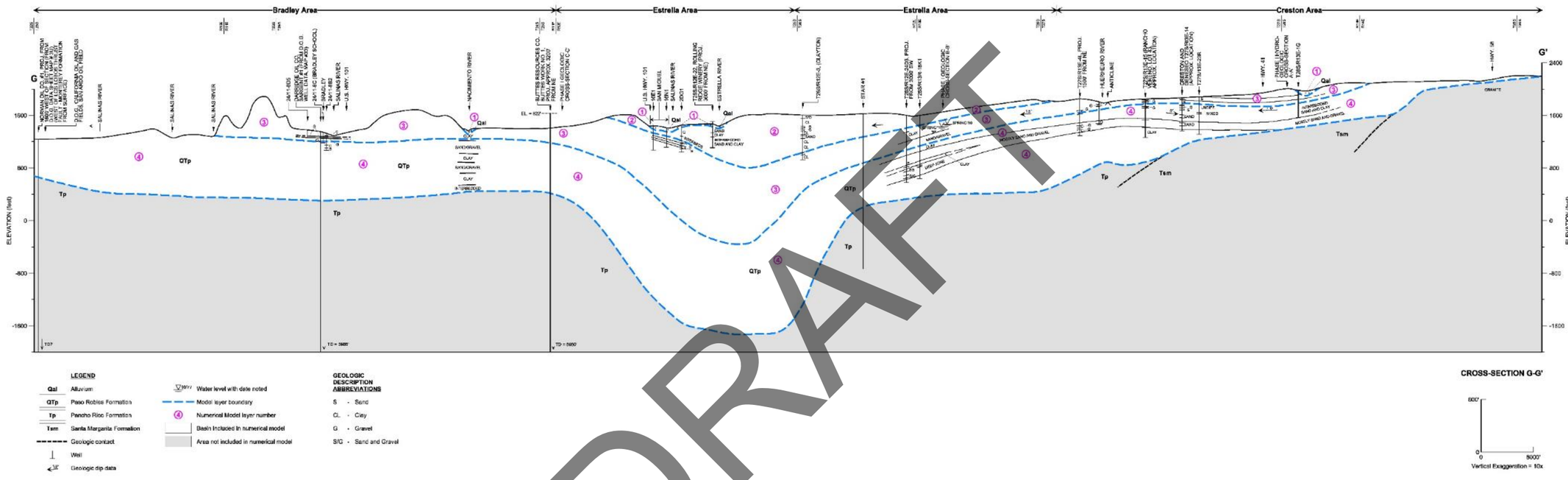



Figure 4-10. Geologic Section H-H'

Source: Modified from Fugro (2005)

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## 4.3.2 Geologic Formations Within the Subbasin

The main criteria used by previous authors for defining which geologic formations constitute the groundwater basin are:

1. The formation must have sufficient permeability and storage potential for the movement and storage of groundwater such that wells can reliably produce more than 50 gallons per minute (gpm), and

2. The groundwater produced from the geologic formation must be of generally acceptable quality (Fugro, 2002) based on the classification by DWR (1979) of groundwater with a conductivity of 3,000 micromhos/centimeter or less as fresh water.

The only two geologic formations that reliably meet these two criteria are the Quaternary-age alluvial deposits and the Tertiary-age Paso Robles Formation. Therefore, these are the only two formations that constitute the Subbasin. A general discussion of these two formations is presented below.

### 4.3.2.1 Alluvium

Alluvium occurs beneath the flood plains of the rivers and streams within the Subbasin. Figure 4-4 shows the location of the alluvial deposits, labeled as Quaternary alluvium, identified as Qal. These deposits are typically no more than 100 feet thick and comprise coarse sand and gravel with some fine-grained deposits. The alluvium is generally coarser than the Paso Robles Formation, with higher permeability that results in well production capability that often exceeds 1,000 gpm.

### 4.3.2.2 Paso Robles Formation

The largest volume of sediments in the Subbasin are in the Paso Robles Formation. This formation has sedimentary layers up to 3,000 feet thick in the northern part of the Estrella area and up to 2,000 feet near Shandon. Figure 4-4 shows the location of the Paso Robles Formation deposits, identified as QTp. Throughout most of the Subbasin the Paso Robles Formation sediments have a thickness of 700 to 1,200 feet.

The Paso Robles Formation is derived from erosion of nearby mountain ranges. Sediment size decreases from the east and the west, becoming finer towards the center of the Subbasin, indicating sediment source areas are both to the east and west. The Paso Robles Formation is a Plio-Pleistocene, predominantly non-marine geologic unit comprising relatively thin, often discontinuous sand and gravel layers interbedded with thicker layers of silt and clay. The formation was deposited in alluvial fan, flood plain, and lake depositional environments. The formation is typically unconsolidated and generally poorly sorted. The sand and gravel beds in

the Paso Robles Formation have a high percentage of eroded Monterey shale and have lower permeability compared to the overlying alluvial unit. The formation also contains minor amounts of gypsum and woody coal.

Poor quality groundwater with elevated concentrations of iron, manganese, and in some cases hydrogen sulfide odor have been observed within deeper portions of the Paso Robles Formation in some areas. There is no published evidence of elevated arsenic. The 2002 Fugro report says, "No fluoride, arsenic, selenium, or uranium radioactivity exceeded the MCL in the samples reviewed from public water purveyor wells" and "Dissolved arsenic concentrations are present in most areas of the basin, typically at levels below 10 µg/l."

### 4.3.3 Geologic Formations Surrounding the Subbasin

Underlying and surrounding the Subbasin are older geologic formations that either typically have low well yields or have poor quality water. In general, the geologic units underlying the Subbasin include:

1. Tertiary-age or older consolidated sedimentary beds;
2. Cretaceous-age metamorphic rocks; and
3. Granitic rock.

Figure 4-11 shows the location of oil and gas exploration wells drilled in the Subbasin. These oil and gas wells help identify the depth and extent of the geologic formations that surround and underlie the Subbasin.

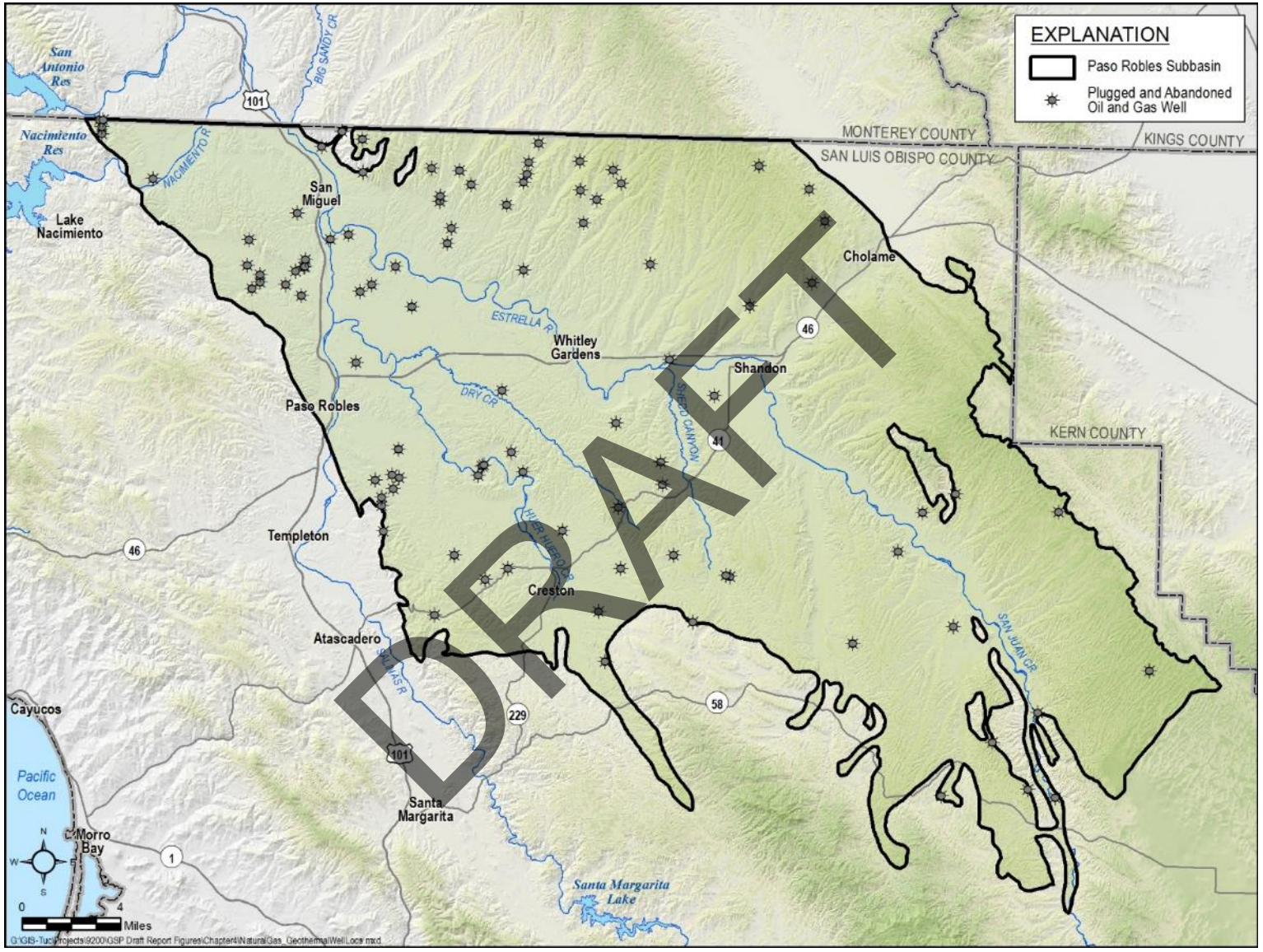



Figure 4-11. Natural Gas Exploration Well Locations and Geothermal Wells

#### 4.3.3.1 Pancho Rico Formation

The Pancho Rico Formation (Tp) is a Pliocene-age marine deposit found mostly in the northern portion of the study area. In places it appears to be time-correlative to the Paso Robles Formation, and may be in lateral contact as a facies change. The unit predominantly consists of fine-grained sediments up to 1,400 feet thick that yield low quantities of water.

#### 4.3.3.2 Santa Margarita Formation

The Santa Margarita Formation (Tsm) is an upper Miocene-age marine deposit, consisting of a white, fine-grained sandstone and siltstone with a thickness of up to 1,400 feet. The unit is found beneath most of the Subbasin. The Santa Margarita Formation is relatively permeable, but is not considered part of the Subbasin because the water quality is usually very poor. The geothermal waters contained in the Santa Margarita Formation in this area are often highly mineralized and characterized by elevated boron concentrations that restrict agricultural uses.

#### 4.3.3.3 Monterey Formation

The Miocene-age Monterey Formation (Tm) consists of interbedded argillaceous and siliceous shale, sandstone, siltstone, and diatomite. The unit is as great as 2,000 feet thick in the study area, and is often highly deformed. Wells in the Monterey Formation are generally of too low yield to consider the Monterey Formation part of the Subbasin; although isolated areas in the Monterey Formation can yield more than 50 gpm. Additionally, groundwater produced from the Monterey Formation often has high concentrations of hydrogen sulfide, total organic carbon, manganese, and iron.

#### 4.3.3.4 Vaqueros Formation

The marine Oligocene-age Vaqueros Formation (Tv) is a highly cemented fossiliferous sandstone that reaches a thickness up to 200 feet. Springs in the Vaqueros Formation with flows up to 25 gpm are common in canyons on the western and southern sides of the study area. Most water wells tapping this formation produce less than 20 gpm. Generally, the quality of water in this unit is good, though hard due to the calcareous cement within the rock.

#### 4.3.3.5 Metamorphic and Granitic Rocks

The southern and western edges of the Subbasin are bordered by Cretaceous-age metamorphic and granitic rock. The metamorphic rock units include the Franciscan, Toro, and Atascadero Formations. The Franciscan consists of discontinuous outcrops of shale, chert, metavolcanics, graywacke, and blue schist, with or without serpentinite. The Toro Formation (Kt) is a highly consolidated claystone and shale that does not typically yield significant water to wells. The

Atascadero Formation (Ka) is highly consolidated, but does have some sandstone beds that yield limited amounts of water to wells.

The granitic rock unit (Kgr) lies east of the Rinconada fault system, south of Creston, east of Atascadero, and in the area northwest of Paso Robles. The granitic rocks are often capped by a layer of granular decomposed granite that may be weathered to clay. This decomposed granite may be up to 80 feet in thick and may contain limited amounts of groundwater.

## 4.4 Principal Aquifers and Aquitards

Water-bearing sand and gravel beds that may be laterally and vertically discontinuous are generally grouped together into zones that are referred to as aquifers. The aquifers can be vertically separated by fine-grained zones that can impede movement of groundwater between aquifers. Two aquifers exist in the Subbasin:

- A relatively continuous aquifer comprising alluvial sediments that underlie streams;
- An interbedded and discontinuous aquifer comprising sand and gravel lenses in the Paso Robles Formation.

Figure 4-4 shows the location of geologic sections that were used to depict the aquifers in the subsurface. Figure 4-12 through Figure 4-15 show the aquifers that are interpreted from the geologic logs, geophysical logs, groundwater levels, and water quality (Fugro, 2002 and 2005). Water-bearing zones are interpreted to be discontinuous lenses of sand and gravel and shown as tapering off on the cross sections. Because these cross sections are adopted from a study that supported a groundwater model, the cross sections include labels identifying the various layers from the groundwater model. The groundwater model was subsequently updated (GSSI, 2016) and is presented in Chapter 6. For the GSP several additional well logs were added to the sections to refine the extent of the aquifers. These logs have been labeled with the state well inventory number (e.g. E0188061). Appendix B contains the well logs used to update the sections that have publicly available data.

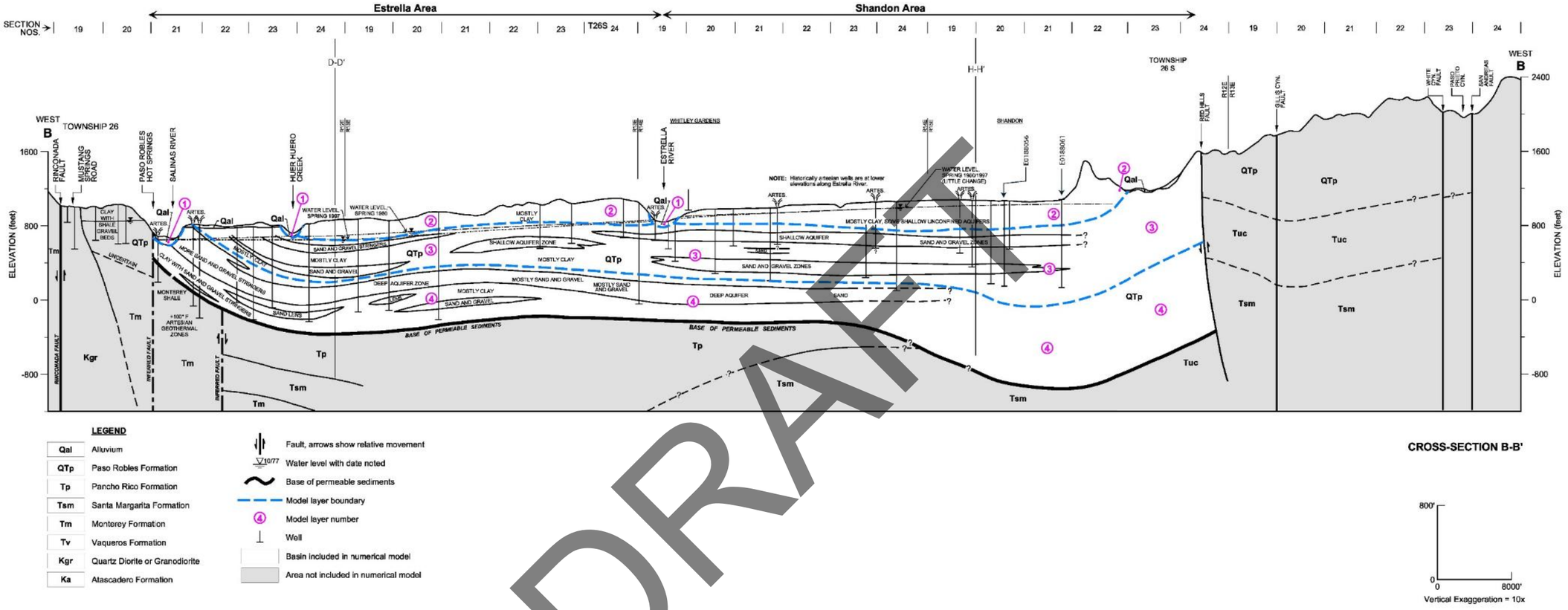
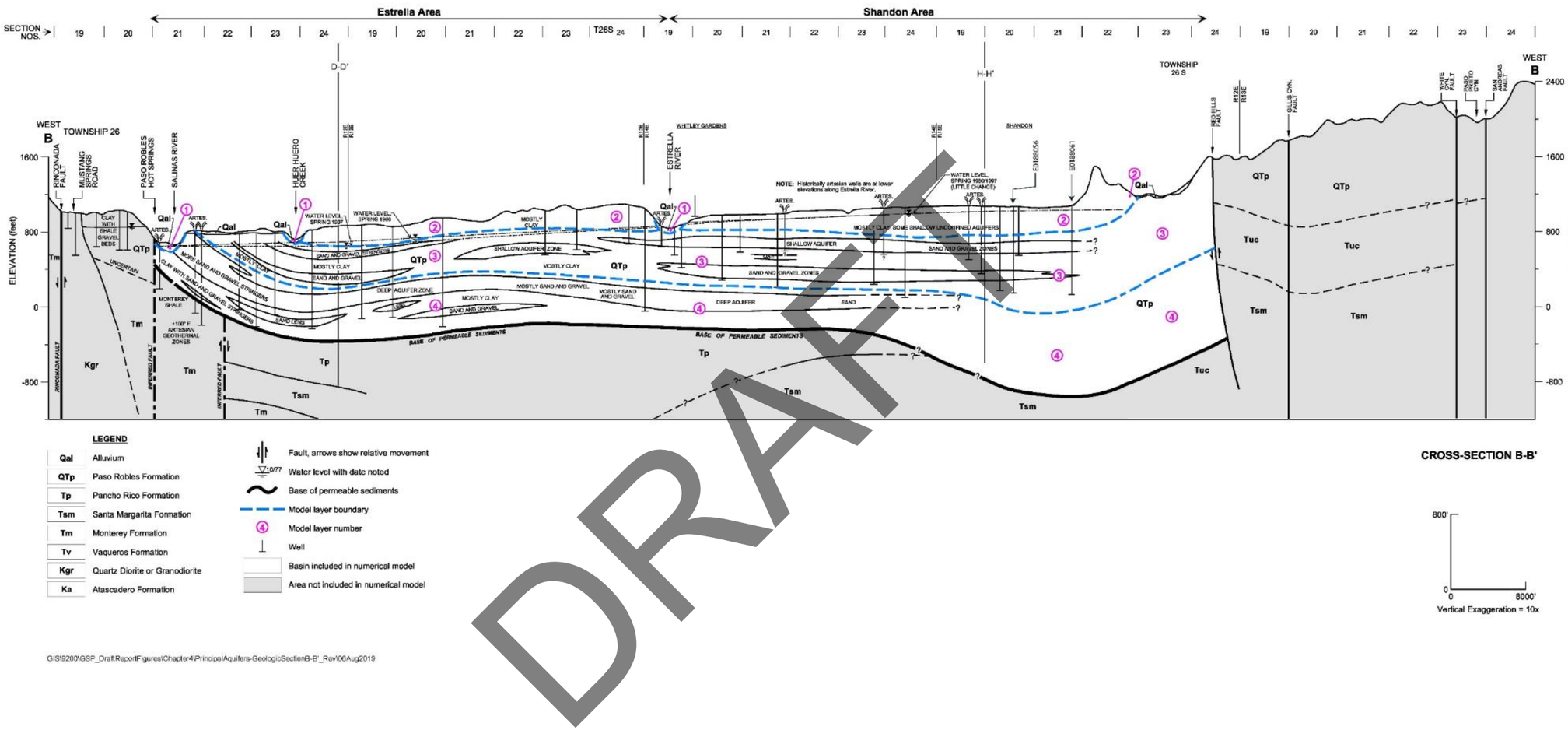





Figure 4-12. Aquifers - Geologic Section B-B'

Source: Modified from Fugro (2005)




**LEGEND**

| | |
|---|---|
| Qal | Alluvium |
| QTp | Paso Robles Formation |
| Tp | Pancho Rico Formation |
| Tsm | Santa Margarita Formation |
| Tm | Monterey Formation |
| Tv | Vaqueros Formation |
| Kgr | Quartz Diorite or Granodiorite |
| Ka | Atascadero Formation |

Fault, arrows show relative movement
▽10/77 Water level with date noted
Base of permeable sediments
Model layer boundary
④ Model layer number
Well
Basin included in numerical model
Area not included in numerical model

GIS\920\GSP_DraftReportFigures\Chapter4\PrincipalAquifers-GeologicSectionB-B'_Rev106Aug2019

**CROSS-SECTION B-B'**

800'
0
0
8000'
Vertical Exaggeration = 10x



Figure 4-13. Aquifers - Geologic Section C-C'

Source: Modified from Fugro (2005)

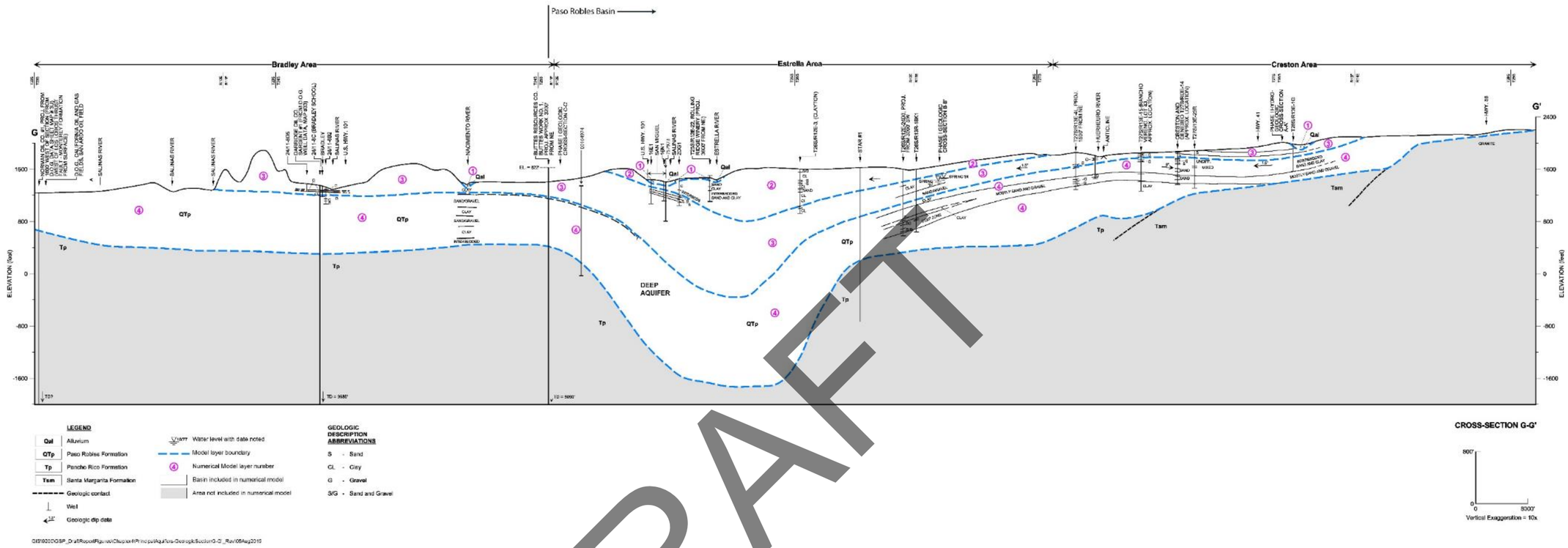



Figure 4-14. Aquifers - Geologic Section G-G'

Source: Modified from Fugro (2005)

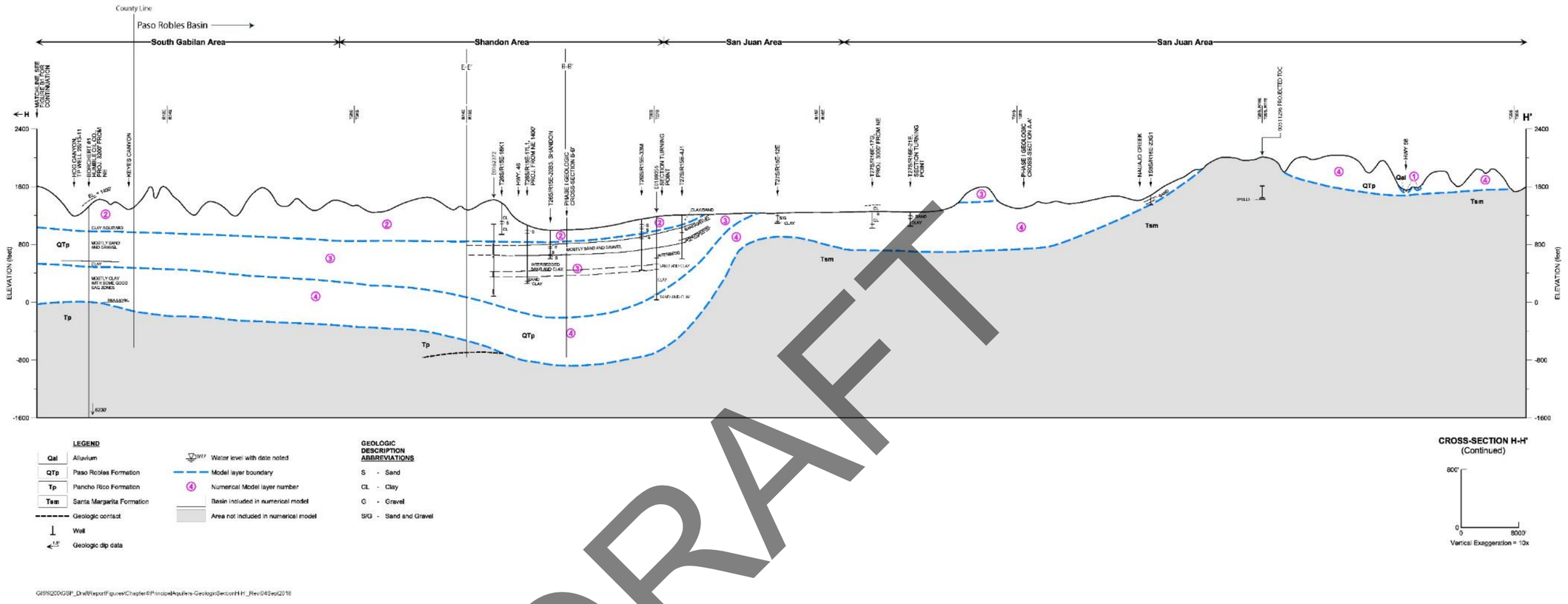






Figure 4-15. Aquifers - Geologic Section H-H'

Source: Modified from Fugro (2005)

### 4.4.1 Alluvial Aquifer

The unconfined Alluvial Aquifer is generally composed of saturated coarse-grained sediments and occurs along Huer Huero Creek, the Salinas River, and the Estrella River; the extent of this aquifer is shown on Figure 4-4. The alluvial aquifer varies in thickness, but is generally about 100 feet thick. The Alluvial Aquifer is highly permeable. Wells screened in the alluvial aquifer can yield up to a 1,000 gpm (Fugro, 2005).

### 4.4.2 Paso Robles Formation Aquifer

Geologic information reported in Fugro (2002) suggests that the sand and gravel zones that constitute the Paso Robles Formation Aquifer are generally thin, discontinuous, and are usually separated vertically by relatively thick zones of silts and clays. Figure 4-4 shows the extent of the Paso Robles Formation in the Subbasin. In general, the sand and gravel zones occur throughout the Paso Robles Formation, although they may be locally discontinuous or absent in some areas. As shown on Figure 4-14, near Creston the shallow sand and gravel zones are shown as disconnected from western parts of the Paso Robles aquifer, although data is limited in this region.

### 4.4.3 Aquifer Properties

Data reported in Fugro (2002) were reviewed to estimate representative aquifer hydraulic properties. Most aquifer tests have been conducted in the Estrella and Creston areas. Estimated aquifer properties are summarized in Table 4-1, which includes the following characteristics (Driscoll, 1986):

- Hydraulic conductivity: the rate of flow of water in gallons per day through a cross section of one square foot under a unit hydraulic gradient.
- Specific capacity: the rate of discharge of a water well per unit of drawdown, commonly expressed in volume of water at a reference temperature.
- Storativity: the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.
- Transmissivity: the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient.

Table 4-1. Paso Robles Subbasin Aquifer Hydrogeologic Properties

| Well Location | Test Duration (hours) | Flow (gpm) | Well Depth (feet) | Perforated Interval (ft) | Transmissivity (gpd/ft) | Specific Capacity (gpm/ft) | Hydraulic Conductivity (ft/day) |
|---|---|---|---|---|---|---|---|
| Alluvial Aquifer | | | | | | | |
| 28S/13E-36 | 24 | 367 | 70 | 40 | 186,300 | 68 | 620 |
| Paso Robles Formation Aquifer | | | | | | | |
| 27S/12E-09 | 72 | 300 | 450 | 170 | 8,800 | 4.9 | 6.9 |
| 26S/12E-22 | 12 | 220 | 430 | 100 | 900 | 1.2 | 1.2 |
| 25S/11E-24 | 12 | 150 | 350 | 90 | 800 | 0.62 | 1.2 |
| 27S/12E-18 | 8 | 140 | 225 | 35 | 4,100 | 3 | 15.7 |
| 26S/12E-20 | 48 | 115 | 400 | 50 | 7,600 | 10 | 20 |
| 26S/12E-36 | 24 | 400 | 660 | 280 | 8,800 | 5.1 | 4.2 |
| 26S/12E-35 | 18 | 690 | 830 | 370 | 7,900 | 4.9 | 2.9 |
| 27S/14E-18 | 24 | 600 | 740 | 220 | 6,100 | 5.5 | 3.7 |
| 26S/13E-16 | 24 | 200 | 820 | 350 | 3,100 | 2.63 | 1.2 |
| 26S/12E-25 | 24 | 500 | 730 | 340 | 5,700 | 3.6 | 2.2 |
| 25S/13E-30 | 24 | 600 | 720 | 260 | 6,900 | 79 | 3.5 |
| 26S/13E-7 | 24 | 600 | 825 | 380 | 3,200 | 3 | 1.1 |
| 26S/13E-7 | 24 | 600 | 990 | 610 | 5,000 | 4.2 | 1.1 |
| 24S/11E-34 | 24 | 850 | 612 | 100 | 2,805 | 4.5 | 3.8 |

Source: Fugro, 2002



Based on limited aquifer property data available for the Alluvial Aquifer, the transmissivity may be in the range of 150,000 to 200,000 gallons per day per foot (gpd/ft); or between 20,000 and 27,000 square feet per day ($ft^2$/day). Hydraulic conductivity of the Alluvial Aquifer may be over 500 feet per day (ft/d) based on estimated transmissivity and the thickness of the well's perforated interval.

The estimated transmissivity of the Paso Robles Formation Aquifer ranges between 800 gpd/ft and about 9,000 gpd/ft; or between 100 and 1,200 $ft^2$/day. The geometric mean of the Paso Robles Formation transmissivity values is about 4,200 gpd/ft, or 560 $ft^2$/day.

The estimated hydraulic conductivity of the Paso Robles Formation Aquifer ranges from about 1 ft/d to about 20 ft/d. The geometric mean of the tabulated hydraulic conductivity values for the Paso Robles Formation Aquifer is 5 ft/d.

Limited data exist to assess the confined storage properties, such as storativity, of the Paso Robles Formation aquifer (Fugro, 2002). Table 4-2 summarizes reported estimates of specific yield for unconfined portions of the aquifers. Average specific yield was estimated by analyzing 10 to 20 of the deepest well completion logs for each area. Each interval was assigned a specific yield by comparison of the formation description with published estimates based on extensive field and laboratory investigations conducted in southern coastal basins by the DWR and modified for the Paso Robles Formation (DWR, 1958). The assigned specific yield was then

weighted according to the thickness of each bed and averaged over the entire depth of the well (Fugro, 2002). Results of this analysis suggested that a representative average value for specific yield for the Paso Robles Formation in the Subbasin was 0.09. This specific yield may be low. Average specific yields for unconsolidated sand and gravel sedimentary aquifers are commonly between 0.1 and 0.3 (Driscoll, 1986).

Table 4-2. Paso Robles Subbasin Specific Yield Estimates

| Area | Number of Wells Used to Calculate | Average Estimated Specific Yield |
|---|---|---|
| Creston Area | 47 | 0.09 |
| Estrella | 20 | Not provided |
| San Juan | 5 | 0.10 |
| Shandon | 20 | 0.08 |
| North and South Gabilan | 20 | 0.09 |
| Basin Wide Average | | 0.09 |

Estimates of vertical hydraulic conductivity for each of the aquifers were not in reports from previous studies for the Subbasin. Estimates of vertical hydraulic conductivity incorporated into the basin-wide groundwater model are discussed in Appendix E.

### 4.4.4 Confining Beds and Geologic Structures

There is limited information regarding the continuity of stratigraphic features in the Subbasin that restrict groundwater flow within the Subbasin. Conceptually, the presence of laterally continuous zones of fine-grained strata within the Paso Robles Formation can restrict vertical movement of groundwater. These fine-grained zones are generally shown on the sections on Figure 4-12 through Figure 4-15. These figures show that the fine-grained strata are likely more continuous than the sand and gravel layers. These fine-grained zones act as confining beds, and are the cause of the artesian wells that were historically reported in the Subbasin. Fine-grained layers that limit vertical movement of groundwater appear to be more prevalent in the Estrella and Creston areas than in the eastern portion of the Shandon area. This may indicate that infiltration and recharge is more limited in the central part of the basin than it is to the east in the Shandon area.

There is some anecdotal evidence that subsurface geologic structures such as folds and faults may affect groundwater flow in the Subbasin, particularly in the Whitley Gardens area between Estrella and Shandon. Additional investigations would be needed to characterize the effect of structures on groundwater flow.

## 4.5 Primary Users of Groundwater

The primary groundwater users in the Subbasin include municipal, agricultural, rural residential, small community water systems, and small commercial entities. Municipal, domestic, and agricultural demands in the Subbasin currently rely almost entirely on groundwater. Some municipal demands are partially met through imported surface water as presented previously in Chapter 3. The municipal sector pumps primarily from the Paso Robles Aquifer in the Subbasin. The agriculture sector uses groundwater from the Alluvial Aquifer and the Paso Robles Aquifer.

## 4.6 General Water Quality

This section presents a general discussion of the natural groundwater quality in the Subbasin, focusing on general minerals. The general water quality of the Subbasin described in this section is a summary of results in the Fugro 2002 report. A more complete discussion of the distribution and concentrations of specific constituents is presented in Chapter 5.

Groundwater in the Subbasin is generally suitable for drinking and agricultural uses. The two main water types as defined by water chemistry in the Subbasin are calcium bicarbonate and sodium bicarbonate. Calcium-bicarbonate type is the most prominent and is found in the Creston and San Juan areas. Sodium-bicarbonate is the second most dominant water type and is found in the Estrella and Shandon areas. Minor areas of sodium-chloride type water can be found in the eastern portion of the Subbasin and near Cholame Valley. In the northwest portion of the Subbasin, magnesium bicarbonate waters are found in the San Miguel area and a mixed water type is seen in the Bradley area. Summary tables of general water quality in groundwater is provided in Chapter 5.

## 4.7 Groundwater Recharge and Discharge Areas

Areas of significant, natural, areal recharge and discharge within the Paso Robles Subbasin are discussed below. Quantitative information about natural and anthropogenic recharge and discharge is provided in Chapter 6.

### 4.7.1 Groundwater Recharge Areas Inside the Subbasin

In general, natural areal recharge occurs via the following processes:

1. Distributed areal infiltration of precipitation, and
2. Infiltration of surface water from streams and creeks.

Figure 4-16 is a map that ranks soil suitability to accommodate groundwater recharge based on five major factors that affect recharge potential, including: deep percolation, root zone residence time, topography, chemical limitations, and soil surface condition. The map[1] was developed by the California Soil Resource Lab at UC Davis and the University of California Agricultural and Natural Resources Department.

Areas with excellent recharge properties are shown in green. Areas with poor recharge properties are shown in red. Not all land is classified, but this map provides good guidance on where natural recharge likely occurs. Natural recharge is discussed in more detail in Chapter 6.



[1] Figure 4-16 shows the Soil Agricultural Groundwater Banking Index (SAGBI) map for the Paso Robles Subbasin. While the UC Davis database title SAGBI includes the term "banking", its use in this section is strictly as a dataset for evaluating recharge potential in the basin.

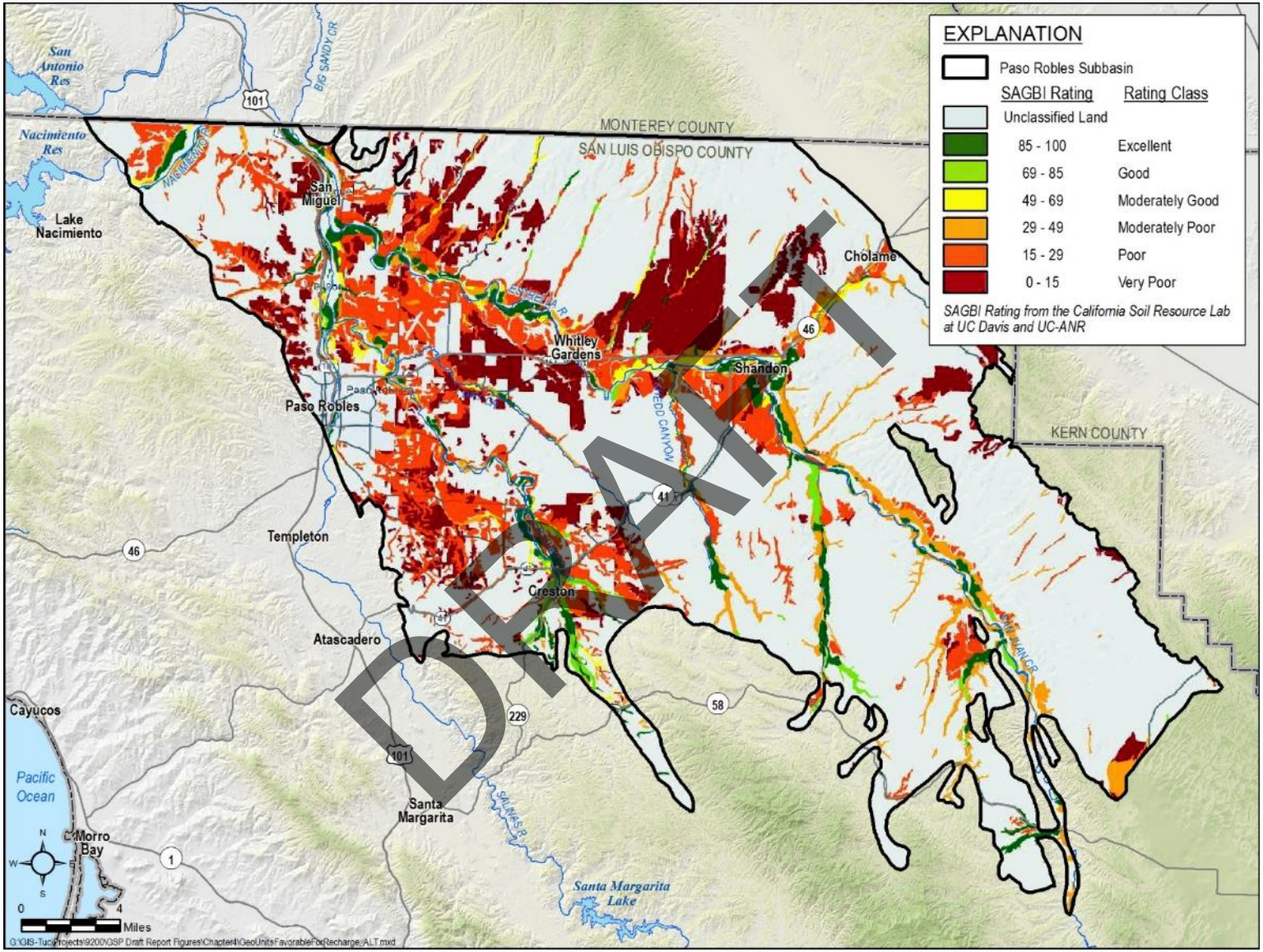



Figure 4-16. Potential Recharge Areas

### 4.7.2 Groundwater Discharge Areas Inside the Subbasin

Natural groundwater discharge areas within the Plan area include springs and seeps, groundwater discharge to surface water bodies, and ET by phreatophytes. Phreatophytes are plants with roots that tap into groundwater. Springs and seeps identified in the National Hydrology Dataset (NHD), and shown on Figure 4-17, tend to be located in the foothills of the Santa Lucia and Temblor mountain ranges. Based on the elevation of mapped springs and seeps, it is likely that these discharge groundwater from shallow, and possibly perched aquifer units. Groundwater discharge to streams – primarily, the Salinas River and Estrella River – has not been mapped to date. Instead, areas of potential groundwater discharge to streams are identified using the groundwater flow model. Orange areas on Figure 4-17 represent streams in the model where simulated average groundwater discharge to the stream reach is at least 10 AFY. In contrast to mapped springs and seeps, which are derived from groundwater in the Paso Robles Formation, groundwater discharge to streams is derived from the Alluvium.

Figure 4-18 shows the distribution of potential groundwater-dependent ecosystems (GDEs) and Natural Communities Commonly Associated with Groundwater (NCCAG) within the Plan area. In areas where the water table is sufficiently high, groundwater discharge may occur as ET from phreatophyte vegetation within these GDEs. Appendix C describes methods used to determine the extent and type of potential GDEs. Figure 4-18 shows only potential GDEs. There has been no verification that the locations shown on this map constitute groundwater dependent ecosystems. Additional field reconnaissance is necessary to verify the existence of these potential GDEs.

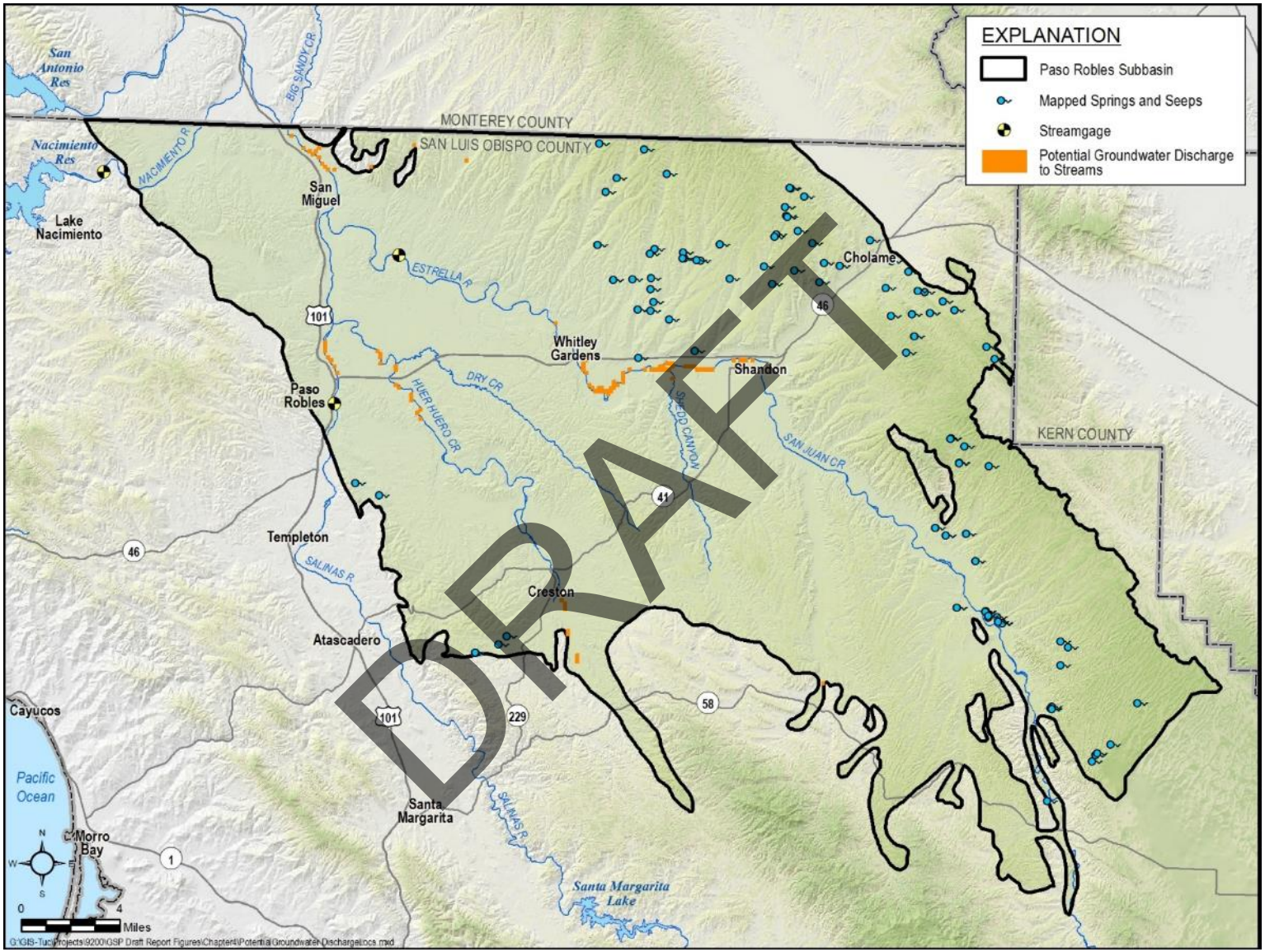



Figure 4-17. Potential Groundwater Discharge Areas

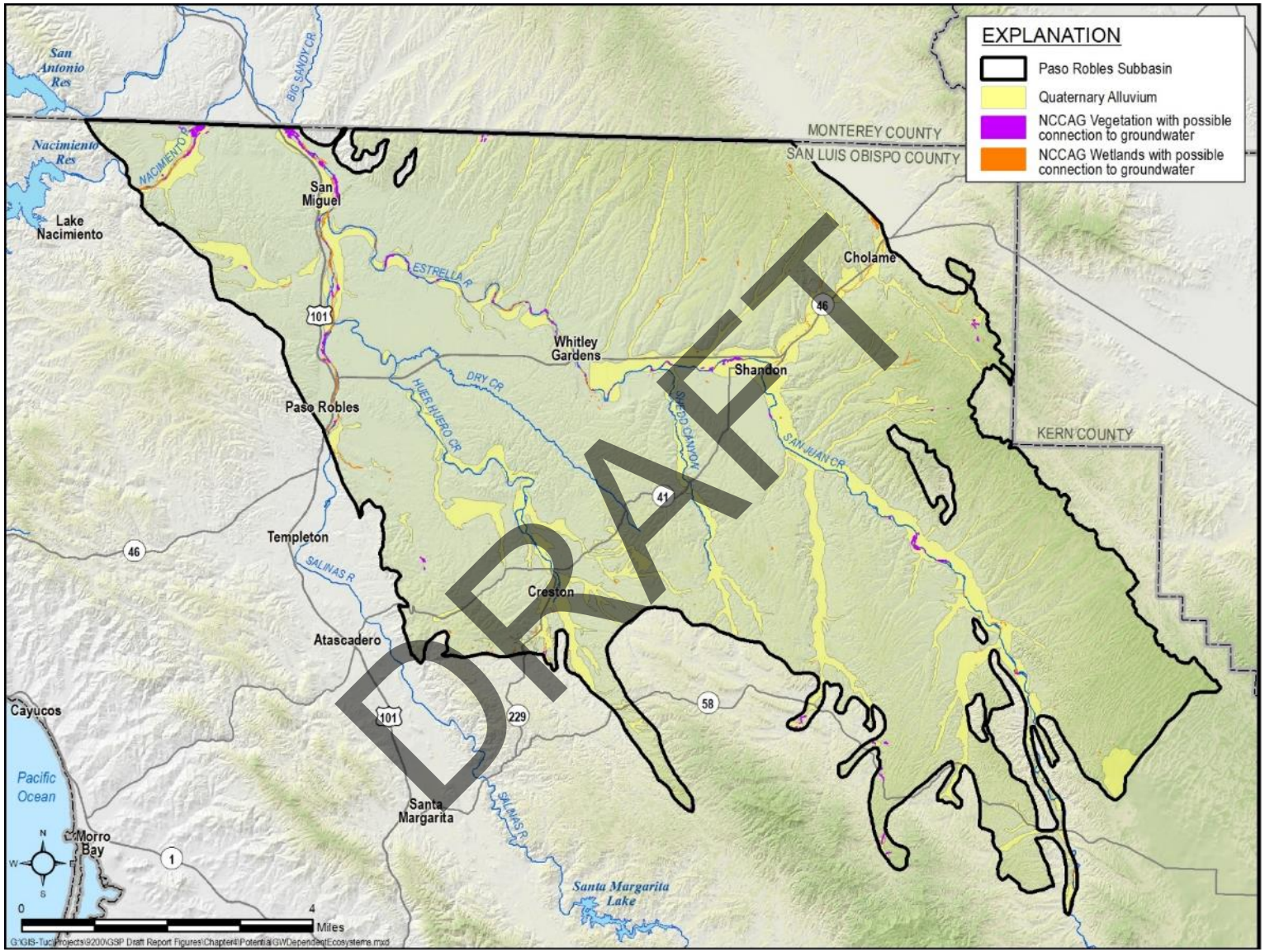



Figure 4-18. Potential Groundwater- Dependent Ecosystems

## 4.8 Surface Water Bodies

Figure 4-19 shows the rivers in the Subbasin that are considered significant to the management of groundwater in the Subbasin. Significant streams that are mostly perennial in the Subbasin include the Nacimiento River, Salinas River, the Estrella River, Huer Huero Creek, San Juan Creek, Dry Creek, and Shedd Canyon. Shell Creek is not included in this list since it is classified as either intermittent or ephemeral with no perennial stretches. These rivers and creeks are ephemeral, and during most of the year the streams lose water to the shallow aquifers. A complete description and quantification of the stream/aquifer interaction is included in Chapters 5 and 6. There are no natural lakes in the Subbasin.

There are no reservoirs within the Subbasin; however, there are two reservoirs in the watershed. The Salinas Dam south of the Subbasin on the Salinas River forms Santa Margarita Lake. The Salinas Dam was constructed in the early 1940s as an emergency measure to provide adequate water supplies for Camp San Luis Obispo. The United States Army Corps of Engineers (USACE) now has jurisdiction over the dam and reservoir facilities. The City of San Luis Obispo has an agreement with USACE to divert the entire yield of Salinas Reservoir (Santa Margarita Lake) for water supply. Nacimiento Reservoir lies just outside of the Subbasin to the northwest. The reservoir discharges to the Nacimiento River, which crosses the northwest corner of the Subbasin.

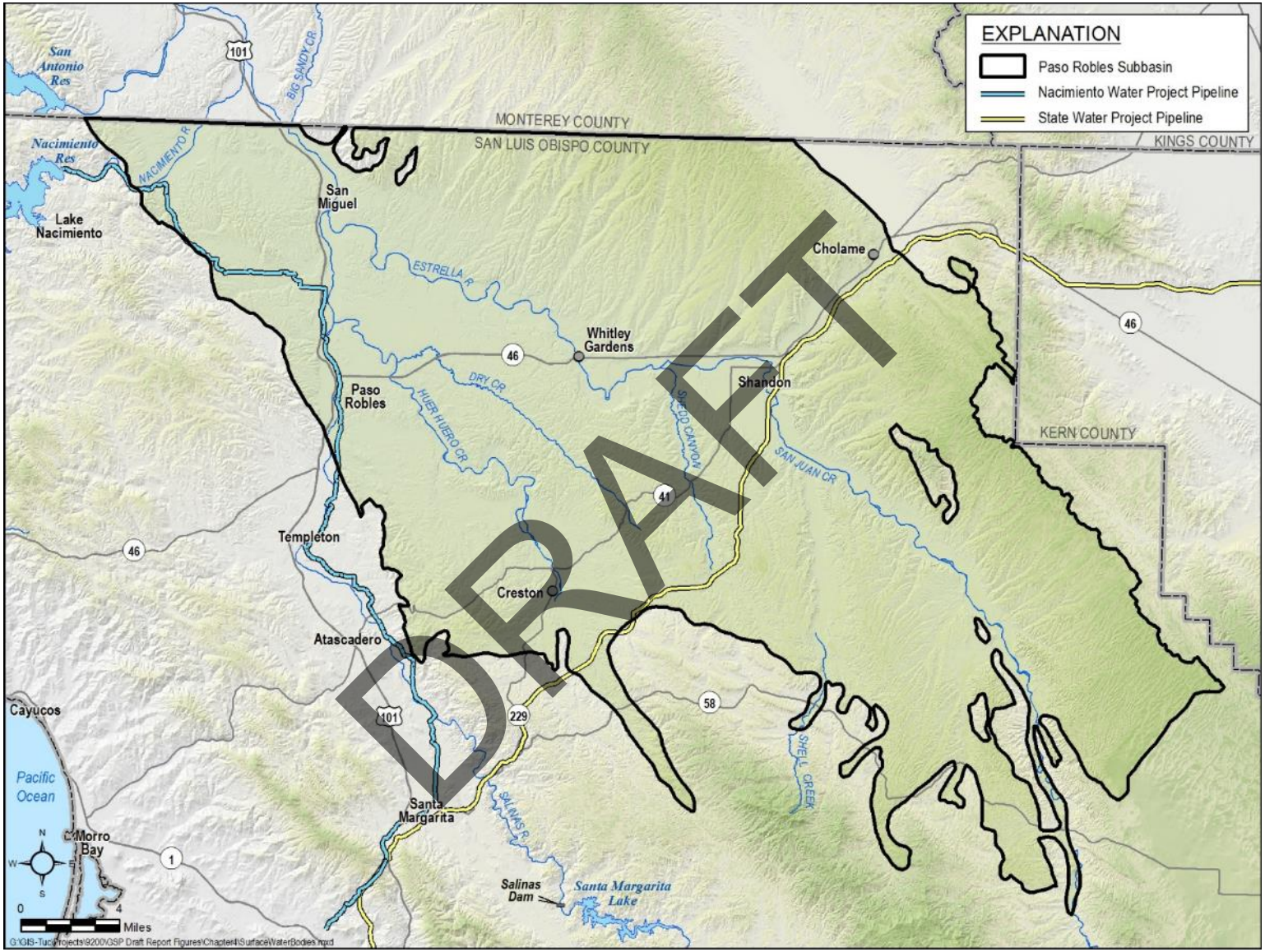



Figure 4-19. Surface Water Bodies

## 4.9 Data Gaps in the Hydrogeologic Conceptual Model

All hydrologic conceptual models contain a certain amount of uncertainty, and can be improved with additional data and analysis. The hydrogeologic conceptual model of the Paso Robles Subbasin could be improved with certain additional data and analyses. Several data gaps are identified below.

### 4.9.1 Aquifer Continuity

Aquifer continuity has a significant impact on how projects and management actions in one part of the Subbasin may influence sustainability in other parts of the Subbasin. As noted earlier, the Paso Robles aquifer comprises many discontinuous sand and gravel beds. However, Figure 4-12 shows a previous interpretation of a deep sand and gravel zone that is relatively continuous across the Subbasin. The continuity of this zone may prove to be important in how effective various projects and programs may promote sustainability. The extent and continuity of the Paso Robles Aquifer should be confirmed through existing or new well logs or other methods such as aerial geophysics. This is particularly important in the areas around Shandon and San Juan. Chapter 10 addresses the implementation plan for addressing data gaps.

### 4.9.2 Fault Influence on Groundwater Flow

Southeast of Paso Robles is an interbasin fault. It is unknown whether this fault and others are barriers to groundwater flow. If these interbasin faults are barriers to groundwater flow, they could compartmentalize the Subbasin and have a significant impact on where projects must be located in order to achieve sustainability. It may be possible to get a better understanding of the influence of these faults by performing aquifer tests and geophysical surveys in the vicinity of these faults.

### 4.9.3 Vertical Groundwater Gradients

There are limited data that demonstrate vertical hydraulic gradients across the basin. Data from a single set of nested wells are presented in Chapter 5; the data are inconclusive to establish a consistent upward or downward vertical gradient. More data about vertical gradients are included in Chapter 5. Demonstrating vertical gradients could be important to assess vertical flows between the Alluvium and the Paso Robles Aquifer as well as vertical flows within the Paso Robles Aquifer.

#### 4.9.4 Specific Yield Estimates

The current estimates of specific yield of the various sedimentary layers composing the Paso Robles Aquifer are based on very limited data. This is a data gap that when filled, will improve the ability of the Model to reflect Basin conditions and interactions.

# 5 GROUNDWATER CONDITIONS

This chapter describes the current and historical groundwater conditions in the Alluvial Aquifer and the Paso Robles Formation Aquifer in the Paso Robles Subbasin. In accordance with the SGMA emergency regulations §354.16, current conditions are any conditions occurring after January 1, 2015. By implication, historical conditions are any conditions occurring prior to January 1, 2015. The chapter focuses on information required by the GSP regulations and information that is important for developing an effective plan to achieve sustainability. The organization of Chapter 5 aligns with the five sustainability indicators applicable to the Subbasin. As required by the regulations, these are:

1. Chronic lowering of groundwater elevations
2. Changes in groundwater storage
3. Subsidence
4. Depletion of interconnected surface waters
5. Groundwater quality

The sixth sustainability indicator, seawater intrusion, is not applicable to the Paso Robles Subbasin.



## 5.1 Groundwater Elevations

The following assessment of groundwater elevation conditions is largely based on data from the SLOFCWCD's groundwater monitoring program. Groundwater levels are measured by the SLOFCWCD through a network of public and private wells in the Subbasin. Additional groundwater elevation data for wells were obtained from other available data sources, including the CASGEM database, USGS, and other regulatory compliance programs. Locations of the wells (about 50 to 55 depending on year) used for the groundwater elevation assessment are shown on Figure 5-1. Data from some of the wells on this figure was collected subject to confidentiality agreements between the SLOFCWCD and well owners. Consistent with the terms of such agreements, the well owner information and specific locations for these wells is not published in this GSP. The set of wells shown on Figure 5-1 were selected from a larger set of monitoring wells in the SLOFCWCD database if there was sufficient information to assign the well to either the Alluvial Aquifer or Paso Robles Formation Aquifer. Additionally, in order to create maps showing historical water level changes over an approximately 20-year period, the wells were chosen if there was data from the years 1997 and 2017.

Groundwater elevation data were deemed representative of static conditions based on a check of consistency with nearby wells. Additional information on the monitoring network is provided in Chapter 7 – Monitoring Networks. In accordance with the SGMA Regulations, the following

information is presented based on available data, in subsequent subsections for both aquifers in the Subbasin:

- Groundwater elevation contour maps for the seasonal high and low periods for 1997 and 2017
- A map depicting the change in groundwater elevation between 1997 and 2017
- Hydrographs for wells with publicly available data
- Assessments of horizontal and vertical groundwater gradients

### 5.1.1 Alluvial Aquifer

Groundwater elevation data for the Alluvial Aquifer are limited. The locations of the Alluvial Aquifer monitoring wells with available groundwater elevation data are shown on Figure 5-1. Some Alluvial Aquifer wells are all in the Alluvium as mapped in Figure 4-4, although some are not adjacent to mapped, named streams.

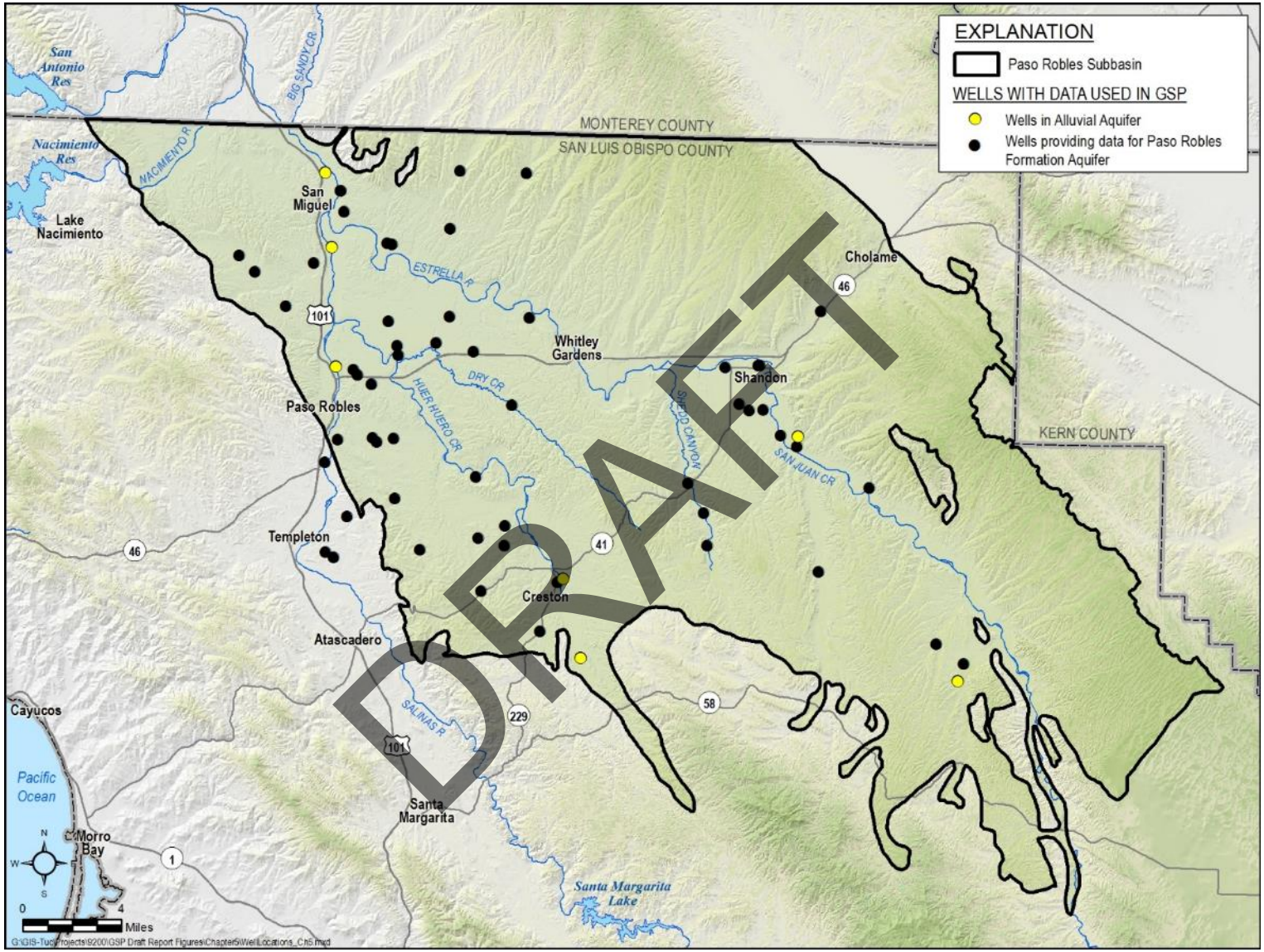



Figure 5-1. Location of Wells Used for Groundwater Elevation Assessments

#### 5.1.1.1 Alluvial Aquifer Groundwater Elevation Contours and Horizontal Groundwater Gradients

Groundwater elevation data for the Alluvial Aquifer are too limited to prepare representative contour maps of the seasonal high and seasonal low groundwater elevations, or to prepare maps of historical groundwater elevations. Figure 5-2 shows current groundwater elevation contours for the Alluvial Aquifer. The contours were developed using 2017 data when available and the most recent data prior to 2017. Contours are only depicted on the map in areas near the wells that are shown on Figure 5-1.

Groundwater elevations range from approximately 1,400 feet above mean sea level (ft msl) in the southeastern portion of the Subbasin to approximately 600 ft msl near San Miguel. Groundwater flow direction is inferred as being from high to low elevations in a direction perpendicular to groundwater elevation contours. Groundwater flow direction in the Alluvial Aquifer generally follows the alignment of the creeks and rivers. Overall, groundwater in the Alluvial Aquifer flows from southeast to northwest across the Subbasin. Groundwater elevation data in the Alluvial Aquifer are too sparse to estimate local horizontal groundwater gradients. On a basin-wide scale, the average horizontal hydraulic gradient in the alluvium is about 0.004 ft/ft from the southeastern portion of the Subbasin to San Miguel.

#### 5.1.1.2 Alluvial Aquifer Hydrographs

Groundwater level data for all of the Alluvial Aquifer wells shown on Figure 5-1 were collected under confidentiality agreements. Therefore, hydrographs for the Alluvial Aquifer are not included in this GSP. The lack of publicly available groundwater level data for the Alluvial Aquifer is a significant data gap. The approach for filling data gaps is presented in Chapter 10.

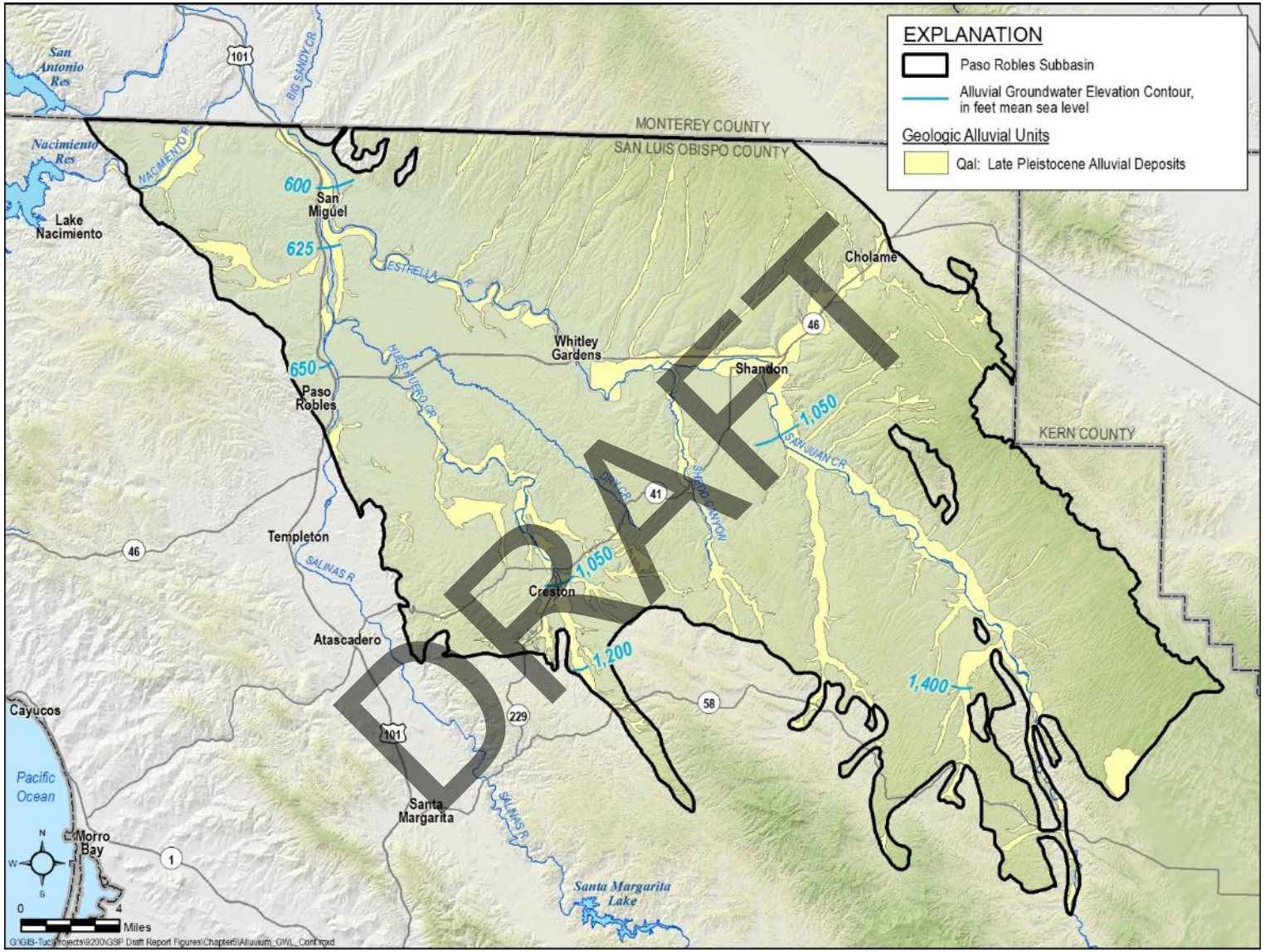



Figure 5-2. Groundwater Elevation Contours for the Alluvial Aquifer

## 5.1.2 Paso Robles Formation Aquifer

The locations of the Paso Robles Formation Aquifer monitoring wells used to assess the hydrogeologic conditions of the Paso Robles Formation Aquifer are shown on Figure 5-1. Groundwater occurs in the Paso Robles Formation Aquifer under unconfined, semi-confined, and confined conditions.

### 5.1.2.1 Paso Robles Aquifer Groundwater Elevation Contours and Horizontal Groundwater Gradients

Groundwater elevation data for 1997 and 2017, respectively, for the Paso Robles Formation Aquifer were contoured to assess current spatial variations, groundwater flow directions, and horizontal groundwater gradients. Contour maps were prepared for the seasonal high groundwater levels, which is typically in the spring, and the seasonal low groundwater levels, which is typically in the fall  In general, the spring groundwater data are for April and the fall groundwater data are for October. Data from public and private wells were used for contouring; information identifying the owner or detailed location of private wells is not shown on the maps. The contours are based on groundwater elevations measured at the well locations shown on Figure 5-1. Contour maps were generated using a computer-based contouring program and checked for representativeness by a qualified hydrogeologist. Groundwater elevation data deemed unrepresentative of static conditions or obviously erroneous were not used for contouring. Similar to groundwater elevation contour maps prepared for previous studies, close inspection of the maps indicates localized areas where interpolated groundwater elevations are above land surface. This typically occurs near streams and incised drainages where land surface tends to be locally lower than surrounding areas. While it is hydrologically possible that groundwater elevations in the Paso Robles Formation Aquifer are above land surface in some local areas, this is more likely an artifact of the computer contouring of sparse groundwater elevation data.



Figure 5-3 and Figure 5-4 show contours of historical groundwater elevations in the Paso Robles Formation Aquifer for spring 1997 and fall 1997, respectively. Overall, groundwater conditions in the Subbasin in the spring and fall of 1997 are similar, but groundwater elevations are generally lower in the fall than spring. Groundwater elevations ranged from about 1,300 ft msl in the southeast portion of the Subbasin to about 550 ft msl near the City of Paso Robles and the town of San Miguel (Figure 5-3 and Figure 5-4). Groundwater flow direction is inferred as being from high to low elevations in a direction perpendicular to groundwater elevation contours. Groundwater flow direction is generally to the northwest and west over most of the Subbasin, except in the area north of Paso Robles where groundwater flow is to the northeast. In general, groundwater flow in the western portion of the Subbasin tends to converge toward areas of low groundwater elevations.

Groundwater gradients range from approximately 0.003 ft/ft in the southeast portion of the Subbasin to approximately 0.01 ft/ft in the areas both southeast of Paso Robles and northwest of Whitley Gardens. The steepest groundwater gradients in the Subbasin are on the margins of the pumping depression in the vicinity of the city of Paso Robles and community of San Miguel.

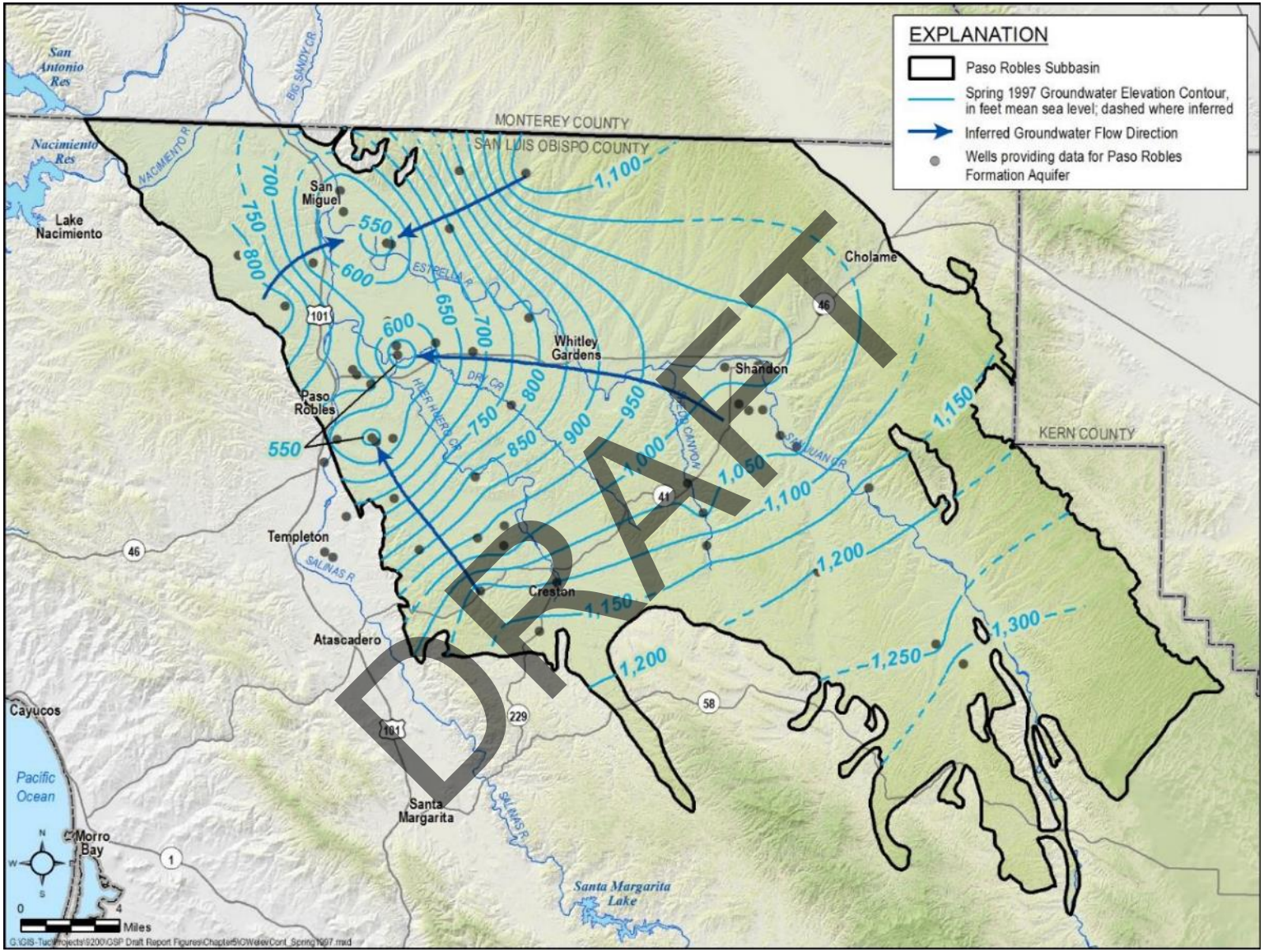



Figure 5-3. Paso Robles Formation Aquifer Spring 1997 Groundwater Elevation Contours

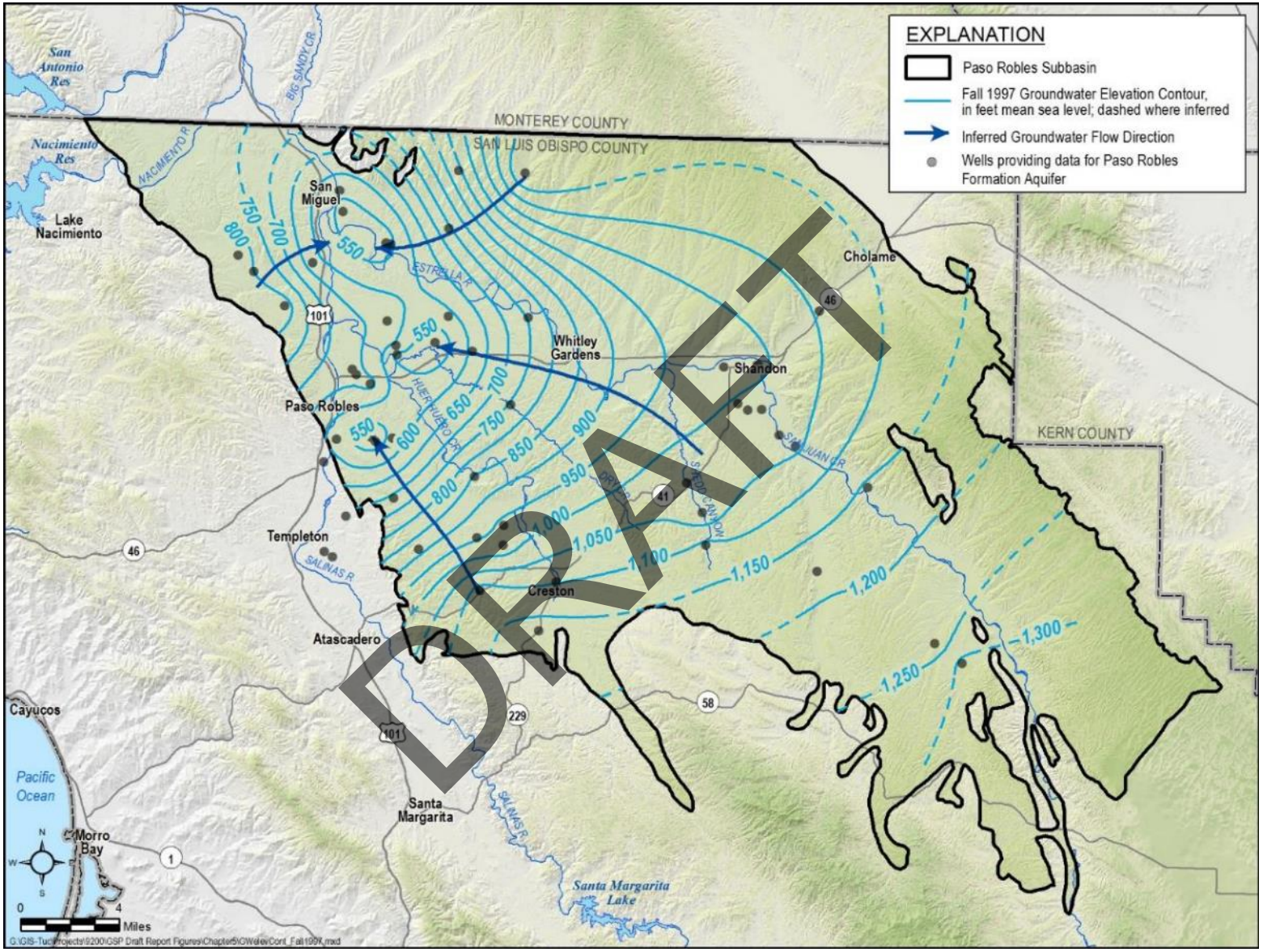



Figure 5-4. Paso Robles Formation Aquifer Fall 1997 Groundwater Elevation Contours

Figure 5-5 and Figure 5-6 show contours of current groundwater elevations in the Paso Robles Formation Aquifer for spring 2017 and fall 2017, respectively. Overall, groundwater conditions in the Subbasin in the spring and fall of 2017 were similar. Close inspection of the contour maps indicates that groundwater elevations are generally lower in the fall than spring. Groundwater elevations in 2017 are also lower than groundwater elevations in 1997. Groundwater elevations in 2017 ranged from about 1,250 ft msl in the southeast portion of the Subbasin to about 500 ft msl east of the City of Paso Robles (Figure 5-5 and Figure 5-6). Groundwater flow direction is inferred as being from high to low elevations in a direction perpendicular to groundwater elevation contours. Groundwater flow direction is generally to the northwest and west over most of the Subbasin, except in the area north of the City of Paso Robles where groundwater flow is to the northeast. In general, groundwater flow in the western portion of the Subbasin tends to converge toward areas of low groundwater elevations. These areas of low groundwater elevation are caused by pumping in the area between the City of Paso Robles and the communities of San Miguel and Whitley Gardens. Horizontal groundwater gradients range from approximately 0.002 foot/foot in the southeast portion of the Subbasin to approximately 0.02 foot/foot in the area southeast of Paso Robles. The steepest horizontal groundwater gradients in the Subbasin in 2017 are on the margins of the pumping depression east of Paso Robles and southeast of the community of San Miguel.

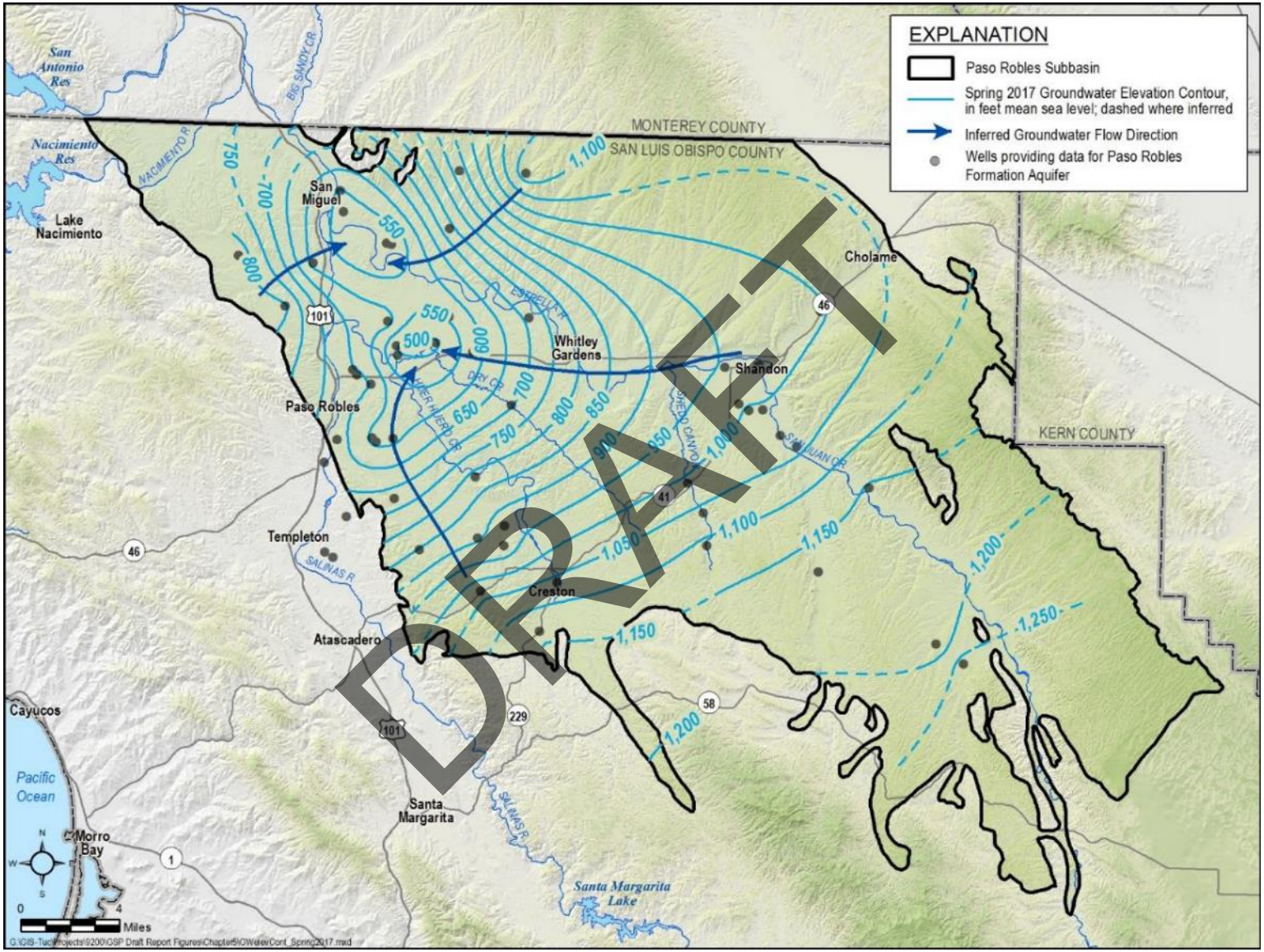



Figure 5-5. Paso Robles Formation Aquifer Spring 2017 Groundwater Elevation Contours

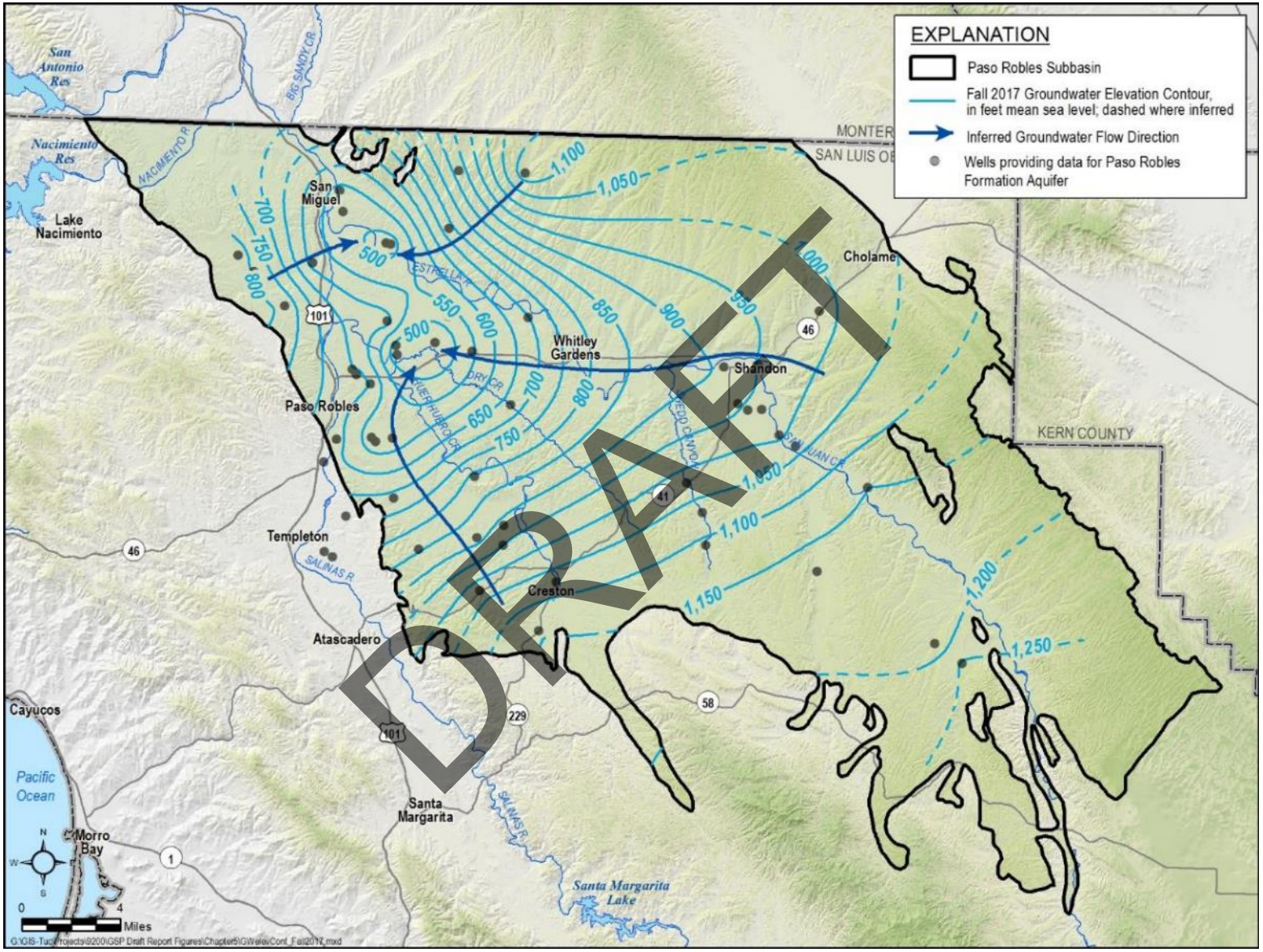



Figure 5-6. Paso Robles Formation Aquifer Fall 2017 Groundwater Elevation Contours

Figure 5-7 depicts the change in spring groundwater elevations in the Paso Robles Formation Aquifer between 1997 and 2017. Figure 5-8 depicts the change in fall groundwater elevations in the Paso Robles Formation Aquifer between and 1997 and 2017. Groundwater elevations are lower in 2017 than 1997 throughout most of the Subbasin. In general, the pattern of groundwater level decline in the spring and fall are similar, with a more pronounced area of decline extending toward Shandon in the fall. More than 80 feet of decline is observed in places during this period. Areas of largest decline are east of Paso Robles, near Creston, and in the southeastern portion of the basin. Limited data suggest an area of higher groundwater elevations exists in the vicinity of Paso Robles in 2017 compared to 1997. The increase may be related to reductions in groundwater pumping and proximity to the Salinas River. Monitoring data obtained during plan implementation will be used to further evaluate these areas.

The groundwater level contours and groundwater level change maps in this GSP are based on a reasonable and thorough analysis of the currently available data. As discussed in Chapter 8, the monitoring network should be expanded to more completely assess Subbasin conditions and demonstrate compliance with the sustainability goal for the Subbasin. Expanding the monitoring network and acquiring more groundwater elevation data will allow the GSAs to refine and modify this GSP in the future based on a more complete understanding of Subbasin conditions.

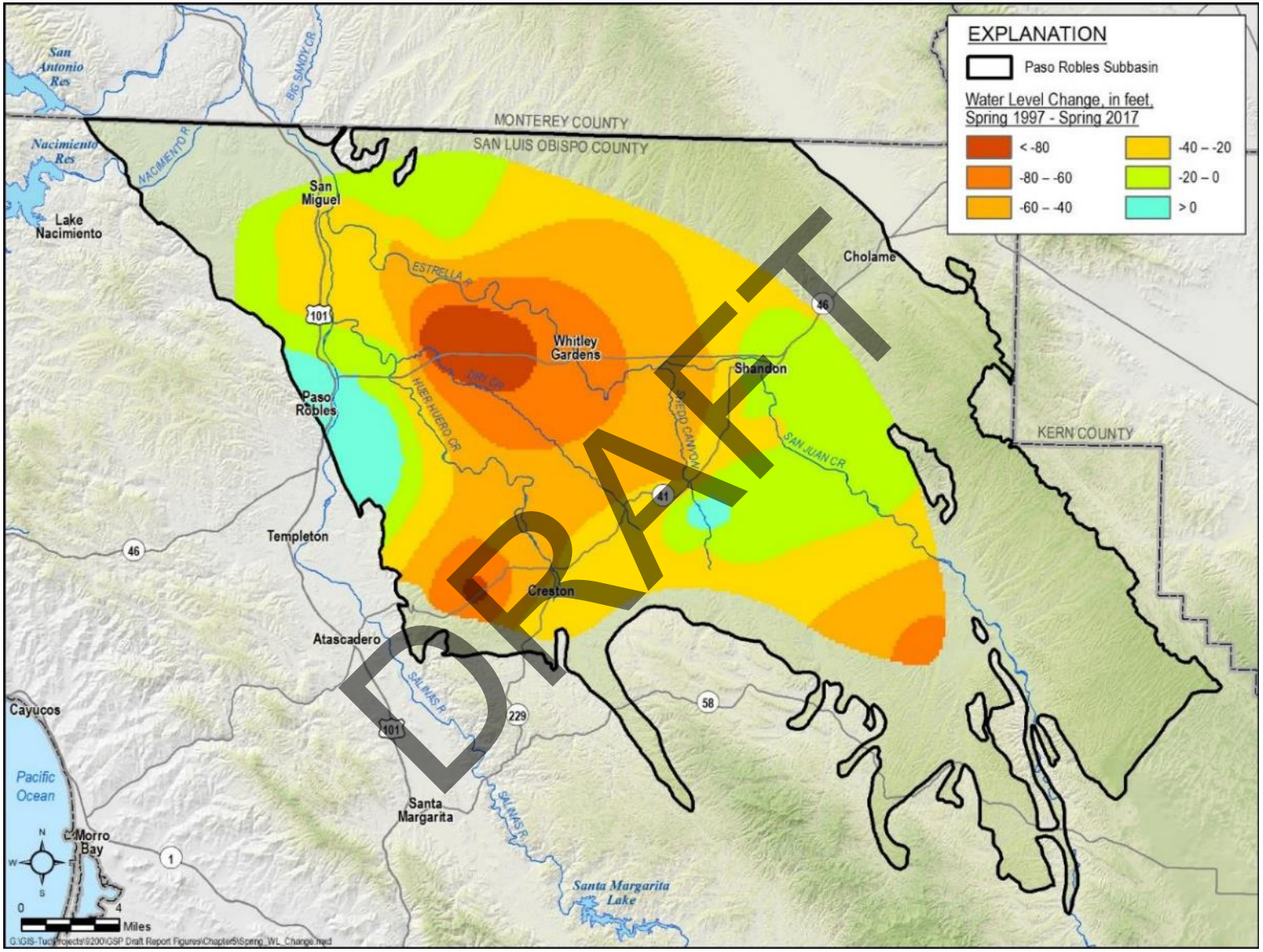



Figure 5-7. Paso Robles Formation Aquifer Change in Groundwater Elevation – Spring 1997 to Spring 2017

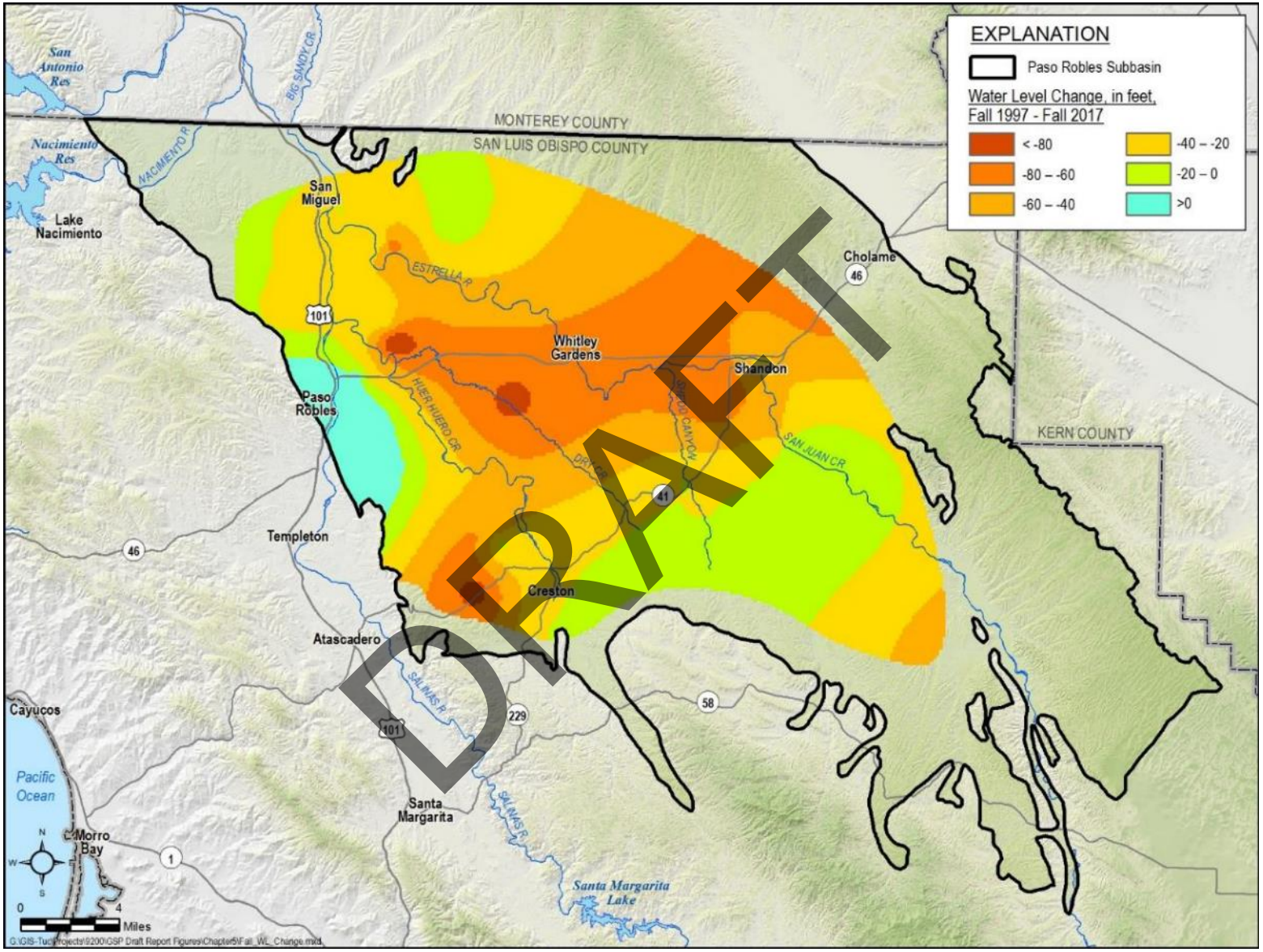



Figure 5-8. Paso Robles Formation Aquifer Change in Groundwater Elevation – Fall 1997 to Fall 2017

### 5.1.2.2 Paso Robles Formation Aquifer Hydrographs

Appendix D includes hydrographs for wells in the Paso Robles Formation Aquifer that have publicly available data. Only 22 of the monitoring wells have groundwater elevation data that were not collected under confidentiality agreements and sufficient information to confirm that the wells are screened in the Paso Robles Formation Aquifer. The lack of publicly available groundwater level data for the Paso Robles Formation Aquifer is a significant data gap. Long-term groundwater elevation declines are evident on some of the hydrographs shown in Appendix D. The magnitude of measured declines over the period of record is generally more than 50 feet at well 25S/12E-26L01, 26S/15E-20B02, and 27S/13E-28F01. Varying hydrogeology and pumping patterns in these locations leads to variable hydrographs for each of these wells.

The hydrographs show periods of climatic variations grouped by the following designations: wet, dry, or average/alternating wet and dry. Precipitation data were reviewed and analyzed to determine the occurrence and duration of wet and dry periods for the Paso Robles Subbasin. Precipitation from the Paso Robles weather station (NOAA station 46730) was used for this analysis because it is representative of conditions in the Subbasin and has the longest period of record of any station in the Subbasin. Figure 5-9 shows total annual precipitation by water year recorded at the Paso Robles station. Mean annual precipitation over the period 1925 to 2017 is 14.6 inches.

Wet and dry periods were determined based on a calculation and review of the Standardized Precipitation Index (SPI), which quantifies deviations from normal precipitation. The SPI was calculated at 1-, 2-, and 5-year time scales using the SPI Generator Tool developed by the National Drought Mitigation Center (NDMC, 2018). The 5-year, or 60-month SPI was selected as representative of multi-year meteorological fluctuations in the basin based on review of the data and computed SPI time series. For a given water year, the 60-month SPI quantifies the wetness or dryness of the preceding 60 months relative to the overall period of record. The annual time-series of the 60-month SPI was reviewed and generalized to determine wet and dry periods from 1930 to 2017 (Figure 5-9). A third category, “average/alternating”, is included for years during which the preceding 60-month period does not show a strong and persistent deviation from normal precipitation.

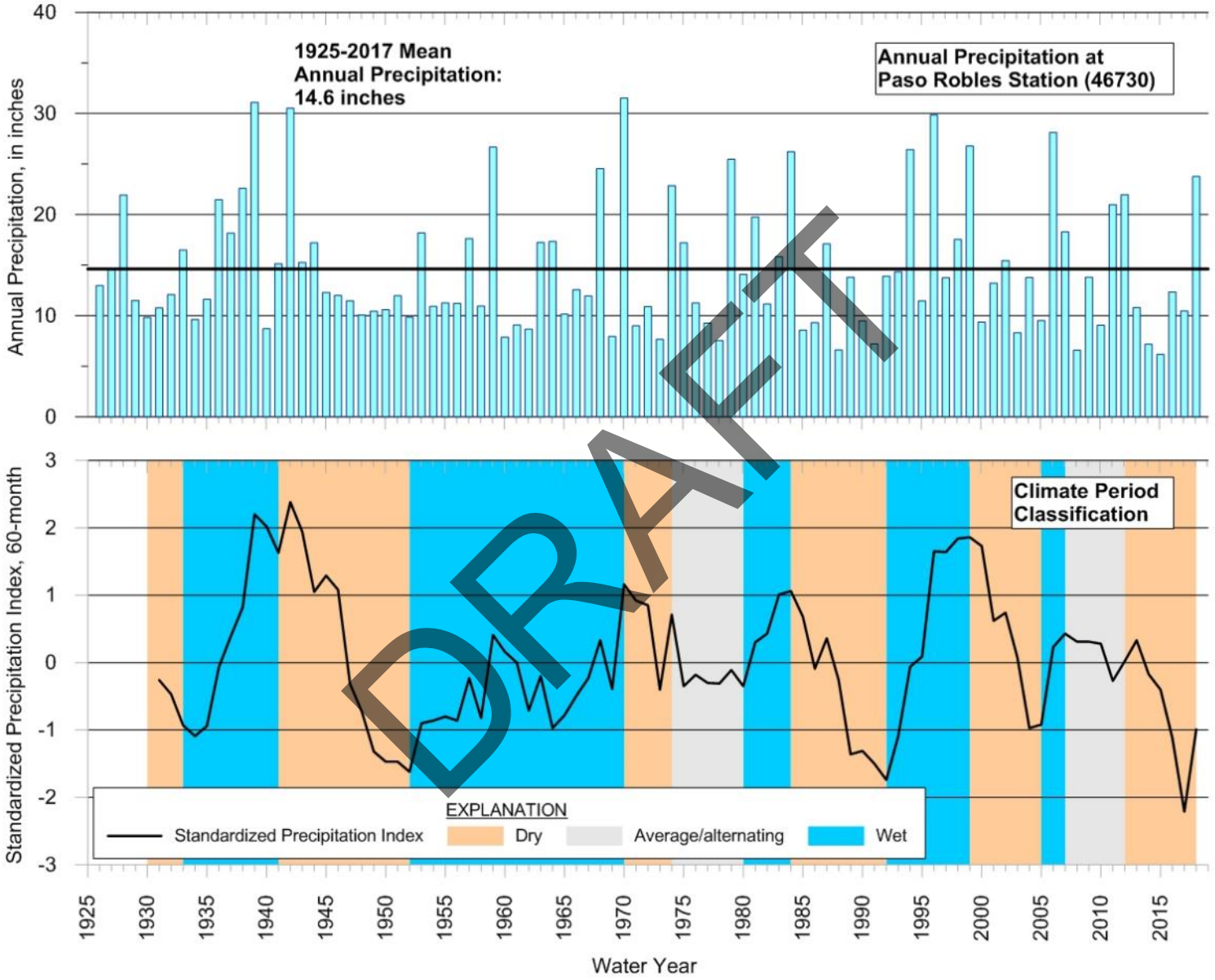





Figure 5-9. Climatic Periods in the Paso Robles Subbasin

### 5.1.3 Vertical Groundwater Gradients

SGMA regulations require assessment of vertical gradients to evaluate the vertical direction of groundwater movement between and within aquifers. Limited data exist to assess vertical groundwater gradients. Previous hydrologic studies of the Subbasin indicate that groundwater elevations are generally higher in the Alluvial Aquifer than the underlying Paso Robles Formation Aquifer, resulting in groundwater flow from the Alluvial Aquifer to the underlying Paso Robles Formation Aquifer (Fugro, 2005). The *Paso Robles Groundwater Basin Study, Phase II* (Fugro, 2005) stated that there is an assumed upward vertical groundwater gradient within the Paso Robles Formation near the northern portion of the Subbasin, although data were not provided to verify this assumption.

Vertical groundwater gradients can be estimated from nested or clustered wells. Wells 25S/12E-16K04, K05, and K06 are nested and provide groundwater elevation data from different depths in the Paso Robles Formation Aquifer near San Miguel. These wells are adjacent to a water supply well and therefore the vertical groundwater gradients may reflect local pumping conditions rather than broad, regional conditions. Hydrographs for these wells are shown on Figure 5-10. Groundwater levels in the shallowest well are shown with a green line, groundwater levels in the middle depth well are shown with a yellow line, and groundwater levels in the deepest well are shown with a red line. Prior to 2002, groundwater levels in the deepest well (red line) were generally higher than the groundwater levels in the middle and shallow wells, indicating an upward vertical groundwater gradient. A consistent vertical groundwater gradient is not apparent between the shallow and middle wells prior to 2002; groundwater elevations in the shallow and middle depth wells fluctuate around each other. After 2012, groundwater elevations in the deepest well were usually similar to or below the groundwater elevations in the shallow and middle depth wells; indicating a change to a downward vertical groundwater gradient.

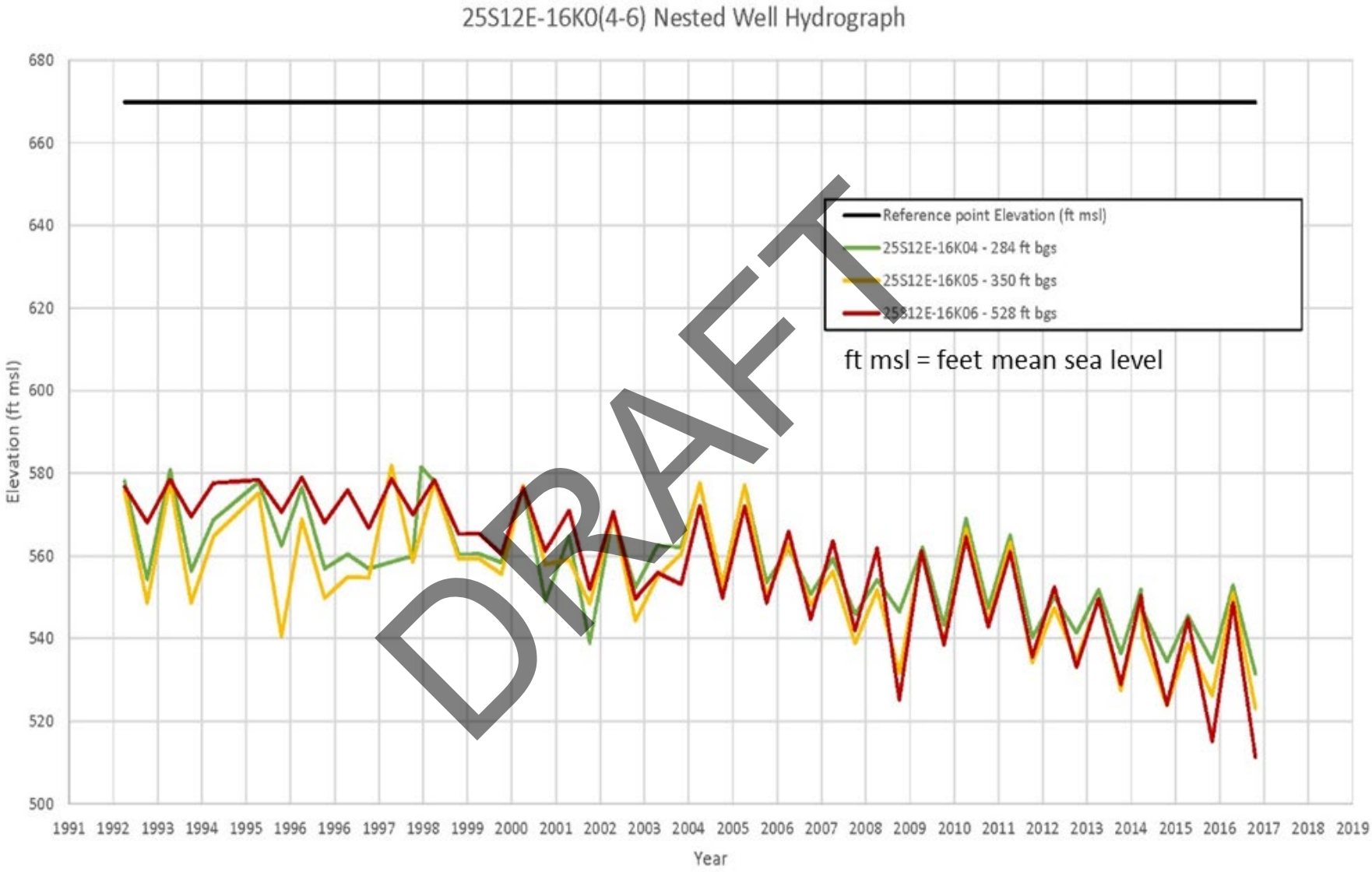



Figure 5-10. Vertical Groundwater Gradients near San Miguel

## 5.2 Change in Groundwater in Storage

This section summarizes changes in the amount of groundwater stored in the Subbasin. Changes in the amount of groundwater stored in the Subbasin was estimated for water years 1981 through 2016 using the updated Paso Robles Subbasin groundwater model. Chapter 6 provides additional information about the groundwater model.

### 5.2.1 Alluvial Aquifer

Figure 5-11 shows the cumulative change in the amount of groundwater stored in the Alluvial Aquifer for water years 1981 through 2016. The cumulative change is calculated as change since 1981. The period from 1981 through 2011 is considered representative of long-term hydrologic conditions prior to the drought period of 2012 through 2016. In accordance with SGMA Regulations § 354.16 (b), the graph also shows the estimated annual groundwater pumping derived from the updated groundwater model and wet, dry, and average/alternating climatic periods based on the analysis presented in Section 5.1.2.2. The cumulative change in storage is generally a function of both annual pumping and annual climatic conditions.

Over the period 1981 through 2011, the model indicates that approximately 20,000 acre-feet (AF) of storage change occurred in the Alluvial Aquifer. During the drought period 2012 through 2016, the model suggests a loss of groundwater in storage in the Alluvial Aquifer of about 50,000 AF. The loss of groundwater from storage during the drought represents an extreme condition which is not indicative of long-term storage trends in the Alluvial Aquifer.

As indicated on Figure 5-11, a decrease in the amount of groundwater stored in the Alluvial Aquifer generally occurs during dry periods and an increase in the amount of groundwater stored in the Alluvial Aquifer generally occurs during wet periods. During the period 1981 through 2011, estimated groundwater pumping from the Alluvial Aquifer decreased from about 6,000 AFY to about 2,000 AFY as indicated by the black bars on Figure 5-11. This suggests that the loss in groundwater in storage is not due to increased pumping, but is more likely a result of lack of recharge during low precipitation years.

The projections of groundwater storage loss in the Alluvial Aquifer were made using the groundwater model. Representation of groundwater conditions in the model for the Alluvial Aquifer is based on a relatively sparse groundwater level dataset. Available data suggest that groundwater levels in the Alluvial Aquifer over model period have been generally stable. This suggests that the amount of groundwater in storage has also been relatively stable. Additional groundwater elevation data will be obtained after GSP adoption to improve the understanding of groundwater conditions in the Alluvial Aquifer, update and recalibrate the groundwater model, and further evaluate groundwater storage conditions in the Alluvial Aquifer.

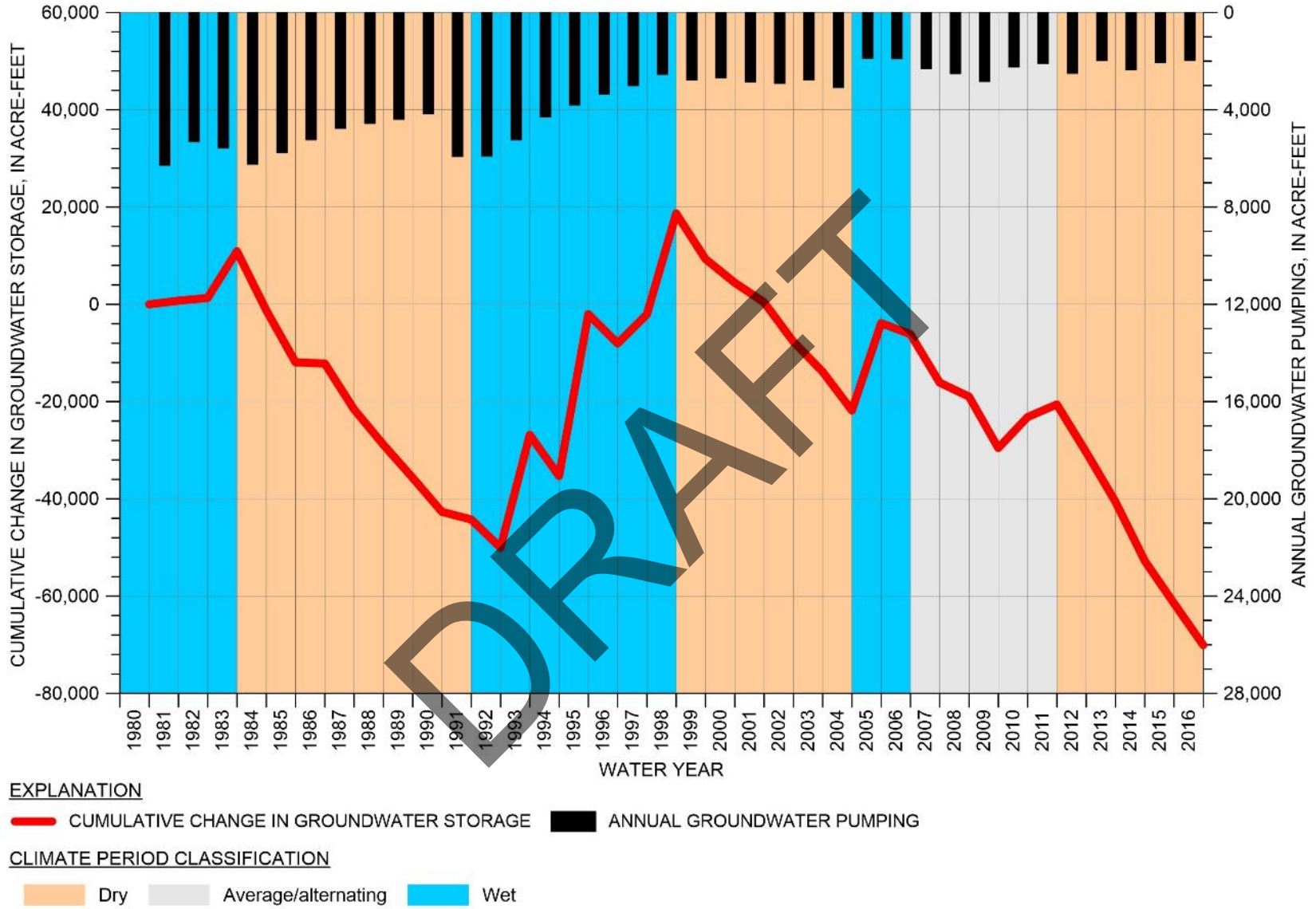



Figure 5-11. Estimated Cumulative Change of Groundwater in Storage in the Alluvial Aquifer

### 5.2.2 Paso Robles Formation Aquifer

Figure 5-12 shows the cumulative change of groundwater in storage in the Paso Robles Formation Aquifer for water years 1981 through 2016. In accordance with SGMA Regulations § 354.16 (b), the graph also shows the annual groundwater pumping and water year type. The climatic variation shown on Figure 5-12 is the same climatic variation developed on Figure 5-9. The cumulative change in storage is generally a function of both annual pumping and annual climatic conditions. Over the period 1981 through 2011, approximately 369,000 AF were removed from storage in the Paso Robles Formation Aquifer. Over the period 1981 through 2016, approximately 646,000 AF were removed from storage in the Paso Robles Formation Aquifer. Depletion of groundwater in storage generally occurs during dry periods and increases in groundwater in storage generally occur during wet periods, as indicated on Figure 5-12. Groundwater pumping decreased during the period from 1981 to 1999 and generally increased from 1999 to 2016. The loss in groundwater in storage in the Paso Robles Formation Aquifer appears to be from a combination of increased pumping since 1999 and a number of dry years with limited recharge.

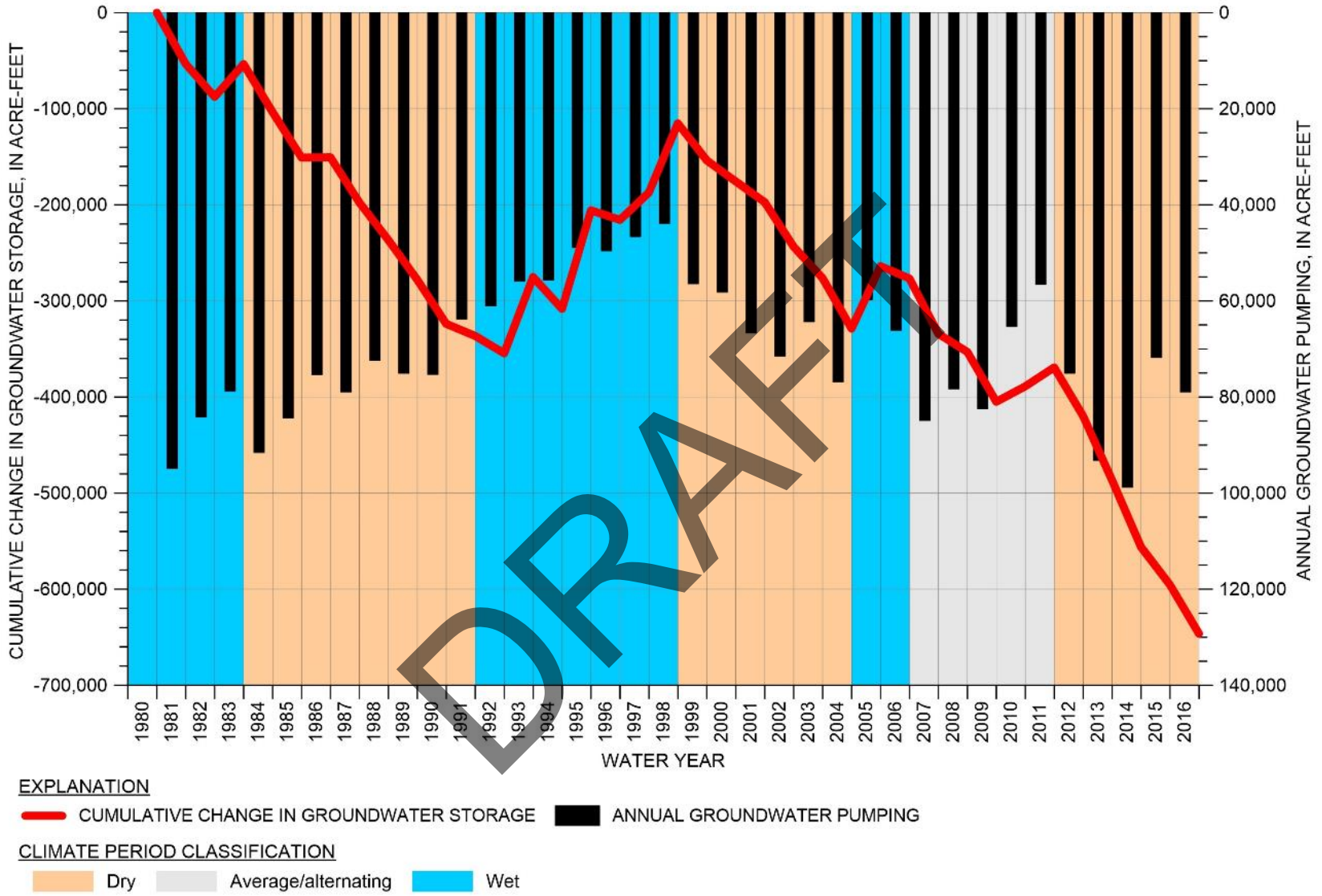



Figure 5-12. Estimated Cumulative Change of Groundwater in Storage in the Paso Robles Formation Aquifer

## 5.3 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator for the Subbasin. The Subbasin is not adjacent to the Pacific Ocean, a bay, or inlet.

## 5.4 Subsidence

Land subsidence is the lowering of the land surface. While several human-induced and natural causes of subsidence exist, the only process applicable to the GSP is subsidence due to lowered groundwater elevations caused by groundwater pumping.

Historical subsidence can be estimated using Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR. InSAR measures ground elevation using microwave satellite imagery data. DWR provides maps of the Subbasin depicting the difference in InSAR measured ground surface elevation for any two months between June 2015 and June 2018.

The InSAR data provided by DWR is subject to measurement error. DWR has stated that, on a statewide level, the total vertical displacement measurements between June 2015 and June 2018 is subject to two error sources (Brezing, personal communication):

1. The error between InSAR data and continuous GPS data is 16 mm (0.052 feet) with a 95% confidence level
2. The measurement accuracy when converting from the raw InSAR data to the maps provided by DWR is 0.048 feet with 95% confidence level.

Simply adding the errors 1 and 2 results in a combined potential error of 0.1 foot (or 1.2 inches). While this is not a robust statistical analysis, it does provide an estimate of the potential error in the InSAR maps provided by DWR. A land surface change of less than 0.1 feet is therefore within the noise of the data, and is equivalent to no subsidence in this GSP.

Figure 5-13 shows the InSAR measured subsidence in the Subbasin. The yellow area on Figure 5-13 is the area with measured ground surface rise or drop of less than 0.1 feet. This is within the measurement error and therefore is an area of no subsidence. The green area on Figure 5-13 is the area with measured ground surface drop of between 0.1 feet and 0.125 feet. This is slightly outside the measurement area, and may indicate subsidence of up to 0.025 feet over three years, or approximately 0.1 inches per year. This is a minor rate of subsidence and is relatively insignificant and not a major concern for the Subbasin. However, ongoing subsidence over many years could add up to a more significant ground surface drop and the GSAs will continue to monitor annual subsidence.

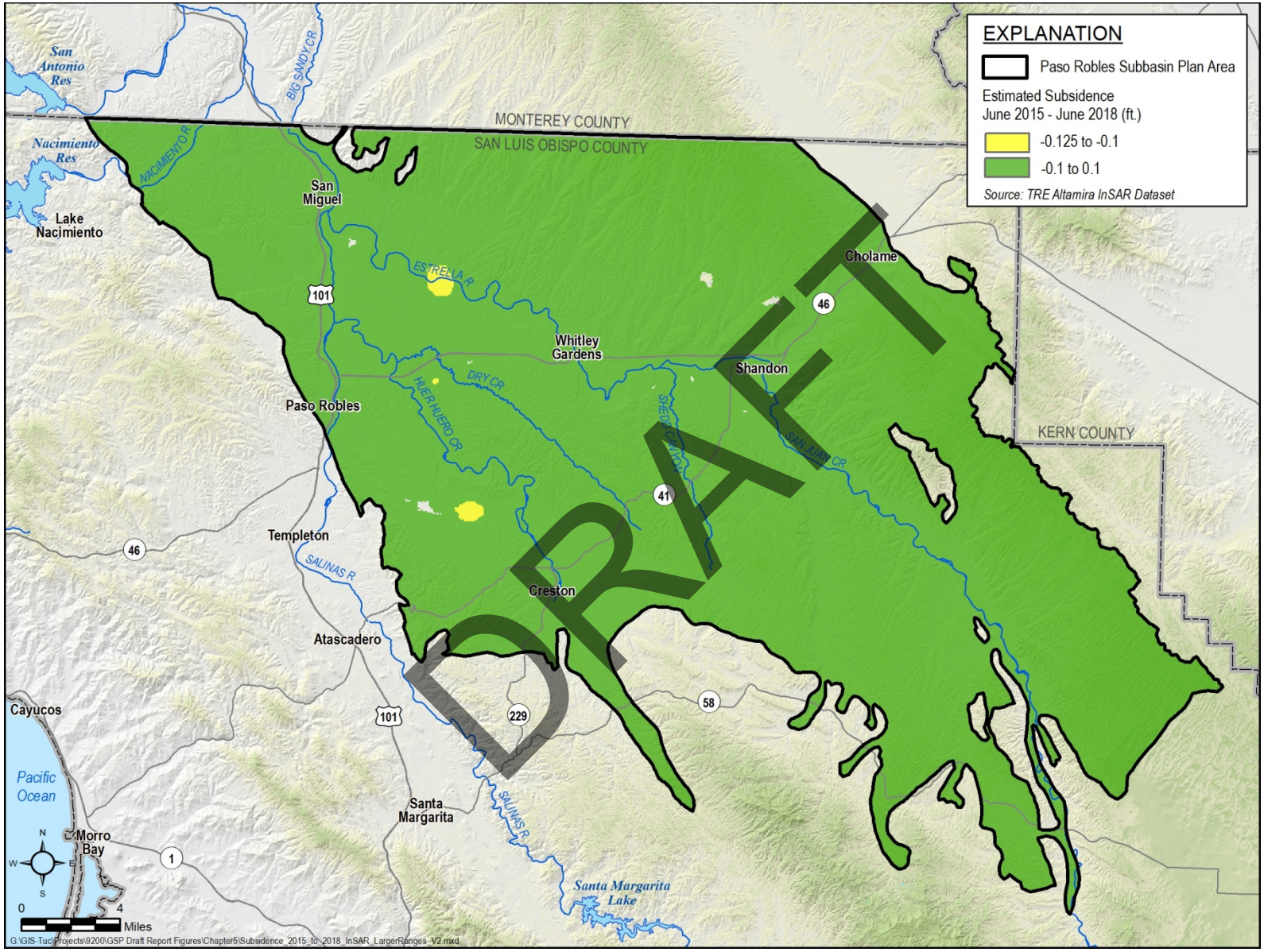



Figure 5-13. Subsidence 2015 to 2018 from InSAR Data

## 5.5 Interconnected Surface Water

Ephemeral surface water flows in the Subbasin over the last 40 years make it difficult to assess the interconnectivity of surface water and groundwater and to quantify the degree to which surface water depletion has occurred. There are no available data that establish whether or not the groundwater and surface water are connected through a continuous saturated zone in any aquifer. Water elevation contour maps of the Paso Robles Formation wells may suggest that a continuous saturated zone between the surface water and the Paso Robles Formation aquifer does not exist. The potential for interconnected surface water with the alluvial aquifer will be assessed as data are developed and analyzed.

Definitive data delineating any connections between surface water and groundwater or a lack of interconnected surface waters is a data gap that will be addressed during implementation of this GSP.

## 5.6 Groundwater Quality Distribution and Trends

Although groundwater quality is not a primary focus of SGMA, GSAs cannot degrade groundwater quality as a result of actions or projects undertaken to achieve sustainability. Therefore, the groundwater quality distribution and trends discussed in this section do not identify conditions that must be addressed by the GSP, but rather identify conditions that should not be exacerbated by this GSP.

Groundwater quality samples have been collected and analyzed throughout the Subbasin for various studies and programs. Water quality samples have been collected on a regular basis for compliance with regulatory programs. Additionally, a broad survey of groundwater quality sampling was conducted for the *Paso Robles Groundwater Basin Study, Phase I* (Fugro, 2002), and most recently by the USGS in 2018. Historical groundwater quality data were compiled for use in the SNMP (RMC, 2015).

This GSP focuses only on constituents that might be impacted by groundwater management activities. The constituents of concern are chosen because:

1. The constituent has either a drinking water standard or a known effect on crops
2. Concentrations have been observed above either the drinking water standard or the level that affects crops.

### 5.6.1 Groundwater Quality Suitability for Drinking Water

Groundwater in the basin is generally suitable for drinking water purposes. The *Paso Robles Groundwater Basin Study, Phase I* (Fugro 2002) reviewed water quality data from public supply wells to identify exceedances of drinking water standards. The drinking water standards

Maximum Contaminant Levels (MCLs) and Secondary MCLs (SMCLs) are established by Federal and State agencies. MCLs are legally enforceable standards, while SMCLs are guidelines established for nonhazardous aesthetic considerations such as taste, odor, and color. The most common water quality standard exceedance in the Subbasin was exceedance of the SMCL for TDS, which exceeded the standard in 14 samples from the 74 samples. Nitrate also exceeded the MCL in four samples. One exceedance of mercury was found in the San Miguel area in a 1990 sample. There have been no recorded exceedances of mercury in any samples collected since that date.

### 5.6.2 Groundwater Quality Suitability for Agricultural Irrigation

Groundwater in the basin is generally suitable for agricultural purposes. Fugro (2002) evaluated the agricultural suitability of groundwater using three metrics:

1. Salinity as indicated by electrical conductivity
2. Soil structure as indicated by sodium absorption ratio and electrical conductivity
3. Presence of toxic salts as indicated by concentrations of sodium, chloride, and boron

Of the 74 samples evaluated 37 had no restrictions on irrigation use (Fugro, 2002) based on this criteria. This does not mean that half of the groundwater in the basin is unsuitable for irrigation; only that half of the samples had some constituent that may restrict unlimited irrigation use. Most cases of slight to moderate restriction on irrigation use were due to sodium or chloride toxicity. Severe restrictions for 13 samples were generally the result of high sodium, chloride, or boron toxicity.

### 5.6.3 Distribution and Concentrations of Point Sources of Groundwater Constituents

As noted in the SNMP (RMC, 2015), groundwater constituents of concern derive from point sources such as spill or leaks as well as diffuse sources, including:

- Irrigation water (e.g., potable water, groundwater, and future recycled water);
- Agricultural inputs (e.g., fertilizer and amendments);
- Septic system recharge;
- Infrastructure (e.g., percolation from treated wastewater ponds, leaking pipes); and
- Rainfall infiltration, mountain front recharge, and natural stream losses.

Potential point sources of groundwater quality degradation were identified using the State Water Resources Control Board (SWRCB) Geotracker website. Waste Discharge permits were also

reviewed from on-line regional SWRCB websites. Table 5-1 summarizes information from these websites. Figure 5-14 shows the location of potential groundwater contaminant point sources. Based on available information there are no mapped groundwater contamination plumes at these sites, although investigations are ongoing.

Table 5-1. Potential Point Sources of Groundwater Contamination

| Site Name | Site Type | Constituents of Concern (COCs) | Status |
|---|---|---|---|
| **Former Chevron 9-0750** | LUST Cleanup Site | petroleum hydrocarbons | remedial action plan submitted Q2 2018 |
| **Kirkpatrick Property (Unocal Portion)** | Cleanup Program Site | crude oil | impacted soil; health risk assessment prepared in 2016 |
| **Lucy Brown Road Pipeline Site (Former ConocoPhillips Site #3469)** | Cleanup Program Site | crude oil, diesel, gasoline | Initial groundwater monitoring data no significant impacts to groundwater. |
| **Estrella Airfield (Paso Robles Municipal Airport)** | Military Cleanup Site | unknown | unknown |
| **Camp Roberts Solid Waste Site** | Land Disposal Site | metals, cyanide, sulfide, herbicides, volatile organic compounds (VOCs), pesticides, PCBs, phthalate esters, phenols, semi-VOCs | TDS, nitrate and manganese detected in wells at concentrations above regulatory standards. |
| **Camp Roberts South and Closed Landfill** | Land Disposal Site | VOCs, chloride, sulfate, nitrate, sodium, manganese, TDS, total organic carbon | carbon tetrachloride detected at concentrations exceeding MCL. |
| **Paso Robles Solid Waste Site** | Land Disposal Site | chloride, total alkalinity, manganese, nitrate, sodium, sulfate, temperature, TDS, VOCs, Pesticides, PCBs, organophosphorus compounds, herbicides, semi-VOCs | COCs not detected in groundwater; sulfate and barium locally elevated; no remedial activities. |

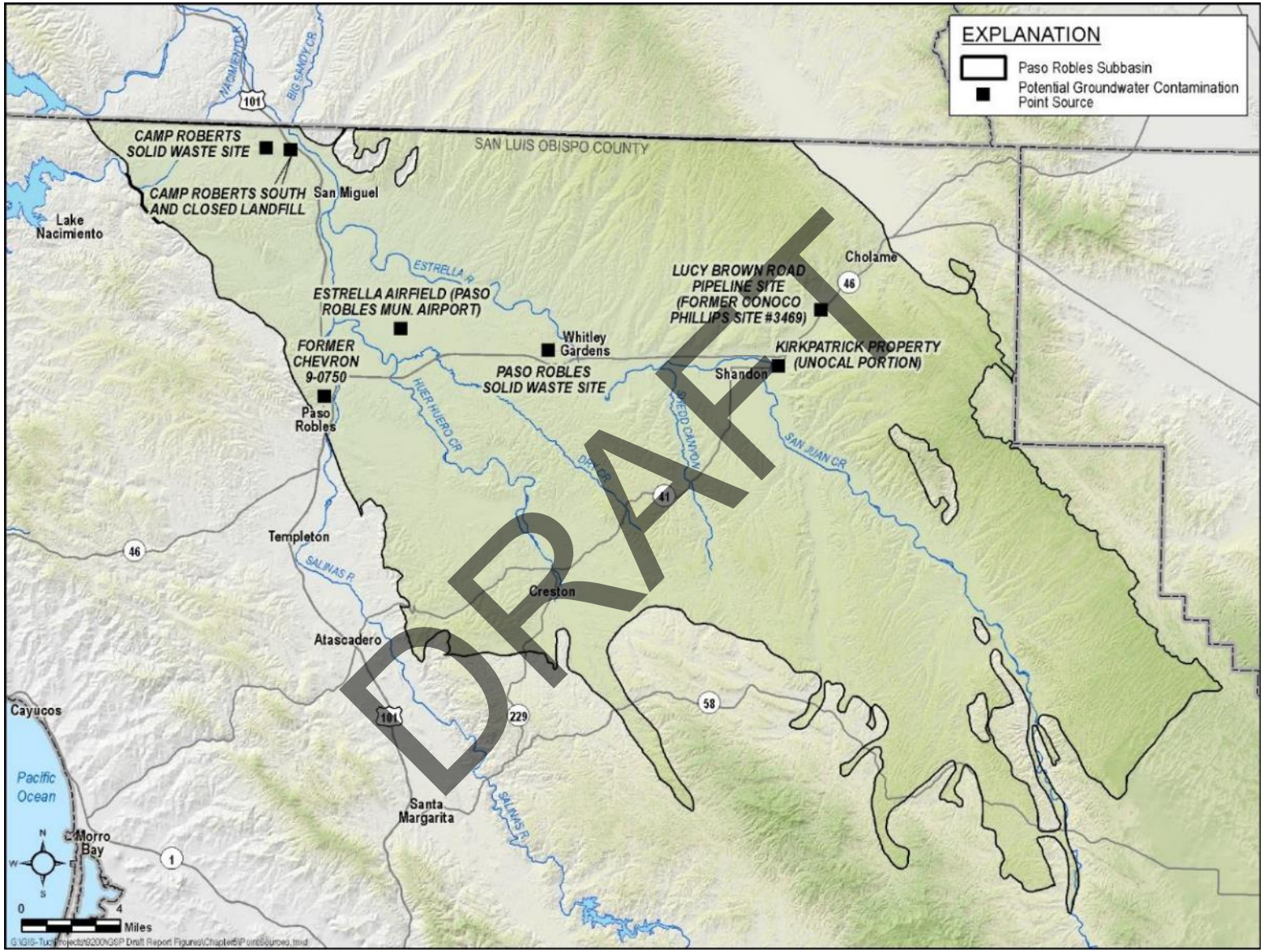



Figure 5-14. Location of Potential Point Sources of Groundwater Contaminants

## 5.6.4 Distribution and Concentrations of Diffuse or Natural Groundwater Constituents

Fugro (2002) identified a number of constituents of concern that are broadly distributed throughout the Subbasin. The SNMP (RMC, 2015) provides additional data on the distribution of certain constituents. The data from these previous reports are presented in terms of the informal subareas that have been used in previous studies to refer to various regions within the Subbasin. These seven subareas are not part of this GSP; RMC, 2015 shows the approximate location of these areas.

### 5.6.4.1 Total Dissolved Solids

TDS is a constituent of concern in groundwater because it has been detected at concentrations greater than its SMCL of 500 milligrams per liter (mg/L). Table 5-2 shows the range and average TDS concentrations by subarea as reported in the SNMP (RMC, 2015). This table shows the average TDS concentrations are greater than the SMCL of 500 mg/L in parts of the Subbasin. This table includes data for portions of the Bradley, North Gabilan, and South Gabilan subareas that are outside the Subbasin.

Table 5-2. TDS Concentration Ranges and Averages

| Hydrogeologic Subarea | TDS Concentration Range (mg/L) | Average TDS Concentration (mg/L) |
|---|---|---|
| Estrella | 350 – 1,560 | 552 |
| Shandon | 270 – 3,160 | 563 |
| Creston | 190 – 1,620 | 388 |
| San Juan | 160 – 2,170 | 425 |
| Bradley | 400 – 1,280 | 751 |
| North Gabilan | 370 – 1,320 | 856 |
| South Gabilan | 370 – 1,320 | 451 |

Source: RMC, 2015

The distribution and trends of TDS in the Subbasin are shown on Figure 5-15. This figure is from the SNMP (RMC, 2015) and includes portions of the Subbasin north of the Monterey County line which are outside the Subbasin. The study area for the SNMP also did not extend to the southeastern edge of the Subbasin. TDS distribution shown on this figure is not differentiated by aquifer or well depth. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause TDS concentrations in groundwater in a well that would otherwise remain below the SMCL to increase above the SMCL.

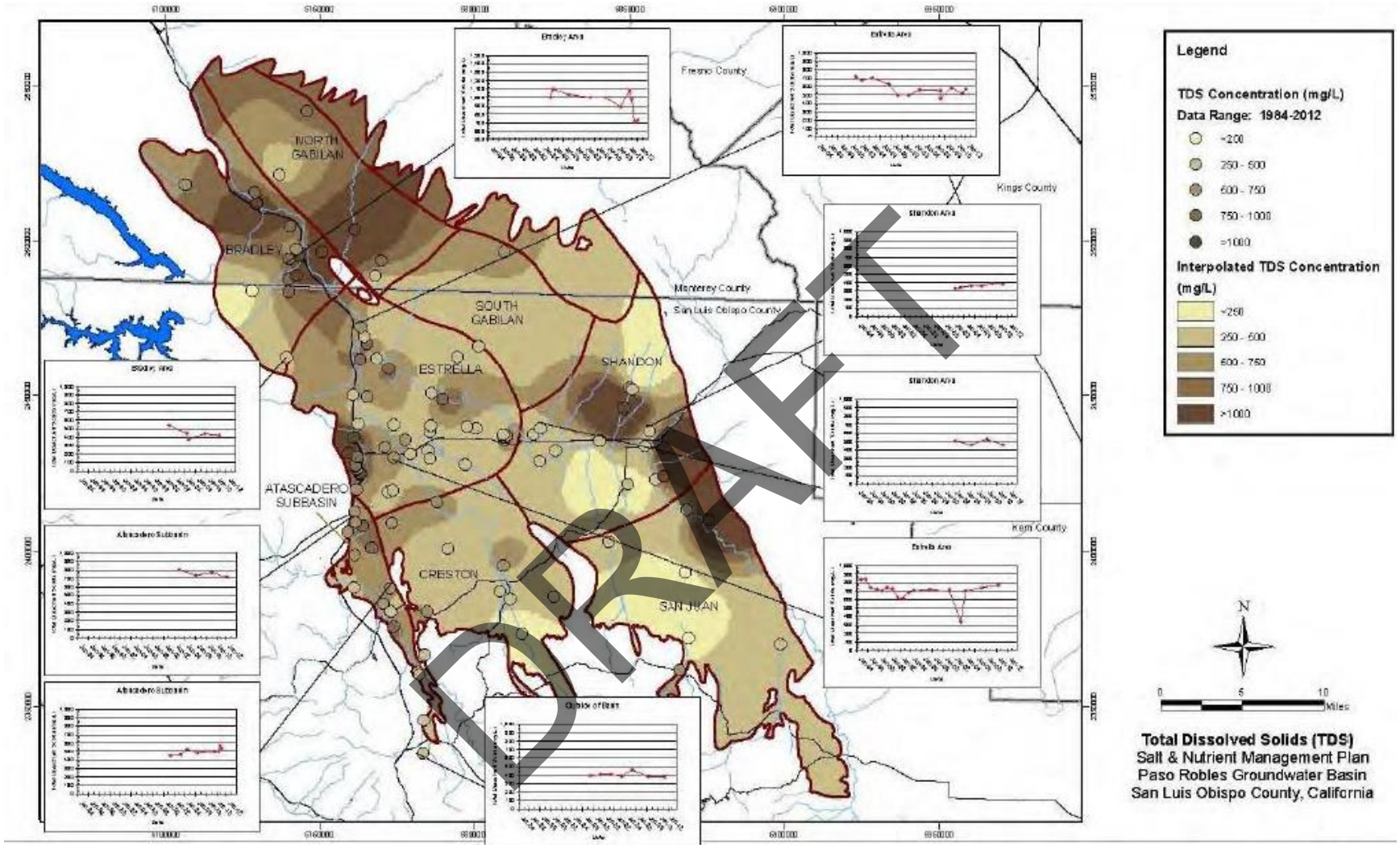



Figure 5-15. TDS Regional Distribution and Trends

Source: RMC, 2015

### 5.6.4.2 Chloride

Chloride is a constituent of concern in groundwater because it has been detected at concentrations greater than its SMCL of 250 mg/L. Elevated chloride concentrations in groundwater can damage crops and affect plant growth. Fugro (2002) reported that slight to moderate restrictions on irrigating trees and vines may occur when chloride concentrations exceed 100 mg/L. Severe restrictions on irrigating trees and vines may occur when chloride concentrations exceed 350 mg/L.

Table 5-3**,** which was compiled based on various tables and related information in the SNMP (RMC, 2015), shows the range and average chloride concentrations by subarea. This table indicates that average chloride concentrations are less than the SMCL of 250 mg/L throughout Subbasin. This table includes data for areas of the Bradley, North Gabilan, and South Gabilan subareas that are outside the Subbasin.

Table 5-3. Chloride Concentration Ranges and Averages

| Hydrogeologic Subarea | Chloride Concentration Range (mg/L) | Average Chloride Concentration (mg/L) |
|---|---|---|
| Estrella | 32 - 572 | 94 |
| Shandon | 31 - 550 | 80 |
| Creston | 25 - 508 | 69 |
| San Juan | 13 - 699 | 64 |
| Bradley | 40 - 400 | 84 |
| North Gabilan | 35 - 209 | 113 |
| South Gabilan | 35 - 209 | 37 |

Source: RMC, 2015



The distribution and trends of chloride in the Subbasin are shown on Figure 5-16. This figure is from the SNMP (RMC, 2015) and includes portions of the Subbasin north of the Monterey County line which are outside the Subbasin. Chloride distribution shown on this figure is not differentiated by aquifer or well depth. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause chloride concentrations in groundwater in a well that would otherwise remain below the SMCL to increase above the SMCL.

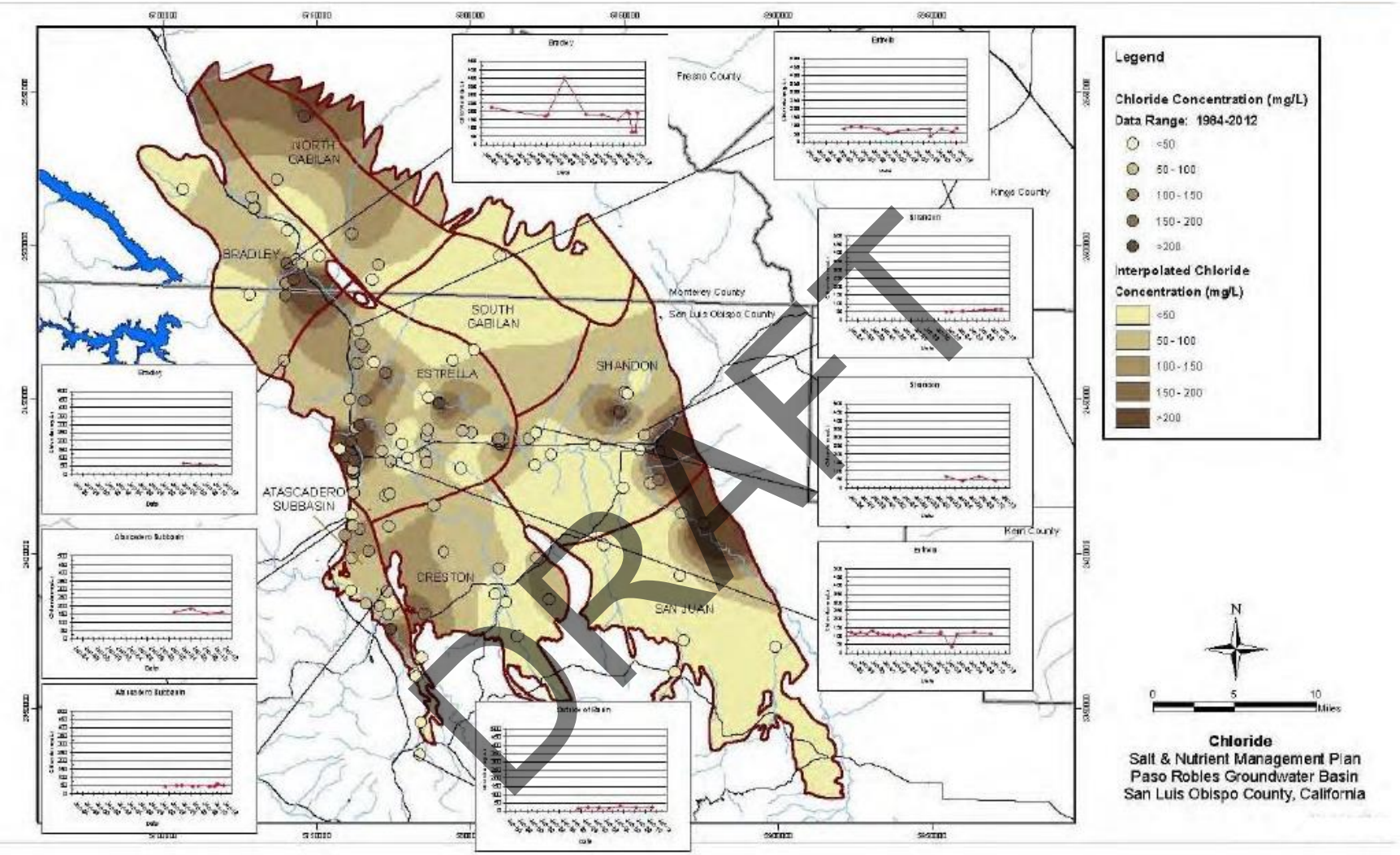



Figure 5-16. Chloride Regional Distribution and Trends

Source: RMC, 2015

### 5.6.4.3 Sulfate

Sulfate is a constituent of concern in groundwater because it has been observed at concentrations above its SMCL of 250 mg/L. Table 5-4 shows the range and average sulfate concentrations by subarea as reported in the SNMP (RMC, 2015). This table shows the average sulfate concentrations are greater than the SMCL of 250 mg/L in many areas of the Subbasin. This table includes data for areas of the Bradley, North Gabilan, and South Gabilan subareas that are outside the Subbasin.

Table 5-4. Sulfate Concentration Ranges and Averages

| Hydrogeologic Subarea | Sulfate Concentration Range (mg/L) | Average Sulfate Concentration (mg/L) |
|---|---|---|
| Estrella | 11 - 375 | 129 |
| Shandon | 14 – 2,010 | 360 |
| Creston | 7 - 353 | 67 |
| San Juan | 24 - 722 | 248 |
| Bradley | 30 - 704 | 296 |
| North Gabilan | 9 - 648 | 194 |
| South Gabilan | 9 - 648 | 194 |

Source: RMC, 2015

Maps of sulfate distribution in the Subbasin were not found in previous studies. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause sulfate concentrations in groundwater in a well that would otherwise remain below the SMCL to increase above the SMCL.

### 5.6.4.4 Nitrate

Nitrate is a constituent of concern in groundwater because concentrations have been detected greater than its MCL of 10 mg/L (measured as nitrogen). Nitrate concentrations in excess of the MCLs can result in health impacts.

Table 5-5 shows the range and average nitrate concentrations by subarea as reported in the SNMP (RMC, 2015). This table shows the average nitrate concentrations are less than the MCL of 10 mg/L throughout Subbasin. The range of measured nitrate concentrations however exceeds the MCL of 10 mg/L in every subarea. This table includes data for areas of the Bradley, North Gabilan, and South Gabilan subareas that are outside the Subbasin.

Table 5-5. Nitrate Concentration Ranges and Averages

| Hydrogeologic Subarea | Nitrate Concentration Range (mg/L) | Average Nitrate Concentration (mg/L) |
|---|---|---|
| Estrella | 0 – 16.2 | 2.5 |
| Shandon | 1.2 – 12.1 | 4.6 |
| Creston | 0.8 – 9.2 | 3.2 |
| San Juan | 0.1 – 5.8 | 2.8 |
| Bradley | 0.0 – 5.8 | 2.7 |
| North Gabilan | 5.0 – 9.8 | 8.4 |
| South Gabilan | 15.8 | 6.3 |

Source: RMC, 2015; the range of nitrate concentration in the South Gabilan subarea is uncertain

The distribution and trends of nitrate in the Subbasin are shown on Figure 5-17. This figure is from the SNMP (RMC, 2015) and includes portions of the Subbasin north of the Monterey County line which are outside the Subbasin. This nitrate distribution shown on this figure is not differentiated by aquifer or well depth. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause nitrate concentrations in groundwater in a well that would otherwise remain below the SMCL to increase above the SMCL.

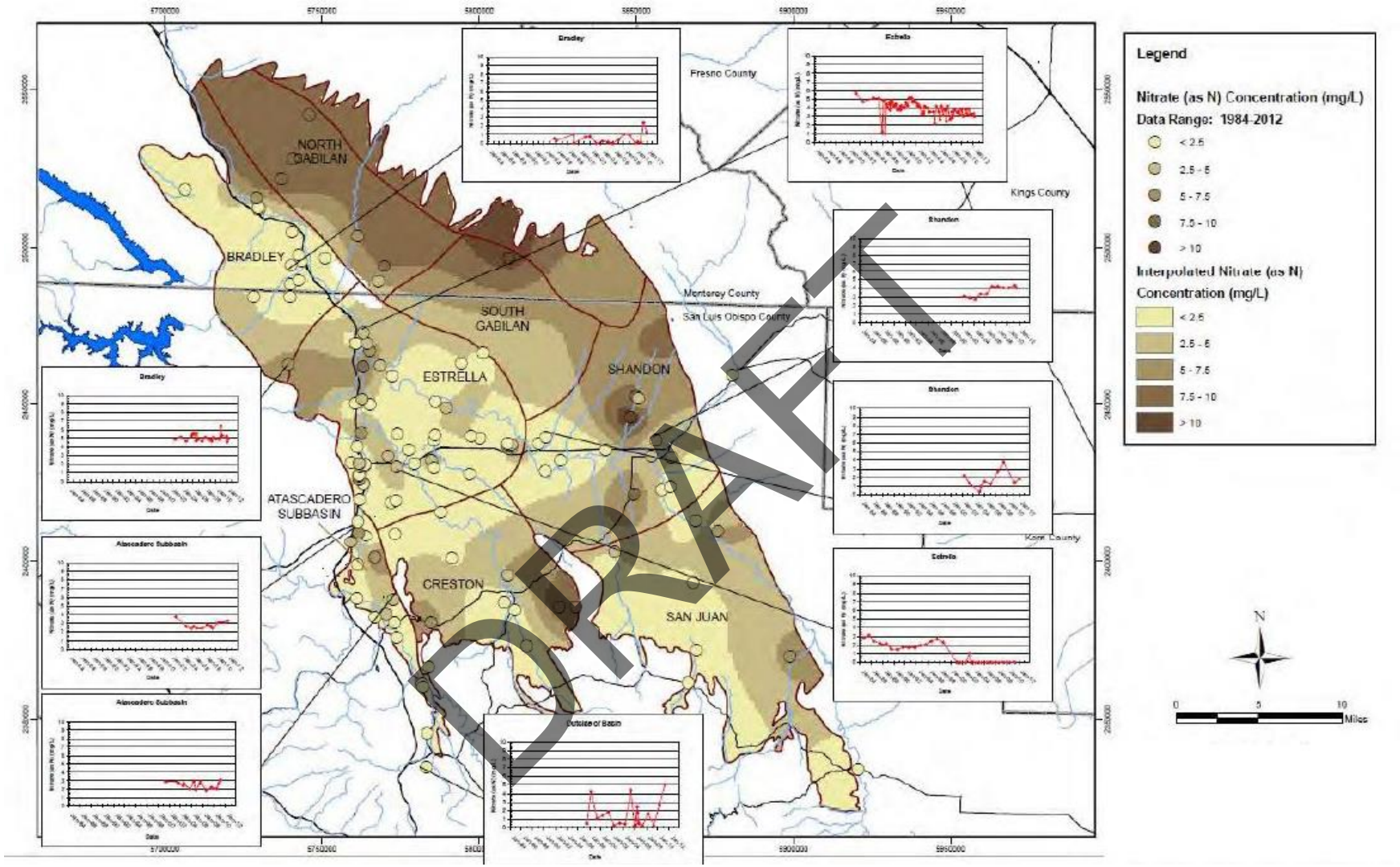



Figure 5-17. Nitrate Regional Distribution and Trends

Source: RMC, 2015

### 5.6.4.5 Boron

Boron is an unregulated constituent and therefore does not have a regulatory standard. However, boron is a constituent of concern because elevated boron concentrations in water can damage crops and affect plant growth. Fugro (2002) reported that severe restrictions on irrigating trees and vines may occur when boron concentrations exceed 0.5 mg/L.

Table 5-6 shows the range and average boron concentrations by subarea as reported in the SNMP (RMC, 2015). Average boron concentration exceeds the severe irrigation restriction level of 0.5 mg/L in the Estrella, Shandon, and San Juan subareas. The table includes data for areas of the Bradley, North Gabilan, and South Gabilan subareas that are outside the Subbasin.

Table 5-6. Boron Concentration Ranges and Averages

| Hydrogeologic Subarea | Boron Concentration Range (mg/L) | Average Boron Concentration (mg/L) |
|---|---|---|
| Estrella | 0.13 – 5.66 | 1.8 |
| Shandon | 0.08 – 2.97 | 0.81 |
| Creston | 0.06 – 0.31 | 0.14 |
| San Juan | 0.08 – 2.29 | 0.74 |
| Bradley | 0.12 – 0.18 | 0.15 |
| North Gabilan | 0.11 – 0.44 | 0.24 |
| South Gabilan | 0.11 – 0.44 | 0.24 |

Source: RMC, 2015

No maps exist of boron distribution in the Subbasin. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause boron concentrations in groundwater in a well that would otherwise remain below the SMCL to increase above the SMCL.

### 5.6.4.6 Gross Alpha Radiation

Gross alpha radiation is a constituent of concern because it has been detected at concentrations greater than the MCL of 15 picocuries per liter (pCi/L). Fugro (2002) reports that gross alpha radioactivity is present in most areas of the basin. Gross alpha particle count activity in groundwater exceeded the MCL for drinking water in the Estrella and Bradley areas. Gross alpha data included in Fugro's 2002 report are summarized in Table 5-7.

Table 5-7. Gross Alpha Concentration Ranges and Averages

| Hydrogeologic Subarea | Gross Alpha Maximum Concentration (pCi/L) | Gross Alpha Average Concentration (pCi/L) |
|---|---|---|
| Estrella | 31 | 20 |
| Shandon | 3 | 3 |
| Bradley | 23 | 2 |

Source: Fugro, 2002

No maps exist of the gross alpha distribution in the Subbasin. Sustainability projects and management actions implemented as part of this GSP are not anticipated to directly cause gross alpha radiation concentrations in groundwater in a well that would otherwise remain below the SMCL to increase above the SMCL.

### 5.6.5 Groundwater Quality Surrounding the Paso Robles Subbasin

Poor quality groundwater has been documented in wells that screen sediments and rocks below the Paso Formation as well as sediments and rocks surrounding the Subbasin. Based on limited observations, there is a concern that this poor quality groundwater may be drawn into wells in the Subbasin and degrade the groundwater quality if groundwater levels are allowed to fall too low. Groundwater levels must be maintained at elevations that prevent migration of poor quality groundwater from beneath or around the Subbasin.

# 6 WATER BUDGETS

This chapter summarizes the estimated water budgets for the Paso Robles Subbasin, including information required by the SGMA Regulations and information that is important for developing an effective plan to achieve sustainability. In accordance with the SGMA Regulations §354.18, the GSP should include a water budget for the basin that provides an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the basin, including historical, current, and projected water budget conditions, and the change in the volume of water stored. Water budgets should be reported in graphical and tabular formats, where applicable.

## 6.1 Overview of Water Budget Development

This chapter is subdivided into three sections: (1) historical water budgets, (2) current water budgets, and (3) future water budgets. Within each section, a surface water budget and groundwater budget are presented. Water budgets were developed using computer models of the Subbasin hydrogeologic conditions. Before presenting the water budgets, a brief overview of the models is presented. Appendix E provides additional information about the models and compares previously reported water budgets to water budgets developed for the GSP.

The water budgets reported herein are for the Subbasin defined in Section 1.2 and depicted on Figure 1-1. Prior to this GSP, water budgets reported for the Paso Robles groundwater Subbasin were often for a larger area that included area within Monterey County and the Atascadero Subbasin. Because the Subbasin boundary was redefined by DWR in 2019, the area within Monterey County and the Atascadero Subbasin are no longer part of the Subbasin and therefore are not considered in water budgets reported in the GSP. The revised Subbasin area results in water budget inflow components, outflow components, and estimates of sustainable yield that are different from previously reported water budgets.

Sustainable yield is defined in SGMA as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result." Actual sustainable yield will be determined once data show undesirable results have not occurred. Thus, the sustainable yield estimate will be revised in the future as new data become available from monitoring data that evaluate the presence or absence of undesirable results.

In accordance with Section 354.18 of the SGMA Regulations, one integrated groundwater budget was developed for the combined inflows and outflows for the two principal aquifers - Alluvial Aquifer and Paso Robles Formation Aquifer – for each water budget period. Groundwater is pumped from both aquifers for beneficial use. Available groundwater elevation data suggest that most of the historic reduction in groundwater storage has occurred in the Paso Robles Formation Aquifer. Due to limitations in available groundwater elevation data for the

Alluvial Aquifer, water budgets for this aquifer are uncertain. Monitoring of hydrologic conditions in both aquifers will be conducted in the future to ensure that aquifer-specific Sustainable Management Criteria are being achieved and undesirable results are being avoided.

Figure 6-1 presents a general schematic diagram of the hydrologic cycle. The water budgets include the components of the hydrologic cycle.

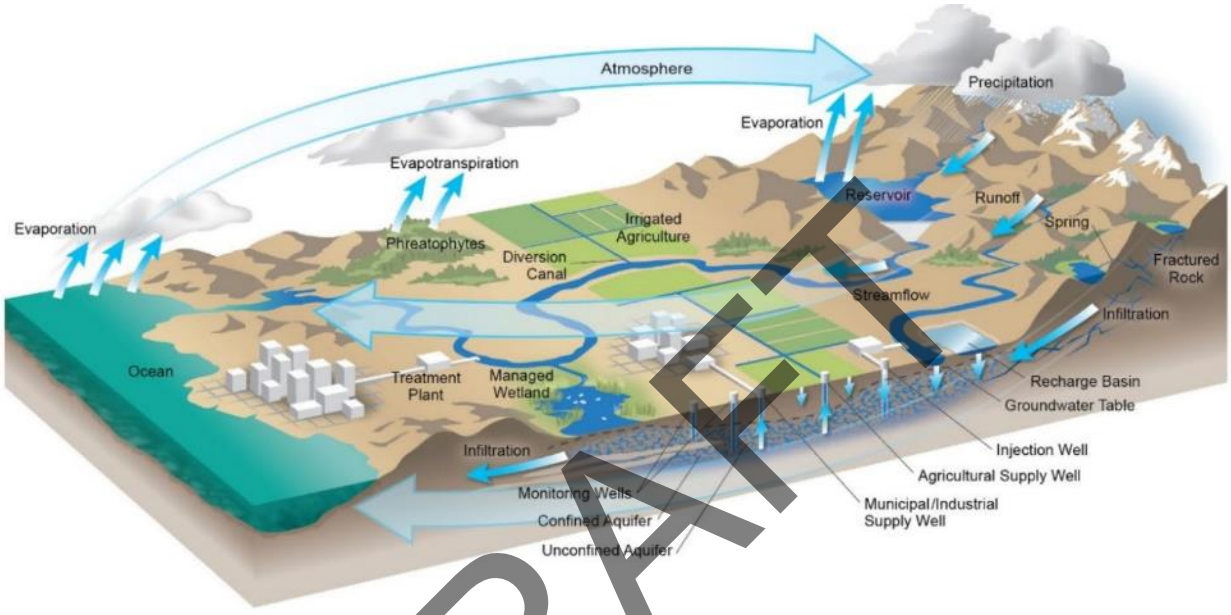



Figure 6-1. Hydrologic Cycle



A few components of the water budget can be measured, like streamflow at a gaging station or groundwater pumping from a metered well. Other components of the water budget are estimated, like recharge from precipitation or unmetered groundwater pumping. The water budget is an inventory of surface water and groundwater inflows (supplies) and outflows (demands) from the Subbasin, including:

Surface Water Inflows:

- Runoff of precipitation and reservoir releases into streams and rivers that enter the Subbasin from the surrounding watershed and that occurs inside the Subbasin
- Groundwater discharge to streams and rivers Surface Water Outflows:
- River flows exiting the Subbasin
- Percolation of streamflow to the groundwater system
- Evaporation (negligible compared to other surface water outflows)

Groundwater Inflows:

- Recharge from precipitation
- Subsurface inflow (including percolation of irrigation return flow, precipitation, and streamflow outside the Subbasin)
- Irrigation return flow (water not consumed by crops)
- Percolation of surface water from streams
- Infiltration of treated wastewater from disposal ponds

Groundwater Outflows:

- Evapotranspiration
- Groundwater pumping
- Discharge to streams and rivers
- Subsurface outflow to the next downgradient groundwater basin

The difference between inflows and outflows is equal to the change in storage.

## 6.2 Water Budget Data Sources and Basin Model

Water budgets for the Paso Robles Subbasin were estimated using an integrated system of three hydrologic models (collectively designated herein as the "basin model"), including:

1. A watershed model
2. A soil water balance model
3. A groundwater flow model

The groundwater model was originally developed by Fugro (2005). The watershed and soil water balance models were developed and integrated with an updated version of the groundwater model by Geoscience Support Services, Inc. (GSSI) (GSSI, 2014 and 2016). These models were developed for San Luis Obispo Flood Control and Water Conservation District (SLOFCWCD). The original models are documented in the following reports:

- Final Report, Paso Robles Groundwater Basin Study Phase II, Numerical Model Development, Calibration, and Application: Fugro, February 2005
- Paso Robles Groundwater Basin Model Update: Geoscience Support Services, Inc., December 2014

- Refinement of the Paso Robles Groundwater Basin Model and Results of Supplemental Water Supply Options Predictive Analysis: Geoscience Support Services, Inc., December 2016

The 2016 version of the basin model was updated for the GSP. The update included incorporating hydrologic data for the period 2012 through 2016 into the models. Appendix E includes a brief summary of the model update process, including:

- A summary of data sources used for the update (Table E-1)
- A summary of modifications made to the basin model to address computational refinements, data processing issues, and conceptual application of the model codes
- A comparison of the water budgets from the updated model and the original 2016 GSSI model.

The updated versions of the basin models are referred to herein collectively as the "GSP model".

Numerous sources of raw data were used to update the basin models for the GSP. Examples of raw data include reported pumping rates from the City of Paso Robles, precipitation data obtained from weather stations in the Subbasin, and crop acreage from the office of the San Luis Obispo County Agricultural Commissioner, among many others. Data sources are listed in Table E-1. Raw data were compiled, processed, and used to develop model input files. Model results were used to develop estimates of the individual inflow and outflow components of the surface water and groundwater budgets. Thus, all of the estimated flow components herein were extracted from the GSP model.



### 6.2.1 Model Assumptions and Uncertainty

The GSP model is based on available hydrogeologic and land use data from the past several decades, previous studies of Subbasin hydrogeologic conditions, and earlier versions of the basin models. The GSP model gives insight into how the complex hydrologic processes are operating in the Subbasin. During previous studies, available data and a peer-review process were used to calibrate the basin model to Subbasin hydrogeologic conditions. Results of the previous calibration process demonstrated that the model-simulated groundwater and surface water flow conditions were similar to observed conditions. The GSP model was not recalibrated. However, after updating it for the GSP, calibration of the model was reviewed and found to be similar to the previous model. Therefore, the GSP model was considered appropriate for the GSP.

Projections made with the GSP model have uncertainty due to limitations in available data and limitations from assumptions made to develop the models. Model uncertainty has been considered when developing and using the reported GSP water budgets for developing sustainability management actions and projects (Chapter 9).

During early implementation of the GSP, additional data will be collected to refine Subbasin understanding. These new data will be used to recalibrate the GSP model after the GSP is adopted. New hydrologic data and the calibrated model will be used to adaptively implement sustainability management actions, and possibly projects, to ensure that progress toward the sustainability goal is being achieved.

## 6.3 Historical Water Budget

The SGMA Regulations require that the historical surface water and groundwater budget be based on at least the most recent 10 years of data. For the Paso Robles Subbasin GSP, the period 1981 to 2011 was selected as the time period for the historical water budget (referred to as the historical base period) because it is long enough to capture typical climate variations, it corresponds to the period simulated in the basin model, and it ends at about the time the recent drought period began. Estimates of the surface water and groundwater inflows and outflows, and changes in storage for the historical base period are provided below.

### 6.3.1 Historical Surface Water Budget

The SGMA Regulations (§354.18) require development of a surface water budget for the GSP. The surface water budget quantifies important sources of surface water and evaluates their historical and future reliability. The water budget Best Management Practice (BMP) document states that surface water sources should be identified as one of the following (DWR, 2016):

- Central Valley Project
- State Water Project
- Colorado River Project
- Local imported supplies
- Local supplies

The Paso Robles Subbasin relies on two of these surface water source types: local imported supplies and local supplies.

#### 6.3.1.1 Historical Local Imported Supplies

During the historical base period, local imported water supplies were not used in the Subbasin. Use of local imported supplies began in 2014; information about these supplies is presented in Section 6.4 – Current Water Budget.

#### 6.3.1.2 Historical Local Supplies

Local surface water supplies include surface water flows that enter the Subbasin from precipitation runoff within the watershed, Salinas River inflow to the Subbasin (including releases from the Salinas Reservoir), Nacimiento River inflow to the Subbasin (including releases from Nacimiento Reservoir), and discharge of groundwater to streams from the Alluvial Aquifer. Table 6-1 summarizes the annual average, minimum, and maximum values for these inflows.

Table 6-1. Estimated Historical (1981-2011) Annual Surface Water Inflows to Subbasin

| Surface Water Inflow Component | Average | Minimum | Maximum |
|---|---|---|---|
| Nacimiento River Inflow to Subbasin | 214,400 | 5,500 | 734,100 |
| Precipitation Runoff within Watershed | 96,900 | 400 | 606,900 |
| Salinas River Inflow to Subbasin | 41,800 | 1,600 | 179,900 |
| Groundwater Discharge to Rivers and Streams from Alluvial Aquifer | 7,300 | 4,300 | 11,800 |
| Total | 360,400 | | |

Note: All values in AF



The estimated annual average total inflow from these sources over the historical base period is about 360,400 AF. The largest component of this average inflow is releases and flow in the Nacimiento River. While average inflows are large from the Nacimiento River, nearly all of this inflow leaves the Subbasin as surface water outflow because the length of the Nacimiento River within the Subbasin is short. The large difference between the minimum and maximum inflows reflects the difference between dry and wet years in the Subbasin.

### 6.3.1.3 Historical Surface Water Outflows

The estimated annual average total surface water outflow leaving the Subbasin as flow in the Salinas River, flow in the Nacimiento River, and percolation into the groundwater system over the historical base period is summarized in Table 6-2.

Table 6-2. Estimated Historical (1981-2011) Annual Surface Water Outflows from Subbasin

| Surface Water Outflow Component | Average | Minimum | Maximum |
|---|---|---|---|
| Salinas River Outflow from Subbasin | 119,100 | 5,300 | 646,300 |
| Nacimiento River Outflow from Subbasin | 214,400 | 5,500 | 734,000 |
| Percolation of Surface Water to Groundwater | 26,900 | 2,000 | 126,000 |
| Total | 360,400 | | |

Note: All values in AF

The estimated annual average total outflow from these sources over the historical base period is about 360,400 AF. Of this 360,400 AFY, approximately 26,900 AFY of the outflow is percolation from streams into the groundwater system. Of this 26,900 AFY of percolation, 7,300 AFY returns to streamflow as groundwater discharge.

#### 6.3.1.4 Historical Surface Water Budget

Figure 6-2 summarizes the historical water budget for the Subbasin.

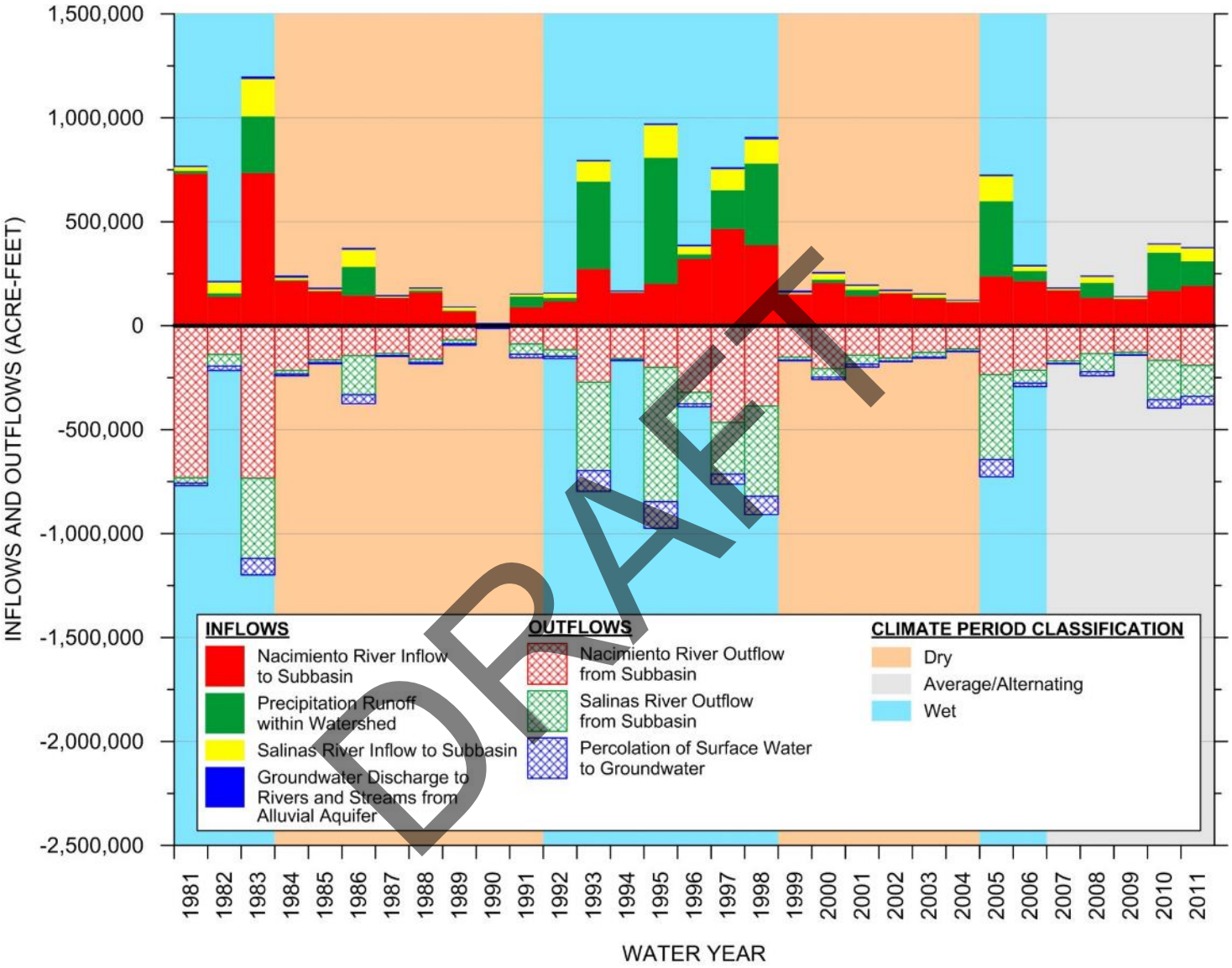



Figure 6-2. Historical (1981-2011) Surface Water Inflows and Outflows

Figure 6-2 shows the strong correlation between precipitation and streamflow in the Subbasin. In wet periods, shown with a blue background, surface water inflows and outflows are large. In contrast, in dry periods, shown with an orange background, surface water inflows and outflows are small. As shown on the graph, several years during the historical base period had total surface water inflows greater than 500,000 AFY. Assuming diversion permits could be obtained, future high flow years may provide opportunities to capture and use excess storm water as a new water supply in the Subbasin. This concept is discussed in more detail in Chapter 9 – Projects and Management Actions.

## 6.3.2 Historical Groundwater Budget

Groundwater supplied most of the water used in the Subbasin over the historical base period. The historical groundwater budget includes a summary of the estimated groundwater inflows, groundwater outflows, and change in groundwater in storage.

### 6.3.2.1 Historical Groundwater Inflows

Groundwater inflow components include streamflow percolation, agricultural irrigation return flow, deep percolation of direct precipitation, subsurface inflow into the Subbasin, wastewater pond percolation, and urban irrigation return flow. Estimated annual groundwater inflows for the historical base period are summarized in Table 6-3. Values reported in the table were estimated or derived from the GSP model using data sources reported in Table E-1 in Appendix E.



Table 6-3. Estimated Historical (1981-2011) Annual Groundwater Inflows to Subbasin

| Groundwater Inflow Component [1] | Average | Minimum | Maximum |
|---|---|---|---|
| Streamflow Percolation | 26,900 | 2,000 | 126,000 |
| Agricultural Irrigation Return Flow | 17,800 | 10,700 | 29,100 |
| Deep Percolation of Direct Precipitation | 12,000 | 300 | 45,400 |
| Subsurface Inflow into Subbasin | 10,100 | 4,900 | 14,300 |
| Wastewater Pond Percolation | 3,400 | 2,400 | 4,400 |
| Urban Irrigation Return Flow | 1,200 | 300 | 2,200 |
| Total | 71,400 | | |

Note: All values in AF

(1) Percolation from septic systems is not directly accounted for because it is subtracted from the total estimated rural-domestic pumping to simulate a net rural-domestic pumping amount.

For the historical base period, estimated total average groundwater inflow ranged from 25,700 AFY to 201,700 AFY, with an average inflow of 71,400 AFY. The largest groundwater inflow component is streamflow percolation, which accounts for approximately 38% of the total annual average inflow. Streamflow percolation, agricultural irrigation return flow, and deep percolation of direct precipitation account for approximately 79% of the estimated total annual average inflow to the Subbasin. The large difference between the minimum and maximum inflows from streamflow percolation and direct precipitation reflect the variations in precipitation over the historical base period.

#### 6.3.2.2 Historical Groundwater Outflows

Groundwater outflow components include total groundwater pumping from all water use sectors, groundwater discharge to streams and rivers from the Alluvial Aquifer, subsurface flow out of the Subbasin, and riparian evapotranspiration. Estimated annual groundwater outflows for the historical base period are summarized in Table 6-4.

Table 6-4. Estimated Historical (1981-2011) Annual Groundwater Outflow from Subbasin

| Groundwater Outflow Component | Average | Minimum | Maximum |
|---|---|---|---|
| Total Groundwater Pumping | 72,400 | 48,200 | 102,900 |
| Groundwater Discharge to Streams and Rivers from Alluvial Aquifer | 7,300 | 4,300 | 11,800 |
| Subsurface Flow Out of Subbasin | 2,600 | 2,300 | 3,000 |
| Riparian Evapotranspiration | 1,700 | 1,700 | 1,700 |
| Total | 84,000 | | |

Note: All values in AF



The largest groundwater outflow component from the Subbasin is groundwater pumping. Estimated annual groundwater pumping by water use sector for the historical base period is summarized in Table 6-5.

Table 6-5. Estimated Historical (1981-2011) Annual Groundwater Pumping by Water Use Sector from Subbasin

| Water Use Sector | Average | Minimum | Maximum |
|---|---|---|---|
| Agricultural | 65,300 | 40,600 | 95,800 |
| Municipal | 3,200 | 1,700 | 6,000 |
| Rural-Domestic [1] | 2,500 | 1,700 | 3,400 |
| Small Commercial | 1,400 | 1,200 | 1,700 |
| Total | 72,400 | | |

Notes: All values in AF

(1) Assumed to be net amount of pumping based on an analysis conducted by GSSI (2016). Net pumping was computed as total pumping amount minus septic return flow.

Agricultural pumping was the largest component of total groundwater pumping, accounting for about 90% of total pumping over the historical base period. Municipal, rural-domestic, and small commercial pumping account for 4%, 4%, and 2%, respectively, of total average annual pumping over the historical base period.

### 6.3.2.3 Historical Groundwater Budget and Changes in Groundwater Storage

Groundwater inflows and outflows for the historical base period are summarized on Figure 6-3. This graph shows groundwater inflow and outflow components for every year of the historical period. Inflow components are graphed above the zero line and outflow components are graphed below the zero line. Groundwater outflow by pumping (green bars) includes pumping from all water use sectors (Table 6-5).

Figure 6-4 shows annual and cumulative change in groundwater storage during the historical base period. Annual increases in groundwater storage are graphed above the zero line and annual decreases in groundwater storage are graphed below the zero line. The red line shows the cumulative change in groundwater storage over the historical base period.

The GSP uses the best available information to quantify the water budget for the Subbasin while recognizing the limitations inherent from existing data gaps. The water budget identifies and tracks changing inflows and outflows to the Subbasin and therefore is an important tool for local water resources management. The GSP contains a plan to gather more and better data in the future, which will be used to further refine the water budget. The GSP is designed to adapt to an increasing data set and expanding understanding of Subbasin conditions and water budget.

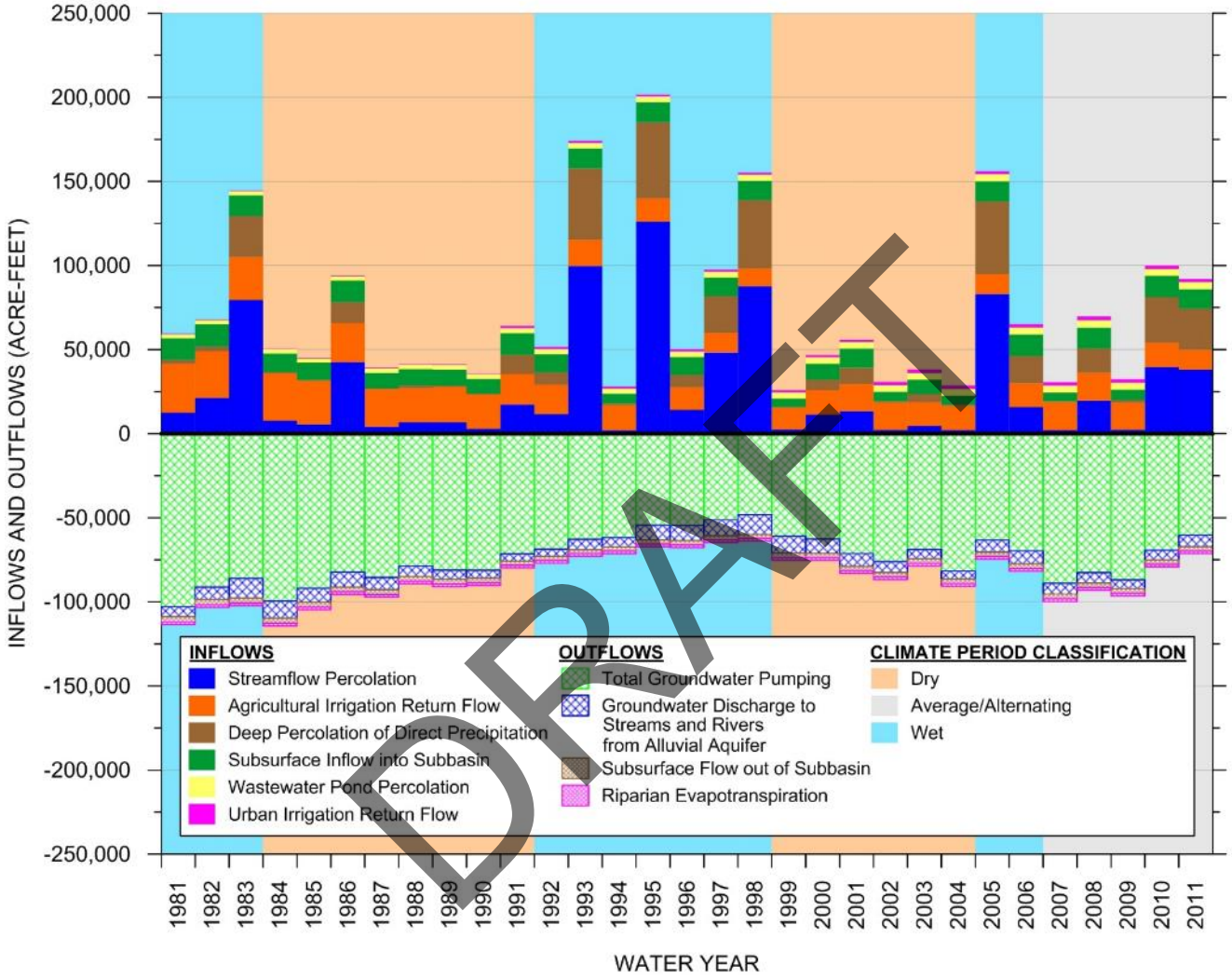



Figure 6-3. Historical (1981-2011) Groundwater Inflows and Outflows

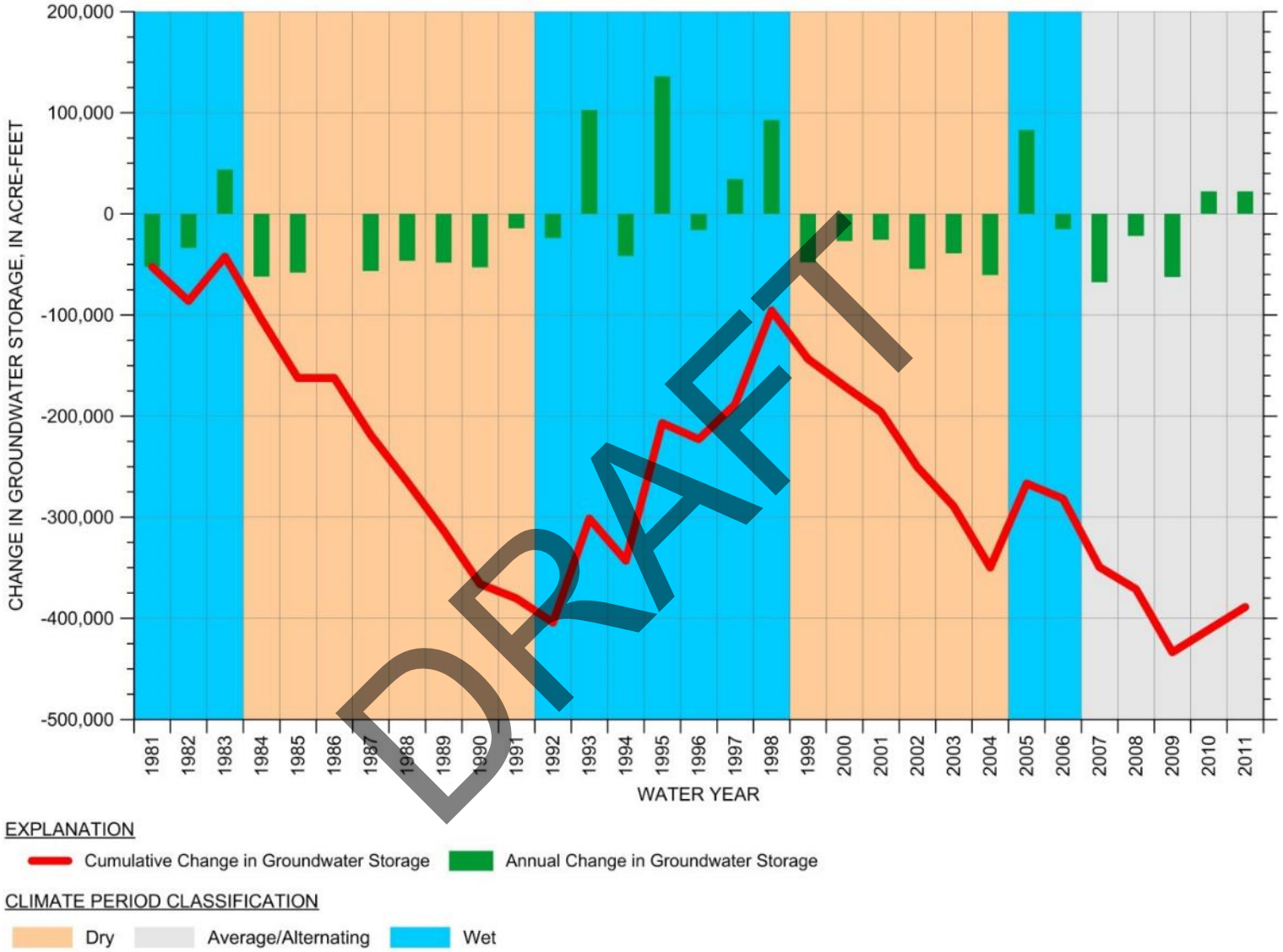



Figure 6-4. Historical (1981-2011) Annual and Cumulative Change in Groundwater Storage

The historical groundwater budget is strongly influenced by the amount of precipitation. During the historical base period, dry conditions prevailed from 1984 through 1991 and 1999 through 2004, as depicted by the orange areas on Figure 6-3 and Figure 6-4. During these dry periods, the amount of recharge and streamflow percolation was relatively low and the amount of pumping was relatively high. The net result was a loss of groundwater from storage. In contrast, wet conditions prevailed in the early 1980s, 1992 through 1998, and 2005 and 2006, as shown by blue areas on Figure 6-3 and Figure 6-4. During these wet periods, the amount of recharge and streamflow percolation was relatively high and the amount of pumping was relatively low. The net result was a gain of groundwater in storage. The period from 2007 through 2011 had generally alternating years of average precipitation. During this period, the amount of recharge and streamflow percolation was average and the amount of groundwater pumping was relatively high. The net result was a loss of groundwater from storage.

The historical groundwater budget is also influenced by the amount of groundwater pumping. Over the historical base period, the total amount of groundwater pumping showed two distinct trends (Figure 6-3). From the early 1980s through the late 1990s, groundwater pumping declined from about 100,000 AFY to about 50,000 AFY. In general, this decline in groundwater pumping corresponded to a period when irrigation of alfalfa and pasture acreage declined and irrigated vineyard acreage increased (Fugro, 2002). The transition from alfalfa and pasture to vineyard resulted in a net decrease in groundwater pumping because the irrigation demand of vineyards is less than alfalfa and pasture. This decrease in pumping contributed to the increase in groundwater in storage during the 1990s. After the late 1990s, groundwater pumping increased to about 100,000 AFY in 2007, largely due to continued expansion of irrigated vineyard acreage. The increase in groundwater pumping during this period contributed to the reductions in groundwater in storage that occurred after the late 1990s.



Over the 31 year historical base period, a net loss of groundwater storage of about 390,000 AF occurred. The annual average groundwater storage loss was approximately 12,600 AF. The average groundwater storage loss of 12,600 AFY is about 18% of the average total groundwater inflow of 71,400 AFY (Table 6-3) and about 15% of the average total groundwater outflow of 84,000 AFY (Table 6-4).

#### 6.3.2.4 Historical Sustainable Yield of the Subbasin

The computed long-term depletion of groundwater in storage indicates that total groundwater outflow exceeded the total inflow in the Subbasin from 1981 through 2011; this depletion is consistent with observed groundwater elevation declines (for example, see groundwater elevation change maps and hydrographs in Chapter 5). As summarized in Table 6-5, total groundwater pumping averaged approximately 72,400 AFY during the historical base period.

In accordance with Section 354.18(b)(7) of the SGMA Regulations, a sustainable yield for the Subbasin for the historical base period was estimated. This estimate was computed by subtracting the average groundwater storage deficit of 12,600 AFY from the total average amount of groundwater pumping. In this case, the historical sustainable yield of the Subbasin for the historical base period is about 59,800 AFY. This estimate of sustainable yield reflects historical climate, hydrologic and water resource conditions and provides insight into the amount of groundwater pumping that could be sustained to maintain a balance between groundwater inflows and outflows. However, it differs from estimates of future sustainable yield, which will be developed for representative average future climate and hydrologic conditions and will be used to plan management actions and projects needed to avoid undesirable results under SGMA.

## 6.4 Current Water Budget

The SGMA Regulations require that the current surface water and groundwater budget be based on the most recent hydrology, water supply, water demand, and land use information. For the Paso Robles Subbasin GSP, the period 2012 to 2016 was selected as the time period for the current water budget. The current water budget period corresponds to a drought period when the average annual precipitation averaged about 62% of the historical average annual precipitation and the average streamflow percolation was 10% of the historical average percolation. As a result, the current water budget period represents a more extreme condition in the Subbasin and is not appropriate for sustainability planning in the Subbasin. Estimates of the surface water and groundwater inflow and outflow, and changes in storage for the current water budget period are provided below.



### 6.4.1 Current Surface Water Budget

The current surface water budget quantifies important sources of surface water. Similar to the historical surface water budget, the current surface water budget includes two surface water source types: local imported supplies and local supplies.

#### 6.4.1.1 Current Local Imported Supplies

As reported in the City of Paso Robles' 2016 Urban Water Management Plan, the most significant source of imported surface water in the Paso Robles Subbasin is the City's entitlement for Nacimiento water through a SLOFCWCD contract (Todd Groundwater, 2016). The total Nacimiento entitlement is about 6,500 AFY. Use of the Nacimiento water by the City began in 2014. Recently the Subbasin has begun to receive relatively small deliveries of up to 100 AFY of State Water Project water to Shandon CSA 16 for residential use. Currently, the City can treat up to about 2,700 AFY of Nacimiento water and deliver it for potable use (Todd Groundwater, 2016). Approximately another 270 AFY of Nacimiento water can be discharged to the Salinas River and recovered by a dedicated recovery well. In times of drought, Nacimiento

water can be discharged to the Salinas River to improve reliability of the City's river recovery wells.

Only a small portion of the total water demand in the Subbasin during the current water budget period was met by the City's entitlement of imported surface water from Nacimiento Reservoir. According to records provided by the City, the amounts of Nacimiento water used in 2014, 2015, and 2016 were 227, 622, and 799 AF, respectively. The limited use is not an indication of the reliability of Nacimiento water, but rather a choice by the City regarding how to operate its water supply portfolio. Nacimiento water is expected to be a stable water supply given the favorable contractual priority of SLOFCWCD for the reservoir supply (Todd Groundwater, 2016).

Given the limited amount of imported Nacimiento water used compared to the amount of other local surface water supplies, the Nacimiento water supply is not aggregated into the surface water budget discussed below.

### 6.4.1.2 Current Local Supplies

Local surface water supplies include surface water flows that enter the Subbasin from precipitation runoff within the watershed, Salinas River inflow to the Subbasin (including releases from the Salinas Reservoir), Nacimiento River inflow to the Subbasin (including releases from Nacimiento Reservoir), and discharge of groundwater to streams from the Alluvial Aquifer. Table 6-6 summarizes the annual average, minimum, and maximum values for these inflows.



Table 6-6. Estimated Current (2012-2016) Annual Surface Water Inflows to Subbasin

| Surface Water Inflow Component | Average | Minimum | Maximum |
|---|---|---|---|
| Precipitation Runoff | 2,900 | 1,300 | 7,500 |
| Salinas Reservoir Releases to Salinas River | 6,600 | 5,200 | 8,500 |
| Nacimiento Reservoir Releases | 73,200 | 29,400 | 163,600 |
| Groundwater Discharge to Rivers and Streams | 4,300 | 3,000 | 6,100 |
| Total | 87,000 | | |

Note: All values in AF

The estimated average total inflow from both precipitation runoff and reservoir releases over the current water budget period was approximately 87,000 AFY, or 25% of the 360,400 AFY over the historical base period. Approximately 84% of the local surface water supply was from Nacimiento Reservoir releases, most of which flows out of the Subbasin as surface flow. As a result, Nacimiento River flows do not result in appreciable amounts of surface water percolation

to groundwater. If Nacimiento releases are not considered in the surface water inflows, surface water inflows during the current water budget period were less than 10% of the surface water inflows for the historical base period. The substantial reduction in surface water inflows reflects the drought conditions that prevailed during the current water budget period.

#### 6.4.1.3 Current Surface Water Outflows

The estimated annual average, minimum, and maximum surface water outflow leaving the Subbasin as flow in the Salinas River, flow in the Nacimiento River, and percolation into the groundwater system over the current base period is summarized in Table 6-7.

Table 6-7. Estimated Current (2012-2016) Annual Surface Water Outflows from Subbasin

| Surface Water Outflow Component | Average | Minimum | Maximum |
|---|---|---|---|
| Salinas River Flow | 11,100 | 8,500 | 14,100 |
| Nacimiento River Flow | 73,200 | 29,400 | 163,300 |
| Percolation of Surface Water to Groundwater | 2,700 | 2,100 | 4,100 |
| Total | 87,000 | | |

Note: All values in AF

.

Reductions in surface water outflow for the current water budget period were similar to those reported above for the surface water inflows.

#### 6.4.1.4 Current Surface Water Budget

Figure 6-5 summarizes the current surface water budget for the Subbasin. Figure 6-5 is on the same scale as Figure 6-2 and shows the effects of the drought conditions that prevailed during the period 2012 through 2016. During this period, precipitation was well below average, which resulted in very little surface water flow.

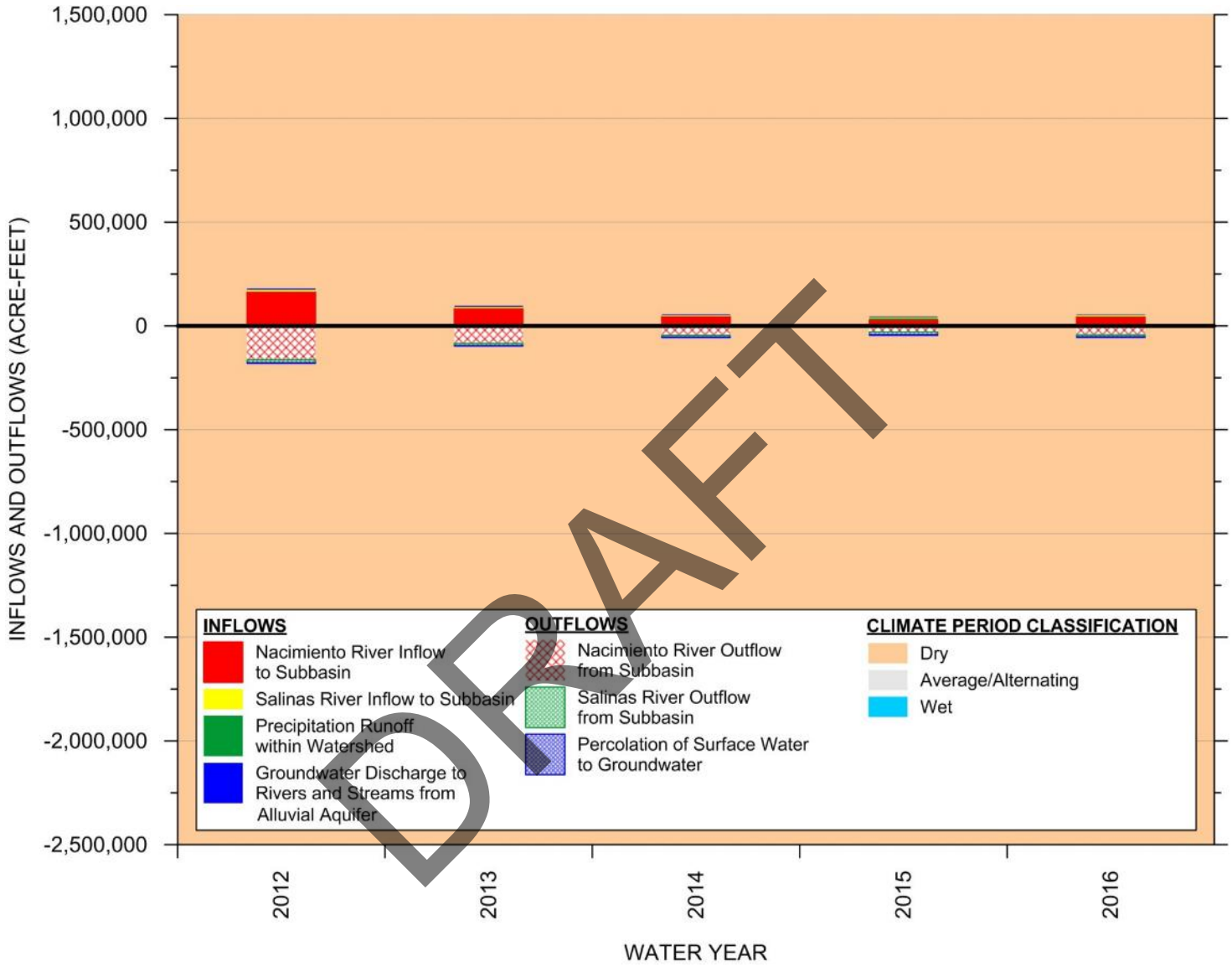



Figure 6-5. Current (2012 – 2016) Surface Water Inflows and Outflows

## 6.4.2 Current Groundwater Budget

Groundwater supplied most of the water used in the basin during the current water budget period. The current water budget includes a summary of the estimated groundwater inflows, groundwater outflows, and change in groundwater in storage.

### 6.4.2.1 Current Groundwater Inflows

Groundwater inflow components include streamflow percolation, agricultural irrigation return flows, deep percolation of direct precipitation, subsurface inflow into the Subbasin, wastewater pond percolation, and urban irrigation return flow. Estimated annual groundwater inflows for the current water budget period are summarized in Table 6-8.

Table 6-8. Estimated Current (2012-2016) Annual Groundwater Inflows to Subbasin

| Groundwater Inflow Component [1] | Average | Minimum | Maximum |
|---|---|---|---|
| Streamflow Percolation | 2,700 | 2,100 | 4,100 |
| Agricultural Irrigation Return Flow | 13,100 | 12,400 | 13,800 |
| Deep Percolation of Direct Precipitation | 1,400 | 500 | 3,800 |
| Subsurface Inflow into Subbasin | 4,900 | 4,400 | 6,000 |
| Wastewater Pond Percolation | 4,700 | 4,600 | 4,900 |
| Urban Irrigation Return Flow | 2,100 | 2,000 | 2,200 |
| Total | 28,900 | | |

Note: All values in AF

(1) – Percolation from septic systems is not directly accounted for because it is subtracted from the total estimated rural-domestic pumping to simulate a net rural-domestic pumping amount.



For the current water budget period, estimated total average groundwater inflow ranged from 27,500 AFY to 33,100 AFY, with an average inflow of 28,900 AFY. Notable observations from the summary of groundwater inflows for the current water budget period included:

- Average total inflow during the current water budget period was about 40% of the historical base period.
- Unlike the historical base period, when the largest inflow component was streamflow percolation, the largest groundwater inflow component for the current water budget is

agricultural irrigation return flow, which accounts for approximately 45% of the total average inflow.

- The relatively small difference between the minimum and maximum inflows reflects the drought condition that prevailed during the current water budget period, when precipitation and runoff were continuously low.
- Total annual average streamflow percolation in the current water budget period was approximately 10% of the streamflow percolation in the historical base period. This reflects the very low streamflows during the drought. The low streamflows had a significant impact on the groundwater basin because streamflow percolation was the most significant source of groundwater recharge during the historical period.
- Total annual average recharge from direct precipitation for the current water budget period was about 12% of the recharge from direct precipitation for the historical base period.

### 6.4.2.2 Current Groundwater Outflows

Groundwater outflow components include total groundwater pumping from all water use sectors, groundwater discharges to streams and rivers from the Alluvial Aquifer, subsurface flow out of the Subbasin, and riparian evapotranspiration. Estimated annual groundwater outflows for the current water budget period are summarized in Table 6-9.



Table 6-9. Estimated Current (2012-2016) Annual Groundwater Outflow from Subbasin

| Groundwater Outflow Component | Average | Minimum | Maximum |
|---|---|---|---|
| Total Groundwater Pumping | 85,800 | 73,900 | 101,200 |
| Discharge to Streams and Rivers from Alluvial Aquifer | 4,300 | 3,000 | 6,100 |
| Subsurface Flow Out of Subbasin | 2,500 | 2,300 | 2,600 |
| Riparian Evapotranspiration | 1,700 | 1,700 | 1,700 |
| Total | 94,300 | | |

Note: All values in AF

For the current water budget period, estimated total average groundwater outflows ranged from 81,200 AFY to 109,300 AFY, with an average annual outflow of 94,300 AF. Notable observations from a comparison of the historical (Table 6-4) and current groundwater outflows include:

- Total annual average groundwater pumping was about 19% higher during the current water budget period.
- Groundwater discharge from the Alluvial Aquifer to streams was about 40% lower during the current water budget period, reflecting lower precipitation and lower groundwater levels.

The largest groundwater outflow component from the Subbasin in the current water budget period is pumping. Estimated annual groundwater pumping by water use sector for the current water budget period is summarized in Table 6-10.

Table 6-10. Estimated Current (2012-2016) Annual Groundwater Pumping by Water Use Sector

| Water Use Sector | Average | Minimum | Maximum |
|---|---|---|---|
| Agricultural | 77,000 | 65,600 | 92,300 |
| Municipal | 3,800 | 3,200 | 4,300 |
| Rural-Domestic [1] | 3,500 | 3,400 | 3,600 |
| Small Commercial | 1,500 | 1,500 | 1,500 |
| Total | 85,800 | | |

Note: All values in AF

(1) Assumed to be net amount of pumping based on an analysis conducted by GSSI (2016). Net pumping was computed as total pumping amount minus septic return flow.



For the current water budget period, estimated total average groundwater pumping ranged from 73,900 AFY to 101,200 AFY, with an average pumping of 85,800 AFY. Agricultural pumping was the largest component of total groundwater pumping and accounts for about 90% of total pumping during the current water budget period. Municipal, rural-domestic, and small commercial pumping account for 4%, 4%, and 2%, respectively, of total average pumping during the current water budget period.

Notable observations from a comparison of the historical (Table 6-5) and current total annual average groundwater pumping include:

- Total annual average agricultural groundwater pumping was about 18% higher during the current water budget period when compared to the historical period (increase of 11,700 AFY)

- Total annual average rural-domestic groundwater pumping was about 40% higher during the current water budget period when compared to the historical period (increase of 1,000 AFY)

#### 6.4.2.3 Current Groundwater Budget and Change in Groundwater Storage

Groundwater inflows and outflows for the current base period are summarized on Figure 6-6. This graph shows inflow and outflow components for every year of the current water budget period. Inflow components are graphed above the zero line and outflow components are graphed below the zero line. Groundwater outflow by pumping (green bars) includes pumping from all water use sectors (Table 6-10).

Figure 6-7 shows annual and cumulative change in groundwater storage during the current water budget period. Annual decreases in groundwater storage are graphed below the zero line. The red line shows the cumulative change in groundwater storage over the historical base period.

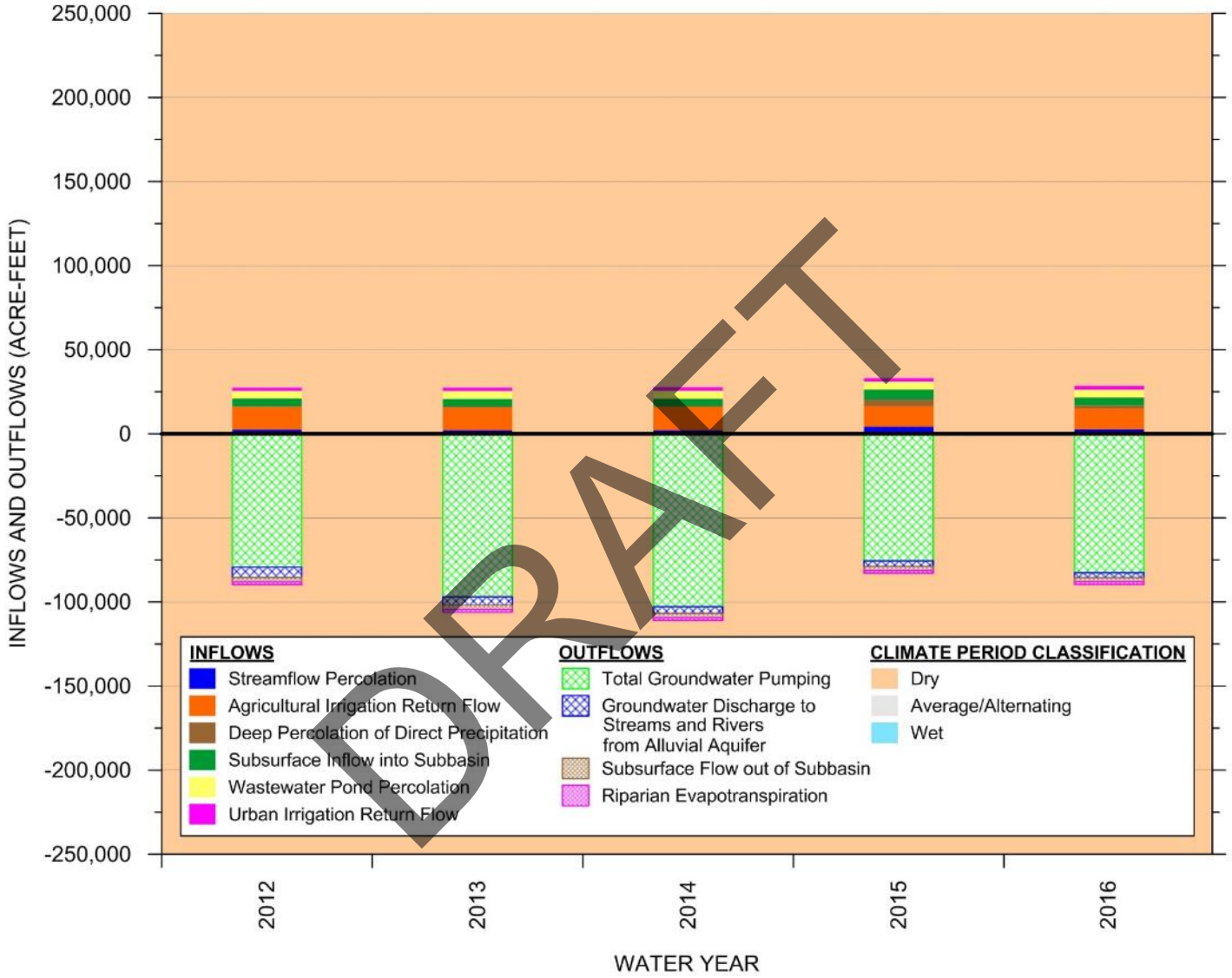



Figure 6-6. Current (2012-2016) Groundwater Inflows and Outflows

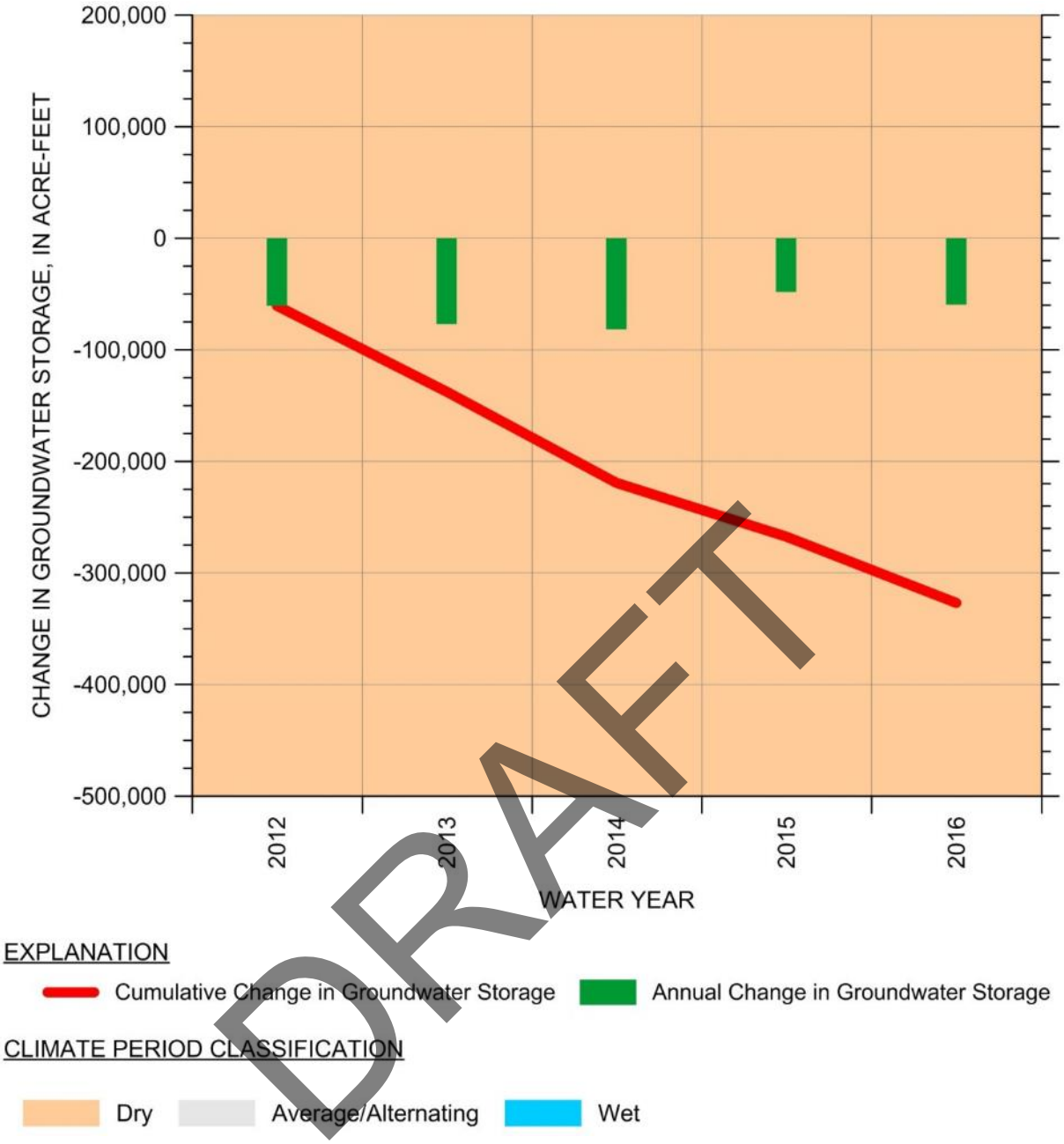





Figure 6-7. Current (2012-2016) Annual and Cumulative Change in Groundwater Storage

The current groundwater budget is strongly influenced by the drought; total groundwater pumping shows no trend over the five years that might be related to any continuing land use change. During the current water budget period, the amounts of recharge and streamflow percolation were very low and the average amount of pumping was slightly greater than the historical water budget period. Over the five-year current water budget period, an estimated net loss of groundwater in storage of about 327,000 AF occurred (Figure 6-7). The annual average groundwater storage loss, or the difference between outflow and inflow to the Subbasin, was approximately 65,400 AF.

#### 6.4.2.4 Current Sustainable Yield

The substantial short-term depletion of groundwater in storage indicates that total groundwater outflows exceeded the total inflows over the current water budget period. As summarized in Table 6-9, total groundwater pumping averaged approximately 85,800 AFY during the current period. The sustainable yield of the Subbasin can be estimated by subtracting the average groundwater storage deficit of 65,400 AFY from the total average amount of groundwater pumping. For the current water budget, the sustainable yield for the Subbasin is about 20,400 AFY. Due to the drought conditions, the estimated groundwater storage loss and low sustainable yield for the current water budget period are not appropriate for long-term sustainability planning.

## 6.5 Future Water Budget

SGMA Regulations require the development of a future surface water and groundwater budget to estimate future baseline conditions of supply, demand, and aquifer response to GSP implementation. The future water budget provides a baseline against which management actions will be evaluated over the GSP implementation period from 2020 to 2040. Future water budgets were developed using the GSP model.

In accordance with Section 354.18 (c)(3)(A) of the SGMA Regulations, the future water budget should be based on 50 years of historical precipitation, evapotranspiration, and streamflow information. The GSP model includes only 31 years of historical precipitation, evapotranspiration, and streamflow data. Therefore, the future water budget is based on 31 years of historical data rather than 50 years of historical data. It is believed that this time period is representative and is the best available information for groundwater sustainability planning purposes.

### 6.5.1 Assumptions Used in Future Water Budget Development

Assumptions about future groundwater supplies and demands are described in the following subsections. An overarching assumption is that any future increases in groundwater use within

the Subbasin will be offset by equal reductions in groundwater use in other parts of the Subbasin, or in other words, groundwater neutral through implementation of the GSP.

Future water budgets were developed using the GSP model. During the update process for the GSP model, all model components (e.g., groundwater pumping) of the entire original 2016 GSSI model area were updated, including components with Monterey County and the Atascadero Subbasin. However, information provided for the future water budget only pertains to the GSP Subbasin (Figure 1-1), thus do not include areas within Monterey County or the Atascadero Subbasin.

#### 6.5.1.1 Future Non-Agricultural Water Demand Assumptions

Future non-agricultural water demands were estimated for the City of Paso Robles (City) and San Miguel Community Services District (SMCSD) based on the following available planning documents:

- Paso Robles 2015 Urban Water Management Plan (UWMP) (Todd Groundwater, 2016)
- San Miguel Community Services District Water & Wastewater Master Plan Update (Monsoon Consultants, 2017)

Projections of the City's groundwater demand were obtained from the City's UWMP. A portion of the City's future groundwater demand will be offset by imported Nacimiento water. The projected water demand for SMCSD was assumed to be satisfied solely by groundwater. Projections for non-agricultural water demand for entities other than those listed above, such as residential wells and smaller commercial water users, were not available. Water demand for these users was assumed to remain constant into the future to be consistent with the overarching assumption that future growth will be groundwater neutral through the implementation of this GSP.

Total non-agricultural groundwater demand in the Subbasin is projected to increase from about 8,500 AFY in 2020 to about 8,700 AFY in 2040.

#### 6.5.1.2 Future Wastewater Discharge Assumptions

Discharge of treated wastewater to the Salinas River provides a source of recharge to the Alluvial Aquifer. Rates of future wastewater discharge were estimated as a percentage of total water demand. Wastewater discharge as a percentage of water demand was calculated separately for each water provider. Projected annual wastewater discharge for San Miguel CSD is about 200 AFY, and projected annual wastewater discharge for the City of Paso Robles increases from about 2,900 AFY in 2020 to about 3,600 AFY by 2040. If the future wastewater discharge amounts differ from the estimated values cited above the GSP model and future water budgets will be adjusted during implementation to account for these changes.

#### 6.5.1.3 Future Crop Acreage and Irrigation Efficiency Assumptions

In accordance with Section 354.18 (c)(3)(B) of the SGMA Regulations, the most recently available land use (in this case, crop acreage) and crop coefficient information should be used as the baseline condition for estimating future water demand. For the GSP, the 2016 crop acreage data obtained from the office of the San Luis Obispo County Agricultural Commissioner were used. These crop acreage data were the most recently available. To account for irrigation efficiency in the future water budget, the reported crop coefficient information from GSSI (GSSI, 2016) was used.

Projections for agricultural water demand are not available. Agricultural water demand was assumed to remain constant into the future to be consistent with the overarching assumption that future growth will be groundwater neutral through the implementation of this GSP.

#### 6.5.1.4 Future Climate Assumptions

The SGMA Regulations require incorporating future climate estimates into the future water budget. To meet this requirement, DWR developed an approach for incorporating reasonably expected, spatially gridded changes to monthly precipitation and reference ETo (DWR, 2018). The approach for addressing future climate change developed by DWR was used in the future water budget modeling for the Subbasin. The changes are presented as separate monthly change factors for both precipitation and ETo, and are intended to be applied to historical time series within the climatological base period through 2011. Specifically, precipitation and ETo change factors were applied to historical climate data for the period 1981 to 2011 for modeling the future water budget.

DWR provides several sets of change factors representing potential climate conditions in 2030 and 2070. DWR recommends using the 2030 change factors to evaluate conditions over the GSP implementation period (DWR, 2018). Consistent with DWR recommendations, datasets of monthly 2030 change factors for the Paso Robles area were applied to precipitation and ETo data from the historical base period to develop monthly time series of precipitation and ETo, which were then used to simulate future hydrology conditions.

### 6.5.2 Modifications to Modeling Platform to Simulate Future Conditions

The existing modeling platform was modified to simulate future conditions, and the results of these simulations are used to develop the future water budget.

#### 6.5.2.1 Modification to Soil Water Balance Model

The soil water balance model operates on a daily time scale and tracks daily variations in soil water storage for different agricultural areas in the Paso Robles Subbasin. For consistency with

the monthly climate change factors provided by DWR, the daily model was used to develop monthly soil water balance calculations. These calculations compute irrigation demand as the residual crop evapotranspiration demand unsatisfied by effective precipitation.

These calculations use monthly precipitation and ETo, rescaled by the monthly climate change factors provided by DWR, and the same monthly crop coefficients used in the historical water budget analysis. Empirical relationships were developed to account for soil moisture carryover from the winter into the spring based on results from the daily soil water balance model.

Monthly applied irrigation water was determined over the future base period from computed monthly crop demand and the crop-specific irrigation efficiencies. Agricultural irrigation return flow is then computed as the difference between the applied irrigation water and the crop demand. Results were then averaged to provide average monthly rates of applied irrigation water and irrigation return flow that would be expected under future climate conditions.

#### 6.5.2.2 Modifications to the Watershed Model

The watershed model operates on a daily time scale and simulates streamflow and infiltration of direct precipitation. The watershed model was modified to account for climate change by rescaling daily precipitation and ETo with the monthly climate change factors provided by DWR. The watershed model was then re-run using the modified precipitation and ETo values.

Results from the modified historical base period simulation were then averaged to provide average monthly rates of infiltration of direct precipitation and streamflow under future climate conditions.

#### 6.5.2.3 Modifications to the Groundwater Model

The groundwater model operates at a semi-annual time scale, with stress periods representing six-month periods. The groundwater model was extended and modified to simulate the period 2020 to 2040. Starting groundwater levels for the future simulation were set to groundwater levels at the end of Water Year (WY) 2016, extracted from the updated groundwater model.

Future groundwater recharge components were computed using the modified soil water balance model and watershed model, as described above. Future streamflow generated both inside and outside the Subbasin was computed using the modified watershed model.

Future agricultural groundwater pumping was computed based on the modified soil water balance model. Future non-agricultural groundwater pumping was determined based on water demand assumptions described in Section 6.4.1.1.

Future groundwater recharge, streamflow, and agricultural pumping are specified in the groundwater model as repeating average time-series, based on average monthly calculation of

applied irrigation water, excess irrigation water, recharge of direct precipitation, and streamflow. This approach was adopted to simplify the future water budget and allow reporting of average future conditions accounting for climate change. Future non-agricultural pumping and wastewater return flows are the only inputs to the groundwater model that exhibit a long-term trend over the implementation period.

## 6.5.3 Projected Future Water Budget

Future surface water and groundwater budgets were projected.

### 6.5.3.1 Future Surface Water Budget

The future surface water budget includes average inflows from local imported supplies, average inflows from local supplies, average stream outflows, and average stream percolation to groundwater. Average future local imported supplies are estimated to be approximately 1,400 AFY. Table 6-11 summarizes the average local supply components of projected surface water budget.

Table 6-11. Projected Future Annual Average Surface Water Budget

| Surface Water Budget Component | Flow Amount |
|---|---|
| **Inflows** | |
| Nacimiento River Inflow to Subbasin | 214,300 |
| Precipitation Runoff within Watershed | 84,800 |
| Salinas River Inflow to Subbasin | 39,300 |
| Groundwater Discharge to Rivers and Streams | 4,600 |
| **Total** | 343,000 |
| **Outflows** | |
| Nacimiento River Outflow from Subbasin | 214,300 |
| Salinas River Outflow from Subbasin | 99,900 |
| Percolation of Surface Water to Groundwater | 28,800 |
| **Total** | 343,000 |

Note: All values in AF



### 6.5.3.2 Future Groundwater Budget

Projected groundwater budget components are computed using the modified groundwater flow model to simulate average conditions over the implementation period.

Table 6-12 summarizes projected annual groundwater inflows. In contrast to the historical groundwater budget which accounted for month-to-month variability, the projected groundwater budget is based on average monthly inflows. Therefore, variability in simulated groundwater budget components is minor, and minimum and maximum values are not included in Table 6-12.

Table 6-12. Projected Future Annual Groundwater Inflow to Subbasin

| Groundwater Inflow Component | Average |
|---|---|
| Streamflow Percolation | 28,800 |
| Agricultural Irrigation Return Flow | 14,500 |
| Deep Percolation of Direct Precipitation | 12,600 |
| Subsurface Inflow into Subbasin | 8,300 |
| Wastewater Pond Leakage | 3,500 |
| Urban Irrigation Return Flow | 1,800 |
| Total | 69,500 |

Note: All values in AF



The total average annual groundwater inflow is 1,900 AF less during the future period than during the historical base period. Annual agricultural irrigation return flow is the inflow component with the most significant reduction – about 3,300 AF – between the historical base period and future water budget period. Reduction in agricultural irrigation return flow is due partly to changes in historical cropping patterns and partly to improvements in vineyard irrigation efficiency.

Table 6-13 summarizes projected annual groundwater outflows.

Table 6-13. Projected Future Annual Groundwater Outflow from Subbasin

| Groundwater Outflow Component | Average |
|---|---|
| Total Groundwater Pumping | 74,800 |
| Discharge to Streams and Rivers from Alluvial Aquifer | 4,600 |
| Groundwater Flow Out of Subbasin | 2,100 |
| Riparian Evapotranspiration | 1,700 |
| Total | 83,200 |

Note: All values in AF

The total average annual groundwater outflow is estimated to be 800 AF less during the future period than during the historical base period. Future total annual groundwater pumping is projected to increase by about 2,400 AF compared to the historical base period. Concurrently, total annual discharge to streams and rivers and total annual groundwater outflow from the Subbasin are projected to decrease by about 2,700 AF and 500 AF, respectively.

### 6.5.3.3 Future Sustainable Yield

The projected future groundwater budget shows a long-term imbalance between inflows and outflows, with projected groundwater inflows of about 69,500 AFY and projected groundwater outflows of about 83,200 AFY. The projected future imbalance indicates an average annual decrease in groundwater in storage of 13,700 AFY. The projected future sustainable yield of the Subbasin was estimated by subtracting the average groundwater storage deficit of 13,700 AFY from the total projected future average amount of groundwater pumping of 74,800 AFY. In this case, the future sustainable yield for the Subbasin period is estimated to be approximately 61,100 AFY. The estimated future sustainable yield is similar to the estimated sustainable yield for the historic base period. This similarity indicates that potential future changes in climate are not projected to have a substantial impact on the amount of groundwater that can be sustainably used compared to historical conditions. The calculated sustainable yield of the Subbasin is a reasonable estimate of the long-term pumping that can be maintained without producing undesirable results. The definitive sustainable yield can only be determined once data show undesirable results have not occurred. The sustainable yield estimate will be revised in the future as new data become available from monitoring data that evaluate the presence or absence of undesirable results.

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