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DATE: July 2, 2021 **PROJECT #:** 9090.1301

TO: Ad Hoc Sustainable Groundwater Planning Advisory Committee (GSU22 Committee)

CC: Brian Lockwood, P.G., C.Hg. and Casey Meusel, Pajaro Valley Water Management Agency (PV Water)

FROM: Cameron Tana, P.E. (M&A), Patrick Wickham (M&A), and Paul Friedlander, P.E. (Carollo)

PROJECT: Basin Management Plan: Groundwater Sustainability Update 2022 (GSU22)

SUBJECT: Sustainability Status in Pajaro Valley Subbasin: Implementation Status of Projects and Management Actions and Progress for Groundwater in Storage and Seawater Intrusion Indicators

SUMMARY OF PROPOSED FIRST RECOMMENDATION FOR SUSTAINABILITY STATUS

Based on the analysis of observed data, the GSU22 Committee recommends that the PV Water Board accepts the conclusion that while 2014 Basin Management Plan Update (BMP) projects and management actions are not meeting planned yields, BMP implementation has helped increase groundwater in storage and reduce rate of seawater intrusion.

INTRODUCTION

The Pajaro Valley Water Management Agency (PV Water) submitted a Groundwater Sustainability Plan (GSP) Alternative for the Pajaro Valley Subbasin (Basin) on December 31, 2016, to meet requirements under the Sustainable Groundwater Management Act (SGMA). The California Department of Water Resources (DWR) approved the GSP Alternative on July 17, 2019. The 2014 Basin Management Plan Update (BMP) (Carollo, 2014) serves as the primary document of the GSP alternative. The BMP presents projects and management actions to achieve sustainability in the Basin with the focus on eliminating groundwater overdraft to address reduced groundwater in storage and seawater intrusion, 2 of the 5 SGMA sustainability indicators applicable for the Basin. DWR accepted the GSP Alternative's description of sustainable management criteria for reduction of groundwater in storage as presented in the BMP, while the GSU22 Committee has recommended sustainable management criteria for seawater intrusion. This document summarizes the implementation status of PV Water's projects

and management actions to achieve sustainability and provides an evaluation of progress in addressing reduced groundwater in storage and seawater intrusion based on accepted and recommended sustainable management criteria.

A subsequent technical memorandum will summarize the status of the Basin in meeting sustainable management criteria for chronic lowering of groundwater levels, degraded water quality, and depletion of interconnected surface water, the 3 other SGMA sustainability indicators applicable for the Basin.

Another technical memorandum will present a projected water budget for the Basin based on simulations of BMP projects and management actions with the Pajaro Valley Hydrologic Model (PVHM) that has been updated by the United States Geological Survey (USGS). The simulations will incorporate effects of climate change and sea level rise so the assessment of the ability of projects and management actions to achieve sustainability in the future may diverge from this document's assessment of current progress for achieving sustainability.

STATUS OF PROJECTS AND MANAGEMENT ACTIONS

PV Water's projects and management actions for sustainability are categorized as follow:

- BMP Phase 1 projects and management actions that are currently operational.
- BMP Phase 1 projects that are in the process of being implemented but not yet operational.
- A BMP Phase 2 project for which Phase 1 progress needs to be assessed before proceeding.
- Projects and programs not included in the BMP.

The following BMP Phase 1 projects and management actions are operational:

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- Conservation Program
- Increased Recycled Water Storage at the Recycled Water Facility (now referred to as the Recycled Water Facility Optimization Project)
- Increased Recycled Water Deliveries (including the Coastal Distribution System Expansion Project)

The following BMP Phase 1 projects are in the process of being implemented but not yet operational:

- College Lake with Inland Pipeline to Coastal Distribution System (now referred to as the College Lake Integrated Resources Management Project)
- Harkins Slough Recharge Facilities Upgrades & Watsonville Slough with Recharge Basins (now referred to as the Watsonville Slough System Managed Aquifer Recharge and Recovery Projects)

The BMP also includes the Murphy Crossing with Recharge Basins project but describes the project as a Phase 2 project. Phase 2 will only proceed if Phase 1 projects and management actions are evaluated to be insufficient to achieve sustainability. This and subsequent technical memoranda will evaluate the sufficiency of Phase 1 and other existing projects to achieve sustainability based on current information, but a formal review and assessment of the Phase 1 projects and management actions will take place by 2025 as described in the BMP. Therefore, PV Water has not yet initiated implementation of the Murphy Crossing project.

In addition to the BMP components listed above, PV Water has implemented or is in the process of implementing the following additional projects and programs:

- Recharge Net Metering
- Coastal Distribution System F-Pipeline Expansion Project
- Pajaro Valley Hydrologic Model Update, Data Collection, and Analysis for Sustainability

More details about the status of each of the projects and management actions that are operational or being implemented are provided below. First though, we summarize the overall status of the projects and management actions against the goal for yields from the project and management actions.

COMPARISON OF PROJECT AND MANAGEMENT YIELDS TO PLANNED GOALS

The BMP describes one of its goals as the planned total yield of water to be provided from the projects and management actions to achieve sustainability. A primary assessment of the projects

DRAFT

and management actions is whether they collectively achieve the total goal of 12,100 acre-feet per year (AFY) documented in the BMP.

Table 1 below summarizes planned yield goals for projects and management actions as compared to yield estimates updated based on operational data and new modeling. Yield from the projects and management actions in operation has been nearly 20% short of the 7,000 AFY for those projects and management actions in the BMP.

Total yield after implementation of all BMP projects can be expected to be somewhat lower than the numbers presented in Table 1 and therefore somewhat less than the 12,100 AFY goal in the BMP. Estimated yields have not been updated for the Watsonville Slough System project but estimated diversions for the project have been updated to be lower than planned yields. Therefore, yields are expected to be reduced from planned yields.

The implementation status of the projects in operation or in process of implementation is summarized in the following subsections.

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Table 1. Summary of Project Expected and Current Yields

Project	Planned Average Annual Yield Goal	Basis for Updating Yield	Basis for Baseline Used to Quantify Yield	Baseline Value	Updated Value	Updated Average Annual Yield
Conservation Program Based on Agricultural Water Use	5,000	Agricultural Water Use 2016 – 2020	Agricultural Water Use 2006-2010	46,200	41,620	4,580
Recycled Water Facility Optimization and Increased Recycled Water Deliveries[1]	2,000	Deliveries for 2016 – 2020	Deliveries for 2011	1,940	2,940	1,000
Operational Total	7,000	–	–	–	–	5,580
College Lake Integrated Resources Management	2,400	Modeling Estimate of Future Yield	–	–	1,800 – 2,300	1,800 – 2,300
Watsonville Slough System Managed Aquifer Recharge and Recovery	2,200	Modeling Estimate of Future Diversions	Project Yield 2002-2013	200	<2,060	<1,860
Currently Planned Total	11,600	–	–	–	–	<9,240-9,740
Murphy Crossing	500	No New Evaluation	–	–	N/A	500
BMP Total	12,100	–	–	–	–	<9,740-10,240
Recharge Net Metering	1,000	Infiltration Volume 2020[2]	–	–	151	151
All Projects and Programs Total	~13,000	–	–	–	–	<9,890 – 10,390

All volumes in acre-feet per year.
[1] Reflects total recycled water deliveries.
[2] First year with two sites in operation; 2017-2019 only included a single site.

DRAFT

OPERATIONAL BMP PHASE 1 PROJECTS AND MANAGEMENT ACTIONS

Conservation Program

The BMP established a 5,000 AFY water conservation goal, which is estimated as 40% of the solution to the Basin's groundwater overdraft and seawater intrusion problems. In 2014, the Board approved the implementation of a Pilot BMP Conservation Program and in August of 2015, adopted the BMP Conservation Program. The program focuses on agricultural water conservation but also provides conservation services for domestic water users (home and garden). The conservation program leverages numerous partners and their programs including the Resource Conservation District of Santa Cruz County (RCDSCC), the National Resources Conservation Service (NRCS), the Monterey County Resource Conservation District (RCDMC), UC Cooperative Extension, Water Conservation Coalition of Santa Cruz County, Community Water Dialogue, and private consultants. The main components of the BMP Conservation Program are:

- Conservation outreach: Work in this area aims to raise awareness of groundwater overdraft issues, connect growers with conservation resources, receive feedback, and adaptively manage programs in order to better address growers' and residents' needs.

- Partner collaboration and program coordination: Work in this area includes coordinating with partners and grower groups to support other Pajaro Valley programs, align program goals with the BMP, document progress, and leverage resources.

- Workshops and trainings: Workshops and special events provide training and/or demonstrate the benefits of irrigation efficiency tools and practices. Work in this area aims to increase participation from new audiences, and, to increase awareness of, and accessibility to available resources.

- Irrigation Efficiency Program: The main components of the Irrigation Efficiency Program include a) initial irrigation system evaluations, b) technical and financial assistance with implementation of recommendations, c) training to optimize irrigation scheduling by watering to crop evapotranspiration (ET), and d) follow-up assistance to maximize adoption of new practices.

- Irrigation Efficiency Program Evaluation: The conservation goal of 5,000 acre-feet per year is being evaluated against the average agricultural water use of 46,200 acre-feet per year for the 5- year baseline period from 2006 – 2010, as established in the BMP. Objectives for this work area include continued work with partners to align program goals and developing performance measures to evaluate progress of Pajaro Valley programs toward the conservation goal.

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PV Water and partners continue to engage water users in all aspects of the conservation program. PV Water sponsors or hosts multiple workshops and trainings for agricultural growers throughout each year focusing on providing technical support. Outreach efforts through direct communication, newsletters, social media platforms, and mass media are utilized to encourage program participation and provide water saving information. In December 2020, the PV Water Board approved a $1.25 million agricultural water conservation program through December 2023 in collaboration with the RCDSCC. Compared to the program baseline period, the most recent rolling 5-year annual average (2016 - 2020) of total agricultural (groundwater + supplemental) water use in the Pajaro Valley was approximately 4,580 AFY less. While this reduction in water use represents a substantial portion of the conservation goal, it is important to note that variation in climate is not accounted for, nor the specific portion of water savings achieved by conservation alone.

Recycled Water Facility Optimization Project

The Recycled Water Facility Optimization Project, called *Increased Recycled Water Storage at the Recycled Water Facility* in the BMP, was estimated to allow PV Water to produce and distribute up to an additional 750 acre-feet (AF) of recycled water per year based on historical average dry weather flows to the City of Watsonville wastewater treatment plant of approximately 6.5 million gallons per day. The project is split into 3 phases:

- Phase I: The Recycled Water Storage and Distribution Pump Station Improvements Project,
- Phase II: The Disk Filter Upgrade Project, and
- Phase III: A potential project that could include additional recycled water storage and UV disinfection upgrades.

The Phase I Recycled Water Distribution and Pump Station Improvements Project was completed in January 2018. The project included construction of a 1.5 million-gallon recycled water storage tank and improvements to the distribution pump station, including two new distribution pumps and modifications to the four existing pumps, which resulted in increased operational efficiency. The enhanced storage and distribution systems implemented with Phase I have resulted in increased recycled water deliveries within the Basin; PV Water delivered an average of 3,123 AFY of recycled water for WY2018 through WY2020. This was an average increase of 349 AFY of recycled water compared to the average amount of recycled water delivered from WY2015 through WY2017. The amount of recycled water delivered is expected to increase if dry weather flows to the City of Watsonville wastewater treatment plant return to the historical average noted above.

DRAFT

The Phase II Disk Filter Upgrade Project commenced operation in April 2020. The PV Water Board of Directors (Board) accepted final completion of the project in January 2021. The project included construction of a new disk filter facility, modification of the existing instrumentation, and replacement of a coagulant polymer aid tank with a larger storage tank to increase system reliability.

PV Water recently amended an agreement with the State Water Resources Control Board to extend the timing for the Phase III project, which would also increase system reliability. Staff are working to refine the Phase III project to potentially include a UV Treatment Facility upgrade. The Phase III project could be in construction in 2022.

Increased Recycled Water Deliveries

The Increased Recycled Water Deliveries Project planned to increase nighttime irrigation recycled water deliveries by approximately 1,000 AFY and shoulder period recycled water deliveries by approximately 250 AFY for a total of 1,250 AFY from 2011 levels. Four strategies were identified to achieve this and include pricing of delivered water, peer encouragement, lease or producer requirements, and a mandatory use ordinance.

Since the adoption of the BMP, two of the strategies, pricing of delivered water and peer encouragement, have been enacted. PV Water formed two Ad Hoc Funding Committees, one in 2014 and one in 2019, that supported rate setting processes to produce sufficient revenue for current and future projects. The rate structures were designed in part to help incentivize delivered water use over groundwater. In addition, PV Water formed a Tiered Rate Study Group in 2018 that discussed whether and how PV Water could implement a tiered rate structure that would incentivize reduced groundwater use. PV Water has bolstered peer encouragement for recycled water use through hosting annual meetings that inform growers and irrigators of the benefits of utilizing delivered water and through outreach efforts including but not limited to quarterly newsletters, radio and television advertising, and web-based outreach that highlight PV Water projects, programs, and services.

Compared to the baseline 2011 recycled water use total of approximately 1,940 AF, the most recent rolling average annual recycled 2,940 AFY shows an approximate increase of 1,000 AFY. While this increase is favorable, it is important to note that the BMP included a combined target of increasing recycled water deliveries by 2,000 AFY with both the Increased Recycled Water Deliveries Project and the Recycled Water Facility Optimization Project.

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BMP PHASE 1 PROJECTS IN PROCESS OF BEING IMPLEMENTED

College Lake Integrated Resources Management Project

The College Lake Integrated Resources Management Project (College Lake Project), called *College Lake with Inland Pipeline to Coastal Distribution System (CDS)* in the BMP, includes an adjustable weir and intake facilities, a water treatment plant, and an approximately 6-mile-long pipeline to convey treated water from College Lake to the CDS. The project was estimated in the BMP to provide an average yield of 2,100 to 2,400 AFY. Hydrologic and hydraulic modeling conducted in 2018 to refine the anticipated yield resulted in an updated estimate of an average of approximately 1,800 to 2,300 AFY, with a maximum yield of 3,000 AFY (cbec, 2018). Increased surface water deliveries to the CDS have the dual benefits of promoting reductions in groundwater use and recharging freshwater through any agricultural losses.

Environmental documentation and CEQA compliance in support of the College Lake Project is in process. PV Water published the Draft Environmental Impact Report (EIR) for the Project on April 17, 2019. The formal comment period closed on June 21, 2019. PV Water published the Final EIR on September 30, 2019. On October 16, 2019, the PV Water Board adopted the following two resolutions:

- **Resolution 2019-18** Certifying the Final Environmental Impact Report, Adopting Findings Pursuant to the California Environmental Quality Act, Adopting a Statement of Overriding Considerations, and Adopting a Mitigation Monitoring and Reporting Program for the College Lake Integrated Resources Management Project.
- **Resolution 2019-19** Selecting, Approving, and Adopting the College Lake Integrated Resources Management Project.

Leading up to the October 16, 2019 Board meeting, PV Water staff and consultants developed a project feasibility study for federal grant funding eligibility; completed conceptual design drawings of the proposed weir, intake, pump station, treatment plant, and pipeline for evaluation in the EIR; completed hydrologic and hydraulic modeling to evaluate operational and potential flood hazard conditions associated with the project; completed a cultural resources survey, an archeological resources survey, and a wetland delineation. PV Water submitted a water-right permit application to the State Water Resources Control Board (SWRCB) in October 2017; the SWRCB held a public hearing regarding PV Water's College Lake water-right permit application on September 22, 2020, and PV Water staff anticipate receiving the water-right permit in 2021.

Design, environmental permitting, property procurement, and outreach in support of the project is underway. In August 2020, the PV Water Board approved agreements totaling approximately

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$4.2 million for design and bid period services. In October 2020, the Board approved agreements total approximately $500,000 for services related to development of an addendum to the Final EIR evaluating a revised pipeline alignment, environmental permitting, fish passage design, property appraisals, and preparation of a College Lake Project Adaptive Management Plan through a stakeholder process. Final designs and environmental permitting should be complete in 2022. Construction is estimated to occur over approximately 18 months beginning in 2022, pending acquisition of necessary permits and property rights.

Watsonville Slough System Managed Aquifer Recharge and Recovery Projects

The BMP includes 2 projects which are collectively known as the Watsonville Slough System Managed Aquifer Recharge and Recovery Projects. The essential function of the projects is to divert water from sloughs, infiltrate it into a shallow terrace aquifer through recharge basins, recover water through recovery wells, and send it to the Coastal Distribution System.

One project is the Harkins Slough Recharge Facilities Upgrades. The project would improve infrastructure and water treatment facilities at the point of diversion to increase recharge potential. It would also improve recharge and recovery operations through the construction of a new recharge basin and recovery production wells. The target average yield for the Harkins Slough Managed Aquifer Recharge and Recovery Facility in the BMP was 1,200 AFY, an increase of 1,000 AFY above the baseline yield of 200 AFY. Hydrologic modeling was conducted in 2020 to define the anticipated available diversion based on updated water quality data and environmental mitigation measures. The model estimated an average diversion of approximately 740 AFY, which is less than the target average yield.

The second project is the Struve Slough Project, called *Watsonville Slough Diversion with Recharge Basins* in the BMP. In the current project description, the point of diversion of the project is in Struve Slough, which is further upstream and farther away from the influence of Monterey Bay and brackish water incursions. Struve Slough is one of the 6 major branches of the Watsonville Slough System. The Struve Slough Project is designed to divert and utilize fresh water from Struve Slough, with an approach and design similar to those of the existing Harkins Slough Managed Aquifer Recharge and Recovery Facility. The target average yield for the Struve Slough Project in the BMP was 1,200 AFY. Hydrologic modeling was conducted in 2020 to define the anticipated available diversion based on updated water quality data and environmental mitigation measures, resulting in an estimated average diversion of approximately 1,320 AFY.

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Total average diversions for the projects are estimated to be 2,060 AFY, which is less than the BMP target yield of 2,400 AFY. Although estimates for yield have not been updated, the combined yield will be somewhat less than 2,060 AFY estimated for diversions.

PV Water published the Draft EIR for the Projects on September 1, 2020. The formal comment period closed on October 19, 2020. PV Water published the Final EIR on January 8, 2021. On January 20, 2021, the PV Water Board adopted the following 2 resolutions:

- **Resolution 2021-03** Certifying the Final Environmental Impact Report, Adopting Findings Pursuant to the California Environmental Quality Act, Adopting a Statement of Overriding Considerations, and Adopting a Mitigation Monitoring and Reporting Program for the Watsonville Slough System Managed Aquifer Recharge and Recovery Projects.
- **Resolution 2021-04** Selecting, Approving, and Adopting the Watsonville Slough System Managed Aquifer Recharge and Recovery Projects.

In September 2020, PV Water submitted water-right permit application A033151 to the SWRCB to divert up to 4,000 AFY from Struve Slough. In April 2021, PV Water submitted supplemental information and revisions requested by the SWRCB and are awaiting a response to the application.

PROJECTS AND PROGRAMS NOT IN BMP

Recharge Net Metering

PV Water is in the fifth year of a 5-year pilot Recharge Net Metering Program with partners from the University of California at Santa Cruz, and the RCDSCC. The program began in October of 2016 and has the goal of enhancing groundwater recharge by 1,000 AFY. The program incentivizes recharge projects by providing rebates based on acre-feet of water infiltrated to help offset costs incurred by landowners for operation and maintenance of water collection and infiltration systems on their land. Recharge Net Metering participants benefit directly through the rebate program; they also benefit indirectly (along with other resource users and the regional hydrologic system) because managed aquifer recharge helps to improve and sustain both the supply and quality of groundwater. During a wet water year (WY) 2017, the Bokariza-Drobac Infiltration System, which was the first and only system in operation for the initial 3 years of the pilot program, infiltrated approximately 140 AF of stormwater runoff. In WY2018, a dry year, that same system infiltrated 73 AF, and in a wet WY2019 infiltrated 107 AF. In WY2020, the Kelly-Thompson Infiltration System became operational. WY2020 was a dry year, and the 2 systems collectively infiltrated 151 AF. While the program is well short of the original 1,000 AFY goal, interest in the program continues to grow as landowners see the

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hydrologic and financial benefits of systems in operation. The PV Water Board of Directors will be considering the future of the Recharge Net Metering Program following conclusion of the pilot study later this year and will also be considering whether to pursue water-right permits for the systems.

Coastal Distribution System F-Pipeline Expansion Project

The F-Pipeline Expansion Project constructed approximately 9,900 linear feet of new distribution pipeline in 2020, ranging in diameter from 10 to 30 inches, to provide supplemental water through 6 new turnouts to as much as 700 irrigated acres of prime farmland between approximately Sunset Beach Road and Academy Road, in Santa Cruz County. The area is affected by seawater intrusion, and water deliveries through the newly constructed pipeline will help to reduce future seawater intrusion and groundwater overdraft through in-lieu recharge. The project expanded PV Water's delivered water service area from approximately 5,100 acres to 5,800 acres.

Pajaro Valley Hydrologic Model Update, Data Collection, and Analysis for Sustainability

In June of 2018, the PV Water Board of Directors approved a four-year, $553,000 agreement with the USGS to improve, update, and expand the capabilities of the Pajaro Valley Hydrologic Model (PVHM), one of PV Water's principal planning tools. The agreement includes the eight tasks listed below.

- Model Updates
- Model Calibration
- Development of SGMA Metrics
- Develop Budget and SGMA Metric Tools
- Model Update Documentation and Training
- Stream Gauging to Better Quantify Surface Water Resources
- Evaluation of Land Subsidence
- Reporting

PV Water and the USGS finished the update the PVHM through 2018 and initiated a second update of the PVHM through 2020. The 2018 update included structural changes to the model that improved the representation of farm processes, surface water deliveries, aquifer storage and

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recovery, seawater intrusion, and continued to refinement of the "self-updating" structure of the model. The updated model was calibrated utilizing a parameter estimation tool (PEST) and is being used to support PV Water's 5-year Groundwater Sustainability Plan Alternative Update. The USGS developed a series of water budget and SGMA metric reporting tools to extract simulated groundwater levels, diversions and stream hydrographs, water-use demand calculations, and have incorporated the SGMA reporting wells into the PVHM. In addition to model improvements, the USGS completed a preliminary analysis of land subsidence in the Pajaro Valley. They conducted comprehensive evaluation of land surface elevations utilizing interferometric synthetic aperture radar (InSAR), continuous GPS data, Light Detection and Ranging (LiDAR), and water level data. The analysis evaluated the 3-year period of 2015 to 2018 and indicated that the Pajaro Valley is generally stable with some seasonal deformation, which is common and typically recoverable in basins with seasonal water level fluctuations. The USGS presented the preliminary results to PV Water's GSU22 Committee in December 2020. The final report on the subsidence analysis is scheduled to be published by the end of the year. Stream gauging is also a part of the project. PV Water and the USGS completed the installation of 2 new stream gauging stations on the Pajaro River at Murphy Crossing and at Main Street in WY2019. The new gauges continue operation and the data collected are used analytical and modeling efforts.

STATUS OF SUSTAINABILITY INDICATORS THAT ARE FOCUS OF BMP PROJECTS AND MANAGEMENT ACTIONS

One of the primary goals of the BMP was to develop projects and management actions that help solve the groundwater overdraft and seawater intrusion problems. This focus lines up with the reduction of groundwater in storage and seawater intrusion indicators defined by SGMA. DWR accepted the BMP definition of sustainable management criteria (SMC) for reduction of storage in approving PV Water's GSP Alternative submittal. Based on DWR's recommended action to define SMC for seawater intrusion, the GSU22 Committee has recommended chloride isocontours as seawater intrusion SMC for Board approval. Basin conditions are compared versus these SMC to evaluate the progress towards the sustainability goals for the projects and management actions. The sustainability status related to the other 3 applicable sustainability indicators will be summarized in a subsequent technical memorandum.

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REDUCTION OF GROUNDWATER IN STORAGE

The approved SMC for PV Water's Alternative GSP include the minimum thresholds defined as the pre-SGMA rate of groundwater in storage depletion occurring in the Subbasin. The measurable objective can be considered elimination of annual overdraft or 100 percent reduction in the rate of groundwater in storage depletion. The BMP describes 80 percent reduction in the rate of groundwater in storage depletion by 2025 as an interim milestone. These criteria were developed based on groundwater modeling using the PVHM for the BMP (HydroMetrics WRI, 2013). The modeling, and therefore the criteria, define groundwater in storage depletion as resulting from declining groundwater levels only; seawater intrusion is treated separately as described in the next section.

PV Water's annual reports submitted for SGMA (PV Water, 2018-2021) estimate rate of groundwater in storage depletion as a change of groundwater in storage based on groundwater level contour maps. The change of groundwater in storage is calculated based on the annual change in groundwater storage in the Aromas using the average annual change in groundwater elevations and an average storativity value reflective of the Basin's hydrogeology. Average annual change in storage from the last 5 years was approximately 5,460 AFY and was positive in all years except for Water Year 2018 (Figure 1). Therefore, not only has the measurable objective of 100% reduction of the rate of groundwater in storage depletion been achieved during BMP implementation, but there has been an increase of groundwater in storage during this time.

This increase of groundwater in storage is corroborated by hydrographs included in the Water Year 2020 Annual Report (PV Water, 2021). Despite interannual variation correlated with water year type, groundwater elevations continue to recover from lows experienced in the recent 2011 to 2015 drought and the Water Year 2016-2020 period exhibits stable or increasing trends in all wells.

The measurable objective for reduction of groundwater in storage has been achieved despite BMP projects and management actions in operation not meeting their planned yields (Table 1) and operational yields of 5,700 AFY less than 50% of the overall yield goal of 12,100 AFY. However, groundwater pumping has decreased 10,900 from average pumping for 2006-2010 to 2016-2020 (Figure 2). This number approaches the 12,100 AFY goal for the total volume of water needed to make up the average annual shortfall in the Basin even if only just over half can be attributed to BMP projects and management actions. This large decline in groundwater pumping helps explain why SMC for reduction of storage are met.

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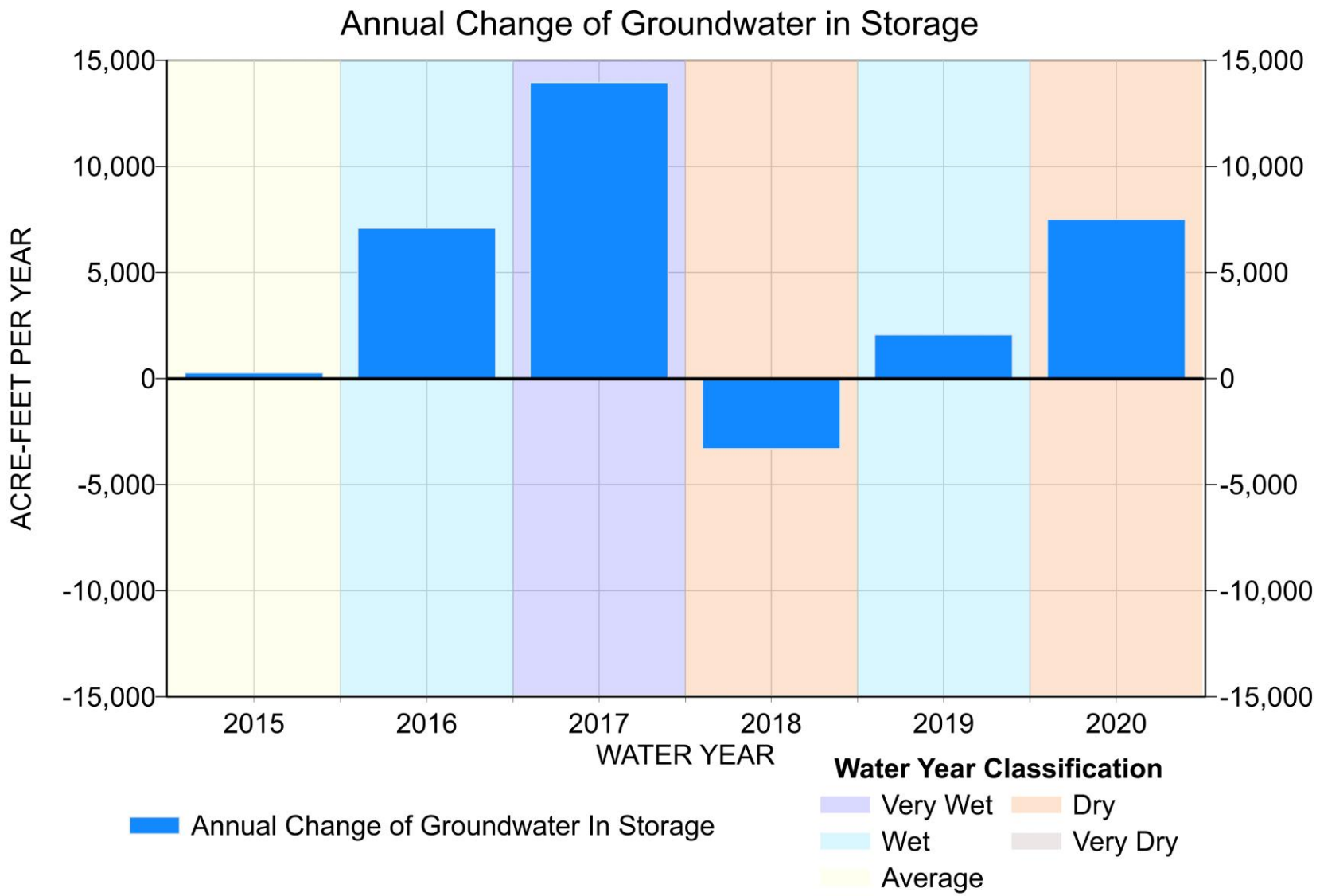

Figure 1. Change of Groundwater in Storage during Implementation of 2014 BMP Update

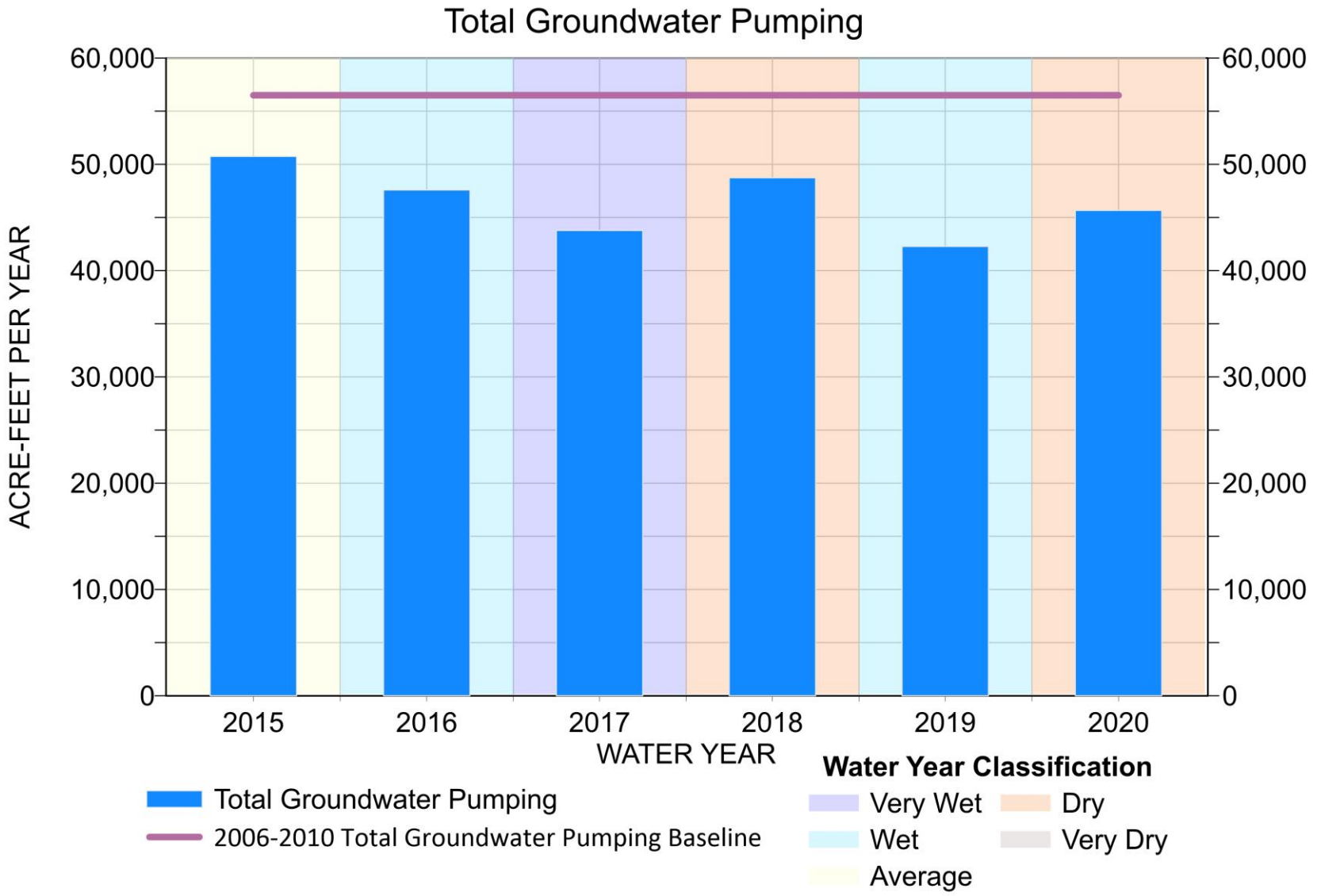

Figure 2. Basin Groundwater Pumping during Implementation of 2014 BMP Update

SEAWATER INTRUSION

In response to DWR's recommended actions for the GSP Alternative, the GSU22 Committee has recommended adoption of SMC consistent with GSP regulations. The recommended sustainable management criteria include defining the minimum threshold as the 250 mg/L chloride isocontour located 1,000 feet inland of the 250 mg/L chloride isocontour as of 2020, per the best estimates of all available data (

Figure 3). The recommended measurable objective is groundwater chloride concentrations less than or equal to 100 mg/L chloride inland of the minimum threshold isocontour.

Although there are no minimum threshold exceedances as of 2020 by definition, an initial evaluation of the BMP implementation project can be based on chemographs that show chloride concentrations over time. Wells adjacent to the 250 mg/L chloride isocontour as of 2020 include the PV8 wells and the PV6 wells within the delivered water zone and the confidential well K1 and the Hudson wells outside the delivered water zone (Figure 3).

In the delivered water zone, observed chloride concentrations adjacent to the 250 mg/L isocontour are relatively stable or declining. At PV8S, there has been an increase of concentrations, but at a low rate and magnitude such that minimum threshold exceedances are not imminent (Figure 4). The deeper PV8M and PV8D that historically had higher chloride concentrations can no longer be sampled. PV6D shows stable chloride concentrations (Figure 5), while chloride concentrations at the shallower PV6MD and PV6S have declined from being above the measurable objective of 100 mg/L prior to 2016 (Figure 6). Implementation of the BMP appears to be reducing advancement of seawater intrusion in the delivered water zone where BMP projects to increase recycled water deliveries have provided in-lieu recharge to reduce groundwater pumping.

There are increases in chloride concentrations adjacent to the 250 mg/L isocontour at wells outside the delivered water zone. Confidential well K1 shows an increasing trend for 2017-2020 compared to 2008-2014 (Figure 7). Increased chloride in the HudsonS well likely results from intrusion of water from nearby Elkhorn Slough, evidenced by stable concentrations in the deep HudsonD well below 50 mg/L (Figure 8). These increasing concentrations indicate that groundwater pumping may be drawing brackish water from the slough. Additional monitoring wells to assess potential inland advancement of seawater intrusion outside the delivered water zone is likely needed.

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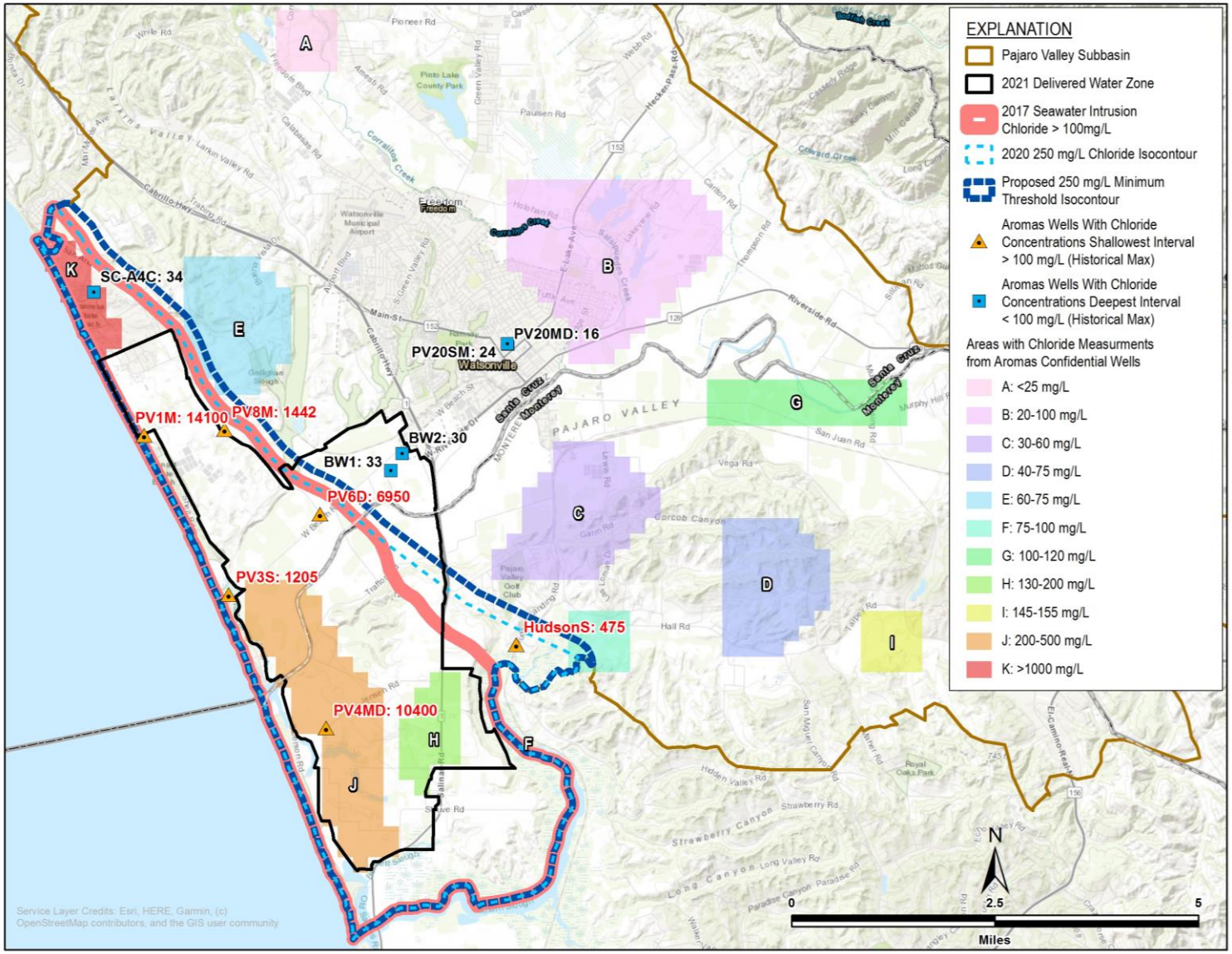

Figure 3. Proposed Sustainable Management Criteria for Seawater Intrusion and Aromas Well Locations with Historical Maximum Chloride Concentrations

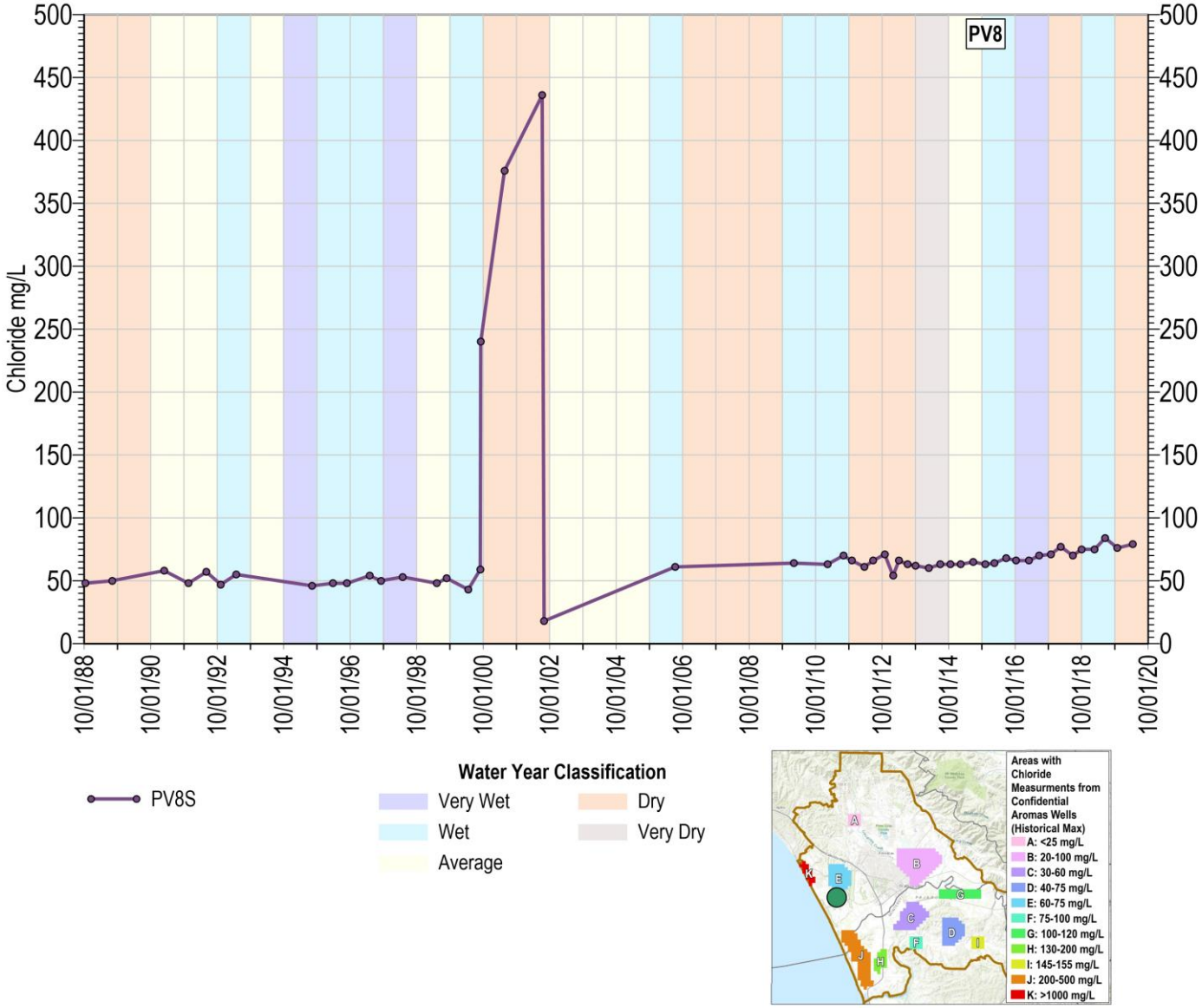

Figure 4. PV8S Chloride Chemograph

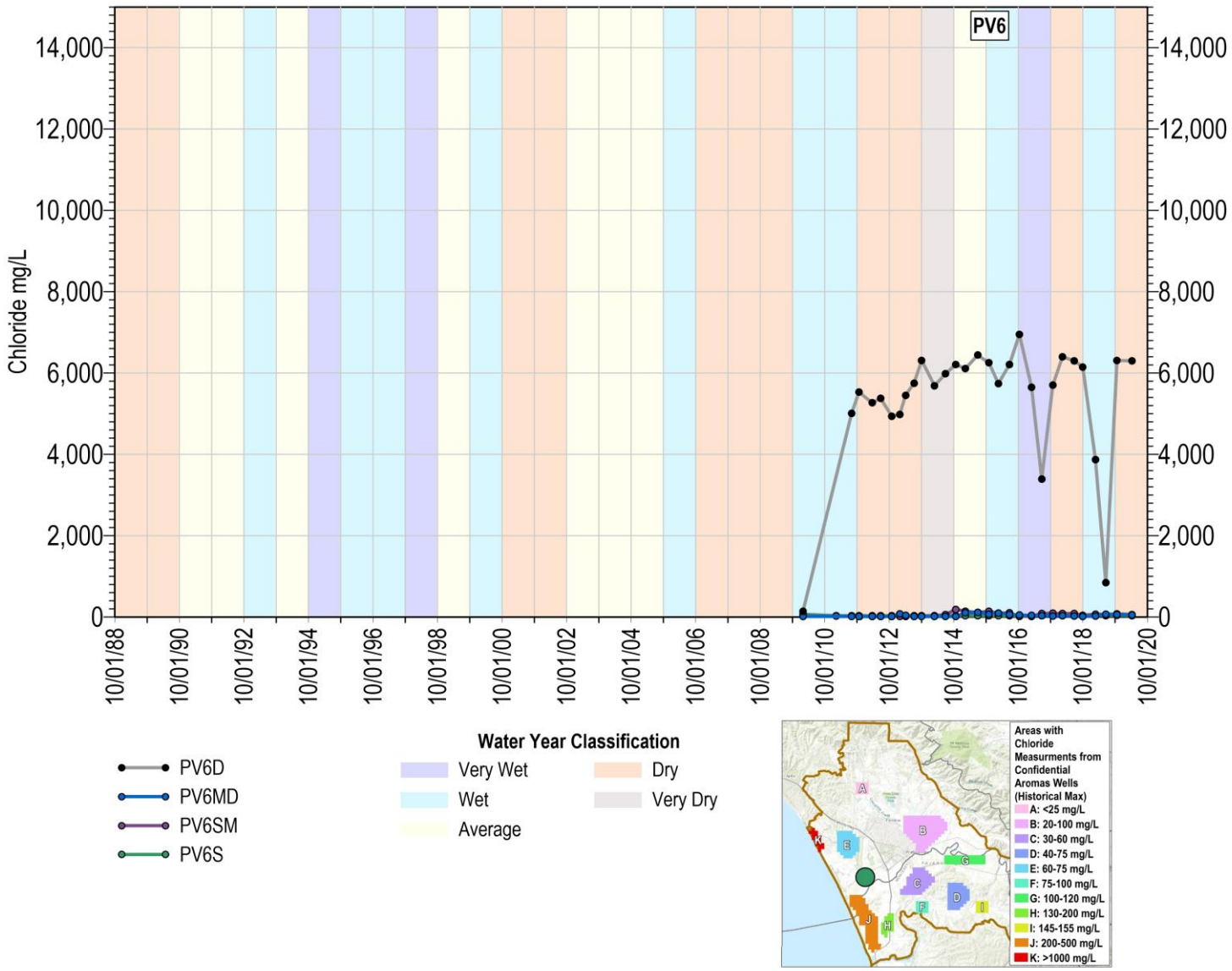

Figure 5. PV6D Chloride Chemograph

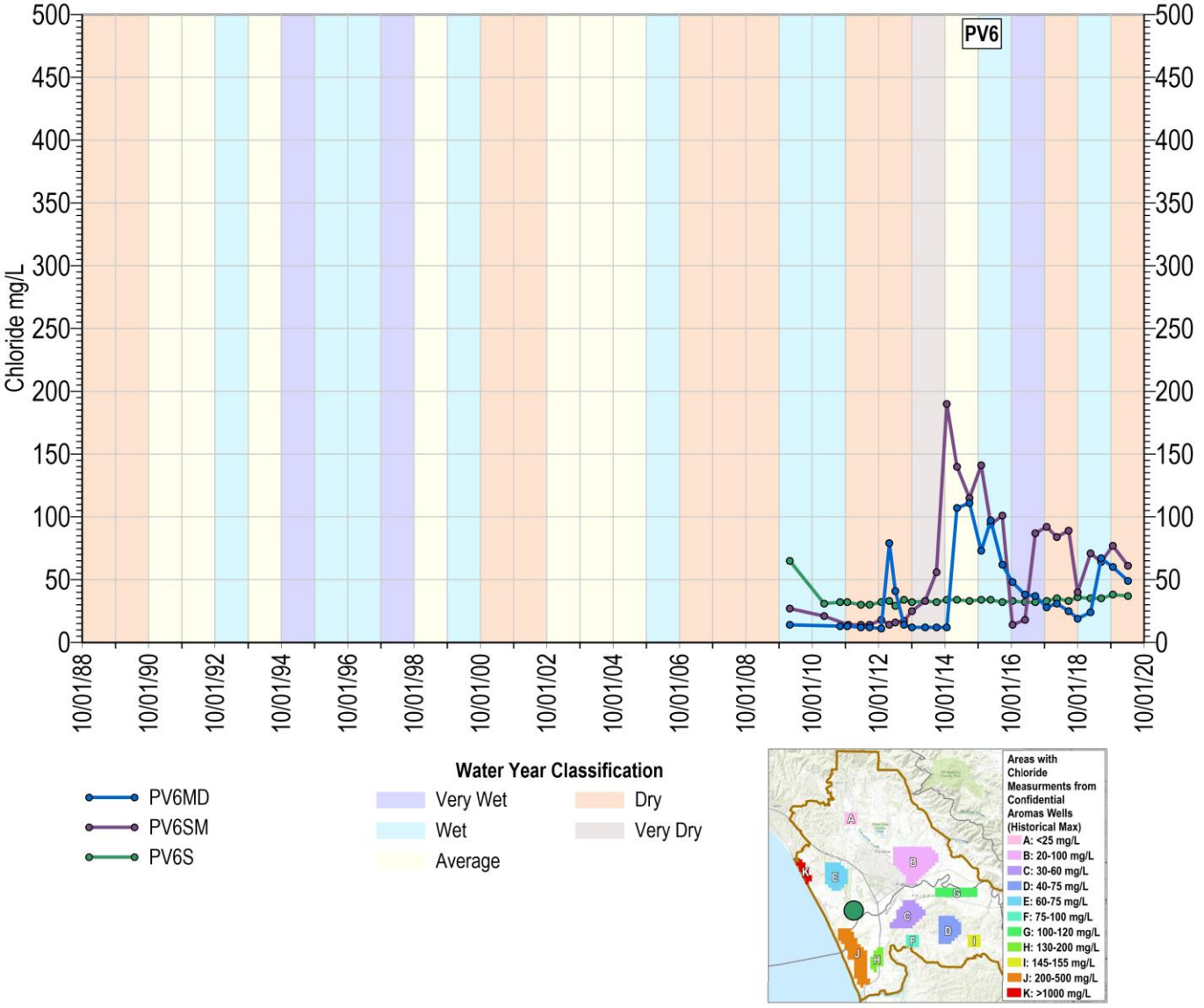

Figure 6. PV6MD, PV6SM and PV6S Chloride Chemographs

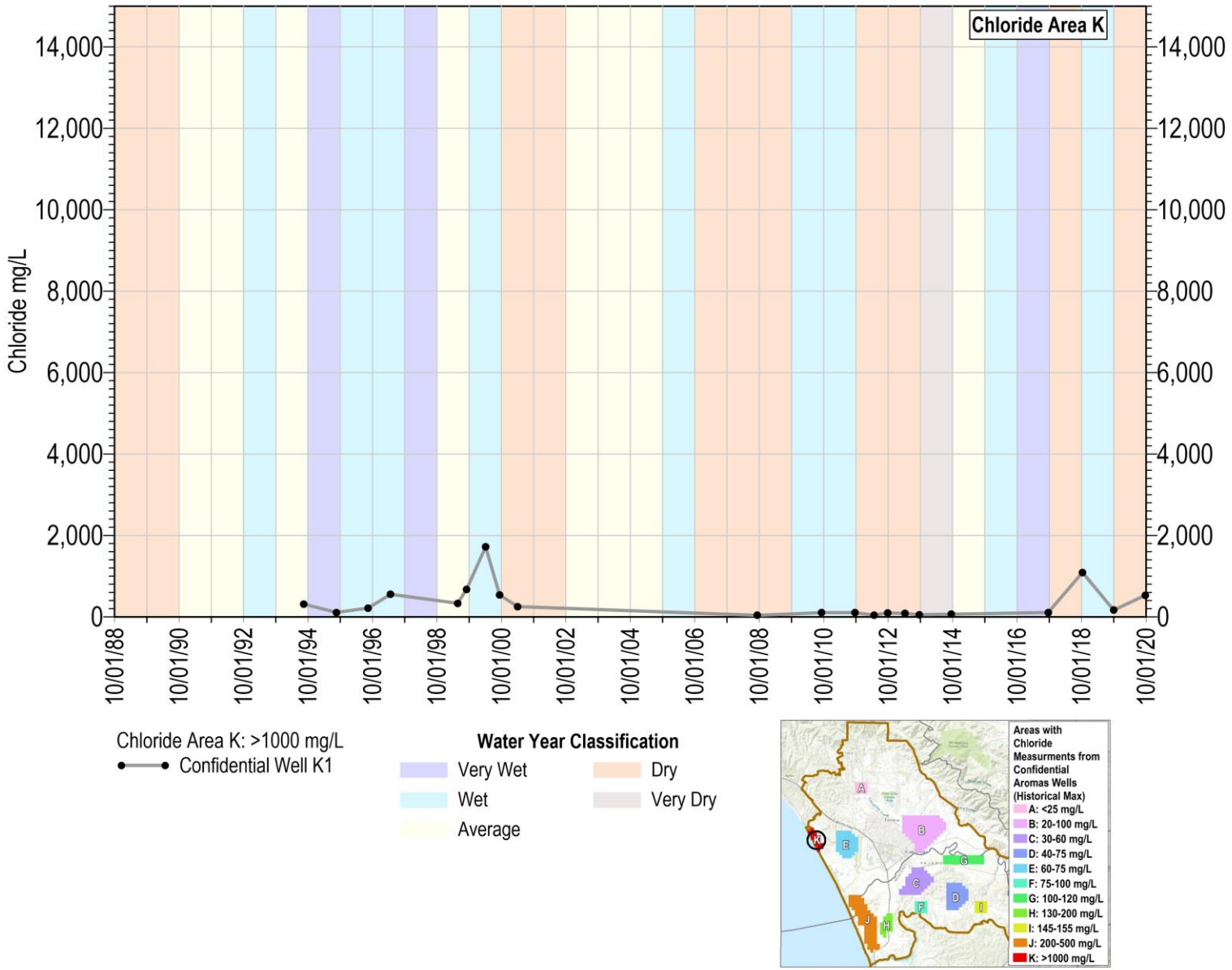

Figure 7. Confidential Well K1 Chloride Chemograph

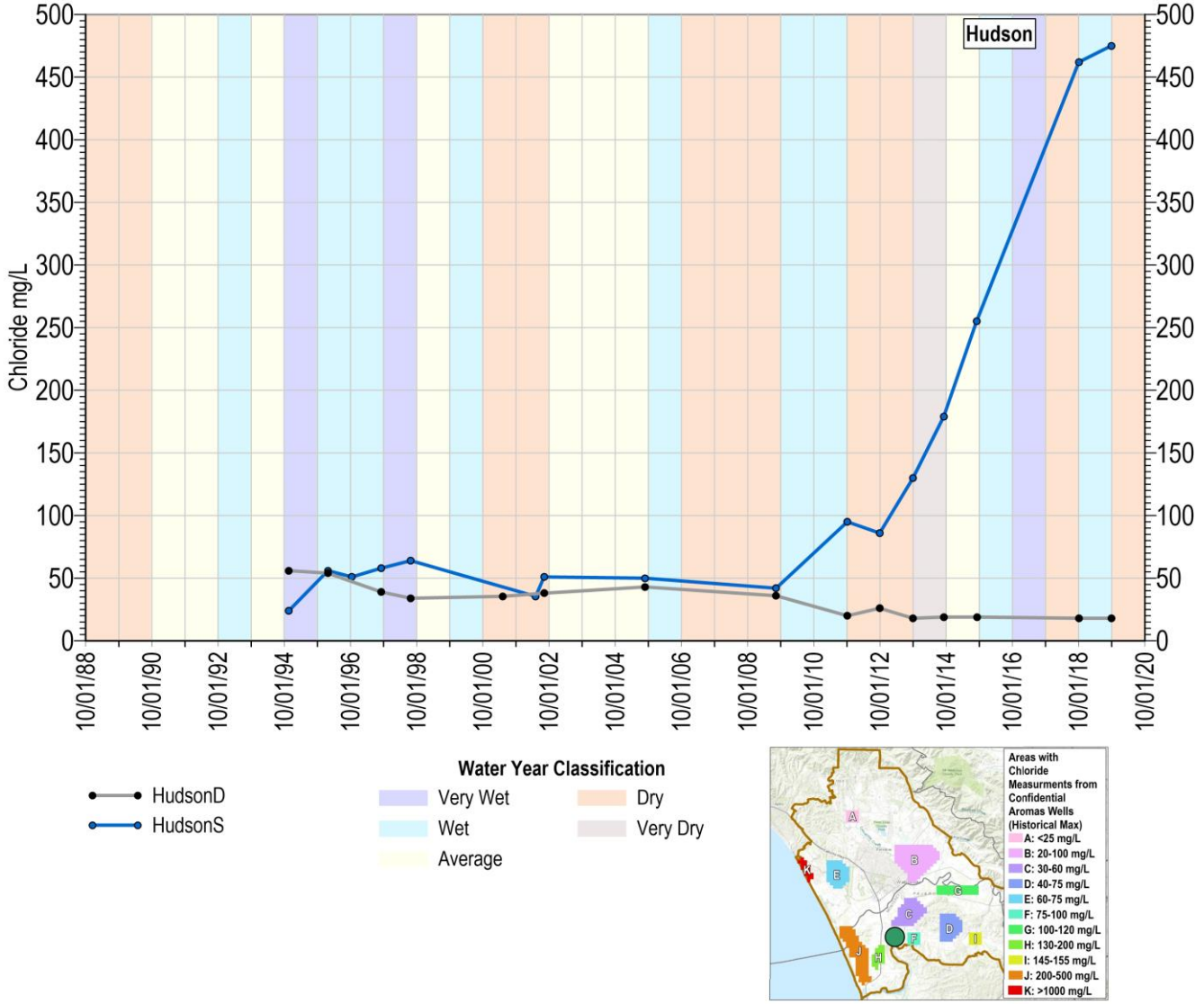

Figure 8. Hudson Wells Chloride Chemographs

The BMP estimates the reduction in rate of seawater intrusion estimated to be achieved by projects and management actions. These estimates are based on simulated results from the PVHM evaluating seawater intrusion flows at the coast (HydroMetrics WRI, 2013). Therefore, chemographs for wells near the coast are evaluated for chloride concentration trends that may indicate effect of BMP implementation on seawater intrusion rates. The wells near the coast in or just outside the delivered water zone are the PV1 wells, the PV3 wells, the PV4 wells, and confidential well J1. Confidential well K1 is outside the delivered water zone and may indicate advancement of seawater intrusion in that area (Figure 7).

Chemographs for the wells in the delivered water zone mostly show stable concentrations, but there are wells with increasing concentrations. PV1M is the PV1 well with the highest chloride concentrations and concentrations over 2016-2020 are generally in a similar range to prior years. There has been an increase in concentrations at the deeper PV1D over the last 5 years. Chloride concentrations in the PV3 wells have been stable over 2016-2020. Chloride concentrations at the PV4 wells have declined over 2016-2020, but chloride concentrations at confidential well J1 in the same area have increased over the time period. The water quality data appears to indicate a possible reduction in rate of seawater intrusion at the coast for portions of the delivered water zone, though seawater intrusion continues to increase in some areas.

In general, observed water quality data appear to indicate BMP implementation is decreasing the rate of seawater intrusion, especially within the delivered water zone. Additional monitoring wells are likely needed to assess extent of seawater intrusion outside the delivered water zone. Modeling of flows across the SMC isocontour and the coastline will also inform on the effect of BMP implementation on seawater intrusion rates. Geophysical studies that can identify presence of saline water between wells should also be considered.

CONCLUSION

The operational yields for BMP projects and management actions have not met planned goals and updated estimates for yields of BMP projects in process of being implemented are lower than initially planned. However, BMP projects and management actions have contributed to groundwater pumping declining nearly enough to eliminate the shortfall estimated in the BMP. As a result, there has been an increase of groundwater in storage over the last 5 years, achieving the measurable objective for that indicator. Implementation of the BMP also appears to be reducing the rate of seawater intrusion.

The efficacy of BMP projects and management actions to achieve sustainability over the long term will be further evaluated based on projected water budget provided by PVHM simulations under climate change and sea level rise scenarios. The status of the groundwater levels,

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groundwater quality, and interconnected surface waters sustainability indicators will also be evaluated.

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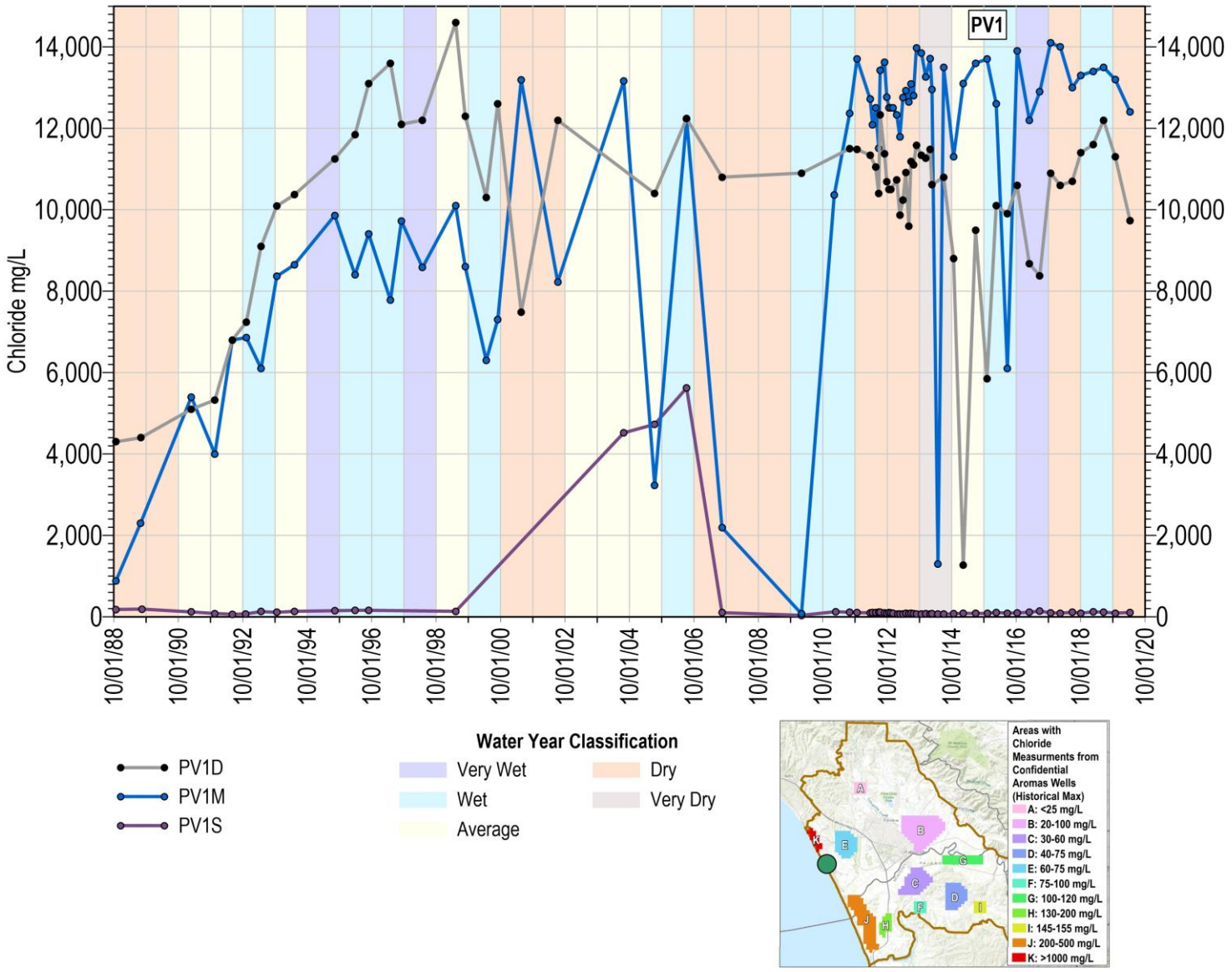

Figure 9. PV1 Chloride Chemographs

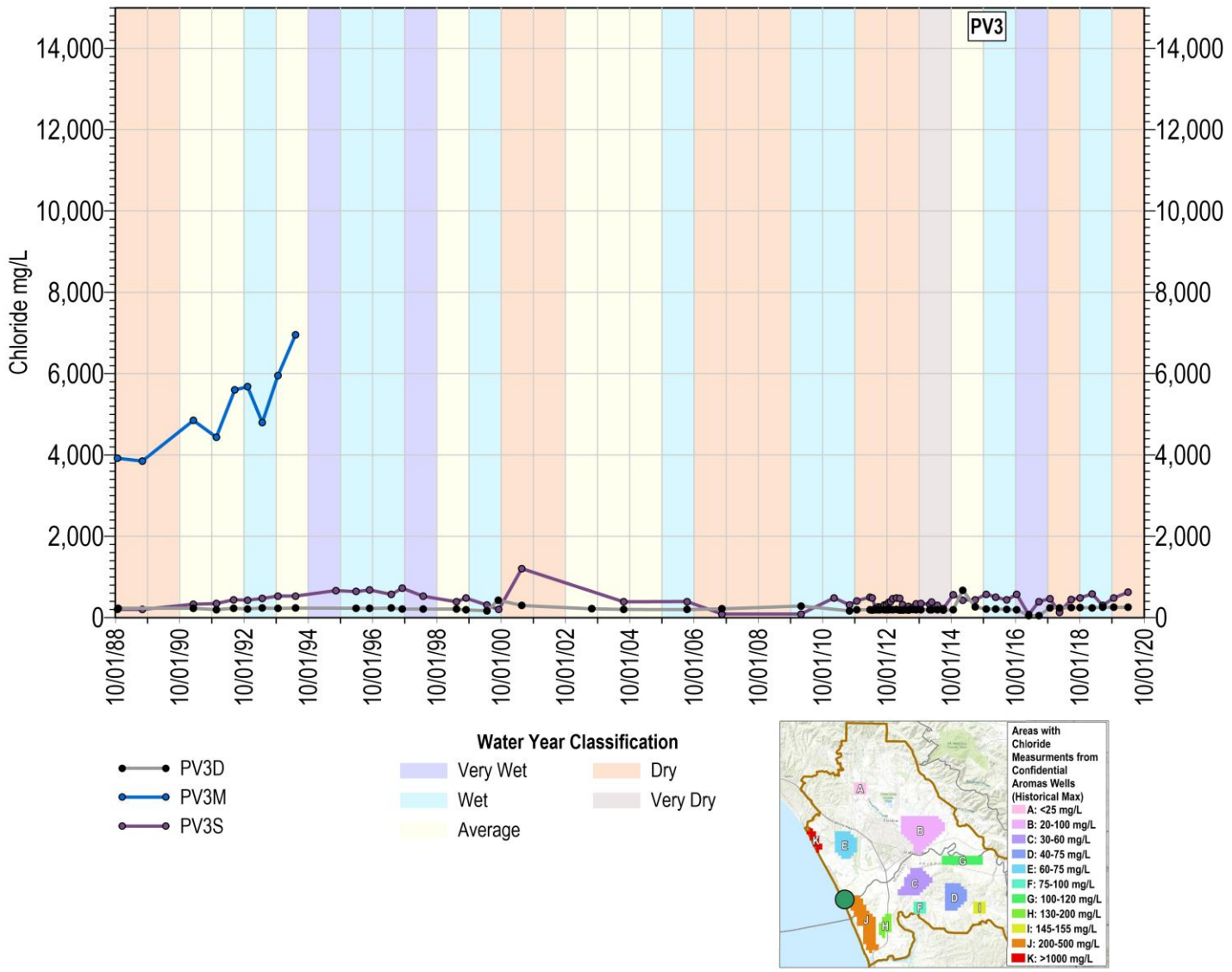

Figure 10. PV3 Chloride Chemographs

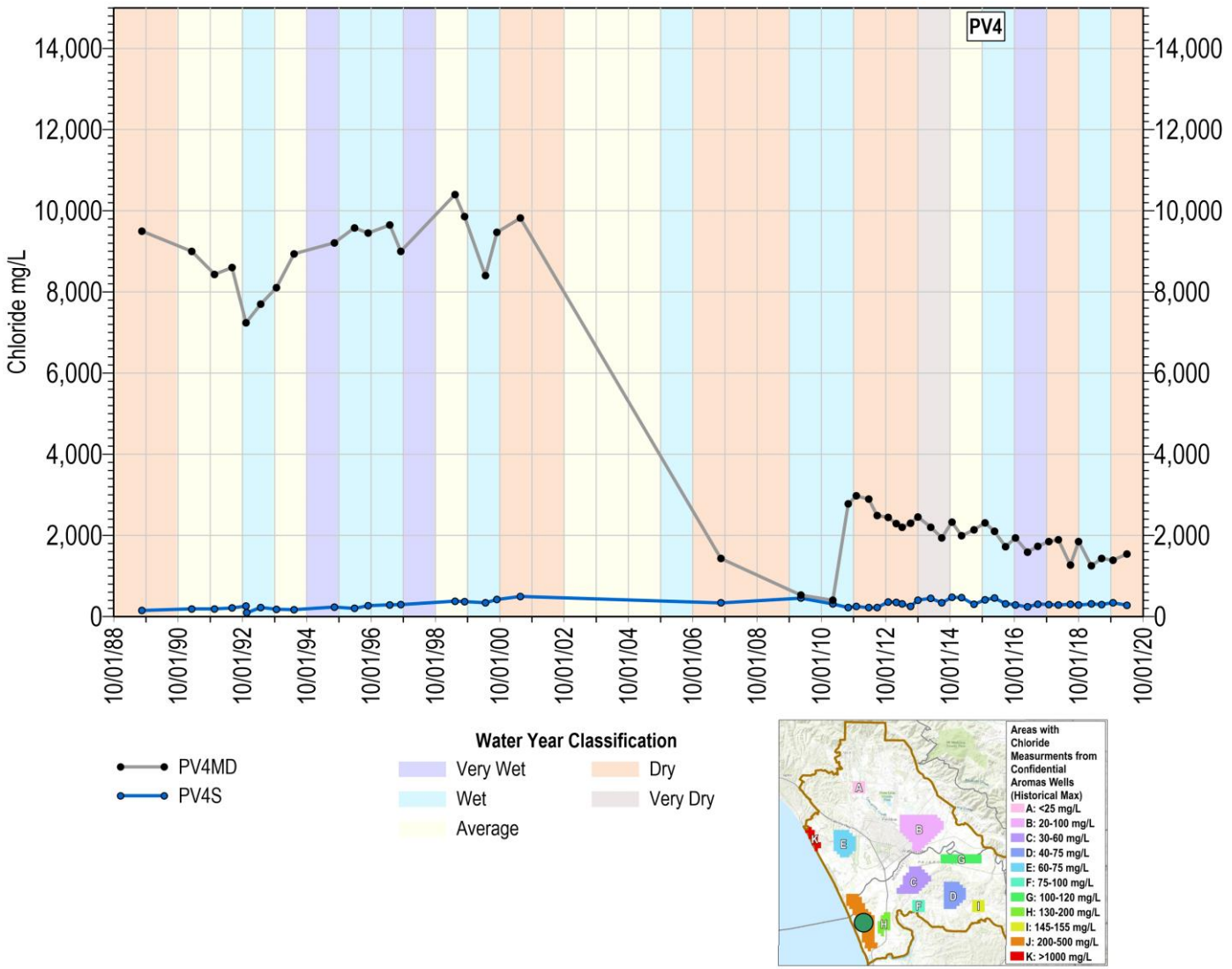

Figure 11. PV4 Chloride Chemographs

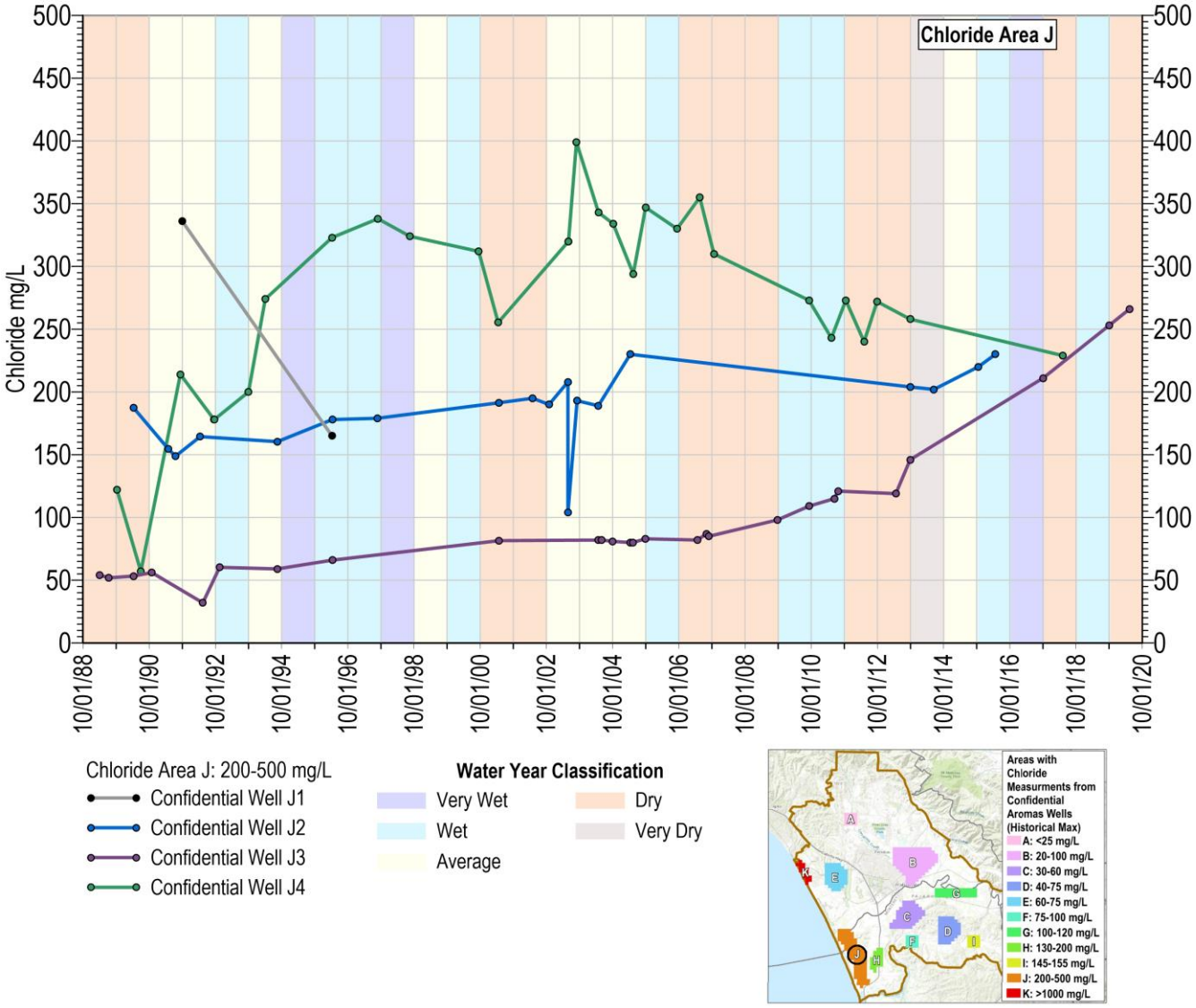

Figure 12. Confidential Well J3 Chloride Chemograph

REFERENCES

California Department of Water Resources (DWR), 2019, Sustainable Groundwater Management Program Alternative Assessment Staff report, Corralitos – Pajaro Valley (Basin No. 3-002.01), July 2019

Carollo, 2014, Basin Management Plan Update, Prepared for Pajaro Valley Water Management Agency, February 2014

Cbec, 2018, College Lake Integrated Resources Management Project Hydrologic and Hydraulic Modeling Technical Memorandum, prepared by cbec, inc. for Environmental Science Associates, Nov 2018.

Hanson, R.T., et al, 2014, Integrated Hydrologic Model of Pajaro Valley, Santa Cruz and Monterey Counties, California, USGS Scientific Investigations Report 2014–5111, Prepared in cooperation with Pajaro Valley Water Management Agency.

HydroMetrics WRI, 2013, Hydrologic Model Analysis of Basin Management Plan Alternatives Revised July 2013, prepared for Pajaro Valley Water Management Agency, July.

Montgomery and Associates (M&A), 2021, Proposed Sustainable Management Criteria for Seawater Intrusion, Draft Technical Memorandum, March 2021

Pajaro Valley Water Management Agency (PV Water), 2018, Pajaro Valley Subbasin Water Year 2017 Annual Report, March, https://www.pvwater.org/images/about-pvwma/assets/annual_reports_assets/SGMA-WY/_PVWater_AR_WY2017_Submitted-web.pdf

_____, 2019, Pajaro Valley Subbasin Water Year 2018 Annual Report, March, https://www.pvwater.org/images/about-pvwma/assets/annual_reports_assets/SGMA-WY/SGMA_WY2018_AR_Compiled_Final-web.pdf

_____, 2020, Pajaro Valley Subbasin Water Year 2019 Annual Report, March, https://www.pvwater.org/images/about-pvwma/assets/annual_reports_assets/SGMA-WY/SGMA_WY2019_AR_Final.pdf

_____, 2021, Pajaro Valley Subbasin Water Year 2020 Annual Report, March, https://www.pvwater.org/images/about-pvwma/assets/annual_reports_assets/SGMA-WY/PVWater_AR_WY2020.pdf.