MONTGOMERY & ASSOCIATES

DRAFT TECHNICAL MEMORANDUM

DATE: August 7, 2021 **PROJECT #:** 9090.1301

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

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

FROM: Cameron Tana, P.E. (M&A), Luis Mendez (M&A), and Casey Meusel (PV Water)

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

SUBJECT: Sustainability Status in Pajaro Valley Subbasin: Water Quality

PROPOSED RECOMMENDATION FOR SUSTAINABILITY STATUS OF WATER QUALITY

Based on the analysis of observed data, the GSU22 Committee recommends that the PV Water Board accepts the conclusion that the current groundwater conditions show a water quality undesirable result for nitrate in the coastal zone as defined by the Salt and Nutrient Management Plan (SNMP). There is no undesirable result for nitrate in the Basin inland of the SNMP coastal zone. There are no water quality undesirable results for total dissolved solids (TDS) or chloride in the Basin.

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 Groundwater Sustainability Update 2022 (GSU22) will be submitted as the 5-Year Update to the GSP Alternative that is due January 1, 2022. In order to update DWR on the sustainability status of the Basin, GSU22 will describe current groundwater conditions for each applicable sustainability indicator relative to sustainable management criteria (SMC). The water quality sustainability indicator is applicable to the Basin and DWR accepted the GSP Alternative's description of water quality SMC as the assimilative capacity thresholds described in PV Water's Salt and Nutrient Management Plan (SNMP, PV Water, 2016). This document summarizes current groundwater conditions relative to these accepted SMC for the Basin.

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ASSIMILATIVE CAPACITY THRESHOLDS APPROVED AS WATER QUALITY SMC

DWR's staff report (2019) documenting its assessment and approval of the GSP Alternative describes assimilative capacity thresholds described in the SNMP and how they are proposed as SMC:

> The Salt Management Plan describes how groundwater quality will be monitored and assessed as the projects described in the Basin Management Plan are implemented. The Salt Management Plan quantifies the assimilative capacity for total dissolved solids, chloride, and nitrate in two sub-zones (inland and coastal) within the Subbasin. Assimilative capacity represents the capacity for a volume of water to receive inputs of certain constituents without exceeding a determined water quality objective. The Alternative Elements Guide describes that these assimilative capacity thresholds are comparable to minimum thresholds defined by SGMA and that the measurable objective is a "100% reduction of assimilative capacity decreases" (i.e., to not reduce the assimilative capacity further). The Salt Management Plan notes that the Subbasin is currently exceeding the chloride assimilative capacity value within the coastal zone, where seawater intrusion has already occurred.

DWR's staff report later concludes that the "The Salt Management Plan identifies quantitative criteria for tracking future water quality undesirable results in the form of assimilative capacity thresholds" and "The Plan provides reasonable quantifications and standards related to groundwater storage and water quality."

Assimilative capacities are calculated based on the average concentrations for total dissolved solids (TDS), chloride, and nitrate for the inland and coastal zones (Figure 1). The SNMP therefore describes assimilative capacity thresholds as concentrations representing water quality objectives for TDS, chloride, and nitrate. If an average concentration for any of the 3 constituents exceeds the assimilative capacity threshold concentration for the constituent in either SNMP zone (referred to as sub-zone by DWR, Figure 1), assimilative capacity for the zone for that constituent is exceeded and therefore there is a minimum threshold exceedance and undesirable result for water quality. To achieve the measurable objectives to not further reduce assimilative capacities, average concentrations must be stable or decreasing. Table 1 shows the approved water quality minimum thresholds and the average concentrations over 2002-2011 reported by the SNMP for each constituent.

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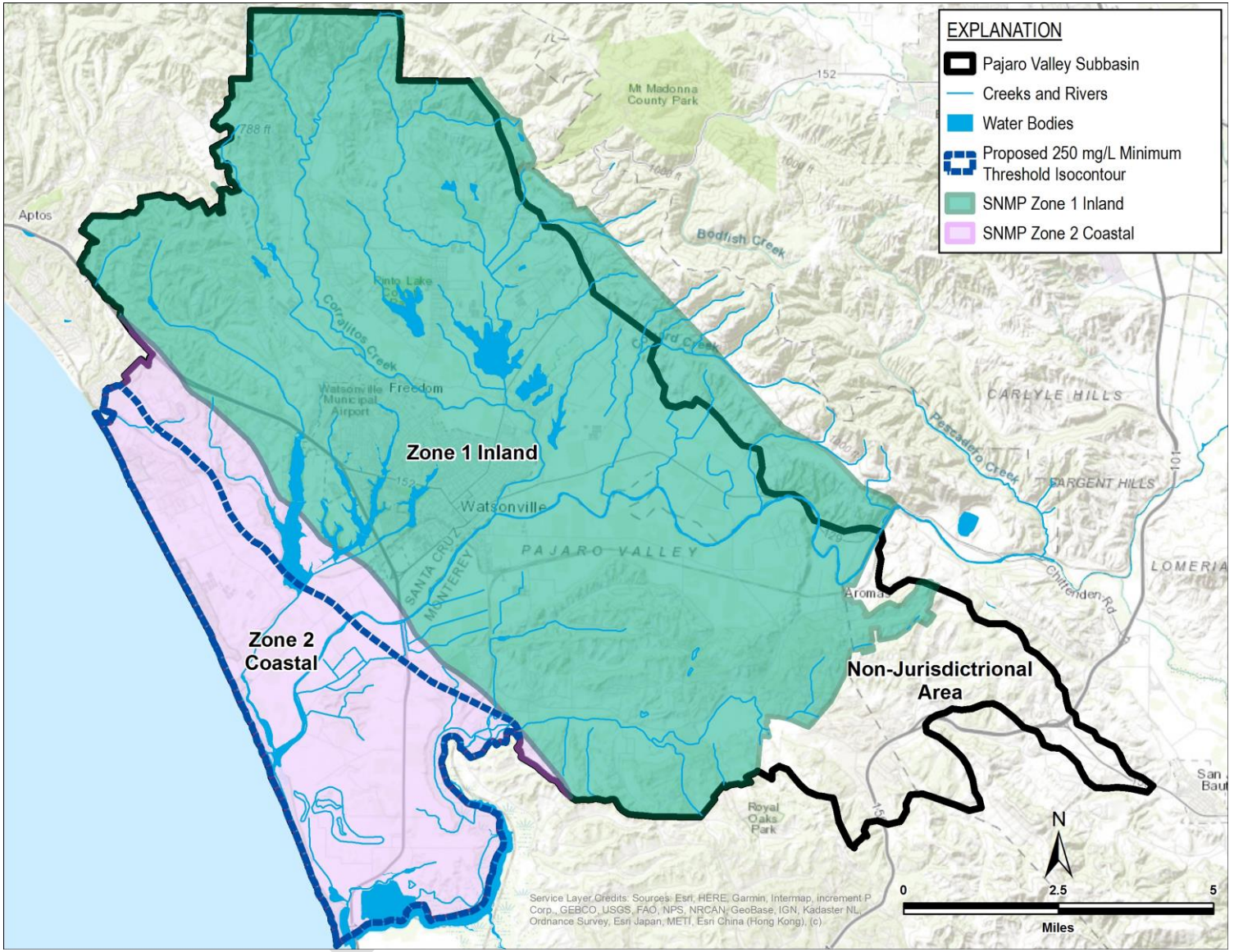

Figure 1. SNMP Assimilative Capacity Zones and Seawater Intrusion Minimumum Threshold Isocontour

Table 1. Water Quality Minimum Thresholds and 2002-2011 Average Concentrations by SNMP Zone

Constituent	Minimum Threshold (mg/L)	SNMP Inland Zone (Zone 1)	SNMP Coastal Zone (Zone 2)
TDS	1,000	466	730
Chloride	150	46	198*
Nitrate (NO_3)	45	24	39

* Chloride concentrations above the minimum threshold in the coastal zone are due to seawater intrusion, which is evaluated with the seawater intrusion SMC. Therefore, this is not a water quality undesirable result.

As shown above, the average chloride concentration (Table 1) for the coastal zone was already above the chloride minimum threshold of 150 mg/L. The SNMP identified that this exceedance of chloride assimilative capacity was due to seawater intrusion. The GSU22 has identified a 250 mg/L isocontour shown on Figure 1 as the minimum threshold for seawater intrusion that represents the extent to which seawater intrusion would not be significant and unreasonable. This effectively supersedes the minimum threshold for chloride in the overlapping coastal zone. Therefore, average concentrations of chloride resulting from seawater intrusion greater than 150 mg/L in the coastal zone is not considered an undesirable result for water quality.

It should be noted that DWR accepted SMC based on zonal averages that do allow individual areas within the zones to have concentrations that exceed minimum threshold concentrations. SNMP identified that while 15% of sampled wells in the Basin exceeded the minimum threshold concentration for TDS of 1,000 mg/L, these were not undesirable results as the average concentrations for both zones were both below the minimum threshold. SNMP also identified that 27% of sampled wells in the Basin exceeded the minimum threshold concentration for nitrate of 45 mg/L, but these were also not undesirable results as the average concentrations for both zones were below the minimum threshold. This is consistent with sustainability under SGMA being defined basin-wide.

UPDATED EVALUATION OF GROUNDWATER QUALITY CONDITIONS

For an updated comparison with the approved water quality sustainable management criteria, PV Water calculated average concentrations over 2016-2020 for the three constituents by zone. Even though the SNMP evaluated average concentrations over 10 years, this sustainability status update for GSU22 uses the last 5 years for two reasons:

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1. GSU22 will be submitted as a 5-year update to PV Water's approved GSP Alternative.

2. The 5-year period represents a period following PV Water's adoption of its 2014 Basin Management Plan Update (BMP 2014) that describes PV Water's projects and management actions to achieve sustainability.

The following describes the methodology for the calculation of 2016-2020 concentrations.

METHODOLOGY

PV Water compiled groundwater quality datasets from its own monitoring network, the State Water Resources Control Board (State Water Board) Groundwater Ambient Monitoring and Assessment Program (GAMA), and Soquel Creek Water District to generate spatial representations of groundwater conditions for TDS, chloride, and nitrate as NO_3 during the 5-year period of 2016 through 2020. The data represents a network of 175 wells PV Water directly monitors supplemented by GAMA wells located within the Basin, and Soquel Creek Water District's monitoring and production wells located in the Basin and along the adjacent Santa Cruz Mid-County Basin boundary. In total, over 630 well locations and thousands of discrete water quality samples were used in the analyses.

The temporal sampling of a specific well ranged from a single sampling event to numerous samples resulting from long-term or regulatory sampling programs. The intent of compiling multiple data collection programs to assess groundwater quality was to create representative maps that reasonably reflect recent groundwater conditions for the constituents of concern given the inherent seasonal and inter-annual variability of groundwater quality. The 5-year period of 2016-2020 represents a range of water year types similar to the methodology used to create the assimilative capacities in the SNMP. The period of 2016-2020 consisted of 2 "dry," 2 "wet," and 1 "very wet" water year(s) based on a water year type classification analysis of annual precipitation at Watsonville Water Works station in Watsonville (PV Water, 2021).

Due to the majority of water quality data being derived from privately owned wells, the SNMP used methods to display data that protected the anonymity of the private well locations and the confidential nature of the information. To accomplish this, the SNMP used the inverse distance weighted (IDW) toolset in geographic information systems (GIS) software to generate an interpolated surface based on the nearest five well locations. The 2016-2020 assessment of recent conditions used IDW as an interpolator consistent with the SNMP methodology to compare against the adopted minimum thresholds.

Average concentrations for each zone are calculated from the interpolated surface. The average concentration calculated for the inland zone is the SNMP inland zone within the Basin plus the

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non-jurisdictional area of the Basin to the southeast (Figure 1). The average concentration represents the entire area of the Basin inland of the coastal zone. This ensures the evaluation of sustainable management criteria covers the entire Basin as required by SGMA.

DATA LIMITATIONS

The spatial and temporal limitations of the dataset used to assess recent groundwater conditions are discussed below:

- Several wells were only sampled once and it is recognized that the values assigned to these sites may be influenced by the conditions at the time of sampling. However, these single concentrations were included in the analysis in order to increase the spatial resolution and temporal resolution of the summaries. The IDW statistical interpolation creates concentration contours using the 5 nearest wells, limiting the influence of individual samples on the final results.

- The hydrogeology of the Basin is complex, and the population of wells sampled is screened across a range of depths and different hydrogeologic units within the aquifer. The spatial datasets produced for this analysis are composite representations that combines spatial and geologic variations onto to a single dataset, which represents average groundwater quality conditions.

- Additional datasets from the GAMA program and Soquel Creek Water District were used in the 2016-2020 analysis of Basin conditions. State and local efforts to improve data management systems and data sharing efforts has improved the availability of water quality data for wells across the Basin and increased the total number of wells used from ~300 in the SNMP to over 630 wells in the 2016-2020 analysis. Variation in the dataset makeup may partially account for changes in observed conditions.

- The temporal variability of groundwater quality is significant and can be influenced by climate, variations in groundwater inputs or outputs, and/or changes in the source loading. The 5-year period of 2016-2020 is intended to represent recent observed groundwater conditions to evaluate against assimilative capacities defined for TDS, chloride, and nitrate in the SNMP and accepted by DWR as minimum thresholds for the GSP Alternative.

RESULTS

Figure 2 through Figure 4 show interpolated surfaces for average TDS, chloride, and nitrate concentrations over 2016-2020. Table 2 shows the average concentrations by zone and the percentage change from the average concentration during 2002-2011.

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Table 2. Water Quality Minimum Thresholds and 2016-2020 Average Concentrations by SNMP Zone

Constituent	Minimum Threshold (mg/L)	SNMP Inland Zone (Zone 1) and Non-Jurisdictional Area[1]	SNMP Coastal Zone (Zone 2)
TDS	1,000	475	816
Chloride	150	61	273*
Nitrate (NO_3)	45	24	52

[1] Combined area is area of Basin inland of Zone 2

* Chloride concentrations above the minimum threshold in the coastal zone are due to seawater intrusion, which is evaluated with the seawater intrusion SMC. Therefore, this is not a water quality undesirable result.

Red denotes water quality undesirable result.

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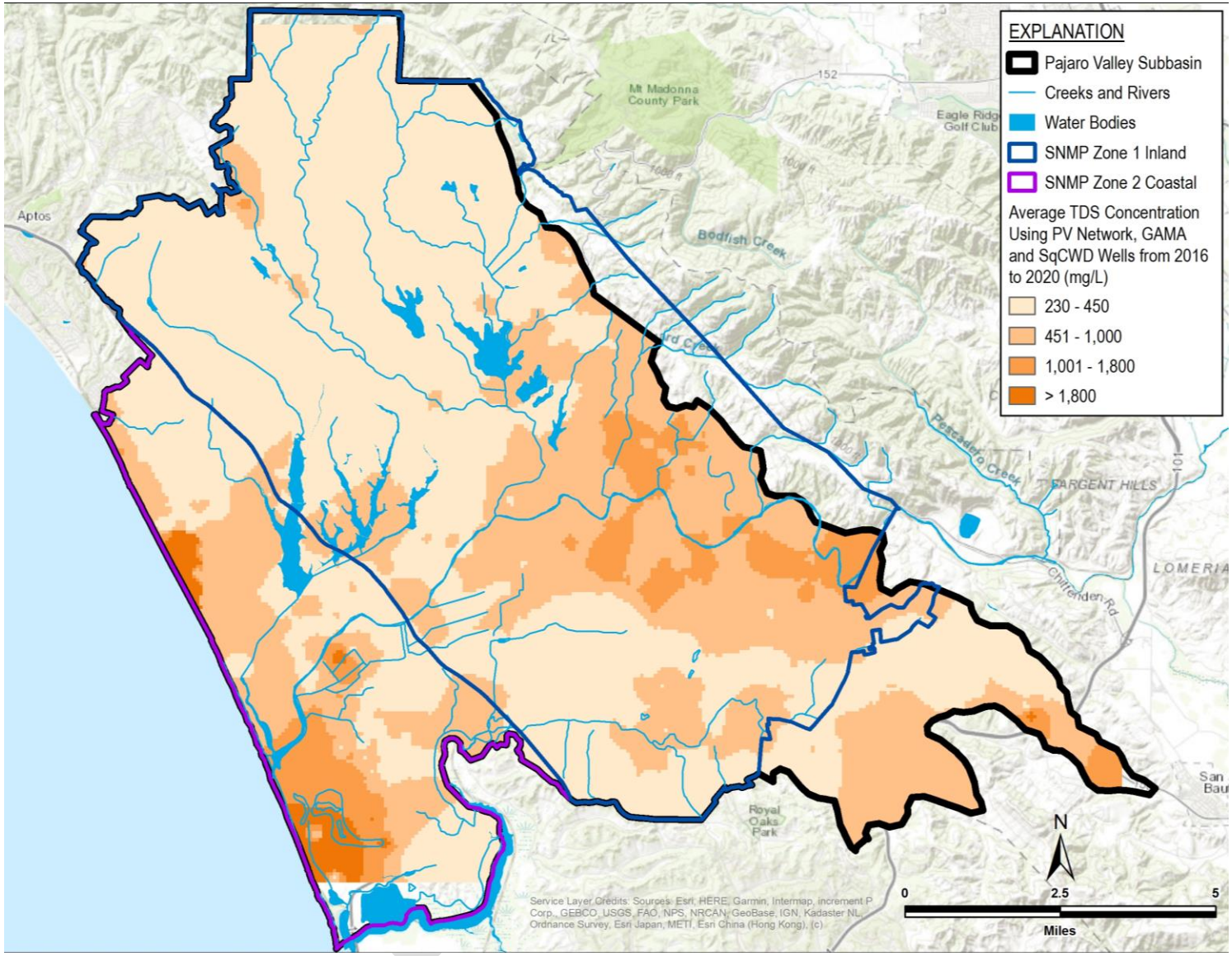

Figure 2. Interpolated Surface of Average TDS Concentrations, 2016-2020

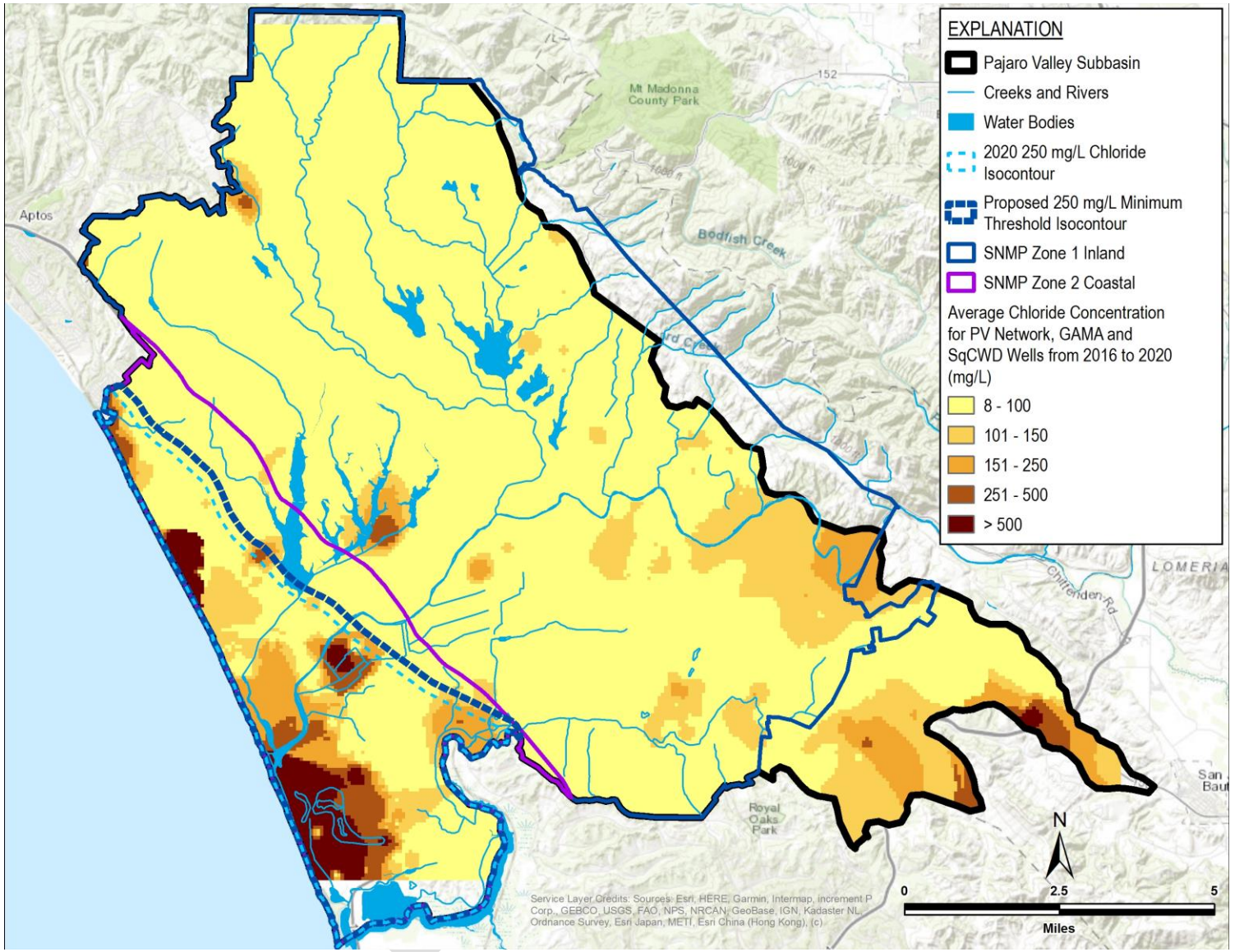

Figure 3. Interpolated Surface of Average Chloride Concentrations, 2016-2020

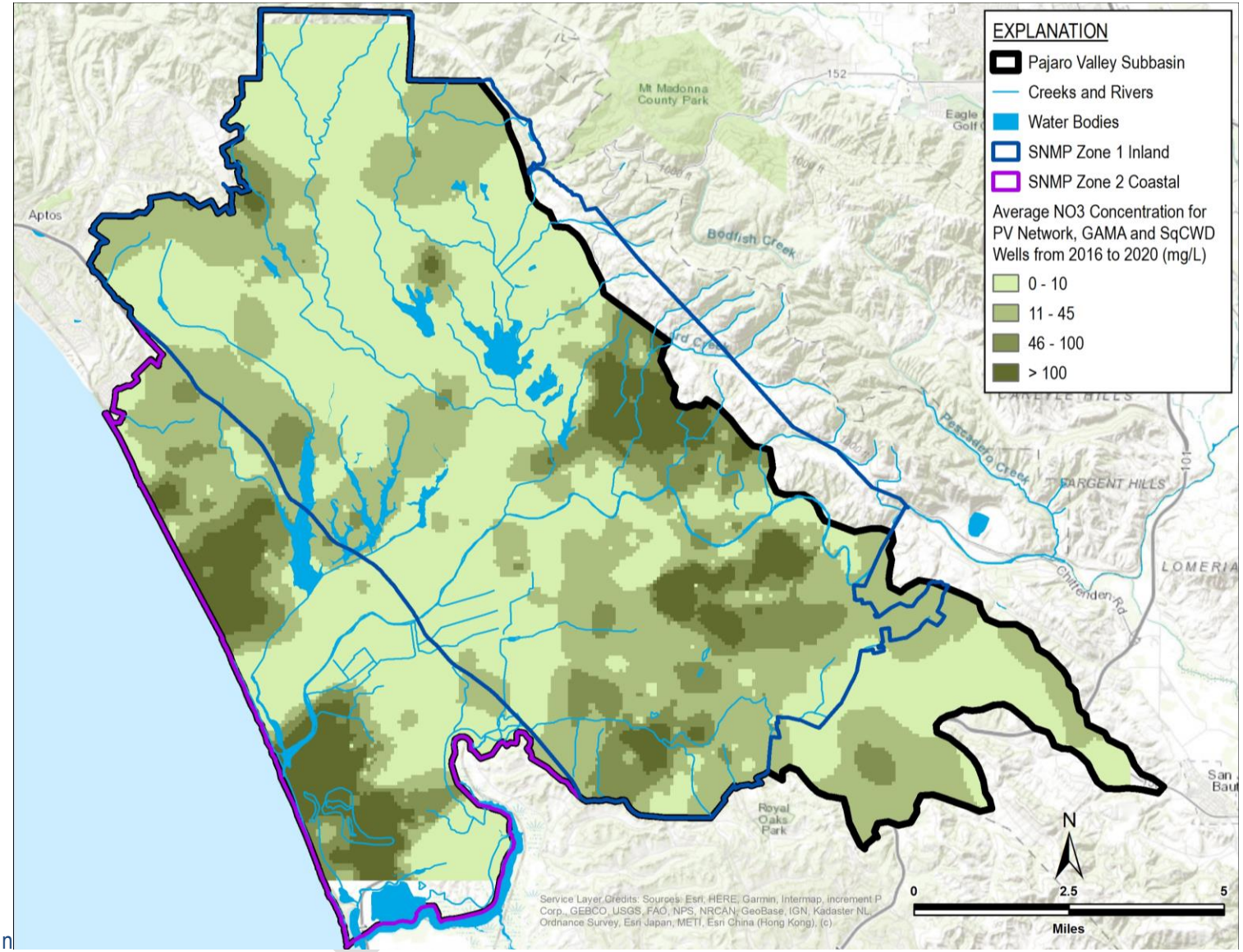

Figure 4. Interpolated Surface of Average Nitrate as NO_3 Concentrations, 2016-2020

Average concentrations during 2016-2020 by zone for the 3 constituents are below minimum thresholds except for nitrate and chloride in the coastal zone. The minimum threshold exceedance for nitrate is an undesirable result. This is a result of an increase of calculated average concentration from slightly below the minimum threshold in 2002-2011 to above the minimum threshold in 2016-2020.

Chloride concentrations in the coastal zone are above 150 mg/L but is a result of seawater intrusion so the seawater intrusion SMC isocontour applies. The SNMP coastal zone does extend inland of the seawater intrusion SMC isocontour where chloride concentrations are not a result of seawater intrusion. In the area of the coastal zone inland of the seawater intrusion SMC isocontour is approximately 42 mg/L.

Changes of average concentration by zone can be compared to measurable objectives of eliminating increases in concentrations. However, there has been an expansion of the dataset used for calculating average concentrations and the average for the inland zone now includes the non-jurisdictional area. Therefore, the change of average concentration should not be evaluated by comparing the calculated 2016-2020 averages by zone (Table 2) and the 2002-2011 averages in the SNMP (Table 1). Future comparisons of averages based on more comparable datasets will allow for a more accurate evaluation of measurable objectives.

CONCLUSION

This evaluation of groundwater quality conditions for comparison with approved water quality SMC for the Basin shows that there are no undesirable results for water quality in the inland zone, and for TDS or chloride in the coastal zone.

An increase of average nitrate concentrations in the coastal zone has resulted in an undesirable result. Undesirable results must be eliminated to achieve sustainability by 2040 and avoid state intervention in Basin management after 2040. PV Water should evaluate its existing projects and management actions and consider new projects and management actions to reduce nitrate concentrations in the coastal zone and eliminate this undesirable result by 2040.

REFERENCES

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