Focused Technical Review:
July 2019 Merced Subbasin Draft Groundwater Sustainability Plan (GSP)

Water Levels

The draft GSP sets the minimum thresholds (MTs) for groundwater levels as the shallower of: (1) the construction depth of the shallowest well in a two-mile radius of each representative monitoring well, or (2) the minimum pre-January 2015 elevation. The GSP further defines the undesirable result (UR) as being when greater than 25% of the representative monitoring wells (RMWs) are below their respective MT for two consecutive years. This approach to setting water level MTs leaves key beneficial users in the subbasin, specifically domestic well users and in particular members of disadvantaged communities (DACs), potentially vulnerable to impacts.

- The water level MTs are set relative to the bottom of the total well construction depth. A water supply well becomes unusable or subject to decreased performance and longevity as water levels fall within the screened interval, which will occur before water levels reach the bottom of the well. **Therefore, many domestic wells within the two-mile radius may be impacted before this MT is exceeded or URs are triggered**.
- Given the limited spatial distribution of the RMW network, a substantial proportion of domestic wells within the subbasin appear to have not been considered in the development of these MTs. **Figure 1** shows the location of domestic wells within the subbasin. Each dot is scaled to represent the number of wells located within a given PLSS Section (i.e., approximately a 1-square mile grid cell). Based on this assessment, approximately 1,100 out of approximately 3,600 domestic wells in the subbasin are located outside of the two-mile radius areas used to establish these MTs. **Nearly one-third of all domestic wells in the subbasin were therefore not considered in the establishment of MTs.**
- The RMWs are generally located in the center of the subbasin, while domestic wells are distributed widely across the subbasin. In particular, as shown in **Figure 1**, the domestic wells located in and around the DACs of El Nido, Planada, Le Grand, and south of the City of Merced are located outside of the areas being monitored for water levels. **As such, there are no water level RMWs, or SGMA compliance points, for water levels in the vicinity of these beneficial users.**
- **Figure 1** also shows the location of community water systems in the subbasin. As you can see in this figure, the **RMW network does not provide adequate coverage for the Planada Community Services District (CSD), Planada Elementary School, or Le Grand CSD; combined, these systems serve a population of over 6,800 people.**
- In order to improve the RMW network, we recommend that additional *representative* monitoring wells (with MTs) be established to be protective of the DACs of Planada, El Nido, and Le Grand.
- **Figure 2** shows the approximate elevations of the domestic well depths (as estimated elevations) with an inset of Figure 3-3 from the draft GSP, which presents the groundwater levels at the proposed MTs for the RMW network. Domestic well depths are shown using the same color

scheme as in the GSP figure, with red representing the shallowest wells and blue representing the deepest wells. Based on this assessment, it appears that many domestic wells are completed to shallower depths than the proximate water level MTs. We acknowledge that this assessment is a "quick and dirty" assessment of well elevations; however, the GSP does not clearly and transparently present the domestic well data used for the establishment of these MTs, nor does it present an assessment of how many and which domestic wells are expected to go dry if the MTs are reached. **Per 23 CCR § 354.28, these assessments should be included in the GSP in order for the public and DWR to able to fully evaluate the ability of the proposed sustainable management criteria and monitoring program to protect beneficial users within the subbasin.**

Water Quality

The draft GSP includes limited analysis of water quality constituents and defines URs for water quality as a "reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP." For the reasons identified below, the water quality monitoring network and analysis presented in the draft GSP appears to be inadequate, and the sustainable management criteria do not appear to be sufficient to ensure that the stated water quality UR of impacting the long-term viability of the groundwater resource, particularly for domestic water users including DACs, will be avoided.

- The draft GSP sets MTs for groundwater quality for only five *representative* monitoring wells within the subbasin.[1] This represents only one well for over 153 square miles of groundwater subbasin, or 0.65 wells per 100 square miles. This monitoring well density is just barely within the established DWR guidance for monitoring well densities of between 0.2 and 10 wells per 100 square miles.[2] Further, the DWR guidance provides a range of recommended monitoring density and notes that the frequency of monitoring wells depends on local geology, extent of groundwater use, and how the GSP defines undesirable results. **Given the complexity of this subbasin and the geographic distribution of sensitive beneficial users, this proposed network of water quality RMWs appears to be insufficient to monitor impacts to groundwater for drinking water beneficial users, particularly domestic well users and DACs.**

- **Figure 3** shows the location of domestic wells within the subbasin. Each dot is scaled to represent the number of wells located within a given PLSS Section (i.e., approximately a 1-square mile grid cell). **Figure 3** also shows the location of the five water quality RMWs. Over 2,600 out of 3,600 domestic wells in the subbasin are located outside of a two-mile radius of these RMWs. **Over 70% of all domestic wells in the subbasin are therefore located more than two miles from RMW locations where water quality sustainability will be evaluated against MTs.**

- As shown in **Figure 3**, nearly 70 community water systems are located in the subbasin, most of which are located far from the water quality RMWs, including Planada CSD, Le Grand CSD, and many systems supplying schools in the area. The proposed water quality representative monitoring network appears to be inadequate for measuring and quantifying the sustainability of

[1] It is noted that the GSP acknowledges that water quality data from additional wells will be included for annual reporting purposes, but not compliance purposes under SGMA.

[2] DWR, 2016. *Best Management Practices for the Sustainable Management of Groundwater, Monitoring Networks and Identification of Data Gaps (BMP #2),* December 2018.

the groundwater resource for these systems. The GSP explains that community water systems are required to conduct periodic water quality monitoring on their systems; however, this does not prevent the systems from being impacted by degraded water quality resulting from groundwater use and management actions in the subbasin. **At a minimum, the draft GSP should explain how the data from the community water systems will be incorporated into subsequent GSP evaluations and decisions. Further, the draft GSP should describe how the proposed RMWs will ensure that the groundwater used by these community water systems will be managed to avoid significant and unreasonable negative water quality impacts to these beneficial users.**

- In order to improve the monitoring network for water quality, we recommend that additional *representative* monitoring wells (with MTs) be established to be protective of the DACs of Planada, El Nido, and Le Grand, as well as in the western portion of the subbasin.
- The draft GSP states that "The primary naturally-occurring water quality constituents are arsenic and uranium." However, despite being a primary water quality constituent, uranium data are not reviewed and included in the document. Based on data listed as available in Data Management System (DMS; described in Appendix E), uranium data are available to the GSAs for review and analysis. **In order to characterize the water quality conditions in the subbasin and evaluate sustainability management criteria, uranium concentrations, including temporal and spatial trends, should be analyzed, in particular with respect to use of groundwater by drinking water users.**[3,4]
- Arsenic is also identified in the draft GSP as a primary water quality constituent. The draft GSP presents a five-year average of arsenic concentrations (2007-2012) as a contoured map, with no explanation as to the methodology used to contour the map. This methodology of presenting the data has the potential to obscure "hot spots" and localized trends. Appendix E presents time plots of arsenic concentrations from 1984 – 2012, and based on the data presented, areas of higher arsenic concentrations are present in the subbasin. The draft GSP also does not present any analysis comparing the change in arsenic concentrations to the change in water levels. Further, the draft GSP does not include any arsenic data post 2012, which is an omission of the evaluation of possible change in water quality as a result of the lowered water levels experienced during the recent drought. In addition, arsenic concentrations haven been shown in some areas to have a relationship to the dewatering of the Corcoran Clay.[5] This spatial trend should also be evaluated, with data presented clearly with respect to the presence of the clay. **The analysis of arsenic concentrations in groundwater are therefore incomplete with respect to 1) recent data, 2) correlation to changing water levels, and 3) relationship to the presence of the Corcoran Clay.**[3,4]
- The draft GSP provides the following justification for not establishing MTs for naturally occurring constituents, including arsenic and uranium: "Thresholds are not set for these constituents as there is no demonstrated local correlation between fluctuations in groundwater elevations

[3] DWR, 2017. *Best Management Practices for the Sustainable Management of Groundwater, Sustainable Management Criteria (BMP #6),* Draft November 2017.
[4] Stanford, 2019. *A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act,* Spring 2019.
[5] Smith, Ryan et al. "Overpumping leads to California groundwater arsenic threat." *Nature communications* vol. 9,1 2089. 5 Jun. 2018, doi:10.1038/s41467-018-04475-3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5988660/

and/or flow direction and concentrations of these constituents at wells."(Section 3.6.2). The draft GSP makes the conclusion that there is no demonstrated correlation between water quality and water elevations, but does not present the data or analysis to support this claim. In particular, the draft GSP omits all water quality data collected after 2012 for arsenic. The water quality trend data presented in Appendix E only provides data through 2012 for selected water quality constituents (TDS, arsenic, nitrate, hexavalent chromium, DBCP, 1,2,3-TCP, etc.) and therefore does not present temporal trend data that would be associated with the lowered groundwater levels during the drought. This is an incomplete analysis of groundwater conditions that could have a significant impact to sustainability and the usability of the groundwater resource by drinking water users. [3,4] **The draft GSP makes a key conclusion relevant to the long term management of water quality in the subbasin based on a conclusion that is unsupported by the analysis presented in the draft GSP.**

- The draft GSP also states that "The primary water quality constituents of concern related to human activity include salinity, nitrate, hexavalent chromium, petroleum hydrocarbons (such as benzene and MTBE), pesticides (such as DBCP, EDB, 1,2,3 TCP), solvents (such as PCE, TCE), and emerging contaminants (such as PFOA, PFOS). *Of these issues, nitrate is the most widespread issue with a direct impact on public health. [Emphasis added.*] Salinity is also an issue due to the widespread nature of the problem and difficulty of management given increases in salinity as a result of both urban and agricultural use." Table 2-8 indicates that the Merced County Department of Public Health considers nitrate to be an adverse groundwater quality parameter for most regions in the subbasin. Despite its widespread importance and impacts to drinking water the GSP does not set MTs for nitrate, or for any water quality constituent other than TDS. The justification given for this is that "Thresholds are not set for these constituents as the GSAs have no authority to limit the loading of nutrients or agrochemicals." Per 23 CCR § 354.28**, the draft GSP should provide a detailed explanation as to how this approach will result in protection of groundwater for DACs and other drinking water beneficial users in the subbasin.**

Other Monitoring Network Comments

- The GSP proposes a project to install two monitoring well clusters in and near the community of El Nido, a severely disadvantaged community (SDAC) for the purposes of "understanding of stratigraphy and groundwater conditions in the area and improve ongoing monitoring of water elevation and water quality" primarily to "understand water movement and causes of land subsidence in this area." The GSP also purports that this project "also directly benefits a SDAC." However, the GSP makes no mention that these new wells will be come *representative* monitoring wells or that MTs will be established for these wells. **To ensure that these new wells will provide a benefit to the community of El Nido, these should be established as RMWs with established water level and water quality MTs, as quantifiable measurements of sustainability. Setting these as RMWs will better support the GSAs to manage groundwater sustainably in this area and thus protect these beneficial users.**

Well Mitigation Program

Based on our assessment of the water levels, a significant proportion of domestic wells have the potential to be partially or fully dewatered if water levels reach the proposed MT levels. However, the draft GSP

does not include or describe any plans to develop a well impact mitigation program. Such a program could include a combination of replacing impacted wells with new, deeper wells and/or connecting domestic users to a public water system. A plan to reestablish the emergency tanked water program may be an appropriate short-term solution, but would not be a good long-term solution for community members. Key considerations for establishing such a program should include:

- A strong preference for connecting current domestic well users to a public water system, whenever possible. Public water systems have an obligation to test water quality for water served, and although the public water systems in this area typically have limited resources, they do have a greater ability to install treatment systems to address water quality impacts, recoup funds for litigated contamination such as 1,2,3-TCP, and apply for and receive grant funding for beneficial projects. Because of this, public water systems, including small community water systems, provide a more reliable drinking water source than privately-owned domestic wells.
- A secure and reliable funding source and mechanism for implementation of such a mitigation program needs to be identified. While grant or emergency funding could potentially be available for such a program when needed, the availability of these funds is not certain. A more secure funding mechanism could be the establishment of a reserve fund that is paid into on an annual basis and accrues funds that would then available as water levels drop in the future.
- The implementation of a mitigation program should be triggered before wells begin to become unusable, so that funding will be available, and the necessary planning and contracting will be completed such that the necessary construction will be implemented without unnecessarily leaving community members without access to drinking water. Thus, the program should be designed to be proactive, rather than reactive.
- A well mitigation program should not be established only in case of emergency, such as the tanked water program during the last drought. Droughts are said to be becoming more and more frequent and severe, and as such should be included as part of the long-term sustainability planning for the subbasin.

Water Budget

The Water Budget section (2.3) and Climate Change Analysis section (2.4) of the draft GSP were reviewed to identify approaches and assumptions used in the water budget development that may not be protective of domestic water users and small community water systems. Water budgets for the subbasin were developed for historic, current, and projected conditions using the Merced Water Resources Model (MercedWRM). The MercedWRM produces water budgets for the Stream & Canal System, Land Surface System, and Groundwater System. Comments regarding the adequacy of the assessment and projections of conditions relevant to DACs are provided below.

- The draft GSP presents only a brief listing of the data sources used to specify conditions for the model periods used to develop the water budgets. There is very little discussion on how the model input relative to the water budget was developed from the listed sources. It is noted in the text that additional data used for model development is included in Appendix D (MercedWRM Model Documentation), but Appendix D is still under development and was not included in the draft GSP. Therefore, any additional data related to the water budget could not be reviewed at this time.

The draft GSP made available to the public is incomplete, and a full evaluation of the model and assumptions cannot be made at this time.

- According to the draft GSP, urban water demand is based on the 2015 Urban Water Management Plan (UWMP)[6] and municipal pumping records. However, no information is provided on the magnitude of the urban demand, population information, or per capita water use specified in the model. The draft GSP does not identify which municipal water providers provided data and which required estimation of water demand. Nor does it discuss how estimated water use from rural domestic water users or small community water systems was represented in the model or the magnitude of these values. **Therefore, based on the limited data provided in the draft GSP, the public cannot review the drinking water demand estimates for domestic users, community water systems, or large urban water suppliers and make an assessment as to the appropriateness of the demands considered in the historical, current, or future water budgets.**
- There is no specific information included in the draft GSP on how historical land use was determined from available data or how it varies over the historical water budget period. According to the draft GSP, the current water budget uses 2013 CropScape data and the projected water budget uses the 2013 CropScape data, 2015 agricultural water management plan projections, and information from local agencies and farmers. No summary of acreages by land use type is provided so the accuracy of the representation of urban and agricultural areas cannot be assessed by the public. **Without this information the public cannot assess how domestic well users and small community water systems are represented in the land use data.**
- The majority of the draft GSP section discussing the water budget focuses on the results of the water budget. These results are presented as average annual values for the entire subbasin which limit the ability for the public to evaluate and understand the impacts to DACs and small community water systems. Time series graphs of the water budget results are needed to evaluate if the water budget adequately represents the temporal variability and trends in drinking water demand. **By presenting only subbasin-level water budget results and only as average annual values, the presented results are opaque with respect to drinking water use by DACs, as well as demands by other types of beneficial users.**
- The draft GSP does not include any discussion of the uncertainty in the data used for the model and its potential effects on the water budget results. **The GSP should include an uncertainty analysis to identify the plausible range in water budget results and an indication of the magnitude of the effects these inherent uncertainties may have on the water budget results.[7]**
- The estimate of sustainable yield for the subbasin was determined using the Projected Conditions Baseline scenario. According to the draft GSP, in this scenario, agricultural and urban demand is reduced across the model domain to achieve a net storage change of zero. Agricultural demand was reduced by reducing agricultural land use. Urban demand was reduced by reducing the per capita water use. However, the draft GSP does not present information on how per capita water

[6] The water budget section of the GSP refers to a singular UWMP – but does not specify if the UWMP used was for the City of Merced, City of Livingston, or both.

[7] DWR, 2016. *Best Management Practices for the Sustainable Management of Groundwater, Modeling (BMP #5),* December 2016.

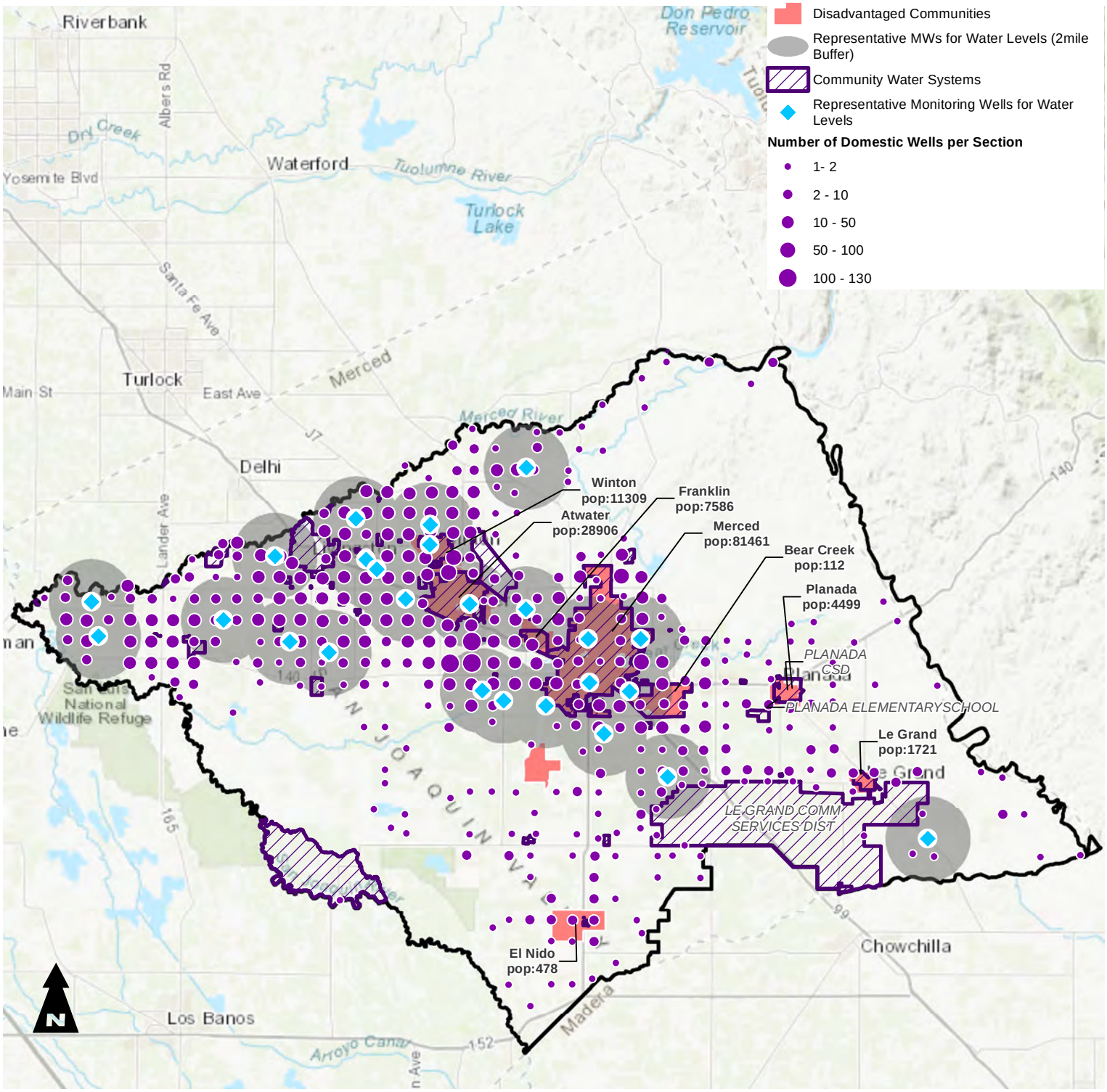
use reductions were determined or if they were applied equally to all drinking water users (municipal users, rural domestic users, small community waters systems, etc.). The document also does not include a discussion of how these reductions would affect domestic water users or small community water systems. **Therefore, based on this, it is not clear how demands by drinking water users were considered in the sustainable yield calculation.**

Attachments

Figure 1 - Representative Monitoring Network for GW Levels Relative to Domestic Wells, DACs, and Community Water Systems
Figure 2 - Water Level MTs and Domestic Wells
Figure 3 - Representative Monitoring Network for Water Quality Relative to Domestic Wells, DACs, and Community Water Systems

Figure 1 - Representative Monitoring Network for GW Levels Relative to Domestic Wells, DACs, and Community Water Systems

Merced Subbasin



Notes

1. All locations are approximate.

References

1. Domestic Well Densities: CWC draft Vulnerability Tool as of August 6, 2019.
2. Disadvantaged community data: downloaded on August 6, 2019 from the DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/.
3. Community Water System data: downloaded on August 6, 2019 from Tracking California: https://trackingcalifornia.org/water/map-viewer.
3. Groundwater level monitoring well information are from Draft Merced Subbasin GSP dated July 2019.

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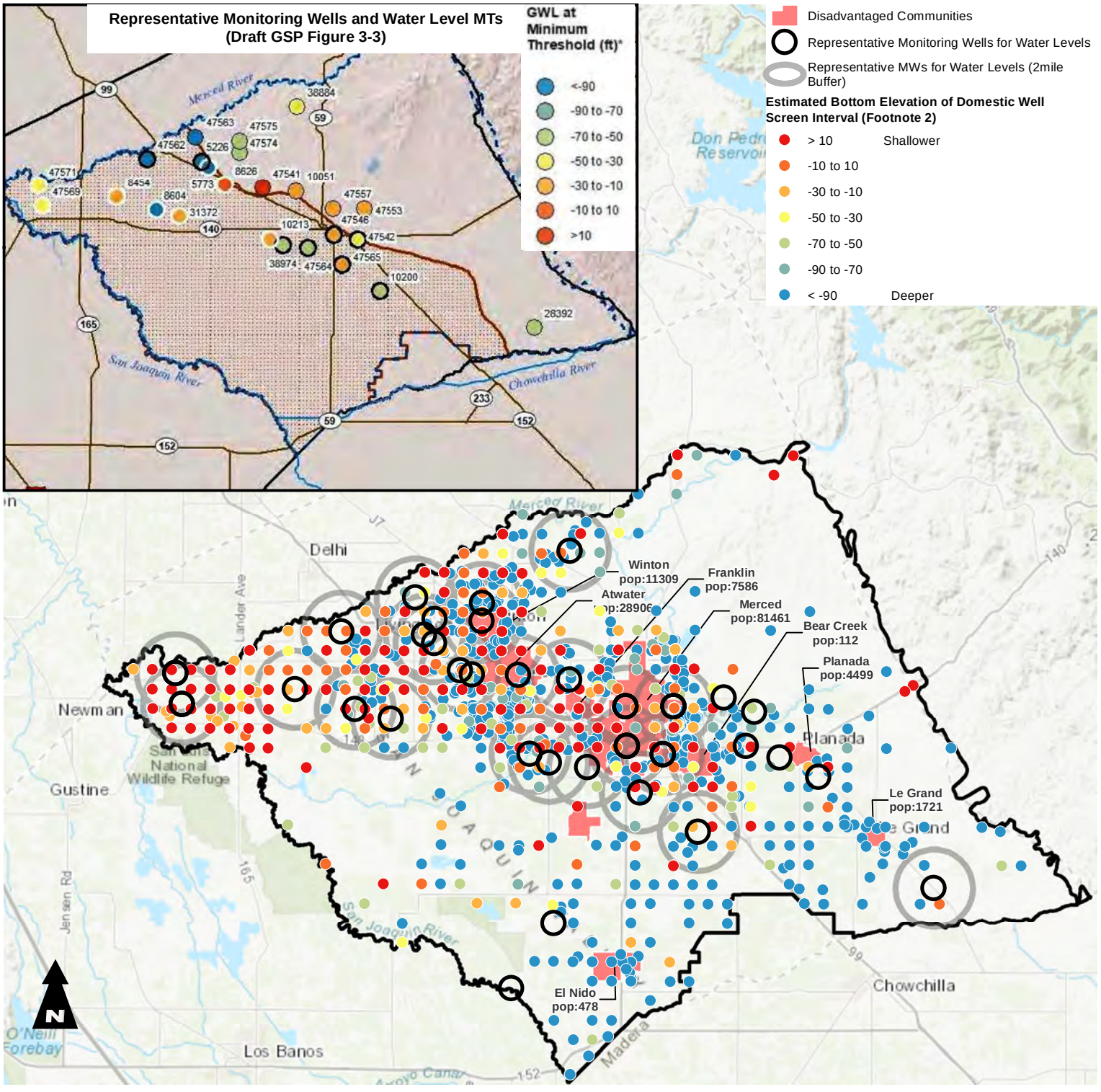
Figure 2 - Water Level MTs and Domestic Wells

Merced Subbasin



Notes

1. All locations are approximate.
2. In order to estimate the domestic well elevations, the depth of domestic wells is subtracted from the ground surface elevation. For purposes of this assessment, the ground surface elevation is assumed to be 100 ft above sea level for the entire Merced Subbasin area. Where available, bottom of screen interval was used for this assessment, and bottom of well depth was used for the remaining wells.

References

1. Domestic Well data: CWC draft Vulnerability Tool as of May 16, 2019.
2. Disadvantaged community data: downloaded on August 6, 2019 from the DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/. Last updated in 2016.
3. Groundwater monitoring well information are from Draft Merced Subbasin GSP, dated July 2019.

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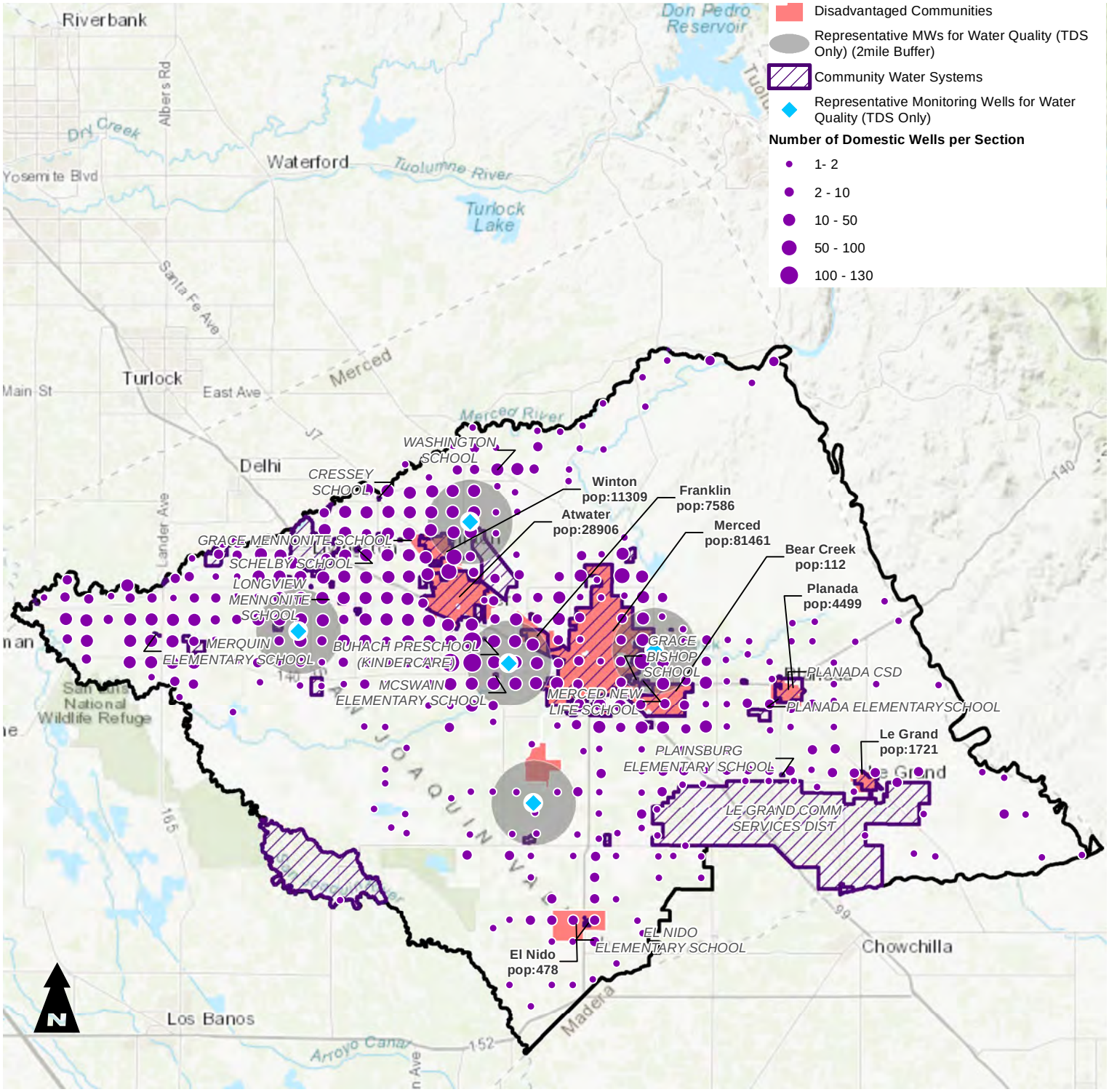
Figure 3 - Representative Monitoring Network for Water Quality Relative to Domestic Wells, DACs, and Community Water Systems

Merced Subbasin



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1. All locations are approximate.

References

1. Domestic Well Densities: CWC draft Vulnerability Tool as of August 6, 2019.
2. Disadvantaged community data: downloaded on August 6, 2019 from the DAC Mapping Tool: https://gis.water.ca.gov/app/dacs/.
3. Community Water System data: downloaded on August 6, 2019 from Tracking California: https://trackingcalifornia.org/water/map-viewer.
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