Permit Sonoma. Well Ordinance Public Trust Policy Development Process

Outcomes and Recommendations Report

Dated: March 13, 2023

Submitted to:
Director Tennis Wick, Permit Sonoma

Submitted for:
Policy Work Group and Technical Work Group
Developed by: Consensus Building Institute in collaboration with Policy and Technical Work Group Members and Permit Sonoma Staff

Executive Summary

From November 17, 2022, through March 1, 2023, Permit Sonoma, a department for Sonoma County, convened two working groups to advise the Permit Sonoma director on policies and the best available science to develop a well ordinance in consideration of public trust resources. This report summarizes the outcomes and recommendations of these groups: the Technical Working Group and the Policy Working Group. And, Table 1 provides a brief sketch of the proposals developed, the rationale for support or concern, and other issues and considerations for the County. The Permit Sonoma director will consider these outcomes and recommendations when preparing a draft well ordinance for the Board of Supervisors to consider in April of 2023.

Terms

In summarizing topics and the rationale for support or concern, the term "Proposal" reflects the working proposal that the working groups advanced and refined through the process. The term "Pro" refers to positive aspects of the working proposal that have broad support from the working groups. The term "Con" refers to the working groups' shared concerns or perspective on negative aspects of the working proposal. The term "Issue" identifies specific concerns or points of view that one or more working group members raised. Generally, working group members did not have broad agreement on perspectives summarized in "Issues."

Table 1. Public Trust Well Ordinance Policy and Technical Work – At a Glance

[Click on Topic on left in Table 1 to read more.]

Adverse Impacts	**Proposal**: Adverse impacts are based on habitat value for salmonids and streamflow depletion of >=10% in streams that support Coho and >=20% in streams that support Steelhead. Salmonids are a proxy for other public trust resources. **Pro:** The Technical WG supports the thresholds because they are based on scientific literature. The proposal is workable if refined periodically given future recommendations to define in-stream flow criteria.

	Pro: The Policy WG agreed that adverse impacts to salmonids in both navigable and non-navigable tributary streams should be the focus of the public trust review of the well ordinance. **Issue:** The proposal looks at streamflow reduction July - September. Some Technical WG members would recommend looking at streamflow reduction either all year long or June - May during a year with a dry spring or June – October; all are in consideration of salmonid migration. **Issue:** Some Technical WG members support refining the approach to use the California Environmental Flows Framework.
Public Trust Review Area	**Proposal:** The review area map identifies areas with moderate-to-high risk of impacts to public trust resources. The area includes high habitat value watersheds and factors in streamflow depletion associated with pumping. Wells within these areas must adhere to specific requirements, like water conservation and monitoring. **Pro**: *Approach* - All Policy WG and Technical WG members can at least "live with" or support this public trust review area as the method for delineating the area (evaluating streamflow depletion and habitat value), which is available to the County in the *near term*. **Pro:** The map provides certainty to permit applicants as to whether the public trust consideration and additional water conservation requirements apply to their permit application. **Con:** Some Technical WG / Policy WG members think that applying the review area to the whole county would provide more certainty to landowners because the review area wouldn't have to be regularly delineated to account for changes in climate and pumping conditions. **Issue:** Some Policy WG members feel that the review area will suffice at this time but could need to change once data are collected to assess the effectiveness of the approach. **Issue:** A clear and time-bound commitment to assess and develop a plan to address data and modeling needs is essential to ensure a robust and reasonable ordinance.
Well Classification: Ministerial and Discretionary	**Proposal:** Permit Sonoma would screen wells first based on location. In the review area, volume and well type (new, replacement, etc.) would determine whether a permit is ministerial (routine) or discretionary (tailored review). **Pro:** The Policy WG supports incentivizing storage tanks, stormwater capture, groundwater recharge, and regenerative agriculture via the Zero Net Increase well class. **Issue:** A remaining concern of CDFW and others is cumulative impacts (including impacts from existing wells) and that those impacts may not be fully addressed and mitigated as part of these recommendations. **Issue:** Some Policy WG and Technical WG members have proposed that a more thorough public trust impact analysis be used to determine if a well applicant falls into a ministerial or discretionary permitting process.

	This approach is considered in the future recommendations since it is not available in the immediate time frame. **Future Recommendation**: Some Policy and Technical WG members support quantifying low water use by parcel acreage so large parcels are allowed the use of more groundwater under the "low water use" ministerial category.
Well Implementation Requirements – Conservation and other Measures	**Proposal:** Nearly all wells, except public water wells (generally under local government jurisdiction), would require water conservation for permit approval. Many from the Policy WG would like to factor volume of water use into well permitting requirements, the Policy WG was evenly split on the options for this purpose. **Proposal:** Roughly half of the Policy WG members support setting the water use threshold at 2 acre-feet per year (AFY) similar to the Governor's drought order and SGMA's de minimis threshold. The other half support creating a low water use (less than 0.5 AFY) well class and a moderate water use (0.5-2.0 AFY) well class. **Issue:** The primary reason for support for delineating a low water use class is tied to most residences typically relying on 0.5-1.0 AFY on average and putting low water use well owners on notice that additional conservation would be necessary to offset increased pumping. **Issue:** A concern is that this is difficult to measure.
Discretionary Review Process	**Proposal:** Wells associated with increased groundwater use, greater than 2.0 AFY would be subject to discretionary review. The County would conduct the analysis for the discretionary review process, assess adverse impacts, and set mitigation requirements. Adverse impacts include reduction in streamflow due to cumulative groundwater use, and acute impacts of groundwater pumping of the project and nearby wells. **Pro:** The Policy WG and the Technical WG would recommend that the County lead the analysis for the discretionary review process, which should reduce costs for landowners, provide consistency, and streamline reviews.
Metering and Monitoring Requirements	**Proposal:** The groups propose two options for consideration, including meters on all new wells and annual reporting; the distinction Is on whether low water use residential and existing use wells have voluntary or mandatory reporting. Wells or parcels using more than 5 AFY would report water levels, and agriculture, commercial, and industrial would report on conservation practices.
Adaptation Recommendations	**Proposal**: Recommendations pertain to improving data; improving analytical and numerical modeling; quantifying conservation; developing standards for future ministerial permits associated with sustainability; coordinating with groundwater sustainability agencies; continuing stakeholder engagement; systematically reviewing the well ordinance; and developing funding for implementation.

Contents

Advisory Policy and Technical Working Groups Overview

In fall of 2022, Permit Sonoma convened two working groups, one focused on policy and the other focused on scientific information, to develop recommendations to advise the Permit Sonoma Director on proposed revisions to Sonoma County's well ordinance in relation to the County's obligations under the Public Trust Doctrine. The Director is considering the input from these two working groups, summarized in this report, when developing the well ordinance policy that the Sonoma County Board of Supervisors will consider and decide upon in early April 2023.

The responsibility of the **Policy Working Group** (Policy WG) was to advise the Director on well policy related to public trust doctrine. The role and responsibility of Policy WG members was to represent, solicit, and integrate community and stakeholder interests into recommendations on the revised well ordinance. The Policy WG members have also integrated the best available science to inform policy for groundwater sustainability and availability for people and the environment in Sonoma County.

The responsibility of the **Technical Working Group** (Technical WG) was to advise on the analytical processes necessary to implement any potential policies. The Technical WG focused on technical development through data compilation, modeling, and other measures to better understand the interconnection of public trust surface waters and groundwater. The Technical WG collaborated with the Policy WG members to answer questions and assisted in developing policy and ordinance working proposals.

The Director selected members of the Policy and Technical Working Groups, so meetings were not subject to the Brown Act. However, Policy WG meetings and Joint Meetings between the two work groups were open to the public.

Each group held six formal meetings and three joint meetings between November 17, 2022, and March 1, 2023. Members of the Technical WG also met in small groups to delve into detailed work. The Chairs met weekly with the Permit Sonoma staff, technical consultants (O'Connor Environmental Inc.), and the facilitation team (Consensus Building Institute) to plan meetings.

Guiding Questions

To guide their efforts, the working groups considered the following policy development questions:

- Is the ordinance clear and understandable?
- Ease of implementation?
- Is it enforceable?
- Does the ordinance reflect a good faith effort to address the public trust duty?
- Does it account for mitigating harms to public trust whenever feasible?
- Does it address public interest necessity and justify circumstances when permit may issue despite harm to public trust uses?

Common Interests to Weigh Options

The Policy WG identified these common interests to evaluate working proposals for a well ordinance that would consider and mitigate impacts to public trust resources when permitting groundwater wells.

Address Public Trust Duty – Protect Public Trust

Recover listed endangered species that depend on navigable waterways and the tributaries to navigable waterways that provide essential habitat.

Water reliability for people and the environment
Head toward a system of water supply that provides for all

Must be implemented this year

Simplicity (why, what's involved)

Predictable, understandable permitting

Timeline for permitting process is reasonable

Streamlined permitting when possible

Link with SGMA prioritized basins / Groundwater Sustainability Plans (GSPs)

Cost of reviews to landowner

Cost of implementation to county and landowner

Feasibility of implementation for county

Cumulative impact considerations

Adaptive management – recognize need for certainty yet manage with new information and conditions

Community benefit – full participation of the County

Political considerations

Public Trust Legal Backdrop

Provided by Office of Sonoma County Counsel to guide the Policy and Technical Working Groups

The Public Trust Doctrine is a legal doctrine, reflected in Article X, section 4, of the California Constitution, that provides that the government holds certain natural resources 'in trust' for the benefit of current and future generations. The resources include tidelands, submerged land, and land underlying inland navigable waters. Public trust purposes or uses include commerce, recreation, fishing, wildlife habitat, and preservation of trust lands in their natural state.

In 1983, the California Supreme Court in *National Audubon Society v. Superior Court* held that the Public Trust Doctrine "protects navigable waters from harm caused by diversion of non-navigable tributaries." In 2018, *Environmental Law Foundation (ELF) v. State Water Resources Control Bd.,* the California Court of Appeals found that the Public Trust Doctrine applies to permitting of groundwater wells if extraction of groundwater adversely impacts a navigable waterway.

Groundwater is not a public trust resource. However, extraction of groundwater that is interconnected with a stream or river may result in reduced streamflow and impact public trust resources of a navigable waterway.

Known navigable waters in Sonoma County include the main stem of the Russian River from Jenner to the Sonoma/Mendocino County line and waterways identified as navigable by the U.S. Army Corps of Engineers survey Navigable Waterways as of 2 August 1971 (Link to scanned document on Corps site).

Under the *ELF* decision, impacts to public trust resources must be considered and mitigated, if feasible, when a county issues a permit for a well that may reduce flows and adversely impact public trust resources of navigable waters. Neither the *ELF* decision nor case law generally details exactly how a county must consider and mitigate impacts to public trust resources when permitting groundwater wells. Yet the "how" is the technical and policy task that this effort is addressing. The technical and policy working groups can best support the Director by developing recommendations and options for *how* the County may best meet that legal obligation and articulating the reasons for those recommendations and options.

Adverse Impacts

Framing Questions

What is a substantial adverse impact to a public trust resource? (Watershed, waterway, basins)
What methods should be employed to evaluate adverse impacts to public trust resources?

Adverse Impacts Proposal Overview

Adverse impacts proposed by staff to the working groups are based on habitat value for salmonids and streamflow depletion relative to estimated unimpaired flow conditions (Richter et. al, 2012, Gleeson and Richter, 2018, California Environmental Flows Framework Technical Team, 2018, Public Trust Review Area Documentation). In streams that support Coho, an adverse impact is defined as occurring if >=10% reduction in estimated unimpaired streamflow occurs during periods of summer rearing. In streams that support Steelhead, an adverse impact is defined as occurring if a >=20% reduction in unimpaired streamflow occurs during periods of summer rearing. Salmonids are being used as proxy for other public trust resources.

Adverse Impacts Working Groups' Areas of Agreement, Issues, and Concerns

Pro: The Technical WG supports the adverse impact thresholds because it is based on scientific literature. The proposal is workable if this is refined periodically over time given future recommendations to define in-stream flow criteria.

Pro: The Policy WG agreed that adverse impacts to salmonids in both navigable and non-navigable tributary streams should be the focus of the public trust review of the well ordinance. Impacts to fish habitat are a primary issue of concern for stakeholders since salmonids are a good aquatic ecosystem indicator for assessing adverse impacts to public trust resources.

Issue: The working proposal looks at streamflow reduction July - September. Some Technical WG members would recommend looking at streamflow reduction either all year long or June - May during a year with a dry spring or June – October. Smolt outmigration can extend into June. Fall migration of Chinook salmon can be affected during October before first rains arrive.

Issue: The Technical WG recommends that Permit Sonoma improve the methodology to determine unimpaired flows associated with the streamflow depletion thresholds. Some Technical WG members recommend that any methodology used to determine unimpaired flows have a low level of error.

Issue: Some Technical WG members support refining adverse impacts using the California Environmental Flows Framework (CEFF) process. Some Technical WG members do not support using the Nature Conservancy's Natural Flows Database associated with CEFF due to the incomplete use of local USGS stream gauge data in model development and concerns about uncertainty or potential errors in the modeling dry season unimpaired flows.

Issue: Some Technical WG members are concerned that expanding to non-navigable tributary streams would make the task of developing a revised ordinance more difficult. Other Technical WG members counter that the navigable versus non-navigable distinction is not relevant for fish habitat and viewing the stream system as a whole is simpler.

Issue: Some Technical WG members suggest that the navigable versus non-navigable distinction is not relevant if other analytical approaches were applied to screen for potential public trust impacts prior to designating whether well applicants would fall into the ministerial or discretionary permitting process. However, numerical models are currently not available across the entire county and would need to be implemented over a greater area and diversity of regions for this purpose.

Issue: While several Technical WG members support the working proposal, the details of how this would be implemented to determine adverse impacts should be the subject of future discussions as part of the adaptive management process. For example, what happens in streams that are already reduced by 10% or 20%? Or, if flow criteria have been established via other processes in some watersheds? Unfortunately, there has not been time to fully discuss this and other concerns as part of this process.

Public Trust Review Area

Framing Questions

What waterways require impact analyses under the public trust doctrine?

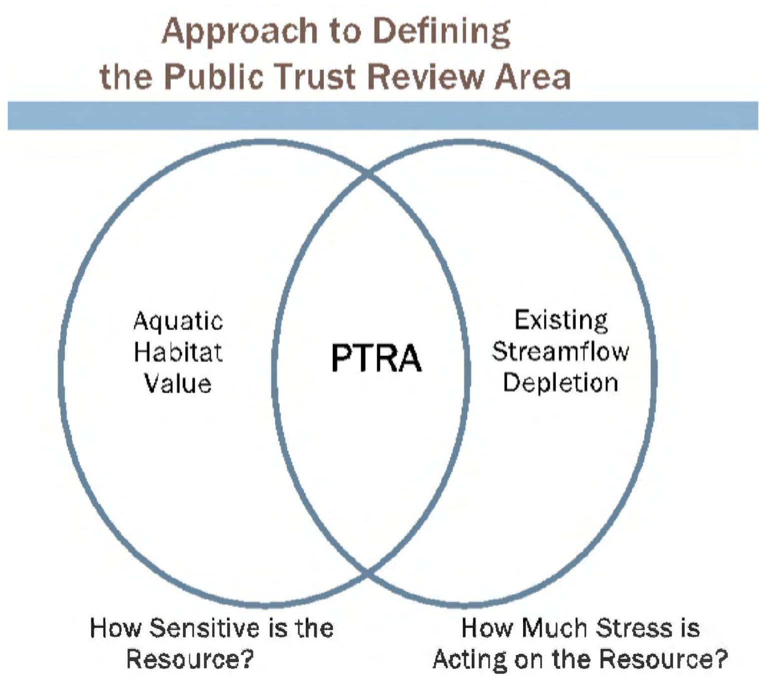
What public trust resources (uses and habitat) are sensitive to streamflow depletion due to groundwater extraction?

What aquifers are interconnected with public trust waterways, and does groundwater extraction from these aquifers have an adverse impact on public trust resources?

Working Proposal

Please see Technical Rationale in Appendix C.

The public trust review area was designed to serve as a screening tool for permitting. Wells within the area are subject to certain requirements (conservation, metering, monitoring) to address public trust resources. The public trust review area was defined by considering regions with sensitive aquatic habitat value and stress on the resource, measured through streamflow depletion. The overlap of these regions defines the public trust review area. The public trust review area includes select areas within all major navigable watersheds of Sonoma County including the Russian River, Gualala, Salmon Creek, Petaluma River, and Sonoma Creek.



An applicant can look at the map to determine if the well is in the public trust review area. The applicant is then on notice that the public trust implementation requirements are necessary for this well to move forward.

The public trust review area map identifies areas with moderate to high risk of impacts to public trust resources due to present-day groundwater pumping.

The area includes high habitat value watersheds (Upper Mark West, Dutch Bill, Mill and Green Valley creeks) and other tributaries that support salmonids and have moderate or high levels of streamflow depletion. Areas identified as medium or high habitat value are included by defined stream buffers along waterways or entire sub watersheds depending on the estimated reduction in flow occurring in those streams due to existing groundwater pumping. Areas identified as very high habitat value for Coho are included as entire sub watersheds regardless of streamflow depletion. Areas identified as low habitat value for salmonids are excluded from the public trust review area.

Other Approaches / Options to defining the Public Trust Review Area

The Technical WG explored other frameworks that could be used to address public trust county-wide in well permitting. Some Technical WG/Policy WG members proposed an alternative approach that would expand the public trust review area to the entire county, where all well applicants would go through an initial public trust impact screening process to determine if the well applicant warrants a ministerial or discretionary permit. This approach is considered in the future adaptation recommendations (later in this report) since it is not available in the immediate time frame.

Public Trust Review Area Working Groups' Support and Concerns

Pro: *Approach* - All Policy WG and Technical WG members can at least "live with" or support this public trust review area as the method for delineating the area by evaluating depletion (pumping ratio, analytical methods, numerical models) and habitat value, which is available to the County in the near term.

Pro: The map provides certainty to permit applicants as to whether the public trust consideration and additional water conservation requirements apply to their permit application.

Con: Some Technical WG / Policy WG members think that applying the public trust review area to the whole county could provide more certainty because the public trust review area wouldn't have to be regularly delineated to account for changes in climate and existing pumping conditions. The public trust review area method needs to be periodically delineated into the future with new pumping and recharge information. A county-wide approach could also help inform water reliability efforts.

Issue: Other Policy WG members may feel that the public trust review area will suffice at this time but could need to change once data are collected and analyzed to assess the effectiveness of the approach.

Issue: Additional monitoring and analysis conducted should be used to refine the well permitting process. The county should use these additional data to update the public trust review area map and as the basis to evaluate future well applications.

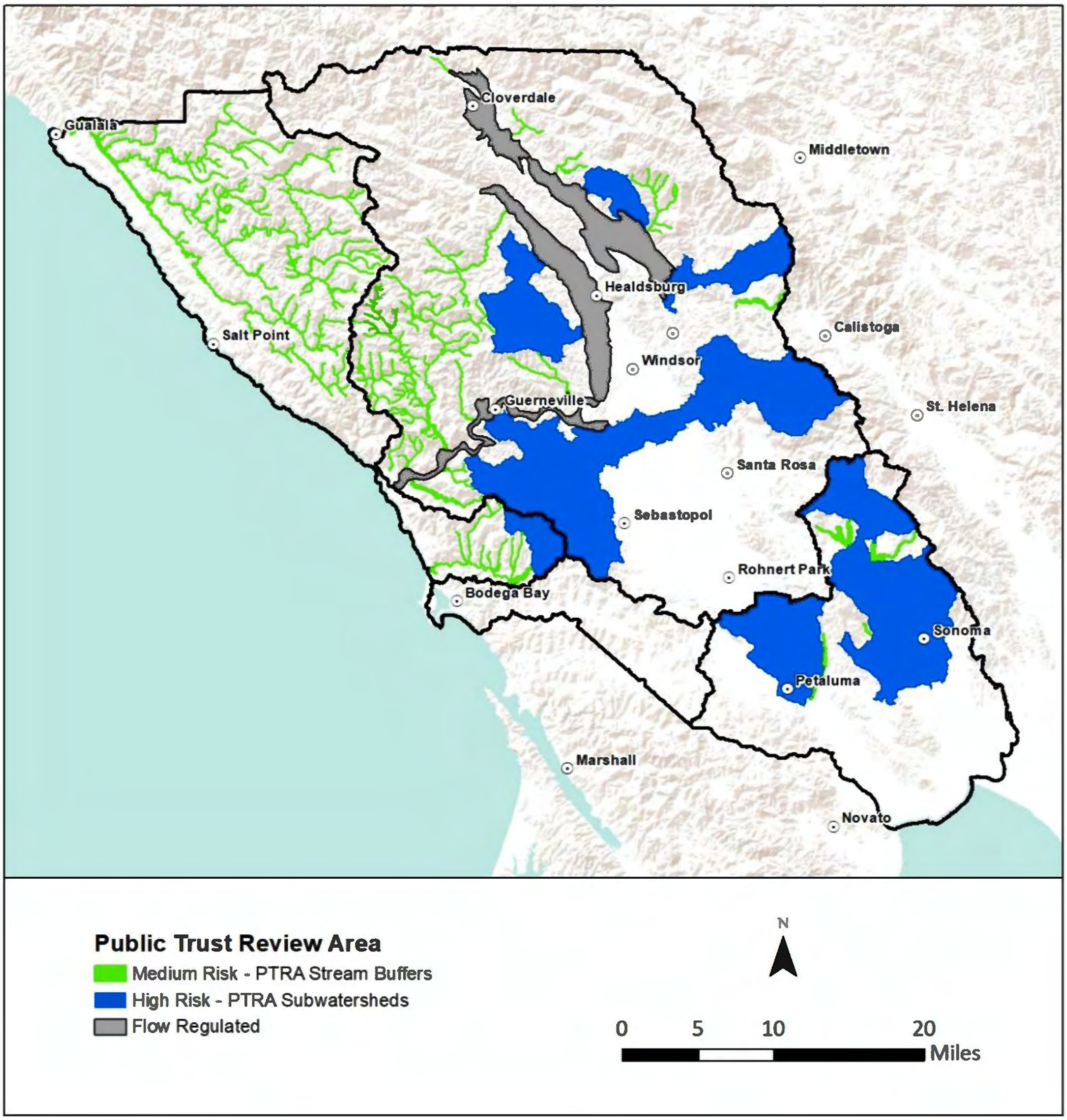
Issue: While the proposed method estimated county-wide streamflow depletion as the cumulative impact of existing groundwater extraction, a Technical WG member identified a limitation of the current approach that it does not address the fact that new wells outside of the public trust review area could have small but cumulative impacts. A basin-wide model is needed to assess how new and existing wells are contributing to streamflow depletion and also to help quantify the benefits of conservation/recharge actions.

Issue: Some Technical WG members (including NMFS and CDFW) support updating the public trust review area using monthly estimates of streamflow depletion from the driest month of dry years (May - October), instead of the current proposal using the average streamflow depletion for the three-month dry season (July - September). This analysis could not be evaluated in the working group time frame.

Issue: Continued data collection, analysis, and adaptation must be included to achieve public trust protections. Existing uses, cumulative impacts, and climatic changes will require ongoing research to address implementation. As an example, impacts from wells outside the PTRA will occur but won't be accounted for or addressed by this program.

Issue: A clear and time-bound commitment to assess and develop a plan to address data and modeling needs is essential to ensure a robust and reasonable management plan/ordinance. Although not yet available, both working groups seek a commitment from the County to do the analysis and update the protocol, where appropriate.

Map of Public Trust Review Area



Well Classifications: Ministerial and Discretionary

Framing Questions

What classes or categories of wells receive a ministerial (routine) permit? What well classes receive a discretionary (more tailored) review? (Replacement domestic wells, low use, residential, public water wells, zero net use, etc.)

Working Proposal

Permit Sonoma would screen wells first based on their location in the county and second by well type. For well permit applications within the public trust review area, the volume of water used and whether new or replacement would determine whether a well is ministerial or requires discretionary review. Ministerial wells would include low water use wells, wells supporting existing uses, public water wells, and wells regulated by the State Water Resources Control board.

Innovation and conservation are captured in the Net Zero Increase class, which would also be ministerial except applications that include groundwater recharge or regenerative agriculture practices. Those involving recharge and regenerative agriculture would be discretionary until Permit Sonoma can set objective criteria. Permit Sonoma will identify conservation actions that are well defined, quantifiable, and verifiable.

Understanding Ministerial and Discretionary Permits

Ministerial permits refer to routine, over-the-counter permits. **Discretionary permits** have a tailored process for analyzing impacts before issuing approval. For clarification on ministerial versus discretionary permits:

- For permits within the public trust review area, those that fit into defined ministerial well classes that require no interpretations or judgment by staff are ministerial.
- Only permits that are in the public trust review area and do not qualify as one of the ministerial classes would be discretionary.

Water conservation and monitoring are the mitigating strategies for ministerial wells. Permit Sonoma would develop mitigation on a site-specific basis for discretionary permits.

Table 2. Ministerial Well Class Definitions and Alternatives

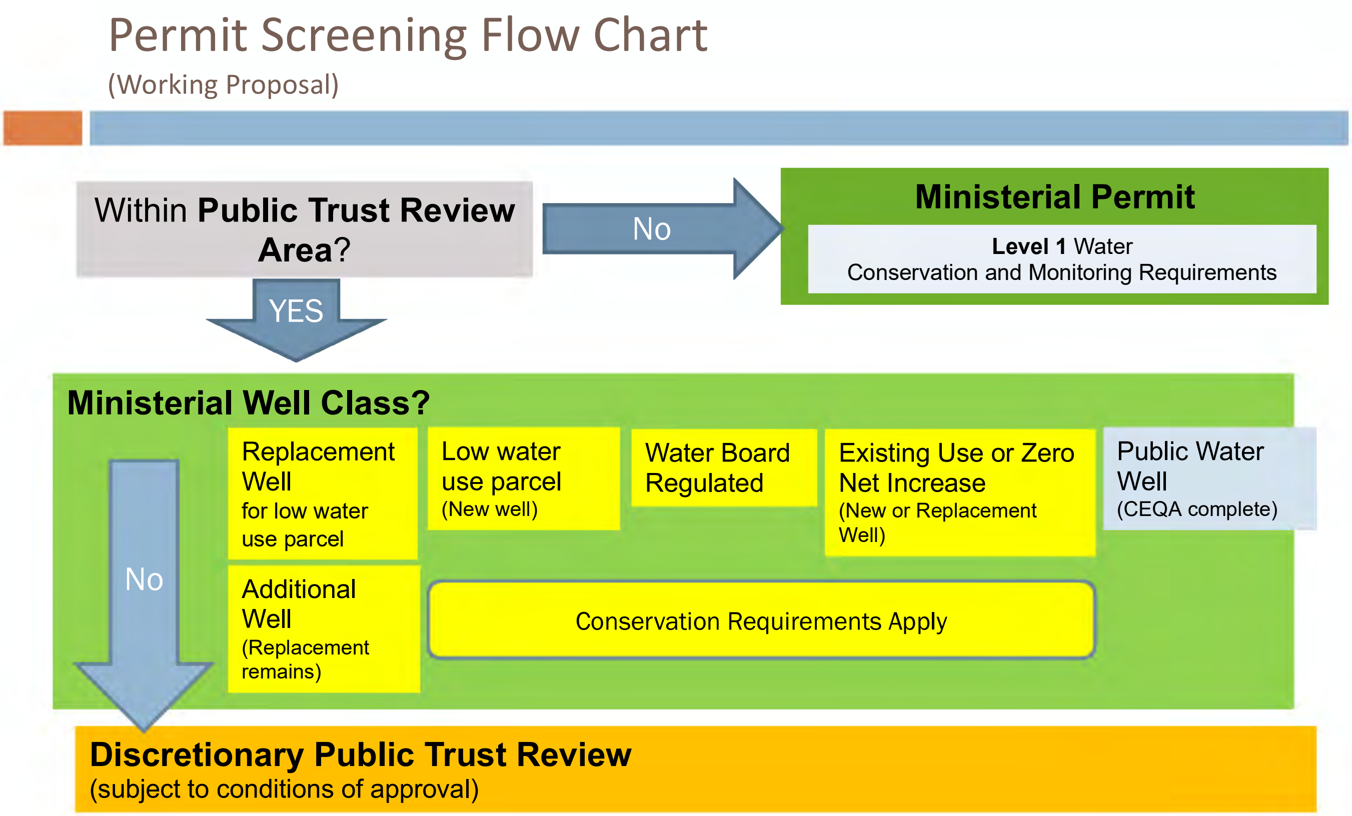
Well Class	Description		Conservation Requirements
Replacement Well *Located no closer to the nearest stream compared with existing well.*	**Option 1A**: Using less than 2.0 Acre-Feet per Year (AFY)	**Option 2A:** Using less than 0.5 AFY	**Level 1**
	Not applicable	**Option 2A**: Using 0.5-2 AFY	**Level 1 + 2**
Low Water Use – New Well	Not applicable	**Option 2A + 2B:** Using less than 0.5 AFY	**Level 1**
	Option 1A + 1B: using less than 2 AFY	**Option 2A + 2B:** Using 0.5-2 AFY	**Level 1 + 2**
Additional Well	Old well is still present not destroyed, but additional well is installed. No additional water use anticipated. Located no closer to the nearest stream compared with existing well.		**Level 1** **Or** **Level 1 + 2**
Public Water Well	A public water well for which environmental review under the California Environmental Quality Act is complete.		None
Water Board Regulated	Water wells, for any land use, that will serve as a point of diversion associated with an appropriative water right regulated by the CA State Water Resources Control Board, Division of Water Rights		**Level 1 +2**
Existing Use New or Replacement Well	Same use, greater 2.0 AFY Water wells, for any land use, where total groundwater use of the parcel is limited to and does not exceed the amount of groundwater used as of the date of ordinance adoption for legally established land uses. Existing use will be based off average use from a 3 to 5-year period (2017-2022, which includes dry years).		**Level 1 + 2**
Zero Net Increase Well	Water well, for any land use, where the proposed use would not result in a net increase in groundwater use on site through implementation of water conservation measures, rainwater catchment or recycled water reuse system, water recharge project, or local groundwater management project.		**Level 1 + 2**

Notes on Table 2

Water Board Regulated - The State Water Resources Control Board regulates surface water rights. The Water Board has primary responsibility for consideration of public trust for wells that serve as point of diversion for a surface water right.

Public Water Wells: The Water Board Division of Drinking Water regulates public water wells, and if acting as lead agency under CEQA would have responsibility for consideration of public trust. The CEQA lead agency (commonly a city or water agency) for a public water well will complete the environmental review and has primary responsibility for consideration of public trust.

Figure 1. Permit Screening Flow Chart



Well Classification Working Groups' Support, Issues, and Concern

Pro: The Policy WG supports incentivizing storage tanks, stormwater capture, groundwater recharge, and regenerative agriculture via the Zero Net Increase well class.

Issue: Permit Sonoma would need to set standards and objectives for groundwater recharge and regenerative agriculture before it can administer ministerial permits for permit applications that propose use of these features or practices.

Issue: A remaining concern of CDFW and others is the issue of cumulative impacts (including impacts from existing wells) and that they may not be adequately addressed or mitigated as part of these current recommendations. Proposed ministerial well definitions do not address or consider cumulative impacts of existing wells.

Issue: Protecting public trust resources requires proper analysis and consideration of streamflow depletion, which is directly related to the volume and timing of well pumping. Allowing a ministerial permitting process for what could be a significant impact from a single applicant with a large parcel is at odds with adequately analyzing public trust resource impacts resulting from the well permitting program.

Issue: Some Technical WG members prefer discretionary permitting of low water use wells that may contribute to an adverse impact. Others consider discretionary review for low water use wells to be impractical from a cost and implementation perspective and prefer a ministerial permit process with reasonable and appropriate conservation requirements.

Issue: CEQA does not require review of the effect of municipal wells on unimpaired flows as this ordinance is requiring for other wells therefore municipal wells should not be exempted. However, others contend that the County is not the appropriate regulatory authority for public water wells. Public water wells are regulated by the State Water Board, Division of Drinking Water, and often owned and operated by a separate government agency.

Issue: At least one working group member is concerned that ministerial classification fails to account for impacts from new and replacement wells being added to existing impacts, which are causing overdraft or unsustainable groundwater use, without sufficient evidentiary support that the conservation requirements will result in reducing the adverse impact. Allowing for additional impacts that aren't "adequately considered" or "feasibility mitigated" may not satisfy the task at hand as described by the ELF case. The working groups have answered the "how question" – how the county must consider and mitigate impacts to public trust resources when permitting groundwater wells – in two ways, by defining a public trust review area and by limiting the water use of new wells in that area through conservation. The working groups did not have time to comprehensively consider and weigh different mitigation measures for their feasibility. Is simply reducing the extent or size of an individual impact a feasible mitigation for potentially perpetual accumulating impacts to public trust resources?

Others counter that requirements for water conservation and limits on use of wells that will support existing land uses and new land uses is appropriate mitigation. The working proposal would require discretionary review of wells where groundwater use of the parcel is increasing above 2.0 AFY.

Issue: As mentioned previously, some Policy WG and Technical WG members have proposed that a more thorough public trust impact analysis be used to determine if a well applicant falls into a ministerial or discretionary permitting process. Some others would question the implications for streamlining review. This approach is considered in the future recommendations since it is not available in the immediate time frame.

Issue: One Policy WG member notes that protecting public trust resources requires consideration of streamflow depletion, which is directly related to the volume and timing of pumping. Allowing ministerial permitting for what could be a significant impact from a single applicant is at odds with adequately analyzing public trust resource impacts resulting from the well permitting program.

Others point out that the working proposal requires discretionary review for most wells that will expand groundwater use beyond 2.0 AFY, within the Public Trust Review Area.

Future Recommendation: Some Policy and Technical WG members support quantifying low water use by parcel acreage so large parcels are allowed the use of more groundwater under the "low water use" ministerial category. Members were interested in developing some type of per-acre threshold to inform future categorization and quantification for permitting and addressing public trust resources. The working groups did not have time to evaluate this approach in this timeframe and would recommend that this be explored in future revisions. See Table 4 and low water use section below.

Well Implementation Requirements – Conservation and other Measures

Framing Questions

What conservation and monitoring requirements should be in place for ministerial wells?
What water usage categories should level 1 and 2 conservation requirements be in place for?
What should be included in conservation requirements?

Working Proposal

Nearly all wells in the public trust review area, except public, would require conservation measures to secure approval. The Policy WG recommends implementation requirements for water conservation and monitoring based on well class and water use. Level 1 conservation requirements are recommended on all wells, except public water wells, which fall under local government and/or State Water Board jurisdiction. Additional Level 2 requirements are recommended for all wells within the public trust review area that have higher water use.

Implementation Requirements Work Groups' Support, Issues, and Concern

Pro: The Policy WG mostly supports Level 1 conservation requirements for all wells permits and Level 2 requirements for some well classes in the public trust review area.

Conservation Requirements. Table 3

Pro: The Policy WG supports implementing conservation measures.

Issue: Some Policy WG members would like to better understand and quantify water saved to ensure water conservation is able to minimize or avoid impacts to public trust resources as a result of landowner well pumping.

Con: One Technical WG member would urge defining more stringent Level 3 conservation measures to be implemented during drought.

Con: A Technical WG member expressed concern that landscape conservation is insufficient and not protective of public trust resources.

Issue: Conservation requirements should have some sort of measurable objectives. California's standard for residential indoor water use is 55 gallons per person per day. Conservation requirements should strive to achieve something like this measurable objective.

Low Water use Wells (Specifying use less than 2 AFY) Table 4

Options Overview: While many from the Policy WG would like to factor water use into well permitting requirements, the Policy WG was evenly split on the Table 4 Options.

Comments in Support of Well Classes of 2 AFY (Option 1A and 1B in Table 4)

Proposal: Roughly half of the Policy WG members support the option that would set the water use threshold at 2 AFY similar to the Governor's drought order and SGMA's de minimis threshold.

Con: One Policy WG member expressed concern that if the overarching goal is to avoid impacts to streamflow and public trust resources, using 2.0 AFY for low water use is inconsistent with many other water conservation guidelines especially given that dry season Steelhead habitat is vulnerable/sensitive to streamflow depletion. Low water use wells can still adversely impact public trust. Furthermore, if new wells continue to have impacts on streamflow this could lead to negative impacts to existing surface water right holders.

Con: One Technical WG member suggests that SGMA never defined public trust resource impacts so relying on a "de minimis" characterization from the SGMA process is inappropriate. Whether the SGMA threshold of 2 AFY is truly "de minimis" has not been evaluated. The "de minimis " designation in SGMA informs whether a well owner can be charged GSA fees and be required to meter their usage; the threshold was not generated regarding public trust resource protection, especially the specific goal of minimizing impacts to stream-dwelling salmonids resulting from groundwater pumping.

Con: This amount of water (which equates to 1,785 gallons per day) may have been determined to be 'de minimis ' for the purposes of requiring fees for SGMA, but this determination has nothing to do with the potential for impacts to public trust resources associated with pumping 2 AFY. It is therefore inappropriate to use 2 AFY for the purposes of this well permitting ordinance when there is overwhelming evidence to support that this is more water than a small domestic user (household family of 4) would need. Several members of the Technical WG have cited data sources to support the 0.5 AFY as being the appropriate amount to be considered low water use.

Comments in Support of Well Classes of 0.5 AFY (low) and 0.5-2 AFY (moderate) (Options 2A and 2B)

Proposal: Roughly half of Policy WG members support using alternative classifications and definitions for "Replacement" and "Low Water Use" wells. Option 2A and 2B would create a low water use (less than 0.5 AFY) well class and a moderate water use (0.5-2.0 AFY) well class.

Pro: The primary reason for support is tied to most residences typically relying on 0.5-1.0 AFY on average and putting low water use well owners on notice that additional conservation would be necessary to offset increased pumping. Delineating use serves as a reminder or threshold that all sectors must conserve water to ensure that Sonoma County has water for people, the economy, and the environment.

Con – Option 2A. One Policy WG member is concerned that if a threshold other than 2.0 AFY is used, it would be inconsistent with other regulations and would create confusion for the public and be hard to track.

Issue: Permit Sonoma would need to decide how to estimate residential, commercial, and agricultural use by volume in the permitting process. And, how to ensure that actual water use rates fall within the appropriate well classes. This would require mandatory meters and reporting.

Issue: The Policy WG also flagged that assigning use to well classes without collecting data is a challenge.

Table 3. Conservation Requirements. Levels 1 and 2

Category	Level 1 Conservation	Level 2 Conservation
Indoor Water Use	Efficient **faucets and showerheads** Leak and Water Conservation **Audit**	Efficient toilets
Outdoor Water Use	**Prohibit non-functional turf** Leak and Water Conservation **Audit**	Water Efficient Landscape Regulations. Existing landscapes with less than 600 square feet of irrigated turf are exempt. Disconnected downspouts from all new or existing structure.
GSA Basins	Compliance with applicable water conservation requirements adopted by Groundwater Sustainability Agency	
Commercial and Industrial Sites		**Water Conservation Plan**: Includes facility water budget, water conservation practices, water efficient appliances and features (e.g., high pressure sprayers), process water reuse, employee training, etc.
Agriculture		**Agricultural Water Conservation Practices Plan** (Farm Plan): includes use of drip or micro sprayers, monitoring of soil moisture and shoot tips, irrigation scheduling, irrigation system maintenance, etc., vineyard and orchard irrigation limits (excludes frost protection) 0.6 AFY per acre (UC Cooperative Extension and the Sonoma County SGMA Agriculture Working Group), or existing use supported by data or study, Frost protection, enrollment in frost protection program or frost protection plan

Policy Options on Requirements for Low Water Use Wells

The chart below summarizes four options for ministerial permitting requirements for low water use wells. When ranking the four options, the Policy WG was split between Options 1 and 2.

Table 4. Policy Options for Low Water Use Wells, using less than 2 AFY

Classification Option	Well Type	Conservation Requirement
Option 1A	Replacement Well less than 2 AFY	Level 1
	New Well less than 2 AFY	Level 1 + 2
Option 1B	Replacement Well less than 2 AFY	None
	New Well less than 2 AFY	Level 1 + 2
Option 2A	**Low Water Use** Replacement Well <0.5 AFY New Well <0.5 AFY	Level 1
	Moderate Water Use New and Replacement Well 0.5-2 AFY	Level 1 + 2
Option 2B	Replacement Well <0.5 AFY	None
	New Well <0.5 AFY	Level 1
	New and Replacement Well 0.5-2 AFY	Level 1 + 2

Discretionary Review Process

Framing Questions

What is the nature of that review? (CEQA, other)
What requirements are defined by what anticipated impacts?

Working Proposal

Well Classes Subject to Discretionary Review

The following well classes within the Public Trust Review Area would require a discretionary review:

- Wells associated with increased groundwater use, greater than 2.0 AFY
- Wells applying for zero net increase (without adopted objective standards)*

*Wells apply for zero net increase that are enhancing groundwater recharge or are employing agricultural practices that improve soil health, increase recharge, and reduce irrigation long-term (regenerative agriculture) *would be discretionary until the County adopts objective standards.*

Adverse Impacts to evaluate during Discretionary Review

Adverse impacts include reduction in streamflow due to cumulative groundwater use, and acute impacts of groundwater pumping of the project and nearby wells. Where available, calibrated numerical models supported by site-specific hydrogeologic data should be used for evaluating adverse impacts. In watersheds without numerical models, best available information including use of analytical models, site specific hydrogeologic data, and regional estimates of streamflow depletion and natural flows should be used.

Discretionary Review Process

The County (staff or contractors) would conduct the analysis for the discretionary review process, assess adverse impacts, and set mitigation requirements.

Table 6. Adverse Impacts

Habitat/Stream/Area	Percent Reduction of Flow
Coho Summer Rearing Streams	>10% reduction of monthly natural flows during periods of spawning, rearing and migration
Steelhead Streams	>20% reduction of monthly natural flows during periods of spawning, rearing, and migration and Consistent with sustainable management criteria in GSA regulated basins

Discretionary Review Work Groups' Agreement, Issues, and Concerns

Pro: The Policy WG and the Technical WG would recommend that the County lead the analysis for the discretionary review process.

Pro: The Technical WG would recommend that the County conduct the public trust impacts analysis rather than asking the applicant to provide the analysis. The reasons are that the County will likely be more cost effective for the applicant, provide consistency and standards on the analyses, shorten permit processing times, and be streamlined. The Technical WG expressed concerns about consistency across analyses and that consultant fees could be quite high for landowners. If an adverse impact is identified, the applicant can develop mitigation measures. An applicant could also refute the findings and provide additional information.

Pro: Numerous watersheds, including the GSA basins and the critical habitat watersheds, have well calibrated numerical models that may be used for evaluating adverse impacts. The Technical WG recommends leveraging numerical models for impacts analysis in these areas.

Con: A Policy WG member would recommend that the discretionary review apply to wells using greater than 0.5 AFY if located within a defined proximity to a stream (e.g., 300 feet) given the much higher potential impact to streamflow depletion.

Issue: Watersheds without numerical models will have relatively large uncertainty or require more extensive technical evaluations to estimate streamflow depletion.

Issue: Reduction in streamflow is measured relative to natural (unimpaired) flows that would occur without groundwater pumping or surface water diversions. Estimating natural unimpaired flows is challenging and will require additional technical work in watersheds without calibrated numerical models. Surface and spring water diversions are also complicating factors.

Issue: Some Technical and Policy WG members support defining environmental flows and adverse impacts using The Nature Conservancy's Natural Flow Database and the California Environmental Flows Framework. Some Technical WG members analyzed the TNC methodology and presented their analysis and raised a concern regarding a lack of available local stream gauges in the Natural Flows Database model development. That analysis showed that the Natural Flows database over-estimated dry season flows as compared to measured stream flow in some local creeks. Another Technical WG member countered that the Natural Flows Database is based on peer-reviewed science (https://rivers.codefornature.org/#/science) and is the best available science for defining environmental flows statewide.

Issue: There was a general consensus that the County should explore the possibility of implementing the California Flows Framework or other approaches to improve environmental flow criteria for Sonoma County as outlined in the adaptation section.

Metering and Monitoring Requirements

Framing Questions

What groundwater monitoring conditions (water meter readings, depth to water measurements, etc.) should be required of specific classes of wells?

Working Proposal

The proposals require meters on each new well / service connection and annual reporting of monthly data collected, except for low water use residential wells, who would report on a voluntary basis for option 2 and required for option 3. These requirements would be for all well permits in the county. The recommendations section also notes extending the voluntary meter program for existing wells to increase data collection to improve water use estimates.

The working proposal requires **water level monitoring** for wells on parcels that use more than 5 AFY.

The working proposal also includes **conservation practices reporting** for agriculture, commercial, and industrial sites that use more than 5 AFY through enrollment in agricultural conservation program or self-reporting with water meter readings.

Table 5. Metering and Monitoring Options

	Option 2	Option 3 / Universal Requirements
Water Meter Installation	Meter for each new well, all well classes.	Same as Option 2
Water Meter Reporting	Monthly data collected, reported annually, all well classes except low water use residential wells Low water use residential wells and existing use wells may report in voluntary program	Monthly data collected, reported annually, all well classes
Water Level Monitoring	Monthly data collected, reported annually for parcels using 5 AFY or more.	Same as Option 2
Conservation Practices Reporting for Agricultural, Commercial, and Industrial sites	Annual reporting of implementation of agricultural, commercial, and industrial water conservation practices for parcels using 5 AFY or more. 1.Through enrollment in agricultural conservation program, or 2.Through verifiable self-reporting form	Same as Option 2

Metering and Monitoring Working Groups' Issues and Concerns

Pro: The Policy WG and Technical WG expressed support for these monitoring and metering requirements. The Technical WG leaned toward Option 3, with one member expressing concern but letting the group move forward. All Policy WG members could support or "live with" Option 2 if the low water use for residential wells was 0.5 AFY. If low water use for residential was defined as 2.0 AFY, then all but one Policy WG member could support or "live with" the proposal. All, except 1, Policy WG members could support or live with Option 3.

Pro Option 3 / Con-Option 2: Two Technical WG members observed that Option 2 is missing residential wells that account for a large percentage of new wells, which is problematic, so they expressed preference for Option 3.

Pro: The value of a metering program would be to gather water use data from a portion of the wells in Sonoma County to help improve water use estimates and to update data for future adaptation of the ordinance's implementation. Water level data need to be targeted, consistent with the Technical WG's recommendation for focusing on priority areas initially. The Policy WG urged linking monitoring and reporting to other monitoring efforts in the county.

Issue: The Policy WG expressed concern regarding the cost of meter installation, which is estimated between $300-$10,000 per meter, to the applicant and urged financial assistance when needed. The annual reporting program could cost $150-$450 per year per well.

Issue: The Technical WG would caution that reporting and data management require significant effort. Permit Sonoma would need to evaluate the metering program (technical, financial, and policy) and additional staff resources may be needed for this. The Policy WG discussed the consideration of pilot projects in high-risk areas with potential collaboration with other interests who seek grant funding.

Adaptation for the Future Policy and Technical Work

The Technical WG's recommendations pertain to reducing data gaps to allow for improved technical evaluations of streamflow depletion and impacts to public trust resources, developing quantitative data supporting water conservation as mitigation to reduce impacts to public trust resources, increasing analytical and numerical modeling capacity to support technical evaluations of public trust impacts, developing objective standards and metrics for allowing ministerial permitting of new and innovative projects like groundwater recharge and sustainable (regenerative) farming. In addition, the Technical WG recommends that Permit Sonoma:

- coordinate and partner with the Sonoma County Groundwater Sustainability Agencies (GSAs) on initiatives of mutual interest and benefit.
- continue to work with stakeholders, especially those with technical expertise to support Permit Sonoma's implementation of the well ordinance; and
- develop a funding plan to support Permit Sonoma staff to increase data collection, analyze, implement, and update the well ordinance at regular intervals; and to refine the existing models and potentially develop new models to reduce uncertainty and address areas not currently covered by the existing model.

1. Reduce Key Data Gaps

The Technical WG recognizes that the lack of data is a significant impediment to more robust technical approaches to evaluating impacts to public trust resources and providing objective standards for ministerial permitting. Accordingly, the following recommendations are intended to improve the data and information needed to more accurately evaluate groundwater pumping impacts to public trust resources:

a. Groundwater Level Monitoring

- Evaluate existing state, county, other public and NGO sponsored monitoring programs in relation to the needs of ordinance implementation to better assess groundwater-surface water interactions as they relate to streamflow depletion and identify the most relevant existing data and significant data gaps.

- Implement a groundwater level monitoring program for both pumping wells and dedicated monitoring wells to supplement existing monitoring data and reduce data gaps.
- Prioritize monitoring in sub-watersheds identified as medium and high-risk areas of impact to public trust resources (i.e., high streamflow depletion in areas that contain indicator salmonid public trust resources).
- Ensure monitoring outside the public trust review area occurs so groundwater pumping expansion and cumulative impacts are observed in a timely manner and can be subsequently addressed via changes to the public trust review area and well ordinance.

b. Streamflow Monitoring

- Increase streamflow monitoring of medium and high-risk areas of impact to public trust resources (i.e., streams that contain indicator salmonid public trust resources).
- Increase monitoring of streamflow focused on periods of low streamflow in areas where there are both medium and high risks of impacts to public trust resources (i.e., in streams providing habitat for coho salmon and Steelhead across a range of estimated streamflow depletion conditions).

c. Surface Water – Groundwater Interactions

- Conduct studies related to characterizing surface water – groundwater interaction through installation of monitoring wells, stream gages, geophysics, natural tracers (temperature and isotopes), geomorphology and other methods of investigation to better understand the mechanisms and processes that control these interactions.
- Conduct studies, such as those above, to reassess and refine well buffer widths to ensure buffers (see Public Trust Review Area documentation) are sufficiently protective of public trust resources.
- Seek to conduct aquifer pumping tests and obtain and evaluate data from past and future pumping tests conducted in the County that would provide aquifer hydraulic parameters used in all numerical model and analytical techniques.

d. Metering

These measures would complement metering programs which the county might adopt as part of the ordinance.

- Implement a county-wide voluntary metering program including existing wells, to improve water use estimates for various land use and parcel sizes.
- Develop and implement voluntary monitoring and reporting programs including existing wells to improve knowledge of groundwater level trends, especially in areas of medium and high risk.

2. Improve Analytical and Numerical Modeling Capabilities

a. Take advantage of opportunities to leverage coupled surface water – groundwater numerical models to improve the evaluation of public trust impacts. For example:
   i. In the near-future, the Russian River regional GSFLOW-MODSIM model developed by the U.S. Geological Survey will be available for the County's use.
   ii. The GSAs will continue to maintain and improve upon their well calibrated numerical models as will the NGOs responsible for other well calibrated numerical models of Mill Creek, upper Mark West Creek, Green Valley Creek and Dutch Bill Creek used in development of the Technical WG's approach for estimating streamflow depletion.
   iii. The County should leverage these tools and support expansion of these models to include processes in the upper watersheds for analysis of impacts in tributary streams that support salmonids to develop approaches to estimating unimpaired flows, and to evaluate and/or inform potential use of analytical techniques explored by the Technical WG.

b. The County should maintain a comprehensive parcel-based water use database. Metered data and refined groundwater use estimates should be used to continually update this database. The expectation is that this database will be used as input for a variety of models and analyses.

c. The County (Permit Sonoma) should explore grant funding, when possible, in collaboration with other interested parties to develop web interface tools for county staff to utilize to screen for public trust impacts and to share groundwater and streamflow data and modeling results of streamflow depletion.

d. The County should explore grant funding to develop additional numerical models or an analytical depletion function model for the greater county. Prior to release the model should be validated against existing calibrated numerical models. Permit Sonoma should explore the use of this tool for evaluating impacts and screening well permits, similar to the water withdrawal assessment tool developed by the State of Michigan.

3. Water Conservation

The proposed updated well ordinance includes several quantifiable water conservation measures for ministerial permits to help reduce impacts to public trust resources. Permit Sonoma should coordinate and partner as appropriate with the Sonoma-Marin Saving Water Partnership for technical support. As stated in recommendation 8, the Permit Sonoma should proactively pursue grant funding to support quantification and implementation of residential, commercial, industrial, and agricultural conservation programs.

4. Development of Objective Standards for Future Ministerial Permits for Sustainable Management Programs/Projects

The proposed updated ordinance specifies that well applicants that are part of innovative sustainable management programs are eligible to be permitted as a ministerial permit once objective standards can be developed to appropriately ensure that such applications are protective of public trust resources. Until these standards are developed and evaluated (verified), these permits will remain discretionary.

a. **Groundwater Recharge Projects** – As allowed by available data, the county should develop objective standards for ministerial well permits associated with groundwater recharge projects. As available, numerical groundwater models could be used to guide the development of objective standards for groundwater recharge projects.

b. **Sustainable (Regenerative) Agriculture Programs** – Regenerative farming practices are an innovative and evolving strategy that potentially could yield benefits to protection of public trust and groundwater resources. Permit Sonoma should engage academic experts and agricultural practitioners piloting regenerative farming to monitor the status and progress in this promising strategy. Permit Sonoma should develop objective standards to allow for ministerial well permits related to programs with regenerative farming practices as new data and research emerges to support the development of standards.

5. Coordinate with Groundwater Sustainability Agencies

Given their common interests, Permit Sonoma should coordinate and partner with the three Sonoma County GSAs to implement actions in the most cost-effective manner. Particular areas desirable for coordination and partnering include monitoring of groundwater and surface water, investigating interaction between surface water and groundwater, seeking grant funding, and coordinating definitions of adverse public trust impacts and approaches to simulating and validating streamflow depletion.

6. Continued Technical Stakeholder Engagement

It is recognized that Permit Sonoma must develop an updated well ordinance in a compressed time frame. As described above, several issues remain that should be further investigated, and which would benefit from the input of informed stakeholders with subject matter expertise. Accordingly, it is recommended that a technical advisory group, representing important areas of technical and regulatory expertise related to groundwater and public trust resources be established by Permit Sonoma to support not only the development but the implementation and potential future refinement of the updated ordinance.

7. Well Ordinance Review

a. Permit Sonoma should provide annual updates to the Board and stakeholders summarizing the well permitting program including:
   i. Numbers of permits by class, by watershed, by location (within and outside of public trust review area), and by use (type and amount)
   ii. Average permit processing time by permit class
   iii. An assessment of the effectiveness of implementation of the revised well ordinance and of progress toward fulfillment of public trust obligation including identification of any issues of concern (e.g., adverse unintended consequences), and

iv. Recommended program improvements to address necessary adaptation to the Ordinance, ministerial and discretionary permitting, and projects.

8. Develop a Funding and Implementation Work Plan that includes Adaptive Measures

Permit Sonoma should develop a document that presents a plan for implementing the new well ordinance that includes the above-described adaptive measures intended to improve the well ordinance over time. The work plan should describe planned actions, identify anticipated outcomes with timelines, and identify partners for collaboration. As part of this effort, Permit Sonoma should provide estimated costs for implementation of adaptive measures and identify potential funding sources for these measures (e.g., permit fees, county funding, grants).

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Appendix B: Public Trust Policy Development Process Topics

Table 7. Work Group Discussion Topics

TOPICS	Key Discussion Issues / Questions
Public Trust / GW Review Area	What waterways require impacts analysis under the public trust doctrine? What public trust resources and uses are sensitive to streamflow depletion due to groundwater extraction? What aquifers are interconnected with public trust waterways, and what groundwater extraction from these aquifers is likely to have an adverse impact on public trust resources?
Well Classification: Ministerial and Discretionary	What classes or categories of wells receive a ministerial (routine across the counter) permit? What well classes receive a discretionary (more tailored) review? Replacement domestic wells, public water wells, zero net use, etc.
Well Implementation Requirements – Conservation and other Measures	What water conservation measures should be required of each class of wells? Water efficient landscape regulations, maximum allowed use, etc. Other measures: groundwater recharge, farm practices, etc.
Adverse Impacts / Impact Definitions	What is a substantial adverse impact? (watershed, waterway, basins) What methods should be employed to evaluate adverse impacts?
Discretionary Review Process	What is the nature of that review? (CEQA, other) What requirements are defined by what anticipated impacts?
Monitoring Requirements	What groundwater monitoring conditions (water meter readings, depth to water measurements, etc.) should be required of specific classes of wells?
Adaptation	What information or discovery will trigger the need to revisit these policies or approaches? What recommended studies and/or data collection activities could the County consider reducing data gaps and improve understanding of impacts to public trust resources?

Appendix C: Public Trust Review Area Methodology, O'Connor Environmental, Inc.

Sonoma County Well Ordinance
Public Trust Review Area Delineation

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Introduction

Sonoma County is developing a new ordinance to modify how the county's permitting agency, Permit Sonoma, will evaluate applications for proposed groundwater wells. The objective of the revised ordinance is to include a process for consideration of impacts to public trust resources (PTR), consistent with responsibilities under the Public Trust Doctrine. The Public Trust Doctrine affirms the public's right to use California's waterways for navigation, fishing, recreation, habitat protection, and other water-oriented activities. Broadly, PTR are the natural resources that the government holds 'in trust' for the benefit of current and future generations for certain public trust purposes or uses including commerce, navigation, recreation, fishing, wildlife habitat, and preservation of trust lands in their natural state.

The Public Trust Doctrine applies to navigable waters. Diversions of non-navigable surface water or groundwater that impact PTR of navigable waters are also subject to review under the Public Trust Doctrine. The doctrine applies to the extraction of groundwater that impacts a navigable waterway, and in such circumstances, the County has a responsibility to consider the impact on PTR and implement mitigation measures to the extent feasible.

Groundwater pumping has the potential to diminish such PTR by reducing streamflow, a process referred to by hydrogeologists as "streamflow depletion". For the purposes of well permitting, it is useful to identify areas where PTR may be sensitive to groundwater pumping. The "Public Trust Review Area" (PTRA) is intended to define this area. The PTRA defines portions of the County where certain requirements, standards, or conditions will apply for approval of permit applications for different categories of wells to reduce or mitigate potential impacts to PTR. Additional review and water conservation requirements are intended to avoid or mitigate adverse impacts to PTR. The PTRA has been identified based on analyses and interpretations of aquatic habitat value, hydrogeologic conditions, processes that generate streamflow, and groundwater use that could cause streamflow depletion in the County. This document summarizes these analyses and the geographic areas they delineate.

Policy and Technical Working Group members recommended that evaluation of impacts to PTR should focus on impacts to aquatic habitat of navigable and non-navigable tributary streams that support salmonids. Salmonids inhabit and depend on habitat conditions of both navigable and non-navigable waterways and migrate between the two over their various life stages. Groundwater extraction has the potential to decrease streamflow, alter flow and habitat conditions, and therefore impact salmonid habitat within non-navigable and navigable waterways. Salmonids have been found to be particularly sensitive to flow conditions in non-navigable tributary streams during periods of summer rearing.

While non-navigable waters are not subject to the public trust, in order to meaningfully address impacts to trust resources for uses including wildlife habitat where wildlife move from non-navigable to navigable waters, consideration of impacts to PTR should include an expanded scope. For this reason, working group members recommended that impacts to salmonid habitat be considered by the County when permitting wells, even when the impact may

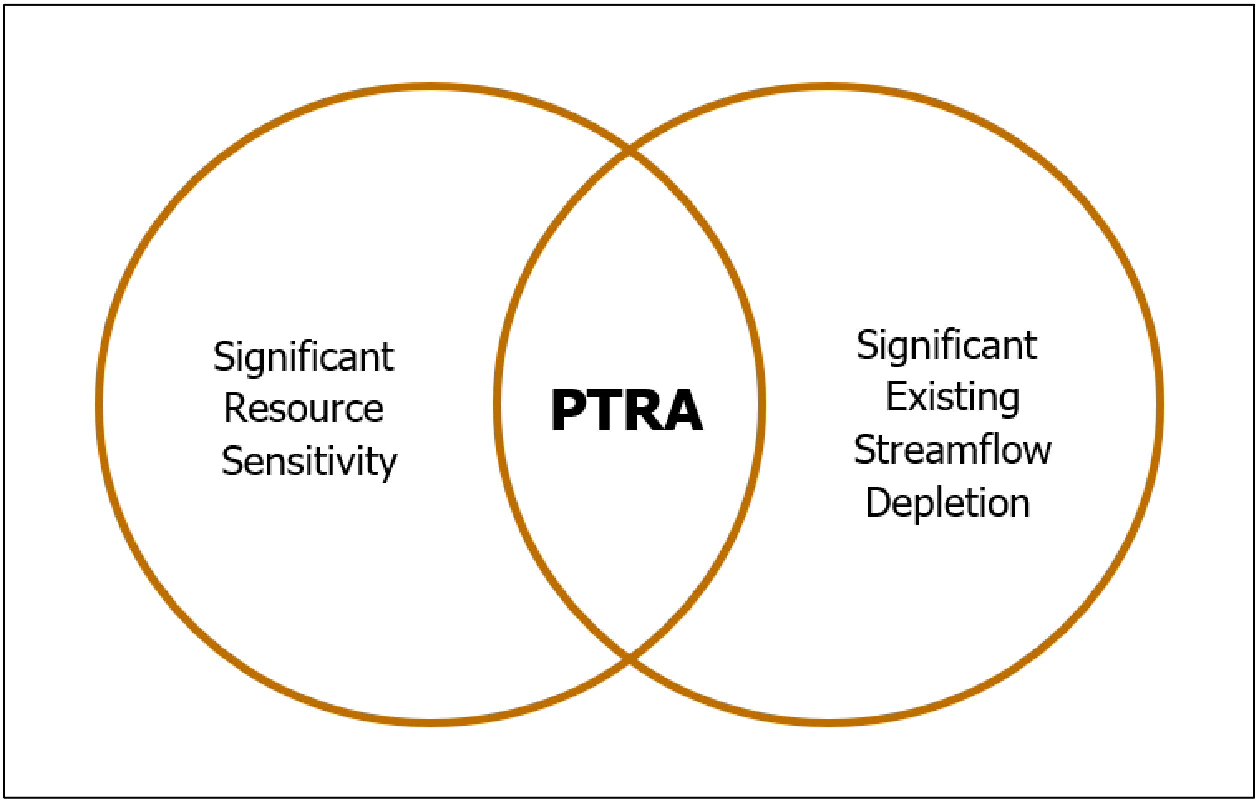

Figure 1: Diagram showing the two factors used to define the PTRA.

be to non-navigable waters that are tributary to navigable waters. Following the direction of the working groups and for the purposes of delineation of the PTRA, all navigable waters, and non-navigable waters that support salmonids are proposed for consideration in the well permit process. Non-navigable waters that do not support salmonids are not proposed for consideration in the permit process.

A risk-based approach was developed to define the PTRA. This approach considers two primary factors: the sensitivity of the PTR to streamflow depletion and the best available estimates of existing streamflow depletion. The PTRA describes the portions of the County where both sensitivity of PTR and estimated streamflow depletion are relatively high (Figure 1); in these areas, additional oversight of well construction is needed to prevent significant degradation of PTR. These areas are differentiated from areas outside the PTRA where risks are relatively low, and the County's current ministerial permitting process can continue.

Evaluation of the sensitivity of PTR focuses on aquatic habitat and uses salmonids (coho salmon and steelhead trout) as indicator species sensitive to streamflow depletion to represent overall sensitivity of PTR. This approach has received general consensus from working group members as well as from the Groundwater Dependent Ecosystem practitioner working groups that were convened as part of the Groundwater Sustainability Agency process for the Santa Rosa Plain, Sonoma Valley, and Petaluma Valley groundwater basins. Estimates of existing streamflow depletion are based on county-wide estimates of groundwater pumping in comparison to estimates of groundwater recharge from prior hydrologic modeling (Kobor & O'Connor, 2017). The relationship between estimated groundwater pumping and estimated groundwater recharge as a predictor of streamflow depletion is derived from existing distributed hydrologic models of three watersheds that are calibrated using existing data to directly simulate streamflow depletion as a function of groundwater pumping (Kobor & O'Connor, 2016, Kobor et al., 2020; Kobor et al., 2021).

Public Trust Review Area Mapping Overview

There are many potential approaches to mapping the PTRA spanning a wide range of complexity and data requirements. The adopted approach was selected as the best use of available data and numerical model predictions pertaining to streamflow depletion for implementation at the county scale within the time constraints of the ordinance development process. The approach integrates various existing data sources describing habitat and groundwater recharge and pumping conditions and uses predictions from existing numerical hydrologic models to interpret those data in relation to streamflow depletion and effects on PTR. Simpler approaches are more likely to result in less skillful predictions due to lack of representation of key factors driving streamflow depletion that are better represented in available numerical models, whereas more complex approaches would require significant input data and estimation of poorly constrained aquifer hydraulic parameter values across complex and variable hydrogeologic settings leading to larger uncertainty. Although the adopted approach is considered the preferred approach given data and implementation timeline constraints, it is subject to limitations and uncertainty associated with data availability and simplifying assumptions.

A series of steps were performed to define the two factors (resource sensitivity & existing streamflow depletion), interpret them using a classification system, and use those interpretations to map the PTRA (Figure 2). Mapping was performed at the HUC-14 watershed scale which divides the County into a series of subwatersheds based on drainage area. This mapping scale allows for significant spatial detail but doesn't attempt to map conditions at a scale beyond what can be justified given the limits of the underlying input data and assumptions. Resource sensitivity was mapped based on a combination of critical steelhead and coho habitat. Existing streamflow depletion was mapped by estimating existing groundwater pumping and recharge, calculating the ratio of pumping to recharge, and relating those ratios to streamflow depletion based on the findings of existing numerical hydrologic models. Finally, a classification system was developed to integrate the two factors (resource sensitivity & existing streamflow depletion) and map the PTRA (Figure 2). Each of these steps is explained in greater detail below.

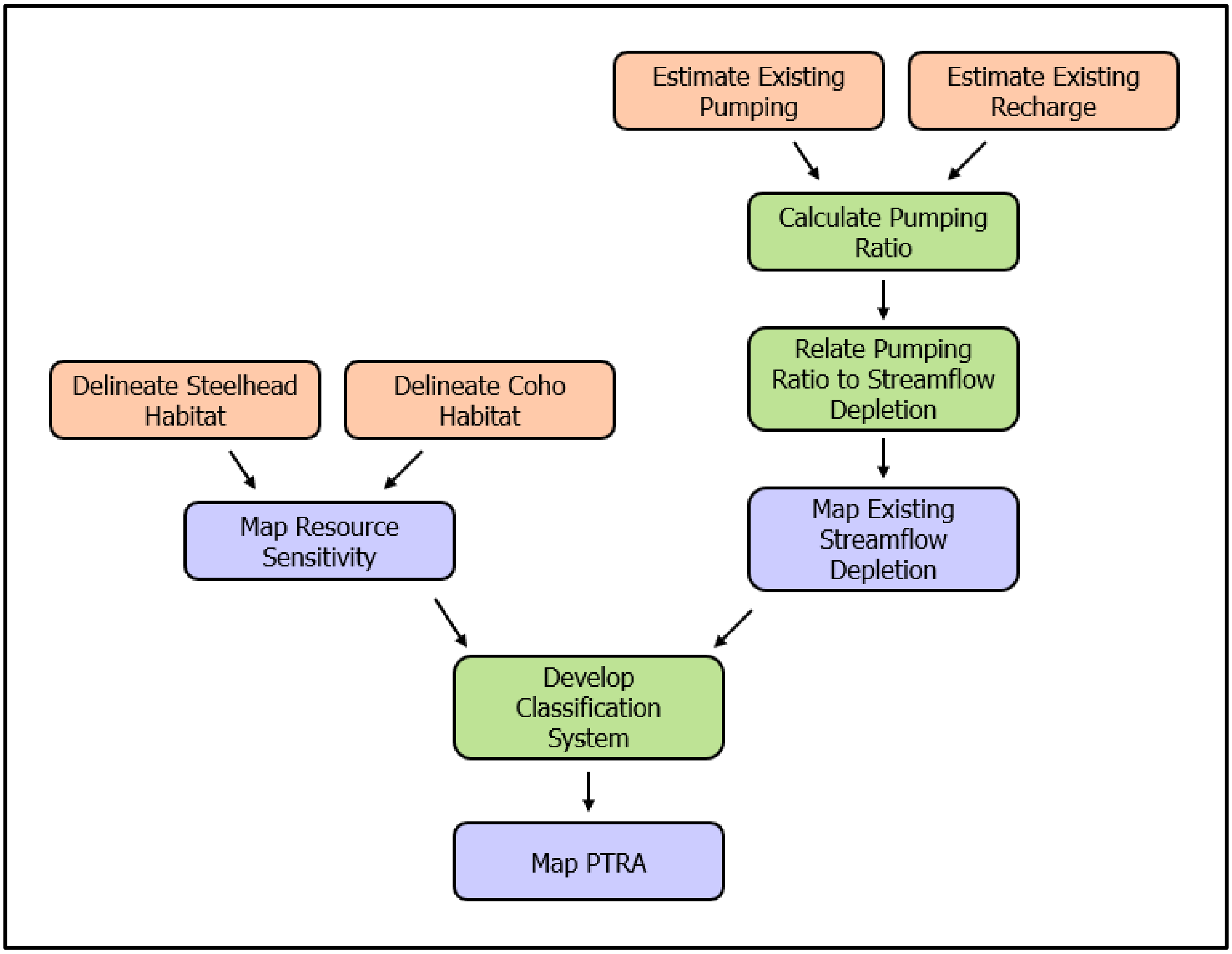

Figure 2: Diagram showing the steps used to define the PTRA.

Habitat & Resource Sensitivity Mapping

Central California Coast coho salmon (*Oncorhynchus kisutch*) are listed as endangered under the Federal Endangered Species Act (ESA) and extensive efforts are underway to restore habitat conditions in the key watersheds in Sonoma County that support the species. For purposes of defining the PTRA, these key watersheds were considered representative of the areas of the county where PTR are most sensitive. High priority coho habitat streams within the Russian River basin were identified from an ArcGIS shapefile obtained from the California Department of Fish & Wildlife (CDFW, 2023). High priority coho habitat streams outside of the Russian River basin were based on the 'Core' and 'Phase I Expansion' areas identified as priority areas for restoration in the Federal recovery plan for central coast coho (NMFS, 2012). The HUC-14 watersheds corresponding to the high priority coho streams were selected to represent waters with "High" sensitivity PTR.

Central California Coast Steelhead and Northern California Steelhead (*Oncorhynchus mykiss*) are listed as threatened under the Federal ESA. Watersheds providing steelhead habitat were selected to represent waters with “Medium” sensitivity PTR. ArcGIS shapefiles of critical steelhead habitat streams were obtained from the National Marine Fisheries Service (NMFS, 2023). The HUC-14 watersheds corresponding to the high priority steelhead streams that were not coded as “High” sensitivity as described above for coho habitat were coded as ”Medium” sensitivity PTR.

HUC-14 watersheds not considered as priority habitat of either coho or steelhead were coded as “Low” sensitivity PTR.

Within the Petaluma River basin, HUC-14 watershed boundaries were adjusted to include areas draining to streams with documented steelhead spawning activity based on available spawning survey information (Leidy et al., 2005; NMFS, 2014) and coded as ”Medium” PTR sensitivity; watersheds not identified as providing spawning habitat were coded as ”Low” for PTR sensitivity. Within the lower portions of the Sonoma Creek basin, areas draining to creeks not identified as critical habitat for steelhead or coho that flow directly into tidally influenced reaches were coded as ”Low” sensitivity PTR.

A group of fisheries experts from NMFS, CDFW, Cal Trout, Sonoma Water, and Sonoma Ecology Center with detailed local knowledge of habitat conditions in Sonoma County was convened. The group reviewed the draft aquatic habitat classification maps discussed above and suggested a set of revisions designed to improve the initial mapping by incorporating more detailed local knowledge. Due to their critical importance at the basin and state-wide level, a new “Very High” sensitivity category was added for Mill, Mark West, Green Valley, and Dutch Bill Creeks. These four watersheds were the subject of the 2015 State Water Resources Control Board’s Emergency Information Order and are widely considered to be the most important watersheds for supporting coho restoration efforts in the lower Russian River. The Wheatfield Fork of the Gualala River watershed and the Adobe Creek watershed were reclassified from medium to high given they are considered the most important steelhead streams in the Gualala River and Petaluma River watersheds respectively. The Ward Creek watersheds were also reclassified from medium high to high consistent with the rest of the Austin Creek Watershed. The Windsor Creek Watershed and portions of the southern Sonoma Valley were reclassified from medium to low owing to their low importance for supporting steelhead compared to the other identified priority watersheds (Leidy et al., 2005; Sonoma Water et al., 2022).

Watersheds with high or very high sensitivity PTR comprise ~482 square miles (30% of the County) including the Salmon, Willow, Dutch Bill, Green Valley, Austin, Porter, Mill, Pena, Dry, Mark West and Redwood Creek watersheds as well as the South Fork Gualala River watershed (Figure 1). Watersheds with medium sensitivity PTR comprise ~665 square miles (41% of the County) and include most of the Russian River watershed not classified as high or very high excluding the Santa Rosa Plain and drainages impounded behind Warm Springs Dam. Watersheds with medium sensitivity PTR also include significant portions of the Sonoma Creek and Petaluma River drainages. Low resource sensitivity watersheds comprise the remaining ~477 square miles of the County (Figure 3).

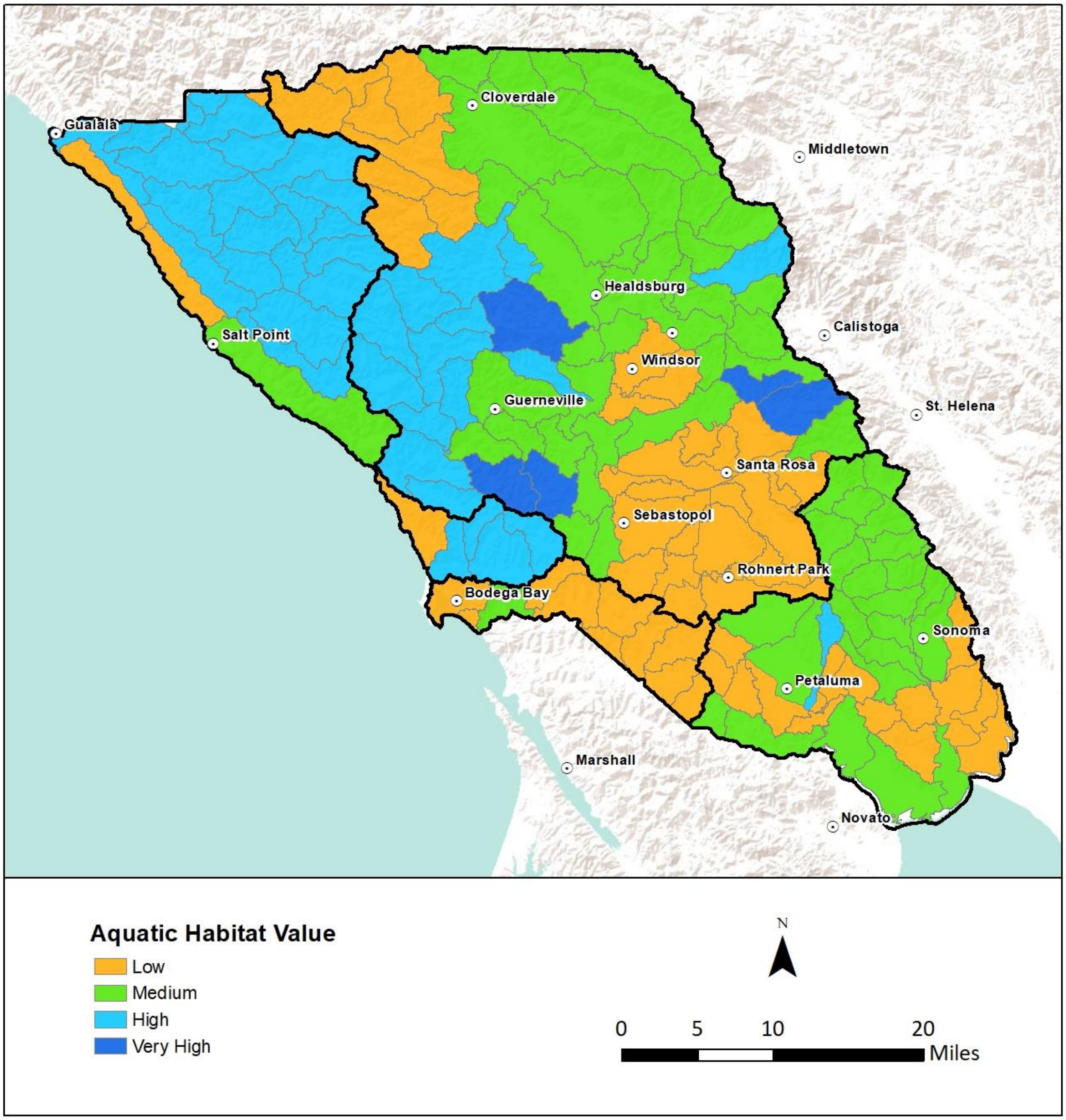

Figure 3: Subwatershed resource sensitivity classification based on aquatic habitat value.

Streamflow Depletion Estimation

Background

For the purposes of this analysis, streamflow depletion is defined as the reduction in streamflow resulting from groundwater pumping. Streamflow depletion is a consequence of the law of physics requiring the conservation of mass applied to water balance models describing the movement of water in watersheds and groundwater aquifers. In such water balance models, inflows to an aquifer must be balanced by outflows from the aquifer adjusted for changes in the volume of water in storage. In most watersheds, streamflow accounts for the majority of outflow; as groundwater pumping proceeds, the volume of water supplied to wells is largely balanced by decreases in streamflow and/or aquifer storage. In the short-term, water supplied to wells is derived primarily from decreases in aquifer storage. Over longer periods these storage changes generally stabilize and streamflow depletion becomes the primary source of water pumped from wells (Barlow & Leake, 2012).

To better understand the definition of streamflow depletion, it is helpful to differentiate between “acute” and “cumulative” streamflow depletion. Acute manifestations of streamflow depletion occur when the time response of streamflow depletion is relatively short such that pumping by an individual well causes streamflow depletion coincident or near-coincident with the timing of pumping. Wells causing acute streamflow depletion are likely to have a disproportionate effect on streamflow because, in general, the timing of pumping over the summer/early fall months corresponds to the timing of minimum streamflows. Cumulative streamflow depletion occurs when the total volume of water pumped by a population of wells becomes significant relative to the total inflows to the aquifer and can occur regardless of the time response.

There are many methods available for estimating streamflow depletion due to groundwater pumping including field techniques, statistical and analytical solutions, and numerical models (Rathfelder, 2016; Zipper et al., 2022). There are distinct advantages and disadvantages to each of these approaches and direct application of any of them at the county-wide scale with limited time and resources is infeasible. Field investigation and statistical techniques for estimating streamflow depletion are inherently problematic owing to the difficulties of differentiating between changes in measured streamflow caused by groundwater pumping and changes caused by other factors such as climate-related fluctuations or surface water diversion. Analytical solutions are mathematical representations and predictions of the effect of individual pumping wells on groundwater elevations and the consequent reductions in groundwater flow delivered to stream channels. Analytical solutions are generally most applicable for addressing acute impacts from individual wells. Analytical solutions have the advantage of being relatively easy to implement but require many necessary simplifying assumptions regarding aquifer and stream channel geometries and hydraulic characteristics used to calculate groundwater flow (Rathfelder, 2016; Zipper et al., 2022). These simplifications and associated uncertainties limit the accuracy of analytical solutions in describing specific real-world conditions (Barlow & Leake, 2012). Physically based, spatially distributed and calibrated hydrologic numerical models are generally considered the most accurate tools for estimating streamflow depletion; however, these models require large amounts of input data and effort to implement.

The proposed approach for the PTRA analysis uses a relatively simple water balance method to estimate cumulative streamflow depletion that can be implemented across the County. This simple water balance approach is significantly enhanced by simulations of streamflow depletion from existing calibrated numerical hydrologic models of high priority coho watersheds. The approach also uses analytical solutions to guide determination of buffer zones around streams within which additional oversight of well construction may be required to prevent or mitigate acute streamflow depletion.

Groundwater Recharge, Pumping, & Pumping Ratio

As alluded to above in the discussion of water balance methods, for a conceptual watershed water balance with a control volume including groundwater aquifers, the status of the hydrologic system can be expressed most simply as:

Inflow = Outflow +/- Change in Storage (1)

Inflow and outflow terms in Equation 1 can be expanded to include more details describing hydrologic processes. For a water balance describing a groundwater system, inflows to an aquifer typically include groundwater recharge and subsurface inflow. Outflow terms typically include streamflow, groundwater pumping, evapotranspiration from groundwater, and subsurface outflow (Healy, 2010). Over long periods of time (years or decades), groundwater recharge generally represents the majority of inflow to an aquifer and stream baseflow (streamflow) and groundwater pumping generally represent the majority of outflow. Consequently, an approximate aquifer water balance can be restated as:

Groundwater Recharge ≈ Streamflow + Groundwater Pumping +/- Change in Storage (2)

As is clear from Equation 2, as groundwater pumping increases, those increases must be balanced by either reductions in streamflow (streamflow depletion), reductions in storage, or increases in groundwater recharge. Over the long-term, changes in storage and recharge generally stabilize such that the majority of water supplied to wells is balanced by streamflow depletion (Barlow & Leake, 2012). Cumulative streamflow depletion increases in proportion to cumulative groundwater pumping. As the rate of groundwater pumping approaches the rate of groundwater recharge, streamflow approaches zero; this scenario is equivalent to a ratio of groundwater pumping to groundwater recharge equal to one. From these relationships, it can be seen that the ratio of groundwater pumping to groundwater recharge (i.e., groundwater pumping divided by groundwater recharge) provides an objective, hydrologically significant, indicator of the relative magnitude of streamflow depletion occurring in a given watershed.

Groundwater pumping was estimated for each HUC-14 watershed in the County using the methodology adopted for the rate and fee studies that have been prepared for the three Groundwater Sustainability Agencies (GSA) in the county (SCI & LWA, 2022a; 2022b, 2022c). The method estimates residential and commercial uses at the parcel scale based on County Tax

Assessor use codes and descriptions and estimates irrigation uses at the parcel scale based on crop acreages as represented in data available from the California Department of Water Resources (DWR, 2018). Standard use rates were assigned for each use category as described in the rate and fee studies. Residential and commercial uses in areas served by public water systems (PWS) were excluded from the initial parcel-based estimates which were then aggregated to the HUC-14 watersheds. Groundwater use for PWS are reported to the state and these uses were added to the corresponding subwatershed use estimates. Five-year average annual uses were calculated within the GSAs, and outside of the GSAs the estimates were based on data from 2020.

A simplified approach was used to adjust the initial subwatershed estimates of groundwater pumping for the portion of use that is sourced from surface water. The DWR's Electronic Water Rights Information Management System (eWRIMS) data was used to associate all active points of diversion with a corresponding parcel. For small domestic water rights, surface water was assumed to meet the corresponding residential uses on a given parcel, and for all other active water rights, surface water was assumed to meet the corresponding irrigation uses on a given parcel. This approach does not consider riparian surface water rights or pre-1914 water rights not included in the eWRIMS. The final estimates of mean annual groundwater use are the sum of the initial parcel-based estimates and the PWS reported uses minus the surface water uses (Figure 4).

Annual groundwater use normalized by watershed area ranges from <0.25 to ~5 inches. The lowest cumulative groundwater use areas occurs in rural portions of the county including most of the South Fork Gualala River watershed, the Austin Creek watershed, Big Sulphur Creek watershed, and most watersheds draining to Dry Creek. The highest cumulative groundwater use areas occur in the Santa Rosa Plain, portions of the Sonoma Creek watershed, and the lower Atascadero Creek watershed (Figure 4).

Estimates of mean annual groundwater recharge were taken from an existing Soil Water Balance (SWB) model analysis of the County (Kobor & O'Connor, 2017). This model code was developed by the United States Geological Survey (USGS) to provide recharge estimates for numerical groundwater flow models. The model utilizes rainfall, temperature, land cover, and soils data and uses a curve number approach for runoff and a modified Thornthwaite-Mather soil water balance approach for simulating Actual Evapotranspiration and groundwater recharge (Westenbroek et al., 2010). The model was calibrated to available data from unimpaired watersheds at a monthly timescale (Kobor & O'Connor, 2017). This approach focuses on infiltration recharge only and does not consider streambed recharge which may be significant in some subwatersheds. Although the model does not account for spatial variations in bedrock conditions, it does represent the proportion of recharge that is unable to enter the aquifer due to aquifer hydraulic conductivity limitations (rejected recharge) through use of a calibrated maximum daily recharge value. Distributed results from the SWB analysis were aggregated to the HUC-14 watersheds (Figure 5) and the groundwater pumping ratio was calculated for each watershed as the ratio of mean annual groundwater recharge to mean annual groundwater pumping (Figure 4).

Estimated mean annual recharge ranges from ~3 to 18 inches and is largely controlled by the variations in precipitation and soil types across the county (Figure 5). The lowest recharge occurs in the drier southern portions of the County including the Sonoma and Petaluma Creek watersheds and portions of the Santa Rosa Plain particularly in areas dominated by clay-rich soils. Intermediate rates of annual recharge on the order of 9-12 inches occur over large portions of the northeastern and central parts of the County including the Alexander Valley, lower Dry Creek Valley, and the Green Valley and Atascadero Creek watersheds. The highest rates of annual recharge occur in the wetter northwestern portions of the County including the South Fork Gualala River and lower Russian River watersheds such as Austin Creek, particularly in areas dominated by silty and sandy soils (Figure 3).

The groundwater pumping ratio (groundwater pumping expressed as a percentage of estimated recharge) ranges from <2.5% to ~80% (Figure 6). The lowest ratios occur in the rural portions of the county which in general are also areas with moderate to high potential recharge rates. These areas include most of the South Fork Gualala River watershed, Big Sulphur Creek watershed, the south-flowing drainages in the lower Russian River watershed, and the upper and east-flowing watersheds draining to Dry Creek. Intermediate ratios (~5-20%) occur in the Alexander Valley, upper Green Valley and Atascadero Creek watersheds, and portions of the Santa Rosa Plain, the upper Petaluma River and upper Sonoma Creek watersheds. The largest ratios occur in the more densely developed portions of the county, particularly those areas with relatively low estimated potential recharge. These areas include most of the Santa Rosa Plain and portions of the Sonoma Creek and Petaluma River watersheds (Figure 6).

Streamflow Depletion

Existing distributed hydrologic models have been developed and calibrated to available streamflow and groundwater elevation data through several multi-year modeling efforts funded by CDFW and the California Wildlife Conservation Board (Kobor & O'Connor, 2016, Kobor et al., 2020; Kobor et al., 2021). These models cover most of the high priority coho watersheds in the county including the Mill, upper Mark West, Green Valley, Atascadero, and Dutch Bill Creek watersheds. Estimates of cumulative streamflow depletion following 50 years of pumping are available for upper Mill, Mark West, and Green Valley creeks. Each of these models was used to develop a second estimate of streamflow depletion using a hypothetical scenario with significantly higher pumping rates ranging from 3-8 times existing estimated pumping rates. A groundwater pumping ratio was calculated from the numerical models based on mean annual results over a representative 10-yr simulation period for each of the six pumping scenarios.

Despite substantial variations in geology across the watersheds, a reasonably well-defined relationship was established between the groundwater pumping ratio and the mean July through September percent streamflow depletion (Figure 7). This finding indicates that over timescales of several decades the relationship between the groundwater pumping ratio and streamflow depletion is relatively consistent across the range of bedrock geologies in Sonoma County. There

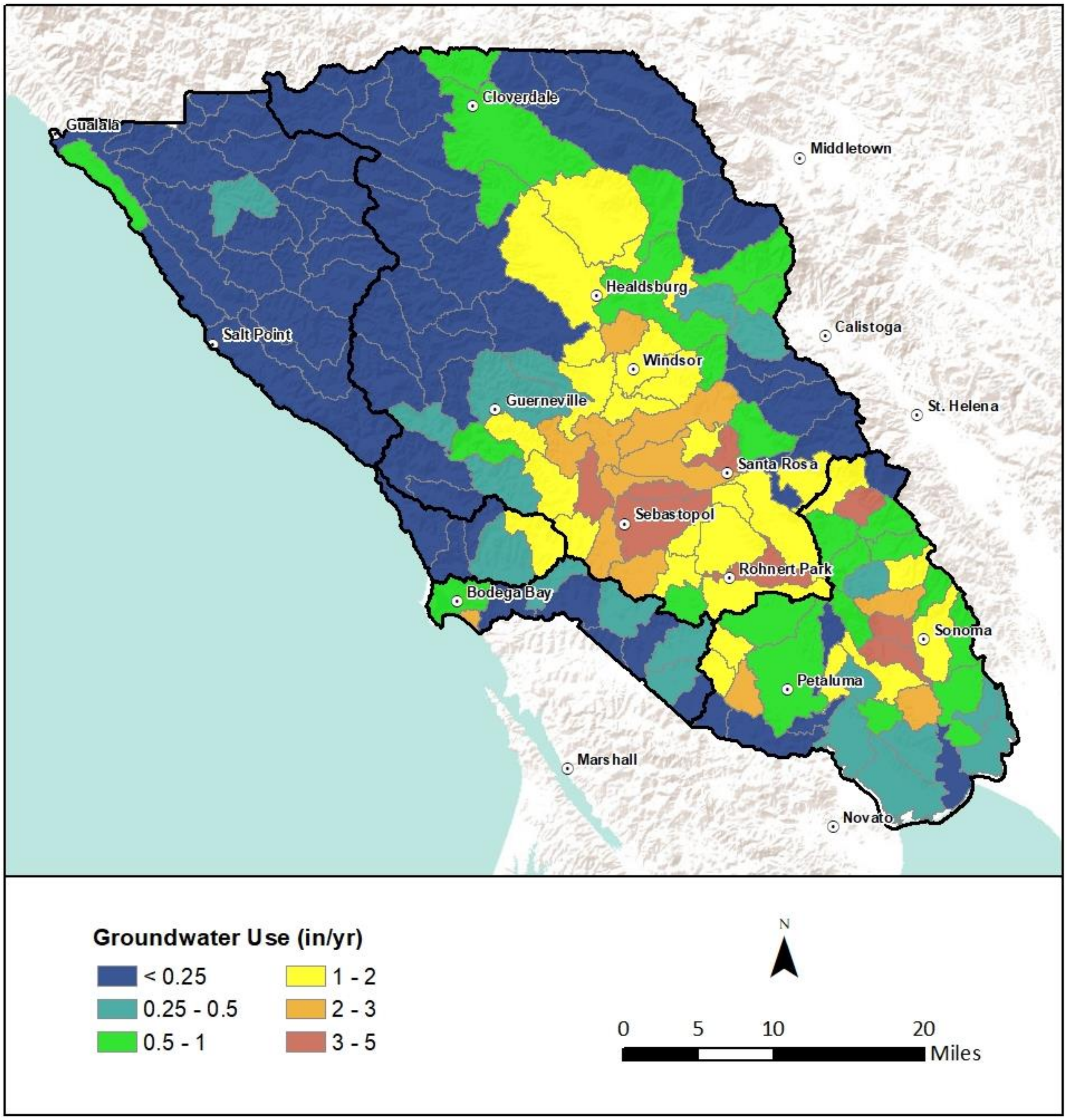

Figure 4: Estimated area-normalized mean annual groundwater use per subwatershed.

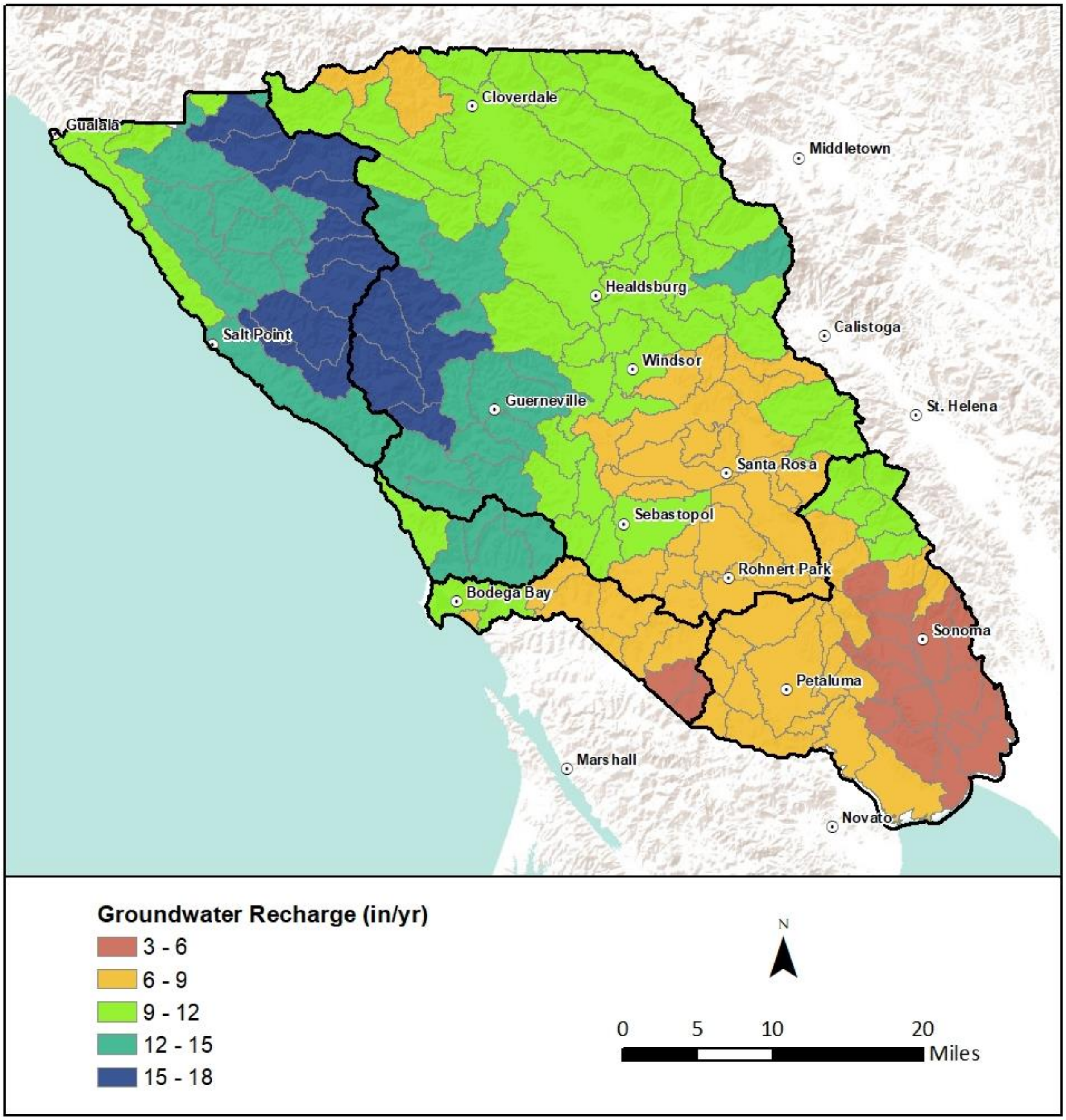

Figure 5: Estimated mean annual groundwater recharge per subwatershed.

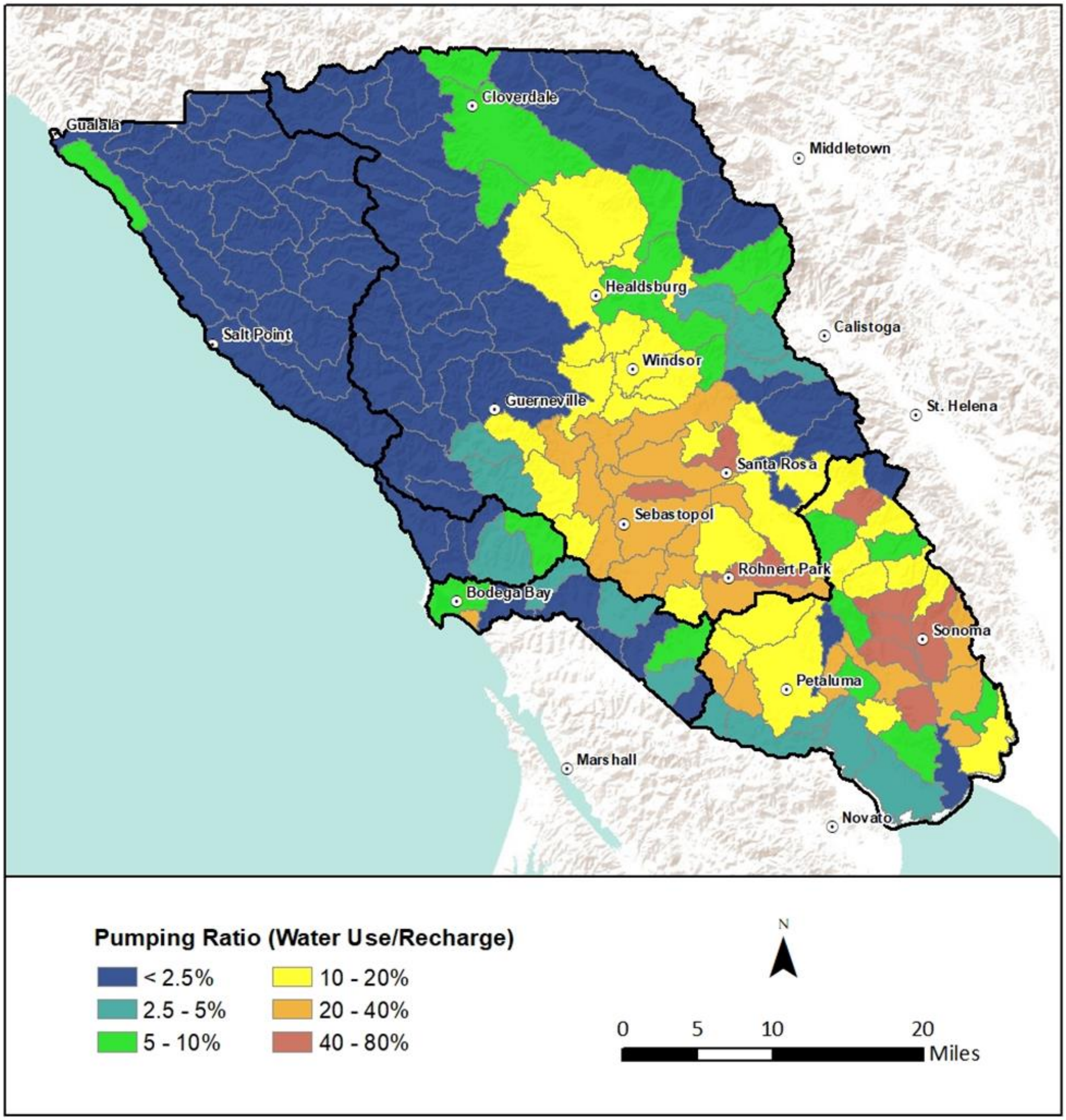

Figure 6: Groundwater pumping ratio per subwatershed.

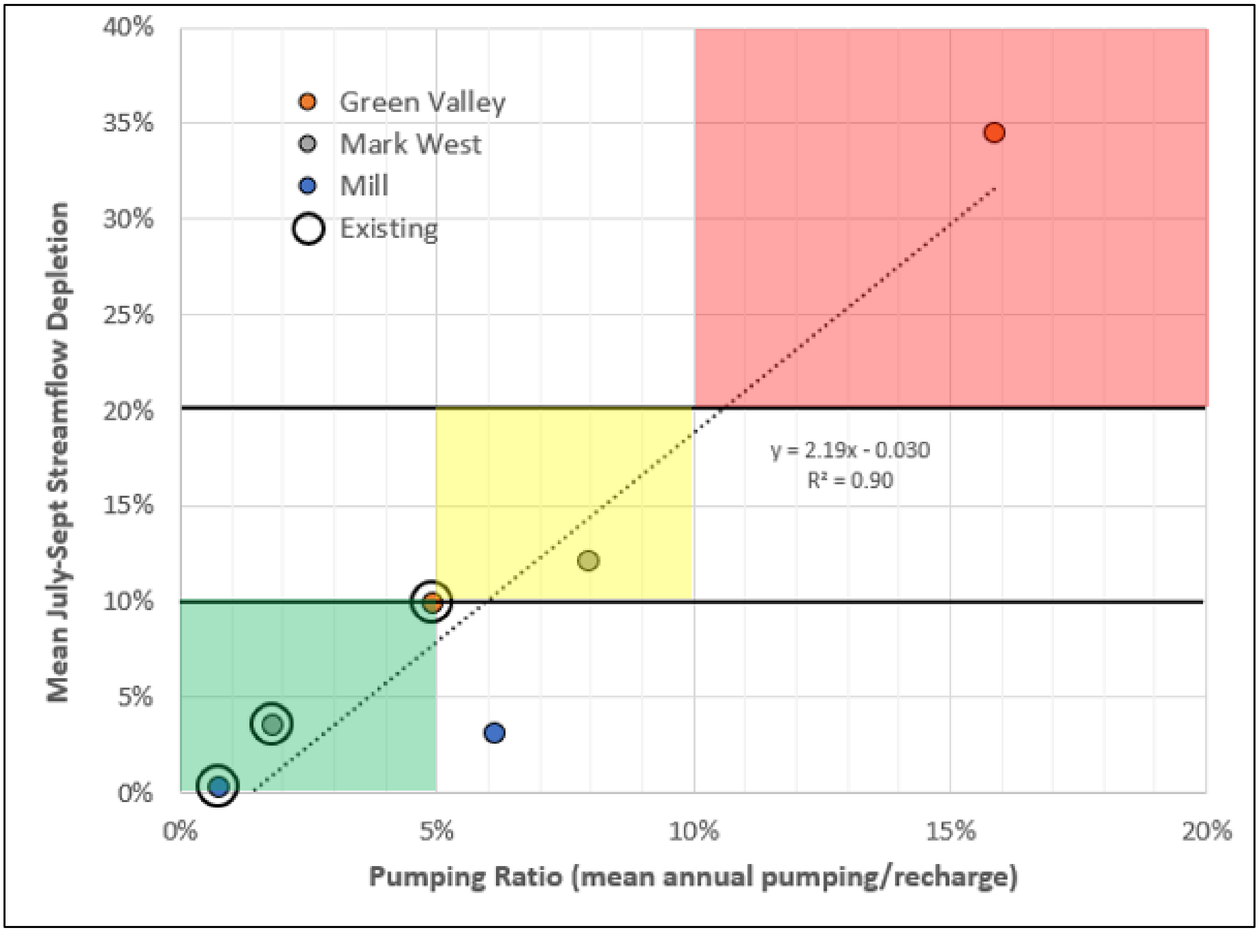

Figure 7: Relationship between the groundwater pumping ratio and summer streamflow depletion calculated from distributed hydrologic models of the upper Mill, Mark West, and Green Valley Creek watersheds. The green, yellow, and red colors indicate the zones where streamflow depletion was defined as low, medium, or high respectively based on Richter et al. (2012).

is some indication of lower depletion rates in watersheds dominated by relatively low-permeability rocks of the Franciscan Formation such as upper Mill Creek relative to those with higher permeability rocks of the Wilson Grove Formation and the Sonoma Volcanics such as upper Green Valley and Mark West Creeks.

The mean July through September streamflow was used because this time period corresponds to the typical period of lowest streamflows in Sonoma County where streamflow depletion effects on juvenile salmonid rearing habitat are expected to be greatest. Salmonids can be affected by streamflow depletion occurring during other time periods, most notably the spring smolt outmigration and adult in migration periods; however, basing the analysis on the low flow summer rearing period when impacts are expected to be greatest should also be protective of streamflows during periods corresponding to these other life stages.

To classify each subwatershed as having a Low, Medium, or High level of streamflow depletion we utilized the findings of Richter et al. (2012) who proposed presumptive standards for environmental flow protection in the absence of detailed studies evaluating site-specific environmental flow needs. A high level of ecological protection is presumed to be provided when flow alterations are no greater than 10% and a moderate level of protection is provided when flow alterations are in the 11-20% range (Richter et al., 2012). The distributed model scenarios indicate that streamflow depletion of 10% or less occurs when the groundwater pumping ratio remains below ~5% and streamflow depletion of 11-20% occurs when the groundwater pumping ratio remains below ~10%. Based on these findings, subwatersheds with a groundwater pumping ratio of less than 5% were coded as Low for streamflow depletion, subwatersheds with a groundwater pumping ratio of between 5 and 10% were coded as Medium, and subwatersheds with a pumping ration in excess of 10% were coded as High for streamflow depletion.

The distributed modeling results for Mill Creek suggest that somewhat higher thresholds could be used in areas dominated by low permeability materials such as the Franciscan Complex, however the lower thresholds are appropriate because they provide a margin of error and because it is likely that streamflow depletion in these areas would be higher (and more consistent with the other bedrock geologies) after extended time frames longer than 50-yrs. The models do not contain thick alluvial deposits such as those found in the Santa Rosa Plain, and thus their predictions are likely less applicable for these areas. Additionally, significant streambed recharge can occur in alluvial basins, complicating the relationships between the pumping ratio and streamflow depletion. Nevertheless, the pumping ratio remains a valid indicator of relative of streamflow depletion in alluvial basins and is thus broadly applicable despite the additional uncertainties.

Validation

Given the inherent difficulty of directly measuring streamflow depletion in the field, well parameterized and calibrated numerical models are generally considered the most accurate tools for evaluating streamflow depletion (Barlow & Leake, 2012; Zipper et al., 2022). To evaluate the validity of the streamflow depletion estimates obtained using the groundwater pumping ratio approach used to map the PTRA, the estimates were compared to estimates obtained from available numerical models in the County (Figure 8). These models included the Sonoma Valley and Santa Rosa Plain GSFLOW models developed for the Groundwater Sustainability Agencies (Farrar et al., 2006; Woolfenden & Nishikawa, 2014) and the MIKE SHE models of the Mill, Mark West, and Green Valley Creek subwatersheds discussed in the previous section (Kobor & O'Connor, 2016, Kobor et al., 2020; Kobor et al., 2021). Mean July-September streamflow depletion estimates were extracted from the models and expressed as a percentage of the total flow in the absence of any groundwater pumping. Calculations were performed over the most recent 10-yr period covered by the simulations which corresponded to 2009-2018 in the Sonoma Valley and Santa Rosa Plain models and 2010-2019 in the coho watershed models.

There is general agreement between the two estimates with both approaches showing Mill and Mark West Creeks having relatively low streamflow depletion and the Sonoma Valley and Santa

Rosa Plain having relatively high depletion, with Green Valley Creek in between (Figure 8). The pumping ratio approach over-predicts streamflow depletion in Green Valley Creek and underpredicts in the Sonoma Valley and Santa Rosa Plain. There are many factors potentially influencing the observed differences including differing groundwater use and recharge estimates and variability in the streamflow depletion response between basins due to the influence of local hydrogeologic and well construction details. Nevertheless, the results indicate that the relative magnitude of streamflow depletion between basins can be well-predicted using the simple pumping ratio approach and are appropriate for their intended purpose of delineating areas with low, medium, or high streamflow depletion as part of the PTRA mapping methodology.

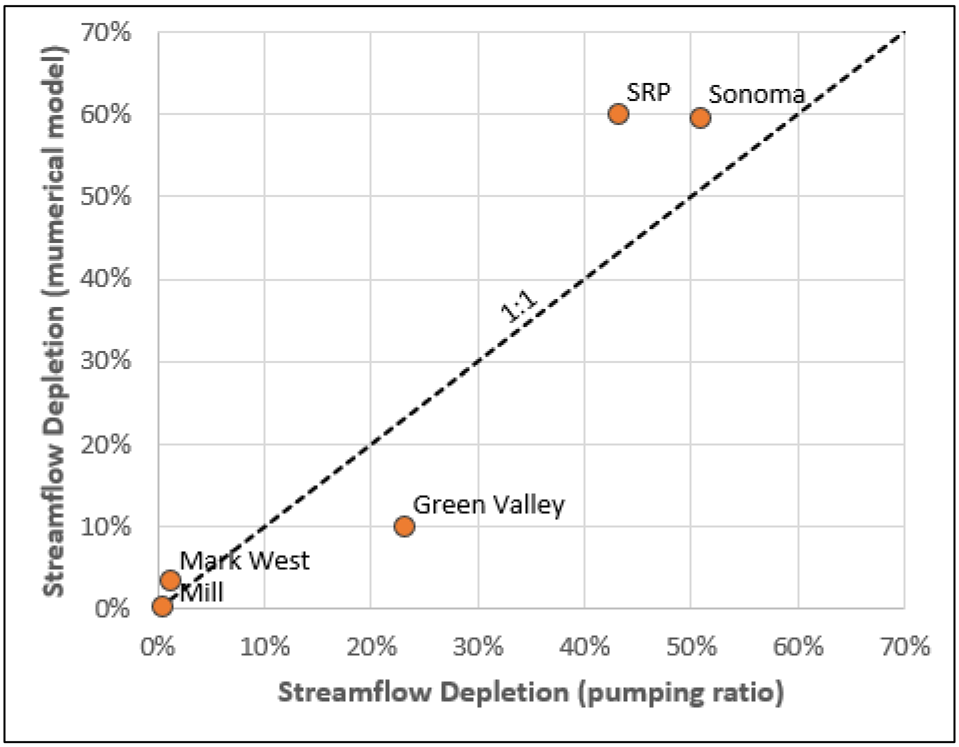

Figure 8: Comparison between summer (July-September) streamflow depletion estimated with the pumping ratio approach used to inform the PTRA mapping and estimates obtained from available numerical models.

Public Trust Review Area Mapping

Overview

A PTRA matrix was developed to define the PTRA based on the results of the resource sensitivity and streamflow depletion mapping described below (Table 1). Low risk areas not included in the PTRA consist of those areas classified as Low resource sensitivity (aquatic habitat value) as well as those areas classified as Medium resource sensitivity and Low existing streamflow depletion.

Moderate risk areas include areas classified as Medium resource sensitivity and Medium existing streamflow depletion as well as areas classified as High resource sensitivity and Low existing streamflow depletion (Table 1). The PTRA in these areas consists of stream buffers (as described in the Stream Buffers section below) designed to be protective of acute streamflow depletion impacts. High risk areas where the entire subwatersheds are included in the PTRA to be protective of both acute and cumulative streamflow depletion impacts include areas classified as Medium resource sensitivity with High existing streamflow depletion and areas classified as High resource sensitivity with Medium or High existing streamflow depletion. High risk areas also include the areas classified as Very High resource sensitivity where the entire subwatersheds are included in the PTRA regardless of the level of existing streamflow depletion (Table 1).

Table 1: PTRA matrix indicating how areas were treated based on the results of the resource sensitivity and existing streamflow depletion classes.

	Low SFD (0 – 10%)	Medium SFD (10 – 20%)	High SFD (>20%)
Low Habitat Value	Low Risk Area Not included in PTRA	Low Risk Area Not included in PTRA	Low Risk Area Not included in PTRA
Moderate Habitat Value	Low Risk Area Not included in PTRA	Moderate Risk Area Stream buffers	High Risk Area Sub-watershed
High Habitat Value	Moderate Risk Area Stream buffers	High Risk Area Sub-watershed	High Risk Area Sub-watershed
Very High Habitat Value	High Risk Area Sub-watershed	High Risk Area Sub-watershed	High Risk Area Sub-watershed

Stream Buffers Distances

Within the portions of the PTRA where stream buffers are used, existing cumulative streamflow depletion is Low or Medium and acute streamflow depletion is expected to be the primary risk to streamflow. The concept of the Stream Depletion Factor (SDF) was used to assist in defining stream buffer distances that are protective of acute streamflow depletion impacts. SDF is a relative measure of how rapidly streamflow depletion occurs in response to new pumping (Barlow & Leake, 2012). SDF is commonly used to assess the timescale and potential for near stream wells to cause streamflow depletion and it is defined as the time in days of pumping when streamflow depletion equals 50% of the pumping rate.

SDF is dependent on the transmissivity and storativity of the aquifer and the distance of the well from the stream. Wells in aquifers with high transmissivity and low storativity are associated with smaller values of SDF for a given distance from the stream. Pumping of wells with low values of SDF will quickly translate into reduced streamflow. The timing and short-term pumping regime of a near stream well may be important for determining if the well will have adverse impacts on streamflow. Pumping of wells at locations with large SDF values will translate into reduced streamflow over longer periods of time, and the short-term pumping regime is unlikely to be a relevant factor in evaluating impacts.

To assist in defining an appropriate SDF threshold that identifies stream buffer distances where acute impacts of groundwater wells may occur, streamflow depletion was evaluated for hypothetical pumping wells using the analytical depletion function from Jenkins (1968). In this exercise, the pumping well extracts groundwater on the 1st of each month at a rate of 28 to 31 gallons per minute (gpm) for a 24-hour period, equivalent to a mean monthly pumping rate of about 1 gpm (Figure 9). This hypothetical pumping regime could be representative of wells that are used for short intervals to meet high demands. Results of this analysis (Figure 8) show that when the SDF is equal to 30 days, streamflow depletion peaks at about 1.35 gpm (35% greater than the average pumping rate). When the SDF is equal to 10 days, streamflow depletion peaks at about 3 gpm (300% greater than the average pumping rate). When the SDF is equal to 180 days, streamflow depletion gradually increases with subdued oscillation to about 0.6 gpm, and would eventually deplete streamflow by about 1 gpm if simulated for a longer period of time.

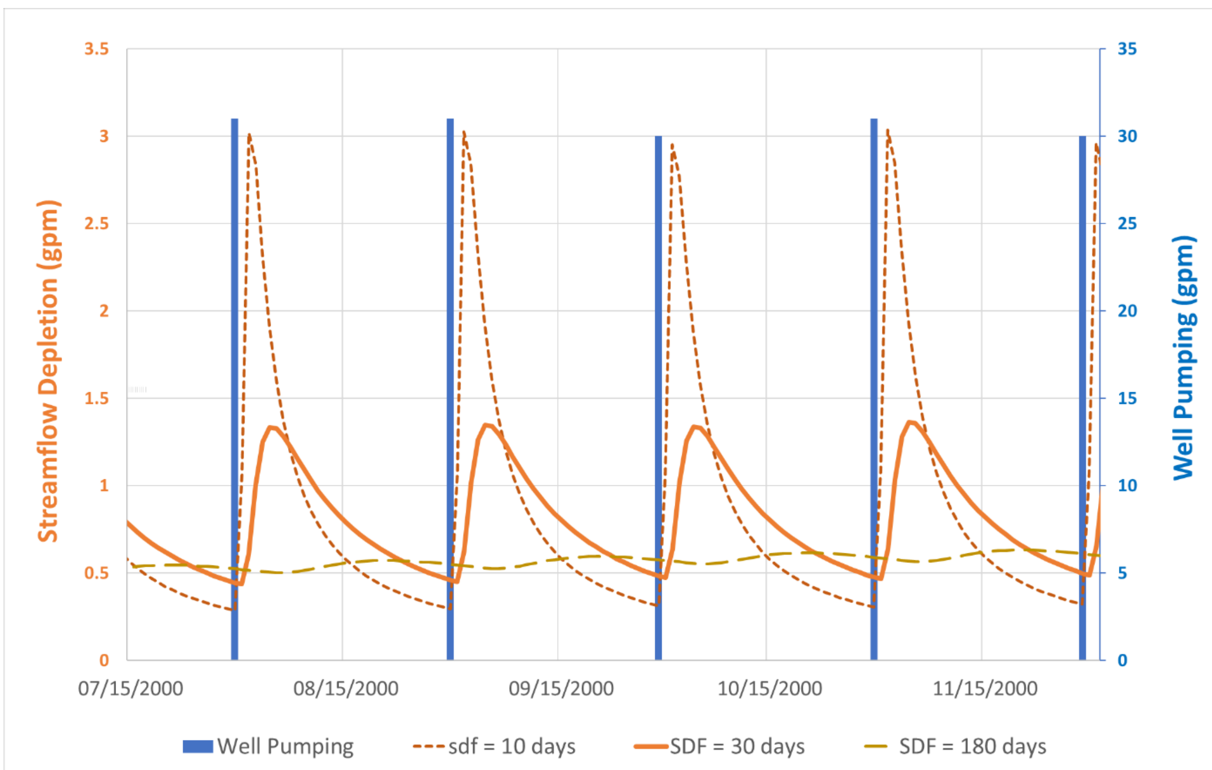

Figure 9. Streamflow depletion from hypothetical wells located at a distance corresponding to Stream Depletion Factor (SDF) of 10, 30 and 180 days based on application of an analytical depletion function (Jenkins, 1968).

As evidenced by the examples above, wells located at distances that correspond with SDFs greater than 30 days are much less likely to pose acute risks to streamflow from intermittent pumping. Distances where the SDF equals 30 days were estimated for various major rock types in Sonoma County using the analytical depletion function from Jenkins (1968) and existing estimates of hydrogeologic properties for these materials (Kobor & O'Connor, 2016; Kobor et al., 2020; Kobor et al., 2021; Woolfenden & Nishikawa, 2014). Based on this analysis, this distance is ~100 ft for the Franciscan Complex, ~250 ft for the Sonoma Volcanics, and ~750 ft for the Wilson Grove Formation and alluvial sediments. Significant spatial variations in hydrogeologic properties occur within these general rock types which translates to significant variability in the distance where SDF equals 30 days, and the above distances were selected based on professional judgement of appropriate representative values for a given formation.

The major rock types were delineated based on the County's existing groundwater classification system. Class I areas represent alluvial sediments, Class II areas represent Wilson Grove Formation, Class III areas represent Sonoma Volcanics, and Class IV areas represent the Franciscan Complex. Mapping of alluvial materials by Stetson Engineering (2008) was used to refine the representation of small alluvial aquifers not captured in the groundwater classification mapping. In basins where stream buffers are used to define the PTRA, streams delineated as critical steelhead habitat by the National Marine Fisheries Service (NMFS, 2023) as well as all contributing perennial streams as identified in the National Hydrography Dataset (NHD) were used to delineate buffer widths corresponding to the defined distances for a given rock type. In reaches where the 750-ft buffer width extended beyond the extent of alluvial or sedimentary materials mapped by Stetson Engineering (2008), the uniform buffers were clipped to the extent of the mapped materials they are intended to represent.

Flow Regulated Reaches

Flows within the main-stem of the Russian River and Dry Creek are controlled by releases from Lake Mendocino and Lake Sonoma and are subject to minimum flow requirements established by the State Water Resources Control Board. Application of the methodology used in other areas of the County to define the relationship between groundwater pumping and streamflow depletion are not valid in these streams due to the controlling influence of the flow releases from the reservoirs (Steiner, 1996; Sonoma County Water Agency, 2016). Therefore, the DWR Bulletin 118 groundwater basins corresponding to the Russian River and Dry Creek were excluded from the PTRA. The groundwater basin boundaries were adjusted to exclude areas where the basins included significant drainage areas associated with tributary streams rather than their flow-regulated main-stems (Figure 10).

Summary

The final PTRA covers ~313 square miles (19% of the county) with stream buffer areas accounting for ~25 square miles and subwatersheds accounting for ~288 square miles (Figure 10). Areas within the PTRA with stream buffers include the South Fork Gualala River watershed, the Adobe, Austin, Bidwell, Crocker, Freezeout, Gill, Jenner Gulch, Pena, Sausal, and Willow Creek watersheds, and portions of the Maacama and Salmon Creek watersheds. Areas where the entire subwatershed was included within the PTRA include the Atascadero, Crane, Dutch Bill, Gird, Green Valley, Mark West, Mill, Miller, and Wine Creek watersheds, watersheds in the northern portion of the Santa Rosa Plain, upper Salmon Creek watershed, large portions of the upper and middle Sonoma Creek watershed, and the northeastern portion of the Petaluma River watershed (Figure 9).

As with any approach to delineating the PTRA, there are uncertainties and limitations associated with the adopted approach. As new data and model predictions become available it is recommended that the methodology and analysis be improved and updated over time. In particular, water use metering requirements associated with the new well ordinance would provide valuable data with which to refine estimates of existing groundwater pumping. New USGS numerical modeling of the Russian River basin is also underway which will provide refined estimates of groundwater recharge and additional estimates of existing streamflow depletion. By periodically refining the approach and analysis used to delineate the PTRA, it is expected that more accurate predictions and mapping can be developed and uncertainty can be reduced over time.

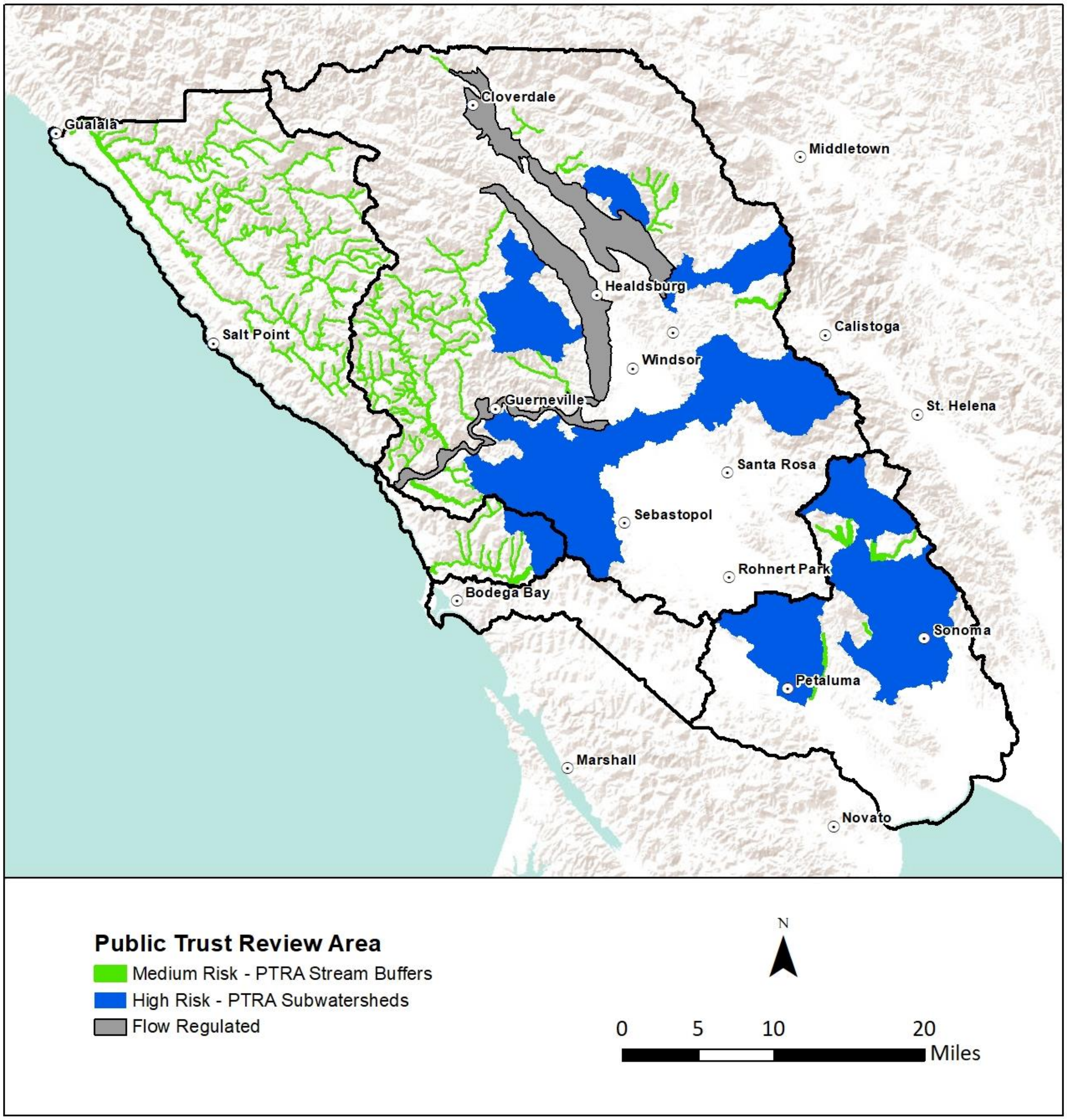

Figure 10. Public Trust Review Area for Sonoma County.

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