

Groundwater Rights, Regulation and Use

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Sharing Water in the Santa Rosa Plain

Prepared and Presented by:

Jane E. Nielson, Ph.D.
Geologist

SHARING GROUNDWATER IN THE SANTA ROSA PLAIN

Jane Nielson, Ph.D.

Groundwater is a critical resource for Sonoma County. In its 2004 report, the Sonoma County Grand Jury found that “Nearly all of the county’s population relies on groundwater as either a primary or backup source of water supply. Sonoma County is reported to have more wells than any other county in the State of California.”¹ Since 2002, Sonoma County well owners have struggled with a variety of groundwater problems, as the whole world faces an uncertain climate future. Even the relatively slow-growing population drives ever-increasing demands for a limited public resource, particularly in the Santa Rosa Plain.

GROUNDWATER FACTS

The Resource: Scientific Facts and (Legal) Fictions

The Facts²

All water at or below the surface of the earth starts out as rain falling on the surface, which is part of the natural hydrologic cycle that results from interactions of solar heat with Earth’s atmosphere and its gravitational attraction. These interactions produce Earth’s climatic zones and climatic fluctuations, and distribute the hydrologic cycle’s effects across the globe.

Rainfall may collect at the surface in ponds or lakes or flow from hillsides and more level lands into large or small streams. Rain and surface waters seep into soils from surface ponds (including lakes), and streams (including rivers and creeks), and into some types of rocks, then to subsurface groundwater reservoirs, called aquifers. Soils may collect water, but if the rocks below do not have aquifer characteristics, the soil water will seep out wherever the underlying rock comes to the surface.

All groundwater aquifers ultimately are connected to surface waters: they are a single resource³. Withdrawing groundwater can affect stream flows, and withdrawing stream water can

¹ Sonoma County Grand Jury, Got Water? July 1, 2004. Available online: owlfoundation.net/OWLfound.GrandJury.html

² Much of this section is from Howard G. Wilshire, Jane E. Nielson, and Richard W. Hazlett, *The American West at Risk: Science, Myth, and Politics of Land Abuse and Recovery*, Oxford University Press (in press). (See: www.losingthewest.com)

deplete the regional groundwater supply. In times of low stream flow, groundwater can drain from aquifers back into stream channels; conversely, stream water can drain into depleted groundwater aquifers.

Groundwater aquifers are replenished (recharged) from the surface episodically, and generally at a low rate of accumulation. To transmit water, soils and rocks must be permeable—but to store water they must contain open spaces (pores), such as the tiny openings between mineral grains in sedimentary rocks. Fractures and caves also provide water-holding openings. A rock may be highly porous or fractured, but if the pores or fractures do not interconnect to provide throughgoing pathways, it will be relatively impermeable.

Ideal aquifers are permeable *and* porous soils or rocks, which provide relatively rapid flow rates and hold abundant groundwater supplies. When exposed at the surface a good aquifer rock or soil also makes good recharge material. Stream sediments and many sandstone rock layers make excellent aquifers and recharge sites, for example. Clay soil, shale rock layers, and hard igneous and metamorphic rocks are relatively to highly impermeable, so pass and store little or no water. These aquitards and aquicludes also make poor recharge materials. Unconfined groundwater aquifers are recharged directly from the surface, while aquitard or aquiclude materials separate deeper “confined” aquifers from surface recharge zones.

Water must seep through a zone of relatively dry soil or rock, called the unsaturated zone (or vadose zone or zone of aeration) to reach the groundwater zone, where pores and fractures are saturated (completely filled with water). The groundwater zone also is called the saturated zone, and the top of the saturated zone is called the water table. In unsaturated zones, pore spaces and fractures may be barely moist or partly filled with water droplets or vapor. In the unsaturated and groundwater zones, water may percolate slowly, moving pore to pore along grain boundaries in the rock, or may flow more quickly through interconnected fractures and other openings (preferred pathways), or both.

Plants, leaf litter, and other organic debris have a large capacity to retain water and slowly release it into the soil or rock, so water seeps into the unsaturated zone more easily from vegetated than from denuded surfaces. Urbanized areas generally obstruct groundwater recharge. Urban and

³ Thomas C. Winter, Judson W. Harvey, O. Lehn Franke, and William M. Alley, *Ground Water and Surface Water: A Single Resource*, U.S. Geological Survey Circular 1139, 1998. Available from U.S. Geological Survey Information Services, Box 25286, Denver, CO 80225.

suburban developments on recharge land diminish the recharge capacity an average of 40 percent, depending on the density of buildings and paved surfaces.

Unlike water stored in surface reservoirs, groundwater in aquifers continually moves from higher to lower levels, depending on the slope of the water table. In many cases, the groundwater and surface waters flow in the same direction, but layering in rocks, faults, and other underground conditions can deflect groundwater along different routes. Where a water table comes to the surface on a hill slope or through valley or canyon walls (perched water table), the groundwater flows or seeps out in unpressurized (effluent) springs. Some aquifers accumulate recharge water high in the mountains, and are warped enough to carry the water to deeper confined levels below an adjacent valley or plain. This water can be under enough pressure to rise through cracks in rock and soil against the pull of gravity and emerge at the surface in bubbling artesian springs.

Legal Fictions and Frictions

No Federal laws regulate groundwater and each state addresses it differently. California law defines water present in subsurface soil, either percolating downward, or present in confined or unconfined aquifers, as groundwater. Unfortunately, State law treats surface water as if it is quite separate from groundwater.

Many state's laws, including California's, invent a type of groundwater — "subterranean streams flowing through known and definite channels." Groundwater may flow through subterranean levels as streams in soluble limestone rocks, but generally in climates of higher rainfall than most of the western United States. California has very few limestone aquifers, and there are none in Sonoma County. Joseph Sax, of U.C. Berkeley's Boalt Hall School of Law, has written "To put the matter as simply as possible, the above categories do not accord with scientific understanding of the occurrence and distribution of water on and in the earth. To hydrologists water is a continuum. The same water may be found on the surface of the earth and at other times underground."⁴

California cedes regulation of groundwater withdrawals to local authorities, but only 28 of the 58 counties, plus 167 municipal water suppliers, do regulate them. Except for areas designated as

⁴ Joseph L. Sax, Review of the Laws Establishing the SWRCB's Permitting Authority over Appropriations of Groundwater classified as Subterranean Streams and the SWRCB's Implementation of Those Laws, Final Report, SWRCB Contract No. 0-076-300-0, January 19, 2002. Available online: [www.waterrights.ca.gov/hearings/SaxReport/SubStreamRpt\(2002-01-20\).pdf](http://www.waterrights.ca.gov/hearings/SaxReport/SubStreamRpt(2002-01-20).pdf)

“water scarce,” Sonoma County issues well permits with little review and does not require any aquifer yield testing or reporting before granting permits for agricultural and most residential wells. In California’s non-groundwater regulating counties, groundwater disputes are based on the “Correlative,” “Appropriative,” and “Prescriptive” legal water rights doctrines enshrined in State law, and variously interpreted by courts over many decades.⁵ This system creates a tangled web of jurisprudence that often boggles the most astute legal minds.

Sharing the Resource

Except for residents in very remote areas with very low populations, all well owners share the water in their local aquifer with neighbors. Householders’ relatively low-yield residential wells pump 1 to perhaps 30 gallons per minute. In some areas, residential well owners compete with high-yielding (300 gallons per minute) agricultural wells, the deep wells of mutual water associations that provide water to a neighborhood or small development, or with very deep and powerful municipal water supply wells, potentially pumping between 20 and 50 million gallons per month (11,000 to 30,000 gallons per minute), on average.

Calculating the availability of water supplies from an aquifer or groundwater basin resembles calculating withdrawals from a bank account: the deposits (recharge) must balance withdrawals (discharges, including from wells). The amount of fresh groundwater available for all uses depends on:

- The amount of annual rainfall
- The extent and topography of the recharge area(s)
- The surface vegetation, which slows the water and helps it seep into the ground, preventing it from all running off into creeks or ponds
- The ability of unsaturated soil and rock to transmit water
- The volume of aquifer soil or rock
- The capacity of a rock to transmit water to wells, which depends on both the texture and structure of the rock or soil
- Total discharges, including natural discharge to springs, wetlands, and streams and lakes, and from evapotranspiration of plants

⁵ Wells A. Hutchins, California Ground Water: Legal Problems California Law Review, vol. 45, no. 5, December 1957, p. 688-697.

Other natural restrictions on available clean groundwater relate to the surface conditions and aquifer composition. Forested soils have the ability to filter percolating water and produce pure groundwater. But groundwater can become contaminated if the water extracts (leaches) too many minerals from rocks and soils, or it can come in contact with natural saline brines in some rock units.

Obviously, a water budget is complex — less like your household budget and more like the Federal budget, with its huge annual income from taxes and even larger set of expenditures, including many small, unidentified leaks. Also like the Federal budget, supplying all the water demand of a populous and growing groundwater basin can drive the resource dangerously close to its deficit point every year.

Sharing the resource is tricky because every pumping well has the effect of lowering the water table in a generally symmetrical zone around the pump, called a “cone of depression” (or drawdown cone). If you drill a well to a deeper level than your neighbor’s, your new well’s deeper cone of depression can draw the local water level lower than the neighbor’s well. If neighboring wells are sited too close together, their cones of depression can overlap and lower the water table for everybody’s well.

The cone of depression for very large agricultural or municipal water supply wells, with powerful pumps, will be much larger than the drawdown cones of most residential wells. The cones of depression for large wells can lower the water table over many thousands of feet, and the cones due to a number of large wells in the same area can lower the water table for whole regions. The deepest wells with the most powerful pumps represent the longest straws into an aquifer, and they have the potential to draw the local water table lower than householders’ wells.

Overpumping of a shared groundwater source is a major concern in populous rural and semi-rural areas, especially for householders living near municipal water supply wells. Where the rainfall is reliable and aquifers recharge quickly, overpumping might not be a problem in the short term. But continual long-term overpumping may remove more water from an aquifer or groundwater basin than yearly rainfall can replace, leading to groundwater overdraft. We often forget that overpumping also dries up water supplies that native plants and animals depend on: springs and discharges to small creeks, for example. The natural systems and their functions are important natural resources, which provide life support to humans as well as to fish and other wildlife.

Recovery of overpumped groundwater zones is not guaranteed. The time that surface water takes to get through an unsaturated zone to the water table and recharge an aquifer depends on the depth of the water table and the way the water moves. Recharging unconfined aquifers can occupy days or weeks, while refilling very deep confined aquifers might take centuries or millennia. Most very deep aquifers hold (or once held) water that collected very slowly over thousands of years — it is actually “fossil” water. Such very deep aquifers take a long time to recharge, much longer than well owners can wait for the water supply to recharge, so pumping deep fossil water is called “mining groundwater.”

Mining deep groundwater has destroyed confined aquifers. Removing the groundwater reduced the pore fluid pressure enough that the deep rocks’ pore spaces collapsed, eventually causing surface collapses. Following pore space collapse, the deep aquifers cannot be refilled. For example, aquifer collapses in Tucson, Arizona, and other southwestern cities have destroyed homes and urban infrastructure. Fifty years of groundwater mining in some parts of the San Joaquin Valley has lowered the regional surface by 27 feet.

The Well Owner’s Dilemma

Many Americans are unaware that U.S. and State property transfer laws do not automatically confer a right to make use of minerals and other substances beneath their homes and yards. Generally, property owners buy only the surface rights and must get special permits to dig minerals out of the ground. Water is an exception, but a limited one. In California the Correlative (or “Overlying”) right entitles an owner of the overlying property to drill a well and withdraw reasonable amounts of groundwater for “beneficial use,” as long he or she does not waste the water or impact a neighbor’s right to beneficial use of the same resource. If conflict arises a court can specify each user’s water allocation. In addition, a property’s correlative water right can be legally defined and sold, but the lack of an overlying right to the groundwater must be disclosed to potential purchasers.

Most potential rural property buyers want a house in the country and do not know to ask about their future well’s water supply or its reliability. Any potential well owner ought to be, but generally is not, advised of the local recharge characteristics, number and power of a property’s main water supply competitors, or of the well’s pumping drawdown-recovery characteristics. Few realtors know enough about groundwater supplies to advise their clients on these issues.

The owner of any property bordered by or containing a surface stream has the “riparian right” to take water directly from that stream for their beneficial use, as long they do not impair the riparian rights of people downstream, or waste water. Wells located near a small stream, outside the “underflow” zone that the State regulates as surface stream flow, may decline if the stream’s flow declines. No California law protects a stream in order to protect the groundwater supplies, nor does any law restrict pumping of groundwater to protect a stream.

Groundwater contamination limits clean water supplies. Well owners may not know their wells are contaminated until they and their families become ill. One problem is too-closely spaced septic systems in rural areas. If septic tank placements are not carefully regulated, a leaking tank or a failed leach field can contaminate household water supplies for the tank’s owner and neighbors alike. Clearly, a lack of regulations that control the spacing of wells relative to each other, and to septic systems, can produce unending conflict and litigation. In semi-rural and suburban areas, leaking sewer pipes and underground gas station or chemical-storage tanks can contaminate the groundwater supply across whole neighborhoods. Past practices that allowed dry cleaners, photographic processing and metal-plating, and other chemical-using establishments to dispose of chemicals into shallow sumps or regular sewer lines, have contaminated groundwater supplies in many areas. People may drink chemical-laced water for some time before they find out about the contamination.

Santa Rosa Plain Groundwater Facts

Human water uses require water storage, whether in tanks or behind dams, or in the ground. The geologic framework of an area — the soils and rocks, and their conditions, determines where and how much water is stored underground. Recharge does not happen everywhere. The locations of recharge areas and aquifers are determined by the geology: if soils and rocks exposed at or near the surface cannot absorb and hold water, and also transmit water, they cannot recharge underlying aquifers. Conversely, recharge rocks and soils may or may not be connected to aquifers, but instead feed water into fractured subsurface rock units. If we could cut a slice through Sonoma County as though it were a layer cake, and look at it from the side, we would see the distribution of Sonoma County’s recharge rocks and aquifers imposes severe limitations on its underground water flows and groundwater storage potential.

Geology and Groundwater

This talk deals only with geologic units of the southern Santa Rosa Plain groundwater subbasin,⁶ which coincides with both the southern Laguna de Santa Rosa watershed, mostly lying south of Guerneville Road, and the County's largest population centers. The watershed includes both the flat-lying central Santa Rosa Plain and its flanking uplands to west, east, and south. The Laguna de Santa Rosa, one of California's larger wetlands, occupies the western half of the Santa Rosa Plain. The Laguna rises in the Sonoma Mountains and Cotati Hills, and flows northward toward the Russian River on a very gently sloping surface.

A large part of hilly southwestern Sonoma County is capped by Wilson Grove Formation, a relatively young (formed about 6 million years ago), highly permeable and porous sandstone (formerly called Merced Formation). This rock generally is reliable for both recharge and water storage. The Wilson Grove Formation is exposed on coastal hilltops as far east as Sebastopol (Wilson Grove Formation Highlands), then disappears beneath the Laguna de Santa Rosa, where it may be as much as a thousand feet thick.

Recent geologic studies along the western Laguna de Santa Rosa have shown that the Wilson Grove Formation interfingers with the same-aged, but less porous and permeable, Petaluma Formation.⁷ This interfingering of the two units, plus the relatively impermeable clay layers within the Wilson Grove Formation, probably account for the locally confined aquifers that create the artesian springs and wells common along Gravenstein Highway (State Route 116).

Petaluma Formation thickens eastward beneath the central Laguna de Santa Rosa, where Wilson Grove Formation thins to nothing. East of the Laguna, thick Petaluma Formation units interfinger with the generally same-aged Sonoma Volcanics, the main rock unit exposed in the eastern Santa Rosa Plain and flanking hills. Petaluma Formation underlies Bennett Valley, and extends as far east as Sonoma Valley. The Sonoma Volcanics consist of massive, relatively impermeable lava, and irregularly interspersed fragmental volcanic rocks (volcanic ash and breccia), which are more porous and permeable than the massive rocks, and can serve as aquifers.

⁶ M.C. Blake, R.W. Graymer, and R.E. Stamski, Geologic Map and Map Database of Western Sonoma, Northernmost Marin, and Southernmost Mendocino Counties, California, 2002; U.S. Geological Survey Miscellaneous Field Map, MF-2402, 2002. Available online at: pubs.usgs.gov/mf/2002/2402/

⁷ James Rollin Allen, Stratigraphy and Tectonics of Neogene Strata, Northern San Francisco Bay Area: A Thesis Presented to the Faculty of the Department of Geology, San José State University, May, 2003.

Other rocks of comparable age to the Wilson Grove and Petaluma Formation (such as Glen Ellen Formation) underlie northern parts of the eastern Santa Rosa Plain, but are not extensive or thick enough to be significant aquifers or recharge areas in the southern Santa Rosa Plain subbasin.

All of the County's other prime recharge areas and groundwater basins, are shallow stream (alluvial) deposits. Both the alluvial deposits, and the reliably recharged Wilson Grove Formation are relatively thin compared to the highly impermeable Franciscan Formation, Sonoma County's oldest "basement" rock. The Franciscan Formation has very few water-bearing zones, which are not well identified, and their recharge potential is unknown.

Franciscan Formation underlies all other geologic units in Sonoma County. The potential for increasing groundwater withdrawals by drilling deeper is highly restricted in all areas where Franciscan is relatively close to the surface. Where Franciscan rocks are exposed at the surface, it's safest to assume that water mostly passes from unsaturated soil zones into fracture zones. Those who rely on Franciscan rocks for water have well flow rates as low as one-half to five gallons per minute.

Where the Santa Rosa Plain's Groundwater Comes From

A California Department of Water Resources (DWR) map of Sonoma County's natural recharge areas shows that the most populous central and eastern parts of Sonoma County have relatively few recharge areas, most of them alluvial stream deposits. The eastern area also has lower rainfall totals than hilly western County, where the recharge rocks are sponge-like Wilson Grove Formation. Because it was deposited in the ocean, however, water from the Wilson Grove Formation may not be very good quality.

Under and upslope from Rohnert Park, the only State-identified recharge areas for Petaluma Formation and Sonoma Volcanics aquifers are old sedimentary hillslope ("alluvial fan") materials along the base of Sonoma Mountain. The volcanic units are so complex, and complexly interlayered, that potential aquifers are not easily identified. In addition, a number of earthquake faults, including the Rodgers Creek Fault, separate the Santa Rosa Plain from potential recharge areas in the mountains to the east. Some faults block groundwater flow, so the long-term recharge capacity of aquifers beneath the eastern Santa Rosa Plain is largely unknown.

The DWR map does not depict either the Laguna de Santa Rosa or the Santa Rosa Plain as recharge areas. The Laguna's human-dredged drainage channel probably provides some degree of

recharge to very shallow groundwater levels, feeding shallow private wells, but likely does not recharge the deeper zones (some 500-700 feet below the surface) fast enough to compensate for current levels of water withdrawal. The Laguna is a flood zone because the water does not easily infiltrate through widely-distributed clay layers deposited in lakes and ponds that once dotted the valley, sporadically shifting position. The rest of the Santa Rosa Plain is used either for agriculture, which breaks up the shallow clay layers and so can promote recharge, or by dense urban-suburban development, which severely restricts recharge.

Streams and creeks that flow from flanking hills through developed areas on the way to the Santa Rosa Plain and Laguna de Santa Rosa have been channelized or otherwise reconfigured, and some now flow through pipes or cement troughs. The pipes and cement restrict the recharge potential of those streams. Whether or not substantial recharge to the southern Santa Rosa Plain takes place through permeable sedimentary deposits in the channel of the Russian River's lower reach, southwest of Healdsburg, is unknown at this writing.

Where the Water Comes Out

Under California's Appropriative Right doctrine, the Sonoma County Water Agency (SCWA), and cities built on the Wilson Grove Highlands and Santa Rosa Plain, derive some part of their municipal water supplies from wells. Appropriators may pump "surplus" water, for use on non-overlying land in the same basin, *or for export to a different basin*.⁸ Most of the municipal water supply wells are drilled into and derive their water from the thick segment of Wilson Grove Formation that edges or underlies the Laguna de Santa Rosa. Of these water-providers, only the City of Sebastopol relies entirely on its own wells. The others — Santa Rosa, Rohnert Park, and Cotati — all use their wells to supplement contracted water deliveries from SCWA, mostly withdrawals from the Russian River, augmented in the dry summer season by water diversions from the north-flowing Eel River in Mendocino County.⁹

Part of the water SCWA pipes southward to Sonoma and Marin County contractors, comes from wells on Occidental, Sebastopol, and Todd Roads in the Laguna de Santa Rosa close to Sebastopol. The three wells all take water from the thick Wilson Grove Formation aquifer. Originally these wells were constructed for emergency backup water supplies, during times when

⁸ Hutchins, California Ground Water

⁹ League of Women Voters of Sonoma County, Water Watch in Sonoma County, October, 2004. Available online at: http://sonco.ca.lwvnet.org/Water_Watch.html

Russian River water-extracting pumps experienced difficulties, and in drought years. Between 1999 and 2001 the SCWA's Laguna wells became full time water-production wells, however, and now add between 1.0 and 1.7 *billion* gallons of water per year to SCWA's aqueduct.

Slightly upslope from the SCWA wells, Sebastopol pumps water from three or four wells, constructed in thick Wilson Grove Formation at the Laguna's edge. One of Sebastopol's wells failed in 2005 but a replacement currently is under construction. City data show that these wells pumped between 427 and 496 million gallons of water per year from 1993 to 2005. The wells most likely are recharged from hilltop areas west of the City boundary along Pleasant Hill Road, and from all exposed areas between Pleasant Hill Road and the well sites. Unfortunately, urban and residential development covers a large part of this area, reducing the recharge potential.

For several decades, the City of Rohnert Park pumped on the order of a billion gallons of water per year from many deep wells in the southern part of the southern Santa Rosa Plain groundwater subbasin. The disappearance of water from private wells in nearby Penngrove initiated a lawsuit that forced Rohnert Park to turn off its pumps and mostly rely on SCWA water deliveries.

In 2002, however, the ruling from a lawsuit filed against SCWA prevented the agency from increasing the Eel River withdrawals that augment summertime Russian River flows.¹⁰ This decision forced SCWA to make do with its current allotment of 75,000 acre-feet of Russian River water per year, instead of the anticipated 101,000 acre-feet required to meet its contractors' total requests. As a result, SCWA's Restructured Agreement with its contractors, and its Water Supply and Transmission Reliability Project, now require the contractors to develop conservation programs, plan for irrigation with treated wastewater, and use "other" water sources to carry out their expansion plans. The SCWA's 2005 Urban Water Management Plan (UWMP) makes clear that the "other" water supplies are groundwater resources.

A 1995 report to SCWA by Parsons Engineering Science consultants¹¹ estimated a total of 275 other wells withdraw water from the southern Santa Rosa Plain, including municipal, domestic, agricultural irrigation, and industrial water supply wells. The amount of water pumped from all these wells is not metered and therefore is unknown. Estimating an annual water use of about half

¹⁰ League of Women Voters of Sonoma County, Water Watch

¹¹ Parsons Engineering Science, Inc., Evaluation of Groundwater Supply Alternatives: Water Supply and Transmission System Project, prepared for Sonoma County Water Agency, August, 1995.

an acre-foot (about 163,000 gallons) per household, the total rural residential water withdrawals in the Santa Rosa Plain and flanking hills could be equivalent to or exceed the total of SCWA's wells.

Impacts from Human Uses

No official agency has declared the Santa Rosa Plain subbasin to be in a state of groundwater overdraft. A 1987 DWR groundwater model¹² documented a profound cone of depression beneath Rohnert Park, however, which appeared to affect the water table across the whole southern Santa Rosa Plain. The Parsons Engineering report compared this cone of depression with groundwater data in a 1958 U.S. Geological Survey report, and concluded that **pumping in the vicinity of Rohnert Park may have caused groundwater levels to be lowered by as much as 130 feet relative to pre-1960 levels.** The same cone of depression had been clearly visible in 1977 groundwater data.

Groundwater basin overdraft occurs when the rate of groundwater withdrawals exceeds the basin's average annual recharge amount from rainfall or percolation from other natural water sources. Once a basin is officially declared in overdraft, obviously there is no more surplus to pump and water appropriators lose their right to take the water. But in an interesting kink of California law, **appropriators who somehow keep on pulling water from an overdrafted basin for five years or more can obtain a Prescriptive right to continue pumping.**¹³ The Prescriptive right takes away the injured well owners' Correlative right to the water under their own lands, and they also lose the right to sue the offending appropriator.

Could the southern Santa Rosa Plain groundwater subbasin become overdrafted? California DWR monitors groundwater levels in a number of wells throughout the Santa Rosa Plain. A SCWA compilation of those monitoring data from 1970 to 2003 shows a pattern of consistent groundwater decline over that period. For example, water elevations declined from 70 to 80 feet above mean sea level in 1970, to 38 to 51 feet above mean sea level in 2000, with no compensating increases during the many intervals of higher than average rainfall over three-plus decades. The DWR-monitored wells showed only slight recovery in 2000, when Rohnert Park turned off its water supply wells, which indicates a slow or insufficient level of recharge in that part of the Santa Rosa Plain, compared to the level of water demand. These conditions, along with the Penngrove area's

¹² California Department of Water Resources, Santa Rosa Plain Groundwater Model, 1987, 281 p.

¹³ Hutchins, California Ground Water

documented drying of shallow householder wells and declining water quality, are the indicators of developing groundwater overdraft.

SCWA's monitoring data from its Laguna de Santa Rosa wells show drawdown effects at shallow, intermediate and deep groundwater levels. Monitoring wells at the Sebastopol Road well indicate a water level decline from +25 above sea level before pumping began, to between 40 and 100 feet below sea level at intermediate and deeper levels after pumping started in mid 2001. In mid-2003, a sharp water level decrease at one monitoring well corresponded to commencement of pumping at the reconstructed Occidental Road well. Data from all wells indicate that deeper and intermediate zone pumping affects shallow groundwater. Since the pumping at one well can be discerned in the monitoring records of the others, the drawdown effects of all three wells affect groundwater over roughly a four-mile area. Proposed new developments in the Santa Rosa subbasin, such as the Indian casino and resort planned for a site west of Rohnert Park, to be supplied by at least two 1,000-ft wells, can only increase the current rate of groundwater decline.

In 2003, the wells of rural residents located near Sebastopol's and SCWA's municipal water supply wells began to go dry, and volatile organic compounds from old contamination sites showed up in some wells. Drying wells under one of Sonoma County's relatively well-watered areas, in one of Sonoma County's best recharge rocks, should be a wakeup call. For those who could afford to construct new wells, drillers had to bore 200 to 300 feet below the ground surface to find water. Many of the householders had to pay \$10,000 to \$20,000 to replace their old shallow wells, which had provided ample water for many decades.

Santa Rosa Plain Groundwater Connections

The Highlands and Laguna de Santa Rosa Connection

Only a few studies contain data that bear on the possible connections between the Santa Rosa Plain subbasin's recharge areas and aquifers. Ambitious development plans are pushing forward in spite of the knowledge gaps. Meanwhile, a U.S. Geological Survey study to better define the region's groundwater conditions began in 2005, in partnership with the Sonoma County Water Agency. But the study will not be complete for several more years.

Drilling records for the SCWA's Laguna de Santa Rosa wells show clearly that they draw water from a thick underground section of Wilson Grove Formation. The recharge for these wells is not

well defined. Between Cotati and Sebastopol, the poorly-defined Sebastopol Fault separates the Wilson Grove Formation Highlands from the Laguna, which has lead to speculation that Wilson Grove Formation Highlands groundwater does not flow into Santa Rosa Plain aquifers. But the 1987 DRW groundwater data, interpreted in the 1995 Parson's report, indicate that the Wilson Grove Formation Highlands aquifer does connect through the subsurface to the Santa Rosa Plain.

According to the Parsons report, "The groundwater contour maps included in DWR (1987) (Figure 4) show the groundwater contours as oriented approximately parallel to the Sebastopol fault. If the fault were acting as a groundwater barrier, the groundwater contours would be expected to reflect this effect by displaying an orientation that is perpendicular to the fault, not parallel..."¹⁴ Similarly, the Draft Environmental Impact report for Sebastopol's proposed Northeast Area redevelopment project states that the City's wells "receive recharge water primarily from the Wilson Grove Formation in the hills west of Sebastopol, with some additional water recharge from the Santa Rosa Plain to the east." The data seem to show, therefore, that the Sebastopol Fault does not impede groundwater and so the Wilson Grove Formation Highlands and Santa Rosa Plain are hydrologically connected.

Establishing a connection between the southern Santa Rosa Plain groundwater subbasin and the fringing Wilson Grove Formation Highlands has great significance for the regional groundwater supply. Automatically issuing well permits for properties in those highlands could be impairing a crucial groundwater supply for everyone drawing water from Santa Rosa Plain aquifers.

The Russian River and Laguna de Santa Rosa Connection

It is still unknown whether Russian River recharge water is a critical factor for maintaining the Santa Rosa Plain's groundwater supply. The ongoing U.S. Geological Survey study of the Santa Rosa Plain basin will investigate the interaction between Russian River and Santa Rosa Plain groundwater. If a connection between the Russian River and the southern Santa Rosa Plain subbasin can be established, then changing flow regimes in one will affect the other. Ambitious groundwater development projects could cause Russian River water to drain into the Laguna, while lowering Russian River flows for protracted periods could drain more groundwater into the River.

¹⁴ Parsons Engineering Science, Inc., Evaluation of Groundwater Supply Alternatives, p. 12

Legal “Ethics”

The term “legal ethics” may seem an oxymoron, especially for California water law, which confers on water appropriators the piratical ability to take over all the rights of Correlative water users by Prescription. But since 1990, a number of Federal court decisions have defined wildlife and habitat protection as a beneficial use of water tapped by Federal water projects, and the evidence of limited water supplies have resulted in recent California court decisions to limit water diversions from the Eel River to protect salmon, and from the Sacramento River delta to protect delta smelt.

In 2000, a California Appellate Court judge detected an “aura of unreality,” in urban expansion plans, which projected that the State water project someday would deliver 4.2 million acre-feet of water to Los Angeles and cities in Kern County, 175 percent more than at present. The judge ruled that the development was illegally based on “paper water.” In 2005, the California Court of Appeals found a new State water plan “legally insufficient,” in part because it is based on the “pre-conceived notion that inevitable growth in California necessitates ... increased water delivery from north to south.” Questioning the dogma of inevitable growth, the court objected that the plan “appears not to have considered ... smaller water exports from the Bay-Delta region which might ... lead to smaller population growth due to the unavailability of water to support such growth.”

In response to these decisions, the State legislature has enacted a number of so-called “show-me-the-water” laws aimed to avoid the worst potential water supply problems, while preserving the imperative that every population center across California must keep on expanding indefinitely. These laws include the 1983 Urban Water Management Planning (UWMP) Act, much amended from the 1990’s to the present, and the 2001 passage of SB-610, and SB-221.¹⁵ In addition, California’s AB 3030 statute encourages water-management agencies to plan and implement groundwater management, and encourages “conjunctive” groundwater-surface water management.

“Other Sources” (SCWA’s Restructured Agreement)

Government agency policies that encourage groundwater development in the Santa Rosa Plain, such as SCWA’s Restructured Agreement, are likely to exacerbate the already-existing drawdowns, leading to even worse overdraft conditions. In addition, California’s push to irrigate landscape and agriculture with treated wastewater, reflected in the Restructured Agreement, is based on two

¹⁵ David Lanferman, Impact of New Water Laws on Development in California, January 29, 2002. Available online: www.sheppardmullin.com/publications-articles-61.html.

outmoded regulations, the California Toxics Rule and standards of the Federal Safe Drinking Water Act. Neither of these instruments protect people from the long list of potentially harmful substances, including pharmaceuticals, illegal recreational drugs, unprocessed antibiotics, and personal care products, which pass unaltered through standard treatment plants. Multi-drug resistant DNA and RNA are newly-identified contaminants in treated wastewater.¹⁶ Spreading billions of gallons of water containing these substances on the ground surface could have unforeseen negative health effects. But one thing is certain: putting them into soils and water supplies will inevitably put them into the groundwater.

Groundwater and Urban Water Management Plans

The Urban Water Management Planning Act requires Urban Water Suppliers (providing for 3,000 or more water/sewer connections) to submit an Urban Water Management Plan (UWMP) to DWR every 5 years, to “identify and quantify ... the existing and planned sources of water available to the supplier” over a span of 20 years, in five-year increments, “or as far as data is available.” UWMPs must describe all current and potential water sources and the provider’s legal right to them, programs planned or in place for enhancing and conserving water supplies, and an assessment of the water supply’s reliability in a normal, dry, and multiple dry years. “For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors,” a UWMP must “describe plans to supplement or replace that source with alternative sources or water demand management measures, *to the extent practicable*.”

UWMPs that rely on groundwater supplies require a description of the resource, including a groundwater management plan or adjudication orders, and whether or not in overdraft, but do not require assessments of the effects of using the water supply on all others who draw water from the same water groundwater basin. In practice, water providers are likely to claim that they have or will find enough water to cover their growth objective, and the only oversight body likely to challenge assertions based on paper water is the public.

Groundwater and Water Supply Assessments

Passed in 2001, SB 610 addressed the appellate court’s refusal to approve development based on “paper water.” It requires a Water Supply Assessment (WSA) to accompany the environmental

¹⁶ Amy Pruden, Ruo Ting Pei, Heather Storeteboom, and Kenneth Carlson, Antibiotic Resistance Genes as Emerging Contaminants: Studies in Northern Colorado, *Environmental Science and Technology*, 2006, v. 40, p7445-7450

reviews required under the California Environmental Quality Act for proposed developments of more than 500 residential units, or ones large enough to push a municipal water supplier's service level above 3,000 connections. Like a UWMP, the WSA must project the water supply 20 years into the future, and must assess the adequacy of supply for all existing and planned uses in addition to the development's requirements. Again, public review is the sole means identifying and challenging a WSA's dependence on paper water. SB 221, a companion 2001 law, requires that cities and counties cannot approve a final subdivision map of 500 units or more unless the developer verifiably demonstrates an available water supply sufficient to serve it. The verification must be based on "substantial evidence," which may include the current UWMP, a WSA conforming to SB 610, or "other information relating to the sufficiency of the water supply."

It remains unclear whether or not a WSA must contain "substantial evidence" for verification of groundwater supplies. In deciding a lawsuit challenging Rohnert Park's WSA for its proposed eastward expansion, Sonoma County Judge Knoel Owen stated "the plain language ... seems to require ... an analysis of the sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand ..." This decision has been appealed to the State appellate court.

Future Prospects

Nobody can fully comprehend the forces of nature and history set in motion by past events or present actions, or see deeply enough into the minds of men and deities, to predict the future. Yet some broad outlines are visible.

Drought?

Rapid global warming has begun to show us its power, and climate scientists are predicting that this climatic change will yield longer droughts than the U.S. has experienced in its history. Even without rapid climate warming, geologic evidence from lake basins and tree rings record droughts that lasted 60 years, and those conditions inevitably will return. The southwestern U.S., including southern California, has been enduring drought conditions since 2000, and northern California will have its turn. Even without drought, rapid climate warming will have a number of other water-reducing effects: water will evaporate faster from soils, lakes, and reservoirs; trees will use more soil water and transpire faster; and mountain snows will melt earlier in the year, overflowing

reservoirs and causing higher evaporative losses. Farms, gardens, lawns, and landscaping will all be thirstier, forests more vulnerable to fire, and groundwater recharge levels will be reduced.

Groundwater/Aquifer Impairment? Adjudication?

Especially in the case of a protracted drought, the Santa Rosa Plain groundwater subbasin is highly likely to become impaired. The winter of 2006-2007 provided below-average rainfall to northern California, and to save enough water in Lake Mendocino for the fall, 2007, salmon run, the State Water Board ordered SCWA to cut back its Russian River withdrawals by 15% from June through the middle of October. The City of Cotati made up the difference between the reduced SCWA water deliveries and its perceived needs by bringing two wells online. A July 2007 *Santa Rosa Press Democrat* story on water conservation strategies reported that Rohnert Park again turned on its wells.

In 2005, Santa Rosa began test-drilling supplemental well sites in the central Santa Rosa Plain south of Guerneville Road. Between 2000 and July of 2006, the City wells pumped 11 million gallons from wells along Farmers Lane, in Santa Rosa's hills. This is a very small contribution to Santa Rosa's water use, but the pumping levels are likely to increase. Absent the wells, groundwater from the Farmer's Lane area eventually would contribute recharge to aquifers in the Santa Rosa Plain subbasin.

Once an overdraft is officially recognized, citizens have five years to legally stop an appropriator from continuing to pump water from the affected basin before the appropriator gains Prescriptive rights. So far there has been no finding of overdraft, and a lawsuit over Correlative rights could trigger a water adjudication. Under adjudication, a court takes away the water rights of everyone in the affected basin or basin portion, eventually re-assigning a level of water rights and maximum amounts available to each user. Commonly, the court appoints a Water Master to determine the holders of senior and junior water rights, define the amounts, watch over the resulting process, and resolve additional conflicts.

Conjunctive Management?

The 2003-2004 Sonoma County Grand Jury recommended that:

- The county and each of its cities include a "water element" in their general plans
- The county and each of its cities develop a comprehensive groundwater management plan

- An independent regional water resources management board be established.

Groundwater management is not necessarily groundwater conservation, as the Grand Jury recognized, adding, “If the county does not implement a countywide groundwater resource management plan and does not continue to further invest in educating the public regarding water conservation, there is every reason to believe that groundwater resources will be further threatened and that population and business growth will be limited. Water conservation measures by all residents of Sonoma County are an immediate and practical first step in resolving these issues. It costs much less to preserve water resources than to try to replace them after they are lost.”¹⁷

The genius of AB 3030 is its required involvement of all basin stakeholders, so that groundwater is managed by local consensus to the benefit of all. The sister statute, AB 303, provides financial assistance to groundwater management programs that conform with AB 3030 requirements. Because groundwater and surface water are a single resource, DRW supports combining groundwater and surface water management into “conjunctive” water management programs. This approach adds watershed and wetlands protection, and other surface water protection and management strategies, many under Federally or State-funded programs.

FINAL WORDS

In *Crossing the Next Meridian*, Charles Wilkinson wrote: “Water development in the American West ... bears the bright and ironic imprint of the prodigal waste of an assertedly precious resource.”¹⁸ Prodigal waste of groundwater surely must end. Intensified conservation programs will be essential, along with eliminating reservoirs and the many wasteful uses of clean water from rivers and groundwater aquifers, such as flushing toilets. Using wastewater for irrigation, just to keep our population growing, is more problematic and must be approached with great care. We need to understand that “... reality has a way of forcing its way into human consciousness, and sooner or later we must acknowledge that our relationship to water is intimate, complex, and primal: if we abuse it, we inevitably suffer the consequences.... We must accommodate ourselves to the water, not the other way around.”¹⁹

¹⁷ Sonoma County Grand Jury, *Got Water?*

¹⁸ Charles F. Wilkinson, *Crossing the Next Meridian*, Covelo, California, Island Press, 1992, p 230.

¹⁹ Jacques Leslie, *Running Dry: What happens when the world no longer has enough freshwater?*, *Harpers Magazine*, July 2000, p. 37-53

ACKNOWLEDGMENTS

I am grateful for the contributions to this paper from Howard Wilshire, Public Employees for Environmental Responsibility; Steven Carle, H.R. Downs, and Susan Panttaja, OWL (Open Space, Water Resource Protection, and Land Use) Foundation; Stephen Fuller-Rowell, Sonoma County Water Coalition; David Noren, Sebastopol Water Information Group; Brenda Adelman, Russian River Protection Committee; and Carl Hauge, formerly Chief Hydrologist of the California Department of Water Resources.

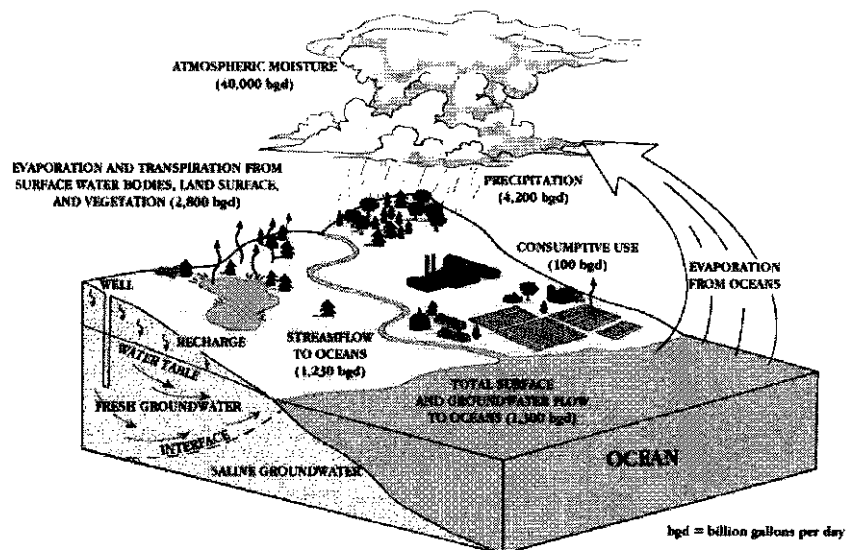
Sharing Groundwater in the Santa Rosa Plain

Jane Nielson, Ph. D.

Illustrations

The Resource: Facts

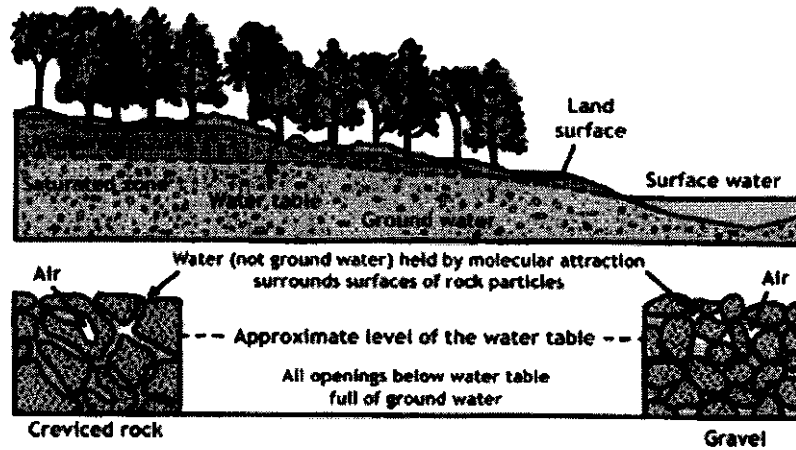
THE HYDROLOGIC CYCLE



from U.S. Geological Survey "Ground Water and the Rural Homeowner"

The Resource: Facts

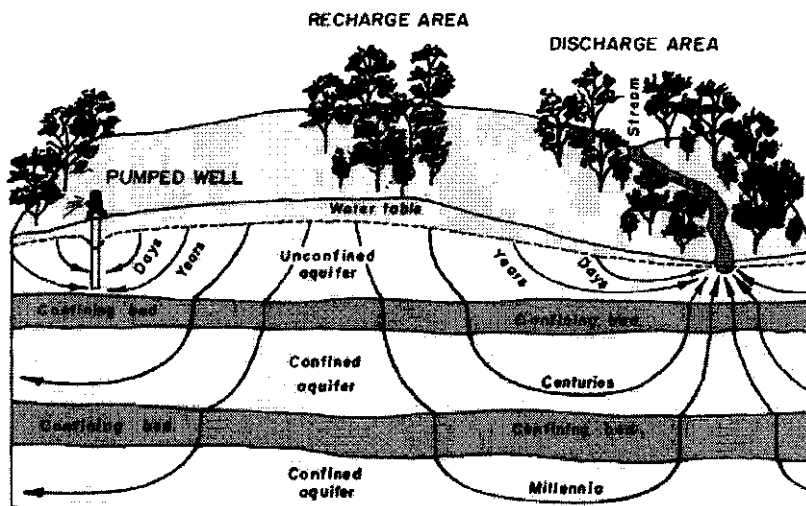
Unconfined Aquifer



from U.S. Geological Survey, "Ground Water and the Rural Homeowner"

The Resource: Facts

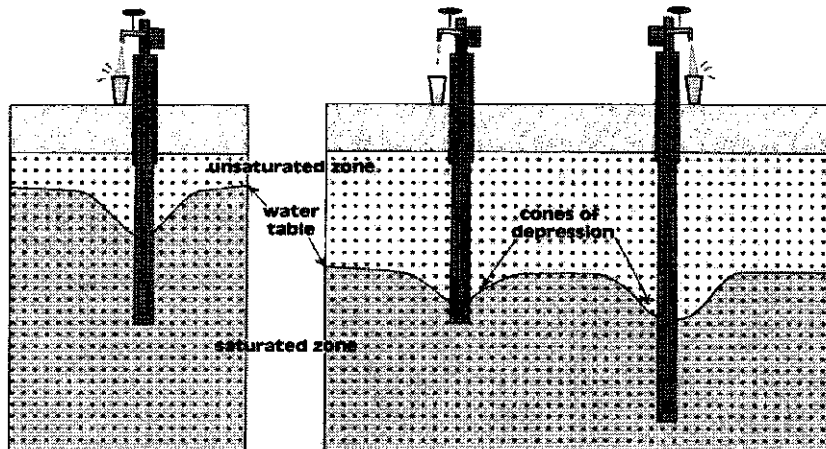
Confined Aquifers



from H. G. Walter, J. E. Nelson, and R. W. Hazlett, "America's West at Risk: Science, Myth, and Politics of Land Abuse and Recovery," Oxford University Press (2008)

Sharing the Resource

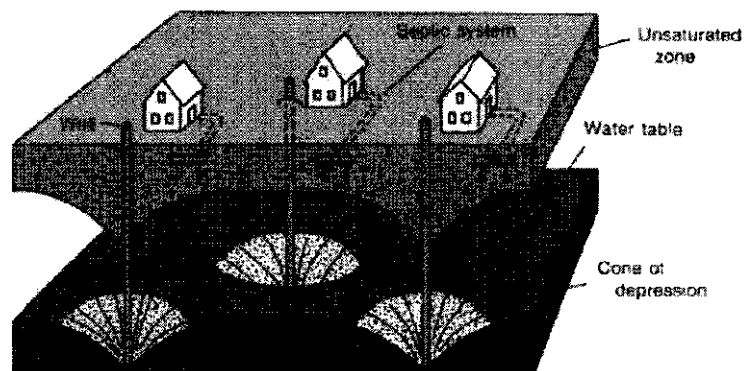
cones of depression (drawdown)



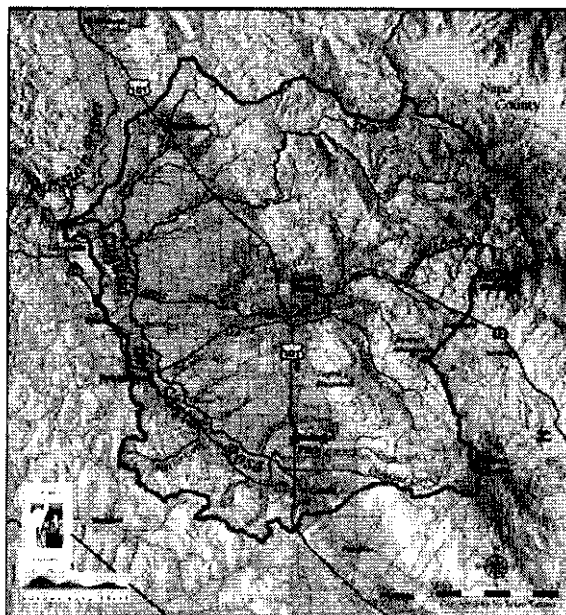
adapted from U.S. Geological Survey publication "Ground Water and the Rural Homeowner"

The Well Owner's Dilemma

water table declines and contamination



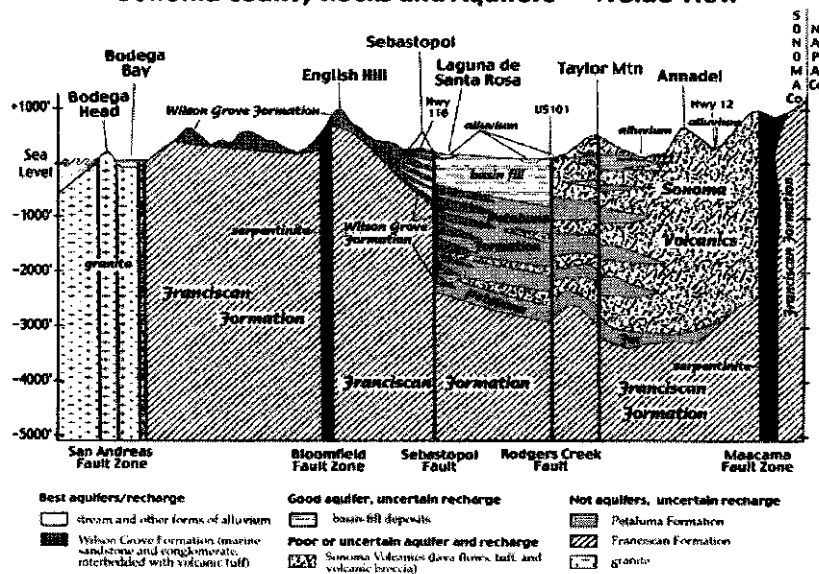
from U.S. Geological Survey "Ground Water and the Rural Homeowner"

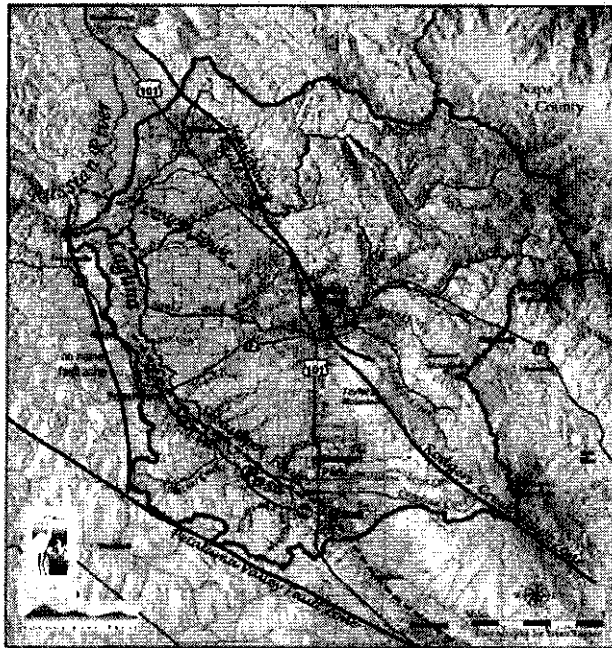


Santa Rosa Plain Groundwater Facts

The Laguna de Santa Rosa Watershed coincides with the southern Santa Rosa Plain groundwater subbasin

Geology and Groundwater in Sonoma County Sonoma County Rocks and Aquifers -- A Side View



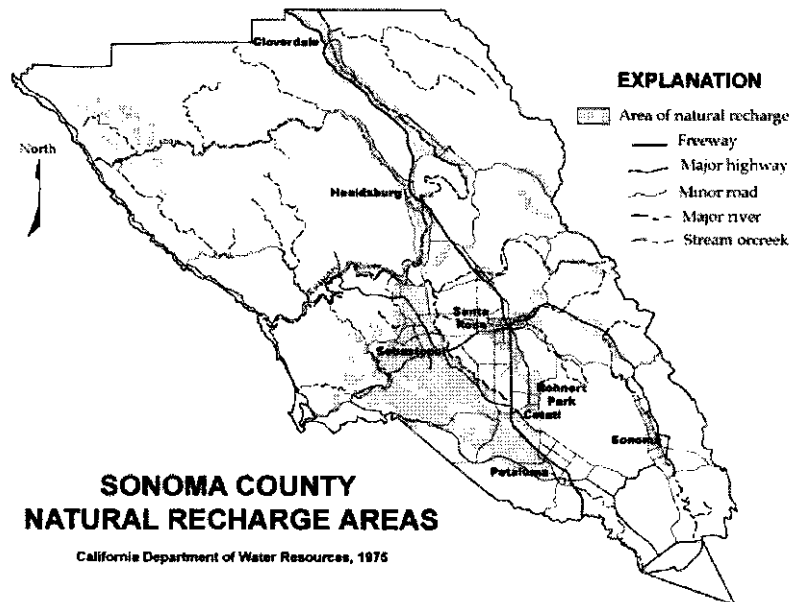


Laguna Watershed Faults

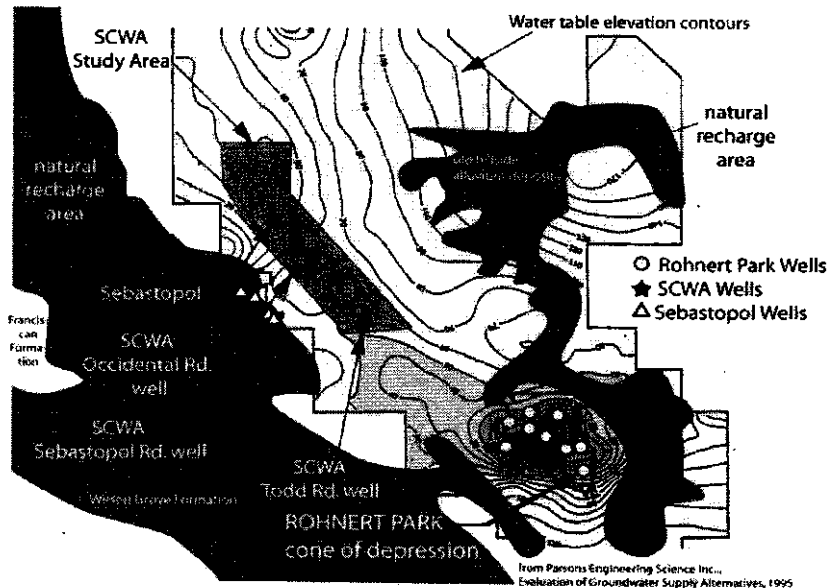
(highly generalized)

faults may block or impede groundwater

Where the Santa Rosa Plain's Groundwater Comes From

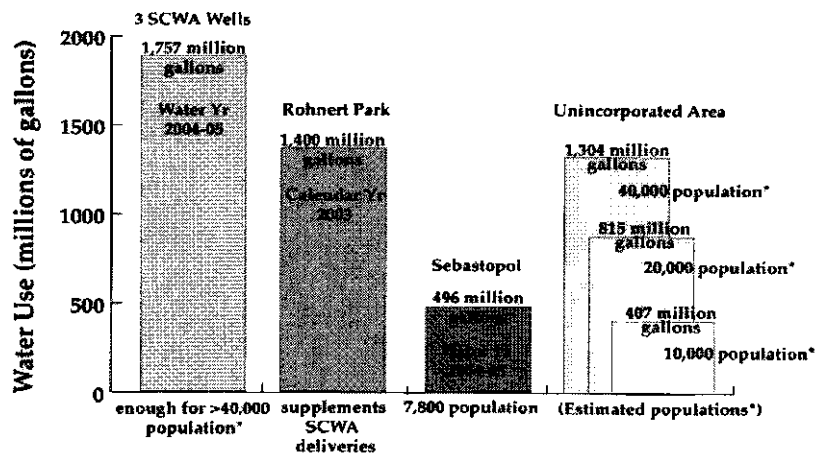


Where the Water Comes Out



Where the Water Comes Out

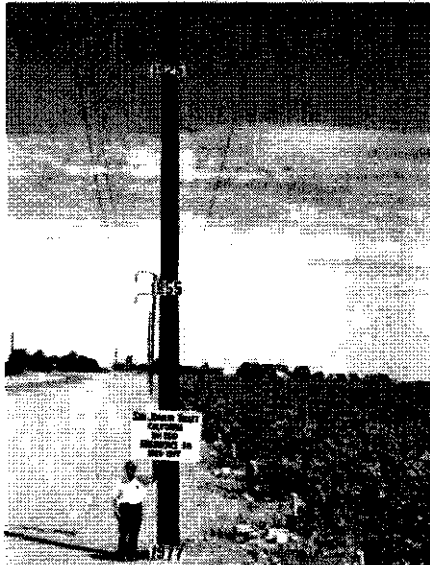
Well Pumping Levels in the Santa Rosa Plain



*Estimates based on water use of 1/2 acre-ft per yr (about 163,000 gallons) for a family of 4
(20,000 population = 5,000 families, 10,000 population = 2,500 families, etc.)

SCWA data from Sonoma County Water Agency, March, 2007
Sebastopol data from City of Sebastopol Public Works Department, May, 2007
Rohnert Park data from Parsons Engineering Science, Inc., 1995 and SCWA graphics, 2006

Impacts from Human Uses:

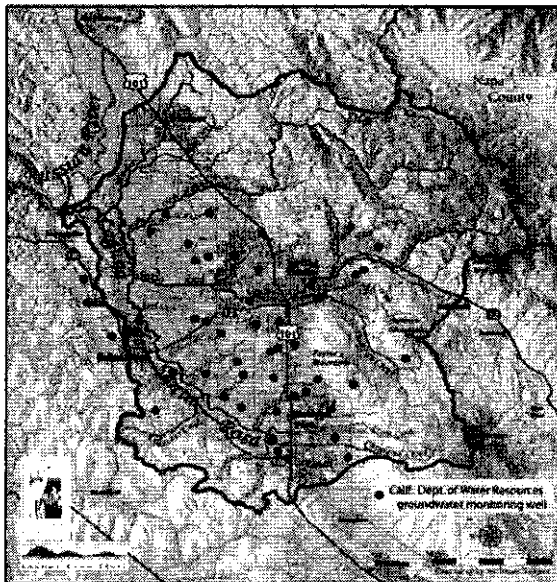


Groundwater Mining from a deep aquifer can cause the aquifer to collapse, also causing collapse at the surface.

(1977 photo from the San Joaquin Valley)

Impacts from Human Uses

Monitoring Human Uses



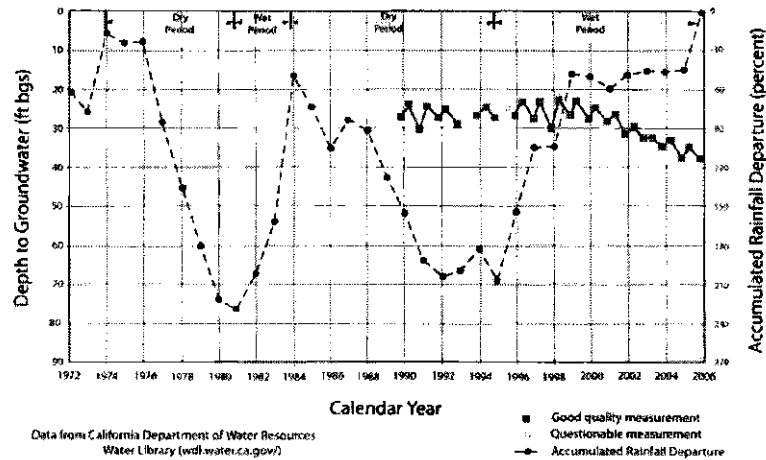
California's Department of Water Resources has numerous monitoring well locations in the Santa Rosa Plain

Wells and results are online:
<http://wdl.water.ca.gov/gw/>

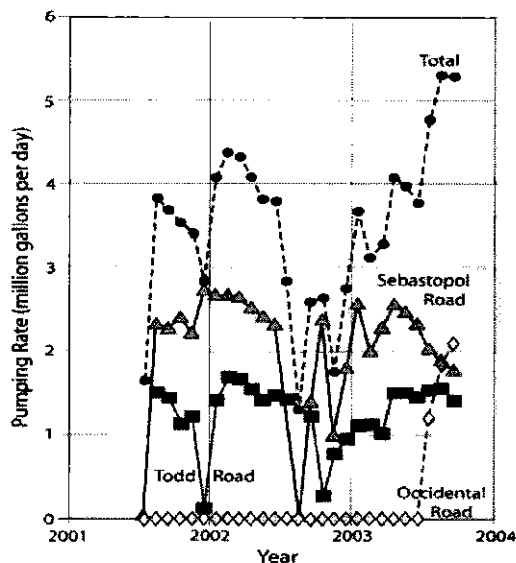
DWR Monitoring Well Record

Groundwater level or declining in rainy years (dashed line), indicate overpumping

Hydrograph of CA Water Library Well 7N9W26P-1 (Santa Rosa Plain)



SCWA's Laguna Well Pumping 2001-



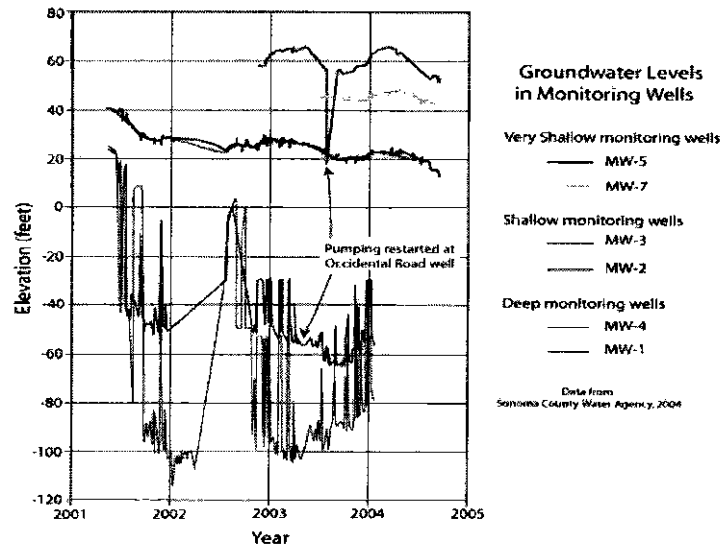
The mid-2003 restart of pumps at the Sonoma County Water Agency's Occidental Road well caused a temporary low in shallow ground-water, and declines in deep and intermediate aquifers at the Sebastopol Road well, 4 miles away.

(see next illustration)

Impacts from Human Uses

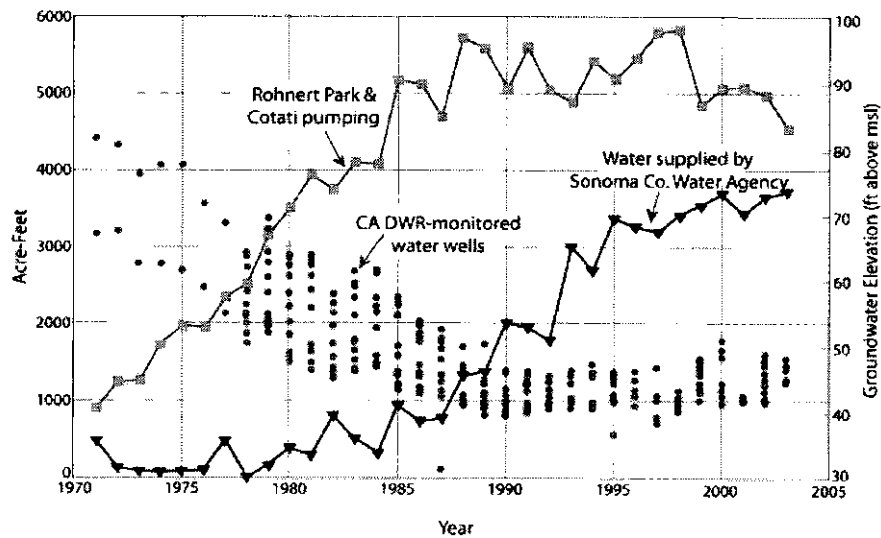
SCWA Well Drawdown, 2001-2005

SCWA Sebastopol Road Well

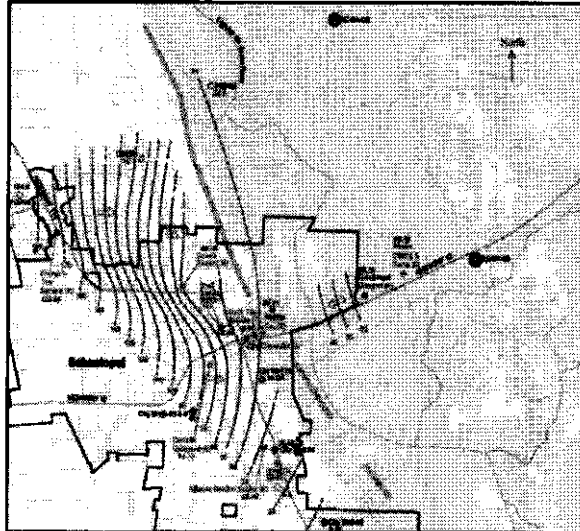


Impacts from Human Uses

Overdraft is Long Term Groundwater Decline



Santa Rosa Plain Groundwater Connections



Contours on the Wilson Grove Formation Highlands water table indicate that groundwater crosses the Sebastopol Fault, and recharges the southern Laguna de Santa Rosa subbasin

from Water Supply Assessment for Northwest Area Specific Plan, Sebastopol IPES Environmental, Inc., 2007

Distinguishing Groundwater from Surface Water: When is Underground Water Subject to the Law of Surface Water Rights?

Prepared and Presented by:

Barbara J. Leidigh, J.D.
Attorney

Distinguishing Groundwater from Surface Water: When is Underground Water Subject to the Law of Surface Water Rights?

I. OVERVIEW: TYPES OF WATER RIGHTS IN UNDERGROUND WATER

A. Overlying Rights

Similar to riparian rights; based on ownership of the appurtenant overlying land. With an overlying right, the water can be taken from either an underground stream or percolating groundwater without needing a water right permit, and it may be used on the overlying land.

B. Appropriative Rights

An appropriative right is a right to take water from its source and use it or store it and then use it elsewhere. No water right permit is needed if the water is percolating groundwater. If the water is in a subterranean stream, a water right permit is required before appropriating the water. Also, if water is acquired from a surface supply under an appropriative water right and is stored underground, it is subject to the conditions on the use of the surface water, including where it is stored, the place of use, and the purpose of use.

II. WHEN DO GROUNDWATER PUMPERS NEED WATER RIGHT PERMITS?

A. Subterranean Streams

1. Statutory Provision

Water Code section 1200 provides:

“Whenever the terms stream, lake or other body of water, or water occurs in relation to applications to appropriate water or permits or licenses issued pursuant to such applications, such term refers only to surface water, and to subterranean streams flowing through known and definite channels.”

Section 1200 derives from section 42 of the Water Commission Act of 1913. It became effective following a public referendum on December 19, 1914 (Stats. 1913, ch. 586, S 42, p. 1033. As originally adopted, the relevant sentence in section 42 stated:

“Whenever the terms stream, lake or other body of water, or water occurs in this act, such term shall be interpreted to refer only to surface water, and to subterranean streams flowing through known and definite channels.”

Section 1201, which is derived from the 1913 Water Commission Act, section 11, provides:

“All water flowing in any natural channel, excepting so far as it has been or is being applied to useful and beneficial purposes upon, or in so far as it is or may be reasonably needed for useful and beneficial purposes upon lands riparian thereto, or otherwise appropriated, is hereby declared to be public water of the State and subject to appropriation in accordance with the provisions of this code.”

Based on section 1201, appropriations from subterranean streams flowing through known and definite channels are subject to permitting by the State Water Board.

2. Case Law

It is presumed in the case law that naturally-occurring underground water is percolating ground water. (*City of Los Angeles v. Pomeroy* (1899) 124 Cal. 597.) As a result, unless it is proved that water is flowing in a subterranean stream, a well owner can appropriate underground water without having a water right permit from the State of California.

The *Pomeroy* case discussed the distinctions between subterranean streams and percolating ground water at length, and concluded that Los Angeles had the ownership of an appropriative right to certain underground water flowing in the San Fernando Valley. The distinction was important because Los Angeles claimed a Pueblo Water Right to the river, and the issue was whether the underground water was in the river.

After *Pomeroy*, the California Supreme Court in *Katz v. Walkinshaw* (1903) 141 Cal. 116 (*Katz*) decided that parties other than overlying owners of the land could appropriate percolating ground water, thus making it less necessary, for a while, to distinguish between percolating ground water and subterranean streams. (See *North Gualala Water Company v. State Water Resources Control Board* (2006) slip opinion page 33, footnote 12.)

The 1913 Act changed the law, reviving the need to distinguish a subterranean stream from percolating ground water by requiring that appropriations of water flowing in subterranean streams have a water right permit. Despite the change, the presumption that all underground water is percolating, combined with the relative abundance of groundwater in the past and a lack of enforcement by the State, apparently allowed parties appropriating such water to ignore the permitting requirement. By the 1990's, ground water became scarce enough statewide to require a closer look at whether water is being extracted from a subterranean stream.

The principal decisions of the State Water Resources Control Board (State Water Board) regarding subterranean streams are State Water Board Decision 1639 (*In re Garrapata Water Co.*, decided June 17, 1999) and Orders WR 2003-0004 and WR 2003-0009, determining that groundwater

extracted by North Gualala Water Company from its wells near the North Fork Gualala River was extracted from a subterranean stream flowing in a known and definite channel.

The State Water Board in the *Garrapata* decision (D-1639) specified a four-part test of the physical conditions that must exist to classify groundwater as a subterranean stream flowing through a known and definite channel: 1. A subsurface channel must be present; 2. The channel must have a relatively impermeable bed and banks; 3. The course of the channel must be known or capable of being determined by reasonable inference; and 4. Groundwater must be flowing in the channel.

3. *North Gualala Water Company v. State Water Resources Control Board*

The *North Gualala* opinion issued by the Court of Appeal, First District, in 2006, is a thorough modern analysis of the law of subterranean streams. The court confirmed that the analysis to determine whether a subterranean stream is present is a factual analysis consistent with the *Garrapata* test. In the *North Gualala* orders, the State Water Board applied the test it had developed in *Garrapata*, and found that the water in question was flowing in a subterranean stream and that its appropriation required a permit. North Gualala Water Company challenged the State Water Board's 2003 orders. The Superior Court upheld the State Water Board's orders, and North Gualala appealed to the First District Court of Appeal. The Court of Appeal also upheld the State Water Board's 2003 orders. The Court of Appeal opinion is cited as *North Gualala Water Company v. State Water Resources Control Board* (2006) 139 Cal.App.4th 1577 [43 Cal.Rptr.3d 821]. The California Supreme Court declined to review the Court of Appeal opinion.

B. Surface Water Stored Underground

The appropriation of surface water requires a permit to appropriate the water. (Wat. Code, section 1201.) The Water Code expressly recognizes that surface water may be stored in underground reservoirs for later use. (Wat. Code, § 1242.) Section 1201 is derived from the 1913 Water Commission Act, section 11. Section 1201 provides:

“All water flowing in any natural channel, excepting so far as it has been or is being applied to useful and beneficial purposes upon, or in so far as it is or may be reasonably needed for useful and beneficial purposes upon lands riparian thereto, or otherwise appropriated, is hereby declared to be public water of the State and subject to appropriation in accordance with the provisions of this code.”

1. Water Code section 1242 provides:

The storing of water underground, including the diversion of streams and the flowing of water on lands necessary to the accomplishment of such

storage, constitutes a beneficial use of water if the water so stored is thereafter applied to the beneficial purposes for which the appropriation for storage was made.

Section 1242 has been interpreted as meaning that if water has been introduced into an underground basin for storage, the overlying landowners have no rights to the stored water other than rights that they might obtain through the appropriator of the water (i.e., by contract). Also, the Legislative Counsel cited *Peabody v. City of Vallejo* (1935) 2 Cal.2d 351 for the point that the stored water is a property right of the appropriator entitled to the protection of the courts. (Op. Leg. Counsel, 1957 A.J. 4034, 4035.)

State Water Board regulations implement this section:

- Section 733¹ of the Board's regulations requires that an application proposing underground storage provide information that includes:
 - the location of each point where water will be diverted or rediverted from a natural channel to spreading grounds or taken under control for direct percolation into the stream channel;
 - a description of the physical works used to divert and convey the water and to accomplish the underground storage, the capacities of the conduits and spreading grounds, the surface areas and capacities of the underground reservoirs, and the method and points of measurement of the water diverted to and withdrawn from underground storage;
 - if the application includes both surface diversion and underground storage, the application must include the information for both the surface diversion and the underground storage. (Cal. Code Regs., tit. 23, § 733.)
- Section 722² of the Board's regulations requires special maps to accompany applications for underground storage. Underground

¹ Section 733 provides: "Applications proposing underground storage shall include the following information upon a form that will be supplied by the board: (a) The location of each point where it is proposed to divert or redivert water from a natural channel to spreading grounds away from the stream, or to take water under control for direct percolation into the stream channel. All locations shall be described in the manner detailed in Section 715(c). (b) A description of the physical works used to divert and convey the water and to accomplish the underground storage, including the headworks, conduits and spreading grounds; the capacities of the conduits and spreading grounds; the underground reservoirs, including the projected surface areas and capacities thereof; and the method and points of measurement of the water diverted to and withdrawn from underground storage. (c) In event an application proposes both surface diversion and underground storage, the appropriate paragraph of the regular form shall be completed regarding surface diversion and in addition the underground features shall be described in the special form as provided in this section."

² Section 722 provides: "Maps accompanying applications for underground storage shall show the location of points of diversion or redirection to underground storage, the conduit system, the areas, estimated capacities and locations of spreading grounds, the areas, capacities, and locations of underground reservoirs, and the places of measurement of water diverted to underground storage, and the place of use."

storage maps must show the points of diversion and redirection from the surface watercourse; the conduit system; the areas, estimated capacities and locations of spreading grounds; the areas, capacities, and locations of underground reservoirs; the places of measurement of water diverted to underground storage; and the place of use.

- The State Water Board has had regulations specifying the required contents of water right applications for underground water storage at least since 1955. (The oldest code history for this section shows a predecessor of this regulation having been filed 12-1-55, at Register 55, No. 17.)

2. State Water Board Decisions

The State Water Board has addressed the underground storage of surface water in only a handful of decisions, but more are likely in the future because of the growing interest in the conjunctive use of water. The decisions are:

- Decision 894 (1958) approving appropriations to surface storage and to underground storage;
- Decision 935 (1959), denying for lack of evidence an application to appropriate up to 2 million acre-feet of water to underground storage by the Bureau of Reclamation but recognizing that the Bureau's contractors would store project water, apparently under their own rights;
- Decision 1129 (1963) approving an application to appropriate water for surface storage and for underground storage;
- Decision 1121 (1963) denying three applications to appropriate water to underground storage because the Department of Water Resources, not the applicants, would divert the water from the natural watercourse;
- Decision 1275 (1967) approving the Department of Water Resources' applications to appropriate water and noting that some of the water would be stored underground by the purchasers and subsequently used for the purposes state in the applications;
- Decision 1235 (1965) approving an application to appropriate water from the Santa Margarita River that included underground storage;
- Decision 1290 (1967) approving underground storage of up to 1 million acre-feet per year in the Tulare Lake Basin.

Prepared and Presented by:
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UNDERGROUND WATER

WATER RIGHT ISSUES

Types of Water Rights in Underground Water

- **Overlying Rights**
- **Appropriative Rights**

A Water Right Permit is Required

- If the water is flowing in a subterranean stream
- If the water is taken from a surface source and stored underground

Water in Subterranean Streams is Surface Water

Water Code section 1200, originally adopted in 1913, defines the water in an underground stream as surface water:

"Whenever the terms stream, lake or other body of water, or water occurs in relation to applications to appropriate water or permits or licenses issued pursuant to such applications, such term refers only to surface water, and to subterranean streams flowing through known and definite channels."

Surface Water Appropriations Require Permits

Water Code section 1201 provides:

"All water flowing in any natural channel, excepting so far as it has been or is being applied to useful and beneficial purposes upon, or in so far as it is or may be reasonably needed for useful and beneficial purposes upon lands riparian thereto, or otherwise appropriated, is hereby declared to be public water of the State and subject to appropriation in accordance with the provisions of this code."

What Constitutes a Subterranean Stream?

Four physical conditions must exist:

- 1. A subsurface channel must be present;
- 2. The channel must have a relatively impermeable bed and banks;
- 3. The course of the channel must be known or capable of being determined by reasonable inference; and
- 4. Groundwater must be flowing in the channel

Pomeroy's Definition Remains

- *Pomeroy*: the terms "contracted" and "bounded" describe a defined channel.
- *North Gualala*: these terms mean the channel constrains and controls the flow, and that the water is confined in the channel by the relative impermeability of surrounding materials
- *Pomeroy*: the stream is flowing *through* a known and definite channel.
- *North Gualala*: the water has to be generally flowing in the direction of the channel. Deviations should be explained by localized conditions.
- The permitting requirement is narrow, and the presumption remains that underground water is percolating.

Underflow

- Underflow is a subcategory of a definite subterranean stream (*North Gualala* slip opinion, page 48)
- Appropriation of water from the underflow of a stream requires a permit

Surface Water Stored Underground

- Appropriation of surface water requires a permit, per Water Code section 1201.

Surface Water May be Appropriated and Stored

- Section 1201 provides:
"All water flowing in any natural channel, excepting so far as it has been or is being applied to useful and beneficial purposes upon, or in so far as it is or may be reasonably needed for useful and beneficial purposes upon lands riparian thereto, or otherwise appropriated, is hereby declared to be public water of the State and subject to appropriation in accordance with the provisions of this code."

Section 1242 Avoids Forfeiture

- Section 1242, enacted in 1919, provides:
"The storing of water underground, including the diversion of streams and the flowing of water on lands necessary to the accomplishment of such storage, constitutes a beneficial use of water if the water so stored is thereafter applied to the beneficial purposes for which the appropriation for storage was made." (Wat. Code, § 1242.)

The Forfeiture Problem

- Section 1242 establishes an exception to the principle that an excessive application of water to land is either a waste of water or is a non-beneficial use of the water. Thus, if water is spread on land for percolation into a groundwater basin, this section establishes that the flowing of the water on the land for underground storage is a beneficial use of water if the water is thereafter applied to a beneficial purpose.
- This provision is necessary to justify issuance of a water right permit and avoid a finding of waste.
- This provision is restrictive in that it requires that the water be applied to a beneficial use.

Applications to Appropriate Water to Underground Storage

- Special requirements
- Section 733 (23 Cal.Code Regs) requires:
 - Point of diversion from surface channel
 - Description of diversion, conveyance, and spreading facilities, area and capacity of underground reservoirs, method and points of measurement of water introduced to and withdrawn from reservoirs
- Section 722 requires:
 - Maps of points of diversion, conduits, spreading grounds, underground reservoirs, measurement locations, and place of use

Ownership of Water Stored Underground

- The right to use water stored underground is the property of the appropriator and is entitled to the protection of the courts. (Op. Leg. Counsel, 1957 A.J. 4034, 4035, citing *Peabody v. City of Vallejo* (1935) 2 Cal.2d 351 .)
- Further the landowners overlying an underground reservoir have no independent rights to the stored water. (*Id.*)

State Water Board Decisions I

- Decision 894 (1958) and Decision 1129 (1963) approving appropriations to surface and underground storage
- Decision 935 (1959): Approved the Friant Reservoir applications and denied underground storage, but suggested contractors could store deliveries underground under the direct diversion approvals in the permits.

State Water Board Decisions II

- Decision 1121 (1963): the applicant to appropriate water to underground storage must be the same entity that diverts the water from the natural watercourse. Thus, only the Department of Water Resources could apply for a permit to store water underground that the Department appropriated.
- Decision 1275 (1967): approved the Department's applications to appropriate water to surface and underground storage. Under the permits, some of the appropriated water would be stored underground by the agencies contracting to buy the water and subsequently would be used for the purposes specified in the applications.

State Water Board Decisions III

- Decision 1235 (1965): approved a permit for the U.S. Navy to appropriate water from the Santa Margarita River, including underground storage.
- Decision 1290 (1967): approves the underground storage by Fresno Irrigation District, et al., of up to 1 million acre-feet per year in the Tulare Lake Basin.

Applying for a Permit

- If the applicant seeks to appropriate water and percolate it into the ground, and the water will later be extracted and used for beneficial purposes, the applicant must include an underground storage supplement with the application.
- Meet all the requirements in sections 722 and 733 of the Board's regulations.
- Underground Storage Supplement must identify:
 - points of diversion and redirection from the natural watercourses,
 - beneficial uses of water after it is extracted from storage,
 - the place of use of the water,
 - the means for transporting water to the reservoir and from the reservoir to the place of use, and
 - the method and location of measuring water that is withdrawn from underground storage
- Extraction wells for removing water from underground storage are not points of redirection of the water

Action on an Application: Issues

- Some parties argue the Board can approve applications to appropriate water for direct diversion in cases where the water will be spread on highly permeable lands to recharge the water supply in an underground basin. These parties claim they would then abandon the water, letting others use it, and avoid including a storage component in the application.
- Potential questions likely in a water right proceeding are:
 - Whether abandonment of appropriated water is reasonable;
 - Whether the proposed use of the water is a beneficial and reasonable use of water under the Constitution, or a waste of water;
 - Whether the water will be recovered and used for beneficial uses other than recharge and if so, who will pay;
 - Whether the appropriator will use or be compensated for the amount of water placed in the underground basin;
 - Whether the recharge of an underground basin using surface water diversions affects other surface water right holders and instream uses of water. Does the frequency of the recharge (annually versus one time) affect the determination as to the need for a permit that controls the uses of water after it is placed in the underground basin?

Likely Conditions on a Permit

- The terms and conditions will depend on the circumstances involved, and will include protections for other water right holders and for public trust uses of the surface water source
- The terms and conditions will describe the project that is approved, including points of diversion, place of use, purpose of use, physical facilities to be used, amount of water to be diverted, amount of water to be used, place and amount of storage, and monitoring requirements

Is a Storage Permit Needed?

- Parties who wish to avoid having to account for the subsequent extraction and use of water they have placed in underground basins raise a now-theoretical question whether they can simply spread water on the ground to recharge an aquifer and abandon it, letting others extract and use the water without legal obligations to comply with permit conditions.
 - Query: if the appropriator intends to recharge an aquifer and then abandon the water to others uses, can the recharge of an aquifer be treated differently from the storage of water underground?
 - Query: can the Board issue a permit and meet the constitutional reasonable use requirement if the only stated purpose of spreading the water on highly permeable ground is to create habitat for waterfowl?

CERTIFIED FOR PUBLICATION

IN THE COURT OF APPEAL OF THE STATE OF CALIFORNIA

FIRST APPELLATE DISTRICT

DIVISION ONE

NORTH GUALALA WATER
COMPANY,

Plaintiff and Appellant,

v.

STATE WATER RESOURCES
CONTROL BOARD,

Defendant and Respondent.

A109438

(Mendocino County
Super. Ct. Nos. SCUK CVG '01 86109,
SCUK CV PT '03 90347)

ORDER MODIFYING OPINION
AND DENYING REHEARING

[NO CHANGE IN JUDGMENT]

THE COURT:

It is ordered that the opinion filed herein on May 31, 2006, be modified as follows:

1. On page 21, in the fourth sentence of the first paragraph, the word "not" is deleted, so the sentence reads:

NGWC insists that it did exhaust its administrative remedies because: (1) it expressly argued to the Board that the *Garrapata* test must be qualified in specified respects, and (2) the arguments and evidence on which it relies on appeal are in substance identical to those it advanced in the administrative proceedings.

2. On page 34, the last sentence on the page that begins with "Accordingly" is modified to read as follows:

Accordingly, the Board may enforce Term 9 according to its interpretation that the term applies to all diversion points subject to the permit.

There is no change in the judgment.

Appellant's petition for rehearing is denied.

Dated:

Marchiano, P.J.

CERTIFIED FOR PUBLICATION
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NORTH GUALALA WATER
COMPANY,

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STATE WATER RESOURCES
CONTROL BOARD,

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A109438

(Mendocino County
Super. Ct. Nos. SCUK CVG '01 86109,
SCUK CV PT '03 90347)

The North Gualala Water Company (NGWC) appeals from a judgment denying two consolidated petitions for writ of mandate. The petitions challenge the State Water Resources Control Board's (Board) jurisdiction to compel NGWC to obtain a permit to pump groundwater from two wells located near the North Fork Gualala River, as well as the Board's interpretation of pumping limitations placed on the permit. In an issue of first impression, the parties dispute the proper construction of the statutory phrase, "subterranean streams flowing through known and definite channels," which has defined the Board's permitting jurisdiction over the state's groundwater resources since 1914.¹ As a fallback position in the event that the Board's statutory permitting authority over the

¹ The quoted language appears in Water Code section 1200, which limits the Board's permitting authority over subsurface water as follows: "Whenever the terms stream, lake or other body of water, or water occurs in relation to applications to appropriate water or permits or licenses issued pursuant to such applications, such term refers only to surface water, and to subterranean streams flowing through known and definite channels." All further statutory references are to the Water Code unless otherwise indicated.

wells is upheld, NGWC argues that the Board has placed unwarranted conditions on the company's permit. We affirm the trial court's judgment denying NGWC's petitions.

I. BACKGROUND

A. Water-Right Permit 14853 and Term 9

NGWC provides municipal water service to approximately 1,000 customers in, or near, the Town of Gualala. Between 1965 and 1989, NGWC diverted surface water directly from the North Fork of the Gualala River (North Fork) by means of an infiltration gallery located at the confluence of the North Fork and the Little North Fork Gualala River.² This diversion was authorized by appropriative water-right permit 14853 (Permit 14853), issued by the Board's predecessor in 1965.

Permit 14853 authorized NGWC to divert two cubic feet per second from the North Fork. To resolve a protest to its permit application by the California Department of Fish and Game (DFG), NGWC agreed to accept limitations on its right to divert water from the river that were intended to maintain instream flows for the protection of fish life. These limitations were set forth in "Term 9" of the permit. However, given flow conditions in the North Fork at that time, Term 9 in its original form never actually limited NGWC's diversions.

In 1978, as a result of a further protest by DFG and after discussions between NGWC and DFG, the Board amended Term 9 to read as follows: "For the protection of fish and wildlife, permittee shall during the period: (a) from November 15 though February 29, bypass a minimum of 40 cubic feet per second; (b) from March 1 though May 31, bypass a minimum of 20 cubic feet per second; (c) from June 1 though November 14, bypass a minimum of 4 cubic feet per second. The total streamflow shall be bypassed whenever it is less than the designated amount for that period."³ Under

² An infiltration gallery is a network of perforated collector pipes located just beneath the surface of the river bed which are connected to a pumping system that draws the water out for treatment, storage, and distribution.

³ In a later order, the Board explained that the word "bypass" in Term 9 originally referred to the volume of water that must flow past the point of diversion per second before water could be diverted under Permit 14853. As discussed below, when NGWC

certain flow conditions, the amended Term 9 did restrict NGWC's right to divert water from the North Fork.

B. NGWC's Production Wells: 1989–2001 Proceedings

In 1989 and 1996, NGWC developed two production wells, Wells 4 and 5, in an area adjacent to the North Fork known as Elk Prairie. Both wells were located approximately 200 feet from the river. One purpose of constructing the wells was to improve the quality of water and reduce water treatment costs. The wells draw groundwater from depths of approximately 50 and 140 feet below the ground.

When NGWC developed Well 4 it did not seek any water right permit for it because NGWC believed that Well 4 was pumping percolating groundwater which is not subject to the Board's permitting jurisdiction. (See § 1200.)⁴ In a June 1989 letter replying to a third party complaint lodged against NGWC by the Gualala River Steelhead Project, the chief of the Board's Division of Water Rights addressed the jurisdictional issue as follows: "Your letter also requested information regarding [NGWC's] River Deep Well. Our information indicates that the well is located near the North Fork Gualala River, about 100 feet upstream of [NGWC's] point of diversion. The well is about 100 feet deep. Analysis of the well water indicates that it has a composition different than the surface supply which suggests that well water is percolating ground water, not river underflow. The Board does not have jurisdiction over the use of percolating ground water."

In November 1992, a groundwater geologist hired by the Sea Ranch Water Company, Richard Slade, reported to the Board that relatively impermeable rock formations underlie the North Fork channel, that the stream valley itself is filled with

later changed the point of diversion under the permit, the bypass terminology in Term 9 could no longer be applied according to its original meaning.

⁴ As further discussed below, subsurface water that is not part of a subterranean stream flowing through a known and definite channel is referred to in the case law as "percolating groundwater," which falls outside the Board's jurisdiction. (See *People v. Shirokow* (1980) 26 Cal.3d 301, 304, fn. 2.)

alluvial deposits⁵ of unconsolidated layers of gravel, sand, silt, and clay, and that a water quality analysis indicated that the source of the well water was the Gualala River system. The report concluded that the groundwater extracted by Well 4 from the alluvium underneath Elk Prairie was from a subterranean stream as defined by the Board. Based on the Slade report, the Board staff notified NGWC that its extraction from Well 4 was an illegal diversion of water, and advised it to submit a water right application for the well.

In February 1993, NGWC filed a petition to change the authorized points of diversion in Permit 14853 to include Well 4. In its petition, NGWC stated that it was reserving the right to challenge the Board's conclusion that Well 4 pumped water from a subterranean stream after conducting additional field work. NGWC filed a petition to add Well 5 to Permit 14853 in 1994.

In January 1998, NGWC's consultants, Luhdorff & Scalmanini Consulting Engineers, filed a technical report with the Board regarding the groundwater pumped by Wells 4 and 5. Based on its own measurements and data collection, Luhdorff & Scalmanini concluded that the groundwater in the alluvial deposits under the Elk Prairie is not recharged from the North Fork and is not flowing in a subterranean stream. Contrary to the conclusion of the Slade report, Luhdorff & Scalmanini found that the groundwater underneath Elk Prairie is maintained by a combination of deep percolation of surface precipitation during the rainy season and subsurface flow from the underlying bedrock formations into the alluvium during the dry season. Also contrary to Slade's analysis, Luhdorff & Scalmanini concluded that the underlying bedrock beneath Elk Prairie was not relatively impermeable, but was highly fractured and permeable, most likely due to its proximity to the San Andreas fault zone.

The chief of the Board's Division of Water Rights responded to NGWC that, after reviewing Luhdorff & Scalmanini's analysis, the Division of Water Rights still believed

⁵ "Alluvium" is defined by Webster's Dictionary as "clay, silt, sand, gravel, or similar detrital material deposited by running water." (Merriam-Webster's Collegiate Dict. (10th ed. 2000), p. 31.)

the groundwater pumped by Wells 4 and 5 was flowing in a known and definite channel, and thus was subject to the Board's jurisdiction. Citing Slade's analysis, other studies of the area, and the Board's own investigations, the Division of Water Rights rejected Luhdorff & Scalmanini's critical finding that the bedrock was permeable to water relative to the overlying alluvium. It opined instead that "it appears that the bedrock is sufficiently impervious relative to the alluvial aquifer material to form the bed and banks of a subterranean stream." The Division of Water Rights advised that if NGWC wished to withdraw its petition to change the point of diversion, it would recommend that the Board hold a groundwater classification hearing to resolve the issue of the Board's permitting authority.

NGWC made no formal request for a groundwater classification hearing at that time. It informed the Board that it wished to continue the process of petitioning to change the point of diversion, while reserving the issue of groundwater classification for any future hearing to be held on its change petitions.

In August 1999, the Board adopted Order WR-99-09-DWR which granted NGWC's petitions to substitute Wells 4 and 5 for the previous points of diversion. DFG and other fishing interests protested the change sought by NGWC. The protestants expressed concern that NGWC was not meeting the bypass flow requirements of Term 9, and that the company would have trouble supplying the water demand of its customers if it was required to reduce diversions from the wells to meet these requirements. To address these concerns, Order WR-99-09-DWR required as a condition of the approval that NGWC submit a surface flow measurement plan to ensure compliance with Term 9 of Permit 14853. A subsequent order, Order WR 99-11, added a further condition that NGWC prepare a water supply contingency plan to address how municipal water needs would be met if the natural flow of the North Fork fell below the minimum amounts specified in Term 9.

NGWC did not challenge any of the findings or conditions in the 1999 orders, but proceeded to develop and file proposed plans for measuring surface flows and addressing water supply contingencies. In January and August 2000, the Board staff requested

changes in these plans. Through its attorneys, NGWC agreed to some of the changes. At the same time, NGWC asserted that the Board had never issued a formal decision on the issue of whether the groundwater pumped by Wells 4 and 5 was part of a subterranean stream or percolating groundwater, and that NGWC had not waived its rights on that issue. In addition, NGWC disputed whether, by its terms, the second sentence of Term 9 (“[t]he total streamflow shall be bypassed whenever it is less than the designated amount for that period”) placed any limitation on the pumping of groundwater from Wells 4 and 5 so long as the pumping did not reach a level that would reverse the normal groundwater gradient between the wells and the river, thereby reducing surface streamflows. NGWC requested that its issues concerning the classification of the groundwater and the application of Term 9 be resolved through a formal hearing.

In April 2001, the chief of the Division of Water Rights informed NGWC that its plans were not approved. The chief’s letter explained that Term 9 applied to any diversions of water under the permit, and since Wells 4 and 5 are the only points of diversion in the permit, Term 9 applied to them. NGWC petitioned the Board for reconsideration of the chief’s decision. The petition asked the Board to hold a hearing on the legal classification of the groundwater pumped by Wells 4 and 5 and on the interpretation of Term 9.

In Order WR 2001-14, issued in June 2001, the Board: (1) upheld the chief’s decision that NGWC’s water measurement and water supply plans were inadequate; (2) determined that a groundwater classification hearing was not properly part of a proceeding seeking reconsideration of the chief’s decision to disapprove the two plans submitted by NGWC; (3) discussed and rejected NGWC’s interpretation that Term 9 was not a limitation on its ability to pump groundwater from Wells 4 and 5; and (4) invited NGWC to petition to change the bypass flow requirements in Term 9 and to bring the groundwater classification issue before the Board, either by raising it as a defense to a future enforcement action or by initiating an independent proceeding.

In July 2001, NGWC filed a complaint for declaratory relief and petition for writ of mandate challenging the sufficiency of the evidence to support Order WR 2001-14

(2001 mandate petition). NGWC's 2001 mandate petition also challenged the Board's interpretation of Term 9. The trial court stayed the case in December 2001 to allow NGWC to formally petition the Board for a groundwater classification hearing and to permit the Board to resolve that issue before the case proceeded.

C. 2002 Groundwater Classification Hearing

NGWC filed its request for a groundwater classification hearing in January 2002 and a hearing was conducted on June 4 and 5, 2002. In addition to NGWC, the participants included DFG and a "permitting team" from the Division of Water Rights. By established Board procedure, the permitting team was separated by an ethical wall from the "hearing team" that assisted the hearing officer and Board members in the hearing.

The Board proposed to apply a four-part test for determining whether groundwater fell within its permitting authority that it had first utilized in a 1999 decision concerning the Garrapata Water Company: "[F]or groundwater to be classified as a subterranean stream flowing through a known and definite channel, the following physical conditions must exist: [¶] 1. A subsurface channel must be present; [¶] 2. The channel must have a relatively impermeable bed and banks; [¶] 3. The course of the channel must be known or capable of being determined by reasonable inference; and [¶] 4. Groundwater must be flowing in the channel."⁶ (*In re Garrapata Water Co.* (June 17, 1999) State Wat.

Resources Control Bd. Dec. No. 1639

<<http://www.waterrights.ca.gov/hearings/Decisions.htm>> [as of May 31, 2006]

(*Garrapata*.) The Board based the *Garrapata* test on its reading of an 1899 California Supreme Court case, *City of Los Angeles v. Pomeroy* (1899) 124 Cal. 597 (*Pomeroy*).

NGWC accepted the four-part test with certain qualifications, but argued that the groundwater pumped by Wells 4 and 5 did not satisfy its requirements because: (1) the

⁶ The Board utilized the test again in 2002 in a case involving the Pauma Valley Water Company. (*In re Determination of Legal Classification of Groundwater in the Pauma and Pala Basins etc.* (Oct. 17, 2002) State Wat. Resources Control Bd. Dec. No. 1645 <<http://www.waterrights.ca.gov/hearings/Decisions.htm>> [as of May 31, 2006].)

only subsurface channel present, that formed by the alluvial materials in the vicinity of the North Fork, does not narrow or contract in the direction of the alleged flow as would be required under a correct reading of *Pomeroy*; (2) the Franciscan bedrock forming the bed and banks of the alluvial channel is not sufficiently impermeable to satisfy the second element of the test; and (3) the groundwater underneath Elk Prairie is not in fact flowing “in the channel,” but in a direction perpendicular to it.

DFG expressed its concern that absent regulation by water right permit, NGWC could significantly expand its pumping and reduce river flows to levels inadequate for fish protection.

The Board found in Order WRO 2003-0004 that all elements of its four-part test had been met and that the water pumped from NGWC’s wells required a water right permit. Upon NGWC’s ensuing petition for reconsideration, the Board rejected NGWC’s argument that the water in a subterranean stream must always be flowing in a direction parallel to the sides of the subsurface channel. The Board found that “water is in fact flowing generally downstream within the channel under Elk Prairie, following a hydraulic gradient and following the path of least resistance.”

D. 2003 Mandate Petition

In May 2003, NGWC filed a new petition for writ of mandate, challenging Order WRO 2003-0004, which was eventually consolidated with NGWC’s 2001 mandate petition.

The trial court concluded that the Board’s four-part test was the appropriate means of making the determination required by section 1200. The court applied the substantial evidence standard to each of the four elements, and found that substantial evidence existed to support the Board’s findings as to all four elements. The court denied NGWC’s consolidated petitions for writ of mandate, and entered judgment in favor of the Board on December 14, 2004. This appeal followed.

II. DISCUSSION

A. *Standard of Review*

The parties differ over the applicable standard of review. The Board concedes that its interpretation of the “subterranean stream” language in section 1200 is subject to de novo review, but argues that if the four-part *Garrapata* test properly effectuates the intent of that language, the Board’s findings that the various elements of the test have been satisfied must be upheld unless they are unsupported by substantial evidence. NGWC maintains that this court must conduct a de novo review of the Board’s determination that it has jurisdiction over the wells because the Board made no findings of fact on “the principal disputed factual issues.”

NGWC had maintained that to be part of a subterranean stream coming within section 1200 the groundwater must (1) flow in a direction generally parallel to the subterranean channel and (2) not be maintained by subsurface inflows emanating from fractures in the underlying bedrock. It asserts that Order WRO 2003-0004 contained no findings of fact on these disputed factual issues. According to NGWC, the Board must therefore have determined *as a matter of law* that the groundwater is part of a subterranean stream for purposes of section 1200 based solely on the fact that the groundwater occurs in alluvial deposits which are more permeable than the Franciscan bedrock underlying them. Although we do not believe this accurately characterizes the Board’s findings or methodology in this case, we concur that the materiality of groundwater source and flow direction present questions of law that we will consider de novo.

In sum, both parties agree that the Board’s interpretation of the “subterranean stream” clause of section 1200 presents a question of law subject to de novo review. Issues regarding the materiality of groundwater source and flow direction under section 1200 also present questions of law subject to de novo review. To the extent that NGWC disputes any of the facts found by the Board, as opposed to disputing the legal methodology the Board applied to determine its jurisdiction, the Board’s findings must be

upheld unless they are unsupported by substantial evidence. (§ 1126, subd. (c); Code Civ. Proc., § 1094.5, subd. (c).)⁷

B. Deference Due to Board's Interpretation of Section 1200

The parties also differ over the degree of deference which this court should give to the Board's interpretation of section 1200. According to the Board, because the Legislature has delegated a "designated field of expertise" to the Board, the Board's statutory interpretation should "generally be followed unless it is clearly erroneous." (*San Mateo City School Dist. v. Public Employment Relations Bd.* (1983) 33 Cal.3d 850, 856.) NGWC maintains that the proper standard is that applicable when a court must decide whether an agency regulation exceeds the authority delegated to the agency by the Legislature. (See *Yamaha Corp. of America v. State Bd. of Equalization* (1998) 19 Cal.4th 1, 11, fn. 4 (*Yamaha*); *Environmental Protection Information Center v. Department of Forestry & Fire Protection* (1996) 43 Cal.App.4th 1011, 1022.) According to NGWC, when an agency is construing a statute affecting its own jurisdiction, the proper standard of review is therefore one of " 'respectful nondeference.' " (*Environmental Protection Information Center v. Department of Forestry & Fire Protection*, at p. 1022.)

Yamaha distinguishes between two types of administrative rule-making: "[T]here are two categories of administrative rules One kind—quasi-legislative rules—represents an authentic form of substantive lawmaking: Within its jurisdiction, the agency has been delegated the Legislature's lawmaking power. [Citations.] . . . When a

⁷ When a fundamental vested right is affected, the reviewing court applies the independent judgment test rather than the substantial evidence test. (*Strumsky v. San Diego County Employees Retirement Assn.* (1974) 11 Cal.3d 28, 32.) Under the independent judgment test, the trial court independently reviews the administrative record to determine whether the weight of the evidence supports the administrative body's findings and action. (*Bixby v. Pierno* (1971) 4 Cal.3d 130, 143, fn. 10.) After the trial court exercises its independent judgment, the appellate court need only review the record to determine whether the trial court's findings are supported by substantial evidence. (*Ibid.*) NGWC made no argument in its opening brief that the independent judgment test applies, and has therefore waived the point. (*Tisher v. California Horse Racing Bd.* (1991) 231 Cal.App.3d 349, 361.)

court assesses the validity of such rules, the scope of its review is narrow. If satisfied that the rule in question lay within the lawmaking authority delegated by the Legislature, and that it is reasonably necessary to implement the purpose of the statute, judicial review is at an end. [¶] . . . [¶] [T]he other class of administrative rules, those interpreting a statute, . . . does not implicate the exercise of a delegated lawmaking power; instead, it represents the agency's view of the statute's legal meaning and effect, questions lying within the constitutional domain of the courts. But because the agency will often be interpreting a statute within its administrative jurisdiction, it may possess special familiarity with satellite legal and regulatory issues. It is this 'expertise,' expressed as an interpretation (whether in a regulation or less formally . . .), that is the source of the presumptive value of the agency's views. An important corollary of agency interpretations, however, is their diminished power to bind. Because an interpretation is an agency's legal opinion, however 'expert,' rather than the exercise of a delegated legislative power to make law, it commands a commensurably lesser degree of judicial deference." (*Yamaha, supra*, 19 Cal.4th at pp. 10–11, italics omitted.)

The interpretation of section 1200 that the Board has formulated in the context of deciding the *Garrapata* and subsequent groundwater cases comes within the class of administrative rules interpreting a statute under *Yamaha*. Deciding these cases is not an exercise of the Board's quasi-legislative power to adopt regulations of general applicability. Thus, we reject the Board's proposed standard—based on pre-*Yamaha* case law—that we must defer to the Board's interpretation of section 1200 unless it is clearly erroneous. At the same time, the issue before us is not whether the Board has adopted a regulation or test that is outside of the realm of authority delegated to it by the Legislature. Whether the Board's interpretation of section 1200 is correct or not, its power to formulate and apply a construction of that statute in the course of adjudicating permitting disputes is not in question in this proceeding. The Board could not decide groundwater classification issues if it did not have that power. NGWC's proposed standard of “ ‘respectful nondeference’ ” is thus also inapplicable.

The degree of deference to which the Board's interpretation of section 1200 is entitled depends on a series of situation-specific factors identified in *Yamaha*: "[There are] two broad categories of factors relevant to a court's assessment of the weight due an agency's interpretation: Those 'indicating that the agency has a comparative interpretive advantage over the courts,' and those 'indicating that the interpretation in question is probably correct.' [Citations.] [¶] In the first category are factors that 'assume the agency has expertise and technical knowledge, especially where the legal text to be interpreted is technical, obscure, complex, open-ended, or entwined with issues of fact, policy, and discretion. A court is more likely to defer to an agency's interpretation of its own regulation than to its interpretation of a statute, since the agency is likely to be intimately familiar with regulations it authored and sensitive to the practical implications of one interpretation over another.' [Citation.] The second group of factors . . . —those suggesting the agency's interpretation is likely to be correct—includes indications of careful consideration by senior agency officials ('an interpretation of a statute contained in a regulation adopted after public notice and comment is more deserving of deference than [one] contained in an advice letter prepared by a single staff member' [citation]), evidence that the agency 'has consistently maintained the interpretation in question, especially if [it] is long-standing' [citation]) ('[a] vacillating position . . . is entitled to no deference' [citation]), and indications that the agency's interpretation was contemporaneous with legislative enactment of the statute being interpreted. If an agency has adopted an interpretive rule in accordance with Administrative Procedure Act provisions—which include procedures (e.g., notice to the public of the proposed rule and opportunity for public comment) that enhance the accuracy and reliability of the resulting administrative 'product'—that circumstance weighs in favor of judicial deference. However, even formal interpretive rules do not command the same weight as quasi-legislative rules. Because ' "the ultimate resolution of . . . legal questions rests with the courts" ' [citation], judges play a greater role when reviewing the persuasive value of interpretive rules than they do in determining the validity of quasi-legislative rules." (*Yamaha, supra*, 19 Cal.4th at pp. 12–13.)

The relevant situational factors in this case counsel in favor of limited deference to the Board's interpretation of the statutory language, as embodied in the *Garrapata* test. The language in issue is unique to section 1200, and has no analogue elsewhere in the statutes of this state. Judging from the record before us, even expert hydrologists disagree about the physical conditions and range of naturally occurring phenomena to which the subterranean stream language might refer. Translating that language into a usable and practical legal test therefore necessarily draws upon areas of the Board's technical expertise, experience, and familiarity with its own prior precedents. Although the *Garrapata* test does not reflect a long-standing administrative interpretation of section 1200, it has been adopted and applied by the agency's highest officials in a considered manner following contested proceedings. These factors warrant some degree of deference on our part to the test the agency has formulated. At the same time, our analysis of the history, text, and intent of the subterranean stream language leads us to the conclusion that the Board's jurisdiction over groundwater was intended to be the exception rather than the rule when the Legislature adopted the language in issue. Where the Board appears to be seeking endorsement for a more expansive construction of its potential jurisdiction, as in its reading of *Los Angeles v. Hunter* (1909) 156 Cal. 603 (*Hunter*), we have not deferred to the Board's views.

C. Historical Roots of the Subterranean Stream Language in Section 1200

California is the only western state that still treats surface water and groundwater under separate and distinct legal regimes. (Sax, *We Don't Do Groundwater: A Morsel of California Legal History* (2003) 6 U.Denv. Water L.Rev. 269, 270 (hereafter *We Don't Do Groundwater*)). The persistence of these alternative regimes inevitably leads to thorny issues of classification and boundary-setting. As the present case illustrates, classification disputes in this field quickly take on an Alice-in-Wonderland quality because the legal categories (e.g., “ ‘subterranean streams flowing through known and definite channels,’ ” “percolating water”) are drawn from antiquated case law and bear little or no relationship to hydrological realities. (See generally, *We Don't Do*

Groundwater, at pp. 270–304.)⁸ Because the Legislature has shown little inclination to reformulate this area of law, we are left to try to construe and apply a legal classification that is borrowed from cases decided more than 100 years ago.

1. Origin of Section 1200

Section 1200 derives from section 42 of the Water Commission Act of 1913 which was passed by the Legislature in 1913 as part of Assembly Bill No. 642, and became effective following a public referendum on December 19, 1914. (See Stats. 1913, ch. 586, § 42, p. 1033; *People v. Shirokow*, *supra*, 26 Cal.3d at p. 307, fn. 6.)⁹ The Water Commission Act grew out of a 1912 report by the California Conservation Commission (Commission) which found that the then-existing means of regulating the appropriation of water and water rights did not adequately protect the public's interest in the state's water resources, and did not effectively settle disputes over water rights. Regarding underground water, the Commission called for its statutory regulation and predicted that the failure to enact such legislation would result in increasing litigation over the use of underground water.

As introduced in January 1913, Assembly Bill No. 642 would have given the Board's predecessor, the State Water Commission, the power to investigate and determine appropriative "rights to water or the use of water" in "all streams, stream systems, portions of stream systems, lakes, or other bodies of water" in the state. (Assem. Bill No. 642 (1913 Reg. Sess.) Jan. 23, 1913, § 10.) Section 42 of the bill as introduced provided that "[t]he word 'water' in this act shall be construed as embracing

⁸ Professor Sax argues that section 1200 was intended to end the artificial legal separation of surface water and groundwater by giving the Board broad jurisdiction over all groundwater flows that have a direct and appreciable impact on a surface stream. (*We Don't Do Groundwater*, *supra*, 6 U.Denv. Water L.Rev. at pp. 286–306.) However, neither party to this litigation has embraced Sax's analysis, and we find no support for it in the legislative history or text of the statute.

⁹ The relevant sentence of section 42 of the Water Commission Act stated: "Whenever the terms stream, stream system, lake or other body of water or water occurs in this act, such term shall be interpreted to refer only to surface water, and to subterranean streams flowing through known and definite channels."

the term ‘or use of water’; and the term ‘or use of water’ in this act shall be construed as embracing the word ‘water.’ ” The bill’s broad grant of authority to the water commission made no apparent distinction between underground and surface water. However, by amendments made on April 2 and 22, 1913, the following sentence limiting the state water commission’s jurisdiction to surface water was added to section 42: “Whenever the terms stream, stream system, lake or other body of water or water occurs in this act, *such term shall be interpreted to refer only to surface water.*” (Italics added.) Finally, on April 30, 1913, the phrase “and to subterranean streams flowing through known and definite channels” was added to this sentence of section 42.

The record before us contains no evidence of contemporaneous statements discussing the legislative intent of the subterranean stream language in section 42 of the Water Commission Act, and no published court cases have interpreted the phrase since its enactment into law in 1914. From the sequence of amendments made to section 42 of Assembly Bill No. 642, it appears that the Legislature deliberately rejected wording that might otherwise have supported a broad assertion of jurisdiction over subsurface water. The addition, a few weeks later, of the phrase “and to subterranean streams flowing through known and definite channels” cannot reasonably be construed as an attempt to restore any major part of that jurisdiction. First, in contrast to the broad and inclusive list used to describe the state water commission’s surface water jurisdiction (“stream, stream system, lake or other body of water”), the phrase “subterranean streams flowing through known and definite channels” seems deliberately narrow. Virtually every word in it sets a limiting condition (e.g., flowing, known, definite, channel) that seems to reduce its breadth. Second, the use of the word “only” in the sentence is inconsistent with any legislative intent or understanding that jurisdiction over subterranean streams would encompass a major part of the state’s groundwater resources.

As discussed below, the concept of a subterranean stream flowing through a known and definite channel did not spring fully-formed from the 1913 deliberations over Assembly Bill No. 642. The concept played an important role in a series of California Supreme Court water rights cases going back to 1871. One 1899 California Supreme

Court case, *Pomeroy*, used language identical to that adopted by the Legislature in 1913. The parties have therefore properly focused our attention on these pre-1913 water law authorities. (See *People v. Lawrence* (2000) 24 Cal.4th 219, 231 [where the language of a statute uses terms that have been judicially construed there is a strong presumption that the terms carry the same technical meaning that had been placed upon them by the courts].)¹⁰

2. Distinction Between Flowing and Percolating Groundwater

In several cases decided between 1871 and 1909, the California Supreme Court addressed the distinction between groundwater flowing in subterranean streams and groundwater that was considered to be merely percolating through the soil. The former was governed by riparian and appropriative restrictions on use,¹¹ while the latter was (until 1903) subject to the unrestricted ownership rights of the overlying property owner. Thus, in *Hanson v. McCue* (1871) 42 Cal. 303, 308–309, the court observed that a “subterranean stream of a defined character, and flowing in a defined channel” would be subject to the same riparian rules that govern the use of “similar streams flowing upon the surface of the earth.” In contrast, “[w]ater filtrating or percolating in the soil belongs to the owner of the freehold—like the rocks and minerals found there.” (*Hanson v. McCue*, at p. 308; see also, *Southern Pac. R. R. Co. v. Dufour* (1892) 95 Cal. 615, 620; *Gould v.*

¹⁰ At the Board’s request, we have also taken judicial notice of the 1914 ballot arguments in favor of and against the Water Commission Act. The opponents of the measure claimed that it would “place under the control of a political commission all of the waters of the state, both of surface and underground stream or flow.” However, exaggerated characterizations of the scope of a ballot measure, made in an unsuccessful effort to defeat it, are not persuasive.

¹¹ “The riparian doctrine confers upon the owner of land contiguous to a watercourse the right to the reasonable and beneficial use of water on his land.” (*People v. Shirokow*, *supra*, 26 Cal.3d at p. 307.) “All riparians on a stream system are vested with a common ownership such that in times of water shortage all riparians must reduce their usage proportionately. [Citations.]” (*United States v. State Water Resources Control Bd.* (1986) 182 Cal.App.3d 82, 101.) The diversion of water for other than riparian or overlying uses is subject to the appropriation doctrine under which the appropriator’s right to the water is subordinate to those of riparian users and earlier appropriators. (*Id.* at pp. 101–102.)

Eaton (1896) 111 Cal. 639, 644; *Pomeroy, supra*, 124 Cal. at pp. 630–637; *Vineland Irr. Dist. v. Azusa Irr. Co.* (1899) 126 Cal. 486, 494–495; *Katz v. Walkinshaw* (1903) 141 Cal. 116, 125–126 (*Katz*); *Hunter, supra*, 156 Cal. at pp. 607–608.) Under the case law, groundwater was presumed to be percolating; the burden of showing that it flowed instead in a defined subterranean stream rested with the party asserting rights in such a stream. (See *Hanson v. McCue*, at p. 308; *Pomeroy*, at pp. 628, 633–634; *Arroyo D. and W. Co. v. Baldwin* (1909) 155 Cal. 280, 284.)¹²

3. The *Pomeroy* Case

Among all of the pre-1913 cases, *Pomeroy* contains the most extended and detailed discussion of how to classify groundwater as either water flowing in a subterranean stream or percolating in the soil. It also utilizes language identical to that later adopted by the Legislature in section 42 of the Water Commission Act. The specific phrase, “subterranean streams flowing through known and definite channels,” appeared for the first time in *Pomeroy* and the *Pomeroy* court emphasized that “the main question in the case” was “the proper definition of a subterranean stream.” (*Pomeroy, supra*, 124 Cal. at p. 632.) *Pomeroy* accordingly provides the best available evidence of the original legislative intent of the phrasing now found in section 1200.

The central issue in *Pomeroy* was the valuation of lands condemned by the City of Los Angeles under its eminent domain powers. (*Pomeroy, supra*, 124 Cal. at p. 604.) The lands were to be used for the purpose of constructing a tunnel and filtration galleries to divert water flowing underneath the bed of the Los Angeles River at its narrow outlet

¹² The rule recognizing absolute ownership of percolating groundwater was abrogated by the California Supreme Court’s 1903 decision in *Katz, supra*, 141 Cal. at pages 128–129, 132–134. *Katz* rejected the doctrine that “each landowner owns absolutely the percolating waters in his land, with the right to extract, sell, and dispose of them as he chooses, regardless of the results to his neighbor,” and held instead that percolating groundwater in California was subject to the same common law restrictions on use as surface water and subterranean streams. (*Id.* at pp. 121, 133–136.) As a result of the *Katz* decision, it was no longer necessary for the courts to determine at common law whether groundwater in dispute between litigants was percolating groundwater or groundwater flowing in subterranean streams. (*McClintock v. Hudson* (1903) 141 Cal. 275, 281.)

from the San Fernando Valley, to supply the city's inhabitants. (*Id.* at pp. 604–607.) The city asserted that the groundwater on defendant's property was part of the river's underflow for which the city would not have to pay compensation. (*Id.* at pp. 607, 617.) The defendants maintained that the groundwater was percolating groundwater which they owned and for which compensation must be made in the jury's award. (*Id.* at p. 617.) After being instructed in detail about how to distinguish percolating groundwater from water flowing in a subterranean stream, the jury made no award for the value of the water. (*Id.* at pp. 616–617.) On appeal in the Supreme Court, the defendants challenged several of the jury instructions on this issue. (*Id.* at pp. 630–636.) The court affirmed the judgment and upheld the trial court's instructions. (*Id.* at pp. 630–636, 650.)

Pomeroy rejected the defendants' claim that "all water passing through sand, gravel, and [boulders] is percolating water" and instead endorsed the view that a subterranean stream can exist "when the material through which the water forces itself fills a well-defined channel with impervious sides and bed." (*Pomeroy, supra*, 124 Cal. at p. 631.) Later in the opinion, the court observed that such a channel could be formed by the "*comparatively* impervious mountain sides" creating the opening through which the disputed water passed out of the San Fernando Valley. (*Id.* at p. 632, italics added.)

Turning its attention to the proper definition of a subterranean stream, the *Pomeroy* court quoted in full from and endorsed as a correct statement of the law the following discussion found in Clesson S. Kinney's 1894 volume, *A Treatise on the Law of Irrigation* (hereafter *Kinney on Irrigation*): " 'Subterranean or underground water courses are, as their names indicate, those water currents that flow under the surface of the earth. A large portion of the great plains and valleys of the mountainous regions of the west is underlaid by a stratum of water-bearing sand and gravel, and fed by the water from the mountain drainage. This water-bearing stratum is of great thickness, the water is moving freely through it, is practically inexhaustible, and, if it can be brought to the surface, will irrigate a large portion of the country overlying it. In and near the mountains many streams have a bed which was originally a rocky canyon, but has been filled up with [boulders] and coarse gravel. In this debris a large portion or all of the

water sinks from sight, to reappear only when some rocky reef crosses the channel and forces the water to the surface. The movement of this water through the porous gravel, owing to the declivity of the stream, is often quite rapid, and a considerable volume may thus pass down the channel hidden from sight.

“ ‘These watercourses are divided into two distinct classes—those whose channels are known or defined, and those unknown and undefined. It is necessary to bear this distinction in mind in our discussion, as they are governed by entirely different principles of law. And in this connection it will be well to say that *the word “defined” means a contracted and bounded channel, though the course of the stream may be undefined by human knowledge; and the word “known” refers to knowledge of the course of the stream by reasonable inference.* Regarding the laws governing these two classes, it must be known that if underground currents of water flow in well-defined and known channels, the course of which can be distinctly traced, they are governed by the same rules of law that govern streams flowing upon the surface of the earth.

“ ‘The owner of land under which a stream flows can, therefore, maintain an action for the diversion of it if such diversion takes place under the same circumstances as would enable him to recover if the stream had been wholly above ground. But for this purpose the underground water must flow in known and well-defined channels . . . in order that the riparian owner or appropriator may invoke the same rules as are applied to surface streams, or otherwise the presumption will be that they have their sources in the ordinary percolations through the soil. This rule practically disposes of the second class of subterranean waters—those whose channels are unknown and undefined—although there are undoubtedly a great many underground streams whose waters flow in confined channels but whose courses are not known, and, following the above rule, these are all classed with percolating waters.’ ” (*Pomeroy, supra*, 124 Cal. at pp. 633–634, quoting Kinney on Irrigation, *supra*, § 48, pp. 69–70, italics added.)¹³

¹³ Section 49 of Kinney on Irrigation, which was not quoted in *Pomeroy*, states the following rationale for distinguishing between known subterranean streams and percolating waters and those whose sources are unknown: “Where there is nothing to show that the waters of a spring or well are supplied by any defined flowing stream the

The *Pomeroy* court goes on to apply these definitions and distinctions to the case before it: “In this case the boundaries of the channel and the existence and course of the underground stream were unknown and undefined except so far as they could be inferred, but there was a great amount of evidence from which a reasonable inference could be drawn that the channel was bounded and defined by the sloping sides of the Cahuenga and Verdugo hills meeting under ground, and that there was a subsurface flow corresponding with the surface flow from west to east out through the gap. Without any excavation beneath the surface, or other test or experiment, all this could be inferred from the topography of the country, the amount of rainfall and the gradually augmenting volume of the surface stream in its approach to the narrowest point in the pass. And the court was certainly justified in submitting to the jury the question whether the subsurface flow was a part of the stream unless the mere fact that it was forcing its way through sand and gravel and [boulders] deprived it of the character of a stream. [¶] Upon this point we are satisfied that the view of the superior court was the reasonable and just view and not opposed to anything that has ever been decided in this court.” (*Pomeroy, supra*, 124 Cal. at p. 634.)

presumption will be that they have their source in the ordinary percolations of water through the soil. Percolating waters, and those whose sources are unknown, belong to the realty in which it is found. The reason for this rule is that, as percolations spread themselves in every direction through the earth[,] it is impossible to avoid disturbing them without relinquishing the necessary enjoyment of the land the law does not therefore forbid their disturbance.” (Kinney on Irrigation, *supra*, § 49, pp. 70–71, fns. omitted.) As stated in *Wheatley v. Baugh* (1855) 25 Pa. 528, 532: “When the filtrations are gathered into sufficient volume to have an appreciable value, and to flow in a clearly defined channel, it is generally possible to see it, and to avoid diverting it without serious detriment to the owner of the land through which it flows. But percolations spread in every direction through the earth, and it is impossible to avoid disturbing them without relinquishing the necessary enjoyment of the land. . . . [¶] . . . No man could dig a cellar, or a well, or build a house on his own land, because these operations necessarily interrupt the filtrations through the earth.”

D. Parties' Conflicting Analyses of Section 1200

As an initial matter, the Board claims that NGWC cannot challenge whether the *Garrapata* test reflects a correct interpretation of section 1200 on this appeal because NGWC failed to exhaust its administrative remedies. The Board maintains that both sides explicitly accepted the *Garrapata* framework in their arguments and presentation of evidence before the Board, but merely disputed whether certain elements of the test were satisfied as applied to the groundwater pumped by NGWC's wells. (See *San Franciscans Upholding the Downtown Plan v. City and County of San Francisco* (2002) 102 Cal.App.4th 656, 686–687 [exhaustion of administrative remedies doctrine bars party from offering its own property appraisal methodology for the first time on appeal].) NGWC insists that it did not exhaust its administrative remedies because: (1) it expressly argued to the Board that the *Garrapata* test must be qualified in specified respects, and (2) the arguments and evidence on which it relies on appeal are in substance identical to those it advanced in the administrative proceedings. With the possible exception of one argument, discussed below, that NGWC raised for first time in the trial court, we agree with NGWC (and the trial court) that there was no failure to exhaust administrative remedies. We will therefore consider NGWC's arguments on their merits.

With one exception, NGWC does not disagree that the wording of the Board's four-part test, as far as it goes, is consistent with *Pomeroy*. Thus, NGWC does not disagree that under *Pomeroy* the existence of a "subterranean stream[] flowing through a known and definite channel" requires that a subsurface channel be present, that the course of the channel be known or capable of being determined by reasonable inference, and that groundwater be flowing in the channel. NGWC also agrees that the channel must have a bed and banks, although it disagrees that a bed and banks composed of "relatively impermeable" materials would suffice under *Pomeroy*. In essence, NGWC argues that the *Garrapata* test omits important limiting factors that are found in or implicit in the

pre-1913 case law. Without these limitations, NGWC maintains that the test is over inclusive and therefore overstates the Board's statutory jurisdiction.¹⁴

1. Meaning of "Contracted"

First, NGWC argues that *Pomeroy's* definition of a "defined" channel as a "contracted and bounded" channel means that the width of the channel must be narrowing rather than widening as the groundwater flows through it. According to NGWC, this was clearly the case in *Pomeroy* where the court was concerned with a relatively narrow outlet from the San Fernando Valley. In contrast, the channel posited by the Board in this case is not "contracted" at Elk Prairie, but widens at that location.

NGWC places too much weight on the word "contracted." *Pomeroy* quoted the phrase "contracted and bounded" from *Kinney on Irrigation*. (*Pomeroy, supra*, 124 Cal. at pp. 633–634.) The phrase apparently derived from two earlier Irish cases. (See *Kinney on Irrigation, supra*, § 48, p. 69, fn. 1; *Black v. Ballymena Township Cmmrs.* (1885) 17 I.L.R. 459; *Ewart v. Belfast Poor-Law Guardians* (1881) 9 I.L.R. 172.) A few cases from other jurisdictions have also quoted this formulation, citing *Kinney on Irrigation*. (See *Huber v. Merkel* (1903) 117 Wis. 355, 360; *Deadwood Cent. R. Co. v. Barker* (S.D. 1901) 86 N.W. 619, 621.) None of these authorities, including *Pomeroy*, support NGWC's thesis that unless the channel through which the groundwater is flowing is narrowing or contracting the water is not flowing in a "definite" channel. Aside from the bare use of the word "contracted" none of the authorities discusses or endorses any such restriction in classifying groundwater. In context, the word "contracted" appears to mean simply that the channel constrains and controls the flow of the groundwater compared to how the water would behave if the channel did not exist. There is no indication in *Pomeroy* or any of the other pre-1913 authorities that determining whether a subterranean channel is narrowing, widening, or maintaining the same width is essential to the classification of the groundwater flowing in it.

¹⁴ This court has also reviewed and considered amicus curiae briefs submitted by the California Water Association and the Northern California Water Association addressed to the Board's jurisdiction.

2. Meaning of “Bounded”

Second, NGWC argues that the bed and banks of a subterranean channel must be more than “relatively impermeable.”¹⁵ In NGWC’s view, the proper test under *Pomeroy* is whether the bed and banks present a “significant boundary to groundwater flow.” In NGWC’s formulation, the *relative* permeability of the materials composing the bed and banks is a potentially relevant but never dispositive factor in that determination. The critical question, according to NGWC, is whether the bed and banks are *sufficiently impermeable* that they “ ‘prevent the transmission of all but relatively minor quantities through the channel boundary’ ” (quoting language actually used by the Board in its *Garrapata* decision). NGWC argues that the second element of the test, as so modified, has not been established. According to NGWC’s expert, the majority of the groundwater in the alluvium under Wells 4 and 5 originates in the Franciscan formation north of Elk Prairie and then flows south *across* the interface between the Franciscan rock and the alluvium. If so, then the channel boundary between the bedrock and alluvium at Elk Prairie is not an effective barrier to the transmission of groundwater.

According to the Board, the critical question in deciding whether a definite subterranean channel exists is whether groundwater, once it enters the channel, will be confined to it. This, in turn, is a function of the permeability of the materials filling the channel compared to those forming the channel’s bed and banks, as well as of the gradient or slope at which the groundwater is descending toward sea level. The Board cites the testimony of NGWC’s expert that the flow of water across the interface between

¹⁵ Although not specified in the shorthand statement of the four-part test quoted earlier, the Board compared the permeability of the materials contained within the channel, in this case the alluvial aquifer materials beneath Elk Prairie, with the permeability of the materials forming the bed and banks, in this case the Franciscan bedrock. DFG’s expert found, based on various measurements, that the alluvium was two and one-half to three orders of magnitude more permeable than the bedrock. The Board accepted this finding. According to the Board, this means in lay terms that for every drop of water that passes through the bedrock 300 to 1,000 drops would flow through the alluvial aquifer. To the extent that NGWC disputes the Board’s factual findings concerning the relative impermeability of the bedrock, they are supported by substantial evidence.

the bedrock and the alluvium on the north side of Elk Prairie is a one-way flow; water flows into the alluvium but no water flows back out into the bedrock. The Board also notes, and NGWC implicitly concedes, that no natural, geologic boundary is 100 percent impermeable.

In our view, the Board's position is more consistent with *Pomeroy* and other pre-1913 case law than is NGWC's. These cases focus not on the source of the water gathered in a subterranean stream, but on the physical coherence of the stream *once it is formed*: “ ‘Where percolating waters collect or are gathered in a stream running in a defined channel, no distinction exists between waters so running under the surface or upon the surface of land.’ (*Cross v. Kitts* [(1886)] 69 Cal. 217.) Water passing through the soil, not in a stream, but by way of filtration, is not distinctive from the soil itself; the water forms one of its component parts. In this condition it is not the subject of appropriation. When, however, it gathers in sufficient volume, whether by percolation or otherwise, to form a running stream, it no longer partakes of the nature of the soil, but has become separate and distinct therefrom and constitutes a stream of flowing water subject to appropriation.” (*de Wolfskill v. Smith* (1907) 5 Cal.App. 175, 181.) As stated in one of the jury instructions approved in *Pomeroy*: “ ‘If such [underground] watercourse exists, it is immaterial, so far as the watercourse is concerned, from or through what lands the waters flow in reaching the channel, or whether they reach the same by percolation or by clearly defined streams.’ ” (*Pomeroy, supra*, 124 Cal. at p. 624.)

Thus, nothing in the pre-1913 case law suggests that the one-way seepage of water into a subterranean (or surface) stream through bedrock fissures or fractures, as posited by NGWC's expert, negates the existence of a “known and definite” subterranean channel, any more than the infiltration or seepage of water into a surface stream negates its character as a defined surface channel.¹⁶

¹⁶ The pre-1913 cases recognize, either implicitly or explicitly, that water in known, subterranean channels implicated the same legal rights as that in surface streams because both behaved in an essentially similar fashion, i.e., crossing through adjacent properties in well-defined and ascertainable courses. (See, e.g., *Hanson v. McCue, supra*, 42 Cal. at p. 308.) As stated in the same section of *Kinney on Irrigation* from which the

The type of comparative analysis required by the Board's test is certainly consistent with *Pomeroy*, which described the mountain sides forming the bed and banks of the alluvial channel in issue there as "comparatively impervious." (*Pomeroy, supra*, 124 Cal. at p. 632.) Just as the bed and banks of surface streams necessarily permit some seepage of water, an absolute standard that subterranean channels be watertight would be entirely unrealistic. As stated in one of the jury instructions approved in *Pomeroy*, the bed of a subterranean watercourse " 'may consist of any material which keeps the waters from penetrating below a certain depth and such banks or sides may consist of any material which has the effect of confining the waters within circumscribed limits.' " (*Id.* at p. 623.) We find nothing in *Pomeroy* nor any evidence in the administrative record suggesting that a subsurface channel boundary that is two and one-half or three orders of magnitude less permeable to water than the materials it contains is insufficient for those purposes.

While the Board's "relatively impermeable bed and banks" requirement might profit from greater specificity, we cannot say that NGWC's "significant boundary" formulation is an improvement, or that it is more consistent with the pre-1913 case law. It fails most notably to draw any distinction between the various means by which groundwater may enter the channel and the degree to which the channel contains and confines the water once it has entered.

3. Relevance of Flow Direction

Third, NGWC points out that section 1200 and *Pomeroy* both refer to subterranean streams flowing *through* a known and definite channel. (§ 1200; *Pomeroy, supra*, 124 Cal. at p. 632.) NGWC construes this to mean that the groundwater flow must be

Pomeroy court quoted at length: "No distinction exists between waters running under the surface, in defined channels, and those running in distinct channels upon the surface. The distinction is made between all waters running in distinct channels, whether upon the surface or subterranean, and those oozing or percolating through the soil in varying quantities and uncertain directions." (Kinney on Irrigation, *supra*, § 48, pp. 69–70, fn. 2, citing *Strait v. Brown* (1881) 16 Nev. 317.)

parallel to the channel or, if not precisely parallel to it, then at least flowing in the same general direction at all times. NGWC maintains that the water pumped by Wells 4 and 5 flunks this essential test because its flow direction underneath Elk Prairie is perpendicular to the alluvial channel forming the bed and banks of the asserted subterranean stream. In NGWC's view, the north-south flow direction is caused by the significant amounts of groundwater entering the alluvial channel through fractures in the bedrock north of Elk Prairie. According to NGWC, this north-south stream is flowing *across* the defined alluvial channel, not *through* it as contemplated by section 1200. NGWC rejects as inconsistent with the available data any theory that the groundwater underneath Elk Prairie is merely "channelized" groundwater moving in a westerly direction along the alluvial channel that has been deflected south by the damning effect of a subsurface geological formation.

DFG's expert presented an alternative theory to account for the flow direction at Elk Prairie. He cited evidence (which was disputed as insufficient by NGWC) that groundwater is flowing from east to west through the subsurface channel just upstream of Elk Prairie, before it encounters a relatively impermeable clay layer under Elk Prairie which deflects it toward the south. He also believed that the proximity of the San Andreas fault zone immediately to the west of Elk Prairie could contribute to the bend in subsurface flow direction toward the North Fork. DFG's expert rejected as speculative and unsupported NGWC's theory that the bedrock north of Elk Prairie could be a significant source of groundwater flow into the alluvium that would account for its north-south flow direction at Elk Prairie.

In its decision in this case, the Board held specifically as follows: "The fourth element in [the *Garrapata* test] does not require that the flow direction within the subterranean streamflow be parallel to the channel. . . . Further, any directional deviation of the subterranean stream from parallel to the channel is irrelevant to the issue of whether [NGWC's] wells are taking water from a subterranean stream in a known and definite channel. Nothing in Water Code section 1200 or . . . in the [relevant] case law requires that a subterranean stream exactly follow the course of the channel. Therefore,

the test is satisfied as long as the water is flowing within the channel.” The Board asserted that this analysis was consistent with the behavior of surface streams: “In a surface stream, the flow may deviate or even reverse at points from the general direction of flow as water enters from a tributary, flows around a barrier, or moves along the bottom of the stream. Likewise, such deviations may occur in a subterranean stream.”

Subject to certain qualifications, we agree with the Board’s position. Nothing in the relevant case law requires that a subterranean stream *precisely* follow the course of the channel. As in surface streams, flow direction need not be parallel to the banks of the channel at all locations along its length. The presence of local obstructions or seasonal variations in flow volume, among other conditions, may affect flow direction. Thus, a directional deviation of the subterranean stream from parallel to the channel at the point of diversion would, in general, be irrelevant to the issue of whether the Board would have jurisdiction over appropriations from the stream, as the Board stated in Order WRO 2003-0004.

At the same time, the further statement in the Board’s decision that the *Garrapata* test “is satisfied as long as the water is flowing within the channel” is gratuitous, and may invite an overbroad application of the *Garrapata* test in future cases. Construed together, the words of the subterranean stream clause clearly contemplate that the stream flows in the same general direction as the channel. The following sentence from *Pomeroy* is illustrative: “ ‘[T]here are undoubtedly a great many underground streams whose waters flow in confined channels but whose courses are not known, and, following the above rule, these are all classed with percolating waters.’ ” (*Pomeroy, supra*, 124 Cal. at p. 634, quoting Kinney on Irrigation, *supra*, § 48, p. 70.) Thus, as stated in Kinney on Irrigation, and as the Supreme Court recognized in *Pomeroy*, a subsurface stream only avoids classification as percolating water if the course of the *stream* is known and definite. That the course of the channel through which it flows is known and definite matters only insofar as that course defines the course of the stream, and allows the latter to be ascertained. This point is underlined by the critical passage in *Pomeroy* in which the court, using Kinney on Irrigation, defined the key terms later borrowed for section 1200:

“ ‘[T]he word “defined” means a contracted and bounded channel, though the *course of the stream* may be undefined by human knowledge; and the word “known” refers to *knowledge of the course of the stream* by reasonable inference.’ ” (*Pomeroy*, at p. 633, italics added.)¹⁷

Thus, the subterranean stream clause of section 1200 cannot properly be construed to grant jurisdiction over a groundwater stream that wanders independently of the banks of the putative channel. Such a reading would be inconsistent with *Pomeroy* and with the original legal rationale for treating water flowing in definite underground streams differently from percolating groundwater. Where, as in this case, the flow direction of the underground stream is perpendicular or nearly perpendicular to the banks of the asserted channel, some explanation is required for the stream’s extreme deviation from the general course of the channel. Contrary to NGWC’s position, such a deviation (or even a reverse flow) at the point of diversion does not negate the existence of a subterranean stream flowing through a known and definite channel *if* such a flow direction can be satisfactorily explained by localized conditions that obstruct or divert the stream from its path along the channel.

The Board recognized the need in this case to explain the north-south flow direction of the stream under Elk Prairie in Order WRO 2003-0004 by citing in a footnote to the testimony of DFG’s expert on this point. In its subsequent petition for reconsideration of Order WRO 2003-0004, NGWC attacked the expert’s opinions on this point as being unsupported and misleading. The Board’s order denying reconsideration discussed the DFG expert testimony at some length and responded to NGWC’s contentions in relevant part as follows: “[NGWC] wants the [footnote] to state that it is just a report of the opinion of the DFG witness, and impliedly wants it not to be a finding of the [Board]. Further, [NGWC] argues that the entire footnote ignores [NGWC’s] rebuttal testimony. [NGWC] asserts that its rebuttal testimony was successful in

¹⁷ The very rationale for treating subterranean streams differently than percolating water—that the landowner would know where he could excavate and build on his land without disturbing the stream—depends on the premise that the stream generally follows the known and definite course of the channel. See footnote 13, *ante*.

demonstrating that the opinions of the DFG expert regarding flow direction are not supported by the available data and are contrary to basic principles of groundwater hydrology. The [Board] disagrees with this assertion. [¶] . . . [¶] [The footnote] points out that the record does contain substantial evidence in the form of testimony and exhibits presented by a qualified expert witness that explains why the groundwater is flowing from north to south at [NGWC's] production wells. First, due to the subsurface conditions beneath Elk Prairie, one would not expect the groundwater to flow parallel to the channel at that location. . . . At the location of the wells, the less-permeable clay sediments in the alluvium near the wells tend to force the subterranean streamflow into the more permeable parts of the alluvium, making it easier for the groundwater to flow around, rather than through, the clay sediments. Second, the presence of clay deposits influences the groundwater gradient beneath [NGWC's] property by causing the groundwater to flow in a more southerly direction in that area. . . . [¶] [W]ater in the channel flows in a gradient from a higher to a lower elevation within the channel. Based on the evidence, the observed deviation of the groundwater flow direction at the wells from a predominantly east to west direction of the channel is consistent with a general downstream flow of the subterranean stream. . . . [¶] . . . The evidence in the record demonstrates that water is in fact flowing generally downstream within the channel under Elk Prairie, following a hydraulic gradient and following the path of least resistance.”

An administrative agency must “render findings sufficient both to enable the parties to determine whether and on what basis they should seek review and, in the event of review, to apprise a reviewing court of the basis for the board’s action.” (*Topanga Assn. for a Scenic Community v. County of Los Angeles* (1974) 11 Cal.3d 506, 514.) But such findings need not be stated with the formality and precision required in judicial proceedings. (*Alford v. Pierno* (1972) 27 Cal.App.3d 682, 691.) They are to be liberally construed to support rather than defeat the decision under review. (*Fair Employment Practice Com. v. State Personnel Bd.* (1981) 117 Cal.App.3d 322, 329.) Nor must the court remand if it determines that necessary findings may be reasonably implied. (*Alford v. Pierno*, at p. 691.) We must uphold the decision of an administrative agency

during the dry season when water seeps down the alluvial channel without flowing on the surface. (2 Wiel, *Water Rights in the Western States*, *supra*, ch. 43, § 1077, p. 1012.)

Moreover, there is no indication in *Pomeroy* or other pre-1913 cases that the phrase “subterranean stream flowing through a known and definite channel” referred exclusively to underflows of a surface stream or water flowing through channels in bedrock. Rather, the pre-1913 case law suggests that underflows of surface streams were simply a subcategory of definite underground streams, not a distinct, stand-alone category recognized as such in the cases. The case law does not support NGWC’s claim that the subterranean stream language in the statute categorically excludes water flowing in an alluvial channel unless it is the underflow of a surface stream.¹⁸

Two final caveats are in order concerning our approval of the Board’s methodology in this case. First, NGWC and amici curiae are concerned with language in the Board’s decision suggesting that water moving within a wide alluvial valley, whatever its form or direction, constitutes a subterranean stream. In particular, the Board appears to read *Hunter*, *supra*, 156 Cal. 603 as holding that all groundwater flowing in the San Fernando Valley is part of a single subterranean stream. We reject any such expansive view of the Board’s jurisdiction. Such a view would be directly at odds with *Pomeroy*,¹⁹ and no case has cited *Hunter* as authority for so sweeping a proposition.

¹⁸ In *Pomeroy*, the court approved a jury instruction stating that if the jury found the water moving underground was “ ‘in the same general direction as the surface stream and in connection with it,’ ” then the water should be considered part of the watercourse. (*Pomeroy*, *supra*, 124 Cal. at p. 624.) The *Pomeroy* court thus may have considered underflow to be a *sufficient* condition to establish the existence of a subterranean stream, but not necessarily an *essential* condition.

¹⁹ In rejecting the property owners’ claim that the entire San Fernando basin was a subterranean stream under the trial court’s instructions, the *Pomeroy* court cited the following instruction: “ ‘[I]t must be made to appear that the water usually flows in a certain direction and in a regular channel, with banks or sides, though it need not . . . be in a straight line. [¶] Waters, whether under or above ground, having no certain general course or definite limits, such as those merely percolating through the strata of the earth and those diffused over its surface, are not watercourses [¶] . . . [¶] Water moving by force of gravity in a valley or basin of wide extent . . . and moving generally through the whole or through a large portion of the basin, along through the natural voids or

However, we do not find that the Board's interpretation and application of section 1200 in this case depends in any way on its analysis of *Hunter*.

Second, we reject as inconsistent with section 1200 the trial court's passing suggestion that once the operation of NGWC's wells is shown to have an impact on the North Fork surface flows, the Board's jurisdiction over the wells follows automatically. We find no indication in the record that the Board relied on any such "impact" test in rendering its classification decision.

Subject to the qualifications stated in this opinion, we hold that the four-part *Garrapata* test is consistent with the language and intent of section 1200, that the Board made all findings necessary to determine that the groundwater in issue satisfied the test, and that such findings were supported by substantial evidence.

E. Application of Term 9

NGWC argues in the alternative that even if the Board has permitting jurisdiction over the wells in issue, it has improperly construed the manner in which Term 9 applies to them. According to NGWC, the second sentence of Term 9 ("[t]he total streamflow shall be bypassed whenever it is less than the designated amount for that period") has no application to Wells 4 and 5 unless the company's groundwater pumping actually *reduces* surface streamflows during a period when they were already below one of the seasonal minimums specified in the first sentence of Term 9.²⁰ The Board, on the other hand, construes Term 9 to mean that all groundwater pumping is automatically prohibited whenever surface water flows fall below the minimums specified.

interstices of the earth, composed of alluvial or other deposit lying throughout the entire basin . . . do not constitute a watercourse.' " (*Pomeroy, supra*, 124 Cal. at pp. 626–627, 631–632.)

²⁰ This would occur, at least theoretically, if NGWC was pumping Wells 4 and 5 at levels that induced infiltration of surface water from the North Fork. However, NGWC's expert testified that the company's pumping had not historically produced any induced infiltration, and could not be made to do so even under test conditions exceeding normal pumping.

In our view, NGWC waived this issue by failing to timely raise it in 1999 when the Board issued Orders WR-99-09-DWR and WR 99-11. (§ 1126, subd. (b) [“party aggrieved by any decision or order may, not later than 30 days from the date of final action by the board, file a petition for a writ of mandate for review of the decision or order”]; see *Travis v. County of Santa Cruz* (2004) 33 Cal.4th 757, 767 [holding claim of invalid zoning permit conditions to be untimely]; *United States v. State of Cal.* (E.D.Cal. 1981) 529 F.Supp. 303, 312 [dismissing as untimely challenge to state water board decision not filed within 30 days after final decision].) These orders placed conditions on NGWC’s request for a change in the point of diversion—the development of water measurement and water supply contingency plans—that were unmistakably premised on Term 9’s restrictions being fully applicable to groundwater diversions, not just to surface water diversions that could only occur under extreme pumping scenarios. NGWC could not have misunderstood the nature of the protests lodged against its change petition, nor the reading of Term 9 on which the Board predicated its ensuing orders addressing these concerns. It could not, consistent with section 1126, manifest its acceptance of the conditions and then wait until nearly two years later to challenge the premise on which they were self-evidently based.

In any event, we do not find NGWC’s interpretation of Term 9 persuasive on the merits. Generally, we extend considerable deference to an administrative agency’s interpretation of its own regulations and language. (*Communities for a Better Environment v. State Water Resources Control Bd.* (2003) 109 Cal.App.4th 1089, 1107; *Bello v. ABA Energy Corp.* (2004) 121 Cal.App.4th 301, 318.) Such interpretation is entitled to great weight unless it is unauthorized, unreasonable, or clearly erroneous. (*Bello v. ABA Energy Corp.*, at p. 318.) Although Term 9 is awkwardly worded in light of the change in the point of diversion, the Board’s interpretation that the term applies to all diversion points subject to the permit is reasonable in light of Term 9’s history and purpose in protecting streamflows and fish life in the North Fork. In contrast, NGWC’s proposed interpretation would make Term 9 substantially, if not completely, ineffective in fulfilling these purposes. Accordingly, should the Board determine that it has

jurisdiction over NGWC's wells, it may enforce Term 9 according to its interpretation that the term applies to all diversion points subject to the permit.

We find no error in the trial court's disposition of NGWC's petitions.

III. DISPOSITION

The judgment denying the consolidated petitions is affirmed.

Margulies, J.

We concur:

Marchiano, P.J.

Swager, J.

Trial Court: Mendocino County Superior Court

Trial Judge: Hon. Leonard J. LaCasse

Counsel:

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Nossaman, Guthner, Knox & Elliott, Frederic A. Fudacz, Nicole A. Tutt, Alfred E. Smith for California Water Association as Amicus Curiae on behalf of Plaintiff and Appellant.

Bill Lockyer, Attorney General, Tom Greene, Chief Assistant Attorney General, Mary E. Hackenbracht, Senior Assistant Attorney General, Mark W. Poole, Deputy Attorney General for Defendant and Respondent.

REFERENCES REGARDING SUBTERRANEAN STREAMS AND UNDERGROUND STORAGE

A. Subterranean Streams references

Statutes

Water Code section 1200 (Stats. 1913, ch. 586, § 42 [1913 Water Commission Act])
Water Code section 1201
Water Code section 1260-1265

Water Right Decisions and Orders

State Water Board Orders WR 2003-0004 and WR 2003-0009 (North Gualala)
State Water Board Decision 432 (San Luis Rey River)
State Water Board Decision 729 (Escondido Canyon)
State Water Board Decision 724 (Mono County – inadequate evidence)
State Water Board Decision 1639 (Garrapata Creek)
State Water Board Decision D 1110 (Russian River)
State Water Board Decision D 1142 (Russian River)
State Water Board Decision D 1258 (Russian River)
State Water Board Decision D 1266 (Russian River)
State Water Board Decision 1576 (Russian River)
State Water Board Decision 1589 (Morro and Chorro Creeks)
State Water Board Decision 1604 (Russian River)
State Water Board Decision 1645 (San Luis Rey River)
Order WR 95-10 (Carmel River)

Published Court Opinions on Subterranean Streams and on Percolating Groundwater

- Subterranean streams

North Gualala Water Company v. State Water Resources Control Board (2006) 139 Cal.App. 4th 1577 [43 Cal.Rptr.3d 821]
City of Los Angeles v. Pomeroy (1899) 124 Cal. 597, 632 [57 P. 585]
United States v. Fallbrook Public Utility District, et al. (9th Cir. 1965) 347 F.2d 48, 55-56 (water right permit needed to appropriate from subterranean stream)
Vineland Irrigation District v. Azusa Irrigating Company (1899) 126 Cal. 486 [58 P. 1057] (San Gabriel River; presence of a well-defined subsurface stream)
Cross v. Kitts (1886) 69 Cal. 217 [10 P. 409]
Rancho Santa Margarita v. Vail (1938) 11 Cal.2d 501 [81 P.2d 533] (surface and subsurface parts of the stream are a common supply)
City of Los Angeles v. Hunter (1909) 156 Cal. 603 [105 P. 755] (subterranean flow of the Los Angeles River)

- Percolating water

Hanson v. McCue (1871) 42 Cal. 308
Southern Pac. R.R. Co. v. Dufour (1892) 95 Cal. 615, 620
Gould v. Eaton (1896) 111 Cal. 639
Katz v. Walkinshaw (1903) 141 Cal. 116 [74 P. 766]

McClintock v. Hudson (1903) 141 Cal. 275, 281
Arroyo Ditch & Wat. Co. v. Baldwin (1909) 155 Cal. 280, 284
Miller v. Bay Cities Water Co. (1910) 157 Cal. 256 [107 P. 115]
City of San Bernardino v. City of Riverside (1921) 186 Cal. 7 [198 P. 784]
City of Pasadena v. City of Alhambra (1949) 33 Cal.2d 908 [207 P.2d 17]

B. Underground Storage references

Statutes

Water Code section 1201
Water Code section 1242
Water Code section 1260-1265
Water Code section 1266
Water Code section 1375 (c)
Water Code section 1381

Regulations

California Code of Regulations section 722 (maps)
California Code of Regulations section 733 (information)
California Code of Regulations section 846 (measurement devices)

Water Right Decisions

Decision 894 (1958)
Decision 935 (1959)
Decision 1129 (1963)
Decision 1121 (1963)
Decision 1235 (1965)
Decision 1275 (1967)
Decision 1290 (1967)

Published Court Opinions That May Affect Actions on Water Right Applications and Change Petitions Regarding Underground Storage

Peabody v. City of Vallejo (1935) 2 Cal.2d 351
Stevens v. Oakdale Irr. Dist. (1939) 13 Cal.2d 343
Central Delta Water Agency v. State Water Resources Control Board (2004) 124 Cal.App.4th 245, 20 Cal.Rptr.3d 898.

Legislative Counsel Opinion

Op. Leg. Counsel, 1957 A.J. 4034, 4035.)

Local Management And Regulation Of Groundwater: The Sonoma County Example

Prepared and Presented by:

Rebecca Ng, R.E.H.S.
Sonoma County Permit and
Resource Management Department

Sonoma County Groundwater Basins

Sonoma County Groundwater Basins and Subbasins

The groundwater generally beneath Sonoma County consist of fifteen basins and seven subbasins and are identified in Department of Water Resources Bulletin 118. The names and the descriptions of each basin and subbasin follow.

The *Annapolis Ohlson Ranch Formation Highlands Groundwater Basin* consist of a series of discontinuous, uplifted sedimentary deposits that lie along the northern California coastal region with Sonoma and part of Mendocino counties. This formation is exposed in a discontinuous band inland along the coastline spanning a distance of approximately 30 miles from the Sonoma-Mendocino County line to Salt Point Park. There is no information available on the groundwater storage capacity for this basin.

The *Knights Valley Groundwater Basin* is a northwest trending structural depression in the Coast Ranges approximately 35 miles north of the San Pablo Bay. Total groundwater storage capacity for this basin is estimated to contain 15,000 acre-feet of water with an average specific yield of 7.54% (DWR, 1975).

The *Alexander Area* is a subbasin of the *Alexander Valley Groundwater Basin*. The Alexander Valley Groundwater Basin also includes the Cloverdale area subbasin to the north, and occupies a structural depression in the Coast Ranges north of the San Francisco Bay. The groundwater storage capacity for this basin was estimated at 762,000 acre-feet (DWR, 1983).

The *Cloverdale Area* is a subbasin of the *Alexander Valley Groundwater Basin* and occupies a structural depression in the Coast Ranges north of the San Francisco Bay. The groundwater storage capacity in the basin is estimated at 71,000 acre-feet (DWR, 1983).

The *Santa Rosa Valley* occupies a northwest-trending structural depression in the southern part of the Coast Ranges of northern California. This depression divides the Mendocino Range on the west from the Mayacamas and Sonoma Mountains on the east. The *Santa Rosa Plain subbasin* is bounded on the northwest by the Russian River plain approximately one mile south of the City of Healdsburg and the Healdsburg subbasin; mountains of the Mendocino Range flank remaining western boundary. The DWR performed a study of the area and calculated a groundwater storage capacity for this basin to be approximately 4,313,000 acre-feet (DWR, 1982).

The *(Santa Rosa Valley) Healdsburg Area subbasin* includes the floodplain of the Russian River. The groundwater storage capacity has been estimated at 489,000 acre-feet (DWR, 1983).

The *Santa Rosa Valley* occupies a northwest-trending structural depression in the southern part of the Coast Ranges of northern California which divides the Mendocino Range on the west from the Mayacamas and Sonoma Mountains on the east. *Rincon Valley subbasin* occupies a portion of a small north to northwest-trending structural trough located east of the larger Santa Rosa Valley and the City of Santa Rosa. An estimate of the groundwater in storage during the spring of 1980 of approximately 43,000 ace-feet was obtained using data from Bulletin 118-4 Volume 2 (DWR, 1982).

The *Bodega Bay Area Groundwater Basin* lies along the Sonoma County coastline about 55 miles north of San Francisco. No information is available on the groundwater storage capacity.

The *Lower Russian River Valley Groundwater Basin* is a narrow, meandering river canyon located in the Mendocino Range within west-central Sonoma County. The DWR estimated the groundwater storage capacity at 22,000 acre-feet for the lower Russian River alluvium below Rio Dell assuming a 40 foot saturated thickness (depths of 10 to 50 feet) (1965).

The *Fort Ross Terrace Groundwater Basin* consist of a series of discontinuous uplifted marine terraces that lie along the northern California coastline within Mendocino and Sonoma Counties. Estimates have been established for the terrace deposits known as the Point Arena subbasin but there are no estimates for the terrace deposits south of Gualala to Bodega Bay area.

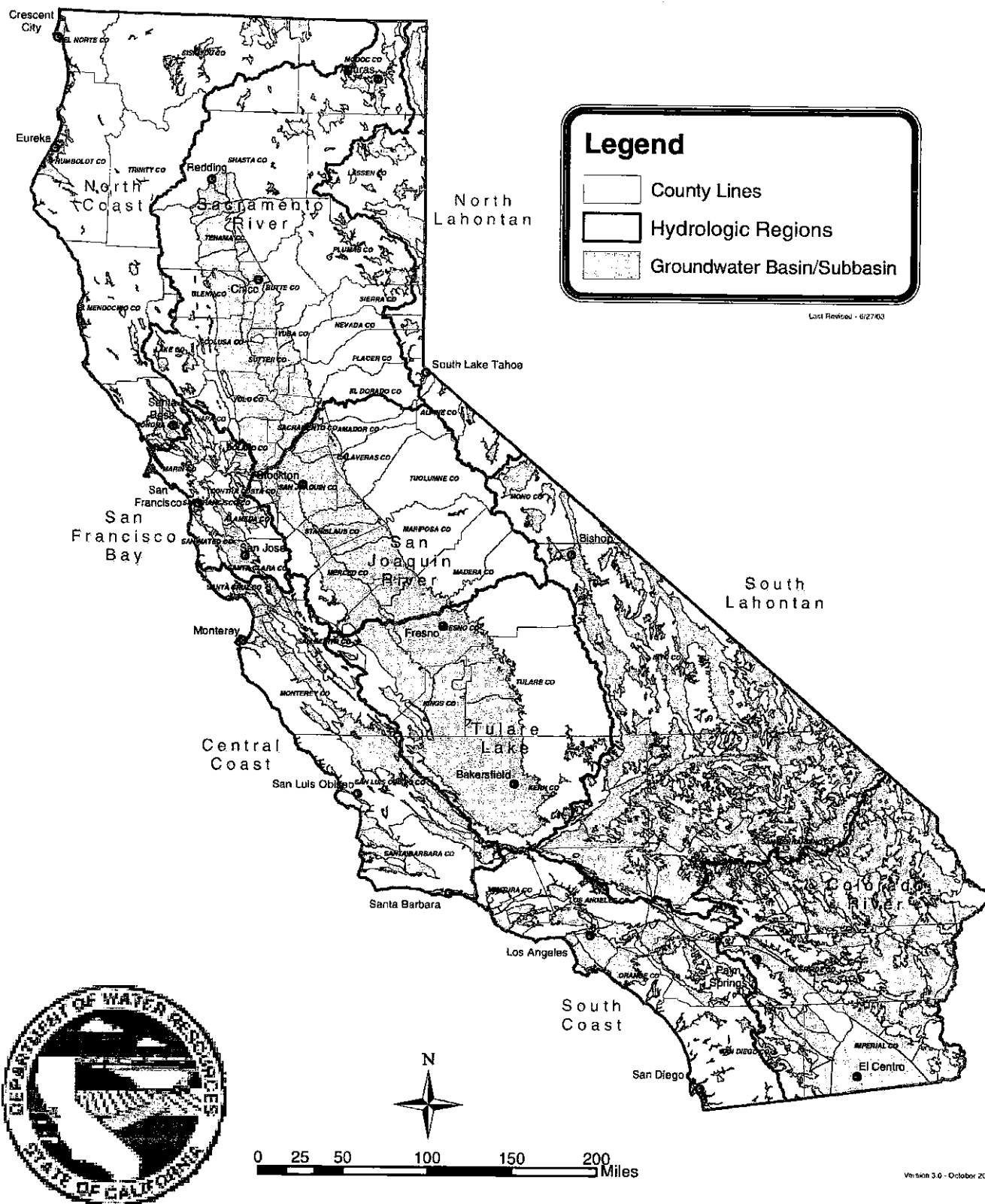
The *Petaluma Valley Groundwater Basin* occupies a structural depression in the Coast Ranges immediately north of San Pablo Bay. The 1982 California Department of Water Resources Bulletin 118-4 published the total groundwater storage capacity for the study area at an estimated 1,697,000 acre-feet based on an area of 60,000 acres. Portions of the study area are now included in the Wilson Grove Formation Highlands groundwater Basin and the Napa Sonoma Volcanic highlands groundwater basin. As presently defined, the Petaluma Valley groundwater Basin contains 46,000 acres, therefore, the total storage capacity will be less.

The *Sonoma Valley Groundwater Subbasin* occupies a northwest trending structural depression in the Coast Ranges immediately north of San Pablo Bay. The groundwater storage capacity was addressed in two separate studies and the definition of the subbasin has changed. Therefore, the estimates are variable, 180,000 acre-feet (Kunkel and Upson, 1960) and less than 708,000 acre-feet (DWR, 1982).

The *Napa-Sonoma Lowlands* is a subbasin of the *Napa-Sonoma Valley Basin*. The subbasin occupies lowland area immediately north of San Pablo Bay. There are no published reports addressing the groundwater storage capacity for the Napa-Sonoma Lowlands subbasin.

The *Kenwood Valley Groundwater Basin* occupies a northwest-trending structural depression in the southern part of the Coast Ranges of northern California, which divides the Mayacamas Mountains on the east and the Sonoma Mountains on the west. An estimate of the usable storage capacity is 45,000 acre-feet using an area of 4,300 acres, a specific yield of 5.5 percent, and an alluvial aquifer thickness of 190 feet (DWR, 1965).

Groundwater Basins in California



Sonoma County Groundwater Availability Zones

General Plan - Groundwater Availability Zones

PRMD's predecessors, the Planning Department and the Well and Septic Section of the Environmental Health Division, created four Groundwater Availability Zones in Sonoma County in the late 1970's for the purposes of development planning and resource conservation. The zones were based on the California Department of Water Resources 1975 Bulletin 118-4. The Groundwater Availability Zones were modified slightly with input by the local well drilling industry and incorporated into the Resource Conservation Element of the 1989 General Plan.

The 1989 General Plan Resource Conservation Element Objective RC-3h says, "Require proof of adequate groundwater in Class III and IV water areas. Require test wells or the establishment of community water systems in Class IV water areas. Test wells may be required in Class III areas. Deny discretionary applications unless a geologic report establishes that groundwater supplies are adequate and will not be adversely impacted by the cumulative amount of addition development."

The four Groundwater Availability Zones are: Zone 1 - major groundwater basin; Zone 2 - major natural recharge area; Zone 3 - marginal groundwater availability; Zone 4 - areas with low or highly variable water yield. These zones have been mapped and also are available through the County's GIS Department.

Groundwater Availability

Legend



Major groundwater basin (Zone 1)



Major natural recharge area (Zone 2)

Marginal groundwater availability area (Zone 3)

Areas with low or highly variable water yield (Zone 4)



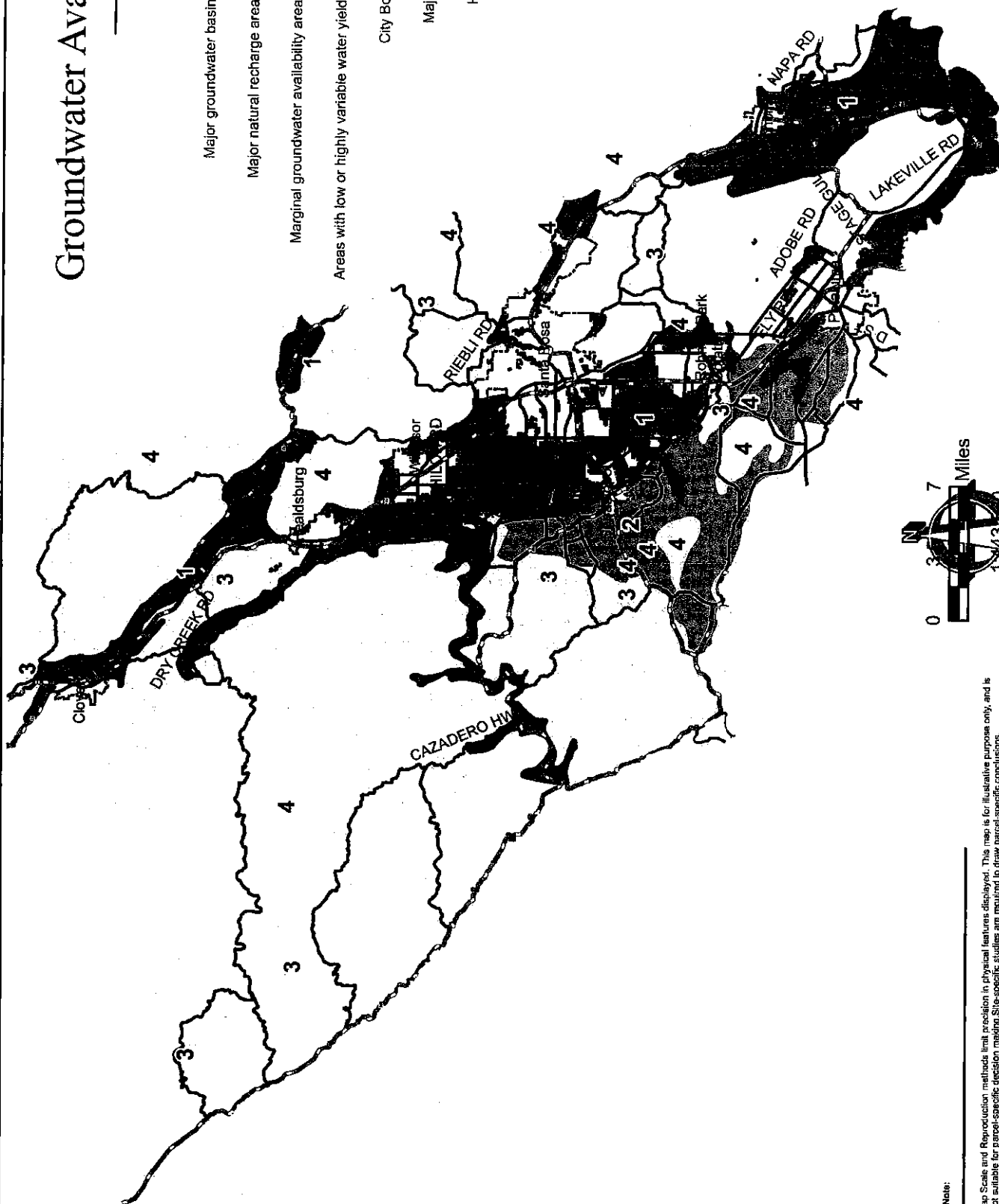
City Boundaries



Major Roads



Highways



Note:

Map Scale and Reproduction methods limit prediction in physical features displayed. This map is for illustrative purpose only, and is not suitable for parcel-specific decision making. Site-specific studies are required to draw parcel-specific conclusions.

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County of Sonoma

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**Sonoma County
Water Well Ordinance
Chapter 25B**

CHAPTER 25B WATER WELLS

Article I. In General.

Sec. 25B-1. Purpose.

Sec. 25B-2. Definitions.

Sec. 25B-1. Purpose.

(a) The purpose of this chapter is to protect the groundwater by regulating the construction, placement, reconstruction and destruction of water wells, test wells, test holes and observation wells within the unincorporated portion of the county of Sonoma; prescribing permits required therefor; imposing fees required therefor; applying penalties for the violation hereof; and creating a well standards advisory and appeals board to assist in the implementation of the chapter.

(b) Protection of groundwater. No person shall knowingly install or maintain a well, test well, test hole or observation wells in any manner that will result in the pollution or contamination of the potable groundwater, and/or which allows the entrance of surface waters into the potable or usable groundwater.

(c) During well construction or destruction any stratum of groundwater found to be polluted, contaminated or otherwise unfit for human consumption shall be so sealed off to preclude commingling with other water bearing strata.

If evidence is presented to the satisfaction of the administrative authority that any existing well, test well, test hole or observation well is polluting or contaminating the potable groundwater, the administrative authority shall require that such well, test well, test hole or observation well be destroyed in accordance with the provisions of Article III, or repairs be made to such well or test hole to eliminate the pollution or contamination or the entrance of surface water into the potable or usable groundwater.

(d) Notwithstanding any urgency (or other) ordinances adopted by the board of supervisors limiting, or, in the alternative, establishing standards for the installation or maintenance of a well, test well, test hole or observation well in any health and safety concerns to the public health department, in an effort to permit maximum utilization of properties located within such areas, the county will permit limited exemptions from such general area-wide standards and/or prohibitions upon a showing by substantial evidence that such standards or prohibitions are unnecessary to protect the public health and safety as hereinafter further described. (Ord. No. 4316 § 1, 1990; Ord. No. 2326.)

Sec. 25B-2. Definitions.

"Abandoned well" means any well whose original purpose and use has been permanently discontinued or which is in such a state of disrepair that it cannot be used for its original purpose.

Administrative Authority. Whenever the term "administrative authority" is used in this chapter, it shall be construed to mean the director of permit and resource management department or his authorized representative.

"Annular space" means the space between an excavation and the casing of a well or the space between two (2) concentric casings.

"A.W.W.A." means American Water Works Association.

"Conductor casing" means an outer casing installed in the upper part of the well to control a caving formation during the well construction.

"Contamination" means an impairment of the underground waters of the state by sewage or industrial waste to a degree which creates a hazard to the public health through poisoning or through the spread of disease.

Grouting or sealing materials.

(1) Additives -- Quick setting cement, retardants, hydrated lime (up to ten percent (10%) of the volume of cement) and bentonite (up to five percent (5%)) used in neat cement, cement grout or concrete.

(2) Concrete -- "Class A" shall mean concrete with six (6) sacks of Portland Cement per yard, "Class B" shall mean concrete with five (5) sacks of Portland Cement per yard. All concrete shall have a maximum size aggregate of three-fourths inch or less.

(3) Concrete grout -- Shall mean a mixture composed of not more than two (2) parts sand and one (1) part of Portland cement, and not less than five (5) or more than seven (7) gallons of water per sack of cement (ninety-four (94) pounds).

(4) Neat cement -- Shall mean a mixture composed of one (1) sack of Portland Cement (ninety-four (94) pounds) to not less than five (5) nor more than seven (7) gallons of water.

(5) Puddled clay -- Shall mean bentonite clays (muds), silts or clay mixed with water into a dense mass, in such manner as to become impermeable in place. Silts or clay must have a coefficient of permeability of less than 100 feet (100') per year.

"Human consumption" means use of water for drinking, food preparation, dish washing, bathing, showering, handwashing or oral hygiene.

"Pollution" means an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects (1) such waters for beneficial uses; or (2) facilities which serve beneficial uses. "Pollution" may include "contamination."

"Observation well" means any excavation fifteen feet (15') or greater in depth or extending into a water bearing stratum which is constructed for the purpose of studying the hydrologic conditions.

"Potable ground water" means water below the surface of the ground at a depth such that it has been protected from surface pollution or contamination by an impervious soil stratum or which has received an acceptable degree of natural treatment by filtration through a considerable amount of soil.

"Potable water" means water intended for human consumption which meets, at a minimum, State primary drinking water requirements as defined in Title 22 of the California Code of Regulations (or subsequent revisions) whether this water is supplied from ground water, treated ground water or any other source.

"Public water system" means a system for the provision of piped water for human consumption which has five (5) or more service connections or regularly serves an average of at least twenty-five (25) individuals daily at least sixty (60) days out of the year.

"Sanitary well seal" means a device placed into the topmost part of well casing which by means of expanding gasket excludes foreign material from entering the top of the well casing, or a device producing an equivalent effect. Such device shall prevent the entrance of surface water to the well.

"Seepage pit" means any excavation in the ground sixty inches (60") or more in depth which receives liquid waste from sewage, domestic or industrial uses, and disposes of the same.

"Sewage disposal system" means a septic tank and subsurface disposal field or other type system or appurtenance thereto, whether public or private, receiving domestic or industrial sewage waste. Sewage disposal system does not include a sewer pipe line.

"Sewer pipe line" means a pipe conveying sewage waste matter from any building or premises to a point of disposal such as to a septic tank or sewage treatment or disposal plant.

"Shallow well" means any well thirty feet (30') or less in depth.

"Test well" means a test boring to determine the geological structure of the underground stratum for the purpose of constructing a water well.

"Test hole" means any excavation constructed in the earth exceeding a depth of fifteen feet (15') below the original ground surface for the purpose of exploration of the subsurface of the earth for building or structure foundation, presence of water, or any other purpose other than for

construction of a water well.

"Waste" means and includes sewage and any other waste substances, liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing or processing operation of whatever nature.

"Well" means any artificial excavation constructed into the earth by any method, for the purpose of extracting or recharging groundwater, excluding oil, gas, and geothermal wells.

"Well cover" means a device to cover the topmost part of a well casing. The device must be so constructed to be structurally sound, securely attached, and prevent the entrance of foreign material.

"Well destruction" means and includes certain work done to an existing water well, the intent of which is to effectively seal the entire well up to the surface, in such a manner that each intersected water stratum is sealed and fated from every other stratum and from surface water.

"Well reconstruction" means and includes certain work done to an existing water well in order to restore its production, replace defective casing, seal off certain strata or surface water or similar work, not to include the cleaning out of sediments or surging, or maintenance to the pump or appurtenances where the integrity of the annular seal or water bearing strata are not violated.

"Well standards advisory and appeals board" means a five-member board appointed by the board of supervisors to advise the administrative authority on the implementation of this chapter, to hear appeals, and to act on such other matters properly referred to it. (Ord. No. 5329 § 1, 2002; Ord. No. 4906 § 7 (A), 1995; Ord. No. 2326.)

Article II. Procedure.

Sec. 25B-3. Permits.

Sec. 25B-4. Construction requirements.

Sec. 25B-3. Permits.

(a) Permit Required. No construction or reconstruction of a well shall be commenced on any property nor shall any well be destroyed until a permit to do such work shall have been first obtained from the administrative authority, except in the event of an emergency, affecting health, life or crops, or livestock, a licensed contractor may start work immediately and shall notify the administrative authority by telephone of the work being done and make written application for a permit on the next regular business day thereafter.

(b) Issuance of Permits. No permit shall be issued to construct or reconstruct or destroy a well except to a contractor, licensed as a well driller in accordance with the provisions of the California Contractors Law (Chapter 9, Division 3, of the Business and Professions Code); however, a permit may be issued to the owner of record of any property, in the event that said owner shall agree to personally purchase all material and perform all labor in connection with the construction, reconstruction or destruction of a well located on said property or that he shall employ a licensed well drilling contractor to perform such work.

(c) Classes of Permits. There shall be three types of permits, namely: Class I, Class II and Destruction.

(d) Class I Permits. Shall be issued for the installation or reconstruction of a well, test well, test hole or observation well, where such well location conforms with the minimum distances set forth in Table 1, and where the administrative authority deems no conditions exist which would result in a pollution or contamination of the potable groundwater.

(e) Class II Permits. Shall be required for the installation or reconstruction of a well, test well, test hole or observation well, where such well location is closer than the minimum distances set forth in Table 1, or where the administrative authority deems conditions may exist which may result in a contamination or pollution of the potable groundwater unless special construction features are included in the well construction. In no instance shall wells be less than fifty feet (50') from septic tanks or sewage disposal system.

(f) Reconstruction Permits. Shall be issued for any well, test well, test hole or observation well reconstruction work.

(g) Destruction Permits. Shall be issued for any well, test well, test hole or observation well destruction work.

(h) Application for Permit. Any person legally entitled to apply for and receive a permit shall make such application on forms provided for that purpose. He shall give a description of the character of the work proposed to be done, and the location and ownership of the job site.

Each application shall be accompanied by a fee as provided in this chapter. Fifty percent (50%) of the fee shall be returned to the applicant should the permit be denied or if the permit is cancelled within sixty (60) days after issuance and no work has been done. A permit shall remain in effect for one year from date of issuance.

The administrative authority may require the owner or his duly authorized agent to submit plans, specifications or drawings, and such other information as he may deem necessary.

If the administrative authority determines that the plans, specifications, drawings, descriptions, or information furnished by the applicant are in compliance with this ordinance he shall issue the permit applied for upon payment of the required fee as hereinafter fixed.

(i) Obtaining Permit. Any person who shall commence any work for which a permit is required by this chapter without first having obtained a permit therefor, shall if subsequently permitted to obtain a permit, pay double the permit fee for such work, provided however, that this provision shall not apply to emergency work when it shall be proved to the satisfaction of the administrative authority that such work was urgently necessary and that it was not practical to obtain a permit before commencement of the work. In all cases a permit must be obtained as soon as it is possible to do so, and if there be an unreasonable delay as determined by the administrative authority in obtaining such permit, a double fee as herein provided shall be charged.

(j) Cost of Permit. Upon making application for a permit the applicant shall pay a fee as established by resolution of the board of supervisors.

(k) Inspection. All wells or test holes constructed or reconstructed, or destroyed, shall be subject, after issuance of the permit, to inspection by the administrative authority to insure compliance with all the requirements of this chapter. If, after notice is given between 8:00 and 9:00 a.m. (normal county working days) with a minimum of one-hour lead time to the administrative authority, inspection is not made during normal process of construction, work shall continue; however, compliance with the code shall be strictly adhered to by the permit holder and/or applicant. (Ord. No. 2326.)

Sec. 25B-4. Construction requirements.

(a) Requirements for Well Construction. All materials and workmanship shall be no less than the quality specified herein. The requirements of these standards are minimal only and any material or method determined by the administrative authority to give equivalent or better results may be required. Materials or methods not covered by these standards must receive the written approval of the administrative authority prior to use. Wells intended as a water supply source for a public water system as defined in Article I of this chapter shall be constructed in accordance with the standards recommended by the California Department of Water Resources. Bull. No. 74. Water Well Standards; State of California.

(b) Location. Wells shall be located as prescribed in Table 1.

Table 1.
Minimum Distances

From property line	5 feet
From septic tank/sewage disposal system	100 feet
From public or private sewer pipe line of approved watertight piping and joining materials	25 feet
From other public or private sewer pipe line	50 feet
From subsurface disposal field	100 feet
From seepage pit	150 feet

(c) Exemption. A well may be installed closer than the minimum distances prescribed in Table 1 if the administrative authority finds that compliance is impractical because of unusual conditions and if he finds that special standards may be applied to the well construction so that in his opinion no danger of contamination or pollution to the potable groundwater will result; however, under no circumstances shall a well be constructed less than fifty feet (50') from a septic tank or sewage disposal system. Such special standards of construction shall be approved by the administrative authority and additional inspections may be required to assure strict conformance with such special standards. Such a well, test well, test hole or observation well shall require a

Class II permit.

(d) Protection. At all times during the progress of the work the well shall be protected in such a manner as to prevent, as far as possible, tampering with the well, the entrance of foreign matter into the well, or the entrance of drilling mud into streams, etc. Water and drilling mud used in drilling shall be free from contamination, or rendered free from contamination, by chlorination or other approved methods. Pits constructed for recirculation of drilling mud during construction shall be so protected that no undue safety hazard is created for man or animals.

(e) Casings. All metal casings used in well construction shall be new and shall have a minimum thickness of twelve (12) gauge for wells up to and including eight inches (8") in diameter, and a minimum thickness of ten (10) gauge for wells ten inches (10") in diameter or over.

All casings shall be placed with sufficient care to avoid damage to casing sections or joints. The uppermost perforations shall be at least 25 feet (25') below the ground surface, except in the case of a shallow well and below an impervious stratum whenever possible.

All concrete pipe casing used in well construction shall be new, free of defects and shall conform to the latest revision of the following specifications (AWWA C301).

(a) State of California specifications for concrete culvert pipe (ASTM C-14), plain concrete pipe or equal.

(b) State of California specifications for reinforced concrete culvert; reinforced concrete pipe specs (ASTM C-76 and/or ASSHO M-170 or equal).

All polyvinylchloride casing used in well construction shall be new, free of defects, and shall be class 160 or equivalent, and shall meet ASTM 2241-73 and 1784-69 standards.

Other casing material may be accepted upon recommendation of the Well Standards Advisory and Appeals Board.

The casing shall extend at least six inches (6") above the ground surface, and at least one-half inch (1/2") above the surface of any surrounding concrete slab. Exceptions may be allowed by the administrative authority. (Ord. No. 1932 § 1.)

(f) Grouting. The annular space shall be filled with acceptable grout having a minimum thickness of two (2) inches, except in the case of a concrete pipe cased well, which shall be three inches (3").

The grouting material shall consist of neat cement, cement grout, puddled clay, or concrete.

The grout shall extend from the ground surface to at least twenty feet (20') below the ground surface; except in the case of shallow wells where no water bearing stratum is encountered below twenty feet (20'), the grout shall extend to a depth of ten feet (10').

Prior to grouting, a packer of cement, concrete, or steel may be installed at the bottom of the annular space to be grouted. The grout shall be applied in one continuous process either by pressure or by gravity in accordance with proper construction practice, in such a manner as to exclude surface and other undesirable water from the well.

(g) Conductor Casing. When a conductor casing is used, the grout seal shall extend at least four feet (4') below the lowest point of such conductor casing, or a minimum of twenty feet (20').

(h) Gravel. The gravel used shall be clean, selected and free of contaminants. In such formations where appreciable amounts of sand or silt may be drawn from the well, a pipe for the addition of additional gravel to the pack may be installed and capped.

(i) Well Pits. Well pits or below ground discharge pipes may be permitted at the discretion of the administrative authority. Where the well casing terminates in a pit below the ground surface, the pit shall be constructed of monolithic, reinforced Class A concrete, or equal, watertight in all respects. The top of such pit shall be covered either with a concrete slab or equal material, or with a housing of satisfactory construction. The casing shall be carried at least eight inches (8") above the pit floor. The well pit shall be so constructed and protected that flood, rain, or surface waters cannot enter the pit. The pit shall be provided with a drainage sump and an automatic sump pump (or if topography permits, a "free" discharge protected against entrance of rodents, insects or flooding). The discharge pipe from the sump pump shall not be connected to any sewer or pipe drain. Pits shall have easy access for proper operation, maintenance and inspection of the equipment and shall have a locked hatch. Doorways or hatches shall at all times effectively keep water out of the pit.

(j) Access Opening into Well Casing. Access openings into the well casing or conductor pipe for addition of gravel to a gravel packed well, for sounding the well, for air release, for disinfection and for any other purpose necessary for maintenance and operation of the well are permitted, but must terminate above flood and high water levels, or have a watertight seal. These openings shall be protected by caps against entry of small animals, insects, flood water, drainage or pump drippage, and other contaminating matter.

(k) Disinfection. Newly constructed or reconstructed wells shall be adequately treated in such a manner as to disinfect all parts of the well upon completion with chlorine or an equal disinfecting chemical.

(l) Completion. Upon completion of a well, the driller shall be responsible for the abandonment of pit used for circulation of drilling mud and the installation of a well cover. Final approval of the water well by the administrative authority requires submission to the administrative authority within thirty (30) working days of completion of the well, a completed water well driller's report made out in detail on the State Department of Water Resources reporting form or equal. (Ord. No. 2326.)

Article III. Abandonment and Destruction of Wells.

Sec. 25B-5. Abandoned wells, test wells or holes, and destruction of wells.

Sec. 25B-5. Abandoned wells, test wells or holes, and destruction of wells.

(a) Abandoned Wells. Upon determination by the Sonoma County department of health services that a well is polluted or contaminated, or is a potential hazard to the purity of the underground waters, and reasonable efforts to clear the pollution or contamination have been unsuccessful, the administrative authority, hereinafter the Permit and Resource Management Department (PRMD), shall have the authority to enforce permanent destruction of said well in accordance with the procedures listed in this section or to review proposals for continued maintenance of the well in accordance with the requirements described below. The owner of any property shall be responsible for destroying any such well located thereon. The burden of expense for the abandonment, capping, continued maintenance or studies of such wells or test holes shall be the responsibility of the property owner.

(1) Definition of Polluted or Contaminated Well. A well that is used entirely or in part for production of water for human consumption, is polluted or contaminated if it does not produce potable water as defined in this code. Other wells may be considered to be polluted or contaminated if the water from the well does not meet Basin Plan water quality objectives. Any such well shall be considered to be not polluted or contaminated, if PRMD determines, after receiving written confirmation from the Regional Water Quality Control Board (RWQCB), that the proposed use of the well is in compliance with the RWQCB's water quality objectives.

(2) Temporary Capping of Wells. A polluted or contaminated well may be temporarily capped for up to five (5) years or until efforts to remediate polluted or contaminated ground water have been successfully accomplished. Use of the well for production of water for human consumption shall cease during this time unless exempted. PRMD may extend the five (5) year time period if necessary to accommodate the ground water remediation process. PRMD may approve alternative methods of water supply while remediation efforts are in progress. See subsection (a) (9) below.

(3) Temporary Use of Polluted or Contaminated Wells. Use of a polluted or contaminated well may be approved by PRMD for a time period of one year (see subsection (a)(6)). For temporary use of the well, a well head water treatment system shall be provided that insures that water from the well meets potable water standards. See subsection (a)(5) below for criteria. PRMD may extend the one year temporary use time period if necessary to allow for provision of an approved permanent water supply which may include but is not limited to an alternative water supply as described in subsection (a)(9) below. The temporary use of the well shall cease when a permanent water supply approved by PRMD becomes available to the property and the well shall be properly destroyed unless exempted under subsection (a)(8) below.

(4) Permanent Use of Polluted or Contaminated Wells. Permanent use of a polluted or contaminated well for potable water supply may be approved by PRMD only: (a) in the case of bacteriological pollution or contamination where permanent well head treatment is provided to eliminate the contaminant (see subsection (a)(5) below for criteria), or (b) in the case of a public water system regulated by the State of California Department of Health Services (DHS) when DHS has approved continued use of the well, in writing. Continued use of the well is subject to meeting the requirements imposed by State of California DHS.

(5) Water Treatment Systems for Polluted or Contaminated Wells. Any water treatment system for a polluted or contaminated non-public water supply well, whether permanent or temporary, shall meet the following standards: (a) design and installation of the water treatment equipment shall be performed by a person who holds a valid license from the State of California which allows for the design and installation of water treatment facilities, (b) routine testing, as defined by PRMD, shall be performed by a State certified laboratory, (c) the test results shall demonstrate

that the treated water meets the definition of potable water contained in this code, (d) the property owner shall keep records of all testing results, and (e) the requirement for treatment and ongoing testing of the water shall be recorded by PRMD with the deed to the property pursuant to Section 2-320.

(6) Prohibition of Pollution or Contamination. Sonoma County PRMD shall have the authority to require destruction of any well which presents a potential pollution or contamination hazard to groundwater or to other wells, as determined by the Sonoma County DHS in consultation with PRMD, the RWQCB and the State of California DHS. Any such destruction shall be in accordance with the standards of this code.

(7) Studies of Polluted or Contaminated Wells. PRMD shall have the authority to require studies of polluted or contaminated wells to determine proper destruction techniques, to determine if the well presents a threat to groundwater or to other wells or to determine if the well is in compliance with other requirements of this code. PRMD may consult with other agencies to determine if studies are available.

(8) Exemption Criteria. A polluted or contaminated well may be exempted from the destruction requirement if it meets all of the following criteria: (a) the well does not present a potential pollution or contamination hazard to groundwater or to other wells. This determination will be made by PRMD, after receiving written input and recommendations from the RWQCB that has jurisdiction and based upon knowledge of the well construction including the presence and depth of a sanitary seal and well perforation depths, (b) the continued use of the well complies with the regulatory requirements of the RWQCB that has jurisdiction, does not result in an unauthorized discharge of groundwater contaminants to land or surface water and does not impair or exacerbate a ground water investigation or cleanup project, and (c) the Sonoma County DHS has made a determination that continued use of the well is protective of public health.

(9) Alternative Water Supplies. PRMD may approve alternative water supplies in order to insure a potable water supply. These may include hauling potable water to an approved storage tank and pressure system or other methods that will insure a continued source of potable water.

At the expiration of any time period for approval of continued maintenance of a well, the well shall be properly destroyed unless written approval is received from PRMD to extend the time period for allowing the continued maintenance of the well as specified in subsections (a)(1) and (2) above.

PRMD may develop and implement standards for well head treatment, reliability of proposed treatment systems, capping of wells, and alternative methods of water supply.

(b) Wells, Test Wells, Test Holes or Observations Wells. Any well, test well, test hole or observation well which is not completed as a finished well shall be abandoned in accordance with the approved procedures by the well driller prior to leaving the site. Abandoned wells, test holes, test wells or observation wells shall not be used for the disposal of any substance or liquid that may contaminate or pollute the ground water. Test holes, test wells, or observation wells are to be backfilled with the same soil excavated, which is to be compacted to such a degree that ninety (90) days after completion of backfill, such backfill is at or above surrounding ground level. A preferable alternate is to fill such holes with Class B concrete. If water formations are encountered in the test hole and the test hole is not cased and sealed, the top twenty feet (20') of test hole shall be sealed with proper seal or grouting materials as listed in section 25B.

After such destruction of a test well, test hole, observation well is complete, a report shall be submitted to the administrative authority, which shall include a log of soil formations and water strata encountered and the method and material of backfilling of sealing the test hole in compliance with this ordinance.

(c) Destruction of Wells. Prior to destroying a well, a detailed evaluation and report on the well shall be submitted to the administrative authority by a licensed well-contractor. Such report shall indicate the type of well to be sealed, all known information of the geological conditions of the soil and the methods and materials to be used in the destroying and sealing process. The methods and materials used in destroying wells and test holes shall be such that the potable or usable ground water is protected from pollution or contamination or the entrance of surface water thereto.

All abandoned wells shall be destroyed as follows:

(1) Any obstruction in the well shall be removed when possible.

- (2) As much casing shall be removed as possible.
- (3) Wherever possible (depending on the type of casing) the remaining casing shall be ripped or perforated.
- (4) The well shall be filled to within not more than thirty feet (30') from the surface with uncontaminated clay, sand or other inorganic material then sealed to a depth of at least thirty feet (30') with impervious materials such as Class B concrete, concrete grout, neat cement or puddled clay.
- (5) The placement of the material shall be done in such a way as to assure a dense seal, free of voids, in order to exclude surface water.
- (d) Alternative Methods. Other methods of destroying wells and test holes may be approved by the administrative authority if in his opinion an equivalent effect will result, and no contamination or pollution to the potable or usable ground water will occur. (Ord. No. 5329 § 1, 2002; Ord. No. 2326.)

Article IV. Well Reports.

Sec. 25B-6. Well reports.

Sec. 25B-7. Well standards advisory board.

Sec. 25B-8. Function of the well standards advisory board--Public constituted.

Sec. 25B-9. Well standards appeals board.

Sec. 25B-10. Function of the well standards appeals board.

Sec. 25B-6. Well reports.

Every person who hereafter digs, bores or drills a water well, test well, test hole, observation well or cathodic protection well, or abandons or destroys any such well or test hole, or who deepens or re-perforates any such well or test hole, shall file with the administrative authority a report of completion of such well or test hole within thirty (30) days after its construction or alteration has been completed.

The report shall be made on forms furnished by the department of water resources or the administrative authority and shall contain such information as the department of water resources or the administrative authority shall require, including but not limited to: (a) description of the well or test hole site sufficiently exact to permit location and identification of the well or test hole; (b) detailed log of the well or test hole; (c) description of the type of construction; (d) details of perforation; and (e) methods used for sealing off surface or contaminated waters. (Ord. No. 2326.)

Sec. 25B-7. Well standards advisory board.

A well standards advisory board appointed by the board of supervisors shall consist of five (5) members: one (1) licensed well drilling contractor; an agricultural representative; a qualified sanitary engineer or registered geologist qualified in the field of ground water hydrology; a California registered sanitarian experienced in well construction; and a member at large.

Members shall serve for a three (3) year term and until the qualification of a successor, except that the first members shall serve staggered terms, as determined by drawing of lots, in the following manner: one (1) member shall serve for a one (1) year term of office; two (2) members shall serve for a two (2) year term of office; two (2) members shall serve for a three (3) year term of office. All such terms shall end on the first Monday of the year in which such term is to expire.

Travelling and other expenses incurred by each board member in the performance of his official duties shall be reimbursed at a rate to be determined by the board of supervisors. (Ord. No. 2326.)

Sec. 25B-8. Function of the well standards advisory board--Public constituted.

(a) The well standards advisory board is established to advise the administrative authority on the acceptability of alternate materials and well drilling practices. The director of permit and resource

management department as the administrative authority shall be an ex officio member and shall act as secretary of the well standards advisory board.

(b) The board of supervisors declares that the individuals appointed to the office of member of the well standards advisory board are intended to represent the public interest by preservation of the groundwater resource. Accordingly, the board of supervisors finds for purposes of persons who hold such office, the well industry is tantamount to and constitutes the public generally within the meaning of Section 87103 of the Government Code. (Ord. No. 4906 § 7 (B), 1995; Ord. No. 2326.)

Sec. 25B-9. Well standards appeals board.

The board of supervisors shall serve as well standards appeals board. (Ord. No. 2326.)

Sec. 25B-10. Function of the well standards appeals board.

The well standards appeals board shall hear appeals from decisions of the administrative authority for appropriate application of regulations and procedures established under this chapter.

Within thirty (30) days after the decision by the administrative authority, appeal may be taken to the well standards appeals board. The application of appeal shall be filed with the administrative authority. Appeal may be taken by any applicant, the owner of property to which the application relates, or the owner of property contiguous to the property to which the application relates. For purposes of determining contiguity, the property line shall be projected to the center of public streets or highways.

At the hearing, the applicants and the administrative authority shall be given reasonable opportunity to be heard and present evidence. After an express finding of fact, decisions shall be in writing and shall be delivered to the applicant in person or by mailing to the address stated on the application, and to the administrative authority. Decisions of the well standards appeals board are final. Should no decision be rendered within thirty (30) days after hearing an appeal, the appeal is denied unless time is extended by action of the board.

Article VI. Penalties.

Sec. 25B-11. Penalties.

Sec. 25B-11. Penalties.

(a) The director of permit and resource management department and director's authorized agents and/or employees are authorized to issue citations for violation of this chapter.

(b) Any person, firm, or corporation or agency, or employee of any person, firm or corporation or agency who violates or knowingly permits violation of any regulatory provision of this chapter shall be guilty of a public offense. The first conviction shall be an infraction punishable by a fine of not more than one hundred dollars (\$100.00). The second or subsequent conviction for a violation of the same regulatory provision of this chapter shall be a misdemeanor and shall be punished by a fine of not more than one thousand dollars (\$1,000.00) or by imprisonment in the county jail for not more than six (6) months, or by both such fine and imprisonment. Each person, firm or corporation or agency or employee thereof shall be guilty of a separate offense for each day, or any portion thereof, during which any violation of this chapter is committed, continued, or permitted and shall be punished accordingly.

(c) Every violation of any regulatory provision of this chapter is hereby declared to be a public nuisance and the district attorney or county counsel of the county of Sonoma shall take such action as he may deem necessary to abate the same. (Ord. No. 4906 § 7 (C), 1995; Ord. No. 3726, 1986.)

Article VII. Exemption from Well Standards.

Sec. 25B-12. Exemption from general area-wide well limitations and standards.

Sec. 25B-12. Exemption from general area-wide well limitations and standards.

(a) If the administrative authority finds that compliance with any of the requirements prescribed herein or in any urgency ordinances adopted by the board of supervisors is not required to preserve public health and safety, or appears impractical due to unique or unusual conditions, or if compliance would result in construction of an unsatisfactory well, the administrative authority may waive compliance and prescribe alternative requirements which are "equal to" those standards in terms of the protection of the public's health and safety and prevention of groundwater or aquifer degradation.

(b) In the event the administrative authority's alternative requirements are greater than those regarded to be necessary by the well owner or his representative, the director of permit and resource management department shall, upon petition, review the data submitted by the well owner or his representatives to ascertain whether there is substantial evidence to reduce or otherwise modify the proposed alternative requirements. The findings of the director of permit and resource management department are subject to judicial review pursuant to Section 1094.5 of the Code of Civil Procedure.

(c) This exemption procedure shall not apply when the board of supervisors hereinafter expressly prohibits the application of the administrative waiver process outlined in this article to a particular environmental hazard area or zone. (Ord. No. 4906 § 7 (D), 1995; Ord. No. 4316 § 1, 1991.)

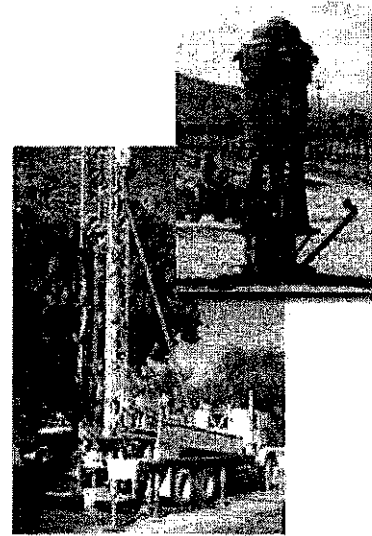
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Until 1990, the California Water Well Standards were found in Department of Water Resources Bulletin 74-81 and the Cathodic Protection Well Standards in Bulletin 74-1. In 1990, the Department published Bulletin 74-90 as a supplement to Bulletin 74-81 and as a replacement for parts of the Water Well Standards in Bulletin 74-81. Also, Bulletin 74-90 replaced Bulletin 74-1 for Cathodic Protection Well Standards and added a new section on Monitoring Well Standards. Therefore, it has been necessary to have both bulletins for the complete Water Well Standards. Readers have found that flipping back and forth between the two documents is tedious and confusing.

To make the Well Standards easier to use and more widely available, the Southern District has combined the contents of Bulletins 74-81 and 74-90, integrated the Water Well Standards, and made them available on this web site.



Because the wording and formatting are not always consistent in the two bulletins, some modifications were made. Other modifications were made to take advantage of Internet features such as hyperlinks.

Modifications include:

- "Part" used in Bulletin 74-81 is equivalent to "Subsection" in Bulletin 74-90; Subsection is used in this web version of the Well Standards.
- References to specific page numbers in the bulletins have been deleted.
- Typos found in the bulletins have been corrected.
- Equivalent metric units found in Bulletin 74-81 have been deleted.
- Footnotes found in the text have been linked to small pop-up windows; whereas footnotes in tables are found at the bottom of the tables.
- Minor rewording has been made.
- The front matter found in the bulletins has been deleted.
- The two-word spelling of "ground water" found in the bulletins has been changed to one word, which is the current Department style.

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Geothermal Heat Exchange Wells - Draft Well Standards, April 1999

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CHAPTER II. STANDARDS

Part I. General

Section 1. Definitions. ^{Note 5}

- A. *Well or Water Wells.* As defined in Section 13710 of the Water Code, well or water well:

"...means any artificial excavation constructed by any method for the purpose of extracting water from, or injecting water into, the underground. This definition shall not include: (a) oil and gas wells, or geothermal wells constructed under the jurisdiction of the Department on Conservation, except those wells converted to use as water wells; or (b) wells used for the purpose of (1) dewatering excavations during construction, or (2) stabilizing hillsides or earth embankments."

- B. *Community Water Supply Well.* A water well used to supply water for domestic purposes in systems subject to Chapter 7, Part 1, Division 5 of the California Health and Safety Code. Included are wells supplying public water systems classified by the Department of Health Services as "Noncommunity water systems" and "State small water systems" (California Waterworks Standards, Title 22, California Administrative Code). Such wells are variously referred to as "Municipal Wells", "City Wells", or "Public Water Supply Wells".
- C. *Individual Domestic Well.* A water well used to supply water for the domestic needs of an individual residence or systems of four or less service connections (or "hook-ups" as they are often called).
- D. *Industrial Wells.* Water wells used to supply industry on an individual basis (in contrast to supplies provided through community systems).
- E. *Agricultural Wells.* Water wells used to supply water only for irrigation or other agricultural purposes, including so-called "stock wells".
- F. *Recharge or Injection Wells.* Wells constructed to introduce water into the ground as a means of replenishing groundwater basins, repelling the intrusion of seawater or disposing of waste water. ^{Note 6}
- G. *Air-conditioning Wells.* Wells constructed to return to the groundwater which has been used as a coolant in air conditioning processes. Because the water introduced into these wells is degraded (from the standpoint of temperature), such

wells have been construed as waste discharges and are, therefore, subject to the water quality control laws (Division 7 of the Water Code and Division 5 of the Health and Safety Code).

- H. *Horizontal Wells*. Water wells drilled horizontally or at an angle with the horizon (as contrasted with the common vertical well). This definition does not apply to horizontal drains or "wells" constructed to remove subsurface water from hillsides, cuts, or fills (such installations are used to prevent or correct conditions that produce landslides).
- I. *Exploration Hole (or Boring)*. An uncased, temporary excavation whose purpose is the determination of hydrologic conditions at a site.
- J. *Test Wells*. Wells constructed to obtain information needed for design of other wells. Test wells should not be confused with "exploration holes", which are temporary. Test wells are cased and can be converted to other uses such as groundwater monitoring and, under certain circumstances, to production wells.
- K. *Inactive or Standby Well*. A well not routinely operating, but capable of being made operable with a minimum effort.
- L. *Enforcing Agency*. An agency designated by duly authorized local, regional, or State government to administer and enforce laws or ordinances pertaining to the construction, alteration, maintenance, and destruction of water wells. The California State Department of Health Services or the local health agency is the enforcing agency for community water supply wells.

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CHAPTER II. STANDARDS

Section 2. Application to Type of Well.

Except as prescribed in Sections 3 and 4 (following) these standards shall apply to all types of wells described in Section 1. Before a change of use is made of a well, compliance shall be made with the requirements for the new use as specified herein. Note 7

Section 3. Exemption Due to Unusual Conditions.

If the enforcing agency finds that compliance with any of the requirements prescribed herein is impractical for a particular location because of unusual conditions or if compliance would result in construction of an unsatisfactory well, the enforcing agency may waive compliance and prescribe alternative requirements which are "equal to" these standards in terms of protection obtained.

Section 4. Exclusions.

The standards prescribed in Part II, "Construction", do not apply to exploration and test holes. However, the provisions of Section 7 "Reports" (following) and Part III, "Well Destruction", do apply to these holes.

Springs are excluded from these standards. Note 8

Section 5. Special Standards.

- A. In locations where existing geologic or groundwater conditions require standards more restrictive than those described herein, such special additional standards may be prescribed by the enforcing agency.
- B. Special standards are necessary for the construction of recharge or injection wells, Note 9 horizontal wells and other unusual types of wells. Design of these wells is subject to the approval of the enforcing agency.

Section 6. Well Drillers.

The construction, alteration, or destruction of wells shall be performed by contractors licensed in accordance with the provisions of the Contractors License Law (Chapter 9, Division 3, of the Business and Professions Code) unless exempted by that act.

Section 7. Reports.

Reports concerning the construction, alteration, or destruction of water wells shall be filed with the California Department of Water Resources in accordance with the provisions of Sections 13750 through 13755 (Division 7, Chapter 10, Article 3) of the California Water Code.^{Note 10}

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Part II Construction

Section 8. Well Location With Respect to Pollutants and Contaminants, and Structures.

A. *Separation.* All water wells shall be located an adequate horizontal distance from known or potential sources of pollution and contamination. Such sources include, but are not limited to:

- sanitary, industrial, and storm sewers;
- septic tanks and leachfields;
- sewage and industrial waste ponds;
- barnyard and stable areas;
- feedlots;
- solid waste disposal sites;
- above and below ground tanks and pipelines for storage and conveyance of petroleum products or other chemicals; and,
- storage and preparation areas for pesticides, fertilizers, and other chemicals.

Consideration should also be given to adequate separation from sites or areas with known or suspected soil or water pollution or contamination.

The following horizontal separation distances are generally considered adequate where a significant layer of unsaturated, unconsolidated sediment less permeable than sand is encountered between ground surface and groundwater. These distances are based on present knowledge and past experience. Local conditions may require greater separation distances to ensure groundwater quality protection.

Potential Pollution or Contamination Source	Minimum Horizontal Separation Distance Between Well and Known or Potential Source
Any sewer (sanitary, industrial, or storm; main or lateral	50 feet
Watertight septic tank or subsurface sewage leaching field	100 feet
Cesspool or seepage pit	150 feet
Animal or fowl enclosure	100 feet

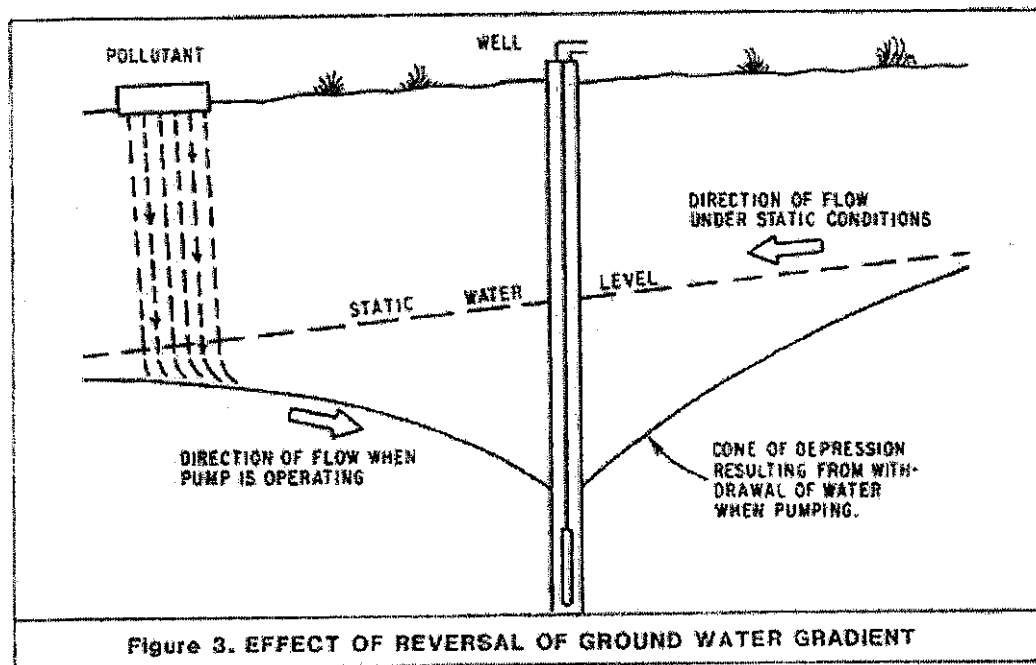
If the well is a radial collector well, minimum separation distances shall apply to the furthest extended point of the well.

Many variables are involved in determining the "safe" separation distance between a well and a potential source of pollution or contamination. No set separation distance is adequate and reasonable for all conditions. Determination of the safe separation distance for individual wells requires detailed evaluation of existing and future site conditions.

Where, in the opinion of the enforcing agency adverse conditions exist, the above separation distances shall be increased, or special means of protection, particularly in the construction of the well, shall be provided, such as increasing the length of the annular seal.

Lesser distances than those listed above may be acceptable where physical conditions preclude compliance with the specified minimum separation distances and where special means of protection are provided. Lesser separation distances must be approved by the enforcing agency on a case-by-case basis.

- B. *Gradients.* Where possible a well shall be located up the groundwater gradient from potential sources of pollution or contamination. Locating wells up gradient from pollutant and contaminant sources can provide an extra measure of protection for a well. However, consideration should be given that the gradient near a well can be reversed by pumping, as shown in Figure 3, or by other influences.



- C. *Flooding and Drainage.* If possible, a well should be located outside areas of flooding. The top of the well casing shall terminate above grade and above known levels of flooding caused by drainage or runoff from surrounding land. For community water supply wells, this level is defined as the:

"...floodplain of a 100 year flood..." or above "...any recorded high tide...",
(Section 64417, Sitting Requirements, Title 22 of the California Code of Regulations.)

If compliance with the casing height requirement for community water supply wells and other water wells is not practical, the enforcing agency shall require alternate means of protection.

Surface drainage from areas near the well shall be directed away from the well. If necessary, the area around the well shall be built up so that drainage moves away from the well.

- D. *Accessibility.* All wells shall be located an adequate distance from buildings and other structures to allow access for well modification, maintenance, repair, and destruction, unless otherwise approved by the enforcing agency.

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Section 9. Sealing the Upper Annular Space.

The space between the well casing and the wall of the drilled hole, often referred to as the annular space, shall be effectively sealed to prevent it from being a preferential pathway for movement of poor-quality water, pollutants, or contaminants. In some cases, secondary purposes of an annular seal are to protect casing against corrosion or degradation, ensure the structural integrity of the casing, and stabilize the borehole wall.

- A. *Minimum Depth of Annular Surface Seal.* The annular surface seal for various types of water wells shall extend from ground surface to the following minimum depths:

Well Type	Minimum Depth Seal Must Extend Below Ground Surface
Community Water Supply	50 feet
Industrial	50 feet
Individual Domestic	20 feet
Agricultural	20 feet
Air-Conditioning	20 feet
All Other types	20 feet

1. *Shallow groundwater.* Exceptions to minimum seal depths can be made for shallow wells at the approval of the enforcing agency, where the water to be produced is at a depth less than 20 feet. In no case shall an annular seal extend to a total depth less than 10 feet below land surface. The annular seal shall be no less than 10 feet in length.

Caution shall be given to locating a well with a 'reduced' annular seal with respect to sources of pollution or contamination. Such precautions include horizontal separation distances greater than those listed in Section 8, above.

2. *Encroachment on known or potential sources of pollution or contamination.* When, at the approval of the enforcing agency, a water well is to be located closer to a source of pollution or contamination than allowed by Section 8, above, the annular space shall be sealed from ground surface to the first impervious stratum, if possible. The annular seal for all such wells shall extend to a minimum depth of 50

feet.

3. *Areas of freezing.* The top of an annular surface seal may be below ground surface in areas where freezing is likely, but in no case more than 4 feet below ground surface. 'Freezing' areas are those where the mean length of the freeze-free period described by the National Weather Service is less than 100 days. In other word, 'freezing' areas are where temperatures at or below 32 degrees Fahrenheit are likely to occur on any day during a period of 265 or more days each year. In general, these areas include:

- portions of Modoc, Lassen, and Siskiyou Counties;
- portions of the North Lahontan area including the eastern slope of the Sierra Nevada and related valleys north of Mount Whitney and Mono Lake; and,
- the area of Lake Arrowhead in the San Bernardino Mountains;

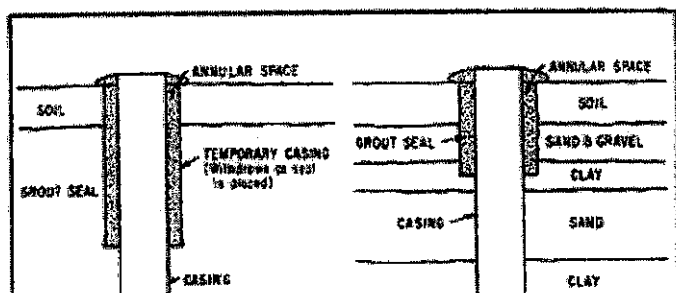
4. *Vaults.* At the approval of the enforcing agency, the top of an annular surface seal and well casing can be below ground surface where traffic or other conditions require, if the seal and casing extend to a watertight and structurally sound subsurface vault, or equivalent feature. In no case shall the top of the annular surface seal be more than 4 feet below ground surface. The vault shall extend from the top of the annular seal to at least ground surface.

The use of subsurface vaults to house the top of water wells below ground surface is rare and is discouraged due to susceptibility to the entrance of surface water, pollutants, and contaminants. Where appropriate, pitless adapters should be used in place of vaults.

- B. *Sealing Conditions.* The following requirements are to be observed for sealing the annular space:

1. *Wells drilled in unconsolidated, caving material.* An 'oversized' hole, at least 4 inches greater in diameter than the outside diameter of the well casing, shall be drilled and a conductor casing temporarily installed to at least the minimum depth of annular seal specified in Subsection A, above. Permanent conductor casing may be used if it is installed in accordance with Item 3 and Item 5, below and if it extends at least to the depth specified in Subsection A, above. One purpose of conductor casing is to hold the annular space open during well drilling and during the placement of the well casing and annular seal.

Temporary conductor casing shall be withdrawn as sealing material is placed between the well casing and borehole wall, as shown in Figure 4A (Bulletin 74-81). Sealing material shall be placed at least within the



interval specified in Subsection A, above. The sealing material shall be kept at a sufficient height above the bottom of the temporary conductor casing as it is withdrawn to prevent caving of the borehole wall.

Temporary conductor casing may be left in place in the borehole after the placement of the annular seal only if it is impossible to remove because of unforeseen conditions and not because of inadequate drilling equipment, or if its removal will seriously jeopardize the integrity of the well and the integrity of subsurface barriers to pollutant or contaminant movement. Temporary conductor casing may be left in place only at the approval of the enforcing agency on a case-by-case basis.

Every effort shall be made to place sealing material between the outside of temporary conductor casing that cannot be removed and the borehole wall to fill any possible gaps or voids between the conductor casing and the borehole wall. At least two inches of sealing material shall be maintained between the conductor casing and well casing. At a minimum, sealing material shall extend through intervals specified in Subsection A, above.

Sealing material can often be placed between temporary conductor casing that cannot be removed and the borehole wall by means of pressure grouting techniques, as described below and in Appendix B (Bulletin 74-81). Other means of placing sealing material between the conductor casing and the borehole wall can be used, at the approval of the enforcing agency.

Pressure grouting shall be accomplished by perforating temporary conductor casing that cannot be removed, in place. The perforations are to provide passages for sealing material to pass through the conductor casing to fill any spaces and voids between the casing and borehole wall. Casing perforations shall be a suitable size and density to allow the passage of sealing materials through the casing and the proper distribution of sealing material in spaces between the casing and borehole wall. At a minimum, the perforations shall extend through the intervals specified in Subsection A, above, unless otherwise approved by the enforcing agency.

Temporary conductor casing that must be left in place shall be perforated immediately before sealing operations begin to prevent drilling or well construction operations from clogging casing perforations. Once the casing has been adequately perforated, sealing material shall be placed inside the conductor casing and subjected to sufficient pressure to cause the sealing material to pass through the conductor casing perforations and completely fill any spaces or voids between the casing and borehole wall, at least within the intervals specified in Subsection A, above. Sealing material shall consist of neat cement, or bentonite prepared from powdered bentonite and water, unless otherwise approved by the enforcing agency.

Sealing material must also fill the annular space between the conductor casing and the well casing within required sealing intervals.

2. *Wells drilled in unconsolidated material with significant clay layers.* An 'oversized' hole, at least 4 inches greater in diameter than the outside diameter of the well casing, shall be drilled to at least the depth specified in Subsection A, above, and

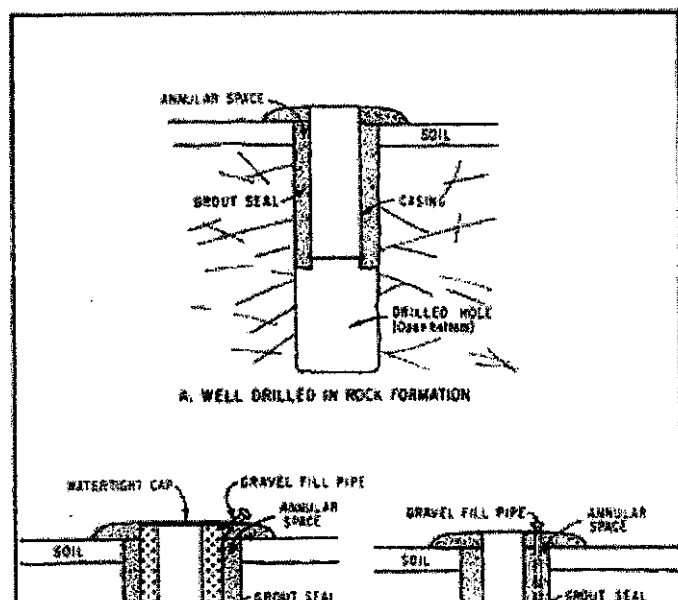
the annular space between the borehole wall and the well casing filled with sealing material in accordance with Subsection A, above (see Figure 4B, above). If a significant layer of clay or clay-rich deposits of low permeability is encountered within 5 feet of the minimum seal depth prescribed in Subsection A, above, the annular seal shall be extended at least 5 feet into the clay layer. Thus, the depth of seal could be required to be extended as much as another 10 feet. If the clay layer is less than 5 feet in total thickness, the seal shall extend through its entire thickness.

If caving material is present within the interval specified in Subsection A, a temporary conductor casing shall be installed to hold the borehole open during well drilling and placement of the casing and annular seal, in accordance with the requirements of Item 1, above. Permanent conductor casing may be used if it is installed in accordance with Item 3 and Item 5, below, and it extends to at least the depth specified in Subsection A, above.

3. *Wells drilled in soft consolidated formations (extensive clays, sandstones, etc.).* An 'oversized' hole, at least 4 inches greater than the outside diameter of the well casing, shall be drilled to at least the depth specified in Subsection A, above. The space between the well casing and the borehole shall be filled with sealing material to at least the depth specified in Subsection A, above, as shown by Figure 4C, above.

If a permanent conductor casing is to be installed to facilitate the construction of the well, an oversized hole, at least 4 inches greater in diameter than the outside surface of the permanent conductor casing, shall be drilled to the bottom of the conductor casing or to at least the depth specified in Subsection A, above, and the annular space between the conductor casing and the borehole wall filled with sealing material. In some cases, such as in cable tool drilling, it may be necessary to extend permanent conductor casing beyond the depth of the required depth of the annular surface seal in order to maintain the borehole. Sealing material is not required between conductor casing and the borehole wall other than the depths specified in Subsection A, above, and Section 13, below.

4. *Wells situated in "hard" consolidated formations (crystalline or metamorphic rock).* An oversized hole shall be drilled to the depth specified in Subsection A, above and the annular space filled with sealing material. If there is significant overburden, a conductor casing may be installed to retain it. If the material is heavily fractured, the seal should extend into a solid material. If the well is to be open-bottomed (lower section uncased), the casing



shall be seated in the sealing material (see Figure 5A).

5. *Gravel packed wells.*

- a. *With conductor casing.* An oversized hole, at least 4 inches greater than the diameter of the conductor casing, shall be drilled to the depth specified in Subsection A, above and the annular space between the conductor casing and drilled hole filled with sealing material. (In this case the gravel pack may extend to the top of the well but to prevent contamination by surface drainage, a welded cover shall be installed over the top in the space between the conductor casing and the production casing, see Figure 5B).
- b. *Without conductor casing.* An oversized hole at least 4 inches greater in diameter than the production casing, shall be drilled to the depth specified in Subsection A, above and the annular space between the casing and drilled hole filled with sealing material. If gravel fill pipes are installed through the seal, the annular seal shall be of sufficient thickness to assure that there is a minimum of 2 inches between the gravel fill pipe and the wall of the drilled hole. The gravel pack shall terminate at the base of the seal (see Figure 5C). If a temporary conductor casing is used, it shall be removed as the sealing material is placed.

6. For wells situated in circumstances differing from those described above, the sealing conditions shall be as prescribed by the enforcing agency.
7. *Converted wells.* Wells converted from one use to another, particularly those constructed in prior years without annular seals, shall have annular seals installed to the depth required in Subsection A, above and at the thickness described in Subsection E. Where it is anticipated that a well will be converted to another use, the enforcing agency may require the installation of a seal to the depth specified for community water supply wells. ^{Note 11}
8. *Wells that penetrate zones containing poor-quality water, pollutants, or contaminants.* If geologic units or fill known or suspected to contain poor-quality water, pollutants, or contaminants are penetrated during drilling, and, the possibility exists that poor-quality water, pollutants, or contaminants could move through the borehole during drilling and well construction operations and significantly degrade groundwater quality in other units before sealing material can be installed, then precautions shall be taken to seal off or 'isolate' zones containing poor-quality water, pollutants, and contaminants during drilling and well construction operations. Special precautions could include the use of temporary or permanent conductor casing, borehole liners, and specialized drilling equipment. The use of conductor casing is described in Item 1, above.

- C. *Conductor Casing.* For community water supply wells, the minimum thickness of steel conductor casing shall be 1/4 inch for single casing or a minimum of No. 10 U. S. Standard Gage for double casing. Steel used for steel casing shall conform to the specifications for steel casing described in Section 12.

D. *Sealing Material.* Sealing material shall consist of neat cement, sand cement, concrete, or bentonite. Cuttings from drilling, or drilling mud, shall not be used for any part of the sealing material.

1. *Water.* Water used to prepare sealing mixtures should generally be of drinking water quality, shall be compatible with the type of sealing material used, be free of petroleum and petroleum products, and be free of suspended matter. In some cases water considered nonpotable, with a maximum of 2,000 milligrams per liter chloride and 1,500 mg/l sulfate, can be used for cement-based sealing mixtures. The quality of water to be used for sealing mixtures shall be determined where unknown.
2. *Cement.* Cement used in sealing mixtures shall meet the requirements of American Society for Testing and Materials C150, Standard Specification for Portland Cement, including the latest revisions thereof.

Types of Portland cement available under ASTM C150 for general construction are:

Type I - General purpose. Similar to American Petroleum Institute Class A.

Type II - Moderate resistance to sulfate. Lower heat of hydration than Type I. Similar to API Class B.

Type III - High early strength. Reduced curing time but higher heat of hydration than Type I. Similar to API Class C.

Type IV - Extended setting time. Lower heat of hydration than Types I and III.

Type V - High sulfate resistance.

Special cement setting accelerators and retardants and other additives may be used in some cases. Special field additives for Portland cement mixtures shall meet the requirements of ASTM C494, Standard Specification for Chemical Admixtures for Concrete, and latest revision thereof.

Hydrated lime may be added up to 10 percent of the volume of cement used to make the seal mix more fluid. Bentonite may be added to cement-based mixes, up to 6 percent by weight of cement used, to improve fluid characteristics of the sealing mix and reduce the rate of heat generation during setting.

Dry additives should be mixed with dry cement before adding water to the mixture to ensure proper mixing, uniformity of hydration, and an effective and homogeneous seal. The water demand of additives shall be taken into account when water is added to the mix.

Minimum times required for sealing materials containing Portland cement to set and begin curing before construction operations on a well can be resumed are:

- Types I and II cement -- 24 hours
- Type III cement -- 12 hours
- Type V cement -- 6 hours

Type IV cement is seldom used for annular seals because of its extended setting time.

Allowable setting times may be reduced or lengthened by use of accelerators or retardants specifically designed to modify setting time, at the approval of the enforcing agency.

More time shall be required for cement-based seals to cure to allow greater strength when construction or development operations following the placement of the seal may subject casing and sealing materials to significant stress. Subjecting a well to significant stress before a cement-based sealing material has adequately cured can damage the seal and prevent proper bonding of cement-based sealants to casing(s).

If plastic well casing is used, care shall be exercised to control the heat of hydration generated during the setting and curing of cement in an annular seal. Heat can cause plastic casing to weaken and collapse. Heat generation is a special concern if thin-wall plastic well casing is used, if the well casing will be subject to significant net external pressure before the setting of the seal, and/or if the radial thickness of the annular seal is large. Additives that accelerate cement setting also tend to increase the rate of heat generation during setting and, thus, should be used with caution where plastic casing is employed.

The temperature of a setting cement seal can be lowered by circulating water inside the well casing and/or by adding bentonite to the cement mixture, up to 6 percent by weight of cement used.

Cement-based sealing material shall be constituted as follows:

- Neat Cement.* For Types I or II Portland cement, neat cement shall be mixed at a ratio of one 94-pound sack of Portland cement 5 to 6 gallons of 'clean' water. Additional water may be required where special additives, such as bentonite, or 'accelerators' or 'retardants' are used.
- Sand Cement.* Sand-cement shall be mixed at a ratio of not more than 188 pounds of sand to one 94-pound sack of Portland cement (2 parts sand to 1 part cement, by weight) and about 7 gallons of clean water, where Type I or Type II Portland cement is used. This is equivalent to a '10.3 sack mix.' Less water shall be used if less sand than 2 parts sand per one part cement by weight is used. Additional water may be required when special additives, such as bentonite, or 'accelerators' or 'retardants' are used.
- Concrete.* Concrete is often useful for large volume annular seals, such as in large-diameter wells. The proper use of aggregate can decrease the permeability of the annular seal, reduce shrinkage, and reduce the heat of hydration generated by the seal.

Concrete shall consist of Portland cement and aggregate mixed at a ratio of at least six-94 pound sacks of Portland cement per cubic yard of aggregate. A popular concrete mix consists of eight-94 pound sacks of Type I or Type II Portland cement per cubic yard of uniform 3/8-inch aggregate.

In no case shall the size of the aggregate be more than 1/5 the radial thickness of the annular seal. Water shall be added to concrete mixes to attain proper consistency for placement, setting, and curing.

- d. *Mixing.* Cement-based sealing materials shall be mixed thoroughly to provide uniformity and ensure that no 'lumps' exist.

Ratios of the components of cement-based sealing materials can be varied depending on the type of cement and additives used. Variations must be approved by the enforcing agency.

3. *Bentonite.* Bentonite clay in 'gel' form has some of the advantages of cement-based sealing material. A disadvantage is that the clay can sometimes separate from the clay-water mixture.

Although many types of clay mixtures are available, none has sealing properties comparable to bentonite clay. Bentonite expands significantly in volumes when hydrated. Only bentonite clay is an acceptable clay for annular seals.

Unamended bentonite clay seals should not be used where structural strength of the seal is required, or where it will dry. Bentonite seals may have a tendency to dry, shrink and crack in arid and semi-arid areas of California where subsurface moisture levels can be low. Bentonite clay seals can be adversely affected by subsurface chemical conditions, as can cement-based materials.

Bentonite clay shall not be used as a sealing material if roots from trees and other deep rooted plants might invade and disrupt the seal, and/or damage the well. Roots may grow in an interval containing a bentonite seal depending on surrounding soil conditions and vegetation.

Bentonite-based sealing material shall not be used for sealing intervals of fractured rock or sealing intervals of highly unstable, unconsolidated material that could collapse and displace the sealing material, unless otherwise approved by the enforcing agency. Bentonite clay shall not be used as a sealing material where flowing water might erode it.

Bentonite clay products used for sealing material must be specifically prepared for such use. Used drilling mud and/or cuttings from drilling shall not be used in sealing material.

Bentonite used for annular seals shall be commercially prepared, powdered, granulated, pelletized, or chipped/crushed sodium montmorillonite clay. The largest dimension of pellets or chips shall be less than 1/5 the radial thickness of the annular space into which they are placed.

Bentonite clay mixtures shall be thoroughly mixed with clean water prior to placement. A sufficient amount of water shall be added to bentonite to allow proper hydration. Depending on the bentonite sealing mixture used, 1 gallon of water should be added to about every 2 pounds of bentonite. Water added to bentonite for hydration shall be of suitable quality and free of pollutants and contaminants.

Bentonite preparations normally require $\frac{1}{2}$ to 1 hour to adequately hydrate. Actual hydration time is a function of site conditions and the form of bentonite used. Finely divided forms of bentonite generally require less time for hydration, if properly mixed.

Dry bentonite pellets or chips may be placed directly into the annular space below water, where a short section of annular space, up to 10 feet in length, is to be sealed. Care shall be taken to prevent bridging during the placement of bentonite seal material.

- E. *Radial Thickness of Seal.* A minimum of two inches of sealing material shall be maintained between all casings and the borehole wall, within the interval to be sealed, except where temporary conductor casing cannot be removed, as noted in Subsection B, above. A minimum of two inches of sealing material shall also be maintained between each casing, such as permanent conductor casing, well casing, gravel fill pipes, etc., in a borehole within the interval to be sealed, unless otherwise approved by the enforcing agency. Additional space shall be provided, where needed, for casings to be properly centralized and spaced and allow the use of a tremie pipe during well construction (if required), especially for deeper wells.
- F. *Placement of Seal.*
1. *Obstructions.* All loose cuttings, or other obstructions to sealing shall be removed from the annular space before placement of the annular seal.
 2. *Centralizers.* Well casing shall be equipped with centering guides or 'centralizers' to ensure the 2-inch minimum radial thickness of the annular seal is at least maintained. Centralizers need not be used in cases where the well casing is centered in the borehole during well construction by use of removable tools, such as hollow-stem augers.

The spacing of centralizers is normally dictated by the casing materials used, the orientation and straightness of the borehole, and the method used to install the casing.

Centralizers shall be metal, plastic, or other non-degradable material. Wood shall not be used as a centralizer material. Centralizers must be positioned to allow the proper placement of sealing material around casing within the interval to be sealed.

Any metallic component of a centralizer used with metallic casing shall consist of the same material as the casing. Metallic centralizer components shall meet the same metallurgical specifications and standards as the metallic casing to reduce the potential for galvanic corrosion of the casing.

3. *Foundation and Transition Seals.* A packer or similar retaining device, or a small quantity of sealant that is allowed to set, can be placed at the bottom of the interval to be sealed before final sealing operations begin to form a foundation for the seal.

A transition seal, up to 5 feet in length, consisting of bentonite, is sometimes placed in the annular space to separate filter pack and cement-based sealing materials. The transition seal can prevent cement-based sealing materials from infiltrating the filter pack. A short interval of fine-grained sand, usually less than 2 feet in length, is sometimes placed between the filter pack and the bentonite transition seal to prevent bentonite from entering the filter pack. Also, fine sand is sometimes used in place of bentonite as the transition seal material.

Fine-sized forms of bentonite, such as granules and powder, are usually employed for transition seals if a transition seal is to be placed above the water level in a well boring. Coarse forms of bentonite, such as pellets and chips, are often used where a bentonite transition seal is to be placed below the water level.

Transition seals should be installed by use of a tremie pipe, or equivalent. However, some forms of bentonite may tend to bridge or clog in a tremie pipe.

Bentonite can be placed in dry form or as slurry for use in transition seals. Water should be added to the bentonite transition seal prior to the placement of cement-based sealing materials where bentonite is dry in the borehole. Care should be exercised during the addition of water to the borehole to prevent displacing the bentonite.

Water should be added to bentonite at a ratio of about 1 gallon for every 2 pounds of bentonite to allow for proper hydration. Water added to bentonite for hydration shall be of suitable quality and free of pollutants and contaminants.

Sufficient time should be allowed for bentonite transition seals to properly hydrate before cement-based sealing materials are placed. Normally, $\frac{1}{2}$ to 1 hour is required for proper hydration to occur. Actual time of hydration is a function of site conditions.

The top of the transition seal shall be sounded to ensure that no bridging has occurred during placement.

4. *Timing and Method of Placement.* The annular space shall be sealed as soon as practical after completion of drilling or a stage of drilling. In no case shall the annular space be left unsealed longer than 14 days following the installation of casing.

Sealing material shall be placed in one continuous operation from the bottom of the interval to be sealed, to the top of the interval. Where the seal is more than 100 feet in length, the deepest portion of the seal may be installed first and allowed to set or partially set. The deep initial seal shall be no longer than 10 feet in length. The remainder of the seal shall be placed above the initial segment in one continuous operation.

Sealing material shall be placed by methods (such as the use of a tremie pipe or equivalent) that prevent freefall, bridging, or dilution of the sealing material, or separation of sand or aggregate from the sealing material. Annular sealing materials shall not be installed by freefall unless the interval to be sealed is dry and no deeper than 30 feet below ground surface.

5. *Groundwater Flow.* Special care shall be used to restrict the flow of groundwater into a well boring while placing material, where subsurface pressure causing the flow of water is significant.
6. *Verification.* It shall be verified that the volume of sealing material placed at least equals or exceeds the volume to be sealed.
7. *Pressure.* Pressure required for placement of sealing materials shall be maintained long enough for cement-based sealing materials to properly set.

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CHAPTER II. STANDARDS

Section 10. Surface Construction Features.

A. *Openings.* Openings into the top of the well which are designed to provide access to the well, i.e., for measuring, chlorinating, adding gravel, etc., shall be protected against entrance of surface waters or foreign matter by installation of watertight caps or plugs. Access openings designed to permit the entrance or egress of air or gas (air or casing vents) shall terminate above the ground and above known flood levels and shall be protected against the entrance of foreign material by installation of down-turned and screened "U" bends (see Figures 6 and 7).

All other openings (holes, crevices, cracks, etc.) shall be sealed.

A "sounding tube", ^{Note 12}

taphole with plug, or similar access (see Figure 6) for the introduction of water level measuring devices shall be affixed to the casing of all wells. For wells fitted with a "well cap" the cap shall have a removable plug for this purpose.

1. Where the pump is installed directly over the casing, a watertight seal (gasket) shall be

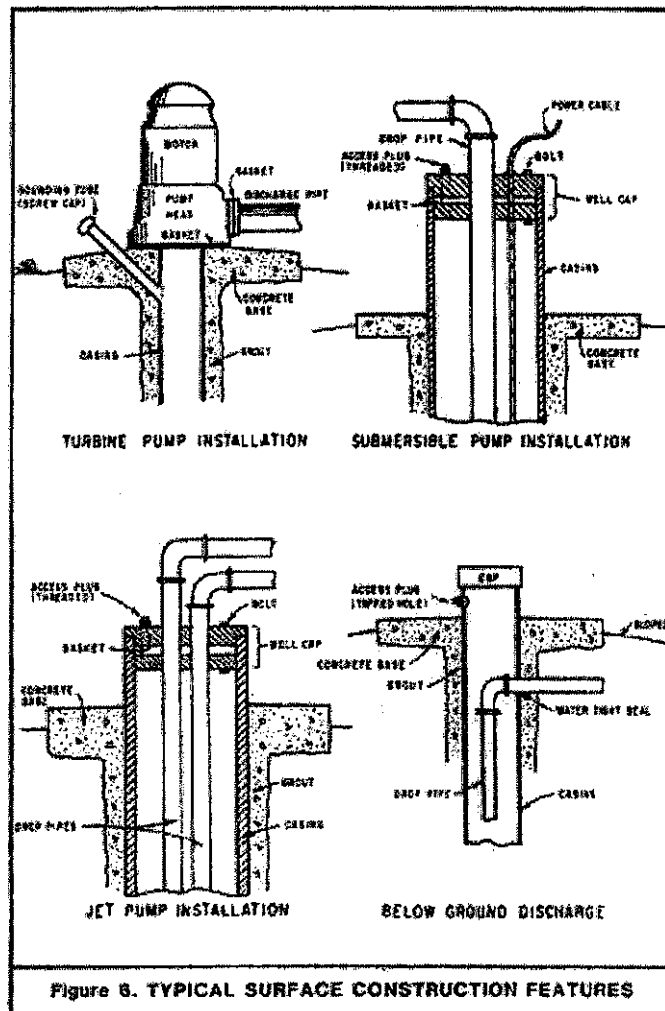
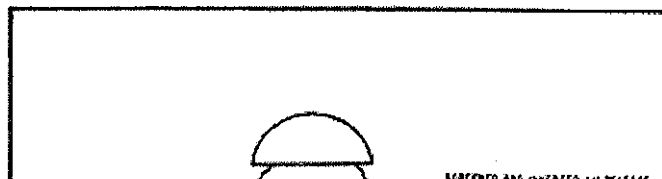


Figure 8. TYPICAL SURFACE CONSTRUCTION FEATURES



vault and its lid shall be strong enough to support vehicular traffic where such traffic might occur.

The top of the vault shall be set at, or above, grade so that drainage is away from the vault. The top of the well casing contained within the vault shall be covered in accordance with requirements under Subsection A, above, so that water, contaminants, and pollutants that may enter the vault will not enter the well casing. The cover shall be provided with a pressure relief or venting device for gases.

- C. *Enclosure of Well and Appurtenances.* In community water supply wells, the well and pump shall be located in a locked enclosure to exclude access by unauthorized persons.
- D. *Pump Blowoff.* When there is a blowoff or drain line from the pump discharge, it shall be located above any known flood levels and protected against the possibility of backsiphonage or backpressure. The blowoff or drain line shall not be connected to any sewer or storm drain except when connected through an air gap.
- E. *Air Vents.* In community water supply wells to minimize the possibility of contamination caused by the creation of a partial vacuum during pumping, a casing vent shall be installed (Figure 7). In addition, to release air trapped in the pump column when the pump is not running, air release vents shall be installed (Figure 7). Air vents are also recommended for other types of wells except those having jet pump installations requiring positive pressure (which cannot have a vent).
- F. *Backflow Prevention.* All pump discharge pipes not discharging or open to the atmosphere shall be equipped with an automatic device to prevent backflow and/or back siphonage into a well. Specific backflow prevention measures are required for drinking water supply wells as prescribed in Title 17, Public Health, California Code of Regulations (Sections 7583-7585 and 7601-7605, effective June 25, 1987).

Irrigation well systems, including those used for landscape irrigation, and other well systems that employ, or which have been modified to employ, chemical feeders or injectors shall be equipped with a backflow prevention device(s) approved by the enforcing agency.

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CHAPTER II. STANDARDS

Section 11. Disinfection and Other Sanitary Requirements.

- A. *Disinfection.* ^{Note 13} All wells producing water for domestic use (i.e., drinking or food processing) shall be disinfected following construction, repair, or when work is done on the pump, before the well is placed in service.
 - B. *Gravel.* Gravel used in gravel-packed wells shall come from clean sources and should be thoroughly washed before being placed in the well. Gravel purchased from a supplier should be washed at the pit or plant prior to delivery to the well site.
 - C. During placement of the gravel in the annular space disinfectants (usually calcium hypochlorite in tablet or granular form) shall be added to the gravel at a uniform rate (two tablets per cubic foot or one pound of the granular form per cubic yard).
 - D. *Lubricants.* Mud and water used as a drilling lubricant shall be free from sewage contamination. Oil and water used for lubrication of the pump and pump bearing shall also be free from contamination.
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Section 12. Casing.

- A. *Casing Material.* ^{Note 14} Requirements pertaining to well casing are to insure that the casing will perform the functions for which it is designed, i.e., to maintain the hole by preventing its walls from collapsing, to provide a channel for the conveyance of the water, and to provide a measure of protection for the quality of the water pumped.
1. Well casing shall be strong and tough enough to resist the force imposed on it during installation and those forces which can normally be expected after installation.
 2. Steel is the material most frequently used for well casing, especially in drilled wells. The thickness of steel used for well casing shall be selected in accordance with good design practices applied with due consideration to conditions at the site of the well. ^{Note 15} There are three principal classifications of steel materials used for water well casing, and all are acceptable for use so long as they meet the following conditions.
 - a. *Standard and line pipe.* This material shall meet one of the following specifications, including the latest revision thereof:
 - (1) API Std. 5L, "Specification for Line Pipe".
 - (2) API Std. 5LX, "Specification for High-Test Line Pipe".
 - (3) ASTM A53, "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless".
 - (4) ASTM A120, "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses".
 - (5) ASTM A134, "Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (sizes NPS 16 and over)".
 - (6) ASTM A135, "Standard Specification for Electric-Resistance-Welded Steel Pipe".
 - (7) ASTM A139, "Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (sizes 4 inches and over)".

- (8) ASTM A211, "Standard Specification for Spiral-Welded Steel or Iron Pipe".
- (9) AWWA C200, "AWWA Standard for Steel Water Pipe 6 Inches and Larger".
- b. *Structural Steel*. This material shall meet one of the following specifications of the American Society for Testing and Materials, including the latest revision thereof:
 - (1) ASTM A36, "Standard Specification for Structural Steel".
 - (2) ASTM A242, "Standard Specification for High Strength Low Alloy Structural Steel".
 - (3) ASTM A283, "Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality".
 - (4) ASTM A441, "Tentative Specification for High-Strength Low Alloy Structural Manganese Vanadium Steel".
 - (5) ASTM A570, "Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality".
- c. High strength carbon steel sheets referred by their manufacturers and fabricators as "well casing steel". At present, there are no standard specifications concerning this material. However, the major steel producers market products whose chemical and physical properties are quite similar. Each sheet of material shall contain mill markings which will identify the manufacturer and specify that the material is well casing steel which complies with the chemical and physical properties published by the manufacturer.
- d. Stainless steel casing shall meet the provisions of ASTM A409, "Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service".
- 3. *Plastic*. Two basic types of plastic are commonly used for plastic well casing: thermoplastics and thermosets. Thermoplastics soften with the application of heat and reharden when cooled. Thermoplastics can be reformed repeatedly using heat and sometimes can unexpectedly deform. Attention should be given to the effect of heat on thermoplastic casing from the setting and curing of cement. Additional discussion on sealing material and heat generation is in Section 9, Subsection D, 'Sealing Material'.

Thermoplastics used for well casing include ABS (acrylonitrile butadiene styrene), PVC (polyvinyl chloride), and SR (styrene rubber). PVC is the most frequently used thermoplastic well casing in California. Styrene rubber is seldom used.

Unlike thermoplastics, thermoset plastics cannot be reformed after heating. The molecules of thermoset plastic are 'set' during manufacturing by heat, chemical action, or a combination of both. The thermoset plastic most commonly used for well casing is fiberglass.

- a. *Thermoplastics.* Thermoplastic well casing shall meet the requirements of ASTM F480. Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80, including the latest revision thereof. (Note: A 'dimension ratio' is the ratio of pipe diameter to pipe wall thickness.)

Pipe made in Schedule 40 and 80 wall thicknesses and pipe designated according to certain pressure classifications are listed in ASTM F480, as well as casing specials referencing the following ASTM specifications:

- (1) ABS Pipe. ASTM D1527, Standard Specification for Acrylonitrile- Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80.
- (2) PVC Pipe. ASTM D1785, Standard Specification for (Poly Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- (3) Pressure-Rated PVC Pipe. ASTM D2241, Standard Specifications for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

Thermoplastic well casing that may be subject to significant impact stress during or after installation shall meet or exceed the requirements for impact resistance classification set forth in Section 6.5 of ASTM F480. Casing that may be subject to significant impact forces includes, but is not limited to; casing that is installed in large diameter, deep boreholes; and casing through which drilling tools pass following installation of the casing in a borehole.

- b. *Thermoset Plastics.* Thermoset casing material shall meet the following specifications, as applicable, including the latest revisions thereof:

- (1) Filament Wound Resin Pipe. ASTM D2996, Standard Specification for Filament Wound Reinforced Thermosetting Resin Pipe.
- (2) Centrifugally Cast Resin Pipe. ASTM D2997, Standard Specification for Centrifugally Cast Reinforced Thermosetting Resin Pipe.
- (3) Reinforced Plastic Mortar Pressure Pipe. ASTM D3517, Standard

Specification for Reinforced Plastic Mortar Pressure Pipe.

(4) Glass Fiber Reinforced Resin Pressure Pipe. AWWA ^{Note 16} C950, AWWA Standards for Glass-Fiber-Reinforced Thermosetting-Resin Pressure Pipe.

- c. *Drinking Water Supply.* All plastic casing used for drinking water supply wells, including community supply well and individual domestic wells, shall meet the provisions of National Sanitation Foundation Standard No. 14, Plastic Piping Components and related Materials and any revision thereof. The casing shall be marked or labeled following requirements in NSF Standard No. 14. Standard No. 14 includes the requirements of ASTM F480.
- d. *Storage, Handling, and Transportation.* Plastic casing shall not be stored in direct sunlight or subjected to freezing temperatures for extended periods of time. Plastic casing shall be stored, handled, and transported in a manner that prevents excessive mechanical stress. Casing shall be protected from sagging and bending, severe impacts and loads, and potentially harmful chemicals.
- e. *Large Diameter Wells.* Because large diameter plastic casing has not been used extensively at depths exceeding 500 feet, special care shall be exercised with its use in deep wells.

- 4. Concrete pipe used for casing should conform to the following specifications, including the latest revision thereof:

- (a) ASTM C14, "Standard Specifications for Concrete Sewer, Storm Drain, and Culvert Pipe".

- (b) ASTM C76, "Standard Specifications for Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe".

- (c) AWWA C300, "AWWA Standard for Reinforced Concrete Pressure Pipe Steel Cylinder Type, for Water and Other Liquids".

- (d) AWWA C301, "AWWA Standard for Prestressed Concrete Pressure Pipe Steel, Cylinder Type, for Water and Other Liquids".

- 5. *Unacceptable Casing Materials.* Galvanized sheet metal pipe such as 'downspout' tile pipe, or natural wood shall not be used as well casing.
- 6. *Other Materials.* Materials in addition to those described above may be used as well casing, subject to enforcing agency approval.

- B. *Casing Installation.* All well casing shall be assembled and installed with sufficient care to prevent damage to casing sections and joints. All casing joints

above intervals if perforations or screen shall be watertight. Any perforations shall be below the depths specified in Section 9, Subsection A, above.

Casing shall be equipped with centering guides or 'centralizers' to ensure the even radial thickness of the annular seal and filter pack.

1. *Metal Casing.* Metallic casing may be joined by welds, threads, or threaded couplings. Welding shall be accomplished in accordance with the standards of the American Welding Society or the most recent revision of the American Society of Mechanical Engineers Boiler Construction Code. Metallic casing shall be equipped with a 'drive shoe' at the lower end if it is driven into place.
2. *Plastic Casing.* Plastic casing may be joined by solvent welding or mechanically joined by threads or other means, depending on the type of material and its fabrication. Solvent cement used for solvent welding shall meet specifications for the type of plastic casing used. Solvent cement shall be applied in accordance with solvent and casing manufacturer instructions. Particular attention shall be given to instructions pertaining to required setting time for joints to develop strength.

The following specifications for solvent cements and joints for PVC casing shall be met, including the latest revisions thereof:

- a. *ASTM D2564*, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- b. *ASTM D2855*, Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

Plastic casing or screen shall not be subjected to excessive stress during installation and shall not be driven into place. Care shall be taken to ensure that plastic casing and joints are not subjected to excessive heat from cement-based sealing material.

A specifically designed adapter shall be used to join plastic casing to metallic casing or screen.

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CHAPTER II. STANDARDS

Section 13. Sealing-off Strata.

In areas where a well penetrates more than one aquifer, and one or more of the aquifers contains water that, if allowed to mix in sufficient quantity, will result in a significant deterioration of the quality of water in the other aquifer(s) or the quality of water produced, the strata producing such poor-quality water shall be sealed off to prevent entrance of the water into the well or its migration to other aquifer(s).

- A. Strata producing the undesirable quality water shall be sealed off by placing impervious material opposite the strata and opposite the confining formation(s). (See Figure 8.) The seal shall extend above and below the strata no less than 10 feet even should the confining formation be less than 10 feet in thickness. In the case of "bottom" waters, the seal shall extend 10 feet in the upward direction. The

sealing material shall fill the annular space between the casing and the wall of the drilled hole in the interval to be sealed, and the surrounding void spaces which might absorb the sealing material. The sealing material shall be placed from the bottom to the top of the interval to be sealed.

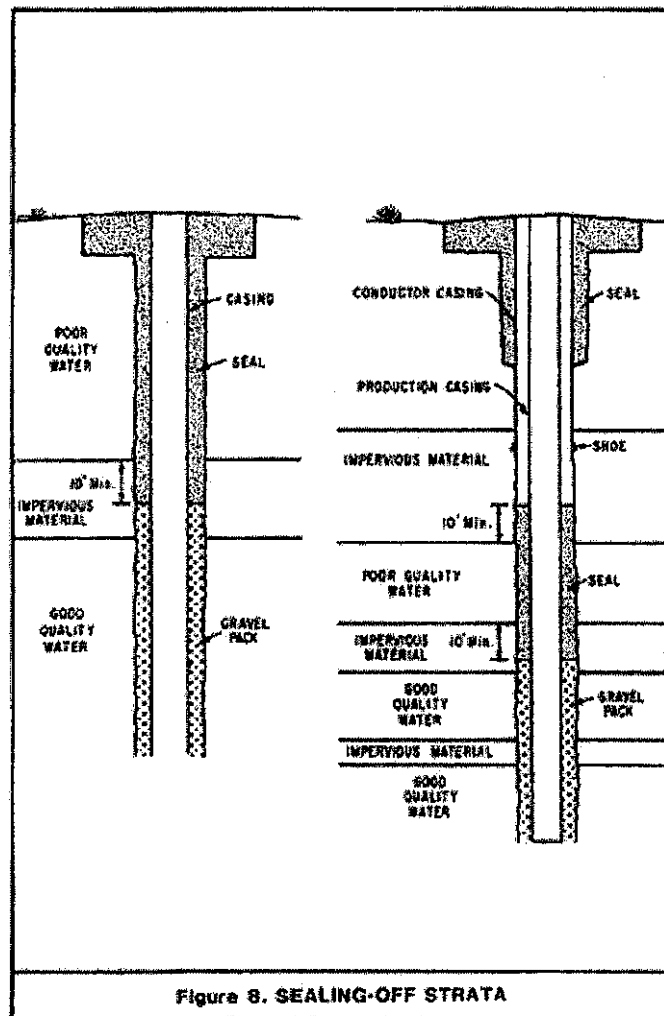


Figure 8. SEALING-OFF STRATA

In areas where deep subsidence may occur (as, for example, portions of the San Joaquin Valley) provision shall be made for maintaining the integrity of the annular seal in the event of subsidence. Such preventive measures may include

the installation of a "sleeve" or "slip joint" in the casing, which will allow vertical movement in the casing without its collapse.

- B. Sealing material shall consist of neat cement, cement grout, or bentonite clay (see Section 9, Subsection D for description of the various materials).
- C. Sealing shall be accomplished by a method approved by the enforcing agency.^{Note 17}

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Water Well Standards

CHAPTER II. STANDARDS

Section 14. Well Development.

Development, redevelopment, or reconditioning of a well shall be performed with care, by method that will not damage the well structure or destroy natural barriers to the movement of poor quality water, pollutants, and contaminants.

Acceptable well development, redevelopment, or reconditioning methods include:

- Overpumping;
- Surging or swabbing by use of 'plungers';
- Surging with compressed air;
- Backwashing or surging by alternately starting and stopping a pump;
- Jetting with water;
- Introducing specifically-formulated chemicals into a well; and,
- Combinations of the above.

Hydraulic fracturing (hydrofracturing) is sometimes an acceptable well development and redevelopment method when properly performed. Good quality water shall be used in hydrofracturing. The water shall be disinfected prior to introduction into a well. Material used as 'propping' agents shall be free of pollutants and contaminants, shall be compatible with the use of a well, and shall be thoroughly washed and disinfected prior to placement in a well.

Development, redevelopment, or reconditioning by use of specially designed explosive charges is in some cases, another acceptable development method. Explosives shall be used with special care to prevent damage to the well structure and to any natural barriers to the movement of poor-quality water, pollutants, and contaminants. Explosives shall only be used by properly-trained personnel.

Wells subjected to chemicals or explosives during development, redevelopment, or reconditioning operations shall be thoroughly pumped to remove such agents and residues immediately after the completion of operations. Chemicals, water, and other wastes removed from the well shall be disposed of in accordance with applicable local, State, and federal requirements. The enforcing agency should be contacted regarding the proper disposal of waste.

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Water Well Standards

CHAPTER II. STANDARDS

Section 15. Water Quality Sampling. ^{Note 18}

The requirements to be followed with respect to water quality sampling are:

- A. *Community Water Supply Wells and Certain Industrial Wells.* The water from all community water supply wells and industrial wells which provide water for use in food processing shall be sampled immediately following development and disinfection, and appropriate analysis made. Rules and regulations governing the constituents to be tested, type of testing, etc, for community water supply systems are contained in Chapter 15, "Domestic Water Quality and Monitoring", of Title 22, California Administrative Code. Water analysis shall be performed by a laboratory certified by the California Department of Health Services. A copy of the laboratory analysis shall be forwarded to the California Department of Health Services or to the local health department. Approval of the enforcing agency must be obtained before the well is put into use.

Except where there is free discharge from the pump (that is, there is no direct connection to the water delivery system such as to a sump), a sample tap (see [Figure 7](#)) shall be provided on the discharge line so that water representative of the water in the well may be drawn for laboratory analysis. The tap shall be located so as to prevent back siphonage to the pump discharge when the pump is shut off (e.g., on the system side of the check valve).

- B. *Other Types of Wells.* To determine the quality of water produced by a new well it should be sampled immediately following construction and development. Appropriate analyses shall be made based upon the intended uses of the water.

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Section 16. Special Provisions for Large Diameter Shallow Wells.

- A. *Use as Community Water Supply Wells.* Because shallow groundwaters are often of poor quality and because they are easily contaminated, the use of bored or dug wells, or wells less than 50 feet deep, to provide community water supplies shall be avoided (unless there is no other feasible means for obtaining water). When used for this purpose, these wells shall be located at least 250 feet from any underground sewage disposal facility.
- B. *Bored Wells.* All bored wells shall be cased with concrete pipe or steel casing whose joints are water-tight from 6 inches above the ground surface to the depths specified in Section 9, Subsection A. Except where corrugated steel pipe is used as casing, the minimum thickness of the surrounding concrete seal shall be 3 inches. Where corrugated steel pipe is employed, the joints are not watertight and a thicker annular seal (no less than 6 inches) shall be installed.
- C. *Dug Wells.* All dug wells shall be "curbed" with a watertight curbing extending from above the ground surface to the depths specified in Section 9, Subsection A. The curbing shall be of concrete poured-in-place or of casing (either precast concrete pipe or steel) surrounded on the outside by concrete.

If the curbing is to be made of concrete, poured-in-place, it shall not be less than 6 inches thick. If precast concrete pipe or steel casing is used as part of the curbing, the space between the wall of the hole and the casing shall be filled with concrete to the depths specified in Section 9, Subsection A. The minimum thickness of the surrounding concrete shall be 3 inches.

- D. *Casing Material.* Either steel (including corrugated steel pipe) or concrete may be used for casing bored or dug wells. Corrugated aluminum pipe is not recommended for use as casing. ^{Note}
₁₉

1. 1. Steel used in the manufacture of casing for bored and dug wells should conform to the specifications for casing material described in Section 12. Minimum thickness of steel casing for bored and dug wells shall be:

<u>Diameter (inches)</u>	<u>U.S. Standard Gage or Plate Thickness</u>
18	8 gage
24	1/4 inch
30	1/4 inch
36	1/4 inch
42	1/4 inch
48	1/4 inch

Corrugated steel pipe used as casing shall meet the specifications (including the latest revision) of ASTM^{Note 20} A444, "Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the HOT-DIP Process for Culverts and Under-drains". The minimum thickness of sheet used shall be 0.109 inch.

2. Concrete casing can consist of either poured-in-place concrete or precast concrete pipe. Poured-in-place concrete should be sufficiently strong to withstand the earth and water pressures imposed on it during, as well as after, construction. It should be properly reinforced with steel to furnish tensile strength and to resist cracking, and it should be free from honeycombing or other defects likely to impair the ability of the concrete structure to remain watertight. Aggregate small enough to place without "bridging" should be used. Poured-in-place concrete shall be "Class A" (6 sacks of Portland cement per cubic yard) or "Class B" (5 sacks per cubic yard).

Precast concrete pipe is usually composed of concrete rings from 1 to 6 feet in diameter and approximately 3 to 8 feet long. To serve satisfactorily as casing, these rings should be free of blemishes that would impair their strength or serviceability. Concrete pipe shall conform to the specifications listed in Section 12, Subsection A, Item 4.

- E. *Covers*. All bored and dug wells shall be provided with a structurally sound, watertight, cover made of concrete or steel.

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Water Well Standards

CHAPTER II. STANDARDS

Section 17. Special Provisions for Driven Wells ("Well Points").

- A. If the well is to be used as an individual domestic well, an oversize hole with a diameter at least 3 inches greater than the diameter of the pipe shall be constructed to a depth of 6 feet and the annular space around the pipe shall be filled with neat cement, cement grout, or bentonite mud.
- B. The minimum wall thickness of steel drive pipe shall not be less than 0.140 inch.
- C. Well points made of thermoplastic materials should not be driven but jetted or washed into place.

Section 18. Rehabilitation, Repair, and Deepening of Wells.

- A. Rehabilitation is the treatment of a well by chemical or mechanical means (or both) to recover lost production caused by incrustation or clogging of screens or the formation immediately adjacent to the well. The following methods used for rehabilitating a well when done with care are acceptable: (1) introduction of chemicals designed for this purpose, (2) surging by use of compressed air, (3) backwashing or surging by alternately starting or stopping the pump, (4) jetting with water, (5) sonic cleaning, (6) vibratory explosives, and (7) combinations of these. Methods which produce an explosion (in addition to the use of vibratory explosives mentioned above) are also acceptable provided, however, they are used with great care, particularly where aquifers are separated by distinct barriers to the movement of groundwater.

In those cases where chemicals or explosives have been used, the well shall be pumped until all traces of them have been removed.

- B. In the repair of wells, material used for casing shall meet the requirements of Section 12 "Casing" of these provisions. In addition, the requirements of Section 11, Subsection A "Disinfection" and, when applicable, Section 13 "Sealing-off Strata" shall be followed.
- C. Where wells are to be deepened, the requirements of Section 11, Section 12, Section 13, Section 14, and Section 15 of these standards shall be followed.

Section 19. Temporary Cover.

Whenever there is an interruption in work on the well such as overnight shutdown, during inclement weather, or waiting periods required for the setting up of sealing

materials, for tests, for installation of the pump, etc., the well opening shall be closed with a cover to prevent the introduction of undesirable material into the well and to insure the public safety. The cover shall be held in place or "weighted-down" in such a manner that it cannot be removed except with the aid of equipment or through the use of tools.

During prolonged interruptions (i.e., one week or more), a semipermanent cover shall be installed. For wells cased with steel, a steel cover, tack- welded to the top of the casing, is adequate.

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Section 23. Requirements for Destroying Wells.

A. *Preliminary Work.* Before the well is destroyed, it shall be investigated to determine its condition, details of construction, and whether there are obstructions that will interfere with the process of filling and sealing. This may include the use of downhole television and photography for visual inspection of the well.

1. *Obstructions.* The well shall be cleaned, as needed, so that all undesirable materials, including obstructions to filling and sealing, debris, oil from oil-lubricated pumps, or pollutants and contaminants that could interfere with well destruction are removed for disposal.

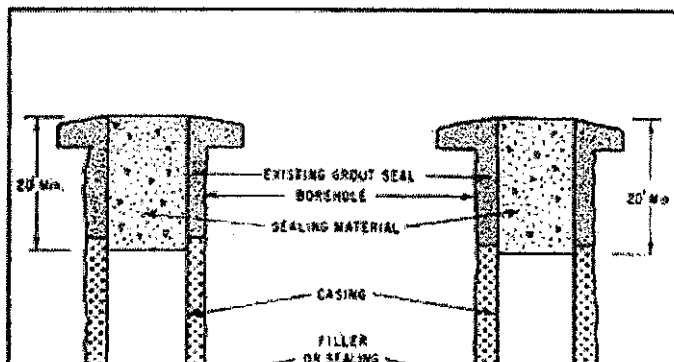
The enforcing agency shall be notified as soon as possible if pollutants and contaminants are known or suspected to be in a well to be destroyed. Well destruction operations may then proceed only at the approval of the enforcing agency.

The enforcing agency should be contacted to determine requirements for proper disposal of materials removed from a well to be destroyed.

2. Where necessary, to ensure that sealing material fills not only the well casing but also any annular space or nearby voids within the zone(s) to be sealed, the casing should be perforated or otherwise punctured.
3. In some wells, it may be necessary or desirable to remove a part of the casing. However, in many instances this can be done only as the well is filled. For dug wells, as much of the lining as possible (or safe) should be removed prior to filling.

B. *Filling and Sealing Conditions.* Following are requirements to be observed when certain conditions are encountered:

1. *Wells situated in unconsolidated material in an*



unconfined groundwater zone. In all cases the upper 20 feet of the well shall be sealed with suitable sealing material and the remainder of the well shall be filled with suitable fill, or sealing material. (See Figure 9A, of Bulletin 74- 81.)

2. *Well penetrating several aquifers or formations.* In all cases the upper 20 feet of the well shall be sealed with impervious material.

In areas where the interchange of water between aquifers will result in a significant^{Note 22} deterioration of the quality of water in one or more aquifers, or will result in a loss of artesian pressure, the well shall be filled and sealed so as to prevent such interchange. Sand or other suitable inorganic material may be placed opposite the producing aquifers and other formations where impervious sealing material is not required. To prevent the vertical movement of water from the producing formation, impervious material must be placed opposite confining formations above and below the producing formations for a distance of 10 feet or more. The formation producing the deleterious water shall be sealed by placing impervious material opposite the formation, and opposite the confining formations for a sufficient vertical distance (but no less than 10 feet) in both directions, or in the case of "bottom" waters, in the upward direction. (See Figure 9B.)

In locations where interchange is in no way detrimental, suitable inorganic material may be placed opposite the formations penetrated. When the boundaries of the various formations are unknown, alternate layers of impervious and pervious material shall be placed in the well.

3. *Well penetrating creviced or fractured rock.* If creviced or fractured rock formations are encountered just below the surface, the portions of the well opposite this formation shall be sealed with neat cement, sand-cement grout, or concrete. If these formations extend to considerable depth, alternate layers of coarse stone^{Note 23} and cement grout or concrete may be used to fill the well. Fine grained material shall not be used as fill material for creviced or fractured rock formations.
4. *Well in noncreviced, consolidated formation.* The upper 20 feet of a well in a noncreviced, consolidated formation shall be filled with impervious material. The remainder of the well may be filled with clay or other suitable inorganic material.
5. *Well penetrating specific aquifers, local conditions.* Under certain local conditions, the enforcing agency may require that specific aquifers or formations be sealed off during destruction of the well.

C. *Placement of Material.* The following requirements shall be observed in placing fill or sealing material in wells to be destroyed:

1. The well shall be filled with the appropriate material (as described in Subsection D of this section) from the bottom of the well up.

2. Where neat cement grout, sand-cement grout, or concrete is used, it shall be poured in one continuous operation.
3. Sealing material shall be placed in the interval or intervals to be sealed by methods that prevent free fall, dilution, and/or separation of aggregate from cementing materials.
4. Where the head (pressure) producing flow is great, special care and methods must be used to restrict the flow while placing the sealing material. In such cases, the casing must be perforated opposite the area to be sealed and the sealing material forced out under pressure into the surrounding formation.
5. In destroying gravel-packed wells, the casing shall be perforated or otherwise punctured opposite the area to be sealed. The sealing material shall then be placed within the casing, completely filling the portion adjacent to the area to be sealed and then forced out under pressure into the gravel envelope.
6. When pressure is applied to force sealing material into the annular space, the pressure shall be maintained for a length of time sufficient for the cementing mixture to set.
7. To assure that the well is filled and there has been no jamming or "bridging" of the material, verification shall be made that the volume of material placed in the well installation at least equals the volume of the empty hole.

D. *Materials.* Requirements for sealing and fill materials are as follows:

1. *Impervious Sealing Materials.* No material is completely impervious. However, sealing materials shall have such low permeability that the volume of water passing through them is of small consequence.

Suitable impervious materials include neat cement, sand-cement grout, concrete, and bentonite clay, all of which are described in Section 9, Subsection D, "Sealing Material" of these standards; and well-proportioned mixes of silts, sands, and clays (or cement), and native soils that have a coefficient of permeability of less than 10 feet per year.^{Note 24} Used drilling muds are not acceptable.

2. *Filler Material.* Many materials are suitable for use as a filler in destroying wells. These include clay, silt, sand, gravel, crushed stone, native soils, mixtures of the aforementioned types, and those described in the preceding paragraph. Material containing organic matter shall not be used.

E. *Additional Requirements for Wells in Urban Areas.*

In incorporated areas or unincorporated areas developed for multiple habitation, to make further use of the well site, the following additional requirements must be met (see Figure 9C):

1. A hole shall be excavated around the well casing to a depth of 5 feet below the ground surface and the well casing removed to the bottom of the excavation.
2. The sealing material used for the upper portion of the well shall be allowed to spill over into the excavation to form a cap.
3. After the well has been properly filled, including sufficient time for sealing material in the excavation to set, the excavation shall be filled with native soil.

F. *Temporary Cover.* During periods when no work is being done on the well, such as overnight or while waiting for sealing material to set, the well and surrounding excavation, if any, shall be covered. The cover shall be sufficiently strong and well enough anchored to prevent the introduction of foreign material into the well and to protect the public from a potentially hazardous situation.

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CHAPTER II. STANDARDS

Part III. Destruction of Wells

Section 20. Purpose of Destruction.

A well that is no longer useful^{Note 21} (including exploration and test holes) must be destroyed in order to: 1. Assure that the groundwater supply is protected and preserved for further use. 2. Eliminate the potential physical hazard.

Section 21. Definition of "Abandoned" Well.

A well is considered 'abandoned' or permanently inactive if it has not been used for one year, unless the owner demonstrates intention to use the well again. In accordance with Section 115700 of the California Health and safety Code, the well owner shall properly maintain an inactive well as evidence of intention for future use in such a way that the following requirements are met:

- (1) The well shall not allow impairment of the quality of water within the well and groundwater encountered by the well.
- (2) The top of the well or well casing shall be provided with a cover, that is secured by a lock or by other means to prevent its removal without the use of equipment or tools, to prevent unauthorized access, to prevent a safety hazard to humans and animals, and to prevent illegal disposal of wastes in the well. The cover shall be watertight where the top of the well casing or other surface openings to the well are below ground level, such as in a vault or below known levels of flooding. The cover shall be watertight if the well is inactive for more than five consecutive years. A pump or motor, angle drive, or other surface feature of a well, when in compliance with the above provisions, shall suffice as a cover.
- (3) The well shall be marked so as to be easily visible and located, and labeled so as to be easily identified as a well.
- (4) The area surrounding the well shall be kept clear of brush, debris, and waste materials.

If a pump has been temporarily removed for repair or replacement, the well shall not be considered 'abandoned' if the above conditions are met. The well shall be adequately covered to prevent injury to people and animals and to prevent the entrance of foreign material, surface water, pollutants, or contaminants into the well during the pump repair period.

Section 22. General Requirement.

All "abandoned" wells and exploration or test holes shall be destroyed. The objective of destruction is to restore as nearly as possible those subsurface conditions which existed before the well was constructed taking into account also changes, if any, which have occurred since the time of construction. (For example, an aquifer which may have produced good quality water at one time but which now produces water of inferior quality, such as a coastal aquifer that has been invaded by seawater.)

Destruction of a well shall consist of the complete filling of the well in accordance with the procedures described in [Section 23](#) (following).

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Cathodic Protection Well Standards

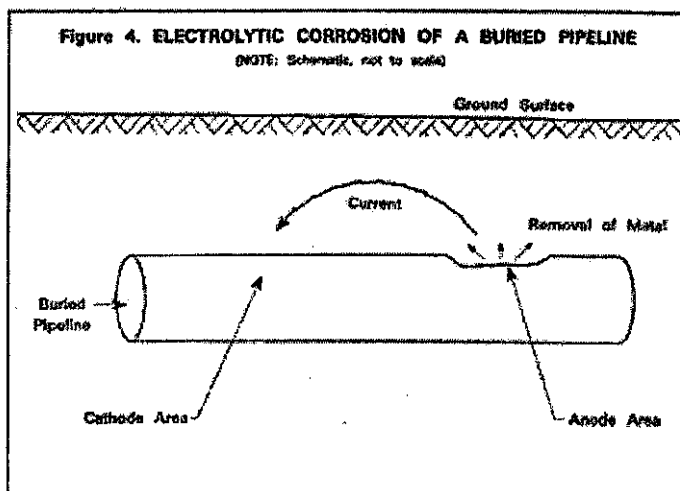
INTRODUCTION

Most wells in California are constructed to extract groundwater, inject water, or monitor groundwater conditions. Other, less common types of wells include cathodic protection wells. Cathodic protection wells, sometimes called 'deep groundbeds,' house devices to minimize electrolytic corrosion of metallic pipelines, tanks, and other facilities in contact with the ground.

Electrolytic Corrosion

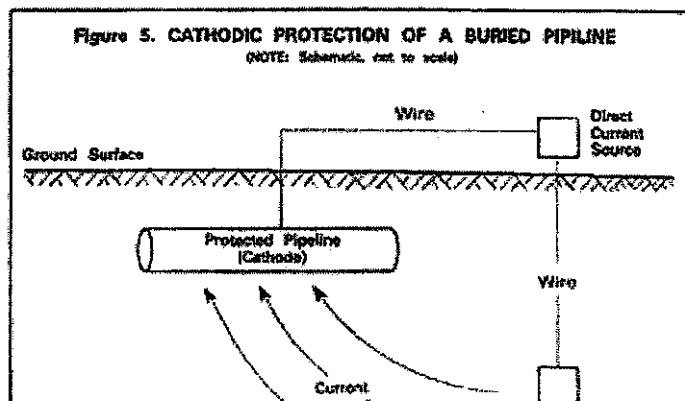
For the purpose of these standards, electrolytic corrosion is defined as the deterioration of metallic objects by electrochemical reaction with the environment. The electrolytic corrosion process is illustrated in Figure 4 for a metallic pipeline in a soil-water environment. This process gradually weakens the pipeline and can cause its failure.

In Figure 4, an electric potential is induced on the surface of the pipeline as a result of variations in the concentrations of salts in the soil and water surrounding the pipeline. This potential results in an electric current in the soil-water electrolyte. Current flows from an "anode area" on the pipeline to a "cathode area" on the pipeline. Metal is removed from the anode area by the current.



Cathodic Protection

"Cathodic protection" is a term used for certain measures taken to prevent or minimize electrolytic corrosion of metallic equipment and structures. Cathodic protection devices redirect current to flow from a "sacrificial" anode to the soils-water electrolyte, instead of from an anode area on a pipeline or other metallic structure to be



Corrosion Coordinating Committees

Serious electrical interference problems can occur where cathodic protection networks criss-cross one another or are too close to one another. Also, stray currents produced from electrical transmission lines and other equipment can sometimes interfere with the operation of cathodic protection systems. Interference problems are usually most pronounced in urban areas.

Corrosion control coordinating organizations have been formed in areas of California to overcome system interferences and other problems. Most organizations are affiliated with or are chapters of the National Association of Corrosion Engineers.

Corrosion control organizations represent the majority of utilities and other groups that install cathodic protection devices, including cathodic protection wells. Organization members coordinate the installation and operation of cathodic protection facilities with the goal of minimizing problems of electrical interference.

Four organizations that deal with Central and Southern California are:

- Southern California

The Southern California Cathodic Protection Committee is a formal committee covering all of Southern California south of San Luis Obispo, Kern, and Inyo counties, except San Diego County.

- San Diego County

The San Diego County Underground Corrosion Control Committee is an informal organization that deals with the San Diego area.

- Central California

The Central California Cathodic Protection Committee is a formal committee covering all of Central California plus Sacramento Valley counties, and western Sierra Nevada mountain counties south of Plumas County.

- San Francisco Bay Area

The activities of the two committees that formerly covered the San Francisco Bay Area have been assumed by the San Francisco Section of the National Association of Corrosion Engineers. The committees were disbanded in 1985.

No coordinating organizations function in coastal counties north of San Francisco or in the northeastern part of the State.

Unfortunately, not all who install and operate cathodic protection facilities work with a corrosion coordinating organization. Those not associated with an organization are usually individuals or local agencies that are sometimes unaware of the existence of other installations. Non-coordinated facilities can seriously interfere with one another

electrically.

Need for Cathodic Protection Well Standards

Cathodic protection wells, along with other types of wells, can allow groundwater quality degradation to occur. Improperly constructed or destroyed cathodic protection wells can constitute a preferential pathway for the movement of poor-quality water, pollutants, and contaminants. Cathodic protection wells constructed with gravel backfill to land surface are particularly conducive to the movement of poor-quality water, pollutants, or contaminants.

Water and electrolytes are sometimes introduced into cathodic protection wells through vent pipes, or gravel fill in the annulus, to keep wells functional where natural electrolytes are lacking. Such a practice could be considered "waste disposal" and may be illegal if poor-quality water is used.

Permanently inactive cathodic protection wells pose a threat for the movement of poor-quality water, pollutants, and contaminants, and should be properly destroyed. Permanently inactive cathodic protection wells are a threat to groundwater quality because they become dilapidated with time, are sometimes forgotten, and are sometimes used for waste disposal.

Many cathodic protection wells have small diameter vent pipes that prevent entry by persons and most animals. However, large vent pipe sizes can pose a serious safety threat if left open at land surface.

History of Cathodic Protection Well Standards

The California Legislature enacted legislation in 1949 directing the California Department of Water Resources to develop recommended water-quality protection standards for the construction and destruction of wells. The Legislature amended the Water Code in 1968 to require standards for cathodic protection wells.

Cathodic protection well standards for California were first published in 1973 as DWR Bulletin 74-1, Cathodic Protection Well Standards: State of California. Standards presented here replace those contained in Bulletin 74-1. Additional discussion on the history of well standards is contained in the "introduction" section of this supplement (Bulletin 74-90) and Bulletin 74-81, Water Well Standards: State of California.

Scope of Standards

The following are recommended minimum standards for construction, alteration, maintenance, and destruction of cathodic protection wells in California. They only serve as minimum guidelines toward ensuring cathodic protection wells do not constitute a significant pathway for movement of poor-quality water, pollutants, and contaminants. These standards do not ensure a cathodic protection well will perform its corrosion protection function adequately.

The functional requirements for cathodic protection wells may conflict with the

application of certain standards for the protection of water quality. Consequently, some compromise has been made between well function and resource protection in the development of these standards.

Organization of Standards

These standards are arranged in a format similar to the Water Well Standards. Since many of the standards that apply to water wells also apply to cathodic protection wells, many references are made in these standards to the Water Well Standards. Standards that apply only to cathodic protection wells or that require emphasis for cathodic protection wells, are discussed in detail in these standards.

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Cathodic Protection Well Standards

STANDARDS

Part I. General

Section 1. Definitions. ^{Note 26}

- A. *Cathodic Protection Well.* A cathodic protection well is defined in Section 13711 of the California Water Code as:

"... any artificial excavation in excess of 50 feet constructed by any method for the purpose of installing equipment or facilities for the protection electrically of metallic equipment in contact with the ground, commonly referred to as cathodic protection."

- B. *Enforcing Agency.* An agency designated by duly authorized local, regional, or State government to administer and enforce laws or ordinances pertaining to the construction, alteration, maintenance, and destruction of cathodic protection wells.
- C. *Casing.* All vent pipe, anode access tubing, electrical cable conduit, and other tubular materials that pass through the interval to be sealed.
- D. *Conductor Casing.* A tubular retaining structure temporarily or permanently installed in the upper portion of the well boring between the wall of the well boring and the inner well casing. Conductor casing is often installed to keep the borehole open during drilling if caving conditions are expected. Despite its title, conductor casing does not normally serve an "electrical" function for cathodic protection wells.

Section 2. Exemptions Due to Unusual Conditions.

Under certain circumstances the enforcing agency may waive compliance with these standards and prescribe alternate requirements. These standards may be waived only where they are impractical or ineffective because of unusual conditions, or would result in unsatisfactory condition or well function. In waiving any of these standards, the enforcing agency shall, if at all possible, require that measures be implemented to provide the same or greater level of water-quality protection that would otherwise be provided by these standards.

Section 3. Special Standards.

The enforcing agency may prescribe measures more stringent than standards described here, where needed to protect public safety or protect water quality.

Section 4. Responsible Parties.

Corrosion control engineers are normally responsible for the design and supervision of corrosion control facilities incorporating cathodic protection wells. Pursuant to Section 13750.5 (Division 7, Chapter 10, Article 3) of the California Water Code, construction, alteration, and destruction of cathodic protection wells shall be performed by contractors licensed in accordance with the California Contractors' License Law (Division 3, Chapter 9, California Business and Professions Code), except where exempted by law. Above-ground electrical facilities for cathodic protection wells should be installed by an appropriately licensed contractor.

Section 5. Reports.

Cathodic protection well construction, alteration, and destruction reports shall be completed on forms provided by the California Department of Water Resources. Other types of forms may be used for submission to the Department with the prior approval of the Department. The completed forms shall be submitted to the Department in accordance with relevant provisions of Sections 13750 through 13754 (Division 7, Chapter 10, Article 3) of the California Water Code. Information concerning completion and submission of well construction, alteration, and destruction reports is contained in "How to Fill Out a Well Completion Report", Department of Water Resources, November 1999. This pamphlet is available in PDF format (646KB) and can be viewed with Adobe Acrobat Reader.

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Cathodic Protection Well Standards

STANDARDS

Part II. Cathodic Protection Well Construction

Section 6. Well Location With Respect to Pollutants and Contaminants, and Structures.

- A. *Separation.* Cathodic protection wells shall be located an adequate distance from known or potential sources of pollution or contamination, where site constraints and corrosion control considerations allow. Potential sources of pollution and contamination include those listed in Section 8 of the Water Well Standards.

As specified in Section 7 below, the length of the annular seal for a cathodic protection well shall be increased if the well is located in a congested urban area, or is located within 100 feet of any potential source of pollution or contamination.

- B. *Flooding and Drainage.* Cathodic protection wells should be located in areas protected from flooding, if possible. Wells located in areas of flooding shall be protected from flood waters and drainage, including protective measures outlined in Section 8, below.

Ground surface surrounding a cathodic protection well shall slope away from the well. Drainage from areas surrounding a cathodic protection well shall be directed away from the well.

- C. *Accessibility.* All cathodic protection wells shall be located an adequate distance from buildings and other structures to allow access for well maintenance, modification, repair, and destruction, unless otherwise approved by the enforcing agency.

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Cathodic Protection Well Standards

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Part II. Cathodic Protection Well Construction

Section 7. Sealing the Upper Annular Space.

The space between the cathodic protection well casing and the wall of the well boring, often referred to as the "annular space," shall be effectively sealed to prevent it from being a preferential pathway for the movement of poor-quality water, pollutants, or contaminants. In some cases, secondary purposes of the annular seal are to stabilize the borehole wall, protect casing from degradation or corrosion, and ensure the structural integrity of the casing.

General discussion of sealing requirements and methods is contained in Section 9 and Section 13 of the Water Well Standards and Appendix B (Bulletin 74-81). Special requirements for sealing cathodic protection wells are:

A. *Minimum Depth of Annular Seal.*

1. *Minimum Depth.* The annular space shall be filled with appropriate sealing material from ground surface to a depth of at least 20 feet below land surface. The annular space shall be sealed to a depth of at least 50 feet below land surface in congested urban areas, or where a cathodic protection well is within 100 feet of any potential source of pollution or contamination. Additional annular sealing material shall be installed to greater depths where adverse conditions exist that increase the risk of pollution or contamination of groundwater.
2. *Fill.* Any annular space existing between the base of the annular surface seal and the top of the anode and conductive fill interval shall be filled with appropriate fill or sealing material. Fill material should consist of washed granular material such as sand, pea gravel, or sealing material. Fill material shall not be subject to decomposition or consolidation after placement and shall be free of pollutants and contaminants. Fill material shall not contain drill cuttings or drilling mud. Sealing material is often more practical and economical to use for filling the annular space than granular material.
3. *Sealing-Off Strata.* Additional annular sealing material shall be placed below the minimum depth of the annular surface seal, as needed, to prevent the movement of poor-quality water, pollutants, and contaminants through the well to zones of good-quality water. Requirements for sealing off zones are in Section 10, below.

- B. *Sealing Conditions*. Requirements for sealing the annular space under varied conditions are detailed in Section 9, Subsection B of the Water Well Standards.
- C. *Radial Thickness of Seal*. A minimum of 2 inches of sealing material shall be maintained between all casings and the borehole wall within the interval to be sealed, except where temporary conductor casing cannot be removed as noted in Section 9 of the Water Well Standards. At least 2 inches of sealing material shall be maintained between all casings in a borehole, within the interval to be sealed unless otherwise approved by the enforcing agency. Additional space shall be provided, where needed, to allow casings to be properly centralized and spaced and allow the use of a tremie pipe during well construction (if required), especially for deeper wells.
- D. *Sealing Material*. Sealing material shall consist of neat cement, sand-cement, concrete, or bentonite clay as discussed in Section 9 of the Water Well Standards. Cement-based sealing material shall be used opposite zones of fractured rock used. Concrete shall only be used at the approval of the enforcing agency. Drill cuttings and used drilling mud shall not be used as any part of sealing material.
- E. *Placement of Seal*. Standards for the placement of annular seals are described in Section 9 of the Water Well Standards and Appendix B (Bulletin 74-81).
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Cathodic Protection Well Standards

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Part II. Cathodic Protection Well Construction

Section 8. Surface Construction Features.

Surface construction features of the cathodic protection well shall serve to prevent physical damage to the well; prevent the entry of surface water, pollutants, and contaminants; and prevent unauthorized access.

- A. *Locking Cover.* The top of a cathodic protection well shall be protected by a locking cover or equivalent level of protection to prevent unauthorized access. All such covers shall allow the venting of gases.
- B. *Casing Cap.* The top of a cathodic protection well casing shall be fitted with a watertight cap, cover, "U" bend, or equivalent device to prevent the entry of water, pollutants, and contaminants into the well bore. All such covers shall allow venting of gases from the well.
- C. *Flooding.* The top of the well casing shall terminate above ground surface and known levels of flooding, except where site conditions, such as vehicular traffic, will not allow.
- D. *Bases.* A concrete base or pad shall be constructed around the top of a cathodic protection well casing at ground surface and contact the annular seal, unless the top of the casing is to be below ground surface as provided by Subsection E, below. The base shall be at least 4 inches thick and shall slope to drain away from the well casing. The base shall extend at least 2 feet laterally in all directions from the outside of the well boring, unless otherwise approved by the enforcing agency.

The base shall be free of cracks, voids, and other significant defects likely to prevent water tightness. Contacts between the base and the annular seal, and the base and the well casing must be water tight and must not cause the failure of the well casing or annular seal.

Where cement-based annular sealing material is used, the concrete base shall be poured before the annular seal has set, unless otherwise approved by the enforcing agency.

- E. *Vaults.* At the approval of the enforcing agency, the top of a cathodic protection well may be below ground surface because of traffic or other critical considerations. A watertight, structurally-sound vault, or equivalent feature, shall

be installed to house the top of the well casing if it terminates below ground surface.

The vault shall extend from the top of the annular seal to at least ground surface. In no case shall the top of the annular seal be more than 4 feet below ground surface.

The vault shall contact the annular seal in a manner to form a watertight and structurally-sound connection. Contacts between the vault and the annular seal, and the vault and the well casing (if any), shall not fail, or cause the failure of the well casing or annular seal.

Where cement-based annular sealing materials are used, the vault shall be set into or contact the annular sealing material before it sets, unless otherwise approved by the enforcing agency. If bentonite-based sealing material is used for the annular seal, the vault shall be set into the bentonite before it is fully hydrated.

Cement-based sealing material shall be placed between the outer walls of the vault and the excavation into which it is placed to form a proper, structurally sound foundation for the vault, and to seal the space between the vault and excavation.

Sealing material surrounding the vault shall extend from the top of the annular seal to ground surface, unless precluded in areas of freezing. If cement-based sealing material is used for both the annular seal and the space between the excavation and vault, the sealing material shall be emplaced in a "continuous pour." In other words, cement-based sealing material shall be placed between the vault and excavation and contact a cement-based annular seal before the annular seal has set.

The vault cover or lid shall be watertight but shall allow the venting of gases. The lid shall be fitted with a security device to prevent unauthorized access and shall be clearly and permanently labeled "CATHODIC PROTECTION WELL." The vault and its lid shall be strong enough to support vehicular traffic where such traffic might occur.

The top of the vault shall be set at grade, or above, so that drainage is away from the vault. The top of the casing contained within the vault shall be capped in accordance with requirements of Subsection B, above so that water, contaminants, and pollutants that may enter the vault will not enter the well casing.

- F. *Protection From Vehicles.* Protective steel posts, or the equivalent, shall be installed around a cathodic protection well casing where it is terminated above ground surface in areas of vehicular traffic. The posts shall be easily seen and shall protect the well from vehicular impact.

Additional requirements for surface construction features are contained in Section 10 of the Water Well Standards.

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Section 9. Casing.

Vent pipe, anode access tubing, and any other tubular materials that pass through the interval to be filled and sealed are all considered casing for the purpose of these standards. Materials used for cathodic protection well casing generally shall meet the requirements for casing materials and their installation in Section 12 of the Water Well Standards. Variance from the standards shall be at the approval of the enforcing agency. It is recommended that practices prescribed by the National Association of Corrosion Engineers also be followed in the design and installation of gas vents and electrical conduit.

Cathodic protection well casing should be at least 2 inches in internal diameter to facilitate eventual well destruction.

Section 10. Sealing-Off Strata.

If a cathodic protection well penetrates a stratum or strata below the minimum required annular surface seal depth specified in Section 7, above and the stratum contains poor-quality water, pollutants, or contaminants that could mix with and degrade water contained in other strata penetrated by the well, additional annular sealing material shall be placed below the minimum required annular surface seal to prevent mixing and water-quality degradation.

The following minimum requirements shall be observed for isolating zones containing poor-quality water, pollutants, or contaminants for various cases:

Case 1. Upper Stratum. If a stratum containing poor-quality water, pollutants, or contaminants lies above a stratum to be protected, annular seal material shall extend from the top of the stratum containing the poor-quality water, pollutants, or contaminants down at least 10 feet into the confining layer separating the two strata, or through the entire thickness of the confining layer, whichever is least.

Case 2. Lower Stratum. If a stratum containing poor-quality water, pollutants, or contaminants lies below a stratum to be protected, the annular space opposite the stratum to be protected shall be sealed along its full length. The seal shall extend at least 10 feet into the confining layer separating the two strata, or through the entire thickness of the confining layer, whichever is least.

Case 3. Multiple Strata.

- a. Where two or more strata containing poor-quality water, pollutants, or contaminants are adjacent to one another and overlie a stratum to be protected, the annular space opposite the strata containing poor-quality water, pollutants, or contaminants and opposite all interbedded confining layers shall be sealed. The annular seal shall extend at least 10 feet down into, or completely through, whichever is least, the confining layer separating the strata containing poor-quality water, pollutants, or contaminants and the underlying stratum to be protected.
- b. Where two or more strata containing poor-quality water, pollutants, or contaminants underlie a stratum to be protected, the annular space opposite the stratum to be protected shall be sealed. The seal shall continue down at least 10 feet into, or completely through, whichever is least, the confining layer separating the stratum to be protected and the underlying strata containing poor-quality water, pollutants or contaminants.
- c. Where two strata containing poor-quality water, pollutants, or contaminants are separated by a stratum to be protected, the annular space opposite the stratum to be protected, the confining strata underlying and overlying the stratum to be protected, and the upper stratum containing poor-quality water, pollutants, or contaminants shall be sealed off.

The supplementary seals described in the cases above shall extend up to and contact the base of the required minimum annular surface seal described in Section 7 above, if they are otherwise required to be within 10 feet of the surface seal. Sealing the entire annulus above the anode interval will often economically fulfill the conditions outlined above.

Requirements for sealing materials and their placement are described in Section 7, above.

Section 11. Repair of Cathodic Protection Wells.

Materials used for repairing cathodic protection well casing shall meet the requirements of Section 9, above.

Section 12. Temporary Cover.

The well or borehole opening and any associated excavations shall be covered at the surface to prevent the entry of foreign material, water, pollutants, and contaminants, and to ensure public safety whenever work is interrupted by such events as overnight shutdown, poor weather and required waiting periods to allow setting of sealing materials and the performance of tests. The cover shall be held in place or weighted down in such a manner that it cannot be removed except by equipment or tools.

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Part III. Destruction of Cathodic Protection Wells

Section 13. Purpose of Destruction.

A cathodic protection well that is no longer useful, permanently inactive or "abandoned" must be properly destroyed to:

- (1) Ensure the quality of groundwater is protected, and,
- (2) Eliminate a possible physical hazard to humans and animals.

Section 14. Definition of "Abandoned" Cathodic Protection Well.

A cathodic protection well is considered "abandoned" or permanently inactive when its anodes are exhausted and cannot, or will not, be replaced. A cathodic protection well is also considered "abandoned" or permanently inactive if it has not been used for one year, unless the owner demonstrates intention to use it again. To provide evidence of intention for future use of a well, the well owner, in accordance with Section 24400 of the Health and Safety Code, shall maintain the well in such a way that the following requirements are met:

- "(1) The well shall not allow impairment of the quality of water within the well and groundwater encountered by the well.
- (2) The top of the well casing shall be provided with a cover, that is secured by a lock or by other means to prevent its removal without the use of equipment or tools to prevent unauthorized access, to prevent a safety hazard to humans and animal, and to prevent illegal disposal of wastes in the well. The cover shall be watertight where the top of the well casing or other surface openings to the well are below ground level, such as in a vault or below known levels of flooding. The cover shall be watertight if the well is inactive for more than five consecutive years. A pump motor, angle drive, or other surface feature of a well, when in compliance with the above provisions, shall suffice as a cover.
- (3) The well shall be marked so as to be easily visible and located, and labeled so as to be easily identified as a well.
- (4) The area surrounding the well shall be kept clear of brush, debris, and waste materials."

Section 15. General Requirements.

All permanently inactive or "abandoned" cathodic protection wells shall be properly destroyed. The purpose of destruction is to prevent a possible safety hazard to humans and animals and to eliminate the well structure as a possible means for the preferential migration of poor-quality water, pollutants, and contaminants.

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Part III. Destruction of Cathodic Protection Wells

Section 16. Requirements for Destroying Cathodic Protection Wells.

General requirements for well destruction are contained in Section 23 of the Water Well Standards. Special considerations for cathodic protection wells are as follows:

- A. *Preliminary Work.* A cathodic protection well shall be investigated before it is destroyed to determine its condition, details of its construction and whether conditions exist that will interfere with filling and sealing.

The well shall be sounded immediately before it is destroyed to make sure that no obstructions exist that will interfere with filling and sealing. The well shall be cleaned before destruction, as needed, to ensure that all undesirable materials, including obstructions to filling and sealing, debris, and pollutants and contaminants that could interfere with well destruction are removed for disposal. The enforcing agency shall be notified as soon as possible if pollutants and contaminants are known or suspected to be in a well to be destroyed. Well destruction operations may then proceed only at the approval of the enforcing agency. The enforcing agency should be contacted to determine requirements for proper disposal of materials removed from a well to be destroyed.

- B. *Filling and Sealing Conditions.* The following minimum requirements shall be followed when various conditions are encountered.
1. *Wells that only penetrate unconsolidated material and a single "zone" of groundwater.* At a minimum, the upper 20 feet of the well casing and the annulus between the well casing and borehole wall (if not already sealed) shall be completely sealed with suitable material. Sealing material shall extend to a minimum depth of 50 feet below land surface if the well to be destroyed is located in an urban area, or is within 100 feet of any potential source of pollution or contamination. Additional sealing material may be needed if adverse conditions exist. The remainder of the well below the minimum surface seal shall be filled with suitable granular fill material, such as clean sand or pea gravel, or with sealing material.
 2. *Wells that penetrate several water-bearing strata.* The upper portion of the well casing and annular space shall be filled with sealing material as described in Item 1, above. Strata encountered below the surface seal that contain poor-quality water, pollutants, or contaminants that could mix with and degrade water in other strata penetrated by the well, shall be effectively

isolated by sealing the well bore and annulus within intervals specified in Section 10, above. The remainder of the well shall be filled with suitable granular fill or sealing material.

3. *Wells penetrating fractured rock.* Sealing material shall be installed as outlined in Items 1 and 2, above. Cement-based sealing material shall be used opposite fractured rock. The remainder of the well shall be filled with fill or sealing material, as appropriate.
4. *Wells in nonfractured consolidated strata.* Sealing material shall be installed as outlined in Items 1 and 2, above. The remainder of the well shall be filled with fill or sealing material, as appropriate.
5. *Wells penetrating water-bearing zones or aquifers of special significance.* The enforcing agency may require that specific water-bearing zones be sealed off for well destruction.

- C. *Placement of Material.* The placement of sealing materials for cathodic protection well destruction is generally described in Section 23 of the Water Well Standards and Appendix B (Bulletin 74-81). The following additional requirements shall be observed in destroying cathodic protection wells.

Casing, cables, anodes, granular backfill, conductive backfill, and sealing material shall be removed as needed, by redrilling, if necessary, to the point needed to allow proper placement of sealing materials within required sealing intervals. Removal of some or all well materials will likely be required for cathodic protection wells that were not constructed in accordance with these standards, or standards adopted by the Southern California Cathodic Protection Committee in December 1969.

Casing that cannot be removed shall be adequately perforated or punctured at specific intervals to allow pressure injection of sealing materials into granular backfill and all other voids that require sealing.

The following requirements shall be observed in placing fill and sealing material in cathodic protection wells to be destroyed.

1. *Placement Method.* The well shall be filled and sealed with appropriate material upward from the bottom of the well using a tremie pipe or equivalent.

Sealing material shall be placed by methods (such as by the use of a tremie pipe or equivalent) that prevent freefall, bridging, or dilution of the sealing materials, or separation of aggregates from sealants. Sealing materials shall not be installed by freefall unless the interval to be sealed is dry and no deeper than 30 feet below ground surface.

2. *Timing of Placement.* Sealing material shall be placed in one continuous operation (or "pour") from the bottom to the top of the well unless conditions in the well dictate that sealing operations be conducted in a

staged manner and prior approval is obtained from the enforcing agency.

3. *Groundwater Flow.* Special care shall be used to restrict the flow of groundwater into a well while fill and sealing material is being placed, if subsurface pressure causing the flow of water is significant.
 4. *Sealing Pressure.* Pressure required for placement of cement-based sealing material shall be maintained long enough for the cement-based sealing material to set.
 5. *Verification.* Verification shall be made that the volume of sealing and fill material placed in a well during destruction operations equals or exceeds the volume to be filled and sealed. This is to help determine that the well has been properly destroyed and that no jamming or bridging of the fill or sealing material has occurred.
- D. *Sealing Material.* Materials used for sealing cathodic protection wells for destruction shall have low permeabilities so that the volume of water and possible pollutants and contaminants passing through them will be of minimal consequence. Sealing material shall be compatible with the chemical environment into which it is placed and shall have mechanical properties compatible with present and future site uses.

Suitable sealing materials include neat cement, sand-cement, concrete, and bentonite, as described in Section 9 of the Water Well Standards. Sealing materials used for isolating zones of fractured rock shall be cement-based, as described in Subsection B, above. Drilling mud or drill cuttings shall not be used as any part of a sealing material for well destruction. Concrete may be used as a sealing material at the approval of the enforcing agency.

- E. *Fill Material.* Many fill materials are suitable for destruction of cathodic protection wells. These include clean, washed sand or gravel or sealing material. Fill material shall be free of pollutants and contaminants and shall not be subject to decomposition or consolidation after placement. Fill material shall not contain drilling mud or cuttings.
- F. *Additional Requirements for Destruction of Cathodic Protection Wells in Urban Areas.* The following additional requirements shall be met at each well site in urban areas, unless otherwise approved by the enforcing agency:

(1) The upper surface of the sealing material shall end at a depth of 5 feet below ground surface, and,

(2) If the casing was not extracted during destruction and sealing operations, a hole shall be excavated around the well casing to a depth of 5 feet below ground surface after sealing operations have been completed and sealing materials have adequately set and cured. The exposed well casing shall then be removed by cutting the casing at the bottom of the excavation. The excavation shall then be backfilled with clean, native soil or other suitable material.

- G. *Temporary Cover.* The well borehole and any associated excavations shall be covered at the surface to prevent the entry of foreign material, water, pollutants, and contaminants and to ensure public safety whenever work on the well is interrupted by such events as overnight shutdown, poor weather, and required waiting periods to allow setting of sealing materials and performance of tests. The cover shall be held in place or weighted down in such a manner that it cannot be removed except by equipment or tools.
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Sonoma County Water Yield Test Guidelines

Well Pump Test Guidelines in Water Scarce Areas

PURPOSE

These Guidelines will apply to well pump tests performed for the purpose of demonstrating compliance with minimum water quantity requirements of the Sonoma County Code for residential construction in water scarce areas or second dwelling units in marginal water availability areas of Sonoma County.

GENERAL

Pump tests conducted on or after the effective date of this policy will remain valid for a period of 3 years or as long as aquifer conditions remain substantially the same as established by a Registered Geologist or Registered Civil Engineer. [Grandfather clause: Pump tests accepted by the County prior to this Policy's initial implementation date of 06-08-04 will remain valid for 3 years from the date of the test.]

AUTHORITY

Sections 7-12, 25-17, 25-56 and 26-88-060H of the Sonoma County Code.

DEFINITIONS

"Discharge rate" means the rate at which the well discharges water (usually expressed in gallons per minute).

"Draw down" means the difference measured in feet between the static and dynamic water levels.

"Dynamic water level or stabilized pumping level" means the level of water in the well during the pump test.

"Post-test static water level" means the level of water seventy-two hours after the pump test.

"Recovery" means the difference in feet between the post test static water level and the pumping level (dynamic water level)

"Specific capacity" means the discharge rate divided by the draw down (usually expressed as gallons per minute per foot of draw down).

"Static water level" means the level of water in the well before the pump test.

PROCEDURE

A. Pump Test Requirements

1. General Conditions

The Sonoma County Code requires demonstration of at least one gallon per minute per dwelling unit for new or replacement dwellings located in water scarce areas and for

second dwelling units in marginal water availability areas. The code specifies a sustained yield, metered pump test from a well or wells for a specified time period of 8-12 hours for water systems with 1-2 connections, 16-24 hours for water systems with 3-4 connections and 72 hours for systems with 5 or more connections. The 72 hour test may be modified by the administrative authority but in no case shall be less than 48 hours. Note: Also refer to Section 64563 of the California Code of Regulations for systems with 5 or more connections.

Testing to meet the above yield requirements shall be conducted from July 15 to October 1 each year or as extended by the Project Review and Advisory Committee. This time period is referred to as the dry weather pump test period. The Permit and Resource Management Department shall be notified 24 hours in advance of any testing. Pump tests may be performed by or under the direction of a licensed drilling contractor (C57), pumping contractor (C61/D21), a Registered Civil Engineer or a Registered Geologist.

2. A copy of the previously completed State of California Department of Water Resources Well Completion Report, if available, shall be submitted with the completed Permit and Resource Management Department's form, Certification of Water Yield in Water Scarce Areas - WLS-010.
3. If multiple wells are being used to meet the minimum water production requirements, then all wells must be pumped simultaneously.

B. Pre-Test Requirements

1. Identify the location of the well, by either the NAD83 California State Plane II or WGS 84 lat./long. or by the measured distance reference to a fixed landmark. Record this information on the WLS-010 form. Include the estimated elevation of the well head.
2. Measure and record the static (non-pumping) water level in the well. If well is operational, so note on the WLS-010 form. Provide information on measuring points (top of casing, surface seal, access port, etc.) Measurements should be taken relative to ground level. The measuring point above ground level should be measured and noted on the WLS-010 form. In order to establish the static level, the well must not be pumped for at least 12 hours prior to measurement of the static water level.
3. Record the type of discharge measurement method. Indicate the type and model of flow meter or provide an accurate description of weir or orifice plate set up.

C. Twelve-Hour Pump Test Method

1. Record the static level.
 2. Calculate the volume of water stored in the well.
-

3. Remove a volume of water equivalent to the calculated volume stored in the well.
4. Select a dynamic water level for the test. Lower the water level to the selected dynamic water level as quickly as possible. Maintain the dynamic water level for the duration of the test by adjusting the discharge rate. Pump at a rate of no less than one gallon per minute and continue pumping for twelve hours.
5. If it is not feasible to use a water level sensing device (probe), a stable pumping rate must be maintained for a period of 3 hours prior to the start of the sustained yield test. This condition may require pulling the pump to determine the static water level prior to conducting the test, reinstalling the pump to conduct the test, and pulling the pump again to read the 72 hour recovery.
6. If a low water yield pump protector device is used and the dynamic water level is not established above the pump setting, the dynamic water level will be assumed to be at the pump.
7. Record the dynamic water level and discharge rate according to the following schedule:

Time since pumping began (including pumping to remove stored volume)	Time Interval
0-5 minutes	1 minute
5-60 minutes	5 minutes
60-100 minutes	20 minutes
100 minutes to establish the dynamic water level	30 minutes

Once the stabilized dynamic water level has been reached for a minimum period of 3 hours, the water level must be read a minimum of every 12 hours to the end of the test.

8. At the end of the pumping test, measure, and record the final discharge rate and dynamic water level.

D. Alternative Eight-Hour Pump Test Method

1. An alternative eight-hour pump test method can be used instead of the twelve-hour pump test method for systems of 1 or 2 connections if, after 4 hours of pumping, the specific capacity is greater than 0.05. While conducting the alternative eight-hour pump test the dynamic water level and discharge rate are to be recorded in accordance with the time intervals specified in Section C above.

E. Alternative Sixteen-Hour Pump Test Method

1. An alternative sixteen-hour pump test method can be used instead of the twenty-four hour pump test method for systems of 3 or 4 connections if, after 4 hours of pumping, the

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specific capacity is greater than 0.05. While conducting the alternative sixteen-hour pump test the dynamic water level and discharge rate are to be recorded in accordance with the time intervals specified in Section C above.

F. Post Test Measurement

1. Measure and record the static level in the well seventy-two (72) hours after the final dynamic water level measurement.

G. Calculate the Well Recovery

1. Determine the water level draw down by subtracting the initial static water level measurement from the stabilized dynamic pumping level. Record this result as the well draw down.
2. Next determine the water level recovery by subtracting the post test (72 hour) static water level from the stabilized dynamic pumping level. Record this result as the well recovery.
3. Next determine the percent recovery of the well. Divide the water level recovery by the water level draw down and multiply by 100. Record this result as the percent well recovery.

Example:

- a. Initial static water level: _____ (Measured value)
- b. *Post test static water level: _____ (Measured value)
- c. **Stabilized Pumping level: _____ (Measured value)
- d. Draw down: _____ (Calculate by subtracting A from C)
- e. Recovery: _____ (Calculate by subtracting B from C)
- f. Percent recovery: _____ (Calculate by dividing E by D and multiplying the results by 100)

Well percent recovery (F) must be 90% or greater within a 72 hour period.

* The static water level after 72 hours or less post pump test.

** Kleinfelder refers to this as the dynamic pumping level.

ATTACHMENTS

Effective: 07/01/2005

Permit and Resource Management Department
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None

Approved by:



Pete Parkinson, Director

Lead Author: Kleinfelder Associates

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Effective: 07/01/2005

**Sonoma County
Monitoring Guidelines
for
Large Capacity Water Wells**

***Monitoring Guidelines for Large Capacity Water Wells Pursuant to
General Plan Policy RC-3b***

PURPOSE

The purpose of this policy is to provide groundwater monitoring guidelines for commercial and industrial projects requiring a use permit. The guidelines apply to use permits applied for after February 24, 2004.

GENERAL

- A. All commercial and industrial projects which rely on water wells and require a use permit shall include a proposed groundwater use estimate prepared by a civil engineer or registered geologist as part of the project application. The following categories are to be applied to projects for purposes of determining water well monitoring requirements. Projects using less than .5 acre-feet/year are "Small Commercial and Industrial Projects." Projects using greater than .5 acre-feet/year, but less than 5 acre-feet/year, are "Large Commercial and Industrial Projects." Projects using greater than 5 acre-feet/year are "Very Large Commercial and Industrial Projects."

- B. Requirements for Small Commercial and Industrial Projects.

If geologic reports prepared pursuant to section RC-3h of the General Plan or mitigations established through the CEQA process require ongoing well monitoring to reduce impacts to neighboring properties, then Small Commercial and Industrial Projects may be required to conduct groundwater monitoring. Otherwise they are exempt from groundwater monitoring requirements.

- C. Requirements for Large Commercial and Industrial Projects.

1. Measuring Devices.

Each water well shall be equipped with a meter and a sounding tube or other water level sounding device and marked with a measuring reference point. Water meters shall be calibrated at least once every five years.

2. Recording and Reporting Requirements.

Static water level and the total quantity of water pumped shall be recorded quarterly. Static water level is the depth from ground level to the well water level when the pump is not operating. Static water level shall be measured by turning the pump off at the end of the working day and recording the water level at the beginning of the following day before turning the pump back on.

Groundwater monitoring reports shall be submitted annually to the Project Review Division at Permit and Resource Management Department (PRMD) by January 31 of each year. The annual report shall show a cumulative hydrograph of static water levels and the total quarterly quantities of water pumped from all wells on the property.

3. Fire Precautions.

Before measuring static water level, the following fire precautions shall be completed:

- a. Prior to turning off the pump, inspect all fire storage tanks on the site to insure that the required quantity of water is available.
- b. When the pump is turned off, an instruction sign shall be placed over the pump's on-off switch. The instruction sign shall be made of metal or plastic. The letters shall be at least two inches tall and written in contrasting colors. The words shall be visible from at least 25 feet away. The instruction sign shall inform readers how to turn the pump on in case of an emergency.

4. Recorded Easement.

An easement shall be recorded in favor of the County to allow County personnel to enter the property during normal business hours to read the water meter, measure the water level, and take other measurements as necessary to determine compliance with permit conditions.

5. Additional Monitoring Reports.

Any additional monitoring reports shall be submitted to PRMD as required by the conditions of project approval.

D. Requirements for Very Large Commercial and Industrial Projects.

1. Measuring Devices.

Each water well shall be equipped with a meter and a sounding tube or other water level sounding device and marked with a measuring reference point. Water meters shall be calibrated at least once every five years.

2. Monitoring Well.

A well shall be constructed and developed solely for the purpose of monitoring groundwater ("monitoring well"). A well permit must be obtained before construction of the monitoring well. The monitoring well shall be the same depth and contain the same screened interval as the primary water well. The monitoring well shall be located as far from other water wells, streams, waste water disposal fields and ponds as the parcel will allow, yet be located within the same geological formation(s) as the primary water well and be accessible by street vehicle. The monitoring well location shall be approved by PRMD and shall be representative of the geologic and hydrologic conditions of the project well. The monitoring well shall be marked with a measuring reference point. The well's Global Positioning System (GPS) coordinates (in NAD83 California State Plane II

Permit and Resource Management Department
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or WGS 84 lat./long.) shall be submitted to PRMD and shall be held in a non-confidential status.

3. Recording and Reporting Requirements.

The monitoring water well level and the total quantity of water pumped shall be recorded monthly.

Groundwater monitoring reports shall be submitted annually to the Project Review Division at PRMD by January 31 of each year. The annual report shall show a cumulative hydrograph of the monitoring well water levels and the total monthly quantities of water pumped from all of the wells on the property.

4. Recorded Easement.

An easement shall be recorded in favor of the County to allow County personnel to enter the property during normal business hours to read the water meter(s), measure the water level, and take other measurements as specified in the use permit conditions.

5. Additional Monitoring Reports.

Any additional monitoring reports must be submitted to PRMD as required by the conditions of project approval.

AUTHORITY

Sections RC-3b and RC-3h of the Resource Conservation Element of the Sonoma County General Plan.

PROCEDURE

A. Tasks necessary to implement this policy:

1. The application shall include an engineer's estimate of water use by the proposed project.
2. Conditions will be added to project approvals requiring groundwater monitoring, reporting, easements, and monitoring wells as specified. Additional conditions may be added to project approvals specifying the quantity of groundwater use approved.
3. Groundwater monitoring reports shall be submitted annually to the Project Review Division at PRMD between January 1 and January 31 of each year. Violations of project approval conditions shall be forwarded to Code Enforcement.
4. The Project Review Division shall conduct quality control site inspections to collect verifying water meter readings and, if applicable, monitoring well groundwater level

Effective: 05-18-04

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measurements. The target goal is to collect verifying data on 5 percent of the subject sites per year.

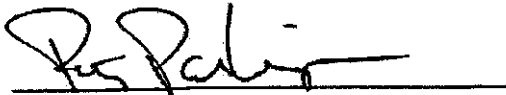
B. Individual project approvals to be completed prior to project operation or final occupancy.

1. Requirements for all Large Commercial and Industrial Projects (using greater than 0.5 ac/ft/yr, and less than 5 ac/ft/yr):
 - a. Proof of installation of a water meter and water level measuring port on the water well(s). The water meter shall provide water flow measurements in cumulative number of gallons and shall be installed in accordance with the manufacturer's specifications.
 - b. Conformed copy of the recorded easement to allow County personnel to read and record the water meter(s).
2. Requirements for all Very Large Commercial and Industrial Projects (using greater than 5 ac/ft/yr):
 - a. Proof of installation of a water meter and water level measuring port on the water well(s).
 - b. Conformed copy of the recorded easement to allow County personnel to read and record the water meter(s) and measure groundwater levels in the monitoring well.
 - c. Final approval of the well permit to install a monitoring well.

ATTACHMENTS

None

Approved by:



Pete Parkinson, Director

Lead Author: Jon Tracy

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Drinking Water Standards



U.S. Environmental Protection Agency

Ground Water & Drinking Water

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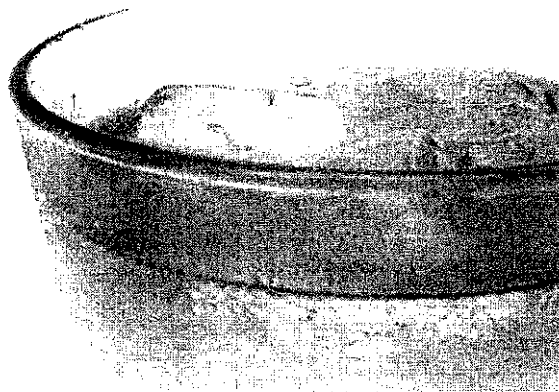


[EPA Home](#) > [Water](#) > [Ground Water & Drinking Water](#) > [Current Drinking Water Standards](#)

List of Drinking Water Contaminants & MCLs

National Primary Drinking Water Regulations

National Primary Drinking Water Regulations (NPDWRs or primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. Visit the list of regulated contaminants with links for more details.



- [List of Contaminants & their Maximum Contaminant Level \(MCLs\)](#)
- [Setting Standards for Safe Drinking Water](#) to learn about EPA's standard-setting process
- [EPA's Regulated Contaminant Timeline](#) (86 K PDF FILE, 1 pg) (ALL ABOUT PDF FILES)
- [National Primary Drinking Water Regulations](#) [EXIT disclaimer](#) - The complete regulations regarding these contaminants available from the Code of Federal Regulations Website

National Secondary Drinking Water Regulations

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

- [List of National Secondary Drinking Water Regulations](#)
- [National Secondary Drinking Water Regulations](#) [EXIT disclaimer](#) - The complete regulations regarding these contaminants available from the Code of Federal Regulations Web Site.

Unregulated Contaminants

This list of contaminants which, at the time of publication, are not subject to any proposed or promulgated national primary drinking water regulation (NPDWR), are known or anticipated to occur in public water systems, and may require regulations under SDWA. For more information check out the list, or visit the Drinking Water Contaminant Candidate List (CCL) web site.

- [Drinking Water Contaminant Candidate List 2](#)
- [Drinking Water Contaminant Candidate List \(CCL\) Web Site](#)
- [Unregulated Contaminant Monitoring Program \(UCM\)](#)

List of Contaminants & their MCLs

EPA 816-F-02-013
July 2002

[Microorganisms](#) | [Disinfectants](#) | [Disinfection Byproducts](#) | [Inorganic Chemicals](#) | [Organic Chemicals](#) | [Radionuclides](#)

- The links provided below are to either Consumer Fact Sheet, Rule Implementation web sites, or PDF files ([ALL ABOUT PDF FILES](#))
- [Alphabetical Version of this chart in PDF format EPA 816-F-03-016 June 2003 \(396 K PDF FILE\)](#) ([ALL ABOUT PDF FILES](#))

Microorganisms

Contaminant	MCLG ¹ (mg/L) ²	MCL or TT ¹ (mg/L) ²	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
<i>Cryptosporidium</i> (pdf file)	zero	TT ³	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and fecal animal waste
<i>Giardia lamblia</i>	zero	TT ³	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Heterotrophic plate count	n/a	TT ³	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment
<i>Legionella</i>	zero	TT ³	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems
Total Coliforms (including fecal coliform and <i>E. Coli</i>)	zero	5.0% ⁴	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present ⁵	Coliforms are naturally present in the environment; as well as feces; fecal coliforms and <i>E. coli</i> only come from human and animal fecal waste.
<u>Turbidity</u>	n/a	TT ³	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff
Viruses (enteric)	zero	TT ³	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste

Disinfection Byproducts

Contaminant	MCLG ¹ (mg/L) ²	MCL or TT ¹ (mg/L) ²	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
<u>Bromate</u>	zero	0.010	Increased risk of cancer	Byproduct of drinking water disinfection
<u>Chlorite</u>	0.8	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection
<u>Haloacetic acids (HAA5)</u>	n/a ⁶	0.060	Increased risk of cancer	Byproduct of drinking water disinfection
<u>Total Trihalomethanes (TTHMs)</u>	none ⁷ ----- n/a ⁶	0.10 ----- 0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection

Disinfectants

Contaminant	MRDLG ¹ (mg/L) ²	MRDL ¹ (mg/L) ²	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
<u>Chloramines (as Cl₂)</u>	MRDLG=4 ¹	MRDL=4.0 ¹	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes
<u>Chlorine (as Cl₂)</u>	MRDLG=4 ¹	MRDL=4.0 ¹	Eye/nose irritation; stomach discomfort	Water additive used to control microbes
<u>Chlorine dioxide (as ClO₂)</u>	MRDLG=0.8 ¹	MRDL=0.8 ¹	Anemia; infants & young children: nervous system effects	Water additive used to control microbes

Inorganic Chemicals

Contaminant	MCLG ¹ (mg/L) ²	MCL or TT ¹ (mg/L) ²	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
<u>Antimony</u>	0.006	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
<u>Arsenic</u>	0 ⁷	0.010 as of 01/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes
<u>Asbestos</u>	7	7 MFL	Increased risk of developing	Decay of asbestos cement

(fiber >10 micrometers)	million fibers per liter		benign intestinal polyps	in water mains; erosion of natural deposits
<u>Barium</u>	2	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
<u>Beryllium</u>	0.004	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries
<u>Cadmium</u>	0.005	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints
<u>Chromium (total)</u>	0.1	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits
<u>Copper</u>	1.3	TT ⁸ ; Action Level=1.3	Short term exposure: Gastrointestinal distress Long term exposure: Liver or kidney damage People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits
<u>Cyanide (as free cyanide)</u>	0.2	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories
<u>Fluoride</u>	4.0	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories
<u>Lead</u>	zero	TT ⁸ ; Action Level=0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits
<u>Mercury</u>	0.002	0.002	Kidney damage	Erosion of natural deposits;



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Special Instructions							

(inorganic)				discharge from refineries and factories; runoff from landfills and croplands
<u>Nitrate</u> (measured as <u>Nitrogen</u>)	10	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
<u>Nitrite</u> (measured as <u>Nitrogen</u>)	1	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
<u>Selenium</u>	0.05	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
<u>Thallium</u>	0.0005	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories

Organic Chemicals

Contaminant	MCLG ¹ (mg/L) ²	MCL or TT ¹ (mg/L) ²	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
<u>Acrylamide</u>	zero	TT ⁹	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/wastewater treatment
<u>Alachlor</u>	zero	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops
<u>Atrazine</u>	0.003	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops
<u>Benzene</u>	zero	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills

<u>Benzo(a)pyrene (PAHs)</u>	zero	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines
<u>Carbofuran</u>	0.04	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa
<u>Carbon tetrachloride</u>	zero	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities
<u>Chlordane</u>	zero	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide
<u>Chlorobenzene</u>	0.1	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories
<u>2,4-D</u>	0.07	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
<u>Dalapon</u>	0.2	0.2	Minor kidney changes	Runoff from herbicide used on rights of way
<u>1,2-Dibromo-3-chloropropane (DBCP)</u>	zero	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards
<u>o-Dichlorobenzene</u>	0.6	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories
<u>p-Dichlorobenzene</u>	0.075	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories
<u>1,2-Dichloroethane</u>	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
<u>1,1-Dichloroethylene</u>	0.007	0.007	Liver problems	Discharge from industrial chemical factories
<u>cis-1,2-Dichloroethylene</u>	0.07	0.07	Liver problems	Discharge from industrial chemical factories
<u>trans-1,2-Dichloroethylene</u>	0.1	0.1	Liver problems	Discharge from

				industrial chemical factories
<u>Dichloromethane</u>	zero	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories
<u>1,2-Dichloropropane</u>	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
<u>Di(2-ethylhexyl) adipate</u>	0.4	0.4	Weight loss, liver problems, or possible reproductive difficulties.	Discharge from chemical factories
<u>Di(2-ethylhexyl) phthalate</u>	zero	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories
<u>Dinoseb</u>	0.007	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
<u>Dioxin (2,3,7,8-TCDD)</u>	zero	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories
<u>Diquat</u>	0.02	0.02	Cataracts	Runoff from herbicide use
<u>Endothall</u>	0.1	0.1	Stomach and intestinal problems	Runoff from herbicide use
<u>Endrin</u>	0.002	0.002	Liver problems	Residue of banned insecticide
<u>Epichlorohydrin</u>	zero	TT ⁹	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals
<u>Ethylbenzene</u>	0.7	0.7	Liver or kidneys problems	Discharge from petroleum refineries
<u>Ethylene dibromide</u>	zero	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries
<u>Glyphosate</u>	0.7	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use

<u>Heptachlor</u>	zero	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide
<u>Heptachlor epoxide</u>	zero	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor
<u>Hexachlorobenzene</u>	zero	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
<u>Hexachlorocyclopentadiene</u>	0.05	0.05	Kidney or stomach problems	Discharge from chemical factories
<u>Lindane</u>	0.0002	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
<u>Methoxychlor</u>	0.04	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock
<u>Oxamyl (Vydate)</u>	0.2	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes
<u>Polychlorinated biphenyls (PCBs)</u>	zero	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals
<u>Pentachlorophenol</u>	zero	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories
<u>Picloram</u>	0.5	0.5	Liver problems	Herbicide runoff
<u>Simazine</u>	0.004	0.004	Problems with blood	Herbicide runoff
<u>Styrene</u>	0.1	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills
<u>Tetrachloroethylene</u>	zero	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners
<u>Toluene</u>	1	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories

<u>Toxaphene</u>	zero	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
<u>2,4,5-TP (Silvex)</u>	0.05	0.05	Liver problems	Residue of banned herbicide
<u>1,2,4-Trichlorobenzene</u>	0.07	0.07	Changes in adrenal glands	Discharge from textile finishing factories
<u>1,1,1-Trichloroethane</u>	0.20	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories
<u>1,1,2-Trichloroethane</u>	0.003	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories
<u>Trichloroethylene</u>	zero	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories
<u>Vinyl chloride</u>	zero	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories
<u>Xylenes (total)</u>	10	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories

Radionuclides

Contaminant	MCLG ¹ (mg/L) ²	MCL or TT ¹ (mg/L) ²	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Alpha particles	none ² ----- zero	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
Beta particles and photon emitters	none ² ----- zero	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation
Radium 226 and	none ²	5 pCi/L	Increased risk of cancer	Erosion of natural

Radium 228 (combined)	----- zero			deposits
Uranium	zero	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits

Notes

¹ Definitions:

Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.

Maximum Contaminant Level Goal (MCLG) - The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.

Maximum Residual Disinfectant Level (MRDL) - The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG) - The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Treatment Technique - A required process intended to reduce the level of a contaminant in drinking water.

² Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million.

³ EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium*: (as of 1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99% removal.
- *Giardia lamblia*: 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- *Legionella*: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter.
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Filter Backwash Recycling; The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

⁴ more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli* if two consecutive TC-positive samples, and one is also positive for *E. coli* fecal coliforms, system has an acute MCL violation.

⁵ Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

⁶ Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L). Chloroform is regulated with this group but has no MCLG.
- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L). Monochloroacetic acid, bromoacetic acid, and dibromoacetic acid are regulated with this group but have no MCLGs.

⁷ MCLGs were not established before the 1986 Amendments to the Safe Drinking Water Act. Therefore, there is no MCLG for this contaminant.

⁸ Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

⁹ Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when acrylamide and epichlorohydrin are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows:

- Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)
- Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)

National Secondary Drinking Water Regulations

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

- For more information, read [Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals](#).

Contaminant	Secondary Standard
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L

Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

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September 12, 2003

NOTE: This extract from Title 22 of the California Code of Regulations is prepared as an aid to staff of the DHS Drinking Water Program and cannot be relied upon by the regulated community as the State of California's representation of the law. The published codes are the only official representation of the law.

TITLE 22, CALIFORNIA CODE OF REGULATIONS

DIVISION 4. ENVIRONMENTAL HEALTH

CHAPTER 15. DOMESTIC WATER QUALITY AND MONITORING

ARTICLE 4. PRIMARY STANDARDS—INORGANIC CHEMICALS

Section 64431. Maximum contaminant levels - inorganic chemicals

Table 64431-A

Maximum Contaminant Levels Inorganic Chemicals

<i>Chemical</i>	<i>Maximum Contaminant Level, mg/L</i>
Aluminum	1.
Antimony	0.006
Arsenic	0.05
Asbestos	7 MFL*
Barium	1.
Beryllium	0.004
Cadmium	0.005
Chromium	0.05
Cyanide	0.15
Fluoride	2.
Mercury	0.002
Nickel	0.1
Nitrate (as NO ₃)	45.
Nitrate + Nitrite (sum as nitrogen)	10.
Nitrite (as nitrogen)	1.
Selenium	0.05
Thallium	0.002

*MFL = million fibers per liter; MCL for fibers exceeding 10 um in length.

Article 4.1. FLUORIDATION

Section 64433.2. Optimal fluoride levels

Table 64433.2-A
Optimal Fluoride Levels

<i>Annual average of maximum daily air temperatures, degrees</i>		<i>Optimal fluoride level, mg/L</i>	<i>Control Range, mg/L</i>	
<i>Fahrenheit</i>	<i>Celsius</i>		<i>Low</i>	<i>High</i>
50.0 to 53.7	10.0 to 12.0	1.2	1.1	1.7
53.8 to 58.3	12.1 to 14.6	1.1	1.0	1.6
58.4 to 63.8	14.7 to 17.7	1.0	0.9	1.5
63.9 to 70.6	17.8 to 21.4	0.9	0.8	1.4
70.7 to 79.2	21.5 to 26.2	0.8	0.7	1.3
79.3 to 90.5	26.3 to 32.5	0.7	0.6	1.2

ARTICLE 5. RADIOACTIVITY

Section 64441. Natural radioactivity

Section 64443. Man-made radioactivity

Table 4
MCL Radioactivity

<i>Constituent</i>	<i>Maximum Contaminant Level, pCi/l</i>
Combined Radium-226 and Radium-228	5
Gross Alpha particle activity (including Radium-226 but excluding Radon and Uranium)	15
Tritium	20,000
Strontium-90	8
Gross Beta particle activity	50
Uranium	20

ARTICLE 5.5. PRIMARY STANDARDS—ORGANIC CHEMICALS

Section 64444. General requirements

Table 64444-A
Maximum Contaminant Levels
Organic Chemicals

<i>Chemical</i>	<i>Maximum Contaminant Level, mg/L</i>
(a) Volatile Organic Chemicals (VOCs)	
Benzene	0.001
Carbon Tetrachloride	0.0005
1,2-Dichlorobenzene	0.6
1,4-Dichlorobenzene	0.005
1,1-Dichloroethane	0.005
1,2-Dichloroethane	0.0005
1,1-Dichloroethylene	0.006
cis-1,2-Dichloroethylene	0.006
trans-1,2-Dichloroethylene	0.01
Dichloromethane	0.005
1,2-Dichloropropane	0.005
1,3-Dichloropropene	0.0005
Ethylbenzene	0.3
Methyl- <i>tert</i> -butyl ether	0.013
Monochlorobenzene	0.07
Styrene	0.1
1,1,2,2-Tetrachloroethane	0.001
Tetrachloroethylene	0.005
Toluene	0.15
1,2,4-Trichlorobenzene	0.005
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane	0.005
Trichloroethylene	0.005
Trichlorofluoromethane	0.15
1,1,2-Trichloro-1,2,2-Trifluoroethane	1.2
Vinyl Chloride	0.0005
Xylenes	1.750*

Table 64444-A (continued)
Maximum Contaminant Levels
Organic Chemicals

<i>Chemical</i>	<i>Maximum Contaminant Level, mg/L</i>
(b) Non-Volatile Synthetic Organic Chemicals (SOCs)	
Alachlor	0.002
Atrazine	0.001
Bentazon	0.018
Benzo(a)pyrene	0.0002
Carbofuran	0.018
Chlordane	0.0001
2,4-D	0.07
Dalapon	0.2
Dibromochloropropane (DBCP)	0.0002
Di(2-ethylhexyl)adipate	0.4
Di(2-ethylhexyl)phthalate	0.004
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Endrin	0.002
Ethylene Dibromide (EDB)	0.00005
Glyphosate	0.7
Heptachlor	0.00001
Heptachlor Epoxide	0.00001
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
Lindane	0.0002
Methoxychlor	0.03
Molinate	0.02
Oxamyl	0.05
Pentachlorophenol	0.001
Picloram	0.5
Polychlorinated Biphenyls	0.0005
Simazine	0.004
Thiobencarb	0.07
Toxaphene	0.003
2,3,7,8-TCDD (Dioxin)	3×10^{-8}
2,4,5-TP (Silvex)	0.05

*MCL is for either a single isomer or the sum of the isomers.

ARTICLE 16. SECONDARY DRINKING WATER STANDARDS

Section 64449. Secondary maximum contaminant levels and compliance

Table 64449-A
Secondary Maximum Contaminant Levels
Consumer Acceptance Limits

<i>Constituents</i>	<i>Maximum Contaminant Levels/Units</i>
Aluminum	0.2 mg/L
Color	15 Units
Copper	1.0 mg/L
Corrosivity	Non-corrosive
Foaming Agents (MBAS)	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Methyl- <i>tert</i> -butyl ether (MTBE)	0.005 mg/L
Odor—Threshold	3 Units
Silver	0.1 mg/L
Thiobencarb	0.001 mg/L
Turbidity	5 Units
Zinc	5.0 mg/L

Table 64449-B
Secondary Maximum Contaminant Levels - Ranges

<i>Constituent, Units</i>	<i>Maximum Contaminant Level Ranges</i>		
	<i>Recommended</i>	<i>Upper</i>	<i>Short Term</i>
Total Dissolved Solids, mg/L or	500	1,000	1,500
Specific Conductance, micromhos	900	1,600	2,200
Chloride, mg/L	250	500	600
Sulfate, mg/L	250	500	600

CHAPTER 17.5. LEAD AND COPPER

ARTICLE 1. GENERAL REQUIREMENTS AND DEFINITIONS

Section 64672.3. Determination of compliance with lead and copper action levels

- (a) The lead action level is exceeded if the concentration of lead in more than 10 percent of tap water samples collected during any monitoring period conducted in accordance with Article 6 is greater than 0.015 mg/L (i.e., if the "90th percentile" lead level is greater than 0.015 mg/L).
- (b) The copper action level is exceeded if the concentration of copper in more than 10 percent of tap water samples collected during any monitoring period conducted in accordance with Article 6 is greater than 1.3 mg/L (i.e., if the "90th percentile" copper level is greater than 1.3 mg/L).

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CHAPTER 5.5. THE ELDER CALIFORNIA PIPELINE SAFETY ACT OF 1981

§51010.5. Definitions.

As used in this chapter, the following definitions apply:

(a) "Pipeline" includes every intrastate pipeline used for the transportation of hazardous liquid substances or highly volatile liquid substances, including a common carrier pipeline, and all piping containing those substances located within a refined products bulk loading facility which is owned by a common carrier and is served by a pipeline of that common carrier, and the common carrier owns and serves by pipeline at least five such facilities in the state. "Pipeline" does not include the following:

(1) An interstate pipeline subject to Part 195 of Title 49 of the Code of Federal Regulations.

(2) A pipeline for the transportation of a hazardous liquid substance in a gaseous state.

(3) A pipeline for the transportation of crude oil that operates by gravity or at a stress level of 20 percent or less of the specified minimum yield strength of the pipe.

(4) Transportation of petroleum in onshore gathering lines located in rural areas.

(5) A pipeline for the transportation of a hazardous liquid substance offshore located upstream from the outlet flange of each facility on the Outer Continental Shelf where hydrocarbons are produced or where produced hydrocarbons are first separated, dehydrated, or otherwise processed, whichever facility is farther downstream.

(6) Transportation of a hazardous liquid by a flow line.

(7) A pipeline for the transportation of a hazardous liquid substance through an onshore production, refining, or manufacturing facility, including a storage or inplant piping system associated with that facility.

(8) Transportation of a hazardous liquid substance by vessel, aircraft, tank truck, tank car, or other vehicle or terminal facilities used exclusively to transfer hazardous liquids between those modes of transportation.

(a) "Flow line" means a pipeline which transports hazardous liquid substances from the well head to a treating facility or production storage facility.

(b) "Hydrostatic testing" means the application of internal pressure above the normal or maximum operating pressure to a segment of pipeline, under no-flow conditions for a fixed period of time, utilizing a liquid test medium.

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program. The report shall include, but not necessarily be limited to, all of the following information:

- (1) Participation in watershedwide activities to improve water quality in the Canyon Lake Reservoir.
- (2) Annual results of volatile organic compounds, general minerals, and nutrients testing results provided to the department.
- (3) A summary of available monitoring in the Canyon Lake Reservoir provided to the department for giardia and cryptosporidium.
- (4) The most current sanitary survey of the watershed and water quality monitoring plan.
- (5) A summary of monthly reports provided to the department on intake water bacteria and water quality.
- (6) A summary of monthly reports provided to the department on water usage in Canyon Lake Reservoir.
- (7) An evaluation of the impact on source water quality due to recreational activities on the Canyon Lake Reservoir, including any microbiological monitoring, and a summary of monthly reports provided to the department on treatment plant performance.
- (8) A summary of activities between Elsinore Valley Municipal Water District and the Canyon Lake Property Owners Association for operation of recreational uses and facilities in a manner that optimizes the water quality.
- (9) The reservoir management plan and the operations plan.
- (10) The annual water quality reports submitted to consumers each year.

(d) If there is a change in operation of the treatment facility or a change in the quantity of water to be treated at the treatment facility, the department may require the Elsinore Valley Municipal Water District to file a report that includes, but is not limited to, the information required pursuant to subdivision (c), and the district shall demonstrate to the satisfaction of the department that water quality will not be adversely affected.

(e) This section shall remain in effect only until January 1, 2008, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2008, deletes or extends that date.

§115845. Fees

The public agency operating any water supply reservoir that is open for recreational use pursuant to this article may charge a use fee to cover the cost of policing the area around the reservoir, including the cost of providing the necessary sanitary facilities and other costs incidental to the recreational use of the reservoir.

§115850. Terminal reservoir exemption

This article does not apply to terminal reservoirs for the supply of domestic water.

PART 12. DRINKING WATER

CHAPTER 4. CALIFORNIA SAFE DRINKING WATER ACT

Article 1. Pure and Safe Drinking Water

§116270. Declaration

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The Legislature finds and declares all of the following:

- (a) Every citizen of California has the right to pure and safe drinking water.
- (b) Feasible and affordable technologies are available and shall be used to remove toxic contaminants from public water supplies.
- (c) According to the State Department of Health Services, over 95 percent of all large public water systems in California are in compliance with health-based action levels established by the department for various contaminants.
- (d) It is the policy of the state to reduce to the lowest level feasible all concentrations of toxic chemicals that when present in drinking water may cause cancer, birth defects, and other chronic diseases.
- (e) This chapter is intended to ensure that the water delivered by public water systems of this state shall at all times be pure, wholesome, and potable. This chapter provides the means to accomplish this objective.
- (f) It is the intent of the Legislature to improve laws governing drinking water quality, to improve upon the minimum requirements of the federal Safe Drinking Water Act Amendments of 1996, to establish primary drinking water standards that are at least as stringent as those established under the federal Safe Drinking Water Act, and to establish a program under this chapter that is more protective of public health than the minimum federal requirements.
- (g) It is the further intent of the Legislature to establish a drinking water regulatory program within the State Department of Health Services in order to provide for the orderly and efficient delivery of safe drinking water within the state and to give the establishment of drinking water standards and public health goals greater emphasis and visibility within the state department.

§116275. Definitions

As used in this chapter:

- (a) "Contaminant" means any physical, chemical, biological, or radiological substance or matter in water.
- (b) "Department" means the State Department of Health Services.
- (c) "Primary drinking water standards" means:
 - (1) Maximum levels of contaminants that, in the judgment of the department, may have an adverse effect on the health of persons.
 - (2) Specific treatment techniques adopted by the department in lieu of maximum contaminant levels pursuant to subdivision (j) of Section 116365.
 - (3) The monitoring and reporting requirements as specified in regulations adopted by the department that pertain to maximum contaminant levels.

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(d) "Secondary drinking water standards" means standards that specify maximum contaminant levels that, in the judgment of the department, are necessary to protect the public welfare. Secondary drinking water standards may apply to any contaminant in drinking water that may adversely affect the odor or appearance of the water and may cause a substantial number of persons served by the public water system to discontinue its use, or that may otherwise adversely affect the public welfare. Regulations establishing secondary drinking water standards may vary according to geographic and other circumstances and may apply to any contaminant in drinking water that adversely affects the taste, odor, or appearance of the water when the standards are necessary to assure a supply of pure, wholesome, and potable water.

(e) "Human consumption" means the use of water for drinking, bathing or showering, hand washing, or oral hygiene.

(f) "Maximum contaminant level" means the maximum permissible level of a contaminant in water.

(g) "Person" means an individual, corporation, company, association, partnership, limited liability company, municipality, public utility, or other public body or institution.

(h) "Public water system" means a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A public water system includes the following:

(1) Any collection, treatment, storage, and distribution facilities under control of the operator of the system which are used primarily in connection with the system.

(2) Any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system.

(3) Any water system that treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption.

(i) "Community water system" means a public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents of the area served by the system.

(j) "Noncommunity water system" means a public water system that is not a community water system.

(k) "Nontransient noncommunity water system" means a public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year.

(l) "Local health officer" means a local health officer appointed pursuant to Section 101000 or a local comprehensive health agency designated by the board of supervisors pursuant to Section 101275 to carry out the drinking water program.

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(m) "Significant rise in the bacterial count of water" means a rise in the bacterial count of water that the department determines, by regulation, represents an immediate danger to the health of water users.

(n) "State small water system" means a system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year.

(o) "Transient noncommunity water system" means a noncommunity water system that does not regularly serve at least 25 of the same persons over six months per year.

(p) "User" means any person using water for domestic purposes. User does not include any person processing, selling, or serving water or operating a public water system.

(q) "Waterworks standards" means regulations adopted by the department that take cognizance of the latest available "Standards of Minimum Requirements for Safe Practice in the Production and Delivery of Water for Domestic Use" adopted by the California section of the American Water Works Association.

(r) "Local primacy agency" means any local health officer that has applied for and received primacy delegation from the department pursuant to Section 116330.

(s) "Service connection" means the point of connection between the customer's piping or constructed conveyance, and the water system's meter, service pipe, or constructed conveyance. A connection to a system that delivers water by a constructed conveyance other than a pipe shall not be considered a connection in determining if the system is a public water system if any of the following apply:

(1) The water is used exclusively for purposes other than residential uses, consisting of drinking, bathing, and cooking or other similar uses.

(2) The department determines that alternative water to achieve the equivalent level of public health protection provided by the applicable primary drinking water regulation is provided for residential or similar uses for drinking and cooking.

(3) The department determines that the water provided for residential or similar uses for drinking, cooking, and bathing is centrally treated or treated at the point of entry by the provider, a passthrough entity, or the user to achieve the equivalent level of protection provided by the applicable primary drinking water regulations.

(t) "Resident" means a person who physically occupies, whether by ownership, rental, lease or other means, the same dwelling for at least 60 days of the year.

(u) "Water treatment operator" means a person who has met the requirements for a specific water treatment operator grade pursuant to Section 106875.

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(v) "Water treatment operator-in-training" means a person who has applied for and passed the written examination given by the department but does not yet meet the experience requirements for a specific water treatment operator grade pursuant to Section 106875.

(w) "Water distribution operator" means a person who has met the requirements for a specific water distribution operator grade pursuant to Section 106875.

(x) "Water treatment plant" means a group or assemblage of structures, equipment, and processes that treat, blend, or condition the water supply of a public water system for the purpose of meeting primary drinking water standards.

(y) "Water distribution system" means any combination of pipes, tanks, pumps, and other physical features that deliver water from the source or water treatment plant to the consumer.

(z) "Public health goal" means a goal established by the Office of Environmental Health Hazard Assessment pursuant to subdivision (c) of Section 116365.

§116280. Condition for exclusion

This chapter does not apply to a public water system that meets all of the following conditions:

(a) Consists only of distribution and storage facilities and does not have any collection and treatment facilities.

(b) Obtains all of its water from, but is not owned or operated by, a public water system to which this chapter applies.

(c) Does not sell water to any person or user, except for the sale of water to users pursuant to Section 2705.5 of the Public Utilities Code through a submetered service system if the water supply is obtained from a public water system to which this chapter applies.

By enacting this subdivision, it is not the intent of the Legislature to change existing law as to responsibility or liability for distribution systems beyond the mastermeter.

§116282. Handwashing exemption

Except as provided in this section, and except for the fee requirements of Section 116565, the department shall exempt from the water quality requirements of this chapter, any noncommunity water system serving a transient population that provides restrooms for employees or the public provided that the water system demonstrates to the department that it meets all of the following criteria:

(a) The water system is in compliance with either of the following:

(1) No water is served by the water system for any public human consumption other than for handwashing.

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titled "Notice of Compliance with Safe Drinking Water Requirements" that states that the "Notice of Noncompliance with Safe Drinking Water Requirements" has no further force or effect.

(f) A water district subject to this section shall annually publish a notice in a newspaper of general circulation describing any requirements and actions prescribed by the department to be taken by the water district and any record of compliance by the water district with these requirements and actions.

(g) This section shall not relieve a water district from complying with any other provisions of law.

§116290. Agricultural exclusion

Before August 6, 1998, in areas where the water service rendered by a person is primarily agricultural, and domestic service is only incidental thereto, this chapter shall not apply except in specific areas in which the department has found its application to be necessary for the protection of the public health and has given written notice thereof to the person furnishing or supplying water in the area.

The department may prescribe reasonable and feasible action to be taken by those persons or the users to insure that their domestic water will not be injurious to health.

§116293. PHG for perchlorate

(a) On January 1, 2003, the Office of Environmental Health Hazard Assessment shall perform a risk assessment and, based upon that risk assessment, shall adopt a public health goal based exclusively on public health consideration for perchlorate using the criteria set forth in subdivision (c) of Section 116365.

(b) On or before January 1, 2004, the department shall adopt a primary drinking water standard for perchlorate found in public water systems in California in a manner that is consistent with this chapter.

Article 2. Department and Local Responsibilities

§116325. Department responsibility for all public water systems

The department shall be responsible for ensuring that all public water systems are operated in compliance with this chapter and any regulations adopted hereunder. The department shall directly enforce this chapter for all public water systems except as set forth in Section 116500.

§116330. Local primacy delegation

(a) The department may delegate primary responsibility for the administration and enforcement of this chapter within a county to a local health officer authorized by the board of supervisors to assume these duties, by means of a local primacy delegation agreement if the local health officer demonstrates that it has the capability to meet the local primacy program requirements established by the department pursuant to subdivision (h) of Section 116375. This

delegation shall not include the regulation of community water systems serving 200 or more service connections. The local primacy agreement may contain terms and conditions that the department deems necessary to carry out this chapter. The local primacy agreement shall provide that, although the local primacy agency shall be primarily responsible for administration and enforcement of this chapter for the designated water systems, the department does not thereby relinquish its authority, but rather shall retain jurisdiction to administer and enforce this chapter for the designated water systems to the extent determined necessary by the department.

(b) Any local health officer seeking a local primacy delegation shall submit an application to the department. The application shall be submitted by March 1, 1993, for local health officers seeking local primacy agreements for the 1993-94 fiscal year. Thereafter, the application shall be submitted by January 1, of the fiscal year immediately preceding the commencement of the fiscal year for which the local primacy delegation is sought. The application shall be in the format, and shall contain information, required by the department. The department shall approve the application for primacy if the department determines that the local health officer is capable of meeting the primacy program requirements established by the department.

(c) A local primacy delegation approved by the department shall remain in effect until any of the following conditions occur:

(1) The delegation is withdrawn by mutual agreement.

(2) The local primacy agency provides 120-day advance written notice to the department that it no longer wishes to retain local primacy.

(3) The department determines that the local primacy agency no longer complies with the department's local primacy program requirements. The department shall provide written notice to the local primacy agency and the board of supervisors and shall provide an opportunity for a public hearing prior to initiation of any local primacy revocation action by the department.

(d) The department shall evaluate the drinking water program of each local primacy agency at least annually. The department shall prepare a report of the evaluation and list any program improvements needed to conform to the department's local primacy program requirements. A copy of the evaluation report shall be provided to the local primacy agency and the board of supervisors. The local primacy agency shall be granted a reasonable amount of time to make any needed program improvements prior to the initiation of any local primacy revocation actions.

(e) To the extent funds are available in the Safe Drinking Water Account, the department shall provide the local primacy agency with an annual drinking water surveillance program grant to cover the cost of conducting the inspection, monitoring, surveillance, and water quality evaluation activities specified in the local primacy agreement. The annual program grant pursuant to this subdivision shall not exceed the amount that the department determines would be necessary for the department to conduct inspection, monitoring, surveillance, and water quality evaluation activities in the absence of a local primacy agreement for those systems in that county.

(f) The local primacy agency shall act for the department as the primary agency responsible for the administration and enforcement of this chapter for the specified public water systems and shall be empowered with all of the authority granted to the department by this chapter over those water systems.

§116340. State small water systems

This chapter shall not apply to state small water systems except as provided under this section:

(a) The department shall adopt regulations specifying minimum requirements for operation of a state small water system. The requirements may be less stringent than the requirements for public water systems as set forth in this chapter.

(b) The minimum requirements for state small water systems adopted by the department pursuant to subdivision (a) shall be enforced by the local health officer or a local health agency designated by the local health officer. In counties that do not have a local health officer, the requirements shall be enforced by the department. Local health agencies may adopt more stringent requirements for state small water systems than those specified in the state regulations.

(c) The reasonable costs of the local health officer in carrying out the requirements of this section may be recovered through the imposition of fees on state small water systems by the local governing body in accordance with Section 101325.

§116345. County monthly report and Department 3-year review

(a) The local health officer shall submit a report monthly to the department regarding the status of compliance with this chapter by the public water systems under the jurisdiction of the local health officer. The report shall be in a form and manner prescribed by the department.

(b) The department shall review the public water system program of the local health officer at least every three years to assure compliance with this chapter. A report of the findings of the review along with any recommendations of the department shall be provided to the local health officer and the board of supervisors.

Article 3. Operations

§116350. Department responsibilities

(a) The department shall administer the provisions of this chapter and all other provisions relating to the regulation of drinking water to protect public health.

(b) The department shall also have the following responsibilities:

(1) Conduct research, studies, and demonstration projects relating to the provision of a dependable, safe supply of drinking water, including, but not limited to, all of the following:

(A) Improved methods to identify and measure the existence of contaminants in drinking water and to identify the source of the contaminants.

(B) Improved methods to identify, measure, and assess the potential adverse health effects of contaminants in drinking water.

(C) New methods of treating raw water to prepare it for drinking, so as to improve the efficiency of water treatment and to remove or reduce contaminants.

(D) Improved methods for providing a dependable, safe supply of drinking water, including improvements in water purification and distribution, and methods of assessing health-related hazards.

(E) Improved methods of protecting the water sources of public water systems from contamination.

(F) Alternative disinfection technologies that minimize, reduce, or eliminate hazardous disinfection byproducts.

(2) Enforce provisions of the federal Safe Drinking Water Act and regulations adopted pursuant thereto.

(3) Adopt regulations to implement this chapter.

(c) The department may conduct studies and investigations as it deems necessary to assess the quality of private domestic water wells.

§116355. Safe Drinking Water Plan

(a) Once every five years the department shall submit to the Legislature a comprehensive Safe Drinking Water Plan for California.

(b) The Safe Drinking Water Plan shall include, but not be limited to, the following information:

(1) An analysis of the overall quality of California's drinking water and the identification of specific water quality problems.

(2) Types and levels of contaminants found in public drinking water systems that have less than 10,000 service connections. The discussion of these water systems shall include the following:

(A) Estimated costs of requiring these systems to meet primary drinking water standards and public health goals.

(B) Recommendations for actions that could be taken by the Legislature, the department, and these systems to improve water quality.

(4) A discussion and analysis of the known and potential health risks that may be associated with drinking water contamination in California.

(5) An evaluation of how existing water quality information systems currently maintained by local or state agencies can be more effectively used to protect drinking water.

(6) An evaluation of the research needed to develop inexpensive methods and instruments to ensure better screening and detection of waterborne chemicals, and inexpensive detection methods that could be used by small utilities and consumers to detect harmful microbial agents in drinking water.

(7) An analysis of the technical and economic viability and the health benefits of various treatment techniques that can be used to reduce levels of trihalomethanes, lead, nitrates, synthetic organic chemicals, micro-organisms, and other contaminants in drinking water.

§116485. Exemption for emergency grants

Any remedial action taken or contracted for by the department pursuant to Section 116480 shall be exempt from the following provisions:

(a) State Contract Act provided for pursuant to Chapter 1 (commencing with Section 10100) of Part 2 of Division 2 of the Public Contract Code.

(b) Chapter 10 (commencing with Section 4525) of Division 5 of Title 1 of the Government Code.

(c) Section 14780 of the Government Code and Article 5 (commencing with Section 10355) of Chapter 2 of Part 2 of Division 2 of the Public Contract Code.

(d) Article 4 (commencing with Section 10335) of Chapter 2 of Part 2 of Division 2 of the Public Contract Code.

Article 6. Enforcement Responsibility

§116500. Contract county authority

This chapter shall be enforced directly by the department for all public water systems, including state small water systems, in any county that does not have a local health officer, or contracts with the department for environmental health services pursuant to Section 1157 and elects not to enforce this chapter.

Article 7. Requirements and Compliance

§116525. Permits

(a) No person shall operate a public water system unless he or she first submits an application to the department and receives a permit as provided in this chapter. A change in ownership of a public water system shall require the submission of a new application.

(b) The department may require a new application whenever a change in regulatory jurisdiction has occurred.

(c) The department may renew, reissue, revise, or amend any domestic water supply permit whenever the department deems it to be necessary for the protection of public health whether or not an application has been filed.

§116530. Technical report

A public water system shall submit a technical report to the department as part of the permit application or when otherwise required by the department. This report may include, but not be limited to, detailed plans and specifications, water quality information, and physical descriptions of the existing or proposed system, and financial assurance information.

§116535. Permits application review

Upon determination that an application submitted pursuant to this chapter is complete, the department shall make a thorough investigation of the proposed or existing plant, works, system,

or water supply, and all other circumstances and conditions that it deems material, including any required financial assurance information.

§116540. Issue, deny or conditional permits

Following completion of the investigation and satisfaction of the requirements of subdivisions (a) and (b), the department shall issue or deny the permit. The department may impose permit conditions, requirements for system improvements, and time schedules as it deems necessary to assure a reliable and adequate supply of water at all times that is pure, wholesome, potable, and does not endanger the health of consumers.

(a) No public water system that was not in existence on January 1, 1998, shall be granted a permit unless the system demonstrates to the department that the water supplier possesses adequate financial, managerial, and technical capability to assure the delivery of pure, wholesome, and potable drinking water. This section shall also apply to any change of ownership of a public water system that occurs after January 1, 1998.

(b) No permit under this chapter shall be issued to an association organized under Title 3 (commencing with Section 20000) of Division 3 of the Corporations Code. This section shall not apply to unincorporated associations that as of December 31, 1990, are holders of a permit issued under this chapter.

§116545. Public hearings

Prior to the issuance of any new, revised, renewed, or amended permit, or the denial of a permit, the department may conduct a public hearing to obtain additional public comment. Notice of the hearing shall be provided to the applicant and interested persons at least 30 days prior to the hearing. The department may require the applicant to distribute the notice of the hearing to affected consumers.

§116550. Changes requiring amended permit

(a) No person operating a public water system shall modify, add to or change his or her source of supply or method of treatment of, or change his or her distribution system as authorized by a valid existing permit issued to him or her by the department unless the person first submits an application to the department and receives an amended permit as provided in this chapter authorizing the modification, addition, or change in his or her source of supply or method of treatment.

(b) Unless otherwise directed by the department, changes in distribution systems may be made without the submission of a permit application if the changes comply in all particulars with the waterworks standards.

§116551. Augmentation of source with recycled water

The department shall not issue a permit to a public water system or amend a valid existing permit for the use of a reservoir as a source of supply that is directly augmented with recycled water, as defined in subdivision (n) of Section 13050 of the Water Code, unless the department does all of the following:

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(a) Performs an engineering evaluation that evaluates the proposed treatment technology and finds that the proposed technology will ensure that the recycled water meets or exceeds all applicable primary and secondary drinking water standards and poses no significant threat to public health.

(b) Holds at least three duly noticed public hearings in the area where the recycled water is proposed to be used or supplied for human consumption to receive public testimony on that proposed use. The department shall make available to the public, not less than 10 days prior to the date of the first hearing held pursuant to this subdivision, the evaluations and findings made pursuant to subdivision (a).

§116555. Operational requirements

(a) Any person who owns a public water system shall ensure that the system does all of the following:

- (1) Complies with primary and secondary drinking water standards.
- (2) Will not be subject to backflow under normal operating conditions.
- (3) Provides a reliable and adequate supply of pure, wholesome, healthful, and potable water.
- (4) Employs or utilizes only water treatment operators or water treatment operators-in-training that have been certified by the department at the appropriate grade.
- (5) Complies with the operator certification program established pursuant to Chapter 4 (commencing with Section 106875).

(b) Any person who owns a community water system or a nontransient noncommunity water system shall do all of the following:

- (1) Employ or utilize only water distribution system operators who have been certified by the department at the appropriate grade for positions in responsible charge of the distribution system.
- (2) Place the direct supervision of the water system, including water treatment plants, water distribution systems, or both under the responsible charge of an operator or operators holding a valid certification equal to or greater than the classification of the treatment plant and the distribution system.

§116556. Redwood Valley County Water District exemption

Notwithstanding subdivision (c) of Section 116555 and its implementing regulations, including Sections 64562 and 64568 of the California Code of Regulations, the Redwood Valley County Water District, in order to relieve hardship, may make not more than 135 new 3/4-inch equivalent domestic service connections to its water system if all of the following conditions are met:

(a) The district has a contract, agreement, or independent water right to divert water from Lake Mendocino or another adequate source of water supply.

(b) Redwood Valley is an allowed place of use under that contract, agreement, or water right.

January 3, 2006

CHAPTER 13. OPERATOR CERTIFICATION

Article 1. Definitions

§63750.10. Accredited Academic Institution.

"Accredited academic institution" means an academic institution accredited by the Western Association of Schools and Colleges or an accrediting organization recognized by the Council of Post Secondary Education.

§63750.15. Certificate.

"Certificate" means a certificate of competency issued by the Department stating that the operator has met the requirements for a specific operator classification of the certification program.

§63750.20. Certified Distribution Operator.

"Certified distribution operator" means a distribution operator who possesses a valid certificate issued pursuant to this chapter.

§63750.25. Chief Operator.

"Chief operator" means the person who has overall responsibility for the day-to-day, hands-on, operation of a water treatment facility or the person who has overall responsibility for the day-to-day, hands-on, operation of a distribution system.

§63750.30. Comprehensive Operator Training Program.

"Comprehensive Operator Training Program" means an on-the-job training program that allows an operator to gain proficiency in all systems and processes related to a water treatment facility.

§63750.35. Contact Hour.

"Contact hour" means not less than 50 minutes of specialized training or a continuing education course.

§63750.40. Continuing Education Course.

"Continuing education course" means a presentation that transmits information related to the operation of a treatment facility and/or distribution system.

§63750.45. Distribution Operator.

"Distribution operator" means any person who maintains or operates any portion of a distribution system.

§63750.50. Distribution System.

"Distribution system" means any combination of pipes, tanks, pumps, etc., which delivers drinking water from a source or treatment facility to the consumer and includes:

(a) Disinfection facilities for which no *Giardia* or virus reduction is required pursuant to §64654 (a).

(b) The composite of all distribution systems of a public water system.

§63750.55. GED.

"GED" means a general equivalency diploma.

§63750.60. Interim Distribution Operator Certificate.

"Interim Distribution Operator Certificate" means a certificate issued by the Department pursuant to §63810.

§63750.65. Operator Experience.

"Operator experience" means the daily performance of activities consisting of the control or oversight of any process or operation at a water treatment facility or in a distribution system that may affect the quality or quantity of water.

§63750.70. Shift Operator.

"Shift operator" means a person in direct charge of the operation of a water treatment facility or distribution system for a specified period of the day.

§63750.75. Specialized Training.

"Specialized training" means college level courses providing at least 36 contact hours of training each in drinking water or waste water quality, drinking water or waste water treatment, drinking water distribution, or drinking water or waste water facility operation, offered by an accredited academic institution or an organization either accredited by the International Association of Continuing Education Training (IACET) or an authorized provider of IACET, or courses completed and deemed acceptable by the Department prior to January 1, 2001 for the purpose of operator certification.

§63750.85. Water treatment facility.

"Water treatment facility" means a group or assemblage of structures, equipment, and processes that treat or condition a water supply, affecting the physical, chemical, or bacteriological quality of water distributed or otherwise offered to the public for domestic use by a public water system as defined in Health and Safety Code §116275. Facilities consisting of only disinfection for which no *Giardia* or virus reduction is required pursuant to §64654(a) and which are under the control of a certified distribution operator are not included as water treatment facilities.

Article 2. Operator Certification Grades

§63765. Water Treatment Facility Staff Certification Requirements.

- (a) Except as provided in (c), chief and shift operators shall possess valid operator certificates pursuant to Table 63765-A.

TABLE 63765-A
Minimum Certification Requirements for Chief and Shift Operators

<i>Treatment Facility Classification</i>	<i>Minimum Certification of Chief Operator</i>	<i>Minimum Certification of Shift Operator</i>
T1	T1	T1
T2	T2	T1
T3	T3	T2

T4	T4	T3
T5	T5	T3

(b) Treatment operators not designated by the water supplier as chief or shift operator pursuant to §64413.5 shall be certified but may hold certificates of any grade.

(c) Until January 1, 2003, a shift and/or chief operator may continue to be employed in that capacity provided that the operator:

(1) Is in compliance with the certification requirements that were in effect on December 31, 2000, and

(2) Has been in continuous employment since December 31, 2000 in a water treatment facility that has not modified its treatment process resulting in a change in classification.

(d) Operators who possessed treatment operator certificates valid as of December 31, 2000 shall be deemed to hold certificates pursuant to Table 63765-B.

TABLE 63765-B
Certificate Grade Equivalents

<i>Operator Certification Grades December 31, 2000</i>	<i>Operator Certification Grades January 1, 2001</i>
I	T1
II	T2
III	T3
IV	T4
V	T5

§63770. Distribution System Staff Certification Requirements.

(a) Chief and shift operators shall possess valid operator certificates pursuant to Table 63770-A.

Table 63770-A
Minimum Certification Requirements for Chief and Shift Operators

<i>Distribution System Classification</i>	<i>Minimum Certification of Chief Operator</i>	<i>Minimum Certification of Shift Operator</i>
D1	D1	D1
D2	D2	D1
D3	D3	D2
D4	D4	D3
D5	D5	D3

(b) Water systems shall utilize only certified distribution operators to make decisions addressing the following operational activities:

- (1) Install, tap, re-line, disinfect, test and connect water mains and appurtenances.
- (2) Shutdown, repair, disinfect and test broken water mains.
- (3) Oversee the flushing, cleaning, and pigging of existing water mains.
- (4) Pull, reset, rehabilitate, disinfect and test domestic water wells.
- (5) Stand-by emergency response duties for after hours distribution system operational emergencies.
- (6) Drain, clean, disinfect, and maintain distribution reservoirs.

(c) Water systems shall utilize either certified distribution operators or treatment operators that have been trained to make decisions addressing the following operational activities:

- (1) Operate pumps and related flow and pressure control and storage facilities manually or by using a system control and data acquisition (SCADA) system.
- (2) Maintain and/or adjust system flow and pressure requirements, control flows to meet consumer demands including fire flow demands and minimum pressure requirements.

(d) Water systems shall utilize either certified distribution operators or treatment operators to make decisions addressing the following operational activities:

- (1) Determine and control proper chemical dosage rates for wellhead disinfection and distribution residual maintenance.
- (2) Investigate water quality problems in the distribution system.

Article 3. Operator Examination Criteria and Applications

§63775. Eligibility Criteria for Taking a Water Treatment Operator Examination.

(a) An applicant who has had a certificate revoked, and not reinstated, for any reason other than failure to meet renewal requirements pursuant to §63840 shall not be eligible for water treatment operator examination at any grade level.

(b) In order to be eligible for taking the T1 operator exam, an applicant shall have a high school diploma or GED. The following experience and/or training may be substituted for a high school diploma or GED:

- (1) Successful completion of the "Basic Small Water System Operations" course provided by the Department, or
- (2) One year as an operator of a facility that required an understanding of chemical feeds, hydraulic systems, and pumps.

(c) In order to be eligible for taking the T2 operator exam, an applicant shall have:

(1) A high school diploma or GED. The following experience and/or training may be substituted for a high school diploma or GED:

(A) Successful completion of the "Basic Small Water System Operations" course provided by the Department, or

(B) One year as an operator of a facility that required an understanding of chemical feeds, hydraulic systems, and pumps.

(2) Successfully completed at least one course of specialized training covering the fundamentals of drinking water treatment.

(d) In order to be eligible for taking the T3 operator exam, an applicant shall have:

(h) A certificate replacement fee of \$25 shall be paid by any certificate holder requesting to have a lost, stolen, or destroyed certificate replaced.

CHAPTER 14. WATER PERMITS

Article 1. Applications

§64001. Water Permit Application.

(a) Within 30 calendar days of receipt of an application for a permit or petition for permit modification pursuant to Section 40119 or 401910, Health and Safety Code, the Department shall inform the applicant in writing that it is either complete and accepted for filing or that it is deficient and what specific information or documentation is required to complete the application. An application is considered complete if it is in compliance with the requirements of Section 401211, Health and Safety Code. For proposed water system improvements, new water systems or a "project" as defined in Section 15378, Title 14, California Administrative Code where environmental documentation is required, a copy of such documentation shall be included in the application.

(b) Within 90 calendar days from the date of filing of a completed application, the Department shall inform the applicant in writing of its decision regarding an application.

§64002. Processing Time.

The Department's time periods for processing an application from the receipt of the initial application to the final decision regarding issuance or denial of a water permit based on the Department's actual performance during the two years preceding the proposal of this section, were as follows:

- (a) The median time was--7.5 months
- (b) The minimum time was--1.5 months
- (c) The maximum time was--85.5 months

§64197. Service Connection Fee.

(a) Each public water system serving at least 200 service connections shall pay to the Department a one time fee of fifty cents (\$0.50) for each service connection it serves. The fee shall be submitted to the Department no later than April 30, 1991.

(b) The fee shall be based on the number of service connections previously reported to the Department for the calendar year 1989.

9 Section 4011 has been recodified to 116525. OAL has been notified of this by request for a "change without regulatory effect".

10 Section 4019 has been recodified to 116550. OAL has been notified of this by request for a "change without regulatory effect".

11 Section 4012 has been recodified to 116530. OAL has been notified of this by request for a "change without regulatory effect".

Article 3. State Small Water Systems

§64211. Permit Requirement.

(a) No person shall operate a state small water system unless a permit to operate the system has been issued by the local health officer. Within 30 calendar days of receipt of an application for a permit, the local health officer shall inform the applicant in writing that the application is either complete and accepted for filing or that it is deficient and what specific information or documentation is required to complete the application.

(b) The state small water system shall submit a technical report to the local health officer as part of the permit application. The report shall describe the proposed or existing system as follows: service area, distribution system including storage and pumping facilities, the water source including source capacity, water quality, and any water treatment facilities. The report shall identify the owner of the system and the party responsible for day to day operation of the system. The report shall include a plan for notification of those served by the system under emergency conditions. The report shall describe the operating plan for the system and shall specify how the responsible party will respond to failure of major system components.

(c) Within 90 calendar days from the date of filing of a completed application, the local health officer shall inform the applicant in writing of its decision regarding an application.

(d) A change in ownership of a state small water system shall require the submission of a new application.

(e) By July 1, 1992, each state small water system in existence on January 1, 1992, shall submit to the local health officer a plan for notification of those served by the system under emergency conditions.

(f) Each state small water system shall provide the following notice to the consumers served by the state small water system: "The domestic water supply for this area is provided by a state small water system. State regulatory requirements for operation of a state small water system are less extensive than requirements for larger public water systems. If you have questions concerning your water supply, you should contact [insert (1) name of water system, (2) name of responsible person, and (3) telephone number] or your local health department." This notice shall be by direct delivery on an annual basis or by continuous posting at a central location within the area served by the state small water system.

§64212. Bacteriological Quality Monitoring.

(a) Each water supplier operating a state small water system shall collect a minimum of one routine sample from the distribution system at least once every three months. The sample shall be analyzed for the presence of total coliform bacteria by a laboratory certified by the Department for bacteriological analyses pursuant to Section 402512 of the Health and Safety Code. The results of the analyses shall be reported to the local health officer no later than the 10th day of the month following receipt of the results by the state small water system.

12 Section 4025 has been recodified to 116390. OAL has been notified of this by request for a "change without regulatory effect".

(b) If any routine sample is total coliform-positive, the water supplier shall collect a repeat sample from the same location within 48 hours of being notified of the positive result. If the repeat sample is also total coliform-positive, the sample shall also be analyzed for the presence of fecal coliforms or *Escherichia coli* (E. Coli). The water supplier shall notify the local health officer within 48 hours from the time the results are received and shall take corrective actions as directed by the local health officer to eliminate the cause of the positive samples.

(c) The local health office may require a state small water system to sample the distribution system each month, in lieu of the requirements of subsection (a), if the system has bacteriological contamination problems indicated by more than one total-coliform positive sample during the most recent 24 months of operation. The monthly sample shall be analyzed for the presence of total coliform bacteria by a laboratory certified by the Department for bacteriological analyses pursuant to Section 4025¹³ of the Health and Safety Code. The results of the analyses shall be reported to the local health officer no later than the 10th day of the month following receipt of the results by the state small water system.

§64213. Chemical Quality Monitoring.

(a) Each water supplier operating a state small water system shall sample each source of supply prior to any treatment at least once. The sample shall be analyzed by a laboratory, certified by the Department pursuant to Section 4025¹⁷ of the Health and Safety Code, for fluoride, iron, manganese, chlorides, total dissolved solids, and the inorganic chemicals listed in Table 64431-A, Section 64431(a).

(b) Each groundwater source which has been designated as vulnerable by the local health officer pursuant to criteria set forth in Sections 64445(d)(1) and (2) shall be sampled by the water supplier operating the state small water system at least once prior to any treatment and analyzed for volatile organic compounds according to Environmental Protection Agency Method 502.2, "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water," September 1986. The analysis shall be performed by a laboratory certified by the Department to perform Method 502.2 analyses for organic chemicals pursuant to Section 4025¹⁷ of the Health and Safety Code.

(c) The results of the laboratory analyses shall be submitted to the local health officer by the state small water system no later than the 10th day of the month following receipt of the results by the state small water system. A copy of the results of the analyses and a comparison of the results with the maximum contaminant levels for those contaminants listed in Table 64431-A and B, Section 64431(a) and Table 64444-A, Section 64444 shall be distributed by the state small water system to each regular user of the water system within 90 days of receiving the results. A copy of the distribution notice shall be provided to the local health officer.

¹³ Section 4025 has been recodified to 116390. OAL has been notified of this by request for a "change without regulatory effect".

(d) The water supplier operating a state small water system shall comply with any corrective actions ordered by the local health officer for any chemical contaminant which exceeds the maximum contaminant level.

§64214. Service Connection Limitation.

No state small water system shall add additional service connections to the system such that the total number of service connections served by the system exceeds 14 before the water system has applied for and received a permit to operate as a public water system from the Department.

§64215. Water Supply Requirements.

Prior to receiving permit approval, a state small water system which was not in existence on November 12, 1991 shall demonstrate to the local health officer that sufficient water is available from the water system's sources and distribution storage facilities to supply a minimum of three gallons per minute for at least 24 hours for each service connection served by the system.

§64216. Mutual Associations Prohibited.

No state small water system which was not in existence on November 12, 1991 shall be issued a permit to operate if the water supplier is an unincorporated association organized under Title 3 (commencing with Section 20000) of Division 3 of the Corporations Code.

§64217. Surface Water Treatment Requirement.

All state small water systems using surface water as a source of supply shall provide continuous disinfection treatment of the water prior to entry to the distribution system.

Article 4. Local Primacy Delegation

§64251. Definitions.

(a) For the purpose of this Article the following definitions shall apply:

(1) "Small Water System" means a community water system except those serving 200 or more service connections, or any noncommunity or nontransient noncommunity water system.

(2) "Primacy Delegation Agreement" means the document, issued by the department and signed by the local health officer, delegating primacy to a local health officer.

(3) "Routine Inspection" means an on-site review of a small water system which includes, but is not limited to, inspections of system operations, operation and maintenance records, system facilities and equipment.

(4) "Sanitary Survey" means an on-site review of a small water system which includes, in addition to the elements of a routine inspection, an evaluation of the watershed for surface water sources and vulnerability assessments for groundwater sources.

§64252. Primacy Delegation Application.

(a) The primacy delegation application submitted by a local health officer pursuant to section 116330 of the Health and Safety Code shall describe how the primacy requirements of this article will be complied with and shall contain the following information relating to the small water system program to be delegated:

(1) The number of staff persons, percentage of time and personnel classification of each staff person, and a description of the program responsibilities of each person involved in the small water system program.

(2) A proposed program budget projecting both revenues and expenditures for the first year of the program. The expenditures categories shall include personnel, general expense (i.e. rent, supplies and communications), travel, equipment, data management, any other specific services to be provided (e.g. laboratory), administrative overhead and other indirect charges. The anticipated revenues shall specify all planned sources of revenues to be used for support of the small water system program.

(3) A description of engineering and legal resources to be used in conducting the program.

(4) A description of the electronic data management system to be used to comply with the requirements of section 64256 (e) and the compatibility of the proposed system with the data management system used by the department.

(5) A description of the current status of compliance with Division 5, Part 1, Chapter 7; Division 104, Part 1, Chapters 4 and 5; Division 104, Part 12, Chapters 1 through 6 of the Health and Safety Code and California Code of Regulations, Title 22, Division 4 Chapters 15, 17, and 17.5 of the small water systems within the county. This description shall include the following:

(A) All violations of drinking water monitoring or reporting requirements by any of the systems during the 12 months preceding the submission of the application for primacy.

(B) All violations of standards of California Code of Regulations, Title 22, Division 4, Chapters 15, 17, and 17.5 during the 12 months preceding the submission of the application for primacy.

(C) All enforcement actions against small water systems taken by the county during the 12 months preceding the submission of the application for primacy.

(6) A current inventory list of the small water systems within the county. For each small water system the inventory list shall specify the system name, water system identification number, mailing address, type of system (community, nontransient noncommunity or noncommunity), name and address and phone number of the responsible party, type of ownership, type of water source, type of treatment if any, dates of operation for seasonally operated systems, and either:

(A) for a community water system, the number of service connections; or

(B) for a noncommunity or nontransient noncommunity water system, the average monthly population served.

(b) For applications submitted by March 1, 1993, the primacy application shall demonstrate that the local primacy program requirements specified in Article 4.1, sections 64253 through 64258 will be complied with by June 30, 1994. If these requirements cannot be fully complied with by June 30, 1994, the application shall set forth a priority implementation schedule for activities to be conducted such that the program requirements will be fully complied with by June 30, 1995.

(c) For applications submitted for fiscal years subsequent to the fiscal year 1993-94, the application shall demonstrate that the local primacy agency will be able to immediately

(b) The workplan developed pursuant to subsection (a) shall describe the activities proposed to be performed by the local primacy agency during the forthcoming fiscal year and shall include:

(1) The anticipated number of new small water system permits to be issued and the proposed number of existing community or noncommunity permits (designated by category) to be updated or amended.

(2) A description of how the small water system inventory specified in section 64255 (a) will be maintained.

(3) A description of how the surveillance activities specified in section 64255 (b) through (f) will be conducted and the priorities to be used in determining the activities to be performed.

(4) The number of planned routine inspections and sanitary surveys to be performed for each category of small water systems (community, noncommunity and nontransient noncommunity).

(5) A listing of small water systems proposed for enforcement action and the priorities to be used in determining these systems.

CHAPTER 15. DOMESTIC WATER QUALITY AND MONITORING REGULATIONS

Article 1. Definitions

§64400. Acute Risk.

“Acute Risk” means the potential for a contaminant to cause acute health effects, i.e., death, damage or illness, as a result of a single period of exposure of a duration measured in seconds, minutes, hours, or days.

§64400.10. Community Water System.

“Community water system” means a public water system which serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents.

§64400.20. Compliance Cycle.

“Compliance cycle” means the nine-year calendar year cycle during which public water systems shall monitor. Each compliance cycle consists of three three-year compliance periods. The first calendar year cycle began January 1, 1993 and ends December 31, 2001; the second begins January 1, 2002 and ends December 31, 2010; the third begins January 1, 2011 and ends December 31, 2019.

§64400.30. Compliance Period.

“Compliance period” means a three-year calendar year period within a compliance cycle. Within the first compliance cycle, the first compliance period runs from January 1, 1993 to December 31, 1995; the second from January 1, 1996 to December 31, 1998; the third from January 1, 1999 to December 31, 2001.

§64400.40. Confluent Growth.

“Confluent growth” means a continuous bacterial growth covering the entire filtration area of a membrane filter, or a portion thereof, in which bacterial colonies are not discrete.

§64400.42. Customer.

“Customer” means a service connection to which water is delivered by a community water system or a person that receives water from a nontransient-noncommunity water system for more than six months of the year.

§64400.44. Detected.

“Detected” means at or above the detection limit for purposes of reporting (DLR).

§64400.45. Detection Limit for Purposes of Reporting (DLR).

“Detection limit for purposes of reporting (DLR)” means the designated minimum level at or above which any analytical finding of a contaminant in drinking water resulting from monitoring required under this chapter shall be reported to the Department.

§64400.47. Fluoridation.

“Fluoridation” means the addition of fluoride to drinking water to achieve an optimal level, pursuant to §64433.2, that protects and maintains dental health.

§64400.50. Initial Compliance Period.

“Initial compliance period” means the first full three-year compliance period which began January 1, 1993, for existing systems. For new systems, the “initial compliance period” means the period in which the Department grants the permit.

§64400.60. Initial Finding.

“Initial finding” means the first laboratory result from a water source showing the presence of an organic chemical listed in §64444, Table 64444-A.

§64400.65. IOC.

“IOC” means inorganic chemical.

§64400.70. MCL.

“MCL” means maximum contaminant level.

§64400.80. Nontransient-noncommunity Water System.

“Nontransient-noncommunity water system” means a public water system that is not a community water system and that regularly serves at least the same 25 persons over 6 months per year.

§64401. Repeat Compliance Period.

“Repeat compliance period” means any subsequent compliance period after the initial compliance period.

§64401.10. Repeat Sample.

“Repeat sample” means a required sample collected following a total coliform-positive sample.

§64401.20. Replacement Sample.

“Replacement sample” means a sample collected to replace an invalidated sample.

§64401.30. Routine Sample.

“Routine sample” means a bacteriological sample the water supplier is required to collect on a regular basis, or one which the supplier is required to collect for a system not in compliance with Sections 64650 through 64666 when treated water turbidity exceeds 1 nephelometric turbidity unit (NTU), pursuant to §64423(b).

§64401.40. Sanitary Survey.

“Sanitary survey” means an on-site review of a public water system for the purpose of evaluating the adequacy of the water source, facilities, equipment, operation and maintenance for producing and distributing safe drinking water.

§64401.50. Significant Rise in Bacterial Count.

“Significant rise in bacterial count” means an increase in coliform bacteria, as determined in §64426, when associated with a suspected waterborne illness or disruption of physical works or operating procedures.

§64401.55. SOC.

“SOC” means synthetic organic chemical.

§64401.60. Standby Source.

“Standby source” means a source which is used only for emergency purposes pursuant to §64414.

§64401.70. System with a Single Service Connection.

“System with a single service connection” means a system which supplies drinking water to consumers via a single service line.

§64401.75. Too Numerous to Count.

“Too numerous to count” means that the total number of bacterial colonies exceeds 200 on a 47-mm diameter membrane filter used for coliform detection.

§64401.80. Total Coliform-positive.

“Total coliform-positive” means a sample result in which the presence of total coliforms has been demonstrated.

§64401.85. Transient-noncommunity Water System.

“Transient-noncommunity water system” means a public water system that is not a community water system or a nontransient-noncommunity water system.

§64401.90. Treatment.

“Treatment” means physical, biological, or chemical processes, including blending, designed to affect water quality parameters to render the water acceptable for domestic use.

§64401.95. VOC.

“VOC” means volatile organic chemical.

§64402. Vulnerable System.

“Vulnerable system” means a water system which has any water source which in the judgement of the Department, has a risk of containing an organic contaminant, based on an assessment as set forth in §64445(d)(1).

§64402.10. Water Source.

“Water source” means an individual groundwater source or an individual surface water intake. Sources which have not been designated as standby sources shall be deemed to be water sources.

§64402.20. Water Supplier.

“Water supplier”, “person operating a public water system” or “supplier of water” means any person who owns or operates a public water system. These terms will be used interchangeably in this chapter.

(a) “Wholesale water supplier,” or “wholesaler” means any person who treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption.

(b) “Retail water supplier,” or “retailer” means

(1) Any person who owns or operates any distribution facilities and any related collection, treatment, or storage facilities under the control of the operator of the public water system which are used primarily in connection with the public water system; or

(2) Any person who owns or operates any collection or pretreatment storage facilities not under the control of the operator of the public water system which are used primarily in connection with the public water system.

Article 2. General Requirements

§64412. Determination of Persons Served.

(a) The number of persons served by a community water system shall be determined by the water system using one of the following methods:

(1) Utilizing the most recent United States census data, or more recent special census data certified by the California Department of Finance, for the service area served by the water system;

(2) Multiplying the number of service connections served by the water system by 3.3 to determine the total population served;

(3) Determining the total number of dwelling units or efficiency dwelling units as defined in the Uniform Building Code (Title 24, California Code of Regulations), the number of mobile home park spaces and the number of individual business, commercial, industrial and institutional billing units served by the water system and multiplying this total by 2.8 to arrive at the total population served by the system.

(b) Each community water system shall report to the Department annually the number of persons and the number of service connections served by the system using the procedures set forth in subsection (a).

(c) The system maintains contact at least twice a week with the Department and local health departments to assess illness possibly attributable to microbial occurrence in the public drinking water system;

(d) The system has analyzed, on a monthly basis, at least the number of samples required pursuant to the approved sample siting plan and has not had an *E. coli*-positive compliance sample within the last six months, unless the system demonstrates to the Department that the occurrence is not due to contamination entering the distribution system;

(e) The system has undergone a sanitary survey conducted by the Department within the past twelve months;

(f) The system maintains a cross-connection control program in accordance with sections 7583 through 7605, title 17 of the California Code of Regulations;

(g) The system agrees to submit a biofilm control plan to the Department within twelve months of the granting of the first request for a variance;

(h) The system monitors general distribution system bacterial quality by conducting heterotrophic bacteria plate counts on at least a weekly basis at a minimum of ten percent of the number of total coliform sites specified in the approved sample siting plan (preferably using the methods in section 9215(a), 18th edition of Standard Methods for the Examination of Water and Wastewater, 1992, American Public Health Association, et. al); and

(i) The system conducts daily monitoring at distribution system total coliform monitoring sites approved by the Department and maintains a detectable disinfectant residual at a minimum of ninety-five percent of those points and a heterotrophic plate count of less than 500 colonies per ml at sites without a disinfectant residual.

(j) No water system shall be eligible for a variance or exemption from the MCL for total coliforms unless it demonstrates that the violation of the total coliform MCL is due to a persistent growth of total coliforms in the distribution system pursuant to §64426.5, rather than to fecal or pathogenic contamination, a treatment lapse or deficiency, or a problem in the operation or maintenance of the distribution system.

§64427. Sanitary Survey.

Systems which collect less than five routine samples per month shall be subject to an initial sanitary survey by the Department by June 29, 1994 for community water systems and June 29, 1999 for nontransient-noncommunity and transient-noncommunity water systems. Sanitary surveys shall be repeated every five years.

Article 4. Primary Standards--Inorganic Chemicals

§64431. Maximum Contaminant Levels--Inorganic Chemicals.

(a) The primary MCLs for the drinking water chemicals shown in Table 64431-A shall not be exceeded in the water supplied to the public.

...

Table 64431-A
Maximum Contaminant Levels
Inorganic Chemicals

<i>Chemical</i>	<i>Maximum Contaminant Level, mg/L</i>
Aluminum	1.
Antimony	0.006
Arsenic	0.05
Asbestos	7 MFL*
Barium	1.
Beryllium	0.004
Cadmium	0.005
Chromium	0.05
Cyanide	0.15
Fluoride	2.0
Mercury	0.002
Nickel	0.1
Nitrate (as NO ₃)	45.
Nitrate+Nitrite (sum as nitrogen)	10.
Nitrite (as nitrogen)	1.
Selenium	0.05
Thallium	0.002

* MFL=million fibers per liter; MCL for fibers exceeding 10 um in length.

§64432. Monitoring and Compliance--Inorganic Chemicals.

(a) All public water systems shall monitor to determine compliance with the nitrate and nitrite MCLs in Table 64431-A, pursuant to subsections 64432(c) through (e) of this section and §64432.1. All community and nontransient-noncommunity water systems shall also monitor to determine compliance with the MCLs in Table 64431-A, pursuant to subsections 64432(b) through (l) of this section, and §64432.2. Monitoring shall be conducted in the year designated by the Department of each compliance period beginning with the compliance period starting January 1, 1993.

(b) The frequency of monitoring conducted to determine compliance with the MCLs for the inorganic chemicals listed in Table 64431-A, except for asbestos and nitrate/nitrite, shall be as follows:

(1) Each compliance period, all community and nontransient-noncommunity systems using groundwater shall monitor once during the year designated by the Department. The Department will designate the year based on historical monitoring frequency and laboratory capacity. All community and nontransient-noncommunity systems using approved surface water shall monitor annually. All systems monitoring at distribution entry points which have combined surface and groundwater sources shall monitor annually.

(2) Quarterly samples shall be collected and analyzed for any chemical if analyses of such samples indicate a continuous or persistent trend toward higher levels of that chemical, based on an evaluation of previous data.

(c) For the purposes of Sections 64432, 64432.1 and 64432.2, detection shall be defined by the detection limits for purposes of reporting (DLRs) in Table 64432-A.

Table 64432-A
Detection Limits for Purposes of Reporting (DLRs) for Regulated Inorganic Chemicals

<i>Chemical</i>	<i>Detection Limit for Purposes of Reporting (DLR) (mg/L)</i>
Aluminum	0.05
Antimony	0.006
Arsenic	0.002
Asbestos	0.2 MFL > 10um*
Barium	0.1
Beryllium	0.001
Cadmium	0.001
Chromium	0.01
Cyanide	0.1
Fluoride	0.1
Mercury	0.001
Nickel	0.01
Nitrate (as NO ₃)	2.
Nitrite (as nitrogen)	0.4
Selenium	0.005
Thallium	0.001

* MFL=million fibers per liter; DLR for fibers exceeding 10 um in length.

(d) Samples shall be collected from each water source or a supplier may collect a minimum of one sample at every entry point to the distribution system which is representative of each source after treatment. The system shall collect each sample at the same sampling site, unless a change is approved by the Department.

(e) A water system may request approval from the Department to composite samples from up to five sampling sites, provided that the number of sites to be composited is less than the ratio of the MCL to the DLR. Approval will be based on a review of three years of historical data, well construction and aquifer information for groundwater, and intake location, similarity of sources, and watershed characteristics for surface water. Compositing shall be done in the laboratory.

(1) Systems serving more than 3,300 persons shall composite only from sampling sites within a single system. Systems serving 3,300 persons or less may composite among different systems up to the 5-sample limit.

(g) Each water system shall retain copies of its Consumer Confidence Reports for no less than 5 years.

CHAPTER 16. CALIFORNIA WATERWORKS STANDARDS

Article 1. Applicability, Responsibility and Definitions

§64555. Definitions.

(a) "Asphalt Institute Standard" means a standard or specification issued by the Asphalt Institute.

(b) "ASTM Standard" means a standard issued by the American Society for Testing and Materials (ASTM).

(c) "AWWA Standard" means a standard adopted by the American Water Works Association (AWWA).

(d) "Federal Specification" means a standard approved by the United States General Services Agency for use by federal agencies.

(e) "Flat Rate Water System" means a public water system where water deliveries to at least 50 percent of the service connections are not metered.

(f) "Metered Water System" means a public water system that is not a flat rate water system.

Article 2. General Requirements

§64560. Basic Design.

(a) Additions to or changes in distribution systems shall be designed and constructed to:

- (1) Be free of structural and sanitary hazards.
- (2) Protect the quality of the water delivered to users at all times.
- (3) Protect the distribution system against contamination by backflow.
- (4) Provide adequate size and capacity to meet the requirements of Sections 64562 and 64566.
- (5) Withstand, with ample safety factors, the physical stresses imposed during normal operation.
- (6) Minimize the effects of events such as power supply, equipment, and structural failures, earthquakes, fires, floods and sabotage that are reasonably foreseeable.
- (7) Protect against unauthorized entry and/or vandalism.
- (8) Protect against adverse effects in areas subject to freezing weather.

§64562. Quantity of Supply.

(a) Sufficient water shall be available from the water sources and distribution reservoirs to supply adequately, dependably and safely the total requirements of all users under maximum demand conditions before agreement is made to permit additional service connections to a system.

(b) To ascertain this, first determine the total capacity of the existing source by procedures prescribed in Section 64563 and determine the total storage volume of the existing distribution reservoirs. Then determine the needed source capacity and the needed storage volume by procedures prescribed in Section 64564. The total available source capacity shall not be less than the needed source capacity.

(c) The requirements of this section shall apply to an entire public water system and to each pressure zone within a public water system.

(1) Requirements for an entire public water system shall be determined from the total source capacity, total storage volume and the total number of service connections.

(2) Requirements for a particular pressure zone shall be determined from the total water supply available from the water sources and interzonal transfers directly supplying the zone, from the total storage volume within the zone and from the number of service connections within the zone.

§64563. Procedures for Determining Source Capacity.

(a) The source capacity of a well shall be based on the sustained yield of the well or pump output, whichever is less.

(1) Sustained yield of a well shall be determined from a pump test or from historical records.

(2) The conditions of a pump test used to determine sustained yield of a well shall be acceptable to the Department and shall include:

(A) Constant rate of water discharge from the well during the pump test.

(B) Continuation of the pump test until at least four consecutive measurements of water level drawdown in the well and the elapsed time since the beginning of the pump test yield a straight line when the drawdown is plotted against the logarithm of the elapsed time.

(b) The source capacity of a surface water supply or a spring shall be the lowest anticipated daily yield, based on adequately supported and documented data.

(c) The source capacity of a purchased water connection between two public water systems shall be included in the total source capacity of the purchaser if the purchaser has sufficient storage or standby source capacity to meet user requirements during reasonably foreseeable shutdowns by the supplier.

(d) Where the capacity of a source varies seasonally, the source capacity shall be the capacity at the time of maximum day demand.

§64564. Procedures for Determining Needed Source Capacity and Needed Storage Volume.

(a) Whenever possible, needed source capacity and needed storage volume shall be determined from existing water use records of the water system.

The records used shall clearly indicate total source capacity, total storage volume and maximum day demand of previous years.

The existing records of the water system may be supplemented as needed by the records of a similar water system acceptable to either the Department or a qualified registered engineer.

(b) When the existing records of the water system are inadequate to determine these values and no records of a similar water system can be found to supplement the existing records, the maximum day demand, the needed source capacity and the needed storage volume for typical residential and general commercial areas (without provisions for fire flow) shall be determined as follows:

(1) Determine the maximum day demand (Q_o) from Chart 1 or Chart 2.

(2) When the total capacity of the existing sources equals the maximum day demand (Q_o), the needed storage volume (V_o) to meet peak demand during the day shall be determined from Chart 3 or Chart 4.

(3) When the total storage volume of the existing reservoirs (V) is less than the needed storage volume (V_o), the existing sources shall be supplemented so that the needed source capacity (Q) is met. For a metered water system, $Q = Q_o (2.5 - 1.5V/V_o)$ or for a flat rate water system, $Q = Q_o (2 - V/V_o)$.

(c) The needed source capacity and needed storage volume determined under (b) may be modified, with the approval of the Department, to reflect local conditions such as climate, community type and kinds of users. Unless the Department's written approval is obtained, the needed source capacity shall not be less than the maximum day demand.

(d) The data used and the calculation made by the water supplier to determine whether sufficient water is available to accommodate additions to the systems must be kept and are subject to the Department review and approval at its discretion.

§64566. System Pressure.

(a) Changes in distribution systems shall be designed to maintain an operating pressure at all service connections of not less than 20 pounds per square inch gauge (psig) (140 kiloPascals gauge (kPag)) under the following demand conditions:

- (1) User maximum hour demand.
- (2) User average day demand plus design fire flow.

(b) In a public water system supplying users at widely varying elevations, a water supplier may furnish a service to a user which does not comply with (a) if the user is fully advised of the conditions under which minimum service may be expected and the user's agreement is secured in writing. This waiver shall be applicable only to individual service connections.

(c) Water mains shall be designed to have at least five psig (35 kPag) pressure throughout any buried length of the main except when the main is removed from service for repairs or maintenance. This requirement shall not apply to short lengths of water main near reservoir inlets and outlets provided:

- (1) The water main is on premises owned, leased or controlled by the water supplier; or
- (2) The prior review and written approval of the Department is obtained.

§64568. Conditions for Adding Service Connections.

A new service connection may be added to a distribution system only if the water system will comply with Section 64562 after the new service connection is added and adding the new service connection will not cause pressure at an existing service connection to be reduced below the standards set in Section 64566.

§64570. Internal Combustion Engines.

(a) Where water cooling jackets for internal combustion engines are connected to water mains, the jacket shall be designed so that the water pressure inside the water main at the cooling jacket will at all times be greater than the engine coolant pressure.

(b) Backflow protection of the public water system shall be provided wherever makeup water is supplied to the cooling system of an internal combustion engine.

Article 3. Distribution Reservoirs

§64600. Basic Design of Distribution Reservoirs.

(a) Distribution reservoirs shall be covered.

(b) Vents, overflows, drain outlets and other reservoir openings shall be located and constructed to protect the water stored in the reservoir from contamination. Vents and overflows shall be screened. Vents shall not open upward. Overflows shall be large enough to dispose of reservoir overflow rates equal to the maximum reservoir filling rate.

(c) Provisions shall be made to facilitate removal of floating material from the free water surface and for dewatering the reservoir.

(d) Outlets shall be designed and constructed to minimize movement of sediment from the reservoir floor to the distribution system water mains.

(e) Provisions shall be made for isolating reservoirs and appurtenant facilities from the distribution system without causing violation of Section 64566.

(f) Unless the Department's approval is obtained, distribution reservoir sites shall not be used for nonwater works purposes that would:

- (1) Result in unrestricted public access.
- (2) Create a contamination hazard.

(g) Reservoirs shall be disinfected and sampled for bacteriological quality in accordance with the procedures described in "Methods for Disinfecting Tanks and Reservoirs," American Water Works Association Journal, 71(1):49-50 (January 1979).

§64602. Subsurface Distribution Reservoirs.

(a) Subsurface distribution reservoirs shall be lined and shall be located:

- (1) Above maximum anticipated ground water level.
- (2) At least 50 feet (15 meters) from the nearest sewer and at least 150 feet (45 meters) from all other sewerage facilities.

(b) The land adjacent to a subsurface distribution reservoir shall be graded to route surface water away from the reservoir.

§64604. Corrosion Protection.

Paints or other protective coatings shall comply with AWWA Standard D102-78.

Article 4. Pumping Stations

§64612. Water Sealed Pumps.

Seal water for water sealed pumps shall meet the water quality requirements of the Domestic Water Quality and Monitoring Regulations, Title 22, California Administrative Code, Chapter 15. Adequate drainage shall be provided for disposal of used seal water.

Article 5. Water Mains and Appurtenances

§64622. Water Main Materials.

(a) Water main materials shall meet the applicable standards listed in Table I.

(b) Cast iron and ductile iron pipe shall be cement mortar lined in accordance with AWWA Standard C104/A21.4-80.

(c) Steel pipe shall be protected from internal and external corrosion. Table II lists various acceptable protective coatings and linings with appropriate standards.

Table I
Material Standards

<i>Pipe Material</i>	<i>Standard</i>
Abestos-Cement	AWWA C400-80 or C402-77
Cast Iron	AWWA C106-75
Ductile Iron	AWWA C151/A21.51-81
Steel	AWWA C200-80
Copper	AWWA C800-66
Concrete	AWWA C300-82, C301-79, C302-74 or C303-78
Polybutylene	AWWA C902-78
Polyethylene	AWWA C901-78
Polyvinyl Chloride	AWWA C900-81
Glass Reinforced	
Thermosetting Resin	AWWA C950-81

Table II
Steel Pipe Coatings and Linings

<i>Type of Coating or Lining</i>	<i>Standard</i>
Cement Mortar Coating or Lining	AWWA C205-80 or Federal Specification SS-P-385a
Coal Tar Coating, Lining or Wrapping	AWWA C203-78
Asphalt Mastic Coating	Asphalt Institute M-2 CS-96
Extruded Plastic Coating	Federal Specification L-C-530B (1972)
Rubber-Alkyd Paint Coating	AWWA C204-75
Cold Applied Tape Coating	AWWA C209-76
Coal Tar-Epoxy Coating	AWWA C210-78
Asphalt Coating and Wrapping	Standard Specifications for Public Works Construction (1973), Section 207-10.4.4

§64624. Water Main Selection and Installation.

(a) Steel pipe shall be selected and installed in accordance with American Water Works Association (AWWA) Manual M-11 (1964), "Steel Pipe--Design and Installation." The design shall comply with Sections 6.1 and 6.2 of the manual, except that the minimum design pressure shall be at least the maximum anticipated system pressure, but in no case less than 150 psig (1,030 kPag).

(b) Asbestos-cement, cast iron and ductile iron pipe shall be selected and installed in accordance with the standards listed in Table III.

(c) Polyvinyl chloride pipe shall be selected and installed in accordance with Appendix A of AWWA Standard C900-81.

Sonoma County General Plan 2020

PLANNING COMMISSION

RECOMMENDED DRAFT

WATER RESOURCES ELEMENT

Sonoma County Permit and Resource Management Department

2550 Ventura Avenue

Santa Rosa, CA 95403

**Adopted by Resolution No. XX-XXXX
of the Sonoma County Board of Supervisors
XX, 200X**

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WATER RESOURCES ELEMENT

1. INTRODUCTION

1.1 PURPOSE

Water is an essential element of all life forms. Plants and animals are mostly composed of water and need water and the nutrients carried by water. An adequate and high quality water supply is therefore required for continued human survival, development and use of the land, and the health of the entire natural environment.

Due to its critical importance, water is legally considered a public resource, an adequate and high-quality water supply is considered a basic human right, and the use and quality of water have long been regulated by government. Since water moves easily across city and county boundaries, much of the regulation is at the regional, State and Federal levels. However, since cities and counties have legal authority over development and land use, they are involved in considering the adequacy of water supplies and how development affects the quantity and quality of water available for other beneficial uses.

As development has continued, the long-term adequacy of groundwater and surface water resources has become a major public concern. Water-related issues include lowered groundwater levels, increased stormwater runoff, sediment and pollutants in runoff, water diversions into and out of the Russian River basin, summer rationing in dry years, the water needs of fish and wildlife, the rates of water usage, conservation methods, water storage limitations, the growing re-use of water and continuing changes in State and Federal regulations.

In order to address these issues, the conditions of groundwater and surface water in the County that would be effective in future water management, more information is required regarding the many aspects of the water environment in the different areas of the County. As a result, an organized data collection and problem identification effort is a necessary step to formulate a prudent management strategy.

The primary purpose of this element is to ensure that Sonoma County's water resources are sustained and protected. To achieve this purpose, water resource management ~~should~~ **will be** in an integrated manner throughout all jurisdictions in the County and be on a sustainable yield and quality protection basis which considers the amount of quality water that can be used over the long term without exceeding the replenishment rates over time or causing long term declines or degradation in available surface water or groundwater resources. Nothing in this element should be construed to encourage or condone illegal use of water.

1.2 RELATIONSHIP TO OTHER ELEMENTS

The Water Resources Element addresses a range of water related issues in Sonoma County. Some other water-related topics are also addressed in other elements. Water availability as a factor in land use plan map densities is addressed in the Land Use Element. The Open Space and Resource Conservation Element addresses riparian corridors, wetlands, wildlife protection, tree protection, fishery resources and other biotic resources, water-oriented recreation, soil erosion, forestry, and mineral resources, the Public Facilities and Services Element addresses connections to public water systems. The Public Safety Element addresses flood hazards, fire suppression, and hazardous materials. The Agricultural Resources Element addresses aquaculture.

The Water Resources Element has been developed to be consistent with other elements. References to policies in other elements are provided where they support or implement the objectives of the Water Resources Element.

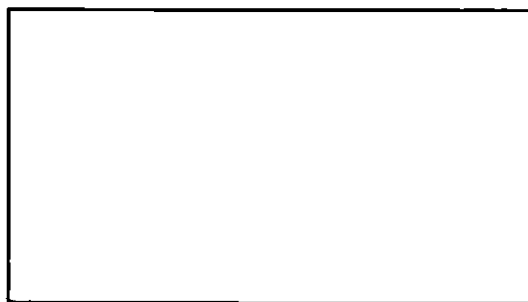
1.3 SCOPE AND ORGANIZATION

The Water Resources Element is organized as follows. Section 2 reviews the relevant water rights law, the hydrologic system, the major streams and drainage basins, the role of vegetation in the water cycle, and the natural underground water storage in the County. Section 3 states the County's goals, objectives, and policies in each of five topical areas. The implementation programs are described in Section 4.

2. WATER RESOURCES BACKGROUND

2.1 WATER RIGHTS

The California Constitution requires that water be used in a reasonable and beneficial manner and prohibits misuse and waste of water. Water is used beneficially when, for example, it is used to drink, grow crops or wash cars. What is reasonable water use depends on the circumstances; for example, it could be unreasonable to wash cars during a severe drought. All types of water rights are subject to this constitutional policy, and a State agency, the State Water Resources Control Board (SWRCB), is authorized to take action to prevent unreasonable uses of water.



There are two principal types of surface water rights in California, riparian rights and appropriative rights.

Riparian Water Rights

A riparian water right allows a landowner bordering a watercourse to share the water flowing past his property with other riparian landowners. Riparian rights are not defined by California statutes but have been established by common law and court decisions. Permits or other government approvals are not required to exercise riparian rights. However, a permit from the Army Corps of Engineers or some other regulatory agency, or an agreement with the California Department of Fish and Game, may be necessary to construct diversion facilities needed to exercise riparian or appropriative rights.

Riparian rights extend only to natural flow and do not apply to water imported into a stream system or water released from storage in an upstream reservoir. Riparian rights do not allow a water user to store water in a reservoir during the wet season for use during the dry season. In times of shortage, riparian rights are entitled to share the supply before any appropriators may divert water. The water from riparian rights can only be used on the riparian lands and cannot be transferred or exported for use on other properties or outside the watershed.

Riparian rights ordinarily cannot be lost through nonuse and generally remain with property when it changes hands. However, a riparian right may be impaired or lost if a parcel is subdivided or the land otherwise severed from its water source, if SWRCB approves a prescriptive appropriative right, or if a court approves allocation of a stream's water among users.

Appropriative Water Rights

Since 1914, all new appropriations of surface water have required a permit from the State. The permits are issued by the SWRCB and specify the amount of water that may be diverted, purposes for the water use, seasons of diversion, and the locations of diversion, storage (including underground storage) and use. An appropriative water right permit may allow the use of water at locations outside the watershed. When the State Board considers an application for a permit, it evaluates whether water is available during the requested season and potential environmental impacts, including any impacts on the rights of the public to use the waterway for navigation, commerce, fishery, recreation, aesthetic enjoyment and the preservation of open space, ecological study areas and wildlife habitat. Based on this evaluation, the State Board decides whether or not to issue a permit, and, if it issues a permit, what conditions to include in the permit.

Appropriative rights are limited to the amount of water that may be put to beneficial use, and a right may be lost after a period of nonuse. Appropriative water rights are based on a "first come, first served" principle; the first to take water has a superior right over later appropriators. In times of shortage, all appropriators must stop diverting water, if necessary to satisfy riparian rights. There is no sharing of a shortage among appropriators; instead, senior appropriators are entitled to exercise their rights to satisfy all of their reasonable needs before junior appropriators may divert any water. The SWRCB determined in 1989 that the Mendocino County portion of the Russian River is fully appropriated from July 1 to October 31 of each year.

Water flowing in subterranean streams through known and defined channels is subject to

diversion, use and regulation under riparian and appropriative rights as described above. Water is considered to be flowing in a subterranean stream through a known and definite channel if it is in contact with surface water and moving in the same direction in a relatively defined channel. **Groundwater not flowing in any subterranean stream through a known and defined channel is known as "percolating groundwater" and is not subject to surface water rights.**

Groundwater Rights

Except for groundwater flowing in subterranean streams through known and defined channels, there is no statewide statutory regulation of groundwater in California. Landowners overlying groundwater have rights to share the groundwater under their property with other overlying landowners without obtaining a permit from any State agency. Groundwater may also be used on lands which that are not overlying, but this right is subordinate to the prior use of any overlying landowners. Surface water can be diverted or pumped into aquifers for later extraction, with SWRCB approval.

The courts have held that cities and counties may regulate groundwater use under their police powers to protect the public's health, safety and welfare. In addition to those powers, the State Water Code provides other regulatory tools including the adoption and implementation of a groundwater management plan under the Groundwater Management Act (Water Code Section 10750-10755.4; AB 3030). Several California counties have adopted groundwater regulation programs. Litigation has also resulted in court decrees regulating groundwater use in some cases.

2.2 WATER CYCLE

Overview

Water moves continuously from Earth's surface into the air and then back to the land, changing only in form. This movement is commonly referred to as the hydrologic cycle and is powered by sunshine and gravity. When the sun heats up water in streams, lakes and oceans, the water evaporates into vapor or steam in the atmosphere. **In Sonoma County, the hydrologic cycle of water movement is dominated by the frequent inflow of moisture-laden air from over the Pacific Ocean.** As the moisture-laden air cools, particularly where it is forced higher by steep slopes, the vapor condenses into water which that falls as rain or, if the vapor is chilled enough, it forms solid ice crystals and falls as snow. Most of the rain and snowmelt runs off into surface water bodies which that drain back to the sea. Some of the precipitation is absorbed into the Earth and becomes "groundwater", some of which moves slowly through subsurface layers to streams, lakes and the oceans. **When the sun heats up this surface water, it evaporates into vapor or steam in the atmosphere and again becomes potential precipitation.**

There is as much water today in the water cycle as there ever was, but 97 percent of Earth's water is contained in the oceans and is too salty for most land-based uses. Since the salt is left

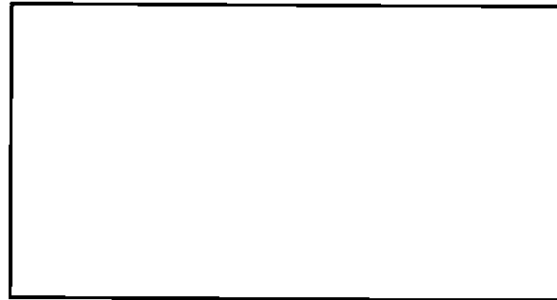
behind during evaporation, the resulting precipitation is fresh water. Of the 3 percent of the water on Earth that is fresh water, most is locked in icecaps and glaciers. Streams and lakes contain only about one-fiftieth of one percent of Earth's water, and ground water constitutes only about half of one percent. Although nearly all water becomes air-borne vapor at one time or another, the atmosphere contains only one-thousandth of one percent of Earth's water.

Sonoma County

Due to the range of temperatures, and cloud cover, found in the County, the moisture and evaporation levels, vary widely. From a water availability perspective, these small variations in weather pattern when combined with the effects of topography, vegetation, and development, can result in varying rainfall levels at any particular time in each of the watersheds in the County. In addition, long-term changes in snowpack and precipitation related to global warming climate change could change affect future precipitation patterns, regional availability and temperature of water, surface runoff and sea level elevation.

2.3 WATERSHEDS

The term "watershed" refers to the surface water drainage area that is tributary to or drains into a particular stream. Hydrologically, most land in Sonoma County falls within the three main watersheds: Russian River, Gualala River and San Pablo Bay. The watersheds and sub-basins watersheds within Sonoma County are shown on Figure WR-1. The portions of the watersheds that lie within the County are:



Subbasins Watershed Characteristics

In general, subbasins watersheds in the northern areas of the county (Gualala River, Austin Creek, Dry Creek, Big Sulphur Creek, and Maacama Creek) consist of mountainous, rugged terrain with little urban development. Land use in these upper watersheds is predominantly rural, with timber production and grazing being the primary uses. Over time, management of natural resources in these subbasins has resulted in erosion and sedimentation of waterways and subsequent degradation of water quality.

Most subbasins in of central Sonoma County are tributaries to is part of the Russian River watershed and ultimately drains west to the Pacific Ocean. This area has These subbasins generally have moderate topography and lies in the ancient alluvial floodplain of the Russian River. Much of the suburban and urban development of Sonoma County is located within these central subbasins subwatersheds, including Healdsburg, Windsor, Santa Rosa, Sebastopol, Figure

Table WR-1 Watershed Boundaries

Watershed	Subbasin Subwatershed	Size (Square Miles)
Gualala River		269
Russian River	Big Sulphur Creek	80
	Maacama Creek	69
	Dry Creek	175
	Mark West Creek	83
	Laguna de Santa Rosa	89
	Green Valley Creek and Atascadero Creeks	32
	Austin Creek	70
	Santa Rosa Creek	81
	Other subbasins subwatersheds	237
	Watershed total	921
Coastal	North Coast	49
	South Coast	9
	Salmon Creek	32
	Estero Americano	50
	Stemple Creek	22
	Watershed total	162
San Pablo Bay	Sonoma Creek	170
	Petaluma River	112
	Watershed total	282

The portions of these watersheds that lie outside Sonoma County are:

Watershed	County	Size (Square Miles)
Russian River	Mendocino and Lake	564
Gualala River	Mendocino	31
Estero Americano	Marin	13
Stemple Creek	Marin	28
Petaluma River	Marin	34

Rohnert Park and Cotati. The North Coast Regional Water Quality Control Board has characterized the entire Russian River watershed as an impaired water body due to excessive sedimentation and siltation from such activities as grazing, agriculture, logging, roads, and urban and rural residential development.

Subbasins- The watersheds for the Petaluma River and Sonoma Creek in the southern portions of the county are tidally-influenced (Petaluma River, Sonoma Creek). They have their headwaters on the steep grass and oak foothills of the Sonoma Mountains and coast range, pass through small valleys where the Petaluma and Sonoma urban areas are located, and open up to wide marshlands that interact with the San Pablo Bay. Land use in these subbasins is varied and includes agriculture and rural and urban residential use. Water quality concerns in these subbasins revolve around low levels of dissolved oxygen and high levels of coliform bacteria and ammonia.

2.4 AQUIFERS

Groundwater is an important source of agricultural, industrial, and domestic water supply in Sonoma County. While the Russian River is the primary source of domestic water for the county's urban areas, most rural areas are served by groundwater. Groundwater resources are tapped by both municipal and private wells. However, not all groundwater in the county is of sufficient volume, has a reasonable rate of recharge, or is of potable quality suitable for drinking water or other purposes.

In 1975, the California Department of Water Resources (DWR) identified the following groundwater basins and subbasins in Sonoma County.

Most of these groundwater basins are centered along major creek and river valleys in the central and southern portions of the county. Recharge of groundwater typically occurs along the major streams as well as their principal tributaries. The principal water-bearing formations in Sonoma County groundwater basins are typically alluvium. While other geologic units can yield adequate amounts of water in some areas, much of the county may not have dependable groundwater supplies.

The quality of groundwater in Sonoma County varies greatly, depending on land use, geology, and withdrawal rates. Human activities that degrade groundwater include failing septic systems and livestock and dairy production (high nitrate concentration) and overdraft (salt water intrusion).

Poor groundwater quality can also be the result of geologic conditions such as the highly mineralized water extracted from the Sonoma Volcanics or brackish water from the Petaluma Formation. Also, some groundwater naturally contains dissolved elements such as arsenic, boron, selenium, mercury and/or radon (a gas formed by the natural breakdown of uranium in the soil).

Figure Table WR-2 Groundwater Basins and Sub-Basins

Groundwater Basin	Subbasin	DWR Number
Annapolis-Ohlson Ranch Formation		1-49
Knights Valley		1-50
Alexander Valley	Alexander Area	1-54.1
	Cloverdale Area	1-54.02
Santa Rosa Valley	Santa Rosa Plain	1-55.01
	Healdsburg Area	1-55.02
	Rincon Valley	1-55.03
Bodega Bay Area		1-57
Wilson Grove Formation Highlands		1-59
Lower Russian River Valley		1-60
Fort Ross Terrace Deposits*		1-61
Petaluma Valley*		37652
Napa-Sonoma Valley	Sonoma Valley	2-2.02
	Napa-Sonoma Lowlands	2-2.03
Kenwood Valley		37670
*note: an asterisk indicates that the basin is partially in Sonoma County, another county.		

The sizes of the larger basins and basin groups are as follows:

Groundwater Basin	Size (Square Miles)
Santa Rosa Valley	158
Sonoma Valley	70
Petaluma Valley	70
Napa-Sonoma Volcanics	65
Alexander Valley	47
Annapolis-Ohlson Ranch Formation	13.5
Kenwood Valley	8
Knights Valley	6
Fort Ross Terrace Deposits	3.5

2.5 BIOTIC RESOURCES AND WATER

The policies in the Water Resources Element recognize the importance of natural vegetation and wildlife habitat, both as beneficial water uses whose needs must be considered but also as factors in maintaining adequate water quality and quantity. However, the supporting biotic resource goals, objectives, and policies are contained in the Open Space and Resource Conservation Element.

Trees and other natural vegetation are dependent on water, but their presence also supports affects the long-term quality and quantity of water resources in several ways. The natural vegetation found around wetlands, streams and lakes benefits water quality by filtering out sediment and pollutants from runoff before it enters surface water bodies. Vegetation can also block stream flows and increase the retention of stormwater, thereby recharging groundwater, absorbing pollutants, and slowing and diminishing modifying flood peak levels. Vegetation on stream banks reduces bank erosion as a source of sediment. Trees and shrubs provide shade which can lowers the temperature of the water and thus increases its value as fishery habitat in a warm climate. Streamside trees which that fall into stream channels may aid fishery habitat by providing shelter, diverting flood flows, and scouring of deep holes. The Open Space and Resource Conservation Element also includes discussion of the relationship of biotic resources to water.

Trees and other vegetation need and use water but also help maintain year-round water levels in streams and groundwater. In the fall, many trees stop absorbing water and release the water they have absorbed. Trees in exposed foggy areas reportedly increase precipitation. Trees in any location provide shade which that cools the ground surface and reduces evaporation. Plants add moisture to the air through transpiration of water from their leaves. Natural vegetation can also increase the retention of stormwater and recharge of groundwater and slow the passage of flood peaks.

The policies in the Water Resources Element recognize the importance of natural vegetation and wildlife habitat, both as beneficial water uses whose needs must be considered but also as factors in maintaining adequate water quality and quantity. However, the supporting biotic resource goals, objectives, and policies are contained in the Open Space and Resource Conservation Element.

3. WATER RESOURCE GOALS, OBJECTIVES, AND POLICIES

3.1 WATER QUALITY

Water Quality Regulations

Water quality protection has long been a priority at all levels of government. In California, programs implementing the Federal Clean Water Act and the State Porter-Cologne Act are administered by the SWRCB and the nine regional water quality control boards (RWQCB). In Sonoma County, the Sonoma Creek and Petaluma River watersheds are in the Bay Area RWQCB jurisdiction, and the remainder of the county is governed by the North Coast RWQCB. Waste discharge requirements are set by each RWQCB for point sources, including industrial and commercial uses, community wastewater management systems and individual septic systems. Implementation of point source controls has led to substantial increases in the level of treatment and quality of discharges.

Over time, development and management of natural resources has resulted in erosion, sedimentation and degradation of surface water quality in the Russian River watershed and elsewhere. Surface water quality concerns in some watersheds include low levels of dissolved oxygen, high temperatures, and high levels of coliform bacteria, ammonia, nutrients, pathogens, metals, herbicides, pharmaceuticals and exotic species.

National Pollutant Discharge Elimination System

The focus of regulatory efforts has expanded in recent years to address surface runoff pollutants into drainage channels, streams and groundwater. The National Pollutant Discharge Elimination System (NPDES) program requires individual permits for construction sites and certain industrial and commercial activities and requires "municipal" area wide permits for urbanized areas and Beginning in 2003, Municipal NPDES permits will be required for all local jurisdictions having a population greater than 10,000. In addition, an existing The cooperative NPDES permit with the City of Santa Rosa, County of Sonoma, and the Sonoma County Water Agency (SCWA) will include unincorporated areas near the cities of Santa Rosa, Healdsburg, Windsor, Sebastopol, Rohnert Park, and Cotati an expanded area of the Santa Rosa Plain. Other areas in both the North Coast and Bay Area RWQCB areas will likely be required to develop similar permits and programs. Another NPDES municipal permit program has been established for the Petaluma and Sonoma areas in the south part of the County. Similar approaches to controlling stormwater pollution are being developed in the county's Coastal Zone in response to California Coastal Commission policies. The

requirements for NPDES permits now include the "California Toxics Rule" and State and Federal criteria for metals, pesticides and other pollutants which that could affect aquatic life and human health.

Total Maximum Daily Load Program

The other major Clean Water Act program affecting the county in the future is the Total Maximum Daily Load (TMDL) program. The RWQCBs are required to determine which surface water bodies are "impaired" by certain pollutants limiting beneficial uses of water and then to initiate a public process to assess pollutant sources, determine acceptable levels, allocate allowable pollutant loads to various sources, and establish an implementation programs. All of the major streams in the county. Water bodies in Sonoma County that have been identified as impaired are the Russian River, Gualala River, Lake Sonoma, Santa Rosa Creek, Laguna de Santa Rosa, Estero American, Stemple Creek, Sonoma Creek, Petaluma River, and San Pablo Bay. for one or more pollutants of concern typically, mostly are sediment/siltation, nutrients, pathogens, and temperature but also include low dissolved oxygen, mercury, other metals, herbicides and exotic species. The listing of impaired water bodies is periodically re-evaluated by the RWQCBs. The following water bodies in the county have been identified as impaired; the Gualala River and Russian River for sediment/siltation and temperature, two portions of the Russian River for pathogens, Lake Sonoma for mercury, Santa Rosa Creek for pathogens, the Laguna de Santa Rosa for low dissolved oxygen, the Estero Americano for nutrients, Stemple Creek for sediment/siltation and nutrients, and Sonoma Creek and the Petaluma River for nutrients, pathogens, and sediment/siltation. The time frames for completing the TMDL processes in Sonoma County vary greatly with one already underway and others due over the course of the next decade or so. In the meantime, Sonoma County can continue to be proactive in addressing water quality issues through a combination of education, restoration, and development policies.

Dissolved Elements Groundwater Quality

The objectives of the water quality laws and programs described above include the protection of groundwater quality. Some groundwater naturally contains dissolved elements such as arsenic, boron, selenium, or radon (a gas formed by the natural breakdown of radioactive uranium in the soil). Whether these natural contaminants that can cause health problems, depending on the amount concentrations and combinations of the substances present. In addition to natural contaminants, According to the RWQCBs, groundwater also is often polluted by human activities generating plumes of contaminants such as microorganisms, gasoline and diesel fuels, solvents, nitrates, pesticides, pharmaceuticals, and metals (Reference: Sonoma County Environmental Health Division (SCEHD) The underground flow and concentration of these contaminants and ocean saltwater can be influenced by the extraction of groundwater and changes in levels of groundwater and surface water.

- GOAL WR-1:** Protect, restore and enhance the quality of surface and groundwater resources to meet the needs of all reasonable beneficial uses.
- Objective WR-1.1:** Work with the Regional Water Quality Control Boards (RWQCB) and interested parties in the development and implementation of RWQCB requirements.
- Objective WR-1.2:** Require quality of treated water to conform with beneficial water use standards to the maximum extent feasible.
- Objective WR-1.32:** Establish development standards to maximize retention of runoff and regulate development to avoid, to the maximum extent practicable, Avoid pollution of stormwater, water bodies and groundwater.
- Objective WR-1.4:** Encourage new groundwater recharge opportunities and protect existing groundwater recharge areas.
- Objective WR-1.53:** Inform the public about practices and programs to minimize water pollution and provide educational and technical assistance to agriculture in order to reduce sedimentation and increase on-site retention and recharge of stormwater.
- Objective WR-1.6:** Conserve and recognize stormwater as a valuable resource.
- Objective WR-1.7:** Require consideration of naturally occurring and human caused contaminants in groundwater in new development projects. Work with the SCEEID and RWQCB to educate the public on evaluating the quality of groundwater.
- Objective WR-1.84:** Work with the SWRCB, DWR, California Department of Health Services (DHS), CalEPA, and applicable County and City agencies to s Seek and secure funding sources for development of countywide groundwater quality assessment, monitoring, management, remedial and corrective action and awareness/ and education programs regarding groundwater quality issues.
- Objective WR-1.95:** Seek to protect Ensure that groundwater will not be adversely affected by from saltwater intrusion.

The following policies, in addition to those in the Land Use, Open Space and Resource Conservation, and Public Facilities and Services Elements, shall be used to accomplish the above objectives:

Policy WR-1a: Coordinate with the RWQCB, SCWA contractors public water suppliers, Cities, Resource Conservation Districts, watershed groups, stakeholders and other interested parties to develop and implement public education programs and water quality enhancement

activities and provide technical assistance to minimize stormwater pollution, support RWQCB requirements and manage related County programs. Where appropriate, utilize watershed planning approaches to resolve water quality problems.

Policy WR-1b: Design, construct, and maintain County buildings, roads, bridges, drainage and other facilities to minimize sediment and other pollutants in stormwater flows. Develop and implement "best management practices" for ongoing maintenance and operation.

Policy WR-1c: Prioritize stormwater management measures in coordination with the RWQCB direction, focusing first upon watershed areas that are urbanizing and watersheds with impaired water bodies. Work cooperatively with the RWQCBs to manage the quality and quantity of stormwater runoff from new development and redevelopment in order to:

- (1) Prevent, to the maximum extent practicable, pollutants from reaching stormwater conveyance systems.
- (2) Ensure, to the maximum extent practicable, that discharges from regulated municipal storm drains comply with water quality objectives.
- (32) Limit, to the maximum extent practicable, stormwater flows from post development sites to pre-development quantities.
- (43) Conserve and protect natural areas to the maximum extent practicable.

Policy WR-1d: Where appropriate, support RWQCB waste discharge requirements for all wastewater treatment systems and other point sources.

Policy WR-1e: Participate Assist in the development of Total Maximum Daily Loads (TMDLs) for the impaired water bodies and pollutants of concern identified by the RWQCB to achieve to the maximum extent practicable compliance with adopted TMDLs. Work with the RWQCB to develop and implement measures consistent with the adopted TMDLs.

Policy WR-1f: Work closely with the RWQCB, incorporated cities, SCWA public water suppliers, and other interested parties in the development and implementation of water quality plans and measures.

Policy WR-1g: Minimize deposition and discharge of sediment, debris, waste and other pollutants into surface runoff, drainage systems, surface water bodies, and groundwater.

Policy WR-1h: Continue to require grading plans to include measures to avoid soil erosion and consider upgrading requirements as needed to avoid sedimentation in stormwater to the maximum extent practicable.

Policy WR-1i: Implement erosion and sediment control requirements for vineyards and row crops. Develop and implement educational and technical assistance programs for agricultural activities including vineyard and crop production and maintenance practices and educational

programs and technical assistance to grazing, ranch, and dairy operations. Encourage programs to disseminate information on the benefits of on-site retention and recharge of stormwaters. **Develop standards for erosion and sediment control for orchards similar to the standards established for vineyards.**

Policy WR-1j: Support educational technical assistance programs for agricultural activities and dissemination of best management practices for erosion and sediment control, which include on-site retention of stormwater, maintaining natural sheetflow and drainage patterns, and avoiding concentrated runoff, particularly on slopes greater than 35%.

Policy WR-1jk: Seek opportunities to participate in developing programs and implementing projects for water quality restoration and remediation with agencies and organizations such as RWQCBs, CDFG and RCDs in areas where water quality impairment is a concern.

Policy WR-1kl: Consider development or expansion of community wastewater treatment systems in areas with widespread septic system problems which that are a health concern and cannot be addressed by on-site maintenance and management programs.

Policy WR-1nm: Consider on-site wastewater management districts in areas with septic problems.

Policy WR-1in: Initiate a review of any sewer systems when they persistently fail to meet applicable standards. If necessary to assure that standards are met, the County may deny new development proposals or impose moratoria on building and other permits that would result in a substantial increase in demand and may impose strict monitoring requirements.

Policy WR-1mo: Encourage **Require that commercial and industrial uses reduce and pretreatment and waste load minimization of commercial and industrial wastes prior to their connection to entering sewer systems.**

Policy WR-1op: Actively pursue the abatement of failing septic systems that have been demonstrated as causing a health and safety hazard.

Policy WR-1pq: Require new development projects to evaluate and consider naturally-occurring and human caused contaminants in groundwater.

Policy WR-1qr: Work with the SCEHD and RWQCB to educate the general public on evaluating, and monitoring **and protecting** the quality of groundwater.

Policy WR-1rs: Resist accepting administrative responsibility for regulatory programs required of by State or Federal agencies unless a State or Federal subvention will compensate the County for costs associated with such shift in administrative responsibility.

Policy WR-1st: Where area studies or monitoring find that saltwater intrusion has occurred,

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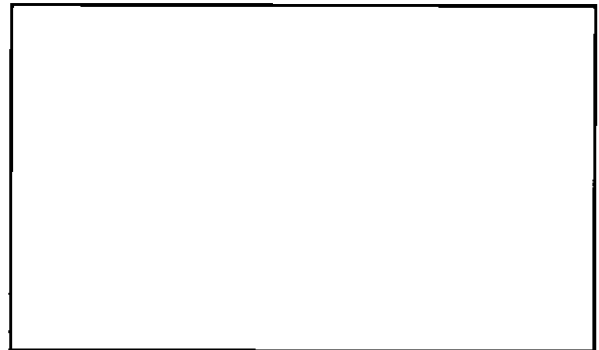
support analysis of how the intrusion is related to groundwater extraction **and support and development of a groundwater management plan or other appropriate measures to avoid further intrusion and, where practicable, reverse past intrusion.**

Policy WR-1tu : In the marshlands and agricultural areas south of Sonoma and Petaluma, require all environmental assessments and discretionary approvals to analyze and, **where practicable, avoid any increase in saltwater intrusion into groundwater.**

Policy WR-1v: Request that the SCWA revise the SCWA flood control design criteria to include a section on stream geomorphic analysis and to update information on bank protection and erosion control to incorporate biotechnical bank stabilization methods for the purpose of preventing erosion and siltation in drainage swales and streams.

3.2 GROUNDWATER

Sonoma County, covering nearly 1,600 square miles, has a population of approximately 470,000 people living in an area characterized by abundant natural resources. Of these resources, Sonoma County's groundwater plays an extremely important role in our natural environment, communities, industry sectors and agriculture. In 2002, there were approximately 40,000 wells in Sonoma County, with 42% of the population supported at least in part by groundwater. Nearly all of the county's population relies on groundwater as either a primary or backup source of water supply. The release of contaminants or pollutants into this resource from natural sources or human activities has the potential for adverse impacts upon human health, the environment and property, depending on the type, location, and quantity of materials released.



The amount of groundwater in an area varies by the recharge from rainfall, the surface runoff in streams and drainage channels, and the local underground geology. The alluvial soils, sand and gravel found in valleys generally can hold large amounts of water and thus constitute the largest aquifers in the county. Sandstone and some other sedimentary rocks can still absorb some water. However, many upland areas of the county are composed of harder rock formations where groundwater is only found in cracks and fractures.

Using information on geology and water yields, The County utilizes a four tier classification system to indicate general areas of groundwater availability. Class 1 are the Major Groundwater Basins; Class 2 are Major Natural Recharge Area; Class 3 are Marginal Groundwater Availability Areas; and Class 4 are Areas with Low or Highly Variable Water Yield. **Since County maps of these areas are utilized in the development review and well permitting process and are available for review at the County PRMD offices the requirements**

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for proving adequate groundwater vary by these classes, a rigorous process is needed to assure that classification mapping is based on the latest available data.

In unincorporated Sonoma County, most users obtain their water from groundwater. Groundwater wells also supply many community water systems and occasionally provide a supplemental or backup source for some of the large municipal systems. As concern over future availability of surface water from the Russian River Basin has heightened in recent years, more municipalities are developing, or considering development of, groundwater resources.

Public concerns over depletion of groundwater supplies have increased as development increases and uses groundwater supplies, but limited factual data about existing groundwater levels and use is currently available upon which to fully assess the problem or to formulate a comprehensive management strategy. Complicating the problem is the proprietary nature of well drilling data, the inconsistent character of the county's varied geology, and water rights law.

In response to reports that groundwater levels have declined in some areas, the County has initiated a long term program designed to gradually increase the available data on groundwater resources and to systematically organize and use it more effectively as development is planned and new well permits are sought. In addition, programs are underway to assess the available groundwater in the County's major basins where most of the municipal groundwater supplies are being tapped. It has been since the 1970s that the last basin assessment of groundwater was conducted for the County by DWR. As these data collection and monitoring efforts begin to produce better information, County decision makers will be in a better position to determine what further measures may be appropriate in order to properly manage these resources.

GOAL WR-2:

Manage groundwater as a valuable and limited shared resource.

Objective WR-2.1:

Conserve, enhance and manage groundwater resources on a sustainable basis which that assures sufficient amounts of clean water required for future generations, the uses allowed by the General Plan, and the natural environment.

Objective WR-2.2:

Monitor-Develop a scientifically-based program to collect the data needed to assess and understand groundwater conditions; require descriptive information for well permits; and analyze, map and publicize the data gathered.

Objective WR-2.3:

Be willing to modify policies and programs as new information becomes available, recognizing the difficulty of assessing and resolving groundwater problems. **Encourage new groundwater recharge opportunities and protect existing groundwater recharge areas.**

- Objective WR-2.4:** Increase institutional capacity and expertise within the County to competently review hydrogeologic reports and data for critical indicators and criteria.
- Objective WR-2.5:** Work with SWRCB, DWR, DHS, CalEPA, and applicable County and City agencies to seek and secure funding sources for development of groundwater assessment, protection, enhancement and management programs.
- Objective WR-2.56:** Avoid additional land subsidence caused by groundwater extraction and reduce subsidence that has occurred.

The following policies, in addition to those in the Public Facilities and Services, Land Use, and Open Space and Resource Conservation Elements, shall be used to accomplish the above objectives:

Policy WR-2a: Encourage and support research on and monitoring of local groundwater conditions, aquifer recharge, watersheds and streams where needed to assess groundwater quantity and quality.

Policy WR-2b: Initiate and support educational programs to inform residents, agriculture, businesses and other groundwater users of best management practices in the areas of efficient water use, water conservation, and increasing groundwater recharge. Implementation would include preparation and distribution of educational materials and public workshops.

Policy WR-2c: Revise Work with well drillers and other parties familiar with groundwater conditions in Sonoma County to develop ordinance requirements for well permits standards in order to drill, replace, deepen or repair all wells as follows:

- (1) **Improve the data obtained from well permit applications on** Show exact locations, depths, yield, use, drilling logs, soil data, flow direction where appropriate, and water levels of proposed wells and existing wells on the site, locations of known nearby wells, proposed uses of the water, and estimated amount of water use. Review available groundwater data and well permit information in the permit area and make this information available to the applicant to the extent allowed by law.
- (2) **Establish standards to reduce the potential for well interference and drawdown.** Based upon available information indicating a need, require that new wells be located definite distances from property lines and existing wells. Implementation would develop setbacks which could vary by well size, location of nearby wells, water use, groundwater availability, lot size and other appropriate factors.
- (3) **Ensure sufficient** Require proof of groundwater quantity and quality sufficient for existing and proposed uses using the subject well and existing beneficial uses on the site in all Class 3 and 4 areas and in other areas with identified water quality and

quantity problems, special area studies underway or where adopted management plans require it. Implementation would develop procedures and quantitative standards for pump tests, well yields, pollutant levels, and water storage, particularly for higher capacity wells.

- (4) Require well monitoring for all wells. Implementation would include procedures for meters, access, testing and reporting water levels, flow direction and quality, and responding to monitoring results. Standards could be less stringent in Class 1 and 2 areas without identified problems.
- (5) Include provisions for applicant fees and other funding of County costs.
- (64) In areas where a groundwater management plan has been approved and has been accepted by the County, require the issuance of well permits and any limitations imposed on well permits to be consistent with the adopted plan.

Policy WR-2d: Continue the existing program to require groundwater monitoring for new or expanded discretionary commercial and industrial uses using wells. Where justified by the monitoring program, establish additional monitoring requirements for other new wells.

Policy WR-2de: Require proof of groundwater with a sufficient yield and quality to support proposed uses in Class 3 and 4 water areas. Require test wells or the establishment of community water systems in Class 4 water areas. Test wells may be required in Class 3 areas. Deny discretionary applications in Class 3 and 4 areas unless a hydrogeologic report establishes that groundwater quality and quantity are adequate and will not be adversely impacted by the cumulative amount of development and uses allowed in the area, so that the proposed use will not cause or exacerbate an overdraft condition in a groundwater basin or subbasin.

Policy WR-2e: Revise procedures for proving adequate groundwater for discretionary projects by adding criteria for study boundaries, review procedures, and required findings that the area's groundwater supplies and surface water flows will not be adversely impacted by the project and the cumulative amount of development allowed in the area and will not cause or exacerbate should consider groundwater overdraft, land subsidence, or saltwater intrusion. Procedures for proving adequate groundwater for discretionary projects should be flexible enough to consider and the expense of such study in relation to the size water needs of the discretionary project.

Policy WR-2f: Require that discretionary projects in Urban Service Areas, to the maximum extent practicable, maintain or increase the site's pre-development absorption of runoff to recharge of groundwater to the maximum extent practicable. Implementation would include standards which could regulate impervious surfaces, vary by project type, land use, soils, and area characteristics, and provide for water impoundments, protecting and planting vegetation, cisterns and other measures to increase runoff retention and groundwater recharge. Develop voluntary guidelines for rural development that would accomplish the same purpose.

Policy WR-2g: In cooperation with SCWA, DWR, and other public agencies and well owners, support the establishment and maintenance by the County, SCWA and other agencies of a system of voluntary monitoring of wells throughout the county, utilizing public water system wells and existing wells where feasible available.

Policy WR-2h: In cooperation with SCWA, DWR and other public agencies, support the establishment and maintenance of -Establish a computerized groundwater data base from available application data, well tests, monitoring results, study reports and other sources; analyze the data collected in an annual report to the Board; provide the data to DWR, and use the data along with other available information to refine the mapping of groundwater availability classes classifications. Protect the proprietary nature of well drilling data and release it only in summary form.

Policy WR-2i: In order to identify areas where groundwater supplies may be declining, in the annual report staff shall review well permit data, monitoring data and reported problems and recommend to the Board of Supervisors the boundaries for areas where comprehensive groundwater studies are needed. In each such special study area which that is approved by the Board following a public hearing, develop a comprehensive groundwater assessment which that includes the following:

- (1) Establish a An existing system of monitoring wells and stream gages gauges.
- (2) Locationse and identify of water wells.
- (3) Collect and present aAvailable data on groundwater and surface water levels and contamination.
- (4) Prepare mMaps and graphs that show past and present data and changes in precipitation, surface water imports, groundwater levels, groundwater quality, and rates of extraction, and the relationship of groundwater to surface water.
- (5) Use dDrillers' logs, geologic data and monitoring data needed to estimate water yields in the area.
- (6) Estimated future rates of imports, recharge, extraction, exports, changes in groundwater levels, and possible changes in groundwater quality.
- (7) Determine a A water budget for the area which that estimates the total amount of water that flows into gain or loss in the area through precipitation and surface water imports and the total amount of water extracted by area wells and exported out of the area.
- (8) Determine aAny needed changes in well monitoring, data collection and reporting.
- (9) Provisions for applicant fees and other funding of County costs.

If an area assessment, as defined above, indicates that future groundwater availability or surface water flows are threatened and there is a demonstrated need for additional management actions to address groundwater problems, prepare a plan for managing groundwater supplies, pursuant to AB 3030 the California Water Code, the County's police powers land use or other legal authority, which may require limitations on water extraction and use and other special standards for allowed development, wells, extraction or use. Consideration of new management actions shall include involvement by the affected water users, and well drillers, in development of alternatives addressing specific problems and a review of legal and fiscal issues for each alternative. The County shall seek the participation and concurrence in the groundwater management plan from local agencies, private water companies and landowners which are or may be extracting groundwater from the affected basin. In recognition of apparent concerns regarding the potential for overdraft condition in the south Santa Rosa Plain groundwater basin, give a high priority to preparation of a groundwater assessment and adoption of a management plan or other appropriate actions in this area prior to approval of any city annexations and changes in land use or density in this area of the county.

Policy WR-2j: As resources permit, coordinate Cooperate with the incorporated cities, SCWA, DWR, US Geological Survey, well drillers, groundwater industry representatives, agricultural interests, and all water users and purveyors in the development of a comprehensive groundwater assessment for each major groundwater basin in the county and the priorities, sequence and timing for such studies. The contents and process shall meet the Prepare such assessments to meet the applicable requirements of the California Water Code for a "groundwater management plan" and may, where appropriate, include, but are not limited to, the following:

- (1) Computer models of groundwater recharge, storage, flows, usage and sustainable yield.
- (2) Assessment of nitrates, boron, arsenic, saltwater and other water quality contaminants.
- (3) Analysis of resource limitations and relationships to other users for wells serving public supply systems and other large users.
- (4) Opportunities for changing the sources of water used for various activities to better match the available resources and protect groundwater.
- (5) Possible funding sources for monitoring, research, modeling and development of management options.
- (6) Provisions for applicant fees and other funding of County costs.

If a basin assessment indicates that future groundwater availability, water quality and surface water flows may be threatened and there may be a need for additional management actions to address groundwater problems, prepare a plan for managing groundwater supplies which may require limitations on water extraction and use and other special standards for allowed development, wells, extraction or use. Consideration of new management actions shall include

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involvement by the interests and parties stated above in development of alternatives addressing specific problems and a review of legal and fiscal issues for each alternative.

Policy WR-2k: Encourage and support comprehensive studies of long-term changes in climate and precipitation patterns in the county and region.

Policy WR-2l: Increase institutional capacity and expertise within the County to competently review hydrogeologic reports and data for critical indicators and criteria.

Policy WR-2m: Work with SWRCB, DWR, California Department of Health Services, (DHS), CalEPA, public water suppliers, and applicable County and City agencies to seek and secure funding sources for development of groundwater assessment, protection, enhancement and management programs.

Policy WR-2n: Coordinate the County's land use decisions and actions to be consistent with the Water Resources Element.

Policy WR-2on: Where area studies or monitoring find that land subsidence has occurred, support analysis of how the subsidence is related to groundwater extraction and develop a groundwater management plan or other appropriate actions, where practicable, to avoid further subsidence and reverse past subsidence.

3.3 PUBLIC WATER SYSTEMS

An adequate and sustainable water supply is essential if Sonoma County is to serve projected increases in population, housing, employment, business, and agriculture. The main purpose of this section is to address what the County can do to help maintain the long-term adequacy of water supply services provided by public and private entities, given the legal limitations on the County's authority over such services.

Large water systems serve the county's cities as well as some of the larger unincorporated communities. The largest system is operated by the SCWA in the Russian River watershed. This system stores runoff from rainfall in the Eel and Russian River watersheds in the Lake Mendocino and Lake Sonoma reservoirs, diverts it from large collector wells beside the Russian River, and transmits it primarily to the Cities of Santa Rosa, Petaluma, Rohnert Park, Cotati, and Sonoma, the Town of Windsor, Sonoma County Airport Industrial Area, the unincorporated Forestville and Valley of the Moon areas, and the North Marin Water District. The supply of water has been generally adequate to meet the system's demand in the past, but challenges remain to supply water to Russian River water users in the future, including the limited amount of unappropriated water, potential reduction in water diverted from the Eel River through a hydroelectric power plant, the capacity of water transmission systems, and the ability to secure additional water rights, and — More critical, however, is the potential effect of the recovery plans for threatened and endangered anadromous fish species on water supply and system operations in the Russian River basin.

Other large water systems in the **unincorporated areas of the county** include those serving such communities as Bodega Bay, Sea Ranch, Occidental, Geyserville, Larkfield, Camp Meeker, Kenwood, and Guerneville. Small water systems supply water to a wide variety of uses such as rural businesses, residences and schools, mobile home parks and small unincorporated communities. Most are owned by mutual companies or other private entities, and a few are operated by special districts. These systems have small revenue bases and relatively high per capita costs and often have difficulty financing major capital investments needed to replace aging facilities or accommodate growth.

All water systems are responsible for meeting and maintaining water quality standards established by DHS and the RWQCBs. The suppliers are required to prepare and adopt wellhead protection plans that will avoid future contamination. To the extent that these plans may need to rely upon the regulation of land uses around supply wells, the County's cooperation may be necessary for wells located in the unincorporated area.

In light of concerns over the future availability of water from the Russian River system and from groundwater sources, water conservation, re-use, and alternative water resources such as impoundments, desalinization, etc. are an increasingly important part of all of the supply systems.

GOAL WR-3:

Assure that Encourage public water systems and their sources to provide an adequate supply to meet long-term needs that is consistent with adopted general plans and urban water management plans and that is provided in a manner that maintains water resources for other water users while protecting the natural environment.

Objective WR-3.1:

Assist public water suppliers in the collection and dissemination of surface and groundwater data and the assessment of available water supplies and protection of water quality.

Objective WR-3.2:

Work with SCWA and other public water suppliers in the development and implementation of long term plans for water supply, storage, and delivery necessary to first meet existing water demands and, secondly, to meet planned growth within the designated service areas, consistent with the sustainable yield of water resources.

Objective WR-3.3:

Work with the SCWA and other public water suppliers in the assessment and provision of sustainable water supplies for the existing customers in those areas under contract for water supply.

Objective WR-3.4:

Work with the SCWA CH and other public water suppliers in the assessment of sustainable water supplies for the planned growth in those areas under contract for water supply.

Objective WR-3.5: Work with the SCWA and public water suppliers to establish a surface and groundwater data management program for Sonoma County which would provide a common information management resource for participating agencies to develop various plans for assessment, management, monitoring and reporting.

Objective WR-3.63: Work with public water suppliers to decrease reliance on groundwater and prevent diminishment of groundwater supplies and surface water to assure the sustainability of both resources.

The following policies, in addition to those in the Land Use and Public Facilities and Services Elements, shall be used to accomplish the above objectives:

Policy WR-3a: Work with public water suppliers in assessments of the sustainable yield of surface water, groundwater, recycled water and conserved water, **including during possible drought periods.** This work should include the exploration of potentially feasible alternative water supplies. Surface and groundwater supplies must remain sustainable and not exceed safe yields.

Policy WR-3b: Support to the extent feasible the actions and facilities needed by public water systems suppliers to supply water sufficient to meet the demands which that are estimated in adopted master facilities plans, consistent with adopted general plans, urban water management plans and the sustainable yields of the available resources and in a manner protective of the natural environment.

Policy WR-3c: Request technical assistance and water resource data from public water suppliers and share available water resource information with them and the public.

Policy WR-3d: Assist public water suppliers in complying with Federal and State water quality standards by assuring that water sources used for public water systems are not contaminated by land uses or pollutants in the watershed, by supporting continued study and monitoring of water quality, and by encouraging acquisition of critical watershed areas **by the suppliers or the Sonoma County Agricultural Preservation and Open Space District.**

Policy WR-3e: Support **Work with** public water suppliers in developing and implementing wellhead protection plans which may include county and city land use regulations or other actions needed to maintain quality standards, provided that the water supplier consults with relevant jurisdictions and provides reasonable public notice during the formulation of such plans.

Policy WR-3f: Support water conservation and education programs with measurable targets for public water suppliers.

Policy WR-3g: Assist public water suppliers in assuring that proposed water supplies and facilities are consistent with adopted general plans, that all planning jurisdictions are notified of and consider potential water supply deficiencies during the preparation of such plans, and that adopted general plans accurately reflect secure water sources.

Policy WR-3h: Help public water suppliers to disseminate and discuss information on the limits of available water supplies, how the supplies can be used efficiently, **the possible effects of drought conditions**, acceptable levels of risk of shortage for various water users, priorities for allocation of the available water supply, conditions for use of limited supplies, and limits of alternate sources which that could be used or developed.

Policy WR-3i: Prepare or encourage the preparation of master facilities plans, and urban water management plans where required by State law, for all public water supply systems to design and construct all facilities in accordance with sustainable yields and the general plans of applicable jurisdictions. A master facilities plan should contain but not be limited to the following:

- (1) Maps showing future service area boundaries.
- (2) Forecasted growth and relationship to General Plan projections and limits.
- (3) Projected service and facility needs.
- (4) Estimated costs and revenues for needed improvements.
- (5) System design parameters and assumptions.
- (6) Monitoring and mitigation measures to assure long-term adequacy of sources, including during possible drought conditions.
- (7) Water conservation measures.

In the event that a master plan or monitoring fails to show adequate public water facilities or supplies for planned growth, consider moratoria on plan amendments, zoning changes, building permits or other entitlements in order to protect services to existing residents.

Policy WR-3j: Seek to maintain consistency between the **Sonoma County** General Plan, adopted groundwater management plans and the master facilities plans of public water suppliers through meetings between staff of PRMD and public water suppliers, PRMD review of proposed master facilities plans, and referral of General Plan changes to all public water suppliers.

Policy WR-3k: Cooperate with public water suppliers in the planning, development and construction of the storage and transmission facilities needed to supply water pursuant to adopted General Plan policies, urban water management plans, water supply agreements, master facilities plans, and, **where applicable**, programs to mitigate identified groundwater overdraft conditions, where applicable.

Policy WR-3l: Pursuant to the requirements of Government Code 65400-65402, request that **local public agencies that are** public water suppliers, including cities, the SGWA, county-dependent districts, special districts and other local public agencies, consult with the County

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prior to acquiring a site or developing any well or facilities for public water supplies in the unincorporated area and request a determination of consistency with the Sonoma County General Plan.

Policy WR-3m: Pursuant to an adopted groundwater management plan, require **Encourage** public water suppliers and other water users which use or rely upon groundwater sources that **are developing or have adopted groundwater management plans** to monitor and report groundwater levels and, yields and other information on groundwater conditions in order to avoid long-term overdrafting or decline.

Policy WR-3n: **Encourage** public water suppliers who currently utilize water from the SCWA system will, to the maximum extent feasible, utilize water from the SCWA system and other surface water sources instead of groundwater to balance their use of surface water and groundwater so that environmental impacts and impacts on other legal water users are minimized.

Policy WR-3o: Pursuant to applicable laws, require **Encourage** public water suppliers to avoid or minimize significant adverse impacts on the environment resulting from water supply, storage and transmission facilities, including impacts on other water users.

Policy WR-3p: Involve public water suppliers in any development of area studies, groundwater management plans and general plans in order to assure full compliance by suppliers with the groundwater management plans and mitigation measures.

Policy WR-3q: Support **cooperative** inter-regional planning efforts by the public water suppliers, their contractors and involved stakeholders in, **other existing water users and Sonoma County to consider future demand projections concurrently with the availability of sustainable water supplies** determine the preferred combination of sources to meet projected demand.

Policy WR-3r: Work with the SCWA in the following ways to provide an adequate water supply for its contractors consistent with this element:

- (1) Support SCWA participation in proceedings of the Federal Energy Regulatory Commission, California Public Utilities Commission, and State Water Resources Control Board involving the Potter Valley Project to ensure that the interests of all water users in Mendocino, Sonoma, and Marin Counties receive consideration and that decisions on the use of Eel River water are made on a sound scientific basis.
- (2) Encourage SCWA to working cooperatively with Mendocino County interests to resolve environmental and economic impacts, water rights and supply resource issues, including assessment of water resource projects, groundwater, recycling or other water supply alternatives and use of recycled water.
- (3) Work with agricultural interests **all water users** along the Russian River and its tributaries to encourage development of water supply alternatives for existing water

users.

- (4) Support SCWA actions to define and defend existing water rights and the rights of other existing water users.
- (5) Support SCWA efforts to evaluate acquisition of additional water diversions, recognizing the rights of other existing water users and avoid significant environmental impacts.
- (6) Support SCWA participation in programs to maintain, restore and protect the Russian River fisheries.
- (7) In SCWA evaluations of requests by municipalities, districts or other entities to be added as water contractors, support assessment of the available water resources and the long-term effects on water supply needs of the existing contractors, consider impacts on other existing water users, and, to the greatest extent practicable, require water conservation measures, use of recycled water and bearing risks, responsibilities and costs as required by the existing contractors.
- (8) Cooperate with the SCWA in the planning, development and construction of the storage and transmission facilities needed pursuant to adopted agreements and County policies and support development of the SCWA Water Supply and Transmission System Project.

Policy WR-3s: Cooperate with public water suppliers in the planning, development and construction of the storage and transmission facilities needed to serve projected demand consistent with adopted general plans.

Policy WR-3s: Coordinate the County's land use decisions and actions to be consistent with the Water Resources Element

3.4 CONSERVATION AND RE-USE

Water conservation has long been a practice in Sonoma County households, businesses, and agriculture. The rise of environmental consciousness in the 1970s and a prolonged drought in 1976/77 led to the early efforts by some water suppliers to reduce demand. Planned re-use of treated water in the Santa Rosa Plain was initiated by the City of Santa Rosa during this same period as part of its regional wastewater system. Most of these earlier conservation efforts were not well-publicized and, due to the relative abundance of fresh water sources, were not thought to be significant as a water supply strategy.

In recent years, both water conservation and re-use programs have expanded considerably. As advanced treatment has become an increasingly standard practice, re-use programs are becoming even more viable. However, the quality of recycled water still remains an issue. Most of the larger municipal water systems, particularly those which that rely upon the Russian River Water Supply and Transmission System, have water conservation programs, including low-water use appliances and landscaping, various education and promotional programs, and water rate

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incentives. Meeting peak demands in the future may require increased conservation efforts and water recycling by water users in both urban and rural areas.

GOAL WR-4: Increase the role of conservation and safe, beneficial re-use in meeting water supply needs of both urban and rural users.

Objective WR-4.1: Increase the use of treated, recycled water where the quality of the recycled water is maintained, it meets all applicable regulatory standards and is the appropriate quality and quantity for the intended use and beneficial uses of other water resources will not be significantly impacted.

Objective WR-4.2: Promote and encourage the efficient use of water by all water users.

Objective WR-4.3: Avoid water reuse which could significantly adversely affect the quality of groundwater or surface water.

Objective WR-4.3: Conserve and recognize stormwater as a valuable resource

The following policies, in addition to those in other sections of the Water Resources Element and the Public Facilities and Services Element, shall be used to accomplish these objectives:

Policy WR-4a: Encourage disposal methods which that minimize reliance on discharges into natural waterways. If discharge is proposed, review and comment on projects and environmental documents and request that projects maximize reclamation, conservation and reuse programs to minimize discharges and protect water quality and aquifer recharge areas.

Policy WR-4b: Use water effectively and reduce water demand by developing programs to:

- (1) Requiring Increase water conserving design and equipment in new construction.
- (2) Encouraging Educate water users on water conserving landscaping and other conservation measures.
- (3) Encouraging retrofitting with water conserving devices.
- (4) Designing wastewater collection systems to minimize inflow and infiltration to the extent economically feasible.
- (5) Limiting Reduce impervious surfaces to minimize runoff and increase groundwater recharge.

Policy WR-4c: Support programs to monitor ~~establish and publicize~~ **determine** per capita or per unit water use in each community and area and utilize this data in groundwater management plans, master facilities plans, and wastewater treatment plans.

Policy WR-4d: Encourage monitoring for all water use and water metering and pricing systems for public water suppliers which ~~that~~ require water users to pay all ~~for~~ costs of the amount of water used. Encourage **tiering and other** pricing mechanisms for public water suppliers which ~~that~~ provide incentives for water users ~~to~~ employing conservation and reuse programs.

Policy WR-4e: Require water-conserving plumbing and water-conserving landscaping in all new development projects and require water-conserving plumbing in all new dwellings. ~~Educate and p~~Promote programs to minimize water loss and waste by public water suppliers **and their customers**. Require County-operated water systems to minimize water loss and waste.

Policy WR-4f: ~~Educate and p~~Promote programs for retrofitting plumbing, providing cost rebates, identifying leaks, changing landscaping, irrigating efficiently and other methods of reducing water consumption by existing users.

Policy WR-4g: Require that development and redevelopment projects, where feasible, retain stormwater for on-site use which ~~that~~ offsets the use of other water. Implementation could include standards for runoff retention and storage, impervious surfaces, vegetation removal, landscaping, and preservation of wetlands and riparian areas.

Policy WR-4h: Encourage and support conservation for agricultural activities which ~~that~~ increase the efficiency of water use for crop irrigation, frost protection and livestock. Work with RWQCB and DWR to promote stormwater impoundments for agricultural uses.

Policy WR-4i: Assess water use by County buildings and facilities and reduce water consumption to the maximum extent practicable.

Policy WR-4j: Ensure that **public** wastewater disposal systems are designed to reclaim and reuse treated **recycled** water **for agriculture, geothermal facilities, landscaping, parks, public facilities**, on agricultural crops, and for other irrigation and wildlife enhancement projects and other uses to the extent practicable, **provided that the water meets the applicable water quality standards and is supplied in appropriate quantities for the intended uses**.

Policy WR-4k: Encourage participation in programs for reuse of treated water, including the establishment of wastewater irrigation districts.

Policy WR-4l: Support the use of recycled water to offset use of other water where the quality of the recycled water is maintained, meets all applicable regulatory standards, and is appropriate for the intended use and beneficial uses of other water resources will not be significantly impacted.

Policy WR-4m: Coordinate with the cities and other wastewater treatment entities in the planning of uses and minimizing of impacts for treated water in agricultural activities, geothermal facilities and other uses in the incorporated and unincorporated areas.

Policy WR-4n: Support the use of treated water for irrigation, landscaping, parks, public facilities and other appropriate uses.

Policy WR-4ok: Where consistent with water quality regulations, encourage graywater systems, roof catchment of rainwater and other methods of re-using water and minimizing the need to use potable surface water or groundwater.

Policy WR-4l: Establish a program to revise County Codes to increase, where appropriate, the use of reclaimed water for new commercial, residential, and agricultural development.

3.5 IMPORTING AND EXPORTING

For many years, Sonoma County has municipalities have relied to some degree upon importation of water from sources outside of the County borders. Since 1908, water has been diverted from the Eel River watershed through a hydroelectric power plant into the Russian River watershed. This water has increased dry-season flows in the Russian River and supplemented water supplies for downstream users.

Russian River water is also exported to Marin County. Exports of recycled water outside of Sonoma county have also been considered. However, as statewide water supplies are falling behind demand, areas with relatively abundant water supplies are likely to be targeted for additional exports. An example is the proposal to export water from the Gualala and Albion Rivers to Southern California. While such proposals are within the jurisdiction of the SWRCB, Sonoma County needs to be proactive in protecting its water resource interests.

GOAL WR-5:

Assure that new proposals for surface and groundwater imports and exports are consistent with Sonoma County's ability to sustain an adequate and supply of high quality water supply for all its water users and dependent natural resources.

Objective WR-5.1:

Protect the interests of current and future water users of Sonoma County water users in the review of proposals to export water from Sonoma County.

Objective WR-5.2:

Consider Assure consideration of the environmental impacts of all proposed water imports and exports.

The following policies, in addition to those in the other sections of the Water Resources Element, shall be used to accomplish this- these objectives:

Policy WR-5a: Require or request full assessment of Assess the environmental impacts and

impacts on **current and future water users in Sonoma County** water users of any proposals to physically export water to new locations **or to new water users** outside Sonoma County or to substantially increase water supply to existing out-of-county **water users locations**.

Request that ~~a~~Any consideration of **to** exporting additional water resources shall place primary priority upon the benefit of and need for the **water** resources in Sonoma County and shall assure that water resources needed by urban, rural and agricultural water users in Sonoma County will not be exported outside the county.

Policy WR-5b: Require or request full assessment of the environmental impacts of any proposals to import additional water into Sonoma County.

Policy WR-5c: Where allowed by State law, require that groundwater not be exported off site for commercial purposes without prior discretionary approval of the County.

3.6 WATERSHED MANAGEMENT

GOAL WR-6:

Foster Improve understanding, valuation and sound management of the water resources in Sonoma County's diverse watersheds.

Objective WR-6.21:

Seek and secure funding **for addressing water resource issues on a watershed basis** to evaluate the quality and quantity of water resources in each of the watershed basins.

Objective WR-6.12:

Correlate Support programs to **assess** the quality and quantity of the water captured, stored and contained- used within each unique watershed to the needs of beneficial water uses by all county residents, local industry, agriculture and the natural environment.

The following policies, in addition to those in other sections of the Water Resources Element, shall be used to accomplish these objectives:

Policy WR-6ba: Work with the RWQCBs, watershed-focused groups and stakeholders in the collection, evaluation and use of watershed-specific water resource information.

Policy WR-6ab: Where there is a **water-related** problem identified, promote and seek funding for the evaluation and remediation of the problem through a watershed management approach.

Policy WR-6b: Work with the RWQCBs, watershed-focused groups and stakeholders in the collection, evaluation and use of watershed-specific water resource information.

4. WATER RESOURCE IMPLEMENTATION PROGRAMS

Water Resources Program 1: Education and Technical Assistance

Program Description: Develop a public education and technical assistance program that provides property owners, applicants and the general public with information regarding stormwater pollution, efficient water use, public water supplies, water conservation and re-use, and groundwater. **Include the preparation of "best management practices" for agricultural cultivation that address reduction of peak runoff from cultivated slopes and erosion and sediment on slopes greater than 35 percent.** (Policy reference: WR-1a, -1i, -1j, -1r, -2a, -2b, -2h, -3a, -3b, -3c, -3d, -3e, -3f, -3h, -4b, -4e, -4f, -4h, -4o), -6a, -6b.

Water Resources Program 2: County Facilities

Program Description: Prepare and implement a "best management practice" manual for minimizing stormwater pollutants associated with construction and maintenance of County buildings, roads, and other facilities. Assess water use in County operated facilities and implement programs for efficient water use and wastewater re-use (Policy reference: WR-1b, -4b, -4e, -4i, -4n).

Water Resources Program 3: Stormwater Management Regulations

Program Description: Work with the RWQCBs during the official formulation and adoption process for stormwater pollution management regulations affecting Sonoma County (Policy reference: WR-1c, -1e, -1f, -1g).

Water Resources Program 4: Total Maximum Daily Load (TMDL) Regulations

Program Description: Work with the RWQCBs during the official formulation and adoption process for TMDL regulations affecting Sonoma County (Policy reference: WR-1e).

Water Resources Program 5: Grading Ordinance and Erosion and Sediment Control

Program Description: Prepare, adopt, and implement a revised grading, erosion and sediment control ordinance to include **slope-related standards and standards for orchards and row-crops similar to that which was adopted for vineyards** (Policy reference: WR-1g, -1h, -1i).

Water Resources Program 6: Well Permits and Procedures

Program Description: Prepare, adopt, and implement a revised well permit ordinance which **that provides for improved data collection and monitoring of groundwater supply and quality.** Prepare revised procedures for proving adequate ground water for discretionary projects (Policy reference: WR-2c, -2d, -2e).

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Water Resources Program 7: Groundwater Monitoring and Annual Report

Program Description: Establish a ground water database and monitoring program consisting of well permit data and basin studies. Prepare an annual report to the Board of Supervisors assessing the current status of groundwater conditions in the unincorporated area and evaluating the need for any special studies and/or management actions that may be necessary in problem areas (Policy reference: WR-1s, -2d, 2g, -2h, -2i, 2j, -2k, -2e, , 2l, -3a, -3l, -3m, -4c, -6a).

Water Resources Program 8: Public Water Supply Plans

Program Description: Develop an information sharing program in cooperation with public water suppliers as necessary to make appropriate data available to the public pertaining to water supply and water use in each supplier's jurisdiction. Cooperate with public water suppliers in the development and implementation of measures necessary to protect the water quality of its water supply sources (Policy reference: WR-3a, -3b, -3c, -3d, -3e, -3g, -3h, -4d, -4e, -4f).

Water Resources Program 9: Integrated Water Resources Funding

Program Description: Work with public water suppliers, utility districts, stakeholder groups and interested parties to seek and secure outside funding sources for Water Resources Element programs and associated plans. Sources considered should include acquisition of critical watershed areas by the Sonoma County Agricultural Preservation and Open Space District and establishing a stewardship fund derived from the use and off-site sale of extracted groundwater to provide a financial base for the on-going protection, monitoring and management of the groundwater resource (Policy reference: Implementation programs 1-8 above).

Water Resources Program 10: Watershed Planning

Program Description: Seek funding opportunities for collaborative watershed planning approaches to water quantity and quality enhancement and protection by watershed groups, resource conservation districts, scientific research programs, and other interested parties, where such an approach is the desired method of accomplishing the program objectives (Policy reference: WR-1a, -1c, -1e, 1f, -2j, -3r, -6a, -6b).

Water Resources Program 11: Water Conservation in New Development

Program Description: Prepare, adopt, and implement an ordinance that requires water-conserving plumbing in all new dwellings and water-conserving plumbing and water-conserving landscaping in all new development projects. Develop programs to reduce water demand and increase groundwater recharge. (Policy reference: WR-4b, -4e).

Water Resources Program 12: Reclaimed Water

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Program Description: Revise County Codes in order to enable greater re-use of recycled water where appropriate to the use (Policy Reference: WR-4I).

Figure WR-1: Watershed Boundaries

Figure WR-2: Groundwater Basins and Sub-Basins

Integrating Science into the Public Policy Discussion to Promote Effective Local Groundwater Management

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1.0 Introduction

An effective groundwater management strategy aimed at cooperative local control should promote the development of science-based information to serve as the common ground in public policy discussions by stakeholder groups and decision makers. Consensus by local stakeholders regarding actions necessary for groundwater management is more likely to be achieved by structuring a program that emphasizes objective information over an agenda-driven discourse. To establish such a focus, prior to involving diverse stakeholder groups, a lead agency should: (1) develop a clear picture of the state of knowledge or facts as well as the significant uncertainties that exist; (2) structure a process ensures that local approaches are in alignment with State management policies; and (3) identify the vision and approach of the management program by defining key parameters such as whether the program will be regulatory or non-regulatory and the degree of stakeholder involvement.

The following describes a general approach to developing and implementing a groundwater management planning process starting with the context of the Statewide perspective and then focusing on local planning programs, including a case study.

2.0 The Statewide Perspective

Before embarking on a program to evaluate groundwater management within your region or locality, it is important to understand the Statewide perspective in terms of overall water resource management. Programs and policies set forth at the Statewide level will directly and indirectly affect local efforts of groundwater resource management and can also frame the issues for stakeholders. The following briefly summarizes: (1) the conclusions of the California Water Plan, (2) groundwater management options in California; (3) AB 3030 groundwater management plans; and (4) State incentives for developing and implementing groundwater management plans.

2.1 California Water Plan

The California Water Plan 2005 (Water Plan) prepared by the Department of Water Resources (DWR, 2005) frames the overall challenge of water supply planning facing the State. The Water Plan attempts to bracket the likely issues through its planning horizon to the year 2030 by considering three different scenarios:

Current Trends: This scenario assumes that current rates of water demand (urban, agricultural, and environmental) and current levels of water conservation are maintained.

Less Resource Intensive: For this scenario, lower rates of water demand than currently observed were assumed for urban, agriculture, and industry water demand while higher water demand is assumed to be dedicated for environmental purposes. Water conservation is assumed to be higher than the current trends scenario but less than full implementation of all cost-effective measures.

More Resource Intensive: This scenario considers higher rates of water demand for urban, agriculture, and industry with no additional water dedicated for environmental purposes beyond water allocated year 2000. Water conservation is assumed to be lower than the current trends scenario.

Figure 1 illustrates the estimated change in demand for urban, agricultural, and environmental sectors from 2000 to 2030 for each of these scenarios.

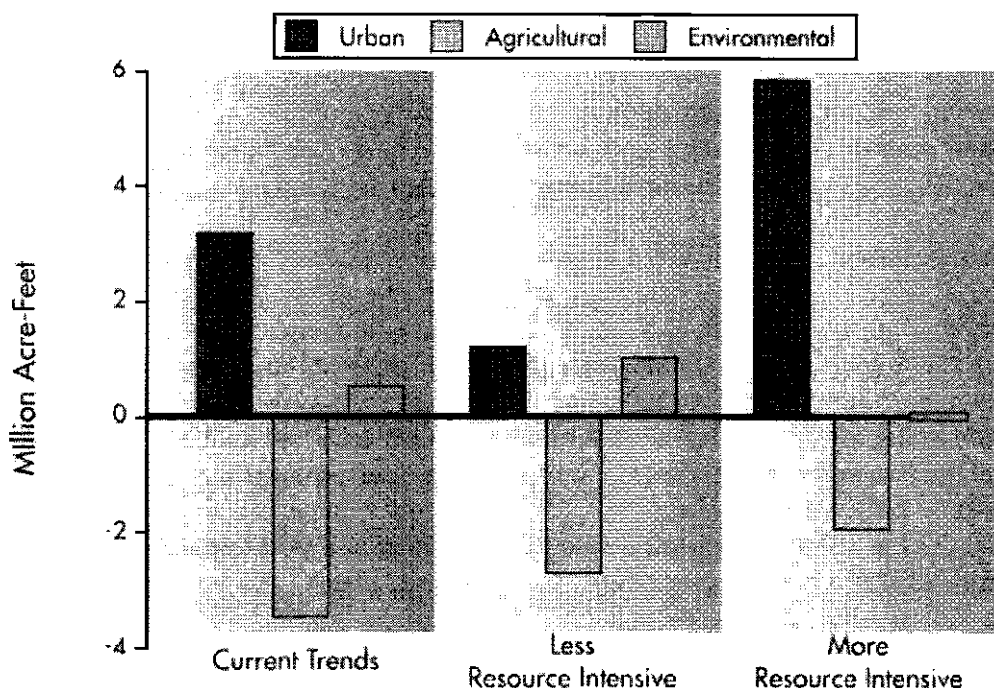


Figure 1 - Projected changes in water demand between 2000 and 2030 (DWR, 2005)

Climatic and demographic factors create stressors on the State's water system and also strongly influence the future water supply picture. As a result, storage of winter water is needed, because the timing of natural water occurrence (typically winter and spring) is

not coincident with periods of high water demand (typically summer). Storage occurs naturally through snowpack at higher elevations and recharge of groundwater basins during the winter and spring or through engineered projects such as dams or groundwater banking.

Another stressor to the State's water system is the difference in the geographic distribution of where water naturally occurs relative to where most water is used. These geographic constraints require significant conveyance systems to move water throughout the state from its source to end users.

In addition, the effects of global warming are starting to be evaluated in terms of potential impacts to the State water system. Although not addressed in the 2005 State Water Plan in detail, global warming will be a key factor in statewide and local future planning efforts. Several programs and technical studies are underway to better understand impacts of global warming on the State water supply. In general, computer climate models predict that warming in California will decrease the snowpack by increasing the elevation of snowfall. This snowpack, a natural storage reservoir that is relied upon throughout the State for water supply, is predicted to decrease due to global warming. The impacts of less snowfall, corresponding to more rainfall over time, will result in an increased risk of flooding. For non-snowpack areas such as the coastal areas of California, computer modeling is not currently able to accurately predict future patterns of rainfall or fog. For these areas, the timing of rainfall is important. For example, water managers will need to know if rainfall patterns will shift to earlier or later in the year, or become more concentrated but less frequent in occurrence. Another potential impact of global warming is that the higher summer temperatures could increase the demand for water in the summer, thus further straining the State's water storage and conveyance systems.

The Water Plan provides a strategy to manage water resources to ensure sustainable supplies in the future based on integration of water sources and diversification of water supply portfolios. Figure 2 illustrates the range of potential additional water supply that could be achieved via Statewide implementation of 8 water management strategies.

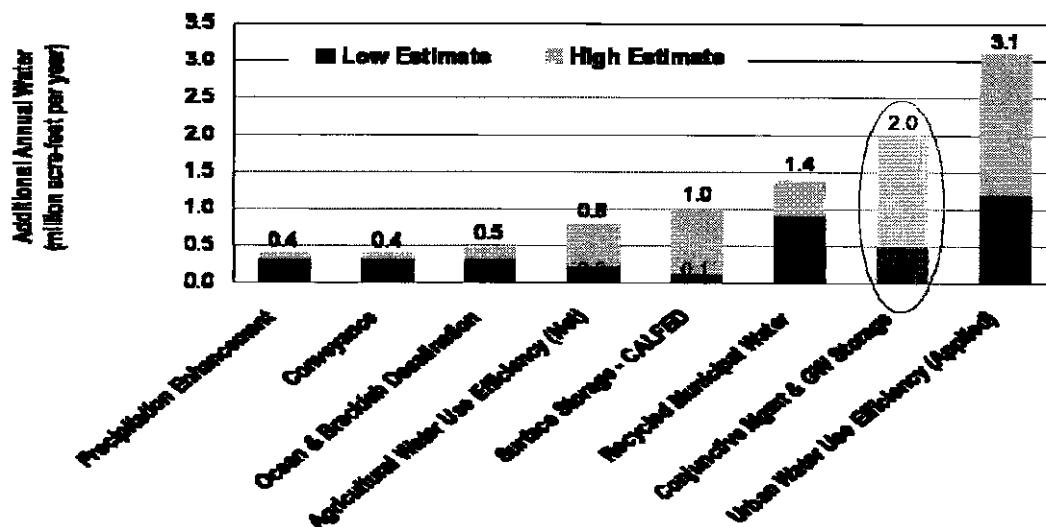


Figure 2 - Potential range of increased water demand reduction and supply increase for eight water resource management strategies (DWR, 2005)

Of note, the three most beneficial strategies to increase water supply (or demand reduction) throughout the State are urban water use efficiency, conjunctive water use and groundwater storage, and use of recycled water. It is important to consider how these management strategies fit into a local groundwater management program. A groundwater management plan that is in alignment with the Statewide strategy will be better situated to achieve results and to obtain support from State agencies including funding and technical support. For example, a groundwater management plan that promotes conservation, recycled water, and conjunctive use leading to integration of water management options and water supply diversification will likely be more effective than more narrowly defined plans.

2.2 Groundwater Management Options

Various mechanisms are available to implement groundwater management. These mechanisms vary in the role of lead agency, regulatory powers, and degree of local control by stakeholders. The following summary distinguishes between these management options and is based on information provided by the Groundwater Resources Association of California (GRA, 2005).

Coordinated Agreements

- Can provide for development of groundwater basin model, joint capital projects and joint operational policies
- Unanimous agreement between parties (e.g., water purveyors, other users, regulatory agencies)
- Potentially time consuming and cumbersome

- Can be used to coordinate groundwater management planning (AB 3030, ordinances) between multiple local jurisdictions within the same basin

Groundwater Management Act (Assembly Bill [AB] 3030)

- Local Agency groundwater management
- May exercise powers of a water replenishment district
- Provides for agreements between public and private parties
- Permissive legislation and voluntary cooperation

Adjudication and Physical Solution

- Control over extractions
- Can create comprehensive physical solution for basin management
- Time consuming and expensive
- Effective dispute resolution by court's continuing jurisdiction and watermaster administration of judgment; continuing jurisdiction allows more flexibility with changed future conditions
- As of 2005, there are 20 adjudicated basins in the State

General Act Districts

- Management indirectly accomplished through assessments and incentives
- No authority to regulate or limit groundwater extractions
- Possible limited jurisdiction over groundwater basin
- Possible conflict with other nearby agencies holding similar powers.

Water Replenishment Districts

- Can obtain supplemental supplies to directly or indirectly replenish overdrafted groundwater basins
- Some water quality authority
- Currently only one district in the State
- Local agencies with AB 3030 plans could exercise authority of a water replenishment district

Special Act Agencies and Districts

- Powers and organization customized for the individual, political and technical characteristics of the area
- Generally empowered to conduct studies, regulate extractions and replenish extracted supplies
- As of 2005, there are 13 Special Act agencies and districts
- Formed by an act of the Legislature

City and County Powers

- Applies to cities and counties

- Comprehensive or general plans
- Police power regulation; management through groundwater ordinance
- Coordination with AB 3030 plans

2.3 AB 3030 Plans

Of the groundwater management options listed above, AB 3030 plans have become a relatively popular method of groundwater management because they allow for local control of the process and are flexible so that the plan can be implemented to match the “flavor” of the local community. The Groundwater Management Act incorporated into Section 10750 *et seq.*, of the California Water Code provides the framework for local agencies (that provide water service) to develop groundwater management plans. Originally enacted as Assembly Bill (AB) 3030 in 1992, the Groundwater Management Act encourages voluntary groundwater management at the local level. The legislation also provides encouragement for local public agencies to work cooperatively towards groundwater management and to adopt formal plans to manage groundwater resources. AB 3030 applies to all groundwater basins identified in DWR Bulletin 118-2003, except for those already subject to groundwater management, for example, by a watermaster, pursuant to judgment, decree or adjudication. In 2002, the passage of Senate Bill (SB) 1938 mandated that all water agencies adopt or participate in a groundwater management plan to be eligible for state funds for groundwater supply and groundwater quality projects.

There are seven mandatory components identified in Water Code § 10750 *et seq.* Plans must include these components to be eligible for funds awarded and administered by DWR for the construction of groundwater projects or groundwater quality projects. In addition, there are seven recommended components identified in DWR Bulletin 118-2003. Table 1 summarizes the mandatory and recommended components of an AB 3030 groundwater management plan.

Groundwater Management Plan Component
A. Water Code § 10750 <i>et seq.</i>, Mandatory Components
1. Documentation of public involvement statement
2. Basin Management Objectives (BMOs)
3. Monitoring and management of groundwater elevations, groundwater quality, inelastic land surface subsidence, and changes in surface water flows and quality that directly affect groundwater levels or quality or are caused by pumping
4. Plan to involve other agencies located within groundwater basin
5. Adoption of monitoring protocols by basin stakeholders
6. Map of groundwater basin showing the Agency area subject to the plan, other local agency boundaries, and groundwater basin boundary as defined in DWR Bulletin 118
7. For agencies not overlying groundwater basins, prepare plan using appropriate geologic and hydrogeologic principles
B. DWR Recommended Components
1. Manage with guidance of advisory committee
2. Describe area to be managed under plan
3. Create link between BMOs and goals and actions of plan
4. Describe plan monitoring program
5. Describe integrated water management planning efforts
6. Report on implementation of plan
7. Evaluate plan periodically

Table 1. Required and Recommended AB 3030 Plan Components

2.4 State Incentives

State policy, set forth by legislation such as AB 303 and SB 1938, encourages the development of groundwater management plans by providing the opportunity for funding of studies and projects that are included in plans. The opportunity to access State funds is often a key reason for developing a groundwater management plan. Therefore, it is important to develop plans that meet State requirements (Water Code Section 1750 *et seq.*) and are in alignment with State priorities as described in the Water Plan.

3.0 Factors to Consider in Developing an AB3030 Groundwater Management Plan

Effective groundwater management planning relies on a strong foundation of facts, data, and scientifically derived information. These facts serve as a common ground for stakeholders throughout the planning process. In addition, it is essential that an educational process occurs so that stakeholders clearly understand both the facts and the uncertainties that exist. A program that emphasizes these two strategies – development

of objective information and education of stakeholders regarding what that information means – will increase the likelihood of an effective planning process.

The following describes the basic steps in developing and implementing a groundwater management plan and discusses factors that should be considered throughout the process.

- Start with the science
- Bring in the stakeholders
- Develop the approach
- Prepare the groundwater management plan
- Implement the plan
- Modify the plan

3.1 Start with the Science (What are the Facts?)

Before embarking on a groundwater management program, it is important to ask “what do we know and what don’t we know?” It is important to get past the anecdotal stories that often dominate conversation by introducing objective scientifically based data into the conversation. That does not mean that anecdotal information should be ignored, but it should not be given the same weight as objective data. For example, anecdotal statements about wells losing production capacity need to be evaluated to determine what the facts are. Although such claims are often attributed to basinwide overdraft, reductions in well production capacity could be caused by other factors such as poor well maintenance, collapsed well casing due to age or poor construction, shallow (vulnerable) wells, localized (non-regional) pumping, seasonal fluctuations, or drought conditions.

After compiling the existing information and evaluating what is known, establish the goals of the technical study program considering limitation and constraints. Consider teaming with other entities included State and Federal agencies that may have expertise and funding available for technical studies. Design the study program in phases, building on information obtained from subsequent phase to avoid wasting resources on non-essential issues. The goal and objectives of the study program should be developed and communicated to involved and interested parties.

Study Program Components

Data compilation – Relevant data include, but is not limited to, well logs and construction details, topography and physiography, water-level and chemistry data, geophysical surveys and tests, hydrogeological test results, surface water flow records, precipitation records, pumping data from public systems, land use data, public water supply system groundwater pumping records, and geologic mapping.

Estimate groundwater demand over time – This is typically accomplished by using pumping records when available (public water systems) and employing a land use approach for agricultural operations.

Develop a GIS database – Although a GIS database requires an initial investment, it is an effective way to manage and utilize data and will likely pay off over time due to increased efficiency in data management. Web-based databases are being developed which allow access to different types of information to various stakeholders and involved parties while maintaining confidentiality for other data.

Develop a geologic framework model - A geologic framework model establishes the geologic boundaries of the basin, structure such as faulting that may control groundwater flow and the distribution and occurrence of aquifer material. This is accomplished by closely examining the regional geology, structural geology, well logs, and geophysical data (e.g., aeromagnetic surveys, seismic refraction, down-hole geophysics). Other than local agencies, sources of information include the U.S. Geological Survey (USGS), California Geological Survey, and DWR.

Evaluation of water quality - Large scale water quality issues (such as saline water intrusion, thermal water intrusion, nitrate plumes) should be identified. The migration of large-scale plumes can provide information regarding groundwater flow. Also analysis of isotopes and other natural tracers can lead to a better understanding of groundwater recharge processes.

Development of the basin water balance – A water balance describes: (1) how much water enters into a groundwater basin from processes such as recharge from surface water bodies, rainfall or subsurface flow, (2) how much water leaves the basin (groundwater pumping, evapotranspiration, subsurface flow out of the basin), and (3) the amount of water stored in basin. If sufficient historical data is available, the water balance should be developed for different periods of time to show the temporal changes.

Development of a conceptual model – The conceptual model “tells the story” by tying together the available information. This is done by incorporating the geologic framework model, water quality, groundwater occurrence and distribution, land use and water demand. The conceptual model generally describes where groundwater occurs, how it moves, and how it interacts with surface water, as well as describing large scale issues identified by the data (e.g., saline water intrusion). The site conceptual model will not describe all processes in detail and should be considered a work in progress that is subject to continued improvement and refinement. Ideally, the conceptual model also describes changes to these processes over time.

Development of groundwater flow model – A groundwater flow model is a numerical representation of the conceptual model. Although expensive, a groundwater flow model

can be a valuable tool to identify data gaps, test assumptions and forecast future scenarios including evaluating the potential benefits of various management strategies.

Other Considerations for a Technical Study Program

It is important to decide when you have enough information to begin discussions regarding the possibility of groundwater management with policy makers and stakeholders. There is no formula for this decision and it's a judgment call based on the specific circumstances. Consider forming a technical advisory committee for the study program where this issue could be discussed. Patience is required, some members of the public, stakeholders, and even policy makers may push for "action" before the facts are sufficiently known. However, developing the scientific understanding of the groundwater conditions in sufficient detail to accurately make management decisions takes time and money. A groundwater management program that is launched prematurely without a clear understanding of the physical conditions is unlikely to garner widespread support from stakeholders.

Conversely, there will never be enough data to achieve absolute certainty. The challenge is to identify the key parameters that result in the largest degree of uncertainty and work to improve the understanding of those issues in a way that brackets the uncertainty with hi/low estimates. A flow model can be very helpful at this stage because a sensitivity analysis can be done to quantify and compare which parameters are most critical and estimate how much the results will vary if those parameters are changed. Groundwater recharge (amount and processes) and groundwater use are two of the most significant parameters that have inherent uncertainty associated with them.

3.2 Bring in the Stakeholders

Upon deciding that sufficient data exists to move forward with groundwater management planning, the next step is to begin engaging stakeholders. The first step in this process is to conduct a stakeholder assessment. Ideally, a stakeholder assessment should be conducted by an independent, objective third party. The assessment should canvas or survey key interest groups and users and should not contain individual attributions. Each stakeholder should be interviewed in person or by telephone from a list of consistent questions. The results of the stakeholder assessment can be compared to the existing data and facts to gauge perceptions versus reality. The stakeholder assessment should investigate what issues related to water supply in general are of concern, knowledge of groundwater management planning, necessity of groundwater management, and what type of groundwater management planning, if any, is desirable. After conducting the assessment, input from policy makers as to whether to proceed with groundwater management planning should be obtained.

3.3 Develop the Philosophy and Approach

Once a decision has been made to move forward with groundwater management planning, it is important to identify how it will be accomplished. Initial questions that need to be answered to shape the direction of the management process include:

- What is local?
- What type of management, regulatory or non-regulatory?
- How involved will stakeholders be and what is their role?
- What are the desired outcomes?
- Who is the lead agency, what are the roles of other agencies or entities?

Organizational Components

A project team should be assembled to implement the process. The team should consist of a project manager, an independent facilitator, and possibly technical experts. Selecting a group of stakeholders to participate through the development of the plan is a critical task. Stakeholders don't need to be the same as those interviewed in the preliminary assessment. The stakeholder group should consist of a balanced representation of all interest groups with redundancy for each interest group to minimize the chance that one stakeholder can hijack an entire constituency group. Stakeholders should be seen as leaders within their respective constituencies and willing to work productively with others. Stakeholders should be solution-oriented and agenda driven. The number of stakeholders depends on the specific circumstances of the situation. Although there should be a sufficient number of stakeholders to provide representation of constituencies with some redundancy, too many stakeholders can lead to logistical issues and possibly slow down the process.

Other organizational considerations include:

- Establishing a meeting schedule and frequency
- Setting milestones
- Developing a charter describing how the lead agency, stakeholder group, and the project team will interact
- Forming subcommittees (technical, outreach, etc.)
- Developing a communication and outreach program (website, brochure, newsletter, media plan, email announcements, etc.)

The results of these activities can be documented in a work plan so decision makers, the project team, and stakeholders have a roadmap to follow.

Establish Funding

Given that funding is usually limited, obtaining multiple sources of funding from stakeholders or public agencies is optimal. For example, funding from sanitation agencies may be available if recycled water plays a role in reducing groundwater pumping. State funding is also available for some facilitation services and technical support activities.

3.4 Developing the Groundwater Management Plan

One of the first actions required by the Water Code is for the lead agency's governing board to hold a public hearing and adopt a resolution of intent to prepare a groundwater management plan (Water Code Section 10753.2). Upon adoption of the resolution of intent, the lead agency has two years to prepare a groundwater management plan. If a plan is not completed within this timeframe, the lead agency can hold another hearing and adopt another resolution of intent. After the plan is prepared, the lead Agency must hold a second hearing to decide whether to adopt the plan (Water Code Section 10753.5). If there is a majority of protests representing more than 50 percent of the assessed value of land within the area subject to groundwater management, the plan cannot be adopted nor can any plan be adopted for at least one year.

The first several meetings of the stakeholder group should focus on organizational issues and education regarding water issues. In terms of organization issues, a charter should be developed that describes how the role of the lead agency, other supporting agencies, stakeholder group (advisory, not a legal authority). The charter should also describe the roles of the project team and contain provisions for dispute resolution. In regard to education, the stakeholder group should be briefed on groundwater management planning including what is required of an AB 3030 plan, general scientific concepts related to groundwater, local water supply issues, the roles of different organizations involved in local and regional water supply issues, the results of technical studies, and the key unknowns or uncertainties in the data. This process takes a while but is worth the effort and time as it strengthens the knowledge of the science and hence elevates the common ground.

Once the group is ready to start developing the management plan, begin with a proposed outline of the plan showing key components. At this time, also begin working with the group to develop a goal and basin management objectives. Although some time in the larger group needs to be spent "word-smithing," save time by forming an ad-hoc subcommittee of a few panel member (balanced between stakeholder groups) who enjoy this kind of activity to flesh out the concerns voiced by the panel. The ad-hoc subcommittee can then bring back their suggested text to the larger group.

Additional factors to consider during plan development include:

- Proceed in sections with chapters sent out for panel review and discussion
- Have a technical subcommittee handle some issues like preparing a monitoring plan, working on developing the scope of potential studies, prioritize work programs, and modeling future potential scenarios
- Identify specific areas of interests for guest speakers to present information to the stakeholder panel (general hydrogeology, water conservation technology, well construction, water sampling, recycled water, etc.)
- Invite speakers from other areas that are implementing groundwater management programs to learn from their experiences
- Have stakeholders make presentations about how they use groundwater and water in general
- Involve outside resources such as DWR and California Department of Public Health. This can help establish the groundwork for future funding by aligning the program to statewide priorities. Also, DWR can provide information from other groundwater management programs and the lessons learned through those efforts.
- Compile and describe all ongoing related activities by stakeholder groups or other parties in the basin
- Stakeholders should update their constituencies and solicit their feedback to bring back to the panel throughout the process.
- The lead agency and any other stakeholder that has elected officials needs to update them periodically.
- Conduct outreach describing the status of the development of the groundwater management plan via website, press releases, workshops or public meetings.

In addition, the following perspectives may be helpful to keep the process moving forward:

- Be persistent and keep working toward the endpoint. Sometimes detours are necessary if the group deems important, but the process should not be allowed to be hijacked by an individual or minority of stakeholders. Keeping focus is one of the benefits of having an independent facilitator.

- Be prepared to deal with initial impatience by some stakeholders regarding the inherent uncertainty of the science, as many people are not used to dealing with the “art form” of hydrogeology. It takes time to educate people so that they accept that the database will never be complete, and that there will always be a degree of uncertainty. Emphasize the progress that is being made relative to what was known in the past and that groundwater management is a long-term process.
- Keep a broad perspective, groundwater management planning is really more than groundwater since all sources of water are connected (i.e., conjunctive use).
- Gain panel consensus on management programs that the plan will promote and the priorities of those programs. Manage expectations and communicate limitations that may impact implementation, especially funding.
- Look for “low hanging fruit”; don’t get hung up on larger more controversial programs to start. Gain some success and develop some momentum. A lot can be accomplished through cooperation and coordination, especially where none has existed before.
- Since multiple people will, in effect, be writing a document, it is a given that there will be conflicting input, comments, and edits. Therefore, make sure to close the loop for substantial comments that are in conflict or bring to the panel for discussion and resolution.
- Have a deadline and stick to it as much as possible, otherwise there can be continued writing and re-writing of the document. The plan will never be perfect, but some will want to keep working on it to attempt to make it perfect.
- Emphasize that the plan is a work in process, it can be updated as new information becomes available

3.5 Implement the Groundwater Management Plan

Once the groundwater management plan has been adopted by the lead agency, it is important to keep a stakeholder group in place to ensure that the plan continues to be connected to the local community. If possible, have the same stakeholder panel continue meeting, although possibly on a less frequent basis. It is also important to maintain a technical working group of the stakeholders together to advise on the results of monitoring and study data. The plan should specify the frequency for updating. If new data indicates that the plan needs to be modified to reflect changed conditions, the stakeholder group should meet to discuss such changes.

The following lists types of activities that are conducted during plan implementation:

- Outreach to NGOs, research institutions, etc. for collaborations and partnering to pursue potential funding opportunities
- Develop a data management system if one doesn't already exist
- Conduct studies to close or reduce key data gaps
- Support other entities implementing groundwater projects in the area covered by the groundwater management plan
- Initiate or continue monitoring program and report results periodically to panel
- Prepare update reports on an established schedule as specified in the GMP
- Continue public outreach (e.g., website, newsletter, press release)

4.0 Case Study – Sonoma County

In recent years there have been extensive activities in Sonoma County with the purpose of increasing the knowledge of groundwater conditions and working towards developing management programs that will enhance the sustainability of the resource. These activities have emphasized the development of scientifically derived data and information that, in turn, are used as the basis for stakeholders to work together to identify programs that will increase the sustainability of groundwater resources. The following briefly summarizes: (1) the water resources setting in Sonoma County; (2) study programs that are intended to enhance the scientific understanding of groundwater conditions within the major groundwater basins in the county; and (3) the groundwater management program in one of those basins, the Sonoma Valley.

4.1 Water Resource Setting

Water resources in Sonoma County consist of surface water supplies primarily derived from the Russian River and groundwater supplies occurring mainly in relatively small alluvial basins. Groundwater outside the alluvial basins is limited in occurrence and quantity due to the existence of hard rock formations with little water bearing capacity. Land use planning policies by the County of Sonoma have promoted urban-centered growth and the preservation of open space. As a consequence, it is necessary to move water from source areas such as the Russian River to urban centers where the demand is concentrated. This is accomplished in large part through a water supply and transmission system owned and operated by the Sonoma County Water Agency (Agency), a California Special District, authorized to provide wholesale water supply to several cities and water districts in Sonoma and Marin Counties. Although the Agency's Board of Directors and the County's Board of Supervisors are comprised of the same individuals, the Boards are legally distinct. Unlike the County, the Agency does not have police power regulation authority.

The primary source of the Agency's water supply is naturally filtered Russian River water that is conveyed via a transmission system to retail customers (Figure 3). The Agency supplements Russian River supplies by operating three groundwater supply wells in the Santa Rosa Plain. The Agency's retail customers, in turn, deliver Agency-provided drinking water to more than 600,000 residents in portions of Sonoma and Marin counties. The retail customers also implement water conservation measures, recycled water projects to offset water demand for irrigation and landscaping, and utilize local water supplies (primarily groundwater).

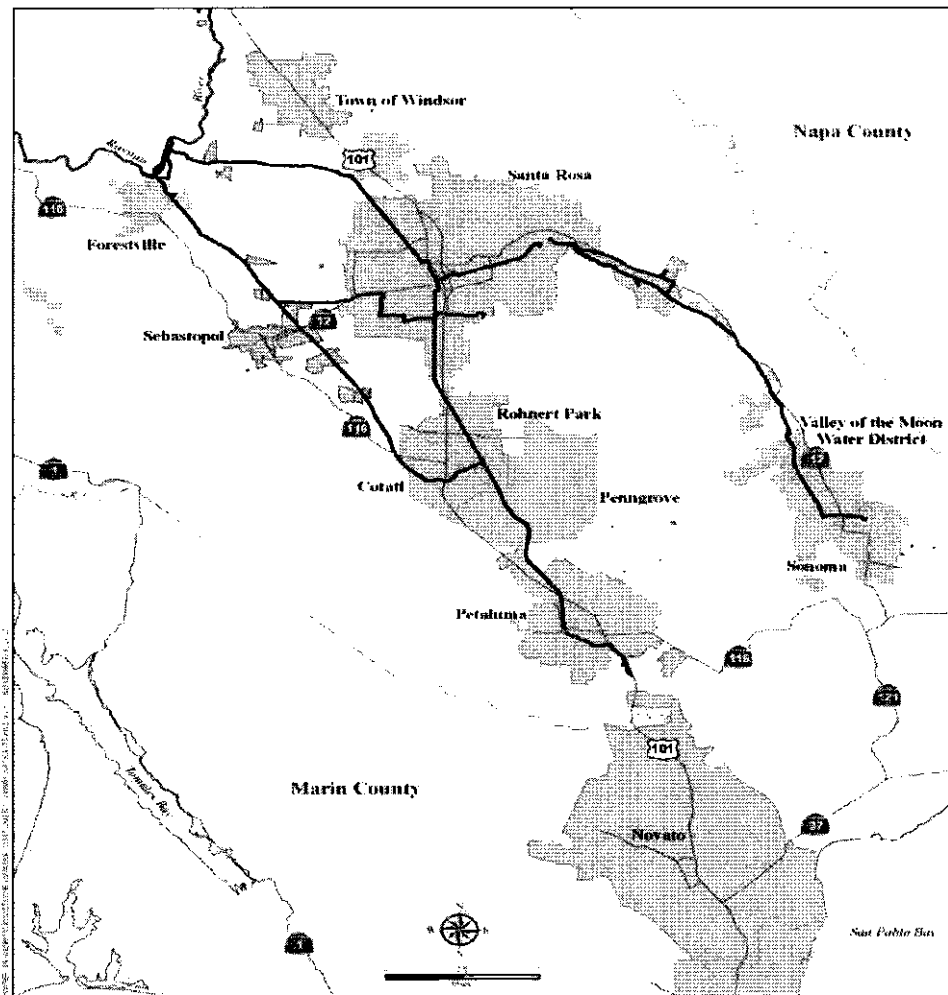


Figure 3 – Sonoma County Water Agency Transmission System

The Agency has submitted an application to the State Water Resources Control Board (SWRCB) to increase its diversion/re-diversion water rights for the Russian River from 75,000 acre-feet per year to 101,000 acre-feet per year to meet future needs based on projections in the 2005 Agency Urban Water Management Plan (Brown & Caldwell, 2006). To obtain this increased water right, the Agency will need to ensure that its current and future operations comply with environmental regulations and requirements. The Agency projects completion of the permitting process by 2016, and subsequently providing additional imported water supplies to its retail customers (Brown & Caldwell, 2006).

Under the Endangered Species Act (ESA), two species of salmon have been listed as threatened and another as endangered in the Russian River watershed. All three species are potentially adversely affected by the Agency's facilities. The National Marine Fisheries Services (NMFS) is working towards issuing a biological opinion covering the Agency's existing operations for water supply and flood control. According to the 2005 Urban Water Management Plan (Brown & Caldwell, 2006), it is reasonable to assume that "with the implementation of mitigation measures, ESA constraints will not affect or impair the current water supply available to the Agency for delivery to its transmission system customers." The Agency is currently working with the NMFS to finalize the biological opinion covering the Agency's existing operations.

The Agency and its retail water customers focus their water resource planning efforts on meeting demand by maximizing water conservation and recycled water use and then balancing local supplies such as groundwater with Agency supplies mainly derived from the Russian River. Constraints in the Agency's water transmission system, particularly during periods of peak summer demand, often force the use of increased local supplies by retail water purveyors to meet demand. The aforementioned challenges in gaining additional Russian River water rights to divert/redivert water (mainly stored in Lake Sonoma) also put pressure to increase the other three sources of water: conservation, recycled water, and groundwater.

The Agency is interested in better managing these resources, so that strategic actions are carried out that are beneficial to the public and environment. The Agency also recognizes that each of its retail water customers has their own unique water "portfolio" and that planning based on input from local stakeholders is more likely to produce effective programs to achieve this goal. Therefore it is important to develop programs that are not "top down" and instead designed within the regional framework, but with the priorities of the local community. In addition, it is important to recognize that such programs should be comprised of diversified actions that integrate the available water supplies to the community (i.e., conservation, recycled water, Russian River water, and local supplies).

4.2 Groundwater Study Program in Sonoma County

In 2000, the Agency embarked on a multi-year program in conjunction with the USGS to systematically evaluate the major groundwater basins in Sonoma County. These basins are the Alexander Valley, Sonoma Valley, Santa Rosa Plain, and the Petaluma Valley. The goals of the cooperative program are to evaluate the relationship between Russian River and groundwater supplies in these basins. The Agency's transmission system provides imported water to urban areas in the Sonoma Valley, Santa Rosa Plain, and Petaluma Valley. Although the Agency and its retail water suppliers continue to focus efforts on maximizing water conservation and recycled water use, as limitations in Russian River water rights approach and transmission system constraints increase over time, there is an increased reliance on local groundwater supplies.

The basic elements of the groundwater studies consist of:

- Physiography and geologic setting
- Geologic framework model
- Hydrology
- Surface water and groundwater chemistry
- Site conceptual model
- Groundwater flow model (Sonoma Valley and Santa Rosa Plain)

At this time basin-wide assessments have been completed for the Alexander Valley (USGS, 2006a) and Sonoma Valley (USGS, 2006b). A five year study of the Santa Rosa Plain study began in December 2005. Several of the Agency's retail customers are providing support to these studies through funding and in-kind services. Ultimately the Agency and the USGS intend to link these basin groundwater flow models with model on the Russian River so can better evaluate connection between the river and other groundwater basins.

4.3 Stakeholder Assessment and Development of Workplan

A group of stakeholders were interviewed in the fall of 2005 by the Center of Collaborative Policy, Sacramento State University, to identify concerns and develop a process for stakeholders to work together. Stakeholders included representatives from agriculture, economic interests, residential groundwater users, environmental local governments/public agencies, and water purveyors. The recommendations from the stakeholder assessment were to:

- Use a collaborative process to address groundwater management issues
- Convene a basin advisory panel comprised of stakeholders representing the Sonoma Valley's diverse interests

- Work with the panel to develop a groundwater management plan with the Sonoma County Water Agency as a lead agency

Based on the USGS study and the stakeholder assessment, a workplan for a groundwater management plan was developed and approved by the Agency's Board of Directors in June 2006.

4.4 Sonoma Valley Groundwater Management

(The following excerpt is from the executive summary of the Sonoma Valley Groundwater Management Plan [Schlumberger Water Services, 2007])

Groundwater resources have long played a significant role in the development, growth and sustainability of the Sonoma Valley, with more than half the water demand in a given year met by local groundwater resources. With continuing and increasing demand on finite local groundwater supplies, overall groundwater storage in the Sonoma Valley has been and will continue to be depleted without appropriate actions in the near future. This voluntary, non-regulatory Sonoma Valley Groundwater Management Plan (Plan) has been created to identify a range of water management actions to sustain the resources for future generations. ***The goal of the Plan is to locally manage, protect, and enhance groundwater resources for all beneficial uses, in a sustainable, environmentally sound, economical, and equitable manner for generations to come.***

The Plan was developed in coordination with the Sonoma County Water Agency (Agency), the Valley of the Moon Water District (VOMWD), and City of Sonoma (City) under a collaborative and cooperative process that also included a broad range of stakeholders who live in the Sonoma Valley. The Plan has been prepared under the authority of the Groundwater Management Act Water Code § 10750 *et seq.*, originally enacted as Assembly Bill (AB) 3030, to encourage voluntary groundwater management at the local level, subsequently modified under Senate Bill (SB) 1938 which mandated that all water agencies adopt or participate in a groundwater management plan to be eligible for state funds for groundwater projects.

The Plan area (Figure 4), referred to as the Sonoma Valley, is the Sonoma Creek Watershed. The Sonoma Valley is approximately 166 square-miles in size, and is bounded by Sonoma Mountain to the west, the Mayacamas Mountains and Mount Hood to the east and north, and San Pablo Bay to the south.

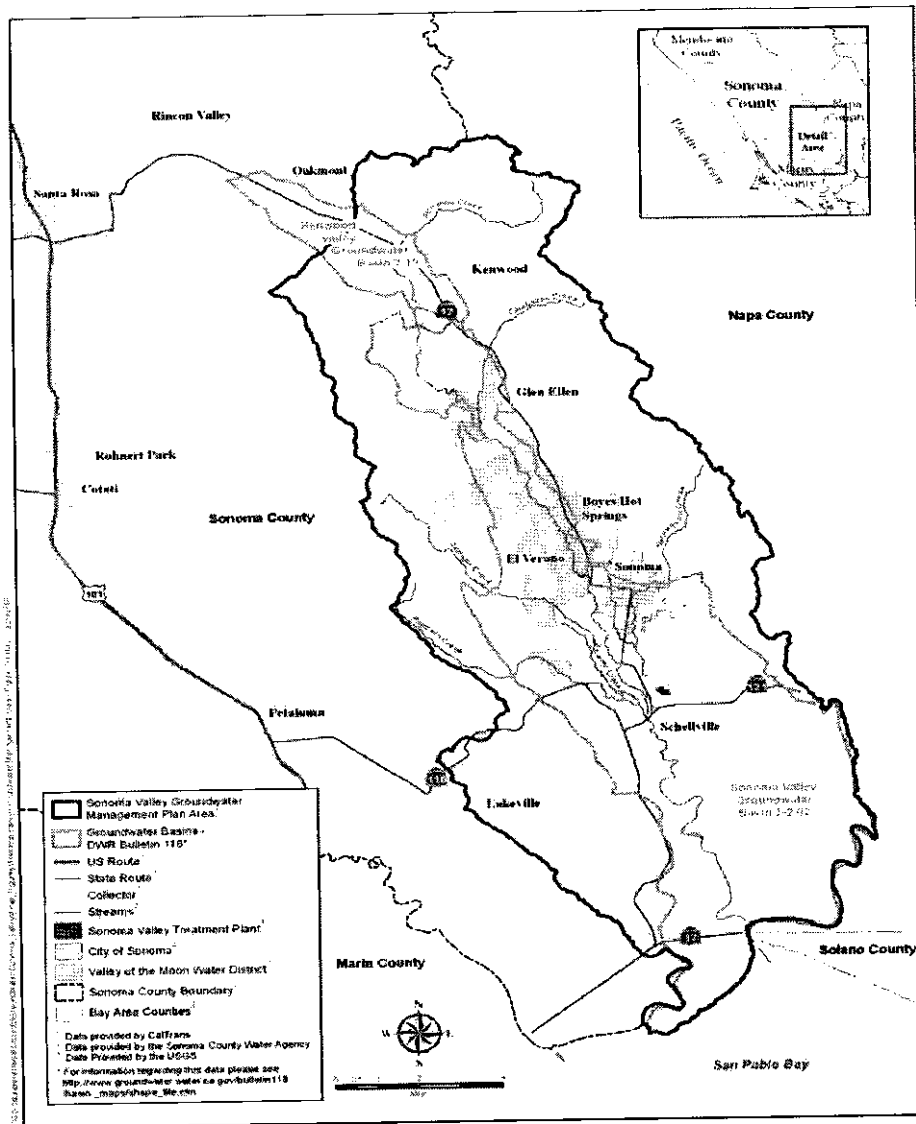


Figure 4 - Sonoma Valley Groundwater Management Plan Area

PROBLEM STATEMENT

In 2001, the Agency's Board authorized an agreement with the United States Geological Survey (USGS) to develop a cooperative study to characterize major groundwater basins in Sonoma County. The study estimated that pumping in the basin has generally increased from approximately 6,200 acre-feet per year (af) to 8,500 af since the basin was last studied in 1974 (approximate 25% increase in pumping). The USGS also estimated

on the basis of groundwater flow modeling that from 1975 to 2000, 17,300 acre-feet was lost from overall groundwater storage. As a result, the Sonoma Valley has been experiencing localized declining groundwater levels in some areas, and potential groundwater quality problems from seawater intrusion and geothermal upwelling.

SONOMA VALLEY WATER RESOURCES SETTING

Water Supply

The Sonoma Valley relies on groundwater and imported surface water to meet domestic, agricultural and urban demands. Based on the study conducted by the USGS (USGS 2006), in 2000 more than half the water demand was met with groundwater (57%), followed by imported water (36%), with the remaining demand met from recycled water (7%), and local surface water (unquantified) (Figure 5). The largest use of *groundwater* in the Sonoma Valley in 2000 was for irrigation (72 percent), followed by rural domestic use (19 percent), and urban demand was the third largest (9 percent). For the year 2000, *total water use* in the Sonoma Valley, including groundwater and imported water, was estimated at 14,018 acre-feet, with 48 percent for irrigation, 41 percent for urban use, and the remaining 11 percent for rural domestic use.

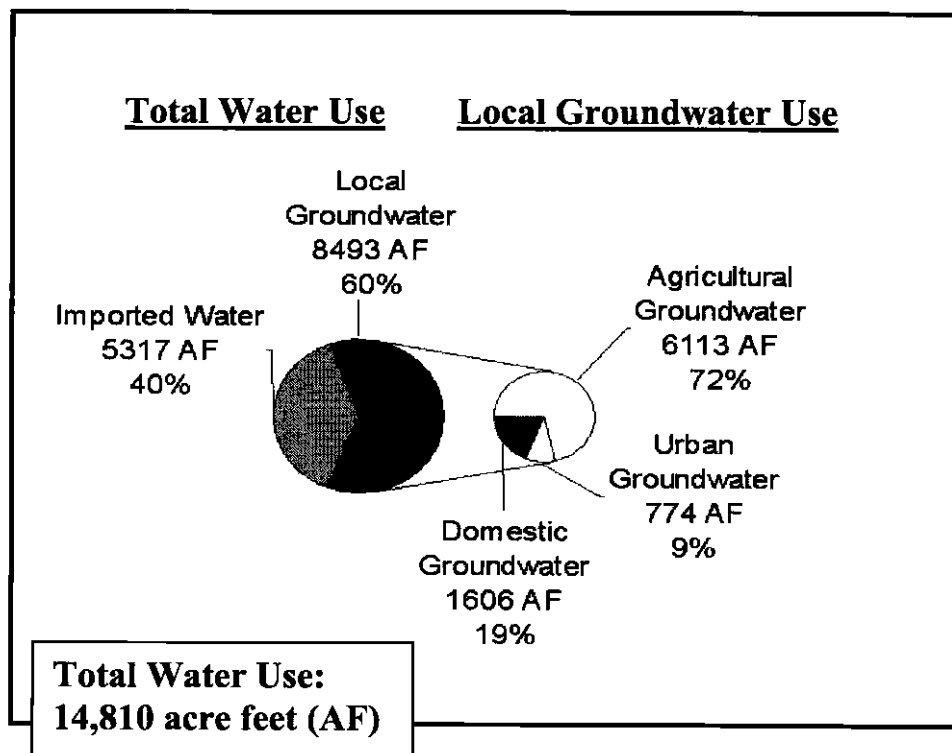


Figure 5 - Sonoma Valley Water Supply for Year 2000

Note: acre-feet per year (AF). One AF is equal to 325,800 gallons or the approximate amount of water needed to cover a football field one foot deep.

Groundwater is the primary supply for approximately 25 percent of the Sonoma Valley population and is the sole source of drinking water supply for rural domestic and other unincorporated areas not being served by urban suppliers. Rural domestic demand is met by groundwater through privately owned and operated wells. There are also mutual water companies in the Sonoma Valley that supply multiple households predominantly with groundwater, although some companies also use imported water. Agricultural water demands are largely met by Sonoma Valley groundwater supplies.

Imported water, the primary source of drinking water to meet urban demands, serves approximately 75 percent of the Sonoma Valley population. Imported water supplies from the Russian River are provided via aqueduct by the Agency to the VOMWD and the City, who in turn provide water directly to their urban customers. The imported water is supplemented in dry years with local groundwater from the City and VOMWD public supply wells.

One of the key elements in meeting the future urban water demands is the strategy to increase imported water supply. The Agency is in the process of obtaining additional water rights, and if successful, around 2016 there should be an increase of imported water into the Sonoma Valley to VOMWD and the City to help meet the increase in urban water demands. Until that time, the City and VOMWD plan to increase their Sonoma Valley groundwater use to meet their projected increasing demands.

GROUNDWATER MANAGEMENT PLAN ELEMENTS

The following section presents the elements of a groundwater management plan prepared by the PANEL, including Basin Management Goal, Objectives, and program components and actions to meet the goal and objectives. Modeling results are discussed after the Plan Goal and Objectives to provide background and the basis for the components and action items aimed at implementing the Plan.

Plan Goal

The goal of the Plan is to *locally manage, protect, and enhance groundwater resources for all beneficial uses, in a sustainable, environmentally sound, economical, and equitable manner for generations to come.*

Plan Basin Management Objectives (BMOs)

The following ten BMOs provide the foundation for the Plan:

- BMO-1 Maintain groundwater elevations for the support of beneficial uses of groundwater, and to protect against inelastic land subsidence
- BMO-2 Improve water use efficiency and conservation

- BMO-3 Identify and protect groundwater recharge areas and enhance the recharge of groundwater where appropriate
- BMO-4 Manage groundwater in conjunction with other water sources
- BMO-5 Protect groundwater quality for beneficial uses including minimizing saline intrusion
- BMO-6 Protect against adverse interactions between groundwater and surface water flows
- BMO-7 Improve the community's awareness of groundwater planning, water resources, and legal issues
- BMO-8 Improve the groundwater database and basin understanding through consistent monitoring and additional surveys, and improve basin analytical tools including the groundwater simulation model
- BMO-9 Manage groundwater with local control
- BMO-10 Explore, identify and maximize non-regulatory approaches to manage the groundwater resource

Results of Forecasts Using the Groundwater Model

To supplement previous modeling completed by the USGS (USGS, 2006b), additional groundwater modeling analysis was completed as part of the Plan development to evaluate increasing demands on groundwater between 2001 and 2030. Additional modeling analyzed normal and dry year weather scenarios. As previously discussed, around 2016 it is anticipated there will be an increase of imported water into the Sonoma Valley to VOMWD and the City to help meet the increase in urban water demands. Until that time, the City and VOMWD plan to increase their Sonoma Valley groundwater use in addition to continued conservation efforts to meet their projected increasing demands. Based on the uncertainty surrounding the timing and availability of additional imported water from the Russian River, the modeling analyzed both an increase in imported water as well as static supplies of imported water. The static imported supply scenarios were developed to represent the most conservative and worst-case estimate of future imported supplies.

Based on the groundwater modeling, rural domestic, agricultural and urban groundwater use in the Sonoma Valley is projected to increase from an estimated total of 8,500 acre-feet in 2000 to an estimated 10,100 to 11,300 acre-feet per year in 2030, respectively, with and without an increase in imported water supplies. This increased demand on groundwater is estimated to result in a reduction of approximately 16,000 to 22,000 acre-feet from storage in the groundwater basin. The losses from overall groundwater storage will likely result in downward trending groundwater levels, and associated potential adverse impacts including increased extraction costs, possible well deepening or replacements costs, possible groundwater quality degradation including salinity intrusion, potential land subsidence, decreases in streamflow, and environmental damage. The

modeling results provide the rationale and basis for groundwater management actions to be implemented in the Sonoma Valley.

The modeling results are shown below in Figure 6. In summary, only three scenarios resulted in an increase in groundwater storage within the Basin, Scenarios A, B, and C. Plan components and actions that achieve the most storage have been prioritized by the PANEL. The components and actions are discussed in the following section.

Plan Component Actions

The Plan Component Actions presented below were developed to attain groundwater sustainability and achieve the Plan Goal and BMOs. While the PANEL recommended implementing all of the components presented below, the PANEL prioritized Groundwater Sustainability and Groundwater Quality Protection as components that would best achieve the Plan Goal and BMOs.

Groundwater Sustainability - The Plan seeks to attain groundwater sustainability by pursuing: 1) stormwater recharge, 2) groundwater banking, 3) increased use of recycled water to offset groundwater pumping, and 4) increased conservation and demand reduction measures.

Groundwater Quality Protection - Groundwater quality protection is critical to ensuring a sustainable groundwater resource. Groundwater quality protection includes: 1) strategies to prevent and minimize contamination in the Sonoma Valley basin and 2) mitigation of existing contamination including saline water intrusion.

Monitoring Program - A robust monitoring program should be capable of assessing the current status of the Sonoma Valley and predicting responses in the basin as a result of future management actions. The Plan includes actions related to:

- Monitoring of groundwater elevations and groundwater quality
- The potential for land surface subsidence resulting from groundwater extraction
- Developing a better understanding of the relationship between surface water and groundwater along Sonoma Creek
- Adopting and implementing monitoring protocols and the monitoring program; and maintaining a central data management system of monitoring information

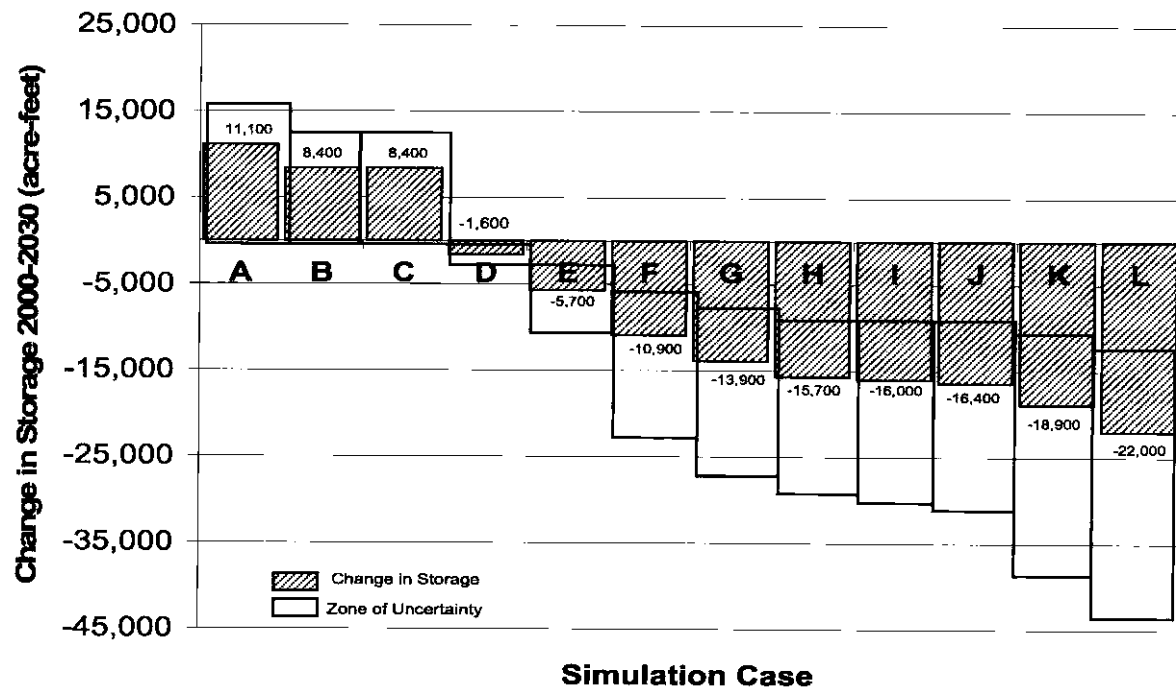


Figure 6 - Simulated Change in Groundwater Storage in Acre Feet in the Sonoma Valley for the 12 Simulation Cases:

- A) Additional imported water and all options implemented, normal weather year scenario
- B) Additional imported water and all options implemented, dry weather year scenario
- C) All options implemented, normal weather year scenario
- D) Groundwater banking implemented, normal weather year scenario
- E) Additional imported water, stormwater recharge, recycled water and conservation implemented, normal weather year scenario
- F) Additional imported water, recycled water and conservation implemented, dry weather year scenario
- G) Conservation implemented, normal weather year scenario
- H) Recycled water implemented, normal weather year scenario
- I) Additional imported water, normal weather year scenario
- J) Stormwater recharge implemented, normal weather year scenario
- K) Normal year weather scenario
- L) Dry year weather scenario

Planning Integration - Integrating water management planning on a regional scale is critical. Planning integration includes coordination and incorporation of existing urban water management plans, drinking water source assessment and protection program plans, land use planning issues through local and county plans, and other planning documents that have been or will be developed in the valley. These include an integrated water resources management plan being planned, and the Sonoma Creek Watershed Enhancement Plan.

Stakeholder Involvement - Several means of achieving broad stakeholder participation in the management of the Basin will be used, including: 1) outreach to the public, 2) coordinating with advisory groups, 3) informing public agencies and stakeholders, and 4) coordination and pursuit of a variety of partnership opportunities.

Plan Implementation

Implementation of the Plan is structured in order to encourage an open, collaborative and cooperative process for implementing groundwater management activities, and to maximize coordination of the many actions envisioned by the PANEL in the coming years. Plan studies, projects, and programs will be conducted under the Agency as the lead, with guidance from the PANEL and a supporting Technical Advisory Committee. The preliminary implementation schedule is based on the priorities that the PANEL identified during preparation of the Plan, which includes the Groundwater Sustainability and Groundwater Quality Protection components.

Plan Funding

Implementation of these actions is anticipated to be funded from a variety of sources including the Agency, funding and/or in-kind services by member agencies, state or federal grant programs, and partnerships at the local, state, and federal level. Procurement of funding will be critical to move forward with programs identified in the Plan. Stakeholder Involvement and the Monitoring Program form the foundation for the Plan, and are required Plan components under the Water Code to be eligible for state funds for groundwater projects. These activities are funded by the Agency, through cooperative partnerships, and through available existing funding sources.

The Groundwater Quality Protection, Groundwater Sustainability, and Planning Integration components contain many more planned actions that are not funded and will require study, data, feasibility analysis, and pre-design before funding can be obtained. Implementation of many of these actions, including significant projects such as groundwater banking and stormwater recharge, are probably a minimum of 3 to 5 years in the future, and will depend on obtaining funding.

Annual Plan Implementation Reporting and Future Review

The Agency will describe implementation progress in an annual report that summarizes the groundwater conditions in the Sonoma Valley. The Plan is a living document that will continually evolve as more information about the Sonoma Valley becomes available. Additional actions may be identified as the Agency continues to evaluate all of the actions and objectives over time to determine how well they are meeting the overall Plan Goal.

5.0 Summary

Groundwater management planning that emphasizes input from the local community through stakeholder groups requires combining scientific information and education of stakeholders to develop a management plan that makes sense from both a technical and community perspective. This effort requires patience, diplomacy, and adept human relations to pull off. However, the promise of effective groundwater management planning based on community input is that real solutions consistent with State and regional approaches will be implemented to ensure the community's water resource goals are met as opposed to "top down" solutions that lack community support.

Important considerations include:

- Base the plan on sound data and science
- Identify stakeholder issues and interests and understand how perceptions compare with data
- Spend the time to educate stakeholders regarding technical issues and the state of the science
- Utilize objective facilitation with agreed upon rules for the process
- Be realistic, accept that there will never be enough data and the plan will never be perfect from all perspectives
- Focus on common ground (science)
- Start with simple non-controversial actions ("low hanging fruit") to gain momentum and success
- Evolve and adapt as you learn
- Continue to collect data and monitor so that you continue to use best available science to guide your decisions during plan implementation
- As a lead agency, be a panel stakeholder and sit at the table and negotiate with other panel members
- Look for win-win solutions

6.0 References

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