Salmon Creek Water Conservation Plan

Coastal Conservancy

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Salmon Creek Water Conservation Plan

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With funding from the California State Coastal Conservancy

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The Salmon Creek Water Conservation Program (SCWCP) is a multi-year, multi-stakeholder effort focused on developing alternative water supply solutions that support human needs while protecting and restoring instream flows for fish and wildlife.

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EXECUTIVE SUMMARY

Salmon Creek is a rural, coastal watershed (Figure 1) with strong local support for protecting the environment, sustaining local communities, and restoring salmonid populations. The Salmon Creek Watershed drains a 35-square-mile area to the Pacific Ocean. Land use within the watershed is a mix of family-owned ranches, rural residential development, and small vineyards. The watershed's four communities (Occidental, Freestone, Bodega, and Salmon Creek) uniquely reflect the character and interests of their residents.

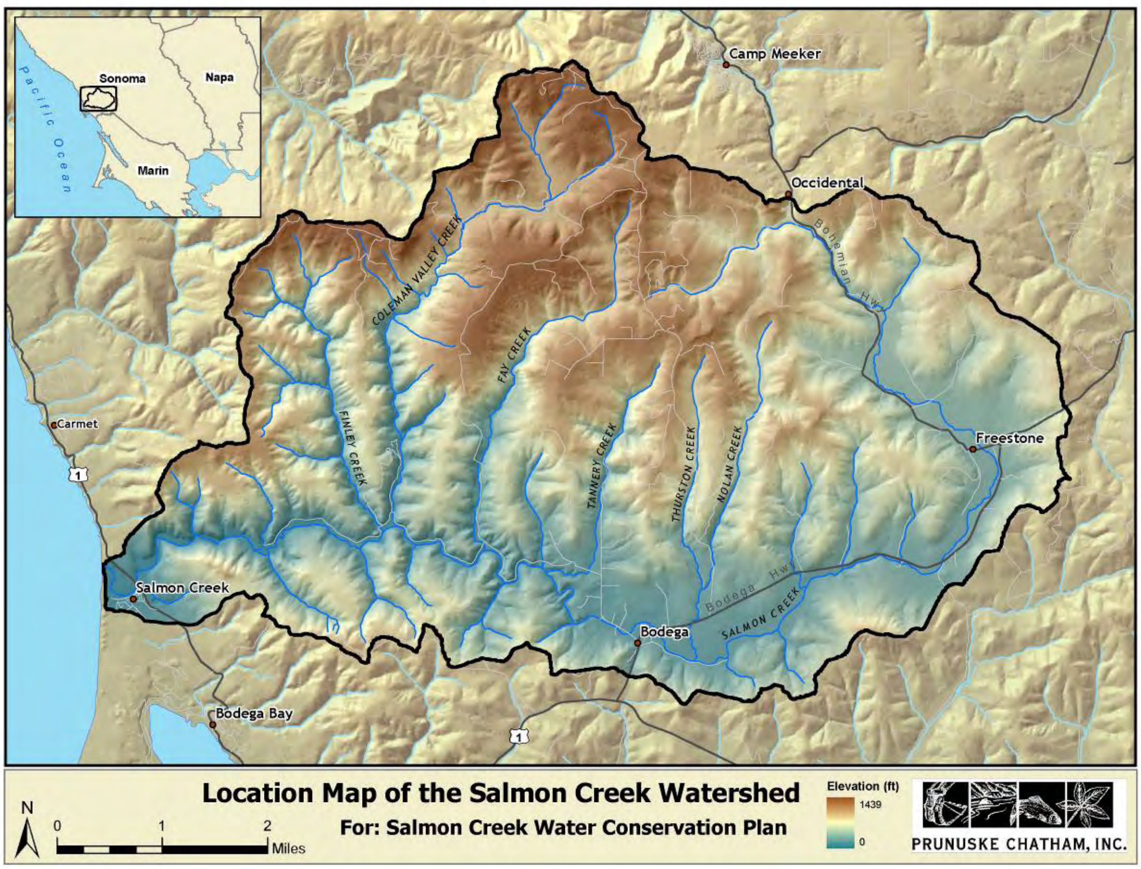

Figure 1. Salmon Creek Watershed, located in western Sonoma County, California

Examination of **water extractions and their impact on instream habitat** for imperiled salmonids in the watershed was initiated in 2003 through a study of the Salmon Creek estuary funded by the State Coastal Conservancy (SCC). *Salmon Creek Estuary: Study Results and Enhancement Recommendations*, completed in 2006 by Prunuske Chatham, Inc. (PCI) for the Occidental Arts and Ecology Center (OAEC), identified **lack of sufficient streamflow in late spring and summer as a primary factor limiting successful rearing of juvenile steelhead**.

Insufficient summer streamflow in both the upper watershed and the estuary creates disconnected rearing habitat with debilitating water quality conditions. This, coupled with inadequate cover for predator protection in pools and the estuary, leads to high rates of juvenile salmonid mortality.

Seasonal water scarcity is also an ongoing issue for the human residents of the watershed, often requiring that water be trucked in during summer months. In addition, streamflow conditions and water supply availability are likely to see climate change-related shifts due to projected changes in temperature and precipitation.

Many opportunities exist to reduce demand on extractive water sources that, through direct or cumulative effects, reduce streamflow and degrade instream habitat. Measurably increasing streamflows to improve salmonid rearing conditions and water supply sustainability requires that the following methods be integrated and applied in a concentrated manner in critical rearing reaches:

- Water conservation and wise-use practices;
- Groundwater recharge through practices to slow and infiltrate stormwater runoff;
- Development and wide implementation of alternative, non-extractive water supplies, including rainwater storage; and
- Reduction in riparian water diversions.

The Salmon Creek Water Conservation Program (SCWCP) was developed in response to the need to increase dry season instream flows for improved aquatic habitat while simultaneously supporting the freshwater demands of residents. Current SCWCP's efforts are focused on:

- Describing extractive water usage in the watershed and identifying opportunities to reduce its impacts on streamflow;
- Developing tools to promote water use efficiency and conservation; and
- Supporting residents in implementing measures to shift their reliance on extractive water supplies to alternative, storage-based sources.

Initial SCC funding was secured in 2008 to build the SCWCP framework through completing essential research, planning, and community outreach. The Grantee, OAEC's WATER Institute, partnered with consultants PCI, Virginia Porter Consulting, and Kathleen Kraft to complete this work.

The **objectives** of the 2008 SCC grant were to:

- **Analyze water supplies and demands** within the Salmon Creek Watershed, including local utilities, rural residences, and agricultural operations to characterize water use and focus water conservation efforts;
- **Develop Conservation Strategies** that both support the effective, long-term implementation of the SCWCP and are transferrable to other water-scarce communities along California's coast;
- **Design and implement public outreach materials and workshops**, including development of stakeholder meetings, to promote the SCWCP and use of the Conservation Strategies; and
- **Build a pilot demonstration program (the Bodega Pilot Program)** to show how small coastal communities can effectively combine water conservation with sustainable water supply planning.

This Salmon Creek Water Conservation Plan (Plan) summarizes SCWCP progress thus far and provides recommendations for ongoing work.
This Plan introduces the background and science supporting the SCWCP, outlines the results of the water consumption analysis, describes the Bodega Pilot Program and the wider outreach effort, summarizes and presents the Conservation Strategies, and recommends future SCWCP research, projects, and outreach efforts.

CHAPTER 1: SALMON CREEK WATER CONSERVATION PROGRAM BACKGROUND

THE ISSUES

Coastal Water Scarcity: A Scarcity of Storage

Author: L. Hammack

Due to its Mediterranean climate, steep topography, and geology, the Salmon Creek Watershed's dry-season water supplies often cannot meet the demands of existing human habitation needs. Irregular winter-season precipitation and unfailingly dry summers create a conflict between seasonal water availability and periods of high demand (Figure 2). The metamorphic rocks underlying much of the watershed and region are a poor aquifer; plus the steep terrain and relatively thin soils constrain rainfall infiltration and groundwater recharge. Thus, Salmon Creek, along with much of the coastal range in Marin, Sonoma, and Mendocino Counties, can be considered a water-scarce area (Kleinfelder 2003; Grantham et al. 2010).

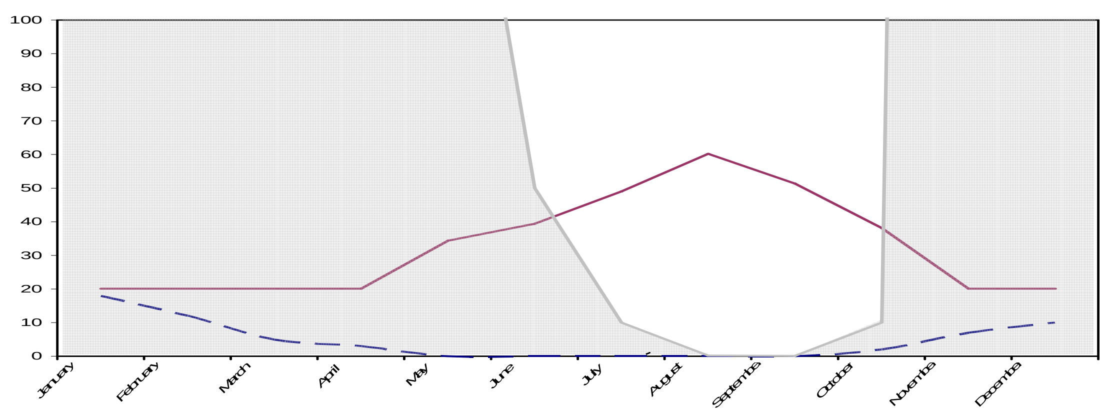

Figure 2. Diagram showing relative relationship of monthly consumptive water demand in acre-feet (solid line) to monthly rainfall in inches (dashed line) and surface water availability in acre-feet (fill area), as depicted by streamflow. Based on actual Salmon Creek Watershed data. Note that in the summer months demand far exceeds the amount of water in Salmon Creek. It is postulated that redirection of a portion of the current demands from direct extractions to winter-derived storage supply would increase streamflows proportionally. Monthly winter runoff and streamflow volumes often exceed demands by more than two orders of magnitude (i.e., 2000-6000 acre-feet).

Native species reliant on riparian habitat and instreamflows to survive are particularly vulnerable to water shortages and periods of drought. Naturally low streamflow conditions inherent to the Mediterranean climate are exacerbated by direct water extractions and groundwater depletions. Direct streamflow diversions in the summer have caused reaches of Salmon Creek to dry (during drought years) and pools to become disconnected (PCI 2006).

Ultimately, seasonal coastal water scarcity is a result of inadequate water storage. As shown on Figure 2, rural coastal watersheds such as Salmon Creek receive more than enough rainfall to meet the annual water demands of the residents; more information on this is in available in the Water Consumption Analysis in Chapter 2 of this Plan. However, with a Mediterranean climate, rainfall is concentrated mainly between the months of November and March.

This seasonal cycle of water abundance and scarcity can be balanced out—for the benefit of humans and fish—through the **strategic storage** of rainwater in off-channel ponds and roofwater harvesting systems for non-potable irrigation and livestock watering needs. With proper filtration and treatment, rainwater can also be used as a potable water source in accordance with applicable regulations.

However, water storage is not a panacea for all water supply concerns, and cannot substitute for efficient and conservative water use. The impacts of reservoirs on hydrologic flow regimes necessary to maintain ecosystem health have been widely documented (Graff 1999; Richter and Thomas 2007; Grantham et al. 2010). Instreamflow regulations for the State of California (AB 2121) are in final draft form and attempt to address these impacts. It is unlikely that small storage ponds or rainwater catchment systems used to fulfill existing water demands in rural coastal areas such as Salmon Creek would significantly decrease peak runoff during winter storm events. However, multiple, on-channel storage ponds within a small catchment may reduce early winter base flows and affect salmonid migratory flows. Grantham et al. (2010) suggest that there is an optimal storage capacity for a given watershed that can be calculated to meet water demands, while ensuring critical habitat needs and ecosystem function.

Water Use and Extractions

Many coastal communities and residents struggle to maintain adequate, stable water supplies. Water sources associated with surface water and adjacent to streams—wells, direct in-stream diversions, and on-channel storage ponds—tend to provide a more consistent and higher production supply and, thus, are preferentially developed and used. Residents in upland areas along the ridgelines are dependent upon groundwater wells and springs.

All water extractions likely affect streamflow, either directly or indirectly through cumulative impacts. Groundwater sources in the uplands are connected through aquifers, bedrock fractures, and geologic-formation contacts to springs. Springs feed directly into first and second order tributaries, or they locally maintain the water table that sustains summer streamflows. Groundwater wells in the alluvial valleys, thought to be disconnected from the water table by an impervious clay layer, are likely impacting shallow groundwater sources feeding the creeks (PCI 2006).

As shown below, there are 43 active documented water diversions (Figure 3) in the Salmon Creek Watershed (WRIMS database 2010). The combined diversion volume for the appropriative and registered water rights is 424 acre-feet (including both storage and direct diversions). The claimed riparian rights are not required to list a diversion amount, and most riparian water users do not file Statements of Diversion. The use of riparian supplies is common throughout the watershed for year-round domestic and agricultural water supply, as well as summer irrigation. See the Water Consumption Analysis in Chapter 2 for more information on water sources and supplies in the Salmon Creek Watershed.

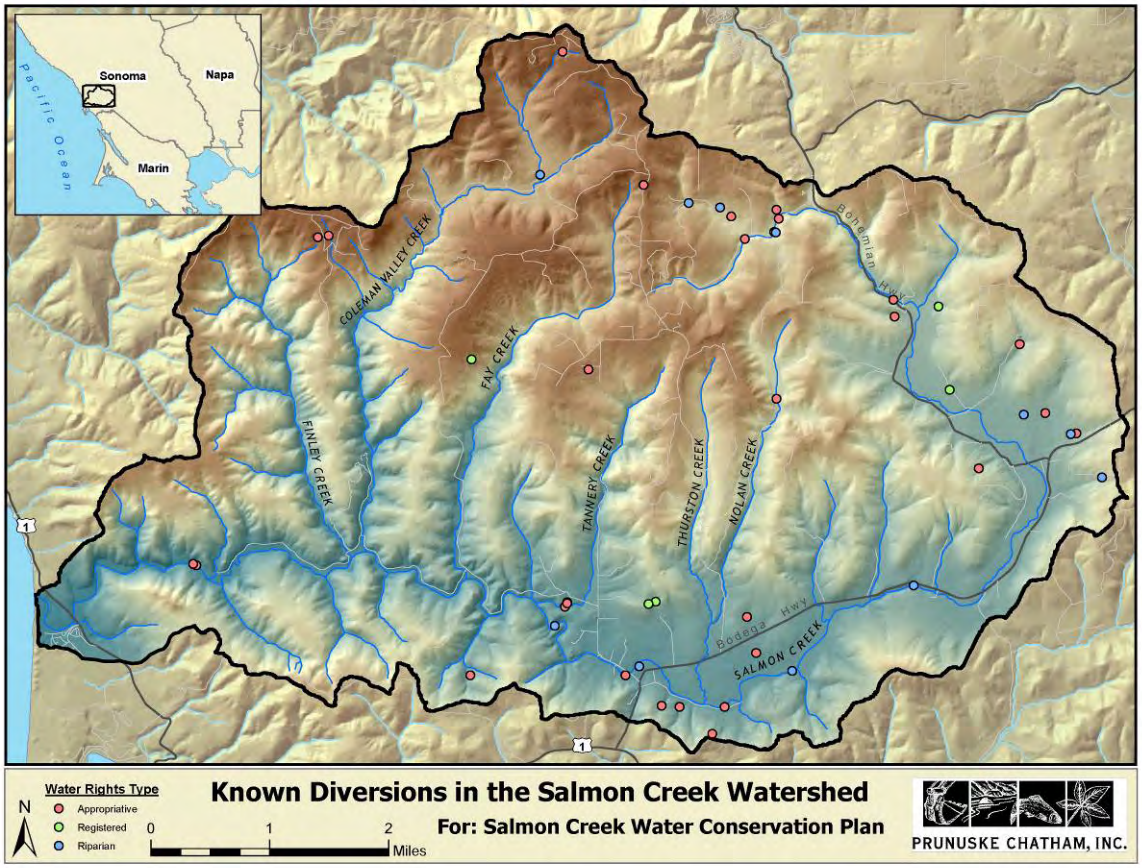

Figure 3. Locations of documented active diversion and storage rights in the Salmon Creek Watershed by type: appropriative, riparian, and registered stockponds/small domestic use.

Regulatory Framework

Water is recognized as a public trust resource and must be managed reasonably and for "beneficial uses," which historically included municipal and industrial uses, irrigation, hydroelectric generation, and livestock watering. The concept of beneficial use has recently been expanded to include recreational use, fish and wildlife protection, and enhancement and aesthetic enjoyment (State Water Resources Control Board 2010). The following description summarizes the current view of water and water rights held by the State Water Resources Control Board:

> "As increasing emphasis is placed on protecting instream uses—fish, wildlife, recreation and scenic enjoyment—surface water allocations are administered under ever-tightening restrictions, posing new challenges and giving new direction to the State Board's water right activities.
>
> "Under the public trust doctrine, certain resources are held to be the property of all citizens and subject to continuing supervision by the State. Originally, the public trust was limited to commerce, navigation and fisheries, but over the years the courts have broadened the definition to include recreational and ecological values.
>
> "In a landmark case, the California Supreme Court held that California water law is an integration of both public trust and appropriative right systems, and that all appropriations may be subject to review if 'changing circumstances' warrant their reconsideration and reallocation. The courts also have concurrent jurisdiction in this area. At the same time, it held that like other uses, public trust values are subject to the reasonable and beneficial use provisions of the California Constitution." (http://www.waterboards.ca.gov/waterrights/board_info/ accessed 04/05/10)

Use of surface water for water supply may be subject to water rights regulation and permit process. There are two types of surface water rights in California—appropriative and riparian. **Riparian rights** come with parcels adjacent to water bodies and are non-permitted or licensed, though they should be formally claimed through a Statement of Diversion and Use to be considered vested and ensure superiority over any appropriative rights. Riparian water users have rights only to the water naturally flowing by the parcel and are not allowed diversion to storage or use on parcels not adjacent to the stream.

Appropriative water rights are required for water diversions to storage and uses on non-riparian parcels. Appropriative rights permits commonly restrict the period of diversion to outside of the dry season (e.g., December through March). Permits are not required for use of springs or standing pools lacking natural outlets. Prior to 1969, all existing stockponds less than 10 acre-feet and small domestic uses were registered and granted a certificate of use. Today, it is necessary to secure permits on a case-by-case basis.

Groundwater is not regulated at this time in California except in basins with court-adjudicated decrees.

Decline of Salmonids and Other Sensitive Aquatic Species

Author: J. Michaud

Historic and ongoing land-use practices, combined with changes in ocean conditions, have had a dramatic effect on salmonid populations within the Salmon Creek Watershed. Steelhead (*Oncorhynchus mykiss)* and coho salmon (*O. kisutch*), collectively known as salmonids, were once abundant in Salmon Creek and its tributaries. Tales of their numbers, sizes, and favorite pools are still a vital part of the local history. Now only a small population of steelhead continues to return each year, and native runs of coho salmon are believed to be extirpated from the watershed. The last naturally propagated coho salmon was seen in 1996 (Cox 2005), and the watershed is now part of a reintroduction program.

Steelhead and coho salmon populations have declined from historic levels as a result of widespread, cumulative impacts, including those associated with ocean cycles and conditions, fishing, logging, land clearing and development, channel clearing and modification, stream diversions, water extractions, and water pollution.

Juvenile coho salmon.
Photo courtesy of Joe Pecharich (NOAA Restoration Center)

As a result, these species are now protected under the federal and State Endangered Species Acts. Salmon Creek steelhead are part of the central California coast Distinct Population Segment (DPS), which is federally listed as threatened by NOAA's National Marine Fisheries Service (NMFS). Coho salmon, central California coast DPS, are both federally and state-listed as endangered. Despite their decline, efforts are being made to reverse this trend. Many residents, community groups, and agencies have come together to understand reasons for the decline and attempt to restore the fisheries. **These efforts include the development of recovery plans and restoration projects to improve the key habitat features that support each life stage of these migratory species.**

Salmonids in the Watershed

There is a long history documenting steelhead and coho salmon populations within the watershed; see *Historical Timeline of Salmon Creek Watershed* in PCI 2006). Throughout the 1950s, fish were relatively abundant in the watershed. A record from 1953 noted 20 anglers caught 13 silver salmon (coho) in a period of 39 hours, all ranging in size from 2.5 to 10 pounds.

In 1961, the first stream survey of Salmon Creek was conducted by California Department of Fish and Game (CDFG) and noted the presence of both adult steelhead and coho salmon. Stream surveys were also conducted in 1964 and 1965. In the 1964 survey, the majority of fish observed were silver salmon, 50 to 100 fish per 100 feet with similar findings in 1965. During a survey in 1970, 25 to 40 fish per 100 feet were noted. In 1974, there was a record salmon catch at sea off Salmon Creek. Up to the 1970s, fishermen annually broke through the sandbar at the estuary noting coho salmon just "rushed in" and always made it to the plate in time for Thanksgiving.

By the early 1980s, coho salmon yearlings were reportedly stocked in Salmon Creek. At about that time, local CDFG biologist Bill Cox began regular surveys for fish. While he didn't have access throughout the watershed, he did observe coho salmon on a regular basis, especially in Tannery Creek in the late 1980s through early to mid-1990s. However, by 1996, he noted the last wild coho salmon ever to be seen in the watershed. Ongoing survey work since that time has documented steelhead throughout the watershed; however, no sightings of wild coho salmon have been recorded (CDFG 2003a-b; CDFG 2004a-e; PCI 2006; Hines 2010).

Other Sensitive Aquatic Species in the Watershed

In addition to listed salmonids, the Salmon Creek Watershed also provides critical habitat for a number of special-status aquatic species. Particularly noteworthy are the presence of California red-legged frog, California freshwater shrimp, northwestern pond turtle, and one estuarine fish—tidewater goby. These

species have similar aquatic habitat requirements to salmonids in that they also require adequate water supplies, especially freshwater shrimp and tidewater goby, which are entirely aquatic, and complex instream habitats, intact riparian canopies, and high-flow refuge habitat.

The **tidewater goby** (*Eucyclogobius newberryi*) is federally listed as endangered and a California Species of Special Concern. It is a small, elongate, grey-brown fish endemic to coastal lagoons, estuaries, and marshes of California. Its annual lifecycle is closely tied to the dynamics of lagoons and estuaries with breeding commencing after their habitat closes to the ocean. Small vertical nesting burrows are dug in the substrate in areas of coarse sand with peak breeding activity occurring in late April through early May. Threats to tidewater goby include development, water diversion and manipulation of habitat, channelization, nonpoint and point source pollution, discharge of agricultural and sewage effluents, and impacts from cattle grazing. The Salmon Creek estuary supports a robust population of gobies (PCI 2006).

California red-legged frog *(Rana draytonii)* is federally listed as threatened and a California Species of Special Concern. In general, they are most common in marshes, streams, lakes, reservoirs, ponds, and other water sources with plant cover. Breeding occurs in deep, slow-moving waters with dense shrubby or emergent vegetation from late November through April. Egg masses are attached to emergent vegetation (e.g., *Typha* sp. or *Scirpus* sp.) near the water's surface. Tadpoles require 3.5 to 7 months to attain metamorphosis. Adults take invertebrates and small vertebrates. Larvae are thought to be algal grazers. Within the watershed, California red-legged frogs are known to occur within stream channel habitats from the estuary and further upstream near the town of Bodega (CDFG 2010). Reservoirs, wetlands, and other large perennial water sources also support this species; however, reported observations in these areas are spotty.

California freshwater shrimp *(Syncaris pacifica)* is federally and State-listed as endangered. It is a small, 10-legged crustacean occurring in low-elevation and gradient (less than 1%) perennial streams in Marin, Sonoma, and Napa counties. They occur in shallow pools away from the main current where they feed primarily on detritus and, to a lesser extent, on decomposing vegetation, dead fish, and invertebrates. Most shrimp appear opaque to nearly transparent with

Photo courtesy of Bill Cox

colored flecks across their bodies. Females can appear dark brown to purple under certain conditions. Breeding occurs in the autumn, but young do not hatch until the following May or early June. After breeding, female shrimp carry the fertilized eggs attached to their abdominal swimming legs throughout the winter. The freshwater shrimp has been extirpated from many streams and continues to be threatened by introduced predators, pollution, and habitat loss. Within the watershed, there have been freshwater shrimp sightings reported from approximately 2.25 miles upstream of the estuary to just north of Freestone along the mainstem. Population numbers within the watershed have tended to fluctuate from year to year due to pollution and drought (CDFG 2010).

The **northwestern pond turtle** *(Actinemys marmorata marmorata)* is a California Species of Special Concern and is one of two distinct subspecies of the western pond turtle. They are most commonly found in or near permanent or semi-permanent water sources in a variety of suitable habitats throughout much of western California. This omnivorous species requires basking sites, such as emergent logs, rocks, mud banks, or mats of aquatic vegetation, for thermoregulation. Underwater retreats are also required for predator avoidance. Nesting sites of this species have been found some distance, up to 1,300 feet or more, from aquatic habitat. They have also been found using upland sites for aestivation and overwintering. Within the watershed, pond turtles occur along stream channel habitats and also utilize reservoirs and other permanent water sources extensively (CDFG 2010).

Impaired Instream Habitat Conditions

Author: J. Michaud

Extensive assessments of watershed and stream conditions have been completed in Salmon Creek and its tributaries (CDFG 2003a-b; CDFG 2004a-e; PCI 2006; GRRCD 2009; GRRCD and PCI 2007; GRRCD and PCI in press; UCCE 2007; and PWA 2007). Evaluation of the habitat-related data and results from these assessments provides some indication of the limiting factors with the greatest potential to inhibit recovery of coho salmon and the continued existence of steelhead. Key findings of the assessment and ongoing monitoring efforts, with specific attention to summer base flows and water quality, are discussed below.

Summer flows are critical for the survival of rearing juvenile fish and maintaining high-quality habitat. Flows provide rearing space, allow for movement between habitats, maintain water quality and temperature, and facilitate delivery of food for juvenile fish. Near-channel shallow wells located in the alluvial valley have been found to be drawing from subsurface flows and affecting stream depths, especially during the summer rearing periods (PCI 2006). Flow monitoring in Salmon Creek shows that riffles become disconnected by early July, stranding juvenile salmonids, decreasing water quality in pools, and resulting in above-optimal instream temperatures (PCI unpublished data). Adequate streamflow in the lower watershed, immediately upstream of the estuary, has been shown to be a primary factor in determining habitat quality and dynamics of lagoon formation and breaching (PCI 2006). Anecdotal information about the system in the 1950s, 60s, and 70s suggests that summer freshwater flows were much higher than typically occur today. This is likely a result of population growth in the watershed and associated increases in water consumption.

Low flow conditions in lower Salmon Creek.

Long-term water quality monitoring data has been collected in freshwater habitats in Salmon Creek and the downstream estuary. Suitable water quality conditions are critical for the development, growth, and survival of salmonids at all life stages, as well as for other fish and the macroinvertebrates that comprise the base of the aquatic food chain. Steelhead and salmon need cool water temperatures, high dissolved oxygen (DO), and low quantities of fine sediment for successful juvenile rearing and adult migration and spawning. Overall, water quality is rated as fair to good at the monitoring locations, with tributaries exhibiting better conditions than the mainstem (UCCE 2007). The monitoring program shows that turbidity, temperature, and DO seasonally test outside optimal levels for salmonids and other aquatic organisms. Lethal concentrations of DO (<3 mg/L) have been measured in pools and the estuary during the summer months where salmonids are rearing (PCI 2006; GRRCD and PCI 2010 in press).

Maintaining streamflows in Salmon Creek and its tributaries throughout the summer to keep pools connected and aerate the water as it flows over the riffles and bedrock ledges is a principal way to ensure beneficial water quality. High pool DO concentrations are observed to be primarily associated with freshwater surface flows upstream, while pools with very low DO are disconnected and stagnant. Where groundwater continues to feed surface water during the dry months, the water will generally be cool and continuous.

Other keys to maintaining high summer water quality include:

- Dense, continuous forest canopy along the riparian corridor;
- Limited or no livestock access to the streams; and
- Well-managed uplands.

Implications of Climate Change

Author: L. Hammack

Streamflow conditions and water supply availability are likely to be subject to climate change-related shifts due to projected changes in temperature and precipitation. Average temperature in California has risen 1.5° F over the past 50 years and is projected to rise another 2-4° F by the end of the century (Karl et al. 2009). In California, precipitation is likely to decline slightly overall but with more intense storms during a shorter rainy period and longer, hotter dry seasons, resulting in both more droughts and more floods (Karl 2009). **While regional climate change models vary in their predictions, it is expected that there will be additional impacts water supply in coastal areas already experiencing summer water shortages.**

More intense winter storms over a shorter rainy season will affect the amount of precipitation available to recharge the groundwater aquifers. **The importance of slowing stormwater runoff in the uplands and promoting groundwater recharge throughout the watershed will increase**. Streams will rely on the seasonal water table to sustain flow for longer, hotter dry seasons, further increasing the need to reduce direct diversions and reliance on riparian water for agriculture and non-potable demands.

The **longer dry season** is likely to reduce summer and early fall minimum flows, exacerbating higher temperature conditions and resulting in insufficient water quantity for juvenile summer rearing and fall spawning. In addition, extreme summer heat events may temporarily push streams above thermal maximums while warmer summer evenings are likely to increase water temperature overall during the warmest months (Luers et al 2006).

In addition to direct thermal stress, higher water temperature may indirectly affect salmonid habitat through promoting algal growth and lowering dissolved oxygen. Both high water temperatures and low dissolved oxygen have direct physiologic impacts on juvenile salmonids. Temperature changes may also result in increased competition from warm water species (Bisson 2008).

THE RESPONSE

Community Action

Author: A. Crawford

As a Salmon Creek Watershed resident recently stated, "Water has always been an issue here, and people have always been careful about their supply." (pers. comm. A. Bleifus 4/26/10). **This water awareness has resulted in a range of community actions.**

Several years ago, some residents, seeing reduced flows in the creek, filed formal complaints with the State Water Resources Control Board about these withdrawals. Other residents began educating themselves about creek health and water sustainability. As word spread that no coho had been seen in Salmon Creek since 1996, a few landowners focused on implementing creek restoration projects in their own backyards, including riparian plantings; partnerships with Gold Ridge Resource Conservation District (GRRCD) funded some of these early efforts. Agricultural landowners protected riparian areas through installing fencing to exclude cattle from certain areas.

In the late 1990s, a group of residents began meeting in Freestone to discuss their increasing interest in fostering a healthier watershed. These early meetings resulted in the formation of the Salmon Creek Watershed Council (Council), which hosted the first Watershed Day at Harmony School in 1998 (pers. comm. A. Bleifus, 4/26/10).

The momentum from this first Watershed Day inspired the formation of watershed groups in adjacent watersheds. As the Council matured and built partnerships with local agencies and non-profits, the focus of the Council shifted to developing the scientific information necessary to demonstrate how land and water uses in the watershed impact streamflows.

The concept of the SCWCP, including the Bodega Pilot Program was also developed at this time as stakeholders recognized the need to increase dry season instream flows for improved aquatic habitat while simultaneously supporting the freshwater demands of residents. Detailed information on the SCWCP planning approach is below in Chapter 2.

As discussed above, the *Salmon Creek Estuary: Study Results and Enhancement Recommendations* (PCI 2006) provided the scientific foundation for the recommendations that guided the development of the SCWCP.

Several other watershed studies and reports have also been completed by resource agencies and non-profits active in the watershed, including habitat assessments by CDFG (2003, 2004) and the *Salmon Creek Watershed Assessment and Restoration Report* (GRRCD and PCI 2007). Currently, GRRCD and PCI are preparing the *Salmon Creek Integrated Coastal Watershed Management Plan*: http://www.goldridgercd.org/watersheds/salmoncreekplan.html.

Continuing restoration work has been undertaken by many watershed stakeholders, including local, state, and federal resource agencies, GRRCD, private landowners, and community organizations. Although the primary focus has been to improve instream fish habitat, many of the projects also improve water quality and promote infiltration. Highlights include:

- Cross fencing and water development to improve grassland vitality;
- Riparian fencing and off-channel livestock watering systems,
- Native plant revegetation to restore wide riparian buffers for shade;
- Sediment filtration, and streambank stability;
- Biotechnical streambank repair projects to reduce fine sediment delivery and improve riparian cover; and
- Instream habitat structures, designed to deepen pools, enhance riffles, create gravel bars, and/or provide cover for juvenile and adult salmonids.

Salmonid Habitat Enhancement and Recovery

Author: J. Michaud

State and federal agencies are charged with protecting and recovering native salmonid populations along the central California coast. Small coastal streams, such as Salmon Creek, that have fairly intact habitat and limited development pressure, are considered key systems for the protection of these threatened and endangered species. Watersheds with strong community support to protect and restore the natural resources will be supported by agencies to recover historic populations. The following sections describe some of these recovery efforts and how this Plan and the SCWCP integrate with these efforts.

Recovery Planning

NMFS recently completed a draft Recovery Plan for the central California coast evolutionarily significant unit (ESU) coho salmon to provide a scientific framework for the preservation, enhancement, and restoration of this species and their habitat (NMFS 2010). The Salmon Creek Watershed is grouped in a subset of watersheds with geographically linked populations and similar environmental conditions labeled the coastal "diversity strata," one of five in the central California coast ESU. Recovery of the species depends on the combined abundance within each of the five diversity strata, rather than individual watershed populations. Thus, each subwatershed's population goals are linked with and support the other watersheds to produce a regionally viable population with low extinction potential.

The Recovery Plan identifies drought and flooding as the greatest threats to recovery of coho salmon within the Salmon Creek Watershed, followed by channel modification, climate change, livestock farming and ranching, and water diversions and impoundments (NMFS 2010). Aside from supporting funding, outreach, and reintroduction as part the of broodstock program, the high priority recovery actions for streamflow include:

- "Avoid and/or minimize the adverse effects of water diversions on coho salmon by establishing a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage; and
- Minimize water use and seek alternatives during droughts."

Captive Broodstock Reintroductions

In an effort to **reestablish coho salmon** within the Russian River basin, the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP) was initiated through a collaborative partnership with the Sonoma County Water Agency, U.S. Army Corps of Engineers, NMFS, CDFG, and others. In 2001, the first wild coho salmon juveniles were collected and reared at Warm Springs Hatchery (NMFS 2010). To improve genetic diversity and the distribution and abundance of coho salmon, captive-reared fish were released into streams within their historic range starting in 2004 (Conrad et al. 2005). Since that time, coho salmon have been released into Russian River tributaries in the fall and spring at select locations.

In 2008, Salmon Creek was selected as an additional release site for captive-reared coho salmon. In December 2008, adults and advanced fingerlings were released into the watershed, and adults were released into the watershed again in December 2009. Releases included captive-reared fish from the Russian River Watershed and Olema Creek, a tributary to Lagunitas Creek in Marin County. The fish were selected from these two strains in an attempt to recreate the likely genetic composition of the historic Salmon Creek fishery.

CHAPTER 2: SALMON CREEK WATER CONSERVATION PROGRAM PLANNING APPROACH

The SCWCP is directed toward identifying water usage in the watershed and developing tools to promote water conservation by all users, including residents and public utilities.

WATER CONSUMPTION ANALYSIS

Author: L. Hammack

Water security for both humans and the ecosystem is a concern for residents, water utilities, and agencies tasked with managing and recovering salmonid populations. Securing sufficient freshwater supply for homes and livelihoods is an ongoing challenge in this coastal watershed, and in some cases, historically stable wells and springs are becoming unreliable. As noted previously, streamflow volume and connectivity in the summer appear to be primary factors limiting salmonid survival and population viability. Anecdotal evidence indicates that summer streamflows have been decreasing, and climate change scenarios indicate that drought conditions may occur more frequently.

To support development of long-term strategies for water security in the watershed, an inventory of water supplies and water demands by types of water use was performed to characterize and quantify water consumption patterns. **This section describes how the residents of Salmon Creek use water and how that demand is distributed and supplied throughout the watershed.** The different freshwater supplies are characterized, and impacts of their use on ecosystem function are discussed.

Water Demand

Consumptive water demand in the Salmon Creek Watershed was assessed through a multi-pronged, land use based approach, as described in **Appendces B1 and B2**. Through this process, 14 land use based water use types were defined and mapped (Figure 4). Because the amount of water and seasonal usage patterns vary among types of agricultural use, the commercial agriculture properties were broken out into 4 categories:

- Pasture land for livestock—cattle and sheep are currently the primary grazing animals in the watershed;
- Dairies;
- Vineyards; and
- Non-irrigated orchards.

Residential units are associated with most, but not all, agricultural properties, and this distinction was made for demand accounting purposes. Developed rural residential parcels were determined through the County Assessor's Parcel database.

Four communities have water utilities that serve customers treated and metered Salmon Creek water—Freestone, Bodega, Salmon Creek, and Bodega Bay. Part of the town of Occidental is in the Salmon Creek Watershed, but Occidental is served by Russian River water. The parcels served by metered water are distinguished from the other residential properties, and their consumptive demand was calculated separately; **see Appendix B1 for a summary memo of the metered communities demand inventory.** Several other miscellaneous water use types were defined, including schools and church camps, and data on water demand for these uses was collected where possible.

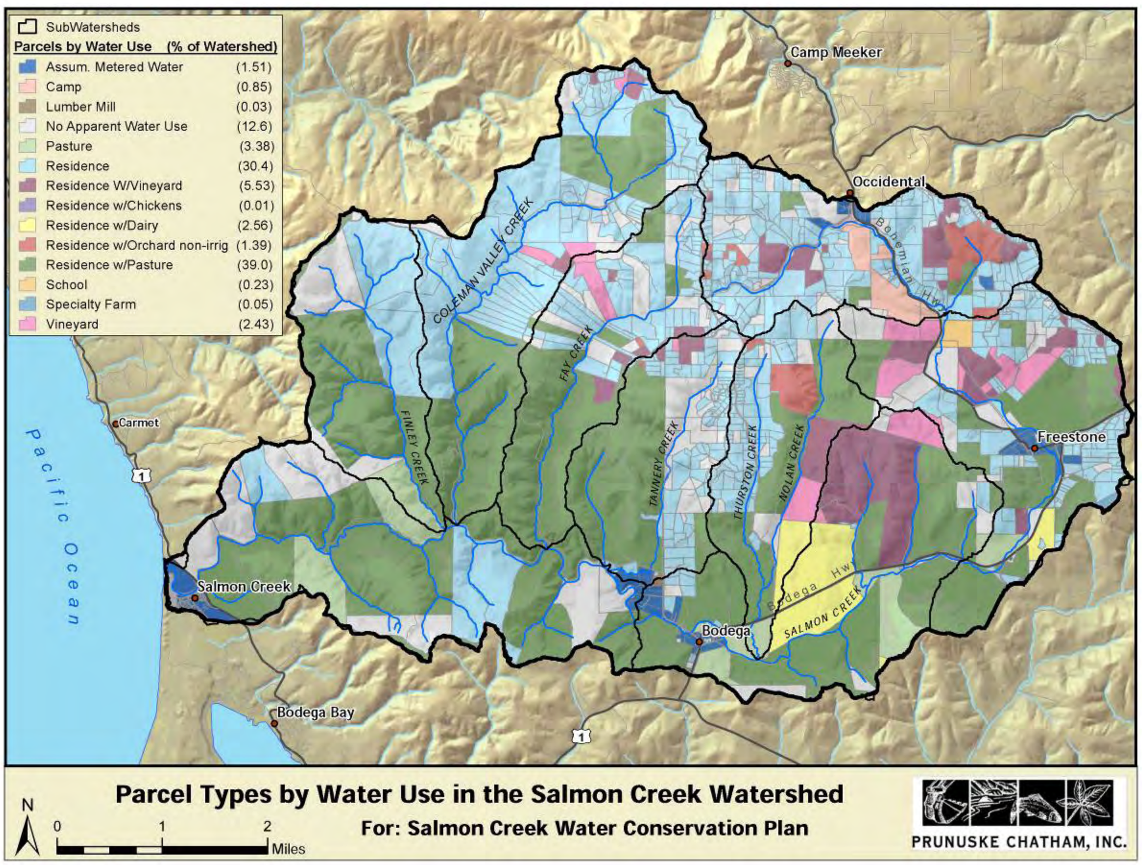

Figure 4. Water use types as defined by land use within the Salmon Creek watershed. Note the distribution pattern of rural residential in the upper watershed and along the ridgelines, with large livestock ranches in the lower watersheds and valley bottoms. This distribution is linked to vegetation, slope, and water supply availability. Vineyards are located primarily on ridge tops, out of the frost zone.

As expected, **freshwater demands** in the Salmon Creek Watershed are **primarily for residential and agricultural uses** (Figure 5). Residential water use accounts for 73% of the total consumptive demand and is comprised of potable indoor uses and outdoor irrigation with some non-commercial livestock, which can be served with non-potable supply. Vineyards and livestock-based ranches are the two primary commercial agricultural land uses in the watershed, accounting for 8% and 12% of total water demand, respectively. Community water systems for Freestone, Bodega, and Salmon Creek make up 5% of the total demand, while Bodega Bay—through an inter-basin transfer—utilizes approximately 1%. The three communities supplied wholly by local wells and springs have a small number of commercial properties that are constrained by water supply availability.

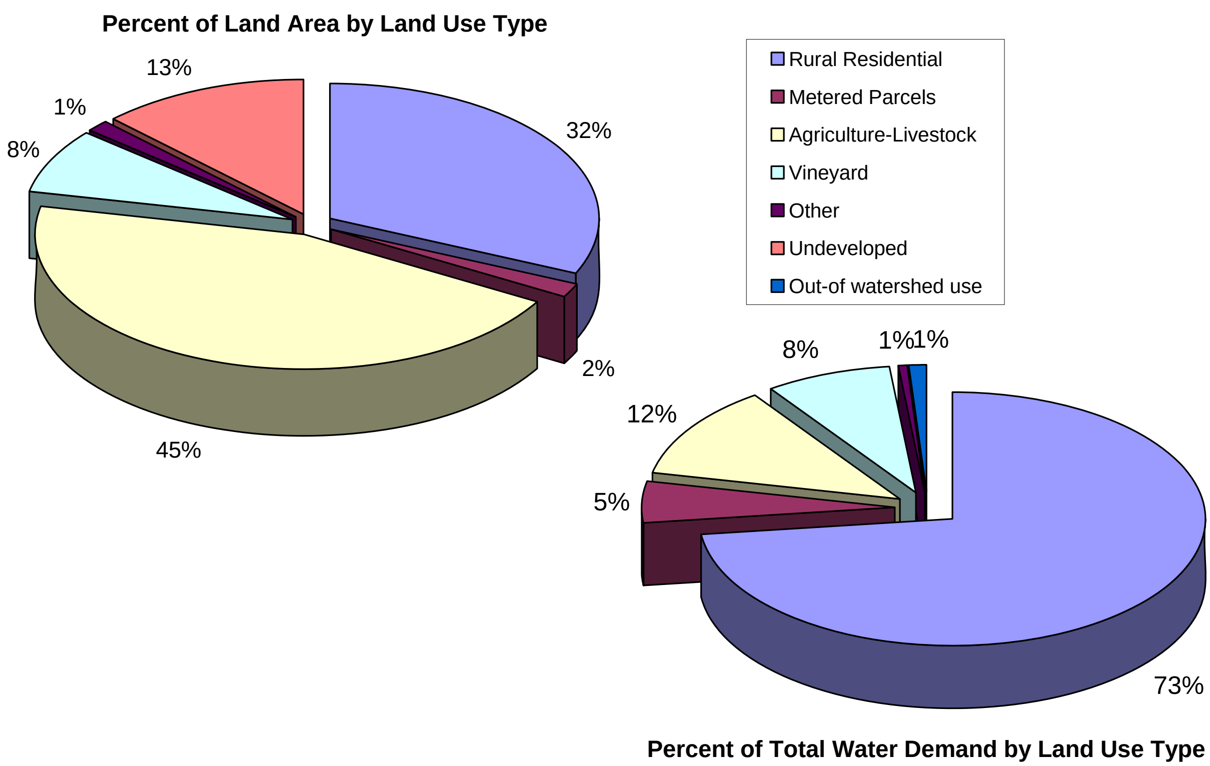

Figure 5. Distribution of land uses and their comparative percent usage of overall annual water demand within the Salmon Creek Watershed. Note that residential water demand is disproportionately higher than agricultural demand, especially given the proportion of the watershed acreage each utilizes.

Total annual water demand for each subwatershed area and the whole Salmon Creek Watershed is summarized in Table 1. **Consumption criteria methodologies developed for different water use categories are described in Appendix B and applied to parcel counts, livestock counts, and vineyard**

acreages. Residential demands are based on one household per parcel. This is likely an underestimation of the number of households, as many larger parcels in the watershed have multiple houses.

Livestock numbers for the entire watershed were roughly estimated by GRRCD staff and a daily water consumption by species applied; see Appendices B1 and B2[1]. The family livestock ranching and dairy operations are increasingly difficult to sustain as economically viable livelihoods due to loss of local support services and competition from large corporate farms. These agricultural operations, with their large parcel sizes and multiple generations of families, are crucial to maintaining the cultural and ecological integrity of the Salmon Creek Watershed.

Table 1. Estimated consumptive annual water demands by water use category for the Salmon Creek Watershed, listed by subwatersheds for water conservation planning purposes (data presented from demand inventories in Appendix B). One acre-foot is equal to approximately 326,000 gallons.

	Annual Water Demand (acre-feet)									
	Upper Salmon Creek	Freestone Valley	Bodega Valley	Thurston and Nolan Creek	Tannery Creek	Fay Creek	Coleman Valley Creek	Finley Creek	Lower Salmon Creek	Total
Residential	77.6	59.1	13.3	27.9	36.2	33.1	30.7	3.6	5.0	**286.4**
Metered		6.0	7.7						12.0	**25.7**
Vineyard	3.5	12.1	7.6	0.9	1.2	2.9	2.8	0.0	0.0	**31.0**
School	0	2.4	0	0	0	0	0	0	0	**2.4**
Sub-Total	**81.1**	**79.6**	**28.5**	**28.8**	**37.4**	**36.0**	**33.5**	**3.6**	**17.0**	**345.5**
Livestock	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**47.2**
Total										**392.7**

Vineyard calculations were based on actual acreages mapped from 2009 aerial photographs (Figure 6) and application of a 2 acre-inch per year irrigation rate.

[1] A more accurate accounting of the livestock type and distribution densities within subwatershed reaches would further refine the demand estimates and provide better data for water conservation planning. See Recommendations in Chapter 5.

The Salmon Creek Watershed has supported vineyards since the early 1800s when the Russians farmed the Freestone Valley. The recent interest in low-production, single-vineyard, high-end wines has renewed vineyard development in the watershed. For example, in the Joy Road area, which covers the upper Salmon Creek, Fay Creek, Tannery Creek, and Thurston Creek subwatersheds and is considered a Sonoma County water-scarce area, there has been an approximately 70% increase in the number of acres in vineyard since 1974 and a 22% increase since 2000. A number of vineyards that currently being developed in the upper Salmon Creek and Bodega Valley subwatersheds are not included in this analysis.

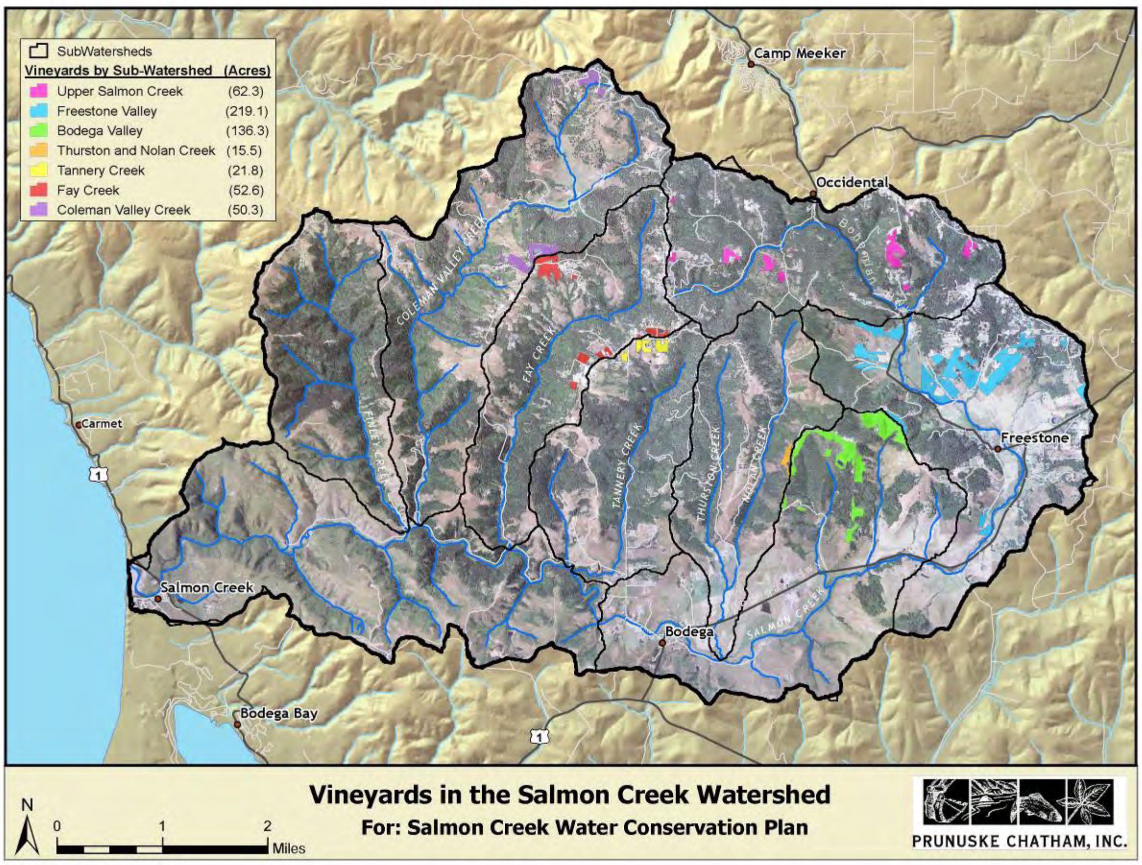

Figure 6. Acreage and location of vineyards in the Salmon Creek Watershed as of 2009. The vineyards are concentrated in the eastern portions of the watershed and on ridgetops–areas less affected by summer fog. Frost protection measures are not currently employed at vineyards within the watershed due to the milder coastal climate, although a few vineyards in the valley bottoms do experience frost losses.

The total annual consumptive water demand for water uses in the Salmon Creek Watershed is estimated to be approximate 393 acre-feet (128 million gallons). As discussed above, this estimate is likely low, although reasonable given the assumptions and high quality data utilized.

Note that permitted surface water diversion and storage rights in the watershed exceed the estimated demand (424 acre-feet versus 393 acre-feet), and the permitted diversions only account for a small portion of the supplies used to satisfy the existing demands. A possible explanation for this discrepancy is that the permitted water diversions and storage volumes are not currently being utilized fully for consumptive uses. See below for a description of water sources and the distribution and/or utilization of freshwater supplies by water use type.

Water Supply

All consumptive water uses, as well as the needs of the wildlife and plant communities, must be met by water supplies within the Salmon Creek Watershed. **Consumptive water demands are met by storage of rainfall runoff (ponds and roofwater catchment tanks), the annually recharged shallow groundwater table, bedrock aquifer storage, and direct streamflow withdrawals.**

The geology (Figure 7) and hydrogeology of a watershed largely determine the type of water supply available and utilized for a given parcel. In the uplands, along the ridgetops and steep canyons where the rural residential parcels are predominantly clustered, water sources are primarily groundwater wells and springs. However, the dominant geologic formation, Franciscan mélange, is a poor aquifer with typical yields averaging less than 3 gallons per minute (Kleinfelder 2003). The Franciscan mélange's metamorphic and sheared rocks are impermeable, carrying and storing water only along fracture zones. The Wilson Grove sandstone formation, locally capping the mélange, is a better, more consistent aquifer, but it is limited in extent and storage capacity. Riparian parcels typically extract water supplies directly from their watercourses through shallow wells or in-channel cisterns, as these sources are consistent and easily developed. Many parcels in Freestone Valley, Bodega Valley, and lower Salmon Creek have deep (over 80 feet) wells tapping the alluvial fill aquifer. The location, production, and quality of water in the valley alluvial aquifer are inconsistent.

Groundwater supplies in the upper watersheds are unpredictable. Residents in the area report that wells on neighboring parcels range from 25 gallons per minute to nominal amounts. Many residents report that their groundwater wells experience dramatic seasonal changes in production rates, with many requiring holding tanks to compensate for reduced pressure in the summer (pers. communications 2010). Other residents are forced to truck water in during the dry months. Studies of the Joy Road area document that groundwater wells and springs commonly experience diminished or intermittent production with perpetual use and adjacent extraction pressures (Kleinfelder 2003; Sonoma County 1974). Kleinfelder (2003) also documented that between the 1970s and 2000 the depths of new wells increased to follow a lowering water table and that this trend correlates to development rates, indicating an overdraft condition in the aquifer.

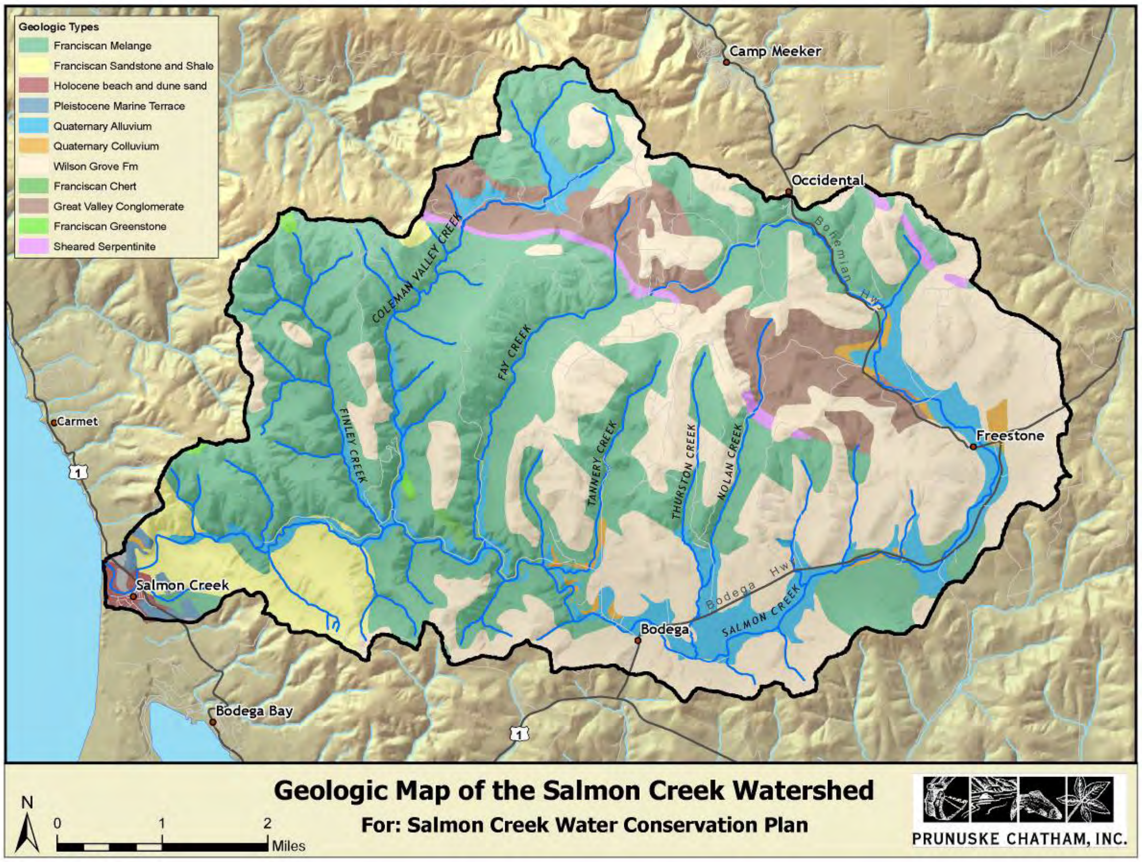

Figure 7. Geology of the Salmon Creek Watershed. Groundwater supplies from all of these formations are unpredictable and inconsistent. The Wilson Grove formation has high permeability but limited capacity as an aquifer. Springs typically occur along the interface between the impermeable Franciscan mélange and the Wilson Grove above it. The Quaternary alluvium filling the valleys along mainstem Salmon Creek and the lower portions of the tributaries provides seasonal groundwater storage for summer streamflows.

Springs are another common water source in the uplands. Anecdotal evidence indicates that springs in the uplands of Coleman Valley and Finley Creek are consistent and have not seen depletions in production associated with surrounding development pressures (pers. communications 2010). However, springs found lower in the watershed, down-gradient from rural residential concentrations, have decreased production since the 1960s and 1970s when development of the uplands took place.

The vast majority of **vineyards** (Figure 6) are using pond water captured during the rainy season. Thus, most are not pumping from groundwater during the irrigation season (pers. communication K. Beitler 2010). The ponds fill within the first few storms; the water is sand-filtered and used for irrigation. Some vineyards truck in water, especially during initial establishment of the vines. Vineyards in the Freestone Valley use a combination of pond storage, direct riparian diversions, and spring sources for their water supplies.

Water sources along the **riparian corridors** include direct diversions, pond storage, and riparian wells (both deep and shallow infiltration-gallery wells). Riparian and upland spring sources tend to be preferentially developed compared to groundwater when possible, as they are more consistent and often have better water quality. Direct diversions for consumptive water supplies can have localized impacts to habitat conditions and cumulatively can reduce streamflow volumes within a reach during the dry season.

Observations of community supply wells in the riparian corridor indicate that there is immediate water table response to pumping in the summer dry season and chronic effects to streamflow and instream habitat in drought conditions (PCI 2006; PCI 2010, Appendix A1). Storage ponds, which collect winter rainfall runoff for use in the summer, negate the need to directly extract riparian water during the dry season.

Bringing It All Together: Sustainable Supplies and Healthy Streamflow

Author: L. Hammack

As discussed in Chapter 1 of this Plan, inadequate summer dry-season water supplies are a result of the Mediterranean climate conditions and water demand pressures. One solution is to offset water shortages through storage of excess winter precipitation.

Watershed-wide water consumption data developed for the Water Consumption Analysis was divided into monthly demands for different water use types. The water demand for each water use type was further broken out by potable and non-potable use volumes. Riparian direct diversions were estimated based on known water use type supplies (metered parcel use in Bodega and Bodega Bay, a proportion of rural residential use, and livestock demand) and the State Board's water right dataset. Figure 8 illustrates the results of this **monthly demand analysis** and compares it to average monthly streamflow volumes.

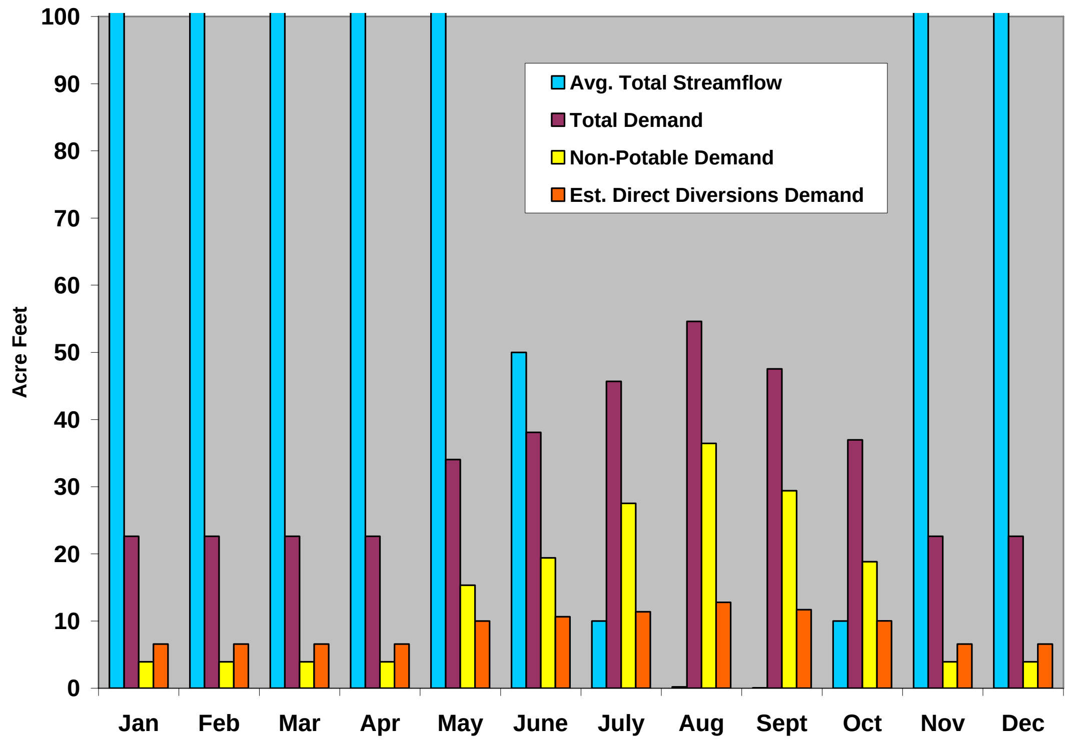

Figure 8. Monthly water demands versus streamflow volumes in Salmon Creek. This illustrates conceptually the contrast between extractive demands and available water supplies. It also illustrates the potential volume of water that could be available for instreamflows if current direct riparian diversions were converted to winter storage supplies.

Streamflows in mainstem Salmon Creek and its tributaries decline dramatically from July through October, with August and September flows often becoming intermittent or stopping altogether. This summer period is also the period of highest demand—vegetable gardens, landscaping, and higher livestock water needs occur during the warm, dry season. Along the stream courses these non-potable water demands are often met with direct riparian diversions or upland springs that directly feed first order tributaries.

Replacing these direct diversion extractions with stored winter precipitation or runoff could correspondingly increase water available for instream flows by the levels shown in Figure 8.

Withdrawals from groundwater and springs that are not directly connected to the stream system do not have an immediate and localized impact on streamflows during the summer but do reduce the amount of water available for summer base flows in the watershed overall and within individual subbasins.

Practices to increase groundwater infiltration will help maintain and improve groundwater supplies, while using stored winter rainfall and runoff will reduce the need to use extractive supplies to support non-potable water uses. Installation of winter storage projects for non-potable water uses could increase the water directly and indirectly available for instream flows by the levels shown in Figure 8.

Practices to reduce direct diversions, as well as increase groundwater supplies, are likely to have the most impact on dry-season streamflows within localized reaches of their subwatershed. Figure 9 shows the subwatersheds within the Salmon Creek Watershed and indicates areas that are currently considered high priority salmonid rearing reaches. **Water conservation and water storage projects concentrated in these reaches will have the most immediate impact on summer flows and salmonid survival.**

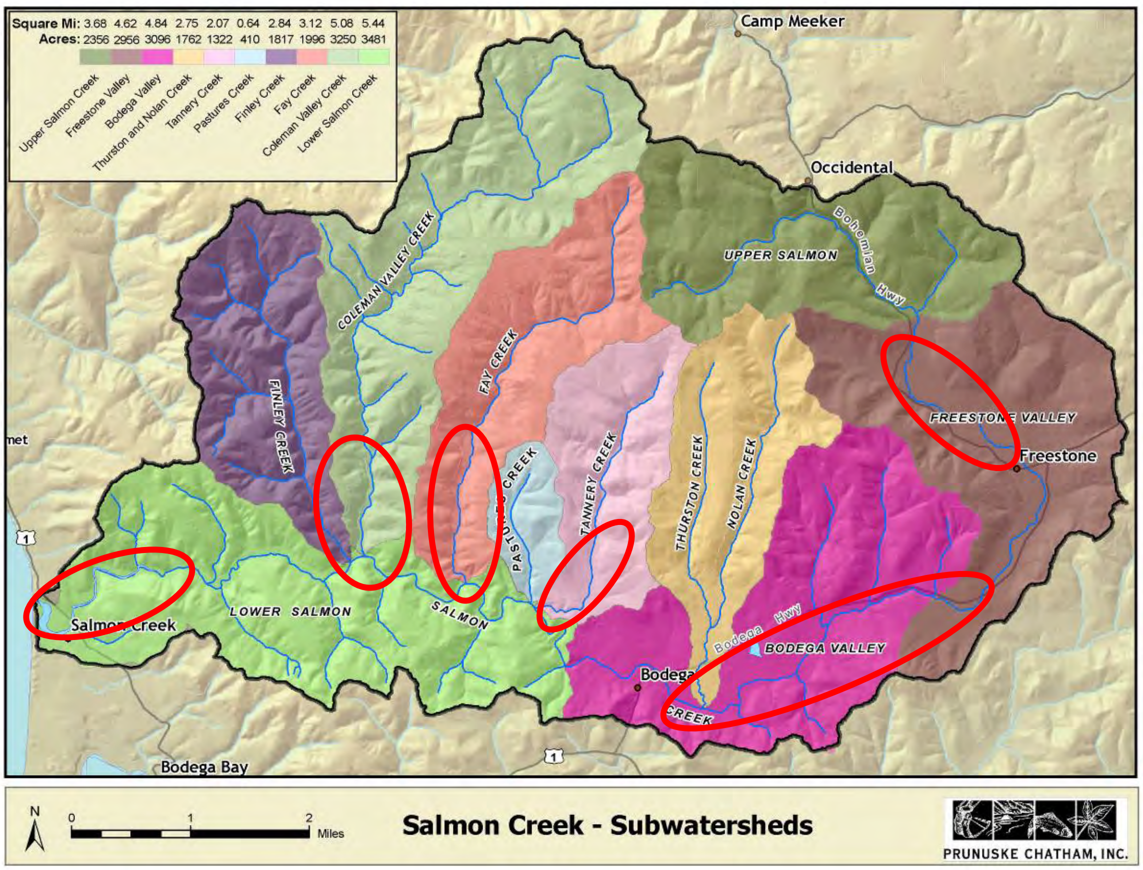

Figure 9. Subwatersheds in Salmon Creek Watershed with known salmonid-rearing reaches circled. Implementation of water conservation practices and winter rainfall storage projects that will protect and increase summer streamflows in these reaches are high priority.

Many opportunities exist to reduce demand on extractive water sources that, through direct or cumulative effects, reduce streamflow and degrade instream habitat. Measurably increasing streamflows to improve salmonid rearing conditions and water supply sustainability requires that the following methods be integrated and applied in a concentrated manner in critical rearing reaches:

- Water conservation and wise-use practices;
- Groundwater recharge through practices to slow and infiltrate stormwater runoff;
- Development and wide implementation of alternative, non-extractive water supplies, including rainwater storage; and
- Reduction in riparian water diversions.

The following section describes the pilot program integrating these methods that has been initiated in the town of Bodega.

BODEGA PILOT PROGRAM

History and Purpose

Authors: A. Crawford and L. Hammack

In 2004, the Bodega Pilot Program (BPP) was envisioned by a group of Salmon Creek residents who, having seen the creek's flows dip precariously in the summer months, understood that an effective rehabilitation strategy for the creek was possible because the Salmon Creek Watershed is home to landowners who wanted to improve the health of their watershed, threatened species, and a local water utility in need of infrastructure improvements. These residents also understood that the relatively small size of the watershed made it a manageable area in which innovative water conservation measures could be implemented and the effectiveness of those measures in improving instream flows could be monitored (pers. comm. B. Cluer 3/19/10).

Over the last five years, the original BPP vision has guided many planning efforts in the watershed and almost 2 million dollars have been secured for projects that demonstrate the effectiveness of rainwater harvesting, water conservation, and enhanced storage capacity to reduce extractive demands on streamflow during dry season months and improve fish habitat conditions. **By demonstrating the link between conservation and instream flows, the BPP provides a model to other communities and landowners along salmonid rearing streams; more detailed in formation is in Appendix A1.**

The ongoing success of the BPP depends upon multiple factors, including:

- **BPP participants receive benefits** in the form of greater water security and cost-effectiveness;
- **The BPP** is developed and implemented in a manner that **replaces, rather than augments, extractive water supply**. Water supply savings must be retained in the stream or groundwater table during the dry season;
- The **volume of water supplied by rainwater harvesting and increased storage are maximized** for a given location (well or pump) to either replace an extractive source or measurably reduce withdrawals from the extractive source;
- **Streamflow and groundwater extractions at a location (well or pump) are reduced** from existing pre-BPP conditions, the reductions are documented annually, and the amounts are commensurate with volumes generated by alternative sources and storage improvements;
- **The benefits and requirements of the BPP are clearly articulated** so that participation occurs with full "buy-in" for a long-term commitment;
- **Details of BPP participation** are understood and supported by the larger community;
- **Participants receive ongoing technical support** to maintain and utilize alternative water sources;
- **Partnership agreements** for BPP activities are made between funding agencies, resource management agencies, water suppliers and/or landowners that are pragmatic, comprehensive, and enforceable; and
- **An implementation monitoring program** is developed to track actual reductions in extractions over time and compliance with agreements.

A technical memo detailing BPP Water Supply Security and Streamflow Augmentation Criteria is Appendix A1 to this Plan.

Bodega Water Company Planning Process

Authors: A. Crawford and L. Hammack

The town of Bodega is considered a disadvantaged community, with some of the highest water rates in the state. Early Bodega residents utilized springs and wells and drew water from the creek. In 1981, the town's first centralized water system, the Bodega Water Company (BWC), was created to supply water to a golf course that, ultimately, was never constructed (pers. comm. A. Bleifus

3/26/10; BWC Articles of Incorporation). In the course of planning for this development, local residents were invited to join the nascent company. Today, BWC is a member-owned, mutual benefit corporation that supplies potable water to 39 hookups within the Bodega Valley. **BWC is one of the larger single users of Salmon Creek water in Bodega Valley, as the majority of their water supply comes from a shallow "gallery" well adjacent to Salmon Creek.** The depth of this well is only slightly lower than the streambed and is considered by the Department of Water Resources (DWR) to be drawing from shallow groundwater feeding Salmon Creek. BWC has two other deep groundwater wells that are limited in their production and have water quality issues.

BWC has applied for an appropriative water right for their well; however, the terms of this water right preclude the use of the well during the dry season. BWC has been seeking alternate water sources and storage options to reduce the use of the well in order to comply with DWR's terms for their appropriative water right.

BWC's proximity to Salmon Creek and need to explore alternate water supply options offer a unique and powerful opportunity to demonstrate the important role local water utilities can play in fisheries restoration. Because BWC is an all-volunteer, member-based organization, their ongoing involvement in the SCWCP depends on the professional technical support the SCC has funded through this SCWCP.

SCWCP partners Virginia Porter Consulting and PCI have worked closely with BWC to assess the company's infrastructure, analyze supply and demand data, and develop long-term strategies for water conservation measures and alternative supply options that will produce a reliable, sustainable water supply. Based on this assessment, recommendations have been made to the BWC Board for upgrading and repairing elements of the BWC water system, as well as conservation and other measures BWC members can take that will contribute to supply sustainability.

Rainwater Catchment System Design and Implementation

Authors: A. Crawford and L. Hammack

One recommendation in the *Salmon Creek Estuary Study and Recommendations* (PCI 2006) was to support local domestic water providers in securing offstream water storage and/or new water sources to reduce summer withdrawals from Salmon Creek.

In 2008, during the course of the SCWCP planning, the project team developed a framework for installing rainwater catchment systems throughout the watershed, in both upland areas and critical reaches of Salmon Creek. The information gathered during this planning process provided an important demonstration of the instream improvement potential if rainwater catchment systems were strategically installed in critical reaches.

In early 2009, the opportunity arose to apply, through the NOAA Restoration Center, for implementation funding from the American Recovery and Reinvestment Act (ARRA). Utilizing water use information from BWC and ideas generated as part of the BPP, SCWCP partners PCI and GRRCD developed a proposal for the "Save Our Salmon" (SOS) Program. GRRCD was awarded the grant for the SOS Program in mid-2009. **The SOS Program is now underway, with installation the following rainwater catchment systems planned for summer 2010:**

- **One tank at the new Bodega Volunteer Fire Department (BVFD) firehouse**
    - BVFD has often relied on treated BWC water from a shallow riparian well for emergency uses. This 38,000-gallon tank will provide an alternative source of water for department training, fire suppression, and community emergency uses. **Appendix A2 provides a summary of the planning and implementation for this tank.**
- **Residential property roofwater catchment systems**
    - These tanks will replace approximately 200,000 gallons of treated water from a shallow riparian well and be used for summer non-potable irrigation and livestock watering. The actual number of tanks installed will depend on the individual needs of residential properties.
- **Underground storage tank on an agricultural property**
    - This 230,000-gallon capacity tank will collect and store roofwater for summer cattle watering, replacing the use of a shallow riparian well and direct stream withdrawls.

The SOS Program is an important step forward in demonstrating the link between winter water storage and improved spring and summer instream flows in Salmon Creek. The NOAA ARRA funding is also supporting a 2-year ecological effectiveness monitoring program for the grant activities; the results of this monitoring will inform local and regional future projects.

In addition to the tanks funded by the NOAA ARRA grant, the BPP would benefit from additional installation of catchment systems on residential and agricultural properties in the town of Bodega and in Bodega Valley. Additional recommendations can be found below in Chapter 5.

CHAPTER 3: CONSERVATION STRATEGIES

Author: V. Porter

The SCWCP Water Conservation Strategies support efforts in California's coastal communities in their efforts to developing water conservation measures and alternative water supply solutions that support human needs while protecting and restoring instream flows for fish and wildlife. **The complete Strategies are Appendix D to this Plan.**

Table 2 below lists the 8 Water Conservation Strategies developed for the SCWCP, along with the target community for the specific strategy.

Table 2. SCWCP Water Conservation Strategies

Conservation Strategy	Target Community
1. Streamflow Restoration for Salmonids	All residents, businesses, visitors
2. Residential Self-Survey for Efficient Water Use	Residents on metered systems or private supply, single-family and multi-family
3. Low Water Gardening	Residents and businesses with gardens or landscapes
4. Stormwater Management	All landowners and land managers
5. Roofwater Harvesting	All property owners
6. Conservation in the Hospitality Industry	Hotels, restaurants, spas, golf courses, recreational facilities
7. Water Rates	Water purveyors – public and private
8. Managing Water Systems	Water purveyors – public and private

Each Strategy includes a brief summary of the topic, discussion of the target community, an assessment of the effect of implementation and numerous tools and resources to facilitate implementation. **The complete Strategies are Appendix D to this Plan.** Below is a brief discussion of each Strategy explaining how each one advances the goals of the SCWCP.

STREAMFLOW RESTORATION FOR SALMONIDS

The Streamflow Restoration establishes the rationale for all the rest of the Strategies by describing critical habitat requirements for the watershed's listed salmonid species.

Populations of steelhead trout and coho salmon have declined for many reasons, including past and current water diversions, development, removal of large wood from creeks, and degradation of riparian areas. As a result, the species are now protected under the federal and State Endangered Species Acts in most of coastal California.

Businesses, residents, water purveyors, and visitors to coastal California communities can make decisions that improve aquatic habitat if they understand the lifecycle of the native salmonid populations in their watersheds. As communities make decisions with the fish in mind, their water supply security will improve because a more diverse set of supply strategies may provide a buffer against mandatory use reduction if fish populations do not improve.

The next 7 SCWCP Water Conservation Modules provide specific guidance for implementing decisions that support fish habitat.

RESIDENTIAL SELF-SURVEY

The residential self survey is a tool for residents on community water systems or on private water supply (well, spring, pond) to identify opportunities to conserve water through improved efficiency. It is **a "do-it-yourself" water-saving approach that can result in tremendous savings in household water use.**

Residents complete the self-survey on their own. Water suppliers, community groups, and Resource Conservation Districts can promote use of the survey throughout by sponsoring educational self-survey workshops and neighborhood gatherings.

The survey consists of two steps:

1) Water audit, and

2) Calculation of efficient water use.

The water audit targets all household water uses, both indoor and outdoor. It identifies opportunities for detecting and then replacing or repairing inefficient fixtures and systems. In particular, the audit provides how-to steps for determining flow rates of faucets and showerheads, as well as toilet flush volumes; techniques for detecting leaks in the home and garden and information on leak repair; and data on irrigation needs based on climate conditions of four distinct coastal regions. **The self-survey also includes a Residential Water Use Calculator for determining the amount of water used at the residence, both indoors and outdoors. The Calculator is tailored to coastal California climates by geographic region.**

The 2003 study by the Pacific Institute *Waste Not Want Not: the Potential for Urban Water Conservation in California* reports the potential to save up to 40% of indoor water use in residences in California by installing efficient plumbing hardware and adopting practices to maximize water use efficiency. Pacific Institute further reports 25% - 40% savings of outdoor water use through garden design and maintenance practices. Performing the survey gives a resident the information needed to estimate the savings potential at their home.

By using the self-survey to reduce water use, residents can improve the likelihood that more water will be available instream during critical summer months. **Water security may also improve because residents will more clearly understand their water use patterns and will know how to curtail use as needed.**

LOW WATER GARDENING

Low Water Gardening minimizes the need for summer irrigation by recommending specific garden practices that, coupled with developing alternate water supplies, such as rainwater or graywater, will provide the maximum benefit to aquatic habitat.

In coastal California approximately 35% of all residential water use is outdoors. Implementing the principles of Low Water Gardening will result in a 25-50% reduction in outdoor water use, especially if high-water-using plants are replaced with less thirsty varieties.

Additional benefits accrue as a result of these practices, including reduced use of chemical pesticides and fertilizers, increased groundwater recharge, reduced run-off from irrigation and stormwater, and increased soil health. **Low Water Gardening principles may also result in a greater diversity of plant species, beneficial insects, and bird and mammal species.**

STORMWATER MANAGEMENT

This Strategy describes how to develop robust, scalable, decentralized stormwater management strategies, which are critical for improving watershed health and water security.

Implementing effective stormwater management measures address both human needs, and total watershed health.

Benefits to the watershed include:

- Increasing uplands water infiltration and retention capacity will improve water security by recharging groundwater aquifers, while increasing base flows in streams and reducing mortality in listed fish populations;
- Slowing down stormwater runoff will decrease topsoil loss, erosion, flooding and streamflow variance by reducing the volume and rate of peak flow events;
- Removing pollutants in runoff will improve water quality in streams and aquifers; and
- Reducing the delivery of erosion products to streams will increase flows by keeping pools and riffles free of excess sedimentation.

Benefits to landowners include:

- Recharging groundwater supplies will increase water security by improving the function of groundwater wells and alleviating the economic and resource costs of trucking in water;
- Well-designed roads will retain better drivability, with reduced maintenance needs;
- Reducing flooding will protect property values and lower expenses for stopgap measures like pumping, levees and raising houses;
- Increasing the quantity of infiltrated and stored water onsite will help increase fire suppression capacity and defensible space; and
- Retaining soil will keep land productivity high, lowering fertilizer costs.

ROOFWATER HARVESTING

Throughout California, **during summer months when rainfall, streamflows and groundwater supplies are lowest, human demand for water is highest and listed fish populations are under extreme stress.** Additionally, due to climate change, greater seasonal variation in rainfall is predicted, with the potential for diminishing California's overall water security. Given that most of California's coastal regions have adequate rainfall during the year to support our communities, incorporating this storage component increases the options for using the supply during the times of the year when we need it the most.

Roofwater harvesting systems are a viable method for capturing winter rains for water use during the dry season. A well-designed roofwater harvesting system can reduce or eliminate demand for surface and groundwater supplies.

Most often roofwater is used to supply non-potable needs such as garden irrigation. Roofwater supply can also be a source for potable uses with proper filtration and disinfection, and roofwater harvesting can diversify a landowner's water supply sources and decrease reliance on traditional sources. On a community scale, it can improve water supply security and improve fire protection supplies while supporting better streamflows for fish and other aquatic life during the dry season.

CONSERVATION IN THE HOSPITALITY INDUSTRY

The hospitality industry consists of food services, accommodations, recreation, and entertainment businesses and they have a **unique opportunity to create a "water resource stewardship" identity because of their contact with visitors.** Creating this message and enlisting the support of customers can positively influence the community's involvement in water conservation.

Depending on the community, a significant portion of the overall water may lie in supplying hospitality industry businesses. Many coastal communities in California depend on tourism and have relatively high water use in this sector. There are numerous cost-effective water efficiency measures that can be implemented by hospitality businesses to achieve water savings without reducing the quality of service provided by the business. Many of these actions will also reduce wastewater flow to a sanitary sewer or septic system.

Studies have shown that 25%-40% of savings can be achieved in most hospitality businesses by implementing the measures outlined in this Strategy. All the measures can result in reduced reliance on local water supply. Savings in landscapes and golf courses has the added effect of reducing demand during the peak irrigation season, which is also the peak time when increased streamflow is needed for aquatic habitat.

WATER RATES

The amount of water used by customers on metered water systems tends to respond to the water rate and rate structure. Rate structure design can be used effectively to send a "price signal" to customers to reduce use, and can guide overall water use toward a more sustainable level.

Where local water supplies utilize streams that are breeding habitat for listed salmonid species, water rate structures can be used to target customers' discretionary uses during the critical periods of the year for aquatic habitat.

Using approaches such as seasonal rates, increasing block rates, or individual "goal" rates, utilities can result in reduced water use during the summer dry season. Rate structures to implement these approaches are discussed in detail in this Strategy.

Water purveyors have many options for rate structure design. Most rates are made up of two components: 1) a "fixed" charge that is assessed regardless of the amount of water used, and 2) a commodity fee for the actual amount of water used. **Examples of two very different structures are:**

- **"Flat fee":** A fixed amount is charged each month regardless of the amount of water that is used, and provides no financial incentive to use water efficiently; or
- **"Increasing block rate":** Has a fixed monthly fee, and a commodity charged for all water used, with higher rates per unit for successive blocks, or fixed quantities of water. This structures provides a measurable pay-back when efficient fixtures are installed or waste is reduced.

The Strategy describes a variety of structures with a focus on those that incentivize conservation.

MANAGING WATER SYSTEMS

Most rural coastal communities have small water systems with few connections. These systems face financing and staffing challenges. Because the financial burden of system operation and regulatory compliance is spread across relatively few customers, rates are often high in comparison to larger communities. Staffing can be a challenge, in part, due to the licensing requirements for water treatment operators and water distribution operators in California. Under these conditions, systems often suffer from deferred maintenance and high unaccounted-for-water (UAW). Coastal systems may also experience accelerated deterioration of components such as valves, pumps and pipelines because of the corrosive nature of salt in the air and soil.

A well-managed water system provides community stability, viability, and a sense of water stewardship. A physically well-managed system will have very little UAW, ideally less than 10%, so the water that is produced has the potential to be put to maximum beneficial use. Long-term planning can assure that demand is not allowed to grow past the sustainable supply capacity of the source water. Environmental water needs such as instream flow for fish can be maintained and managed for the beneficial use.

This Strategy presents system management techniques to increase water security and minimize water loss, thereby improving instream flow conditions. These techniques include:

- **Preventative maintenance** such as exercising valves and monitoring for leaks;
- **Timely reactive maintenance** such as leak repair;
- **Redundancy in physical systems** such as pumps and power sources;
- **Redundancy in human resources** such as operators;
- **Long-range planning for the physical system** replacement and upgrade; and
- **Long-range planning for water supply sustainability.**

CHAPTER 4: OUTREACH AND EDUCATION

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WATERSHED SIGNAGE

One of the objectives of the SCC SCWCP grant was to **design and install signage alerting residents and visitors to low-flow conditions as a means to encourage water conservation during these periods**. OAEC's WATER Institute led the SCWCP team in designing the look and content of these signs. Working with sign designer Ron Blair Signs, OAEC developed a mobile system that will allow signs to be rotated throughout the watershed on a seasonal basis.

This mobility will increase the visibility of the SCWCP, educating local residents and seasonal visitors about water conservation efforts in the watershed. The signs also provide the address of the updated Salmon Creek Watershed Council's website (www.salmoncreekwater.org; see below) which has many resources posted, including the Conservation Strategies and this Water Conservation Plan.

See Appendix E for the sign designs.

PUBLIC WORKSHOPS

OAEC's WATER Institute developed and hosted two successful workshops with two associated tours that focused on alternative water supply and conservation practices. The first workshop, held in late 2009, focused on rainwater catchment systems and included the option of touring a nearby residential rainwater catchment system. Thirty-one people attended. The second workshop and tour, held in April, 2010, provided the dozen attendees with an overview of water conservation measures and technical information summarized in the Conservation Strategies. The tour focused on the water conservation methods (including stormwater management and roofwater catchment) currently in use at the OAEC.

UPDATED SALMON CREEK WATERSHED COUNCIL WEBSITE

An important part of our outreach strategy was to make our **educational materials easily available to the coastal communities they serve**. SCWCP partners at OAEC's WATER Institute and PCI worked with the Salmon Creek Watershed Council to update their website (www.salmoncreekwater.org) and post resources produced as part of the initial SCWCP planning work.

This updated site will provide a place for community members to learn about all conservation activities happening in the watershed, with links to the partner organizations that are carrying them out. An email announcement will be sent to watershed groups, public resource agencies and elected officials in targeted coastal counties inviting them to use this new resource.

STAKEHOLDER INTERVIEWS

A key component of this SCWCP planning process was to "convene a group of local residents and organizations to implement the water conservation plan and develop future programs to assist with design and installation of conservation and catchment projects". The intended outcome was to **encourage and empower local residents to develop and implement a range of projects that would advance the SCWCP goal.**

Due to the state budget freeze in late 2008, progress on convening the group was delayed for almost a year. Once funding was again available, the SCWCP team re-assessed what was feasible for this community outreach effort in the time remaining for the grant. **Because the time for a series of community meetings was limited by the time funding was re-released, the team discussed other approaches to soliciting community input.**

After receiving positive feedback from stakeholders in Sonoma Valley who had been part of a groundwater planning community process facilitated by the Center for Collaborative Policy (Center), **OAEC's WATER Institute retained the Center to conduct interviews with a range of stakeholders and make recommendations** for how to best move forward developing robust community collaboration that will support the SCWCP. In addition, all the interviewees were invited to a professionally facilitated meeting in early May where water consumption analysis information was presented and recommendations for future work was solicited from all present.

The facilitator's summary and recommendations, along with a list of the interviewees, is in Appendix C.

CHAPTER 5: RECOMMENDED WATER CONSERVATION AND STREAMFLOW RESTORATION EFFORTS

These recommendations have been synthesized from numerous meetings and discussions with SCWCP partners, watershed residents, local utilities, and many others during this initial planning process.

1. CONTINUE COLLABORATIVE SCWCP EFFORTS

A. **Partnerships:** Hold professionally-facilitated quarterly planning meetings with existing and potential SCWCP partners. Objectives for these meetings include:

- Adopting an updated SCWCP name that is agreeable to all SCWCP partners and reflects more accurately the SCWCP goals of developing alternative water supply solutions that support human needs while protecting and restoring instream flows for fish and wildlife.
- Developing products, including educational materials, that makes the SCWCP partners and projects easily recognizable to watershed residents and funding organizations.
- Identifying additional partners, including local utilities, state and federal agencies, and non-profits;
- Building agreement about optimal communication methods between partners;
- Cooperative scheduling of community education and outreach through development of a web-based "watershed calendar";
- Increasing understanding of the unique role each partner plays in restoring streamflows in the watershed; and
- Identifying collaborative funding opportunities, as well as methods for supporting each organization's individual fundraising efforts.

B. **Incentives:** With SCWCP existing and potential partners, develop watershed-wide incentive programs for implementing water conservation measures, including:

- Limiting the amount of landscaping and irrigation installed around residential buildings;

- Installing water wise landscaping where appropriate and using low flow gardening methods; and
- Installing water-conserving household plumbing fixtures, including toilets, showerheads, aerators, and washing machines.

2. *IMPLEMENT PRIORITY REACH-BASED PROJECTS*

A. **Riparian Sources:** With SCWCP partners, identify, develop, and implement reach-concentrated water diversion reductions and streamflow restoration projects and practices in the watershed. Proposed project types include:

- Design and installation of residential roofwater harvesting systems to replace extractive water sources for non-potable water uses;
- Design and installation of agricultural water supply storage such as off-channel ponds and roofwater harvesting systems, including water distribution systems for livestock use and riparian corridor fencing; and
- Continuation of the Bodega Pilot Program through implementation of roofwater harvesting and off-channel water storage projects that measurably reduce direct diversions from Salmon Creek, as well as associated SCWCP effectiveness monitoring.

B. **Uplands:** With SCWCP partners, identify and implement regionally-concentrated groundwater recharge and spring enhancement projects and practices in the watershed. Proposed project types include::

- Grading and planting stormwater infiltration swales on residential and agricultural roads;
- Design and installation of rain gardens to capture and infiltrate excess stormwater;
- Replacement of impervious surfaces (such as parking areas and patios) with pervious materials (such as grass pavers and porous concrete) to increase groundwater recharge; and
- Design and installation of residential roofwater harvesting systems to replace groundwater sources for non-potable water uses.

3. RESEARCH AND PRACTICE DEVELOPMENT

A. **Research:** Conduct scientific research and planning tools to support SCWCP efforts, including:

- Researching, mapping, and designating high-priority groundwater recharge areas within the watershed based on known characteristics of geology, soils, slope stability, and land uses;
- Developing an accurate accounting of livestock types and distribution densities within the subwatersheds;
- Exploring linkages between upland springs and creeks and flows in Salmon Creek and its tributaries;
- Researching and incorporating climate change predictions into developing projects that improve the watershed's resiliency to predicted alterations in weather patterns and events;
- Researching the viability of beaver (*Castor canadensis*) re-introduction into appropriate locales within the watershed to provide instreamflow and fish habitat improvement;
- Researching and reporting on the relationship between riparian vegetation and instreamflow;
- Refining hydrologic models of the watershed, including water supply, demand, and diversion datasets, to identify priority sites for rainwater catchment and runoff storage systems; and
- Researching options for tracking reductions in water extractions and monitoring streamflow and/or streamflow related habitat responses.

B. **Practices:** Bring SCWCP scientific research, data, and methodologies to a wide audience, including:

- Refined practices to increase groundwater recharge, spring enhancement, and direct diversion reductions.
- Research and options for protecting existing streamflows and voluntary discontinuations of diversions for instreamflow restoration;
- Protocols for transferring SCWCP scientific findings to appropriate Sonoma County agencies (such as the Sonoma County Water Agency

and the Sonoma County Permit and Resource Management Department) for use in their planning efforts.

4. *Continue Outreach and Education to Watershed Residents*

A. **Community Sustainability:** Communicate via meetings, website content, and other materials, that the SCWCP objective is to improve the watershed resident's quality of life and local agriculture while improving instream flows and habitat for fish and other aquatic organisms.

B. **Ecological Awareness:** Develop materials and strategies for educating residents about:

- Ecological impacts of pumping water directly from creeks;
- Importance of maintaining healthy and fire resilient forests and woodlands to ensure optimal stream health;
- Options for abstaining from using riparian water rights for the purpose of improving salmonid habitat; and
- Practices and implementation materials that support landowners in increasing upland spring production and groundwater recharge.

C. **Water Supply, Use and Policy:** Develop and host workshops that provide substantive water supply, use and policy information to residents, including:

- Types and levels of water use in the watershed (including rural residential, dairies, ranching, schools and recreational properties, and vineyards);
- Impacts that varying types of vegetation have on streamflows (for example, willows or redwoods);
- Interconnection of groundwater, surface water, and springs;
- Documented changes in streamflow levels over the past decades;
- Impacts of upstream diversions on downstream users; and
- Potential impacts of emerging legislation (such as AB 2121, AB 811, and AB 2304) on landowners' existing and future water supply and use rights.

D. **Agricultural Water Conservation:** Develop and host workshops and individual consultations for agricultural landowners on targeted water conservation methods for agricultural operations.

E. **Existing Programs:** Inform residents about existing water conservation incentive Programs, including Sonoma County Energy Independence Program.

F. **Community Monitoring:** Explore opportunities for involving volunteers in monitoring water supply, including:

- Promoting volunteer monitoring of creek conditions and refining the methods for collecting data about creek conditions;
- Seasonal spring flow monitoring;
- Promoting installation of residential rain gauges and refining methods for collecting and analyzing data from the gauges; and
- Developing a well monitoring program and methods for collecting and analyzing data on spatial and temporal variations in groundwater supplies.

5. SUPPORT MANAGEMENT OF WATER SYSTEMS IN THE WATERSHED

A. **Infrastructure**: To reduce unaccounted-for water losses in water systems throughout the watershed, identify opportunities to upgrade each system's infrastructure, including:

- Developing and maintaining accurate records of system infrastructure;
- Sub-metering to troubleshoot leaks;
- Repair and/or replacement of leaking water lines;
- Repair and/or replacement of leaking storage tanks; and
- Regular replacement of water meters.

B. **Water Supply Sustainability:** Research and develop a suite of options for ensuring ecologically-sound water supply sustainability in the watershed, including:

- Working with local water systems to develop water balance strategies for each system so that water demands do not exceed supply;

- Long-term planning and implementation for adequate storage for each system, including options that support the reduction or elimination of extractive diversions during the dry season;

- Developing and hosting a series of workshops with SCWCP partners and regulators to align on mutually-agreeable alternative sources for potable and non-potable water; and

- Developing recommendations for appropriate water conservation rate structures for each small water system.

C. **Customer/Member Engagement:** Support engagement of local water system customers/members in water conservation efforts by:

- Providing SCWCP materials to water system staff for distribution to customers/members and

- Developing targeted SCWCP workshops to present information about each system's infrastructure and operations. Depending on the preference of the water system management, these workshops could be co-hosted with water system staff.

6. *COASTAL COMMUNITY INFORMATION TRANSFER*

- Utilize SCWCP partner expertise and products to conduct trainings for organizations in other coastal communities seeking to develop water conservation programs that support improved aquatic habitat while simultaneously supporting the freshwater demands of residents.

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APPENDICES

A. Bodega Pilot Program Planning Process Memos

1. Water Supply Security and Streamflow Augmentation Criteria
2. Bodega Volunteer Fire Department Landscaping and Roofwater Catchment System

B. Water Supply and Demand Memos

1. Salmon Creek Watershed—Metered Water Systems Supply and Demand Inventory Summary
2. Salmon Creek Watershed Rural Water Demand

C. SCWCP Interviews: Overall Observations & Recommendations

D. Conservation Strategies

1. Streamflow Restoration for Salmonids
2. Residential Self-Survey
3. Low Water Gardening
4. Stormwater Management
5. Roofwater Harvesting
6. Conservation in the Hospitality Industry
7. Water Rates
8. Managing Water Systems

E. Watershed Signage