CHAPTER 6: WATER SUPPLY SUSTAINABILITY ACTION PLAN

Context

Water supplies within the Salmon Creek Watershed must sustain all consumptive water uses, as well as the needs of the wildlife and plant communities. Consumptive water demands are met by the annually recharged shallow groundwater table, bedrock aquifer storage, direct streamflow withdrawals, and the storage of winter rainfall runoff.

The Mediterranean climate and limited groundwater resources produce dry-season water supplies that often cannot meet the demands of both human habitation and wildlife needs concurrently. Salmon Creek, along with much of the coastal range in Marin, Sonoma, and Mendocino Counties, is often considered a water-scarce area (Kleinfelder 2003; Grantham et al. 2010). Groundwater wells and springs commonly experience diminished or intermittent production with regular use and adjacent extraction pressures (Kleinfelder 2003; PCI 2010). Many small coastal communities and residents struggle to maintain adequate, stable water supplies. Water sources adjacent to streams, whether wells or direct instream diversions, tend to provide more reliable supply and are thus preferentially developed and used.

Perennial streamflows are necessary to sustain aquatic ecosystem health and successfully recover salmonid populations. "Water is the most important of all habitat attributes necessary to maintain a viable fishery and … one of the most difficult threats to address effectively." (NMFS 2010). Intermittent flows during the summer rearing period trap salmonids and other aquatic organisms in disconnected pools, subjecting them to increased predation pressures, water quality impairments, and, in some cases, desiccation. When streamflows go subsurface, the cooling and oxygenating effects of water flowing over riffles are lost. High water temperatures and low dissolved oxygen levels in pools can severely stress juvenile salmonids; see Chapter 5. High stress levels lead to reduced feeding behavior, smaller smolts, and, ultimately, poor survivorship.

Low summer baseflows also impact estuary/lagoon habitat conditions. The ratio of freshwater to saline water is critical in determining the viability of the summer lagoon to support estuarine organisms, salmonids, and other special-status species, such as tidewater goby. When freshwater inflows are insufficient to dilute the remnant saline water—delivered prior to the sand bar closing the estuary mouth—stratification of the lagoon water column occurs. Saline water is heavier and thus sinks to the bottom of the lagoon, while the freshwater floats on top. The lower saline

Dry pool in reach of Salmon Creek adjacent to near-channel wells.
Photo courtesy of Lauren Hammack (PCI)

layer, which comprises the majority of the water column, typically becomes heated, anoxic, and inhospitable to fish. This scenario has been documented in the Salmon Creek estuary (PCI 2006), and it limits the viable habitat to a shallow, wind-mixed reach along the sand bar. Restricted habitat due to poor water quality and low streamflows is implicated in the demise of thousands of juvenile steelhead rearing annually in the Salmon Creek lagoon.

National Marine Fisheries Service states in their Public Draft Recovery Plan for Central California Coast coho salmon (2010):

> "Summer baseflow is a critical attribute that is degraded in many streams … [and] a substantial amount of coho salmon habitat has been lost or degraded as a result of water diversions and groundwater extraction (DFG 1997, KRBFTF 1991). The nature of diversions varies from major water developments which can alter the entire hydrologic regime in a river, to small domestic diversions which may only have a localized impact during the summer low-flow period. In some streams the cumulative effect of multiple small legal diversions may be severe. Illegal diversions are also believed to be a problem in some streams within the range of coho salmon (CDFG 2004). The use of wells adjacent to streams is also a significant and growing issue in some parts of the coho salmon range. Extraction of flow from such wells may directly affect the adjacent stream, but is often not subject to the same level of regulatory control as diversion of surface flow."

All water extractions in the watershed likely have an impact on streamflow, some directly and some through indirect cumulative effects. 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. It has been shown that groundwater wells in the alluvial valleys, thought to be disconnected from the water table by an impervious clay layer, can lower the water table and impact streamflows (PCI 2006) and in drought conditions may contribute to localized channel drying.

Riparian pumping and livestock watering directly reduce streamflows. During the summer dry season, particularly during drought years, direct withdrawals may cause riffle disconnection within a reach and, eventually, shallow or dry pools. As described above, multiple extractions reduce overall streamflow and impact instream habitat conditions.

Coastal rural watersheds such as Salmon Creek receive more than enough rainfall to meet the annual water demands of the residents (PCI 2010). However, with a Mediterranean climate, this rainfall comes mainly between the months of November and March. Thus, the water scarcity is seasonal and related to lack of storage. Land-use practices that harden the landscape and route stormwater to drainages limit infiltration, thus reducing the volume of water available to recharge bedrock aquifers and the shallow groundwater that maintains water table levels throughout the dry season.

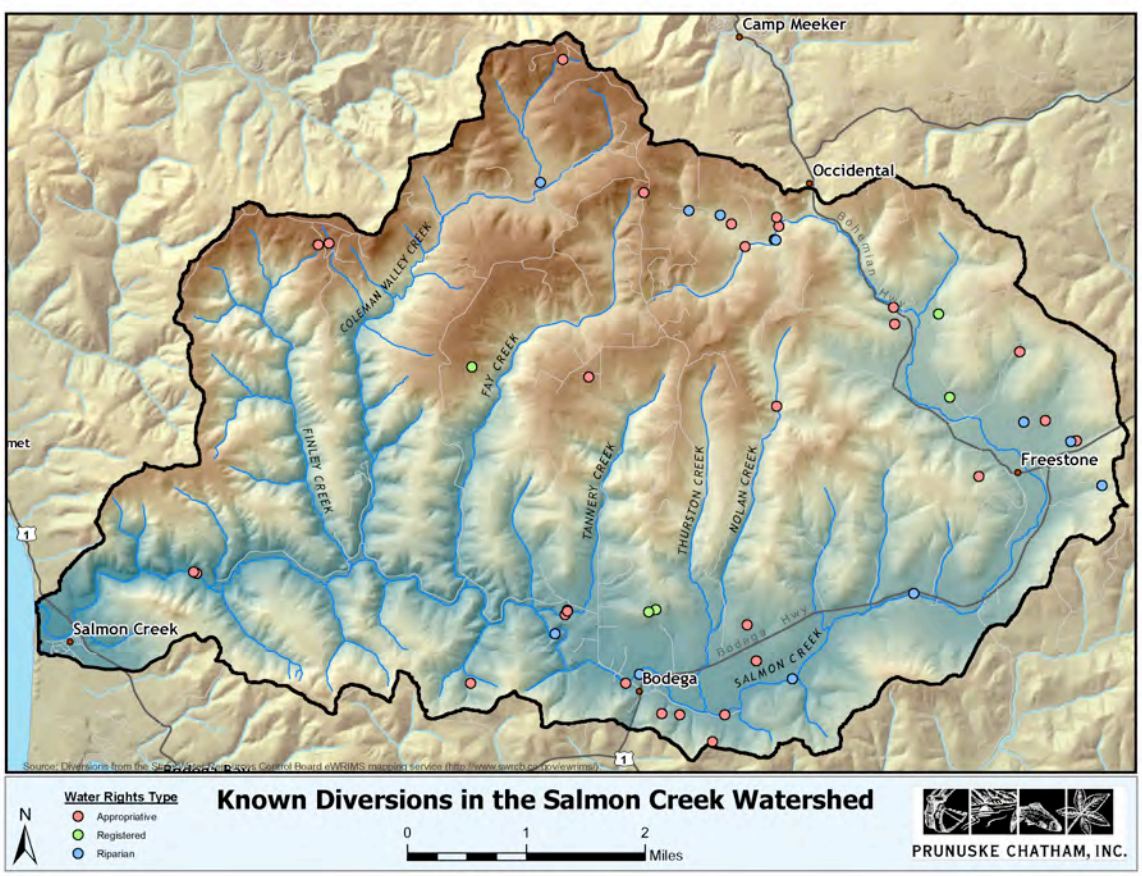
Opportunities exist to reduce demand on extractive water sources that, through direct or cumulative effects, reduce streamflow and degrade instream habitat. Water conservation and wise-use practices can significantly reduce water demand. Stored rainwater in off-channel ponds and roofwater harvesting systems can easily be used for non-potable irrigation and livestock watering needs. Roofwater can also be used as a potable water source with proper filtration and treatment. Practices to slow and infiltrate stormwater runoff can have long-term impacts on groundwater recharge, spring production, and streamflows.

Concurrent with the development of this Plan, OAEC has spearheaded the Salmon Creek Water Conservation Program with the participation of many partners. The purpose of the program is to support the community in increasing summer instream flows while providing for the freshwater needs of residents. Much of the research and analysis in this chapter is based upon work completed under this program. The program's Salmon Creek Watershed Conservation Plan (PCI et al. 2010) provides detailed conservation strategies and recommendations for residents and community water system operators, and supports the vision and overall goals of this Plan; see Chapter 1.

Goals

- Water demands do not exceed supply.
- Surface water and groundwater supplies within the watershed are managed to support residents' quality of life, family agriculture, and ecosystem needs.
- Extractive water sources and practices that impact summer streamflows are minimized and replaced by alternative water sources or improved storage.
- Streamflows support fish and other aquatic organisms at all lifestages.

Figure 10. Known diversions in the Salmon Creek Watershed.

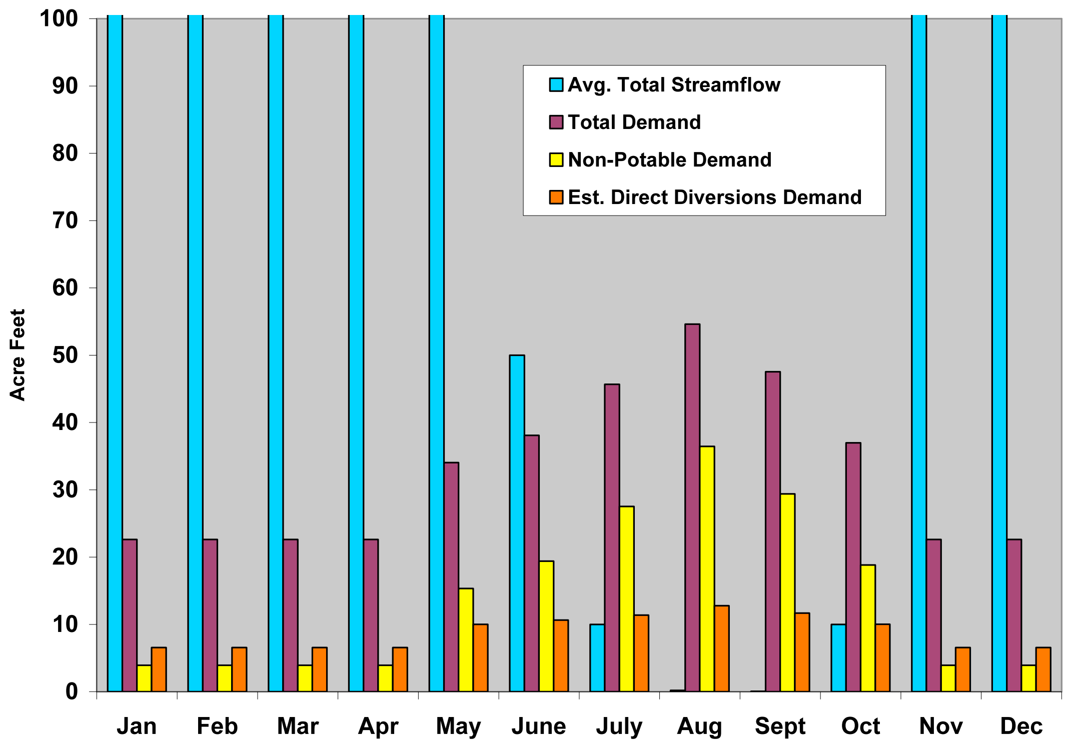


Water Supply Recommendation 1: Develop storage-based water supplies to reduce reliance on, and utilization of, extractive sources.

Scientific Reasoning

Seasonal water scarcity in groundwater and surface water supplies can be offset by storing winter rainfall runoff. Coastal, rural watersheds such as Salmon Creek receive more than enough rainfall to meet the annual water demands of the residents and existing land uses (PCI et al. 2010). Figure 11 illustrates the seasonal cycle of water abundance (winter) and scarcity (summer) as contrasted with the water demand cycles. The seasonal availability disparity can be balanced out—benefiting humans and fish—through the strategic use of storing rainwater in off-channel ponds and roofwater harvesting systems for non-potable irrigation and livestock watering needs. With proper filtration and treatment, roofwater can also be used as a potable water source.

Figure 11. Comparison of water demands in the Salmon Creek Watershed to relative supply, as depicted by streamflow volume.



Source: from PCI et al. 2010.

Estimated late-summer demands on instream sources are 50-200 times greater than streamflow volumes (Figure 11). The direct consumptive uses of instream water in the Salmon Creek Watershed are community water supply wells, livestock watering, summer landscape and garden irrigation, and a small portion of the rural residential use. Capture and storage of winter runoff to replace these direct streamflow withdrawals on a parcel-by-parcel approach could improve instream habitat conditions locally and have significant cumulative effects on summer flows watershed-wide. Replacing all non-potable water demands with stored water would reduce extractive pressures on both the surface water and groundwater supplies and provide greater water security for residents.

Large-scale water storage is not a solution for all water supply concerns and limitations, nor does it mitigate the need 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). Instream flow regulations for the state of California (AB 2121) are in final draft form and attempt to manage the impacts of water impoundment on streamflow regimes. While it is unlikely that small storage ponds or rainwater catchment systems used to fulfill existing water demands in Salmon Creek would significantly decrease peak runoff during winter storm events, Grantham et al. (2010) suggest that there is an optimal storage capacity for a given watershed that will meet water demands while ensuring critical habitat needs and ecosystem function. Multiple, on-channel storage ponds within a small catchment may reduce early winter base flows and affect salmonid migratory flows.

Water Supply Action 1a: Develop off-channel ponds and distribution systems.

Implementation Measures

- Evaluate agricultural producer's water supply sources to target those using instream or riparian sources.
  - Size systems to cover four (July-Oct.) to six (May-Oct.) months of water demands.
  - Include water distribution systems for livestock use and fence riparian corridors.

Water Supply Action 1b: Install roofwater harvesting systems.

Implementation Measures

- Design and install roofwater catchment systems to replace non-potable water uses from extractive sources and increase water supply security.
  - Size systems to cover four (July-Oct.) to six (May-Oct.) months of water demands.
  - Include water distribution systems for livestock use and fence riparian corridors.
- Consider installing roofwater catchment systems where potable supplies are unreliable, water quality is poor, or water source is a stream diversion.

Water Supply Action 1c: Support landowners in reducing or eliminating use of instream pumps and near-channel wells.

Implementation Measures

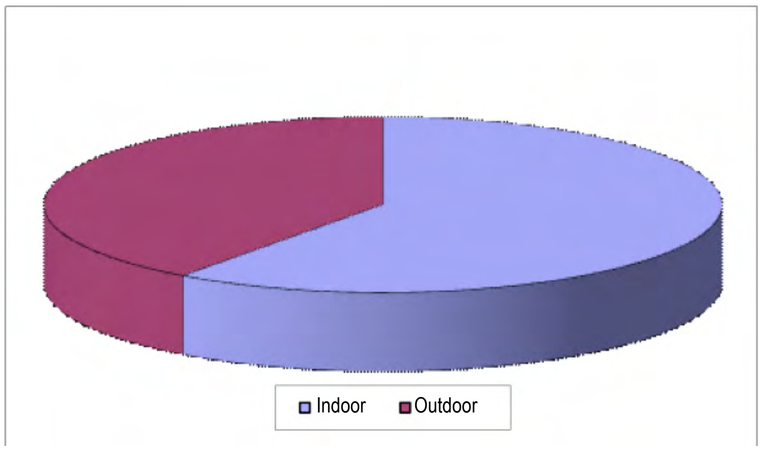
- Conduct an education and outreach program to inform residents of the ecological impacts of using their riparian water rights.
  - Provide alternate solutions to riparian water.
  - Low-flow gardening practices.
- Develop off-channel storage and roofwater harvesting systems to replace riparian water sources; see Water Supply Actions 1a and 1b above.
- Develop program to enroll landowners in abstaining from using their riparian rights for the purpose of salmonid habitat improvements.

Water Supply Recommendation 2: Reduce water demands.

Scientific Reasoning

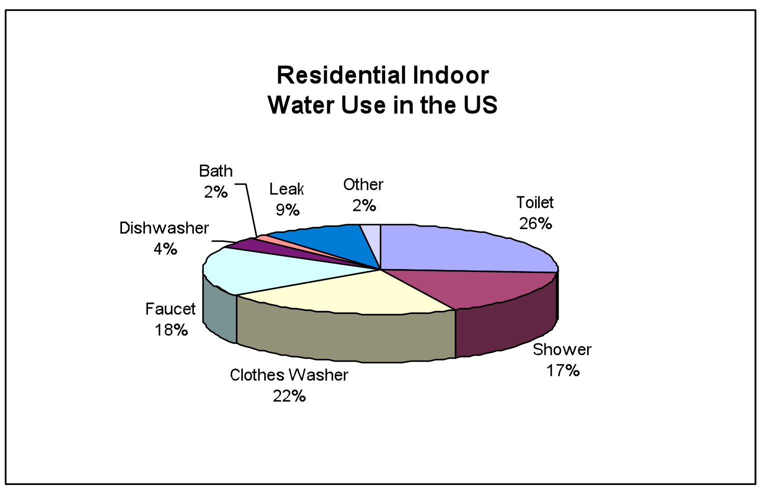
Statewide, the potential exists to reduce residential indoor water use by up to 40% through installing efficient plumbing hardware and adopting practices to maximize water use efficiency and 25-40% in outdoor water use through garden design and maintenance practices (Gleick et al. 2003). Coastal communities and residences fall into the lower portion of these ranges due to climate and water supply constraints. In the Salmon Creek Watershed, it is estimated that a 10-15% reduction in both indoor and outdoor water use could be gained through conservation measures (V. Porter, pers. comm., 4/23/10). Long-term water scarcity issues and increasing water costs have likely pushed residents to implement water conservation measures. Additional water savings may be possible on a site-by-site basis, especially with efficient outdoor irrigation hardware and practices.

It is estimated that 55-65% of all residential water use serves indoor needs in coastal California communities, and outdoor uses make up 35-45% (Pacific Institute 2003). The graph at right illustrates the breakdown of residential water use (PCI et al. 2010).



Actual residential use, or demand, per person (called per capita use) varies according a number of factors, including:

- Age and efficiency of the plumbing fixtures in the home,
- Size of garden, types of plants, climate and efficiency of irrigation,
- Presence of water meters (people use less when water is metered),
- Price of water (people use less when water is costly), and
- Conservation practices used.



A closer look at indoor water use shows that toilets, showers, faucets, and washing machines account for the majority of water use (AWWA 1999); see figure at left (from PCI et al. 2010). The water consumption demand of these devices can be reduced through the installation of low-water use hardware and appliances.

Average nationwide per capita residential indoor water use was measured in a 1999 study (AWWA) to be 73 gallons per person per day. Assuming this represents only 60%

of the residential per capita water use, as discussed above, adding outdoor water use brings the total estimated per capita residential water use to about 120 gallons per person per day. Conservative estimates of Salmon Creek Watershed-specific water demand values align with these nationwide figures (based on an annual demand of 90,000 gallons per residence and 2.06 individual persons per residence; see PCI et al. 2010 for calculation approach and summary). Analyses of meter data from communities within the Salmon Creek Watershed indicate that residences on these systems use 35,000-65,000 gallons per year (47-86 gallons per person per day); however, water costs are relatively high on these systems, and several communities have high numbers of part-time residents (V. Porter in PCI et al. 2010).

Community water systems in the Salmon Creek Watershed have relatively high unaccounted for water (UAW) losses, or the difference between the water produced and water sold (PCI et al. 2010). Water used during routine operational maintenance practices and fire fighting, lost due to leaks, and unaccounted for due to inaccurate meters all comprise UAW. A well-maintained water system should have less than 10% UAW. Freestone and Bodega's UAW are near 30%, which translates to 1,337,800 gallons per year lost. Bodega Bay's UAW averages 14% (PCI et al. 2010). Reducing UAW, especially if it is due to system leaks, and efficiently managing the community water systems will reduce demand on extractive sources (V. Porter in PCI et al. 2010).

Water Supply Action 2a: Implement water conservation program to minimize consumption.

Implementation Measures

- Conduct watershed-wide workshops to educate residents and encourage water conservation practices, such as:
  - Low water use gardening.
  - Water-saving appliances and fixtures.
  - Leak detection and repair.
- Work with County to develop and distribute information on programs that assist landowners in implementing water conservation projects, such as water use audits and Sonoma County Energy Incentive Program (SCEIP).
- Research and develop programs that assist landowners with financial hardships to replace old faucets and appliances with high efficiency devices.

Water Supply Action 2b: Structure water rates to support water conservation and reduce dependence on water supply from sources critical for aquatic habitat.

Implementation Measures

- Address high unaccounted for water losses in community systems.
  - Replace leaking water lines.
  - Replace leaking storage tanks in Bodega.
  - Replace meters regularly.
- Implement conservation rate structure.

Water Supply Recommendation 3: Recharge springs and groundwater.

Scientific Reasoning

In the uplands, along the ridge tops 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 less than 3 gallons per minute (Kleinfelder 2003). The Franciscan mélange's metamorphic and sheared rocks are impermeable, only carrying and storing water along fracture zones. Wells that tap into a fracture zone will have greater yields. The Wilson Grove sandstone formation, locally capping the mélange, is a better, more consistent aquifer, but it is limited in extent and storage capacity. The springs tend to occur along the boundary between the sandstone and mélange formations (Sonoma County 1974), although they likely also occur where fracture zones in the mélange daylight on canyon slopes.

Groundwater supplies on the ridges are unpredictable. Well production on neighboring parcels ranges from 25 gal/min to not enough to do laundry (pers. comm., 03/2010). Residents in the Joy Road and Willow Creek Road area report that their groundwater wells experience dramatic seasonal changes in production rates. Many have installed holding tanks to compensate for reduced pressure in the summer, while others are forced to truck in water (PCI et al. 2010). Studies of the Joy Road area document that groundwater wells and springs commonly experience diminished or intermittent production with regular 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 and indicates an overdraft condition in the aquifer.

Managing stormwater runoff in uplands in ways that slow flow overland, temporarily detain it, and allow it to infiltrate into the ground can increase groundwater recharge. The benefits of increasing aquifer recharge rates and storage capacity are greater groundwater supplies and increased stream base flows. Other benefits of keeping stormwater on site, instead of the historic "pave it and pipe it" approach, are decreased topsoil loss, lower flood peaks downstream, and reduced pollutants in the water.

Water Supply Action 3a: Increase infiltration in upland recharge areas and up-gradient from springs.

Implementation Measures

- Install rain gardens to capture excess runoff.
- Install contour infiltration trenches and infiltration swales to temporarily hold and infiltrate runoff.
- Direct excess runoff into catchment basins that store and allow slow infiltration.
- Replace impervious surfaces, such as parking areas and patios, with pervious materials (grass pavers, porous concrete, and other pervious pavers).
- Effectively manage grasslands and forests; see Chapter 3 Uplands Management Action Plan.

Water Supply Action 3b:Reduce stormwater runoff in uplands.

Implementation Measures

See Chapters 3: Uplands Management Action Plan and 5: Water Quality Management Action Plan.