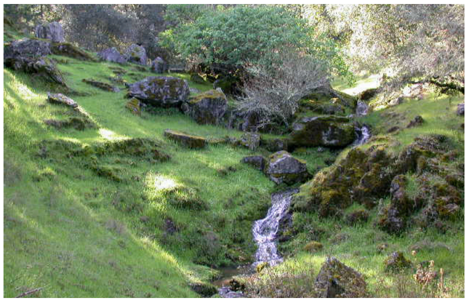
Salmon Creek Water Conservation Program

Conservation Strategy No.5: Roofwater Harvesting for Coastal California Communities

Coastal Conservancy



Overview

In many coastal communities, reliable access to fresh water is limited and watershed health is a concern. During summer months, when stream flows and groundwater supplies are lowest, human demand is highest and endangered fish populations are under extreme stress. Additionally, climate change forecasts indicate that greater seasonal variations in rainfall could affect water security.

Roofwater harvesting systems are a "low-tech" way to capture winter rains for use during dry periods. The following is a brief overview of design and construction considerations for roofwater harvesting systems.

Target community

Residents and businesses within all coastal California communities, especially those with water supplies directly linked to waterways supporting threatened or endangered salmon and steelhead fisheries.

Potential effect

A well-designed roofwater harvesting system can reduce or eliminate demand for surface and groundwater supplies, increase water security, improve fire protection, and result in more reliable instream flows for fish and other aquatic life during the dry season. In addition, capturing and infiltrating storage tank overflows onsite can recharge groundwater supplies while reducing erosion, flooding, and pollution during rains.

Implementation

Design elements common to both potable and non-potable systems are listed below, followed by those specific to potable water systems. Special considerations for residential, non-residential, and agricultural uses are addressed next, with a final section of additional web and print resources that offer in-depth analysis of the information in this Conservation Strategy. For a recent rainwater harvesting case study, see: www.oaecwater.org/education/roofwater-harvesting-booklet

First Steps in System Design

Conservation – Efficiency First

A roofwater harvesting system is not intended as supply augmentation for inefficient use, waste, or increase in demand. Roofwater harvesting in coastal California is one approach to seasonally offset demand for instream flows and groundwater with stored rainwater. In any water system design, conservation, and efficiency are always the first steps.

The following websites offer strategies that can significantly reduce a site's water use. For residential conservation, see www.h20use.org or use the Salmon Creek Water Conservation Program's Residential Self Survey Conservation Strategy at www.salmoncreekwater.org. Many businesses can also use the Salmon Creek Water Conservation Program's Conservation in the Hospitality Industry Conservation Strategy also at www.salmoncreekwater.org Agricultural users visit www.pacinst.org

Regulations and Permitting

Before starting to design a system, research existing policies or ordinances in your area that regulate the use of rainwater, and be sure your intended system will be in compliance. In many counties, tanks over 5,000 gallons will need a building permit for their grading and installation. For more information visit your county's building department website.

Intended Use: Potable or Non-potable

Anyone who has their water supply impacted during the dry season or who uses water from a stream will benefit from installing a roofwater system. The type of system selected will depend on the intended use of the stored water.

Simple non-potable systems provide fire protection, irrigation, and livestock water supply independent of instream flows and groundwater. Potable systems need filtration, treatment, and possibly a backflow preventer. Consider these factors to determine which roofwater system is most appropriate:

- If irrigation or livestock water supplies are insufficient or unusable, or there are water needs in remote/inaccessible areas (even those currently served by stream diversion or pumping), consider a non-potable system.
- If the current potable water supply requires trucking in water, seasonal changes diminish well capacity or reliability, or there are concerns about water quality, then a potable water system may be worth developing.

RAINWATER CALCULATOR

A = (catchment area of building)
R = (inches of rain)
G = (total amount of collected rainwater)

(A) x (R) x (600 gallons) / 1000 = (G)

Site Survey and Water Audit

To determine how much water will be needed during the summer, perform a water audit on the structures and surrounding landscape. A Residential Self Survey Conservation Strategy is available at www.salmoncreekwater.org, and will help in estimating storage capacity needed for the rainless months of the year. For help performing a water audit and designing systems for larger scale agricultural needs, contact your local Resource Conservation District (RCD). The Gold Ridge RCD also has information on roofwater systems for dairy operations. Their website is: www.goldridgercd.org.

Factors Common to Both Potable and Non-potable Systems

Roofwater harvesting systems range in complexity from rain barrels under downspouts to municipal-scale systems. All share the following elements discussed below.

Collection Capacity

To calculate the collection area of a structure's roof, measure the horizontal length and width of your roof line (not the sloped roof) and multiply the two measurements. Next, gather data on average annual rainfall for the area. On-site rain gauge data is optimal, but contacting the local weather service, agricultural extension agent, or public water agency will suffice.

Then, estimate the water quantity the structure's roof could harvest per year using the following formula: (Collection area square footage) x (Average annual inches of rainfall) x (600 gallons) / 1000 = Total gallons of rainfall harvested per year.

While average annual rainfall numbers are a good starting point, it is a valuable exercise to do this calculation for 25- and 50-year drought figures in order to plan for the worst- case scenario. A capacity calculator is available at www.oaec.water.org/calculators

Gutters and downspouts

24-hour storm intensity in the area will determine gutter and downspout size. Ideally, gutters should capture all the rain that falls during a storm without overflowing. In most coastal communities, a 6" gutter system will work for all but the most severe storms.

First flush diverter/pre-filter

During the dry season, debris will accumulate on the roof and in gutters. First flush diverters and pre-filters ensure that the first few minutes of runoff are rejected, allowing time for rain to clean the roof. As a rough estimate of the necessary diverter capacity, plan for 1 to 2 gallons diverted per 100 square feet of roof area.

Storage capacity

In medium to large systems, storage will be the largest expense and occupy the most space, and so needs to be carefully selected and sized. Based on your water audit, include storage for at least a six-month supply (or whatever it takes to get through our lengthy dry season). Remember this is a minimum number—current climate change projections are for worsening droughts and increasingly unpredictable storms. Increasingly, municipalities are offering incentives to offset part of the installation cost for roofwater harvesting systems. For additional information on storage options, see *Water Storage: Tanks, Cisterns, Aquifers and Ponds*, by Art Ludwig.

Overflow

Once the storage structure is full, the overflow water needs to be piped to an appropriate storm water management location like a rain garden or bioswale. For help with designing an overflow system, please read the Stormwater Conservation Strategy available at www.salmoncreekwater.org

Considerations Unique to Potable Water Systems

Potable water systems have more exacting design requirements than non-potable, and need careful consideration of the following elements:

Roofing

The more non-reactive the roof surface, the better. Many common materials add chemicals that are unsuitable for a potable water system, as do lead roof jacks. For some resources concerning roofing materials and water quality, visit: http://www.thecenterforrainwaterharvesting.org/2_roof_gutters2.htm

Gutters

Keeping your gutters clean of debris and leaves is critical for water quality. In fire-prone areas, gutters act as part of the "defensible space" strategy for your home. For best performance, gutters should be:

- Round-bottomed, smooth, durable, and supported every 30"
- Soldered with non-lead solder
- Protected from leaves and debris

Roof washer

For an additional level of filtration after the first-flush diverter, consider using a roof washer system—a device that mechanically removes finer levels of particulates and debris before it gets to the storage structure. Many different designs are available.

Storage

If a tank is employed, at a minimum it should be National Sanitation Foundation (NSF) certified. All storage vessels regardless of type need to be fully enclosed and screened at all inlets and outlets to prevent mosquito breeding. Also include a connection for Fire Department use and plumb for full drainage to allow cleaning. A complete guide to storage methods and materials can be found in *Water Storage: Tanks, Cisterns, Aquifers and Ponds*, by Art Ludwig.

Backflow prevention

In many cases, municipal water supply codes require a backflow prevention device to be installed. These devices require annual inspections by qualified inspectors. For more information regarding these regulations, call your municipal water supply agency.

Post-storage filtration

For potable water, a fine level of post-filtration for particulate matter is required prior to any disinfection treatment. Failure to filter particulates leaves microscopic sheltered sites where pathogenic bacteria and microbes can survive disinfection. Carbon filtration is the preferred technology. Sand filtration and other methods are sometimes used.

Post-storage treatment

Disinfection deals with bacteria, viruses or other pathogens that are small enough to pass through a particulate filter. The three most common options are:

- Chlorine: the primary biocide in many city water systems and has a long track record, but many people have health concerns with the by-products of chlorination.
- Ozone: can be used as a disinfectant. It is made on site by passing oxygen through ultraviolet light and adding it to the tank water by bubble contact. It requires electricity, has fewer potentially dangerous by-products and leaves no taste or odor.
- Ultra Violet (UV) light: a proven technology that kills unwanted microbes. Electricity is required to operate the UV bulb, which must be changed periodically, but it is effective and leaves no chemical residue in the water. Installing UV with carbon pre-filtration at points of use avoids the need for residual chemicals intended to disinfect storage and distribution systems.

Testing

Collect a sample of water at the tap and send it in to a local Environmental Laboratory Accreditation Program accredited laboratory for testing before drinking it. Consider sampling at the downspout, after the storage structure, and after treatment, for a complete system profile. For additional information, see: www.oasisdesign.net/water/quality/coliform.htm

Site Design

Storage structure placement design parameters are beyond the scope of this document and may require professional assistance. At a minimum, the location must be solid, seismically stable, and provide sufficient clearance below your lowest gutter to install the first-flush pre-filter and/or roof washer above the top of the installed tank. For underground installations, be sure to assess the water table before designing the site.

Deciding Who Will Build the System

As with any building project, it is important to ensure that your design is safe. Water is very heavy (over 8,000 pounds for a full thousand-gallon tank) and it is recommended to have professional review of your plans, even if you are building the system yourself. If you prefer to hire a contractor, a list of licensed regional contractors is available at: www.oaec.water.org/roofwater-suppliers

Special Considerations for Residential Applications

Residential lots tend to have limited space as well as setback requirements, making storage installed within the building envelope attractive. Consider a tank in the basement or under a deck. At a minimum, a rain barrel helps—they are cheap, simple, and have fewer design requirements.

Special Considerations for Non-residential Applications

Larger public and commercial buildings have significant collection capacity and opportunities for tank placement within the building envelope or under playing fields, golf courses and parking lots, yielding high storage capacity.

Special Considerations for Agricultural Applications

Large roof area and open spaces can make agricultural installations less prone to restrictions on tank size and siting, while offering much improved water security for crops and animals during drought years. In upland dry sites that are distant from existing plumbed infrastructure, consider placing a freestanding, self-filling tank. If additional capacity is needed, simple shed roofs built over roofwater storage structures can reduce demand for stream withdrawal and groundwater pumping. Collection and storage capacity of the structure must be sufficient to accommodate the stocking rate and duration of use.

Tools

Financial Incentives

For financial incentives and resources related to roofwater harvesting, Brad Lancaster's site is a good place to start: http://www.harvestingrainwater.com/rainwater-harvesting-inforesources/water-harvesting-tax-credits/

The Sonoma County Energy Independence Program offers financial incentives for "permanently installed rainwater cisterns". For more information, see: www.sonomacountyenergy.org

Some municipalities provide rebates on installation of rain barrels. For example, Santa Rosa rebates $0.25 per gallon of storage. Check with your local water agency.

Books/Periodicals

A highly accessible book for the beginning do-it-yourselfer is *Rainwater Collection for the Mechanically Challenged* by Suzy Banks with Richard Heinichen. www.rainwatercollection.com/rainwater_collection_how.html

The definitive introductory book to all things rainwater is *Rainwater Harvesting for Drylands, Volume 1: Guiding Principles to Welcome Rain Into Your Life and Landscape,* by Brad Lancaster. www.Harvestingrainwater.com

Websites

For a list of Environmental Laboratory Accreditation Program accredited laboratories in California that can test drinking water quality, download: www.cdph.ca.gov/certlic/labs/Documents/ELAPLABLIST.xls

For information on restoring and protecting watersheds by utilizing a framework of regenerative water-use practices known as Conservation Hydrology, visit the Occidental Arts and Ecology Center (OAEC) WATER Institute website at: www.oaecwater.org/education/bor-publication and purchase *"Basins of Relations."* Proceeds benefit the WATER Institute.

For educational opportunities, rainwater harvesting seminars, conferences and a business directory, visit The American Rainwater Catchment Systems Association website at: www.arcsa.org

Coastal Conservancy

This conservation strategy was produced by Brock Dolman and Kate Lundquist, Occidental Arts and Ecology Center's WATER Institute and Kevin Swift, Swift Writing, for the Salmon Creek Water Conservation Program (SCWCP). The 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.