

Water Retention Strategies: Approaches for the Methow Valley

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Prepared for the Methow Watershed Council by Mosaic Planning Studio

Introduction

The hydrology of the Methow River Basin reflects that of a typical snow-dominant mountain-west watershed. Snow deposited in the winter at higher elevations melts in the spring, providing abundant streamflows and groundwater recharge through mid- to late summer. With few and relatively small surface-water storage reservoirs, water availability decreases dramatically in our semi-arid climate in late summer and through the fall and winter. Year-to-year fluctuations, with droughts, floods, and variable snowpack, can have a significant effect on our water resources. It is common for streamflows to drop below state-established minimums, for junior water right¹ holders' use to be curtailed, for irrigators to have a truncated season, and for residential wells to experience diminished yield.

Climate change is exacerbating those problems. The warming trend we are already experiencing will result in a shift in winter precipitation from snow to rain, earlier peak runoff, reduced summer flows, and increased winter flows. Extreme dry and wet events are also predicted to increase in intensity and frequency. Our snow-dominant hydrology will transition toward rain-dominant, with more seasonal and annual variability.

Most streamflow leaves the basin during high-flow periods. Researchers estimate that, on average, more than one million acre-feet² (ac-ft) is discharged from the Methow River at Pateros each year. A portion of that is reserved for minimum instream flows³ and existing water rights, but in almost every year there is water that could potentially be stored for later use. This white paper is intended to present potential opportunities for water retention. Effective storage projects could have many benefits for irrigation, recreation, land use, fisheries, and firefighting.

Previous Reports and Studies

Three reports were prepared for the Methow Watershed Council in 2003 and are still relevant to understanding the context and opportunities for water retention.⁴ The first, *Hydrogeology of the*

¹ A water right is a right to use a reasonable quantity of public water for a beneficial purpose during a certain period of time at a certain place. All water in the State of Washington is "public" water—that is, held in trust for the public by the state. The state water codes are based on a "first in time, first in right" doctrine. That means any new water right is subject (or "junior") to existing rights. Therefore, an application may be denied or a water use may be regulated (reduced or shut off) if it adversely affects existing rights. The doctrine also protects established water rights against any impairment by future water users.

² Acre-feet (ac-ft) are commonly used to measure large volumes of water—for irrigation or reservoir storage, for instance. An acre-foot is the amount of water needed to cover one acre to the depth of one foot—about 325,851 gallons.

³ Minimum instream flows were established in the Washington Administrative Code (WAC) by the Methow Instream Flow Rule (hereafter referred to as the Rule). The Rule establishes base flows for seven sub-basins: Lower Methow, Middle Methow, Upper Methow, Methow Headwaters, Early Winters Creek, Chewuch River, and Twisp River. The Rule designates base flows for the first and fifteenth days of each month of the year. All water rights established after the December 28, 1976, Rule implementation are subject to base flows (minimum instream flows) established in the Rule, with the following exception: a reservation of surface water for single domestic and stock uses equal to 2 cubic feet per second (cfs) was set aside in each of the seven sub-basins to meet future needs. Rights to groundwater developed after 1976 are subject to the base flows, if it is determined that groundwater withdrawals will affect surface waters.

⁴ Subsequent water storage evaluations, prepared around 2012 and 2014, were not available to the authors and so were not reviewed for this paper. A review of those evaluations would provide a more complete understanding of water retention in the Methow watershed.

Unconsolidated Sediments, Water Quality, and Ground-Water/Surface-Water Exchanges in the Methow River Basin (USGS), based on extensive fieldwork in 2001 and 2002, provides substantial insight into the effect of water flow between rivers and aquifers⁵ on water-retention potential. Some key findings include:

- Unconsolidated sediment (mostly sands and gravels) on and near the valley floor constitutes the primary aquifer in the Methow River Basin, which, in combination with snowmelt, maintains streamflow during seasonal dry periods and for irrigation, domestic, and public-water supplies. It forms a nearly continuous deposit along the valley bottom from above Lost River to the confluence of the Methow and Columbia rivers. The deposit is 0.5 mile wide and more than 1,000 feet thick at its upper end near Mazama, decreasing to less than 100 feet thick near Winthrop.
- Groundwater discharge from the main valley aquifer to the Methow River contributed 37 to 57 percent of the streamflow near Pateros during low-flow conditions in September 2001, February 2002, and September 2002. Groundwater discharge to the lower Twisp River contributed 45 to 52 percent of streamflow near Twisp during September 2001 and 2002, respectively, but was negligible during February 2001.
- The Methow and Twisp rivers, along with other snowmelt rivers and streams in the basin, are major sources of recharge for the unconsolidated aquifer, particularly during high-flow periods in May and June.
- Seepage from unlined irrigation canals also recharges the unconsolidated aquifer during the late spring and summer. Seepage from the canals is likely to have the greatest effect on streamflow in early fall (more detail below).

The second report from 2003, the *Methow Basin Storage Assessment* by Golder Associates, attempted to determine the feasibility of storing water during periods of “excess” capacity for use during periods of limited capacity. It includes:

- A general overview of potential storage options, including off-channel storage, underground storage, enlargement or enhancement of existing storage, and on-channel storage;
- An inventory of existing storage facilities, available infrastructure, and storage volumes;
- A discussion of issues associated with developing storage, including potential environmental effects; and
- A summary of storage modeling conducted by the U.S. Bureau of Reclamation.

The assessment concluded that additional storage “is a viable consideration and can provide measurable improvements in water availability (both streamflows and irrigation delivery) in the Methow.” The analysis suggests that 5,000 ac-ft of additional capacity could be developed from four sites: Pearrygin Lake (3-foot raise gaining additional 638 ac-ft); Patterson Lake (10-foot raise gaining additional 1,500 ac-ft); plus new relatively large dams/reservoirs at Elbow Coulee and Deadhorse Reservoir. From today’s perspective, it would seem to be a very difficult proposition to build new dams in the valley for what were assessed to be relatively minor benefits, though minor operational changes should be considered.

The third report from 2003 is the *USGS Groundwater Storage Study*, which investigated six sites for artificial aquifer recharge. See the “Artificial Aquifer Recharge” section below for discussion of that effort and approach.

The sections that follow describe water retention methods that are being used or could be considered in the Methow watershed.

⁵ An aquifer is a geological formation made up of enough permeable material to store water and at the same time allow movement of water through it under ordinary conditions. Examples of permeable material are sand and gravels.

Seepage from Open Canals

Around 2002, the USGS estimated that seepage from unlined irrigation canals—approximately 73 miles at that time—represented just under 10 percent of annual non-fluvial (i.e., not originating in rivers) groundwater recharge in the basin. Seepage from the canals is likely to have the greatest effect on streamflow in September and October, when streamflow and diversions are relatively low but groundwater flow from the seepage is still relatively high. The effect diminishes over time and disappears by February.

In the years since that study, nearly half of the 73-mile canal length has been piped, including conveyances belonging to the Methow Valley Irrigation District, Chewuch Canal Company (CCC), Skyline Ditch Association, and Barkley Irrigating Company. Additional piping is being considered by Twisp Valley Power and Irrigation Company, CCC, and possibly others. Piping has positive effects, most notably significantly reduced river diversions and lower maintenance expenses. Piping can also have downsides, including large capital outlay, dehydrated areas along the conveyance, and elimination of the delayed seepage flows back to the river.

There may be opportunities to start diverting water into canals that remain open and leaking significant amounts of water to the aquifer before the start of the irrigation season, when water is abundant in the rivers. The resulting seepage could benefit the river later in the summer. Potential barriers include permit conditions and physical difficulties in diverting while snow and ice remain present.

Artificial Aquifer Recharge

Aquifer recharge represents one approach for redistributing water from periods of high runoff to periods of low runoff. Shallow aquifers can be recharged artificially by distributing water over the land surface (e.g., in ponds) or in the soil column (e.g., through perforated pipes). Artificial aquifer recharge will increase the volume of groundwater available for water supplies or instream uses only when three conditions are satisfied: 1) the streamflow used to recharge the aquifer would not otherwise have recharged the aquifer; 2) the aquifer is not fully saturated when streamflow is available for artificial recharge; and 3) groundwater remains in the aquifer until it is needed for water supply or instream uses. To benefit instream uses, artificially recharged groundwater must continue to flow back into a river after artificial recharge has ceased for the season.

Two types of artificial aquifer recharge are Aquifer Storage and Recovery (ASR) and Managed Aquifer Recharge (MAR). ASR has proven to be a cost-effective way to capture and store water when it is available so that it can be used during times when it is limited. Storage within the aquifer (groundwater storage) can serve the same purposes as surface water reservoirs, without many of the issues and costs associated with dams.

MAR shares elements with ASR but is not intended for storage and subsequent recovery. MAR supplements the natural pattern of recharging groundwater, which typically comes from rain and snow seeping into the ground. Because surface water and groundwater are connected, MAR can help add to the water discharging to streams and rejuvenate wetlands and springs. MAR can be an important tool for stabilizing or reversing declining groundwater levels. In some circumstances, it may be used as mitigation for other water withdrawals.

Field analysis of groundwater storage by the USGS, presented in the 2003 *USGS Groundwater Storage Study*, indicated that, of the six sites investigated, Big Twin Lake, Elbow Coulee, and the terrace south of Twisp between lower Beaver Creek and the Methow River are the best candidates for an artificial recharge program. Groundwater levels at all three sites are likely to be deep enough to allow artificial

recharge throughout the year and, in particular, during periods of high flows when streamflow generally exceeds state regulatory base flow (minimum instream flow).

The net volume of artificially recharged water that could be used at each of those sites could not be estimated with the data available and would require additional analysis. In order for any of the storage projects considered in the analysis to proceed, a great deal of additional work would be needed to prepare environmental and cost/benefit analyses.

As methods of storing water, MAR and ASR have not been practiced widely in Washington, although two case studies, in the Walla Walla Basin and Seattle's Highland Wellfield, were investigated. The geology must be conducive, water for recharge must be readily available, and the ultimate water users need to be able to get the water cost-effectively. The potential barriers to implementing MAR projects are wide-ranging. The most common barriers include water-quality concerns, statutory or regulatory restrictions, water resources allocation, prohibitive costs or lengthy time to implement, water-rights issues, and stakeholder acceptance. MAR projects in Washington include Taneum Creek (Kittitas Reclamation District), Toppenish Fan (Yakama Nation), and a project undertaken by the Kennewick Irrigation District.

Seattle has a permitted ASR project, but it is rarely used. The city relies heavily on its surface water sources and prefers to keep the wells in reserve for emergencies. The aquifer recharge would be used to reestablish the aquifer levels after the wells were utilized. In the Walla Walla Basin, however, a long-running bi-state project to improve groundwater levels has been operating since 2004. From 2004 to 2020, approximately 85,000 acre-feet of recharge volume has been added into the Walla Walla Basin from the Oregon MAR project. Other ASR projects have been operated by the cities of Yakima, Moxee, and Prosser and the Roza Irrigation District.

Twin Lakes Aquifer Coalition Project

One local retention project that has been evaluated over the years and shows promise is delivering water to Twin Lakes. (The project was also included and deemed promising in the 2003 USGS groundwater storage study.) Since the late 1990s, when the Wolf Creek Reclamation District (WCRD) stopped using open irrigation ditches in the vicinity of Twin Lakes, water levels in the lakes and associated aquifer have dropped more than 15 feet. A group called the Twin Lakes Aquifer Coalition (TLAC) conducts water-level monitoring and has evaluated various water sources for raising water levels in the lakes, including a new well, Thompson Creek, and the WCRD system centered on Patterson Lake. Currently, the TLAC favors the well alternative. A feasibility study funded by the Methow Watershed Council (2018-19) was terminated when one of the key water right holders expressed concern over the project. Subsequent changes in land ownership and involvement of key organizations (Sun Mountain Lodge, WCRD, Methow Conservancy) may create an opening for the project to be reevaluated.

Development of a water source for Twin Lakes could conceivably be tied to development of a water source to meet the needs of planned housing on the Sunny M parcel now owned by the Methow Conservancy. With the project in operation, water would be conveyed to Twin Lakes and its aquifer during the irrigation season. Some would be lost to evaporation from the lakes, but most water would discharge from the aquifer to the Methow River throughout all seasons of the year, effectively "retiming"⁶ any withdrawals of the water.

The retiming of the water going to the Methow River is a key aspect of the project and could provide the basis for using that water to mitigate year-round domestic water use. The hydrogeology of the Twin

⁶ Retiming is a process for converting a seasonal (typically agricultural) water right to a year-round water right, usually for the purposes of providing municipal, domestic, or industrial water supply. It usually involves storage of water that is diverted or withdrawn during the irrigation season and use of that water later.

Lakes area is complex because of its glacial history and the influence of the Methow River, Wolf Creek, and irrigation systems. The benefits from a new water development project would be likely to vary year-to-year and need to be evaluated.

Reservoirs

The Methow watershed does not have abundant above-ground water storage. The main reservoirs, used for irrigation and recreation, are Patterson Lake and Pearrygin Lake. Other lakes of notable size, including Davis, Alta, Moccasin, and Libby, are not actively managed for water supply. There are discussions currently underway, involving the Chewuch Canal Company and Town of Winthrop, of using some of the storage in Pearrygin Lake for municipal supply, amounting to about 150 ac-ft/year that could become available to meet Winthrop's municipal water needs. (The quantity cited is preliminary, as discussions are ongoing.)

As noted previously, some potential may exist for modified reservoir operations and allocations at Patterson Lake as well. Numerous smaller existing reservoirs (including the ones listed in the preceding paragraph and about 10 others), used primarily for recreation, might be candidates for enlargement for the purpose of storing additional spring runoff water, but impacts on recreational uses could be significant.

Habitat restoration and enhancement

There has been a tremendous investment in instream and near-stream restoration and enhancement in the Methow watershed, primarily in response to the listing of three anadromous fish species under the Endangered Species Act in the late 1990s. Most restoration and enhancement projects are undertaken to support recovery of the listed fish species. Although the focus of the work is often on improving specific aspects of the instream environment, cold, flowing water is the most critical component of fish habitat, and the projects do affect water retention.

Habitat restoration and enhancement projects fall into two broad categories: in-channel and off-channel restoration and enhancement and low-tech process-based restoration. Both approaches are being used in the Methow watershed. Each is described below, along with specific techniques and examples.

Quantifying the effects of restoration projects is challenging. Water stored in the ground is inherently more difficult to measure than impounded water, and significant change may take decades to realize. The Chelan County Natural Resources Department has had some success measuring the effects of channel restoration in incised channels.

Understanding how much water is retained can help planners analyze the potential benefits of sites and methods and make decisions about how and where to conduct restoration and enhancement projects. It can also help land and water managers understand and manage water supply. Hypothetically, quantifying water stored could also inform water-availability calculations made by permitting agencies. The authors are aware of no instance in which that approach has been tried; it might or might not find favor with Washington's Department of Ecology, which manages the state's water supply.

In-channel and off-channel restoration and enhancement

In-channel and off-channel restoration and enhancement is best suited to large, high-energy stream systems such as the mainstem Methow, Chewuch, and lower Twisp rivers. Techniques used in the Methow watershed include side-channel and floodplain reconnection, increasing structural complexity, and riparian restoration. All three will increase water retention.

Side-channel and floodplain reconnection projects allow streams access to land outside the main channel, increasing the area available to absorb water during high-flow periods. The work may include removing levees or other artificial barriers to channel migration.

Structural complexity may be increased by constructing engineered log jams (ELJs) or placing boulders in the watercourse. The added structure slows moving water, creating habitat and also allowing more water to reach the hyporheic zone—the saturated area underlying the channel—and ultimately move into the aquifer.

Riparian restoration relies primarily on plants to slow water and reduce its erosive force, giving the water an opportunity to spread across the floodplain and soak into the ground.

In-channel and off-channel techniques focus on changing the form of the stream and its surrounds. They often rely on heavy machinery or helicopters to place large material, such as logs with root wads attached. The material may be imported from outside the project area—for instance, from a timber harvest site.

Project planners use hydrographic models to site and design engineered structures. Site selection criteria include stream gradient, annual discharge, valley width, and the presence or absence of a floodplain. Landowner willingness, existing development, adequate funding, permitting, and respect for cultural resources are all factors in planning the work, which often takes place in populated areas that have seen human use since time immemorial.

Low-Tech Process-Based Restoration

Low-tech process-based restoration (LTPBR) aims to create conditions under which a stream, wetland, or meadow can regain its natural processes and functions, rather than directly altering channel form. By slowing flow, LTPBR lets water sink into the ground and begin to move both laterally into the landscape and downward to recharge the underlying aquifer.

LTPBR tends to be most suitable for small, low-energy streams and other places where structures are unlikely to be disturbed by high flows. It is often used in higher-elevation tributaries. The work is generally done using hand tools or small equipment that can easily be transported to remote sites. Unlike engineered structures, LTPBR projects may involve some improvisation in response to site conditions and available materials.

The best-known LTPBR techniques are beaver dam analogs (BDAs) and post-assisted log structures (PALS). BDAs mimic beaver dams, while PALS span most of a watercourse but leave a gap through which fish can pass. PALS catch wood but do not impound water to create ponds. Both types of structures are usually built using materials collected on or near the restoration site.

Although ponds created by BDAs may be colonized by beavers, LTPBR installations generally require human maintenance. Natural beaver dams function effectively because the builders are on the job all day, every day. Restoration crews cannot approach that level of attention, nor is funding for such maintenance readily available.

In the Methow watershed, the Methow Okanogan Beaver Project uses LTPBR, including BDAs, PALS, wood loading, and riparian plantings. On the land he tends, Wren Soperanez uses rainwater harvesting and permaculture techniques to retain water on a micro scale. Julie Vanderwal of Sparrow Song Consulting uses a variety of techniques to improve ecological function.

As a project manager for the Methow Okanogan Beaver Project, Vanderwal is currently collaborating with local landowners and land managers to restore a complex waterway using several methods to slow flows, increase groundwater recharge, and restore biodiversity. Examples include:

- Zeedyk structures, described by the NRCS as “low profile, hand-built treatments made of rock or wood [that] ... help to slow and disperse water, dissipate energy, capture sediment, and increase soil moisture”;
- Deformable rock structures, made with rocks that are already present in the channel and intended to slow and disperse water during moderate flows and to move in response to high flows;
- Living BDAs made with live willow posts and conifer post BDAs, both intended to slow flows and improve groundwater recharge;
- Floating Treatment Wetlands or Floating Vegetation Mats, made with locally abundant natural materials, which can cool and shade a water body, reducing direct evaporation.

Beyond the Methow watershed, the Cascadia Conservation District (CCD), working in Chelan County, and Cascade Columbia Fisheries Enhancement Group (Cascade Fisheries), working in Chelan, Douglas, Ferry, and Okanogan counties, use BDAs and PALS. The CCD has been experimenting with wood loading—pulling woody debris into streams where it can trap sediment and debris—and gully stuffing—using smaller vegetative material gathered onsite to fill incised channels and slow erosion. Both techniques have potential to increase water retention as they slow running water.

The amount of water retained by each LTPBR installation is small, and the water-retention benefits may accrue over a period of years. Generally, in-channel and off-channel restoration and enhancement stores more water than LTPBR. However, because many LTPBR projects take place higher in the watershed, on public land with little infrastructure, there may be fewer barriers to siting them. The need to maintain those distant sites remains a drawback, however.

Whether techniques that are not currently being used in the Methow watershed could be suitable here depends on the specific characteristics of each restoration site, including the level of development and the materials available onsite. *Restoring Western Headwater Streams with Low-Tech Process-Based Methods*, listed in the “Selected Resources” section below, includes discussions of methods, siting parameters, and results.

Utah State University’s Beaver Restoration Assessment Tool (BRAT) can be useful in identifying potential sites for further evaluation. In 2020, Trout Unlimited used a BRAT analysis and other criteria to develop the Upper Columbia Beaver-Powered Restoration Decision Support System tool, which has been used for initial site identification in our region.

Conclusion

The Methow watershed offers a variety of opportunities for increasing water retention. The methods discussed in this paper serve different interests and provide different benefits. Defining intent and conducting a thorough analysis of potential sites prior to choosing a method is critical to successful water-retention projects.

The authors are not aware of any current work to quantify new water retention or storage within the Methow watershed. The proposal to use Pearrygin Lake to supply municipal water to the Town of Winthrop involves retiming rather than new storage.

The Methow Watershed Council (MWC) could have a role in furthering water retention through habitat restoration and enhancement by:

- Convening interested parties in the region to discuss techniques, tools, and opportunities for working at the landscape scale to meet the region’s water needs;
- Hosting and/or participating in field trips to visit and learn about local habitat restoration and enhancement projects;

- Serving as a clearinghouse, perhaps by adding to and publicizing the library now hosted on the MWC website;
- Providing a forum for discussion of potential projects—for instance, during occasional MWC roundtables or in public presentations;
- Participating in Methow Restoration Council meetings;
- Including articles about restoration projects, methods, and initiatives in the MWC newsletter;
- Commissioning additional work to address questions beyond the scope of this paper. That work could include developing one or more publications that would include photos and other graphics to make the information appealing and accessible to the general public.

Several of the ideas listed have potential to support project development that could lead to capital-funding requests.

Selected resources

[Groundwater storage in the Methow basin through artificial aquifer recharge](#) (USGS Groundwater Storage Study). Konrad, C.P. U.S. Geological Survey, 2003. *The study is Appendix D of the linked document and begins on p. 122.*

[Hydrogeology of the Unconsolidated Sediments, Water Quality, and Ground-Water/Surface-Water Exchanges in the Methow River Basin, Okanogan County, Washington](#). Konrad, C.P., *et al.* U.S. Geological Survey, 2003.

[Managed Aquifer Recharge \(MAR\)—Interstate Technology & Regulatory Council \(ITRC\) page](#).

[Methow Basin \(WRIA 48\) Storage Assessment](#). Golder Associates, 2003.

[Methow Okanogan Beaver Project](#)—watershed restoration page.

[Restoring Western Headwater Streams with Low-Tech Process-Based Methods: A Review of the Science and Case Study Results, Challenges, and Opportunities: Version 2.0](#). Corday, J. American Rivers, 2024.

[Upper Columbia Beaver-Powered Restoration Decision Support System](#). Trout Unlimited, 2020. (It may take a moment for the map to disappear and the landing page to appear.)

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