

Eliminating Runoff Water from Your Farm

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Figure 1. Runoff water enters a drain downstream from irrigation on the farm. This drain goes directly into the Malheur River.

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An introduction to phosphorus in surface water

The water that is used for municipalities, industry, agriculture, and recreation in the Treasure Valley comes from reservoirs, groundwater, and rivers. For use in agriculture, canals transport water from reservoirs to the farms of Malheur County. As the water travels from farm to farm through the canal system, return flows pick up a lot of sediment and phosphorus, and the water increases in temperature. When growers fertilize their crops with phosphorus, the fertilizer often does not all go where intended, and some of it runs off the field during irrigation. The result is that by the time the water enters the Malheur, Lower Owyhee, or Snake rivers, it is much too warm and too high in phosphorus (Figure 1).

Why are elevated phosphorus levels and high temperatures a problem?

When there is too much phosphorus in a river, algae can grow at a very fast rate. Excess algal growth reduces dissolved oxygen levels in the water, thus harming fish and other aquatic organisms. When oxygen levels are too low, fish may die.

In order to improve water quality, the Oregon Department of Environmental Quality (ODEQ) established Total Maximum Daily Loads (TMDLs), which regulate the quality of the water that enters certain rivers. TMDLs limit the amount of phosphorus allowed in runoff and set temperature standards for water entering the Malheur and Snake rivers. TMDLs have not been established for the Owyhee Watershed at this time; however, ODEQ and the Oregon Department of Agriculture (ODA) expect the watershed to abide by the Snake River-Hells Canyon TMDL Plan. Rivers and streams within the Owyhee Watershed are tributaries of the Snake River.

Can phosphorus and temperature standards be met in runoff water?

In Malheur County, when water leaves the reservoirs and enters the canal systems, it already contains a large amount of naturally occurring phosphorus. By the time ditch water reaches most farms, it already exceeds the phosphorus and

temperature limits set by the TMDLs. Unfortunately, this leaves growers in a predicament when considering how to mitigate this problem. The best way for growers to meet the new TMDL standards is to eliminate runoff from their fields.

How can runoff be eliminated?

There are a number of ways in which growers can eliminate irrigation runoff from their fields. One way to eliminate runoff from farms is to change irrigation techniques. Furrow irrigation is the least efficient method of irrigation, with much of the water lost to runoff. Drip and sprinkler irrigation are alternative irrigation techniques and have been proven to reduce or even eliminate runoff and to water crops more uniformly. Sediment ponds with pumpback systems are another technique that can eliminate runoff by capturing and reusing irrigation runoff on the farm.

Sprinkler irrigation

Sprinkler irrigation is more efficient than furrow irrigation because it spreads water more uniformly throughout the field and because it is easier to control how much water is applied. Sprinkler irrigation mimics precipitation in a form of “artificial rain” (Figure 2). Sprinklers are a popular method of irrigation because they are easy to use. This system of irrigation can



Figure 2. A sideroll sprinkler system is used to irrigate an alfalfa field in Malheur County, Oregon.

reduce labor costs because, for the most part, the sprinklers do all of the work. The most common types of sprinklers used in the Treasure Valley are center pivots, linears, wheel lines, and solid-set systems. Reduced tillage practices can further reduce water and soil loss under sprinkler irrigation (see page 4).

Drip irrigation

Drip irrigation applies water directly to the root zone of the plant so that very little is lost (Figure 3). Drip irrigation is often more efficient than either furrow or sprinkler irrigation, requiring only 60 percent of the water that would be applied in furrow irrigation. While sprinkler irrigation is around 75–85 percent efficient, drip systems can be designed to be up to 90 percent efficient. Other benefits of drip irrigation include:

- Improved product quality
- Improved product uniformity
- Reduced overall water use
- Reduced crop loss to disease
- Reduced weed growth

A drip irrigation system’s initial cost can be \$500–\$1,200 per acre. While designing and installing drip irrigation can be costly and complicated, in many cases the savings may outweigh the initial



Figure 3. Drip irrigation is used to irrigate onion fields in Malheur County, Oregon.



Figure 4. A sedimentation pond that utilizes a pumpback system to return runoff water to the field.

investment in the system. The use of drip irrigation among growers in the Treasure Valley is increasing, particularly among onion, hops, and grape growers.

For more information, see *Drip Irrigation Guide for Onion Growers in the Treasure Valley*.

Furrow irrigation is problematic

Furrow or flood irrigation is prone to substantial soil and phosphorus losses in runoff water. These losses can be largely eliminated by bordered basin irrigation or the use of sedimentation ponds.

Bordered basins. Bordered basin irrigation is common in areas of California and Nevada where the land is very flat. Fields are nearly level and are flooded sequentially. This system is often used for potato and alfalfa production. Runoff is eliminated.

Sedimentation ponds. Sedimentation ponds are a type of tailwater recovery method that recycles irrigation water on the farm. Irrigation water is captured and directed into the pond. Once the sediment in the runoff water has settled to the bottom of the pond, the water is returned to the field for irrigation. Water can be transported through the system by gravity if lower elevation fields can be irrigated, or with a pumpback system (Figure 4).



Figure 5. Polyacrylamide (PAM) is applied in furrows of a potato field (left) in order to reduce nutrient loss and soil erosion during irrigations.

Periodically, the sediment must be removed from the pond. Growers can reduce the frequency of sediment removal by employing techniques that reduce soil erosion such as laser leveling fields; using polyacrylamide, straw mulch, filter strips, or irrigation scheduling; and reduced tillage.

For more information, see *Tailwater Recovery Using Sedimentation Ponds and Pumpback Systems*.

How can I reduce furrow erosion on my farm?

Polyacrylamide

Polyacrylamide (PAM) is a synthetic water-soluble polymer. It is not harmful to the environment and degrades safely into organic molecules several weeks after it is applied. Polyacrylamide binds soil particles together so they are not carried away with irrigation water. Polyacrylamide reduces soil loss by 90 to 95 percent because of its binding capability. It can reduce water pollution by keeping the soil and nutrients where they belong and not allowing them to end up in the runoff. It can also improve water infiltration (Figure 5). PAM is relatively inexpensive and can be utilized with diverse management practices. Before using PAM, be sure to learn how and when to apply it properly. Safety

considerations are important, especially since spillage on solid surfaces makes surfaces exceedingly slick.

For more information, see *Make Polyacrylamide Work for You!*

Straw mulching

Straw mulch is applied between rows to reduce nutrient loss and soil erosion during irrigation. Mulching can also increase yields by maintaining soil moisture. Mechanical mulching can reduce mulching costs.

Filter strips

Filters, or vegetative strips, are planted at the top and bottom of fields in order to reduce soil erosion. Vegetative strips filter sediment and organic material from the runoff water by trapping sediment. Additionally, filter strips can help prevent flood damage and erosion following heavy rains. A number of plants can be used for vegetative strips, but most commonly grass or wheat is used.

Filter strips can be costly to install. However, while the benefits are mostly environmental, filter strips may be economically viable when used concurrently with other runoff elimination techniques. For example, a filter strip could be used along with a sediment pond to reduce the amount of sediment deposited in the pond. Ultimately, this saves a grower money because the pond does not need to be cleaned out as often.

Irrigation scheduling

Irrigation scheduling can be used by farmers to plan when and how much to water by considering crop needs and soil tension. A good irrigation schedule can improve irrigation efficiency and reduce soil erosion. Applying the right amount of water can help a grower avoid both under-irrigation, which can lead to crop loss, and over-irrigation, which can cause soil erosion, water loss, and crop losses from decay. Soil moisture can be measured using a variety of sensors. These instruments can be costly, but they allow for precise irrigation, which can save water and improve crop quality.

For more information, see *Successful Onion Irrigation Scheduling*. Also see *Irrigation Monitoring Using Soil Water Tension*.



Figure 6. Strip tillage is a method of conservation tillage in which only the planting row is tilled. The area between the rows is left intact.

Reduced tillage, conservation tillage

When the number of passes across a field during cultivation is reduced, soil maintains its structural integrity. Water is less likely to run off the surface and more likely to infiltrate to crop roots. In the Treasure Valley, a number of growers are employing no-tillage and strip tillage conservation methods. Strip tillage is a type of conservation tillage in which only the planting row zones are tilled, leaving the space between the rows intact (Figure 6). In studies conducted by Oregon State University Extension and the Malheur Experiment Station, it was determined that strip tillage can be an economically viable practice that can help growers in the Treasure Valley reduce costs and soil erosion while maintaining or even increasing crop yields. Possible benefits of strip tillage include:

- Reduced labor, fuel, and fertilizer costs
- Equal or greater crop yields
- Reduced soil erosion
- Increased organic matter in soil
- Improved water quality

For more information on strip tillage practices, see *Making Strip Tillage Work for You: A Grower's Guide*.

For more information

OSU Extension publications (available at extension.oregonstate.edu/catalog/)

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