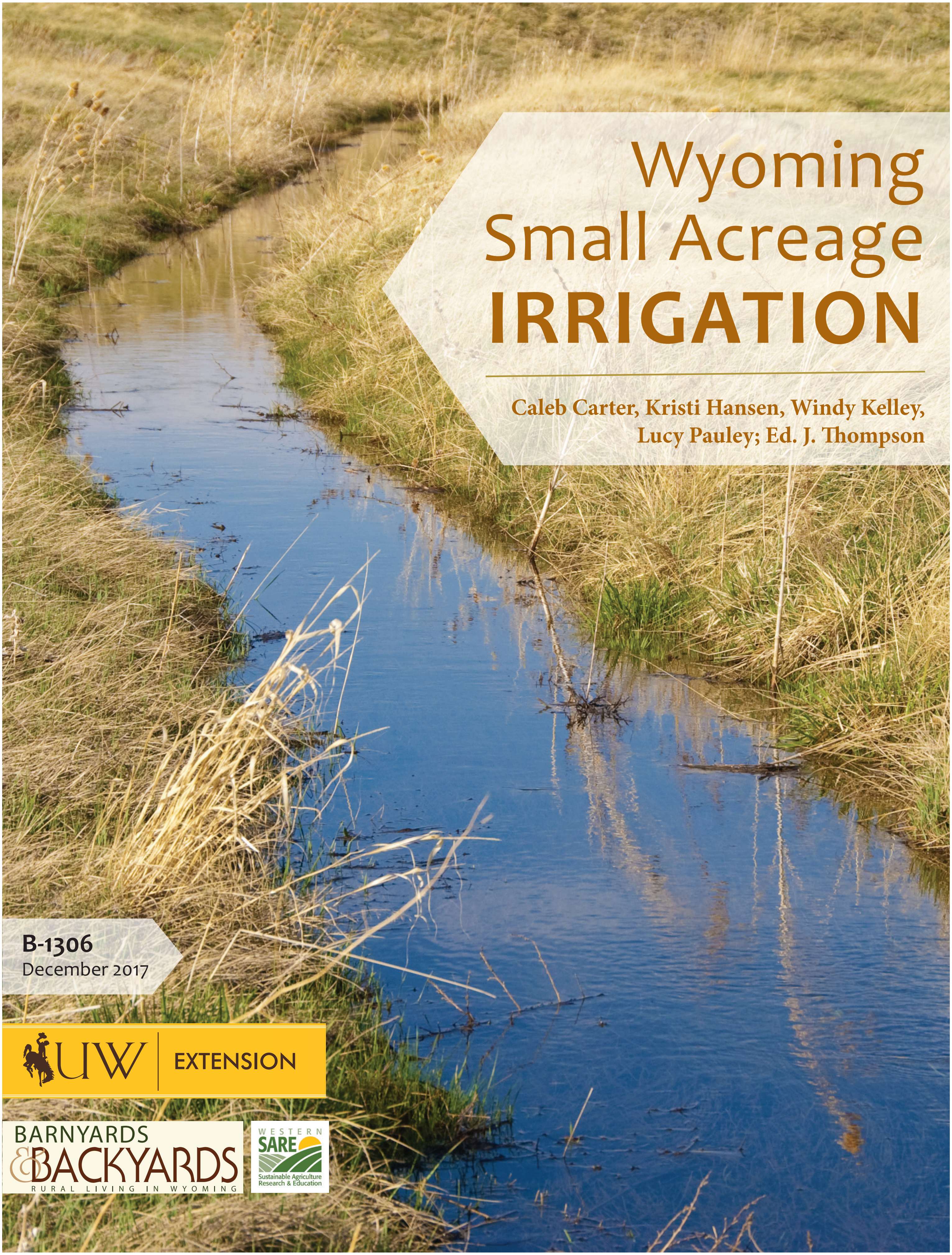

Wyoming Small Acreage IRRIGATION

Caleb Carter, Kristi Hansen, Windy Kelley, Lucy Pauley; Ed. J. Thompson

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Steve Miller, editor, Tana Stith, graphic designer

Links to all documents referred to in this guide (free online) can be found at barnyardsandbackyards.com. Click on "Water" (http://www.uwyo.edu/barnbackyard/resources/irrigguideref.html).

Issued in furtherance of extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Glen Whipple, director, University of Wyoming Extension, University of Wyoming, Laramie, Wyoming 82071.

INTRODUCTION

Are you considering irrigating your small acreage?

Owning and managing a small acreage in Wyoming is exciting but can present some challenges. Precipitation variability in an arid climate and a short growing season can make growing a crop difficult. Generally, using some form of irrigation to produce a crop (whether grass hay for livestock, vegetable, or fruit crops) is necessary.

Whether purchasing a property or already an owner, you may have irrigation questions: Can I use the water from the ditch running across the property? What is a water right? Does the property have one? What is the best method to irrigate my property? How often should I irrigate? What are some ways to deal with conflicts with my neighbor over water?

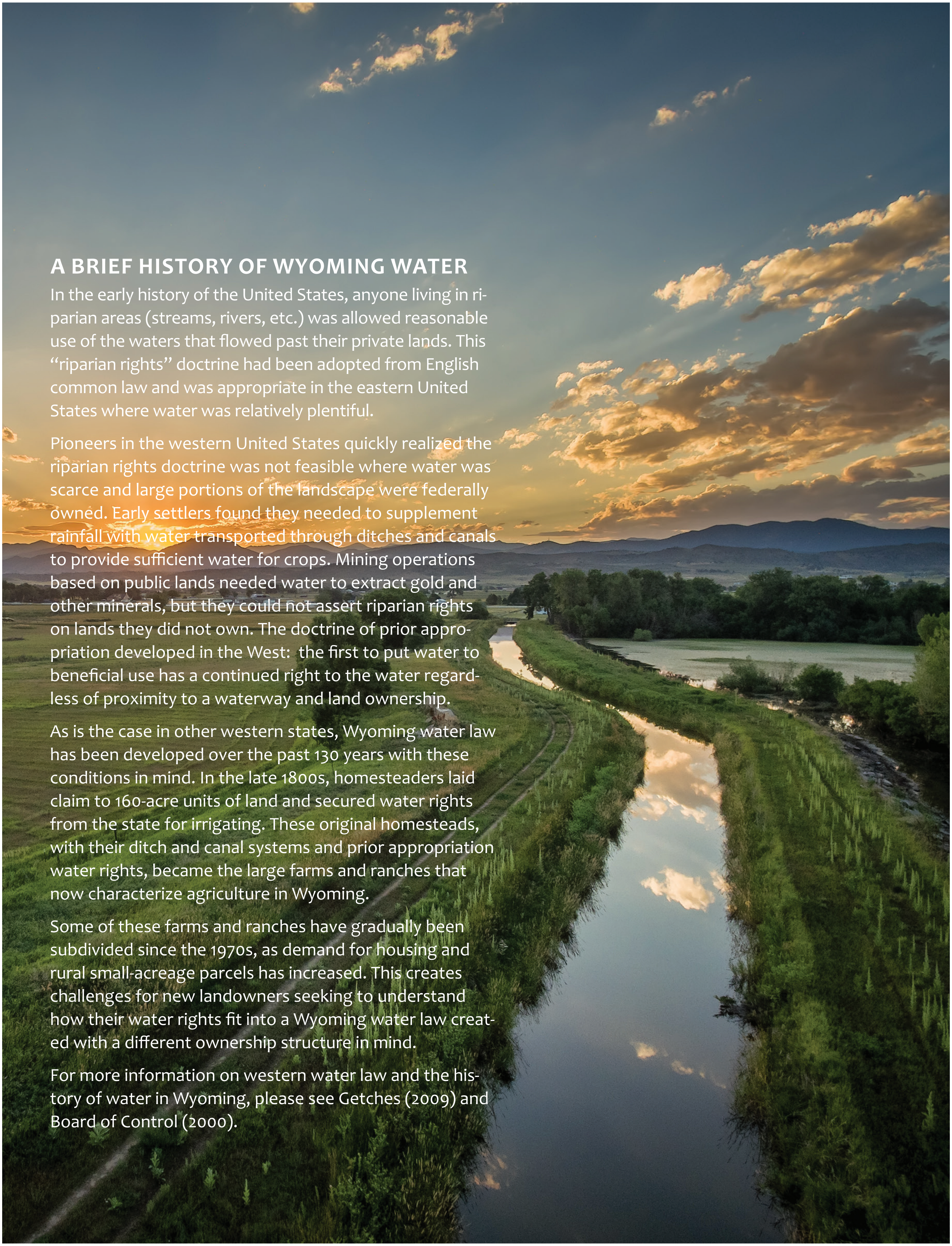
This document is organized into four sections to help answer these questions. The first is, "Can I irrigate?" This section explains how to determine if a property has a water right, how much water does the water right entitle the irrigator to use, how water rights may work within a subdivision, and a brief description of Wyoming water law.

The next section, "How can I irrigate?," discusses various irrigation methods used across Wyoming.

The third section, "Should I irrigate?," then discusses how to determine when to irrigate and how much water to apply.

The last section, "Irrigation Conflicts in Your Neighborhood," gives some points to consider if you find yourself in a water conflict.

With that, welcome to Wyoming small acreage irrigation. We hope you find this a valuable resource as you start exploring the intricacies of irrigation in Wyoming.



A BRIEF HISTORY OF WYOMING WATER

In the early history of the United States, anyone living in riparian areas (streams, rivers, etc.) was allowed reasonable use of the waters that flowed past their private lands. This "riparian rights" doctrine had been adopted from English common law and was appropriate in the eastern United States where water was relatively plentiful.

Pioneers in the western United States quickly realized the riparian rights doctrine was not feasible where water was scarce and large portions of the landscape were federally owned. Early settlers found they needed to supplement rainfall with water transported through ditches and canals to provide sufficient water for crops. Mining operations based on public lands needed water to extract gold and other minerals, but they could not assert riparian rights on lands they did not own. The doctrine of prior appropriation developed in the West: the first to put water to beneficial use has a continued right to the water regardless of proximity to a waterway and land ownership.

As is the case in other western states, Wyoming water law has been developed over the past 130 years with these conditions in mind. In the late 1800s, homesteaders laid claim to 160-acre units of land and secured water rights from the state for irrigating. These original homesteads, with their ditch and canal systems and prior appropriation water rights, became the large farms and ranches that now characterize agriculture in Wyoming.

Some of these farms and ranches have gradually been subdivided since the 1970s, as demand for housing and rural small-acreage parcels has increased. This creates challenges for new landowners seeking to understand how their water rights fit into a Wyoming water law created with a different ownership structure in mind.

For more information on western water law and the history of water in Wyoming, please see Getches (2009) and Board of Control (2000).

SECTION 1. CAN I IRRIGATE?

Are you a landowner with a ditch running across your property? Interested in irrigating crops or pasture? Before doing anything with water on your land, the first question to ask is: Do I have a water right?

What is a water right?

The Wyoming Constitution declares all waters within the boundaries of Wyoming belong to the state; however, permitted water rights are issued by the state to individuals and entities that put the water to beneficial use. Beneficial uses are defined by Wyoming statute or are determined at the discretion of the state engineer and include (among others) agricultural, municipal, industrial and domestic use, and stock watering. A water right grants the holder a legal right to use a certain amount of water for a specified use at a specific place. The Wyoming State Engineer's Office and the Wyoming Board of Control supervise these appropriations. In Wyoming, water rights for irrigation use are attached to the land (place of use). For other uses, the right is attached to the purpose for which it is acquired – this is the case in most, but not all, western states.

Wyoming water law is based upon the doctrine of prior appropriation. Under prior appropriation, the first to claim a right to water on a particular waterway has the most senior right to use the water. Under this "first in time, first in right" approach, senior rights on a waterway are fully satisfied before a junior right holder receives any water. A right holder's seniority is based on the date they file an application with the State Engineer's Office for a water permit. The oldest water rights in Wyoming are "territorial" water rights that pre-date statehood in 1890; an application for a water permit filed today would have a present day priority date.

In Wyoming, a basic water right for irrigation from a surface water source is 1 cubic foot per second (cfs) for 70 acres of land. One cfs is the rate of flow of water that will supply 1 cubic foot of water in one second. One cfs delivered continuously for 1 day is equivalent to 1.98 acre-feet of water. An acre-foot is the volume of water to cover an acre of land 1-foot deep, about enough water to provide two households with water for one year. A water right holder must put their water to beneficial use continuously to maintain the water right. Under Wyoming state law, a water right not used for five successive years, when water was available for diversion, is deemed forfeited and could be subject to abandonment.

How are water rights administered in Wyoming?

The Wyoming State Engineer is responsible for issuing permits for the use of water in Wyoming. Water commissioners, or hydrographer/commissioners, working for their division superintendent and ultimately the state engineer, are responsible for day-to-day activities related to administering water rights in Wyoming. The Board of Control, comprised of the state engineer and four water division superintendents, adjudicates water rights and approves petitions to modify adjudicated water rights, such as allowing existing water right holders to change the point of diversion from the waterway, the place of use, or the type of use (for example, changing irrigation use to municipal use). The Wyoming Board of Control meets four times per year, generally in Cheyenne. Their meetings are open to the public.

Do I have water rights?

Determining whether or not water rights are associated with your property is important. You should not assume you have rights to an irrigation ditch or the associated water even if it crosses your land, as that water could be allocated to someone else's property.

Contact the State Engineer's Office or your local water commissioner, use the State Engineer's Office e-Permit online database, or visit the county clerk's office of where your property resides to determine if water rights are associated with the property. Water rights are not connected to a residential subdivision lot number, but rather to the property's public land survey system legal description. Provide the property public land survey system legal description to the county clerk's office to ensure information for the correct property is accessed.

The public land survey system legal description of a property is defined as the quarter-quarter (or possibly tract or lot), section, township, and range referenced to a principal meridian and base line. The public land survey system legal description of your property may or may not be printed on your property tax assessment notice or tax bill. Your property deed will contain the legal description of your property but not necessarily a public land survey system legal description. This information can often be found on a 7.5 minute United States Geological Service (USGS) topographic map. You can buy a topographic map of your area from a number of sources, such as an outdoor or hunting/fishing shop, or you can visit the USGS website and purchase them online. Additionally, several counties (for example, Sublette, Sweetwater, and Albany) offer online maps for their county free to the public. Typically, the web-based maps have layers a user can add to or remove from the base map, which often includes the legal description.

A county assessor's office should be able to tell you whether or not an irrigation district administers your water rights and, if so, the name of the district. Many irrigation districts assess fees for operation, maintenance, and rehabilitation expenses from landowners whose properties have water rights associated with them. The county assessor's office collects this annual fee.

If an irrigation district doesn't exist, and you have water rights, a less formal "entity" may have formed to deliver water. Examples include ditch companies, corporations, and homeowner associations. You may not be in any kind of organized district, ditch company, or association at all. Your water right may simply be a single diversion out of a creek or stream or a ditch shared with several common landowners.

You've determined you have water rights – now what?

Wyoming statutes (Title 41) govern water rights and responsibilities associated with those rights; however, the state allows flexibility for specifics at a more local level, such as how/when water will be delivered (see pages 8-9 for examples). If you have water rights, understanding state laws and local by-laws/rules governing your use of water is important, as is understanding the extent to which you share water rights with neighbors.

Lay of the land post-subdividing

New housing developments are often constructed on lands formerly part of a farm or ranch with irrigation water rights. Unless the party that subdivides the land completes the legal process of severing water rights from a parcel of land with an irrigation appropriation, which requires approval from the State Engineer's Office or Board of Control, these sub-divided lands will most likely have water rights associated with them.

In some instances, when land is subdivided, a water distribution plan is developed and recorded. These plans include information such as which properties have water rights associated with them, the location of delivery and catch ditches (ditches that "catch" any runoff and keep it from flowing onto a neighboring property in an unconfined way), and easements for ditch maintenance, among other information.

Even if you determine you have a water right, you may not be able to access the water when and how you want, even if you see it flowing on or next to your land. There may be local rules established by your subdivision association, irrigation district, or ditch company that indicate how and when you can access the water. For example, you may need to request permission from your subdivision association, irrigation district, or ditch company before you can activate your ditch. How much water you are able to receive may also vary from year-to-year depending on water availability regardless of the size of your right, because small-acreage water rights are typically part of a larger, shared water right. Small-acreage landowners usually combine their individual irrigation water allocations *"to create a larger volume and then rotate that volume from one acreage to the next in a sequence that provides water to each tract on a regular and timely basis"* (WY BOC, 2000). If this is not done, there is a good probability the water connected to the water right of a single parcel would be too small in volume to make it from the water source to the parcel of land.

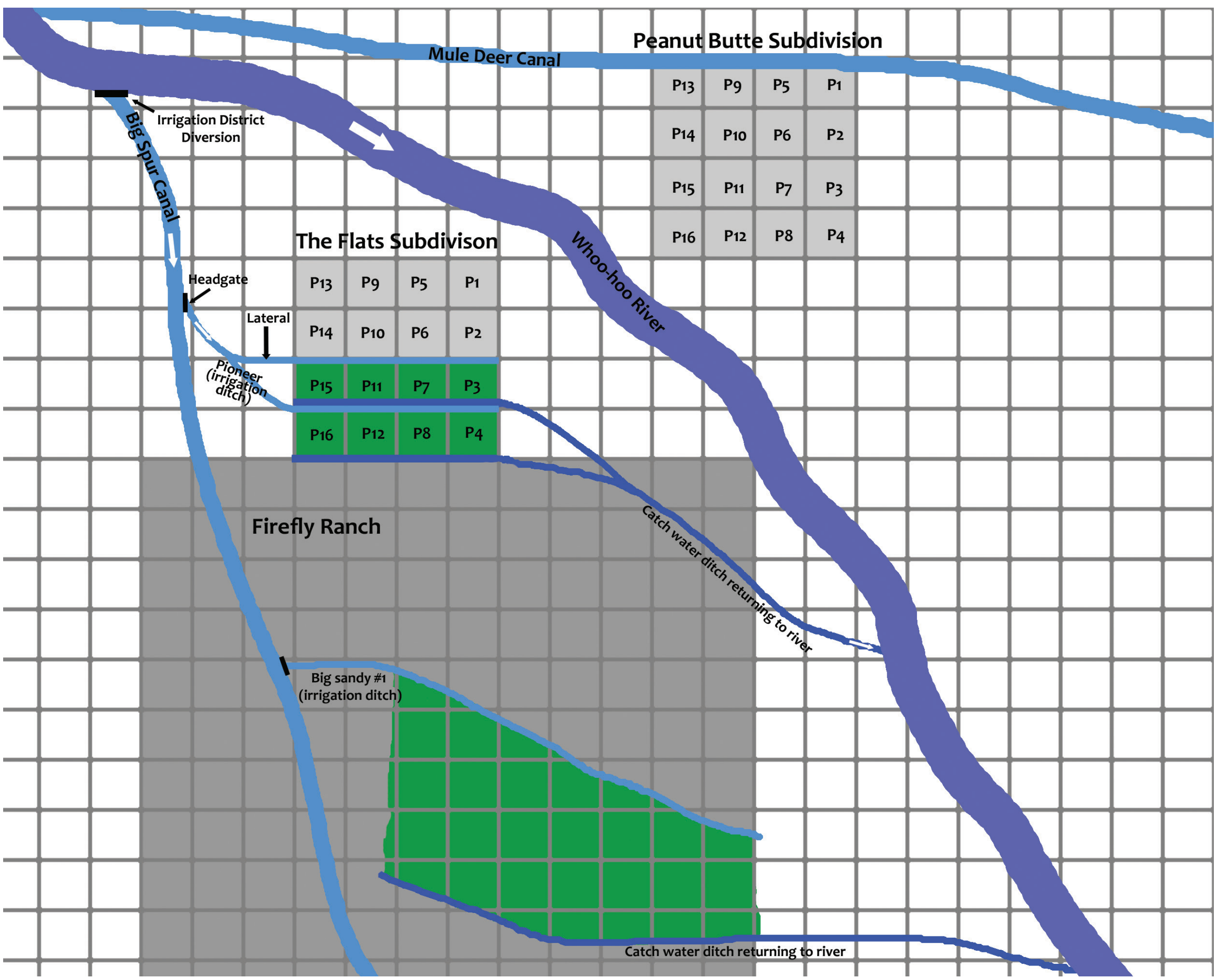


Figure 1. Example with a subdivision (The Flats) with half the parcels having water rights, a subdivision (Peanut Butte) without any water rights, and a ranch (Firefly Ranch) with water rights.

Each landowner should contact a local official (ditch rider/water commissioner) to learn about laws and local bylaws/rules to better understand how to appropriately access their water rights. The following checklist will get you started. Note this is a general list and, depending on the answers, you might want to ask additional questions and/or ask for clarification.

- Do I belong to an irrigation district or ditch company?
- Does the district/company have bylaws or other written rules?
- Does the district/company meet – if so, when do they generally meet?
- Is there a map that shows the irrigation ditch system?
    - If so, where can I get a copy?
- Does the irrigation district/company have a fee?
    - If so, how much is it, when will I be billed, and who do I pay?
    - What are the fees used for?
- How is water allocated among the landowners with water rights?
    - Are water allocations combined and rotated among landowners?
- If so, who is responsible for rotating the water?
    - What happens if I use up my allotment of water before the water is turned off for the year?
- Is the irrigation water automatically turned on each year, or do I have to request water when I want to irrigate?
    - If the former, what is the general timeline for when water is turned on/off each year?
    - If the latter, who do I contact to receive water? How will I know when I will receive water and for how long do I get to keep the water?

There is a lot to know and understand as a small-acreage irrigator. Not all irrigation districts and ditch companies are structured the same.

Different water management structures in Wyoming

The reality is much variability exists throughout Wyoming for how small-acreage/subdivision irrigation water rights are managed. For example, there are different structures at the local level varying from county-assessed irrigation districts to less formal entities that handle their assessment fees internally. This flexibility has many advantages, such as allowing areas to customize how they will manage shared irrigation water; however, it also has the potential to introduce a number of challenges and user conflict (see Section 4, "Irrigation Conflicts in Your Neighborhood," for more information).

Following are a few key ways irrigation districts and ditch companies differ from each other in Wyoming. This section provides an example of how your irrigation water rights might be administered and to help you be better prepared when talking to your neighbors or officials about irrigating.

Governance. An irrigation district is a court-established assessment district organized under Wyoming Statutes to deliver water to the lands within its boundaries that have water rights. A district usually has one large diversion canal and several smaller distribution ditches, called laterals, which carry water from the diversion canal to individual parcels of land with water rights. The State Engineer's Office generally monitors and regulates an irrigation district's diversion at the canal headgate (its point of diversion from the natural water course) but leaves internal distribution of water to irrigated lands to the district.

State law gives irrigation districts authority to collect assessment fees from water users within its boundaries. These fees are generally collected through the county at the same time as property taxes. Irrigation districts are generally formed when irrigators need borrowing authority under state law to help them construct or improve canals, reservoirs, or other infrastructure that make accessing their water rights easier. An elected board of directors governs an irrigation district.

A ditch company is a corporation formed to construct a ditch to convey irrigation water. Ditch company assessments are handled internally rather than through the county. Irrigation districts and ditch companies may hire managers, ditch riders, and/or attorneys. These employees are authorized through company bylaws to enter properties within the boundaries of the district/companies to conduct business of the district.

When a subdivision is within the boundaries of an irrigation district or ditch company, the district/company may require the subdivision association to appoint a watermaster. This watermaster is the point of contact between the district/company and landowners. All decisions and communications about water delivery timing and quantity go through the watermaster. This structure is intended to facilitate more efficient communication between the irrigation district and landowners.

Whether a subdivision is created within or outside the boundaries of an irrigation district or ditch company, there may also be provisions in the subdivision homeowner associations for the collective operation and maintenance of ditches. Like ditch companies, homeowner associations also have the authority to assess themselves and establish rules for members.

People often think once water leaves their property it is no longer their concern. But people are responsible for their wastewater until it returns to a natural waterway.

Assessment fees. Most irrigation districts and ditch companies charge an assessment fee to cover administrative costs and maintain canals and laterals. Ditch riders are a primary expense of many irrigation districts. Ditch riders help maintain the system and open headgates for customers who have called for water. Assessment fees vary greatly depending on the size, complexity, and age of the system. Most irrigation districts charge a per-acre fee. Many districts also charge an additional per-customer fee.

Water delivery. An irrigation district can have difficulties delivering water to the small acreages created by subdivisions when there is not enough water after

(Continued on page 10)

IRRIGATION AND DRAINAGE PLANS

Under state law, a subdivision of five lots or more must address water rights in some fashion. The subdivider may petition to move the rights to other lands, request cancellation of the rights, or develop an irrigation and drainage plan. An irrigation and drainage plan specifies how and where each lot is going to get water and where wastewater goes. The plan must be approved by the State Engineer's Office.

In 2009, all seven irrigation districts in Park County petitioned the county planning and zoning commission to change their rules to require that any piece of land being subdivided must have an irrigation and drainage plan approved by the local irrigation district. Platte County has implemented a similar regulation.

Even with irrigation plans and drainage plans in place, there is still potential for conflict if subdivision landowners are not aware of easements on their properties. Sometimes, easements are not even defined on an irrigation plan. By state law, if a ditch has been in place for over 10 years, an easement may exist, whether recorded or not.

Landowners can acquire information on the irrigation and drainage plan for their subdivision either from the county or from their irrigation district.

SOME EXAMPLES OF HOW IRRIGATION ARRANGEMENTS CAN FUNCTION

Example 1. Producer Irrigation District

Producer Irrigation District has a service area of over 35,000 acres. Although approximately 40 percent of its 1,200 customers are small-acreage landowners, they comprise less than 10 percent of this total acreage (More than 500 of the Producer Irrigation District's customers own 5 acres or less). Farmers in this irrigation district tend to grow alfalfa hay, barley, sugarbeets, and dry beans.

An elected five-member board of directors governs the Producer Irrigation District. Irrigation district customers vote on a per-acre basis. For example, someone with water rights on 4 of their 5 acres has four votes. Producer Irrigation District has an assessment fee of $22/acre. They have an additional assessment of $75 per landowner. Irrigation districts in Wyoming have taxing authority under state law. The Producer Irrigation District assesses its membership once per year, on the same timeline as county property taxes. The irrigation district does not provide water to customers who have not paid their assessments.

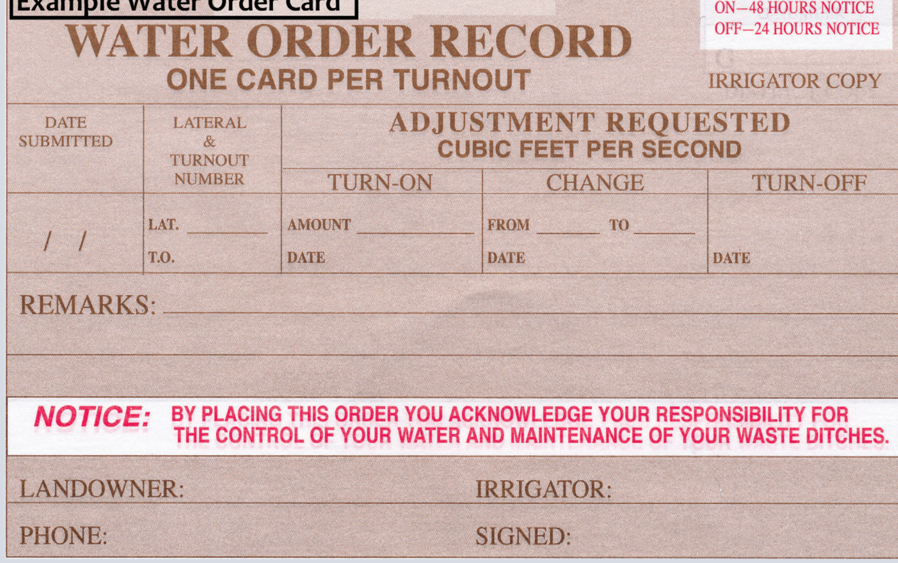
Watermaster: the Producer Irrigation District requires subdivisions within its service area elect a watermaster to be the single point of contact between individual landowners and the irrigation district. The watermaster coordinates delivery of water, collects assessment fees, and resolves problems that arise between landowners within the subdivision.

Generally speaking, each subdivision has a single headgate served by Producer Irrigation District. The irrigation district's responsibility to serve a subdivision stops at the headgate. If somebody within a subdivision is not taking care of a ditch, or somebody is flooding their neighbor's property, then the irrigation district may simply shut off the headgate to the subdivision until the problem is resolved.

Ordering water. Farmers and subdivisions submit water order cards to the irrigation district when they want to irrigate. The ditch rider, an employee of the irrigation district, then divides available water for the day among those who have ordered it on a per-acre basis. The irrigation district requires 48 hours notice to turn on water and 24 hours notice to turn it off.

The subdivision watermaster orders water for a subdivision. The irrigation district ditch rider turns the water into the subdivision's ditch. From that point, the subdivision watermaster and landowners must coordinate water deliveries among themselves. Subdivision landowners have to be organized and communicate among themselves to take the water in rotation when it's their turn.

Example Water Order Card


ON—48 HOURS NOTICE
OFF—24 HOURS NOTICE

WATER ORDER RECORD
ONE CARD PER TURNOUT
IRRIGATOR COPY

DATE SUBMITTED	LATERAL & TURNOUT NUMBER	ADJUSTMENT REQUESTED CUBIC FEET PER SECOND		
		TURN-ON	CHANGE	TURN-OFF
/ /	LAT. ______ T.O.	AMOUNT ______ DATE	FROM ______ TO ______ DATE	DATE

REMARKS:

NOTICE: BY PLACING THIS ORDER YOU ACKNOWLEDGE YOUR RESPONSIBILITY FOR THE CONTROL OF YOUR WATER AND MAINTENANCE OF YOUR WASTE DITCHES.

LANDOWNER: IRRIGATOR:
PHONE: SIGNED:

Example 2. Ranchland Irrigation District

The next irrigation district example is in western Wyoming (Ranchland Irrigation District). The district was formed in the 1990s from an old irrigation system. The district provides water to one ranch and to two subdivisions comprised of lands with adjudicated water. The majority, if not all, of landowners grow grass hay.

The Ranchland Irrigation District encompasses more than 2,129 adjudicated acres of which 97 percent are irrigated by subdivision landowners. The Ranchland Irrigation District landowners meet a minimum of once a year to address annual business, including electing one new water commissioner (see below).

The Ranchland Irrigation District is divided into three sub-districts, each of which has an elected commissioner. The landowners who have water rights within the Ranchland boundaries govern the district by electing the commissioners. Each landowner gets one vote for each whole adjudicated acre in their name.

Commissioners are volunteers who serve three-year terms and receive a minimum stipend to offset costs for fuel and time. The commissioners have a number of responsibilities, including determining the amount of water required, when the primary headgates will be opened, and how the water will be rotated among landowners for their sub-districts. They work with the watermaster to maintain ditches of their sub-districts.

The Ranchland Irrigation District has two part-time employees: an accountant and a water/ditch master. The accountant is responsible for maintaining the Ranchland Irrigation District's ledger and ensuring due diligence is complete for grants the district has received.

The commissioners appoint a watermaster annually to serve a one-year term as an officer of the Ranchland Irrigation District. The watermaster is responsible for the Ranchland irrigation system, managing the system as directed by the commissioners, and enforcing the rules or contacting the appropriate authority, among other duties. A commissioner fills the role of the watermaster when he/she is unavailable.

The other two appointed officers are the president, which is one of the three elected commissioners, and a secretary-treasurer. Additionally, each sub-district/lateral designates a contact person who works with the watermaster and/or commissioner to coordinate irrigation needs.

The Ranchland Irrigation District administers an annual fee for water rights, which is billed and collected through the county assessor's office. At the time of print, each landowner pays a $25/year fee plus an approximately $9/acre fee. The Ranchland Irrigation District uses the funds to pay commissioner stipends, part-time employees, and to maintain the main ditches and associated laterals (for example, tree removal or larger projects, including rerouting a section of the ditch that has become problematic).

As noted earlier, the commissioners determine how the water will be rotated among landowners. In two of the Ranchland sub-districts, the landowners follow a rotation call schedule. The rotation starts with the first person along the ditch. They receive and can use the water for up to 24 hours per 10 acres they own per rotation. They notify the next person on the ditch (at least 24 hours in advance), and the landowners can discuss who and when the water will be moved to the next property. Once the water reaches the last person on the ditch, the first person will receive the water again. The call rotation allows flexibility among the landowners; however, it requires much communication.

For example, if there are 10 landowners in a sub-district and one owns 20 acres, two own 30 acres, and the other seven each own 10 acres, a given landowner can expect to receive water every 15 days. However, sometimes a landowner elects not to keep the water the entire time for any number of reasons, which shortens the time the rotation will start over.

The third sub-district follows a calendar and assigns dates when a landowner can irrigate. In other words, if landowner X is assigned the 4th, 12th, 20th, and 28th, those are the dates of the month they can irrigate. The time they start and stop irrigating is set, for example, start and stop at 6:30 a.m. of a given rotation. The calendar method minimizes the need for communication among landowners; however, the system tends to be less flexible.

ditch losses (water lost in transit by leakage or evaporation) to push the water all the way to the end of the ditch. Some districts/companies may continue to deliver water just to the original headgate of the pre-subdivided ranch and leave internal administration of the water to the homeowner association. In particularly arid areas of Wyoming where there is little hope of receiving much water in any year, the irrigation district may make a single annual delivery to ensure sufficient water left after ditch losses to make the delivery. In less arid areas, irrigation districts have established protocols for sharing water. Check with your district to see if it has procedures in place for rotating water in water-short years.

Districts/companies often establish rules for how often (and how much) landowners can irrigate. For example, a district might have an established rule each landowner will get 24 hours of irrigation water per 10 acres per rotation. A person who owns 20 acres would be allowed to irrigate up to 48 hours each time they receive irrigation water. The number of times they receive water in a given season is contingent on how many acres are irrigated above and below them and the length of the irrigation season.

For information on establishing a water use rotation schedule on small acreages, see Appendix B in the Wyoming State Board of Control's publication *Living on a Small Acreage in Wyoming Irrigation* (2000). (Link on barnyardsandbackyards.com under "Water.")

What if there is no ditch company or subdivision managing the irrigation water?

In some cases, a ditch company, subdivision, or other entity has not been formed to manage irrigation water. Hopefully, the small-acreage landowners can mutually agree to maintain and operate the ditch to ensure the ditch remains operational.

Irrigators who share a private ditch and/or pipeline that is not part of a formal group (for example, a ditch company) can assess themselves a fee and develop rules to maintain the order among themselves. Occasionally, landowners won't agree when to turn water on/off. The general rule of thumb in non-districts/companies is that no person(s) can deny another person(s) access to their water. This said, a person/group of people can deny access to water if granting it would result in "unpreventable" harm, and/or the person(s) who desires water is *"in violation of a rotation that all parties are engaged in"* (WY BOC, 2000). Note that the ditch and headgate issues within the boundaries of an irrigation district, ditch company, or subdivision are civil matters and are not within the purview of the State Engineer's Office. Please see Section 4, "Irrigation Conflicts in Your Neighborhood," for ideas on minimizing conflict.

Irrigation ditch and easement 101

Understanding the separation between water rights and ditch rights, which occurred in 1912 in the state of Wyoming, is important. Considering irrigation ditches are the "vessels" for providing water to irrigators, it is understandable why water and ditch rights are murky. In Wyoming, ditch and easement disputes are civil issues, which means the State Engineer's Office has little to no authority.

> New subdivisions are often built near existing ditches, canals, and laterals. Many homeowners want to park on easement roads, which may be their right as the underlying property owner. However, when irrigation district employees need access to an easement road, those cars need to be moved.

Who is a ditch owner? A person is considered an owner of a ditch, entirely or partially, if a ditch is used to deliver water to their property or the ditch serves to move runoff away from their property. Ditches crossing properties that do not have water rights associated with them are not uncommon. In this situation, someone else (or multiple people) owns the ditch, and they have an easement to access the ditch. An easement allows an individual to rightfully enter the real property of someone else for a specific reason in a specific area. Additionally, an easement permits a ditch to exist in its current location, and sufficient room along the ditch for the ditch owner(s) to perform routine and necessary maintenance.

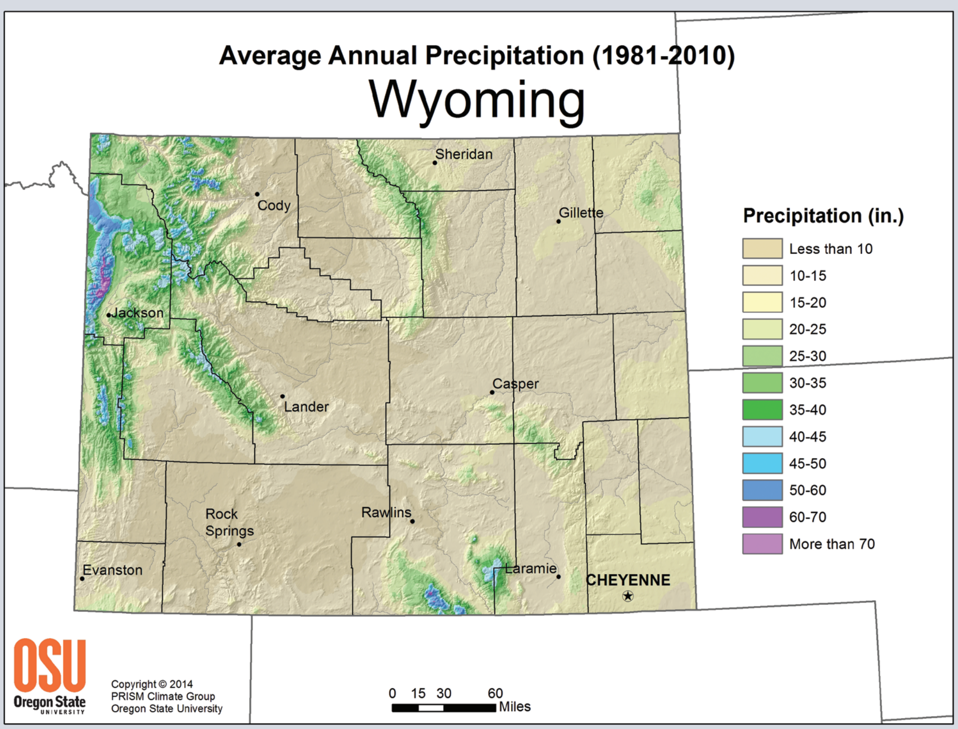
WYOMING'S WATER RESOURCES

Wyoming receives an average of 16 inches of precipitation annually (NOAA, 2015). Because of the state's high elevation and mountainous terrain, there is significant variability in precipitation levels from one basin to the next (see figure below). One basin can be experiencing drought, while another basin is experiencing above-average precipitation. Wyoming is a headwaters state that provides water to four major river basins. Although its precipitation level is relatively low (national average precipitation is over 30 inches per year), Wyoming's large land area means it actually receives a fairly large volume of water in total: approximately 17 million acre-feet annually. One acre-foot is the amount of water it takes to cover 1 acre of land 1-foot deep in water. One acre-foot is approximately enough water to provide two households with water for one year. Much of Wyoming's precipitation occurs in the mountains over the winter months as snow and enters Wyoming's rivers, canals, and reservoirs during the spring months when temperatures rise.

Agriculture uses approximately 80 percent of water in the state. Of this amount, the single largest crop by far is alfalfa and grass hay, primarily used for livestock feed. The remaining water in the state goes to municipal and industrial users and is depleted by evaporation from the state's many reservoirs. (Evaporation is by far the largest of these three.)

Wyoming water users do not have a right to all the precipitation that falls within the state's borders. Downstream states in all four directions have a right to water from Wyoming through a mix of legal compacts, court decrees and, in the case of the Upper Green River Basin in southwestern Wyoming (which is part of the Colorado River Basin), an international treaty with Mexico.

For more information on Wyoming's water resources, please see the State Engineer's Office website and this University of Wyoming Extension bulletin: Hansen, K., C. Nicholson, and G. Paige. *Wyoming's Water: Resources and Management*. (2015). University of Wyoming Extension Bulletin B-1272. Please also see the river basin planning section of the Wyoming Water Development Council website (waterplan.state.wy.us), which contains detailed information on water resources and use by basin.



ADMINISTRATION OF WYOMING WATER AND SMALL-ACREAGE IRRIGATION

Large tracts of land were once a part of the same irrigation system – likely owned by one ranch. A previous owner decided to subdivide the land, which resulted in many private landowners with connected water rights. The structure of Wyoming water and small acreages is similar to the original structure with a few additions, such as a subdivision spokesperson. The following is a schematic of the administrative positions of Wyoming's water and small-acreage irrigation and the role(s) of each level.

- State engineer
  - » Chief administrator of Wyoming water regulation
  - » Job: Supervision and protection of Wyoming waters
    - ◊ Appropriation, distribution, and application of water to beneficial use
- Division superintendents (4)
  - » Administers water for each of their divisions [See Figure 2] with assistance from hydrographer commissioners and water commissioners below.
    - ◊ Division 1: North and South Platte River drainages, and the Niobrara and Little Snake River drainages (office in Torrington)
    - ◊ Division 2: includes all drainages north of the North Platte and Niobrara River drainages and east of the Bighorn Mountains (office in Sheridan)
    - ◊ Division 3: Big Horn and Clark's Fork River drainages (office in Riverton)
    - ◊ Division 4: Green, Bear, and Snake River drainages, and most of the Great Divide Basin (office in Cokeville)
- Wyoming Board of Control is comprised of the state engineer and the four division superintendents
  - » Supervision and protection of Wyoming waters
    - ◊ Adjudication of water rights
    - ◊ Approval of modifications of adjudicated and some unadjudicated water rights
- Water commissioner/hydrographer commissioners
  - » Assists division superintendent in administering water – duties may include:
    - ◊ Routine administration of surface water sources following a "call for regulation"
    - ◊ Measuring streamflow, reservoir content, and operation and maintenance of stream gauging stations and networks
    - ◊ Inspecting water structures and land under water rights permits for compliance and adjudication
    - ◊ Meets with and advises water resource users
- Irrigation districts
  - » An organized group that acts to provide water to its shareholders on a proportionate basis
  - » Public, mandatory, and fee collecting entity
  - » Water is allocated by acre
  - » Can create rules/bylaws for handling water within their boundaries without outside oversight (governed by statutes; held accountable by Department of Audit)
- Mutual ditch company
  - » An organized group that acts to supply and deliver water to its shareholders on a proportionate basis
  - » Private, voluntary, and fee-collecting entity
  - » Holds and manages water rights for shareholders who have pro-rata interest (share)
- Lateral ditch company
  - » An organized group that acts to provide water to its shareholders and maintains the lateral ditch system
  - » Generally smaller and separate legal entities from mutual ditch companies (lateral ditches tend to branch off from mutual ditches)

- Ditch rider/manager
  - » Hired by a ditch company or irrigation district to maintain a ditch and open and close headgates as necessary
  - » Calculates ditch volumes and oversees ditch operations
  - » Coordinates water diversions and "calls" with the water commissioner/hydrographer commissioner during irrigation season
  - » Note: sometimes smaller ditch companies use a rotating "ditch captain" to coordinate efforts with the water commissioner
- Subdivision/homeowner association/etc.
  - » Can create rules/bylaws for handling irrigation water within their boundaries without outside oversight
- Spokesperson
  - » An appointed person who speaks with the irrigation district, water commissioner, and/or ditch rider on behalf of the ditch co-owners
- Co-owners
  - » Individual, small-acreage landowners who have equal water rights and use the same water delivery system
  - » Share the operation and maintenance responsibilities and expenses

Source: Wyoming Water Resources Data System (2015).

Figure 2: Administrative Water Divisions of Wyoming

HOW IS GROUNDWATER REGULATED DIFFERENTLY THAN SURFACE WATER?

Groundwater in Wyoming is also managed under the doctrine of prior appropriation, so an earlier right has a higher priority to water from an aquifer during periods of limited supply. One distinction related to irrigation is that groundwater permits are not based on the 1 cfs/70 acres duty of water that defines issuance of surface water irrigation permits.

Those wanting to drill a well need to follow the same procedures one would to apply for a permit to divert from a surface water source on your land. The first step is to file an application with the state engineer. Your application must be approved before drilling can begin. The required forms to begin this process are available at the State Engineer's Office, offices of water division superintendents, water commissioners, and county clerks.

A permit to construct a well will generally be approved by the state engineer unless the well is in a groundwater control area. Typically, the Board of Control designates groundwater control areas where groundwater withdrawals are approaching or have exceeded the recharge rate. In these locations, a permit to drill will receive greater scrutiny from the state engineer and the local control area board.

There are three groundwater control areas in Wyoming – Goshen, Laramie, and Platte counties (see Figure 3).

If there is an older well on your land used solely for stock and/or domestic purposes, you might not have a permit on file with the state engineer. Wells drilled for these purposes before 1969 are exempt from permitting.

If you want to change the location of an existing well or drill an existing well deeper, you might be able to do so without loss of priority under certain conditions. For example, a change is likely to be approved if the new well location is in the same aquifer and the same general vicinity as the old one. Contact the State Engineer's Office before moving a well or drilling deeper.

Private well owners should conduct water quality monitoring on a regular basis to ensure wells are free of contaminants. Please see Sigler and Carrithers (2007) for more information on water quality testing and proper well maintenance. If you suspect a well might be contaminated, you could contact your local public health department or your local University of Wyoming Extension office for information on how to investigate further. Please see also Kaan and Hiller (1993). For more information on well water quality, please see barnyardsandbackyards.com. Click on "Water."

So which ditch(es) and how much maintenance are you responsible for? You have some level of responsibility to maintain a ditch if it is used to deliver water to your property or carries run-off water away from your property, including catch-ditches. Each ditch owner is responsible for their proportionate ownership of the ditch, which is the *"ratio between the water right of each water user to the total water rights adjudicated under such irrigation works"* (Wyoming Statute Ann. § 41-6-303). The proportionate ownership of a common ditch includes not only the delivery ditch to an irrigator's property, but the stretch of ditch from the point runoff leaves a person's property until the water enters a natural waterway or enters an area under the authority of another entity.

Not using your water rights? Are you still responsible for ditch maintenance and assessed fees? The short answer is yes; however, there is more to the story. Contact the State Engineer's Office for more information.

Ditch embankments are among the most important aspects of ditch maintenance. Proper maintenance of embankments, including removal of trees and shrubs, ensures water from a ditch does not flood or damage the property of others (WY Statue, 41-5-101). A ditch owner is liable for damage due to

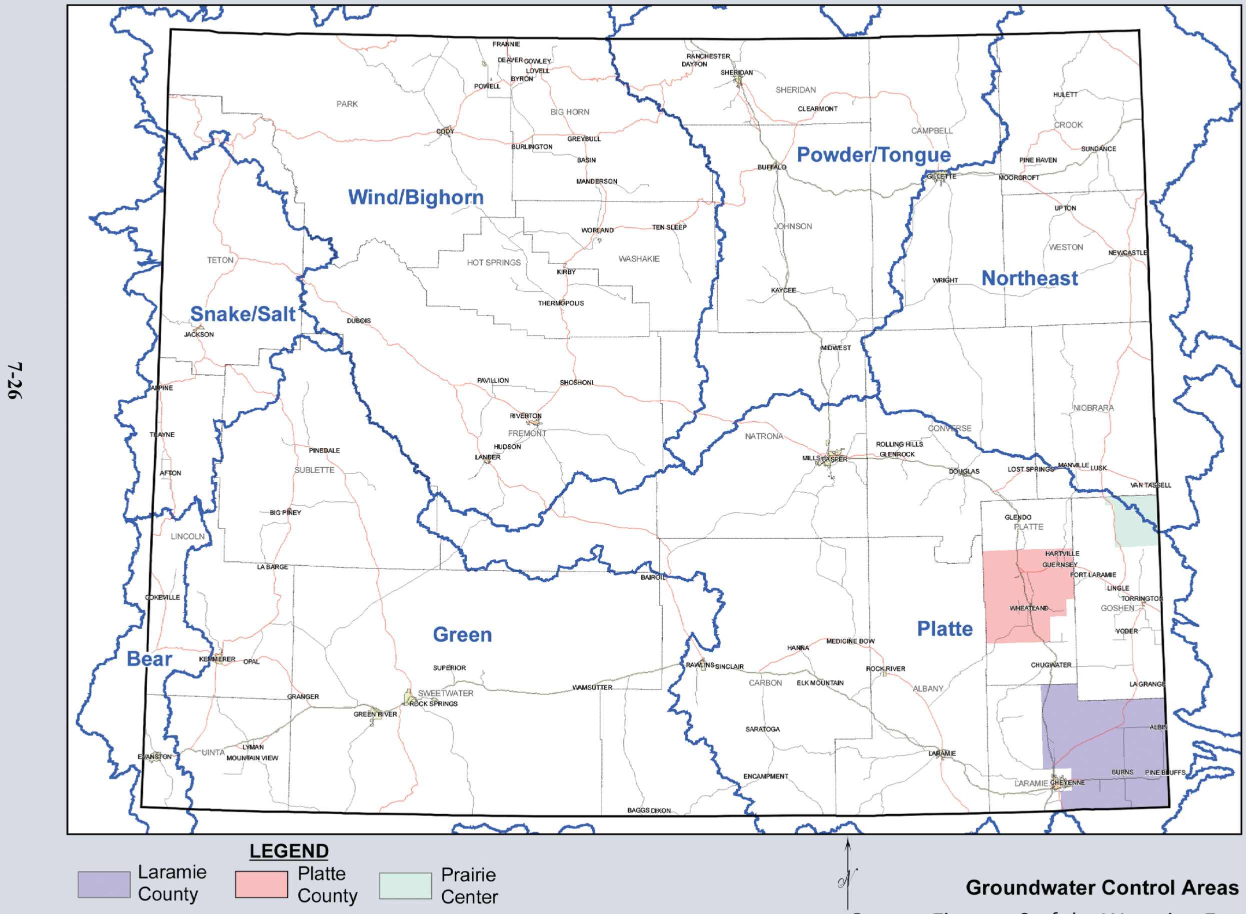


Figure 3: Groundwater Control Areas in Wyoming

Source: Figure 7-8 of the Wyoming Framework Water Plan (WWC,2007)

"negligence or unskillfulness of constructing, maintaining, or operating" their ditch (WY BOC, 2009).

Thinking about moving dirt?

We all have visions of what we will do with our properties, how we will change and improve them over time. Someone's vision might be to fill in and/or reroute a ditch to better irrigate a corner of their property. Although possible, investigate this option thoroughly and only proceed with great caution and care.

Subdivisions may collect a small fee from each landowner to cover ditch maintenance rather than requiring everybody to maintain the portion of the ditch on their property. Requiring everybody maintain the portion of the ditch that is on his or her property can lead to conflict. The person at the top of the ditch is maintaining for everybody; the person at the end of the ditch does not have to maintain their ditch at all. Another recipe for conflict is if someone new comes to the area and is second on the ditch but doesn't maintain their ditch.

The lay of the land can be deceptive to the naked eye. An area that appears flat or to slope in one direction could have a slope great enough, or in multiple directions, to let gravity take over. The outcome is water in unintended locations, which could result in significant destruction. Imagine accidently flooding your home or neighbors due to rerouting an irrigation ditch with the good intention of better irrigating a corner of your property.

Dirt mover beware! State law prohibits a person from wrongfully changing the location of a ditch, which inhibits or eliminates the ability of a co-owner from receiving their water. Many ditches appear to wander across a property rather than proceeding in a straight line. There are often reasons for this, including the need for the ditch to follow a particular slope to deliver the water to the spot where needed. Straightening or deepening a ditch can lead to it not delivering the water as desired or other undesired consequences, such as physical degradation of the system by erosion or down cutting. The possibilities of what can occur when filling-in or rerouting a ditch are endless. Again, you are encouraged to proceed with caution prior to moving dirt. The following is a short list of resources that might help ensure the success of your ditch project.

- Wyoming State Engineer's Office or Board of Control
- USDA Natural Resources Conservation Service
- University of Wyoming Extension
- Land survey and engineering firms
- 811 Call Before You Dig

I want more or less water to flow down the main ditch – can I adjust the amount of water from the natural watercourse into an irrigation delivery system?

The short answer is "maybe." When a river is under administrative regulation, the local water commissioner or other authorized State Engineer's Office representative are the only individuals who may, either directly or indirectly, alter the amount of water leaving the natural watercourse into an irrigation delivery system. (An appropriator may be authorized by the State Engineer's Office representative to adjust a headgate when a watercourse is under regulation). When the watercourse is under "free river" conditions (not under administrative regulation), water users typically adjust their own diversions from the watercourse. The water commissioner from your area will know if the river is under administrative regulation or not. However, your water access may still be restricted by an irrigation district, irrigation company, or homeowner association rules.

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SECTION 2. HOW CAN I IRRIGATE?
Small acreage irrigation 101

This section provides an introduction to irrigation in Wyoming covering relevant terminology, common practices, and determining when and how much water to apply. The pros and cons of each strategy will be covered (Table 2) as well as the best field and environmental conditions for each method (Table 3). Much of this information was adapted from the Colorado Small Acreage Irrigation Guide (Byelich et al., 2013).

Common irrigation methods in Wyoming

There are several factors to consider when choosing an irrigation method, including soil type, the layout of the field, desired crop(s), water availability and quality, and how the water is delivered to a property (conveyance method). Also consider what current or past irrigation practices have been used and existing infrastructure. Choosing the correct irrigation method is as important as learning how to properly manage it. The following are brief descriptions of irrigation methods, including surface, sprinkler, and low-flow (micro or drip) irrigation. The advantages, disadvantages, and special considerations are also discussed.

The conveyance method used has an associated efficiency that must be accounted for, Table 1. Efficiency refers to the amount of water lost from the time the water enters the ditch to when it reaches the field, with an earthen ditch having the lowest efficiency. This efficiency loss can also be affected by debris, trash, or vegetation, which blocks efficient flow. All this determines how much and how quickly water will get to a field.

Table 1. Common irrigation conveyance efficiencies.

Conveyance method	Efficiency (%)
Earthen ditch	70 - 80
Concrete lined ditch	90 - 95
Pipeline	99 - 100

Source: Adapted from USDA-NRCS NEH Part 23, Chapter 2, Irrigation water requirements

Surface Irrigation

Surface irrigation accounts for nearly 80 percent of irrigation practices in Wyoming (USDA-NASS, 2008). Extensive canals and ditch systems across the state can make this a relatively simple, effective, and comparatively inexpensive means to move water across a field.

The most basic form of irrigation consists of applying water by cutting notches in earthen field ditches, in an otherwise uncontrolled fashion, referred to as “flood.” Although very simple and inexpensive, the method is also very inefficient for irrigation purposes (there are beneficial effects to this inefficiency – see below). Many improvements have been made to increase the efficiency of surface irrigation. This

Figure 4. *Flood irrigating alfalfa near Powell using tubes to siphon water from a concrete ditch into the field. Photo by Caleb Carter, University of Wyoming Extension.*

Figure 5. *Flood irrigating a mountain meadow using gated pipe, Fremont County. Photo by Jeff Vanuga, USDA Natural Resources Conservation Service.*

includes the use of **furrows** (a series of small, shallow, uniformly spaced channels used to guide water in field crop production); **corrugations** (small "v" shaped furrows) used for close-growing forage crops such as grass or alfalfa; and **borders** (confining water between two dikes).

Water is delivered to a field via the main ditch and backed up using a **head gate** (slide open gates) or plastic/canvas dam. Methods used to divert water to the field include cutting a notch in the side of the ditch, **siphon tubes** (siphon water over bank of irrigation ditch), or **gated pipe** (series of pipes fastened together with uniformly spaced openings covered with adjustable gates), which can be opened to let the desired amount of water flow across a field. A "set" is each time the dam is moved and reset or a new set of gates is opened. The set time will vary by field depending on many factors, including water flow, soil type, topography, etc. See Section 3 for more information on determining how much water to apply.

Surface irrigation is more suitable to relatively level ground or with only moderate, uniform slopes. Long fields or an irregular surface can make uniform water distribution difficult. Coarse soils (gravel or sand) can also make for uneven water infiltration. Due to the large volume of water applied, surface irrigation strategies are better suited to heavy soils (silt or clay) with high water holding capacity. Surface irrigation methods also require very little energy (head) compared to sprinkler or drip, but labor is more intensive.

Proper management is important when flood irrigating. Soil has many living organisms that require oxygen, which can be killed when a field is flood irrigated too long, excluding oxygen from the soil. Excess water can also leach below the root zone, carrying nutrients along with it and affect the overall yield.

Also, water from pastures irrigated too long usually moves downhill to a neighbor's property where it may not be wanted. Careful monitoring of irrigation water is necessary. Over time, experienced irrigators learn how long to irrigate their fields.

There are benefits of flood irrigation not always obvious at first glance. In some areas of the state, flood irrigation recharges aquifers that supply wells and keeps salts from accumulating in the soil. In other areas, ephemeral wetlands are created that support a wide array of wildlife species during the irrigation season.

Figure 6. *Water flowing into a tailwater recovery catch ditch at the end of a furrow-irrigated field near Powell. Photo by Caleb Carter, University of Wyoming Extension.*

Figure 7. *Gated pipe can help farmers improve irrigation water management and minimize irrigation-induced erosion. Photo by Dan Ogle, USDA Natural Resources Conservation Service.*

Sprinkler Irrigation

Sprinkler irrigation can take many forms, including **hand lines** (lengths of pipe that must be moved by hand between sets); **side rolls**, or wheel lines, (lengths of pipe mounted on wheels, moved by the use of a motor); **dragline**, such as K-Line (sprinklers mounted on plastic pods, connected by plastic pipe, which can be dragged by a 4-wheeler); **mini gun** (self-propelled travelling sprinkler mounted on wheels and fed by a rubber hose); or **solid set** (stationary system where water is supplied by pipes underground with sprinklers mounted aboveground). The various methods differ in cost and amount of labor required. Sprinkler irrigation is more expensive, but with proper design and management, water can be applied in a more efficient and uniform way.

Some advantages of sprinkler irrigation include more precise control over the timing and amount of water applied, better matching water needs of a crop, and potentially increased yields. Sprinklers are good at applying small amounts of water (0.5 to 2 acre-inches) more uniformly than surface irrigation, so are good for coarser textured soils (sand or gravel) and shallow rooted crops.

Disadvantages include potential losses in efficiency due to drift from wind. Also, sprinklers wet the canopy of leaves which can increase the possibility of certain plant diseases, but altering the timing of watering, decreasing the time the canopy is wet, can help alleviate this issue.

Always test groundwater to determine if suitable before irrigation use. Groundwater sources with high salt content can lead to salt accumulation in the soil. This is especially an issue with sprinkler irrigation and must be monitored. It is also possible to use surface water in a sprinkler system, requiring a series of filters and screens to clean the water sufficiently to avoid clogging nozzles.

Low-flow (Micro or Drip) Irrigation

Low-flow irrigation systems can be surface or subsurface. Methods include **drip** (individual emitters apply water to the soil surface); **micro-spray** or **micro-sprinkler** (water is sprayed in a small area close to trees or shrubs); **bubbler** (stream of water is applied to small basins by individual trees); and **subsurface drip irrigation** (SDI) – emitters apply water below the soil surface.

Surface drip systems are often used in vegetable gardens or small-scale production, while SDI systems are typically used in large-scale production. Although around for over 20 years, drip irrigation has just begun to gain popularity in Wyoming.

Drip irrigation utilizes emitters placed in polyethylene tubing, often referred to as drip tape or dripline, applying water directly to the soil. Water is applied in small amounts, typically less than 0.5 gallons per minute (gpm), at regular intervals, matching the needs of the crop and reducing water losses below the root zone of the crop and evaporation from the soil surface.

Advantages of drip irrigation include an efficient use of water as well as a potential reduction in plant disease, as the canopy (leaves, etc.) does not get wet. Applying small, precise amounts of water reduces overall water use, reducing costs for water and electricity.

The high initial cost is a big disadvantage to drip irrigation. Per-acre investment can range from $2,000 to over $4,000 depending on factors such as field proximity to a water source, field shape, the level of automation, and other factors (Reich et al., 2014). Rodent damage is another potential issue, especially in Wyoming. Evaluate the potential and implement control measures prior to installation. Digging up a dripline to find a leak can be difficult and time-consuming.

Due to the small emitter opening, water must be screened or filtered to prevent clogging. Much of Wyoming's groundwater is highly calcareous (high in carbonates and lime) and prone to building up precipitate (mineral buildups), resulting in clogged emitters. Bacteria and algae buildups can also clog emitters. Regular flushing and/or chemical injections may be necessary to keep emitters working properly. Refer to the maintenance section for the system for more information.

Table 2. Irrigation system comparison (does not include some operating costs such as labor and electricity)

Irrigation system	Application efficiency*	Installation cost**	Advantages	Disadvantages
Flood	15-40%	$0-$20 (home-made plastic or canvas dam)	• Low input cost • Low maintenance	• Low efficiency • Increased labor
Furrow • Gated pipe • Corrugation	 40-55% 50-80%	 $2-$3/foot ----	• Control of delivery time and space	• High labor • Low efficiency
Sprinkler • Mini gun • Portable hand lines • Solid set	 55-75% 60-85% 60-85%	 $3,000 ---- $2,000- $4000/acre	• High efficiency • Low labor • Suitable for most crops • Good choice for fields with varied soil & topography	• Higher cost • Higher operation & maintenance • Needs continuous supply of water • Requires pressurized water source
Surface Drip	70-95%	$2,000- $4,000/ acre	• Higher efficiency • Less time and labor • Reduced runoff • Reduced pumping costs • Typically used for vegetables, windbreaks, trees, vines, and shrubs	• High initial cost • Higher management time needed • Needs continuous supply of water • Filtration required

Source: (Barta et al., 2004)

*Application efficiency refers to the percent of water delivered that ends up in the root zone of a crop. Efficiencies can be much lower due to poor design and management.

** Based on 2012 cost estimates.

PUMPING PLANT EFFICIENCY IS IMPORTANT

A pump will wear out over time if used to pump groundwater or pressurize an irrigation system. Poor pump performance also may be caused by:

1. Pump designs poorly matched to the job (this might occur when the operator switches from gated pipe to a center pivot sprinkler or from a high-pressure sprinkler to a lower-pressure package without changing the pump),
2. Pumps that have worn impeller vanes and/or internal seals as a result of pumping sand, or
3. Impellers that were not properly adjusted within the pump bowls.

Regularly monitor the efficiency of the pumping plant to see if improvements could be made that may save on energy expenses. For more information on how to evaluate pumping plant performance, go to the Exploring Energy Efficiency & Alternatives Irrigation Efficiency: Pumping Plant Performance website (Link available at barnyardsandbackyards.com. Click on "Water."). This will walk you through the necessary steps, help estimate potential savings, and help estimate the potential payback period on improvements.

TESTING YOUR WATER

The water quality might not be suitable for irrigation even if there is a water right. There are specific water quality standards set by the Environmental Protection Agency (EPA) for drinking water and for livestock or irrigation uses. When considering buying a property, test the water to identify any potential problems, based on the intended use.

Wyoming residents are responsible for having their wells' water tested. Have domestic wells tested at least annually and test irrigation and stock water wells occasionally. Any new water source should always be tested prior to use for drinking, livestock, or irrigation.

To get your water tested in Wyoming, contact the Wyoming Department of Agriculture Analytical Services Laboratory in Laramie. Contact the lab at (307) 742-2984 for a price quote and sampling instructions prior to sample submission. Other labs can perform water quality tests. Contact your local University of Wyoming Extension office for more information.

The lab can help interpret test results, or you can use the Utah State University Water Quality Interpretation Tool at http://extension.usu.edu/waterquality/htm/wqtool (Link available at barnyardsandbackyards.com. Click on "Water" and then "Irrigation") to help interpret results. Enter test results, and the tool will point out issues based on your water quality and intended use.

Table 3. Comparison of irrigation systems and the desired conditions for the different systems

Desired site and system characteristics	Surface systems	Sprinkler systems		Micro-irrigation
	Improved surface systems	**Intermittent hand/mechanical move**	**Solid-set**	**Micro sprinklers, SDI and drip**
Infiltration rate	Moderate to low	All rates	All rates	All
Slope	Moderate slopes	Level to rolling	Level to rolling	All
Crops	All	Generally shorter crops	All	High value crops to make it economically justified
Water supply	Large stream sizes	Small streams nearly continuous	Small stream sizes	Small streams, continuous and clean
Water quality	All but very high salts	Salty water may harm plants	Salty water may harm plants	All
Labor requirement	High, training required	Moderate, some training	Low to seasonally high, little training	Low to high, some training
Capital requirement	Low to moderate	Moderate	High	High
Energy requirement	Low	Moderate to high	Moderate	Moderately low to moderate
Management skill	Moderate	Moderate	Moderate	High
Machinery operations	Long fields	Medium field length	Some interference	May have considerable interference
Duration of use	Short to long	Short to medium	Long-term	Long-term
Weather	All	Poor in windy conditions	Poor in windy conditions	All
Potential for chemigation & fertigation	Fair to good	Good	Good	Very good

Source: Adapted from Barta et al., 2004

Irrigation system operation

The performance of any irrigation system is only as good as its management. Table 2 (page 22) shows a range for application efficiency for the various irrigation methods. Learning as much as you can about your system's design, operation, and maintenance will produce the best results for your efforts and use water most efficiently. This is referred to as irrigation efficiency. For more information, see the University of Wyoming Extension publication from the E3A Series titled *Irrigation Efficiency*, link available at barnyardsandbackyards.com. Click on "Water."

Surface irrigation

Surface irrigation has been referred to as more art than science. Long-time irrigators have gotten a "feel" for their fields over years of experience. Knowing when to stop watering is the key to efficient surface irrigation.

Surface irrigation is labor intensive, as the water must constantly be moved across the field at the end of each set. The most uniform water application is when the water reaches the end of the **run** (end of the field) within one-quarter of the planned set time. The time it takes to accomplish this depends on factors such as the amount of water flowing, field length, topography, and soil type.

The most efficient water use occurs when the water application is matched to the soil infiltration rate. This can be accomplished by adjusting the number of furrows in each set, the number of gates open in your gated pipe, or by adjusting the ditch flow rate. The flow rate, often expressed in cubic feet per second (cfs), is typically measured using a weir or a flume. Having an understanding of the proper installation, use, and maintenance of your surface irrigation system includes understanding how to measure your water. For more information on how to measure irrigation water, see the University of Wyoming publication B-583R, titled *Irrigation Water Measurement: Irrigation Ditches and Pipelines*, link available at barnyardsandbackyards.com. Click on "Water."

It is best to capture **tailwater** (runoff from end of field) for reuse on lower fields, but if not possible, then some tailwater runoff will occur in order to adequately irrigate the end of the field.

Sprinkler irrigation

To achieve the increased efficiency of sprinkler irrigation, the system must be operated per design. The nozzle size, available pressure, and set duration should work together to produce an application rate matching the intake rate of the soil, while providing an even amount of water to refill depleted soil moisture.

Variations in uniformity may occur due to environmental factors, such as wind or exceptionally hot days, even with proper design and operation. This may require adjusting the move pattern across the field or involve the use of an offset hose. Alternating day and night cycles can also help improve distribution uniformity.

Pressure regulators or flow control nozzles can decrease variations due to topography changes. For more information on efficient operation of hand and wheel lines, see "Small Acreage Irrigation System Operation and Maintenance," Utah State University Cooperative Extension, link available at barnyardsandbackyards.com. Click on "Water."

Low-flow (Micro or Drip) Irrigation

Good screening and filtration of the water is important to prevent clogging due to the small openings of the emitters. The extent of filtration necessary and the type of filter depends on the cleanliness of the water. These filters will also need regular cleaning, more so if the source is from a ditch or canal rather than a well. Low-flow systems are designed to operate at low pressure, around 15 to 25 pounds per square inch (psi). If using household or yard water sources, a pressure regulator is needed to properly reduce this pressure.

Drip irrigation, whether surface or **subsurface** (drip lines are buried lines), can be used on fields of all sizes, from your personal garden to a large field in agricultural production. Size is limited by the system design and available pressure. Because low-flow systems do not wet the entire soil surface, proper spacing of emitters and drip lines is very important to ensure complete wetting of the target root zone. Water moves differently in different soil textures, so spacing is also dependent on soil texture.

Irrigation system maintenance

Maintenance is one part inspection and two parts anticipation. Check your irrigation system thoroughly at the beginning of each irrigation season and regularly throughout the growing season. Look for broken pipes or sprinkler heads, clogged nozzles or emitters, and clean the filters and inspect ditches. Keeping spare parts on hand to replace commonly needed items is important. Regular preventative maintenance and diligence in detecting potential problems can go a long way in extending the life of your irrigation system and maintaining efficiency. The following sections detail important maintenance considerations for each irrigation system.

Surface irrigation

In Wyoming, the owner of an irrigation ditch has the responsibility to maintain that ditch, whether on that person's property or on the property of another. Ditch cleaning is typically a spring ritual, including removing tumbleweeds or other debris, burning of dead weeds and grass (with proper fire-safety precautions taken), repairing ditch banks or damage from rodents, removal of willows or other trees/shrubs that have encroached, and cleaning out sediment build-up. For smaller ditches, a shovel may be sufficient, while larger ditches may require the use of a backhoe or excavator.

Check headgates to ensure proper operation. A broken headgate may prevent water from being diverted to your field. For gated pipe, look for leaks, worn couplers, stuck or broken gates or cracks in the pipe, or sediment buildup. To aid in maintaining uniformity, periodic re-leveling of the field may also be necessary. It may also be good to remove gated pipe from a field to prevent damage from livestock, especially if they are near water tanks or other high traffic areas.

Sprinkler irrigation

Manufacturer guidelines and manuals are available for specific equipment. These should be referred to as the preferred source of information when performing maintenance. Regular maintenance can help reduce repair costs while maintaining the efficiency of the system.

Each system component should be checked for worn or broken parts at the end of the irrigation season. This includes checking nozzles for clogging, corrosion, mismatched sizes, or other wear and tear. Couplers can break or leak and may also need replacement. Pipes can be cracked and may need repair or replacement. Be sure to perform appropriate maintenance and check your motor and/or pump for drops in efficiency. See the sidebar on checking pumping plant efficiency.

Many of these issues can easily be identified while the system is in use, and prompt attention to repairs will ensure the system is running efficiently. End-of-season maintenance is important to ensure the system is operational for the next growing season. Don't put off repairs, or you may forget until you turn on water again in the spring!

Securing the system may be necessary if the sprinkler system is in a field used by livestock over the winter. In the case of a wheel line, this could mean wiring it to t-posts driven into the ground or securing it to a fence. This can also help secure it against movement by wind that can wreck the system. Hand lines are typically removed from the field to allow for harvest or other farming operations.

Low-flow (Micro or Drip) Irrigation

Emitter clogging and rodent damage are the biggest concerns with micro or drip irrigation in Wyoming. Both can lead to constant maintenance and repairs and should be evaluated prior to system installation. The system should be flushed at the beginning of the season to help prevent emitter clogging.

The water source and cleanliness of the water determine the extent of the filtration system. If the source is potable water, a 150- to 200-mesh screen may be sufficient. If a secondary water source is used, such as from a ditch or pond, then a more elaborate sand media filtration system is necessary. Flush the system and clean filters at the beginning of each season and as needed. Regular flushing of the system helps remove large mineral particles and organic matter, which can clog emitters.

Have the water tested to determine any potential problems, such as high pH, high salts, high sodium, or bicarbonates. Much of the water in Wyoming is **alkaline** (pH above 7.0, often exceeding 8.5 in some areas), due in large part to the bicarbonate and lime content. This makes for very hard water, leading to precipitate buildup in lines and emitters. This is treated by adding an acid to the system, called acidizing. It is recommended this be done biannually or after 2 acre-feet are applied through the system. Acidizing is only recommended for large systems; for clogging issues in smaller drip systems in ornamental beds or gardens, it is simpler to replace clogged nozzles.

Flushing and chlorine treatments can treat algae buildup. Rodent damage is best controlled by reducing populations prior to installation. But a solid plan for rodent management in the future is necessary. For more information on drip irrigation maintenance, see "Maintenance of Microirrigation Systems" from the University of California, link available at barnyardsandbackyards.com. Click on "Water."

Section 2 References

Links to all documents (free online) referred to in this section can be found at barnyardsandbackyards.com. Click on "Water."

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SECTION 3. SHOULD I IRRIGATE?
Determining when and how much water to apply

How much water does my crop need?

A crop's water needs are dependent on several factors, including crop type and maturity, management practices, weather variables, and soil type. When planning irrigation, the first step is to determine when and how much water to apply, a process called **irrigation scheduling**. If soil is too dry, plants will be stressed and production reduced, while overwatering can leach nutrients from the soil and starve roots of needed oxygen.

Estimating crop water needs

The first step in irrigation scheduling is to determine how much water the crop needs. Crop water use is expressed as **evapotranspiration** (ET), which is the combined water loss from **evaporation** (water loss from the soil) and **transpiration** (water loss from the plant). Table 4 shows examples of crop water requirements for several regions of Wyoming. The cumulative ET for a crop over the course of a growing season is roughly equivalent to that crop's water requirement. ET can vary greatly by location and is greatly affected by weather factors including air temperature, solar radiation, relative humidity, and wind speed. All of these factors are affected by latitude, elevation, etc.

A good source for information on crop water use across Wyoming is a publication from the University of Wyoming Extension titled *Consumptive Use and Consumptive Irrigation Requirements in Wyoming*, link available at barnyardsandbackyards.com. Click on "Water."

Table 4. Estimated crop water use (ET) (inches/growing season/acre)

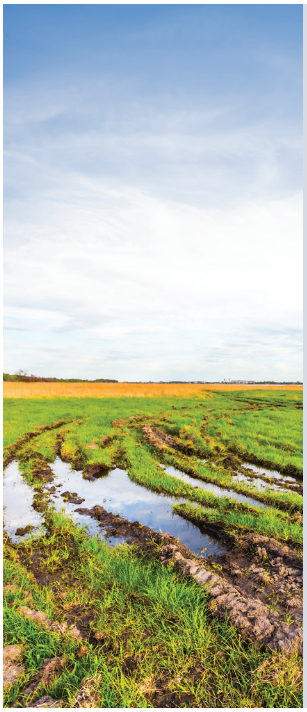
	Sheridan	Torrington	Riverton	Powell
Alfalfa	23.0	25.8	28.2	32.0
Pasture grass	21.5	24.1	26.6	30.2
Winter wheat	11.5	12.9	17.6	17.2
Corn	18.3	18.3	21.6	22.2
Dry beans	N/A	13.1	16.2	16.7
Sugar beets	N/A	20.0	23.5	24.7
Lawn turf	19.8	22.4	27.1	28.4

Source: Pochop et al., 1992

Table 5. Average monthly precipitation (inches)

	April	May	June	July	August	September	October	Total
Sheridan	1.73	2.62	2.94	1.13	1	1.47	1.16	**12.05**
Torrington	1.73	2.56	2.6	1.76	1.04	1.08	0.86	**11.63**
Riverton	1.09	1.77	1.33	0.64	0.42	0.82	0.74	**6.81**
Powell	0.49	1.27	1.28	0.72	0.62	0.74	0.4	**5.52**

Source: Pochop et al., 1992



EXAMPLE 1: HOW MUCH WATER DO I NEED FOR A PARTICULAR CROP?

Hannah lives in Riverton and has a 1-acre grass pasture irrigated by gated pipe. The average ET, or consumptive use, of grass pasture in Riverton is 26.59 inches/season (Table 4). *How many inches per season does Hannah need to water her pasture?*

1. Subtract the average precipitation from the ET to determine the net irrigation. 26.59 inches/season/acre – 6.81 inches/season (Table 5) = 19.78 inches/season/acre.
2. The irrigation efficiency must also be considered. To find the gross irrigation, divide the net irrigation by the irrigation efficiency (Table 2). 19.78 inches/season/acre / .50 (40 to 55% range from Table 2, we used 50%) = 39.56 inches/season/acre.
3. To convert inches/acre to acre-feet, divide by 12.

Hannah needs 39.56 inches/growing season/acre or 3.3 acre-feet (1.08 million gallons) to irrigate her 1-acre grass pasture with gated pipe in Riverton.

Total water right allocation?

After determining the total water requirement for the desired crop, another important consideration is does your water right allot enough water and will it come at the correct time?

Per Wyoming water law, a water right allots 1 cubic feet per second (cfs) for every 70 acres, with water rights prior to March 1, 1945, getting an additional 1 cfs per 70 acres. But, since many small acreages are on a rotational schedule and the water available may vary year-to-year depending on water availability, this needs to also be accounted for when considering growing a new crop. Small vegetables, for example, need more regular irrigation due to shallow roots, while a pasture or forage crop can survive with fewer, deeper irrigations.

Table 6. Estimated average weekly water use

Crop	Water use (inches/week)*
Fruit trees	1-4
Alfalfa	1-2.5
Grass hay/pasture	1-2
Small vegetables	1-2

* For additional regional crop water use information, see Pochop et al., 1992

How do I know how much ditch water to order?

An order for water will typically go through a ditch rider or subdivision watermaster. They will typically ask for it in cfs, so understanding how to make the conversion between ET and cfs is important.

EXAMPLE 2: HOW MUCH WATER DO I NEED TO ORDER?

Andy receives irrigation water from the irrigation district in an earthen ditch and irrigates his 2-acre grass pasture by flood. The water requirement for the pasture is about 1 inch per week, but Andy needs more than 1 inch of water because the earthen ditch and flood irrigation are only about 70 percent and 40 percent efficient, respectively. *If he wants to apply the effective water required for the week over one day (1 in.), how much water will he need to order?*

1. 1 inch/ (.70 x .40) = 3.6 inches total water needed per acre
2. We know 1 inch = 1 acre-inch/acre, so 3.6 in = 3.6 ac-in.
3. Then convert to volume: 3.6 ac-in x (1ft/12 in) x 2 acres = *0.6 ac-ft of water needed.*
4. Most ditch water is ordered in cfs (cubic feet per second).
5. We know that 1 cfs = 23.76 ac-in/day, or 1.98 ac-ft/day, so

To meet his grass pasture's weekly needs using flood, Andy needs to order a constant 0.3 cfs for a full day or 0.6 acre-foot (7.2 ac-in) over the course of one day.

COMMON WATER MEASUREMENT TERMS, CONVERSIONS, AND RELATIONSHIPS*

Volume:

1 acre = 43,560 square feet.

Acre-inch (ac-in): The volume of water required to cover 1 acre 1-inch deep.

Acre-foot (ac-ft): The volume of water required to cover 1 acre 1-foot deep.

1 cubic foot = 7.48 gallons = 62.4 pounds

1 acre-inch = 3,630 cubic feet = 27,154 gallons

1 acre-foot = 12 acre inches = 43,560 cubic feet = 325,851 gallons

1 cubic meter = 1,000 liters = 264.18 gallons

Flow rate:

Wyoming water right = 1 cubic foot per second (cfs)/70 acres

1 cubic foot per second (cfs) = approximately 450 gallons per minute

1 cfs = 0.646 million gallons/day

1 cfs running 24 hours = 1.98 acre feet

1 acre-inch/hour = approximately 450 gallons per minute = 1 cubic foot per second

¾-inch garden hose delivery (as depending upon pressure) = approximately 5 gallons per minute (gpm)

*Source: (Cornia, L., N. Atkinson, 2006)

How do I know when to irrigate?

Determining when to irrigate is the second part of irrigation scheduling. This is based on the moisture-holding capacity of the soil and the rooting depth of the crop. The amount of water the soil can hold is dependent on the texture, or the percentage of sand, silt, and clay. While the units are less important, Figure 8 shows how soil texture affects water-holding capacity.

Pretend your field is like a sponge. Place the sponge in water. The sponge is dripping water when pulled out, representing the water lost to runoff from your field or drainage below the root zone. Once it stops dripping water, your field/sponge has reached "**field capacity**" (the maximum amount of moisture it can hold; in the field it typically takes about 24 to 48 hours following an irrigation or heavy rain event to reach this point). If you wring out the sponge, the water that comes out of it is considered the **plant available water** (PAW). After completely wringing out the sponge, it's still damp, but no more water will come out. This is the **permanent wilting point**. This is the point at which the plant can no longer extract any water from the soil, and it will die due to a lack of water if the field is not irrigated again. So the soil in your field can contain water but if the amount of water it contains is not above the Permanent Wilting Point, the plants will still die.

To avoid stressing the crop, maintain the soil moisture at or above 50 percent of the PAW, referred to as the **Management Allowable Depletion** (MAD). See Table 7 for the MAD percentage for specific crops. Due to the small amount of water applied in low-flow (micro or drip) irrigation systems, the MAD should be 25 to 30 percent of the PAW.

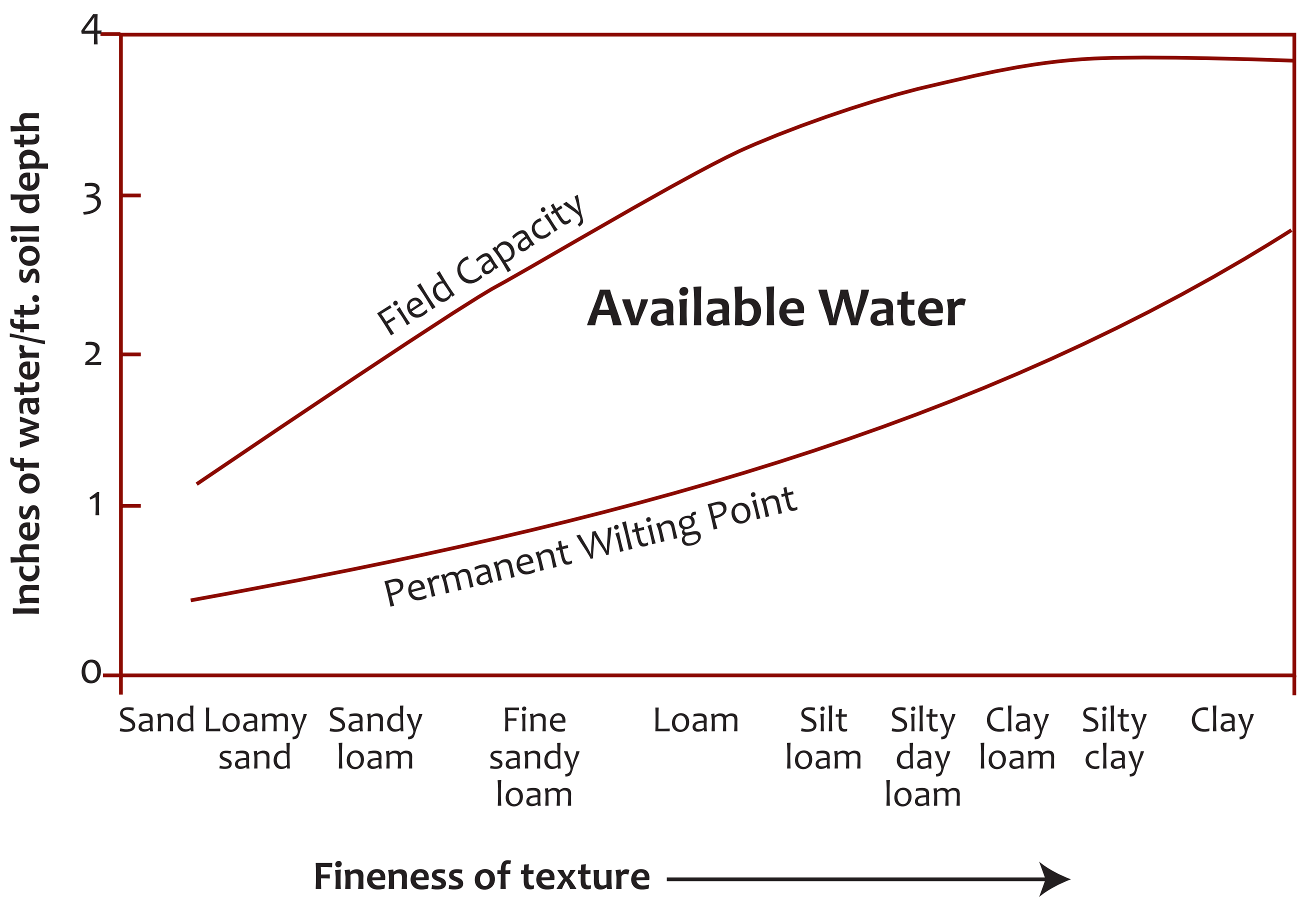


Figure 8. *Plot showing available water capacity over a range of soil textures. Available water is calculated as the difference, in inches of water per foot of soil depth, between field capacity and permanent wilting point, divided by 12 to convert to a fraction. (Ohio Agronomy Guide, 14th Edition, Bulletin 472-05)*

A “hands-on” method

In the absence of soil moisture monitors, and for all but sandy soils, the soil ball method can be a quick way to determine the need for irrigating a field. Take a handful of soil from 6 to 12 inches deep and squeeze into a ball. If it retains its shape when gently “bounced” in your hand, it has more than 50 percent available soil moisture. If it crumbles, it needs irrigation. The NRCS has also provided a great publication with pictures that discusses the process of soil moisture evaluation using the feel method, based on color and feel, for the most common soil types. This can be found at barnyardsandbackyards.com. Click on “Water.”

More advanced options that can help monitor soil moisture in real time include tensiometers and granular matrix sensors. For more information on soil moisture monitoring options, see the National Sustainable Agriculture Information Service publication titled *Soil Moisture Monitoring: Low-Cost Tools and Methods*, link available at barnyardsandbackyards.com. Click on “Water.”

How long should I irrigate?

How long you irrigate determines the amount of water applied and should match the infiltration rate of the soil (Table 9). For example, you would irrigate a clay soil less frequently than a sandy soil, with a lower application rate, as the finer soil particles in the clay soil hold more water, but the intake rate is slower. The coarse soil particles in the sandy or rocky soil will absorb water quicker, but the water holding capacity is less, so you would need smaller, more frequent irrigations.

An efficient irrigation does not apply water deeper than the crop’s roots can reach. This is referred to as the **crop root zone** (soil depth where most of a crop’s roots are found). The amount of moisture held in the soil depends on the soil texture. See Tables 7 and 8 to estimate your crops’ rooting depths and the available soil moisture based on a crop’s root zone.

Table 7. Root zone depths for selected crops.

Crop	Management root zone depth (soil) ft.	Typical management allowed depletion (MAD) %[a]	Approximate time to reach mature root depth (in good growing conditions)
Alfalfa	5	50	60 days new planting
Dry Beans	3	40	50 days after emergence
Corn (field)	4	50	10 days after tasseling
Corn (sweet)	3	40	10 days after tasseling
Grass pasture	3	50	50 days new planting
Orchard grass	5	50	--
Potatoes	3	35	60 days after emergence
Small grains	4	50	Heading
Sugar beets	5	50	110 days after planting

[a]MAD is the maximum amount of soil moisture to be removed prior to triggering an irrigation (see above for more complete explanation)
Source: USDA NRCS

Table 8. Available soil moisture-holding capacity for various soil textures.

Soil texture	Available moisture (inches of water/ foot of soil depth)
Coarse sand and gravel	0.2 to 0.7
Sands	0.5 to 1.1
Loamy sands	0.7 to 1.4
Sandy loams	1.3 to 1.8
Fine sandy loams	1.7 to 2.2
Loams and silt loams	2.0 to 2.8
Clay loams and silty clay loams	1.7 to 2.5
Silty clays and clays	1.6 to 2.2

Adapted from *Soil, Water and Plant Characteristics Important to Irrigation*, NDSU Extension.

The duration of an irrigation is also dependent on the **infiltration rate** (how quickly the soil can absorb water) of the soil. Irrigating beyond the infiltration rate can lead to water running off the field, wasting water, and also carrying away nutrients. See Table 9 for infiltration rates of various soils.

Table 9. Infiltration rates of common soil textures.

Soil texture	Infiltration rate (inches of water/ hour)
Coarse sand	>1.0
Fine sand	0.5 to 1.0
Fine sandy loam	0.50 to .75
Silt loam	0.25 to 0.4
Clay loams	0.10 to 0.4

Adapted from *Irrigation runoff Control Strategies*, A Pacific Northwest Extension Publication

The soil moisture capacity and infiltration rate of your soil is also affected by soil structure, organic matter, and other factors, and will vary by location. If unfamiliar with your soil texture, contact your local extension or NRCS office, or check out the NRCS Web Soil Survey, link available at barnyardsandbackyards.com. Click on "Water."

EXAMPLE 3: HOW LONG SHOULD I IRRIGATE A SPECIFIC CROP?

John wants to grow alfalfa in a loamy sand soil. He is debating between using a sprinkler system, which delivers 0.25 inches/hour, and flood irrigation, which delivers 0.5 inches/hour. How long should he irrigate each time if he uses the sprinkler system and if he uses flood irrigation?

1. First look up important information: Loamy sand soil absorbs an average of 0.8 inches of water per hour (0.7 to 1.0 range from Table 9, we used 0.8 inches). Loamy sand soil needs to be irrigated with 1 inch of water/foot (0.7 to 1.4 range from Table 8, we used 1 inch). The irrigation management depth for alfalfa is 5 feet deep (Table 7).
2. 1 inch of water per foot for loam soil x 5 feet deep = 5 inches of water, equal to the total water holding capacity of the soil. If John is maintaining around 50 percent of his soil moisture (MAD), then the maximum he should need to apply is 2.5 inches.
3. Next consider the irrigation system:
   Sprinkler: If the sprinkler system waters 0.25 inches/hour at an efficiency of 75% (Table 2), then it should run for 13.3 hours to apply 2.5 inches [2.5 / (0.25 x 0.75) = 13.3].

   Flood: if the flood irrigation system puts down 0.5 inches/hour, at an efficiency of 40 percent (Table 2), then it should run for 12.5 hours to apply the 2.5 inches [(2.5 /(0.5 x 0.4) = 12.5.

   John would need to run the sprinkler system 13.3 hours, but if he uses flood irrigation, he has to irrigate for 12.5 hours.

Putting it all together

There are many factors to consider when looking to irrigate a small acreage. The process begins with choosing the correct system for your operation and learning the most efficient application and management of that system. Learn your soils, crops, and environment. Putting it all together will help make the most efficient use of time and water, giving the best return on your investment.

Section 3 References

Links to all documents referred to in this section, listed below and in the text (free online), can be found at barnyardsandbackyards.com. Click on "Water."

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SECTION 4. IRRIGATION CONFLICTS IN YOUR NEIGHBORHOOD

Every summer, the Wyoming Department of Agriculture's Mediation Program receives a couple of calls from landowners seeking help to resolve water conflicts. Small-acreage or large, new landowners and seasoned veterans from any corner of the state, people fight over water. These conflicts increase in times of drought. Water disputes aren't limited to Wyoming. In larger states like California, irrigation districts find themselves battling with urban areas over the use of the water. Water disputes can cross state lines, as evidenced by a U.S. Supreme Court case featuring Wyoming and Montana battling over an interstate water rights lawsuit. While your dispute might not be epic enough for a Supreme Court hearing, chances are pretty good the conflict is affecting your financial health and perhaps even your mental health. Let's take an in-depth look at common irrigation conflicts, your conflict style, and strategies for managing these disputes.

What are these conflicts about?

Several common themes arise in talking to landowners about their irrigation conflicts and in researching issues in other western states:

- **Who, what, and when.** Which user gets their allotment of water and when do they get it? Some users may want to turn the water off at certain points during the irrigation season, while others want it to stay on. In the same vein, some people may want to delay turning on the water, while others are ready for it to start. Some conflicts arise when a landowner is not getting their correct allotment at all. If the landowners are not part of an organized group of irrigators, but just share a private ditch or pipeline, they all have to come together and maintain the ditch, keep it operational, and coordinate their own ditch activities.
- **Issues with ditch maintenance and easements.** Are the ditches in good shape, or are they full of weeds? Lack of maintenance can lead to flooding or loss of irrigation water.
- **The quality of the irrigation water.** Is it muddy from lack of ditch maintenance? Perhaps it runs through another property and picks up mud, manure, or other unwanted additions before gathering into a runoff ditch and continuing down the system. Anyone who uses water to irrigate is responsible for taking care of or making arrangements for downstream neighbors to care for his or her runoff water. Irrigators can't just generate run-off water and then cast it off onto a neighboring property in an unconfined way. Usually, run-off ditches (also called catch ditches) are constructed to carry this water. Those ditches need to be maintained and cleaned regularly, just like irrigation ditches, so the water doesn't overflow or cause damage with excessive runoff.
- Water in open channels only runs downhill. Seems obvious, right? Some landowners may alter the location of the ditch on their property, which will make it harder for the down-ditch neighbors to receive their water.

Responses to conflict

Let's talk a little bit about people's responses to conflict. Everyone has their own style, and each style has advantages and disadvantages. We often expect the other side to respond to conflict in the way we do, and, when they don't, we feel even more frustrated, ignored, disrespected, etc. Most conflict style models look at five basic styles of conflict response: avoiders, accommodators, compromisers, forcers, and collaborators.

Avoiders tend to view conflict as hopeless. They delay or avoid a response to the dispute in the hope the problem will just go away. **Accommodators** consider conflict disastrous. They tend to sacrifice their own interests in the hopes of keeping the peace. **Compromisers** believe conflict provides an opportunity to meet halfway, and they look to split the difference. **Forcers** see conflict as a question of who is right and who is wrong, and they are most concerned with controlling the agreement. Forcers want to win. **Collaborators** view conflict as a natural part of life and recognize the tensions between relationships and differences in viewpoints. They try to find a solution that meets as many concerns as possible. Each conflict strategy has advantages and disadvantages:

- **Avoiding** can be an effective strategy if time for decision-making is short and you have little authority; however, if the avoider cares about the relationship and the outcome, and they use this style for most issues, avoiding conflict may create more problems than it solves.
- **Accommodating** can be an effective strategy if you really don't care about the issue. Like the avoiders, if this is your primary style for every negotiation, you may be missing an opportunity to strengthen a relationship.
- **Compromising** is appropriate when cooperation is important, there isn't a lot of time, and resources are limited. Compromising might also be effective if any solution is better than a deadlock; however, compromising is inappropriate if it's important parties develop a creative solution or if one side can't live with a certain outcome.
- **Forcing** is appropriate if there's an emergency at hand or you are sure you are right and being right is more important than maintaining the relationship. Forcing obviously has drawbacks and if this is your primary strategy, you may find that other people stop negotiating with you, even on small matters.
- **Collaborating**, which many consider to be the gold standard of conflict styles, is appropriate when both sides view the relationship and the issue as equally important, and when there is reasonable

chance to meet everyone's concerns. However, even collaboration has its drawbacks. If time is short and the issues are unimportant, people may find collaboration to be cumbersome and feel overloaded with the process.

Insight into your own conflict style can be an important step in managing conflict. If you tend to be a forcer or even an avoider, consider how this strategy may affect those with whom you interact regularly. Compromising or accommodating each time may mean you are missing the chance to use creative decision-making to find a long-term solution. There are many tools available to help determine your conflict style. Information for this section is adapted from the Peace and Justice Support Network of Mennonite Church USA's *Adult Personal Conflict Style Inventory*.

Strategies for resolving irrigation conflicts

Clear communication is the first and most effective tip for managing conflict. When we are involved in a tough negotiation or a conflict, we might listen to the other side, but we are filtering that information through our own viewpoint and we might frequently misunderstand what the other person is trying to tell us. People routinely fail to interpret what we say in the way we intend it. When we are in the midst of discussing something as important as irrigation plans for a hot, dry summer, we can let our perceptions get in the way of what is really being said.

Actively listening is an important tool in preventing miscommunication. Listening is always important but becomes even more so in tense situations or conflicts. To listen actively means to pay attention to not only the other speaker's words, but also to his or her emotions. Active listeners ask questions for clarification and demonstrate through body language they are paying attention.

Integrated or interest-based negotiation can be another effective tool for managing conflict. Popularized in Roger Fisher and William Ury's *Getting to Yes* text, interest-based negotiation helps both sides of a conflict work together to find a mutually acceptable solution.

The process begins with separating the people from the problem. In most conflicts, the personalities and the issues become intermixed. We frequently allow our perceptions about the other side to color how we view the conflict.

Next, we focus on interests and not positions. Positions are the stances we take ("There will be no pets in this house!"), while interests are our concerns (allergies, costs, responsibility, etc.). If we are able to identify not only our own interests, but also those of the other side, we can focus on our shared interests and find solutions that work for both of us. After we uncover each side's interests, we try to generate a variety of options and then agree on objective criteria that can be used to evaluate each option.

Finally, as we decide upon an agreement, we try to ensure the agreement is solid by taking turns playing devil's advocate and asking "what if" questions to ensure we are developing a lasting solution.

Negotiation is an effective tool for managing irrigation conflicts. Cooperation with neighbors to come up with a plan to help everyone get the water they need is an essential part of the equation, particularly in areas not under irrigation district control. If your acreage is served by a common diversion system, it is crucial for all of the users to come together and participate in decisions as to when and how much water will be turned on and off so all users can prepare accordingly. All users might agree to have one person designated as the one to turn the water on and manage the diversion gate. You might also work with your neighbors and select one landowner to serve as the spokesman for the whole group in that area. Everyone will still need to work together and communicate, but this approach may help manage conflict within a larger group.

You may also have the opportunity to work together with neighbors to develop a water use rotation scheme. Wyoming water law allows users to come together and develop a water rotation plan. Instead of water being divided into several smaller volumes for individuals, the users can each have a turn at the full amount of the water on a regularly scheduled basis.

When we look specifically at irrigation conflicts, there are a few more strategies that will help us manage these types of conflicts. The first is to be as knowledgeable as you can about the situation. Know your water allotment and how to measure it. Know how much water you are using. Don't overuse your allotment. Overuse will probably lead to a hefty fine and at the least, you won't make any friends downstream.

Water board/irrigation districts can be tools if you have first tried other avenues for negotiating with your neighbors and you have reached a stalemate. Depending on the district, they might be able to send a letter or have a discussion with the neighbor about rights and responsibilities. Take the time to meet your local irrigation district board members and the district manager. Attend the irrigation district meetings to find out what's happening in your area and the role you can play.

As mentioned previously, water rights and ditch rights are different under Wyoming law. The State Engineer's Office, through the Wyoming Board of Control, oversees water and grants permits to use water. The Wyoming Board of Control does not have any control over ditches. Disputes involving ditches are civil matters and must be settled by negotiations or court proceedings. Faced with excess run-off water from a neighboring property, a small-acreage landowner might identify a new opportunity, such as putting more land under irrigation. However, any new use of water on the land will require a permit and/or authorization from the State Engineer's Office. Problems related to property damage caused by uncontrolled irrigation run-off are matters for civil court and not the State Engineer's Office.

You may be in a situation in which you've tried to clear up the miscommunication and worked together to negotiate but for a variety of reasons, the conflict still exists. At this point, you might consider bringing in a neutral third party to help both sides have a civil, constructive conversation and try to find a mutually agreed-upon solution. A mediator or a facilitator can help the parties overcome differing conflict styles, communication difficulties, or an inability to see each other's perspective and help them find common ground and develop an agreement that meets everyone's needs. More information about mediation in Wyoming can be found on the Wyoming Agriculture and Natural Resource Program's website at http://wyagric.state.wy.us/divisions/nrp/mediation-program. The program offers a process to assist Wyoming citizens in resolving disputes in a way that is voluntary, confidential, low-cost, and timesaving. Call (307) 777-8788 or toll-free 888-996-9278 or email lucy.pauley@wyo.gov for more information.

Section 4 References

Links to all documents referred to in this section, listed below and in the text (free online), can be found at barnyardsandbackyards.com. Click on "Water."

Huntington, Michelle. 2010. "Working with Neighbors Streamlines Irrigation Water Use." *Barnyard & Backyards Magazine, Summer 2010.* Available online at http://www.uwyo.edu/barnbackyard/_files/documents/magazine/2010/summer/featured%20-andowner-summer-2010.pdf

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