EC 1610 • November 2007
$4.50

Managing Small-acreage Horse Farms

IN CENTRAL AND EASTERN OREGON

Oregon State University | Extension Service

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- Publications and web resources on management of small-acreage horse farms

What do you want from your farm?

Some good goals for a well-managed, small-acreage horse farm are:

- A productive pasture with plenty of grass and few weeds
- Less dust during the dry season and less mud during the wet season
- Healthy horses free of problems associated with dust, manure, mud, and toxic plants
- Manure managed as an important resource on the farm or recycled off the farm
- Good stewardship of your property and the water that flows through, across, and below it
- Satisfied owners who are able to conveniently care for their animals without dreading the chore

The key to meeting these goals is to recognize that horses, grass, manure, soil, and water are interconnected. How you manage one affects the others. When, where, and how long your animals graze affects grass regrowth, weed competition, and the safety of your well water. How you deal with water runoff affects your horse's health, nearby streams, and your own enjoyment of the property. By properly managing each aspect of your farm, you will have greener pastures, healthy horses, and more personal satisfaction.

The key to achieving a well-managed horse farm is understanding that horses, grass, manure, soil, and water are interconnected —how you manage one affects the others.

Poor conditions on horse farms affect animals, people, and wildlife

Living in dust, manure, mud, and/or weeds is unhealthy. Dusty conditions lead to respiratory diseases. Dust carries irritating particles, pathogenic bacteria, and viruses into the lungs. A horse living in dusty conditions is more inclined to respiratory infection. And, a horse suffering from a respiratory infection takes longer to recover in dusty conditions than in dust-free air.

Overgrazed pastures with little grass cover can be a source of sand colic—a serious digestive disorder that occurs when horses fed on bare ground ingest soil and sand. In addition, horses on overgrazed pastures are exposed to manure while eating and are at a higher risk for internal parasite infestations. Horses routinely left on overgrazed pastures reinfest themselves and spread internal parasites to other horses in the herd.

Although the intensity and length of the mud season vary east of the Cascades, mud can be a problem for small-acreage horse farms. Mud harbors bacteria and fungal organisms that cause health problems. Wet conditions soften the hoof and sole, causing cracking and splitting. Horses become susceptible to stone bruising, abscesses, and thrush, an infection of the frog of the hoof. Wet, muddy conditions create slick, unsafe footing that can result in injuries.

Cold, wet, muddy conditions can lower a horse's body temperature and may even cause hypothermia. Animals kept in these conditions burn significantly more calories just to keep warm, and thus require more feed.

Even in central and eastern Oregon, pastures can be muddy.

Why are healthy pastures important?

- Dusty pastures can lead to respiratory disease.
- Overgrazed pastures with little grass cover (1) can be a source of sand colic and increase the risk of parasite infection, (2) promote weed infestation, (3) contribute to polluting runoff water.
- Muddy pastures (1) harbor bacteria and fungal organisms that can lead to hoof problems, (2) create unsafe footing, (3) combined with cold weather, lower a horse's body temperature.

Weeds easily infest overgrazed pastures. While most are harmless, some can be dangerous to horses, and most are unsightly. Weeds indicate a management problem and reduce the value of the pasture as a source of feed.

Poor conditions on horse farms lead to pollution of well water, nearby creeks, and other surface water. Nitrate and bacteria from manure and urine run into creeks and groundwater, affecting the quality of your drinking water as well as that of your neighbors and your animals. These pollutants, as well as excess phosphorus and topsoil runoff, threaten fish and other wildlife that depend on the creeks, rivers, and lakes of central and eastern Oregon.

The condition of your farm is up to you. This publication presents a system for managing horses, pastures, and manure that will make your farm safe, efficient, and environmentally friendly. It is intended for horse farms ranging from 1 to 10 acres in the high, dry regions of eastern and central Oregon.

Because small-acreage owners lack the space of larger farms and ranches, they are confronted with a unique set of challenges. We've tailored our recommendations for small farms, but they can be adapted to larger farms as well. Options for low-cost and higher cost approaches for irrigated and nonirrigated operations are included.

This publication is a place to start. Contact your local OSU Extension office or consult the resources listed at the end of this publication when you need more in-depth information.

What makes horses different?

Horses are adapted to immense, arid grasslands. In their natural environment, they roam a range. Living like this, they stay in one area for only a short time and have little impact on the environment. When we keep horses on small acreages, we must use management practices to minimize their impact.

Most horse owners know that horses are different from other livestock in their behavior and also in how and what they eat. Our reasons for owning horses often are different too.

Activity level

Horses are heavy animals with big, often steel-shod, hooves. Unlike other livestock, they can be very active, and they enjoy running and playing. In contrast, mature cattle tend to eat, lie down while they digest their meal, and make an occasional trip to the water trough.

Horse owners take pleasure in watching their animals run, play, and "kick up their heels." Too much of this activity concentrated on small acreage can, however, severely damage pastures. The horse's natural way of running and its flipping hoof action damage forage by cutting off or uprooting whole plants.

Eating habits

Unlike sheep and cattle, horses have both upper and lower teeth. They also have very active lips. With a short tongue and a sensitive, strong upper lip, horses bring food to their front teeth, and

Horses are efficient grazers and will bite the top off preferred plants until that area is grazed short.

then bite. As a result, they are very efficient grazers—sometimes too efficient. Horses have the ability to quickly eat grasses right to the soil surface. When this happens too often, it kills the grass.

Although horses will eat broadleaf plants, brush, or trees, they have a stronger preference for grass than do cattle or sheep. They prefer short, tender grass over longer, coarser grass.

Horses are biting top-grazers, biting off the tops of preferred plants in an area of the pasture until that spot is grazed short. They continue to graze regrowth on the preferred plant and avoid what seems to be good, taller pasture. Horses prefer the base of the grass stem, which has significantly higher sugar and carbohydrate content than the upper parts of the plant.

Horses are "recreational grazers" and will continue to graze after they have met their nutritional requirements. Table 1 compares the activities of horses, cattle, and sheep on pastures. If unmanaged, horses will spend over half the day eating.

Table 1. Daily Activities of Horses, Cattle, and Sheep on Pastures (hours spent)*

	Horses	Cattle	Sheep
Grazing	14	9	9
Standing	8	4	3
Lying down	1	9	11

*Table used with permission from S. Bittman, O. Schmidt, and T.N. Cramer, 1998. *Advanced Forage Management: A Production Guide for Coastal British Columbia and the Pacific Northwest.* Pacific Field Corn Association, Agassiz, British Columbia.

Seven steps to a safe, efficient, environmentally friendly horse farm

The problems noted on pages 5–6 are common on small-acreage horse farms. The grazing habits and activity of horses can quickly lead to pastures and a farm that are "beat up." The techniques discussed in this publication will reduce this damage. Follow these seven steps to improve your farm:

1. Don't beat up your pasture.
2. Manage your pasture for optimal grass growth.
3. Use buffer strips to protect water.
4. Manage manure and bedding resources.
5. Manage weeds to protect your horses.
6. Install rain gutters and downspouts.
7. Protect your household water supply.

These steps are management practices that together promote a well-managed, sustainable farm that cycles nutrients, protects soil, and improves water quality, while providing an attractive, efficient environment for horses and people.

Why is pasture protection important?

The well-known horse management author Cherry Hill observes, "Horses are wasteful and gluttonous, and their hooves can be very damaging to the land." Overgrazing makes horses fat, and overtreading "beats up" the pasture. Hill recommends that, "…to preserve your pastures and maintain your horse's optimum weight, limit the number of hours your horse is on pasture."

Step 1. Don't beat up your pasture

Many pastures in central and eastern Oregon suffer from overgrazing. Repeated heavy grazing removes too much of the plants' leaves, weakens the root structure, and makes regrowth difficult. As a result, less forage is available for grazing, and pastures are vulnerable to weed invasion, dusty or muddy conditions, and soil erosion.

Overgrazed pastures create dust and mud, as well as promote weed growth. These conditions contribute to health issues and pollution of well water and nearby streams due to runoff.

In contrast, a well-managed pasture with good ground cover provides abundant forage, space for recreation, strong competition against weeds, and protection from water quality problems and other negative environmental consequences associated with horses. These benefits are achieved through good grazing management and by regulating the amount of time horses spend on pastures. The best method to prevent pastures from being "beat up" on a small acreage is to make a dry lot a key part of your grazing strategy.

The dry lot

Using a dry lot is one of the best management tools to maintain pasture condition. A dry lot, sometimes called a paddock, is a small enclosure, such as a corral, pen, or run, that serves as the horse's outdoor living quarters when they should not or cannot be on the pasture. This area holds horses and prevents overgrazing of the pasture when grass is in short supply, prevents damage to the pasture when it is too wet or too dry, and allows owners to control the amount of grass horses consume on a daily basis. A dry lot is also useful for separating or confining animals.

Options for dry lots

A dry lot without additional footing material is often referred to as a "sacrifice area." These lots usually are small areas that are sacrificed to benefit the remainder of the pasture. Sacrifice areas get "beat up" and become dusty or muddy, depending on the season, but they protect the rest of the property from the same fate. This approach is very low cost.

A dry lot can be more than a confinement area for horses when they are not on pasture. These areas can be designed for multiple use and might include, for example, a run from a horse stall, a small outdoor arena, or a round pen for working or lunging.

A dry lot can be designed for multiple uses, such as a run from a horse stall, a small arena, or a round pen for working or lunging.

Adding some type of footing to a dry lot keeps it drier during the wet season and dust-free during the dry season. Footing material provides a dry and stable surface on which horses can stand and/or exercise. Available footing materials vary by region, but the best materials maintain good drainage without compacting, while at the same time providing stability for the intended activities. The goal is to have a safe, well-drained, all-weather surface. Common footings include gravel, sand, and coarse, shredded wood products.

Footing material, such as this coarse sand, can be added to a drylot to provide a dry, stable surface. Other options for footing include gravel or shredded wood.

Gravel drains well and provides a solid, level surface. Select an aggregate size that won't contribute to stone bruising on the feet: ¾- or ⅝-minus generally are used.

Sand drains well and can provide a surface for working horses. It should be coarse and clean and contain very little fine-textured silt and clay. If horses are fed on the ground, however, sand colic can be a concern.

Shredded wood, which is sometimes called "hog fuel," might be available in areas with timber resources. It provides a forgiving surface and reduces urine smells, but it makes manure picking more difficult and must be renewed every year or two.

When choosing a footing material, ask yourself the following questions:

- Is the dry lot only for standing, or is it also for working?
- What footing materials are available locally?
- What are your preferences for footing?

Establishing and maintaining a dry lot

A well-sited dry lot makes it easy to care for your horses and maintain the area. Choose the location of your dry lot carefully. Locate it:

- On higher or well-drained ground
- Away from your domestic wellhead or other water sources
- Close to the barn or other shelter

The dry lot should fit the number, size, and personalities of your horses, and the fences should be strong, secure, and safe.

The dry lot should be sized to fit your farm and the number, size, and personalities of the horses to be confined. It should offer no less than 256 square feet (the equivalent of a 16 × 16 foot stall) per horse. A dry lot of this size does not provide space for exercise, however, and many horse owners prefer a much larger area.

Fences for dry lots should be strong, secure, and safe. Gates must be at least as wide as the equipment you will use to haul footing materials or to clean the pens. Fence height for dry lots is

extremely important. Horses are known for their ability to reach over the best of fences. A good rule of thumb is to place the top rail at withers height—about 5 feet for most horses. Consider the depth of footing material and its accumulation over time when installing fence posts and planning fence height. Horses have poor eyesight, so high visibility is another consideration when planning a dry lot fence.

There is a wide variety of materials for fences. Traditional wood fences are an excellent option. Keep in mind that bored horses may chew wood. Prefabricated metal fence panels designed for use with horses are a good material if horses will be confined for long periods. Many brands are available, and they are economical when one considers their long life. Wire fence material such as "V-mesh" is relatively inexpensive and safe for horses. If electric fencing is used, for example an electrified wire along the top rail, consider using wide electric tape, which is more visible and safer than smooth wire. Barbed wire is never recommended as a fencing material for horses—it can cause severe injuries.

It is important to minimize water runoff from the dry lot. Install rain gutters on buildings to divert clean water away from the dry lot (see "Install rain gutters and downspouts," page 32). In addition, buffer strips between a dry lot and nearby creeks contribute to high-quality surface water (see "Use buffer strips to protect water," page 25).

Trees can provide protection for horses, but they should be fenced off or caged to prevent girdling.

Trees can provide shade and protection from the wind. They also add habitat for wildlife and enhance the aesthetics of your farm. Trees growing inside the dry lot should be protected from chewing, girdling, and soil compaction. It's best to fence along the drip line (the area under the branches) to keep horses away from the trees. At the very least, protect trees from girdling by caging the trunks with wire mesh. This method will not, however, protect the roots from compaction. Consider planting new trees beyond the reach of horses, for example, outside the fence lines.

To reduce parasites and flies, pick manure regularly. The schedule depends on the number of animals and the size of the dry lot. Regular picking keeps the paddock footing clean. When handled properly, horse manure composts well and can play a role in nutrient management for pastures (see "Manage manure and bedding resources," pages 26–29).

Step 2. Manage your pasture for optimal grass growth

Because of a small-acreage horse pasture's limited size, its primary purpose often is to provide a productive cover of grass, free of weeds and bare spots. Meeting the horses' nutritional needs often is secondary. Nutritional needs can be met by hay or by a combination of hay and grain. The small-acreage pasture usually provides supplemental feed and space for recreation.

If you do an excellent job of managing your pasture grass resource, it will take care of your horse. You may be a horse owner, but you're also a grass farmer!

Planning for pasture management

The following tips can promote sustainable horse-keeping in dry-climate areas:

- Understand how and when grasses and other forages grow and how much your horse should eat.
- Manage grazing to maintain vigorous growth and long-term stands of desired pasture plants.
- Select the right pasture plants for your climate, water supply, and soil conditions.
- Manage pasture fertility to promote strong stands of grasses and other forages.
- Use irrigation water efficiently.

Each of these topics is discussed below.

Understand how and when grasses and other forages grow and how much your horse should eat

How grass grows

The long-term health of forage plants requires three things:

- Enough leaf area and sunlight for photosynthesis
- Intact plant growing "points" for quick regrowth following grazing
- Roots sufficient to support the leaves and stems of the plant

Plants manufacture food in their leaves using solar energy, carbon dioxide from the air, and water to make sugars and complex carbohydrates. This process, called photosynthesis, requires "solar receptors" in the form of green leaves. Removing too many leaves through overgrazing slows plant growth and damages the root system.

Why is pasture management important?

Well-managed pastures have many roles. They are important sources of forage and provide exercise space. They protect the environment by reducing soil erosion and filtering water on its way to streams, lakes, and aquifers, and they provide habitat for wildlife and beautify the landscape. Managing pastures for these multiple benefits requires an understanding of the key issues involved in good stewardship of grazing lands.

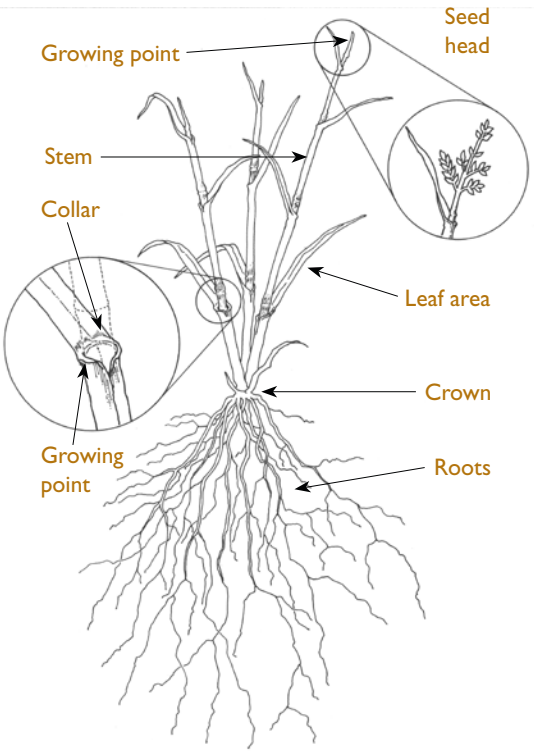

Figure 1. Above- and below-ground forage plant structure.

As shown in Figure 1, forage plants grow from specific points. One growing point is at the tip of the stem. Eventually, this growing point develops into the seedhead. Another growing point is the collar located at the base of the leaf blade. This growing point allows the leaf blade to increase in length. When growing points are grazed off, the plants are unable to regrow. All plants are susceptible to overgrazing, some more than others.

In addition to requiring leaf area and undamaged growing points during the growing season, pasture plants must store sugars and carbohydrates to survive the winter. This stored food allows them to begin growing again the following spring. Good management during the fall is critical, as roots and crown stockpile nutrients for the spring growth spurt at this time. After the final grazing, leave plants no shorter than 3 inches. Give plants time to regrow before winter dormancy. This practice ensures a supply of growth buds for next year and a reservoir of energy for a good start in the spring.

To learn more about how to improve your pasture management based on understanding principles of growth and regrowth, visit http://forages.oregonstate.edu/projects/regrowth/

When grass grows

If pastures produced evenly throughout the year, feeding a horse would be easy. The reality is much different, however. Pasture grass and legume plants are seasonal in their production. Typically, irrigated pastures in central and eastern Oregon grow quickly during the spring, slow their growth during summer, and increase growth slightly again in the fall.

Figure 2 shows the seasonal irrigated pasture growth for central Oregon under optimal and average management. Optimal management includes precisely managing soil fertility, grazing, and

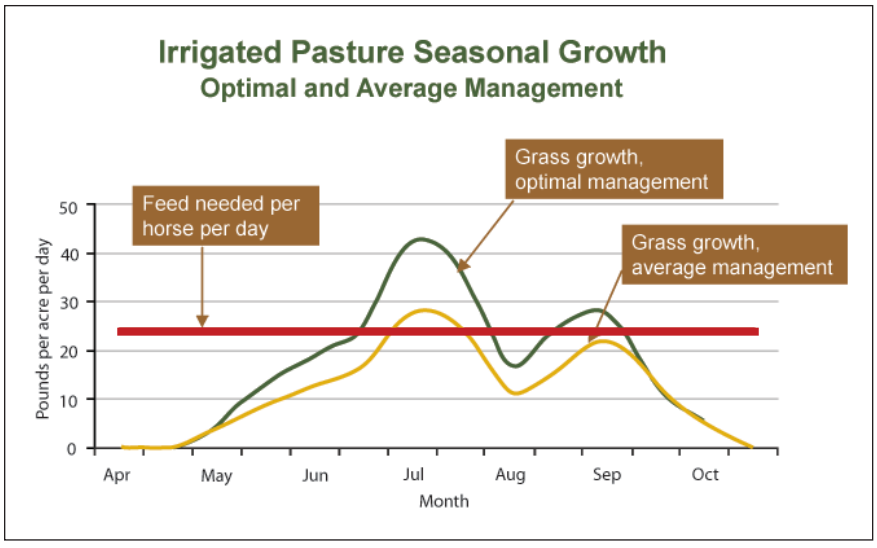

Figure 2. Irrigated pasture seasonal growth.

irrigation so pastures produce at a very high level. Average management is closer to common practice. Note the amount of feed needed per horse per day. Under average management, more than 1 acre is required to feed a horse during most of the grazing season. Typical growth patterns vary by elevation, latitude, soil fertility, plant species, and average rainfall.

This natural growth cycle can provide too much feed at some times and not enough at other times. Some farms use some of their pasture to produce hay that is stored and fed when the pastures are not producing. Small-acreage horse farms may not have this option.

How much your horse should eat

Forages are needed for normal functioning of the equine digestive system, and forage requirements are supplied most easily by pasture and hay. Horses do not have a multicompartmented stomach like cattle, sheep, and goats. Instead, the horse has a simple stomach that works much like a human's. Horses do not effectively digest low-quality forages; hence higher quality, more digestible forages are necessary.

Mature horses performing minimal work can be maintained on good-quality forages without supplementing their diet with grain. Growing, breeding, or working horses may require grain or other concentrates to meet their nutrient needs. For optimal horse health, growth, and development, forages should supply at least one-half of the feed consumed daily.

Horses consume about 2 percent of their body weight per day in feed. This amount is based on a dry-weight basis, so it accounts for the different amounts of moisture in different types of feed. Fresh grass, for example, is about 80 percent water, and grass hay is 10 to 15 percent water. Thus, a 1,200-pound horse requires 24 lb of feed per day on a dry-weight basis, or about 28 lb of hay (10 percent moisture). Over the course of a year, this equals more than 5 tons.

Pastures can supply at least some of the forage feed requirements, depending on the size of the pasture, the number of horses, and the length of the growing season. In central and eastern Oregon, well-managed, irrigated pasture produces 5,500 to 7,000 lb (2¾ to 3½ tons) of forage per acre.

The majority of pasture forage is produced during May and June (see Figure 2). Supplemental feed will be required during other parts of the year.

If irrigated pasture is used as a major feed source, a mature 1,200-lb horse generally needs about 2 acres of pasture. New

owners or managers can provide a safety buffer by doubling this estimate and carefully monitoring pasture conditions, feed supply, and horse body condition.

Manage grazing to maintain vigorous growth and long-term stands of desired pasture plants

The first principle of good grazing management is to never graze the grass too short. The optimum height for most pasture grasses in central and eastern Oregon is between 3 and 8 inches tall. The ideal height depends on the species and on whether the pasture is irrigated or dryland. The minimum height should never be less than 3 inches.

When grasses are between 3 and 8 inches tall, they are in what is called the "vegetative" stage because the grass is very leafy. At this stage, the grass is high in nutrients and very competitive with weeds.

Grass that is grazed too short is weakened, takes a long time to regrow, and is susceptible to competition from weeds. Grazing too short and too often is overgrazing. Allowing horses to graze grass shorter than 3 inches also increases the chance that they will become infected by parasites because the majority of parasite larvae found on forage plants live on the lower part of the grass plant.

As discussed on pages 10–12, a dry lot is an essential part of pasture management on small-acreage horse farms. The dry lot is a comfortable, safe place for your horses when access to the pasture is restricted. Consider the dry lot or paddock the horse's living room and bedroom and the pasture its dining room.

The three grazing strategies discussed below fit well with the use of a dry lot and are good options for small-acreage horse operations. The best option for your farm will depend on your goals and whether your farm is irrigated or dryland. These approaches vary in their ability to maintain pasture cover and reduce the risk of overgrazing. The proper choice involves balancing effectiveness against your management time, expense, and expertise.

Partial-season grazing

Partial-season grazing limits pasture access to the season when the pasture is productive. Some horse owners graze their pastures during spring and early summer, when plant growth is rapid and forage quality is at its peak. When forage has been grazed to the proper height, horses are moved off the pasture into the dry lot and provided supplemental feed. In many areas, horses are not returned to the pasture until the following spring.

This approach is the best way to maintain dryland pastures that otherwise would become severely overgrazed during the dry

season. During the grazing season, dryland pastures can be managed using "limited turnout" or "rotational grazing," as discussed in the next sections.

Limited turnout

Limited turnout allows horses daily access to pasture for very short periods. With this approach, horses spend most of their time in the dry lot with daily turnout periods of an hour or two. This strategy works well on small acreages, particularly with pastures that cannot support longer grazing periods. It also can help maintain horses in proper body condition. Turnout to pasture provides exercise and may save money on feed costs by substituting pasture for some hay, grain, and concentrates.

Rotational grazing

Rotational grazing is the most effective approach to grazing management. This approach divides the pasture into several smaller pastures or "cells." Horses are allowed access to only one cell at a time.

While horses graze one cell, the grass in the other cells regrows. When forage height has been reduced to 3 to 4 inches, horses are rotated into the next cell. The previously grazed cell is rested until forage plants recover. Horses are not allowed to regraze a cell until plants have regrown to 6 to 8 inches. If sufficient regrowth occurs (6 to 8 inches), horses can be returned for more grazing.

Rotational grazing divides the pasture into several "cells." While horses graze one cell, the grass in the other cells regrows.

On irrigated pastures, regrowth may take 2 to 8 weeks, depending on the season. On dryland pastures, each cell is likely to be grazed only once a year.

If all cells have been grazed and none has regrown to 6 to 8 inches, horses are kept in the dry lot until there is sufficient regrowth to allow grazing. With this system, the dry lot also can be used at times to restrict grazing in order to maintain horses in proper body condition. A good rule of thumb is to graze half (the height of the grass) and leave half, especially if pastures are dryland.

The size and number of cells in a rotational grazing system depend on available acreage, number of horses, productivity of the pasture, and how long horses will remain in each cell. Ideally, each cell should contain enough forage to sustain grazing horses for 3 to 5 days. Your situation may differ.

Plants begin to regrow after 3 to 5 days, and horses will overgraze the lush new growth, leaving other grass to become tall and rank. Longer grazing periods also increase damage from hooves, particularly near water and salt sources.

When using rotational grazing for the first time, experiment with the size and number of cells. Be flexible! Avoid a strict calendar of entrance and exit dates. Instead, monitor the pasture condition. When the forage is too short, remove horses to another cell or to the dry lot or paddock.

Remember, horses tend to spot graze (they overgraze some areas while not grazing others). Keep this in mind as you decide when to move them to the next pasture. Mowing between grazings or at regular intervals during the grazing season will clean up pastures and restore the plant cover to a uniform height. In areas with significant snowfall, mowing can be deferred until after snowmelt. Stubble helps catch snow and prevent it from being blown away.

With all these approaches to grazing management, the dry lot is an integral part of the system when pastures are not suitable for grazing.

Winter pasture management

Frozen or snow-covered pastures are less subject to damage from the activity of heavy animals. Grass and other forage plants are dormant under these conditions. Snow-covered pastures provide the most protection to grasses. Frozen pastures reduce soil compaction but expose dormant pasture plants to grazing. Bored horses may graze exposed dormant plants below their growing points or even graze the roots. Although not nutritious, dormant plants satisfy the animal's desire to chew.

During winter, you can promote pasture condition by limiting turnout time to 1 or 2 hours a day. Monitor the activity of your animals and the condition of forage plants during winter turnout times.

Select the right pasture plants for your climate, water supply, and soil conditions

Select pasture plants based on whether you can irrigate your pasture and whether the pasture will be used primarily as an exercise area or for grazing and/or haying. The Oregon State University Extension Service, Natural Resources Conservation Service (NRCS), Soil and Water Conservation District (SWCD), and local seed dealers can help you select appropriate grasses.

Pasture grasses may be used alone, mixed together, or mixed with a legume. Pasture mixes with more than one grass can work well. Keep in mind that different forage species grow at different rates and times. Mixed forage can extend the grazing period but also results in palatability differences, causing overgrazing of one grass and undergrazing of others. In this case, mow the pasture between grazings.

The addition of a small amount of white clover will provide nitrogen to irrigated pastures through nitrogen fixation and will improve the quality and quantity of forage during the hot season when grasses do not perform as well as legumes.

Forage species for dryland pastures

Because nonirrigated pastures depend on snow melt or rain in order to grow, their growing season is much shorter and their potential use by horses is limited to a few months per year. For dryland pastures, choose forage species based on average annual precipitation (Table 2).

Select pasture plants based on whether you can irrigate your pasture and how your pasture will be used—as an exercise area or for grazing or haying.

Table 2. Forage Species for Dryland Pastures
for areas with annual precipitation levels:

Less than 9 inches	9 to 11 inches	12 to 14 inches	15 to 17 inches
Crested wheatgrass	Crested wheatgrass	Crested wheatgrass	Crested wheatgrass
Russian wildrye	Russian wildrye	Russian wildrye	Russian wildrye
Siberian wheatgrass	Siberian wheatgrass	Siberian wheatgrass	Siberian wheatgrass
Thickspike wheatgrass	Thickspike wheatgrass	Thickspike wheatgrass	Thickspike wheatgrass
	Plus these species:	Beardless wheatgrass	Beardless wheatgrass
	Beardless wheatgrass	Big bluegrass	Big bluegrass
	Big bluegrass	**Plus these species:**	Alfalfa
		Alfalfa	Canada wildrye
		Canada wildrye	Hard fescue
		Hard fescue	Idaho fescue
		Idaho fescue	Western wheatgrass
		Western wheatgrass	Sainfoin
		Sainfoin	**Plus these species:**
			Intermediate wheatgrass
			Meadow bromegrass
			Pubescent wheatgrass
			Smooth bromegrass

Nonirrigated pastures benefit from mixtures of three to five species. Leaving 5 to 6 inches of stubble on dryland pastures as they become dormant promotes strong regrowth the following spring.

Forage species for irrigated pastures

Irrigated pastures offer a longer growing season and a longer period of use by horses and, consequently, have a variety of suitable forage species. The species shown in Table 3 are suitable for irrigated pastures in central and eastern Oregon.

Table 3. Forage Species for Irrigated Pastures

Tall fescue
Orchardgrass
Kentucky bluegrass
White clover
Meadow foxtail
Creeping meadow foxtail
Meadow bromegrass

Grasses that can survive very heavy use, such as tall fescue, are best for exercise areas. Kentucky bluegrass alone or mixed with tall fescue also works well. Options for grazing only or for grazing and hay include orchardgrass, Kentucky bluegrass (alone or with white clover), and tall fescue.

Manage pasture fertility to promote strong stands of grasses and other forages

Like horses, pasture plants need nutrients in adequate and balanced amounts. Fertilizing pastures promotes strong stands of desirable pasture plants, which are better able to compete with weeds. Fertilization also boosts grass production.

Nitrogen, phosphorus, potassium, sulfur, and calcium are the nutrients typically added as fertilizer. Nutrients may come from synthetic or organic sources. Manure and composted manure can provide many needed plant nutrients, including nitrogen, sulfur, phosphorus, and potassium, while improving soil biological activity and tilth. (See "Manage manure and bedding resources," page 26, for more information.)

A soil test is the best way to determine which nutrients are needed and in what amounts. Soil test results typically are good for 2 to 3 years; after that, retest. If results indicate that nutrients are becoming deficient, test every 1 or 2 years. A list of soil testing labs (EM 8677) and directions for taking a soil sample (EC 628) are listed in "For more information," pages 35–37.

Apply phosphorus, potassium, calcium, and lime only according to recommendations based on soil test results. In addition, 20 to 30 lb sulfur/acre/year is recommended for irrigated pastures, unless otherwise indicated by the soil test.

Apply nitrogen based on the need for higher or lower levels of pasture production. (See the recommendations on page 22 for irrigated and nonirrigated pastures.) Monitor the results after fertilizing pastures. The level of pasture production should correspond to your farm's feed needs and should be based on the number of animals and their nutritional requirements.

Do not overapply any fertilizer. Overapplication wastes money and increases the possibility of water contamination. In addition, high nitrogen and potassium applications can cause horse health problems, especially during dry years. Forage crops can take up more potassium than needed.

Soil amendment primer

Each plant nutrient plays specific roles in plant growth and development. Nutrients are discussed here in the order they appear on fertilizer bags: N, P, K, S.

Nitrogen (N) promotes plant growth and reproduction. N fertilizer dissolves in water. Apply it only to actively growing plants. Applying N fertilizer or fresh manure to dormant plants wastes money and threatens water quality.

Phosphorus (P) promotes root and shoot growth. It is essential for young plants. Apply P only if soil test results indicate a shortage of available P. P is supplied by manure and by fertilizers.

Potassium (K) promotes photosynthesis, carbohydrate manufacture, and plant succulence. K dissolves readily in water and attaches easily to soil particles. Apply K only according to soil test results.

Sulfur (S) is necessary for synthesis of chlorophyll and plant proteins. Soil tests only approximate plants' sulfur needs. Sulfur is also applied to alkaline soils (pH above 7) to lower pH. Sulfate does not lower pH.

Lime raises soil pH and is applied to acidic soils (pH below 7). It provides calcium (agricultural lime) or calcium plus magnesium (dolomitic lime). Apply lime according to soil test results. It reacts very slowly. It is much more effective to mix lime into the soil. When top-dressed on established pastures, lime takes years to influence soil pH—surface applications influence only 1 inch per year of soil depth.

Nitrogen fertilization practices for irrigated pastures

High level of pasture production: Apply 40 to 60 lb nitrogen/acre three times a year (March 15–April 15, June 1–15, August 1–15). This approach will optimize the pasture's use of irrigation water and promote vigorous growth throughout the growing season.

Moderate level of pasture production: Allow stored soil resources to provide nitrogen for spring growth. Apply 60 lb nitrogen/acre twice per year (June 1–15 and August 1–15).

Low level of pasture production: Apply 40 to 80 lb nitrogen/acre in a single application (early spring, late spring, or early summer after the spring flush of forage production). This approach, if applied every year, may limit forage quantity and quality over time.

Nitrogen fertilization practices for nonirrigated pastures

From 12 to 18 inches of precipitation: Apply 20 to 30 lb nitrogen/acre in early spring to increase pasture production during the late spring and early summer. Further nitrogen fertilization is not recommended.

Less than 12 inches of precipitation: No nitrogen fertilizer is recommended.

Clovers and other legumes are sometimes added to grass pastures. As noted above, a small amount of legumes can offset some nitrogen fertilizer requirements. Consult your OSU Extension Service office personnel or your fertilizer dealer about fertilizer rates under these conditions, as nitrogen fertilization needs may be decreased or eliminated. These sources can also provide local information about the proper fertilizer, or blend of fertilizers, that will supply needed nutrients economically.

Forage-specific dangers to horses

Some varieties of tall fescue and ryegrass, intended for use as turf, are purposely enhanced with a fungus that grows within the plant. It benefits the plant with increased heat tolerance, drought resistance, and insect and disease resistance, but it also produces a toxin that causes reproductive and other health problems in livestock. Pregnant and lactating horses are particularly vulnerable. When buying seed, be sure to select an Oregon-grown, endophyte-free forage variety of tall fescue or ryegrass.

Use irrigation water efficiently

Many pastures in eastern and central Oregon are "dryland." The plants depend on rain and snowfall—8 to 20 inches per year—to supply their water needs. These pastures are productive during the spring and early summer and sometimes for a brief time in the fall. Unless additional water is supplied through irrigation, the plants are dormant during the summer when hot, dry weather, combined with long days, reduces moisture stored in the soil. Plants also sometimes become dormant again under cold winter conditions.

Figure 3 shows a typical season's water demand by forage plants. Notice that the demand increases sharply from February through July, and then drops off as the days become shorter and cooler.

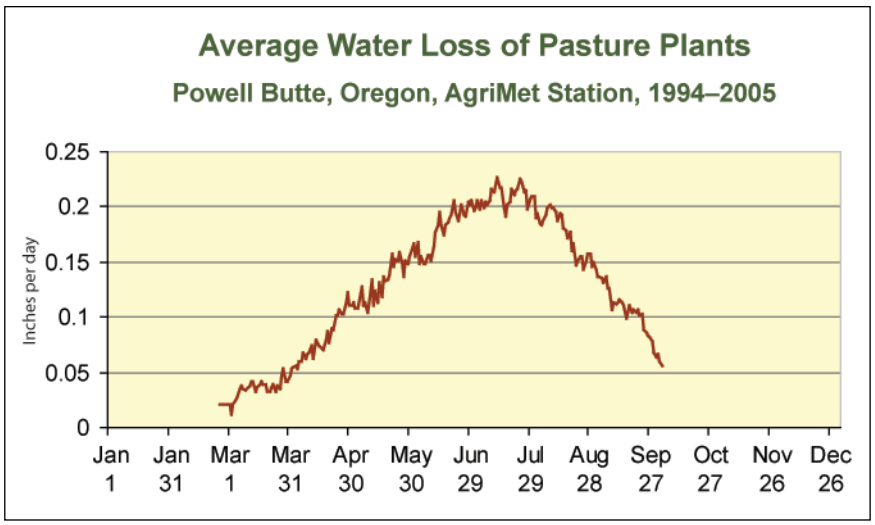

Figure 3. Typical seasonal demand for water by forage plants.

Irrigation, combined with the correct type of pasture plants, nutrients, and grazing management, will maintain active summer growth and provide supplemental feed during dry months. Your ability to irrigate depends on whether your property has irrigation rights.

A number of irrigation methods are available, including flood, K-line, hand- and wheel-line sprinklers, "guns," and pivot irrigation systems. The method you choose will depend on the system that came with the farm; the size of the farm; and the amount of labor, time, and money available. If you use a solid set system for pastures, take care to protect the pipe from curious horses.

Do not leave horses in the pasture while irrigating. To avoid plant damage and soil compaction, wait until the irrigation water has soaked into the soil (typically 2 to 4 days) before turning horses back onto pastures.

Irrigation management is based on matching the plants' water needs with the amount of water applied. For optimal production, pasture

Unless additional water is supplied through irrigation, the plants in many central and eastern Oregon pastures will go dormant during the summer. A number of irrigation methods are available—choose one that is suitable to the nature of your farm.

plants require 26 to 30 inches of water a year. All soils store water. Fine-textured soils, such as clay, can store more than coarser soils such as sandy loams. Sandy soils store little water. Plants absorb water efficiently from the soil until about half of the stored water is used. Irrigation (or rainfall) refills the soil's storage capacity.

Ideally, irrigation refills the soil's water storage capacity and is stopped before water is wasted by running off the field or sinking below the rooting depth of pasture plants. The time between irrigations depends on the season, the weather, your soil's storage capacity, and the rate of plant growth. In the hottest season, a growing pasture uses about ½ inch of water per day.

Irrigation is a technical skill and requires mastery of many details. An irrigation supplement to this publication is available online at (http://forages.oregonstate.edu/resources/publications/fs/IrrigationFactSheet.pdf). An irrigation specialist at your local USDA Natural Resources Conservation Service office can assist in the development of a water management plan. Oregon State University Extension offices also can assist with irrigation questions, resources, and management techniques. You will find sources for more information on irrigation scheduling methods and water use issues on pages 35–36 of this publication.

Step 3. Use buffer strips to protect water

Buffer strips on small-acreage horse farms protect creeks, other surface water, and your wellhead from runoff from paddock areas or manure piles. Buffers can be wide, grassy strips (including your unused pasture) or strips of trees and/or shrubs. The latter stabilize stream or canal banks, filter some pollutants from runoff, and may provide shade. Buffers alone can't prevent contamination of well water or streams, however; the key is to reduce contamination at its source.

Summer pasture/winter buffer

One of the most common buffers consists of irrigated pasture used for grazing or hay in the spring and summer, but left ungrazed as a buffer during times of slow plant growth or potential flooding. This buffer is not a narrow strip along a waterway, but a series of wide, intensively managed pastures. These pastures are grazed and rested throughout a carefully managed rotation to maintain a grass height of at least 3 to 4 inches year-round. Small buffer strips between paddocks can also provide a "buffer" between horses, saving on fence repair and vet bills, while filtering runoff from the paddocks.

Vegetated buffers

Vegetated buffers are valuable along streams to stabilize the bank and provide a natural area for wildlife. These areas can be planted with a variety of trees, shrubs, grasses, and other plants. Exclude horses from these areas or closely monitor light springtime grazing because horses may browse or trample trees and shrubs. If buffers are grazed, minimize horse access to the waterway with permanent fencing or portable electric fencing. This will prevent bank trampling and keep manure out of the water.

How wide should the buffer be?

Buffer width depends on the slope of the field, soil type, and plant density. The minimum width should be 35 feet; however, wider buffers provide greater protection. Increase buffer width under these conditions:

- On steeper sites
- On clay, dense, or compacted soils
- Where plants are widely spaced
- If the area above the buffer is not well vegetated

Width usually is not an issue with summer pasture/winter filter. Almost all pastures are wider than 35 feet. If you don't have room for a buffer between a paddock and drainageway, consider a soil

Why are buffers important?

On farms, a buffer of grass, shrubs, or trees can provide several benefits, including:

- Filtering sediments, manure, pesticides, and bacteria out of water flowing across or through the soil
- Improving infiltration of water into the soil
- Shading streams
- Providing food and cover for wildlife
- Protecting the soil from erosion caused by runoff or floodwater
- Contributing to an attractive landscape

All waterways, including irrigation canals, should be protected from adjacent pastures with buffer strips. The ideal buffer for a natural stream includes a variety of grassy and woody plants.

berm (a raised strip of ground) to catch the runoff and direct it to a filter strip or catch basin.

How do I prepare my grass buffer each fall?

- Leave grass at least 3 to 4 inches tall at all times.
- Do not apply fertilizer or stockpiled manure to the buffer in the fall. The buffer's role is to capture nutrients and bacteria, not release them.
- Remove horses about 30 days before consistent winter conditions or seasonal flooding are expected. Dragging pastures before a hard freeze breaks up manure and prepares it for rains or irrigation. This will allow manure deposited in the field during grazing to break down and provide an opportunity for plant regrowth.
- The buffer period should extend into the spring until soil is no longer saturated, grasses are tall enough to graze or cut, and the chance of streamside flooding has passed.

Step 4. Manage manure and bedding resources

Cover and compost manure

A 1,200-pound horse produces 1 cubic foot of fresh manure every day. This stall waste can be a soil-building resource or a source of muck, weeds, parasites, flies, and water pollutants. Improve your manure handling and composting techniques with these six tips:

- Site manure storage and compost piles to protect surface water.
- Isolate waste piles from streams and irrigation ditches.
- Reduce stall waste volume.
- Cover waste piles to control moisture levels, reduce runoff, and control flies.
- Compost manure.
- Spread manure and compost when plants can use it.

Site manure and compost piles to protect surface water

Consider the soil types on your property when locating long-term, stall-waste storage. Sandy soil drains rapidly, allowing nutrients to travel quickly to groundwater. Water moves more slowly through clay soils, but these soils might permit surface runoff. The other soil types fall between sand and clay in their drainage abilities. Observe the pathways that running water takes across your property.

Why is manure management important?

Proper manure management promotes horse health by reducing parasites in pastures. It promotes pasture health by reducing weed seeds and replacing needed plant nutrients. It promotes water quality by stabilizing nutrients in manure and keeping them from reaching groundwater and surface water.

Distributing manure is important because horses won't eat where they defecate. As a result, areas of tall, untouched grass grow up around manure piles. Harrowing or dragging a pasture once or twice a year is sufficient to spread manure piles. Another effective way is to walk your pasture and kick manure piles apart.

Some pasture managers choose to collect manure and store it throughout the year in a covered pile or compost it until the time is right for spreading.

Do not locate manure storage in low spots, drainageways, or near irrigation ditches. Store all waste above the floodplain so it won't be carried away by high water.

Keep manure away from roof and downspout runoff. Well-planned trenching diverts water away from waste piles (see page 33). Storing stall waste on less desirable sites requires more care and monitoring. Site the manure pile at least 50 feet downslope from your wellhead.

Isolate waste piles from streams and irrigation ditches

Maintain vegetated buffer strips between waste piles and bodies of water to trap flowing contaminants and take up water-carried nutrients (see page 25).

Reduce stall waste volume

There's nothing you can do about the volume of waste a horse produces, but you can affect the size of your manure pile by reducing the amount of bedding used. The amount required to absorb urine is far less than many horse owners provide.

Stall mats provide a cushioned, level surface for standing. They reduce dust and prevent digging. Despite the initial investment, stall mats do reduce bedding costs.

Wood shavings and straw are effective in reduced bedding systems. There is a growing interest in using wood pellets for bedding. These pellets look like wood stove pellets but are manufactured specifically for animal bedding. Pellets are easy to pick, low in dust, more absorbent than shavings, and effectively control ammonia odors. They take up less room in a compost pile than shavings.

Regardless of the bedding used, composting reduces waste volume.

Most stall waste material will compost. Without management, it is a resource going to waste.

Lose your fear of manure!

Many horse owners are reluctant to apply manure to pastures because of the risk of spreading parasites. From a pasture management perspective, however, harrowing is an excellent practice. It breaks up manure and reduces fly habitat somewhat by exposing larvae to the sun's ultraviolet rays. Minimize the risk of parasites by applying manure just before hot, dry weather and after animals have been removed from the pasture. The following practices also reduce parasite larvae in pastures:

- Appropriate stocking rates reduce the amount of parasite larvae deposited on pastures.
- Managed interval grazing interrupts the transmission of parasites.
- Grazing ruminants after horses further breaks the life cycle of parasites. Ruminants are not susceptible to the intestinal parasites that infest horses.
- The vast majority of infective larvae are found on the lower 2 inches of forage plants. Do not graze below 3 inches.
- Composting stall waste and collecting and composting manure deposited on sacrifice areas reduces the numbers of viable parasites.

When manure in pastures is harrowed, however, some parasites are spread, so horses benefit from a deworming program. Follow your veterinarian's recommendations.

Cover waste piles to control moisture levels, reduce runoff, and control flies

Effective manure management requires adequate storage. Size storage areas according to the volume of manure produced.

The most important practice for proper manure management is also the least expensive: cover stall waste piles with a weighted tarp. Water-filled milk jugs tied to the tarp make excellent weights. When evaporation exceeds rainfall, tarping helps maintain adequate moisture. Manure and bedding are difficult to rewet once they dry completely. When rainfall exceeds evaporation, tarping prevents saturated manure piles and undesirable runoff. Tarping also reduces fly habitat.

Covering stall waste is a simple step that helps maintain moisture, reduce runoff, and control flies.

The next level of manure management is to provide a concrete pad and, perhaps, use curbs and weighted rain tarps. Top-of-the-line manure management involves a concrete pad with a roof and, ideally, gutters and downspouts. Many publications show examples of roofed and open storage structures and can help you estimate volumes for adequate storage. Classic three-bin systems can be adapted to many situations.

Compost manure

The specifics of composting techniques vary, so every horse owner can implement a process that best suits his or her site, number of animals, and available equipment.

Inadequate moisture is the number one reason manure piles fail to compost. Check moisture levels when you turn the pile; add more water if needed. You should be able to squeeze one or two drops of moisture out between your fingers, but many drops falling freely

indicates too much moisture. Drip emitters are an effective way to add water to compost piles. Too much water, on the other hand, promotes the growth of odor-causing anaerobic bacteria.

Sufficient aeration speeds composting and promotes heating, which in turn destroys many parasites, flies, and weed seeds. When using sawdust bedding, improve aeration by adding 10 percent by volume of large wood chips. Another method is to lay lengths of 4-inch perforated pipe across the pile every 2 to 3 feet of pile depth, leaving pipe ends exposed. Pipes are often damaged, however, if piles are turned by a tractor.

Tractors and front loaders gain traction when compost is stored on a concrete pad. Turning with heavy equipment is easier if the equipment can push the compost against a reinforced wall. Turn small compost piles by hand.

Spread manure and compost when plants can use it

Spread no more than ½ inch of compost at a time, two times a year, when conditions permit field access and plants are actively growing. Spreading compost in spring is ideal for plant growth. In late summer, short pastures allow efficient compost application shortly before cooler fall temperatures stimulate grass growth. Empty manure storage provides space for the winter's manure and bedding accumulation.

Don't spread manure in late fall when dormant plants are unable to take up nutrients. This practice often leads to surface and groundwater contamination.

Spread compost two times a year—ideally in spring and late summer. Spread no more than ½ inch of compost at a time.

Why is weed control important?

Weeds compete with desirable plants, and some are potentially dangerous to horses. The best weed control strategy is to maintain a healthy, vigorous pasture through proper fertilization and grazing practices. The need for regular herbicide applications to solve weed problems indicates inadequate pasture management. Under good management, desirable plants compete strongly against weeds. Well-managed pastures do not suffer from serious weed problems.

Step 5. Manage weeds to protect your horses

Strategies for weed control

Because horses do not graze all pasture plants to an even height, some mowing may be needed. Mowing a pasture to 3 to 4 inches after moving horses to a new pasture helps control weeds and prevents grasses from developing seedheads and becoming dormant. Mowing after grazing also makes pastures more attractive.

Identify weeds by using various resources (see **Plants, weeds, and toxic plants** in the "For more information" section on page 37) or by taking a sample plant to your local office of the Oregon State University Extension Service. Weeds differ in their life cycles (annual, biennial, perennial), and each type requires different management strategies. They also differ in the threat they pose to a grazing system. Some are toxic, some are noxious, meaning they spread quickly and dominate the pasture, and some are harmless. These factors influence whether and how weeds should be controlled.

Remove established weeds by mowing, pulling, or digging. Sheep and goats eat more broadleaf plants than do horses and can keep weeds under control.

If you choose to use an herbicide, it is critical to time the application to the correct growth phase of the plant. The product label provides information about allowable uses, restrictions, and

Weeds are potentially dangerous to horses. Good pasture management allows desirable plants to compete successfully with weeds.

application timing. It is a violation of federal law to apply a pesticide in a manner inconsistent with its labeling. Read the label and follow the instructions. Follow all safety precautions and grazing restrictions.

The best way to protect horses from toxic weeds is to develop and implement a comprehensive weed control program. A weed control supplement to this publication is available online (http://forages.oregonstate.edu/resources/publications/fs/PoisonFactSheet.pdf). You will find additional resources for weed control on page 37 in the section "For more information."

Six steps to weed control

Major weed problems are rare in well-managed pastures. Grazing management is the best tool in weed control programs. Manage beneficial species so that weeds have a difficult time gaining a foothold. Here are six steps to successful weed control:

1. Identify the weed.
2. Pull, mow, or dig established weeds.
3. Bring in other livestock to graze undesirable plants.
4. Cut off and remove weeds before seed heads develop.
5. If you choose to use an herbicide, select the right one and apply it at the right time in the weed's growth cycle. Read the label and follow all directions.
6. Use the grazing practices outlined in this publication to encourage desirable pasture plants.

Use herbicides safely!

• Wear protective clothing and safety devices as recommended on the label. Bathe or shower after each use.

• Read the herbicide label—even if you've used the product before. Follow closely the instructions on the label (and any other directions you have).

• Be cautious when you apply herbicides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from herbicide use.

Why are gutters and downspouts important?

One inch of rain on a 20 x 50 foot barn roof means 620 gallons of water. In an area that receives 15 inches of annual precipitation a year, that's 9,300 gallons of water a year.

This extra water can create a soupy mess of mud, manure, and urine around a barn, making horses and their owners miserable. It may eventually run off into streams or irrigation ditches and contaminate your household well water.

Gutters and downspouts on your farm buildings direct water away from your high-use areas and help to minimize mud.

Step 6. Install rain gutters and downspouts

Central and eastern Oregon experience annual precipitation ranging from 8 to 20 inches. Although this amount of precipitation may seem insignificant, water from melting snow and heavy rainfall events can saturate pastures and corrals and cause soil erosion. In addition, the roofs of barns and other farm buildings collect large amounts of precipitation and deposit water that can increase problems with mud buildup and soil erosion. You can find precipitation for your location online (http://www.ocs.orst.edu/pub/data_requests/private/maps/orppt.jpg).

Installing gutters and downspouts on your farm buildings directs water away from high-use areas around the barn and immediately reduces the quantity of mud.

Planning for downspouts and gutters

To keep clean water clean, downspouts must direct water away from animal confinement areas. In some instances, you might need to use plastic pipe to carry the water beyond the animal confinement area to a vegetated area. Downspout systems also can be designed to divert water to stock watering tanks for livestock use or into drainage ditches.

Even though the annual precipitation in central and eastern Oregon may seem insignificant, water from melting snow and heavy rainfall can saturate pastures and corrals and cause a soupy mess of mud, manure, and urine around a barn. Gutter and downspout installation is an easy project and well worth the effort.

To protect downspouts from damage, install a physical barrier, such as heavy PVC pipe or a hot wire, or make the downspout inaccessible to horses. In high-traffic areas, bury pipe for protection from horse and vehicle damage.

Some options for gutters

Economical: Installing gutters and downspouts is an easy do-it-yourself project. Home improvement retailers carry a variety of suitable materials. Snow guards reduce the potential of snow and ice damage to gutters.

Top-of-the-line: Numerous businesses specialize in installing aluminum continuous (seamless) gutters. Some businesses also have specialized gutter systems designed for areas that receive large amounts of snow.

Other ways to reduce runoff and mud

The natural drainage of your land may direct water into high-traffic areas around your barnyard. Such water moving downhill through the soil adds significant moisture to farm buildings and sacrifice areas. If this is the case, consider additional ways to divert water, such as French drain lines, drainage tiles, grassed waterways, water bars (like an inverted speed bump for water runoff), ditches, and dry wells. Design help is available from your local Soil and Water Conservation District, USDA Natural Resources Conservation Service, or Oregon State University Extension Service office.

Why is groundwater protection important?

Through proper management of animal waste, you can greatly reduce the risk of contaminating your source of drinking water. Groundwater also supplies your neighbors' wells and eventually runs into streams and rivers.

Practices to protect your drinking water

- Fence horses and other livestock away from your wellhead. Keep livestock and manure piles at least 50 feet from the wellhead.
- Use channels and berms to divert stormwater and drainage away from your wellhead.
- Keep clean water clean and minimize manure-contaminated water by using gutters, downspouts, and pipe to route clean water away from manure and heavy-use areas (see page 32).
- Test well water annually for *Escherichia coli* (*E. coli*) bacteria and nitrate—these indicate a connection with manure, fertilizers, septic-system waste, or similar materials. *E. coli* bacteria should never be present in well water.
- Do not leave a hose immersed in a stock tank. Install an anti-siphon valve for all outdoor hose bibbs, especially those used to water livestock and mix chemicals.
- Inspect your well's sanitary seal. If you have doubts about its integrity, hire a well driller to inspect it.

Step 7. Protect your household water supply

Know your well

To assess the effect you or your livestock have on the quality of your drinking water, first locate your well in relation to your livestock and manure storage areas. Also, locate your septic drain field, petroleum storage tanks, and other potential sources of contamination relative to your well.

Learn all you can about your well. Perform a visual inspection for cracks in the casing or other deficiencies and read your well log. The county well master can help you find this document. These questions may point to items of concern—or relieve your mind:

- Is the well located in a low area of your property?
- Is the wellhead properly sealed, and are the standpipe and screen in place?
- What is the age, depth, and construction quality of your well?
- What is the depth to groundwater?

Check the location, seal, and quality of construction of your well. Test your well water annually for *Escherichia coli* (*E. coli*) bacteria and nitrate, which indicate contamination from manure, fertilizers, or other materials.

For more information

Agencies and organizations

The following sources can provide technical assistance and information about grant programs. Call these statewide numbers or visit their websites to find the local staff person in your area.

Oregon State University Extension Service

Oregon State University Extension Service offers educational programs, seminars, classes, tours, and publications to guide landowners in managing their resources. http://extension.oregonstate.edu/

Oregon Department of Agriculture, Natural Resources Division (ODA)

ODA oversees the Agricultural Water Quality Management (Senate Bill 1010) program, issues permits, helps livestock owners comply with confined animal feeding water management programs, and provides support to Soil and Water Conservation Districts (SWCDs). http://oregon.gov/ODA/NRD; (503) 986-4550

USDA Natural Resources Conservation Service (NRCS)

The NRCS is a federal agency that implements federal cost-share programs to improve management of natural resources on private lands. It works closely with SWCDs (see below). It also provides information on soil types and soil mapping. http://www.or.nrcs.usda.gov; (503) 414-3200

Soil and Water Conservation Districts (SWCD)

SWCDs are subunits of government with locally elected boards. They help landowners improve management of natural resources through technical and financial assistance.

Oregon Association of Conservation Districts
http://www.oacd.org/districts.html; (503) 566-9157; (503) 986-4700

Watershed councils

These local groups bring diverse interests together to resolve local natural resource issues. They conduct watershed assessments, develop and fund watershed enhancement projects, provide educational opportunities, and work with local stakeholders to improve watershed stewardship.

Oregon Watershed Enhancement Board
http://www.oregon.gov/OWEB/WSHEDS; (503) 986-0178

Resources

Horse facility management

Horse Facilities Handbook, Eileen Wheeler, editor (Midwest Plan Service, Iowa State University, 2005). Purchase at: http://www.mwps.org/

Horsekeeping on a Small Acreage: Designing and Managing Your Equine Facilities, 2nd edition, Cherry Hill (Storey Publishing, Pownal, VT, 2005)

Horses for Clean Water, Alayne Blickle, director. http://www.horsesforcleanwater.com/

Pasture and grazing management

Grass Growth and Regrowth. http://forages.oregonstate.edu/projects/regrowth/

Grazing Management. National Forage and Grasslands Curriculum. http://forages.oregonstate.edu/main.cfm?PageID=4#

Greener Pastures on Your Side of the Fence: Better Farming with Voisin Grazing Management, Bill Murphy (Arriba Publishers, Colchester, VT, 1998).

Horse Forage and Forage Management (Noble Foundation Horse Pastures). http://www.noble.org/Ag/Forage/HorseForage/

Management of Small Pastures (University of California Agriculture and Natural Resources publication #2906). http://ucanr.org/pubs.shtml

Management-intensive Grazing. The Grassroots of Grass Farming, Jim Gerrish (Green Park Press, Ridgeland, MS, 2004).

Pasture and Hay for Horses (Penn State University). http://pubs.cas.psu.edu/FreePubs/pdfs/uc099.pdf

Pasture Management for Horses on Small Acreage (Colorado State University). http://www.ext.colostate.edu/PUBS/livestk/01627.html

Rotational Grazing: Livestock Systems Guide (ATTRA—Appropriate Technology Transfer for Rural Areas). http://www.attra.org/attra-pub/PDF/rotgraze.pdf

Small Pasture Management Guide for Utah (Utah State University Extension Service). http://extension.usu.edu/files/agpubs/Pasture.pdf

Small Ranch Manual: A Guide to Management for Green Pastures and Clean Water (University of Nevada Cooperative Extension, EB-95-02).

Statewide Small Lot Acreage Program (Colorado) for Horse Owners, 1992. Boulder Valley Conservation District, 9595 Nelson Road, Box D, Longmont, CO 80501, (303) 776-4034.

Utilizing Soil-Moisture Monitoring to Improve Alfalfa and Pasture Irrigation Management, S. Orloff, B. Hanson, and D. Putnam (Plant Management Network, 2003). http://www.plantmanagementnetwork.org/pub/cm/management/2003/moisture/

Who's Coming to Dinner? Livestock Eating Habits and Their Effects on Grazing Management (Oregon State University Extension Service video, VTP 28, 1998).

Forage species for the West

Forage Information System. http://forages.oregonstate.edu/

Idaho Forage Handbook, 3rd edition (University of Idaho publication 547, Moscow ID, 2005). http://info.ag.uidaho.edu

Montana State University Extension Forage Program Grass Species List. http://www.animalrangeextension.montana.edu/articles/Forage/Species/Grasses/GrassSpeciesList.htm

Soil and fertility analysis

Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis (Oregon State University Extension Service publication EM 8677, revised 2006). http://extension.oregonstate.edu/catalog/html/em/em8677/

Soil Sampling for Home Gardens and Small Acreages (Oregon State University Extension Service publication EC 628, revised 1995). http://extension.oregonstate.edu/catalog/html/ec/ec628/

Horse nutrition

Basic Horse Nutrition (University of Kentucky). http://www.uky.edu/Ag/AnimalSciences/extension/pubpdfs/asc114.pdf

Feeding Horses: A Practical Approach 21134 (Suburban Rancher) (University of California Agriculture and Natural Resources). http://ucanr.org/pubs.shtml

Plants, weeds, and toxic plants

Cornell University Poisonous Plants Informational Database. http://www.ansci.cornell.edu/plants/index.html

Field Guide to Plants Poisonous to Livestock: Western U.S., Shirley A. Weathers (Rosebud Press, Fruitland, UT, 1998).

Guide to Poisonous Plants (Colorado State University). http://southcampus.colostate.edu/poisonous_plants/index.cfm

Horse Owner's Field Guide to Toxic Plants, Sandra Burger (Breakthrough Publications, 1996).

The USDA ARS Poisonous Plant Research Laboratory. http://ars.usda.gov/main/site_main.htm?modecode=54-28-20-00

USDA Natural Resources Conservation Service Plant Links. *Poisonous and Medicinal Plants*. http://plants.nrcs.usda.gov/cgi_bin/link_categories.cgi?category=linkpoison

Weeds of the West (Western Society of Weed Science, revised 2001). Distributed by Oregon State University Extension Service, 422 Kerr Administration, Corvallis, OR 97331; fax (541) 737-0817; e-mail: puborders@oregonstate.edu.

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Acknowledgments

The authors thank faculty at Colorado State University, University of Idaho, Montana State University, and Utah State University for their review and technical advice. The authors also thank horse farm owners Holly Endersby of Pollock, Idaho; Sally Kuhl of Bend, Oregon; and Liz Lotochinski and Andy Zook of Bend, Oregon, for their review and guidance.

Published November 2007.