**MANURE**

INTRODUCTION. If you own a horse or horses, you are probably intensely concerned about your animals’ welfare. You have acquired an encyclopedic knowledge of feeds, footing, tack, training, and a universe of husbandry items that can affect animal welfare. But there are less direct environmental issues that have an effect on horses’ health.

Any time a large group of animals congregates in a small space, waste management becomes a concern. Just as managing trash and sewage from urban areas is key to human health, so managing manure is vital to horse health.

Pathogens are organisms (fungus, helminths, virus, protozoa, bacteria) capable of producing infectious disease. Bacteria are microscopic, single-celled organisms that are the most numerous organisms on earth. They are so small that over five million could be placed on the head of a pin. Bacteria can live in numerous environments and perform many complex actions, some of which are beneficial and some harmful. Most bacteria, however, are not harmful and do not cause human health problems. Those that are disease producing are referred to as pathogenic.

Coliform bacteria are part of the Enterobacteriaceae family and individual cells cannot be seen with the naked eye due to their small size (but colonies can be seen.) While some coliform bacteria can be naturally found in soil, the type of coliform bacteria that lives in the intestinal tract of warm-blooded animals and originates from animal and human waste is called fecal coliform bacteria. *Escherichia coli* (*E. coli*) is one subgroup of fecal coliform bacteria. Even within this species, there are numerous different strains, some of which can be harmful. However, the release of these naturally-occurring organisms into the environment is generally not a cause for alarm. But, other disease causing bacteria, which can include some pathogenic strains of *E. coli*, or viruses may also be present in these wastes and pose a health threat.

Trying to detect disease-causing bacteria and other pathogens in water is expensive and may pose potential health hazards. Further, testing for pathogens requires large volumes of water, and the pathogens can often be difficult to grow in the laboratory and isolate. *E. coli* bacteria are good indicator organisms of fecal contamination because they generally live longer than pathogens, are found in greater numbers, and are less risky to collect or culture in a laboratory than pathogens. However, their presence does not necessarily mean that pathogens are present, but rather indicates a potential health hazard. The EPA has determined that *E. coli* are one of the best indicators for the presence of potentially pathogenic bacteria.

*A little boy runs across a rancher with a truckload of horse manure.*

*The boy asks the rancher what he is going to do with all that poop.*

*The rancher says, “I am taking it home to put on my strawberries.”*

*The boy looks confused and says,*

*“Where I come from we put cream and sugar on our strawberries.”*

PARASITES IN MANURE. Horse owners become experts on manure. I have more than a dozen horses on my ranch, but if you bring me a random sample of manure from my ranch, I can probably tell you which horse produced it. Horse manure is not unpleasant to work with. I truly enjoy the time spent raking it into wheel barrows, my horses around me, my mind wandering. But as benign as it seems, proper management is essential to environmental and horse health. Manure, of course, is the place where many horse parasites live out part of their life cycle. These parasites include:

• Large strongyles (*Strongylus vulgaris* and *Strongylus edentatus*), bloodworms. Large strongyles migrate through the blood vessels, destroy arteries and organs.

• Small strongyles (subfamily Cyathostominae), red worms. Small strongyles, unlike large strongyles, stay in the intestinal tract, and do not move to other organs.

• Ascarids (*Parascaris equorum*), roundworms. Ascarids cause respiratory problems in the immature stage, and as adults move to the small intestine where they cause colic, ruptured gut, blockage, and can cause death.

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• Pinworms (*Oxyuris equi*). Causes itch around the tail region.

• Intestinal threadworms (*Stronyloides westeri*). If diarrhea doesn’t clear up with wormer, you may have threadworms.

While many of these parasites can be killed with worming medication, they can also become resistant to common wormers. The safest approach is to use wormer AND effective manure management practices.

DISEASE VECTORS IN MANURE. Excellent fly-breeding conditions occur in mixtures of manure, urine, spilled feed, and moist bedding. Moisture is a fly and wasp magnet. Flies promote serious conditions such as conjunctivitis, and *Habronema muscae*. *Habronema* infects both horses and flies. Fly maggots ingest nematodes in horses’ feces. The nematodes are then carried by the fly to moist areas on a horse, such as eyes, mouth, penis, or wounds. There they cause irritated areas called “summer sores.” When the nematodes in these sores are licked and swallowed by the horse they travel to the stomach and imbed themselves into the [mucus exudates](http://en.wikipedia.org/w/index.php?title=Mucus_exudates&action=edit&redlink=1).

Mosquitoes, which can carry diseases such as West Nile virus, require standing water to reproduce; therefore, it is imperative to prevent ponding of water. Look for upright buckets that could catch rainwater. Change out water barrels every week in winter and every three days in summer.

CONTAMINATION FROM MANURE. Our horses eat poop and drink standing water, whether we want them to or not. As an avid trail rider, I know that my horses love to smell and taste many disgusting things. My mustang mare thinks living and dead cows are terribly frightening, but a long-dead possum is fascinating and she likes to put her nose right on a smelly little corpse. She likes to drink from muddy puddle water, from streams, and all of my horses like to taste salty ocean water. Thus it is important to keep the water on and off ranches clean.

The feces of horses carry severa bacterial that can cause dermatitis in horses. Moisture in stalls (urine) can promote thrush. Feces in the runoff can spread various viral and bacterial illnesses, even if the horse doesn’t drink the water. Just getting polluted water on his legs, and then scratching his legs with his teeth can be enough. Even if your horse has no known illnesses, it can spread bacteria or viruses that are not problematic to your horse, but may be to others.

Horse manure runoff into waterways may produce fecal coliform contamination levels that can be potentially hazardous to fish and anyone who drinks that water. *Escherichia coli*, *Listeria monocytogenes*, *Salmonella spp*. and *Clostridium tetani* can be present in horse manure and are pathogenic to humans. Protozoan pathogens such as *Cryptosporidium spp*. can be found in horse manure and are known to cause waterborne human disease.

HOW TO REDUCE PARASITES, VECTORS, AND DISEASES. The County of San Diego’s Watershed Protection Ordinance states that manure from stalls must be cleaned up at least twice weekly and composted or stored in a manner that prevents contact with runoff prior to disposal. There isn’t a lot of pasture in this area, but there are guidelines for pasture management, too:

1. Mow two to four times a year and chain harrow (drag) to break up manure piles and expose parasite eggs to the elements.

2. Don’t overstock.

3. Practice rotational grazing if possible.

4. Graze young horses separately from older horses; the younger horses have a higher susceptibility to parasites.

5. Deep harrow or plow pastures that are badly parasite-infested. Deep plow pastures and reseed every three to five years. This also helps break parasite cycles.

For those of us who do not have access to pasture, the manure must be removed altogether from our site, or else properly managed.

**An average 1,000-pound horse produces 9 tons of manure a year (50 pounds per day). Add to that an additional cubic foot of bedding material and you get 730 cubic feet per year from one horse.**

Many ranches pay a waste management company to remove manure. It is usually to a composting facility that produces soil amendments. Onsite composting is another way to promote horse health and avoid environmental contamination. It reduces the substrate available for flies. Only the outside portion of the compost provides the appropriate conditions for egg laying, and this can be made unusable by flies by: Covering with mulch or soil, or by turning every two to three days.

OK fine, composting is good for the horses, fights erosion, promotes groundwater recharge, makes a wonderful soil amendment, and it’s always nice to save the planet. Franklin D Roosevelt said,

***The nation that destroys its soils destroys itself.***

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Thus composting shows your patriotism. Horse manure is just about a perfect soil amendment. Optimal carbon to nitrogen ratios in soil amendments run about 35:1.

**MATERIAL C:N RATIO**

Wood Chips 400:1

Leaves 60:1

Straw 50:1

Pure Horse Manure 30:1

Coffee Grounds 20:1

And yes the tree huggers point out that soils, especially soils made high in carbon through composting, do more to sequester carbon and prevent global warming than all the plants on the planet do, combined. But really, all of this benevolence is irrelevant to the ranch manager who is just trying to make ends meet.

*Composting manure and using it onsite is often a financially good option because transporting materials offsite takes, fuel, time, and money.*

Larger ranches may produce more than they can use onsite. If a ranch produces more than it can use, neighboring farmers may be able the land-apply it on cropland. Plant nurseries and schools may take it. When providing uncomposted manure to a farmer for land application, it should not be applied to land that is highly erodible, frozen or saturated. To protect water sources from manure runoff, do not spread manure within at least 150 feet of a drainage. It is best to incorporate manure into the soil as soon as possible. Mixing the manure with the soil immediately reduces losses of manure nutrients to runoff and volatilization, and reduces odor problems associated with manure left on the soil surface. Additionally, be aware that uncomposted manure can be high in salts, and can have weed seeds, so the crop uses for uncomposted materials should be able to tolerate these possibilities.

Another option besides just composting is to make a marketable fertilizer. However, this is a more technical operation, and may require permitting if you plan to sell the product. The compost generated from horse manure will not be high enough in nitrogen for most fertilizer applications. Average fertilizer content in horse manure is about 19 pounds of nitrogen per ton of manure. By comparison, a ton of fertilizer contains about 200 pounds of nitrogen. To produce marketable fertilizer, nitrogen should be added.

Various forms of nitrogen compounds are available, including ammonium nitrate, ammonium sulfate, and urea. Ammonium nitrate is more expensive, but it provides nitrogen in a form plants can easily use, it has less impact on pH, and lower ammonia volatility. Ammonium sulfate is inexpensive but it is acidic. Urea can be pungent, with high ammonia volatility. It can also raise the pH. Given these differences, it is best to identify a user of the compost first, and decide upon a nitrogen amendment based on the needs of the crops.

HOW TO MAKE COMPOST.

1. Site Selection. Proper site selection for the storage and composting areas is important to safeguard against surface and groundwater contamination. Place stockpiles at least 150 feet away from drainages, ponds, and wells. Establish and maintain buffer areas, preferably vegetated, between drainages and manure piles. You may need to construct a perimeter ditch or berm around the storage area, if needed, to prevent runoff onto or off of the area. Adequate composting area allows for greater flexibility in timing of turning, watering, and manure use. Therefore, be sure you have a large enough area.

* High, level dry area near the point of manure collection, with a hose nearby.
* Locate the compost pile on compacted soil or concrete or asphalt pad.
* Leave a buffer between the compost and any drainages.
* Locate bins out of view and downwind from neighbors.

2. What Size Bin is Necessary?

* Two 5’ x 5’ x 5’ compost bins is sufficient for two horses. One of these size bins will hold approximately 16 wheelbarrow loads of manure/ bedding.
* For 3 horses or more, three bins should be used. The advantage of a three-bin system is that it allows the contents of one bin to be turned into another bin. One bin is for daily wastes, another bin is full and composting, and the third is for finished compost.
* If manure fills up more than six bins, you may want to consider a windrow composting system.

## You can buy bins already made, or build your own. Here is one design:



**Materials**

* Four 12-foot lengths of pressure-treated 2 x 4 lumber
* Two 10-foot lengths of pressure-treated 2 x 4 lumber
* One 10-foot length of construction-grade 2 x 4 lumber
* One 16-foot length of 2 x 6 lumber
* Six 8-foot lengths of 1 x 6 lumber
* A 22-foot length of 36-inch-wide 1/2-inch hardware cloth
* 16d galvanized nails (2 pounds)
* Poultry wire staples (250)
* Twelve 1/2-inch carriage bolts, 4 inches long, with washers and nuts
* One quart wood preservative or stain

**Materials for lids**

* One 4-x-8-foot sheet of 1/2-inch exterior plywood
* One 4-x-4-foot sheet of 1/2-inch exterior plywood
* Six 3-inch zinc-plated hinges
* Twenty-four 3/16-inch galvanized steel bolts, with washers and nuts

**To build a wood and wire three-bin system**

* Cut two 31-1/2-inch and two 36-inch pieces from a 12-foot length of pressure-treated 2 x 4 lumber. Butt-joint and nail the four pieces into a 35-inch x 36-inch "square" (Figure b). Repeat, building three more frames with the remaining 12-foot lengths of 2 x 4 lumber.
* Cut four 37-inch lengths of hardware cloth. Fold back the edges of the wire 1 inch. Stretch the pieces of hardware cloth across each frame. Make sure the corners of each frame are square and then staple the screen tightly into place every 4 inches around the edge. The wood and wire frames will be dividers in your composter.
* Set two dividers on end, 9 feet apart and parallel to each other. Position the other two dividers so that they are parallel to and evenly spaced between the end dividers. Place the 36-inch edges on the ground. Measure the position of the centers of the two inside dividers along each 9-foot edge.
* Cut a 9-foot piece from each 10-foot length of pressure-treated 2 x 4 lumber. Place the two treated boards across the tops of the dividers so that each is flush against the outer edges. Measure and mark on the 9-foot boards the center of each inside divider.
* Line up the marks, and through each junction of board and divider, drill a 1/2-inch hole centered 1 inch from the edge. Secure the boards with carriage bolts, but do not tighten them yet. Turn the unit so that the treated boards are on the bottom.
* Cut one 9-foot piece from the 10-foot length of construction-grade 2 x 4 lumber. Attach the board to the back of the top by repeating the process used to attach the base boards. Using the carpenter's square, or measuring between opposing corners, make sure the bin is square. Tighten all the bolts securely.
* Fasten a 9-foot length of hardware cloth to the back side of the bin, with staples every 4 inches around the frame.
* Cut four 36-inch-long pieces from the 16-foot length of 2 x 6 lumber for front runners. (Save the remaining 4-foot length.) Rip-cut two of these boards to two 4-3/4-inch-wide strips (save the two remaining strips).
* Nail the 4-3/4-inch-wide strips to the front of the outside dividers and baseboard so that they are flush on the top and the outside edges. Center the two remaining 6-inch-wide boards on the front of the inside dividers flush with the top edge and nail securely (Figure 3c).
* Cut the remaining 4-foot length of 2 x 6 lumber into a 34-inch-long piece, and then rip-cut this piece into four equal strips. Trim the two strips saved from Step 8 to 34 inches. Nail each 34-inch strip to the insides of the dividers so that they are parallel to, and 1 inch away from, the boards attached to the front. This creates a 1-inch vertical slot on the inside of each divider.
* Cut the six 8-foot lengths of 1 x 6 lumber into 18 slats, each 31-1/4 inches long. Insert the horizontal slats, six per bin, between the dividers and into the vertical slots.
* (Optional) Cut the 4-x-8-foot sheet of exterior plywood into two 3-x-3-foot pieces. Cut the 4-x-4-foot sheet of exterior plywood into one 3-x-3-foot piece on one of the three bins, and attach each to the back, top board with two hinges.

3. What Size Pile is Necessary?

For small tractor and hand operations, the windrow should be about three to 5 feet high. A pile size of 4 feet by 4 feet by 4 feet is needed to achieve composting temperatures. Base width of the pile should be twice its height.

4. Turning.

Turning keeps the piles aerated, and raises the temperature in the core area. Compost needs to be at least 120 degrees.

**A compost thermometer can cost $20 to $100 or more.**

**It is a very worthwhile investment.**

**It provides the best indication of how successful the compost is at achieving temperatures that kill disease, vectors, and produce a soil product.**

5. Covering.

Covering the compost or storage area with a tarp, mulch, or even dirt helps retain moisture, and further reduces vector-producing substrate. Even if you don’t usually tarp it, do so during rain events, to avoid runoff contamination.

6. Watering.

The compost should be kept about as moist as a wrung-out sponge (30-40% dry matter). Never should the compost be sloppy wet, no runoff should leave the area.

7. Drawbacks of Composting.

In arid Southern California, one of the most significant drawbacks is that composting requires the addition of water. There is no big downside to letting it be drier than it should be for awhile, just know that decomposition will slow dramatically when you do, and the temperature will drop.

The other drawback of composting is the time and work entailed in doing it properly. To avoid vector problems and keep temperatures up, piles should be turned about once per week. Piles should be turned when temperatures fall below 110º F or above 140º F. Depending on the temperature and other factors it can take several weeks to produce a finished product, and if the compost is to be used on food crops, the longer end of processing time should be used. Ranch managers must consider the financial and other value of compost against this cost and make their decisions about composting accordingly.

THE BAD NEWS. Even if the ranch where your horses live is doing a wonderful job of minimizing vectors, parasites, and diseases, the ranches around you may not be. When that is the case horses are still vulnerable. Flies and runoff do not respect property boundaries. Birds to not read “no trespassing” signs.

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Be on the Pollution Patrol.

BUT, there is no need to tell your neighbors how to run their ranches.

Instead, inform the County of fly, runoff, or mosquito problems that could impact the health of others. Source of the complaint is always kept anonymous. If you are feeling guilty about ratting out the neighbors, it might help you to know the consequences:

1) First response to a residential complaint is an educational visit.

2) A compliance officer follows up to see if the problem has been corrected.

3) A notice of violation may be issued if problem persists- this is basically an official warning.

4) Administrative citation may eventually be issued with a $100, $200, $500, or $1000 fine. Citations are the last resort.

ABOUT THE AUTHOR. Lisa Wood has a BA in biology from UC Berkeley, and a MS in biology from San Diego State. She emphasized ecology during her studies, and was always interested in practical, environmental matters. Professionally she has worked as a private environmental consultant. For the last 23 years she has been in the public sector, working for the City of San Diego. She works in the Environmental Services Department on policy issues, as well as on projects, such as recently modifying the permits for the large composting operation located at the Miramar Landfill.

As a child, throughout her school years, and as she entered her professional life, she always maintained a side business working with horses. From taking out stable rides, mucking stalls, and exercising endurance horses, to starting foals and correcting problematic behaviors, she had the opportunity to work with many breeds in different riding disciplines. Later in life she became renowned for her “long rides.” These included a 1,500 miles trip up the coast of California and a 3,000 mile ride from California to Virginia. (The cross country ride was on the mare that likes to smell road kill and drink muddy puddle water.)

She has written two award-winning books on her long rides. Readers insist they finish the books inspired to take on challenges. Lisa’s ranch is located in Lakeside. She boards and trains horses and gives riding lessons. You can find out more about her books, her horse ranch, and Lisa at her website [www.thetrailblazerranch.com](http://www.thetrailblazerranch.com)