University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Riding Arena Footing: Materials and Characteristics

Claire Burnham, Morgan Hayes, and Staci McGill, Biosystems and Agricultural Engineering; and Robert Coleman, Animal and Food Sciences

This publication provides an overview of riding arena footing. Many factors must be considered when planning to build an arena or in determining how to care for an existing arena. This basic guide explains how arenas are structured, describes the components that generally make up arena surfaces, and discusses various considerations that apply to all arenas.

Structure of Arena Surfaces

Footing

The footing is comprised of the following three layers (Figure 1).

Top: The actual riding surface. This layer is lighter, less compact, and can be composed of many different primary components and additive combinations. Depending on use, this layer is often two to six inches thick.

Base: The solid, compacted layer between the sub-base and the top layer. Usually, this layer is six to eight inches thick, depending on arena use.

Sub-base: The lowest part of the arena surface, usually made up of the existing soil structure or added rock to promote drainage. The sub-base can include multiple layers.

Crown

The crown is a raised area in the middle of the arena that promotes drainage to the sides and outside of the arena. Crowns are only necessary in outdoor arenas, due to variable rainfall. The suggested slope for the crown is 1 to 2 percent. Outdoor arenas can be built with either a crown or with an elevated, well-drained surface. Crowns are often used in arenas with less permeable surfaces to eliminate ponding of water. The crown is typically developed during the initial earthwork and is present in both the sub-base and base layers. A crown will affect maintenance protocols; one must be sure not to damage the crown by not crossing over the center of the arena and by dragging from end to end whenever possible.

Footing Materials

Sand

Sand is a very common footing material due to its availability, durability, and drainage capacity. It is a granular component; often described as broken-down rock particles characterized by size, shape, and composition.

Particle Size: Sand particles can be broken down into fine, moderately coarse, and coarse particles. Most arenas utilize coarse sand to promote drainage and reduce dust concerns (Table 1).

Shape: Particles are either angular or rounded (Figure 2). Shape is often a product of the weathering mechanism that acts to shape the grains of sand. More angular particles pack together easily; rounded particles remain spaced apart.

Composition reflects the origin of the sand or mineral particle (location and geologic layer) and affects the durability of the sand. The most common origin rocks for arena use are sedementary (commonly known as limestone), quartz (found in igneous, metamorphic, and sedimentary rocks), feldspar (found in both igneous and metamorphic rock), and river rock (mineral composition dependent on location).

Figure 1. Three layers of footing.

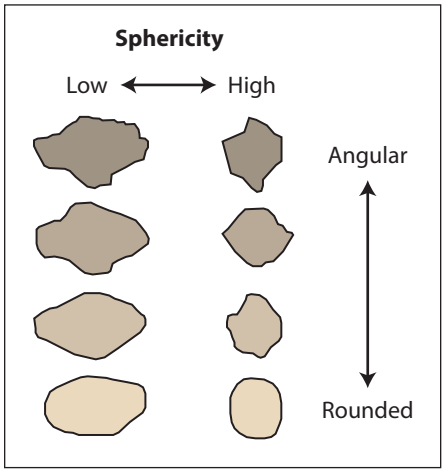

Figure 2. Shape of sand. Donnie Stamper, adapted from Sphericity of Grains on *Oil On My Shoes – Introduction to Petroleum Geology.*

The different origins of rocks will affect the strength of the rocks and the relative durability. The Mohs hardness scale rates the hardness of different materials from 1 to 10 (Figure 3). Sands with mineral

Table 1. Sand size.

Size descriptor	Particle size	Sieve size	General usage
Fine sand	0.075 mm - 0.3 mm	#40 - #200	Plastering
Moderately coarse sand	0.425 mm - 1.18 mm	#10 - #40	Mortar and masonry
Coarse sand	2 mm - 4.75 mm	#4 - #10	Concrete

composition that are higher on the Mohs hardness scale are more likely to resist breaking down.

There are many commercially available types of sands with different regional names and with different characteristics, depending on where the sand is obtained. Following are some common names and their respective descriptions. The primary type of sand used in arena footing is mineral sand, which is formed by the weathering of igneous, metamorphic, or sedimentary rocks.

- **River sand:** Sand sourced from riverbanks and riverbeds. It is usually of varying origin, and this variance depends on the location of the river source. River sand particles tend to be rounded, as they are smoothed by the action of water sweeping particles downstream over time.
- **Silica sand:** A type of sand composed of quartz, which tends to be very hard and resistant to breakdown.
- **Class I sand:** A limestone-based sand. Can be an inexpensive option but will be softer and less resistant to breakdown.

Sorting and grading refers to the variation of size particles within the sand (Figure 4). Typically, uniformly graded (well sorted) sand is best for arenas, though some disciplines and riding styles want some variability. Well-sorted sand also provides good drainage.

Processing

Natural: Sand particles shaped by weathering from water, wind, and movement.

Artificial: Sand particles shaped by man-made processes.

Washed: A form of processing that screens sand to ensure that particles are of similar size. Washed sands will be uniformly graded. They have fewer fine particles, which reduces dust.

Crushed Rock/Construction Aggregate

Crushed rock or construction aggregate is more common in outdoor arenas because it can be very effective at draining water. It does not compact easily if it is poorly or uniformly graded, but well-graded mixtures can be compacted. This tendency for crushed rock to become compacted is dependent upon the size, sorting, and gradation. The characteristics of crushed rock are similar to that of sand in the variation of size, shape, and composition. Often, crushed rock or construction aggregate is used as the sub-base or base for the footing (Table 2).

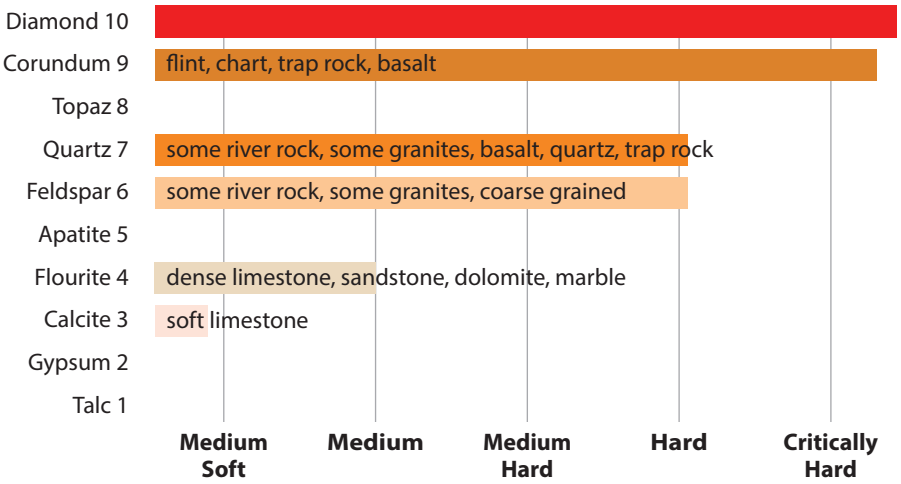

Figure 3. Mohs mineral hardness scale. Premier Equestrian.

Table 2. Particle size.

Size #	Size of Particle
1	90-37.5mm or 3.5-1.5″
3	50-25mm or 2-1″
5	25-12.5mm or 1-0.5″
8	9.5-2.36mm or 3/8″
57	25-4.75mm or ¾″
67	19-4.75mm or ¾″ and smaller

Rubber

Rubber is often seen as a footing additive, but some choose to use it as a primary component. As a primary component, crumb rubber or shredded rubber can have relatively little dust. It is believed to increase shock absorption, which is a common reason it is used as an additive to the primary component. It has a low freezing point, which is beneficial in cold climates where riders want year-round arena usage. Rubber is also affordable.

Rubber is commonly sourced from recycled materials. The source is especially important when the rubber is a recycled material, as it can potentially contain toxins or even metal particles. It is important to determine that the recycled rubber used as a footing material does not contain any materials or additives that may pose health concerns for horses or humans.

Rubber will break down with time, as will any primary component, but it can last longer than other materials.

Soil Mixtures

Soil is a highly variable material that refers to a mixture of sand, silt, and clay. The mixture within the soil can vary greatly and is dependent on the soils that are regionally available (Table 3 and Figure 5).

High proportions of clay in soil tend to produce a footing that is slippery when wet and solid and hard when dry. It is highly compressible, making the management of compaction important.

Table 3. Soil mixture materials and characteristics.

Material	Particle Size	Characteristics
Clay	Less than 0.002mm	Retains water well, and particles tend to stick together. Clay particles are the source of most of the chemical properties of the soil, and they can react with organic material. Very easily compacted due to small particle size.
Silt	0.002mm-0.05mm	Retains water but also readily releases water.
Sand	0.075mm-4.75mm	Particles do not stick together or retain water as readily. Allows water to pass through relatively easily.
Adapted from AASHTO Pavement Manual Chapter 3: Materials Characterization.		

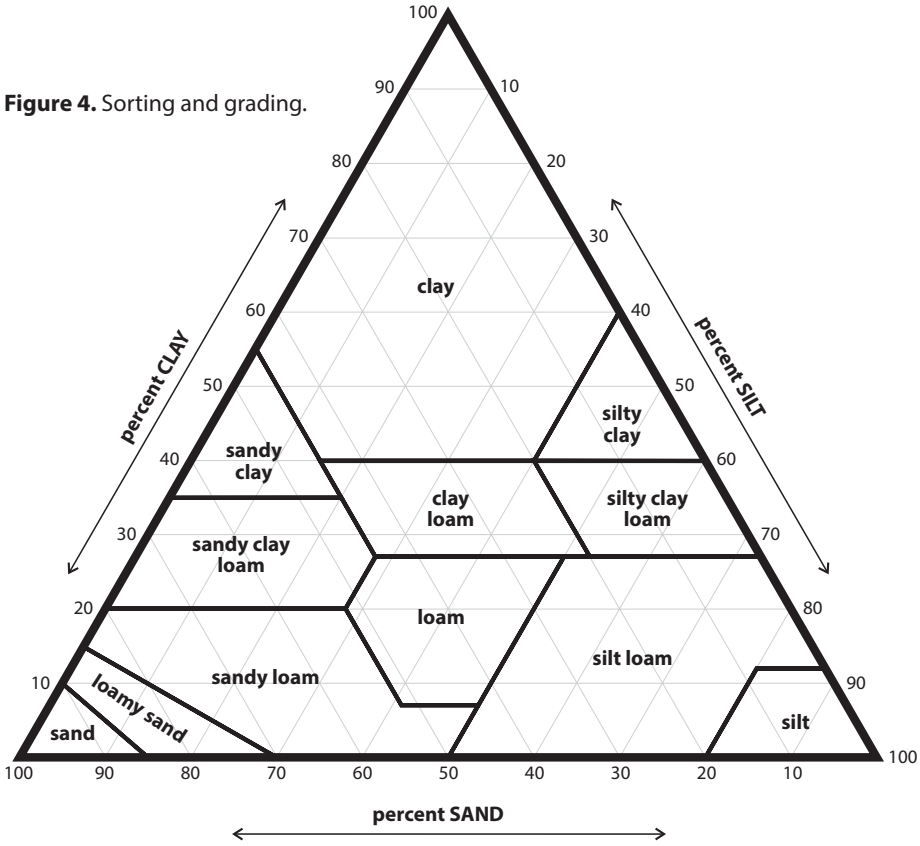

Figure 4. Sorting and grading.

Loam is simply a specific blend of sand, silt, and clay, usually with a lower percentage of clay and higher capacity for holding water.

Wood Chips

Wood chips are a softer footing material that can provide a lot of cushion. Wood chips retain water well but break down relatively quickly and thus pose dust concerns. As a primary component, wood chips require a greater amount of water for dust suppression, which can contribute to freezing in cold climates. Riders in certain disciplines prefer this surface because it tends to be softer. It is generally considered a more affordable option for arena footing.

Common Additives

Whatever the primary component used, it will break down over time. Additives are used to extend the life of the primary footing component and to reduce dust, increase cushion and shear strength, and facilitate drainage.

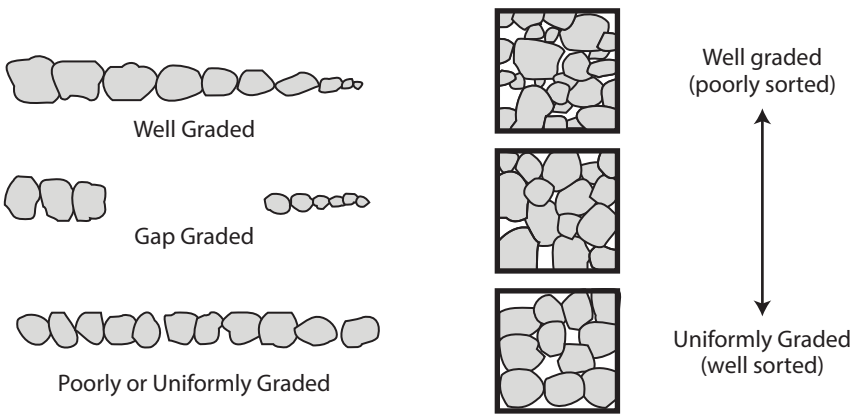

Figure 5. Soil composition in terms of sand, clay, and silt portion. Figure from https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167.

Fiber

Fiber is added to arena surfaces to add stability, to cushion the surface, and to increase the lifetime of the footing. The fibers act similarly to the root system of a plant in soil, which prevents erosion and gives a firmer surface. Fiber can also promote proper drainage of water throughout the footing material. Fibers are said to increase the shear strength of footing, meaning that the addition of fiber to a primary component will increase the primary component's resistance to force.

Many different types of fiber, textile, and fabric can be added to arena surfaces, although synthetic fibers (polyester, polypropylene, nylon) are more common than natural. Synthetic fibers tend to be hydrophobic, meaning they repel water; natural fibers are often hydrophilic and attract water. Hydrophobic fibers can still absorb water, but they do not retain it to the extent that hydrophilic fibers do.

Fiber is commonly added to arenas with a primary component of sand, either sold or created initially as a blend or incorporated into an existing sand arena.

Synthetic fibers are available in various lengths and from different sources. Some are marketed as recycled carpet fibers, and others are produced specifically for use in arena surfaces.

Longer fibers tend to increase shear strength more, but excessively long fibers can be difficult to mix into the primary component. There is a happy medium for fiber length, but this is dependent on many different factors, including the primary component itself, the desired surface characteristics, and even the availability and cost of product.

Rubber

While sometimes used as a primary component, crumb or shredded rubber is also incorporated into other primary components as an additive. Adding rubber can reduce compaction and concussion and increase drainage of the primary component.

Crushed Rock/Construction Aggregate

Adding crushed rock as an additive can help promote drainage of the primary component, reduce compaction (depending on particle size), and is dependent on many of the factors discussed above (size, source rock, etc.).

Other Considerations

A show or event facility will have an arena footing blend that lends itself to higher animal traffic patterns and heavy usage. The footing must be formulated and cared for in order to handle heavy traffic. Traffic includes the increased number of animals working on the surface, as well as larger and heavier equipment and drags used more frequently. This maintenance can also affect how a horse moves over the arena surface. Show facilities may have bias toward a specific discipline or may be adaptable to multiple disciplines. Adapting arena surfaces to multiple disciplines and uses can pose some difficulty depending on the variation necessary within the footing. Larger facilities may have different footings or different arenas with different footing depending on the range of events they host.

A boarding facility that caters to several disciplines will have to consider high usage. Client needs and disciplines will affect maintenance protocols. Regular and frequent maintenance will be necessary to ensure that the arena surface stays workable under heavy usage. Boarding facilities often cater to a common activity, which allows for simpler arena design and maintenance.

A private facility will likely utilize specialized footing for one discipline that the owner of the facility prefers. Depending on the facility, there may be less traffic, and the maintenance needs may vary depending on owner preference and footing type.

There are variances among disciplines. Western riders tend to prefer a deeper, softer footing that is fast and enables sliding. In addition, there is also variation in the desired underlying footing. A reiner would like a smooth surface that ensures horses can slide, but a barrel racer might prefer a choppier base with more grip. Western riders tend to prefer a sand or sand mix footing without additives. A show jumper would instead prefer footing that is firm for take-off and soft and cushioning on landing. Dressage riders typically want something in between, softer than jumpers but not as soft as Western riders. Hunter/jumper and dressage events gravitate toward the sand and fiber blend arenas or other synthetic footings.

The type of footing has tremendous bearing on the maintenance protocol. Some sand and fiber footings have wax or oil coatings that do not require water. Sand and fiber must be kept well mixed to prevent separation, generally requiring a multi-unit or complex drag that has a tilling action. A simple chain harrow is not adequate for such mixing action. Sand mixtures without wax coatings and dirt or clay mixtures often require regular application of water to limit dust.

The primary component of arena footing will break down over time with repeated concussion from the working horses as well as the addition of organic material (manure, bedding, and mud) over time. Even with manure removal, some degree of organic material will be introduced into the footing. Stronger sands may hold up better, and additives will increase the longevity of arena surfaces, but all surfaces will eventually break down. When this happens, it is usually best to add more footing to refresh the surface, or to replace the surface entirely, depending on the state of the primary component and additive. As the primary component of arena footing breaks down, dust often increases in the arena.

Different footing types also wear differently on arena maintenance equipment. Different types of hard sand and gravel can degrade arena equipment, especially with the frequent use required by arena surfaces. Tines and teeth should be monitored regularly to determine any necessary changes in depth setting or required replacement of parts.

The ideal surface for any horse depends on many different factors, such as discipline and environment. Because arena surfaces continually change with use and maintenance, it is important to evaluate the current footing and adapt the maintenance protocol to suit the needs of the horses using the arena.

References

Adams, L. (2019, November 28). Phone interview.

American Recycling. (n.d.) Arena Footing. Retrieved from https://americanrecycling.com/products/equestrian-surfaces/.

Bardet, J.-P., and Sanchez, J. (2011, May 1). Soxhlet Extraction Determination of Composition of Synthetic Soils. Retrieved from https://www.astm.org/digital_library/journals/geotech/pages/gtj102751.htm.

Bartenstein, M. (2019, December 12). Phone interview.

Biggs Waller, S. (2002, January 01). Get a Handle on Your Footing. Retrieved from https://thehorse.com/132566/get-a-handle-on-your-footing/.

Braen, D. (2017, May 3). Crushed Stone Grades: A Complete Guide. Retrieved from https://braenstone.com/crushed-stone-grades/.

Brewster-Keating, C., and Stone, J. (2019, May 15). Phone interview.

Clayton, H., BVMS, Ph.D., DACVSMR, MRCVS. (n.d.). The Most Important Three Inches in Your Horse's Career: AAEP. Retrieved from https://aaep.org/horsehealth/most-important-three-inches-your-horses-career.

Detweiler, B. (2018, November 28). Phone interview.

Diamond Safety. (n.d.) Equine Rubber Footing. Retrieved from https://www.diamond-safety.com/equine-rubber-mulch/.

DR's Country Life Blog. (2017, October 06). Equestrian Arena Footing Maintenance (Part 1/2). Retrieved from https://www.drpowerblog.com/equestrian-arena-footing-maintenance-part-1-2/.

DR's Country Life Blog. (2017, October 06). Equestrian Arena Footing Maintenance: Arena Drag Comparison (Part 2/2). Retrieved from https://www.drpowerblog.com/equestrian-arena-footing-maintenance-arena-drag-comparison-part-2-2/

Equestrian Surfaces blog. (2016, May 4). Fibres. Retrieved from https://www.equestriansurfaces.com/blog/fibres.

Fabian Wheeler, E.E. (2016, May 19). Riding Arena Footing Material Selection and Management. Retrieved from https://extension.psu.edu/rid-

ing-arena-footing-material-selection-and-management.
Hernlund, Elin; Lönnell, Cecilia; Roepstorff, Lars; Lundholm, Marcus; Bergström, Lars; Andersson, Ann-Margrethe; Carlsson, Björn; Fogelberg, Fredrik; Krügel, Fia; Söderberg, Markku, et al (2014). *Equestrian Surfaces—A Guide*. Strömsholm: Swedish Equastrian Federation. [PDF File]. Retrieved from https://inside.fei.org/system/files/Equestrian_Surfaces-A_Guide.pdf
Hobbs, Sarah; Northrop, Alison; Mahaffey, Christie; Martin, Jaime; Clayton, Hilary; Murray, Rachel; Roepstorff, Lars; and Peterson, Michael. (2014). Equine Surfaces White Paper. Retrieved from https://inside.fei.org/system/files/Equine%20Surfaces%20White%20Paper.pdf.
Holt, D., Northrop, A., Owen, A., Martin, J., and Hobbs, S. J. (2014, June 19). Use of Surface Testing Devices to Identify Potential Risk Factors for Synthetic Equestrian Surfaces. Retrieved from https://www.sciencedirect.com/science/article/pii/S1877705814006766.
Hopen, T.J. (n.d.). What Is Sand? Retrieved from https://sandcollectors.org/what-is-sand/.
Horse Journals. (2019, January 14). Arena Footing: Materials, Installation, and Maintenance. Retrieved from https://www.horsejournals.com/arena-footing-materials-installation-maintenance.
Kentucky Equine Research Staff. (2017, December 31). Good Footing is Important for Horse Arenas. Retrieved from https://ker.com/equinews/good-footing-important-horse-arenas/.
Leeming, K. (2018, October 3). Email interview.
Mahaffey, J.W., and Peterson, M.I. (2013, October 31). Analytical Test Methods Used to Characterize Granular Composite Sport Surface Materials. Retrieved from https://www.scientific.net/AMM.440.74.
Masia, S. (2011, November 29). What a Drag—The #1 Resource for Horse Farms, Stables and Riding Instructors: Stable Management. Retrieved from https://stablemanagement.com/articles/what-a-drag.
Metivier, J. (2014, December 1). Aggregate Testing Standards. Retrieved from http://www.enviromineinc.com/research-library/2015/12/24/aggregate-testing-standards.
Meyer, J.F. (2017, March 23). Plan to Ride on Good Ground. Retrieved from https://horseandrider.com/how-to/plan-ride-good-ground.
Munniksma, L. *Happy Landings*. [PDF File]. Retrieved from https://www.usdf.org/EduDocs/Facility-Management/Happy_Landings1.pdf.
Navarra, K. (2011, October 26). The Right Footing—The #1 Resource for Horse Farms, Stables and Riding Instructors: Stable Management. Retrieved from https://stablemanagement.com/articles/the-right-footing.
Nelson, S.A. (2018, April 28). Retrieved from https://www.tulane.edu/~sanelson/eens1110/sedrx.htm.
Polysols. (2013, April 12). Polyester chopped Nw. MSDS [Online]. Polysols Inc: Spartanburg, SC. Retrieved from http://polysols.com/wp-content/uploads/2015/09/MSDSt.pdf.
Premier Equestrian. (n.d.) Sand 101. Retrieved from https://premierequestrian.com/horse-arena-footing/all-about-sand/.
Premier Equestrian. (2016, February 18). *How Arena Surfaces Affect Horse Biomechanics*. [Video File]. Retrieved from https://www.youtube.com/watch?v=l-c347oiAXoE.
Premier Equestrian. (2017, September 29). *Premier Pro Groomer | Horse Arena Grooming Equipment*. [Video File]. Retrieved from https://www.youtube.com/watch?v=LRgJNnd8PIg
Premier Equestrian. (2018, August 15). You Can't Beat Water. Retrieved from https://premierequestrian.com/you-cant-beat-water/.
Premier Equestrian. (2018, August 29). Horse Show vs. Training Surfaces. Retrieved from https://premierequestrian.com/horse-show-vs-training-surfaces/.
Premier Equestrian. (2019, June 19). Five Factors that Create a Great Arena Surface. Retrieved from https://premierequestrian.com/five-factors-create-great-arena-surface/.
ProEquine Grooms. Arena Care Basics! (n.d.). Retrieved from https://www.proequinegrooms.com/tips/barn-management/arena-care-basics.
Reveal, K. (2019, October 19). Phone interview.
Siddiquee, T. (n.d.). What is sand? Composition, Color and Types of Sand. Retrieved from https://civiltoday.com/civil-engineering-materials/sand/233-sand-composition-types.
Steenberg, K. (2018, November 14). Phone interview.
Strickland, C. (2013, September 25). Give New Life to Your Arena Footing—The #1 Resource for Horse Farms, Stables and Riding Instructors: Stable Management. Retrieved from https://stablemanagement.com/articles/give-new-life-to-your-arena-footing-3831.
The Horse. (2018, June 14). Arena Maintenance: What to Remember. Retrieved from https://thehorse.com/112571/arena-maintenance-what-to-remember/.
U Mass Lowell (2015). Soil Classification Basics. [PowerPoint slides]. Retrieved from http://faculty.uml.edu/ehajduk/Teaching/14.330/documents/14.330SoilClassification.pdf.
Ultimate Arena Guide. (2017, February 17). Horse Arena Footing. Retrieved from http://ultimatearenaguide.com/horse-arena/footing/.
Understanding Crushed Stone Grades. (2016, August 9). Retrieved from https://blog.ozinga.com/understanding-crushed-stone-grades/.
Zorn, H. (2018, October 18). Phone interview.

Figure 1 photograph: Matt Barton, Ag Communications

Issued 10-2020