

A Guide For Selecting Bunker Liners

Bunker liners are not a cure-all, but if used properly they can improve bunker conditions.

BY GEORGE WATERS AND TODD LOWE



Deciding which bunker liner to use, or whether a liner is necessary at all, is not always easy. Bunker style, liner cost, and desired playability are all key factors to consider.

Bunker construction has become an increasingly elaborate and expensive process. The wide variety of bunker liners that are now used, and their rising costs, are indicative of this trend. Liners are intended to improve playability, reduce maintenance, and extend the life of bunkers — all worthwhile objectives. Unfortunately, deciding which liner to use, or whether a liner is necessary at all, is not always straightforward. The first step in the process is identifying the issues that a bunker liner is intended to address in a given situation.

REASONS TO USE BUNKER LINERS — REDUCING WASHOUTS

Reducing the frequency and severity of washouts is one of the primary reasons to install a bunker liner. Most liners have a texture that helps sand

adhere to bunker faces, reducing the risk of washouts. Some liners also create a consistent layer of enhanced drainage that removes excess water from bunker sand. This helps to reduce washouts because as sand becomes saturated it is more prone to slumping down a bunker face.

Fewer washouts is a good thing for any golf course. Quickly getting bunkers back in play after a rain event increases golfer satisfaction and limits revenue impacts. The labor savings associated with reducing washouts are also valuable because it can require more than 100 staff hours to repair washouts after a rain event. In areas that see frequent rainfall, the time and money spent repairing washouts each year can be significant.

However, it is important to recognize that there are many other ways to reduce washouts aside from installing

bunker liners. Decisions regarding bunker design, subsurface drainage, sand selection, and maintenance practices can significantly reduce washouts. Addressing issues in these areas is an important complement to installing a liner when the goal is reducing washouts.

Directing surface water away from bunkers is an affordable and effective method for limiting washouts. Liners cannot prevent sand erosion when surface water flows directly into a bunker. The importance of effective subsurface drainage also cannot be overstated. Bunkers with poor subsurface drainage are prone to a wide range of issues, including washouts.

REDUCING CONTAMINATION

Reducing the contamination of bunker sand is another reason to install a bunker liner. Creating a barrier between



Reducing washouts is one of the primary reasons to install bunker liners. Washouts are time consuming to repair and can contaminate bunker sand.

the bunker sand and subsoil prevents the upward migration of fine particles and stones into the sand, extending its useful life. A liner also prevents contamination of bunker sand during washouts and washout repair. If a bunker does not have a liner, washouts will erode the subsoil and contaminate the bunker sand.

Liners cannot prevent all types of bunker sand contamination, however. Some liners cannot be extended up the vertical edges of bunkers, leaving open the possibility of contamination from bunker edge erosion. A liner also cannot prevent contamination that comes from outside the bunker. Examples include soil carried by surface water and airborne debris such as tree litter, grass clippings, and dust. If external contaminants are a potential issue, additional management strategies will be needed to ensure the desired bunker performance.

IMPROVING PLAYABILITY

Bunker liners can improve playability in several ways. By reducing washouts, liners decrease the amount of time that bunkers are disrupted after a rain event. Fewer washouts also means less of an issue with soft sand in recently repaired areas. Unless repositioned sand is

carefully compacted during washout repair, buried lies can be problematic.

Liners can also help maintain the performance and consistency of bunker sand. Without a liner, silt and clay contamination can slow drainage through bunker sand, eventually causing areas of a bunker to play more

firmly or to hold water. A liner also prevents stones and pebbles from migrating into bunker sand and creating playability issues.

Some liners also improve moisture consistency in bunker sand. Liners that provide a uniform layer of rapidly draining material should reduce variations in sand moisture. However, it is important to be aware that more consistent sand moisture may not necessarily mean that a liner helps deliver the desired playability.

ARE THERE SITUATIONS WHERE A LINER IS NOT NECESSARY?

Bunkers that have gently sloped sand areas, with surface water effectively directed away from them, will not experience significant washouts. The sand in these bunkers will also have relatively consistent moisture — barring external factors — because there is limited change in elevation. If contamination is not a serious concern, there may be no reason to install liners in bunkers of this nature.

Potential contamination from stones or soil may not necessarily require a liner to be installed. Bunkers that experience some form of contamination can still provide adequate



Contaminated sand can leave bunkers flooded and unplayable after a rain event, even if the subsurface drainage system is functioning properly.

playability. In fact, some of the most famous golf courses in the world have stones scattered throughout their bunkers. The size of the stones and their prevalence will be key factors to consider. Also, be aware that the new Rules of Golf for 2019 will permit players to remove loose impediments in bunkers without penalty. This may mean that stones in bunker sand will be less of a concern at some facilities because they no longer present a Rules issue. Contamination from native soil will decrease bunker sand performance over time, but the cost of installing a liner to prevent this issue should be balanced against the cost of periodically replacing the sand.

Bunkers situated on extremely sandy soils are also unlikely to require liners, although some sandy soils do contain stones or fine particles, in which case the need for a liner should be evaluated.

LINER TYPES

There are many different liner options to choose from; each has its advantages and drawbacks. Selecting the appropriate liner for your project requires balancing cost with performance goals and understanding golfer preferences at the facility. Researching the performance of liners in your area and testing various options on your site with your desired bunker sand is critical for achieving a satisfactory outcome.

Note: Bunker liner cost ranges were derived from pricing information submitted by four different golf course contractors based in different regions of the U.S.

POROUS AGGREGATE LINERS

Cost Range: \$2.15 - \$3.30 per square foot, materials plus installation.

Advantages: Porous aggregate materials such as stabilized gravel,

porous asphalt, and porous concrete are the newest frontier of bunker liners. These materials allow rapid water infiltration that helps to hold sand in place on bunker faces. They are typically installed in a layer that is several inches deep, effectively eliminating contamination from the subsoil. Porous aggregate materials are more durable than most other liner options and hold up well to daily maintenance practices. These liners can typically be installed by the maintenance staff or a contractor, except products that require a spray-on polymer to be applied by a certified contractor.

Limitations: Porous aggregate liners require extra excavation during the bunker shaping process to account for the thickness of the liner and the required sand depth. Porous aggregate liners cannot be formed up the vertical edge of a bunker, so sand contamination from the bunker edge is still



Porous aggregate bunker liners have become increasingly popular for their ability to reduce washouts and sand contamination, but they can be expensive.



When using porous aggregate liners, some facilities have elected to leave gaps in the liner to prevent a perched water table from causing excessive sand moisture.

possible if sod or an artificial material isn't used to create a seal around the bunker edge.

Installing a layer of porous aggregate beneath bunker sand also carries the risk of creating a perched water table that may cause the sand to remain wetter than desired. This issue is a particular concern in humid regions with increased rainfall or on areas of a golf course that receive frequent irrigation. Wet sand creates firm playing conditions and may allow algae to become established, which can be both an aesthetic and playability issue.

Porous aggregate bunker liners also have specific requirements for their composition and installation. This may limit the availability of some products, restrict who can install them, and influence installation timing. Products that require a spray-on polymer typically have moisture and temperature restrictions, and it may not be possible to

obtain or install asphalt- or concrete-based products below a certain temperature. Most porous aggregates also require a certain amount of time to cure before they are ready for sand.

Tips for Success: It is essential to test the compatibility of porous aggregate liners and bunker sands. Both a bridging test and a water release curve test should be performed by an accredited lab prior to construction. The water release curve will determine how many inches of sand will be required to avoid excessive moisture retention in the bunker sand. If testing reveals that the required sand depth is greater than desired, a more affordable solution may be to create openings in the liner that allow water to flow freely into the bunker drainage system. It is important to coordinate with the manufacturer when planning any modifications to the specified liner design and installation protocol so that you are

fully aware of any performance or warranty implications.

The moisture content of porous concrete products must be carefully monitored for the desired consistency. A simple test is to squeeze some of the product in your hand — the mix should stick and have a moist appearance without being runny. Porous asphalts will be warm and sticky during installation, so staff generally wear gloves and rubber boots. It is also advisable to apply a film of diesel fuel to vehicle beds and tools that will be used during the transport and spreading of porous asphalt to prevent sticking.

FABRIC LINERS

Cost Range: \$1.30 - \$1.85 per square foot, materials plus installation.

Advantages: Fabric bunker liners have been in use on golf courses for decades. Their principal advantages

are a low cost in comparison to other liners, easy installation, reduced sand contamination, and effective washout control. On extremely steep bunker faces, white fabric liners can also create the illusion of adequate sand even if the liner itself and a small amount of sand are the only things present. Because fabric liners are flexible, the liner itself is also resistant to damage from frost heave.

Limitations: The limitations of fabric liners are well known. Pieces of the liner can be dislodged or torn and brought to the surface by mechanical bunker rakes or animals digging in the sand. Sections of liner can also come to the surface when the staples or nails holding the liner to the subgrade are lifted by freeze-and-thaw action or have corroded over time.

Once a section of fabric liner has come to the surface, the only way to properly address the problem is to peel back the surrounding sand, ensure that no sand is underneath the liner, and then reaffix the liner to the subgrade. If the liner is torn or damaged, it may be necessary to install a patch. Unfortunately, when fabric liners come to the

surface of a bunker, the misguided solution is often to cut or tear the exposed piece and then cover the damaged area with sand. This compromises the integrity of the liner and is only a temporary solution. Sand will soon migrate beneath the liner in the torn area and eventually more liner will come to the surface.

Tips for Success: There are several approaches to managing the issue of fabric liners coming to the surface. It is commonly recommended to avoid using a mechanical bunker rake if fabric liners have been installed. However, choosing a low-cost liner that necessitates many years of high-cost hand raking does not make much sense for many facilities. Mechanical bunker rakes can still be used in bunkers with fabric liners; it simply becomes essential to maintain adequate sand depths to ensure that the rake does not snag the liner. Rake attachments will also need to be less aggressive to avoid digging deeply into the sand and catching the liner.

Certain staple types can prove more stable in soils prone to frost heave. Plastic, trident-shaped staples are

one popular option, and they are also resistant to corrosion, although they can be problematic to install in stony soils. Applying industrial-strength adhesives along the seams of the liner and over the top of the installed staples can help consolidate the liner and reduce the risk of failure in weak areas, although using adhesives is not guaranteed to prevent frost heave from lifting the staples. Manufacturer recommendations for staple spacing should be followed and, when in doubt, more staples will not add much cost but may improve performance.

SYNTHETIC TURF

Price Range: \$3.00 - \$3.50 per square foot, materials plus installation.

Advantages: Synthetic turf liners provide many of the same benefits as traditional fabric liners, without some of the limitations. They are heavier and more durable than traditional fabric liners, making them less vulnerable to damage from mechanical rakes or animals. Synthetic turf liners reduce washouts and eliminate sand contamination from the subsoil. These liners also typically include a component that can be placed over the bunker edge, eliminating another potential source of sand contamination. Synthetic turf is flexible, making it resistant to damage from freeze-and-thaw cycles. It can also be installed in-house or by a contractor during a wide range of weather conditions.

Limitations: The weight of synthetic turf liners makes installation more challenging than it is for traditional fabric liners. They also typically come in a multi-part system with different components for the bunker floor, edges, and around the drain lines, adding complexity to the installation process. Synthetic turf liners are impermeable, so they will not provide enhanced drainage. In humid areas with increased rainfall, bunkers lined entirely with this system can remain wet for long periods. Also, adjacent turf may root into the liner and cause issues with edging.

Tips for Success: Installing synthetic turf liners so that the grain of the fabric points against the bunker slope can help reduce washouts.



Fabric liners help prevent washouts on steep bunker faces, but they can be easily damaged by maintenance equipment or animals.

Testing different liner options in a few demonstration bunkers prior to beginning a large-scale bunker project is strongly recommended.



Synthetic turf liners are heavier and more durable than traditional fabric liners. They typically include individual components for the bunker floor, edges, and drain lines.

Some facilities have also had great success lining only bunker faces with synthetic liners. With these “hybrid” liner installations, the bunker floors are either left unlined or are lined with a less costly and more permeable liner.

SOD LINERS

Cost Range: \$0.35 - \$0.75 per square foot, materials plus installation.

Advantages: Lining bunkers with sod can be an effective, low-cost solution to limit contamination issues. The thatch and roots from the sod create a barrier that prevents stones and native soil from contaminating the bunker sand. Sod liners can also be joined with the surrounding sod to reduce contamination from bunker edges, and sod liners are resistant to damage from frost heave.

Limitations: The lifespan of sod as a bunker liner is one limitation. Facilities have reported more than 10 years of effective performance, but that number could be higher or lower depending on local conditions. While the lifespan of sod liners may be shorter than other liner options, the cost of replacing sod liners is low. In most cases, sod liners could be entirely replaced several times before approaching the cost of installing a porous aggregate liner.

Sod liners will not provide enhanced drainage, nor will they provide much benefit in limiting washouts. Therefore, they are primarily an option for bunkers with gently sloped faces and effective control of surrounding surface water. In areas where animals digging in bunkers is an issue, sod liners may not be a good option. Mechanical bunker rakes can be used in bunkers with sod liners, but the same precautions must be taken as with fabric liners.

Tips For Success: The most important factor in achieving good performance from sod liners is allowing sufficient time for the turf to root into the soil before installing bunker sand. Typically, three to six weeks is recommended for establishment. When selecting sod for bunker liners, be aware that some turf species are more likely to grow through the sand than others. It might be sufficient to scalp and bury ryegrass, but Kentucky bluegrass and warm-season grasses should be sprayed with a nonselective herbicide prior to sand installation. If in doubt, applying a non-selective herbicide is an inexpensive way to make sure that grass from the liner does not grow through the sand. It is important to select sod for the liner that has either no mesh or a biodegradable

mesh that will break down over time. Non-biodegradable mesh can find its way to the sand surface over time and cause maintenance issues for many years.

OTHER LINER TYPES — IMPERMEABLE LINERS

There is a broad range of impermeable liner options, including spray-on products and aggregates that can be compacted into an impermeable layer. Impermeable liners tend to be long-lasting, and they are effective at eliminating contamination from the subgrade. They typically have a texture that helps sand adhere to slopes, and they are resistant to damage from mechanical bunker rakes. They do not offer enhanced drainage, and some impermeable liners are potentially vulnerable to damage from frost heave because they are rigid.

POROUS RUBBER

There are several versions of porous rubber liners; some are mixed with a binding agent and spread, while others come in rolls and are cut to size and stapled to the bunker floor. Porous rubber products are more durable than fabric liners and provide enhanced drainage. They are also flexible, mak-



Lining bunkers with turf can be a low-cost way to limit sand contamination.

ing them resistant to damage from freeze-and-thaw cycles. The installation of rolled products is similar to any fabric liner, although the material is heavier and therefore more challenging to work with. Products that are mixed with a binding agent can be more difficult to install because they must be mixed on site and carefully spread over the bunker floor.

CONCLUSION

Making decisions about bunker liners is not easy. There is limited objective research on the topic and there are many factors involved. A multi-year research project is underway at Auburn University to study the performance of bunkers lined with different products. Each liner was installed by the manu-

facturer to ensure the desired performance. Results will be published as they become available and should add some much-needed objective information to aid in liner selection.

In the meantime, most liner decisions must be made based on word of mouth and direct experience. Testing different liner options in a few demonstration bunkers prior to beginning a large-scale bunker project is strongly recommended. Liners will perform differently based on the sand chosen, the maintenance program, and the local environment. It is invaluable to allow golfers and decision-makers the opportunity to experience the playing conditions and observe how different liners perform prior to making a significant investment.

It is also important to recognize that bunker liners will not cure all issues on their own. Surface water management, subsurface drainage, sand selection, architectural style, and maintenance practices in and around bunkers all play roles in the issues that many liners are selected to address. Adjustments in these areas will influence which liner makes the most sense for a given project or whether a liner is necessary at all.

GEORGE WATERS is a manager of USGA Green Section Education.

TODD LOWE was an agronomist in the USGA Green Section Southeast Region for 18 years.

SUBSCRIBE TO THE USGA GREEN SECTION RECORD

TEXT "GREENSECTION" TO "22828" OR [CLICK HERE](#)

Offering the latest information on golf course management, turfgrass culture, environmental issues, research and economic sustainability.