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## Drainage – A Crucial Component for Athletic Field Performance

### Part One: Surface Drainage

Water is applied to maintained turfgrass areas by irrigation or precipitation. Once water hits the soil surface, it may enter the soil, runoff the surface, or be evaporated into the atmosphere. Excessive rainfall, and/or winters with heavy snowfall, often produces excess soil water conditions. Thunderstorms will frequently result in runoff because the rainfall rate is greater than the rate at which water can infiltrate the soil. Irrigation can also cause puddles and runoff if the water application rate exceeds the infiltration rate.

Drainage is the removal of excess water from the soil surface and/or soil profile by either gravity or artificial means. Drainage is one of the most important issues when managing a sports field. Your field will not perform well if you do not have surface, internal, and/or installed drainage systems in place. Turfgrass areas need to be able to withstand foot and vehicular traffic in various weather conditions. Standing water and/or saturated fields can cause cancellation or postponement of events, increase likelihood for compaction and ruts, and lead to poor overall field health. Efficient soil drainage ensures that water does not collect on the athletic surface. A well drained athletic

surface improves safety and playability, allows turfgrass plants to access necessary nutrients, allows better air exchange, and improves turfgrass recovery potential. It is important to understand drainage principles and what types of drainage will work best for your field to enhance user safety, reduce field closures, and keep your field healthy.

There are three key components to successful drainage – surface drainage, internal drainage, and sub-surface installed drainage systems. Surface drainage is when water runs off the surface of the field. Internal drainage refers to water entering and moving through the soil profile. Sub-surface installed drainage systems refer to pipe systems installed beneath the field to direct excess water from the rootzone to a drainage outlet. Depending on your facility, you may not have a sub-surface installed drainage system, or may not have the means to install a system. Therefore, it is important to maximize surface and internal drainage to ensure the health and safety of the field.

This bulletin is part of a three part series. The focus of this bulletin is surface drainage. To access the other bulletins, please visit the STMA website.

### Surface Drainage

Surface drainage is when water runs off the soil surface and is collected in a drain or other natural drainage area, such as a water body. Surface drainage is designed to minimize water ponding on the soil surface following rainfall or irrigation. Surface drainage acts to reduce the volume of water entering the soil profile. Constructing an athletic surface with the proper slope is necessary for successful surface drainage.



Standing water on an athletic surface - Photo courtesy of Chad Price, CSFM

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## Slope and Field Crowns

One of the factors that affect efficient surface drainage is a field's slope. When sports fields have a slope, they have a slight incline that allows water to run off the field surface. A higher slope value indicates a steeper incline. Slopes on athletic fields are very minimal. The highest point is usually about 10-18 inches above the lowest point on the field, which translates to about a 1-1.9% slope. Slopes are important to move water to sideline areas where it can be collected and drained away using swales and/or catch basins.

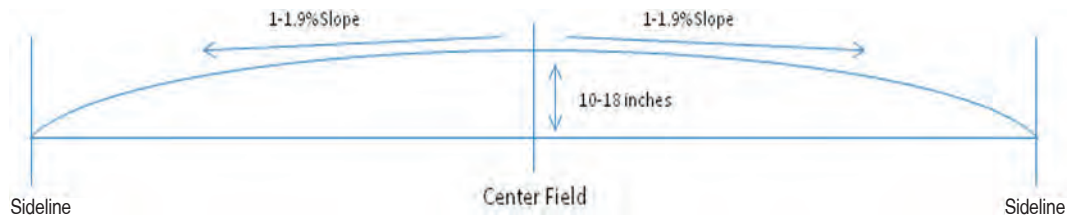
There are two ways to slope fields: using a crown or sloping a field from one side to the other. Crowns are the

most effective way to remove surface water because they move water the shortest distance possible. This keeps high wear areas at the highest and driest points on the field. There are two types of crowns that can be utilized: a 'turtle hump' and a traditional crown.

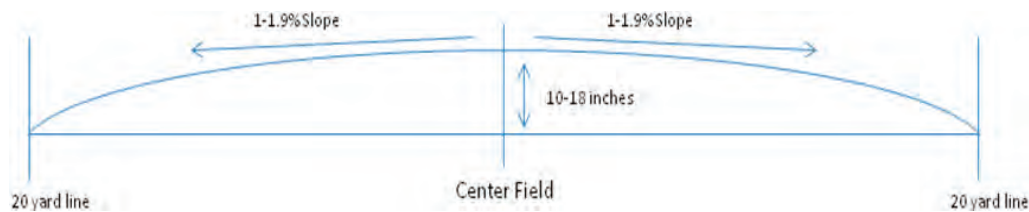
## 'Turtle Hump' Crown

A 'turtle hump' crown can be utilized for football only fields. The 10-18 inch crown (approximately 1-1.9%) should slope uniformly from the center of the field to the sidelines and 20 yard lines. Water will be directed the shortest distance possible to endzones and sidelines where it can be collected and drained away.

## Crown between sidelines:



## Crown between 20 yard lines:

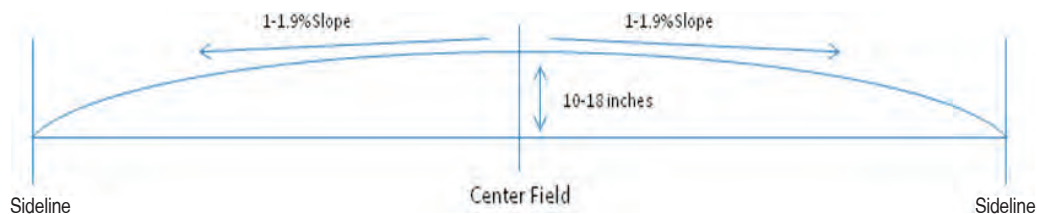


## Traditional Crown

A 'turtle hump' is not a good solution for sports that use goals because it will direct water into the goal areas. Goal areas need to be on the highest part of the field to stay dry, safe, and playable. The traditional crown is the most effective for goal sports. A traditional crown runs down

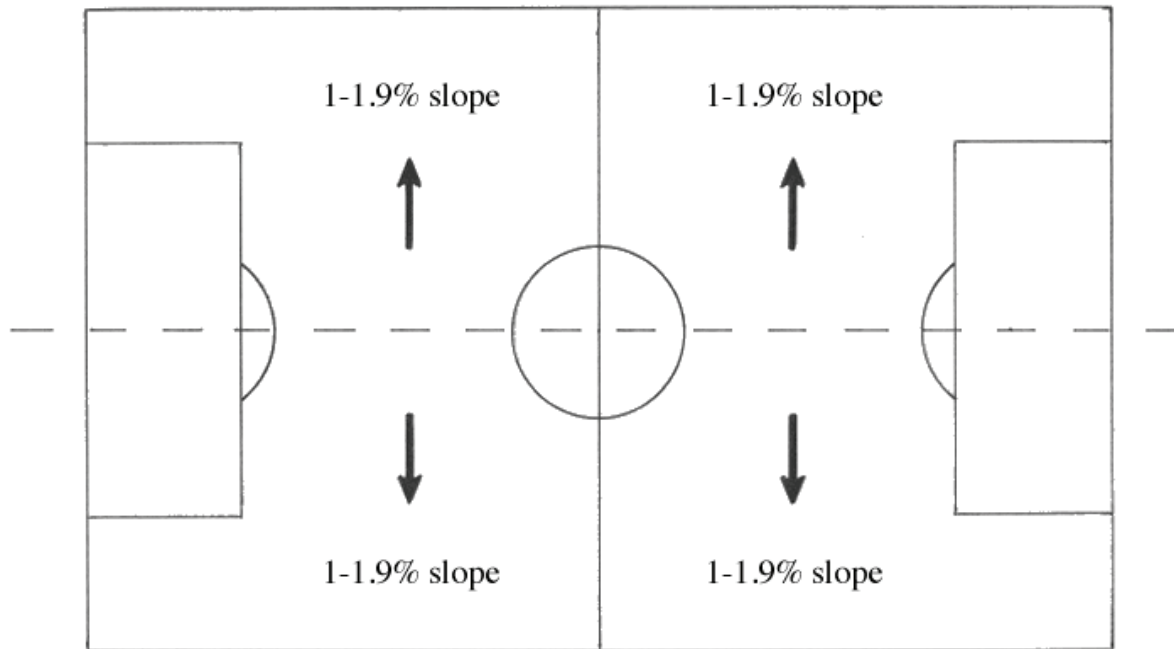
the center of the entire length of a field. The field then slopes away from the center, directing water to sidelines. This design directs water away from the part of the field subject to the greatest mechanical stresses. A traditional crown can be used for sports such as football, rugby, field hockey, soccer, and lacrosse.

## Traditional Crown:



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## Aerial view of traditional crown:

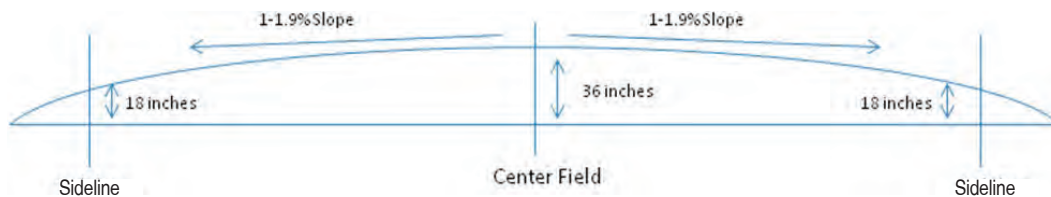


It is not advisable to have more than a 1% slope on soccer or field hockey fields as it makes side shots more difficult. However, if the field is used for football and goal sports, the field may have up to 1.9% slope.

When a crowned area meets a level sideline, it can turn into a wetspot, which creates a hazard for athletes. Level

sidelines are also a problem on multi-use fields. For example, soccer field dimensions are wider than football field dimensions. Therefore, it may be desirable to extend the slope beyond the sidelines. By extending the slope, the field can accommodate various sports and prevent wet, muddy conditions from developing on sidelines.

## Extended slope:



## Single Plane Fields

Some fields are flat and slope to one side (single plane) so they drain from one side to the other. Although it is not ideal, this field design is effective for football, rugby,

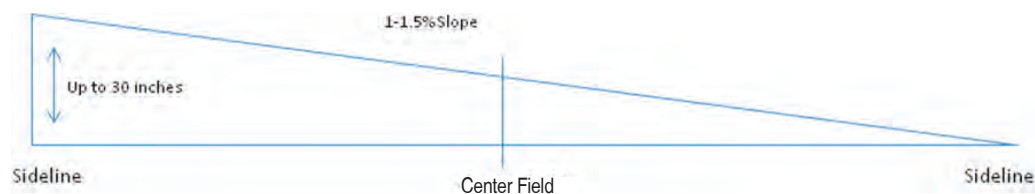
soccer, field hockey and lacrosse. Flat fields operate more effectively when combined with a sub-surface installed drainage system. An installed system can prevent the lower half of the field from becoming too wet.

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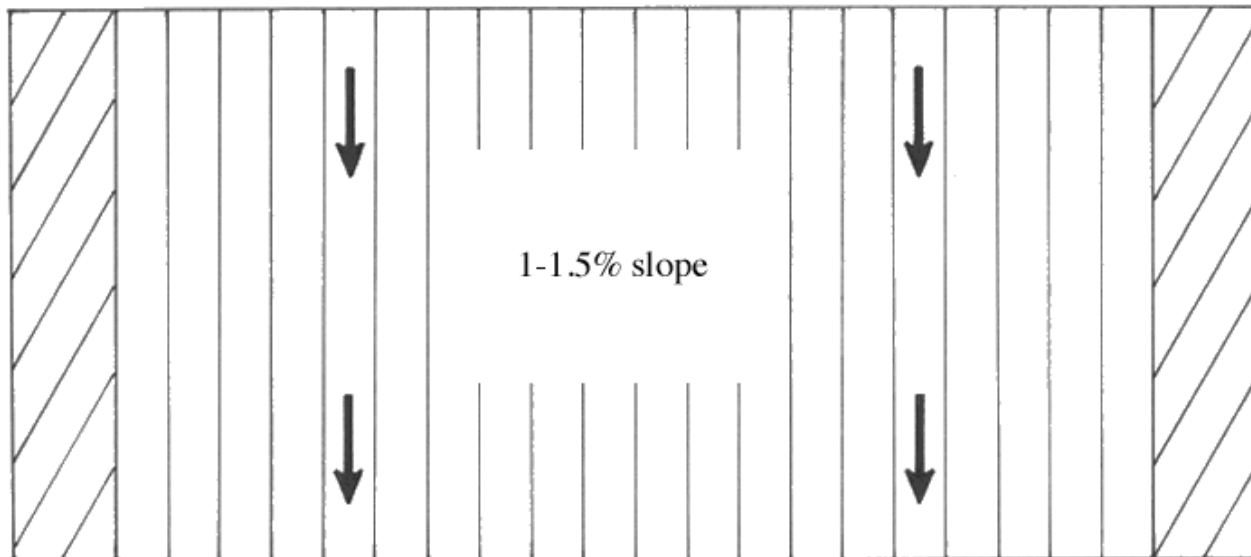
It is important that the person managing the field understands if the field is graded as a single plane. Otherwise, if surface drainage becomes an issue, the manager may try to increase the crown, not realizing there

was not a crown in the first place. Raising the center of the field will result in restricted flow of water and create wet, muddy conditions on the uphill half of the playing surface.

### Side view:



### Aerial view:



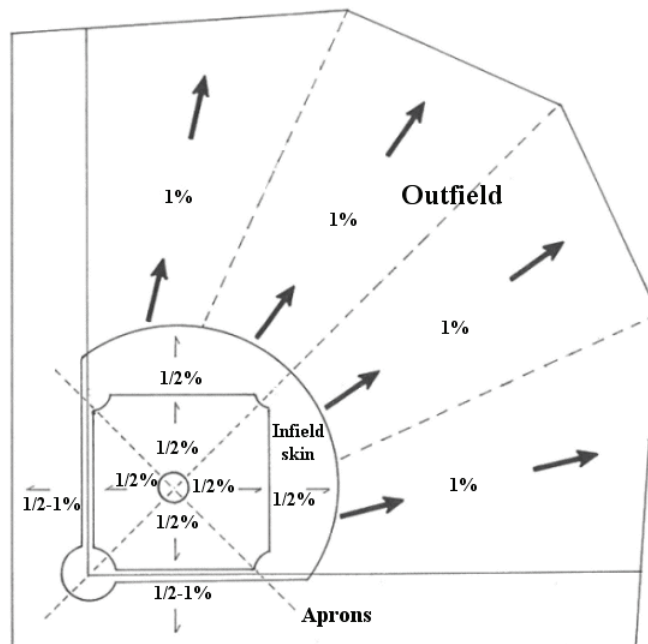
### Baseball and Softball Field Crowns

The highest point on a baseball field should be the pitcher's mound, which is elevated approximately 15 inches above homeplate and the baselines. For the most efficient surface drainage, the field should slope away from the mound in all directions. In addition, a crown can extend from second base into the outfield to direct water to the foul lines. Apart from the pitcher's mound, the infield is higher than the rest of the field and has a 0.5 percent slope into the outfield. The outfield then slopes away at a 1 to 1.5 percent slope.

On softball fields, the infield should be the highest point on the field. The outfield should then slope away from the infield at a 1 to 1.5 percent slope.

Sloping baseball and softball fields away from the infield prevents standing water from accumulating in the infield arc. Positive surface drainage is the only way to ensure a playable infield in wet weather.

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Baseball and Softball Field Grades - Photo from University of Missouri

### Correcting Surface Drainage Problems

Correcting surface drainage problems can be expensive and will require annual maintenance; however, in the long run, addressing problems now may prevent more costly maintenance and renovation in the future.

### Land Leveling and Smoothing

Land leveling or smoothing is a water management practice designed to remove soil from high spots in a field, and/or fill low spots and depressions where water may pond. Applying topdressing to low spots and using a level bar to smooth the surface of the field can eliminate unevenness. Land leveling and smoothing can also be performed with laser equipped tools to ensure the highest quality surface and excellent surface drainage.

### Infield Maintenance

Remove lips and mounded ridges that form in grass edges surrounding skinned areas. Lips and ridges can act as dams to prevent surface drainage. By keeping grass edges free of infield skin materials, surface water can runoff into the grass.

### Mowing

Cut grass shorter during wet periods to allow more sunlight to reach the soil surface and promote drying of the rootzone.

### Soil Amendments and Conditioners

Soil amendments and conditioners, such as calcined clay and calcined diatomaceous earth, can absorb surface water and help firm muddy soil. The primary use of these products has been to improve water absorbing capacity of soil on skinned areas of baseball and softball infields. However, inorganic soil amendments have also been shown to be beneficial when applied to the turfgrass soil surface. When used as topdressing, amendments can be applied before a rain event to prevent muddy soil conditions, or following a rain event to reduce wet, muddy conditions. Their use has been shown to improve footing, reduce turfgrass plant damage, and improve field safety and conditions by reducing muddy, wet areas.

### Reconstructing Field Contours and Installing Waterways

Before reconstruction, conduct a survey to verify how water moves through and around the field. Set new grades and install a crown on the field. Although regrading is expensive, it is the best solution that will be the most successful in the long run and give you the most bang for your buck.

Crowned fields and contours in the landscape can direct runoff water to catch basins, sideline drains, swales, or

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man-made (retention ponds) or natural water bodies for collection. Surface water can be moved quickly when there is a direct conduit to a drainage outlet. For example, installing a drain grate at the soil surface which ties into pipe below can direct runoff water to existing surface water bodies or storm sewers. Collection points need to be correctly installed to ensure water is directed to drainage areas and does not create puddles on sidelines. Drainage areas are only effective when they are situated lower than the surrounding area. For safety, they must be placed well out of play with a small grid on top.



Catch basin - Photo courtesy of A. J. Powell, Jr., Ph.D..

### Conclusion

Successful drainage starts with proper planning. The best time to solve drainage problems is before they happen due to construction or reconstruction mistakes. On fields with existing drainage systems, identifying the most serious problem and correcting it is the most effective solution. Unless a plan is developed to correct the major problems, “band-aid” solutions will cause headaches over and over again.

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