Taking On Winter: The Basics of Irrigation System Blowouts

BY **LUKE FRANK**

Anybody in the turf industry north of 45 degrees latitude should have a firm grasp of proper irrigation system winterization. Otherwise, both acute and chronic forces can cause considerable system damage at spring recharge and nightmarish summer maintenance.

The power of water turned to ice is chilling: it can split mains and laterals, fracture fittings and heave sprinkler heads and valve boxes to new heights. There are three areas of opportunity for executing proper irrigation evacuation. The first two, sound irrigation design and installation, may be forgone conclusions. The third opportunity, actually purging your system, is a logical, methodical procedure of isolating and blowing out your system infrastructure.

Start at the beginning

Those who contend with winter soil frost lines of 4 inches or more have a strong appreciation of nature and its power. Pipes, sprinklers, wires, valves, boxes, and other equipment are continually heaved, and hoed, all winter. Install something poorly in the fall and you'll have to rework it in the spring.

In many cases, there is little we can do to combat our weather conditions. However, there is much that can be done to make a system "give" with weather conditions.

Most systems are designed and installed somewhere within the top 12 to 24 inches of soil. Such systems are in the direct line of fire for winter abuse. Techniques such as pipe pitching, intended to direct water flow to the manual drains when opened in the fall for winter purging, are clever but shortsighted. If pipe truly is pitched at installation, it rarely remains that way due to frost heaving.

Consequently, each autumn, less and less water will be evacuated, so more of it will remain in the piping system. This remaining water then freezes and expands to continually weaken pipe and fittings through fatigue over time. Each year, system damage increases, whether visible or not, and spring recharge costs increase.

If pipes don't remain pitched from frost heaving, then water never really has the chance to get to any drains. Moreover, once winter frost completely surrounds the drain, it becomes ineffective, as it can no longer release the water from the system. For these same reasons, systems that rely exclusively on manual and automatic drains for winterization are at risk.

Essential design features

Basic fundamentals tell us that if a device or technique is marginally effective, additional system service will be incurred. Adding pieces to the system that may fail or not work as specified, or will damage other components, should be avoided.

An irrigation consultant/designer should be aware of winterization techniques required for each specific project before finalizing the layout. For example, mainline systems on all projects should be configured so that compressed air can be introduced into the system at key locations and provide for the easy removal of the majority of water from the entire mainline system promptly. At the water source(s), just downstream of the backflow preventer, an outlet should be provided as the point of connection for the compressor hose.

At the mainlines' ends, or at isolation points in looped system design, quick couplers should be specified to enable water release. Naturally, these also would be useful for manual watering during the season, but placed in key locations so that during winterization, high volumes of water can be easily released from the system. All quick couplers should be accessible and protected by a valve box for easy location in the fall.

Irrigation consultants/designers must have practical knowledge and thorough experience in winterization procedures to truly design a reliable system. Examples are pumping systems designed to require minimal winterization; or the research of and experience with sprinklers, valves, and other components that perform better in colder climates and during winterization. Poor design will result in hard to winterize and maintain systems.

In northern climates choked with heavy frost, building in system flexibility is very important. All systems should be installed with an appropriate flexible riser (preferably swing joints) at each sprinkler. Valves should be installed so that valve boxes don't rest on any incoming pipe or wire.

Mainlines should be installed outside of the electrical valve boxes to allow for wintertime movement, and adequately sized compressor connections should be installed near the water source and outlets, preferably quick couplers at the end of mainlines.

While these installation fundamentals are important, an accurate as-built plan will be your winterization reference tool every fall. As-builts should provide information for your crew about where to begin and end the process and warn of peculiar issues and how to deal with them. Be diligent in regularly updating any changes in product or location as the seasons pass.

Getting down to business

On larger projects with multiple taps and looped mainlines, a game plan should be designed, documented, and followed. The overall goal is to replace the piping system's full water volume with equal or greater air volume by methodically pushing the water out.

Looped mains will have to be isolated to create single, independent flow direction. Multiple tap systems also will have to be isolated, one tap from another, to form independent flow directions.

Proper compressed air volumes and pressure are keys to successful winterization procedures. Generally, compressed air pressures of 70-80 psi combined with air volumes of 160 cfm will service most properly laid out systems.

Larger sites or poorly designed systems might need multiple compressor units to provide the air volume needed to purge water from the system. Remember that full air volumes are the key to the best system purging. And be patient, while a simple residential system may take an afternoon, a baseball complex or golf course could take several days of isolating and purging zones.

To begin the winterization process, shut down the water source. If yours is a metered system (which it should be), it may be as simple as shutting a valve. On a pump station designed for non-winter removal, it may be the same—shutting a valve—plus shutting off power. Depending on the pumping system, effective winterization could require suction line removals, hydraulic valve pumping or microchip removal.

Once the water source is shut down, the compressor can be hooked into locations designed or retrofitted into the system. Fire up the compressor and let it build up the desired pressure. Once accomplished, go to the end(s) of the mainline and insert a quick-coupler key into the quick coupler (again, designed in or retrofitted).

When the key is completely inserted, water will begin to flow. Gradually you'll see a combination of air and water; next very moist air and water vapor; and finally just air. Mainline purging is now complete. Large volumes of water are released first through the mainline, making zone-by-zone procedures less time consuming.

Next, go to the irrigation controller and activate it zone by zone. Repeat the same process looking for the same results. Follow this by locating any manual zones, drip zones, fountain system supply taps, lake fill lines, etc., and perform the same process. If additional quick couplers are on site, the same procedure should be followed.

On larger sports facilities, with varied topography, an additional step is taken. After the initial winterization occurs, compressors are shut down. The remaining water is allowed to "pocket." Later, the compressors are reactivated and the remaining water will be purged.

With the system now purged of water for the winter, you can be assured that the minimum amount of water re-entering the system through sprinklers will not accumulate in volumes large enough to cause damage. Beware: systems that rely exclusively on manual or automatic drains will leave substantial water in the piping. Thus, when water enters through the same sprinklers, larger volumes of water accumulate in the piping and freeze damage will occur.

Most of us aren't lucky enough to have contributed to the original irrigation system design; we work with what we have. But simple compressor hose hook-ups and quick coupler retrofitting in strategic locations will equip crews for good system purging, which in northern climates is a matter of system survival. **ST**

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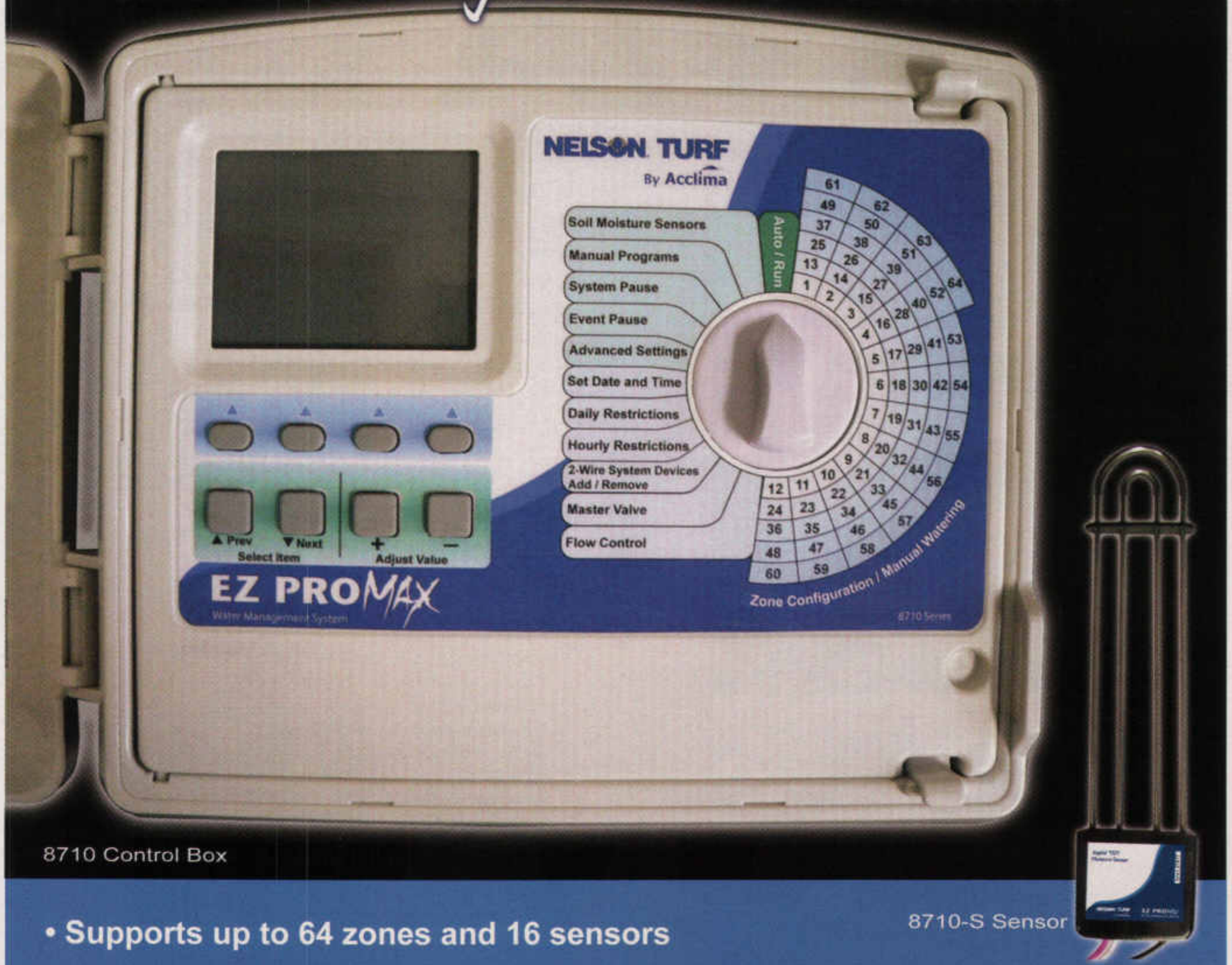

After The Flood

BY JEFFREY L. BRUCE, FASLA, LEED, ASIC

Editor's note: We were working with Jeff Bruce to develop a drainage story for the magazine when Hurricane Katrina hit the Gulf Coast. This article is based on his experiences before Katrina.

As the recovery of the Gulf Coast begins, it is timely to discuss restoration of flood damaged athletic fields and sports surfaces. It is important to understand the impacts of flooding and related issues on field operations. The severity of a flood's impact on the playing field system will be highly variable based upon the length and degree of the flood event. Flood events will have three primary adverse impacts to the playing field system. These include turf inundation, contamination of the rootzone with silt, and contamination of the rootzone with residual chemicals or biological pathogens carried by the floodwater.

Any flood event has the potential to impact the performance of an athletic surface. Catastrophic flood events tend to cause more severe problems because damage to the community is more widespread, releasing chemicals and other contaminants. Any flood event could require some field reconstruction, particularly turf replacement. The size of the drainage basins where the field resides will affect the time of inundation. In small drainage basins flood events will generally be relatively quick and unpredictable (not allowing preparations to be made) but also short-term. Small drainage basin floods should be anticipated on a more frequent basis. Small basin flooding may last only a few hours or days. Typically these types of facilities will have a history of flooding.

In large drainage basins, the flood event while much less frequent could last weeks or months like the 1993 Missouri River flood. Large drainage basin floods will slowly build for days or weeks as the capacity of the basin is filled. As the capacity of the drainage basin is exceeded, floodwater will inundate the floodplain and low-lying areas. In larger basins, the turf manager has some ability to prepare the field surface for a flood event. The flooding of New Orleans was unique because it had the magnitude of

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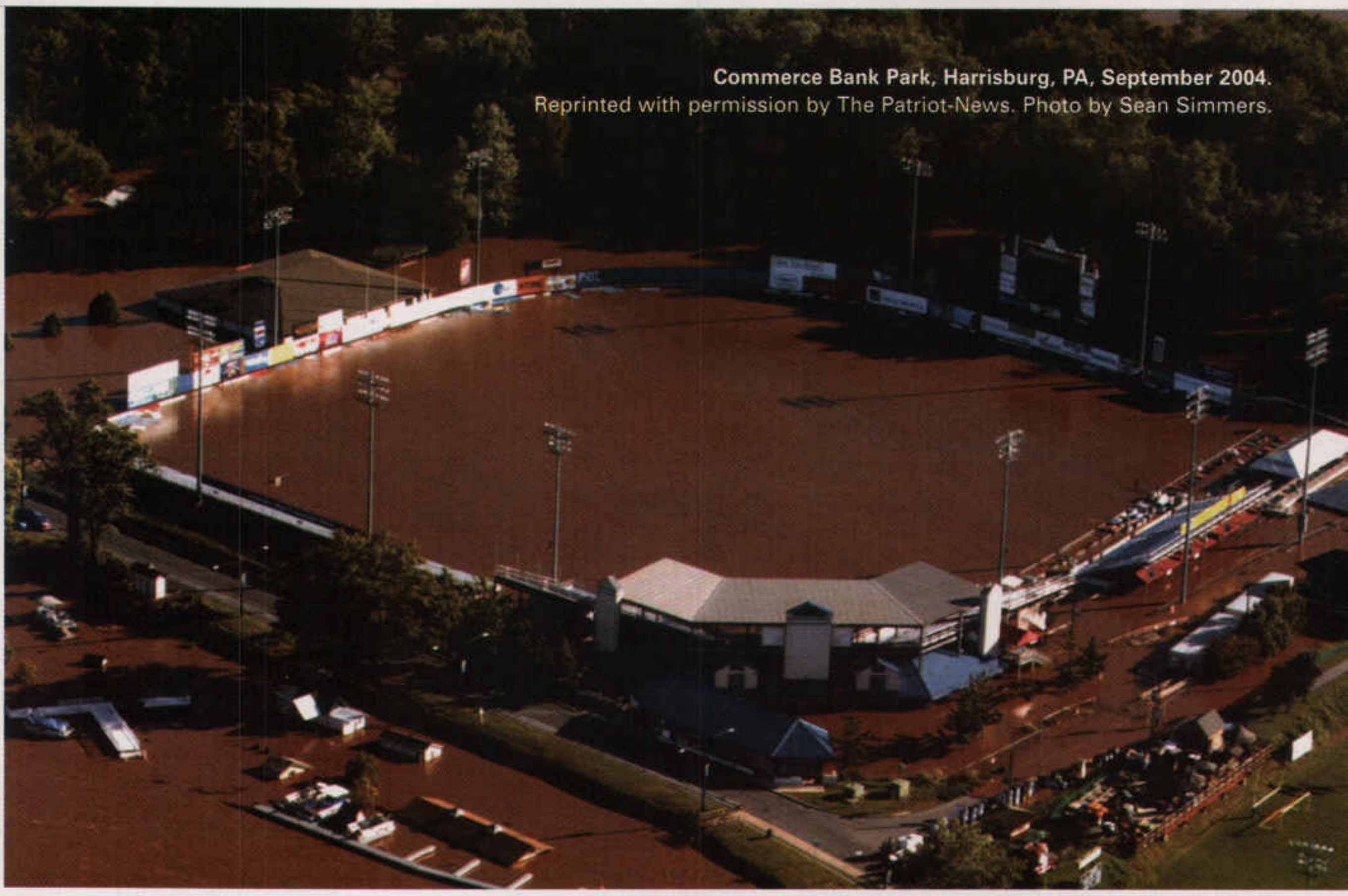
a catastrophic large basin flood, similar to a small basin flood event; allowing no time for preparation.

The first step after a flood event of any duration is to conduct an assessment of the field surface immediately after the floodwater has receded. Photo documentation will provide valuable evidence for insurance claims. Be sure to diligently document the site, noting every detail. We have found you can never have too many photos when you need them. On a site plan, identify extent of turf damage, depth of silt deposition and any grade irregularities as a result of scouring. Check for unusual chemical or biological odors or oily sheens on the surface of the residual silt. This could be evidence of chemical contamination, which may require special remediation. Two composite soil samples should be taken on the field and sent to a lab for analysis.



Commerce Bank Park, Harrisburg, PA, September 2004.
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The first sample should be a composite of 10 to 20 random locations of the silt deposited on the surface of the field. This sample should be sent to the testing lab for a relatively broad screening of chemical and biological contaminants. The chemical and biological screening will provide an indicator of the types of containment present and the relative concentrations. Knowing the composition of the problem will help in defining a mitigation plan for field restoration.

A second sample, with a similar frequency to the first, should be taken of the original growing media. Carefully cut and remove the turf to expose the soil surface and sample the top one to two inches. Be sure not to mix or contaminate the growing media with any silt deposited on the surface from the floodwater. This will distort the results of the test. Have the testing laboratory conduct a particle size analysis (PSA) test on the composite sample. The purpose of this test is to compare the composition of the growing media before and after the flood event to determine if the soil has been contaminated below the turf surface. Look for shifts in particle size or changes

in the infiltration rates of the growing media. Be aware that small changes in the silt and clay content of a growing media can dramatically change infiltration rates. If the test results of the deposited silt show high levels of contaminants, more extensive chemical or biological screening of the growing media may be necessary to determine to what extent the containment may have migrated into the growing media.

Inundation of the turf is the simplest problem to correct. Depending upon the species, turf can withstand inundation for approximately three to five days, after which the turf will die from a number of physiological problems. Flood events with durations of over 5 days will typically require replacement of the turf. In most cases the playing field would be ready for athletic use within six to eight weeks after sod installation. Once the turf is removed, typical field restoration activities such as grade restoration and protection of utilities occur as normal.

Contamination of the sand based growing media with silts and clay particles carried by the floodwater is a more serious problem. Deposition of silts and sediments on the playing field surface will seal the sand-based rootzone, seriously degrading the system's internal drainage. Depositions of silt as little as one quarter of one inch can contaminate the soil structure, so replacement of the sod is necessary in these situations. Silt deposition is greatest in areas of low water movement, which allow the silt to fall from suspension. Edges of the field will slow water movement and create a condition ideal for silt deposition, so it is a primary concern in this situation.

One preparatory practice that could be considered to reduce flood damage is to lightly roll the field with compaction equipment, as a potential flooding event becomes apparent. This would make the thatch layer in the turf system compress together and act as a sort of barrier to the downward movement of the silt into the rootzone. The thatch layer could then be stripped off after the floodwaters have receded, and small amounts of silt may be removed from the field using this method. Vertical mowing, power raking and verticutting are effective methods of removing silt-laden hatch. These activities should occur while the thatch still has some moisture content. If the thatch is too dry the silt and clay particles will not adhere to the thatch and fall further into the soil when agitated.

Even with small amounts of deposited silt, there is an added possibility of contaminating the rootzone during sod replacement activities. Deposition of larger amounts of silt would probably require field reconstruction. After the flood event, the silt and sediment contamination levels can be assessed through soil testing. The test results can be compared to soil tests before the flood event. In most cases the turf and thatch will act as a filter, trapping a majority of the silt particles. However the sand based growing media will also act as a filter, trapping silt and clay in the top inch or two. If testing indicates contamination of the growing media, it may be possible to remove the top inch of the growing media and capture most of the contamination. Sampling the growing media at various depths may provide a clear picture on how much growing media needs to be removed.

The most difficult and possibly most dangerous problem to address regarding a flood event is the contamination of the rootzone with residual chemicals or biological pathogens carried by floodwaters. Floodwater will often contain varying levels of nutrients, heavy metals, stable organics, phenyls, distillates, pesticides, chlorinated hydrocarbons and other chemicals that are toxic not only to the turf, but could be hazardous to individuals who might come in contact with them. While the Environmental Protection Agency (EPA) establishes safe soil and water thresholds for many of the contaminants, an athletic field constitutes a unique risk which may not be recognized by the EPA thresholds. An athlete has much more dermal contact with the field surface and because of that increased contact it is reasonable to assume they require lower thresholds. When chemical contaminants exceed recommended EPA thresholds the rules of the game change dramatically. Construction and restoration activities are subject to a number of environmental regulations in areas such as disposal of materials, disturbance of the site, protective clothing required to be on-site, and handling of contaminated materials. At this point, it is prudent to restrict access to the site and seek professional help on how to mitigate the problem.

Catastrophic flood events that result in the loss of human and animal life provide an ideal environment for the growth of dangerous biological pathogens. Severe flooding also damages sanitary systems releasing sewage into the floodwater. High nutrient loads, aqueous environments and warm temperatures contribute to an explosion in microbial and bacterial populations. Biological pathogens monitored by the EPA include total coliforms and E. *coli*. In themselves, coliforms generally do not pose a danger to people or animals, but they indicate the presence of other disease-causing bacteria, such as those that cause typhoid, dysentery, hepatitis A, and cholera. A much more detailed discussion of about chemical and biological pathogens can be found at www.epa.org.

Fortunately nature grass fields contain biological activity which will process and mitigate harmful pathogens. The natural activity can be used to restore growing media health. Under most circumstances chemical and biological contamination will be confined to the top three inches of the growing media. Removal of the field surface will go a long way in restoring the health and productivity of the growing media. Just remember handling and disposal of the material removed may be regulated.

The most efficient tool in restoring flood damaged athletic facilities is pre-planning. As a precaution, the turf manager should maintain a list of pre-qualified sod farms that meet the desired field specifications so that, in the event of a flood, approved sod could be procured quickly. As with all catastrophic events, there should be a disaster recovery plan for managing and recovering the damaged turf.

Recovery from a flood event is never fun, but with a good plan, systematic documentation, detailed testing and a lot of hard work it is possible to return the athletic facility to its intended programmed use while ensuring everyone's safety. **ST**

Jeffrey L. Bruce is owner of Jeffrey L. Bruce & Company, a national landscape architectural firm in Kansas City that plans, designs and restores athletic and recreational facilities.