Sports Turf Manager

FOR BETTER, SAFER SPORTS TURF. WINTER 2013. VOL. 26. NO. 4.

Optimizing Your Fertilizer Applications

Sean R. Jordan, *T.Ag., Technical Agrologist*

> Efficiency ***noun*** \ ih-fish-uhn-see\: 1. the state or quality of being efficient; competency in performance. 2. accomplishment of, or ability to accomplish, a job with a minimum expenditure of time and effort.

This article is written based on the presentation "Optimizing Fertility" given at the Sports Turf Association Ontario Field Day in September and deals with improving the efficiency of applied fertilizer and amendment products.

Efficiency and Where Losses Occur

Being well into fall, we are transitioning out of the season of "go, go, go" turf management where many days we are happy if we are able to perform the basic tasks ahead of the sports, both organized and not, played on our fields. The months ahead will be filled with repairing, replacing, purchasing and just simply recharging our own batteries in between spurts of snow removal. The fall and winter are also when many purchases of the necessary inputs such as fertilizers and seed are made. Hours will be spent looking over soil test reports, considering user group scheduling and looking at budgets, to decide on the right products to apply. Despite the best planning and products, losses in efficiency can still occur. The following will look at where this happens and where management programs can be adjusted to make the most of the time and money spent planning fertilizer programs.

To best understand how to get the most of fertilizer and amendment applications, we must first look at where losses occur. The following points are presented in no particular order; they all directly contribute to less-than-expected results.

Timing. Apply fertilizers or amendments when they can be best utilized by the turf. Whether adding nutrients to the soil or directly into the plant by way of the foliage, you'll want to plan your application based on when the applied nutrients are of most use to the plant. Consult the accompanying technical materials or fertilizer supplier for more information on timing.

Imbalances. Liebig's Law of the Minimum states: "growth is controlled not by the total amount of resources available, but by

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"Winter is on my head, but eternal spring is in my heart." ~ Victor Hugo

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- 2014 Board of Directors Slate of Nominees and information for the STA Annual General Meeting as it becomes available

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REGULAR COLUMNS, DEPARTMENTS & SMALL FEATURES

Deadline for Spring 2014 Sports Turf Manager: March 7

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President's Desk

BY PAUL GILLEN

Welcome to the Winter edition of your association's newsletter. Your executive has been very active during the late summer and early fall and there will be some exiting new announcements coming later this year and into the spring. Watch your emails for updates and visit the website often during the winter months.

STA, together with the Ontario Recreation Facilities Association, presented in November an Introduction to Synthetic Turf and Air-Supported Structures workshop at the Guelph Turfgrass Institute and University of Guelph. Thank you to our speakers Mark Nicholls, Turf Industry/UBU Sports, Gord Dol, Dol Turf Restoration/Sports Turf International, and Ian McCormick, The Farley Group. After the morning indoor sessions we bussed over to the University of Guelph campus where Bill Clausen, Frank Cain and Andrew Godard took us on a tour of the synthetic turf fields, Fieldhouse and Alumni Stadium. Thanks gentlemen! And thank you to all who joined us on the sunny but very cold excursion! If you were unable to attend this event, Ian McCormick has provided us with an article inside offering you an introduction to air-supported structures. There will also be sessions on synthetic turf in the programs of all three of the upcoming conferences for sports turf managers. See the Event Calendar for dates and details for the Sports Turf Managers Association Conference & Exhibition, the Ontario Turfgrass Symposium, and the Canadian International Turfgrass Conference & Trade Show. We hope to see you at one of them!

Speaking of sports fields and the cold, when you receive this issue the Grey Cup will have been decided... Hamilton versus Saskatchewan – should be a great game in a frigid Regina venue! Read in this issue how the Hamilton Tiger-Cats came to play their 2013 season "home away from home" games in Guelph, just up the road from their actual home in Hamilton, Ontario.

That's it for me!

Our very best wishes for a safe holiday season and happy New Year. •

On the field session at Alumni Stadium, University of Guelph.

Event Calendar

December 15
Early Bird Registration Deadline
Sports Turf Managers Association
Conference & Exhibition
San Antonio, Texas
www.stma.org
STA members can register at STMA rates!

2014

January 7 to 9
Landscape Ontario Congress
Toronto, Ontario
www.locongress.com

January 10
Early Bird Registration Deadline
Ontario Turfgrass Symposium
The Changing Face of Turf
University of Guelph
Guelph, ON
www.turfsymposium.ca

January 21 to 24
Sports Turf Managers Association
Conference & Exhibition
San Antonio, Texas
www.stma.org
STA members can register at STMA rates!

January 27 to February 21
University of Guelph
Turf Managers' Short Course
Guelph, ON
www.turfmanagers.ca

February 17 to 21
Western Canada Turfgrass Association/
Canadian Golf Superintendents Association
Canadian International Turfgrass Conference & Trade Show
Vancouver, BC
www.wcta-online.com

February 19 and 20
Ontario Turfgrass Symposium
The Changing Face of Turf
University of Guelph
Guelph, ON
www.turfsymposium.ca

April 28 to May 1
Sports Turf Association
Sports Turf Management & Maintenance Course
University of Guelph
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May 1
Sports Turf Association
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Optimizing Your Fertilizer Applications *Continued from page 1*

Figure 1. Spreader alignment for pan test (photo courtesy of Ferti Technologies)

Figure 2. Evenly spaced pans to either side of path of travel (photo courtesy of Ferti Technologies)

the scarcest resource." This means that all of the 14 essential nutrients required for plant growth must be present in at least the minimal amount. Although some soils exist with natural imbalances that are nearly impossible to overcome solely through fertilizer and amendment applications (e.g. high calcium levels of southern Ontario), most issues can be dealt with once they are detected. Several methods exist to determine the nutritional state of the soil medium in which turf is grown including soil testing, plant tissue testing and simply looking at the plants for symptoms of deficiency or excess.

Soil testing can provide a good, basic picture of the soil chemistry and changes made over time by a nutrient management plan. While there is very limited research-based data on the exact nutritional needs of turfgrass, there exists a wealth of knowledge, based on years of management of turf in soils. This knowledge allows for fairly accurate fertility programs to be written based on soil analysis, combined with turf type and use requirements. Plant tissue testing provides confirmation of the ability of turf to take in and utilize the applied nutrients, and can also be used for pinpointing more specific issues not easily determined through soil testing. Looking at turfgrass stands for common symptoms of deficiencies such as discolouration of leaf blades and abnormal growth, can also provide clues that an adjustment in soil nutrient levels is necessary. These symptoms may also suggest that certain nutrients are not being taken up due to some existing conditions such as water-logging or cold soil temperatures.

Rate. The rate at which a fertilizer is applied is a very important factor in the efficiency of a fertilizer or amendment application. This will be expanded upon more in the discussion of calibration, further along in this article.

Slow Release Technologies. While the turfgrass industry is quite large, it still is only a small portion of the agriculture/horticulture industry as whole. As such, most of the products we enjoy using in turfgrass management were developed for use in agricultural and/or greenhouse production. We enjoy fruits of the labour spent developing fertilizer and pesticide products for those industries, along with a preview of how they can be best utilized for turfgrass. Among these are slow release nutrient technologies.

Most slow release research deals with the nutrient required in the greatest quantity by the plant: nitrogen. This is partly due to the issues surrounding the instability of nitrogen in the soil. Most nitrogen sources are urea-based as it is the most economical source, due to the relatively low cost of production combined with the high-percentage of nitrogen it provides at 46%. Straight urea, is unfortunately easily converted in the soil to forms that are lost to the environment through leaching and volatilizing as well as being tied up by certain soil microorganisms. Urea is frequently coated, reacted or made less prone to these changes through the addition of inhibitors to microbial degradation.

Additionally, many other nutrients are made slowly available for the purpose of reducing losses and improving plant uptake. Every slow release source has a specific mechanism of release. Many reacted and organic sources require time and soil conditions conducive to microbial breakdown. Some more advanced physical coatings require combinations of soil temperature and the presence of water to allow release in tune with the needs of the turf throughout the growing season.

When these sources are applied with expectations to feed during a time when soil conditions are not ideal for release, there is a large loss of efficiency.

Application. All of the resources spent developing the many products that we have available and creating programs best suited to the specific needs of the sites we manage is wasted if the final step, application, is performed incorrectly. There are many stages in the application process where efficiency can be less-than-ideal, leading to significant losses in efficacy of our products. The next part of this article involves reducing these losses through good planning and education.

Fine Tuning Your Turf Management Program

A fertilizer or amendment product is only as good as the application.

While every aspect of a procedure is subject to improvement over time based on experience and new information, there are a few points relative to fertilizer applications that are often overlooked and can yield great returns if identified and addressed. These are: planning, proper application preparation and equipment calibration.

When I give a talk on calibration I often ask people in the audience: "When do you calibrate your spreaders?" Many times the reply is that it is done just before the application, if at all. A calibration performed under the pressure of time to get out ahead of play or field use is subject to error.

It is common for turf operations to have fertilizers in stock well in advance of application as well as spreaders and the operators to use them. Periods of time when the crew cannot be on the turf due to play, an event or even rainy weather, are built-in opportunities throughout the season for calibration. Most facilities have an equipment storage area that is well suited to use for a calibration of walking spreaders and even some driven ones, which makes this process fairly simple and efficient. By following the steps below, the cost of getting into a routine of calibration in advance and utilizing "down time" will be more than justified in product savings and results.

Many fertilizer and amendment products from companies that supply the turf industry, are formulated using years of experience, customer feedback and testing, to ensure the best results. All of the science and experience in creating products cannot offset the detrimental effect of misapplication. Quite simply, if a product is applied at an improper rate, at the wrong time or with a piece of equipment that has not been properly calibrated, it will not perform as expected.

Calibration: Point-by-Point

Calibration simply defined is "to adjust a feature for accuracy". We calibrate to ensure that the amount of product applied will do the job intended. If too much is applied, you could see negative effects such as excessive growth, increased susceptibility to pests, losses of nutrients into the environment and possibly turf loss. Applications at less than the desired rate will result in poor performance, less tolerance to stressors and a shorter interval before the next application is required.

The equipment used for granular and liquid applications is calibrated in similar ways, but has one distinct difference when it comes to every day applications; granular spreaders should be calibrated for every material as each product will spread differently based on particle sizing, particle shape(s), density and uniformity index. Additionally, every spreader applying a material should be calibrated as age, condition and set-up will vary from unit to unit.

There are three basic pieces of information necessary to calibrate application equipment: application rate, width and speed. Each is discussed individually below.

Rate. The application rate needed to calibrate a granular spreader is based on how much of the product needs to be applied to achieve the prescribed amount of nutrient, or active ingredient in the case of granular pesticide, to a given area. Most times, this information is provided in the technical literature that accompanies the product, or can be derived with some simple math.

The fluid application rate for a sprayer is based on the target area of the spray solution: the leaf blade, crown area or in the soil. These rates will vary from around 6 litres/100 m^2 (1.5 U.G. Gallons/1,000 ft^2) to possibly more than 20 litres/100 m^2 (5 U.G. Gallons/1,000 ft^2). More often than not, managers will calibrate their sprayers with multiple nozzles or at differing speeds/pressures to allow for a range of liquid application rates. Once the sprayer is properly calibrated and double-checked, it is simply a matter of making sure that the volume/weight of product added to the tank matches the amount of area to be sprayed.

Width. The distance from the spreader at which the amount of applied product is approximately one-half of what is applied directly in the path of the spreader is called the effective width. Spread patterns can be different, as there are several types of spreaders including broadcast (with single and double impellers) and pendulum-action, such as Vicons. Some have a triangular shape where the applied amount is gradually reduced as the distance from the spreader increases. Others have a flat pattern where the applied amount remains consistent to a certain point, and then drops off suddenly.

The most common method of determining the effective width of a material applied with a granular spreader is called a pan test and involves placing a series of shallow pans perpendicular to the spreader's path of travel to catch material. The pans can be something as simple as aluminum baking pans lined with cloth or paper, which prevents granular material from bouncing out (Figures 1 & 2). There will be an odd number of pans, with one in the centre and the rest at equal distances out from the centre on each side with one just shy of and one just beyond the estimated width of throw. It is necessary to spread over the pans in the same direction several times to collect enough material to determine the effective width. Always traveling the same direction will also help detect biases in the pattern that can be corrected by adjusting hopper openings or other components of the spreader. The width necessary to calibrate sprayers is the distance between nozzles as there is a simple formula that will provide a distance over which the sprayer should be timed for use later in the procedure.

Speed. The type of spreader being used determines the operating speed. Walking spreaders should be calibrated for each operator as ground speed directly affects effective width. Operators should calibrate at a speed that they can maintain throughout the entire spreading job. If an operator were to calibrate at a fast pace, and then slow down during some point of the spreading job, the applied rate would increase due to a decrease in effective width. To keep this organized, each operator would be assigned a spreader if there are to be multiple applicators for the same product. Differentiating like spreaders with a number or letter will

Figure 3. An example of a gate calibration device (photo: Sean Jordan)

Figure 4. A common calibration catch used for pedestrian broadcast spreaders (photo courtesy of White Castle)

reduce variables at the time of application.

The speed for a vehicle or tractor-mounted spreader should be safe yet productive. When determining a safe speed, the area of turf that poses the greatest danger due to slope or proximity of hazards should be the greatest limiting factor. Also, many times a tractor will be limited in choices of speed due to the fact that a certain engine speed must be maintained for PTO-driven spreaders and sprayers.

Once these three pieces of information are collected or determined, the process becomes one of trial and error to determine the correct spreader setting for each material (and operator, in the case of walking spreaders). Spreader settings that are given on the bag or in the technical literature are provided as starting points for calibration. It is not possible to provide universal settings that will be right for every spreader and every operator as the variations mentioned earlier will cause differences in applied rates between spreaders.

Additionally, there are tools that are specifically developed to aid in calibrating granular spreaders. These include guides to measure the opening of hopper gates at specific settings and devices that catch material as the spreader runs to reduce the mess usually associated with calibrating spreaders (Figures 3 & 4).

Regular cleaning and adjustment is crucial to maintaining application equipment that performs consistently. Follow manufacturers' guidelines found in each piece of equipment's owner's manuals for set up and maintenance. Included in this is information on gate settings, tire pressure and lubrication points, all of which should be checked before each application. As well the spreader should be thoroughly cleaned and dried after each use.

Putting It All Together

Taking the time to formulate a solid fertilizer and amendment program created with good science and experience will pay off. A plan built on a foundation of quality products that are used at the right rate and applied through properly calibrated application equipment will provide the best possible results. As much as the time and effort to develop a good plan may sound like it will cost more, the savings in labour and improved turf stands will more than pay for the plan. •

Impact of Turfgrass Fertilization on Nutrient Losses Through Runoff and Leaching

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Figure 2. Slit ABS pipe placed at the lowest part of the plots to collect runoff water.

Figure 1. Excavated plot with the two plastic sheets and the drain used to collect leachate.

Figure 3. Tipping bucket used to measure water volume from leaching and runoff and plastic container used to collect water sample.

Introduction

Over the last few years, there have been increasing concerns from the population about the effects of turfgrass fertilization on nutrient losses to nearby water bodies. Several cities have even adopted by-laws to restrict, or even ban the use of fertilizers on turfgrass. However, those by-laws are generally not based on science, and their effect to reduce nutrient load to water bodies has not been demonstrated. Furthermore, it has been shown that unfertilized turfgrass can result in higher nutrient losses compared to properly fertilized turf. Indeed, healthy fertilized turfgrass is denser and more efficient to reduce runoff and erosion than unfertilized turfgrass[1–3]. In 2011, we started a research project to quantify nutrient losses through runoff and leaching from two conventional fertilization programs based on industry practices and one program based on a typical by-law. We also included unfertilized treatments as controls.

Methodology

This project was established at our research facility located on Université Laval campus in Québec city. With the help of an excavation company, we built 15 hydrologically isolated plots during the summer of 2011. These plots are 5 m wide by 10 m long, and have a v-shaped bottom with a depth of 50 cm in the middle and 30 cm on the sides. Two sheets of plastic were placed at the bottom of each plot in order to isolate them from the water table, and a perforated drain was placed in on top of these plastic covers (Figure 1). Plots were then filled with the excavated soil and graded with a laser in order to obtain a 5% slope at the surface. Kentucky bluegrass was then sodded on the plots that will be used for the three fertilized treatments. In order to accelerate the effects of not fertilizing turfgrass for the control plots, we harvested turf that was not fertilized for five years from a nearby area, and used that to cover the control plots. In addition to grasses (30% Kentucky bluegrass, 15% sheep fescue, 15% colonial bentgrass) this cover contained about 20% clover and 20% of other broadleaf weeds (dandelion, plantain, orange hawkweed, etc.).

In each plot, we installed three capacitance soil moisture probes (at depths of 10, 20 and 30 cm) and one temperature sensor (at a depth of 10 cm) that automatically took readings every hour. In order to collect runoff water, we placed a 4” ABS pipe with a slit at surface of the soil in the lowest part of the plot (Figure 2). The result is that each plot has two water collection pipes: one for leachate (through the perforated drain) and one for runoff (from the PVC pipe). In order to measure water volumes from these two sources, we placed a tipping bucket hooked to a data logger under each pipe (Figure 3). Once the bucket is filled with 500 mL of water, it tips and the data logger registers this tipping event. By multiplying the number of tips recorded by the data logger by 500 mL, we can determine the total volume of water exiting the plot through runoff and leaching. Since we also collect a water sample from each tip and analyze it for nutrient content

(N and P), we can determine the total nutrient load in the water coming off the plots.

We started applying the treatments in the spring of 2012. Five treatments were evaluated as a completely randomized design with three replicates. The three fertilized treatments were based on industry practices (treatment 1 and 2) and on a typical city by-law currently in place in Québec (treatment 3). We also have two unfertilized treatments, one with some maintenance practices applied (aerification, topdress, overseed) and the other one unmaintained. Specifically, the evaluated treatments are:

1. Synthetic fertilizer: 20-0-12 with 50% slow-release N (1.5 kg N/100 m^2/yr) split in four applications (May, June, August, September).
2. Natural fertilizer: 9-2-5 (1.5 kg N/100 m^2/yr) split in four applications (May, June, August, September).
3. Compost: 1.8-1-0.9 (1.5 kg N/100 m^2/yr) applied all at once in May
4. Unfertilized maintained
5. Unfertilized control

The plots were irrigated in order to prevent turf dormancy. We calibrated the irrigation system to make sure each plot received the same amount of water during the irrigation events. We also evaluated turfgrass visual quality monthly on a 1 to 9 scale (1 = low quality, 9 = high quality, 6 = acceptable quality).

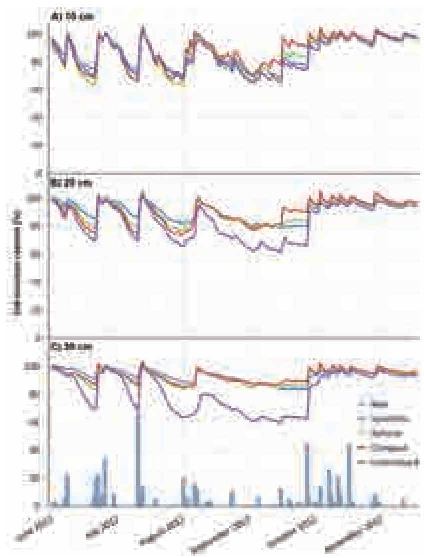

Figure 4. Soil water content at three depths (10, 20 and 30 cm) in the research plots throughout the 2012 growing season.

Results

The results presented here are only from the first year of experiment, and this project is planned to run for at least another year. Thus, they should be considered preliminary. Since we did not apply any maintenance (aerification, topdress, overseed) in 2012, both unfertilized treatments were merged together for the result analysis.

Soil water content. The summer of 2012 was exceptionally dry in Québec city, as shown on the precipitation and soil moisture readings chart (Figure 4). We did observe significant differences in soil moisture content, especially at depths of 20 and 30 cm. The fertilized plots (regardless of the treatment) had a consistently higher soil water content compared to the unfertilized plots. Dry root mass was also significantly smaller in the unfertilized plots (data not shown). Some of these differences are likely due to the type of cover (i.e. Kentucky bluegrass sod, vs mixed species cover), but we do not know yet the exact explanation for these observations.

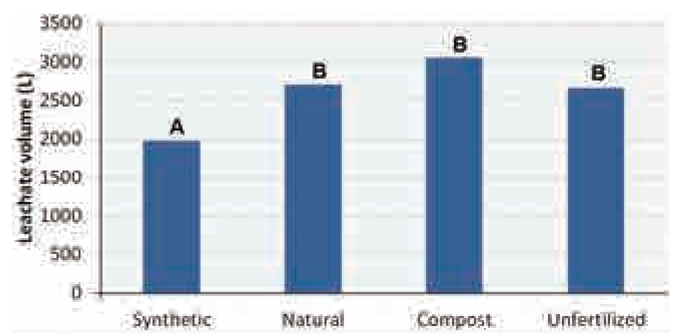

Figure 5. Total leachate volumes as affected by the different treatments during the 2012 season. Columns with the same letter are not statistically different.

Leaching. When we look at the total volume of water leached through the plots, as measured with the tipping buckets, we can see that plots fertilized with the synthetic fertilizer have a significantly lower leaching volume than the other plots (Figure 5). Since all plots received the same amounts of water, and that soil water content was similar for all fertilized plots, this difference could be caused by an increased evapotranspiration rate in these plots. Since this treatment is the one that supplied the most readily available N (50% of quick release N), it probably resulted in an increased growth rate, with plants actively using water.

We observed significant differences between the treatments in nitrate (NO_3-) and ammonium (NH_4+) content in the leachate (Figure 6). There was more nitrate losses through leaching from the fertilized plots than from the unfertilized plots. However, there was more ammonium lost in leachate from unfertilized plots compared to fertilized plots. It is interesting to note that there were no significant differences in nitrogen losses between the different fertilizer sources.

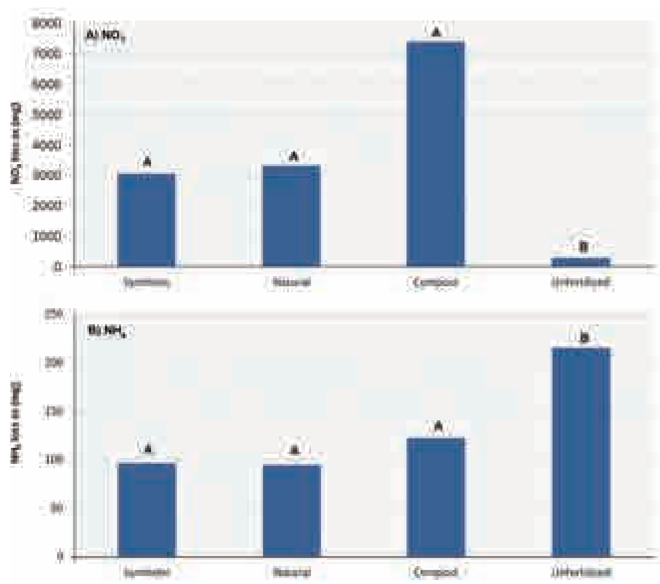

Figure 6. Total nitrogen losses from the experimental plots during the 2012 growing season in A) nitrate and B) ammonium. Columns with the same letter are not statistically different.

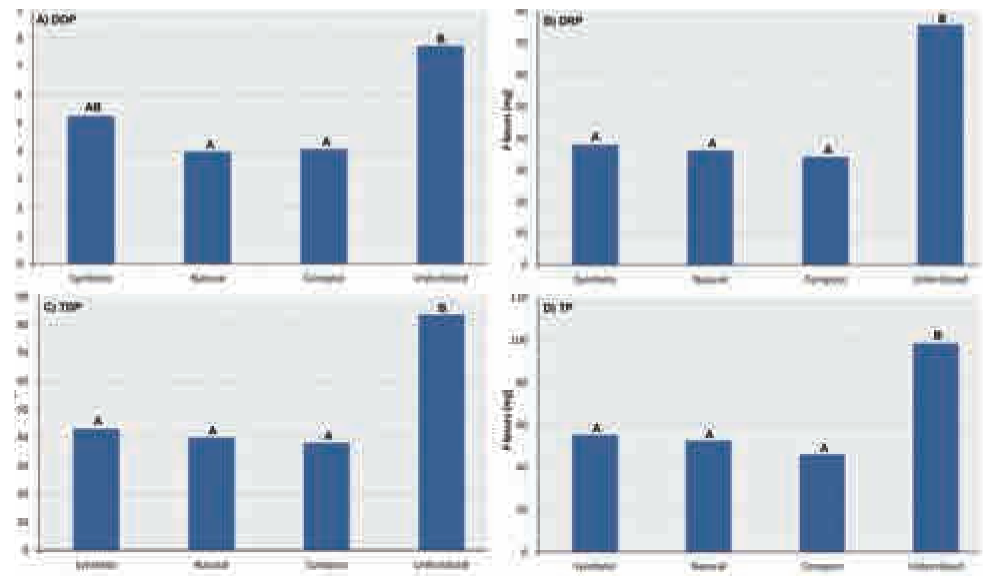

Figure 7. Total phosphorus load in runoff water during the 2012 season. Column with the same letters are not significantly different. (DOP = dissolved organic P, DRP = dissolved reactive P, TDP = total dissolved P and TP= total P).

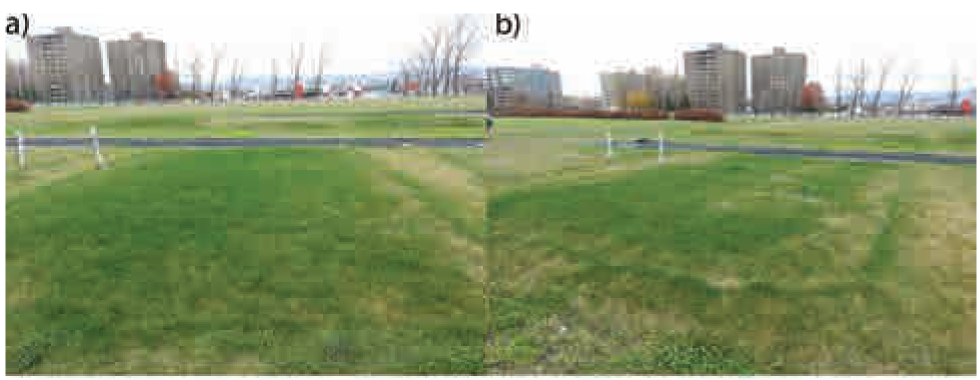

Figure 8. Visual appearance of the fertilized plots at the end of the 2012 season. A) Synthetic treatment, B) Natural treatment, C) Compost treatment.

Also, even if nitrate losses were higher from fertilized plots, the average NO_3- concentration (3 mg L^{-1}) was far below the Québec threshold for potable water (10 mg / L^{-1}) (data not shown).

Runoff. We did not observe any significant differences in runoff volumes between the different treatments (data not shown). However, we did observe differences in phosphorus losses through runoff (Figure 7). We measured four different forms of phosphorus in the water: total P (TP), total dissolved P (TDP), dissolved organic P (DOP) and dissolved reactive P (DRP). The concentration of all these forms of phosphorus was significantly lower in runoff from fertilized plots compared to the unfertilized plots (data not shown). Over the growing season, fertilized turf resulted in a 50% decrease in P load in runoff water compared to unfertilized turf. This effect is probably due to vegetation density and composition on the unfertilized plots.

Turfgrass quality. It is difficult to compare turf visual quality between unfertilized turf composed of mixed species and fertilized turf made from Kentucky bluegrass, since some of the broadleaf "weeds" could be desirable to a homeowner who does not fertilize their lawn. However, we did compare the effects of the three fertilizer sources on turfgrass quality during the growing season. The highest visual quality was observed on plots fertilized with the synthetic treatment, followed with plots fertilized with the natural program (data not shown). The compost treatment, based on a city by-law, resulted in the lowest visual quality. A comparison of the visual appearance of the fertilized plots at the end of the season (November 5, 2012) is shown in Figure 8.

Conclusion

While the results of this experiment are certainly promising from the perspective of turfgrass managers, it is important to reiterate that they are based on only one year of research. Thus, they should be considered preliminary for the moment and taken with a certain reserve. We currently are reviewing data from 2013, and we have requested funding for an additional five years in order to be able to observe the long-term evolution of our research plots. We hope that results from this experiment will be useful for both turfgrass managers and government bodies that want to implement fertilizer regulations. Any question related to this project can be directed to Guillaume Grégoire, research associate at Université Laval (guillaume.gregoire@fsaa.ulaval.ca).

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ornementale du Québec (ASHOQ), Association québécoise de la commercialisation en horticulture ornementale (AQCHO), Fédération interdisciplinaire de l'horticulture ornementale du Québec (FIHOQ) and Canadian ornamental horticulture alliance (COHA). In order to be fully transparent, we plan to publish all the raw data from this experiment once it is over and published in scientific journals. •

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Air-Supported Structures and Synthetic Turf Fields

Ian McCormick, ***Business Development Manager, The Farley Group***

Photos credit: Ian McCormick, The Farley Group

A synthetic turf field is an ideal playing surface for a wide variety of sports and activities – when it's not covered with a foot of snow. Fortunately, there's a building system that can allow for a synthetic turf field to be used during all seasons. Air-supported structures are lower cost alternatives to traditional buildings, particularly for facilities that require large, open, clear span interior spaces. But the most unique feature of these structures is their ability to be taken down and put back up seasonally. Many domes have been installed to cover sports facilities for the winter months and are taken down to allow for outdoor activity in the summer months. Of course, a dome can also be constructed for use as a permanent, year round facility. An air-supported structure is a versatile and cost effective building system for covering large, clear span space – seasonal or year round.

The Market Forces

With the exponential growth in participants in soccer and other field sports and the evolution of the synthetic turf industry, the last decade has seen a significant increase in the number of installations of synthetic turf fields with no signs of slowing down anytime soon. Unfortunately, many of these fields are in areas that are affected by the cold and snow that winter weather brings, rendering them unplayable for several months every year. So, what's the solution for a field that can't be used during the winter months? Well, you can "bubble" it.

Air-supported structures have been installed for a wide range of applications, including warehousing and manufacturing facilities, construction covers, and even bulk storage in the coal industry. However, the demand for air-supported structures has been primarily driven by recreational facilities requiring indoor space during the winter months and the recent growth in field sports has certainly brought the latest push.

Historical Overview

When air structures were first introduced to North America in the early 1970's by industry pioneer Ralph Farley, covering a single tennis court for the winter season was an ambitious endeavour. With the technology already established in Sweden, Farley saw an opportunity to make use of these "bubbles" in areas in Canada and the United States where long, cold winters made it impossible

Main heat and inflation unit and standby inflation fan (Greenville, PA).

Interior view of fabric connections for mechanical equipment and vehicle airlock (King City, ON).

for outdoor surfaces such as tennis courts to be played on after the warm season was over. He teamed up with a tennis club in Toronto and imported a "bubble" from Sweden, specifically patterned and manufactured to cover one tennis court. The fabric membrane was attached to an anchoring system around the perimeter and an electric inflation fan pressurized the interior of the bubble. That winter, people played tennis on the same court that they enjoyed their favourite pastime on in the summer months. The dome was deflated the next spring, rolled up and stored away and the court was played on in the summer as usual.

The next project was even more ambitious, covering three outdoor tennis courts instead of just one. Since then, Ralph and his associates have been involved in hundreds of air-supported structure projects throughout North America and around the world. Today, a three-court tennis dome would be considered a relatively small project compared to the very large field house domes that can cover as much as 100,000 square feet of interior space.

The Technology

An air-supported structure, also known as a "dome" or a "bubble", is a truly unique building system. The entire structure is supported by maintaining slightly higher air pressure within the fabric membrane than the atmospheric pressure outside. This is achieved by an inflation fan constantly introducing fresh air to the interior of the structure.

The inflation unit that maintains the internal pressure of the dome is also a furnace, keeping the interior of the structure at a comfortable temperature. To ensure the dome remains inflated at all times, a standby inflation system is always ready to take over the inflation requirements, even during a power failure.

The interior lighting system is comprised of either fixtures installed on stands around the perimeter, or hung from the fabric membrane, or a combination of both. The industry standard for sports lighting is 1,000 watt metal halide fixtures. These fixtures require a ballast to drive them, which can be placed around the perimeter of the interior, at the base of the light stand poles, or housed in a remote cabinet or other storage building outside of the dome. Several other technologies are being introduced as sports lighting solutions, which hopefully will eventually lead to energy savings without sacrificing light levels required for competitive sports.

The fabric membrane is manufactured using architectural grade vinyl coated polyester fabric. The pattern is specific to every project to create the shape of the structure. This outer material is backed by a 15 to 20-year prorated warranty and can be expected to last anywhere from 18 to 25 years before needing to be replaced. A liner fabric is added to the interior of the membrane to improve thermal and acoustic qualities. Insulation material is placed between the outer structural fabric and the inner liner fabric to maximize energy efficiency, bringing the equivalent insulation value from

Two full field seasonal domes (Downsview Park, Toronto, ON).

R2 to R10. On medium to large sized domes, structural cables are installed over top of the fabric membrane to help stabilize it.

The shape of the dome's membrane adheres to certain design parameters, taking into consideration the wind loads and other climatic data of the site and creating a curvature that promotes snow shedding off the sides and ends of the structure. If an air structure's height to width ratio is too low, the top of the structure becomes too flat, allowing snow to accumulate and putting too much weight on the fabric membrane. To achieve the proper curvature, a dome's height at the peak typically needs to be 30% of the width of the structure (i.e. a dome that is 200' wide would be a minimum of 60' high at the curvature's apex).

Because pressurizing the interior air space supports this fabric membrane, a significant uplift load needs to be offset. This uplift is accomplished by anchoring the membrane to a concrete grade beam around the perimeter of the dome. Soil friction and the weight of the concrete resist the uplift pressure that's created by inflating the dome. An aluminum channel is cast into the top of the grade beam, creating a profile that accepts the fabric membrane. This membrane has a rope edge manufactured into it at the anchor point. Pressure-treated lumber fits into the channel around the entire perimeter of the structure, locking the fabric membrane into the grade beam (Figure 1).

In order to maintain the internal air pressure, specially designed airlocks are installed to allow for easy access into the dome, including revolving doors, pedestrian airlocks for barrier-free access and vehicle airlocks for maintenance and lift equipment. Emergency exit doors are located around the perimeter of the structure to comply with occupancy codes and are only to be used during emergency situations as they will allow the internal air pressure of the dome to escape.

Construction Requirements

While overall project costs are indeed significantly less than a traditional building, site infrastructure costs such as excavation and site preparation, parking lot requirements, storm water management and the supply and distribution of electrical and natural gas utilities are required for an air structure just as they would be for any other type of building. Professional services need to be considered for site planning, such as architectural and engineering drawings and stamps, as well as the applications and approvals required with your local building department.

One difference with the site infrastructure required for an air-supported structure, is the installation of a concrete grade beam to hold the dome down as opposed to a traditional foundation that supports the weight of the building on top of it. The design and engineering of the grade beam depends on the size of the dome and the wind loads of the site's location, as well as the soil conditions at the site. Once these factors are determined, the air structure manufacturer will design the anchoring system accordingly, including requirements for equipment pads for mechanical units and entrance and exit components. The air structure manufacturer will provide a set of construction drawings stamped by a qualified structural engineer.

With new projects, the concrete grade beam and other infrastructure required for the dome, including electrical and natural gas service and distribution are planned and constructed in conjunction with the rest of the site development. Whether or not the dome will be seasonal or year round will need to be considered during the planning stages of the project. There are some subtle changes to the design of the dome and its anchoring system between seasonal and permanent structures. Outside of the scope of the air structure and its related construction, however, is the requirement for field drainage. Simply put, if the dome is going to be seasonal, field drainage will be required because the field will be open to the elements for part of the year; if the dome is going to stay up year round the field won't require this drainage infrastructure.

When the dome and field are being constructed together in new developments, the final installation of the synthetic turf is typically completed after the air structure has been installed. The installation process for the dome typically involves driving around the interior with heavy lift equipment, potentially damaging the brand new field. Plywood can be laid down for the lift equipment

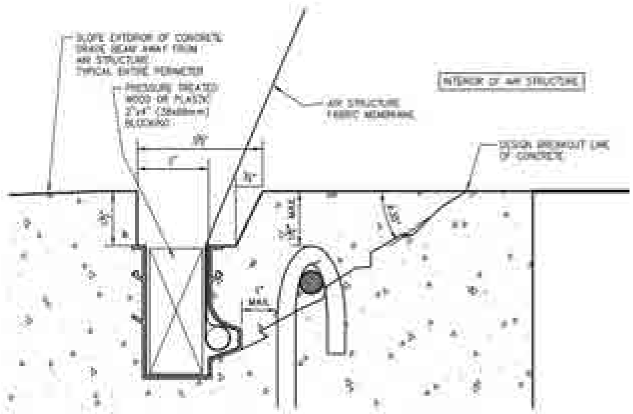

Figure 1. Cross section of cast-in anchoring profile.

to drive on if the field is installed first, or in the case of installing a dome on an existing field.

For existing fields, where the grade beam is installed around the outside of the field, the turf typically needs to be disturbed around the perimeter of the field to install the grade beam. Once the grade beam is completed, the turf is repaired and shored up to the edge of the new concrete. The concrete is flush to grade for seasonal domes, leaving little evidence of it being installed, or it can be raised for permanently installed domes to create a curb on the outside that can be useful for a guideline when clearing snow in the winter time. The grade beam can also be installed across an existing turf field if the plan is to have a seasonal dome cover a portion of the field. Turf fill-in pieces can then be created to cover up the grade beam and allow for regular use when the dome is taken down for the summer.

Installation

Once the grade beam construction and all other site work is complete, the air-supported structure and its related components are ready to be installed. Depending on the size of the dome, the fabric membrane will be manufactured in as few as 2 to 3 or as many as 8 to 10 sections, which are folded and rolled up into bundles for shipping and ease of handling on site. These sections are unfolded, spread into place and connected to one another using aluminum joint plates.

The fabric membrane is then connected to the grade beam around the perimeter and locked into the anchoring channel. If applicable, the structural cables are laid in place and connected to their anchors in the grade beam. The furnace and inflation equipment are connected to the duct work for the dome, which is either a fabric connection through the side of the dome or underground ducts from the equipment pad to floor grates inside the dome. Flip the switch to the inflation equipment and 1 to 2 hours later the dome is fully inflated.

The rest of the installation process includes placing and connecting all of the entrance and exit components to their fabric curtains on the dome, and installing the insulation material, interior

Fabric membrane being locked into anchoring system (Greenville, PA).

Dome spread out and connected to the grade beam, beginning inflation (Greenville, PA).

lighting system, and divider netting or curtains. All in all, the initial installation process usually takes anywhere from 1 to 3 weeks, depending on the size and complexity of the air structure package.

The Ups and Downs

Seasonal domes that are taken down in the spring and reinstalled in the fall basically go through the reverse of the process outlined above every spring and then repeat the process every fall. Of course, the seasonal ups and downs are more efficient than the initial installation, taking about a third of the time. The furnace and inflation equipment typically stays in place while the dome sections and the other attached components are stored away for the summer months. The cost associated with these seasonal take downs and reinstallations can add up for large full-field structures, given the man power and rental equipment required to accomplish the task.

Operating and Maintenance

Operating costs for an air-supported structure include electrical costs for the inflation equipment and the interior lighting system, and heat fuel costs for the furnace. Although air structures have a lower capital cost than traditional buildings and have the unique ability to be removed and reinstalled seasonally, they do require a slightly higher operating budget for utilities than other buildings that can be better insulated and don't require an electric fan for inflation. That being said, significant improvements have been made in the way of insulating the fabric membrane of an air structure with further innovations to this technology on the horizon.

A very important maintenance consideration is snow clearance around the perimeter of the dome. Because an air-supported structure is designed to shed the snow off the fabric membrane, the snow accumulates around the perimeter once it does so. It's extremely important that it gets cleared away from the fabric membrane so it doesn't jeopardize the structural integrity of the dome.

Other maintenance required includes regular checks on the backup inflation equipment to ensure a seamless transition in the event of a power failure, as well as regular maintenance for all mechanical equipment associated with the air structure.

Summary

The evolution of synthetic turf fields over the last decade has brought an abundance of improvements and the industry has seen dramatic growth during this time. There seems to be an ever-increasing demand for the use of these fields with the growing number of participants involved in field sport activities. However, for many parts of North America, these outdoor fields are not able to be used during the winter months. As a cost effective, versatile solution to covering large, clear span space for both seasonal and year round applications, an air-supported structure is a building system that can allow such fields to be used in all weather conditions. •

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FROM ROYAL CITY TO TIGER TOWN

The STA's Michael Bladon asks the University of Guelph's Bill Clausen, and Stephen Day and Steve Lowe of the Hamilton Tiger-Cats Football Club how it came about that the team's 2013 season home games would be played at the UoG's Alumni Stadium after Hamilton's Ivor Wynne Stadium was to be demolished.

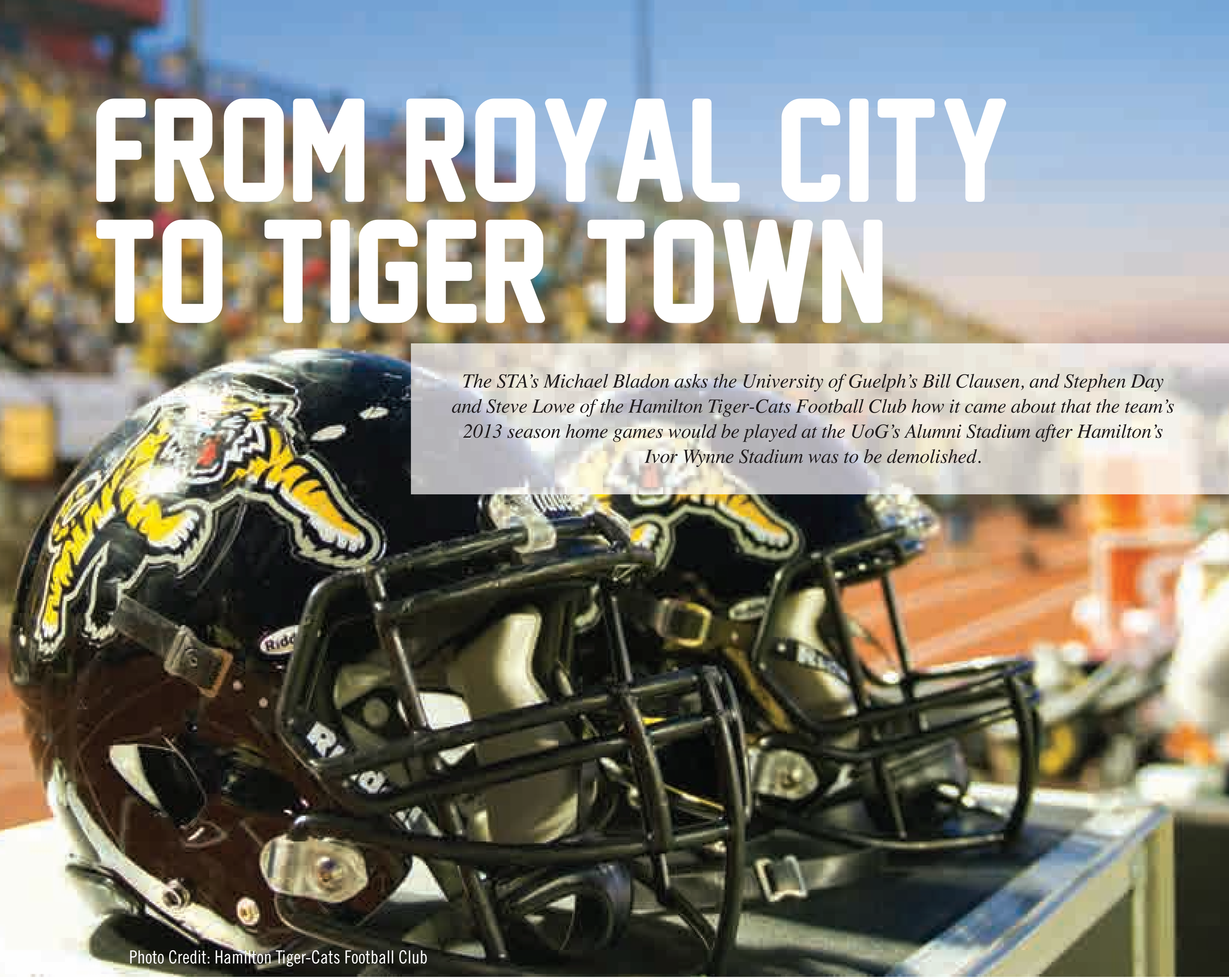

Photo Credit: Hamilton Tiger-Cats Football Club

Q&A with Bill Clausen, Facility Manager, University of Guelph

STA: *When were you first informed the Tiger-Cats would play at Alumni Stadium?*
Clausen: There were rumours back in August 2012 but nothing substantial was requested until October 2012. At that time negotiations went full time.

STA: *Did you participate in the initial meetings with the Tiger-Cats?*
Clausen: Once the decision to host the Tiger-Cats was made by the University's Senior Administration a number of people from various departments across campus were involved in finalizing a contract. Tom Kendall the Athletic Director, Frank Cain the Business Development Manager, Dave Easter the Marketing Manager and I were the Athletics Department staff involved. Campus Police Services led by Robin Begin and Pat Martin, Parking Services Manager Ian Weir, Hospitality Services Director Sylvia Willms, and Paul Mesman and Dan MacLachlan from Physical Resources were all part of the team led by Brenda Whiteside, Associate Vice President.

STA: *What was the involvement and what were the responsibilities of the University of Guelph before games?*
Clausen: Athletics ensured the field was groomed and safe to play on; we put out the corner flags, provided protective matting to cover the jumping pits and runways along the sideline, laid down track protection matting and put the team benches in place. Athletics staff setup the scoreboard controls and provided technical support during the games. Athletics staff also ensured the stadium was clean before each game. Physical Resources provide ongoing technical support for electrical, mechanical and structural issues ensuring the stadium infrastructure was operating in a safe and efficient manner. Campus Community Policing provided security support along with Guelph City Police and the private firm Star Security ensuring that no small issues developed into major problems.

STA: *And after games?*

Clausen: Working with the TiCat Customer Services Team, the Green For Life group and Chantler Environmental Services, Athletics staff ensured that the Stadium and the entire game day site was returned to normal state within hours of the game ending.

STA: *What staffing did the University of Guelph provide for Tiger-Cat games?*

Clausen: I was the Project Manager for the TiCat contract and I was on site for each TiCat setup day and game day from early in the morning until well after the game ended. We also scheduled an Athletic Facilities operator to be present on game days to do last minute setup and cleanup jobs as well as provide technical support for the CFL supplied score clock operators.

STA: *How was the University of Guelph team affected?*

Clausen: Positively for the most part, I believe. They got to see football at the next level and have a greater appreciation of what they will have to do to get to that level themselves. There were a couple of times when the Gryphons had to practice on Varsity Field because the TiCats were playing or the stadium field was being prepared for a TiCat game.

STA: *Describe the field maintenance regime. Does it differ, and if yes how does it differ, from that before the Tiger-Cats came to town?*

Clausen: Field Maintenance was done as prescribed by Field Turf to ensure we maintained our warranty and it was no different than what we did before the TiCats came to town. Davan Landscaping, as part of the Stadium Construction project, is contracted to do the field maintenance at Alumni Stadium. They would groom the field based on hours of use. Early in the season when the field was not as heavily used it might be two or three weeks between groomings, later in the season it was weekly as hours used increased to 80 hours per week.

STA: How is the stadium cleaned following each game?
Clausen: Chantler's Environmental Services and Green For Life were contracted by the TiCats to provide complete environmental services before, during, and after each game. Despite some game days where the weather was just plain terrible, they did an excellent job.

STA: On October 26th both the Hamilton Tiger-Cats and the Guelph Gryphons took to the field. How did that work behind the scenes?!
Clausen: Very well. We knew about the potential double header well in advance. The Athletics Department Event Management staff Jill Taylor and Facility staff Andrew Godard met with the TiCat game staff, devised a plan of action and made it work. The TiCat game ended at 4:15pm and the Gryphons kicked off at 8:00pm. The switch-over worked exceptionally well with both teams doing the work necessary in an effective, efficient and economical manner.

STA: What situations encountered during the season were the most difficult to resolve?
Clausen: To be honest once the decision was made to host the TiCat games we really did not have any real difficult situations. We all worked together as a team with the goal that the players, coaches, spectators, officials and television audience had the best experience possible.

STA: What were the easiest?
Clausen: Dealing with the TiCat staff was exceptionally easy. Steve Day the Project Manager, Steve Lowe the Marketing Director, Maurice Grant, Game Day Manager and all the support staff were great to work with. As is normal there were some miscommunication moments but we worked through them to provide a great experience for all.

STA: The Hamilton Tiger-Cats donated $500,000 to the University of Guelph. What was that to be used for?
Clausen: The TiCats made a $400,000 donation to the University's Better Planet Project specifically to the Athletic Facility Project portion of the campaign. The remaining $100,000 has been used to fund minor renovations, repairs and upgrades to the stadium.
STA: Was there revenue sharing with the Tiger-Cats? If so, what was shared?
Clausen: No there was no revenue sharing with the TiCats.

STA: What did you most enjoy about the experience?
Clausen: Working with an excellent group of people from a wide range of backgrounds and experiences to make a once in a life time series of events happen successfully in Guelph at the University.

STA: What did you dislike about the experience?
Clausen: It would have been greatly appreciated if the weather had cooperated a little better!

Q&A with Stephen Day, Director of Stadium Operations and Guelph Project Manager, and Steve Lowe Director of Marketing of the Hamilton Tiger-Cats Football Club

STA: When did the organization find out you would not be able to play at Ivor Wynne Stadium in 2013?
Ti-Cats: We started looking into potential options for the 2013 season in December 2011. Talks with the University of Guelph began in August of 2012.

STA: When you approached potential universities what requirements/guidelines did you present to them?
Ti-Cats: We needed to present them with the CFL Operation Guidelines to make sure they fully understood the specifications and requirements that would need to be fulfilled in order to host a CFL game.

STA: Was the University of Guelph high on your list as you entered negotiations?
Ti-Cats: The University of Guelph was high on our list due to the proximity to Hamilton, the physical layout of their stadium footprint, and their strong desire to share in the tradition of the Hamilton Tiger-Cats Football Club. We wanted to keep the games in a commutable distance for our season seat holders while also moving to a market within our regionalization zone. The University had also done a

number of upgrades at Alumni Stadium, field turf and stadium lighting, which made the possibility of hosting a CFL venue that much more realistic.

STA: *Can you explain what was required and the logistics involved in acquiring and integrating extra seating, washrooms, change rooms, parking, policing, etc.?*
Ti-Cats: The University of Guelph and the City of Guelph were both very helpful in navigating through all the necessary permitting involved in setting up such a large scale temporary stadium. We worked closely with Tower Events to design and construct the temporary seating at Alumni Stadium. William Scotsman proved a temporary box office and both temporary locker rooms. GFL Environmental Corp. and Chantler's Environmental Services provided all necessary services for waste removal. We also worked closely with Electri-Tech Services Inc, WalterFedy, Regal Tents, Drexler Construction, Connors Construction, and Battlefield Equipment Rentals who all worked tirelessly to meet the tight deadlines to get the stadium up and running for our first pre-season game on June 20th.

STA: *What is the seating capacity and how does it compare to Ivor Wynne Stadium?*
Ti-Cats: The seating capacity at Alumni Stadium was expanded to seat approximately 13,500 and provided a smaller, intimate venue with great sightlines for all fans. Some additional premium seating was added on a game by game basis on the track area surrounding the field of play. Comparatively speaking, the new Tim Hortons Field will have a seating capacity of approximately 24,000.

STA: *How did the teams get from the change rooms to the field?*
Ti-Cats: Teams walked from the change rooms to the field. We created a pathway through the back of house area for field access for the players. A short portion of the walk was through the South Concourse along Alumni Walk. This was a favorite location for fans to watch both teams enter the field and they were able to take pictures, high five players, and get a random autograph.

STA: *Would you change much of what you did in Guelph this year if the new Tim Hortons Field in Hamilton is not finished and you need a stadium for the 2014 season?*
Ti-Cats: Overall the transition to Guelph went smooth and not a lot

At the end of season, the dismantling of the temporary seating begins.

of changes would be made. All reports from Infrastructure Ontario are that Tim Hortons Field will be constructed on time and ready for the 2014 season.

STA: *How many volunteers were involved at home games? What were their responsibilities?*
Ti-Cats: We had few volunteers for home games but we utilized approximately 350 employees to run our game day operations. This included our regular game day staff, customer assistance team, security, parking services, and concession staff.

STA: *Approximately how many fans have travelled from Hamilton to Guelph?*
Ti-Cats: I do not have exact numbers as this changed on a game by game basis. It would be safe to say that in general the stadium consisted of 70% Hamilton based fans and 30% Guelph and surrounding areas.

STA: *Were you pleased with the number of Guelph fans who attended?*
Ti-Cats: We were pleased with the number of Guelph fans who attended and are looking forward to seeing our new fans from Guelph make the trip down Highway 6 to cheer on the Ti-Cats at Tim Hortons Field.

STA: *Overall thoughts of the season with regards to playing at Alumni Stadium? The City of Guelph?*
Ti-Cats: Overall, our season in Guelph was as successful as we could have anticipated. We developed a strong working relationship with the staff at UofG and the intimate atmosphere in Guelph provided a definite home field advantage. The University and City of Guelph welcomed the entire Tiger-Cats organization and supported us throughout the year. Thank you to the City of Guelph and the University of Guelph for sharing in our 2013 season. •


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