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SPORTS TURF Manager

...for better, safer Sports Turf

PRESIDENT'S MESSAGE

Happy New Year. At the time of this writing winter is in full bloom with the temperature around -10°C and a wind chill factor which is most unpleasant. At this time of the year sports field maintenance always seems like a very distant memory.

Winter and cold temperatures, however, usually signals the Ontario Turfgrass Symposium. Such was the case again this year when turf managers from all sectors of the industry braved the elements to gather at the Univ. of Guelph from January 4 to 6. This year's Symposium was another wonderful success with an increase in registered delegates and an outstanding itinerary of topics and speakers. The STA, as a sponsoring association, hosted an excellent series of lectures, panel discussions and seminars directly related to sports turf management. My sincere thanks to everyone who assisted in either planning, hosting or chairing the Sports Turf sessions and making the presentations educational and informative. Special appreciation must be extended to Pam Charbonneau who provided yet another superb effort in ensuring the conference was well organized and smooth running. If you were unable to attend the Symposium this year, I strongly encourage you to try and attend OTS '96. The educational value and professional development enhancement one receives, along with the networking and contact with suppliers, is truly excellent.

The Ontario Turfgrass Symposium was also the venue for our General Meeting. At the meeting it was my pleasure to present an Appreciation Award to Bob Sheard for his magnificent contributions to the Association as Executive Secretary for the past four years. In addition, I presented Michael Bladon on his resignation from the Board with a framed Letter of Appreciation from the STA for eight years of outstanding service and dedication. Other highlights of the meeting were welcoming our new Executive Secretary, Sonja Schneider and nominating Bob Sheard and Everett Nieuwkoop as new Directors. Bob has agreed to continue as Editor of the *Sports Turf Manager* and Everett will be assisting in planning the Field Day. At the meeting I was pleased that the membership agreed to extend our office lease for a five year period, at our current lease rate. This move ensures our members will continue receiving the benefits from having our office located at the centre of turfgrass activities in Ontario, the Guelph Turfgrass Institute.

While athletic turf may be dormant, your Executive are not resting, but staying very active. You will note this newsletter is the first edition under our new name - *Sports Turf Manager* - compete with ISSN number. Our Executive Secretary is very busy getting used to the office, fulfilling her duties and following up on member enquiries. We have now established a routine schedule of office hours during which the Exec. Sec. will be in the office and available to assist our members. Those hours will be listed in each issue of the *Sports Turf Manager*. Please do not hesitate to call Sonja if you have any questions about the Association, or need any assistance related to sports turf.

Several Board members are hard at work planning for the Field day in Hamilton on July 21 - 22. This year's theme is Ball Diamond Maintenance and the format represents a departure from previous Field Days. As always we will be hosting some educational seminars, with top notch speakers. A new feature will be a baseball tournament and barbecue. It plans to be a great opportunity to come out and learn about ball diamond maintenance while having some fun. Please mark the dates on your calendar and plan to attend. A flyer is enclosed with this issue of the "*Manager*".

Finally, about the time you receive this *Sports Turf Manager* you will be receiving your annual dues renewal notice. Thank you for your past support. I sincerely hope that belonging to this Association over the past year has improved your knowledge and awareness of athletic field construction and maintenance. We strive to make being a part of this Association a professional, educational and rewarding experience. Our mission is simple - Better, Safer Sports Turf. If you believe in the mission of the STA, I invite you to renew your membership so that together we may continue to be a leading organization and voice in the turf industry through improving athletic fields for athletes of all ages.

Best wishes for better, safer sports turf,

Christopher Mark
President.

IN THIS ISSUE:

Welcome Sonja Schneider
New STA Executive Secretary

During the recent General Meeting of the STA, President Chris Mark introduced Mrs. Sonja Schneider as the new Executive Secretary. Effective January 1, 1995 Sonja assumed the position from outgoing Executive Secretary, Bob Sheard.

The recruitment and selection process for a new Executive Secretary was a rather time consuming process. We received over sixty applications from a classified advertisement in the Guelph and Kitchener-Waterloo papers. The task was complicated by the excellent quality of the respondents. A short list of five candidates was selected for interviews. After several interviews and discussions, the sub-committee consisting of Chris Mark, Jim Galbraith and Mike Bladon, unanimously recommended the position be awarded to Mrs. Schneider.

Sonja brings to the STA a diverse and comprehensive background in secretarial support and office management. She was employed for thirteen years with Urangesellschaft Canada, an international mining company as Executive Secretary/Office Manager. Her responsibilities included all aspects of secretarial support to senior executive management including reports and submissions to various levels of government.

We feel most fortunate to have Sonja working with us and look forward to her improving the office efficiency through her computer literacy. Among Sonja's responsibilities will be to market the Association, to increase our industry profile, to promote membership recruitment, and improve member support services. Welcome Sonja and we wish you much success!!

OFFICE HOURS

Mrs. Sonja Schneider will be in the office from 9.00 a.m. to 1:00 p.m., Monday, Wednesday and Friday. The office phone number is (519) 763-9431. At other times a message may be left on the Voice Mail system. Please include the vital information of name , telephone number with area code, and time of calling. The office may also be reached at any time on FAX # (519) 766-1704.

Turf for The Sport of Kings

R.W. Sheard, Ph.D., P.Ag.

"It is the bonus course on the continent, it has bounce seldom seen on a grass course", commented Roger Atfield, one of the top ten trainers in North America.

"I have never ridden on anything like it" says jockey Robbie Davis who rode Raindrop, a French-trained horse and winner of the Rothmans Ltd. International Stake on October 16, 1994.

These were some of the superlatives offered about the new E.P. Taylor grass track which opened on Sept. 10, 1994 at the totally redesigned Woodbine Racetrack of the Ontario Jockey Club (OJC).

Early in 1993 the OJC decided to locate all their horse racing facilities in the Toronto area at Woodbine, and offer the standard bred track at Greenwood for sale. To accommodate three different types of facilities at one location they engineered a design unique for North America. It involved a total reconstruction of the existing tracks and the inclusion of a third track for harness racing.

The facility was designed as three concentric circles. The inner circle became a limestone track of seven furlongs for standard bred racing, the middle circle became a eight furlong, or one mile, dirt track for thoroughbred racing, and the outer circle became a one and one-half mile turf track for thoroughbred horses (Fig. 1). The latter has the longest home stretch in North America - 1440 feet.

Construction began following the last race in late October 1993, and over the next eight months millions of yards of dirt were moved, new access tunnels constructed, water systems realigned, irrigation upgraded, and even a portion of the front of the grandstand apron cut back to accommodate the new tracks.

The techniques used in the construction of the dirt tracks were, in general, time honoured procedures. Completion of the new harness racing track was in time for the opening on January 01, 1994. Work continued, when possible, throughout the winter to allow the opening of racing on the new dirt track for thoroughbreds on April 01. At the same time progress was being made on the subgrade for the new turf track.

The first move following the construction of the subgrade was the installation of the drainage system. Beginning at the inside rail, 4-inch corrugated plastic tile lines were installed as concentric circles, 20-feet apart, with the exception that the second last line was 40 feet from the outer rail. At 300 foot intervals collector line was installed perpendicular to 4-inch lines to carry the drainage water to the outlet line at the inner rail. The tile lines were covered with crushed stone and a 4-inch layer of stone was laid over the entire subgrade.

The decision to build a state-of-the-art turf track using a sand based root zone required the extention of the principles formulated for a United States Golf Association (USGA) green to 15 acres of turf.

The principles of USGA construction call for a stone layer having 65% of the stone in the range of 1/4 to 3/8 inch, with not more than 10% greater than 1/2 inch, and not more than 10% below 1/10 inch. The use of this size of stone requires the spreading of a 3-inch intermediate layer (choker layer) of coarse sand (90% between 1 & 4 mm) over the stone to prevent infiltration of the sand from the rooting zone into the stone. The spreading of the choker layer is a slow, hand labour-intensive procedure as heavy construction machinery tends to rut up the stone layer and intermix the sand and the stone.

The alternative was to use a stone of smaller size; the route selected by the OJC. Three performance factors are required of the smaller stone 1) bridging, 2) permeability, and 3) uniformity. For bridging of the root zone particles over the pores in the stone layer to occur the D_{15} of the stone must be less than or equal to five times the D_{85} of the root zone mix.

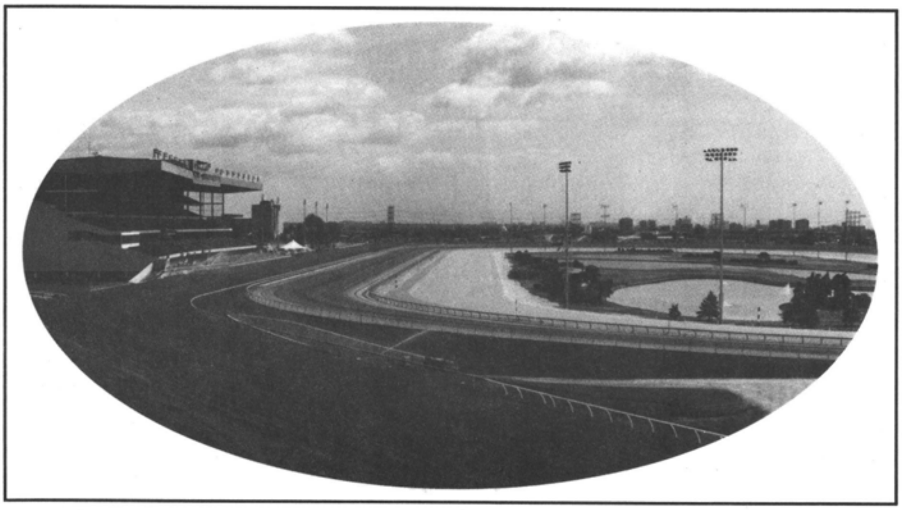


Photo courtesy of Ontario Jockey Club

Likewise for adequate permeability of water to occur the D_{15} of the stone shall be greater than or equal to five times the D_{15} of the root zone mix. Finally the stone should have a gradation index (D_{90}/D_{15}) less than or equal to 2.5. It is also preferable that the stone be of an angular shape.

Crushed stone from many quarries in Ontario might fit the criteria for shape, however, a search was necessary for a satisfactory size. As a guideline, an HL3 asphalt stone was recommended as satisfying the size criteria. A crushed stone was selected from several samples that had the particle size distribution illustrated in Figure 2. The appropriate characteristics required to confirm that the stone met the USGA guidelines are recorded in Table 1. Some problems were encountered in finding a source sufficiently free of sand and dust. Hydraulic screening was found necessary to removed this extraneous material.

Confirmation that infiltration of the root zone mix would not migrate into the stone layer, without installing the choker layer, was obtained from a simple laboratory test. A plastic cylinder, containing 10 cm of the stone overlaid by 15 cm of the root zone sand was dropped 50 times through a vertical distance of 7.5 cm. The cylinder was sectioned and the amount of sand migrating into the stone layer, under both wet and dry conditions, was determined (Table 2). Under moist conditions - as would exist at the base of a root zone supporting an actively growing turf - negligible sand migrated into the stone. The migration of sand under dry conditions points to the necessity of keeping the sand moist at all times during the construction process.

The selection of the material for the root zone mix was a crucial part in the redevelopment process. As the major constituent of the mix was sand, a search was undertaken to find an appropriate sand which would approximate the USGA guidelines. Some 14 different sand samples were analyzed in the selection process. The choice was narrowed down to three, one of which had the particle size distribution illustrated in Figure 3 which fell at the lower side of the USGA envelope of particle size acceptable for the final mix.

The second constituent of the mix was top soil. The top soil to be added must have a very high sand content as the selected sand was already near the low side of the particle size distribution envelope. Fortunately the OJC owned a property from which they extracted subsoil material for the dirt track at Woodbine. As the top soil was a loamy sand texture, containing 4.1% clay, 15.7% silt and 80.2 % sand, it seemed logical to use the top soil which had been stripped from the site to mix with the selected sand for the root zone mix.

A calculation of the volumes of soil and sand which could be blended together without exceeding the 8% total silt plus clay in the root zone mix showed they could be blended at a ratio of three parts sand to one part soil. (Fig. 3)

It was decided to use the same mix throughout the entire depth rather than a layer of the sand overlain by a 6-inch, soil-sand mix as suggested in the USGA specifications. The decision was made because the top soil was a relatively low cost material from the OJC owned property and to expedite the spreading operation. Since top soil was being used throughout the entire root zone it was also decided to dispense with any addition of expensive organic material.

The sand and soil materials were trucked on-site and premixed by passing the required volumes, measured by front-end loader buckets, through a soil screening machine. To provide a high level of phosphate throughout the root zone 1.34 pounds of triple super phosphate (0-46-0) and 0.27 pounds of muriate of potash (0-0-60) were mixed with each cubic yard of the sand-soil mix. No nitrogen or trace elements were included as they could be added at sodding, or after, as required.

The final criteria on which the sand:soil mix was selected was its moisture characteristics. The three sands which had been selected on the basis of the particle size were mixed at a ratio of three parts sand to one part soil in the laboratory. The mixtures were analyzed for density, porosity, hydraulic conductivity and plant available water retention (Table 3). From this data the sand from Source A was selected as the preferred material on the basis of the saturated hydraulic conductivity and plant available water. Since there was little difference between Source A and Source B the final decision was based on price and

Table 1. Characteristics of the stone selected for the drainage layer.

Characteristic	Diameter
	(mm)
D_{15} Stone	3.15
D_{85} Root Zone Mix	.650
D_{15} Root Zone Mix	.185
D_{90}/D_{15} Stone	8.40/3.15 = 2.67

(D_{15} is the diameter below which 15% of the particles lie, etc.)

Table 2. The percentage of sand in the stone layer after agitation to create infiltration.

Moisture Conditions	Distance Below Sand Layer 1 inch	2 inch	Ave.
	(% of sample)		
Wet	0.01	0.02	0.015
Dry	14.92	9.65	12.28

guarantee of delivery.

A saturated hydraulic conductivity of 30.3 cm/hr would suggest that a race can be run immediately following a summer thunderstorm having an intensity of 10 cm/hr without having a slow track, because the excess water will have drained from the system within a half hour. While such a conductivity might be considered excessive, it must be remembered that with time root development and relocation of particles can be expected to reduce the rate by one-half. Nevertheless the rate would still be adequate to insure rapid movement of excess water to the drainage tile and return of air to the system.

Although the total porosity of the root zone mix is on the low side of the USGA specifications it is not expected that the density will be altered through maintenance and racing conditions: thus lowering the total porosity. With the rapid saturated hydraulic conductivity, any excessive water in the root zone will rapidly disappear, preventing anaerobic conditions from developing.

The critical moisture characteristic with respect to daily maintenance of the turf is the water retention value - how much water will the rooting zone retain after drainage has ceased and which will be available for the growth of the turf? This value dictates how often the turf will have to be irrigated to maintain vigorous growth.

It is expected that the rooting of the grass will extend the full 12 inches of the sand:soil depth, encouraged in part by the phosphate additions during mixing and the inclusion of soil throughout the entire depth. Nevertheless, the majority of the active root surface will be within the top six inches. Furthermore, to avoid moisture stress it is recommended that irrigation occur when 50% of the available water has been consumed. Therefore, from the grass roots point of view, there is about 9 mm of water stored in the root zone for use by a vigorous turf.

Research has shown that the maximum rate at which turf can evaporate water is 7.5 mm per day under bright, sunny weather at 25+C and with a 30 km wind and low humidity. Therefore, under these conditions one could expect the sand:soil mix to need irrigation every night. Irrigation during the day should never be necessary. Of course such climatic conditions of sunny, windy and low humidity days seldom occur in Ontario.

Once a section of the track was complete it was sodded with Kentucky bluegrass. The selection of the sod farm was based on

Figure 1. A schematic drawing of the layout of the three racetracks at Woodbine.

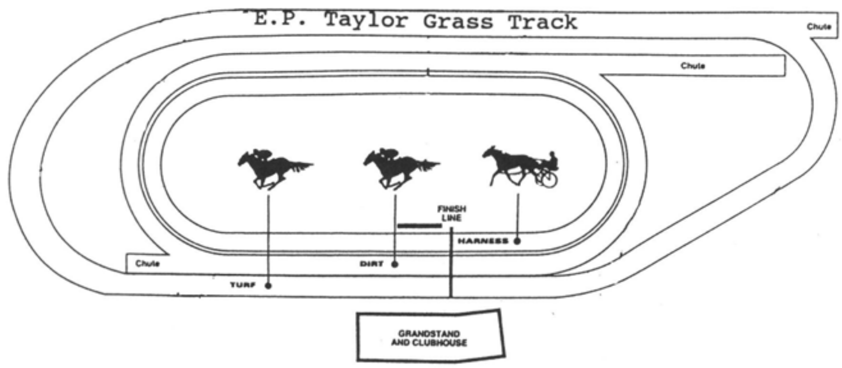


Figure 2. The particle size distribution of the material used for the stone layer and the acceptable envelope of size distribution of the stone layer used without a choker layer of sand.

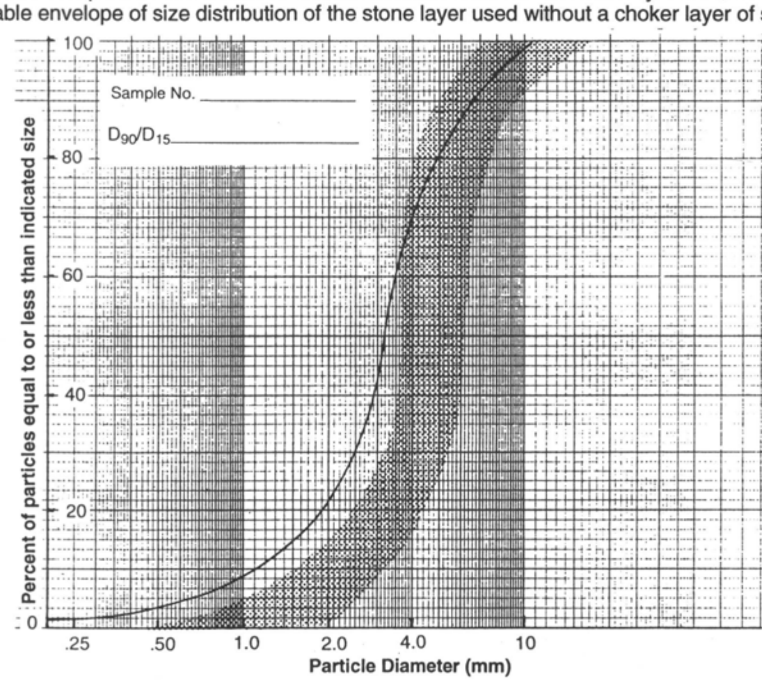
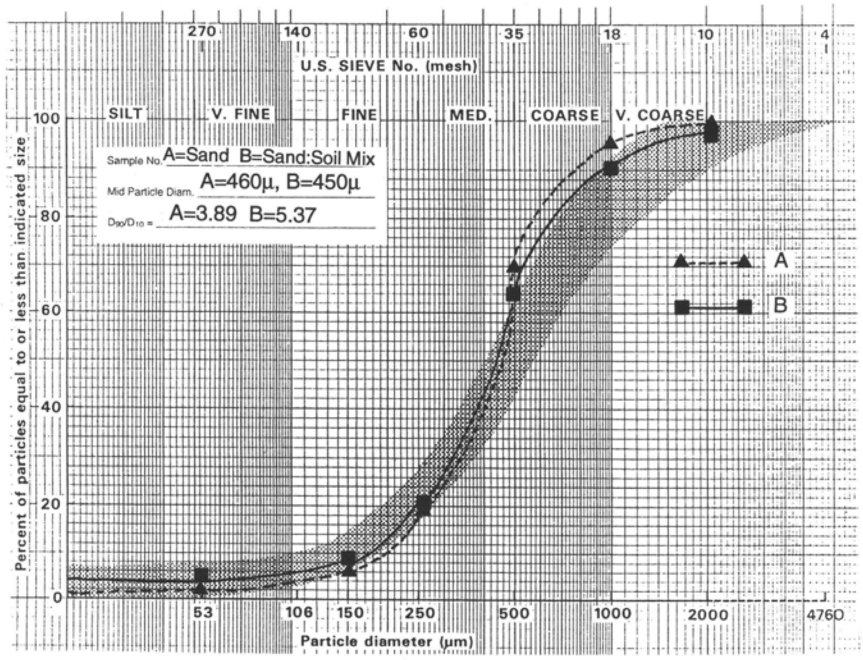


Table 3. The porosity and moisture characteristics of potential sand:soil mixes for the root zone.

Source	Maximum Density	Hydraulic Conductivity	Porosity			Water Retention
			Total	Cap.	Non-Cap.	
	(g/cm^3)	(cm/hr)		(%)		(cm/30 cm)
A	1.67	30.3	36.98	21.88	15.1	3.75
B	1.68	30.5	36.60	22.00	14.6	3.54
C	1.66	40.7	37.36	22.85	14.5	3.31

Figure 3. The particle size distribution of the sand and sand:soil mix used in the root zone.



the texture of the farm's soil to avoid having a sharp change in particle size between the soil associated with the sod and the root zone mix. To this end soil from several sod farms was analyzed for particle size. Fortunately sod was being produced in the immediate vicinity of the property from which the soil for the root zone mix was obtained.

The sod was laid using the wide roll system to reduce the number of seams and to reduce the labour required for installing a large area of sod in a short period of time. Sodding began on July 08 when the first section of the track had been fine graded. The final rolls were laid only three weeks before the first race. At race time, any differences due to seams or in general appearance were not visible.

The success of this operation was due to the cooperation of the design architect, the general contractor and his sub trades, and the turf specialists working in conjunction with the OJC maintenance staff. As a result few racing days were lost and a superb facility awaits the running of the International Breeders Cup for the first time in Canada in 1996.

Welcome Everett Nieuwkoop STA Director

The Sports Turf Association is pleased to announce that Mr. Everett Nieuwkoop has joined the Board of Directors. Everett has been a long time member and supporter of the STA.

Everett has long established roots (no pun intended) in agriculture and horticulture from being born and raised on a farm in the Kingston area, and working for local greenhouse operators. He attended Niagara College, graduating from the Horticulture Technician program with some distinction as he received 2 Horticulture Awards.

He possesses a wealth of knowledge about the horticulture industry from his employment in interior landscaping, operating a garden centre, consultant, and a sales rep for the Golf and Sports Turf Industry. While at Ontario Seed Company in Waterloo Everett established an annual turf field which included trial plots of many varieties of grass.

Currently, Everett is employed with McCracken Golf Supplies Inc. in Brampton and is very positive about the future of the turf and sports industry. He is married to a very special and supportive wife Joyce, and they have a wonderful daughter named Sasha. In his spare time Everett enjoys gardening, camping and coaching hockey.

Already Everett has started assisting us with planning the upcoming Field Day this July in Hamilton, and hopefully will take an active role in membership recruitment due to his contacts and respect within the turf industry.

Welcome aboard Everett. We look forward to your assistance as a Director of the Association.

Michael Bladon STA Director 1987 - 1994

At the recent General Meeting of the Sports Turf Association on Jan. 5, 1995, Michael Bladon stepped down as a Director, completing eight years of distinguished and meritorious service to the STA. This dedication to the Association and commitment to improving athletic fields is truly outstanding and deserves special recognition. On that occasion the President, Chris Mark, presented Mike with a framed Letter of Appreciation.

Mike was a founding member of the Association and has seen the STA grow from its infancy in 1987 to present where it is recognized as a leading organization in the turf industry. While we are most appreciative and respectful of what others have done for the Association in its development, I believe there is no doubt that Mike has put forth the greatest personnel commitment towards our Association. Mike has been at the forefront in striving to achieve the mandate, goals and objectives of the Association.

He has held a string of offices with the Association which includes President, Past-President, Newsletter Editor, and Director. In addition, Mike has participated on numerous Committees which included several Field Day Committees and the Toward 2000 Committee. Major accomplishments of the Association such as the *Athletic Field Manager's Guide* and the series of Turfgrass Videotapes have benefitted from Mike's contribution. In many respects, there are very few accomplishments of the Association which Mike has not assisted on in one form or another.

We hope that Mike's retirement from the Board does not signify the end of his involvement with the Association and that he will always be available to assist on special projects that would benefit from his expertise and knowledge of sports turf.

Our sincerest thanks for the many years of effort and commitment to the Sports Turf Association and by improving athletic fields through promoting **better, safer, sports turf**, Mike's motto for our Association.

We wish Mike only the best in all future endeavours.

UNDERSTANDING TURF MANAGEMENT

BUILDING THE SPORTS FIELD

The 15th in a series by
R.W. Sheard, P.Ag.

Municipal governments, school boards and service clubs are prone to allocating money for the construction of a new sports fields with minimal investigation of field requirements. Often the questions which are asked by the authorities are "What type of construction should we use?", "What should we be specifying in the tender?"

The cart is now before the horse! The questions which should have been asked first are: "What is the *level of expectation* of the field?", "What are the management requirements for maintaining the field - labour, equipment, irrigation, on-going funding?" Then the funding should be allocated.

Any funding organization contemplating the construction of a new sports field should begin their discussion with the first of the above questions because the level of funding for both construction and maintenance depends on the 'level of expectation of the field', not the sport which will use the field - soccer, football, field hockey, etc.

The 'level of expectation' of the field may be divided into three categories. The highest category - Category I fields - are the most expensive to construct and maintain. They are the fields where professional or semi-professional league and tournament play will take place. An infrastructure of stands, change rooms, lights, etc., are included in the budget, and often cost more than the actual field. A further criteria for this category is that pre-game seat sales will occur, thus a cancellation of a game is not an acceptable alternative. This category calls for the construction to follow the United States Golf Association Greens Committee (USGA) specifications for greens construction. Category I fields should never be attempted without a guaranteed, uninterrupted water supply.

The lowest category - Category III fields - are the local neighbourhood facilities for minor league play and unscheduled play by the general public. No change rooms, stands or other facilities are available and minimum security fencing is provided to insure the play does not spill over into adjacent streets. The quality of the turf should be such that good ground cover is maintained to insure the safety of the user.

The middle category - Category II fields - are the most difficult to define, and also to design. They may be considered as fields where play is generally scheduled, but may be cancelled due to field or weather conditions and where limited infrastructure in the form of change rooms and stands are provided. Even so, the quality of turf should be high and the construction such that heavy use may be entertained.

The Drainage System

The first requirement of a field in any of the three categories should be to assure that adequate surface drainage is available. While mandatory for Category I and II fields which, during construction, will be graded to a defined slope or crown, Category III fields often accept the natural grade or slope of the site. Such acceptance in turn leads to future problems where low areas pond water, increasing the potential damage to the turf. Extra funding to insure a proper surface grade prior to seeding the field will result in lower maintenance costs in the future.

The design of all sports fields of Category I and II must begin with an adequate subsurface drainage system in addition to surface drainage. The first step in designing the drainage system should be a satisfactory outlet for any drainage water. The outlet most probably will be the storm water drainage system.

Drains are 4-inch, perforated, plastic tube spaced at least every 40 feet apart, but in impervious clay soils or sand based rooting zones they should not be more than 20 feet apart. Due to the low cost relative to other items in the construction of a field it is often advisable to space the lines 20 feet apart, or less, under all soil conditions.

Some installers prefer to use a herringbone design. The design adds nothing to the efficiency of the system and may contribute slightly to the cost. The simplest and most efficient system from the installers viewpoint are lines running the length of the field: commencing at mid-field, with a falling grade, to extend at least 20 feet beyond the playing surface at the end of the field. An additional line outside the playing surface for the players bench area is often advisable.

Tile lines should be installed at a minimum depth of 18 inches below finished surface grade. A mid-field depth of 18 inches will result in a depth of 24 to 30 inches at the point where the line enters the main line to the outlet. The drain lines are installed at a 0.5 to 1.0% grade (0.5 feet fall/100 feet of run). Remember there is a 0.33% grade in 100 ft of a 4-inch tube itself if it were installed perfectly level.

It is not necessary to place stone below the tile line, unless the stone is used to obtain a uniform grade on the line when installed with a backhoe. Likewise it is not necessary to enclose the line in geotechnic material unless the native soil is a very fine sandy loam or a silt. Many installations are made with a backhoe which does not provide the grade control obtainable with the laser- controlled excavating wheel or chain used on commercial tile laying machines. The use of a laser-controlled tile laying machine is not only more accurate, but faster, and worthy of serious consideration by the contractor.

The tile lines should be installed *after* the subgrade has been graded to the desired slope of the surface of the field. Installing the lines under wet conditions can destroy the smooth subgrade by leaving ruts, thus preventing the free movement of water laterally to the tile lines in the future. Regrading of a disturbed surface may be difficult as the graded material cannot be spilled onto the tile lines. Crushing of the lines can occur if heavy machinery is used over freshly laid lines, therefore care must be exercised in movement of the remaining materials into place by restricting truck movement and plank bridging over the lines.

Category I fields require the placement of a 6-inch depth of stone above the tile and over the entire subgrade surface (Fig 1). The selection of the size of the stone is critical because the migration of the finer materials used in the rooting zone into the stone blanket must be avoided if the drainage system is to function properly for decades.

USGA specifications call for a stone layer having 65% of the stone in the range of 1/4 to 3/8 inch, with not more than 10% greater than 1/2 inch, and not more than 10% below 1/10 inch. The stone layer is then covered with a 3-inch layer of course sand (choker layer) to provide the necessary bridging over the large pores in the stone. Installa-

Fig. 1: A cross section of a sand-based rooting zone for turf.

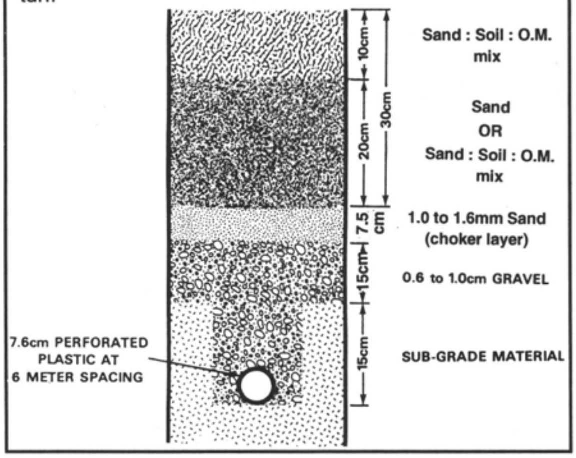
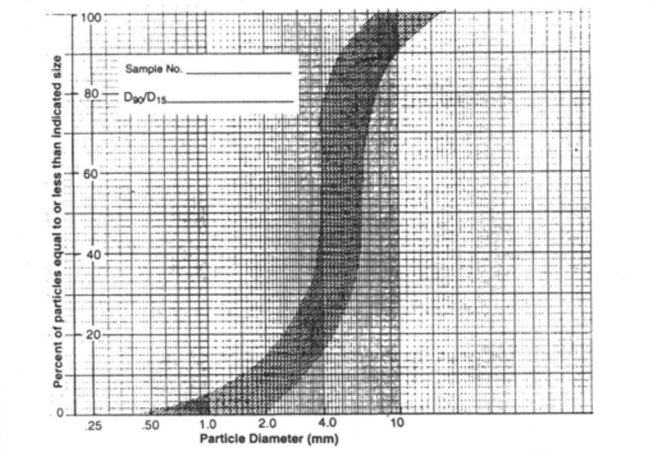


Fig. 2: The envelope for the particle size distribution of the stone layer without a choker layer of sand.



tion of the choker layer is a slow, labour intensive operation.

An alternative now accepted by USGA is to use a smaller stone without the choker layer. For bridging of the root zone particles over the pores in the stone layer to occur the D_{15} (diam. below which 15% of the stone particles lie) of the stone must be less than or equal to five times the D_{85} (diam. below which 85% of the sand particles lie) of the root zone mix. Likewise for adequate permeability of water to occur the D_{15} of the stone must be greater than or equal to five time the D_{15} of the root zone mix. Finally the stone should have a gradation index (D_{90}/D_{15}) less than or equal to 2.5. It is preferable that the stone be an angular shape, suggesting well-screened, crushed aggregate. An example of the size envelope of a satisfactory material is provided in Figure 2.

The Rooting Zone

The next step in the process of construction of Category I and II fields is the selection of the rooting zone mix. Whatever material is used, the rooting zone should be a minimum of 12 inches in depth (Fig 1). The same care must be exercised in placing the root zone material over the stone as was used in putting the stone in place, otherwise rutting and intermixing with the stone will occur.

Many Category II fields are constructed using the native soil for the rooting zone. Prior to approving a native soil for use it should be subjected to particle size analysis and moisture transmission analysis. The textural class of the soil should be a course sandy loam or loamy sand and should have less than a total of 10% silt plus clay. Silt loams and clays should be avoided. It should have the ability to transmit a minimum of six inches of water per hour.

The heavier textured soils may be modified by the addition of sand using the monogram in Figure 3 to select the amount of sand to add. A well-aggregated, screened, surface soil should be selected and thoroughly mixed off site with the sand. Careful costing of the sand modification alternative, relative to other options, should be done because if an incorrect blend of sand and soil is selected this procedure may resulted in a very poorly draining, compacted systems.

The rooting zone of all Category I fields should be based on the principles of USGA greens construction. The principles involve the construction of a tile and stone blanket drainage system on which is placed a special root zone mix. The mix comprises a selected sand to which a relatively small amount of soil and/or organic material is added. The resulting mixture will not be subject to future compaction and will have water transmission values which will permit play under all weather conditions while minimizing the damage to the grass.

The selection of the sand for the root zone is critical. The procedures to follow are outlined below.

Several potential suppliers of sand should be selected and asked to submit a two kilogram sample for particle size analysis. The suppliers should be asked to supply a brick sand or topdressing sand, because these are the trade names for materials which will most probably fit the USGA requirements. The samples should be sent to a laboratory capable of performing sieve analysis of sand and characterizing the moisture relationships of the final mix.

Suitable sands should be selected on the basis of a particle size distribution which falls within the envelope illustrated in Figure 4. Care should be taken to select a sand that is very low in silt and clay size particles (less than or equal to 0.05 mm) because upon the addition of the soil material the final mix must not exceed a total of 8% silt plus clay. Having two or more samples which meet these criteria the contractor is in a position to negotiate price, supply, delivery, etc., with the suppliers.

The next or concurrent step is the selection of a suitable top soil to add to the sand. The preferred soil should be a screened material containing no stones or other debris, weed free, herbicide free, have a high organic matter content and have a sandy loam texture. Samples from potential sources should be subjected to particle size analysis for percent sand, silt and clay by hydrometer analysis, percent organic matter and percent total carbonates. Samples containing less than two percent organic matter and/or more than 10% carbonates will suggest contamination with significant amounts of subsoil.

In many areas a sandy loam soil does not exist. In these cases the local loam or clay loam soils may be used, but the amount which may be added to satisfy the 8% total silt plus clay limitation will be sharply reduced.

Based on the silt and clay analysis of the soil material a calculation is made of the amount of soil which may be added on a volume basis to the sand. A small sample mix is prepared. Organic materials such as peat moss, compost or other organic wastes may then be added. These organic materials should not exceed 10% by volume of the mix. The organic material chosen should also have a loss-on-ignition value in excess of 85% because some organic sources can contribute significant silt and clay to the final mix.

Having prepared the sample root zone mix it is again subjected to screen analysis to confirm the mix still fits within the particle size envelope (Fig. 4). It is recommended that the soil material be very finely ground or physically dispersed in Calgon solution, dried and ground again before adding to the sample mix for sieve analysis. This step is necessary where well-aggregated, high clay content soils are used because the small aggregates of soil will sieve out as sand.

Having satisfied the criteria of particle size by relatively inexpensive sieve analysis the final selection step is to conduct the relatively expensive porosity and moisture characterization of the sample mix. The accepted range of values are listed in Table 1.

In most circumstances if the selection based on particle size analysis has been performed correctly and the criteria for particle size adhered to, the physical properties will fall within the accepted range. If, however, the sample mix fails to pass the one or more of these physical properties it is advisable to re-examine the mix selected.

Installing the Rooting Zone

Pre-mixing the sand, soil and organic material off-site is an absolute necessity to insure proper blending of the ingredients. It is not necessary to screen the top soil below one inch as the larger aggregates act as islands of soil in the sand matrix. Mixing may be adequately performed by front end loaders; adding the materials in the desired ratio by volume of the bucket. Mixing is accomplished by repiling the mix several times. Peat should be moist during the mixing stage to ensure uniform mixing and to minimize peat and sand separation.

It is also a good practice to add 1.5 pounds of phosphate fertilizer (0-46-0) and 0.3 pounds of potassium fertilizer (0-0-60) per cubic yard of mix.

Depending on the economics of the particular site the sand:soil mix may be used throughout the entire 12 inches of rooting zone or restricted to the upper four inches. The shallower depth of sand:soil mix, however, may be more expensive due to the need to install two lifts of material. Of course the bottom lift would be the same sand as was used in making the sand:soil mix. It would not be necessary to add organic material to the lower layer.

Sand which is dry has a very low bearing capacity for equipment whereas sand which is wet will carry substantial loads. It is therefore an essential practice to have an irrigation system installed or a portable system working so that the sand is kept wet at all times. It also aids in preventing wind drift of the sand.

The sand-soil mix is dumped at the edge of the field and bladed into rough position with a small bulldozer. Final surface grading may be accomplished with a motor grader. Moving loaded trucks onto the field can result in rutting the gravel layer and intermixing, particularly by unloaded trucks starting up to move off the field after dumping their load.

It is a good practice to have a vertical division between the adjacent soil material at the edge of the field and the sand root zone mix. The sharp break between the two types of material avoids moisture related growth problems in the future. Strips of plywood or heavy plastic may be used, and moved as the installation progresses.

Sodding, hydro seeding or standard seeding methods may be used to establish the turf. *It is essential that the irrigation system be functional before turf establishment is attempted.* A standard fertilizer program for turf establishment should be followed.

A quality control program during construction is strongly recommended. Periodic, on-site sieve analysis of the sand as it is delivered will insure that the sand conforms to that used in the laboratory analysis and that the field will perform as desired.

Finally, it must be emphasized that Category I fields require a high level of management skills. Some people have regarded these fields as a large hydroponics system. This may be an exaggeration, nevertheless, the field manager must be very conversant with plant nutrition and water use because the normal buffering - ability to resist change - of soils is missing. A delay of two days in irrigation or postponing a fertilizer application for a week can result in an inferior playing surface.

Table 1: The physical properties of a suitable root zone mix.

Criteria	Recommended Range
Total Porosity	35% - 55%
Air-filled Porosity (@ 40 cm tension)	20% - 30%
Capillary Porosity (@ 40 cm tension)	15% - 25%
Saturated Hydraulic Conductivity	15 - 30 cm/hr
Moisture Retention (@ 30 cm tension)	2.5+ cm/30 cm depth

Fig. 3: A monogram for estimating the volume of sand to add to a soil:organic matter mix to provide a suitable rooting zone material.

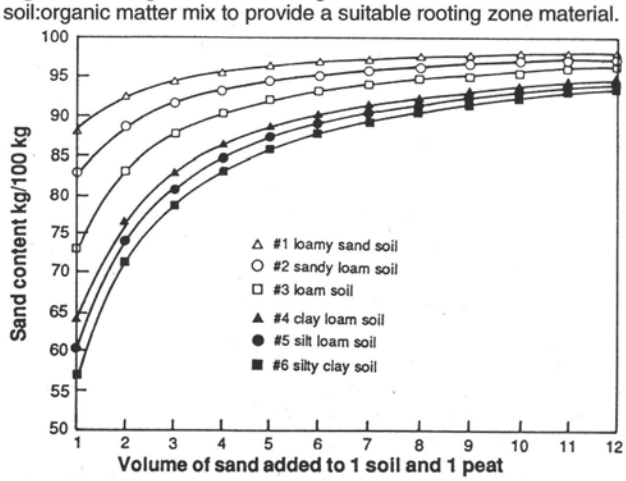
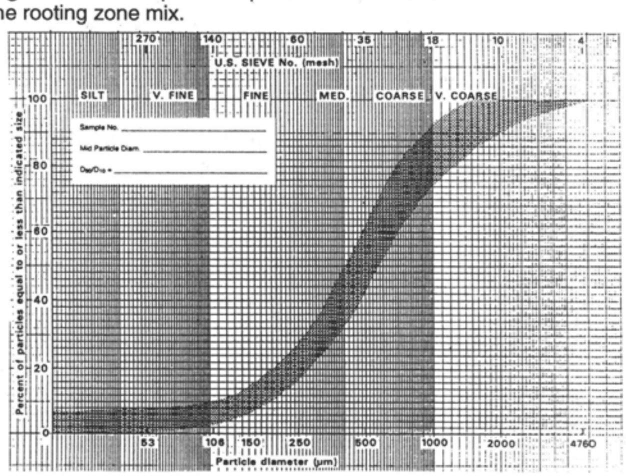


Fig. 4: The envelope of the particle size distribution of the sand for the rooting zone mix.



ANALYTICAL LABORATORIES - SOIL PHYSICAL ANALYSIS

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Univ. of Guelph,
Guelph, ON. N1G 2W1
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(519) 824-4120

Agri-Systems of Texas Inc.
15511 Baldswelle,
Tomball, TX.
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(713) 376-4412

Colorado Analytical Lab.,
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Brighton, CO.
U.S.A. 80601
Attn: Shane Nielson (913) 829-8873

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Brookside Farm Labs. Inc.,
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Attn: Mark Flock
(419) 753-2448

Int. Sports Turf Research Center,
1530 Kansas City Road, Suite 120,
Olathe, KS.
U.S.A. 66061
Attn: Leon Howard
(303) 659-2313

GRASS SEEDS

- Available from the major seed companies in Ontario

The Sports Turf Association strongly recommends to athletic field managers that they use only improved cultivars that have been tested and found superior under local conditions.

SPECIES	SUPPLIER					
	Bishop	Pickseed	Ontario	Oseco	Rothwell	Speare
Kentucky Blue	Aldelphi Baron Barzan Liberty Limousine Lofts 1757 Ram II Regent Shamrock	Alpine America Banff Bronco Cheri Crest Fylking Indigo Nugget Regent Touchdown	Argyle Baron Barzan Classic Eclipse Limousine Liberty Regent	Aspen Baron Classic Gnome Haga Nublue Nugget Midnight Opal Regent	Adelphi Ampellia Argyle Asset Buchingham Broadway Challenger Chateau Classic Conni Cynthia Eclipse Estate Glade Harmony Huntsville Julia Midnight Monopoly Nustar Platini Ram II Raven Regent SR21 SR2000 SR2100 Sabre Scenic Sophia Suffolk Welcome	Baron Eclipse Georgetown Liberty Limousine Lofts 1757 Nassau Ram I Regent Shamrock
Ryegrass	Competitor Elf Envy Omega II Palmer II Prizm Spectacular Yorktown III	Blazer II Cutter Dasher II Edge Express Fiesta II Future 3000	Elite Envy Palmer II Pinnacle Repell Seville Yorktown III Lowgrow	Affinity APM Pinnacle Stallion	All Star Brenda Elegance Imagine Mondial Pebble Beach Seville SR4000 SR4100 SR4200 Stallion Surprise	Competitor Elf Envy Omega II Palmer II Prizm Saturn Sovereign Seville Yorktown III
Fescue: Creeping Red	Franklin Vista	Jasper	Franklin Salem Vista	Herald Marker Shademaster	Dawson Flyer Finelawn I	Franklin Vista
Fescue: Chewings	Jamestown Koket Treasure	Victory	Bridgeport Jamestown Koket	Banner Bridgeport Centre Rudax Wilma	Barfalla Luster SR5000 SR5100	Jamestown Koket Treazure
Fescue: Hard	Serra Nordic	Spartan	Reliant Serra Warwick	Biljart Serra	Scaldis Silvana SR3000 SR3100	Reliant Serra Nordic
Fescue: Sheeps	MX86		MX86 Evergreen	MX86 Quatro		MX86 Azure
Fescue: Tall	Emperor Jacquar II Rebel II Shenandoah	Crossfire Mini Mustang Mustang II Team Jr. Shortstop	Jaguar II Rebel Jr. Williamette	Bonsal Lexus Pixie Twilight Vegas Watersaver	Arid Shenandoah	Emperor Jaquar II Rebel Jr. Tribute Shenandoah
Bentgrass Colonial	Highland	Exeter Higland		Boral Tracenta	Bardo Tracenta	
Bentgrass Creeping	Emerald Penncross Pennlink Pennway Southshore	Cato National Penncross Pennlink Penneagle Pennway Seaside	Highland 18 Green Penncross Pennlink Penneagle Seaside SR1020	Cobra Emerald Penncross Pennlink Penneagle Putter	18 Green Penncross Pennlink Penneagle Prominent Providence SR1020	Crenshaw Penncross Pennlink Penneagle Pennway Southshore
Poa trivialis	Sabre	Colt	Laser Sabre	Cypress Polder		Sabre
Poa supina				Supranova		
Poa compressa	Canada blue	Canin	Canada blue			
Weeping alkali	Fults	Fults		Fults		Salty
Agrostis alba (red top)		Reten				

NEW PRODUCTS & SERVICES

TURF RESTORATION

Dol Turf Restoration is a company dedicated to creating healthy, dense turf. We offer a complete program of turf maintenance services including topdressing, overseeding, aeration, verti-drain aeration, dethatching, big roll sodding, running track maintenance and sports field restoration. The company is under the directorship of Mr. Gord Dol who has 15 years experience in the turf industry in sports turf restoration, specialized turf establishment and erosion control.

CRENSHAW CREEPING BENTGRASS

Crenshaw Creeping Bentgrass was developed at Texas A & M University in 1993 by Dr. Milt Engelke. Although designated as Syn 3-88, it was re-named Crenshaw by Lofts Seed Inc. and distributed in Canada by Speare Seeds of Harriston, Ontario(519-338-3840).

Crenshaw is a dark green, aggressive bentgrass which exhibits tolerance to Rhizoctonia and Pithium blights. It maintains excellent summer density and persistence during periods of heat stress. As well, Crenshaw has exhibited excellent cold tolerance in Canada and the Northern regions of The United States. Crenshaw maintains a good dark green colour after temperatures begin to drop. Due to its aggressive tendencies, Crenshaw establishes well during the shorter and more restrictive northern growing seasons

NATIONAL SPORTS TURF TRIPLEX

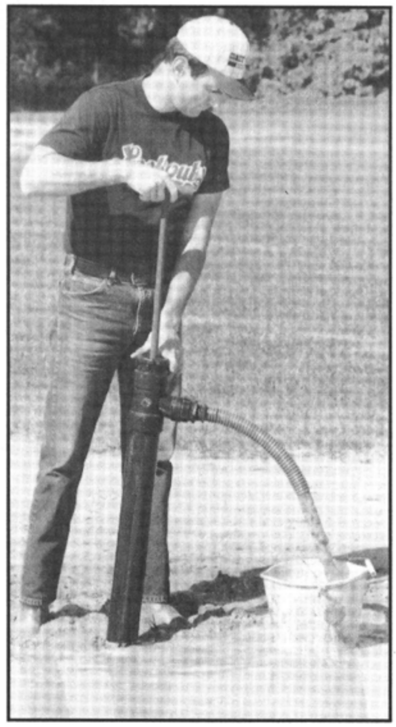
G.C. Duke Equipment Ltd. is pleased to announce the new National 70" Sports Turf Triplex. The tractor chassis is powered by a 16 h.p. Briggs Vanguard engine and is driven with a hydrostatic pump to hydraulic wheel motors. The units, rear steer zero turning radius offers optimum turning ability in the tightest areas. The cutting units are 25", free floating, 6 blade, 7" diameter cutting heads, producing an overall cutting width of 70 inches. The floating head design will allow the mowing units to follow all types of ground contours. For extreme fine turf areas, the National 70" is available with grass catchers and front throw shields.

EQUIPMENT RENTAL

DTR Turf Eguipment Rentals provides 'top-of-the-line' turf equipment to turf professionals. We rent aerators, overseeders, topdressers, fertiizer spreaders, and other speciaized turf equipment. Renting is a cost effective solution to purchasing equipment that is not used daily.

SAND TRAP PUMP

Rittenhouse & Sons Ltd. of St. Catharines, ON. have introduced a new, simple, mechanical Sand Trap Pump to remove standing water from sand traps, dirt infields and ditches. The tough ABS construction only weights seven pounds, making it easy to carry out to a wet spot. It easily pumps 15 gallons per minute through a 1 1/2 inch hose an will not clog.



Rittenhouse & Sons Ltd. New Sand Trap Pump

COMING EVENTS

Pesticide Safety Training Seminars
April 17, 1995-Guelph

Turf & Pest Identification Clinics
April 5-Toronto

Spray Technician Workshop
April 26, 1995-Guelph
Contact: Turfecs
23 Mallard Court,
Guelph, ON. N1C 1B5
(519) 767-1611

Urban Landscape IPM Course
May 16, 17, 1995
Venue: The Old Mill, Toronto
Contact: Doreen Nixon,
Insight Information Inc.,
55 University Ave.,
Toronto, ON. M5J 2V6
(416) 777-1242
FAX: (416) 777-1292

Sports Turf Association Field Day
July 21,22, 1995
Venue: Globe Park, Hamilton
Contact: Sports Turf Association,
328 Victoria Road S.,
Guelph, ON. N1H 6H8
(519) 763-9431
FAX: (519) 766-1704

GTI - OTRF Research Field Day
August 14, 1995
Venue: Guelph Turfgrass Institute
Contact: Ms. Pam Charbonneau,
OMAFRA Turf Specialist,
Guelph Turfgrass Institute,
Guelph, ON. N1H 6H8
(519) 824-4120 Ext. 2597
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- Arthur Foley, Town of Collingwood
- Terry Geddes, Collingwood Parks & Rec.
- Peter Dunbar, Collingwood Parks & Rec.