Best Use Modelling for Sustainable Australian Sports Field Surfaces

Shane Holborn
Sports Turf Institute

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Best Use Modelling for Sustainable Australian Sports
Field Surfaces

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Project Number TU06019

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Purpose of the report:
The two-year project set out to:
1. Provide participating councils throughout Australia with an independent expert analysis on sports field performance, documenting limitations to performance (accessibility, quality and safety).
2. Produce information and tools to aid council decision-making on sports field development, including usage capacity.
3. Develop a national database on sports field performance. Derive tools to guide councils in achieving best practice and optimal allocation of resources for upgrading or maintaining playing surfaces.
4. Produce and deliver resource material to guide those providing services or managing turf surfaces.

Acknowledgement of funding and in-kind support:
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- Horticulture Australia Ltd - Parks & Leisure Australia.
- Sports Turf Institute (Aust) - Department of Employment, Economic Development and Innovation

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media Summary</td>
<td>5</td>
</tr>
<tr>
<td>Technical Summary</td>
<td>6</td>
</tr>
<tr>
<td><strong>1. Introduction</strong></td>
<td>7</td>
</tr>
<tr>
<td>1.1 Defining optimal use of a sport field</td>
<td>7</td>
</tr>
<tr>
<td>1.2 Limitations to optimal use</td>
<td>8</td>
</tr>
<tr>
<td>1.3 The best use modelling project as a means of defining optimal use of sports fields</td>
<td>8</td>
</tr>
<tr>
<td>1.4 Benefits of the project to the turf industry, sports bodies and the community as a whole</td>
<td>9</td>
</tr>
<tr>
<td>1.5 Design of the national sports field best use modelling Project</td>
<td>10</td>
</tr>
<tr>
<td><strong>2. Materials and methods</strong></td>
<td>11</td>
</tr>
<tr>
<td>2.1 General</td>
<td>11</td>
</tr>
<tr>
<td>2.2 Procedure for measuring sports field performance</td>
<td>11</td>
</tr>
<tr>
<td>2.3 Council questionnaire</td>
<td>14</td>
</tr>
<tr>
<td>2.4 Field data collection</td>
<td>14</td>
</tr>
<tr>
<td>2.5 Development of database software</td>
<td>14</td>
</tr>
<tr>
<td>2.6 Development of fact sheets and resource kit</td>
<td>15</td>
</tr>
<tr>
<td><strong>3. Results</strong></td>
<td>16</td>
</tr>
<tr>
<td>3.1 Data collection</td>
<td>16</td>
</tr>
<tr>
<td>3.2 Reporting on data and findings</td>
<td>16</td>
</tr>
<tr>
<td>3.3 The database</td>
<td>16</td>
</tr>
<tr>
<td>3.4 Example of how the database can be used</td>
<td>18</td>
</tr>
<tr>
<td>3.5 Deriving national performance guidelines</td>
<td>21</td>
</tr>
<tr>
<td>3.6 Developing a model for standardising and defining field usage</td>
<td>24</td>
</tr>
<tr>
<td>3.7 Development of associated resource information</td>
<td>25</td>
</tr>
<tr>
<td>3.8 Developing a process for implementation of best use Modelling</td>
<td>27</td>
</tr>
<tr>
<td><strong>4. Discussion</strong></td>
<td>29</td>
</tr>
<tr>
<td>4.1 General</td>
<td>29</td>
</tr>
<tr>
<td>4.2 How the project will assist planning of sports field design and management</td>
<td>29</td>
</tr>
<tr>
<td>4.3 Using the playing surface performance guidelines</td>
<td>29</td>
</tr>
<tr>
<td><strong>5. Technology Transfer</strong></td>
<td>33</td>
</tr>
<tr>
<td><strong>6. Bibliography</strong></td>
<td>34</td>
</tr>
</tbody>
</table>
7. Recommendations

Appendix 1  Council questionnaire on usage and Inventory

Appendix 2  List of participating councils

Appendix 3  Example of report sent to contributing councils

Appendix 4  Considerations when evaluating a site for a new construction

Appendix 5  Strategies to deal with drought
MEDIA SUMMARY

The Best Use Modelling for Sustainable Australian Sports Field Surfaces project has achieved significant success. The project has attracted participation from councils throughout Australia, with in excess of 300 sports fields evaluated from 18 councils to date.

An important project component is the derivation of a recommended standard procedure for specifying the performance of playing surfaces. An associated step has been to establish recommended playing surface performance standards for community level sports fields. The derived modelling also provides information on the expected usage and associated costs of different sports surface development options. This is expected to assist the Australian turf production industry through demonstrating to councils that cost effective natural turf options exist that can meet higher usage expectation (as a viable alternative to synthetic turf).

A web-accessed data base system will be made available to councils from January 2010 on (reference to www.passturf.com). This system will enable participating councils to record and analyse field performance over time. The system is considered world-leading, and will help keep the Australian parks industry to the international forefront.

Tools developed as part of the project offer councils the opportunity to internally assess the performance of their current sports field provision, to identify any deficiencies and to determine the best corrective measure if any deficiency is identified. This is expected to offer community benefits to both sports facility providers and facility user groups. In turn this will aid the provision of affordable community access to safe and good quality playing surfaces.

Tools and associated information material will be made available to councils throughout Australia by the end of this year, via the Parks and Leisure Aust. web site.

The Best Use Modelling Project is work in progress. On-going input will be needed to ensure the web-accessed database software is as user friendly as possible, new performance testing data will need to be inputted, and tools provided to participating councils updated.

Through the support of HAL there is now a well-structured, nationally-supported system in place for benchmarking playing surfaces and for assisting councils to optimise their resource allocation to sports field upgrade or maintenance work.
TECHNICAL SUMMARY

Expanding urban population density, coupled with prolonged drought conditions, has increased the challenge on councils throughout Australia with sports field provision and management. Councils are looking for information and systems that can help guide decision-making and in turn optimize their investment.

A two-year best use modeling of sports fields project has been undertaken by the Sports Turf Institute, in partnership with DEEDI and Parks and Leisure Aust. This project has involved the assessment and benchmarking of approximately 300 sports fields from 18 councils.

The project involved developing and using a standardized system for measuring playing surface performance. Parameters measured include: ground cover % and composition, water infiltration rate, surface hardness, traction, levelness and root depth. Associated information on sports field use and performance was obtained from council or user group survey. Assessment also involved an agronomic evaluation of the turf system and any perceived limitations to performance.

All data has been assembled into a national database on sports field performance. An improved software version, which will enable contributing councils to access and build on information online, will be available from January 2010. This database will be maintained and continually updated by STI, with quality checks imposed on the entry of new playing surface performance data.

A series of tools has been derived to guide councils in decision-making. These tools are designed to help derive best practice and optimal allocation of resources for upgrading or maintaining playing surfaces. Tools include:

- A model to predict optimal sports field usage in relation to specified parameters
- Recommended quality standards for different sports/level of sport
- A national model for usage capacity and a use capacity tool
- A process to identify and overcome any limitations
- Strategies to minimise water use
- Guidelines when constructing a new facility

Tools and related resource material will be made publically available via the PLA website, along with distribution in associated conferences, seminars and industry publications.

Data analysis has demonstrated that many councils are struggling to meet the requirements of user groups. A high proportion of grounds evaluated fail to meet recommended performance standards for community level sports fields.

Field usage data indicates over-use, and poor construction are key factors responsible for the condition of many fields. Recent drought conditions, limited maintenance budgets and poorly adapted turf species selection were additional contributing factors.
1. INTRODUCTION

Changes in our society, including population growth, higher density housing, reduced green space and changes in sports use patterns, have resulted in additional stress on council sports field resources, particularly those in the major metropolitan areas struggling to find enough spare land on which to play sport. Adding to this has been an unprecedented drought, that has seen poorly-irrigated or un-irrigated fields suffer dramatic quality decline, and in some cases have resulted in closure.

It is estimated there is in excess of 15,000 community-based sports fields in Australia. Despite this, many city and district councils are faced with the dilemma of having too few grounds, or grounds which lack the ability to cope with the usage levels and/or expectations demanded by their local communities. Furthermore many councils lack the land resources available for building new grounds. The alternative faced is investing in upgrading existing sports surfaces to a level that is able to sustain usage demands. However, before any significant investment is made in upgrading a sport surface, consideration should be given to whether the council is optimising the usage of their existing facilities and identifying limitations to achieving optimal use.

1.1 Defining optimal use of a sport field

Optimal use can be described as that which gives the maximum level of use of a sport field without detrimental effect on the surface playing quality allowing continued use over time. Optimal use for a particular construction type will vary depending on factors such as:

- Climate, in particular the frequency and intensity of heavy rainfall events, especially during winter when usage demand is greatest.
- Soil type, principally how well the soil drains after heavy rainfall events and how soon play can resume after heavy rain. A sports field built on a heavy clay soil could be out of action for a week or more following an extended period of heavy rain, whereas a well drained sand field could be used within hours of heavy rain.
- Maintenance inputs – adequate application of fertilisers to maintain a healthy, actively-growing sward, pest and disease control to prevent damage to the sward and repairs of any damaged areas.
- Effective renovation programmes during spring and autumn and allowing adequate time between sporting seasons to complete renovations and for the grow in of replacement turf or repairs to damaged areas of the surface.
- User demand - for many councils player demand requires that sports fields are used beyond what could be considered optimal, with a subsequent loss in field quality as a playing season progresses. Adding to the challenge is the fact that playing seasons are tending to be extended beyond the traditional limits. This places increased pressure on grounds staff by limiting the time in which renovations can take place.
1.2 Limitations to optimal use

The loss of ground cover, invasion of weeds, excessive surface hardness and creation of an uneven surface are indicators that a field is not coping with the amount of use.

It is important to appreciate that a deteriorating surface could be attributed to several factors (often compounding), and it is important to thoroughly and professionally evaluate the full system. Factors contributing to deterioration include:

- Over use, beyond the capacity of even the best managed system.
- Problems with management systems, such as unrestricted use under wet conditions, or poor control over location of practices (e.g. no restriction to practice in goal boxes).
- Inadequate renovation program and routine maintenance during a playing season, such that the optimum performance of the turf is not realised.
- Inherent problems with the soil, in particular poor drainage or compaction.
- Unusual weather patterns, such as a dry summer (resulting in poor cover) followed by a wet autumn.

For a council to ensure it is achieving optimal use it will need to give due regard to each of these factors. Feedback suggests there is a need for quality technical information and associated tools to help guide councils in decision-making with sports field use optimisation. This need has been the key driver behind establishing the national sports field best use modelling project.

1.3 The best use modelling project as a means of defining optimal use of sports fields

Sports field best use modelling is a system and series of tools which allows local authorities to assess the performance of their sports fields. The system also provides the means to benchmark performance, along with other aspects of sports field management. In addition the system presents guidelines and options for improving performance of existing playing surfaces.

The best use modelling project sought to achieve four key outcomes, namely:

- Develop an objective, standardised means of measuring sports field performance (quality).
- Evaluate sports field quality in relation to parameters such as usage, maintenance inputs, regional climate and other variables.
- Establish a database to record the information and to provide a means of analysing data, both on a national basis and, for an individual council, trends over time.
- Develop a process to assess limitations to the performance of sports fields and the likely costs and gains from addressing these limitations.
- Assess existing capacity (in terms of usage capacity and playing surface quality) and cost-benefit analysis of potential surface development strategies.
In brief, the best use modelling system is expected to provide councils with the tools and technical information upon which decisions around planning sustainable sports facility provision can be made.

1.4 Benefits of the project to the turf industry, sports bodies and the community as a whole

The best use modelling of sports fields project is expected to offer long term, significant benefits to a range of groups. Examples of expected benefits include:

- Assist councils to optimise the quality and accessibility of sports fields to the community (ultimately overcoming any potential limitations to providing our society with easy, affordable access to outdoor playing surfaces).
- Provide greater consistency of sports field quality and performance across the country.
- Enables a more professional approach to decision-making, with an expected overall increase in resource allocation to sports field maintenance. In turn this will benefit those sectors of the Australian turf industry that are supplying services to sports fields.
- The tools developed in the project provide a system for measuring and benchmarking sports field quality and playing surface safety, which in turn provides councils, schools and sports clubs with a more robust measure of performance and a basis for identifying best practice.

1.5 Design of the national sports field best use modelling project

The Australian best use modelling project was built from the foundations of a similar project recently undertaken in New Zealand (the PASS project). This project involved the benchmarking of 50 fields from 8 councils around New Zealand. The PASS project provided a starting point for both the methodology and the software (the NZ system developed an on-line database system – www.pass.org.nz).

Given the success of the NZ system, and after discussion with local councils, it was apparent that a nationally-coordinated best use modelling project would provide significant benefits in Australia. From the councils surveyed, it was apparent that information was lacking on many aspects such as defining the usage capacity of playing surfaces.

In formulating the design for the project reference was made to previous related work in Australia. Investigations showed that there were individual consultants that had developed systems for assessing surface performance (mainly from a safety viewpoint). In some cases the demand for the performance testing system development of playing surfaces in Australia had come from sports bodies, in particular the AFL. There were also a couple of significant research projects that had established recommended playing surface standards. One of these projects was the Sureplay Project, a HAL-funded project investigating the performance of AFL fields in Queensland (Henderson, 2006). Another relevant project was carried out by David Vial, of Integrated Open Space Services, who helped devise a set of sports field
monitoring playability standards on behalf of Parks and Leisure Australia (Vial, 2006).

PLA’s interest in the project helped ensure it had national coverage and national significance. Selected councils from around Australia were approached to be part of the project. As well as the short term goals mentioned above, the project seeks to develop a sustainable system by which councils can collect, store, retrieve and analyse data from on their playing surfaces.

Illustrations of the best use modelling data collection phase
2. MATERIALS AND METHODS

2.1 General

The sports field best use modelling project involved a series of processes. Key steps in the process were:

Step 1  Develop a standardised methodology for measuring sports field surface performance

Step 2  A council questionnaire to identify inputs to and perceived performance of the test sports fields

Step 3  Collection of field data from selected councils around Australia

Step 4  Development of a software system for storing and analysing data

Step 5  Development of information sheets and a resource kit for Australian councils

2.2 Procedure for measuring sports field performance

2.2.1 Testing positions

Standardised testing positions for football (rugby, League and soccer) and AFL fields were selected (see Fig. 1). Each test area covered an area of approximately 5 m x 5 m. Within each test area, three replicates of each performance test were undertaken.

Figure 1: Example of sampling locations – Football (league, union)
2.2.2 Root zone properties
Performance assessment included an evaluation of the soil profile to approximately 300 mm depth (Fig. 3). Properties recorded included: depth of thatch, visible rooting depth, depth of soil layers, determination of field texture and basic structure and the presence of any mottling and anaerobic activity.

2.2.3 Thatch
Depth of thatch was measured by collecting a sample and using a ruler.

2.2.4 Effective rooting depth
Visible rooting depth and bulk density provides an indication of the level of compaction of the soil and whether this is restricting rooting depth. Effective rooting depth was assessed by taking a 50mm core sample and observing the point of breakage.

2.2.5 Root zone texture
A qualitative assessment was made of the soil texture.

2.2.6 Volumetric water content
Volumetric water content in the surface 100mm was determined using a theta probe (Fig.6).

2.2.7 Turf density and quality
A 0.5x0.5m quadrat was used to determine the % turf cover and % weed content. Species of weed present was also noted (Fig.2).

2.2.8 Surface hardness
Surface hardness was measured using the 2.25 kg Clegg Hammer. Both the 1st and 4th readings were recorded (Fig.4).

2.2.9 Surface evenness
Surface evenness was measured using a 2 m straight edge and a calibrated wedge (Fig.7).

2.2.10 Surface slope
For landfill sites surface slope was measured in localised low spots using a 5m string line.

2.2.11 Surface stability
Use was made of the Going Stick, a device developed in the UK, initially for race track performance assessment. It measures vertical as well as horizontal shear resistance (Fig 5).
Fig. 2. Quadrat for % turf cover and composition

Fig. 3. Root zone evaluation

Fig. 4. 2.25kg Clegg hammer

Fig. 5. Going Stick

Fig. 6. Theta probe for soil moisture

Fig. 7. 3m Straight edge
2.3 Council questionnaire

Contributing councils were required to complete a questionnaire related to structure and performance of the sports fields under study. The questionnaire is in two parts - The first part is pertinent to all the council’s sports fields, and asks for information about the council’s sports fields overall, such as:

- Contact details of the council
- How many individual sports fields are provided by the council

The second part of the questionnaire is specific to the individual fields that were assessed. These questions include elements related to:

- The construction
- Maintenance practices
- Amount of usage the sports field receives
- User group feedback

2.4 Field data collection

Performance assessment of identified playing surfaces was undertaken by STI-certified and accredited personnel (a future development will involve training council staff and others to undertake their own PASS assessments). Two trained staff were present on site for data collection.

In addition to the collection of performance data the visit included an agronomic assessment of the playing surface by a qualified Agronomist. This agronomic assessment provided advice on which management practices could be changed to optimise field performance.

Each contributing council was presented with a report covering both the specific field performance data, plus the agronomic report (see example report in Appendix 3).

2.5 Development of database software

An on-line PASS Database was developed for the safe storage and retrieval of information relating to the best use modelling project and for councils who use the PASS system.

The database allows councils to input, edit and access their own information and view reports comparing their fields to, for example, the national average. Access to the database is possible from anywhere via an internet connection. The database ensures that the information entered into the system is in a uniform format, and that the data is comparable to other datasets within the database.

A late decision was made to commission a company “Attain” to re-design the original software in order to make it more user-friendly (especially in relation to the automatic
This new software will be made available to all participating councils in early 2010.

2.6 Development of fact sheets and resource kit

To further assist managers of sports surfaces a set of tools and information fact sheets has been produced. Included in this tool kit is a “decision tree”, which provides information on what upgrade options are available to address key limitations commonly faced with sports fields.

The resource kit prepared includes:

- A process to identify limitations to optimal use
- Guidelines for options to overcome limitations
- Strategies for minimizing water use
- Guidelines when constructing a new sports field
- Field safety check list
3. RESULTS

3.1 Data collection

Our initial goal (Stage 1) was to collect data from up to 10 contributing councils. This goal was exceeded by a significant margin.

To end of October 2009 data has been collected and evaluated from 300 sports fields from 18 councils (See Appendix 2 for list of participating councils). Please note that the intention is to continue collecting data on an on-going basis to further strengthen the database. We anticipate an addition of at least 50 sports fields from an additional 5 councils to give a total database in excess of 400 fields within 6 months after project completion. Data collection and updating of the national database will be an on-going exercise.

3.2 Reporting on data and findings

Information has been collected from each test sports field. Results have been assembled for the national database, as well as directly reported on, such that each contributing council has a dataset on individual field performance, statistical data for the council’s sports fields as a whole and an agronomic assessment (see Appendix 3 as an example of the report forwarded to a council for each field tested).

3.3 The database

The complete database is now being loaded into a newly-commissioned, web-accessed database, which will be continually updated as new data comes to hand. Data entered includes all performance testing data, as well as the information provided via the survey. The database and information system allows an individual council to extract information on any one of its fields, plus enables a comparison (benchmarking) of specific parameters against national or state ranges and means (for example, enables an evaluation of percentage ground cover of its fields against data for a like region or the country as a whole).

The database provides a secure on-line relational database for the storage of council information, sports park information - including management inputs and usage. Councils are able to input, edit and access their own data and view reports comparing their fields to, for example, the national average (however a council cannot upload new performance testing data, or any other information that contributes to the national database).

The storage of performance characteristic data for a given field enables comparisons with historic data (generated over time) for a field, to show trends over time and whether or not the expected performance characteristics are being achieved. The database also enables the user to generate reports specific to a given sports field, city council and, as the availability of information increases, on a regional or national level.
The best use modelling software will be made available to all contributing councils via the web in early 2010. Councils will have access to upload certain data as it comes to hand. Any new data that forms part of the national data base and statistics pool can only be uploaded via accredited, password-protected personnel (this is to ensure consistency and accuracy of the database).

**Fig. 8.** Schematic representation to show the generation and growth of data in the database
3.4 Example of how the database can be used

The following table and figures provide an illustration of interpretation of fields tested in ACT (population set = 100 fields).

Table 1. Summary of dataset for ACT sports fields

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Field mean</th>
<th>Limits</th>
<th>Benchmark mean (Limits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground cover* (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field overall</td>
<td>76.8</td>
<td>29.3 – 95</td>
<td>In the high wear areas &gt;than 85% mid-season</td>
</tr>
<tr>
<td>Worst location</td>
<td>29.3</td>
<td>3 – 70</td>
<td></td>
</tr>
<tr>
<td>Weed cover** (%)</td>
<td>23.7</td>
<td>7 – 38.3</td>
<td>&lt; 20% grass weeds; &lt;5% broad leaf weeds</td>
</tr>
<tr>
<td>Surface hardness (CIV)</td>
<td>7.4*1</td>
<td>5-30</td>
<td>5-15</td>
</tr>
<tr>
<td>Surface evenness (mm)</td>
<td>23.7</td>
<td>21.3 – 28.3</td>
<td>&lt;25mm over 3 m straight edge</td>
</tr>
<tr>
<td>Infiltration rate(mm/hr)</td>
<td>54</td>
<td>0-1000</td>
<td>&gt;25</td>
</tr>
<tr>
<td>Thatch depth</td>
<td>40</td>
<td>0-100</td>
<td>15</td>
</tr>
</tbody>
</table>

*1 average for sand-based grounds

![Thatch vs. infiltration (sand fields)](image_url)

**Fig 9.** Relationship of thatch depth on infiltration rates across all sand-based grounds in ACT.
Fig 10. Surface hardness (2.25kg Clegg hammer) in relation to soil type for all ACT fields.

Fig 11. Effective rooting depth vs soil type for all fields in ACT.
Fig 12. Thatch depth vs soil type for all fields in ACT.

Fig 13. Surface hardness vs soil type for all fields in ACT.
3.5 Deriving national performance guidelines

An important outcome of the study has been the derivation of recommended playing surface performance guidelines throughout Australia. These guidelines have, to a large degree, been derived from the best use modelling data collection.

In compiling the recommended guidelines consideration has been given to the data collected in the best use modelling project, as well as information provided by other research bodies, both in Australia and off-shore (Vial, 2006). Regard has also been given to standards recommended by national and international sports bodies, such as Australian Football League, International Rugby Board and Federation International Football Association.

<table>
<thead>
<tr>
<th>Component</th>
<th>Method of test</th>
<th>Comments</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface gradient</td>
<td>Use of topographic survey information</td>
<td>Consider requirements of specific sports; sport fields can be too sloped; slope can aid drainage</td>
<td>Maximum gradient in any direction of 1:70 for most sports and levels of sport; Up to 1 in 50 could be used for lower grade</td>
</tr>
<tr>
<td>Surface evenness (mm)</td>
<td>Use of 3m straight edge and/or 5m string line</td>
<td>Surface unevenness impacts on both player safety and smoothness of ball roll/bounce</td>
<td>&lt;100 mm variation under a 5m string line &lt;20mm over 3 m straight edge (Premier/first grade) level &lt;25mm over 3 m straight edge (lower club standard)</td>
</tr>
<tr>
<td>Smoothness/Trip index</td>
<td>Use of 1 m straight edge and ruler</td>
<td>Related to the micro-levels, as they affect surface footing or trueness of ball bounce/roll</td>
<td>No tufty grass plants &gt;15mm above turf canopy No divots deeper than 20mm</td>
</tr>
<tr>
<td>Ground cover</td>
<td>Visual assessment Use of a 0.25 sqm quadrat</td>
<td>Relates to surface appearance, stability and uniformity; bare spots can become low spots</td>
<td>In the high wear areas of the ground total turf cover to be &gt; 98% start of season; &gt; than 85% mid-season (end)</td>
</tr>
<tr>
<td></td>
<td>Minimising bare areas also allows faster grass recovery from wear and limits opportunity for weed establishment</td>
<td>May) No bare patches &gt; than 200mm diameter start of season; &lt; 10 bare areas &gt;200 mm diameter per field mid-season</td>
<td></td>
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<td>------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Weed content (%)</td>
<td>Visual assessment using a quadrat</td>
<td>Impacts on surface appearance and surface uniformity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>For premier grounds &lt; 10% grass weeds; &lt;2% broad leaf weeds For community/club level grounds &lt; 20% grass weeds; &lt;5% broad leaf weeds</td>
<td></td>
</tr>
<tr>
<td>Rooting depth (mm)</td>
<td>Visual observation after core sampling</td>
<td>Relates to ability of turf to withstand stress and the frequency of watering</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Effective rooting depth greater than 125mm</td>
<td></td>
</tr>
<tr>
<td>Sward height (mm)</td>
<td>Use of a floating disk</td>
<td>Grass height relates to performance in relation to ball bounce and roll, as well as impacting on surface hardness and traction. Sward height will be sport and species/cultivar specific.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hockey - 8mm to 20mm Cricket (excluding wicket) - 10mm to 35mm Soccer - 20mm to 40mm AFL - 20mm to 50mm Rugby Union / League - 40mm to 55mm</td>
<td></td>
</tr>
<tr>
<td>Surface hardness (g)</td>
<td>2.25 kg Clegg Hammer® for player/surface interaction</td>
<td>An important safety index measure. Hardness relates to injury potential after impact with the ground Gmax readings above 150 indicate cause for concern, the absolute upper limit is 200 Gmax</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clegg hammer readings to fall between 5 to 13 cv (1st drop)</td>
<td></td>
</tr>
<tr>
<td>Soil condition</td>
<td>Going stick</td>
<td>Hardness relates to the soil moisture content, level of compaction and in turn resistance to root penetration.</td>
<td>Going stick index value of between 10-14.5</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Traction (Nm)</td>
<td>Use of studded disk apparatus</td>
<td>Relates to surface stability and risk injury to players due to insufficient or excessive traction. Low traction also relates to surface damage due to divotting.</td>
<td>Test values to fall between 30 – 50 Nm</td>
</tr>
<tr>
<td>Soil drainage status</td>
<td>Duration of ponding after heavy (more than 50mm in 48 hours) rain; Presence of mottles or gleying in surface 100mm</td>
<td>Drainage performance is critical for minimising ground closures and for minimising damage to turf</td>
<td>1st class grounds – No surface water 1 hour after rainfall ceases Club level grounds – No surface water after 6 hours General sports field – No surface water after 24 hours</td>
</tr>
<tr>
<td>Infiltration rate (mm/hr)</td>
<td>Use of ring infiltrometer</td>
<td>Critical for efficient irrigation and absorption of rain and also for good drainage</td>
<td>&gt; 100 mm/hr for 1st class use grounds &gt; 50 mm/hr for club level grounds &gt; 25 mm/hr for general purpose grounds</td>
</tr>
</tbody>
</table>
3.6 Developing a model for standardising and defining field usage

3.6.1 Introduction

Sports facility planners require to know how many hours of use can be imposed on a playing surface without overloading the system (i.e. resulting in an unacceptable or unsafe surface quality).

Different models have been proposed to define, record and report on usage. Having different systems makes it challenging to draw comparisons. Accordingly we require a widely adopted tool that allows consistency for documenting hours of use.

To determine a model that defines field usage we need to consider the variables that result in damage to a playing surface. Major variables include:

- Type of sport played
- Age of players
- Level (grade) of sport played
- Match duration
- Size of the ground
- Number of participants
- Whether the use is casual, formal practice or match

These variables interact with inherent properties of the turf system and climate to determine the extent of damage incurred through use.

When relating wear damage to usage, consideration must also be given to the wear pattern of each sport. For example in soccer the greatest wear occurs in the goal mouths, centre circle and along touch lines. Modelling will also need to account for the efficiency of player management in a training situation. Good management to shift wear away from high use zones will ultimately improve usage capacity.

3.6.2 Information from literature

Prior feedback on field usage modelling has reported:

- Players under the age of 15 are judged to inflict about half the damage to a pitch than senior players.
- Elite level of the sport will inflict more damage than lower grade sport.
- Training can do at least if not more localized damage than match play.
- A training unit is deemed to be equivalent to 1 hour of (match play) use on a full sized field.
- 1 unit of play is the equivalent of 1 hour of play with 20 players on a standard soccer/league field (approx 7500 sqm).
3.6.3 Proposed model or winter sports season

Effective hours of use = No. of matches/sessions x Duration x A x B x C

Where weighting is given to variable as follows:
A = type of sport played (soccer, rugby and league = 1; AFL, hockey, Touch = 0.7; six–aside soccer of football = 0.5)
B = age of participants (under 15; women and over 35s men = 0.5)
C = level of competition (senior 1.0; community level, juniors and club grade 0.7; social 0.5)

Example:
A soccer field is used during the season for the following:
- 20 senior matches (90 mins long) and 80 senior practice sessions (2 hours)
- 20 lower div matches (75mins long) and 40 other senior men’s trainings
- 10 women’s matches (1 hour) and 20 women’s trainings
- 10 social men’s matches (1 hour);
- 40 junior (below 15) matches (approx 50 mins) and 80 junior trainings (approx 1 hour)

After using weighting factors the effective hours of use can be calculated as:

<table>
<thead>
<tr>
<th>Number of matches/practices</th>
<th>Duration (hrs)</th>
<th>Weighting for age/sex of competitors</th>
<th>Weighting for level of competition</th>
<th>Total hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st/2nd grade men match</td>
<td>20</td>
<td>1.5</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>1st/2nd grade practice</td>
<td>80</td>
<td>2</td>
<td>1</td>
<td>160</td>
</tr>
<tr>
<td>Lower grade men match</td>
<td>20</td>
<td>1.25</td>
<td>1</td>
<td>17.5</td>
</tr>
<tr>
<td>Lower grade men practice</td>
<td>40</td>
<td>1.5</td>
<td>0.7</td>
<td>42</td>
</tr>
<tr>
<td>Women match</td>
<td>10</td>
<td>1</td>
<td>0.5</td>
<td>5</td>
</tr>
<tr>
<td>Women practice</td>
<td>20</td>
<td>1</td>
<td>0.5</td>
<td>10</td>
</tr>
<tr>
<td>Social men match practice</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Social men practice</td>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Juniors match</td>
<td>40</td>
<td>0.8</td>
<td>0.5</td>
<td>16</td>
</tr>
<tr>
<td>Junior practice</td>
<td>80</td>
<td>1</td>
<td>0.5</td>
<td>28</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>313.5</td>
</tr>
</tbody>
</table>
3.7 Development of associated resource information

Various tools and other resources have been developed and are now ready for release to contributing councils. These documents will be made available to all councils via the Parks and Leisure Australia web site. Due acknowledgement to HAL’s contribution to the project will be documented with each tool kit.

Tools that have been developed are shown in Table 3.

Table 3. Tools that have currently been developed as part of the best use modelling project

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A process to identify limitations to optimal use</td>
<td>Description of a process used to evaluate an existing sports field in order to assess any limitations</td>
</tr>
<tr>
<td>Guidelines for options to overcome limitations</td>
<td>List options, cost and benefits of different investments</td>
</tr>
<tr>
<td>Strategies for minimizing water use</td>
<td>Considerations to get the most out a limited water resource</td>
</tr>
<tr>
<td>Guidelines when constructing a new sports field</td>
<td>Outline of procedure and considerations when planning a new construction</td>
</tr>
<tr>
<td>Field safety check list</td>
<td>Provided to clubs to undertake safety audit prior to events</td>
</tr>
</tbody>
</table>

Example of the tools produced are shown in Appendices 4 & 5.

The following schematic points to when each of the tools and components of the best use modelling program should be accessed.
3.8 Developing a process for implementation of best use modelling

A process has been derived to help councils evaluate if their playing surfaces are performing to their potential. The following step by step procedure could form the basis of a sports field auditing and planning exercise.

**STEP 1 – GATHER ACCURATE DATA ON FIELD USAGE AND BENCHMARK USAGE AGAINST THE RECOMMENDED HOURS OF USE FOR THE NATIONAL BEST USE MODELLING PROJECT**

**CONSIDERATIONS**
- Ensure data for field usage is accurate and allowance is made for age and level of participants
- Ensure any benchmarking is “apples for apples”. Narrow down the range so that the benchmarked region and soil type are similar

**STEP 2 – ASSESS THE QUALITY OF THE PLAYING SURFACE TO DETERMINE IF IT MEETS RECOMMENDED AND DESIRABLE STANDARDS THROUGHOUT THE YEAR**

**CONSIDERATIONS**
- Identify the period of greatest concern (most likely mid-winter) and focus evaluation on this period
- Use the best use modelling tools to measure surface performance
- Compare measured performance with recommended values

**STEP 3 – EVALUATE INFORMATION IN STEPS 1 & 2 TO DETERMINE IF OPTIMAL USE IS BEING ACHIEVED**

**CONSIDERATIONS**
- If use matches or exceeds recommended benchmark, and if surface quality meets desirable standards, then you are achieving optimal use.
- If use is below recommended benchmark, and/or surface quality has fallen below the desirable standards then **proceed to Step 4**.

**STEP 4 – DETERMINE HOW EFFECTIVELY THE FIELD IS BEING MANAGED**

**CONSIDERATIONS**
- Determine where the field is failing and where the high wear areas are; are they localised and can be pinpointed to training activity (e.g. under lights; in goal boxes; by club house).
- Identify if there are any practical solutions to the minimise high wear (e.g. relocation of lights; moveable goals; club member education; use of adjacent un-used strips in wet weather).

**STEP 5 – EVALUATE THE TURF MANAGEMENT (AND RENOVATION) PROGRAM**

**CONSIDERATIONS**
- Identify the skill level of the staff looking after the surface.
- Determine if staff are adequately skilled and sufficient resources are allotted to the field (fertiliser etc).
- Identify if there is adequate attention given/window of opportunity for renovation between seasons in order to enable effective repair and recovery of damaged areas.
STEP 6 – EVALUATE THE PROPERTIES OF THE ROOT ZONE AND BASE

CONSIDERATIONS
- Use specialist expertise to identify if there is any inherent root zone properties, such as a compaction layer.
- Identify the impact of the root zone limitation on surface performance and ascertain if the impact is significant.
- Identify potential corrective options for any significant limitation.

STEP 7 – DETERMINE IF ANY ISSUE WITH SURFACE QUALITY IS ON-GOING OR A ONE-OFF (DUE TO CLIMATIC EXTREMES)

CONSIDERATIONS
- Refer to past records and feedback on performance of the surface. Relate past performance to past usage.
- Consider the impact of adverse climatic conditions on the performance of the ground - in particular refer to any drought conditions that might have restricted turf recovery (mainly in un-irrigated fields), and the amount and timing of winter season rainfall.

STEP 8 – PREPARE DEVELOPMENT PLAN TO ADDRESS IDENTIFIED LIMITATIONS

CONSIDERATIONS
- Assess all information to hand
- Seek professional advice on remedial options and costs
- Decide on most cost effective approach
4. DISCUSSION

4.1 General

The sports field best use modelling project is deemed to have been a success on many fronts. In addition to significantly exceeding the targeted number of councils and sports fields involved in the study, the project has successfully produced a recognised system for appraising and benchmarking sports surfaces. This will in turn assist local authorities to identify optimal sports surface provision. It will aid asset planning and development strategies and helps maximise the quality and accessibility of sports surfaces to all users.

The development of an on-line database system is expected to provide councils with a means of storing and retrieving collected data, as well as analyse data in a national context.

The information derived from the data inputted has allowed the identification of achievable/acceptable performance standards for community level sports fields.

The set of guideline performance standards (Table 2) will be useful to councils looking to set field performance targets and in negotiations with contractors and user groups. Further refinement of the recommended standards will occur as the database is enlarged.

Associated tools that have been developed (Table 3) will add to the information base available to councils and will help to both up-skill expertise and guide decision-making.

4.2 How the project will assist planning of sports field design and management

Having standardised and clearly documented processes for collecting, storing and analysing data on sports field performance offers councils a means of benchmarking and analysing their performance.

The system as a whole can also be used to identify any potential limitations to optimal performance and what can be done to address any limitations. For example refer to Figs.14 and 15 for modelling to define and overcome identified limitations.

Overall the project is expected to create more efficiencies with council resource allocation, such that resources are invested in the right areas.

4.3 Using the playing surface performance guidelines

Having measurable/objective, rather than subjective, methods of measuring surface properties provides greater clarity with regard to what is being specified. For example, terms such as “hard”, “slippery” or “uneven” are open to variation based on the individual’s personal assessment. In contrast, putting a measurable value on, say, surface hardness, overcomes operator bias and also allows benchmarking over time and between sites.
Having access to objective information on playing surface performance is expected to offer a number of opportunities, including:

- Providing both the surface user and provider groups with a precise means of defining the quality and safety of the end product
- Providing a basis for tendering out work
- Enabling auditing of contractor activity or turf manager operations
- Benchmarking progress over time or against another system (e.g. improvement in performance), and:
- Providing a basis for negotiating a contract or resolving disputes (including injury/insurance claims).
Fig 14. Schematic representation of identifying and overcoming a drainage problem

**Issue**
- Poor winter field performance

**Limitations**
- Poor infiltration/drainage
- Poor surface (poor cover, evenness, levels)
- Grass species
- Limited management inputs

**Pipe drainage installed**
- Yes
  - Upgrade current drainage
  - Renew pipe drainage
- No
  - Install drainage
  - Upgrade surface

If greater level of usage or performance required, match to appropriate drainage system and/or surface

**Grass species**
- Cool climate
  - Ryegrass
- Warm climate
  - Couch
  - Kikuyu
  - Oversow with ryegrass in autumn

**Construction type**
- Soil
  - Regrade/returf
- Sand
  - Slit drainage
  - Sand banding
  - Gravel banding
  - Full sand profile
  - Sand carpet

**Prepare renovation and maintenance program—consult your local Agronomist**
Fig. 15. Schematic representation of identifying an overcoming high winter use

**Issue**
- Increased winter demand

**Limitations**
- Poor infiltration/drainage
- Poor surface (poor cover, evenness, levels)
- Grass species
- Limited management inputs

**Drainage installed**
- Yes
  - Upgrade current drainage
  - Renew pipe drainage

- No
  - Install drainage
  - Renew surface
  - Upgrade surface

**Cool climate**
- Ryegrass
- Couch
- Kikuyu

**Warm climate**
- Review renovation and maintenance program – consult your local Agronomist

**Grass species**
- Yes
  - Oversow with ryegrass in autumn

**Hours of use per week**
- >25 hours: Intensive use systems such as synthetic turf
- 12-25 hours: Sand carpet, Full sand profile
- 6-12 hours: Sand banding, Gravel banding, Slit drainage
- 2 to 6 hours: Pipe drainage

If greater level of usage or performance required, match to appropriate drainage system and/or surface.
5. TECHNOLOGY TRANSFER

Extension transfer of the best use modelling information is still in progress. To date presentations have been made to:

- Presentation to Parks and Leisure Aust Board 26th Feb 2009
- Presentation to NSW PLA sector 26th March, 2009
- Presentation to Australian Sports Turf Conference, Tasmania July15th, 2009
- 2 presentations to Australian Capital Territory (including Climate change response seminar, June 2008)
- 4 presentations to councils in New Zealand (Auckland, Hamilton, Wellington, Palmerston North)
- Presentation to PLA Queensland
- PLA workshops (Maryborough - 26 May 09, Redlands - 9 Jul. 09)
- Sport & Recreation QLD workshops (Gympie - 1 Oct. 08; Caloundra- 8 Oct. 08; Rockhampton - 12 Jun. 08)
- Presentation at an international turf seminar run by Singapore N-Parks, Oct 2009.

Seminars proposed over the next few months include:

- 3 QPLA regional meetings in November/December
- 2 seminars to councils in NZ (December)
- NSW PLA Annual conference, March 2010
- Presentation to turf managers in Thailand (mid 2010)
- International Turfgrass seminar, Singapore (Oct 2010)

Articles have been compiled for parks and turf groups, including:


Further articles are planned for over the next 24 months.

The technical information provided to councils, either via the PLA web site, through publications or via seminars, will assist councils throughout the country identify any current limitations in sports field performance and to help guide them in developing the most cost effective solution for any upgrading work or best practice management.
6. BIBLIOGRAPHY


7. RECOMMENDATIONS

The sports field best use modelling project has been a major success to date, through having established a national system for benchmarking, storing and analysing data on playing surface performance. Despite the excellent progress made there is still much that could be done to both optimise existing results and to expand on what has been developed.

Key recommendations stemming from the project include:

1. Ensure all councils throughout Australia are made aware of the best use modeling software and related tools. This can best be done via the PLA web site and by ongoing extension through presentations at conferences and in magazines.

2. Continue to refine the database to make it as user friendly and practical as possible, so that member councils make full use of it (we are currently investing in the refinement of the software).

3. Aim for repeat request for data collection from member councils, so that trends can be identified and individual grounds can be benchmarked over time. Additional data sets will also pick up any seasonal or longer term trends.

4. Ensure the database is kept updated and that the enlarged data set is routinely analysed and reported on.

5. Keep investigating (or developing in-house) improved technology for evaluating playing surface performance, and where appropriate introduce new tools.

6. Where practical look to incorporate other playing surface performance data sets that have been collected from the private or commercial sector.

7. Expand on the set of associated tools and resource material provided to councils (e.g. provide further technical information on the costs and benefits of different development options).

8. Investigate the potential to develop a sports field best use modeling project for school playing surfaces. There are many 1000’s of school fields around Australia, and there is very little known about the size of the resource, performance and related budget. Schools would in fact benefit significant from a nationally coordinated project aimed at optimising the investment in and performance of playing surfaces.

9. Further develop/refine the recommended playing surface performance standards to cover all levels of sport, from elite through to community level.
APPENDIX 1 COUNCIL QUESTIONNAIRE ON USAGE AND INVENTORY

Performance Assessment of Sports Surfaces

Part 1 – General sports park information

Council name: 

Staff contact details: 

Sports field provision

1.1 Approximately what is the area (in ha) of sports fields provided by the council? 

1.2 How many fields in total does the council provide? 

1.3 How many registered players are there for each individual sport (junior /senior)?

<table>
<thead>
<tr>
<th>Sport</th>
<th>Junior</th>
<th>Senior</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Touch rugby</td>
<td></td>
<td></td>
</tr>
<tr>
<td>League</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soccer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rugby</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hockey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Softball</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cricket</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.4 For each sport, do you consider that you have sufficient fields to meet current player demands? (If not please estimate the additional number required)

<table>
<thead>
<tr>
<th>Sport</th>
<th>Yes</th>
<th>No</th>
<th>Number required</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Touch rugby</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>League</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soccer</td>
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<td></td>
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<tr>
<td>Rugby</td>
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<tr>
<td>Hockey</td>
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<td></td>
</tr>
<tr>
<td>Softball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cricket</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sports field safety**

1.5 Does the Council have formal policy or standard industry docs covering the safety of its sports fields? (If yes we would appreciate receiving a copy)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

**Sports Field closure**

1.6 Does the Council have a formal written policy covering field closures or use a standard industry guideline? (If yes we would appreciate receiving a copy)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

**Budget**

1.7 What is the estimated total annual maintenance budget for sports fields (includes all maintenance)?

2.10 What proportion of the work is contracted out?

<table>
<thead>
<tr>
<th>Work</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td></td>
</tr>
<tr>
<td>Weed control</td>
<td></td>
</tr>
<tr>
<td>Pest control</td>
<td></td>
</tr>
<tr>
<td>Fertiliser</td>
<td></td>
</tr>
<tr>
<td>Top dressing (sand/soil)</td>
<td></td>
</tr>
<tr>
<td>Physical treatment (spiking; dethatching etc)</td>
<td></td>
</tr>
<tr>
<td>Irrigation system maintenance</td>
<td></td>
</tr>
</tbody>
</table>

37
Part 2 – Individual sports park information

(SEPARATE FORM TO BE FILLED IN FOR EACH GROUND IN THE STUDY)

Sports field name:  

Sport(s) played:  

Level of play (junior, intermediate, senior–representative):  

Overall surface quality (circle which applies)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Surface performance</strong></td>
<td>Very poor</td>
<td>poor</td>
<td>good</td>
<td>Very good</td>
</tr>
<tr>
<td>How do you rate the performance of this field over the winter sports season?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.2 Drainage</strong></td>
<td>&gt;24 hrs</td>
<td>8-24 hrs</td>
<td>1-8 hrs</td>
<td>Less than 1 hour</td>
</tr>
<tr>
<td>For how long following heavy rainfall (more than 50mm over 48 hours) does the surface remain squelchy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.3 Surface levelness</strong></td>
<td>very unsatisfactory</td>
<td>unsatisfactory</td>
<td>satisfactory</td>
<td>excellent</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.4 Ground cover during winter sports season</strong>&lt;br&gt;On average how much ground cover does the centre of the field have at the start of the season</td>
<td>&lt;50%</td>
<td>50 to 75%</td>
<td>75 to 95%</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>On average how much ground cover does the field have in the latter half of the season (start of August)</td>
<td>&lt;10%</td>
<td>11 to 20%</td>
<td>20 to 50%</td>
<td>&gt;50%</td>
</tr>
</tbody>
</table>

|  |  |  |  |  |
|---|---|---|---|
| **2.5 Closures**<br>On average how many days in the winter sports season is the field closed for play or practice or the playing surface deemed unsatisfactory for use | >15 | 11 to 15 | 5 to 10 | <5 |

<table>
<thead>
<tr>
<th></th>
<th>Yes [ ]</th>
<th>No [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.6 Does the field have a watering system?</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sports Park/Field Usage**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>2.7 How are hours of use determined?</strong>&lt;br&gt;(e.g. council booking records, club records):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | | | |</p>
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</thead>
<tbody>
<tr>
<td><strong>2.8 Please provide annual estimated hours of use for last summer’s sporting season in the table below.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of hours of use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Games – club, competition, tournament</td>
</tr>
<tr>
<td></td>
<td>Senior</td>
</tr>
<tr>
<td>Sport</td>
<td></td>
</tr>
<tr>
<td>AFL</td>
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<tr>
<td>Union</td>
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<tr>
<td>League</td>
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<tr>
<td>Touch</td>
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<tr>
<td>Soccer</td>
<td></td>
</tr>
<tr>
<td>Cricket</td>
<td></td>
</tr>
<tr>
<td>Other&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**<br><sup>a</sup> Please name any other sports which make regular use of this field and include number of hours of use<br> <sup>b</sup> Junior level of play includes mini, midget, youth and most grades of play
2.9 Please provide annual estimated hours of use (if available) for last winter’s sporting season in the table below (season defined as April 1st to Sept 30th).

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of hours of use</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Games – club, competition, tournament</td>
<td>Training</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Senior</td>
<td>Junior</td>
<td>Senior</td>
</tr>
<tr>
<td>AFL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Union</td>
<td></td>
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<tr>
<td>League</td>
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<tr>
<td>Touch</td>
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<tr>
<td>Soccer</td>
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</tr>
<tr>
<td>Cricket</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Our sincere thanks to you for helping complete this survey and for contributing to an important national project.

If you have any queries or need help with completing forms please contact me on 04 24634717 or 07 38249503. Please return completed forms by e-mail or post.

Keith McAuliffe, Project Coordinator
Kmc30745@bigpond.net.au;

c/- Redlands Research Station, Box 327
Cleveland 4163, Qld
# APPENDIX 2  List of participating councils and contacts (as at Oct 2009)

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Council/Location</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alex Nicol</td>
<td>Team Leader Parks, Recreation &amp; Building Assets</td>
<td>Warringah Council - NSW</td>
<td>NSW</td>
</tr>
<tr>
<td>Paul Cotter</td>
<td>Recreation And Open Space Officer</td>
<td>City of Greater Geelong</td>
<td>Vic</td>
</tr>
<tr>
<td>Dale Stewart</td>
<td>Senior Recreation Planner</td>
<td>City of Melbourne</td>
<td>Vic</td>
</tr>
<tr>
<td>Darren Bennett &amp; Howard Scott</td>
<td>Manager Leisure Services</td>
<td>Nillumbik Shire Council</td>
<td>VIC</td>
</tr>
<tr>
<td>David Jeffrey</td>
<td>Manager Strategic Support, Sport &amp; Rec Territory &amp; Municipal Services</td>
<td>Sport &amp; Rec ACT</td>
<td>ACT</td>
</tr>
<tr>
<td>Fred Tarry &amp; Tony O'Dell</td>
<td>Supervisor Sportsfields Parks and Recreation</td>
<td>Moreton Bay Regional Council</td>
<td>Qld</td>
</tr>
<tr>
<td>George Nowak</td>
<td>Open Space Operations Coordinator (Technical)</td>
<td>Clarence Valley Council</td>
<td>NSW</td>
</tr>
<tr>
<td>Jason Moroney</td>
<td>Parks Technical Officer Environmental</td>
<td>Goulburn Mulwaree Council</td>
<td>NSW</td>
</tr>
<tr>
<td>Linda Smith &amp; Belinda Griffiths</td>
<td>Manager Recreation &amp; Youth Services</td>
<td>Glen Rira Council</td>
<td>VIC</td>
</tr>
<tr>
<td>Lindsay Peterson</td>
<td>Coordinator, Sport and Active Recreation Parks and Recreation Branch/Parks Director</td>
<td>Toowoomba City Council</td>
<td>Qld</td>
</tr>
<tr>
<td>Fred Tilden</td>
<td>Contracts Coordinator Parks &amp; Reserves</td>
<td>City of Sydney</td>
<td>NSW</td>
</tr>
<tr>
<td>Nigel Brown</td>
<td>Team Leader - Leisure Planning</td>
<td>Kingston City Council</td>
<td>Vic</td>
</tr>
<tr>
<td>Kristina Dickman</td>
<td>Senior advisor Sport &amp; Rec</td>
<td>Redland City</td>
<td>QLD</td>
</tr>
<tr>
<td>Simon Harrison</td>
<td>Park Assets and Services</td>
<td>Centennial Parklands - Sydney</td>
<td>NSW</td>
</tr>
<tr>
<td>Stephen Bourke</td>
<td>Director Community &amp; Recreation</td>
<td>Sutherland Shire Council (but offering Sydney ROC cluster)</td>
<td>NSW</td>
</tr>
<tr>
<td>Danny Edmunds</td>
<td>Sportsgrounds Co-Ordinator</td>
<td>City of Casey</td>
<td>Vic</td>
</tr>
<tr>
<td>John Nightingale</td>
<td></td>
<td>Brisbane City council</td>
<td>Qld</td>
</tr>
<tr>
<td>John Kearney</td>
<td>Manager Parks Services</td>
<td>Brimbank council</td>
<td>Vic</td>
</tr>
</tbody>
</table>
APPENDIX 3  EXAMPLE OF REPORT SENT TO CONTRIBUTING COUNCILS ON FIELD PERFORMANCE

Best Use Modelling Project (BUMP) Review for

Sports field X

Prepared for  =  Council Y
Authors  =  Keith McAuliffe & Peter Munro
Date  =  March 2009
Contact Details  =  Sports Turf Institute
C/- Dept of Primary Industries and Fisheries
PO Box 327
Cleveland 4163
AUSTRALIA

Phone: 0061 7 3824 9503
Fax: 0061 7 3286 3094
Mobile: 0061 4246 34717
Email: kmc30745@bigpond.net.au
Executive Summary

Summary of Recommendations

Thatch and organic matter control

- Apply nitrogen based on turf grass species requirements as opposed to calendar-applied applications. As a guide, apply between 200 – 250 kg/N/ha/yr for couch. There is research data that suggests that the majority of N should be applied in spring (two major applications) and modest amounts during hot, summer weather unless significant rainfall has occurred.
- Maintain soil pH at approximately 6.0 – 6.5 to optimize mineralization and to augment nutrient uptake. Soil test high profile grounds annually to monitor pH and nutrient levels.
- Intensify existing physical treatments to include more frequent and more invasive thatch removal treatments e.g. scarification or dethatching. Up to 10% surface material can be removed in any one treatment.
- Enhance thatch dilution by frequent sand topdressing during the main growth periods. This should be done in conjunction with as many physical treatments as possible to optimize sand/thatch integration.

Likely benefits achieved from an intensive organic matter treatment program

- A significant reduction and greater control of thatch/OM accumulation
- A firmer (not spongy) surface with improved wear tolerance thus increased usage
- A well aerated thatch matrix with improved infiltration and hydraulic conductivity
- Improved root development

Infiltration data shows that the average infiltration rate is less than 50mm/hr.

- Intensive and ongoing physical treatments like coring or verti-draining will be required to relieve surface compaction which in turn will improve water movement.
Diagnostic Study of Sports field X

Introduction

Sports field X was fully tested using the Best Use Modelling Project (BUMP) testing system.

The Best Use Modelling Project (BUMP) testing system uses various methodologies to measure qualitative and quantitative performance values of a sportsground. Data gathered is not only used to map trends and plan maintenance objectives, but allows municipalities to compare maintenance regimes with other municipalities under a similar set of standards. The methodologies used are currently duplicated in other Australian states and New Zealand.

Scope of Study

This study focuses on the provision of benchmarking data and practical recommendations to assist Park Services plan for future usage levels and maintenance requirements of their sports fields.

The benchmarking study (BUMP) comprises of a set of conventional and new sports field testing methodologies. Data is recorded and these values are measured against a set of standards.

The following testing methods were used:

- Surface Hardness rating (2.5 kg Clegg Hammer)
- Soil penetration and shear resistance index (TurfTrax trademark Going Stick)
- Water infiltration rate (mm/hr)
- Thatch and rooting depth determination (mm)
- Soil compaction and characteristics e.g. texture and structure determination
- % Volumetric soil moisture content (Theta probe)
- Turf species composition determination including weeds (Quadrat)
- % Ground cover (Quadrat)
- % Organic matter (samples taken from sand fields & tested in Lab)
- Earthworm contamination severity test (sand fields only)
- Visual assessment of irrigation uniformity
Observations and Findings

Irrigated fields (sprinkler uniformity/coverage on sand profiles):

From our observations the irrigation system appeared to have good sprinkler uniformity with no obvious ‘misses’ or ‘donuts’ often associated with poor irrigation system performance. This was evidenced by the evenness of grass cover, colour and soil moisture in the top 50-100mm.

Soil moisture was surprisingly relatively low - medium (average to 60mm depth was 15.8%) compared to similar fields tested in the area during the same testing period. The deep roots appeared to be in good condition and unaffected by the slightly lower moisture levels at depth.

Thatch and organic matter (OM) on soil-based fields

In-situ samples were taken from at least three locations to quantify thatch and root depth and to examine soil characteristics i.e. compaction layers, colour and texture etc.

OM samples were tested in our laboratory. The upper 20mm layer of 7.7% is nearly 1.5 times the acceptable range of 4.5%. The 20-40mm layer which includes the mesh elements layer has 4.4% organic matter.

This report discusses cultural and physical aspects to addressing OM accumulation and recommends emphasis on renovation treatments to remove thatch (see summary of recommendations).

Grass species composition

The predominant grass species is couch (Cynodon sp). Some paspalum notatum and several patches of kikuyu were noted but only in minor amounts. We suspect that these rogue grasses were imported with the original turf sod.

Figure 1. Paspalum notatum grass contamination  Figure 2. Kikuyu grass contamination
Soil compaction and surface hardness test

The purpose of this test is to look at the implications of soil compaction on plant health e.g. root development, soil water movement and aerobic conditions and to evaluate the grounds for surface hardness, player safety and water infiltration potential.

The methods used for testing compaction and surface hardness included, Clegg hammer (Figure 4), TurfTrax Going Stick penetration and shear resistance (Figure 5), percentage moisture content as measured using a Theta probe (Figure 7) and visual and physical evaluation of soil samples (Figure 6) for obvious compaction layers, root development and earthworm contamination.

Clegg Hammer test values we recorded showed an average cv of 11.8 (118 gravities) and well below 200 gravities threshold and not deemed dangerous for play (Clegg impact values above 200 have been identified as the limit the risk of significant head injury is high).

Volumetric soil moisture content (%) was assessed with a Theta moisture probe. As mentioned earlier, moisture readings averaged 15.8%. We often observe that fields with thatch depth greater than 30mm tend to hold most of the moisture within this zone.

Soil condition and texture analysis test

Deep sampling allowed us to assess texture and general condition of the sand root zone. We looked for colour changes (black layer) that might indicate poor water movement (drainage issues) or water-logging. As the field is quite new, there were no obvious impediments in terms of water movement or retention problems.

The original Mesh Elements layer is not affecting root development or otherwise.

Root depth assessment

Plugs of soil were taken at a maximum possible depth to assess the condition (colour and mass) and depth of the grass roots. Average root depth was 107mm which is still very good for a new ground.

Using the soil water availability comparison table below (Table 1), we can theoretically calculate average daily summer ET losses (e.g. 6mm/day) of cool and warm-season species against the theoretical requirement to restore soil moisture midway between field capacity and permanent wilting point based on root depth on both soil and sand profiles. Based on these calculations, irrigation would theoretically need to be re-applied to the different soil types at the following frequencies;

Couch dominant turf

- Clay loam grounds (average 85 mm root depth) every 3 days
- Sandy loam grounds (average 100 mm root depth) every 2 days
• Silt loam grounds (average 86 mm root depth) every 4 days

Table 1. Soil water availability comparison chart

<table>
<thead>
<tr>
<th>SOIL TYPE</th>
<th>Approx. water available in mm/30cm of root depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>15</td>
</tr>
<tr>
<td>Sandy Loam</td>
<td>33</td>
</tr>
<tr>
<td>Fine Sandy Loam</td>
<td>43</td>
</tr>
<tr>
<td>Silt Loam</td>
<td>53</td>
</tr>
<tr>
<td>Clay Loam</td>
<td>51</td>
</tr>
</tbody>
</table>

Insect activity

During testing we observed some damage to the roots throughout the field from grub activity possibly Black beetle larvae (*Heteronychus arator*). Unfortunately we were unable to find any grubs.
## SPORTS FIELD X

### Test area All

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare ground %</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Cynodon %</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Kikuyu %</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Tall fescue %</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Poa pratensis %</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Paspalum notatum %</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Weeds cover %</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Infiltration rate (mm/hr)</td>
<td>2583.3</td>
<td>2000.0</td>
<td>3000.0</td>
</tr>
<tr>
<td>Volumetric soil moisture content %</td>
<td>15.8</td>
<td>9.0</td>
<td>24.1</td>
</tr>
<tr>
<td>Goingstick penetration resistance</td>
<td>12.4</td>
<td>10.6</td>
<td>14.5</td>
</tr>
<tr>
<td>GoingStick shear resistance</td>
<td>11.9</td>
<td>9.5</td>
<td>14.9</td>
</tr>
<tr>
<td>GoingStick index value</td>
<td>12.2</td>
<td>10.9</td>
<td>13.8</td>
</tr>
<tr>
<td>Hardness cv</td>
<td>11.2</td>
<td>9.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Thatch depth mm</td>
<td>36.7</td>
<td>30.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Root depth mm</td>
<td>106.7</td>
<td>90.0</td>
<td>120.0</td>
</tr>
</tbody>
</table>

### Notes/observations:

<table>
<thead>
<tr>
<th></th>
<th>Recommendations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good root depth</td>
<td>Continue with conventional deep renovation treatments to maintain deep roots</td>
</tr>
<tr>
<td>Evidence of moderate root damage (no larvae seen but suspect Black beetle)</td>
<td>Monitor next spring/summer and if Black beetle treat with imidacloprid</td>
</tr>
<tr>
<td>Paspalum and kikuyu contamination observed but not high enough to record</td>
<td>Selective removal by spot spraying (e.g. glyphosate)</td>
</tr>
<tr>
<td>Significant surface thatch noted</td>
<td>Intensify scarification and sand topdressing</td>
</tr>
</tbody>
</table>
**APPENDIX 4.  Considerations when evaluating a site for a new sports field construction**

**Introduction**

This section is primarily designed for councils wishing to develop a new sports facility; some of the information is also relevant to major upgrades.

Failure to consider all aspects of a sports field construction (or upgrading) project at the outset could result in lost opportunities, or worse, it may not be easy to correct any resultant problems.

When developing a site due consideration must be given to the full inventory associated with the development. Key considerations are listed below:

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>CONSIDERATIONS</th>
<th>CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intended usage – type/amount/standard</td>
<td>Use - Passive- Aesthetic only&lt;br&gt;Active (sport) use&lt;br&gt;Use for slope stability/erosion control</td>
<td></td>
</tr>
<tr>
<td>User expectation</td>
<td>Performance of the finished product&lt;br&gt;Time frame&lt;br&gt;Available budget</td>
<td></td>
</tr>
<tr>
<td>History of the site</td>
<td>How has it performed in the past&lt;br&gt;Nature of construction – e.g. was it cut and fill?&lt;br&gt;What problems have been recorded&lt;br&gt;Land tenure; duration of any lease period&lt;br&gt;Subsidence problems; Any doubts call in a geotechnical engineer&lt;br&gt;Environmental contamination&lt;br&gt;History of flooding</td>
<td></td>
</tr>
<tr>
<td>Location in relation to neighbouring features (e.g. buildings, trees)</td>
<td>Buildings and tree causing shade&lt;br&gt;Tree root problems&lt;br&gt;Potential buried obstructions/cables&lt;br&gt;Potential consent issues&lt;br&gt;Factors such as traffic, noise and floodlighting may impact on neighbours.</td>
<td></td>
</tr>
<tr>
<td>Climate, including rainfall intensity, sunshine hours (or any shading) and exposure to air movement (wind)</td>
<td>Rainfall intensity assists in drainage design&lt;br&gt;Rainfall data indicates need for watering system&lt;br&gt;Air temp, humidity, wind run influence turf selection</td>
<td></td>
</tr>
</tbody>
</table>
| Access details | Especially challenging for urban landscapes such as roof top lawns  
Consider what machinery can/cannot be used |
| Make up of the soil and underlying parent material | What material can be re-used or modified  
Geotechnical features  
Drainage status |
| Drain outlets | Availability and depth of a suitable gravity discharge point  
Alternatives to gravity discharge |
| Legal requirements | Restrictions with working hours  
Health and safety  
Lease tenure |
| Access to power, water, storm water outlet and services | Check power supply needs for pumps, lighting  
& facilities are going to be adequate  
If floodlighting, consider local regulations  
Water supply and water quality are key issues-Check with the water authority in regard to accessing a water supply  
If irrigating check whether the flow and pressure are sufficient to deliver the necessary quantity of water within a given limited time. If not, a storage tank and pump system will be required. |
| Budget | Funding available  
Cost and availability of raw products  
Availability of skilled labour |
| Parking | Provision should be made for paved parking. In addition, clear pedestrian routes from car parks to the facility should be provided |
| Site geometry/area | Determine if the size and shape of the site will accommodate the planned needs of the facility. Consider associated features such as access ways, parking space, etc.  
Also consider the buffer strip needed around a ground from a safety viewpoint.  
From a sports field orientation viewpoint, aim to align sports field N-S in order to minimize glare (especially important for wicket blocks). |
| **Access to the Site** | Consider ease and cost of getting materials to the site.  
Public access?  
Can alternative roads be used during construction and grow-in  
Consider transport regulations such as if the site is adjacent to a main road, especially one carrying high-speed traffic, it will be necessary to plan for a safe acceleration and deceleration lane with adequate sight lines. |
| **Site Topography and Drainage** | Consider the topography of the site and how much earthmoving and re-grading will be needed to provide the required levels.  
Determine the potential risk of erosion, particularly during earthworks; special provision may need to be made to detain sediment and runoff.  
Identify the need for suitable drainage – both to control storm water runoff in the catchment and also to provide good internal water clearance |
| **Environmental** | Consider environmental issues especially those that pertain to resource consents. For example it will be a likely requirement to prepare a nutrient plan and to ascertain the likely potential for nutrient leaching or runoff. |
| **Spectator viewing** | Consider spectator viewing and where bunds, slopes or embankments could be located in order to accommodate seating. |
| **Trees** | Whilst trees can add significantly to the attractiveness and offer shade, they can also create problems of leaf litter in the autumn, which will add to the burden of keeping the surface clean. Tree root competition and shading should also be considered. |
| **Safety and Security** | This includes external as well as internal safety, for example provision of adequate lighting along pedestrian routes. Consider options for protection from vandalism and theft. |
| **Cost benefit analysis of different options** | Refer to information section on costs & benefits of different construction options |
APPENDIX 5. STRATEGIES TO DEAL WITH DROUGHT

Introduction

Australia has been hit by an unprecedented drought over the past decade.

The critical shortage of water, and growing appreciation of water as a precious resource, have caused a re-think in how we plan and manage sports surfaces and associated water resources.

With councils having to pay a high price for use of water (often upwards of $3.50 per m³), there is a need to ensure every effort is made to limit water use for sports turf irrigation.

Various strategies could be considered in the pursuit of water saving. Key strategies include:

- Changes to sports field usage pattern
- Change in turf type
- Minimising the area that is watered (hydroscaping) including synthetic turf
- Efficient turf management that optimizes water use
- Optimal design and use of the watering system
- Alternative water supplies

Strategy 1  Changing usage pattern

Sports faced with pressures of restricted ground availability (whether from moisture deficit or other reasons) are being asked to think outside the square and to consider how their game can be modified to fit the availability of playing surface resource. This challenge can in fact offer potentially exciting opportunities for sport, such as:

- the introduction of 20:20 cricket as a means of maintaining spectator interest and accommodating less spare recreational time
- The development of futsol to accommodate limited space for soccer.

Looking at the Australian sporting scene, considerations to modify rules or habits in order to get more out of a limited sports facility resource could include:

1. Training areas
   - Aim to have training take place off the main match playing areas (or at least shifted from the high wear zones).
   - Avoid where possible locating training areas-fields nearest to the changing sheds and/or grandstands.

2. Customized all-weather training areas
   - There is a trend to constructing specialized, effectively all-weather training pads in order to allow training to take place at times when the main playing fields are vulnerable to damage
   - Such areas are often shared amongst sports clubs in the same town.
3. **Relocation and expansion of lighting systems**
   - Historically lights for training have been rigged up on the main playing ovals.
   - Having lights focused on adjacent areas off the field (if available) or locating more lights around the field will help to spread wear.

4. **Common sense restrictions of access for practice and casual use in high wear zones**
   - Taking soccer as an example, generally the major wear is in the goal boxes
   - Many clubs are now taking steps to rope off goal boxes to prevent practice taking place there.
   - Use of moveable goal posts will allow teams to practice shooting and defending on other areas of the field

5. **Changing the composition/rules of the sport**
   - Associations faced with limited match facilities have been faced with altering the rules and changing the playing habits of participants.
   - One strategy has been to shorten the duration of matches
   - Allowing shorter pre-seasons could help ease use pressure during the summer/winter transition
   - Reduced field sizes is a common strategy internationally, particularly with Junior sport, would allow more users per unit area

---

**Strategy 2. Conversion to a warm season turf type**

**Background**

The process of converting a sports field from cool season to warm season grass species has gained considerable momentum over the past couple of years, partly encouraged by State and Federal subsidies.

Feedback is beginning to come through about the success (or otherwise) of these conversions. Having accurate data on costs and performance comparisons is needed. There is also a need to fully understand the management implications with a conversion if failure is to be avoided.

On paper the concept of converting to a warm season grass where water is limiting looks sound. The following table illustrates that cool season grasses, such as ryegrass, use more water and can’t handle temperature and drought as well as the warm season grasses, such as couch or Kikuyu.

<table>
<thead>
<tr>
<th>Species</th>
<th>Ryegrass</th>
<th>Tall fescue</th>
<th>Buffalo</th>
<th>Kikuyu</th>
<th>Couch</th>
<th>Seashore paspalum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water requirement</strong></td>
<td>V high</td>
<td>V high</td>
<td>Med</td>
<td>Med</td>
<td>Low</td>
<td>Med-low</td>
</tr>
<tr>
<td><strong>Drought resistance</strong></td>
<td>Med/poor</td>
<td>Med</td>
<td>Good</td>
<td>Very good</td>
<td>Very good</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Heat resistance</strong></td>
<td>Med/poor</td>
<td>Med</td>
<td>Good</td>
<td>Very good</td>
<td>Very good</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Turf quality for football</strong></td>
<td>High</td>
<td>Med</td>
<td>Poor</td>
<td>Med</td>
<td>High</td>
<td>Med to High</td>
</tr>
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What are the benefits with a warm-season grass?

- Warm season (C4) grasses will require less water overall than cool season grasses. Some studies point to significant reductions in water use (one study referred to a change from 5.2 Ml/ha/yr to 2.6 Ml/ha/yr for ryegrass and couch, in converting from ryegrass to couch.
- Warm-season grasses handle heat and drought better than cool season grasses. Grasses like couch and Kikuyu grow best at temperatures of 25-35°C, while cool-season grasses are at their optimum with temperatures between 15 and 25°C. Throughout most of Australia the main periods of growth occur during late spring to early autumn for warm-season grasses and spring to autumn for cool-season grasses.
- Another advantage of warm season grasses, such as couch or Kikuyu over ryegrass, is their rhizomatous/stoloniferous growth habit. The rhizome/stolon system offers extra stability to the surface under traffic. This is particularly significant in intensively used sand-based turf systems.
- Ease of recovery of damaged or bare areas on sports fields.

What is the potential downside of warm season grass conversions?

- Warm season grasses (C4 grasses) slow down and cease growth as temperatures drop below 10-12°C (approx) and do not maintain an attractive green colour during the winter months (unlike the cool season or C3 grasses). The exception is where the warm season grass is over-seeded with cool-season grasses. As illustrated in the following tables the climate throughout much of Australia, especially southern states, will cause couch to enter dormancy over the late autumn to late spring months.

Table 1. Average daily temperatures (°C) for selected recording stations in Australia (Sources: Australian Bureau of Meteorology).

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Table 2. Average daily sunshine hours for selected recording stations in Australia (Sources: Australian Bureau of Meteorology).

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- Warm season grasses will require a totally different management strategy compared with cool season grasses. Failure to understand and implement appropriate maintenance strategies will lead to failure of the grass. For places like Victoria, especially inland towns, it must be expected that couch, and to a lesser degree Kikuyu, will remain brown and dormant for several months during the peak use winter football season. There are strategies to combat this but they come at a price. For community level fields it is unlikely these strategies (other than living with the off-colour of the turf) will be affordable.

It is inevitable that there will need to be a change in both how playing surfaces are perceived by user groups and also how sports surfaces are best managed.

What are the main types of warm season grasses used in conversions?

Grasses that are being used for conversions in Victoria, ACT and NSW include:

- Kikuyu (*Pennisetum clandestinum*). Climatic comparisons (Tables 1-2; data for additional sites from the Australian Bureau of Meteorology) suggest that the NSW coast south of Sydney is ideal for Kikuyu. In southern and eastern Australia (to just north of Brisbane), Kikuyu is widely used in home lawns and parks, on sports fields and on racetracks.

- The term “couch” is used to cover a wide range of grass types. Green couch (*Cynodon dactylon*) and its hybrids with *C. transvaalensis* form the main pool of couch types used in sports fields. The bulk of better couches can only be established vegetatively, although there are several seeded varieties (generally coarser types) that are seeded. Common varieties of couch include: Legend, Windsorgreen, Wintergreen, Conquest, Tif Sport and Grand Prix. New couch cultivars are coming on to the market and it is advisable to check latest research information or ask around before deciding on a couch selection.

- Other C4 species. Although not commonly used in Australia at present, it is expected we will see more use being made of Seashore Paspalum (*Paspalum vaginatum*) and Zoysia. Seashore Paspalum is particularly well suited to high salt content root zones.
Establishment methods

There are several ways to establish a warm season grass into an existing cool season grass sports field. Laying full vegetative turf is expensive, but it does give rapid cover and an opportunity for an early use of the ground. Laying turf is also a sound answer where there is a limited water supply and there is no guarantee of keeping the root zone moist during an initial establishment.

Strip sodding is a second option for establishing a warm season grass. This involves placement of sod in spaced rows, and allowing the stolons of the grass to progressively in fill the bare areas.
A further adaptation on strip sodding is spaced planting of the turf sods. This is a common practice in SE Asia with the use of broad-leafed carpet grass (Axonopus compressus).

An alternative is turfing to break up the sod into stolons, which can then be spread and bedded in to a loosened soil surface. By keeping the surface moist throughout the first 2 to 3 weeks the stolons will generate roots and shoots and progressively establish.

Some varieties of warm season grass can be established via seed. Significant research has taken place in the USA in order to develop improved cultivars of seeded couch, as historically seeded couch types were coarser and of poorer quality.

Management strategies to get the best from warm season grass conversions

Although it is impractical to offer a turf maintenance program that covers all regions and facilities, there are key aspects to managing a warm season grass surface in the Australian climate. Some points to consider include:

Minimise competition during establishment.
Warm season grasses, particularly Couch, are poor competitors and very sensitive to shade. Competition from the likes of other grasses must be managed if the newly introduced grass type is to have the best opportunity to establish and be a success.

Ensure there is an adequate grow-in period
It is important to allow time for the grass to establish. Bringing a new field into play too quickly will inevitably result in disappointment. Although site specific, as a guide allow at least 3 months of good growing weather for sprigged fields to establish before use.

Give the warm season grass every chance to recover in spring
Particularly with couch, competition from cool season grasses (especially if oversown in winter) must be kept to a minimum during the mid to late spring period. This will require considering fertilizing, irrigation, mowing and herbicide management strategies.

Ensure the warm season grass goes in to winter in the best possible shape
Ensure the turf is appropriately fertilized during the late summer/early autumn months before it goes into dormancy in order to encourage establishment of strong rhizomes/stolons and carbohydrate reserves.

**Avoid excessive winter damage that destroys the dormant stolons and rhizomes.**
Wearing out the surface leaf of couch or Kikuyu is not a big problem for long term recovery and sustainability provided traffic doesn’t tear out the underground rhizomes.

**Recognise that warm season grasses need different management to cool season turf.**
It is essential that a comprehensive maintenance plan that is specific to the site and the selected grass species is adopted if good results are to be achieved. Literature suggests couch oversown (with ryegrass) requires at least 100 days of good growing conditions during summer to recover fully in time for the next winter overseeding.

### Strategy 3 Reducing the areas to be watered, including use of synthetic turf

**Hydroscaping**

With the pressures of reduced water supplies and higher cost of available water councils have needed to review and prioritise what areas receive (or don’t receive) irrigation. Some councils, have gone to the extent of discontinuing the watering of a number of their sports fields.

Councils are also considering if water can be saved by replacing water-intensive turf grass and other exotic and non-native plants with low-water use grasses, wildflowers and plants that are native to the local environment. Although this isn’t practical for the sports fields, it does apply to surrounding landscaped areas and passive turf areas.

Many of our golf courses have reduced overall water use through reducing the area watered, often by retiring parts of the fairway to non-irrigated native rough.

**Synthetic turf**

Synthetic turf surfaces are making big in-roads globally, particularly the development of new 3rd generation (3G) football (soccer) surfaces and multi-use areas.

A key driver for synthetic surface development in Australia is water (potential savings through the use of synthetics); Subsidies are currently being made available to clubs and councils in states such as Victoria to convert natural turf grounds to synthetic turf.

**Performance analysis**

Synthetic turf products have come a long way in the past decade. We now see a wide array of synthetic turf products that are gaining widespread acceptance amongst sporting bodies (e.g. FIFA actively promote the development and use of synthetic turf.)
### Use of a synthetic surface

1. Subject to Resource Consent conditions (such as lighting and noise). Offers potential for unlimited play; an advantage where grounds are being used at maximum capacity or land availability is limited.
2. Offers consistent playing quality and availability for play under virtually all weather conditions.
3. Ability to free up/reduce playing pressures on natural turf surfaces, thereby better enabling them to meet the users’ expectations.
4. Reduced water use.
5. Can be constructed indoors.

### Limitations of synthetic surface

1. Significant capital cost.
2. New technology and issues such as injury risk or high temperatures remain in question.
3. Challenge of providing a surface that caters for multi-use.

### Health and safety

Much has been stated in recent literature about the potential health hazards of using synthetic turf. Concerns have included: ingestion of crumb rubber, heavy metal contamination, bacterial infections and heat stress. Of these the major concern for Australia is likely to be temperature of the surface during play on hot summer days.

### Cost analysis

An economic analysis of a synthetic turf installation is difficult, given the range of variables to consider and intangibles, such as risk of ground closure and cancellation. Refer to other tools provided in the best use modelling project for synthetic turf cost analysis.

### Strategy 4 Water savings through efficient turf management

Turf managers should be aware that irrigation is not the only requirement for maintaining a quality playing surface. A comprehensive management programme based around best practice will need to be adopted.

### General points to consider

- **If the field is not in use, allowing the turf to go dormant is an option.**
  - It is not necessary for a field to remain green year round, nor is it necessary for a field to be green in order for it to play well. Most of the grasses in use can survive in a dormant state for several weeks as long as there is no traffic or wear.
  - There is a need for user group education in respect to colour of a turf surface; need to get the message across that a brown doesn’t necessarily mean a hard, dry surface.
This is going to become very relevant in southern states moving over to warm season grasses.

- **Don't over fertilize the turf.**
  With turf management we are trying to produce a playing surface and not maximize grass growth (as occurs with farming). The objective in turf is to apply sufficient fertilizer to maintain turf density. Excessive fertilizer use, contributes to:
  a. excessive thatch (soft, spongy surface)
  b. higher rate of water use (evapotranspiration)
  c. Encourages disease etc.

- **Aim to minimise stress to the turf.**
  For example, with low cut turf (< 15mm) raising the mowing height may help produce a deeper root system. Also aim to minimize any unnecessary traffic across the field.

- **Ensure the turf root zone is in a condition that allows deep penetration of both water and roots.**
  De-compaction of root zones is a critical requirement for many ovals, especially with soil-based root zones subjected to heavy use. Programmes whilst site specific aim to:
  a. Optimize water infiltration (winter drainage hence playability)
  b. Encourage deep root development (thereby assisting to reduce water usage
  c. Optimize the performance of irrigation systems (water use)

**Strategy 5  Optimal irrigation system design and management**

**Introduction**

Where adequate water and a budget is available to apply water, the primary objective should be to apply water as efficiently as possible. There is a great deal to consider with irrigation water use efficiency – not just the engineering side of the irrigation system, but how the system and the turf is managed.

**The watering system**

A watering system is a significant investment, both in terms of capital outlay and the on-going costs for water and maintenance. Given this level of investment it would seem logical that due regard be given to ensuring the irrigation system is properly designed and installed.

Irrigation system design is a specialist business, and it is important to commission the services of an experienced company to plan, design and install the system.

**Evaluating an existing watering system**

The performance of many of our existing watering systems in Australia is poorer than desired. Some systems were built to a price, whilst others have suffered from wear and neglect.
Application of water to turf seems to be a case of ‘out of sight out of mind’. A poor watering system appears to perform adequately for much of the year but deficiencies become evident when a stress period is encountered.

It is logical and recommended that effort should be made to ensure a watering system is designed and operated to the highest standards. In order for a council to know how their watering system is performing an irrigation system audit is required.

![Image](image_url)

**Fig 1. Deficiencies with a watering system only become noticeable when the system is most needed.**

**An irrigation audit**

An irrigation system audit is a means by which the efficiency of the watering system can be determined in advance of problems occurring. An irrigation system audit should involve a thorough analysis of how water is used within the system – both with above and below ground water application.

An irrigation system audit should cover:

- How the irrigation system design performs from an engineering viewpoint.
- The agronomy component – that is to ensure that efficient water entry into and storage within the soil is achieved.
- How well the system is operated and maintained.

**Auditing the irrigation system performance**

A starting point is to gather all available information about the watering system, including information on components, scheduling methods, the turf and soil system and climatic data. It is a decided advantage if as-built plans, aerial photos and records of modifications can be accessed.

The audit involves checking the system during operation, noting obvious problems, such as broken, misaligned, sunken, mis-matched or incorrectly positioned heads and high or low pressure. Some of the things to note include:

- Wet spots/areas close to sprinklers (may be related to a faulty check valve or other malfunction of the sprinkler).
• Pop-up risers that do not lift sufficiently above the surrounding ground or are obstructed by grass during operation.
• Damaged or mis-aligned sprinkler heads.
• Sprinkler arcs that fail to achieve full rotation (generally 360°; although sprinklers located on the perimeter of the fields are likely to be set to 180° rotation).
• Sprinklers are perpendicular to the surface
• Mismatched sprinklers (nozzle sizes, 360°/180° operating on same zone).

The audit will determine the uniformity of water application to the surface (DU). The higher the DU, the better the irrigation efficiency, with value in excess of 75% DU targeted for a standard sports field system.

![Fig 2. Checking the uniformity of watering.](image1)
![Fig 3. Measuring pressure using a Pitot gauge.](image2)

The investigation will check that the actual on-site installation, in particular sprinkler spacing/distance, match the design. This will include checking that sprinklers have matched precipitation in terms of sprinkler brand.

The pressure of each sprinkler in the test locations will be tested under normal operating conditions, generally using a standard Pitot gauge. Pressure readings should ideally be recorded at typical scheduling times (e.g. at night) to gain a true representation of the system’s performance, although this is not always practical.

**Irrigation system operation**

Having a properly designed and installed system is only half the battle; it is equally important to ensure the system is correctly operated and maintained. The auditing process will check out whether there are accurate and robust systems in place for water use scheduling.

Irrigation scheduling is a combination of science and experience. The operator needs to have a sound basis for calculating the frequency and duration of watering. A basic soil water balance is a good starting point, enabling the operator to get a ball park estimate of the scheduling requirement. Using a water balance will require routine collection of rainfall and evapotranspiration data, knowledge of the soil water holding properties, irrigation system efficiency and specific crop factor information.
The operator needs to routinely check the water budget calculations against the actual readings obtained from the water meter.

Soil moisture measuring devices, such as a Theta probe, can then be used to fine tune the water balance process. Routine soil moisture monitoring (even if done by core sampling and visual observation) enables problems to be picked up before they start to show up in the turf.

Experience comes in to the equation when accounting for seasonal variation and recognising the variation in watering needs of different areas (for example reduced water use in shaded areas; more frequent water requirement in shallow root zone areas).

Consider what happens below ground

Having a watering system that applies water evenly to the surface and at the correct rate and frequency is still not the end of the story. What happens once water hits the soil surface also impacts on water use efficiency and the auditing process must account for this? The soil must be capable of accepting, storing and releasing applied water.

Points to consider include:

- Identifying the water repellency (hydrophobicity) potential of the soil.
- Recognising the potential for by-pass flow (where water moves directly via large cracks, worm channels or similar to the sub soil or the underlying drainage system).
- Rooting depth and distribution, in so far as it impacts on water storage and retrieval capability.
- Soil water retention characteristics (soil type, organic matter etc).

Without an understanding of the soil and its properties the system operator is flying blind.

Other pointers for using a watering system efficiently

- **Timing.**
  This is often a legal requirement anyway. Watering of a night will help minimize water loss by wind, drift and evaporation.
- **Water deeply and infrequently (where practical).**
  Watering little and often (e.g. daily) is not recommended as it doesn’t encourage deep rooting and sub-surface water uptake.
- **Have a means of checking on soil moisture levels.**
  There are some very good soil moisture probes on the market. The investment in a good moisture probe can be justified, given the potential water savings.
- **Use a moisture stress indicator area or plant.**
  By observing your sports fields you will get to know what areas will show the first signs of moisture stress. An experienced curator will know the onset of moisture stress by symptoms such as the turf colour or footprinting.

- **Where water supply is limiting prioritise areas.**
• Priority should be given to the high frequency of use of playing field and even the zones of higher wear on the field (watering high wear areas more frequently to aid recovery). These areas could include centre squares, halfway lines and goal boxes.

• **Use water meters as a tool to monitor efficiency of water use.** Being able to review the amount of water used on the playing surfaces encourages effective management. Installing a dedicated water meter for the watering system is recommended.

• **Adjust the amount of watering by season.** The rate of evapotranspiration varies markedly between seasons. Temperature, humidity and wind run have a huge impact on how quickly a profile dries out. Water application volumes and frequency need to be adjusted in accordance with regional and seasonal water use (refer to your local Meteorological office for evapotranspiration data).

• **Include a rain sensor in the irrigation system controller and ensure allowance is made for rainfall when scheduling application.**

• **Use wetting agents on soils that are prone to hydrophobicity (water repellency)**

### Strategy 6  Alternative water supplies

#### Desalination

90% of the Earth’s water is contained in the oceans. Consequently desalination technology is a logical solution to the world’s impending water crisis. Improved desalination technology has reduced the per-unit volume costs of desalinated water to become more comparable with that of fresh water.

One of the arguments against desalination is that the process itself could be very harmful to the environment. A by-product of the desalination process is a salty brine discharge that could be harmful to marine life in the area. Another downside is the cost. Start-up construction costs of more than $1 million per desalination plant have inhibited wider adoption of this technology globally.

#### Recycled water

Recycled water has been used throughout the world for the irrigation of golf courses, landscaping and pastures.

The water savings reaped by those using recycled water can be tremendous, but capital costs have, until recently, limited widespread implementation of such systems. The trend in many parts of the world is to find ways of efficiently re-using recycled water from both industrial and municipal discharge sites. Some areas have been able to recover and re-use up to 80% of the waste water production.

Soil management, especially related to drainage and soil conditioning, is critical when water quality (such as recycled water) is doubtful. Salts (specifically sodium) can cause a fine textured soil to lose its structure and compact. In turn this limits both water and root penetration. Good drainage will enable excess water to move through the soil and flush out any salts present
Water harvesting

Water harvesting is simply the capture, storage and later re-use of runoff water. Farmers have been practicing water harvesting for years. So too has the urban environment, through capturing runoff from roofing.

In more recent times consideration is being given to a more diverse range of urban catchments, such as the collection of storm water discharge from parks or roads. Storage facilities include above and below ground tanks, open lakes and, where geomorphology suits, underground aquifers.