Best Practice Sporting Fields

A guide for turf surfaces in the Lower Hunter

Book 5: Planning

Cover Picture: Soccer ball ready for junior game at Cooks Square Park, East Maitland.

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Brief biographies for authors and reviewers are contained in Appendix A of Book 1.

INTRODUCTION

Strategic sports planning is best undertaken in a manner that aligns to conditions on the ground. This involves, for example:

- Reflecting climate zones and turf growing conditions when considering the carrying capacity of natural turf fields
- Accounting for usage hours (not booked hours), sporting code, age of players, etc in determining wear levels across sites
- When assessing carrying capacity, considering turf variety, soils, microclimate at individual sites as well as examples of natural turf sporting fields handling use above 40 hours per week (Figure P.1).

Comparing booked hours to arbitrary, single values for carrying capacity is not based on sound science and often results in many sporting fields being incorrectly identified as "overused". Best practice planning involves making direct comparisons of wear levels (not usage hours) with the current carrying capacity at a site level, with site data aggregated to the portfolio level.

This book examines key sport planning issues and the links to budgetary and environmental considerations, with Book 6 focussing on the construction phase (project planning, procurement, construction). Maintenance and the role of user groups covered in Book 7.

Figure P.1: Two examples of well performing sporting fields that have high levels of use.

CHAPTER 13: IDENTIFYING OVER USED FIELDS

Best practice planning involves making direct comparison of the wear levels (as distinct from usage hours) with the current and potential carrying capacity of each sporting field (or a representative sample of fields). In this chapter we explore the key concepts of use, wear and carrying capacity, and why technical expertise is required to determine the extent to which sporting fields are under or over utilised.

Sports field usage hours

Many sports strategies are based on booked hours because this data is often readily available from the relevant authority (e.g. Council, Operating Committee, facility owner). However, this data is often misleading due to blanket bookings – a practice where clubs "reserve" fields for longer than they are used.

In a recent study of more than 1,150 playing fields in the Sydney Basin, booked hours were typically 1.2 to 2.3 times higher than usage hours (Battam 2022)[31]. As such, it is entirely consistent to find sport strategies incorrectly characterising low wear fields as "heavily overused" based on the booking data (Figure 13.1).

Figure 13.1: An example of a sporting field that is performing well, despite being booked for 62 hours per week. The booked hours are providing a misleading picture of actual wear levels.

Sports field wear

Foot traffic causes damage to turf by tearing leaves, stems, stolons, rhizomes and roots. The amount of wear a field receives is determined from factors such as (but not limited to):

- age of players and the number of players training on a field per hour
- area of the field
- usage hours (as distinct from booked hours)
- type of sport activity: soccer generally has more concentrated wear then other football codes, with school usage by primary students wearing joggers causing far less damage
- standard of sport being played, with higher wear typically associated with elite players.

A rough indication of wear levels can be obtained from player numbers, with low wear generally associated with sites that have less than 175 players per field. However, this value is not accurate enough for detailed planning, with one hour of under 10's rugby league training representing a much lower level of wear than one hour of an adult soccer match.

A comparison of 193 playing fields in the Sydney basin found 5-6 fold variations in wear levels for the same number of booked hours. This variation occurred whether the facility was booked for 5-10 hours per week or 45-50 hours per week (Figure 13.2). This example further demonstrates the problems in using booked hours in sports strategies.

Additional information on the relationship between booked hours and sports field wear levels is provided in the Questions and Answers section of this book.

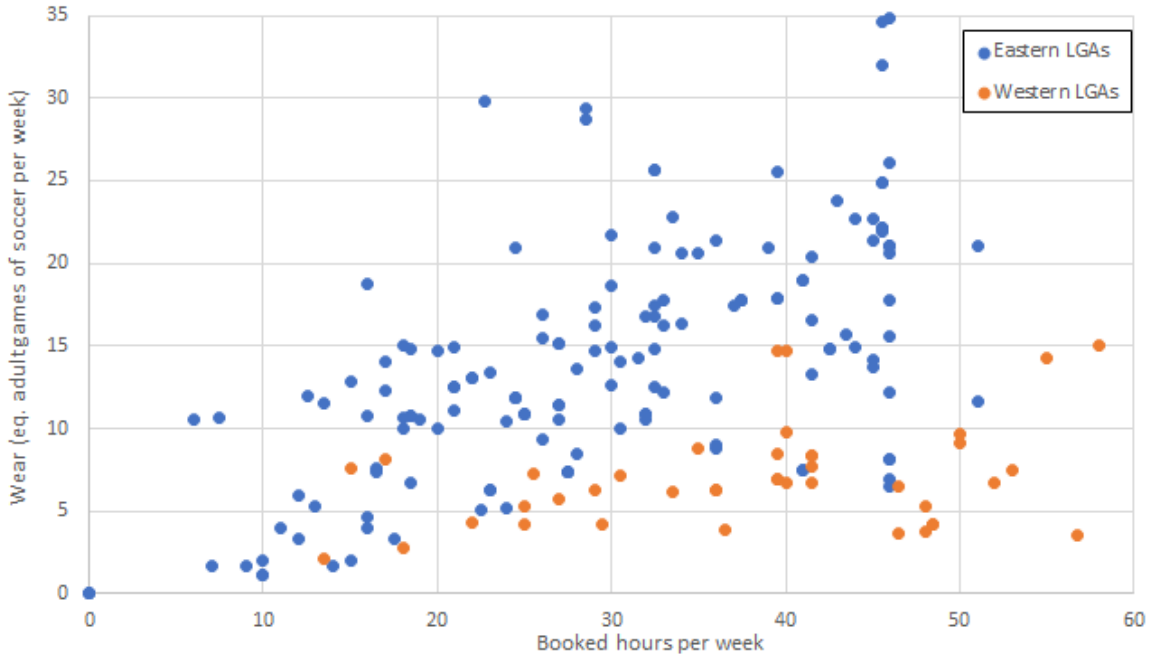

Figure 13.2: Comparison of wear levels and booked hours for 193 playing fields in the Sydney Basin (Battam 2022)[31]. The 5-fold variation in wear levels for a given number of booked hours demonstrates the poor correlation between booked hours and wear. Note: sites with multiple fields may appear as one dot.

Sports field carrying capacity

Carrying capacity refers to the amount of wear (as distinct from usage hours) that a sporting field can handle whilst maintaining an acceptable playing surface. Carrying capacity will depend on the standard of playing surface required (e.g. regional versus local level fields).

Carrying capacity is not a single number

In recent years, carrying capacity has been described in terms of the maximum hours per week a natural turf field can handle. Such comparisons are not scientifically valid because usage hours are poorly related to wear (Figure 13.2) and carrying capacities can vary widely between sites (Figure 13.3, 13.4). Furthermore, the evidence commonly cited to support the incorrect 25 hour per week "limit" (DPIE 2021)[32] consists of:

- material in synthetic turf publications
- sporting field usage hours from cold climates such as playing fields in New Zealand and school ovals in the UK (with no consideration of whether these fields could have handled more use).

Information on the capabilities of natural turf should be based on scientific studies in relevant climatic situations by natural turf experts. It is crucial that information on natural turf fields used in the sports planning process is critically evaluated for its quality and its relevance to local conditions.

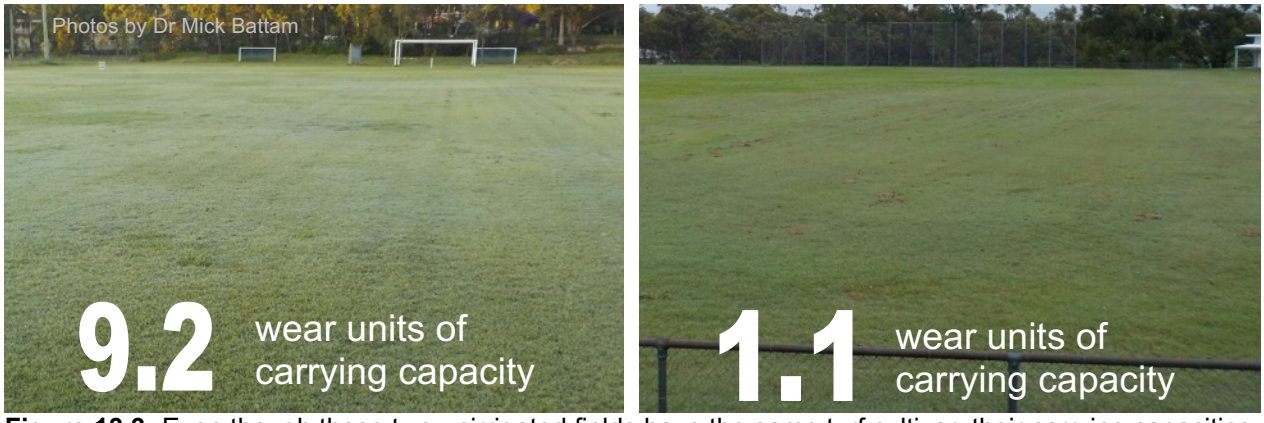

Figure 13.3: Even though these two unirrigated fields have the same turf cultivar, their carrying capacities differ greatly.

Factors determining carrying capacity

Carrying capacity varies with site characteristics that include (but are not limited to):

- soil characteristics which have a major influence over surface stability, turf growth rates and drainage characteristics. Unstable surfaces are more prone to damage by player movements (e.g. turning) and growth rates in poor soils can be reduced by up to 90%
- drainage characteristics: playing on a wet field can more than double the damage
- microclimate: a large amount of shading during the growing season (warmer months) reduces turf growth rates (winter shading is less relevant as turf growth rates are slow)
- turf cultivar: soft cultivars can be more than 4 times more prone to damage
- wear management practices: if users concentrate wear (e.g. training in game day goals or only training on one side of the field) this reduces the carrying capacity. Furthermore, training when the ground is wet, increases damage and reduces carrying capacity
- turf management practices: healthy turf is less prone to damage and much faster to recover (by contrast stressed turf is more prone to damage and slower to recover).

Given the large number of site-specific influences on carrying capacity for natural turf sporting fields, it is inappropriate to use a single value for carrying capacity in sports strategies.

Predicting sports field performance

The performance of a sporting field can be predicted by comparing wear levels with the carrying capacity. In general, if the wear levels are:

- less than the carrying capacity, the field will handle the wear placed on it
- more than the carrying capacity the field will deteriorate.

The condition of a field at any point in time will also be influenced by the time of year, weather conditions (both before and during the winter sports season), sporting club practices (if wear is spread evenly) and the maintenance program implemented for the site. Fields deteriorate if maintenance is inadequate (e.g. lack of weed control or insufficient fertiliser).

A comparison of 152 playing fields in the Sydney Basin found 102 fields had wear levels above their carrying capacity (Figure 13.4). Most of these fields were receiving low or moderate levels of wear (Figure 13.4) which natural turf should be able to handle. However, these fields were struggling to maintain acceptable turf cover because they have been poorly constructed and/or maintained (Battam 2022)[31].

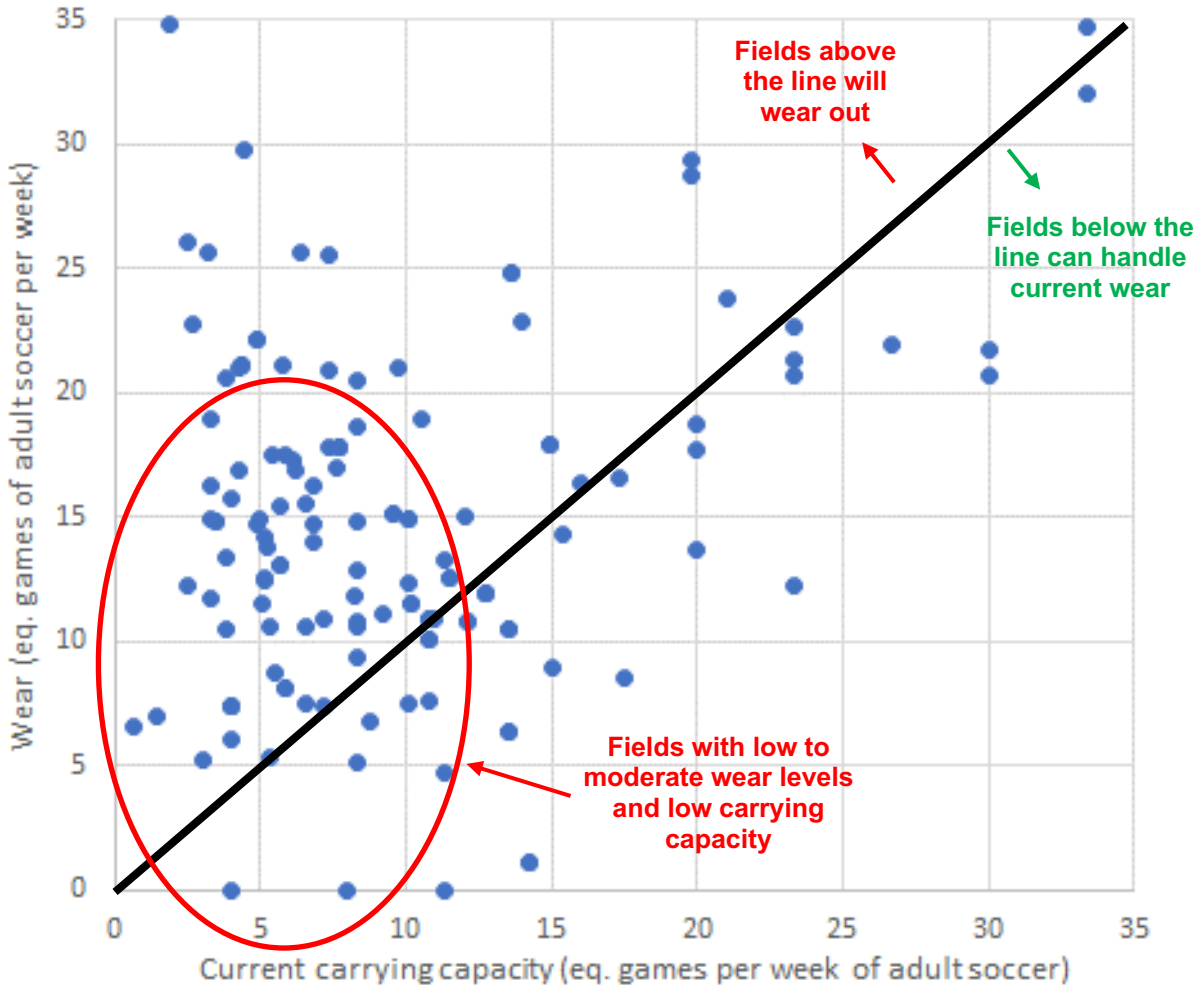

Figure 13.4: Comparison of the carrying capacity and wear levels of 152 playing fields in the Sydney Basin for the Eastern LGA areas (some sites have multiple fields and may appear as a single dot). The 102 fields located above the blackline will struggle to maintain acceptable turf cover during the winter sport season. Note that two of the fields in this study have > 33 wear units of capacity which is more than that received on most fields. Note: one site is receiving 35 wear units yet is only capable of handling 4 units of wear, with this field having minimal grass cover by the end of football season.

Using technical expertise to assess wear and carrying capacity

Identifying whether individual sports fields are able to handle the wear levels placed on them (i.e. carrying capacity exceeds wear) is a foundational element for any sports strategy. This represents a supply versus demand comparison for each site. The results can be aggregated over the portfolio of Council fields to determine whether the whole portfolio can meet sporting demands and what percentage of sites are struggling (i.e. wear exceeds carrying capacity).

Sports strategies often involve the expenditure of millions of dollars in public funds. Hence, it is crucial that they are based on sound science. Best practice involves using technical experts in natural turf, irrigation, drainage and soils to:

- identify the existing wear levels and carrying capacity at each individual site (or a representative selection of sites)
- identify the potential carrying capacity of each site if it was amended to best practice, and the works required to meet best practice (these will vary between sites).

Current industry practice has relied on sports planners to complete this critical task, but this does not represent best practice. Accurately assessing playing field wear and carrying capacity requires specialist knowledge and skills in soils, turf, irrigation and drainage.

What to look for in selecting technical specialists for natural turf fields

In engaging technical expert(s) to assess wear and carrying capacity for natural turf fields, it is important to consider:

- their field of expertise (e.g. it would not be appropriate to engage a synthetic turf specialist)
- their independence – conflicts of interest can pose significant challenges (see section below)
- their qualifications, industry certifications and memberships (e.g. certified professional soil scientist, certified irrigation designer, membership of industry bodies)
- their insurance coverage, particularly professional indemnity insurance
- their experience in the field and track record – the outcomes will depend on technical expertise which rests with the individuals in the team (not the organisation that employs them). Organisational systems/processes are less critical.

If detailed information on the sport type and player numbers is not used it can lead to disastrous outcomes (Book 2, Figure 6.2).

Independence and conflicts of interest

Conflicts of interest present challenges in seeking advice as it can be difficult to determine whether the advice is based primarily on:

- commercial interests
- personal interests
- technical merit and/or the best interests of the client.

A conflict of interest does not necessarily preclude that person from providing advice, but it is a case of “buyer beware”. Individuals and organisations that are independent do not have other interests or relationships that may benefit from the advice they provide.

Councils will often have a business ethics policy or a statement of business ethics. This document requires disclosure of any actual, potential or perceived conflicts of interest. In addition, the ICAC website[33] contains advice on dealing with Conflicts of Interests (COIs). It states: “Your suppliers are entitled to act commercially, however, they should be required to disclose and properly manage any COI that could impact on their performance.”

A best practice approach is to ensure that technical expert(s) each sign a written statement declaring that they have no actual, potential or perceived conflicts of interest; or they declare in writing any conflicts that may exist.

How much will an expert cost?

A report from an independent expert assessing the wear levels, current and potential carrying capacity for natural turf fields is usually less than 5% of the cost to implement major works for a natural turf field. By engaging an appropriately qualified, independent expert these costs are easily recovered by:

- avoiding major works (e.g. automatic irrigation, slit drainage or reconstructing a field) when the field will perform with minor works (Figure 13.5)
- avoiding the cost of converting the field to synthetic when a best practice natural turf field will perform well
- avoiding fundamental errors such as using the wrong turf cultivar or importing unsuitable soil
- avoiding the costs of rework by recommending the appropriate works sequence.

The expert should quantify the effect of the works on field condition, carrying capacity, drought resilience, and provide cost estimates to perform each work activity.

Figure 13.5: This field looked like it needed reconstruction (left), but by implementing about $7,000 of works it improved dramatically and easily handled the next winter sport season (right).

CHAPTER 14: DEVELOPING AN INTEGRATED STRATEGY

There are many elements that need to be pulled together in developing an integrated sports strategy (Figure 14.1) Developing a holistic and integrated sports strategy involves:

- using independent, technical expertise to (Chapter 13):
  - compare wear levels and carrying capacity at each site (or a representative portfolio)
  - identify the works and costs to increase carrying capacity so all fields can handle the current and projected wear levels
- mitigating the risks and impacts of drought on sporting fields
- fitting within the available resources (e.g. budgets, maintenance personnel, water)
- ensuring sporting fields meet best practice benchmarks
- collaborating with internal and external stakeholders and the community
- aligning with organisational goals, such as sustainability and social inclusion objectives.

In this chapter we explore the elements above, with budgets discussed in Chapter 15.

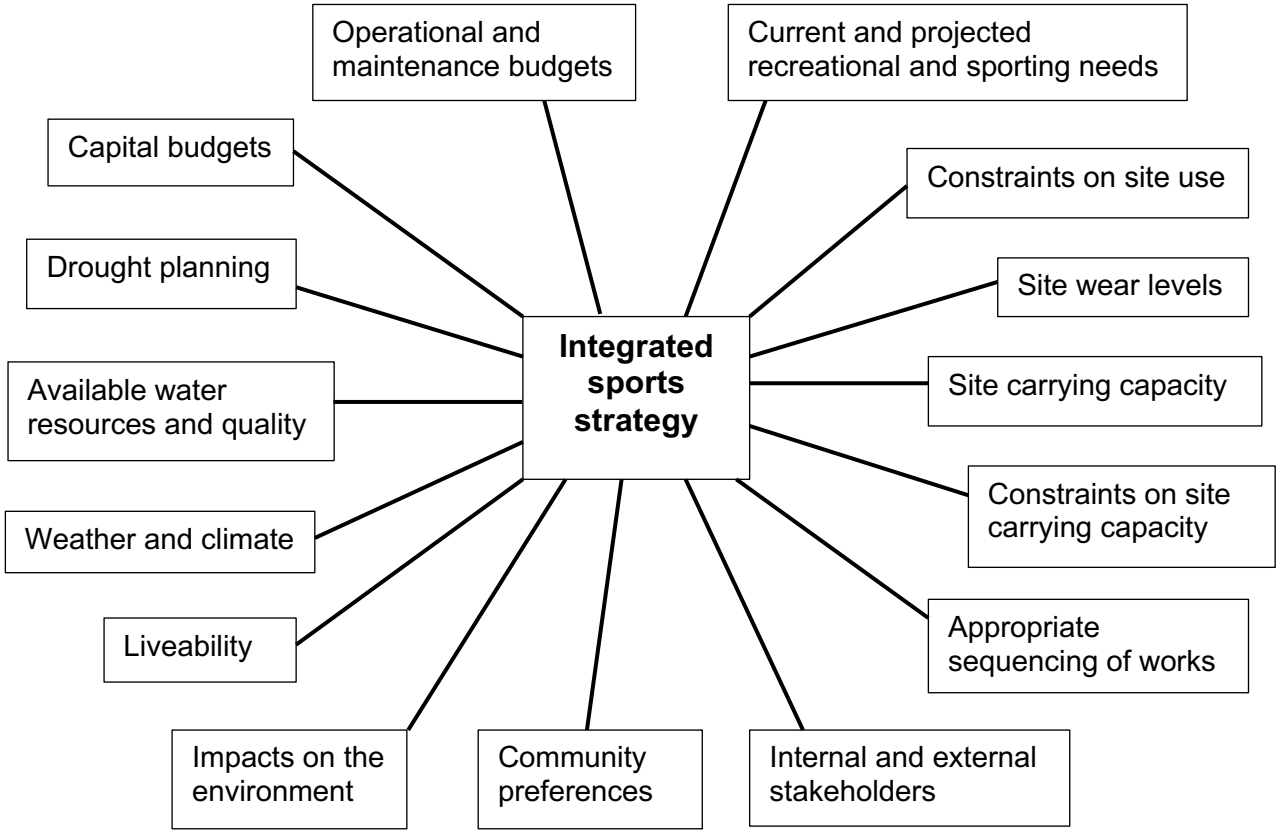

Figure 14.1 Conceptual diagram of the many elements to be considered in an integrated sports strategy. For greenfield sites, the existing site wear levels and carrying capacity will need to be replaced with projected values. The overall levels of wear and carrying capacity for a portfolio of fields should be aggregated from wear levels and carrying capacity at individual sites.

Identifying sites with carrying capacity constraints

As described in Chapter 13, building a sports strategy on sound science requires engaging an independent technical expert with appropriate skills to determine wear levels, current carrying capacity and amended carrying capacity for each site (or a representative portfolio of fields).

Comparing wear with carrying capacity

The findings of the site investigations by the natural turf expert should identify:

- sites with spare capacity and the number of additional players these fields could handle
- sites that have wear levels exceeding the current carrying capacity along with:
    - an estimate of the maximum carrying capacity that could be achieved if the site was amended according to best practice
    - a description of the works needed (and an estimated cost) to amend each site according to best practice.

Direct comparisons can also be made with standards so each site can be identified as having low, medium, high or extreme levels of wear (Figure 14.2). The comparison should also consider future increases in wear levels from population growth, increased sport participation and/or facility upgrades (e.g. lighting, amenities, parking).

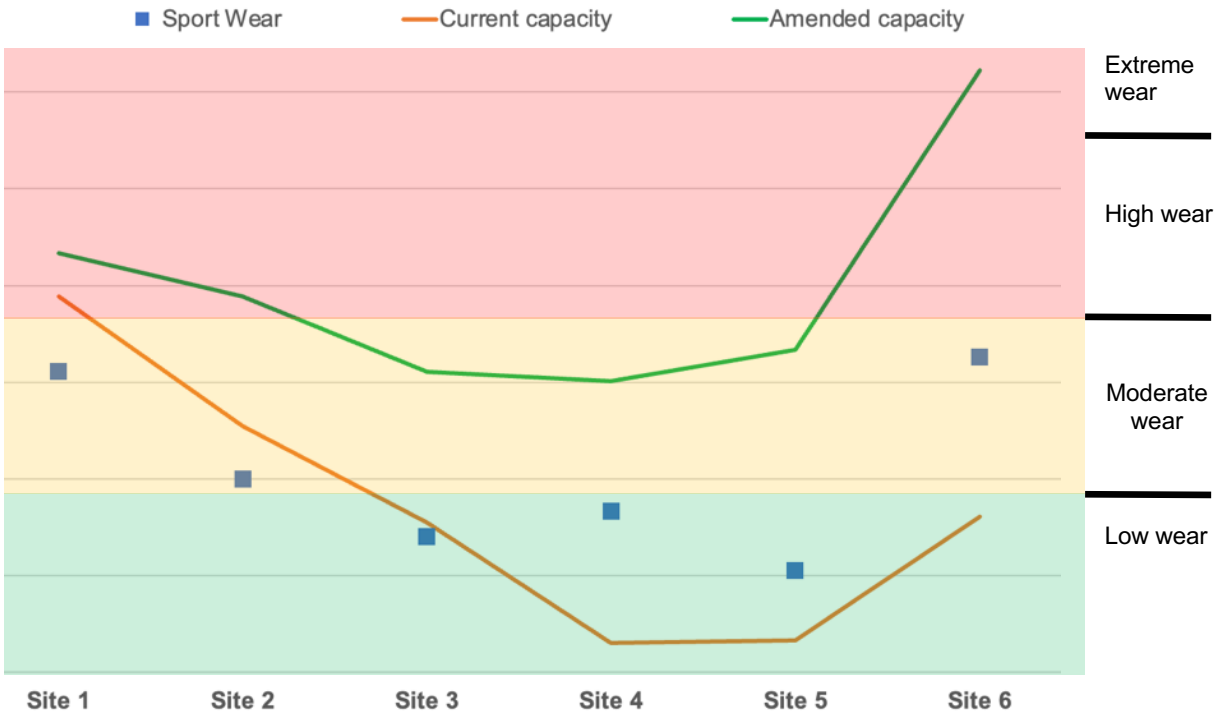

Figure 14.2 Plot of sport wear levels relative to carrying capacity for 6 sites (AgEnviro Solutions, 2020). Three of these sites are likely to struggle because sport wear levels (blue squares) are higher than their current carrying capacity (orange line). All fields could handle their current wear levels if amended to best practice (green line). The variation in best practice carrying capacity between the sites is due to differences in the turf cultivar, soils, irrigation, microclimate, field size and other site-specific factors.

Addressing constraints on carrying capacity

Sites that have wear levels that exceed carrying capacity require intervention by either:

- reducing wear levels by moving some play to underutilised sites (or another field at the same site)
- improving the carrying capacity of these fields by implementing works that would address the constraints imposed by soil, drainage, turf cultivar, irrigation, etc.

The cost of implementing these options should be identified for each site, with an example provided in Table 14.1.

Table 14.1: Example of how player numbers, carrying capacity and amendment costs to achieve best practice benchmarks can be displayed. Highlighting shows those fields that are overused (red) or prone to waterlogging (blue).

Site	Winter Players	Current Capacity (players/wk)	Amended Capacity (players/wk)	Cost to achieve best practice
Field A	320	220	360	$190,000
Field B	250	50	390	$300,000
Field C	400	600	800	$130,000
Field D	90	130	230	$100,000
Field E	60	230	230	Nil
			Total	**$720,000**

Addressing other constraints on sports field use

The amount of use an individual sports field currently receives, as well as the amount of wear, can be limited by factors other than the playing surface. This includes but is not limited to:

- inadequate lighting (either poor coverage and/or inadequate illumination)
- inadequate amenities and/or changing facilities
- lack of car parking
- site safety, e.g. located in an area where it is only safe to use in daylight hours
- location of the site relative to the population base (e.g. in an isolated location)
- booking limits imposed by the managing authority (e.g. Council)
- weather conditions e.g. daytime temperatures mean synthetic turf fields get too hot for use during the day or torrential rain means a natural turf may not be useable during the downpour. Individual weather events, such as local flooding or lightning can also reduce field availability regardless of construction type
- field condition, for example, the field is in poor condition so people don't want to use it (by contrast a field in good condition means more people will want to use it).

Best practice sports planning involves considering the impact of off-field works on field wear levels and ensuring the field and supporting infrastructure has sufficient carrying capacity to handle the increased play. As such, maximising the investment in a high carrying capacity turf field may require additional investment in other facilities that would otherwise restrict play.

Mitigating the risks and impact of drought on sporting fields

Risk to sporting fields

Preparing for and managing drought is an element that has not traditionally been considered in sports planning. However, drought represents a major risk to sports strategies, especially if:

- potable water use for irrigation is reduced or limited by water restrictions
- quantities of non-potable water (groundwater, recycled water, stormwater) decline during the drought which typically has a major impact on stormwater availability
- non-potable water quality declines during the drought to an extent to which it impacts on soil and turf health and/or field carrying capacity.

Best practice strategic sports planning involves considering how drought may impact on the availability and carrying capacity of sports fields (Figure 14.3). It also involves identifying specific mitigation and turf management actions that are required to minimise the risks of ground closures and turf loss.

The cost for replacing turf (without any additional works) is about $60,000 to $90,000 per hectare (ex GST). This cost estimate doesn't include losses incurred by the club/users as games and training would have to move to alternative venues while the ground was restored.

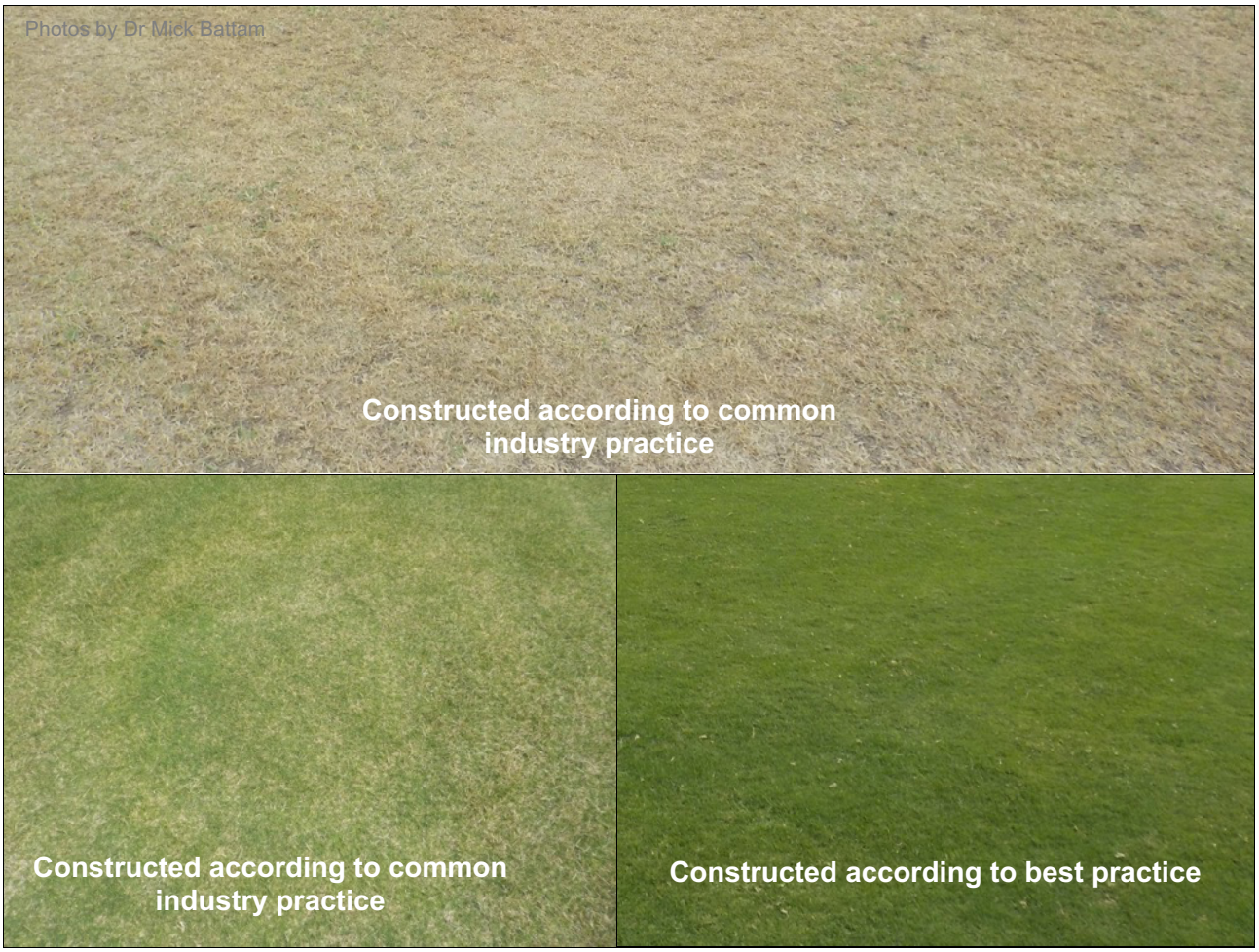

Figure 14.3: There were major differences in the performance of these 3 fields during the 2019-20 drought when level 1 water restrictions were in force. The upper field would struggle to handle any play, with complete turf loss likely under Level 3 restrictions. During severe water restrictions, the field constructed according to best practice (lower right) has 3 times the carrying capacity than the field built using common industry practice (lower left).

Preparing for drought

Drought management plans, strategies and actions will vary across the Lower Hunter depending on local factors, such as the location of, and access to, non-potable water sources. Some of the key elements of drought planning include identifying and documenting the:

- vulnerability of individual sites to drought (loss of carrying capacity and condition), and the consequences (e.g. displacement of players, loss of turf)
- location, availability, suitability, risks and likely cost of non-potable water, both on a permanent and temporary basis (e.g. piped connection or tankering)
- watering requirements for individual sites under severe water restrictions and the carrying capacity obtained
- priority sites for maintaining service delivery (e.g. regional facilities)
- potential location of any drought hubs (i.e. aligning non-potable water sources with available facilities, carrying capacity and likely players numbers)
- number of drought hubs required to cater for sporting needs across the council area
- investment required to address drought carrying capacity shortfalls or create each drought hub (e.g. soil amendment, turf variety, irrigation, non-potable water, water treatment)
- drought specific turf management actions (e.g. use of wetting agents, growth regulators, mowing heights etc) as well as foot traffic management (e.g. limits to training/ground usage, relocating training activities)

Understanding these factors will enable any identified shortfalls in carrying capacity to be addressed in the sports strategy before the drought occurs (Figure 14.4).

Figure 14.4: The percentage of fields that can handle current levels of wear in a study of ~90 fields in the Lower Hunter. Under current conditions just over half can handle current wear levels, but this falls to ~40% under more severe water restrictions. By contrast, fields constructed and maintained to best practice can handle the wear levels they receive. This is sustained even under severe drought and water restrictions.

Selecting appropriate sports field construction methods

Sporting fields should not be constructed using a “recipe”. Instead, the design should encapsulate wear levels, availability of water, weather, construction and maintenance budgets.

Type of field

Sport wear levels and climate conditions often place limits on the type of field that can be constructed at a site. As a general guide for the Lower Hunter:

- elite sand-based fields (typically stadium fields):
  - drain very rapidly but can only handle about 100-150 players per week
  - if wear exceeds carrying capacity, then patching with turf grown on reinforced sand will be required, costing ~$150/m^2. If time permits, washed turf can be used ~$15-$20/m^2
  - have limited drought resilience, so are dependent on a reliable water supply
  - require specialist expertise and equipment with large budgets for maintenance
- soil based sporting fields constructed according to best practice:
  - can handle more than 400 adult players per week during the winter sport season or can be maintained to a regional level standard with fewer players and a modest maintenance budget
  - depending on the site conditions, if constructed correctly, these fields can drain within 30 minutes to a few hours after significant rain
  - a well-constructed, well-draining natural field is a true all-weather surface
- synthetic fields:
  - can handle high wear if the synthetic grass is replaced every 5 to 10 years. (~$450,000/ha). The exact timeframe will depend on wear levels with specialist advice required to determine the expected lifespan for a given level of wear. This is crucial for the business case and allocating budgets
  - surface temperatures can become very high. Synthetics with:
    - white infill: above 50°C when the air temperature is 25°C. At temperatures of 30°C or more, the synthetic turf can exceed 70°C (Figure 14.5).
    - black rubber infill: 88°C was recorded on a 28°C day (Nine News Sydney 11/2/22).
  - As synthetic fields get very hot, they are limited by hot weather. They are also poorly suited to sites that host daytime summer sports such as cricket.

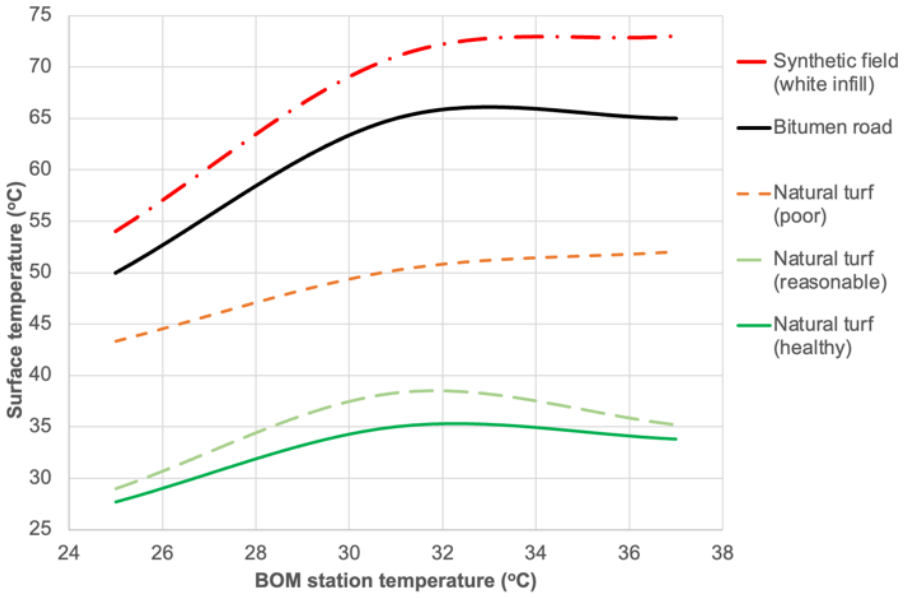

Figure 14.5: Impact of air temperature on the surface temperature of sporting fields at Bernie Mullane Sports Complex Kellyville (AgEnviro Solutions). The infill material on the synthetic field is a translucent colour (black rubber would be hotter), yet it was consistently hotter than the road in full sun.

Elite soil-based fields

Some Councils have sought to construct facilities with the aim of attracting matches for national competitions (e.g. NRL, A-League, Big Bash, Super Rugby). Engineered sand profiles (or USGA profiles) found in stadiums require specialist skills and equipment for maintenance and an extensive maintenance budget. Furthermore, they require a secure and consistent water supply as they have little drought resilience. Therefore, USGA profiles are not recommended for sporting fields outside the top tier stadiums.

Elite soil-based fields are a viable alternative to USGA profiles for Councils looking to construct facilities to attract matches for national competitions. There are many examples of elite sporting fields that have been constructed using soil (as distinct from sand). Some of these fields routinely host NRL and A-League games such as Jubilee Stadium (St George Dragons).

Available water supply

Councils' sustainability goals, water availability and reliability may all have a major effect on the type of sporting field that can be constructed at a site. The amount of water required will depend on several factors, such as: soil profile, turf cultivar, foot traffic, irrigation system efficiency, weather conditions and irrigation management practices to name a few. The independent expert should provide detailed information on the water requirements for the proposed field to ensure the design fits within the available water resources, councils' sustainability goals as well as construction and maintenance budgets.

Detailed water balance modelling is often required to determine the reliability of an intermittent water sources such as stormwater. If non-potable water sources are being considered, then water quality will also need to be examined during the planning stage (Chapter 10).

Figure 14.6: Constructed with a sand-based mix, this field struggled greatly in the 2019/2020 drought even though it was being watered twice a week. The turf on this field may not have survived had level 2 restrictions been implemented earlier in the drought. In contrast, the field constructed according to best practice continued to thrive during water restrictions (insert).

Sufficient capital and operational budget

Regardless of the type of sporting field that is constructed it is essential there is adequate budget to construct and maintain the field in accordance with best practice or problems will occur. For natural turf fields, some of the issues can include:

- **failing to fully amend the soil**: can reduce the carrying capacity of the field by more than 50% and often results in the construction of fields that remain dangerously hard for much of the year
- **building a field using sand-based growing media (e.g. 80:20):** can increase the irrigation requirements by more than 30% and significantly reduce the carrying capacity and drought resilience
- **using an inferior turf cultivar:** can reduce the carrying capacity by more than 50%. In high wear sporting fields this can result in the turf being destroyed in a single football season
- **laying turf with soil attached over a sand profile:** will result in the surface remaining soft for extended periods of time, with the soil highly prone to becoming water repellent.

The suitability of the existing site soil for reuse should be verified by a Certified Professional Soil Scientist during the planning stage as it will have a significant impact on the project costs.

Failing to maintain the field (e.g. adequate fertiliser or weed control) can have devastating impacts on carrying capacity, turf performance, community amenity and service delivery. Therefore, it is vital to ensure that field maintenance requirements and budgets are aligned. Maintenance practices are described in Book 7.

Capital and operating budgets are discussed further in Chapter 15.

Figure 14.7: Less than four years after construction, this field has thin turf and bare ground in low wear areas. The soil was not fully amended and an inferior turf cultivar was used.

Prioritising and sequencing works

Prioritising works

The prioritisation of works across sites will involve a range of factors, including, technical, social, environmental, financial and political elements. Using metrics to compare options for a site (and across different sites) is a means of providing transparency and clarity to the decision-making process. Examples of potential metrics include:

- unit gain in wear levels or carrying capacity (player numbers or equivalent games of adult soccer) per $100,000 spent (lifecycle costs)
    - use the gain in wear levels for off-field works (e.g. lighting or amenity upgrades) that utilise already available carrying capacity to increase the amount of play
    - use the gain in carrying capacity to compare on-field works that increase carrying capacity (e.g. soil amendment, turf changes, irrigation, drainage, synthetic field)
- water use (or demand) per unit of carrying capacity (e.g. kL/player).

These example metrics provide a means to filter potential projects into broad groups based on the relative benefit delivered for the money spent (e.g. high/medium/low). The final prioritisation of projects will depend on other factors such as: available funds, community views and the required works sequence etc. Failing to use metrics can result in large capital investments for minimal gains in carrying capacity (Figure 14.8).

Figure 14.8: The upper field was incorrectly identified in the sport strategy as “heavily overused” due to blanket bookings. In the lower field, failure to use metrics to compare options for increasing carrying capacity resulted in the implementation of one of the least cost-effective options to increase carrying capacity.

[1] In these cases, the additional capacity encompasses more than the carrying capacity of the surface – it considers how much capacity can be easily used (i.e. is readily available). The readily available capacity is limited by factors such as game scheduling logistics, parking, lighting, amenities and location.

Sequencing the works

The sequencing and prioritisation of works will vary, depending on site specific issues and constraints. However, the following principles apply:

- if site constraints mean off-field works (e.g. lighting upgrades) may result in damage to the playing surface (e.g. cranes moving across the field), then the off-field works should be completed before major works on the playing surface (underground services should be routed around the field perimeter, not through the field)
- address the causes rather than symptoms of poor turf performance and carrying capacity
- understand whether an automatic irrigation system is the best option (see Questions and Answers section for case studies). Many fields in the Lower Hunter with low levels of wear do not need an automatic irrigation system if the soils and turf are amended to best practice. Travelling irrigators can be used for the soil amendment and turf works
- understanding whether the viability of works at one site is contingent on another project. For example, importing topsoil is relatively expensive. Hence, combining the amendment works on a site with minimal topsoil with those on a site with surplus topsoil could reduce costs
- where budgets are limiting, liaise with the independent specialist on options to adjust the scale/scope of works that won't severely compromise future works
- undertake works on the playing field that enhance or facilitate subsequent works rather than making them more expensive. The available funds will dictate whether multiple works can be done at once or need to be sequenced over time. The following sequence of works is suggested as a guide:
    - prevent surface water from running onto the field
    - if it is required, install an automatic irrigation system (either first or as part of the soil amendment and turf project)
    - undertake soil amendment and turf works. If the soil amendment and turfing needs to be split, liaise with the independent expert as to which should be done first. There is no hard and fast rule as every site and situation is different
    - install slit drainage (if it is required).

Figure 14.9: Slit drainage was installed in this field which needed the soil amended and the turf cultivar changed to handle the current usage levels. By performing these works in the wrong order, more funds will be needed to reinstate the slit drainage which will be buried during the soil and turf works.

Collaborate with stakeholders

Effective implementation of the sports strategy and delivery of best practice sporting fields relies on collaboration across internal and external stakeholders. For example:

- project management teams must ensure the projects and those undertaking the construction works are effectively managed and deliver fields built to best practice
- maintenance teams require adequate personnel, resources, budget and training to maintain the fields
- users and clubs spread will benefit from spreading wear evenly across the site and avoiding unnecessary damage
- the strategy contains practical measures to deliver on wider responsibilities and goals, such as environmental sustainability, social inclusion and financially responsible expenditure.

It is recommended that proposed approaches and measures be workshopped with stakeholders (including public forums) throughout the development of the strategy. This includes key service providers such as water utilities.

Develop a holistic renovation and capital works program

Once the approach needed to amend each sporting field has been identified, the independent technical expert will be able to provide cost estimates for amending:

- overused sporting fields so they can handle their current wear levels
- remaining fields so they can meet the acceptable standards for playing fields (Chapter 3).

The timeframe needed to perform these amendment works on all playing fields can be calculated based on the size of the existing operational and capital budgets. Council and the independent technical expert can then work together to examine the priorities, budgets and timeframes to ascertain, what, if any changes need to be made to these elements. This may require identifying and allowing for performing interim works to ensure those fields that will not be immediately amended can continue to be played on in the short term (Figure 14.10).

Figure 14.10: Parbury Oval at Swansea would ideally be reconstructed, but major improvements were achieved in the short term by topdressing with a suitable soil amender and aerating. Interim works such as these are often needed on fields that may not be reconstructed for several years.

CHAPTER 15: BUDGET REQUIREMENTS FOR BEST PRACTICE SPORTS FIELDS

Before proceeding with any irrigation, drainage or sports field construction/reconstruction project it is vital to ensure there is sufficient budget for the works. Furthermore, it is critical that there is enough operational budget for ongoing maintenance of the field (e.g. fertiliser, aeration, weed control) and to keep the irrigation system in full working order. Budget is also required for the water usage charges incurred.

Irrigation capital and operating budgets

Irrigation capital costs

Contrary to popular belief, automatic irrigation systems are not cheap, and just because they "work", doesn't mean they are efficient or effective. The base cost for a reasonable sports field irrigation system is at least $50,000 (ex GST) per hectare. This cost is for the "field" components only and does NOT include professional design or utility fees, headworks and water supply items such as the irrigation controller, sensors, tanks, pumps, pump sheds, filters, water meter upgrades, backflow prevention, electrical works and the like. The cost of these items will vary significantly depending on individual site requirements but can easily add up to around $60,000 or more if large tanks, pumps and water supply upgrades are needed.

Irrigation maintenance costs

For ongoing system maintenance, about $3,500 to $4,000 (ex GST) per year (on average) is required for each sports field irrigation system. Slightly higher amounts may be needed for larger systems that cover 3 or more fields. This covers routine maintenance items such as regular inspections, raising/adjusting sprinklers as required and replacement of components (e.g. sprinklers, sensors etc) as needed.

Water costs

Organisations have different ways of managing water usage charges for sports fields and open space turf. This will affect how funds are made available to cover the water costs from irrigation.

For potable water, the current charges for water usage can be obtained from Hunter Water's website and when combined with anticipated water demand (refer to best practice benchmarks in Book 1), it is possible to determine the budgetary impact of the irrigation system. For non-potable water sources, any water usage charges can be obtained from the supplier.

Field drainage capital and operating budgets

Field drainage capital costs

The costs to improve the drainage of the field will depend on the works required (e.g. dish drains) and their scale. In the event a slit drainage system is required, then cost for a sports field slit drainage system can range from $50,000-$100,000 (ex GST) per hectare. The costs will vary depending on the size and length of main line (or collector) pipes and the spacing between slits (or laterals). The closer the spacing, the higher the cost. Furthermore, if the site does not have sufficient elevation for the drainage water to discharge to the stormwater system, then additional budget will be needed for a pump out tank and pump (cost ~$10,000-$20,000 ex GST).

The project budget also needs to allow for design fees to ensure the system is designed to best practice. Design and construct drainage systems have not consistently demonstrated capacity to meet best practice. For example, there are some design and construct drainage systems that only remove excess water from the field at about 2mm per hour due to the mainline being undersized.

Drainage maintenance costs

Regular cleaning of dish drains can be undertaken by club volunteers or alternatively, Council staff during quieter periods. For slit drainage systems, the infiltration rate of the sand slits will decline over time. This can be addressed by re-grooving of sand slits to remove the top layer of old material and replace it with new sand. It is important to note that in new slit drainage systems, the design capacity is usually limited by the discharge capacity of the pipes, not the infiltration rate of the sand slits.

Sand grooving does not need to be undertaken routinely at set time periods (e.g. 6 years), but only when the limitations of the slit drainage system are affecting the ability of the field to return to play within best practice benchmarks. Testing of 13 slit drainage systems in the Lower Hunter found significant variation in the performance of the slit drainage systems over time. Therefore, it is recommended that the infiltration rate on slit drain system be tested at regular intervals after installation (e.g. 3, 5, 7 and 10 years), to determine performance trends and when sand grooving may be needed.

The indicative cost for sand grooving is around $15-20,000 per hectare.

Sports field construction and maintenance budgets

Sports field construction costs

The exact costs to construct/reconstruct a field will vary substantially depending on site conditions. Importing soil can add substantial amounts to project costs. The independent expert will be able to provide cost estimates for the recommended works for each field.

The construction costs for USGA sand profiles (also termed engineered sand profiles or reinforced sand profiles) and synthetic fields are often well above the budgets available for Councils in the Lower Hunter. For example, the costs for:

- elite fields (major stadium) are ~$1.8 million per hectare for a new site with a reinforced sand profile over a gravel base (Graeme Logan, pers comm). The cost to replace the entire soil profile and returf the MCG in 2014 was around $850,000/ha,[34].(roughly equivalent to ~$1.0 million/ha in 2021 after adjusting for construction industry cost increases).
- synthetic fields: ~$1.7 million per hectare (NSW Football Synthetic Fields Guide, 2017)[35]. This rises to ~$2.1 million per hectare when adjusted to reflect construction industry cost increases between 2017 and December 2021

The indicative costs for construction/reconstruction of fields (excluding irrigation and intense drainage) that may reasonably be considered for community facilities in the Lower Hunter are:

- sandy profile (similar to 80:20): ~$590,000 per hectare for a sandy profile over a clay base
- best practice soil profile field: ~$340,000 per hectare
- traditional industry construction with limited carrying capacity: ~$250,000 per hectare

For greenfield sites, there are a number of other additional costs that are likely to be incurred, including, but not limited to: engineering and other professional fees, field lighting, amenities, electrical, water and sewer services and civil works (e.g. site clearing, earthworks).

Figure 15.1 graphically compares indicative capital costs for reconstruction options (including irrigation and drainage) for a poorly performing site (~1.5 hectares). The costs assume no site-specific constraints or risks that significantly escalate construction costs (e.g. contaminated soil, flooding, heritage etc).

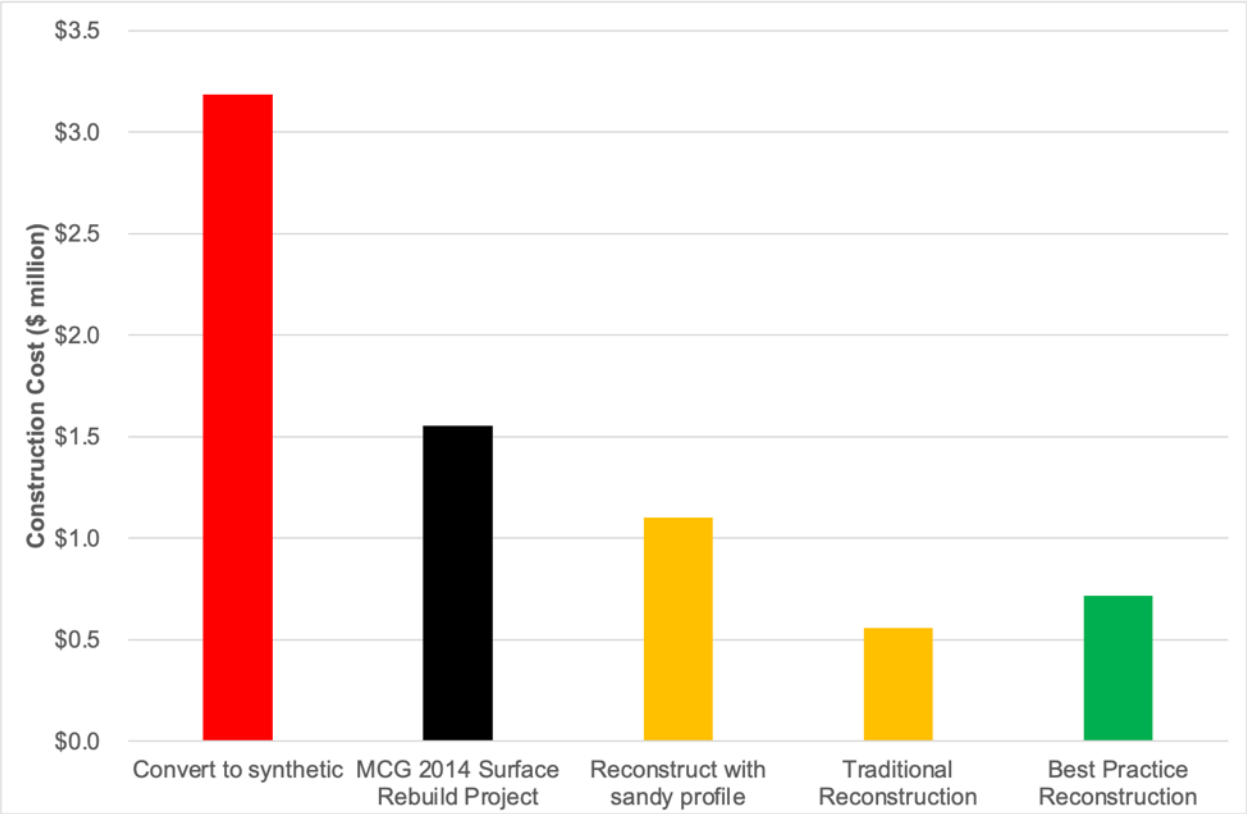

Figure 15.1 Comparison of indicative reconstruction costs (including irrigation and drainage) for a poorly performing site of 1.5 hectares (~ 2 soccer fields side by side). MCG comparison provided for illustrative purposes. All costs have been adjusted to reflect cost escalation between when cost data was published and December 2021.

Sports field maintenance costs

Regardless of construction type, all fields will deteriorate unless they receive adequate maintenance. Maintenance activities are covered in detail in Book 7, but include: mowing, growth regulators, weed and pest control, aeration, fertiliser, and wetting agents. Turf patching is a commonly undertaken maintenance activity, but when fields are constructed according to best practice this activity is rarely needed, especially if clubs do not train in the game day goal areas.

The maintenance requirements for reinforced sand profiles and synthetic fields are often well above the available financial resources for Councils in the Lower Hunter. For example:

- reinforced sand profile fields can have maintenance costs above $600,000 per hectare per year, with re-turfing the entire surface potentially costing over $1 million each time. Furthermore, specialist machinery is needed, and this can cost upwards of $400,000 (Graeme Logan, pers comm)
- synthetic fields have typical maintenance costs of $23,000 to $37,000 per hectare per year, depending on the level of use (figures from 2017 NSW Football Synthetic Fields Guide[35] and adjusted for construction industry cost increases from 2017 to 2021). Additional funding of around $63,000 per hectare per year will be required for major works to the surface and shockpad (about every 7-10 years and every 20 years respectively). The exact timeframe will depend on wear levels with specialist advice required to determine the expected lifespan for a given level of wear. This is crucial for allocating budgets.

The indicative annual costs ($/ha) for different types of turf fields in the Lower Hunter are presented in Table 15.1. The costs will vary between Councils due to different internal structures and methods for allocating costs.

Table 15.1: Indicative annual maintenance costs (per hectare) for turf fields in the Lower Hunter (Peak Water Consulting).

Site Category	Mowing	Water Charges	Irrigation Maintenance	Turf Maintenance
Unirrigated Fields				
Best practice	$3,700	N/A	N/A	$4,000
Traditional build or current conditions	$3,700	N/A	N/A	$8,100
Irrigated fields				
Low wear – Best practice	$4,700	$4,500	$3,500	$5,300
Low wear – Traditional build or current conditions	$4,700	$5,300	$3,500	$10,600
Moderate wear – Best practice	$4,700	$5,000	$3,500	$6,300
Mod. wear – Traditional build or current conditions	$4,700	$5,800	$3,500	$12,600
High wear – Best practice	$4,700	$5,500	$3,500	$7,900
High wear – Traditional build or current conditions	These fields typically perform so poorly that they require reconstruction every 1 to 4 years			
Sandy profile over a clay base (limited capacity to handle wear)	$4,700	$6,300	$3,500	$11,500

Table Notes:

- Costs are based on using internal resources. Costs are substantially higher when using external resources
- Mowing costs are based on fortnightly mows for rainfed fields except during winter (monthly) and weekly mows for irrigated fields in summer, fortnightly in autumn and spring and monthly in winter
- Turf maintenance activities include pest and weed control, fertilisers, aeration, plant growth regulators (for irrigated fields only), wetting agents and turf patching (only on moderate/high wear fields with unamended soil)
- Due to the hard setting nature of the soils, frequent (monthly) aeration is required where the soils haven't been amended to best practice. This is needed to limit surface hardness to reasonable levels. When resources such as labour, budgets and machinery are constrained, this routinely doesn't occur, so the fields are often very hard and carrying capacity is significantly reduced

Lifecycle costs

Natural turf sporting fields require ongoing maintenance such as mowing, fertilising, aeration, spraying, irrigation, topdressing, etc. The cost to perform these maintenance activities over a 20-year period was combined with the construction costs, allowing the lifecycle costs to be determined for sporting fields reconstructed by importing sand, traditional and best practice methods (Figure 15.2).

Synthetic fields also require maintenance activities be performed such as (NSW Football Synthetic Fields Guide)[35]:

- regular grooming to ensure the pile remains upright
- regular cleaning
- algaecide/weedicide application
- replacement of the synthetic surface every 10 years, but this may need to occur more frequently (e.g. 5-7 years) on fields with higher levels of wear
- replacement of the underlying shock pad every 20 years. This may need to occur more frequently with higher levels of wear, with the shock pad on a synthetic field located on the northern beaches of Sydney being replaced after 9 years.

Independent written advice should be sought from synthetic turf specialists on the expected reduction in the life of both the synthetic surface and shock pad with increasing wear levels.

Comparisons of lifecycle costs for different sporting field types are presented in Figure 15.2. This shows that the lifecycle costs for natural turf builds are lower than for synthetic. Furthermore, the lifecycle cost for a best practice turf field is lower than the alternatives, despite having a higher initial construction cost.

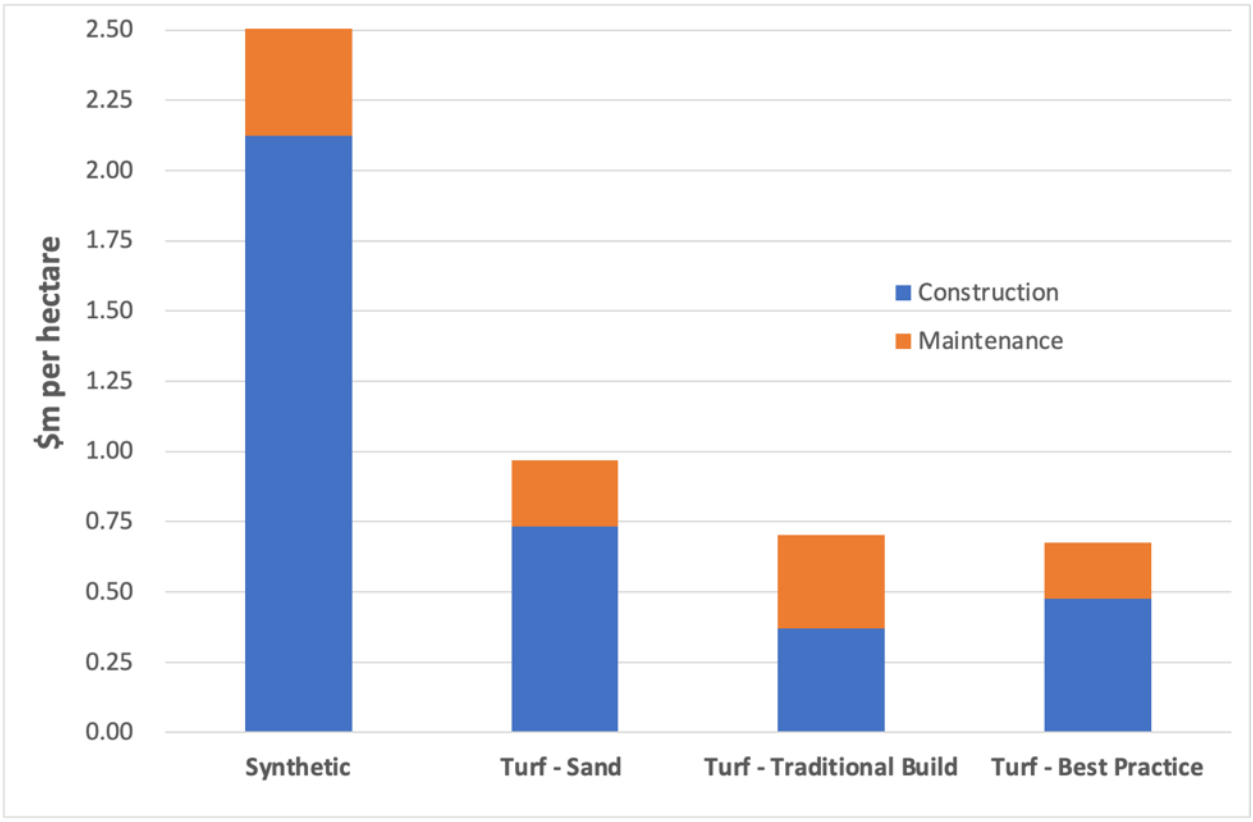

Figure 15.2: Lifecycle costs over 20 years for different types of sports field construction (Peak Water Consulting 2021)

Lifecycle costs versus carrying capacity

The lifecycle costs presented in Figure 15.2 are total costs only and do not consider differences in carrying capacity between the construction methods. The carrying capacity is a measure of the service that a sporting field provides to the community. To obtain a true comparison between construction methods, the lifecycle cost needs to be corrected for the expected carrying capacity. A plot of carrying capacity versus lifecycle cost is presented in Figure 15.3.

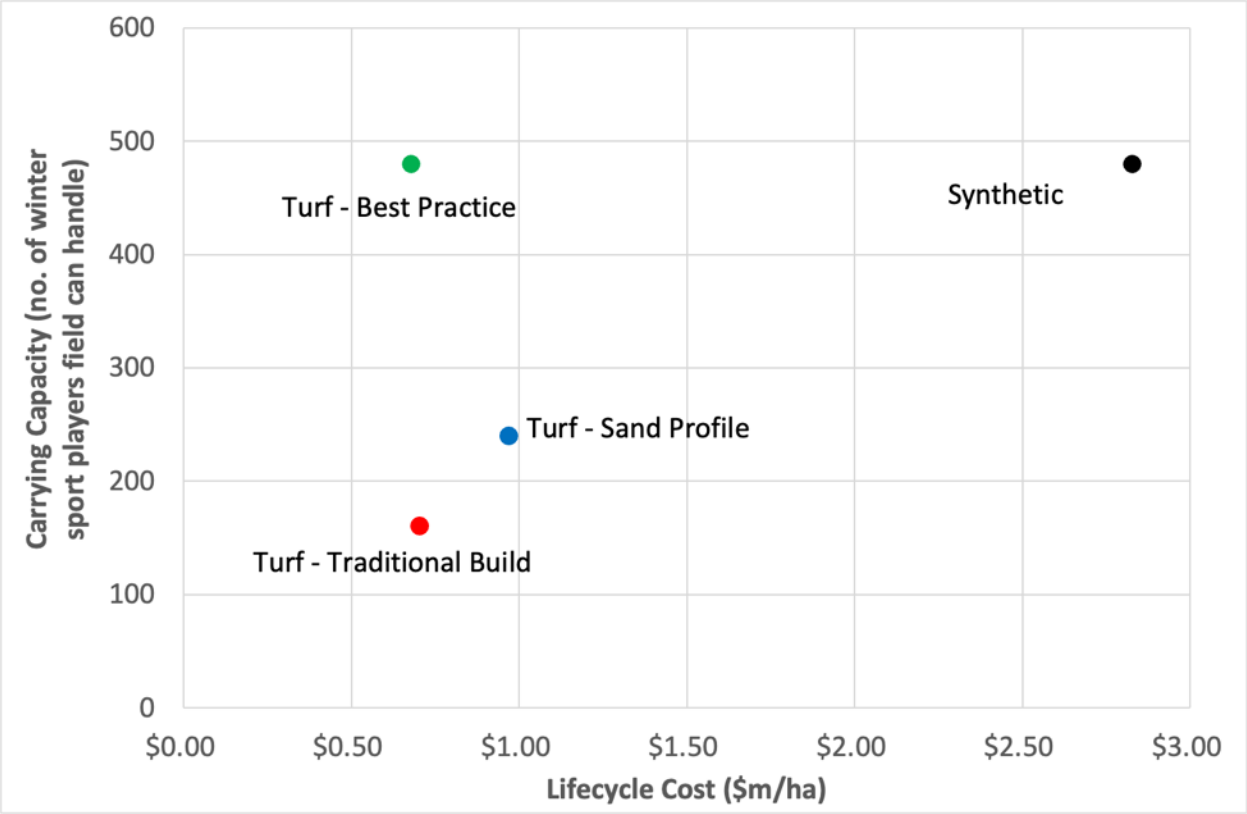

Figure 15.3: Comparison of carrying capacity and lifecycle costs over 20 years for different types of sports field construction (Peak Water Consulting 2021)

When the carrying capacity of each sporting field type is considered, the turf field built to best practice is at-least two to three times more cost effective than alternative options (Figure 15.4).

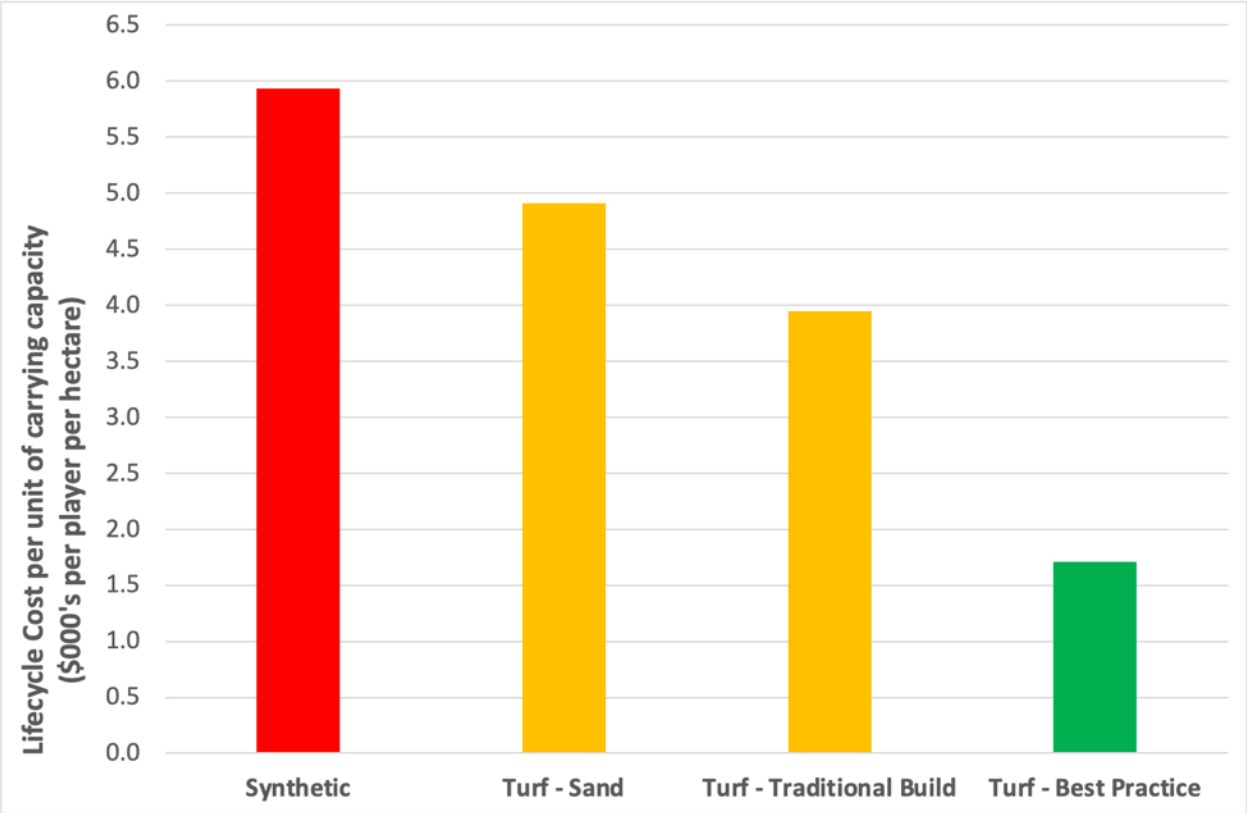

Figure 15.4: Lifecycle costs per unit of carrying capacity for different types of sports field construction (Peak Water Consulting 2021)

The analysis presented in Figures 15.3 and 15.4 is conservative, in that it has understated the carrying capacity of turf fields, as there are examples of natural turf fields in Sydney that are handling 500 to 800 players per week. These fields have survived without turf patching for 7 years. Additional factors which make the analysis conservative include:

- best practice natural turf fields could easily have a lifecycle that exceeds 20 years
- not all best practice natural turf fields require slit drainage systems, but the costs of slit drainage have been included in the analysis
- the business cases for synthetic turf can quote a carrying capacity of 60 hours of use per week which represents 8.5 hours of use every day of the year. These usage levels:
    - are not achieved on most sites as formal sport use is limited by work/school/sleep to ~46 hours per week (4:00pm to 9:30 pm on weeknights and 9 am to 5 pm on weekends)
    - would result in greater wear so the synthetic field would require greater maintenance (including patching) and shortened lifespan for components such as the surface and shock pad
    - don't account for the days in summer a synthetic surface could not be used due to heat levels (Figure 14.5).

No locally relevant published data could be found on the impacts of higher wear levels on the lifespan of synthetic fields. In conference presentations it has been stated that the lifespan of a synthetic surface would be around 5 to 7 years for fields receiving 60 hours per week of use. Obtaining documented evidence of the expected lifespan of the synthetic surface and the shock pad in relation to the expected wear levels is crucial for the business case and allocating budget.

It is clear from the analysis of lifecycle costs that constructing and maintaining a natural turf surface to best practice is by far the best value for money for community sporting fields.

QUESTIONS AND ANSWERS

What is the carrying capacity of natural turf?

Contrary to recent popular belief, the carrying capacity of a natural turf field is NOT 25 hours per week of use. A recent review identified the frequently cited material to support this common belief, which included (DPIE 2021)[32]:

- a study reporting usage levels on sporting fields in New Zealand (which then in turn also referenced a review from the USA which reported school sport field usage in the UK)
- material produced by synthetic turf specialists.

It is noteworthy that the cited material in this evidence base:

- reports data on the number of hours sporting fields were being used but provides no comment on whether these fields could handle higher levels of usage (see Chapter 13)
- does not have studies that are relevant to the climate conditions and turf species/cultivars used in large parts of NSW, including the Lower Hunter.

There are examples of natural turf fields in Sydney that have demonstrated an ability to meet best practice and handle high to extreme levels of wear. If it is properly managed, turf can recover from extreme levels of winter wear. This is because the turf regrows from underground stems (rhizomes). The same regrowth occurs on turf farms after harvest, when the entire grass surface and 5 to 15mm of soil is removed.

The characteristics of these fields are presented in Table A.1, which include:

- they are constructed from soil, not an engineered sand profile
- all fields have adequate topsoil depth and a wear tolerant turf cultivar
- they all have a rapid return to play after significant rain
- they are not oversown with ryegrass (only one field is oversown)
- only some have a slit drainage system
- most, but not all have an automatic irrigation system
- over half are in good condition in August, which is when natural turf fields will be at their worst.

Despite handling high to extreme levels of wear, most of the fields listed in Table A.1 are not receiving adequate maintenance. As such, they could perform better if more appropriate fertiliser and weed control practices were implemented.

Table A.1: Characteristics of 12 sporting fields that handle high or extreme levels of wear yet maintain acceptable turf cover and require minimal or no turf patching (Battam 2022)[31]

	Extreme wear ← → High Wear											
	Site											
Characteristic	1	2	3	4	5	6	7	8	9	10	11	12
Engineered sand profile (perched water table)	No	No	No	No	No	No	No	No	No	No	No	No
Soil profile - very sandy mix (50:50 to 80:20)	No	No	No	No	No	No	Yes	No	No	No	Yes	No
Soil profile – moderately sandy (but not sand)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Soil moderately friable (not heavily compacted)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Somewhat no	Yes	Yes	Yes	Yes
More than 200 mm of topsoil in all areas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Receives adequate fertiliser application	Somewhat yes	Somewhat no	Somewhat no	Somewhat yes	Somewhat yes	Yes	Somewhat no	Somewhat yes	Somewhat yes	Somewhat no	Somewhat yes	Somewhat yes
Soil has an acceptable nutrient holding capacity	Yes	Yes	Yes	Yes	Somewhat yes	Yes	Somewhat no	Yes	Yes	Yes	Yes	Yes
Soil has an acceptable balance of nutrients	Yes	Yes	Yes	Yes	Yes	Yes	Somewhat yes	Yes	Yes	Yes	Yes	Yes
Rapid return to play after moderate rain	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rapid return to play after extended rain	Yes	Yes	Somewhat yes	Somewhat yes	Yes	Somewhat yes	Yes	Yes	Somewhat yes	Yes	Yes	Yes
Has a slit drainage system	Yes	No	No	No	No	Yes	No	Yes	No	Yes	No	No
Has an automatic irrigation system	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Has a wear tolerant turf cultivar	Yes	Yes	Yes	Yes	Yes	Yes	Somewhat yes	Yes	Yes	Yes	Yes	Yes
Has low numbers of weeds	Yes	Yes	Somewhat yes	Yes	Yes	Yes	Yes	Somewhat no	Somewhat yes	Yes	Somewhat yes	Yes
Club spreads wear moderately evenly	Yes	Yes	Yes	Somewhat yes	Yes	Somewhat yes	Somewhat yes	No	Yes	Yes	Yes	Somewhat yes
Is the field oversown with ryegrass?	No	Yes	No	No	No	No	No	No	No	No	No	No
Is the field in good condition in August?	Somewhat no	Somewhat yes	Somewhat no	Yes	Yes	Yes	Somewhat yes	Somewhat yes	Yes	Yes	Yes	Yes
What could be done to improve field:	More fertiliser + primo	More fertiliser + primo	More fertiliser + primo	Spread wear evenly	Install irrigation	Spread wear + more slit drains	Amend soil + control weeds	Control weeds + spread wear evenly	Control weeds	More fertiliser	Control weeds	Spread wear evenly

Legend
- Yes
- Somewhat yes
- Somewhat no
- No

What is the relationship between booked hours and wear?

Booked hours versus usage hours

Many sports strategies are based on booked hours because this data is often readily available. However, booked hours often include so called 'blanket bookings', which are used to reserve the field, but embrace significantly longer periods than actual usage time. It is not uncommon for example for clubs to book a field from 7 am to 11 pm on weekends but play only occurs from 8 am to 5 pm.

A recent study conducted on more than 1,150 sporting fields across 24 councils in the Sydney Basin found booked hours of winter use were on average about 1.2-2.3 times higher than usage hours (Battam 2022)[31]. The difference was greatest for sporting fields in the western LGAs of Sydney (2.3 times higher on average) than the eastern LGAs (1.2 times higher on average).

What are the logistical limits on usage hours?

Irrespective of booked hours, life commitments (e.g work, school and sleep) result in formal winter sport typically being limited to ~46 hours per week within the following timeslots:

- Monday to Thursday from around 4:00 pm to 9:30 pm (5.5 hours per night)
- Friday night from around 5:00 pm to 10:00 pm (5 hours)
- Weekends from about 8:00 am to 5:00 pm (18 hours for the weekend, without night games)

A study of usage on more than 1,150 playing fields in the Sydney Basin found 99% of fields are likely receiving less than 46 hours per week of formal sport and/or school use (Battam 2022)[31].

A limited number of fields host school sport, athletics carnivals and PDHPE classes. This usage typically causes lower impact then formal sport as students often have running shoes instead of football boots. A very small number of fields host midweek lunchtime sports and/or are used daily for lunchtime/recess play by schools.

What do the logistical limits mean for player numbers?

The use of fields by clubs for a maximum of about 46 hours per week (as players are at school, work or sleeping), places limits on the number of players that can use a field. To host games over the weekend (8 am to 5 pm) and on Friday nights (5 to 10 pm), a full-sized soccer field has all timeslots filled by:

- ~ 11 games of adult soccer per weekend (allowing for half time and changeovers)
- ~ 350 players if the club consists solely of senior players
- ~ 650 players if the club has about two thirds of players less than 13 years of age.

The logistical limits on available times for organised sport would apply to all sporting fields (natural turf and synthetic). As such, a fully booked field for sporting use would have about 46 hours per week of actual formal sport bookings. These logistical limits can be used for validating booked hours, verifying claims on future usage and/or club growth and ascertaining potential demand/supply balances if fields were built to best practice.

Usage hours and wear

Sports field booking hours cannot reliably be used to predict wear. In addition to the impact of blanket booking, there are major differences in wear associated with sport code and age of players. For example, there are very different wear levels associated with one hour of:

- rugby league training by 18 junior players (one team training on the field)
- soccer training by 30 adults (two teams training on a field at the same time)

A comparison of 152 playing fields in the eastern LGA areas of the Sydney basin found 5-6 fold variations in wear levels for the same number of booked hours. This variation occurred whether the facility was booked for 5-10 hours per week or 45-50 hours per week (Figure A.2).

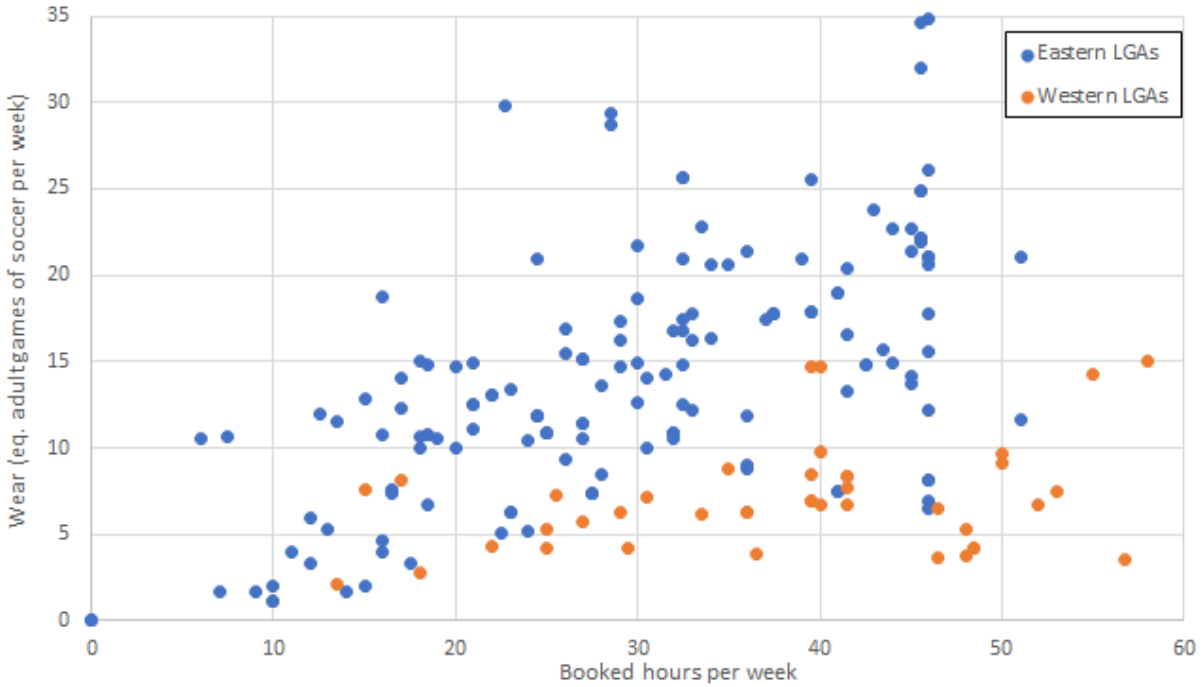

Figure A.2: Comparison of wear levels and booked hours for 193 playing fields in the Sydney Basin (Battam 2022)[31]. The 5-fold variation in wear levels for a given number of booked hours demonstrates the poor correlation between booked hours and wear. Note: sites with multiple fields may appear as one dot.

The evidence shows that there is no meaningful relationship between booked hours and wear. Therefore, data on booked hours should not be used in sports strategies.

Why is my sporting field struggling? What do I do?

Fields deteriorate when the wear greatly exceeds the carrying capacity. Given that 77% of fields in the Lower Hunter are receiving low levels of wear, it is clear from the poor condition of many fields, that factors other than wear (from sport) are limiting turf growth.

In the Lower Hunter, natural turf fields constructed to best practice can often handle more than 400 adult players training and playing games on a single football field each week during the winter sport season. As such, if the site is receiving lower wear levels, then it might be struggling due to one or more of the following common problems (based on an assessment of 256 playing fields unless noted):

- micronutrient deficiency (80% of 46 fields)
- macronutrient deficiency (63% of 46 fields)
- compaction (54% of fields)
- weeds (51% of fields)
- water repellency (46% of fields)
- waterlogging (34% of fields), see Figure A.3
- lack of topsoil depth (34% of fields), see Figure A.4
- soil layering (27% of fields).

Consider whether these factors are contributing to poor turf performance on your playing field, with relevant information on each of these topics provided elsewhere in the guidelines. Keep in mind that most sites will have multiple issues and that an independent expert should be engaged to provide advice for any works that are likely to cost more than $10,000 to implement. Where multiple problems exist, an integrated approach will be needed to address all causes, as fixing one issue and ignoring others may result in minimal improvement.

By addressing these issues, excellent turf cover can often be achieved. Talk to council and/or seek independent advice to ensure that projects on your site are consistent with best practice.

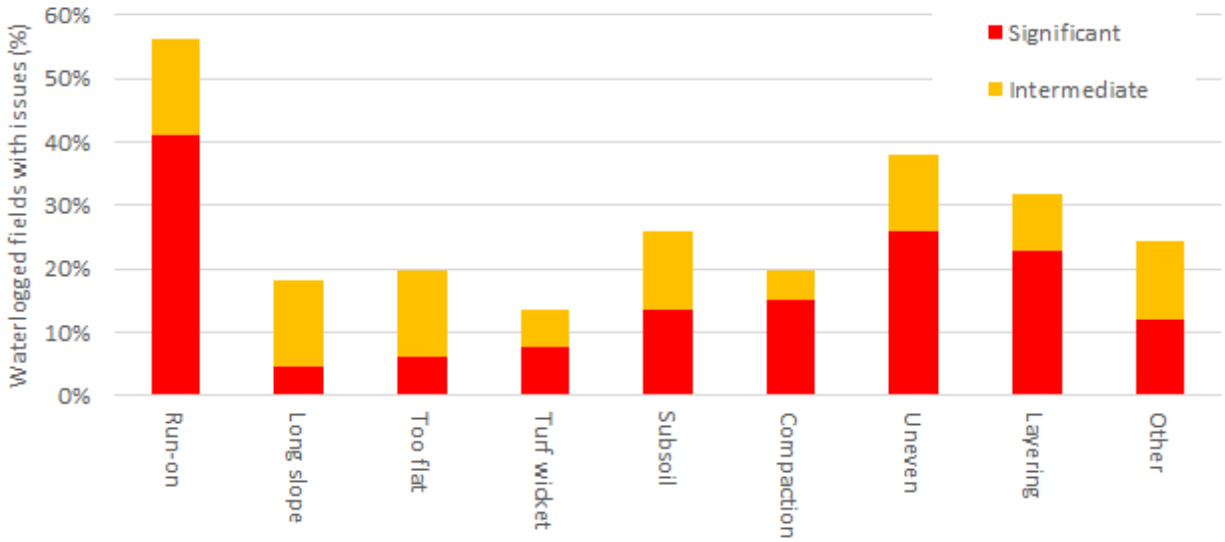

Figure A.3: Causes of waterlogging on fields in the Lower Hunter where it is a significant problem, with most sites having multiple issues.

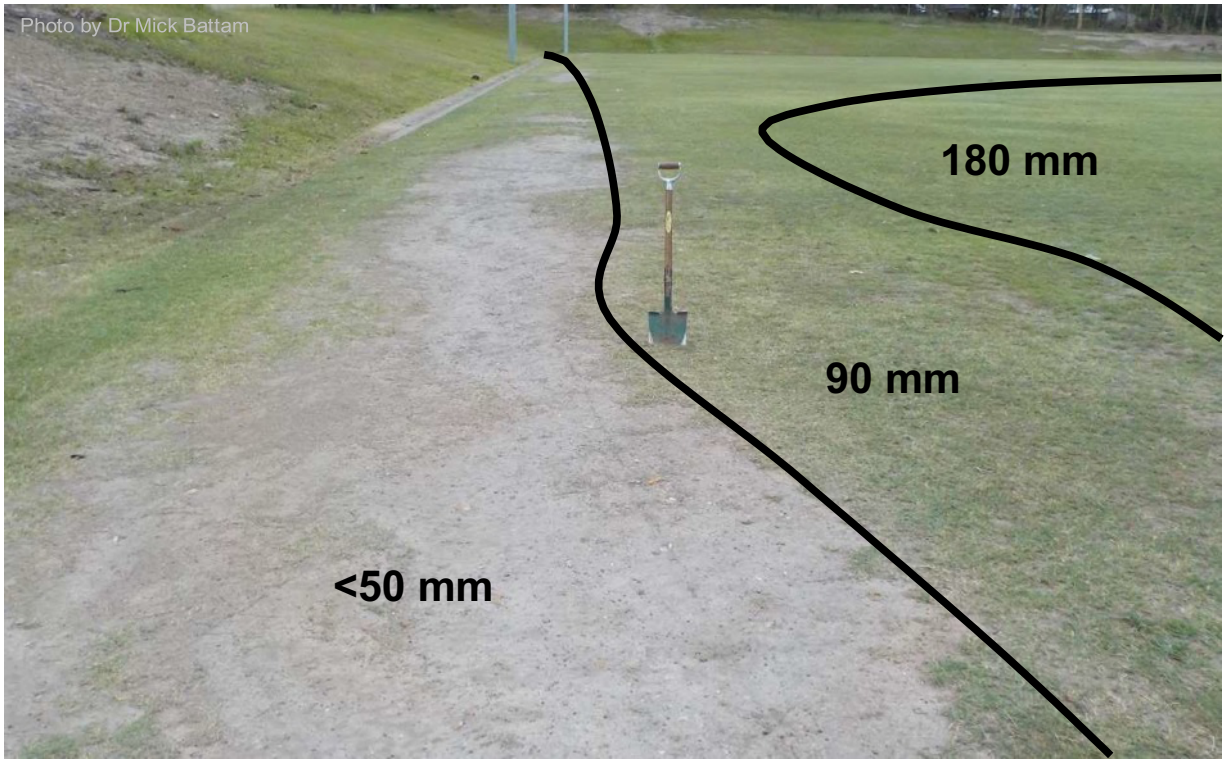

Figure A.4: The effect of topsoil depth on turf performance. Until the topsoil depth is increased this field will continue to struggle. This site also requires weed control and the hard setting nature of the soil to be addressed in order to represent best practice.

How do I manage my field during drought?

During a drought it can be expected that Hunter Water may place limits on the amount of water that can be applied to open space turf areas. Ideally, councils will have identified reliable alternatives to potable water for use on as many sites as possible so there is minimal impact during water restrictions. Other techniques that can be implemented to minimise the impact of drought and water restrictions are discussed below.

Ensure fields are built correctly

Sporting fields built according to best practice with low levels of wear, can remain in acceptable condition using minimal supplementary irrigation. In a study of ~90 sporting fields in the Lower Hunter it was found that the carrying capacity could be massively increased and the impact of water restrictions minimised by amending fields according to best practice (Figure A.5). This is consistent with field observations, where many unirrigated, low wear sporting fields routinely survive hot summers whilst maintaining acceptable turf cover.

Figure A.5: Impact of water restrictions on the carrying capacity of ~90 sporting fields in the Lower Hunter (AgEnviro Solutions, 2020). The total collective carrying capacity and player numbers are shown. The collective capacity is aggregated from each site based on individual site parameters and management such as sporting code, player age distribution, wear and turf management practices etc

Ensure the fields are maintained correctly

Sporting fields that are poorly maintained will often struggle during mild weather conditions but deteriorate significantly when water is limiting. This is especially true of fields that receive:

- inadequate compaction control: more than half of the fields in the Lower Hunter require very frequent aeration (3 to 12 times per year). This is due to lack of soil amendment during construction
- inadequate weed control: these fields not only decline in the heat, but when relieving rain arrives the annual weeds can often outgrow the turf. During winter these annual weeds die

(complete their lifecycle) and leave gaps in the turf during the football season, only to return in the spring
- inadequate water repellency control: not only do these fields dry out, but they struggle to capture any rain that falls, with the water either running off or only wetting small sections of the field.

It costs significantly more to maintain poorly constructed sporting fields, but councils seldom have budgets to perform these works fully. As such, the users of these poorly constructed fields often end up playing on surfaces that are extremely hard (with the associated risks to player safety) and have thin turf cover, with the carrying capacity of these fields rapidly declining when water is limiting (Figure A.5).

Develop and implement a drought plan

During a drought, sporting fields are more vulnerable to wear damage, especially if they have not recovered from the previous winter sport season. Councils should develop drought management plans that can be implemented during water restrictions. These should include measures that minimise the damage to the playing fields whilst maximising sport usage such as:

- ensuring key sites have non-potable water sources so the irrigation of these sites is not affected by water restrictions. Keep in mind that stormwater is also likely to be limited during the drought
- being aware of the carrying capacity of each sporting field during different levels of water restrictions (Figure A.3). Sites that are likely to struggle to handle their current usage levels can be protected from major damage by:
    - identifying alternatives to potable water for use at the site
    - reconstructing the field according to best practice so the impact of water restrictions is minimised
    - moving some play (e.g. training) to other nearby sites that have been set up so they can handle higher levels of usage e.g. larger site that has been reconstructed according to best practice and/or is irrigated with non-potable water
    - insisting the training be performed in joggers instead of football boots

Other measures that should be implemented during the drought include mowing the turf a little higher, applying wetting agents so rain capture is maximised and ensuring weeds are kept under control so that only the turf is utilising any relieving rain that falls.

Does my field need an irrigation system?

When confronted with a poorly performing turf field, the common response is to assume that the field will get better with more water. However, as outlined earlier in the section, “Why is my turf struggling?”, the turf can be struggling for a multitude of reasons, and very few of them relate to applied water.

There are numerous examples of fields in the Lower Hunter that do not have an automatic irrigation system and have excellent turf cover (one example is in Figure A.6). However, most of these fields are receiving low levels of winter wear.

Figure A.6: Excellent turf cover on Keith Barry no. 2 field, only 3 months after drought when less than 6 mm rain fell in a 70-day period. This field has no automatic irrigation system.

Generally, an automatic irrigation system is required for fields with:

- moderate, high or extreme levels of wear
- specific requirements for playing surface outcomes (e.g. regional or district level facilities)
- specialist areas within the field that require specific management (e.g. curation of turf cricket wicket tables). In this circumstance, an automatic irrigation system may be warranted for the specialist area, but not for the entire field.

To determine whether an automatic irrigation system is really needed at a site, a thorough, independent analysis is required for the field, its soils, turf, wear levels and carrying capacity.

The following sections give two examples of “local level” playing fields which currently do not have an automatic irrigation system.

Case Study 1: Gregory Park

Gregory Park at West Wallsend consists of two full sized soccer fields. Like 77% of fields in the Lower Hunter, the site receives low levels of wear with less than 175 players per field, training and playing each week during the soccer season. The soil is hard setting and has low levels of fertility, making it difficult to grow turf and greatly limiting the number of players the site can handle. As such, the fields struggle.

At first glance most people would assume the site should have irrigation and slit drainage installed. However, this would not address the underlying issues limiting turf growth, so the fields would likely continue to not be able to handle the current usage levels (Figure A.7). By contrast, amending the soil and converting the field to a wear tolerant turf cultivar would greatly increase the number of players the site could handle. This would even apply during level 3 water restrictions, when no irrigation is permitted with potable water (Figure A.5).

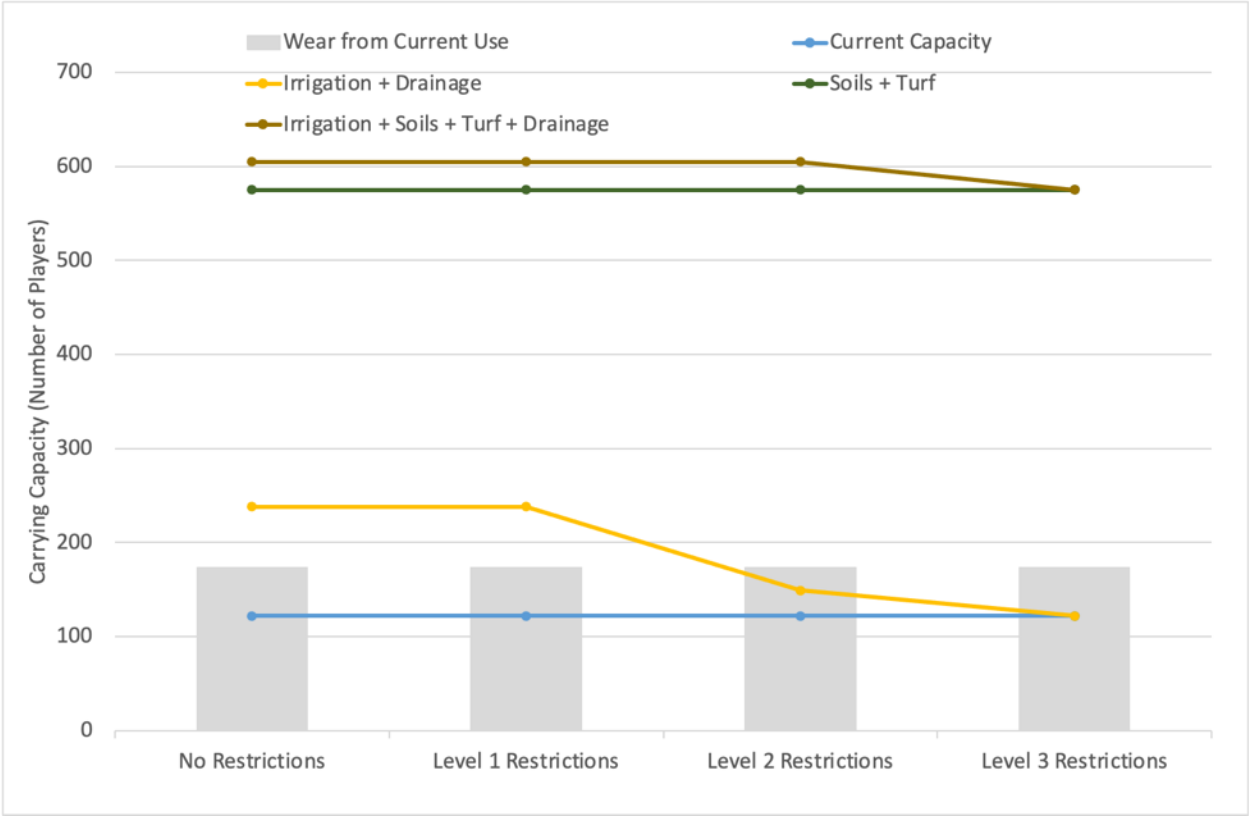

Figure A.7: Comparison of wear, carrying capacity and improvement options for Gregory Park, West Wallsend under varying levels of water availability/restrictions (Peak Water Consulting 2021).

The economic analysis (Figure A.8) shows that the soil amendment and turf option gives a far greater increase in carrying capacity for each $100,000 spent (lifecycle costs). This improvement holds even under severe (level 2 and level 3) water restrictions. By comparison, the investment in irrigation and drainage yields little gain in carrying capacity when water availability is reduced. Instead of using the budget to install irrigation and drainage, this money would be better spent amending the soil and converting the field to a more wear tolerant turf cultivar. (Figure A.8).

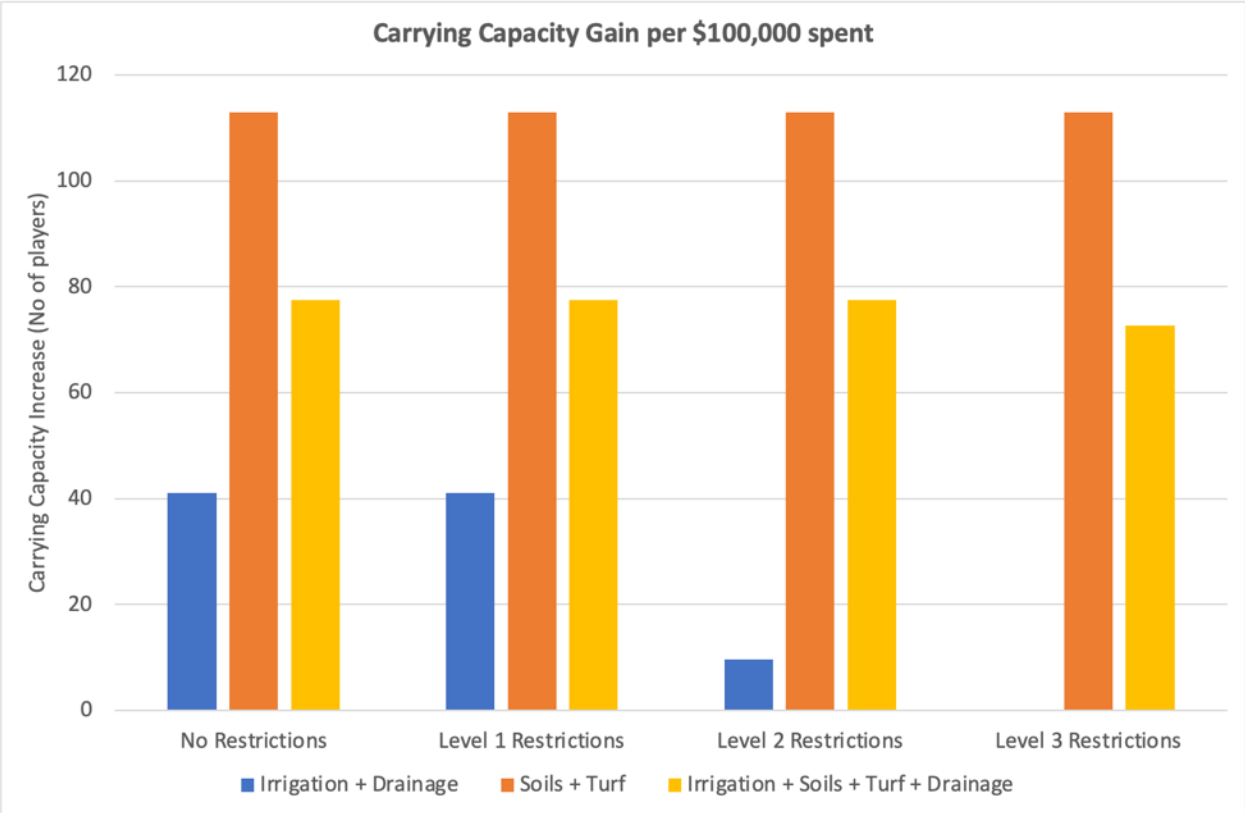

Figure A.8: Comparison of carrying capacity benefits against lifecycle costs for different improvement options for Gregory Park West Wallsend (Peak Water Consulting 2021). The benefits of irrigation are very modest compared to soil and turf improvements. Furthermore, irrigation benefits reduce dramatically, especially for unamended soils under water restrictions (particularly level 2 and level 3 restrictions)

Case Study 2: Myamblah Crescent Reserve

Myamblah Crescent Reserve in Merewether consists of one full sized soccer field and a mini field. The site receives moderate levels of wear, with about 310 players training and playing on the fields each week during the soccer season. Over the past few years, areas of the field have been converted from kikuyu to various couch cultivars to increase the carrying capacity, but the site has hard-setting soil with low levels of fertility.

The analysis of carrying capacity shows that the current wear levels exceed the carrying capacity (Figure A.9). Either installing irrigation or the soil and turf amendment options would increase carrying capacity marginally above current wear. However, the benefits of irrigation (without soil amendment) are marginal under level 2 and level 3 water restrictions. Undertaking the irrigation, soil and turf works would elevate carrying capacity such that it can handle increases in wear from factors such as population growth and higher participation rates.

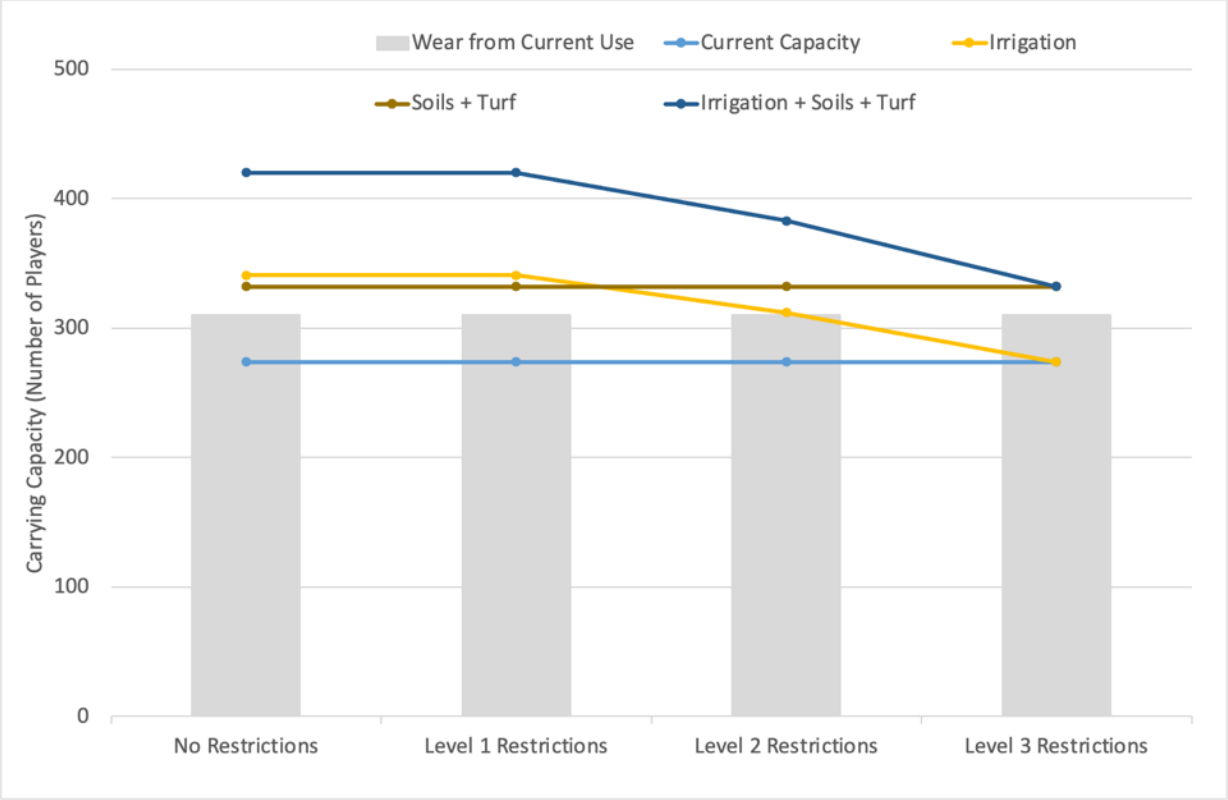

Figure A.9: Comparison of wear, carrying capacity and improvement options for Myamblah Crescent Reserve, Merewether under varying levels of water availability/restrictions (Peak Water Consulting 2021).

The economic analysis (Figure A.10) shows that once lifecycle costs are considered, under non-drought conditions, undertaking all the works (irrigation, soil and turf amendment) delivers the largest return (gain in carrying capacity) for each $100,000 spent (in lifecycle costs). The soil amendment and turf works are needed to sustain improvements in carrying capacity under drought conditions (level 2 and level 3 water restrictions).

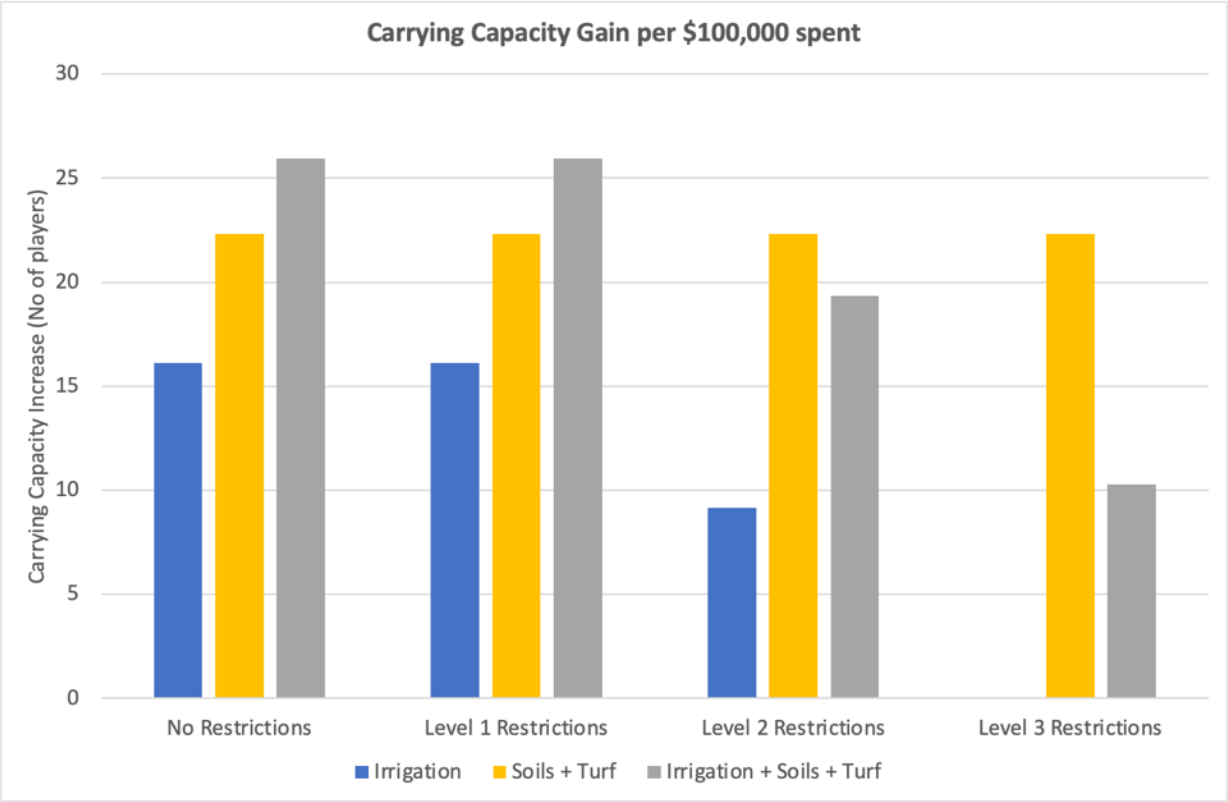

Figure A.10: Comparison of carrying capacity benefits against lifecycle costs for different improvement options for Myamblah Crescent Reserve, Myamblah (Peak Water Consulting 2021). An automatic irrigation system increases the benefits of the soil and turf amendment works, particularly when sufficient water is available (no water restrictions or level 1 restrictions)

BOOK 5 REFERENCES

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FIGURE AND TABLE CREDITS

Dr Mick Battam (AgEnviro Solutions): Figures P.1, 13.1, 13.2, 13.3, 13.4, 13.5, 14.2, 14.3, 14.5, 14.6, 14.7, 14.8, 14.9, 14.10, A.1, A.2, A.3, A.4, A.5, A.6. Tables 14.1, A.1,

Dr Paul Lamble (Peak Water Consulting): Cover photo, Figures 14.1, 14.7, 15.1, 15.2, 15.3, 15.4, A.7, A.8, A.9, A.10. Table 15.1.

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