ATTACHMENT D

END OF LIFE OPTIONS FOR ARTIFICIAL TURF SYSTEMS

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1 INTRODUCTION

Published data suggests artificial turf systems have a lifespan of 8-10 years[1] however informal surveys of Lower Mainland operations staff indicate most fields are replaced 10-12 years after installation. After that, the end of life options for artificial turf and infill materials is an ongoing discussion for municipal park operators. The emerging trend in British Columbia is to remove the infill for re-use and ship the turf to a recycling facility in Asia. The facility is certified by the Geneva, Switzerland-based International Organisation for Standardization (ISO), and meets the US Environmental Protection Act's Resource Conservation and Recovery Act with regards to waste. At the facility, the turf fibres are separated from the backing materials and are processed into small pellets or beads and incorporated into other manufactured products including plastic lumber, irrigation pipe, various household products, and other materials. A third-party certification is provided at the conclusion of this process. A new turf recycling facility is scheduled to open in California in 2020, thus eliminating the need to ship the material overseas. The infill material is either re-used in the replacement field or reclaimed – the end use is dependent on infill type. This appendix aims to provide an overview of what is currently done in the industry worldwide and discusses benefits and challenges associated with end of life options for ATF systems. Understanding these options can help guide the design process for Artificial Turf Fields (ATF) toward a more sustainable product.

2 OVERVIEW

The average turf field is approximately 106m x 71m and weighs around 36kg per m^2.[2] The total weight can be up to 400 000 lbs. of infill and 40 000 lbs. of turf.[3] This is a significant amount of potential waste and highlights the importance of understanding the end of life options for these materials.

One way to reduce the potential end of life waste is to use a shock pad as less infill is needed. While only 39% of fields globally have a shock pad[4], over the last 5 years the majority of fields installed in South Western British Columbia included a shock pad.

What is the turf made of? A report by Eunomia Research and Consulting Ltd. explains "The turf pile itself is usually made from polyethylene (PE) with a primary backing material of polypropylene (PP) that provides the structure and spacing that the pile is woven into. A secondary backing of a liquid polyurethane (PU) or latex is applied and allowed to set in order to bind the pile to the backing." The fact that it is comprised of many different plastics makes it difficult to recycle and this results in it being used for lower grade applications.[5]

Currently, artificial turf follows an open loop recycling system where the next use is a different one.[6] Ideally, a closed loop system is better (which means turf can be used to make more turf). But the turf fibers are made of so many types of plastic and no current technology exists that can separate it perfectly. FIFA states that more support from manufacturers is needed for closed loop recycling to be a

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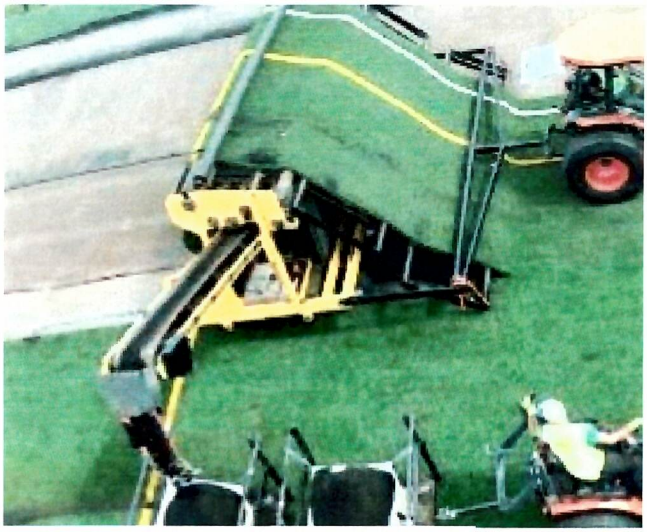
[1] P5 - Synthetic Turf Council. "A Guideline to Recycle, Reuse, Repurpose and Remove Synthetic Turf Systems." October 2017
[2] P8 – Eunomia Research and Consulting Ltd. for FIFA "Environmental Impact Study on Artificial Football Turf", March 2017
[3] P3 - Synthetic Turf Council. "A Guideline to Recycle, Reuse, Repurpose and Remove Synthetic Turf Systems." October 2017
[4] P9 – Eunomia Research and Consulting Ltd. for FIFA "Environmental Impact Study on Artificial Football Turf", March 2017
[5] P15 – Eunomia Research and Consulting Ltd. for FIFA "Environmental Impact Study on Artificial Football Turf", March 2017
[6] P15 – Eunomia Research and Consulting Ltd. for FIFA "Environmental Impact Study on Artificial Football Turf", March 2017

viable option. Some innovation has happened on the turf backing material – the 'hot melt' process binds the fibers and may be melted away when recycling; but this hasn't been done in practice yet.

When it comes to removal, there are machines that can cut the turf, roll it up and remove infill at the same time.

Issues that arise when removing infill include the sand and rubber particles being difficult to separate from each other, even with machines.[7] It may be hard to find industries that could use the mixture. There can also be contamination issues with debris.



Turf removal & infill harvesting machine

3 WHAT ARE THE END-OF-LIFE OPTIONS FOR ARTIFICIAL TURF SYSTEMS?

- Recycling (Processed into material that is used in new products)
- Re-use (Used again, for the same function)
- Disposal at a landfill

E-layers are not currently being recycled or re-used but this may be a possibility in the future.[8] Not having any former experience or examples to refer to is a potential barrier.

3.1 What influences the selection of an option?

- Total cost of that option
- Testing
- Logistics (i.e. storage, handling of material)
- Distance to facility and shipping costs
- Time required for that option
- Local laws (i.e. How strict the rules are for disposing of waste)
- Available technology for recycling
- Finding a buyer for the end material
- Common practices/cultural acceptance
- Carbon footprint

[7] P14 – Eunomia Research and Consulting Ltd. for FIFA "Environmental Impact Study on Artificial Football Turf", March 2017

[8] P11 - Synthetic Turf Council. "A Guideline to Recycle, Reuse, Repurpose and Remove Synthetic Turf Systems." October 2017.

3.2 Descriptions, Pros and Cons of each option:

3.2.1 Recycling

- Artificial turf is currently shipped overseas and turned into plastic pellets that are used by various industries (such as plastic bags, road cones and rubber tiles)[9]
- Recycling requires a certain volume of turf to happen efficiently; the volume of turf sent overseas for recycling from British Columbia on an annual basis is small so there is no economy gained in combining shipments

Pros

- More cultural acceptable to recycle
- Reduces the total GHG emission attributable to an ATF over its lifecycle (GHG emissions to ship to an Asian recycling facility have not been calculated)

Cons

- No local (none in North America) recycling facilities so shipping costs are high
- Shipping turf to Asia increases GHG emissions and offsets reductions attributed to recycling

3.2.2 Re-Use

- ATF surfaces are very rarely re-used for their original purpose due to the difficulty in harvesting the carpet without any damage and limited interest in a degraded surface.
- In rare cases portions of a used ATF surface are re-used in alterative applications. ATF re-use may be feasible when the demand for a used ATF coincides with a turf replacement project.
- FIFA recommends leaving the shock pad in place for re-use when new turf is installed[10]. Shock pads are usually capable of being directly reused at least twice.[11]

Pros

- More culturally acceptable than disposal or recycling
- May reduce the total GHG emission attributable to an ATF over its lifecycle
- Provides a less costly artificial turf option for end users who cannot afford a new product

Cons

- If the turf would have otherwise been sent to a land fill re-use will increase the turf removal cost as it must be done with specialized equipment
- Re-use is dependent on finding a new user group which is not assured as 'second life' options for worn turf are limited
- When turf is re-used it is more likely to end up in the landfill after its second use. [12]

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[9] P6 - Synthetic Turf Council. "A Guideline to Recycle, Reuse, Repurpose and Remove Synthetic Turf Systems." October 2017.
[10] P2 - Synthetic Turf Council. "A Guideline to Recycle, Reuse, Repurpose and Remove Synthetic Turf Systems." October 2017.
[11] P11 - Synthetic Turf Council. "A Guideline to Recycle, Reuse, Repurpose and Remove Synthetic Turf Systems." October 2017.
[12] P15 - Synthetic Turf Council. "A Guideline to Recycle, Reuse, Repurpose and Remove Synthetic Turf Systems." October 2017.

3.2.3 *Disposal*

- Disposal of artificial turf, infill and shock pad at a landfill maybe an end-of-life option however, some local landfills may not accept an ATF so this option requires some investigation to be a consideration.
- Illegal dumping is an issue, and nothing can compete with it as it's very low cost. Education (of both the ATF owners and contractors) is the best way to lower the amount of illegal dumping. Contracts should include instructions for proper disposal.

Pros

- Least costly end-of-life option

Cons

- Not culturally acceptable in many municipalities
- Increases the GHG emissions attributable to an ATF over its lifecycle as compared to other end-of-life options
- Not a sustainable solution
- Can encourage illegal dumping particularly when there are no local options

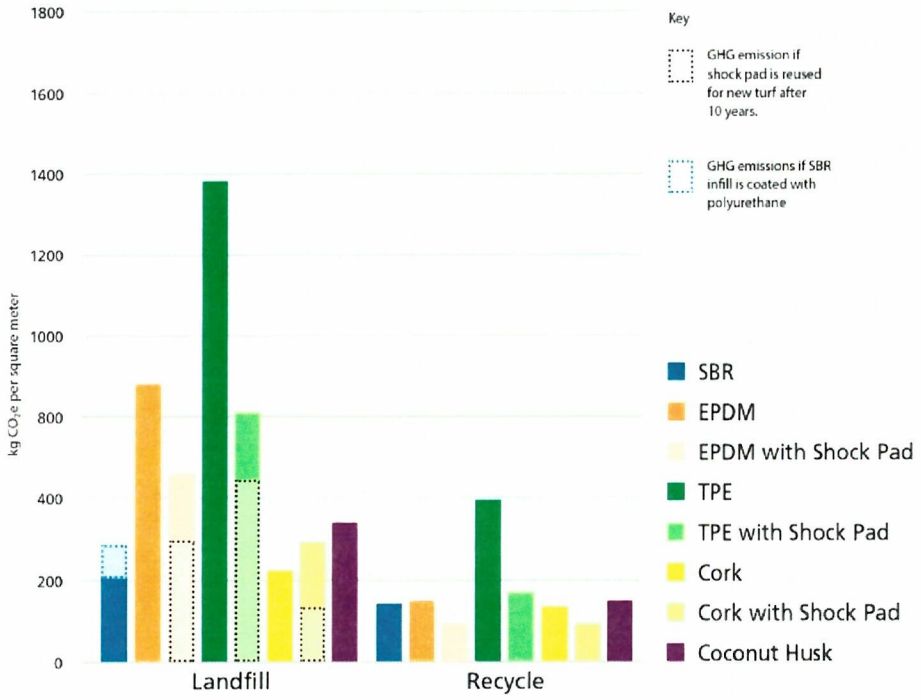
4 END OF LIFE CONSIDERATIONS FOR INFILL TYPES

Turf carpet products generally have similar properties, so none offer significant reductions in environmental impact over another. By contrast, turf infill products are manufactured from a variety of materials so the product that is selected can have a significant impact on the total greenhouse gas (GHG) emissions attributable to an ATF over its lifecycle. When selecting an infill product there are **two factors that influence the total GHG emissions of an ATF system; what it's made of and what the end of life options are for the product.** With these factors in mind an organic infill such as cork or walnut would intuitively be the low GHG choice. However, it cannot be re-used when the turf is replaced so a polymer infill such as TPE (with a shock pad) may have comparable GHG emissions when considering an ATF's full lifecycle because it can be re-used. The following are the key considerations in selecting an infill type.

4.1 Key considerations

- Virgin polymer infills have a larger environmental impact than (recycled) crumb rubber.
- Including a shock pad in the ATF surfacing system greatly reduces the lifecycle GHG emissions for virgin polymer infill materials because less infill material is required, and the shock pad can be re-used when the turf is replaced.
- Markets for recycled SBR rubber remain theoretical. If SBR rubber is not re-used in a replacement ATF it is likely to end up in a landfill.

- It is estimated that 1-4% of plastic infill is lost and replaced each year.[13] Effective controls can limit what leaves the facility to become microplastic pollution but some will still leave on clothing or field equipment, therefore selecting an organic infill is the only way to guarantee there is no microplastic pollution due to infill migration.
- SBR rubber and EPDM are thermoset plastic that cannot be melted into other products which limits recycling options compared to TPE which is a thermoplastic that can melted and re-melted as need[14].
- Organic infills have a smaller environmental impact than polymers however the gap is greatly reduced when polymer infills are re-used in the replacement field.
- For all infill types except for coconut husk and cork, recycling is the option with the lowest CO2 emissions. (These are the greenhouse gas emissions over the life of each product per square meter installed, including raw materials, manufacturing, transport and maintenance). The graph below shows a comparison between the different infill types, from page 10 of the *Environmental Impact Study on Artificial Football Turf*.



GHG Emission Comparison for Turf System with Different Infill Materials

The graph indicates that organic infills represent a significant reduction in lifecycle GHG emissions compared to polymer infill when the ATF is sent to a landfill. However, if the ATF is recycled at the end of its life the environmental impact will be similar regardless of the type of infill when a shock pad is used.

[13] P13 – Eunomia Research and Consulting Ltd. for FIFA "Environmental Impact Study on Artificial Football Turf", March 2017

[14] P9 – Eunomia Research and Consulting Ltd. for FIFA "Environmental Impact Study on Artificial Football Turf", March 2017

5 CONCLUSION

- **Specify a Shock Pad:** A shock pad is recommended regardless of the turf system as it reduces the quantity of infill that is required and when left in place for the replacement turf it further reduces the environmental impact of the ATF.

- **Recycle Turf:** While re-use of artificial turf would appear to offer the lowest environmental impact there is a lack of evidence that it occurs in any significant way. When turf is re-used it generally gets cut up and distributed for use in different applications. Once the turf reaches the end of its "second life" it is likely to end up in landfills due to cost and convenience. Therefore, it can be argued that in most cases recycling turf has a lower environmental impact and as such, is the recommended end-of-life option.

- **Re-Use Infill:** In a single use application organic infill options offer the lowest environmental impact. However, organic infills cannot be re-used and require more maintenance inputs than polymer infills. Therefore, a polymer infill which can be re-used represents similar lifecycle GHG emissions. With this in mind, re-usable polymer infills will be the practical choice for most ATF systems as their proven characteristics tip the scale in their favor.