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August 13, 2020

VIA EMAIL
Mr. Adam Turner
Martha's Vineyard Commission
P.O. Box 1447
Oak Bluffs, MA 02557

RE: Environmental Performance Review of the proposed athletic field improvements at the Martha's Vineyard Regional High School (MVRHS)- FINAL

Dear Mr. Turner:

The Horsley Witten Group, Inc. (HW) is pleased to submit this peer review of the MVRHS track and field improvements. The proposed project includes the installation of a multi-purpose synthetic turf field with a new running track, grandstand and press box, fieldhouse, storage building, modifications to an existing parking lot, as well as the realignment and renovation of a natural grass soccer field. This is the first phase of more extensive athletic facility improvements initially described in the February 2019 master plan. The MVRHS athletic field site is located along the Edgartown-Vineyard Haven Road corridor, within the Lagoon Pond and Sengekontacket Pond watersheds, in a Zone II groundwater protection district, and overlapping with BioMap2 Core Habitat. A Site Plan Review Application has been submitted to the Oak Bluffs Planning Board and a DRI application is currently under review by the MVC. The focus of our review is on the environmental performance of the Phase I project to evaluate: a) compliance of the proposed stormwater and wastewater management approach with local and state standards; b) the application of the latest principles and strategies of low impact development/green infrastructure; c) whether potential impacts to groundwater and other natural resources have been minimized; and d) if opportunities for improved environmental stewardship have been achieved.

Given the concerns with synthetic fields and the potential risks to human health (e.g., leaching of contaminants into groundwater, degradation of microplastics, and disinfection of bacteria and viruses), we evaluated the material specifications, relevant scientific literature, proposed product testing procedures, and industry-based disinfection guidance. Also, we are in the process of contacting several high schools in the region with similar synthetic athletic fields to gain insight on their decision-making process (going synthetic or remaining natural grass), the planning process, and operations and maintenance.

HW reviewed the following materials associated with the DRI application and the Oak Bluff's Planning Board Site Plan Review application for the proposed MVRHS athletic field improvement project:

From the Martha's Vineyard Commission "MVRHS Athletic Fields DRI application" page:

- "Amended Development of Regional Impact (DRI) Application" to the Martha's Vineyard Commission by Huntress Associates, dated January 24, 2020
- "Athletic Field Improvements - Phase One" by Huntress Associates, Inc. and others, dated January 22, 2020 and revised May 18, 2020
- "Cut/Fill" by Huntress Associates, Inc., dated March 28, 2020
- "Enlargement Plan Entry Plaza" by Huntress Associates, Inc., dated April 28, 2020
- "Sanitary Sewer Holding Tanks Site Plan" by Marchionda & Associates, L.P., dated April 15, 2020
- "Martha's Vineyard High School Athletic Field Master Plan" by Huntress Sports, dated February 4, 2019
- "BrockFill Safety Data Sheet" by Brock USA LLC, dated November 13, 2018
- "BrockFill Typical Properties & Specification" by Brock USA LLC, dated March 2020
- "PowerBase YSR Material Safety Data Sheet" by Brock USA LLC, dated April 28, 2015
- "PowerBase YSR Typical Properties & Specification" by Brock USA LLC, dated October 2018
- "Per- and Poly-flouroalkyl Substances (PFAS) in Artificial Turf Carpet" by Toxics Use Reduction Institute at UMass Lowell, dated February 2020
- Field Fund Communications, dated May 22, 2017, May 31, 2017, June 6, 2017, June 12, 2017, June 20, 2017, June 27, 2017, July 12, 2017, July 27, 2017, August 7, 2017, August 4, 2017, August 15, 2017, August 21, 2017, September 10, 2017 and January 11, 2018
- Q&A between Martha's Vineyard Commission and Huntress Associates, dated April 3, 2020
- Q&A between Martha's Vineyard Commission and Huntress Associates, dated May 26, 2020
- "Lifetime Recovery and Re-use Guarantee" by Brock USA LLC
- "No PFAS in TenCate Fibers" email from TenCate Grass, dated October 16, 2019
- "PFAS in Brock products" email from Brock USA, LLC, dated October 23, 2019
- "Potential PFAS presence in Artificial Turf" by Weston & Samson, dated October 14, 2019

From the Oak Bluffs Planning Board "High School Track and Field" page:

- "Site Plan Review Application" to the Oak Bluffs Planning Board by Huntress Associates, dated January 24, 2020
- Stormwater Report by Marchionda & Associates, LP, dated January 22, 2020
- "Campus Plan" by Huntress Associates, dated May 2, 2020
- Letter regarding material and end of life for synthetic turf, from Huntress Associates to Martha's Vineyard commission, dated May 1, 2020
- "Sanderson Avenue Pedestrian Plan" by Huntress Associates, updated May 16, 2020
- "Natural Grass Athletic Field – Annual Maintenance Plan" by Huntress Associates, dated June 8, 2020
- "Staff-applicant meeting" notes, dated June 5, 2020
- Martha's Vineyard Commission DRAFT Staff Report for DRI #352-M4 dated March 25, 2020
- Oak Bluffs Planning Board comments on MVRHS Athletic Field Improvements, dated February 2, 2020

- Oak Bluffs Planning Board Five Areas of Comprehensive Review, dated March 15, 2020
- Comments from Bill Vrooman, dated February 5, 2020
- Comments from Elizabeth Durkee, Conservation Agent, dated February 5, 2020
- Expanded comments from Elizabeth Durkee, Conservation Agent, dated February 11, 2020
- Comments from Meegan Lancaster, Heath Agent, Dated January 29, 2020
- Comments from the Shellfish Committee, dated February 6, 2020
- Comments from Lisa Merritt, Wastewater Department, dated January 20, 2020
- "MVRHS – Athletic Fields" email from Huntress Associates to Oak Bluffs Planning Board, dated October 24, 2019

Other:

- Town of Oak Bluffs, Recodified Zoning By-Laws, dated April 2003 including changes through May 2019
- Martha's Vineyard Island Plan, dated 2009
- Town of Oak Bluffs, "Section 21.0—The Content and Application of Fertilizer for Turf on Martha's Vinyeard, Town of Oak Bluffs," dated January 1, 2015
- "Study of the High School Area and Edgartown-Vineyard Haven Road Corridor Region in Oak Bluffs: Existing Land Uses and Regulations" by MVC, dated March 8, 2017
- "Oak Bluffs High School Pedestrian Crossing Safety Improvements," by Howard Stein Hudson, dated August 6, 2019
- Q&A between HW and Huntress Associates, dated June 27, 2020
- Published research materials on synthetic turf field materials, see Attachment.

Based on our review, we offer the following comments:

**1. The proposed stormwater management plan generally meets state stormwater standards; however, there are several deficiencies in the drainage report and missed opportunities for innovation (e.g. nitrogen reduction, water reuse, and education).** The Stormwater Report (dated January 22, 2020) provides a brief description of the proposed stormwater management approach; summarizes compliance with each of the state stormwater standards; and contains existing and proposed drainage area maps, soils information, peak flow calculations using Hydraflow, and an operations and maintenance plan. Based on our review of the report and the site plans, we have several comments:

A. The proposed stormwater management system provides no nitrogen load reduction benefit. The site sits on the border between Lagoon Pond Watershed and Sengekontacket Pond Watershed, which have nitrogen impairments and reduction targets. Current and proposed stormwater management at the site relies completely on infiltration via leaching catch basins (existing parking lot) and infiltration chambers (proposed track and field). Without some form of pretreatment, these practices provide no nitrogen removal. Nitrogen removal can be better achieved through vegetative filters (bioretention, tree filters, grassed swales, etc.) and practices that are designed with continuously saturated conditions, such as a wet swales. New landscaped areas being proposed in the reconfigured parking lot and around the buildings, entrance, and walkways may provide opportunities for treatment of runoff prior to infiltration.

B. Despite the abundance of groundwater, MVC's island plan promotes limiting water consumption where possible (Island Plan Strategy W1-5). Rainwater harvesting and water reuse are not part of the proposed stormwater management system. Given the proposed irrigation demands for landscaping and the remaining natural grass fields at the school, it may be worth considering options for collecting and storing runoff for non-potable reuse (e.g., convert a section of the recharge chambers into storage tanks, or use cisterns to collect rooftop runoff from the proposed fieldhouse and press box).

C. Students in the area are already involved in various projects to fight climate change, including initiatives to reduce plastic bottle and straw use, and may also be interested in measures to improve water quality. A highly visible surface practice or rainwater harvesting system could become an educational resource for environmental science classes and an educational opportunity for members of the public attending sports events. Students could take ownership of their campus through volunteer maintenance of the plants and the monitoring of practice performance and runoff volume reduction.

D. The test pit logs indicated soils and depth to groundwater are suitable for infiltration as proposed by the applicant, and we concur that drainage controls are likely to function as described. There is missing, incorrect, or inconsistent information presented in the Stormwater Report, however, that the Applicant may want to correct for the public record:

   i. Recharge. The applicant has not provided the recharge calculations to satisfy MA Stormwater Management Standard # 3, although we believe the intent of this standard has been met. Other than the location and label shown on Grading and Drainage plan sheet L-2, there is little information provided on the design of the infiltration trench with two Cultech recharge chambers (330XLHD). The applicant should show chamber dimensions, distribution piping, and access ports/observation wells on the layout plan. The applicant should also provide a detail showing surface cover material and depth, bedding material, geotextile fabric (if any), depth of chambers, etc. The applicant should confirm what the bottom elevation of 81.2 shown on plan sheet refers to (i.e. bottom of chamber or stone bedding). In addition, the Applicant should provide sizing calculations for the infiltration chambers.

   ii. Erosion Control. Some erosion control measures are shown on the Site Preparation Plan (SP-1) and details on sheet SP-2. The plan includes locations for inlet protection and silt socks but does not show the location of the construction entrance, tree protection, dewatering area, or erosion control blankets that are shown on the detail sheet. Stockpiling and staging areas are not shown. No erosion control plan is provided for the soccer field renovation. There is no identification of specific trees that are to be removed, although there is a note about clearing and grubbing with in the limit of work.

iii. Discharges in groundwater/wellhead protection areas. The applicant incorrectly states that the project does not create a discharge within a Zone II area. The proposed recharge chambers are the discharge point, which is allowable per Standard 6.

iv. Long-term O&M. The applicant has not included maintenance of the infiltration chambers as part of the Operations and Maintenance Plan in Appendix 4 of the stormwater report. To meet Standard 9, the applicant should address chamber maintenance and show the location of clean outs and observation ports in the plan set.

In addition, there is no estimated annual maintenance budget for stormwater practices.

v. Peak Discharge. The Applicant likely meets Standard 2, however there are some technical issues with the Hydraflow calculations.

a. The post -development watershed (proposed drainage area) map does not match the Grading and Drainage plan (sheet L-2) provided. Elevations appear to be off >1 ft and the parking lot reconfiguration is not shown. The applicant has stated that the hydrologic calculations are current, however elevations in Hydraflow summaries also do not match elevations in the Grading and Drainage plan. No revised mapping or modeling information was provided that allow us to verify that the modeling has been updated. The Applicant should provide an up-to-date drainage map and Hydraflow calculations.

b. The drainage calculations do not include information about the natural grass soccer field. Even though this part of the project does not ultimately change existing grass surfacing, it does involve changing existing grades, the addition of underdrains, and changes to study points/discharge locations. In addition, there is no information provided on the existing “basin” where the soccer field underdrains will discharge, for example, so we are unable to evaluate system capacity or verify the assertion that the proposed conditions would be identical to current conditions.

c. The project description states that approximately 79,500 sf (approximately 1.82 acres) of new impervious area will be built. Curve number calculations state that the new impervious area will be 4.26 acres. An expanded narrative clarifying which surfaces are considered impervious could help explain conservative modeling and recharge requirements.

d. The Time of Concentration calculation for drainage area P-2 includes a Manning’s n-value of 0.4 for the sheet flow, which is the value for light underbrush. According to the post development watershed map, drainage area P-2 does not contain any forested or underbrush areas. Applicant should revise this calculation to reflect the site conditions in that area. Additionally, the Time of Concentration calculation for drainage area P-3 (the field), has a sheet flow of 90 ft through forest and underbrush. Over

75% of P-3 is impervious area with immediate access to field drains or catch basins, so HW recommends a shorter time of concentration in this area.

e. The applicant should confirm outflows from hydrographs #7 and #6 are correctly accounted for in Hydrograph #8 (i.e., the curves could be overlapping and difficult to see or it is not correctly modeling inflow).

f. The Pond Report for Pond 2 (chamber system) shows a total discharge of 0 cfs between stages 1.85 ft and 2.4 ft (approx.). The applicant should explain how this is possible.

g. The applicant used an exfiltration rate of 8.24 in/hr for both Pond 1 and 2. While we don't believe this will make a significant difference, the standard exfiltration rate for sand is 8.27 in/hr. For Pond 1 (the field), infiltrating stormwater must pass through the turf system and filter fabric, making an exfiltration rate of 8.24 in/hr unlikely.

E. The system is designed to back up into the field under higher rainfall. Due to inconsistencies between Hydraflow and the grading & drainage plan, we cannot confirm the estimated levels of ponding. Can the applicant confirm that there will be no issues with floating of the pine infill product? In addition, the applicant should confirm that the synthetic field drainage is sufficient to prevent freezing in the winter.

**2. Insufficient data exists to definitively conclude that there are/are not impacts to human health or the environmental from the Greenfields MX Elite Woven Synthetic Turf Carpet, Brock YSR Shock Pad and Brock BrockFill Organic Infill.** A more detailed report of our review of the readily available analytical information is attached. Based on our review, we recommend:

A. In addition to the testing and evaluation proposed by Cooperstown Environmental, Total Oxidizable Precursor Assay (TOP) and Total extractable organofluorine (TEO) analysis should be conducted. It is possible that wood infill could also be a source of nitrogen. Depending on the total volume of infill expected to be used, testing BrockFill for soluble nitrogen may be informative. The applicant is proposing to include product testing as part of the construction contract. Earlier testing results may be more useful to the school and permitting authorities.

B. If the project is approved, we recommend adding a condition to the approval requiring the owner to conduct effluent monitoring within the field's subsurface drainage system (in the inlet structures to the infiltration chamber, for example). In this case, a monitoring plan should be developed that includes locations and designs for sample collection and analysis.

C. Crumb rubber is often the source of microplastic contamination from synthetic fields reported in the literature and that product is not being proposed. Some information was found estimating microplastic generation from the deterioration of synthetic carpets, but not necessarily the specific Greenfields product being proposed. Additional testing of the carpet product would be needed to evaluate fraying and rate of deterioration. Arguably, older installations exposed to longer periods of UV and stress would be more prone to deterioration than newer installations. There is emerging evidence that microplastics have been found in bedrock aquifers suggesting mobility in groundwater. There is emerging evidence that microplastics have been found in bedrock aquifers suggesting mobility in groundwater. Consideration should be given to filtering alternatives to trap inevitable microplastics and minimize dispersal of particulates into the environment. The applicant could consider the addition of a filter insert (i.e., 0.45 micron filter cartridge) in the track channel drain at the edge of the field or at other key junctions in the drainage system to capture loose particles from runoff and, to some degree, wind. Plastic fragments collected in the filters could be removed during annual maintenance and properly disposed.

**3. The maintenance practices recommended by the manufacturer for the synthetic field are more extensive than the maintenance program proposed in the Huntress Q&A dated April 3, 2020. Neither maintenance plan includes specific disinfection procedures to prevent COVID-19.** In the Q&A dated April 3, 2030, the applicant's maintenance plan for the synthetic turf field includes weekly inspections and <u>monthly</u> brushing/grooming and disinfecting. However, the manufacturer's guidance provided in the master plan indicate that even with low use, the synthetic field requires <u>weekly</u> infill refill and re-leveling with total surface brushing every two weeks (at a minimum). It is conceivable that during heavy use periods, field inspection and maintenance may be required more frequently. The applicant should:

A. Confirm the frequency of maintenance activities and ensure the budget estimates are consistent with those activities. The applicant has provided a 10 and a 20-year Estimate of Probable Long-Term Costs for the synthetic field (included in Master Plan, page 85), which includes estimated maintenance costs of $7,454.28 per year. The annual budget assumes 36 hours of field grooming and sweeping; 16 hours of topdressing and leveling infill; and lump sum costs for seam repair, Gmax testing and Deep Tine Cleaning two times/yr.

B. Ensure that the maintenance budget includes not only routine maintenance, but also line items for comprehensive (annual) and special maintenance (field markings, stain removal, spills, vehicle protection), as well as maintenance of the drainage infrastructure.

C. Provide a more detailed disinfection plan to account for COVID19 and other viruses. A review of industry-based disinfection guidelines suggests spraying a disinfectant (products based on manufacturers recommendations) on the field after each use. The disinfection plan should include proposed products (such as mPerial), equipment needed, and application frequency in order to better evaluate the cost implications and any potential for groundwater contamination from active ingredients.

D. Confirm that the proposed maintenance plan and long-term cost estimate are sufficient to maintain a safe, quality field and can be implemented within the school's annual facility's budget.

E. The maintenance budget for Phase I should include estimates for maintaining the natural grass soccer field and underdrain.

**4. There is currently no facility that can provide a practical alternative for end-of-life recycling.** While the Greenfields promotional materials claim that the USA MX Elite Woven synthetic turf carpet is fully recyclable, the applicant has not demonstrated the practicality of recycling the materials that are proposed at MVRHS. Objective 4 of the Master Plan is to "Draft a specification that requires end-of-life recycling, including chain of custody certification for all products" (page 16), but only presents a single option for recycling facility to be operated by ReMatch Turf Recycling in Pennsylvania. HW was unable to confirm that this facility will be open in the next few years or confirm the availability of any other such accessible recycling plant. This does not preclude the opening of a facility in the next 7-10 years, which is the likely life span, depending on several factors. If there are other options for recycling or reuse, the applicant should provide alternative plans or more evidence of successful synthetic field recycling in the area.

**5. The proposed fertilization plan for the renovated soccer field (and other natural turf fields) will likely result in an increase in nutrients applied to the grass fields but meets criteria of the local regulations.** The Applicant has provided a fertilization program for the natural grass fields that recommends an application of nitrogen at a rate of 2.84 lbs per 1000 square feet. Oak Bluffs regulations limit nitrogen application to 3 lbs per 1000 square feet per year. The applicant could provide a nitrogen budget comparing current vs. proposed nitrogen load applications on the site in order to claim some nitrogen reduction benefit by the conversion of one natural field to synthetic turf. Current fertilization efforts at MVRHS, however, are likely less than the proposed application rate and frequency.

**6. Additional information is needed to confirm that noise and lighting meeting the environmental performance standards of the Town of Oak Bluffs Zoning By-Laws.**

A. We were unable to find information on the expected noise levels associated with the new field. Presumably, by installing a new track and synthetic field, the existing track and field adjacent to the residential area on the western part of the property will be used less frequently (or abandoned) and noise will decrease at that location. However, because the applicant has not provided specific information about the additional noise levels associated with the new field sound system, larger grandstand, etc. we are unable to confirm this is the case. A sound system layout plan is provided on sheet L-8 of the plan set.

B. Replacing the existing field lighting system with a more efficient system will provide some energy conservation benefit, but a comparison of current and proposed electrical use was not provided. The applicant should provide additional information on the lighting design, including lighting control system. While outdoor sports lighting is counter to some of the principles of dark sky friendly lighting, the International Dark Sky Association (IDA) has created a Community Friendly Sports Lighting Program with guidelines for minimizing impact, and the applicant states the lighting plan is in compliance with these guidelines. HW recommends the applicant apply for certification from the IDA to ensure compliance throughout the design and construction process. The certification consists of two phases, a review of plans (costing $1,000) and a field verification once construction is complete (costing $3,000).

C. Also, the lighting plan shown on page 24 of the Q&A between Huntress and HW shows lumens extending beyond the track perimeter and limit of work. The applicant should confirm that the increased lumens anticipated at the boundary with the Edgartown-Vineyard Haven Road will not have any adverse effects on traffic or pedestrians.

**7. The proposed short-term wastewater management is feasible, but not an ideal or sustainable long-term solution.** The applicant is proposing 21 new toilets generating a total of 83,211 gallons/year to replace 5 permanent and 3 portable toilets that are currently on site. The Oak Bluffs Wastewater Treatment Facility does not have capacity to handle the flow at this time, the applicant proposes to store sewage in a 18,000 gallon tight tank that will be pumped on average every 30 days for 9 months of the year and hauled to the Edgartown Wastewater Treatment Facility. The applicant provided calculations for an annual wastewater flow and the tight tank design, which would be used until capacity is available at the Oak Bluffs Wastewater Treatment Plant. The annual wastewater calculation showed the flow for the Fall and Spring events and the average flow per month to the tight tank, which indicated that the tight tank may need to be pumped more frequent in the Fall than the Spring. While this information may be sufficient for the current stage of the application, the applicant will ultimately need to provide an average daily flow in gallons per day for the future sewer connection to Oak Bluffs sewer system. Additional comments (comments provide by F.P Lee, PE) about the tight tank design include:

A. Applicant has not provided calculations for daily peak wastewater flow during the spring and fall seasons, nor the calculation for frequency of pumping during those seasons. The average monthly flow (9,245 gallons/month) includes the winter months, when usage would likely be much lower. Therefore, pumping every 30 days is not reasonable for the busier seasons of fall and spring. Applicant should provide those materials for further review.

B. Applicant has not provided information on the party responsible for tight tank operation.

C. The discharge pipe should be at least 3-inch in diameter to handle any solid passing through.

D. The discharge pipe inside the pump chamber (or wetwell) and vault should be ductile iron pipe and fittings. If this setup is for a short period of time, schedule 80 PVC is acceptable.

E. A valve vault should be provided to isolate each pump. No operator will enter to pump chamber (or wetwell) to make any valve adjustment.

F. The wetwell and tight tank are classified as Class 1 Division 1.

G. The float switches in wetwell and tight tank should be connected to junction boxes aboveground with proper electrical seal on all conduits from wetwell and tight tank. There is a seal wye showed on the pump chamber.

**8. Even though proposed landscaping is not integrated with stormwater management, it does showcase native species and offers an opportunity for replanting of species that may be cleared from the site in the future.** The landscape plan includes new plantings around the perimeter of the new track, landscaped areas at the entrance to the field and track, and trees in the new islands within the parking lot. Several comments are provided below and on attached annotated PDF (comments from Brian Laverriere):

A. It appears that the cluster of trees proposed along the southern edge of the field are in close proximity to the proposed recharge chambers. The applicant should confirm that sufficient distance from the infiltration trench/recharge chambers is maintained.

B. Consider planting additional tree and shrub species that are likely to be cleared from the site during future phases of the master plan.

C. Consider planting more vegetation to create a better buffer between the site and the Edgartown-Vineyard Haven Road.

D. Maples are used in several locations, including adjacent to the entrance area and in the islands within the parking lot. Maples have a relatively shallow root system and when planted next to paved areas may cause heaving over time. Nyssa, Liquidambar or Bur Oak may be a good substitute.

E. One of the grasses proposed is Miscanthus, which has invasive tendencies. HW recommends using Muhlenbergia instead, which is native. In addition to Miscanthus, the applicant proposed three other non-native grasses. HW recommends the applicant replace these grasses with native species. These plantings are also very public and are an opportunity to expose students and visitors alike to native species.

F. Provide an estimated budget for landscape maintenance.

**9. Several options in the master plan require clearing of mature forest in the southeast corner of the site, which is within BioMap 2 Core Habitat.** This area was identified in 2008 as priority habitat by NHESP, but was subsequently excluded during the 2017 update when the area was aligned with the property boundary. The southwest corner of the athletic field complex is now part of the Core Habitat for species of conservation concern (Figure 1). If this area is to be considered for clearing, we recommend the applicant conduct a more thorough inventory of the species present and the number of trees that will be removed. It is unclear if development of this portion of the site will conflict with open space requirements for the property as a whole, or if mitigation could be offered. This area is part of the forested corridor connecting critical habitats on the north and south side of the road. Further clearing will add to fragmentation issues, habitat loss, and increased invasive species.


**Figure 1.** BioMap2 Core Habitat (in green) with updated NHESP priority habitat area shown in yellow hatching.

We would be pleased to provide additional clarification in any of the above topics and are prepared to attend an upcoming Planning Board public hearing to answer questions from the Board. Thank you for the opportunity to provide this input into your Site Plan Review process.

Sincerely,
**Horsley Witten Group, Inc.**

Anne Kitchell, LEED AP
Associate Principal

Eliza Hoffman, EIT
Staff Engineer

Enclosure(s)
cc: Ewell Hopkins

# Attachment A

Landscape Plan Comments
(comments provided by B. Laverriere, HW Landscape Designer)

# PLANT LIST

| SYMBOL | BOTANICAL NAME | COMMON NAME | NATIVE | QTY | SIZE |
|---|---|---|---|---|---|
| **SHADE TREES** | | | | | |
| AR | ACER RUBRUM ' RED SUNSET' | RED MAPLE | NATIVE | 9 | 2 1/2"-3" CAL. |
| AS | ACER SACCHARUM | SUGAR MAPLE | NATIVE | 9 | 2 1/2"-3" CAL. |
| **EVERGREEN TREES** | | | | | |
| PG | PICEA GLAUCA | WHITE SPRUCE | NATIVE | 2 | 8-10' HT. |
| JV | JUNIPEROUS VIRGINIANA | EASTERN RED CEDAR | NATIVE | 5 | 6-7' HT. |
| PR | PINUS RESINOSA | RED PINE | NATIVE | 3 | 6-7' HT. |
| **ORNAMENTAL TREES** | | | | | |
| BN | BETULA NIGRA 'HERITAGE' | HERITAGE RIVER BIRCH | NATIVE | 2 | 8-10' HT. CLMP |
| AC | AMELANCHIER CANADENSIS | SHADBLOW | NATIVE | 12 | 8-10' HT. CLMP |
| BL | BETULA LENTA | CHERRY BIRCH | NATIVE | 3 | 8-10' HT. CLMP |
| CC | CERCIS CANADENSIS | EASTERN REDBUD | NATIVE | 7 | 8-10' HT. CLMP |
| **SHRUBS** | | | | | |
| PM | PRUNUS MARITIMA | BEACH PLUM | NATIVE | 6 | 2.5-3' HT. |
| CA | CLETHRA ALNIFOLIA | SWEET PEPPERBUSH | NATIVE | 6 | #3 POT |
| CS | CORNUS SERICEA | RED TWIG DOGWOOD | NATIVE | 52 | #3 POT |
| IV | ILEX VERTICILLATA | WINTERBERRY | NATIVE | 6 | #2 POT |
| IG | ILEX GLABRA | INKBERRY | NATIVE | 27 | #2 POT |
| VD | VIBURNUM DENTATUM | ARROWWOOD VIBURNUM | NATIVE | 69 | #2 POT |
| **GRASSES** | | | | | |
| KF | CALAMAGROSTIS X ACUTIFOLIA | 'KARL FOERSTER' REED GRASS | NON-NATIVE | 6 | #2 POT |
| ~~MS~~ | ~~MISCANTHUS SINENSIS 'PURPURASCENS'~~ | ~~PURPLE MAIDEN GRASS~~ | ~~NON-NATIVE~~ | ~~15~~ | ~~#3 POT~~ |
| PA | PENNISETUM ALOPECUROIDES 'RED HEAD' | REDHEAD FOUNTAIN GRASS | NON-NATIVE | 25 | #2 POT |
| EA | ELYMUS ARENARIUS 'BLUE DUNE' | BLUE DUNE LYME GRASS | NON-NATIVE | 10 | #1 POT |
| **PERENNIALS** | | | | | |
| SB | ECHINACEA PURPUREA | PURPLE CONE FLOWER | NATIVE | 30 | #1 POT |
| RP | RATIBIDA PINNATA | YELLOW CONE FLOWER | NATIVE | 24 | #1 POT |
| AC | ACHILEA SPP. | YARROW | NATIVE | 40 | #1 POT |
| CR | COREOPSIS ROSEA 'AMERICAN DREAM' | TICKSEED | NATIVE | 24 | #1 POT |
| ES | EURYBIA SPECTABALIS | EASTERN SHOWY ASTER | NATIVE | 24 | #1 POT |
| CP | COMPTONIA PEREGRINA | SWEET FERN | NATIVE | 48 | #1 POT |
| RF | RUDBECKIA FULGIDA | BLACK EYED SUSAN | NATIVE | 24 | #1 POT |
| SO | SALVIA OFFICINALIS | SAGE | NATIVE | 48 | #1 POT |

NOTE: LOCATE PERENNIALS AS DIRECTED BY LANDSCAPE ARCHITECT IN THE FIELD.

I avoid using Maples in parking lots and along sidewalks as their shallow root system will cause heaving over time. Consider substituting Nyssa, Liquidambar, or even the fabulous Bur Oak.

Love all of these, great choices!

Avoid using Miscanthus as it has invasive tendencies. Muhlenbergia is native and will provide the same dramatic effect

I personally love all three other non-natives and use them myself. However, for a public project with public funding, I might suggest some of our beautiful, native grasses. Such as: Deschampsia, Sporobolus, or Schizachyrium

Personally, I've had far better luck over the years planting Rudbeckia subtomentosa than fulgida.

Salvia isn't native to North America. Very beautiful perennial though.

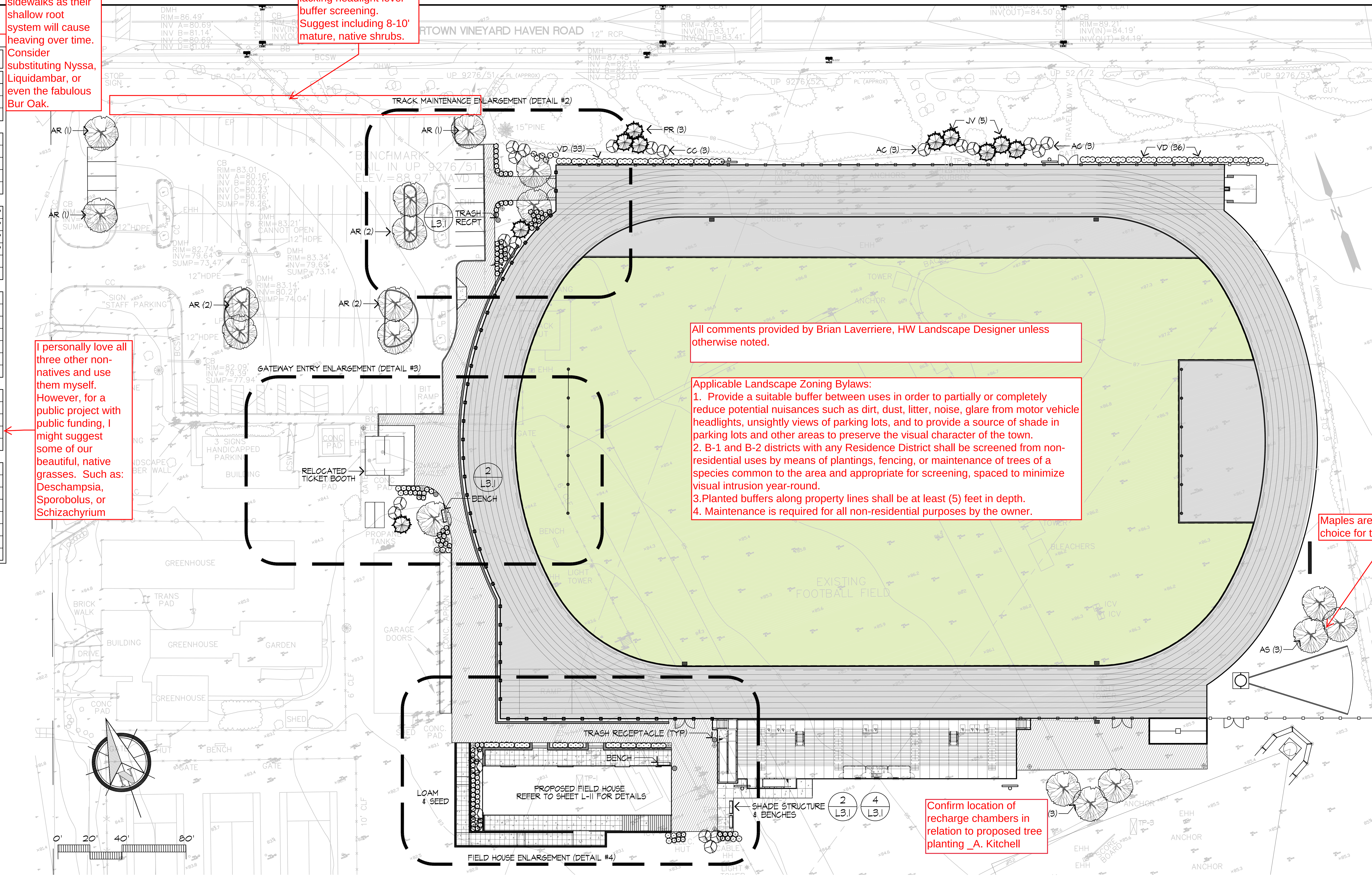
# PLANTING NOTES

1. CONTRACTOR SHALL BEGIN MAINTENANCE IMMEDIATELY AFTER PLANTING AND WILL CONTINUE UNTIL FINAL ACCEPTANCE.
2. CONTRACTOR SHALL MAINTAIN POSITIVE DRAINAGE AWAY FROM ALL BUILDING FOUNDATIONS, STRUCTURES, AND PLANTING BEDS.
3. MAXIMUM SLOPE WITHIN DISTURBED AREAS SHALL NOT EXCEED 3:1, UNLESS OTHERWISE NOTED.
4. ALL AREAS OF THE SITE WHICH HAVE BEEN DISTURBED AND NOT OTHERWISE DEVELOPED SHALL BE LOAMED AND SEEDED WITH A MINIMUM DEPTH OF 6" DEPTH TOPSOIL.
5. ALL PLANTS SHALL BEAR THE SAME RELATIONSHIP TO FINISH GRADE AS TO ORIGINAL GRADES BEFORE DIGGING.
6. MULCH FOR PLANTED AREAS TO BE AGED PINE BARK: PARTIALLY DECOMPOSED, DARK BROWN IN COLOR AND FREE OF WOOD CHIPS THICKER THAN 1/4 INCH. (INSTALL TO 3" DEPTH IN ALL PLANT BEDS)
7. PLANTING SOIL MIX: LOAM THOROUGHLY INCORPORATED WITH ROTTED MANURE PROPORTIONED 5 C.Y. TO 1 C.Y. OR EQUIVALENT. PEAT MOSS WITH FERTILIZER ADDED PER MANUFACTURER'S RECOMMENDED RATES.
8. THE LANDSCAPE CONTRACTOR SHALL GUARANTEE ALL PLANT MATERIALS FOR ONE (1) FULL YEAR FROM DATE OF ACCEPTANCE.

I almost never add fertilizer, that's the beauty of using natives.

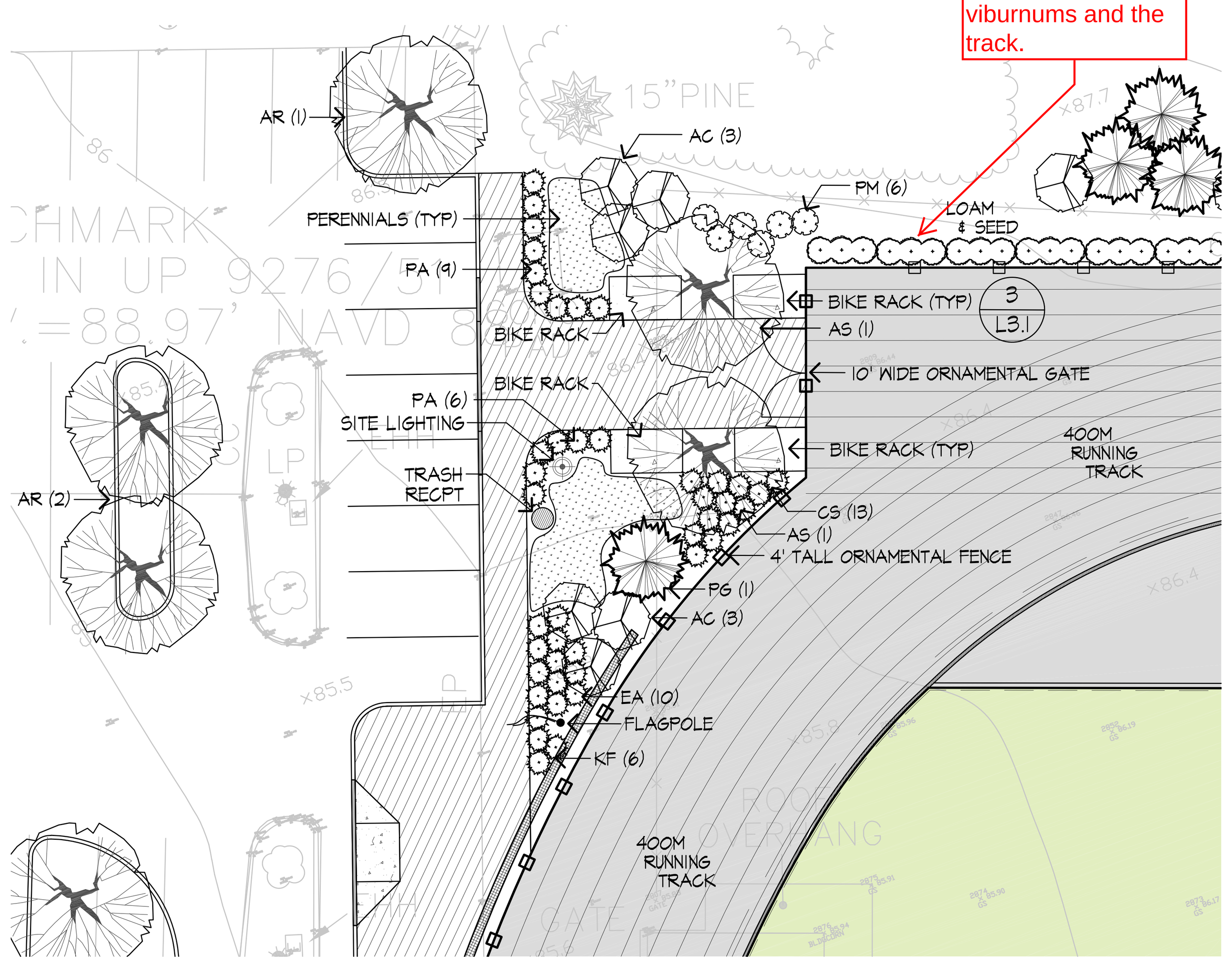
Avoid using manure and peat moss. I might suggest mulched leaf compost for organic matter/ nutrients and mycorrhizal fungi for water absorption.

Will this satisfy the towns 5' minimum buffer requirement? Might suggest a lower tier perennial border plant between the viburnums and the track.



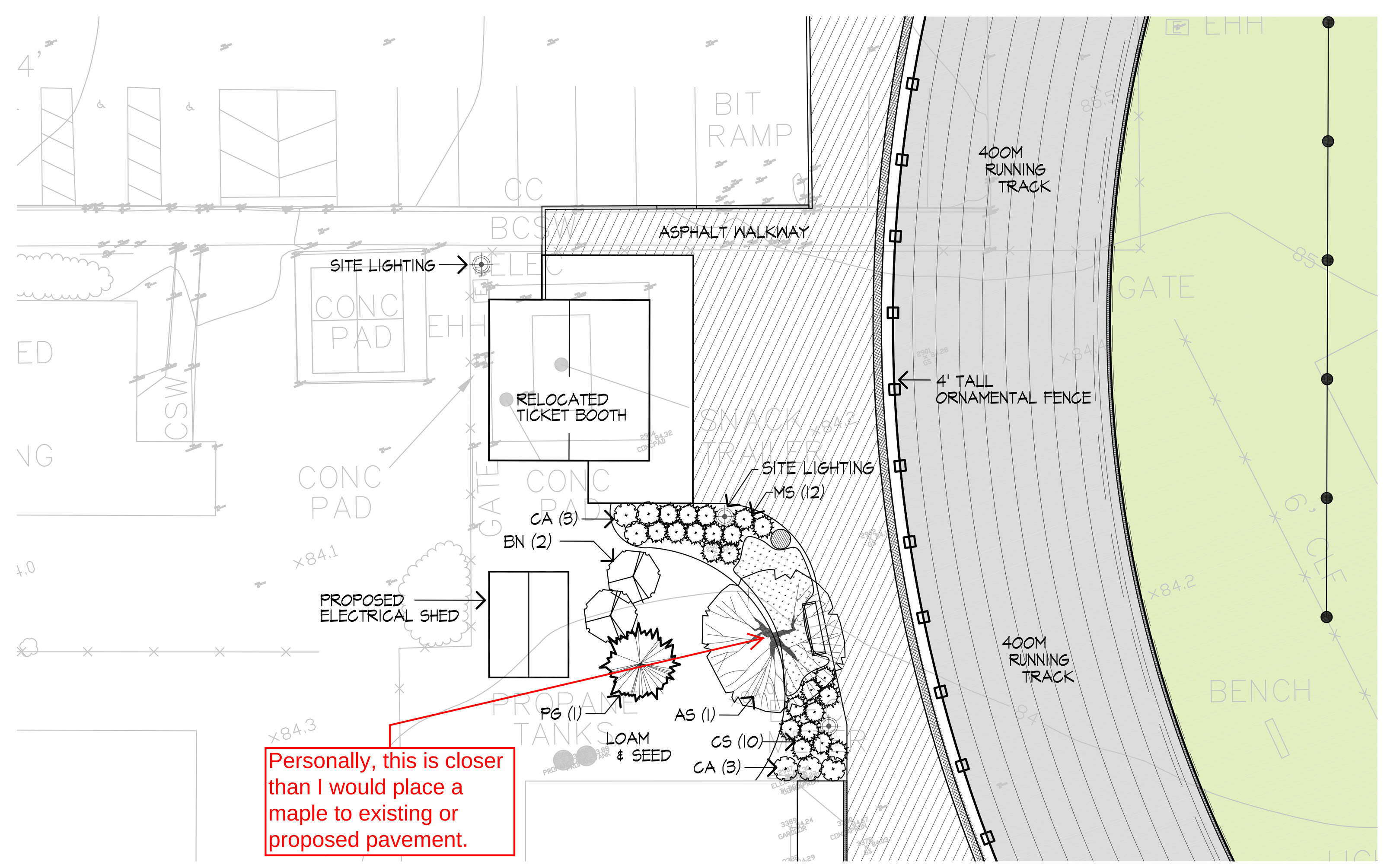

1 PARKING LOT & BUFFER PLANTING PLAN

SCALE: 1" = 40'



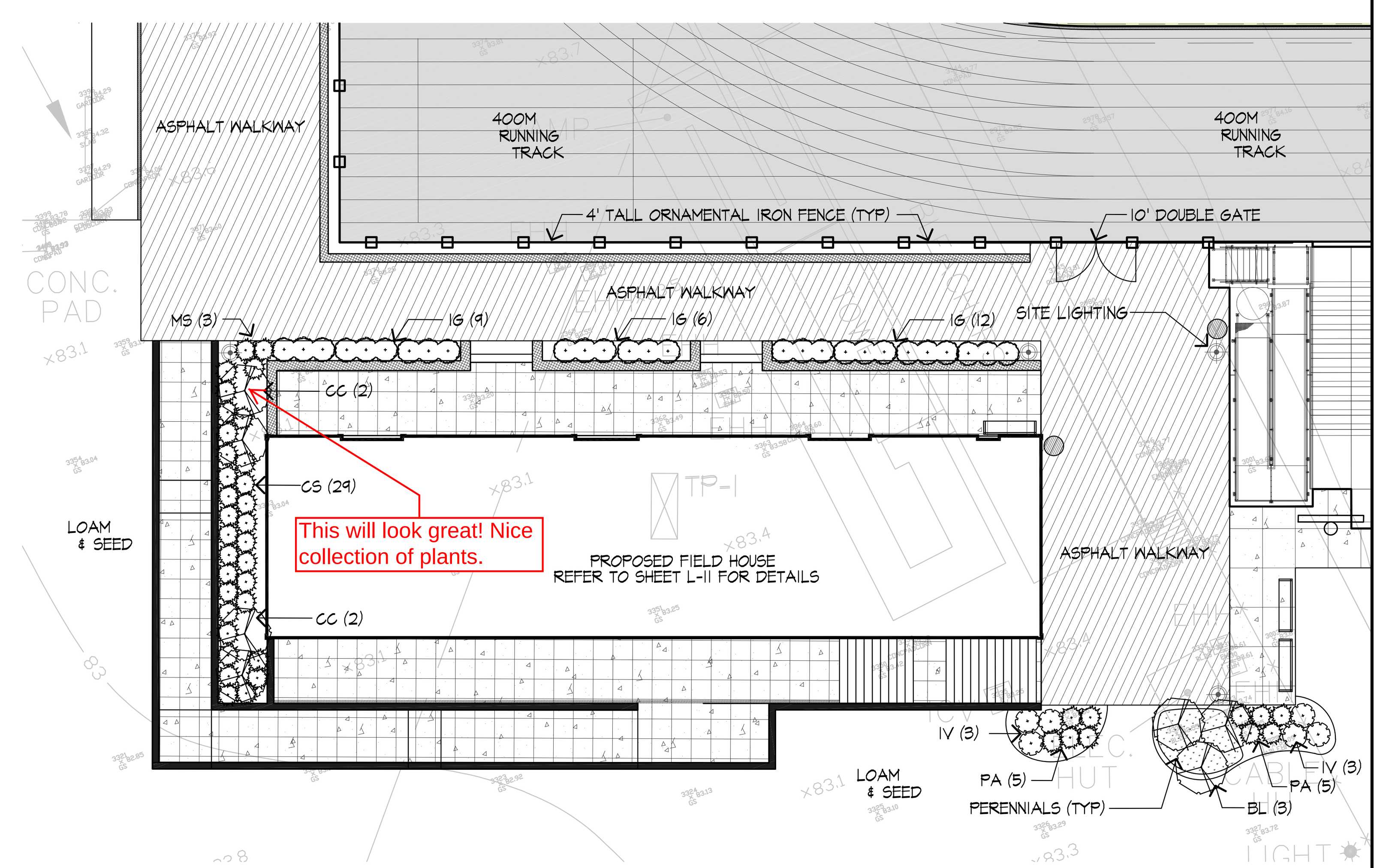

2 TRACK MAINTENANCE ENTRY PLANTING PLAN

SCALE: 1" = 20'




3 GATEWAY ENLARGEMENT PLANTING PLAN

SCALE: 1" = 20'




4 FIELD HOUSE ENLARGEMENT PLANTING PLAN

SCALE: 1" = 20'


Huntress Associates, Inc.
Landscape Architecture & Land Planning
17 Tewksbury Street
Andover, Massachusetts 01810
978 470 8882 FAX 978 470 8890


Project:
**Martha's Vineyard Regional High School**
Oak Bluffs, Massachusetts

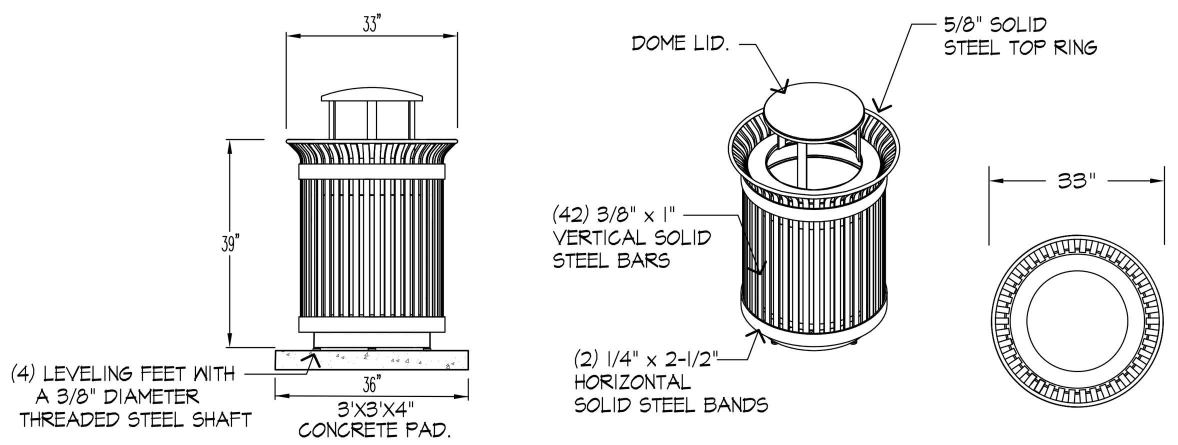
Drawing Title:
**Landscape Plan**

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

| Revision | Date |
|---|---|

| | | |
|---|---|---|
| Scale: | AS NOTED | Drawing No. L-3 |
| Date: | 4.28.20 | |
| Job: | 00-107 | |
| File: | PR-mp | |
| Drawn: | CCH | of |
| Checked: | -- | 13 |

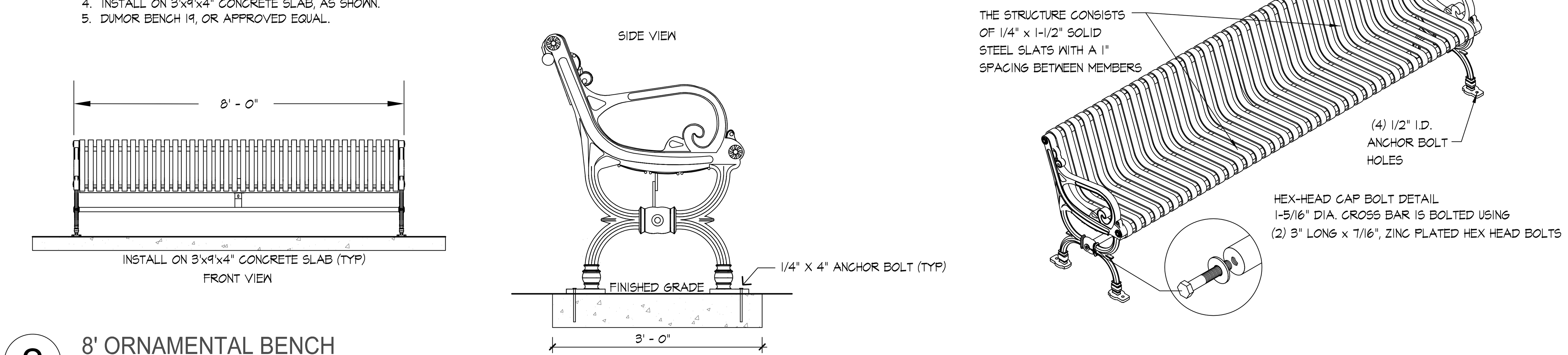
NOTES:
1. ALL STEEL TO BE POWDERCOAT FINISH, COLOR BLACK.
2. ALL STEEL TO BE HOT DIPPED GALVANIZED PRIOR TO APPLICATION OF POWDERCOAT FINISH.
3. PROVIDE ONE (1) 32 GAL. CAPACITY HIGH DENSITY PLASTIC LINER WITH EACH RECEPTACLE.
4. PROVIDE AND INSTALL FOUR (4) RECEPTACLES, AS SHOWN.
5. INSTALL ON 3'X3'X4" CONCRETE PAD.
6. DUMOR RECEPTACLE 157 WITH 87 DOME LID, OR APPROVED EQUAL.




1 TRASH RECEPTACLE - 32 GAL. CAPACITY

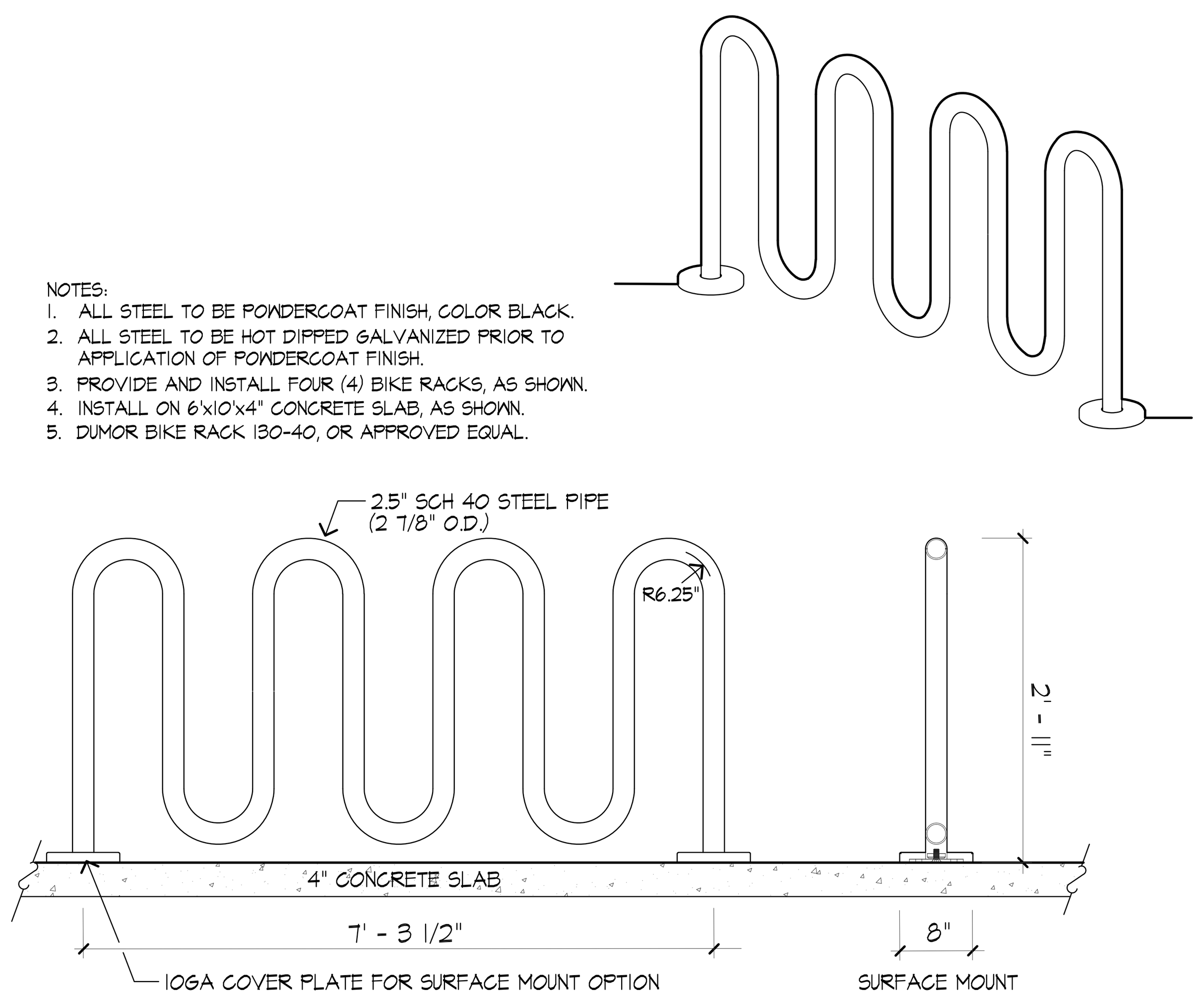
NOTES:
1. ALL STEEL TO BE POWDERCOAT FINISH, COLOR BLACK.
2. ALL STEEL TO BE HOT DIPPED GALVANIZED PRIOR TO APPLICATION OF POWDERCOAT FINISH.
3. PROVIDE AND INSTALL FOUR (4) BENCHES, AS SHOWN.
4. INSTALL ON 3'x9'x4" CONCRETE SLAB, AS SHOWN.
5. DUMOR BENCH 19, OR APPROVED EQUAL.

ALL FABRICATED COMPONENTS SHALL BE STEEL SHOT-BLASTED ETCHED, PHOSPHATIZED AND ELECTROSTATICALLY POWDER COATED WITH TGIC POLYESTER POWDER COATINGS.

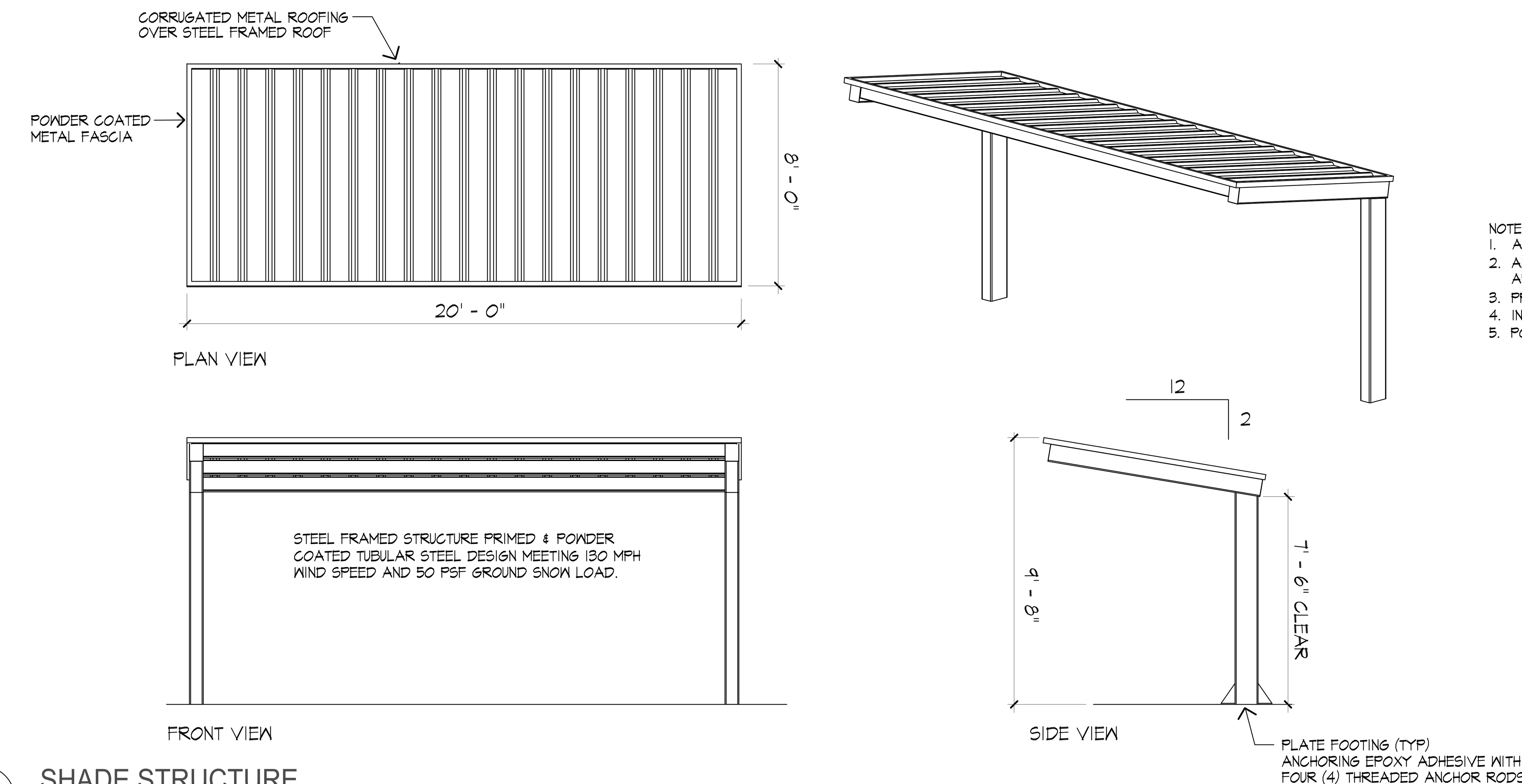



2 8' ORNAMENTAL BENCH

NOTES:
1. ALL STEEL TO BE POWDERCOAT FINISH, COLOR BLACK.
2. ALL STEEL TO BE HOT DIPPED GALVANIZED PRIOR TO APPLICATION OF POWDERCOAT FINISH.
3. PROVIDE AND INSTALL FOUR (4) BIKE RACKS, AS SHOWN.
4. INSTALL ON 6'x10'x4" CONCRETE SLAB, AS SHOWN.
5. DUMOR BIKE RACK 130-40, OR APPROVED EQUAL.

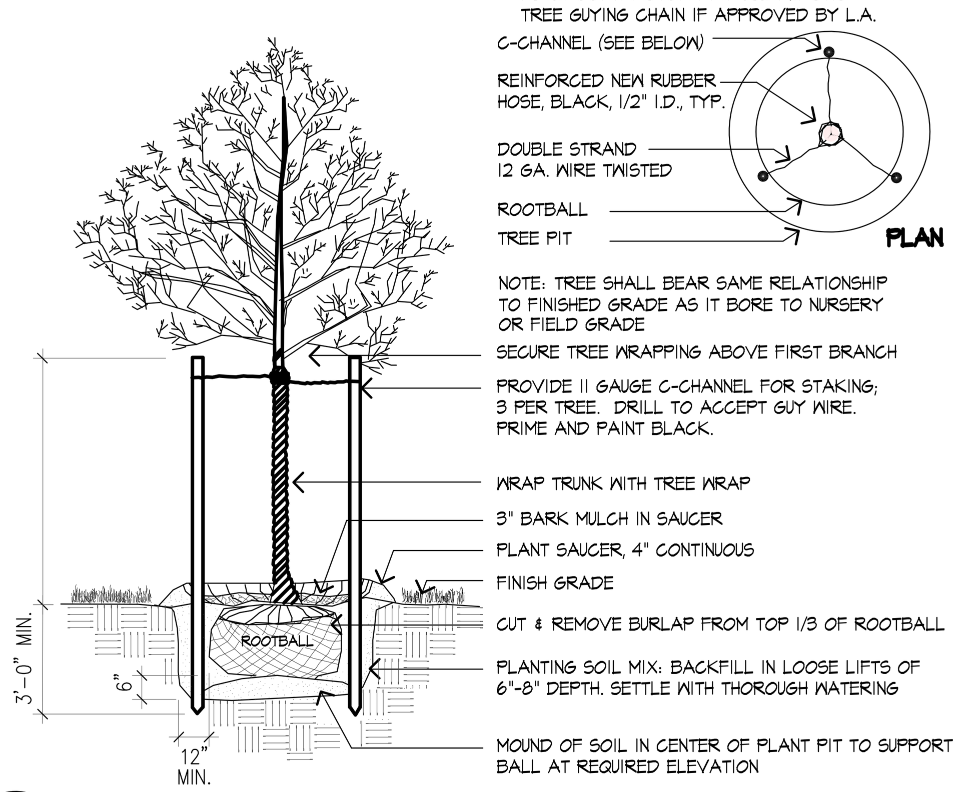



3 BIKE RACK DETAIL



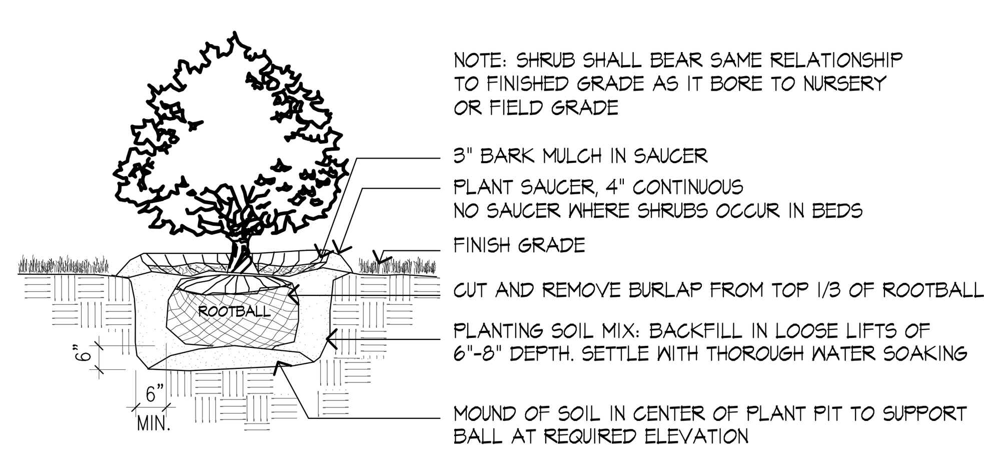

NOTES:
1. ALL STEEL TO BE POWDERCOAT FINISH, COLOR BLACK.
2. ALL STEEL TO BE HOT DIPPED GALVANIZED PRIOR TO APPLICATION OF POWDERCOAT FINISH.
3. PROVIDE AND INSTALL ONE (1) SHADE STRUCTURE, AS SHOWN.
4. INSTALL ON 10'x20'x4" CONCRETE SLAB, AS SHOWN.
5. POLIGON EXTENDED WALKWAY SHADE STRUCTURE (CWE), OR APPROVED EQUAL.

4 SHADE STRUCTURE




5 DECIDUOUS TREE PLANTING AND STAKING

SCALE: N.T.S.




6 TYPICAL SHRUB PLANTING

SCALE: N.T.S.

Loam and seed detail?
What is the specified seed mix(es)?

IRRIGATION NOTES

1. ALL WORK IS TO BE IN COMPLIANCE WITH ALL LOCAL, STATE AND FEDERAL CODES AND ORDINANCES.
2. ALL UNDERGROUND ELECTRICAL CONNECTIONS ARE TO BE MADE WITH DBY WIRE CONNECTORS.
3. ALL AUTO CONTROL VALVES ARE TO BE INSTALLED IN CARSON VALVE BOXES OF APPROPRIATE SIZE.
4. ALL CONTROL WIRING DOWNSTREAM OF THE CONTROLLER IS TO BE 14 AWG, UL APPROVED FOR DIRECT BURY.
5. ALL ROTORS AND SPRAY POP-UPS SHALL BE INSTALLED ON SWING JOINTS.
6. ALL QCV SHALL BE INSTALLED ON 3-ELBOW PVC SWING JOINTS.
7. SYSTEM DESIGN BASED UPON EXISTING CONNECTION TO BUILDING WATER SUPPLY
8. CONTRACTOR TO VERIFY WATER PRESSURE AND AVAILABILITY PRIOR TO INSTALLATION.
9. 120V. TO CONTROLLER AND COPPER STUB, BY IRRIGATION CONTRACTOR
10. THE CONTRACTOR SHALL BE REQUIRED TO FURNISH AND INSTALL ALL MATERIALS NECESSARY TO COMPLETE THE AUTOMATIC IRRIGATION SYSTEM IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS (SECTION 02810)
11. CONTRACTOR TO SUBMIT SHOP DRAWING SHOWING ALL PROPOSED SYSTEMS, CONDUITS, ZONES AND IRIRGATION COMPONENTS PRIOR TO THE START OF CONSTRUCTION. SHOP DRAWINGS TO BE APPROVED BY THE LANDSCAPE ARCHITECT PRIOR TO INSTALLATION.
12. IRRIGATION SYSTEM TO BE COMPLETE WITH WATER VALVES, SHUT-OFFS AND BACKFLOW PREVENTORS AS REQUIRED BY CODE.
13. ALL LAWN AREAS TO HAVE SPRAY HEADS AND ALL PLANTED AREAS TO HAVE DRIP IRRIGATION.


Huntress Associates, Inc.
Landscape Architecture & Land Planning
17 Tewksbury Street
Andover, Massachusetts 01810
978 470 8882 FAX 978 470 8890


Project:
**Martha's Vineyard Regional High School**

**Oak Bluffs, Massachusetts**

Drawing Title:
**Landscape Details**

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

| Revision | Date |
|---|---|

| | | |
|---|---|---|
| Scale: | 1"=40' | Drawing No. |
| Date: | 4.28.20 | **L3.1** |
| Job: | 00-107 | |
| File: | PR-mp | |
| Drawn: | CCH | of |
| Checked: | -- | 13 |

# Attachment B

Review of Synthetic Turf Contamination Information

August 13, 2020

VIA EMAIL
Mr. Adam Turner
Martha's Vineyard Commission
P.O. Box 1447
Oak Bluffs, MA 02557

RE: Synthetic Turf Field Material Review for the proposed athletic field improvements at the Martha's Vineyard Regional High School (MVRHS)

HW reviewed materials provided by the applicant from both the MVC and Oak Bluffs Planning Board websites and additional information:

- Letter from Robert Wright, MD, MPH and Sarah Evans, PhD, MPH, Mount Sinai Children's Environmental Health Center, to the Sharon Conservation Commission, dated December 19, 2019
- "Mass balance of rubber granulate lost from artificial turf fields, focusing on discharge to the aquatic environment," by Hanne Løkkegaard, Bjørn Malmgren-Hansen, Nils H. Nilsson from Teknologisk Institut (Danish Technological Institute), dated December 2018 (Revised May 2019)
- "Tracking Microplastics from Artificial Football Fields to Stormwater Systems" by Ran Li, Stockholm University, 2019
- "Microplastics & Artificial Pitches: The Facts," by Sports Labs
- Attachment 1: extracted from Master Plan and Q&A dated 5/28/20
    - Powerbase YSR Specification & Typical Properties and Material Safety Data Sheet, by Brock, dated Aug 19, 2016 (MP)
    - Greenfields MX Elite information sheet (MP)
    - Brockfill Typical Properties and Specification sheet, by Brock, dated September 2018 (MP)
    - "Environmental Compatibility Testing of Brock Organic Infill," from Millennium Consulting, dated October 16, 2018 (MP)
    - "Proposal for Environmental Consulting Services" from Cooperstown Environmental, dated May 22, 2020 (Q&A)
- Attachment 2: "Sharon High School Synthetic Turf Environmental Compatibility Testing Results," by David Teter Consulting, dated January 20, 2020
- Attachment 3: "PFAS in Brock products" email from Brock USA, LLC, dated October 23, 2019
- Attachment 4: Extracted from Master Plan. "Potential for Synthetic Turf Field to Affect Groundwater at Concord-Carlisle High School, Concord MA," by Haley Aldrich, dated July 2015
- Attachment 5: "Per- and Poly-flouroalkyl Substances (PFAS) in Artificial Turf Carpet" by Toxics Use Reduction Institute at UMass Lowell, dated February 2020
- Attachment 6: "Effective rainwater treatment intercepts microplastics from artificial turf," by Hauraton, Dated September 27, 2019

- Attachment 7: "Microplastic contamination found in common source of groundwater, researchers report" dated January 25, 2019.

**1. BrockFill Engineered Wood Infill**

1.1 *Information from the Martha's Vineyard Commission:*

- "HAI recommends that MVRHS consider a product called BrockFill, Manufactured by Brock USA. This innovative infill product is manufactured from sustainably harvested Loblolly Pine trees from Georgia. The product is 100% organic, recyclable at the end of its useful life, and eliminates the need to use crumb rubber as an infill. The installed cost is also comparable to crumb rubber.
- According to the Brockfill Typical Properties and Specification form (Attachment 1), Brockfill is an Artificial turf infill made from engineered wood particles. Analytical testing of the material by Millennium Consulting Associates identified the following:
    - No pesticides detected above the laboratory method detection limit for a list of approximately 250 pesticide residues.
    - No chlorinated acidic herbicides detected above the laboratory method detection limit.
    - No leachable semi-volatile organic compounds detected above the laboratory method detection limit.
    - Total 17 California Administrative Manual (CAM) metals and/or hexavalent chromium were detected above the laboratory method detection limit however, the results are not included in Attachment 1. The letter indicates "No metals were detected above guideline values for the protection of human health or threshold values for the characterization of hazardous waste".
    - No leachable 17 CAM metals and/or hexavalent chromium were detected above the laboratory method detection limit.
- According to a proposal from Cooperstown Environmental (CE) dated May 22, 2020 (Attachment 1), testing of the Greenfields MX Elite Woven Synthetic Turf Carpet, Brock YSR Shock Pad and Brock BrockFill Organic Infill is proposed. The suggested testing includes MCP 14 Metals and hexavalent chromium (total and leachable), polycyclic aromatic hydrocarbons (total and leachable) and 24 per-and poly-fluoroalkyl substances ([PFAS],total and leachable). The data generated from the testing would then be evaluated by CE to determine the potential impacts to human health (inhalation, ingestion, and direct dermal contact) and groundwater. It is unclear if this testing has been completed.

*1.2 Information from other sources:*

- In a letter report from David Teter Consulting to Tappe Architects dated January 20, 2020 (Attachment 2), Brock infill was tested on behalf of the Town of Sharon for 17 CAM metals, hexavalent chromium and semi-volatile organic compounds (SVOCs) by the synthetic precipitation leachate procedure (SPLP). No metals or SVOCs were detected above the laboratory reporting limit. This correlates with the testing results described above by Millennium Consulting Associates indicating that the 17 CAM metals, hexavalent chromium and

SVOCs do not appear to leach from the Brock infill. Total metals and SVOC data from non-SPLP testing were not included in the letter report.

- In a letter from Brock dated October 23, 2019 (Attachment 3), "Brock products (Powerbase and SP underlayment pads, and BrockFILL infill) do not contain perfluoroalkylated substances (PFAS)". No analytical data was included in the letter. Additional on-line research did not identify any readily apparent sources of PFAS testing for Brock products. Also, it should be noted that release agents containing PFAS are known to have been used during plastic manufacturing to prevent the extruded plastic objects from sticking to the molds. In these instances, PFAs may not be a direct ingredient used to manufacture plastic but could potentially be a residual contaminant associated with the manufacturing process.

**2. Brock YSR Shock pad**

*2.1 Information from the Martha's Vineyard Commission:*

- "HAI Recommends that MVRHS consider the YSR resilient turf underlayment manufactured by Brock USA. The YSR pad is made of recyclable polypropylene, is cradle-to-cradle certified and has a 25-year warranty. The use of a resilient underlayment has been shown to reduce the risk of injuries from head to field contact by as much as 50%.
  - The material safety data sheet (MSDS) from Brock and JSP Specialty Foams for Brock Powerbase YSR (Attachment 1) indicates the material is 100% polypropylene/ethylene copolymer. Toxicological information indicates "No Significant Hazards."
  - A specifications and typical properties sheet prepared by Brock for Powerbase/YSR (Attachment 1) indicates that the product is bacteria and fungi resistant and passes California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986) and California Title 22 (Identification and Listing of Hazardous Waste). California Proposition 65 is administered by the California Office of Environmental Health Hazard Assessment and includes a list of approximately 900 chemicals that are known to cause cancer, birth defects or other reproductive harm. Chemicals are added to the list yearly based on information obtained from the World Health Organization, California's qualified scientific and health expert panel, authoritative bodies (EPA, U.S. Food and Drug Administration, National Institute for Occupational Safety and Health, etc.) or if other agencies of the state or federal government have identified a chemical to be labeled or identified as causing cancer, birth defects or reproductive harm. California Title 22 is administered by the California Department of Toxic Substances Control and determines if a material is hazardous based on characteristics such as ignitability, corrosivity, reactivity and toxicity. As detailed in the CE proposal, a Method 3 Risk Assessment will be used to evaluate product specific laboratory results of the field materials. A Method 3 Risk Assessment determines the estimated excess lifetime cancer risk and non-cancer risk to exposure of chemicals to a given receptor.
  - In a letter from Brock dated October 23, 2019 (Attachment 3), "Brock products (Powerbase and SP underlayment pads, and BrockFILL infill) do not contain perfluoroalkylated substances (PFAS)." No analytical data was included in the letter. Additional on-line research did not identify any readily apparent sources of PFAS testing for Brock products.

- According to a proposal from CE dated May 22, 2020 (Attachment 1), testing of the Greenfields MX Elite Woven Synthetic Turf Carpet, Brock YSR Shock Pad and Brock BrockFill Organic Infill is proposed. The suggested testing includes MCP 14 Metals and hexavalent chromium (total and leachable), polycyclic aromatic hydrocarbons (total and leachable), and 24 PFAS compounds (total and leachable). The data generated from the testing would then be evaluated by CE to determine the potential impacts to human health (inhalation, ingestion, and direct dermal contact) and groundwater.

*2.2 Information from other sources:*

- In a letter report from David Teter Consulting to Tappe Architects dated January 20, 2020 (Attachment 2), Brock pad was tested on behalf of the Town of Sharon for select metals and SVOCs by the synthetic precipitation leachate procedure (SPLP). Several metals and SVOCs were detected above the laboratory reporting limit but below the MCP Method 1 GW-1 (protective of drinking water) and GW-3 (protective of surface water).

**3. Greenfields USA MX Elite Woven synthetic turf carpet**

*3.1 Information from the Martha's Vineyard Commission:*

- "HAI recommend that MVRHS consider a woven synthetic turf carpet. The woven products eliminate the use of polyurethanes in the backing and simplifies the recycling efforts at the end of the field's useful life. Presently there are two manufacturers in the United States that make a woven product, ACT Global and Greenfields".
- A report from Haley and Aldrich dated July 2015 (Attachment 4) reviewed the potential for a synthetic turf field for the Concord-Carlisle High School to affect groundwater. The report reviewed various turf related research documents and included analytical data provided from the manufacturer of the proposed turf and infill (different from those proposed by MVRHS) for 17 CAM Metals and SVOCs. PFAS testing was not included or discussed in the document. The document mainly focuses on the use of tire crumb infill, which is different from what is proposed by MVRHS. Testing of the turf material was not included in the report. The report concluded that the "instillation of a new synthetic turf field at the CCRHS will have no adverse effect on groundwater quality".
- According to a proposal from CE dated May 22, 2020 (Attachment 1), testing of the Greenfields MX Elite Woven Synthetic Turf Carpet, Brock YSR Shock Pad and Brock BrockFill Organic Infill is proposed. The suggested testing includes MCP 14 Metals and hexavalent chromium (total and leachable), polycyclic aromatic hydrocarbons (total and leachable) and 24 PFAS compounds (total and leachable). The data generated from the testing would then be evaluated by CE to determine the potential impacts to human health (inhalation, ingestion, and direct dermal contact) and groundwater.

*3.2 Information from other sources:*

- According to the document titled *Per-and Poly-fluoroalkyl substances (PFAS) in Artificial Turf Carpet* prepared by the Massachusetts Toxics Use Reduction Institute (Attachment 5), PFAS has been found in artificial turf samples collected by two non-profits. Over 4,700 PFAS related chemicals are known and current EPA test methods can identify 29 of them. Total extractable organofluorine (TEO) testing of turf materials has also been used as an indicator for PFAS compounds that may be present but not included in the EPA list of 29. Total Oxidizable Precursor Assay (TOP) is also a helpful method for PFAS determination. This method creates conditions for precursor chemicals located in a sample to be broken down into degradation products that can then be analyzed for PFAS. MassDEP currently regulates only six PFAS compounds.

- Microplastics are a known contaminate associated with synthetic turf fields. Most of the readily available information on-line focuses on crumb rubber as the leading source of microplastic contamination. However, the plastic grass blades are a potential source and should not be discounted. Only one document was identified during the review that included details on the amount of microplastic generated from the turf field grass blades. According to the document titled *Effective Rainwater Treatment Incepts Microplastics from Artificial Turf,* prepared by Hauraton and dated August 27, 2019, approximately 250 to 300 kilograms of microplastics are generated per year from wear and tear of the turf grass blades. However, the Greenfields USA MX turf carpet has not been specifically tested to determine the potential microplastic degradation. Studies have identified microplastics in groundwater wells and springs indicating that microplastics have the potential to migrate in groundwater. HW recommends additional testing to confirm the amount of microplastic generated from the synthetic grass. In addition, the channel drains at the edge of the track (as seen on sheet L-4) do not prevent grass blades or other pieces of turf material from entering the stormwater system. HW recommends the addition of a filtration system (see Attachment 6) to prevent any plastic material from entering the stormwater system. The addition of a filter in the track channel drain or at key collection junctions in the drainage system could be included to trap plastic material from entering the recharge chambers. These could be cleaned out on an annual basis.

**4. Conclusions**

Based on a review of information provided by the Applicant to the Martha's Vineyard Commission and readily available information obtained on-line, inconclusive data exists to determine the potential impacts to human health and the environmental from the Greenfields MX Elite Woven Synthetic Turf Carpet, Brock YSR Shock Pad and Brock BrockFill Organic Infill. To determine the actual impacts, analytical testing and evaluation would be required. The testing proposed by CE with TOP and TEO added would help to determine potential impacts from contaminants Additionally, the proposed drainage system for the field does not prevent grass blades or other pieces of turf material from entering the stormwater system. This could result in a direct discharge of microplastics into groundwater. We recommend the addition of a filtration system to capture microplastics before they are discharged into the ground.

Bryan Massa, LSP
Senior Scientist

# Attachment 1

Extracted from Master Plan and Q&A dated 5/28/20

- Powerbase YSR Specification & Typical Properties and Material Safety Data Sheet, by Brock, dated Aug 19, 2016 (MP)
- Greenfields MX Elite information sheet (MP)
- Brockfill Typical Properties and Specification sheet, by Brock, dated September 2018 (MP)
- "Environmental Compatibility Testing of Brock Organic Infill," from Millennium Consulting, dated October 16, 2018 (MP)
- "Proposal for Environmental Consulting from Cooperstown Environmental, dated May 22, 2020 (Q&A)

POWERBASE YSR
BY BROCK

## Specification & Typical Properties

| | |
|---|---|
| **Product Number** | PB2000YSR258 |
| **Material Type** | Expanded Polypropylene Composite containing up to 23% by volume pre-consumer and/or reground post-consumer recycled material |
| **Part Format** | Interlocking panel |
| **Part Size, nominal net coverage** | 24.15 sq ft per panel (2.24 sq m) |
| **Material Density, nominal** | 3.62 lbs / cubic ft (58.0 g per l) |
| **Part Thickness, nominal** | 1.00 in (25 mm) |
| **Part Length, nominal** | 73.5 in (1867 mm) |
| **Part Width, nominal** | 49.0 in (1245 mm) |
| **Part Weight, nominal** | 5.56 lbs per panel (2.52 kg) |

| Property | Typical Value | Specification | |
|---|---|---|---|
| **Tensile Strength** | 99 psi | > 45 psi | ASTM D3575-08 |
| **Tensile Elongation** | 38% | >10% | ASTM D3575-08 |
| **Vertical Permeability** | 978 in / hr | > 300 in / hr | ASTM F1551: EN 12616/DIN 18-035, Part 6 |
| **Lateral Transmissivity** | | | ASTM D4716 |
| Flow Rate @ .005 Gradient | 0.62 gpm/ft | >0.47 gpm/ft | |
| Flow Rate @ .0075 Gradient | 0.80 gpm/ft | - | |
| Flow Rate @ .01 Gradient | 0.96 gpm/ft | - | |
| Flow Rate @ .015 Gradient | 1.23 gpm/ft | - | |
| **Linear Thermal Expansion** per 1° C change | 0.0833 mm/m | < 0.15 mm/m/°C | ASTM D696-03 |
| **Compression Strength** | | | ASTM D1621-10 |
| @ 25% strain | 31 psi | > 25 psi | |
| @ 50% strain | 42 psi | > 40 psi | |
| @ 75% strain | 78 psi | - | |
| **Compression Set – static load** (35 psi, 900 sec at 23°C, meas. after 48 hrs) | 2% | < 5% | Brock test protocol |
| **Compression Set – repeated impacts** (35 psi, repeated load, 10,000 cycles, after 24 hrs) | 12% | < 15% | Brock test protocol |
| **Friction Coefficient** movement of artificial turf over 50mm | | | |
| maximum force | 2.44 lbs max force | > 1.80 lbs max force | Brock test protocol |
| average force | 1.35 lbs avg force | > 1.00 lbs avg force | |
| **Head Injury Criterion – Critical Fall height (2" turf, 65/35 sand/rubber over concrete)** | 1.7m | 1.4m | ASTM F355-E / ASTM F1292 |
| **Force Reduction (shock absorption)** | 70% | 50% | EN 14808 |
| **Vertical Deformation** | 6.7mm | 12mm | EN 14809 |
| **Gmax** | 80 g | 100 g | ASTM F355-A |
| **Environmental Standards Testing** | | | |
| Cradle to Cradle | Certified | Certified | EPEA Cradle to Cradle |
| California Proposition 65 | Pass | Pass | California Proposition Update effective 06 JUNE 2014 |
| California Title 22 | Pass | Pass | California Code of Regulations, Title 22, Division 4.5, Chapter 11 |
| **Resistance to Acid and Alkaline Liquids** % tensile strength loss - 100yr model | 0% after 12 days | - | EN 14030:2010 ISPO 12960:1998 |
| **Resistance to Oxidation (Accelerated Aging)** % tensile strength loss - 100yr model | 6% after 56 days @ 110°C | - | EN ISO 13438:2004 |
| **Microbiological Analysis** | | | |
| bacteria resistance | No growth | No growth | ASTM G22-76 |
| fungi resistance | No growth | No growth | ASTM G21-96 |

# Material Safety Data Sheet

**Important:** Read this MSDS before handling and disposing of this product. Pass this information on to all employees, customers and users of this product. This is covered by the OSHA Hazard Communication Rule and this document has been prepared in accordance with the MSDS requirements of this rule.

## SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

**Product Name:** Brock PowerBase YSR

**Company:**
Brock USA
2840 Wilderness Place
Boulder, Colorado 80301
USA

**Company:**
JSP Specialty Foams Division
150 East Brook Lane
Butler, PA 16002
USA

**For product information assistance:**
Toll-free + 1 (877) 276-2587

## SECTION 2 — COMPOSITE INFORMATION ON INGREDIENTS

| | CAS No. | Composition by Volume |
|---|---|---|
| Polypropylene/Ethylene Copolymer | 9010-79-1 | 100% |

## SECTION 3 — HAZARDS IDENTIFICATION EMERGANCY OVERVIEW

**Health Hazards:** Inhalation Hazard - particulates / dust
Dust may be an eye irritant

**Physical Hazards:** May produce dust on handling

## SECTION 4 – FIRST AID MEASURES

**General:** In case of an accident or if you feel unwell, seek medical advice IMMEDIATELY.

**Inhalation:** Remove victim to fresh air immediately. Obtain emergency medical attention if breathing difficulty persists beyond 15 minutes.

**Eye Contact:** If eye contact occurs, rinse the exposed eye(s) with clean water for 20-30 minutes.

**Skin Contact:** Not expected to present a significant skin hazard under anticipated conditions of normal use.

**Ingestion:** Not expected to present a significant ingestion hazard under anticipated conditions of normal use.

**Emergency Medical Treatment Procedures:** Treat symptomatically.

**Detoxification Procedures:** After adequate first aid, no further treatment is required, unless symptoms reappear.

Material Safety Data Sheet

## SECTION 5 — FIRE FIGHTING MEASURES

**Fire and Explosion Hazard:** Heat from fire may melt, decompose, and generate flammable vapors.

**Extinguishing Media:** Dry chemical, $CO_2$, Foam, Water.

**Fire-Fighting Procedures:** Do not enter fire area without proper protection. Fight from a safe distance/protected location. For fire, use lots of water as straight stream to "dig" into hot molten mass from outside to open up. Cool interior/prevent re-ignition; spray/fog for surface cooling. Keep above burning material.

## SECTION 6 – ACCIDENTAL RELEASE MEASURES

If handling results in dust generation of high temperatures, local exhaust ventilation should be provided.

| Substance | Source | Date | Type | Value/Units | Time |
|---|---|---|---|---|---|
| Skin<br>Particulates Not Otherwise Regulated<br>No | OSHA | 1989 | TWA | 15MG/M3 | 8 HRS |
| (Total Dust)<br>Particulates Not Otherwise Regulated<br>No | OSHA | 1989 | TWA | 15MG/M3 | 8 HRS |
| (Respirable Fraction)<br>Nuisance Particulates<br>No | ACGIH | 1992 | TWA | 10MG/M3 | 8 HRS |

## SECTION 7 — HANDLING AND STORAGE

Product should be stored away from any heat/ignition source. Adequate exhaust ventilation should be provided when handling results in dust or particulate generation.

## SECTION 8 — EXPOSURE CONTROUPERSONAL PROTECTION

**Eye:** Dust service goggles should be worn to prevent mechanical injury or other irritation to eyes due to airborne particles, which may result from handling this product.

**Skin:** Not normally considered a skin hazard. Where use can result in skin contact, practice good personal hygiene. Wash hands and other exposed areas with mild soap and water before eating, drinking, smoking, and when leaving work.

**General:** Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse.

## SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

**Boiling Point:** N/AP

**Viscosity:** N/AP

**Dry Point:** N/AP

**Freezing Point:** N/AP

**Solubility in Water:** Negligible

**Specific Gravity:** >0.07@39.2°F

# Material Safety Data Sheet

## SECTION 10 – STABILITY AND REACTIVITY

**Hazardous Decomposition Products:** Highly unlikely under normal conditions and use.

**Stability:** Stable **Hazardous Polymerization:** Not expected to occur

## SECTION 11 – TOXICOLOGICAL INFORMATION

| Component | Component Health Hazard |
| --- | --- |
| Polypropylene/Ethylene Copolymer | No significant hazards |

## SECTION 12 – ECOLOGICAL INFORMATIONS

N/AP

## SECTION 13 – DISPOSAL CONSIDERATION

Landfill solids at permitted sites. Use registered transporters. Comply with federal/state/local regulations for solid waste disposal. Solids may be burned, and fired with supplemental fuel. Avoid flameouts. Assure emissions comply with applicable regulations. Contaminated product, soil or water should not be designated RCRA hazardous waste.

## SECTION 14 – TRANSPORT INFORMATION

N/AP

## SECTION 15 – REGULATORY INFORMATION

Colorado Right-To-Know Substance Lists
Special Hazardous Substances (CO-SHS) must be identified when present in materials at levels greater than the state specified criterion. Environmental Hazards (CO-EH) must be identified when present in materials at levels greater than the state specified criterion. Components with CAS numbers present in this material, at levels specified in section 9 - components do not require reporting under the statute.

## SECTION 16 – OTHER INFORMATION

Some of the information presented and conclusions drawn herein are from sources other than direct test data on the material itself.

**Disclaimer of Liability**

The information in the MSDS was obtained from sources which we believe are reliable, HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRENTY, EXPRESS OR IMPLIED, REGARDING ITS CORRECTNESS

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.

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FOOTBALL

# USED AT TOP CLUBS WORLDWIDE, OUR PREMIUM 3G WOVEN PRODUCT OFFERS HIGH SPEED PROFESSIONAL PLAY

## GREENFIELDS MX ELITE

**Key benefits:**

- Woven technology ensures maximum tuft lock
- Equal tuft spacing ensures natural ball roll
- Trio of fibres provides an elite playing performance
- 1-step recycling – backing and fibres part of the same polymer family

GreenFields MX Elite is a high-tech woven system offering the very best performance characteristics for both amateur and professional players.

The patented woven technology results in an extremely high tuft bind, stronger than that of traditional tufted products. This forces the fibres to stand even straighter and more closely resemble natural grass as well as facilitating positive infill movement which optimises performance. Even spacing between the tufts ensures equal ball roll in every direction combined with wider spacing between the individual fibres which enables easy decompaction of the infill.

GreenFields MX Elite offers the highest number of yarns per tuft with a mixture of our top performing yarns; Evolution®, diamond and trilobal shaped. This perfect fibre combination results in an optimum playing surface with a natural look as well as ultimate resilience.

> "The surface not only has to look good it has to play well too. And these do."

**PAUL ASHCROFT**
Grounds Manager
Arsenal F.C.

*The Groundsman - July 2016*

GreenFields

**THE CHOICE OF CHAMPIONS.**

FOOTBALL

NATURAL BALL ROLL

HIGH RESILIENCE DUE TO HIGH DENSITY, FIBRES AND ELASTICITY

NATURAL LOOK AND PLAYING EXPERIENCE

FULLY RECYCLABLE

# YOUR PERFORMANCE

GreenFields is proud to play a role in improving the football experience for people around the world. Our innovative systems have been tested extensively to meet all necessary regulations and have been proven to maximise playing characteristics.

# GREENFIELDS MX PROJECTS


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Falkirk, Scotland

**PSV**
Eindhoven, Netherlands

**F.C. DEN BOSCH**
Den Bosch, Netherlands

**www.greenfields.eu**
**E:** info@greenfields.eu
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**T:** +1 855-773-6668

CS.EN.MXE-F/17-08 1.0

BROCKFILL
THE ENGINEERED INFILL FOR ATHLETES

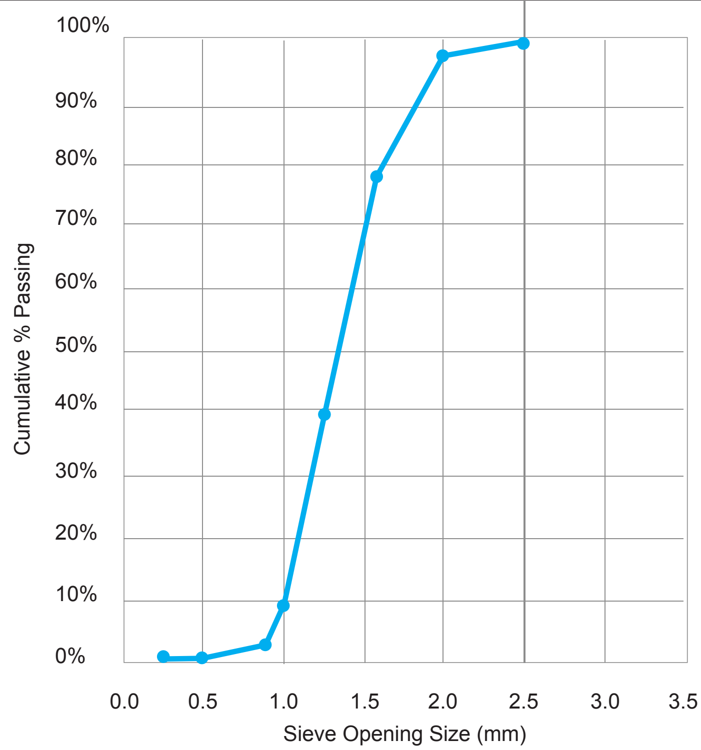
# Typical Properties & Specification

| | |
|---|---|
| **Product Name** | BrockFILL™ |
| **Product Description** | Artificial turf infill made from engineered wood particles |
| **Bulk Density** | 17 lbs / cu ft. |
| **Packaging** | 45 cu. ft Supersacks (approx. 765 lb) or 40 lb bales |
| **Moisture Content** | 10-15% (at time of production) |
| **Color** | Natural to Medium Brown |

## Sieve Analysis - Typical Results

(In accordance with BS EN 933-1:2012)

| Sieve Size (mm) | % Passing | Typical Range |
|---|---|---|
| 2.50 | 100 | 95-100% |
| 2.00 | 98 | 90-100% |
| 1.60 | 78 | 65-90% |
| 1.25 | 39 | 30-50% |
| 1.00 | 9 | 5-15% |
| 0.80 | 3 | 0-5% |
| 0.50 | 1 | 0-5% |
| 0.32 | 1 | 0-3% |




| Test | Method | Result |
|---|---|---|
| **Pesticide Testing** | AOAC Method 2007.01 | PASS |
| **Chlorinated Acidic Herbicides** | FDA PAM II<br>Method 180.292 | PASS |
| **CAM 17 Metals and Hexavalent Chromium** | EPA Method 3050B;<br>EPA Method 6020 | PASS |
| **Leachable CAM 17 Metals and Hexavalent Chromium** | EPA Method 1312;<br>EPA Method 6020 | PASS |
| **Leachable Semi-Volatile Organic Compounds including Phenols** | EPA Method 1312;<br>EPA Method 8270C | PASS |

**DATA ARE TYPICAL PROPERTIES ONLY. THIS DOCUMENT DOES NOT CREATE ANY WARRANTY, EXPRESS OR IMPLIED**

Test reports available upon request

Patent Pending

**Brock USA LLC - September 2018**

MILLENNIUM
CONSULTING ASSOCIATES
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*"Providing Premiere Environmental & Industrial Hygiene Services since 1986"*

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925.808.6700
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October 16, 2018 Project 2054.2000

Mr. Steve Keyser
COO and VP of Engineering
3090 Sterling Circle Suite 102
Boulder, Colorado 80301

**Subject: Environmental Compatibility Testing of Brock Organic Infill**

Dear Mr. Keyser:

Millennium Consulting Associates (Millennium) is pleased to submit this letter report to Brock International (Brock) regarding environmental compatibility testing of a softwood-based organic infill.

## PROJECT UNDERSTANDING

Brock has developed a softwood-based organic infill for use in synthetic turf systems. Brock has requested that Millennium perform an environmental compatibility analysis to determine if the infill has the potential to impact human health through direct exposure or the potential to degrade groundwater whose beneficial uses include municipal water supply or to degrade surface water whose beneficial uses include freshwater aquatic habitat. This analysis will also address if the infill may have any end-of-life waste disposal concerns.

## LABORATORY ANALYSIS

### Total Pesticides

A sample of the organic infill was shipped under chain-of-custody to Pacific Agricultural Laboratory (PAL) of Sherwood, Oregon. PAL analyzed the sample for a comprehensive profile of approximately 250 pesticide residues using AOAC Method 2007.01 (Pesticide Residues in Foods by Acetonitrile Extraction and Partitioning with Magnesium Sulfate; Quechers Method). No pesticide residues were detected above the method limit of quantitation (LOQ). No analytical problems were encountered.

### Total Chlorinated Acidic Herbicides

The organic infill was analyzed by PAL for total chlorinated acidic herbicide residues using FDA PAM II Method 180.292 (GC-MS/MS). No chlorinated acidic herbicide residues were detected above the method LOQ. No analytical problems were encountered.

### Total CAM 17 Metals and Hexavalent Chromium

A sample of the organic infill was shipped under chain-of-custody to McCampbell Analytical of Pittsburg, CA. The organic infill was extracted using EPA Method 3050B (Acid Digestion of Sediments, Sludges, and Soils) and analyzed for total CAM 17 metals using EPA Method 6020 (Inductively Coupled Plasma – Mass Spectroscopy; ICP-MS). The organic infill was also extracted using EPA Method 3060A (Alkaline Digestion for Hexavalent Chromium) and analyzed for hexavalent chromium using EPA Method 7199 (Determination of Hexavalent Chromium in Drinking Water, Groundwater, and Industrial Wastewater Effluents by Ion

Chromatography).Table 1 compares the results of total metals testing to guideline values developed for the protection of human health and threshold values for the characterization of hazardous waste. No metals were detected above guideline values for the protection of human health or threshold values for the characterization of hazardous waste. No analytical problems were encountered.

**Leachable CAM 17 Metals and Hexavalent Chromium**

The organic infill was extracted using EPA Method 1312 (Synthetic Precipitation Leachate Procedure; SPLP) with deionized water and analyzed for the CAM 17 suite of metals using EPA Method 6020. The organic infill will be extracted using EPA Method 1312 with deionized water and analyzed for hexavalent chromium using EPA Method 7199. Table 2 compares the results of leachable metals with target leachate concentrations developed for the protection of surface water and groundwater whose beneficial uses include municipal water supply and cold freshwater aquatic habitat. No metals were detected above laboratory reporting limits and all laboratory limits were below their respective target leachate concentrations.

**Leachable Semi-Volatile Organic Compounds including Phenols**

The organic infill was extracted using the Synthetic Precipitation Leachate Procedure (SPLP; EPA Method 1312) with deionized water. The extract was analyzed for semi-volatile organic compounds including phenols using EPA Method 8270C (Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectroscopy (GC/MS). No semi-volatile organic compounds were detected above the method detection limit. The laboratory control spike (LCS)/laboratory control spike duplicate (LCSD) for N-Nitrosodi-n-propylamine were slightly outside of control limits. This qualifier does not affect the validity of the results.

**DISCUSSION**

Total pesticide and chlorinated acidic herbicide residues were not detected above the method limit of quantitation in the softwood-based organic infill. The infill does not contain concentrations of total heavy metals that exceed guideline values for the protection of human health or threshold values for the characterization of hazardous waste. Leachable heavy metals from the infill were not detected above the method detection limit.

Sincerely,

Millennium Consulting Associates

REGISTERED PROFESSIONAL ENGINEER
DAVID M. TETER
C 82380
Exp. 3/31/2020
CIVIL
STATE OF CALIFORNIA

David Teter, PhD, PE, QSD
Director, Engineering and Environmental Services

Attachments:
Tables 1-2
Laboratory Analytical Reports

May 22, 2020

By email: Chris@HuntressAssociates.com

Mr. Christian Huntress
Huntress Associates, Inc.
17 Tewksbury Street
Andover, MA 01810

Re: Proposal for Environmental Consulting Services
Martha's Vineyard Regional High School

Dear Mr. Huntress:

***Cooperstown Environmental LLC*** (Cooperstown) is pleased to provide you with this scope of work and cost proposal to provide Environmental Consulting Services at the site of the Martha's Vineyard Regional High School (MVRHS) in Oak Bluffs, MA (the Site). This letter proposal provides our proposed scope, schedule, and budget to complete the work described herein.

**PROJECT UNDERSTANDING**

We understand that Huntress Associates, Inc. (HAI) was engaged in 2018 to develop a Master Plan for athletic field improvements at the MVRHS. HAI submitted the Master Plan to MVRHS in January 2019 with the installation of a synthetic turf multi-purpose athletic field selected as the preferred alternative. HAI proposed that the field be constructed using Greenfields USA MX Elite woven synthetic turf carpet, Brock BrockFill engineered wood infill, and a Brock YSR shock pad. The MVRHS School Committee subsequently voted 5-4 to approve the Master Plan.

Based on information that you have provided we also understand that the following environmental conditions have been identified:

- The proposed synthetic turf athletic field is not located adjacent to any Massachusetts Department of Environmental Protection (MassDEP)-delineated wetlands, including marshes, wooded swamps, or salt marshes. Therefore, no impact of stormwater effluent from the field to wetlands is expected.
- The proposed turf field is located at the boundary between the Lagoon Pond Watershed and the Sengekontacket Pond Watershed. The distance from the field to Upper Lagoon Pond is approximately 0.75 miles, and to Sengekontacket Pond is approximately 1.0 mile. Therefore, no impact of stormwater effluent from the field is expected to either Lagoon Pond or Sengekontacket Pond.
- A portion of the proposed turf athletic field is located within a MassDEP Zone II Wellhead Protection Area (WPA; Zone II #212). This Zone II WPA is for the protection of the Oak Bluffs Water District Farm Neck Road Wellfield, which is located approximately 2.2 miles downgradient of the field. Therefore, no impact of stormwater effluent from the field to the wellfield is expected. Because the Town of Oak Bluffs has a Water Resource Protection Overlay District (WRPOD), however, construction of the field requires a Special Permit from the Oak Bluffs Planning Board.
- Contamination from a group of chemicals known as Perfluoroalkyl and Polyfluoroalkyl substances, or PFAPFASas been identified in the Long Pond, Homer Pond, and Watcha Pond Watersheds. Activated-carbon treatment systems have been installed in at least 40 private wells

to remove PFAS from groundwater. The source of the PFAS contamination is from PFAS-containing aqueous film-foaming foam (AFFF) used at the Martha's Vineyard Airport. No potential impact of stormwater effluent from the field to these PFAS-affected watersheds is expected.

Finally, we understand that the Martha's Vineyard Commission (MVC) has expressed concern regarding potential human health risks and potential groundwater contamination associated with the products and materials, including the synthetic turf, infill, and resilient pad, comprising the turf system being proposed for use at MVRHS.

**SCOPE OF SERVICES**

*Task 1 – Develop Acceptance Testing Protocols and Guideline Values*

We propose to develop acceptance testing protocols and guideline values for the impact to human health via exposure to the turf system from inhalation, ingestion, and direct (dermal) contact as well as for the potential impact on groundwater quality from the turf. Guideline values for human exposure will be developed with reference to standards issued by the United States Environmental Protection Agency (EPA), the Massachusetts Department of Environmental Protection (DEP), the Massachusetts Contingency Plan (MCP), or other recognized standards. The acceptance testing protocols, and guideline values will be developed for total and leachable metals (MCP 14 metals and hexavalent chromium), total and leachable polycyclic aromatic hydrocarbons (PAHs), and total and leachable PFAS.

*Task 2 – Laboratory Testing of Synthetic Turf Components*

We will oversee laboratory testing of the three components of the turf system (carpet, shock pad, and infill). Specifically, we will request the manufacturers direct-ship virgin product samples to Alpha Analytical Laboratory (Alpha) of Westborough, MA using chain-of-custody protocols as follows:

- Greenfields MX Elite Woven Synthetic Turf Carpet (1 square foot)
- Brock YSR Shock Pad (1 square foot)
- Brock BrockFill Organic Infill (1 kilogram)

Under contract to Cooperstown, we will request that Alpha analyze each sample as follows:

- Total MCP 14 metals and hexavalent chromium using EPA Methods 6020B, 7471B, and 7196A;
- Leachable MCP 14 metals and hexavalent chromium using EPA Methods 1311, 6020B, 7471B, and 7196A;
- Total PAHs using EPA Method 8270D-SIM (where possible, dependent on whether the sample can be dissolved by the extraction process);
- Leachable PAHs using EPA Methods 1311 and 8270D;
- Total PFAS (24 compounds) by EPA Method 537M (where possible, dependent on whether the sample can be dissolved by the extraction process); and
- Leachable PFAS (24 compounds) by EPA Methods 1312 and 537M.

The laboratory analyses will be requested for a standard turnaround time of 10 business days, however, because PFAS analyses are sometimes delayed due to high demand at the lab, this time is not guaranteed.

*Task 3 – Baseline Testing of Soil and Groundwater*

Baseline testing of current conditions at the field site including both soil and groundwater quality would be useful for identifying existing levels of potential contaminants in soil and groundwater so that future risks to human health and groundwater quality may be assessed and measured over time in order to quantify impacts of the turf. This testing should be completed prior to construction.

Following standard MassDEP sampling protocols, we will collect four surficial (0-1 foot depth) grab soil samples from the area where the field will be installed and analyze each sample for:

- Total MCP 14 metals and hexavalent chromium using EPA Methods 6020B, 7471B, and 7196A;
- Total PAHs using EPA Method 8270D-SIM; and
- Total PFAS (24 compounds) by EPA Method 537M.

As a cost-saving measure, we could collect the four grab samples and composite them into one laboratory sample.

We will utilize the existing monitoring well at the site and collect a sample of groundwater using low-flow sampling protocols and analyze the sample for:

- Dissolved MCP 14 metals and hexavalent chromium using EPA Methods 6020B, 7471B, and 7196A;
- Total PAHs using EPA Method 8270D-SIM; and
- Nitrates using EPA Method 353.2.

If the existing monitoring well is not available or if improperly located, we would discuss with you a revised proposal to install one or more wells.

All samples would be analyzed by Alpha using standard turnaround time of 1-2 weeks.

*Task 4 – Risk Characterization*

Cooperstown will compare the laboratory analytical results for the product samples and soil and groundwater samples to the risk-based guideline values developed in Task 1 to assess the potential risks under both current and proposed conditions to human health and the groundwater resource.

*Task 5 – Report*

Cooperstown will produce a summary report describing the work conducted, the analytical data, the results of the risk characterization, and recommended next steps, if any.

*Task 6 – Project Support*

Upon your request, Cooperstown would be available to conduct further engineering support, Licensed Site Professional (LSP) Services, presentations at public meetings, assistance with public outreach, or other associated tasks.

**COST ESTIMATE**

We propose a time and materials billing approach, invoicing per our hourly labor billing rates plus direct expenses, which are billed at cost plus fifteen percent. The estimated budget for this work is $15,000 - $20,000 and we would communicate with you regarding any potential exceedances of this budget estimate. We request a retainer of $3,000. Invoices are issued monthly and are due upon receipt.

Please authorize this proposal below and the attached contract and return both with the retainer. We look forward to assisting you on this project.

Very sincerely yours,
***Cooperstown Environmental LLC***

James T. Curtis

James T. Curtis, P.E., LSP
President

Accepted by: ______________________

Title: ______________________

For: ______________________

Date: ______________________

# Attachment 2

"Sharon High School Synthetic Turf Environmental Compatibility Testing Results," by David Teter Consulting, dated January 20, 2020

DAVID TETER CONSULTING

January 20, 2020

Mr. Christopher Blessen, AIA, LEED AP
Principal
Tappé Architects
Six Edgerly Place
Boston, Massachusetts, 02116

**RE: Sharon High School Synthetic Turf Environmental Compatibility Testing Results (DRAFT)**

Dear Mr. Blessen:

David Teter Consulting (Consultant) has prepared this letter report to present the results of testing of FieldTurf Vertex, FieldTurf Vertex Prime, and Sprinturf 46 ounce (oz) Dual Fiber DFE synthetic turf carpets for total and leachable non-polymeric per- and polyfluoroalkyl substances (PFAS), total and leachable metals, total polycyclic aromatic hydrocarbons (PAHs), and leachable semi-volatile organic compounds (SVOCs). Recent testing results analyzing BrockFill organic infill and the Brock pad for total and leachable metals, total PAHs, and leachable SVOCs are also included for completeness.

## BACKGROUND AND SITE CONCEPTUAL MODEL

The Town of Sharon is evaluating the installation of a new synthetic turf athletic field at the Sharon High School. Although there has been concern that chemicals leaching from the synthetic turf field could affect one or several of the six groundwater extraction wells operated by the Town of Sharon, the site of the proposed field does not lie within does not lie within a Massachusetts Department of Environmental Protection (MassDEP) Zone II wellhead protection zone because it is in a different drainage sub-basin than any of the wells. Nevertheless, for the purposes of this report, the aquifer underlying the site will be considered to be a potential source of future drinking water and detected concentrations of leachable chemicals of potential concern from the carpets, infill, and pad will be compared to the Massachusetts Contingency Plan (MCP) GW-1 numerical standards for groundwater whose beneficial uses include municipal water supply

The site of the proposed field is adjacent to a wooded swamp deciduous wetland and part of the field falls within the 100-foot buffer surrounding the wetland. The site is also 500 feet to the north of Lake Massapoag. The detected concentrations of leachable chemicals of potential concern from the carpets, infill, and pad will be compared to the MCP GW-3 numerical standards for groundwater which flows into surface waters and could impact aquatic habitat.

Finally, the potential direct contact exposure of chemicals to student athletes will be evaluated. The concentrations of total metals and polycyclic aromatic hydrocarbons (PAHS) in carpets, infill, and pad will be compared to the MCP S-1 numerical soil standards for unrestricted (residential) use.

## SYNTHETIC TURF CARPET SAMPLING AND ANALYSIS

FieldTurf and Sprinturf shipped 1-square-foot samples of FieldTurf Vertex, FieldTurf Vertex Prime, and Sprinturf 46-oz Dual Fiber DFE synthetic turf carpets to ALS Environmental

1662 CLAY STREET, SAN FRANCISCO, 94109 (415) 889-8875 DAVID@DAVIDTETERCONSULTING.COM

# Summary of Comments on Microsoft Word - 20200120 Sharon High School Turf Testing Results_DRAFT_TEXT.docx

## Page: 1

Number: 1 Author: debbietatro Subject: Highlight Date: 1/27/20, 9:42:17 AM

Note that the presence of polymeric PFAS has not been analyzed. Reports of high total fluorine levels in artificial turf are highly indicative of the presence of PFAS, and some of this fluorine could be associated with polymeric PFAS. Polymeric PFAS can generate non-polymeric PFAS after 8 years of aging & weathering, with nearly constant exposure to UV light, and cyclical, sometimes rapid and extreme, temperature changes. Total fluorine levels should have been measured to determine the potential level of polymeric PFAS.

Number: 2 Author: debbietatro Subject: Highlight Date: 1/27/20, 9:58:23 AM

DEP Zone I & II delineations do not agree with other ground water studies in the Town of Sharon, including: 1) ground water contour lines determined in the Horsley Witten Group 2012 Cedar Swamp study; 2) Aquifer Protection Study,1987; and 3) Haley & Aldrich, Inc. ground water study. As shown by the contour lines from the Cedar Swamp study, rain falling and passing through the turf field could flow with the groundwater, downgradient to wells 2-4, particularly well 4. Excess rain water falling on the field could flow through a drainage ditch to our Lake Massapoag swimming beach.

Number: 3 Author: Helen.Poynton Subject: Sticky Note Date: 1/27/20, 9:59:04 AM

I would also like to comment that the risk analysis conducted here only includes chemical analysis of known target chemicals. Within ecotoxicology, the limitations of chemical analysis are well acknowledged and therefore a suite of toxicity tests have been developed to account for unknowns or other chemicals that were not directly measured. This could help to overcome the issue of only measuring a subset of the potential 5000 different PFAS chemicals in production. To understand risk to aquatic life, I would have recommended a series of toxicity tests on crustaceans and fish. To understand human health risks, I would have recommended a series of molecular and developmental toxicity tests including a zebrafish embryo developmental test that is very sensitive to PFAS.

In the absence of this toxicity data, the true risk to aquatic life and human health is unknown. At the meeting, the consultant recognized this and agreed with me that only through toxicity testing can the risk be fully assessed. Therefore, I believe that we need to invoke the Precautionary Principle and reject the artificial turf until it can be proven to be safe.

(The limitation of chemical analysis and the development of molecular assays for toxicity testing was the topic of my PhD dissertation from UC Berkeley. I would be happy to answer any additional questions the committee has on this topic: helen.poynton@umb.edu.)

Number: 4 Author: debbietatro Subject: Highlight Date: 1/27/20, 10:01:15 AM

Only new turf was tested. It was crucial for the purposes of this report for the consultant to test older turf that had been subjected to 8 years of UV irradiation and temperature changes, which breaks down the structure of the polyethylene blades and carpet backing, and can generate non-polymeric PFAS from polymeric PFAS.

(Laboratory) of Kelso, Washington under standard chain-of-custody protocols. ALS Environmental analyzed the synthetic turf carpet samples for the following:

- Total PFAS (30 compounds) by U.S. Environmental Protection Agency (EPA) Method 537 Modified (537M);
- Leachable PFAS (30 compounds) by EPA Methods 1312 (Synthetic Precipitation Leachate Procedure; SPLP) and EPA Method 537M;
- Total CAM 17 metals and hexavalent chromium by EPA Methods 6020A, 7196A, and 7471B;
- Leachable CAM 17 metals and hexavalent chromium by EPA Methods 1312, 6020A, 7196A, and 7471B;
- Total PAHs by EPA Method 8270D in selected ion monitoring (SIM) mode; and
- Leachable SVOCs by EPA Methods 1312 and 8270D.

Deionized (DI; EPA Method 1312 extraction fluid #3) reagent water was used instead of EPA Method 1312 extraction fluid #1 because it has been the Consultant's experience that DI water is more effective at leaching soluble organic compounds from the synthetic turf matrix and that the reason for using the extraction fluid #3 no longer exists; acid rain has been essentially eliminated due to the installation of mandated sulfur dioxide scrubbers at coal-fired power plants and the ongoing decommissioning of coal-fired power plants with non-acid rain producing sustainable power and natural gas turbine and combined cycle power plants.

No significant issues were identified by the laboratory during the analyses that significantly affected the quality of the sample data and no corrective actions were deemed to be necessary. The leachable concentration of bis(2-ethylhexyl) phthalate (DEHP) in the SPLP extraction fluid from the FieldTurf Vertex carpet was determined to be "biased high" due to the presence of non-target background components in the chromatogram. At the time of the issuing of this draft report, we are still awaiting the hexavalent chromium and quality assurance/quality control (QA/QC) results for the Sprinturf 46-oz Dual Fiber DFE synthetic turf carpet.

## SYNTHETIC TURF CARPET PFAS TESTING RESULTS

As shown in Table 1, no concentrations of total PFAS were detected above the method detection limit in any of the synthetic turf carpets. As shown in Table 2, no concentrations of leachable PFAS were detected above the method detection limit in any of the SPLP extraction fluids.

## SYNTHETIC TURF CARPET TOTAL METALS AND PAHs TESTING RESULTS

As shown in Table 3, no detected concentrations of total metals or PAHs were found to exceed the MCP S-1 numerical soil standards for unrestricted (i.e. residential) use.

## SYNTHETIC TURF CARPET LEACHABLE METALS AND SVOCs TESTING RESULTS

As shown in Table 4, no concentrations of leachable metals or SVOCs were found to exceed the MCP GW-1 numerical standards for drinking water. The detected concentration of DEHP in the SPLP extraction fluid from the FieldTurf Vertex carpet was 6.2 micrograms per liter (µg/L) which exceeds the MCP GW-3 numerical standard of 6.0 µg/L. It is the Consultant's opinion that this exceedance is not significant as the laboratory QA/QC narrative notes that the detected

# Page: 2

Number: 1 Author: debbietatro Subject: Highlight Date: 1/27/20, 10:01:27 AM

COC protocols were not followed for FieldTurf products. See FieldTurf PFAS and non PFAS reports, page 10,

Number: 2 Author: debbietatro Subject: Highlight Date: 1/27/20, 10:57:03 AM

Were the blades and backing combined and extracted together? If so, PFAS present in only one of the components would be diluted by combining the materials, and could have contributed to the finding of undetectable. The turf backing and blades should have been analyzed separately. PFAS has been reported in both the blades and the backing.

Number: 3 Author: debbietatro Subject: Highlight Date: 1/27/20, 10:08:55 AM

What solvent was used for the extraction? Since there are no EPA-approved modifications of EPA method 537 (which is for drinking water), was the % recovery of PFAS from polyethylene and/or backing material evaluated in control tests?

Number: 4 Author: debbietatro Subject: Highlight Date: 1/26/20, 9:25:57 AM

This is insufficient reasoning for using DI water. Since the client's concern is primarily the presence of PFAS in the turf, we need to see validation studies showing a comparison of the amount of PFAS found leachable from plastic with pH 4.2 (Extraction Fluid #1, which is recommended for areas of the country east of the Mississippi River) vs. deionized water extraction fluid. In addition, metals are much more soluble at lower pH and so the reported values do not represent total leachable metals from rain water.

Number: 5 Author: debbietatro Subject: Highlight Date: 1/26/20, 9:20:37 AM

Extraction fluid #3 was used, so not sure why the stated rationale is: the reason for using extract fluid #3 no longer exists.

Number: 6 Author: debbietatro Subject: Highlight Date: 1/26/20, 9:21:55 AM

Deionized water was used instead of pH 4.2 water. The rationale for using deionized water is not correct: Acid rain has been reduced not eliminated: rain water pH varies between 5 and 5.5. Because pH is measured on a logarithmic scale, pH 5 is 100 times more acidic than pH 7.

Number: 7 Author: debbietatro Subject: Highlight Date: 1/25/20, 12:07:31 PM

The testing is extremely limited. There are 5000+ PFAS chemicals, so only about 0.6% of them have been tested. The study is 99% incomplete. The consultant should have tested and reported the levels of total fluorine which have been reported to be 40-220 parts per million in artificial turf. This is over 1 million times the proposed drinking water standard for PFAS. Because of the absence of specific testing for >4,900 PFAS chemicals, total fluorine is currently the gold standard test for PFAS testing, and the presence of fluorine is currently interpreted to indicate a very high probability of the presence of PFAS. The consultant's approach, to not measure and report total fluorine, is biased.

Number: 8 Author: Helen.Poynton Subject: Sticky Note Date: 1/26/20, 10:07:34 AM

Because of the proximity to Lake Massapoag and the potential for surface water run-off from the field and the storm drain that flows directly in the Lake Massapoag, I would have rather seen that these results were compared with Aquatic Water Criteria, and not Ground water standards. The Aquatic Water Criteria are established by the US EPA to protect aquatic life and tend to be 100 to 1000 times lower than the ground water standards. I am particularly concerned about the levels of Zn measured in the artificial turf leachate tests and have commented below.

concentration of DEHP SPLP extraction fluid from the FieldTurf Vertex carpet was "biased high" due to the presence of non-target background components in the chromatogram. Furthermore, DEHP has an organic carbon to water partition coefficient ($K_{oc}$) of approximately $10^5$ and would not be mobile in groundwater. The GW-1 numerical standard for DEHP would increase from 6 μg/L to 1,500 μg/L if it were to take into account the surface water dilution factor ($D_{sw}$) and groundwater dilution factor ($D_{gw}$) used to determine the GW-3 numerical standard for DEHP.

## CONCLUSIONS

It is the Consultant's opinion that the installation of any of the three proposed synthetic turf carpets combined with the use of BrockFill infill and a Brock shock pad will not pose an elevated risk to either aquatic habitat or human health. Furthermore, the use of the proposed synthetic turf system has other potential benefits, including:

- A potential reduction in the amount of nutrients (nitrates and phosphates) to the wooded swamp deciduous wetland to the west of Sharon High School and to Lake Massapoag;
- the elimination of the use of pesticides and herbicides and the potential reduction of these compounds to the wetland and lake; and
- the elimination of direct contact exposure to potential carcinogenic (naturally occurring arsenic and anthropogenic PAHs) and non-carcinogenic (aerially deposited lead) chemicals of concern in surficial soil at the proposed synthetic turf athletic field.

## CLOSING

I appreciate the opportunity to work with you on this project. Should you have any questions or require additional information, please do not hesitate to contact me at (415) 889-8875 or at david@davidteterconsulting.com.

Sincerely,

David Teter, PhD, PE
Principal Engineer

**Enclosures**
Table 1 – Total PFAS Testing Results for Synthetic Turf Carpets
Table 2 – Leachable SPLP PFAS Testing Results for Synthetic Turf Carpets
Table 3 – Total Metals and PAHs for Synthetic Turf Carpets, BrockFill, and Brock Pad
Table 4 – Leachable Metals and SVOCs for Synthetic Turf Carpets, BrockFill, and Brock Pad

# Page: 3

Number: 1 Author: debbietatro Subject: Highlight Date: 1/25/20, 12:08:06 PM

Inappropriate comment. Organic grass maintenance is proposed, and nutrients will be provided as needed by testing the soil, so would not be excessive.

Number: 2 Author: debbietatro Subject: Highlight Date: 1/25/20, 12:08:14 PM

Inappropriate comment: Use of pesticides and herbicides are recommended by artificial turf manufacturers for use on artificial turf.

Number: 3 Author: debbietatro Subject: Highlight Date: 1/25/20, 10:59:03 AM

Inappropriate comment:  The consultant has not tested our soil, so does not know that carcinogenic compounds exist naturally in our soil.

*TABLE 1 - Total PFAS results for the tested synthetic turf carpets by EPA Method 537(M). All results are in parts per billion.*

| Analyte Class | Analyte Name | FieldTurf Vertex | FieldTurf Vertex Prime | SprintTurf 46-oz DFE |
|---|---|---|---|---|
| Perfluoroalkane Sulfonic Acids | Perfluorobutane sulfonic acid (PFBS) | < 0.22 U | < 0.22 U | < 0.22 U |
| | Perfluoropentane sulfonic acid (PFPeS) | < 0.17 U | < 0.17 U | < 0.17 U |
| | Perfluorohexane sulfonic acid (PFHxS) | < 0.30 U | < 0.30 U | < 0.30 U |
| | Perfluoroheptane sulfonic acid (PFHpS) | < 0.062 U | < 0.062 U | < 0.062 U |
| | Perfluorooctane sulfonic acid (PFOS) | < 0.13 U | < 0.13 U | < 0.13 U |
| | Perfluorononane sulfonic acid (PFNS) | < 0.16 U | < 0.16 U | < 0.16 U |
| | Perfluorodecane sulfonic acid (PFDS) | < 0.17 U | < 0.17 U | < 0.17 U |
| Perfluoroalkane Carboxylic Acids | Perfluorobutanoic acid (PFBA) | < 0.39 U | < 0.39 U | < 0.39 U |
| | Perfluoropentanoic acid (PFPeA) | < 0.21 U | < 0.21 U | < 0.21 U |
| | Perfluorohexanoic acid (PFHxA) | < 0.31 U | < 0.31 U | < 0.31 U |
| | Perfluoroheptanoic acid (PFHpA) | < 0.19 U | < 0.19 U | < 0.19 U |
| | Perfluorooctanoic acid (PFOA) | < 0.13 U | < 0.13 U | < 0.13 U |
| | Perfluorononanoic acid (PFNA) | < 0.33 U | < 0.33 U | < 0.33 U |
| | Perfluorodecanoic acid (PFDA) | < 0.26 U | < 0.26 U | < 0.26 U |
| | Perfluoroundecanoic acid (PFUnDA) | < 0.18 U | < 0.18 U | < 0.18 U |
| | Perfluorododecanoic acid (PFDoDA) | < 0.27 U | < 0.27 U | < 0.27 U |
| | Perfluorotridecanoic acid (PFTrDA) | < 0.21 U | < 0.21 U | < 0.21 U |
| | Perfluorotetradecanoic acid (PFTeDA) | < 0.18 U | < 0.18 U | < 0.18 U |
| Perfluoroalkyl Sulfonamides | Perfluorooctane sulfonamide (FOSA) | < 0.067 U | < 0.067 U | < 0.067 U |
| | N-Methyl perfluorooctane sulfonamide (MeFOSA) | < 0.073 U | < 0.073 U | < 0.073 U |
| | N-Ethyl perfluorooctane sulfonamide (EtFOSA) | < 0.11 U | < 0.11 U | < 0.11 U |
| | N-Methyl perfluorooctane sulfonamidoethanol | < 0.054 U | < 0.054 U | < 0.054 U |
| | N-Ethyl perfluorooctane sulfonamidoethanol | < 0.088 U | < 0.088 U | < 0.088 U |
| | N-Methyl perfluorooctane sulfonamidoacetic acid | < 0.27 U | < 0.27 U | < 0.27 U |
| | N-Ethyl perfluorooctane sulfonamidoacetic acid | < 0.20 U | < 0.20 U | < 0.20 U |
| (n:2) Fluorotelomer Sulfonic Acids | 4:2 Fluorotelomer sulfonic acid (4:2 FTS) | < 0.088 U | < 0.088 U | < 0.088 U |
| | 6:2 Fluorotelomer sulfonic acid (6:2 FTS) | < 0.15 U | < 0.15 U | < 0.15 U |
| | 8:2 Fluorotelomer sulfonic acid (8:2 FTS) | < 0.029 U | < 0.029 U | < 0.029 U |
| | 10:2 Fluorotelomer sulfonic acid (10:2 FTS) | < 0.036 U | < 0.036 U | < 0.036 U |

Notes and Abbreviations

PFAS: Per- and Polyfluoroalkyl Substances

SPLP: Synthetic Precipitation Leachate Procedure

U: Not Detected Above the MDL (the MRL is equivalent to the MDL for this method)

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Number: 1 Author: debbietatro Subject: Highlight Date: 1/27/20, 10:58:51 AM

The units are meaningless without an indication of how much material they apply to. Is it per 85,000 sq ft of turf (football field size)? Per sq ft of turf? Per gram of turf? In other words, <220 parts per trillion per gram of turf could still be significant PFAS given that PFAS is toxic at parts per trillion, and there are a lot of grams of material in a football field.

# Attachment 3

"PFAS in Brock products" email from Brock USA, LLC, dated October 23, 2019

**October 23, 2019**

**Subject:** PFAS in Brock products

To whom it may concern:

Brock products (Powerbase and SP underlayment pads, and BrockFILL infill) do not contain perfluoroalkylated substances (PFAS). PFAS have historically been used in firefighting foams for petroleum fires, protective coatings, and treatments for textile products to impart stain and water resistance.

PFAS are not added to the raw materials used to make Brock products, nor are they added or used during the manufacturing processes for any of Brock's products. Brock's infill product, BrockFILL, is made from virgin southern yellow pine wood from U.S. forests. No PFAS are added to the wood used for BrockFILL at any point during the manufacturing process. Brock's pad products are made from expanded polypropylene (EPP). The attached certificate from our material supplier certifies that the EPP used for Brock products does not contain PFAS, including PFOA and PFOS, above the relevant reportable threshold limits. Additionally, the base resins used to produce the EPP used for Brock products are permitted by the FDA for use in food contact applications for food types identified in Categories I through IX of Table 1, under conditions of use B through H of Table 2 in 21 CFR 176.170(c), as outlined in the other attached certification from Brock's material supplier.

We hope this letter meets your needs. Please contact Brock if you have additional questions.

Regards,

Tom Murphy, Ph.D.
Senior Materials Engineer
Brock USA, LLC

# Attachment 4

Extracted from Master Plan.

"Potential for Synthetic Turf Field to Affect Groundwater at Concord-Carlisle High School, Concord MA," by Haley Aldrich, dated July 2015 www.haleyaldrich.com

**REPORT ON**

# POTENTIAL FOR SYNTHETIC TURF FIELD TO AFFECT GROUNDWATER CONCORD-CARLISLE HIGH SCHOOL CONCORD, MASSACHUSETTS

by Haley & Aldrich, Inc.
Bedford, New Hampshire

for Concord Carlisle At Play
Concord, Massachusetts

File No. 42185
July 2015

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# 1. Introduction

Concord-Carlisle At Play, Inc. (CCAP) is in the final stages of the development of an outdoor athletic complex that will be one of the highlights of the new Concord-Carlisle Regional High School (CCRHS). CCAP enlisted the services of Gale Associates, Inc. to provide a comprehensive analysis of what will be required for the proposed athletic complex (Gale, 2013). Their report covered all aspects of development including alternative strategies, planning, permitting, renovation, construction and environmental considerations/concerns. They concluded that the choice of a new synthetic turf field ("Option 2") would be the most effective alternative in terms of both playing efficiency (750 times/year) and long term costs. The selection of a synthetic turf field that has already met the approval of both the Concord Natural Resources Commission ("CNRC"), Board of Health ("BoH"), Concord Public Works ("CPW"), and the town residents (via a majority vote at a Concord Town Meeting on April 14th 2015).

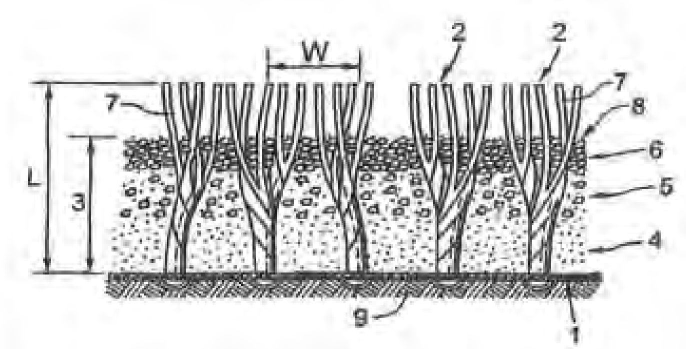
Synthetic turf fields in Concord are not a new development. The existing athletic facilities at CCRHS already have two multi-purpose synthetic turf fields, and Middlesex School constructed two synthetic turf fields in 2010. Additionally, the new synthetic field (installed in 2011) at the Fenn School was controversial (for similar reasons), but regular monitoring at that facility over 4 years has shown no impacts to the environment. Despite these precedents, the Town of Concord is always proactive in terms of maintaining a high level of environmental stewardship. The Town of Concord Zoning Board of Appeals ("ZBA"), in concert with CPW and BoH, has requested CCAP to ensure that the new facility presents *de minimus* risk to the environment. More specifically, they have requested that the "synthetic turf field material (all colors) and rubber infill are free of heavy metals and hazardous materials" and that stormwater "leachate is free of heavy metals or hazardous materials from the synthetic turf material and rubber infill in compliance with all applicable laws, regulations and standards of practice." These stipulations can be found in Condition #7 of the Special Permit issued by the ZBA dated May 2, 2014 (the "Special Permit Documentation" – Appendix A).

As synthetic turf fields have been in existence for over three decades, there is considerable evidence, as documented through both national and regional reviews, that both the turf fiber and the crumb rubber infill (used as a shock-absorbing ballast) presents a insignificant exposure and *de minimus* risk to humans and the surrounding environment (Cheng *et al*., 2014; RMA, 2013; Lioy and Weisel, 2011; Simon, 2010). Because the location of this field is above an aquifer that is classified as a potential drinking water source, the Town of Concord has requested additional information as to whether the presence of the new field may impact underlying groundwater. The purpose of this paper, therefore, is to collate existing case studies that are applicable to the effect of synthetic turf on groundwater and to present whether the overall "weight-of-evidence" is sufficient to warrant any concern at CCRHS.

# 2. Synthetic Turf Design

Gale Associates recently provided CCAP with extensive documentation necessary to fulfill the requirements of the Special Permit, including specifications for the synthetic turf field carpet (Appendix B) and certifications by Sprinturf, the provider contracted to supply and install the synthetic turf system, that provides a guarantee that the plastic turf will be lead free and the crumb rubber infill will have no adverse effect on groundwater (Appendix C). This letter was intended to assure CCAP that the design, construction and materials that will be performed and/or installed at CCRHS will conform to strict industry performance standards.

The proposed system consists of an "above ground" playing surface component (i.e., plastic backing and turf blades; crumb rubber infill) and a "below ground" component (i.e., base layers that consist of drainage matting). The following is an artist's rendering of a typical cross section of a segment of synthetic turf (Gale, 2013):




Because both the plastic components of the carpet and the crumb rubber infill are polymers, almost all of the chemicals used in making the turf are bound up in the polymer matrix (i.e. plastic or rubber) and therefore not "bioavailable" (i.e., cannot be absorbed by humans playing on the field). Additionally, Sprinturf, in order to maintain a quality product and meet industry standards, will copiously wash and rinse all of the turf materials to ensure that they meet the requirements of the American Society for Testing and Materials ("ASTM"). This is to ensure that the material meets the specifications provided to CCAP (Appendix B). For example, the plastic turf blades must be certified as "lead free" prior to the installation and the crumb rubber infill needs to be less than 0.005% free metal content measured in accordance with the ASTM D 5603 7.3.2.

## 3. Regulatory Framework

At CCRHS, the aquifer below the proposed athletic facility is within the Hugh Cargill well field and thereby classified as a Zone II resource. The Massachusetts Contingency Plan thereby applies "GW-1" groundwater standards (310 CMR 40.0974(2)) to this aquifer as it can act as either a current drinking water resource (e.g., within a Zone II of a public water supply) or a potential future source of drinking water. Standards that would apply to metals and organic compounds in groundwater for this classification of water are located in Subpart B entitled "Massachusetts Oil and Hazardous Material List."[1]

The GW-1 standards are similar to, or in some cases more stringent than, the Maximum Contaminant Levels[2] that have also been promulgated to protect the health of humans, particularly children who are more sensitive to environmental contamination (pound for pound, they will receive a bigger "dose" than an adult). Concentrations at or below these levels are safe for drinking water. The MCLs listed in the drinking water regulations (310 CMR 22.00) of Massachusetts Drinking Water Regulations (310 CMR

[1] http://www.mass.gov/eea/docs/dep/cleanup/laws/mohmla.pdf

[2] http://www.mass.gov/eea/agencies/massdep/water/drinking/standards/standards-and-guidelines-for-drinking-water-contaminants.html#Standards

22.00) consist of values promulgated by the USEPA as well as some more stringent values developed and enforced by the Drinking Water Program.

## 3.1 ENVIRONMENTAL PERFORMANCE MONITORING

As discussed above, the Board of Appeals has required under Condition #7 of the Special Permit that the following request be addressed:

- Synthetic turf material and rubber infill proposed for installation shall be free of hazardous materials and heavy metals and in compliance with all applicable laws, regulations and standards of practice. **A minimum of two weeks prior to commencement of installation of the Stadium Field Turf in Phase 2**, the Applicant shall provide to the Health Division, CPW Engineering and Water and Sewer Divisions for review and approval specifications and test results (using applicable ASTM testing methods) demonstrating that the synthetic turf field material (all colors) and rubber infill are free of heavy metals and hazardous materials.

- Depending on the review of the specifications and the test results, the Applicant may be required by the Health Division to adopt a monitoring protocol which includes under-draining a section of the field to allow capture of undiluted leachate and testing of the undiluted leachate demonstrating that the leachate is free of heavy metals or hazardous materials from the synthetic turf material and rubber infill in compliance with all applicable laws, regulations and standards of practice.

Although Sprinturf has provided a written guarantee that ensures the field will not contaminate underlying groundwater (Appendix C: Sprinturf Letter of Certification), CCAP has requested that the "lot" of plastic turf and crumb rubber infill that will be used on the CCRHS field undergo both bulk testing (i.e. digestion of the material and analysis for hazardous constituents) as well as extraction under acid conditions to simulate "worse case" conditions like acid rain ("Synthetic Precipitation Leaching Procedure" or "SPLP"). The testing protocol is intended to replicate as nearly as possible the approach taken in the Teter Engineering Report (Appendix D) and can be summarized as follows:

- Lead Testing on Synthetic Turf Fibers ("all colors") - ASTM Method F2765 or equivalent.

- Total Metals Analysis - All samples are to be analyzed for the California Assessment Manual 17/Title 22 list of metals (CAM 17 metals) prepared by the lab for analysis of total recoverable metals by USEPA Method 3052 and analyzed using USEPA Method 6010B/7471B or equivalent.

- Leachable Metals Analysis – Measurement of infill samples should be consistent with the protocol citied in Teter Engineering report for "Leachable metals" using a modified multiple extraction version of the Synthetic Precipitation Leachate Procedure (SPLP). Fluid (leachate) will be analyzed for CAM 17 Metals using EPA Methods 6020B/7471B and Chromium VI using Method 7199 or equivalent. Per the spec sheet the SBR "Shall have less than 0.005% free metal content measured in accordance with the ASTM D 5603 7.3.2".

- Total Semi Volatile Organic Compounds and PAH's - SBR rubber infill samples are to be prepared by the lab for analysis using EPA Method 3550 or 3540 and analyzed for the SW 846 list of SVOC's using EPA Method 8270C or equivalent.

- Leachable SVOC's and PAH's - As detailed in the Teter Engineering Report, a modified multiple extraction version of the SPLP will be used to simulate a steady state leaching of SVOC's and PAH's from the crumb rubber infill.

This testing protocol is rigorous and the most effective way to determine the chemical composition of the actual materials that will be installed at CCRHS. This testing will commence once the materials have been received from Sprinturf and evaluated against the applicable performance criteria discussed below.

### 3.2 EVALUATION OF RISK

The results of the testing of Sprinturf's product for metals and organic compounds (such as PAHs and semi volatile compounds) were evaluated in a risk assessment that compared the levels of chemicals in the tire crumb rubber to health based standards that are known to be safe to both human health and the environment (Appendix D: Teter Engineering Report). This risk assessment tested two samples, considered to be representative of Sprinturf's synthetic field product, for total semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), leachable metals, and leachable SVOCs/PAHs. The risk assessment concluded that:

> "The concentrations of metals detected in the samples fall below the California human health soil screening levels (CHHSLs) for unrestricted land use, which are highly conservative for a recreational use scenario. Although PAHs were detected in both crumb rubber infill samples, the additional cancer risk from exposure during a recreational use scenario is estimated to fall below the EPA *de minimus* risk level of 1E-06. Furthermore, the additional cancer risk from exposure to PAHs in crumb rubber is indistinguishable from the additional cancer risk from exposure to background levels of PAHs and arsenic in rural and urban surface soils. The concentrations of zinc and phenol in the leachate from both crumb rubber samples are below levels required to affect the taste of drinking water."

The conclusions of this conservative risk assessment are important because they show, *a priori*, that constituents in Sprinturf's product will not adversely affect either human health or leach to groundwater.

Following the analysis of the "lot" sampling requested by CCAP, the results will again be compared to risk-based standards. Per the definition in ASTM Standard F2765-09 and D5603, the turf and crumb rubber will be designated as "lead free" if the analysis shows the total concentration to be less than 0.005% lead (50 mg/kg) by weight. The results of the leachate from the modified SPLP testing of the crumb rubber will be also be compared to Target Leachate Concentrations (TLC) which are protective of groundwater. The TLCs are derived by multiplying the Massachusetts GW-1 water quality criteria by a "Dilution Attenuation Factor" (DAF) of 20. In other words, the DAF anticipates that the "worst case" concentration in the stormwater runoff from the field will be diluted by a factor of 20 as it makes its way into the groundwater table.

## 4. Review of the Applicable Weight of Evidence to Determine if Synthetic Turf Affects Groundwater

One of the most effective methods for determining if a particular technology may pose a risk to the environment is to review as many applicable studies as possible and determine the overall weight-of-evidence, i.e. the number of studies that are, in terms of adverse impacts to groundwater, either pro or con. Table 1 presents a comprehensive review of groundwater impacts from both peer-reviewed studies as well as studies published in the grey literature. The table summarizes the purpose of the study, the experimental design, the analytical results for the media tested and a brief summary. The locations of the case studies include two major studies in Europe (France and Switzerland), one in New York, and six sites in New England (ME, VT, CT and MA), including the Fenn School in Concord which has the most robust groundwater monitoring record (quarterly over a 4 year span) of all the studies presented. These studies mainly address the potential for synthetic turf to impact groundwater, although a few reports measure metals and organics in leachate sampled from underdrains, catch basins or stormwater discharge points (chemicals measured in leachate or drainage water would be more elevated, and thus more conservative, than might be expected in groundwater).

## 4.1 CASE STUDIES

Both of the European studies (Bergs, 2007; Moretto, 2007) conclude that there should be no problems with using recycled tires as infill in the "pitches"; none of the EU water quality groundwater or surface water standards were exceeded. Nilson et al. (2008) who conducted laboratory leaching tests of their own that included other types of infill (Netherlands) and also reviewed investigations from Norway and Sweden, concluded that there was "no reason to question the conclusions of the elaborate Swiss, French and Dutch studies that rubber granules from car tyres pose no major environmental risk".

The New York study sampled monitoring wells at four different fields of varying ages. The results, which showed no concentrations above the method detection limits, are very convincing from the standpoint of groundwater protection. The Connecticut study (Malone and MacBroom, 2008) collected stormwater over a period of one year from three different fields and demonstrated that metals would have no adverse impact to groundwater. The study by Sheehan *et al*. (2006) was based on tire scraps used as infill but was a peer-reviewed study that is directly applicable to the effects of subsurface rubber on groundwater quality. This 5 year exposure showed no significant release of metals or organics from tire fill located above the groundwater table.

In 2011, the Fenn School won an adjudicatory hearing which claimed that tire crumb rubber would have adverse effects on the environment. As part of their Special Permit, Fenn agreed to conditions requested by the CNRC to monitor groundwater and stormwater over a 5 year period. Three monitoring wells, one upgradient of the athletic field and two downgradient, were installed in 2011 (Appendix E, Figure 1). These wells have been monitored and analyzed every quarter for the past four years. Conventional water quality parameters (temperature, conductivity, dissolved oxygen, pH and oxidation-reduction potential) were generally within normal ranges for natural groundwaters (Appendix E, Figure 2). Figure 3 (Appendix E) presents trace levels of dissolved cadmium, copper, lead and zinc plotted over time. These metals were all well below the respective MCP standards of 4, 100, 10 and 900 ug/L (Figure 3). Cadmium was rarely detected and when it was, concentrations in all wells stayed within the range in the up-gradient well (0.1 – 0.4 ug/L) during the baseline sampling program (April and May, 2011). Copper was also infrequently observed above the method detection limit and the highest up-gradient concentration of 12 ug/L was never exceeded in either of the down-gradient wells. Similarly, the highest value observed for lead (8 ug/L) in the up-gradient well (December 2012) was never exceeded in the two down-gradient wells for any sampling period. Zinc, which historically is the metal of greatest concern with regard to leaching from SBR, the ranges for down-gradient wells B202 (3.2 – 22.2 ug/L) and B203 (5.2 – 48) fell within the range for the up-gradient well (2 – 54.5 ug/L).

Although the remaining monitoring investigations were not formally published in the literature, the results are similar to, or better than, the results at Fenn School. Environmental monitoring data for the New England fields was obtained from Gale Associates, Inc. for Middlebury College (Middlebury, VT), Brookwood School (Beverly, MA) and a private sports field in Lancaster MA. As shown in Table 1, none of the New England samples obtained in these case studies had levels of organic compounds in groundwater or stormwater that were above the method detection limit (monitoring data is presented in Appendix D). Additionally, levels of metals, typically cadmium, copper, lead and zinc, were always observed below the groundwater and/or drinking water standards.

## 5. Summary

Based on this review of at least 9 case studies (Table 1), the overall weight-of-evidence strongly suggests that the installation of a new synthetic turf field at the CCRHS will have no adverse effect on groundwater quality. Generally speaking, the studies reviewed in the literature were either negative or, when a metal or organic chemical related to tire crumb rubber was detected, the levels were below the safe, risk-based standard.

Of all the studies examined, the Fenn study deserves special attention because it is within the same town and well field that is below the proposed CCRHS facility and is the only study to regularly monitor groundwater on a quarterly basis for an extended period of time (>2 years). This study confirmed the prediction by Haley & Aldrich that neither metals nor organic compounds from synthetic turf materials would contaminate groundwater and therefore exposure to any site-related constituents of concern would be well below risk-based standards.

Finally, Sprinturf has conducted a health risk assessment using a harsh laboratory extraction that mimics “worst case” environmental conditions (i.e. SPLP method that simulates acid rain). They provide a guarantee that the “infilled” synthetic turf system will not adversely affect the water quality in the surrounding areas and ground water” and that that the proposed synthetic turf is "lead free" per applicable regulations. CCAP is currently repeating those tests using samples from the actual “lot” that will be installed at the CCRHS facility. It is anticipated the results of that testing and the subsequent comparisons to actual regulatory benchmarks will not be significantly different from Sprinturf’s original result for their proprietary product.

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13. Simon, R., 2010. Review of the Impacts of Crumb Rubber in Artificial Turf Applications. Prepared for The Corporation for Manufacturing Excellence (Manex) by the University of California, Berkeley, Laboratory for Manufacturing and Sustainability, College Of Engineering.

14. Crumb Infill and Turf Characterization for Trace Elements and Organic Materials. Submitted by Environmental and Occupational Health Sciences Institute, Robert Wood Johnson Medical School, Piscataway, NJ to New Jersey Department of Environmental Protection, Bureau of Recycling and Planning, Trenton, NJ.

**TABLE I**
Evaluation of the Potential for Groundwater Contamination by Synthetic Turf Fields
Concord Carlisle At Play, Inc.
Concord, MA

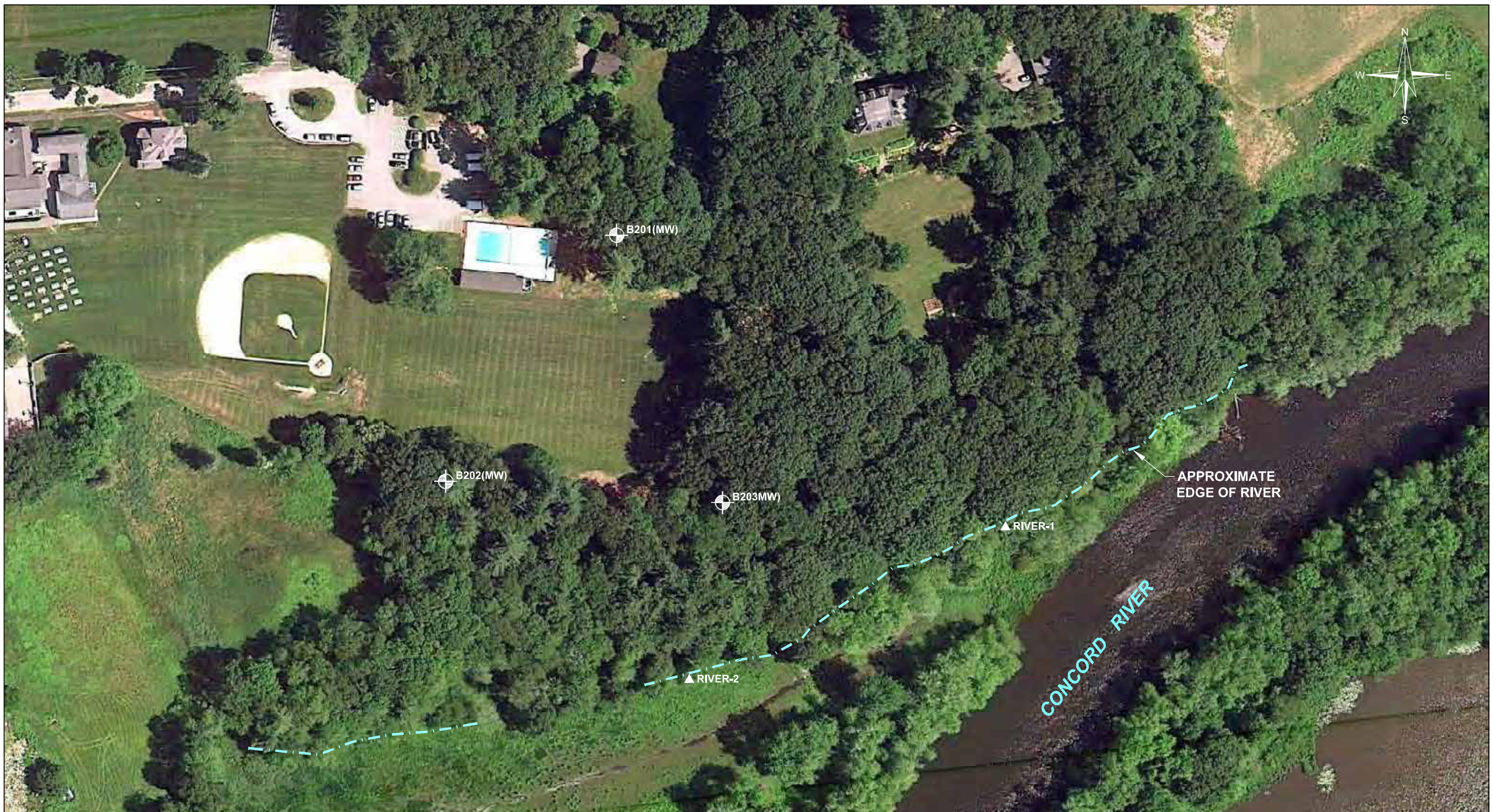
| Study[1] (Location) | Purpose | Design[2] | Analytical Results[2] | | Summary |
|---|---|---|---|---|---|
| | | Groundwater | Groundwater | | |
| | | | Metals | Organics | |
| **Sheehan *et al*. (Maine, 2006)** | Designed to assess if leachates from tire shreds used as roadbed fill will pose a hazard to groundwater. | Chemical concentrations measured in reference and leachate-affected water collected from above and below the water table. | Trace metals in wells generally below limit of detection; zinc detected in one of two wells but below water quality criteria and drinking water standard. | Majority of VOCs were below the limit of detection; VOCs detected were below regulatory standards (0.5 - 16 ug/L). | Extended 5 year exposure showed no significant release of metals or organics from tire fill located above groundwater table. |
| **Bergs (BASPO/IST, Switzerland 2006)** | Comprehensive field study to examine "environmental effects of synthetic sports surfaces" by measuring individual selected chemical trace substances. | Lysimeters used as a "reliable and realistic" tool to measure leachate under field conditions (one surface type, 1 year exposure period). | None of the lysimeter tests revealed elevated zinc concentrations in leachate compared with the blank sample (gravel layer without surface). | Initially elevated levels of aniline, benzothiazole and cyclohexylamine dropped off rapidly (> 10 fold) within two months of field exposure. | Neither small quantities of leached substances nor their toxicological properties constitute any unacceptable potential risk for water resources . |
| **Lancaster MA (2006)** | Sampling and analysis of underdrains, both groundwater wells and surface water (upstream and downstream of McGovern Brook) to identify chemical impacts. | Metals, pesticides, water quality (pH, conductivity, temp, D.O.) and inorganics (ammonia, nitrate/nitrite, TKN, phosphorus) measured in underdrain and monitoring well samples. | Metals were not observed above the method detection limit in every sample but one, which was a well within a "Stormwater BMP" (retention pond). | No organic compounds were observed above the method detection limit (although PAHs and SVOCs were not selected as an analyte which was a shortcoming). | There was no evidence that metals impacted groundwater or surface water since levels were below the detection limit in all but one sample (MW-5 was positive but located within a stormwater retention swale). |
| **Brookwood School, Beverly MA (2006)** | Installation of 3 monitor- ing wells, sampling of 2 catch basins and baseline surface water sampling to ensure that site-derived chemicals would not migrate and affect the environment. | Sampling and analysis of one upgradient well (MW-3) and two downgradient wells (MW-1 and MW-2). "Discharge Point", catch basins and surface water were also sampled. | All metals (cadmium, copper, lead, zinc) were below ambient water quality criteria in surface water and below drinking water standards in groundwater. | The analysis of the full suite of both PAHs and SVOCs were not detected above the method reporting limits. | Samples taken four separate sampling events over a span of 3 years showed that chemicals from the field did not migrate into either surface water or groundwater. |
| **Moretto (France, 2007)** | Chemical analysis of "elements and substances present in the percolates" after transfer through the playin surface (both lab microcosm and field tests). | Eleven month study. Lab microcosms received 0.8 m rainfall per year (control had no SBR). Field leachate collected behind the goal and at perimeter of the "pitch" (field). | Of the 17 metals measured, 10 were highest during the first month of sampling but levels dropped off rapidly after that (below the limit of detection as well as the safe drinking water level). | Cyanide and phenol were all below the method limits of detection. PAHs were all below the "safe" EU drinking water limit of 1 ug/L. | Both laboratory and field testing showed levels of metals and organic compounds in leachates "are compatible with the water resource quality requirements". |

**TABLE I**
Evaluation of the Potential for Groundwater Contamination by Synthetic Turf Fields
Concord Carlisle At Play, Inc.
Concord, MA

| | | | | | |
|---|---|---|---|---|---|
| **Malone and MacBroom (Connecticut, 2008)** | Determine if metals leach from crumb rubber infill at a level that would adversely affect the quality of water. | Sampled stormwater that had "infiltrated the field surface in-fill material and migrated downward" into dedicated drainage (collected at 3 CT synthetic turf fields). | Laboratory analysis indicated that lead, selenium, and cadmium were below the detection limit in the drainage water; zinc levels were BDL or very low (5 - 36 ug/L). | N/A | Stormwater collected over a period of one year from three different fields showed metals would have no impact to groundwater. |
| **Middlebury College VT (2008)** | Chemical analysis of stormwater obtained from catchbasins below a newly installed synthetic turf field. | Metals (RCRA 8), PAHs and SVOCs sampled on three events (July, August, December 2008). Conventional parameters (pH, conductivity, nitrates, alkalinity) also measured. | No metals were detected above the method reporting limits. | No PAHs nor SVOCs were detected above the method reporting limits. Conventional measurements were within normal ranges. | Negative data is strong evidence that metals and chemicals derived from field materials pose no health or environmental hazard. |
| **NYSDEC (New York, 2009)** | Designed to assess potential environmental impacts from the use of crumb rubber as infill material in synthetic turf fields. | Four turf fields were selected ranging from <1 - 7 years old. Monitoring of both stormwater leachate and monitoring wells. | No metals were observed above method detection limits. | Test results of 32 groundwater samples had no detections for 68 organic compounds. | There is no significant threat from chemicals leaching into surface water and groundwater. "Crumb rubber may be used as an infill without significant impact on groundwater quality." |
| **Connecticut DEP (2010)** | Collect stormwater runoff samples from three artificial turf fields. Analyze and develop an environmental risk assessment (no groundwater samples were collected in the study). | Stormwater runoff from 3 synthetic turf fields collected during the first 30 minutes of a storm event at locations that only drained water from the fields. | Detected concentrations of zinc in the stormwater significantly lower than CAES results, with no exceedences of drinking water standards and no significant concerns for groundwater quality. | The concentrations of organic compounds in the study did not exceed Connecticut groundwater protection criteria. | No risk to groundwater protection criteria in the stormwater runoff from artificial turf fields. Conclusion is an extrapolation of the stormwater results collected and the evaluation of data presented in recent studies. |
| **Fenn School (Concord MA, 2015)** | Monitor of groundwater to ensure that applicable Massachusetts groundwater and surface water standards were not exceeded. | One upgradient well and two downgradient wells. All wells were sampled and analyzed once per quarter for 4 years. | Dissolved Cd, Cu, Pb and Zn were either ND or well below their respective MCP Massachusetts DEP groundwater standards (4, 100, 10 and 900 ug/L). | Over a period of 4 years, only bis-2(ethyl-hexyl) phthalate, a common laboratory contaminant, was detected at trace levels (3 out of 16 samples). | No significant exposure to humans or environmental receptors would be expected via groundwater or leachate. |

[1]NYSDEC, NY State Dept of Environmental Conservation

[2]N/A, Not Applicable; ND, Below Detection Limit; VOC, Volatile Organic Compound; SVOC, Semivolatile Organic Compound; SBR, Crumb Rubber Infill; CAES, Connecticut Agricultural Experimental Station




LEGEND:

B201(MW) — DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING CONDUCTED BY NEW HAMPSHIRE BORING OF LONDONDERRY, NEW HAMPSHIRE ON 17 MARCH 2011. (MW) INDICATES 2-IN. DIA. MONITORING WELL INSTALLED IN COMPLETED BOREHOLE.

▲ RIVER-1 — DESIGNATION AND APPROXIMATE LOCATION OF SURFACE WATER MONITORING POINT ON THE CONCORD RIVER AND THE ADJACENT WETLAND

NOTE:

BACKGROUND IMAGE TAKEN ELECTRONICALLY FROM GOOGLE EARTH PRO/MAPS (IMAGE DATED 10 JUNE 2010).

0 100 200
APPROXIMATE SCALE IN FEET

HALEY & ALDRICH

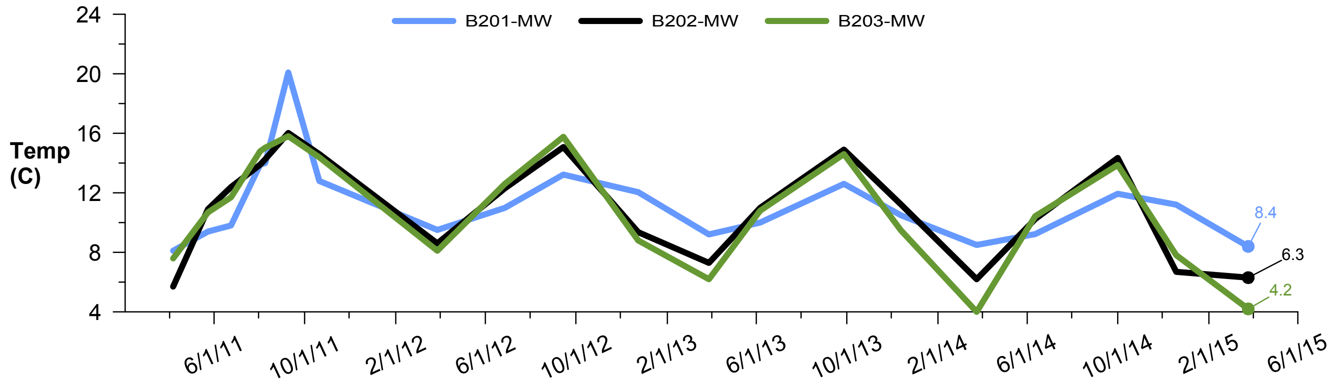
FENN SCHOOL
ATHLETIC FIELD IMPROVEMENTS
CONCORD, MASSACHUSETTS

GROUNDWATER AND SURFACE WATER SAMPLING LOCATION PLAN

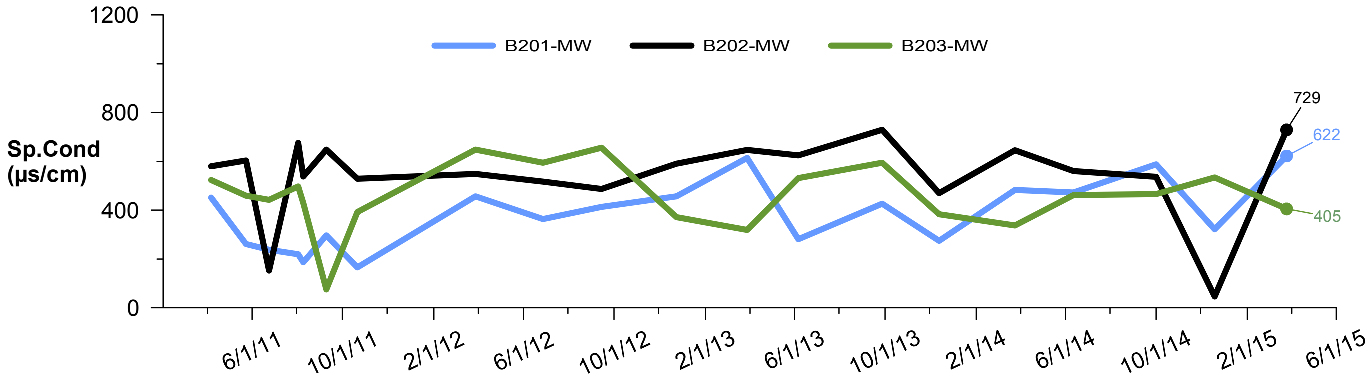
SCALE: AS SHOWN
AUGUST 2011

FIGURE 1

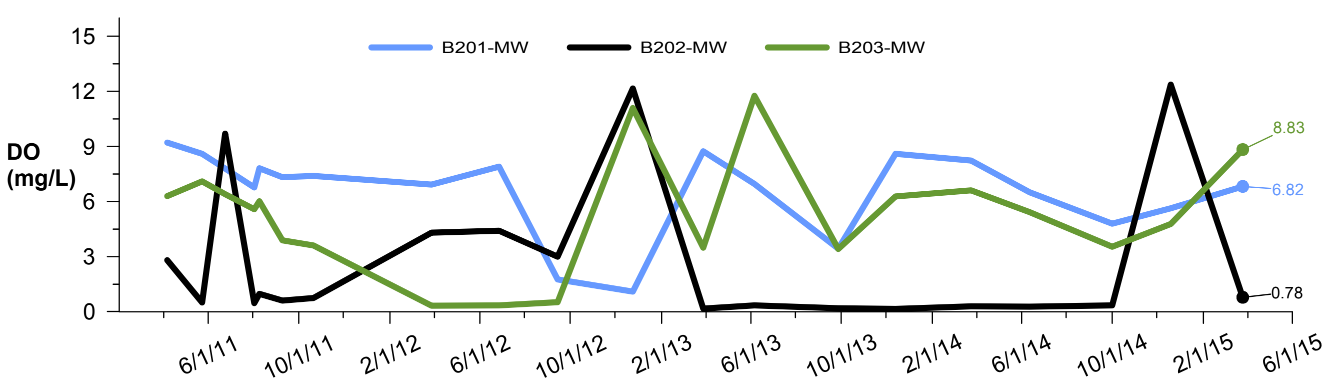
J:\GRAPHICS\36396\36396-006-B003.DWG



B201-MW
B202-MW
B203-MW
Temp
(C)
24
20
16
12
8
4
8.4
6.3
4.2
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
2/1/13
6/1/13
10/1/13
2/1/14
6/1/14
10/1/14
2/1/15
6/1/15

B201-MW
B202-MW
B203-MW
Sp.Cond
(µs/cm)
1200
800
400
0
729
622
405
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
2/1/13
6/1/13
10/1/13
2/1/14
6/1/14
10/1/14
2/1/15
6/1/15

B201-MW
B202-MW
B203-MW
DO
(mg/L)
15
12
9
6
3
0
8.83
6.82
0.78
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
2/1/13
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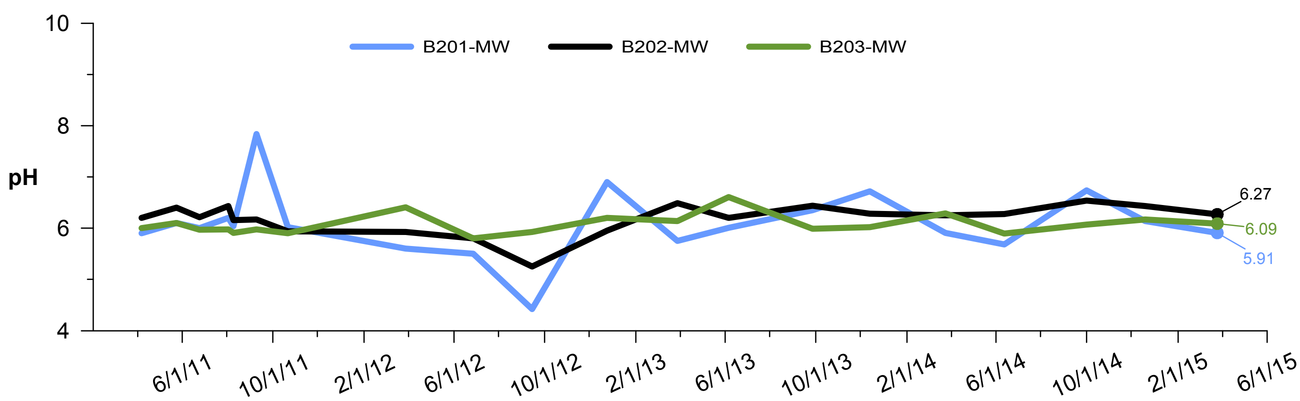
10/1/13
2/1/14
6/1/14
10/1/14
2/1/15
6/1/15

B201-MW
B202-MW
B203-MW
pH
10
8
6
4
6.27
6.09
5.91
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
2/1/13
6/1/13
10/1/13
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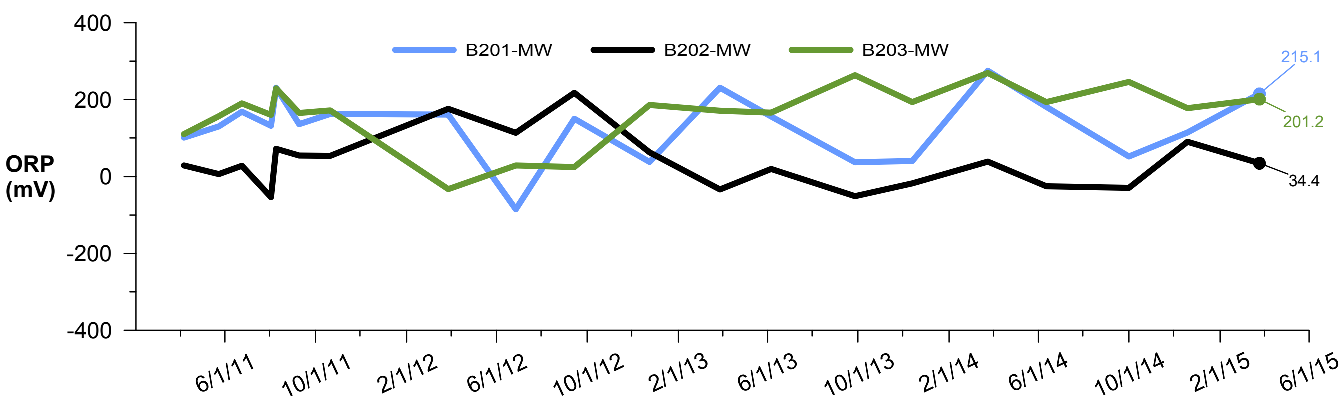
10/1/14
2/1/15
6/1/15

B201-MW
B202-MW
B203-MW
ORP
(mV)
400
200
0
-200
-400
215.1
201.2
34.4
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
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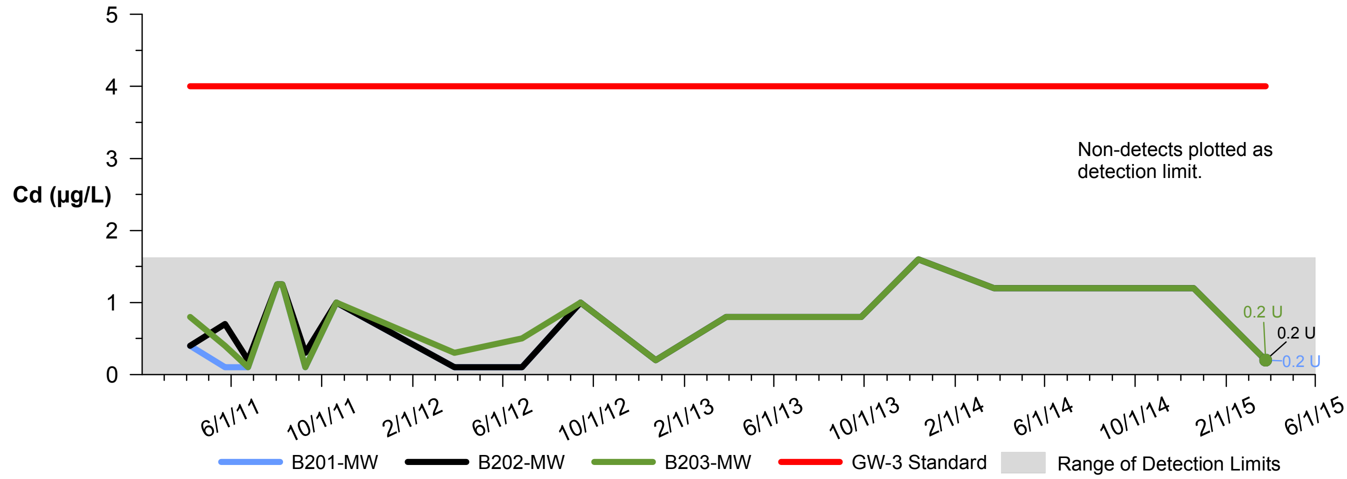
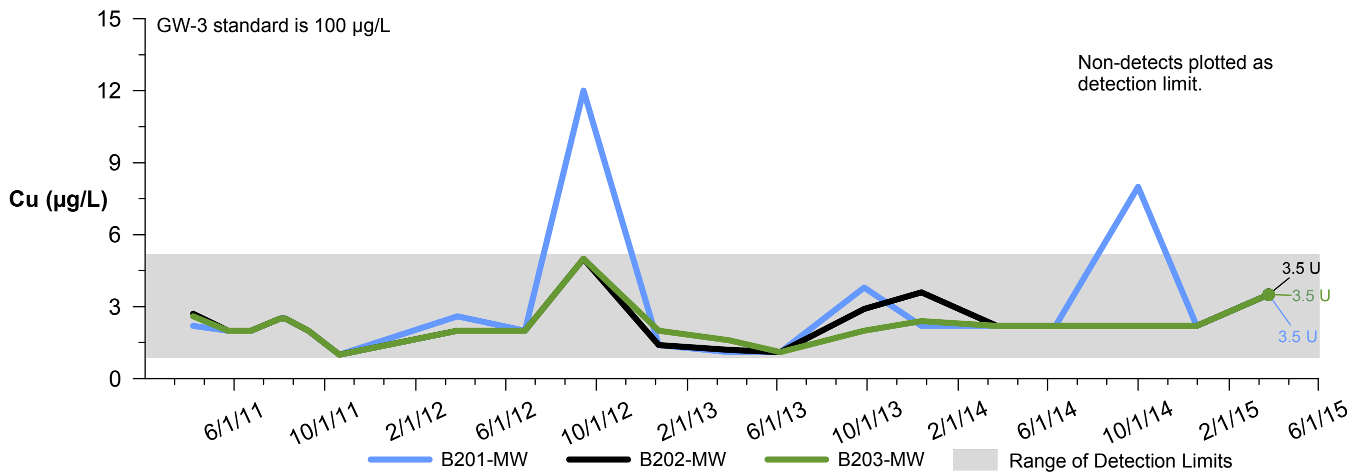
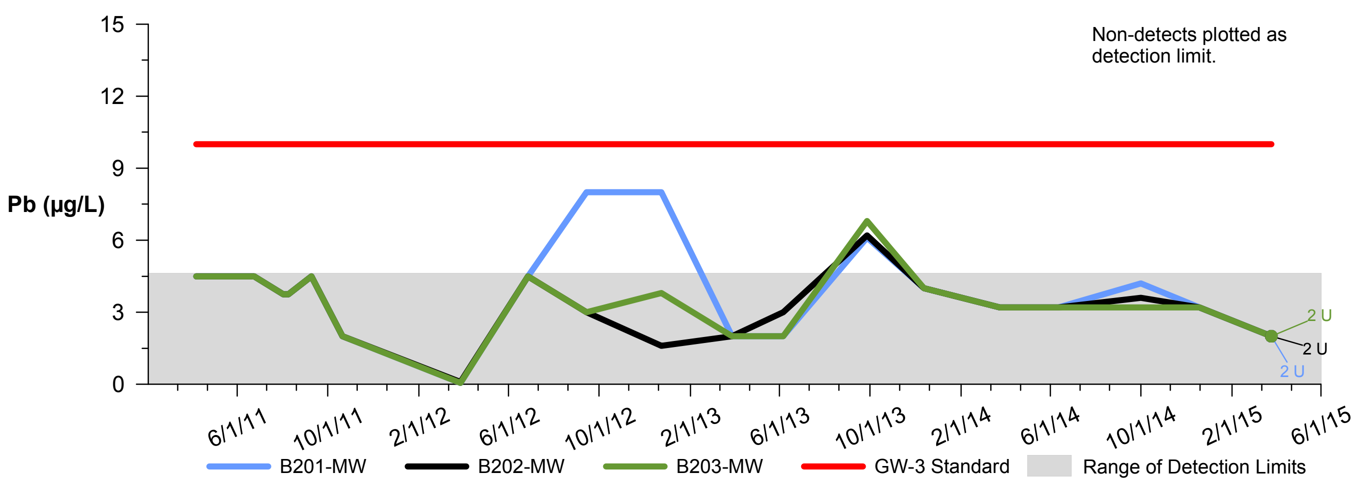
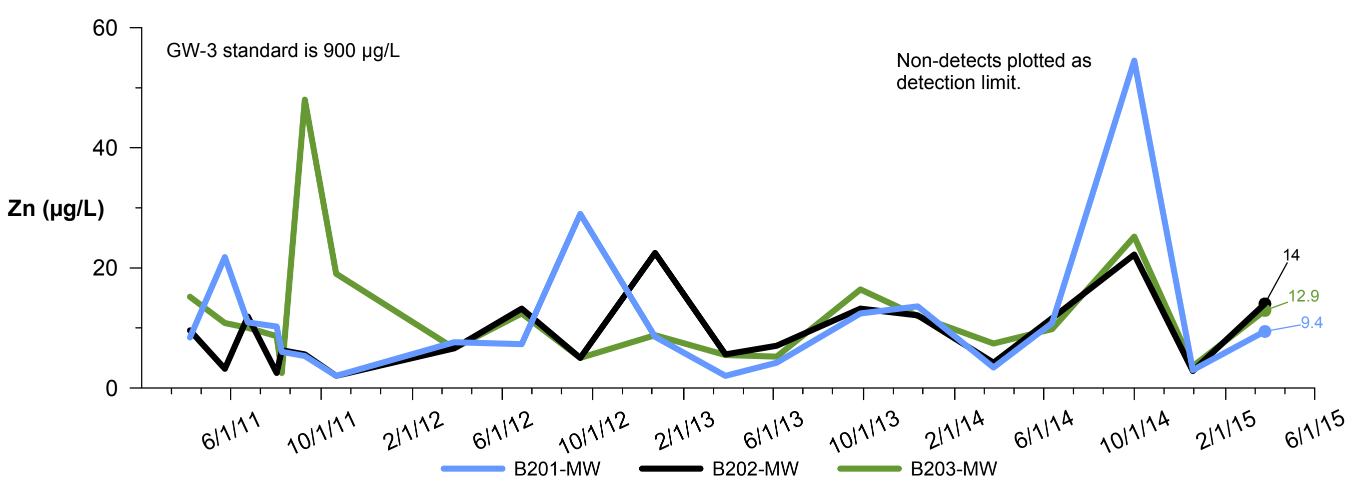
10/1/14
2/1/15
6/1/15


Cd (µg/L)
Non-detects plotted as detection limit.
0.2 U
0.2 U
0.2 U
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
2/1/13
6/1/13
10/1/13
2/1/14
6/1/14
10/1/14
2/1/15
6/1/15
B201-MW
B202-MW
B203-MW
GW-3 Standard
Range of Detection Limits


GW-3 standard is 100 µg/L
Cu (µg/L)
Non-detects plotted as detection limit.
3.5 U
3.5 U
3.5 U
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
2/1/13
6/1/13
10/1/13
2/1/14
6/1/14
10/1/14
2/1/15
6/1/15
B201-MW
B202-MW
B203-MW
Range of Detection Limits


Pb (µg/L)
Non-detects plotted as detection limit.
2 U
2 U
2 U
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
2/1/13
6/1/13
10/1/13
2/1/14
6/1/14
10/1/14
2/1/15
6/1/15
B201-MW
B202-MW
B203-MW
GW-3 Standard
Range of Detection Limits


GW-3 standard is 900 µg/L
Zn (µg/L)
Non-detects plotted as detection limit.
14
12.9
9.4
6/1/11
10/1/11
2/1/12
6/1/12
10/1/12
2/1/13
6/1/13
10/1/13
2/1/14
6/1/14
10/1/14
2/1/15
6/1/15
B201-MW
B202-MW
B203-MW

HALEY & ALDRICH, INC.
3 Bedford Farms Drive
Bedford, NH 03110
(603) 625.5353

30 July 2015
File No. 42185-000

Concord Carlisle At Play, Inc.
33 Bradford Street
Concord, Massachusetts 01742

Attention: Mr. John Boynton, President

Subject: Potential for Synthetic Turf Field to Affect Groundwater at Concord-Carlisle Regional High School in Concord, Massachusetts

Ladies and Gentlemen:

As you are aware, as a board-certified Environmental Toxicologist with over 30 years of experience, I routinely conduct risk assessments addressing the potential impacts of hazardous chemicals to both humans and wildlife. In 2011, I was asked to serve as an expert in the evaluation of the potential impact that a new synthetic turf field at the Fenn School might have on groundwater quality. At that time I provided assurance to the Concord Natural Resources Commission ("CNRC") that synthetic turf would not result in metals and organic compounds to occur in groundwater at concentrations above the safe drinking water standard. Since that time, groundwater monitoring has shown this prediction has been true as the water quality of the aquifer has not changed from the original baseline conditions.

Subsequently, per the request of Concord Carlisle at Play, Inc. ("CCAP"), I have been asked to develop a more comprehensive review than provided in 2011 to the CNRC for the Fenn School. The attached report provides a comprehensive review of peer-reviewed articles, grey literature documents and regional case studies to examine the overall weight-of-evidence on the probability that synthetic turf may contaminate underlying groundwater. The conclusion of the report affirms what has observed over 4 years (16 quarterly reports) of monitoring at the Fenn School, which is that there is no credible evidence to suggest that either new or weathering synthetic turf fields pose a risk to the environment.

This report also includes an Appendix with the results of past laboratory analytical measurements that have been performed on the synthetic turf blades and recycled crumb rubber that is to be used on the new field at the Concord-Carlisle High School. Although the vendor (Sprinturf) guarantees that their turf polymer will be lead free and their crumb rubber product will not pose a hazard to underlying groundwater, CCAP requested that the product to be used at the high school also go through the same tests used to develop Sprinturf's original product specifications. The results of both the bulk laboratory analysis as well as the vigorous leaching tests show that the turf materials, even under harsh environmental conditions, should remain well below levels that may pose a risk to humans and the environment.

The additional literature identified since my initial review for the Fenn School in 2011, as well as the confirmation of the original Sprinturf product specifications by the current testing of the product to be used at the Concord-Carlisle High School, should give both CCAP and the residents of Concord the confidence that the installation of new synthetic turf fields will not pose a risk to groundwater after construction.

Sincerely yours,
HALEY & ALDRICH, INC.

Stephen R. Clough
Senior Toxicologist, Ph.D., DABT

Jay Peters
Lead Risk Assessor

Enclosures

G:\42185 Concord Carlisle At Play\Deliverables\FINAL PDF 7.30.15\2015-0730-CCAP-Groundwater Assessment-F.docx

# Attachment 5

"Per- and Poly-flouroalkyl Substances (PFAS) in Artificial Turf Carpet" by Toxics Use Reduction Institute at UMass Lowell, dated February 2020

# Per- and Poly-fluoroalkyl Substances (PFAS) in Artificial Turf Carpet

## Introduction

The Massachusetts Toxics Use Reduction Institute (TURI) has received inquiries from municipalities and community members regarding the presence of per- and poly-fluoroalkyl substances (PFAS) in artificial turf carpet. This brief fact sheet provides some basic background information on PFAS and on recent testing for these chemicals in artificial turf as reported by nonprofit organizations. This information is provided under TURI's mandate to provide information on toxic chemicals and safer alternatives to businesses, municipalities, community members and others.

TURI has conducted background research on health and environmental effects of PFAS in its work with the Toxics Use Reduction Act (TURA) program's Science Advisory Board. TURI has neither conducted nor sponsored any laboratory testing of PFAS in turf or other products.

## What are PFAS?

PFAS are a category of chemicals that contain multiple fluorine atoms bonded to a chain of carbon atoms. Thousands of such chemicals exist. A study by the Organization for Economic Cooperation and Development (OECD) identified over 4,700 PFAS-related Chemical Abstract Service (CAS) numbers.[1] PFAS chemicals have properties that can be useful in a variety of settings, such as water and stain resistance. They also pose concerns, including persistence, bioaccumulation, and adverse health effects, as summarized below.

## PFAS Nomenclature and Vocabulary

PFAS are sometimes described as "long-chain" or "short-chain" based on the length of the fluorinated carbon chain. They can also be categorized and described based on the number of carbons; for example, a PFAS chemical with an 8-carbon chain may be referred to as "C8." For more information, see the ITRC fact sheet "Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS)."[2]

PFAS "precursors" are complex chemicals that break down into other simpler PFAS compounds ("degradation products"). In addition, some PFAS are fluoropolymers (longer chains of molecules containing carbon and fluorine).

TURI
TOXICS USE REDUCTION INSTITUTE
UMASS LOWELL

February 2020

## Persistence

Although there are thousands of PFAS, most of them break down into a common set of degradation products. These degradation products are characterized by very high persistence in the environment.[3] Persistent chemicals do not break down under normal environmental conditions, and some can last in the environment for hundreds of years or longer. As a result, introducing these chemicals into the environment has lasting consequences.

## Bioaccumulation

All PFAS pose some degree of bioaccumulation concern, especially in air-breathing organisms.[3] In other words, they can accumulate in plants, animals, and humans.

## Health Effects

Due to widespread contamination of drinking water in some areas of the US, the human health effects of certain PFAS have been studied in depth. Other PFAS have been studied in laboratory animals. Because the class of PFAS is so large, many individual PFAS have not been studied in depth. Researchers have emphasized the need to address PFAS as a group rather than one by one. Health effects documented for some PFAS include effects on the endocrine system, including liver and thyroid, as well as metabolic effects, developmental effects, neurotoxicity, and immunotoxicity.[3]

PFAS have been studied by a number of government entities. For example, OECD has done the most comprehensive work on PFAS as a class; the US Environmental Protection Agency (US EPA) has done extensive research on several PFAS compounds; and certain states have researched individual PFAS chemicals in depth.

## Drinking Water Contamination

PFAS have been found as drinking water contaminants in many states. For example, the Massachusetts Department of Environmental Protection (MassDEP) has worked with municipalities to gather data on levels of six PFAS in groundwater and drinking water. According to MassDEP, "since 2013, the sum of the concentrations of the six PFAS compounds above 20 ppt [parts per trillion] have been detected at over 20 PWSs [public water systems] in Massachusetts." MassDEP has issued a proposed regulation that would set a Maximum Contaminant Level (MCL) in drinking water of 20 ppt for the sum of the concentrations of these six PFAS. MassDEP has also finalized and adopted standards for groundwater cleanup.[4]

## PFAS Testing

PFAS testing is difficult due to the large number of individual chemicals in the class, as well as the very low concentrations at which adverse effects may occur. Additional difficulties result from the fact that while methods have been developed for testing drinking water and wastewater, there are no consistent guidelines for testing solid materials. Some of these difficulties have been addressed through the development of methods for testing the total presence of fluorine-containing organic (carbon-containing) compounds.

In many cases, testing may be conducted for a small group of PFAS that have been a particular focus of regulatory activity. The absence of these chemicals does not indicate that all PFAS are absent. For example, US EPA has published methods for testing just 29 PFAS in water.[5]

### Difficulty of Testing Products

Difficulties may be encountered in choosing appropriate test methods for a given material. For example, guidance that has been developed for drinking water is not necessarily applicable to a solid material. In addition, some laboratories use a modified version of a US EPA method; US EPA has not validated these approaches.[5]

In any testing effort, it is important to adopt an appropriate study design. For example, US EPA has provided guidance on approaches to understanding potential leaching of chemicals from liquids, soils and wastes into rainwater. This includes consideration of the acidity of rainwater in certain areas of the US. US EPA recommends choosing an appropriate extraction fluid depending on the relevant environmental conditions in the region.[6]

### Total Fluorine Analysis

In addition to testing for individual compounds, it can also be useful to conduct a Total Fluorine Analysis. This can be carried out using Particle-Induced Gamma Ray Emission (PIGE) spectroscopy, and other techniques such as Combustion Ion Chromatography (CIC).

These tests do not look for specific PFAS chemicals. Rather, they look for fluorine atoms as an indicator of the presence of PFAS chemicals. This kind of test can be useful because testing standards have not been developed for all the types of PFAS that are available on the market. These measurements can also be performed on solid samples.

### TOP Assay

Another test used to gather information about PFAS present in a sample is a Total Oxidizable Precursor (TOP) assay. This test creates the conditions in which precursors are broken down into degradation products. These degradation products are among the PFAS that can be measured by EPA methods in water. TOP assay enables researchers to detect the presence of precursors, even if they do not know which specific precursors are present.[7]

## Understanding Test Results

When interpreting results of testing conducted on products, including turf carpet samples, it is important to understand what test was conducted and what that test has the ability to detect. For example, if a fluoropolymer is present in the product, an appropriate test must be selected to detect its presence.

In summary, lack of detection of one or more specific PFAS does not mean that a material is free of PFAS. To determine whether PFAS are likely to be present, a total fluorine test and/or a TOP assay may be helpful.

Another factor to consider is that in some cases, a test may be carried out only for long-chain chemicals that were used more frequently in the past, or that appear primarily as degradation products in the environment. Knowing the presence of these chemicals is important, but they are not the most likely chemicals to appear in a new product.

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## PFAS Testing in Artificial Turf Carpet

Determining what chemicals are present in a product can be challenging because chemical contents are frequently not disclosed by the manufacturer. Two nonprofit organizations recently tested artificial turf carpet and found evidence of the presence of PFAS in the material.[8] The nonprofit organizations tested backing of both new turf and older, discarded turf. They also tested a number of samples of artificial grass blades (carpet fibers).

They detected one PFAS chemical in the backing of the new turf sample. Specifically, they detected 6:2-fluorotelomer sulfonic acid (known by the abbreviation 6:2 FTSA). 6:2 FTSA has a 6-carbon chain, and is considered a short-chain PFAS because of the way in which it breaks down. In many cases, short-chain PFAS have been adopted as substitutes for longer-chain PFAS.

They detected perfluorooctane sulfonate (PFOS) in the backing of the discarded, older turf sample. PFOS is a long-chain PFAS that is no longer manufactured in the US due to concerns about health and environmental effects.

They also tested a number of synthetic turf fiber samples and found that all of them contained quantities of fluorine that suggest the presence of PFAS.[8] These quantities were in the parts per million range, but given the large surface areas of a typical turf carpet, researchers note these may represent a source of PFAS in the environment.[9] Research on this topic is still in process and it will be important to review new scientific publications as the work continues.

One possible reason for the use of PFAS in the artificial turf grass blades is to serve as an extrusion aid.[10] That is, PFAS is added to the polymer mixture (which is a non-fluorinated plastic) before it is passed through an extruder. An extruder is manufacturing equipment that melts and forms the polymer mixture into its desired shape. The PFAS helps to prevent the polymer from sticking to the extruder. According to a researcher, artificial turf grass blades were previously made from low-density polyethylene, but the material had poor durability. Newer polymer mixtures have greater durability, but were not compatible with existing extrusion equipment. Therefore, PFAS were added in order to facilitate use of the new polymer mixture with existing equipment.[8,9]

The researchers who conducted this work do not know exactly what types of PFAS may be used as processing aids in this application. They are not present in US EPA's Method 537.1 ("Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry"). Thus, using this US EPA method would not be informative in this application. However, the TOP assay allows researchers to confirm the presence of some type of PFAS. According to researchers, preliminary results on two samples indicated the presence of PFBA, PFBS, FPHxA, PFHpA, PFOA and PFOS in turf carpet fibers that had undergone TOP assay.[9]

## Questions about Athletes' Exposure to PFAS

TURI has received questions about the possibility of PFAS exposure associated with playing on artificial turf. PFAS exposure has not been assessed specifically in relation to playing on artificial turf, and studying children's exposures often presents methodological and ethical challenges. More generally, the approach of the Toxics Use Reduction Institute is to identify opportunities to reduce or eliminate the use of toxic chemicals as a means to protect human health and the environment. Eliminating the use of a toxic chemical also makes it unnecessary to assess exposure.

The vast majority of PFAS research to date has focused on the results of ingestion exposure. There is also some emerging information on health effects of dermal exposure to PFAS. Some researchers have suggested that dermal exposure to consumer products treated with PFAS may contribute to over-all PFAS exposure.[11,12] In the absence of more specific information, it may be helpful to follow general guidelines provided by the Icahn School of Medicine at Mt. Sinai and others for helping to minimize exposure to chemicals that may be present in artificial turf.[13]

## Learn more about PFAS

Technical fact sheets from the Interstate Technology Regulatory Council (ITRC) are available at: https://pfas-1.itrcweb.org/

## Acknowledgements

Dr. Graham Peaslee (University of Notre Dame) provided comments on a draft of this fact sheet. Support for TURI's background research on this topic was provided by The Heinz Endowments.

# References

Note: For several points covered in this overview, we have provided the TURA Science Advisory Board's summaries of scientific information as a reference. These summaries draw upon a large set of authoritative government documents and peer reviewed studies.


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The Toxics Use Reduction Institute is a multi-disciplinary research, education, and policy center established by the Massachusetts Toxics Use Reduction Act of 1989. The Institute sponsors and conducts research, organizes education and training programs, and provides technical support to help Massachusetts companies and communities reduce the use of toxic chemicals.


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# Attachment 6

Effective rainwater treatment intercepts microplastics from artificial turf," by Hauraton, Dated September 27, 2019

# Effective rainwater treatment intercepts microplastics from artificial turf

27.08.2019

Precipitation and surface water flush out microplastics from artificial turf pitches. This is a challenge that Hauraton is overcoming with responsible environmental technology. The drainage specialist based in the Baden region has a safe and effective solution for filtering and retaining microplastic particles. In the Sportfix®Clean drainage system and channel filter with filter substrate Carbotec 60, particles as small as 0.45 µm (0.00045 mm) are reliably removed by filtering.

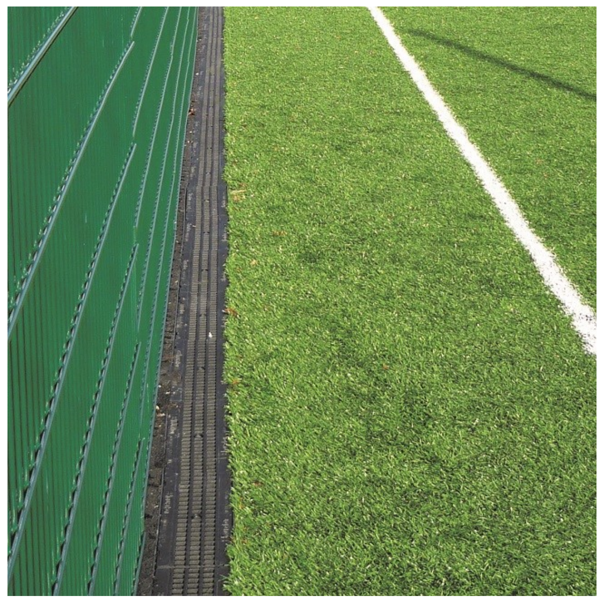

photo: Hauraton

With sports fields being equipped increasingly with artificial turf worldwide, this is highly relevant. Synthetic surfaces are very robust, require much less maintenance than natural turf and provide a high standard of safety for athletes. On modern surfaces, such playing properties as ball roll behaviour are very close to those of natural turf sports pitches. The benefits of artificial turf also include a long useful life of around 1,700 hours per year compared to 400 to 800 hours for natural turf, a service life of at least ten years and greatly reduced maintenance effort.

## News from Member:

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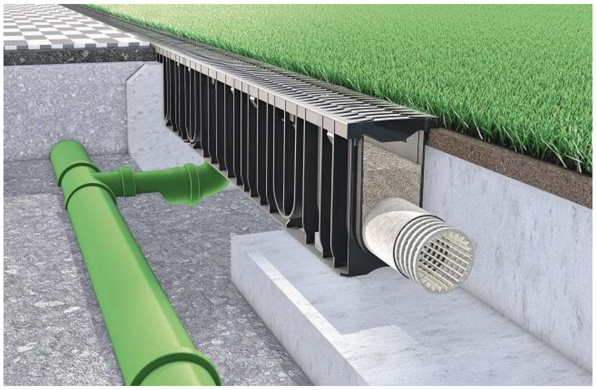
Hauraton GmbH & Co. KG

## Mechanical wear creates tiny plastic particles



graphic: Hauraton

Artificial turf surfaces are a type of plastic carpet. During play on such surfaces, the EPDM granulate (the material used for infilled artificial turf) and the synthetic grass fibres are exposed to repeated stressing. The mechanical wear from high tread loads – as arising during football or rugby – causes tiny particles or blades of artificial grass to break off. This amounts to 250 to 300 kg per year for modern sports pitches. These particles need to be prevented from entering the natural water cycle, and ultimately the food chain, via rainwater draining off the pitch. Research over the last few years has shown that microplastics, now present in large quantities in the world's oceans, have also already entered our food chain. The health consequences are not yet known.

To prevent plastic particles from reaching water bodies, collected surface water must be filtered before it is distributed.

## Surface filtration intercepts the smallest particles

Sportfix®Clean channels offer a simple but extraordinarily simple solution. The channels safely collect not only surface water flowing off the sports field contaminated with microplastics, but also larger microplastic parts transported to and collected along the edge of the pitch during play. The water is collected and drained off in the channel run, while being fed through the channel filter and filtered at the same time. The filter substrate used, Carbotec 60, is able to permanently retain the finest particles with sizes down to 0.45 µm.

photo: Hauraton

### Longer maintenance intervals for extra reliability for the operator

This channel filter functions on the principle of surface filtration. It is therefore twice as effective: not only plastic parts are retained on the filter surface, but also pollutants such as heavy metals and hydrocarbons. The system has been shown to work reliably over very long periods. Long maintenance intervals and simple cleaning are additional benefits. After surface of the filter. This is stripped off during maintenance and then only the filter substrate that has been removed is replenished.

Drainage systems are also usually required for artificial turf surfaces, whether they are used on hockey fields or football pitches. In addition to safe drainage, Sportfix Clean channels also provide a simple way to filter the waste water and permanently retain plastic particles and pollutants. This economical filter system can also be installed at existing facilities.

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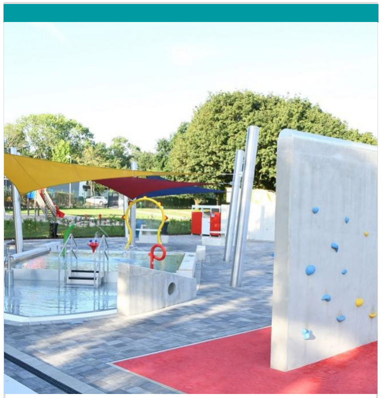

### Südbad Neuss

Berndorf Bäderbau can act as the general contractor in municipal projects. One example is Südbad Neuss where it not only built the swimming pools but also

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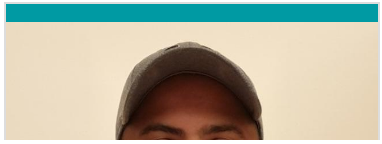

# Attachment 7

"Microplastic contamination found in common source of groundwater, researchers report" dated January 25, 2019.

Home / Earth / Environment

JANUARY 25, 2019

# Microplastic contamination found in common source of groundwater, researchers report

by Lois Yoksoulian , University of Illinois at Urbana-Champaign

Illinois Sustainable Technology Center researcher John Scott is part of a team of researchers who are among the first to explore microplastic contamination in groundwater systems. Credit: Fred Zwicky

Microplastics contaminate the world's surface waters, yet scientists have only just begun to explore their presence in groundwater systems. A new study is the first to report microplastics in fractured limestone aquifers – a groundwater source that accounts for 25 percent of the global drinking water supply.

The study identified microplastic fibers, along with a variety of medicines and household contaminants, in two aquifer systems in Illinois. The findings are published in the journal *Groundwater*.

"Plastic in the environment breaks down into microscopic particles that can end up in the guts and gills of marine life, exposing the animals to chemicals in the plastic," said John

Scott, a researcher at the Illinois Sustainable Technology Center and study co-author. "As the plastics break down, they act like sponges that soak up contaminants and microbes and can ultimately work their way into our food supply."

Groundwater flows through the cracks and voids in limestone, sometimes carrying sewage and runoff from roads, landfills and agricultural areas into the aquifers below, Scott said.

The researchers collected 17 groundwater samples from wells and springs – 11 from a highly fractured limestone aquifer near the St. Louis metropolitan area and six from an aquifer containing much smaller fractures in rural northwestern Illinois.

All but one of the 17 samples contained microplastic particles, with a maximum concentration of 15.2 particles per liter from a spring in the St. Louis area, the study reports. However, deciphering what that concentration means is a challenge, Scott said. There are no published risk assessment studies or regulations.

The researchers did find, however, that concentrations from their field area are comparable to those of surface water concentrations found in the rivers and streams in the Chicago area, said Samuel V. Panno, an Illinois State Geological Survey researcher and lead author of the study.

"The research on this topic is at a very early stage, so I am not convinced we have a frame of reference to state expectations or bounds on what is considered low or high levels," said Tim Hoellein, a biology professor at Loyola University Chicago and study co-author. "Our questions are still basic – how much is there and where is it coming from?"

The researchers identified a variety of household and personal health contaminants along with the microplastics, a hint that the fibers may have originated from household septic systems.

"Imagine how many thousands of polyester fibers find their way into a septic system from just doing a load of laundry," Scott said. "Then consider the potential for those fluids to leak into the groundwater supply, especially in these types of aquifers where surface water interacts so readily with groundwater."

There is still a monumental amount of work to be done on this subject, Scott said. He anticipates that microplastic contamination in both surface water and groundwater will be a problem for years to come.

"Even if we quit plastics cold turkey today, we will still deal with this issue for years because plastic never really goes away," Scott said. "It is estimated that 6.3 billion metric tons of plastic waste have been produced since the 1940s, and 79 percent of that is now in landfills or the natural environment. To me, it is such a weird concept that these materials are intended for single use, yet they are designed to last forever."

**More information:** Samuel V. Panno et al. Microplastic Contamination in Karst Groundwater Systems, *Groundwater* (2019). DOI: 10.1111/gwat.12862

Provided by University of Illinois at Urbana-Champaign

**Citation**: Microplastic contamination found in common source of groundwater, researchers report (2019, January 25) retrieved 5 August 2020 from https://phys.org/news/2019-01-microplastic-contamination-common-source-groundwater.html