8.3 Synthetic Turf Fields

Photo credit: JTSA Sports

Synthetic turf typically consists of polyethylene, polypropylene, or nylon grass-like fibers filled with sand and/or other granular infill atop a porous shock pad and gravel base with an integrated drainage system. This can give synthetic turf fields the quality of being pervious yet still shedding nearly all precipitation as subsurface runoff. Under these conditions, it may be possible to regard synthetic turf as a permeable pavement. This chapter **supplements** Chapter 2.10 – Permeable Pavement for use with synthetic turf fields.

Synthetic Turf as a Permeable Pavement

The void space within the aggregate drainage layers underneath synthetic turf can serve as storage space for the water quality volume (WQv) as a variation of permeable pavement if 1) all turf components are highly permeable and 2) the requisite storage volume is achievable within aggregate voids or storage structures below the surface. Subgrade compaction will dictate most practices be designed to provide extended detention through a subsurface orifice outlet, but it may be possible to infiltrate the WQv under the right conditions. Where conditions are not conducive to designing a synthetic turf field as permeable pavement, use one of the other practices detailed in Chapter Two.

Drainage Area

Restrict the drainage area solely to the turf field and any incidental impervious area to minimize the stormwater and sediment loading on the practice. Synthetic turf is not designed to receive sediment or other pollutants in the same manner as standard permeable pavement or paver systems. Permeable pavement is maintained by routinely vacuuming the filtered sediment from the pavement surface. This type of maintenance is impractical on synthetic turf as are the pretreatment devices required of underground storage.

Water Quality Volume Storage

Calculate the water quality volume (WQv) for the practice's drainage area as described in Chapter 2.16 using a volumetric runoff coefficient (Rv) of 0.95 for the synthetic turf. Provide a detention storage volume for the WQv within the aggregate base as illustrated in Figure 8.3.1 and below the invert of any secondary spillway (for example, local peak discharge control outlet). Consider the effect of crowning or sloping of the field when determining the storage volume. The WQv must be in the void space level to and below an overflow weir. Store the WQv at an elevation that creates sufficient freeboard below the turf surface. Storage volume may be increased through aggregated-filled trenches below the structural base aggregate as shown in Figure 8.3.1 or underground chambers.

Base aggregate must be uniformly graded, angular stone that is washed free of fines or dust to create a clean, interconnected void space (typically an AASHTO #57 or #67). Less than one percent of the placed aggregate should be smaller than 150µm (No. 100 test sieve). For sufficient porosity, the finish layer should be #8 or #9 aggregate, coarse sand, or similar. AASHTO #10 screening or “dust” may not be used as a finish layer. Use a porosity (ϕ) of 0.35 to calculate the storage volume of the gravel aggregate. Consult industry association or manufacturer guidelines for other aggregate and structural base specifications.

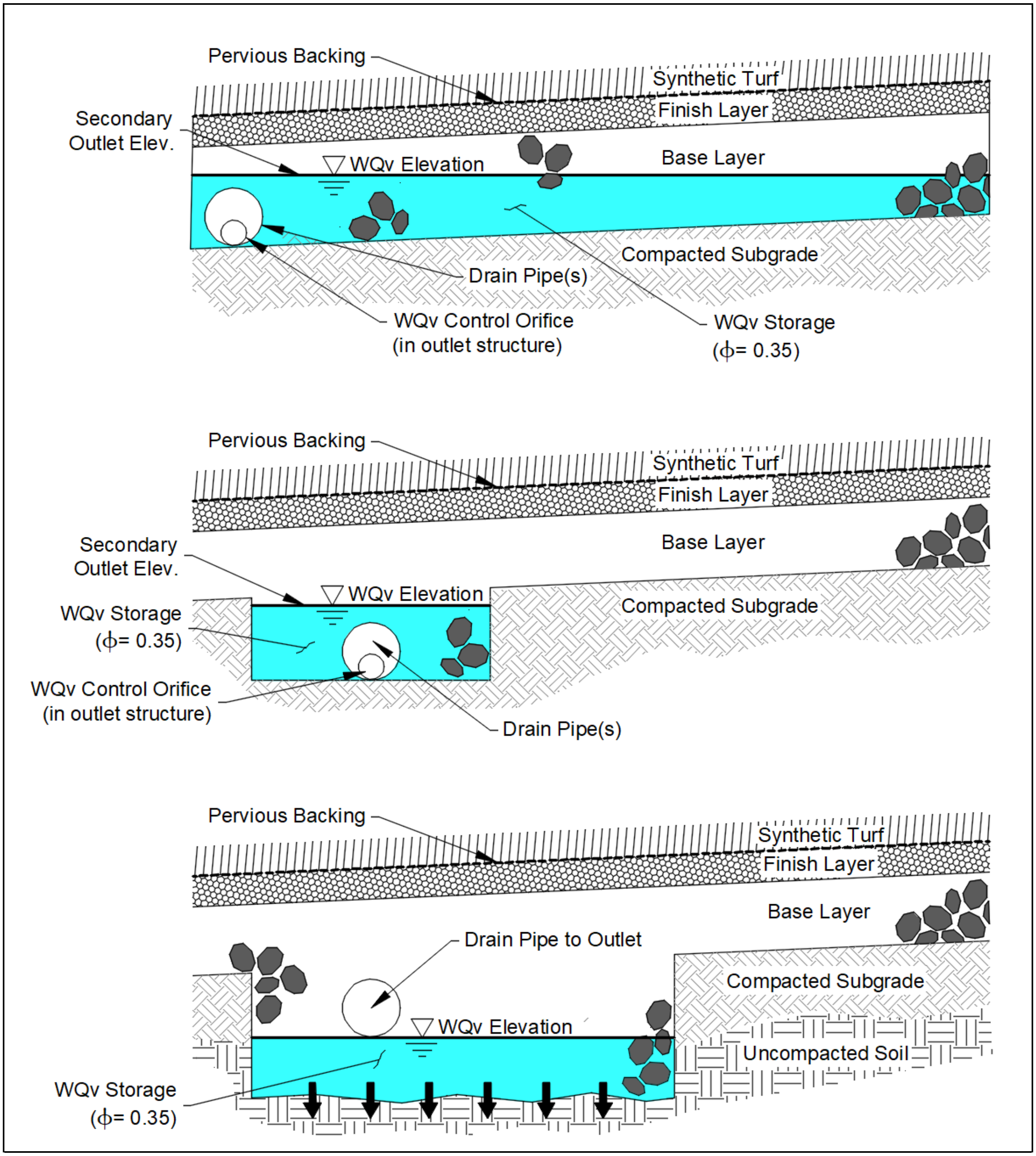

Figure 8.3.1: Schematic of synthetic turf as permeable pavement applied with extended detention in the base layer (above), extended detention in trenches (middle), and infiltration (below) (not to scale).

Water Quality Volume Infiltration and Drawdown

Design the practice to infiltrate the WQv within 48 hours following the guidance in Chapter 2.10 (permeable pavement).

Use a design infiltration rate determined as directed by Chapter 2.17. The design infiltration rate must account for intended and unintended subgrade compaction, especially of the clayey soils prevalent in Ohio. Severe compaction by the aggregate hauling and placement traffic during construction will likely degrade the infiltrative capacity of the subgrade. To counter this, it may be possible to use rock-filled trenches as illustrated in Figure 8.3.1 to develop an infiltration bed on uncompacted soil. Excavate trenches in accordance with Chapter 2.12 (infiltration trench) to develop the necessary storage volume and infiltration bed area. Backfill the trenches and protect them from construction traffic to prevent compaction.

Where infiltration through trenches or the subgrade is not feasible, configure an outlet with an extended detention orifice to drain the WQv over a minimum of 24 hours while not discharging more than the first half of the WQv in less than one-third of the drain time. Position the WQv control orifice in an accessible location where it can be inspected and maintained without destroying the synthetic turf.

Provide an auxiliary outlet above the WQv to discharge larger flows.

Critical Storm Method Considerations

In addition to Ohio EPA's WQv, local stormwater regulations may require the critical storm method (See Appendix 2.A.3) to control peak discharges. An effective runoff curve number (CN) of 95 is recommended to estimate the runoff volume when determining the critical storm of extended detention synthetic turf permeable pavements. This CN represents abstractions typically associated with gravel pavement.

Where the practice is designed to infiltrate the WQv into the subgrade, there can be considerably more abstraction depending on the soil infiltration rate. Sand, sandy loam or loamy sand soil with an infiltration rate of one inch per hour or greater, although rare throughout Ohio, can be represented by a CN as low as 28. Loam soil with an infiltration rate of one-half inch per hour may be represented by a CN as low as 40.

To calculate peak discharge rates of synthetic turf designed as permeable pavement, model the aggregate subbase as a storage reservoir. For infiltrating systems, assign a steady-state discharge rate to the infiltration rate determined using guidelines in Chapter 2.17. Note that the critical duration of flow for these practices is not well defined.

Design Considerations

Geotextiles are often placed for separation at the interface of the aggregate base and soil subgrade. The designer must ensure that fabrics will not clog or blind with sediment or aggregate dust, leading to drainage failure. Geogrids may be an alternative. Refer to industry association or manufacturer specifications for guidance on subgrade separation and stability.

Check for tailwater and backflow conditions. Backflow prevention may be necessary to prevent sediment laden stormwater from entering the storage system from the outlet.

Design and implement erosion and sediment controls during construction, including a temporary sediment basin, sediment barriers, and/or inlet protection devices, as directed in the CGP.

Maintenance Considerations

The practice must operate long-term with sustained performance. The designer must develop a detailed operation and maintenance plan for the owner that outlines the maintenance activities necessary and their expected schedule to ensure a consistent level of treatment occurs over the life of the practice.

Routine maintenance tasks such as removing debris by sweeping, blowing, or vacuuming the turf surface are necessary for both care of the turf as well as to preserve the stormwater and drainage functions. The field may be cleaned by spraying with water, but do not use solvents or cleansers for general cleaning.

Avoid the widespread use of fungicides and anti-bacterial treatments that may contaminate stormwater. Research (McNitt) indicates that UV light and temperature make synthetic turf an inhospitable environment for bacteria.

Replace synthetic turf when the fibers have reached the end of their service life to prevent the breakdown of fibers from contributing microplastic contaminants to stormwater. Perform turf replacement activities in a manner that does not spill granular infill into storm drains or into the aggregate base, where it will reduce the storage volume and permeability.

References

AKRF, Inc. and D.S. Thaler and Associates, LLC. 2011. Effectiveness of FieldTurf Artificial Turf for Management of Stormwater. Prepared for FieldTurf. Pittsburg, PA.

Cashatt, Clay. 2020. Viability of Stone Void Space in Underground Detention/Retention Systems. In proceedings of World Environmental and Water Resources Congress 2020. P149-166. American Society of Civil Engineers. Reston, VA.

Connecticut. 2010. Artificial Turf Study Leachate and Stormwater Characteristics. Department of Environmental Protection.

Hodepohl, M., Buchberger, S., and W. Shuster. 2016. Hydrology of Synthetic Turf Fields: Modeling Approach with Field Data. In J. Irrig. Drain Eng. 142(5): 04016006. American Society of Civil Engineers. Reston, VA.

Jastifer, J., McNitt, A., Mack, C., Kent, R. and K. McCullough. 2019. Synthetic Turf: History, Design, Maintenance, and Athlete Safety. 2019 Jan/Feb; 11(1):84-90. doi: 10.1177/1941738118793378.

McLaughlin, J., Urisaka, M., DiGiovanni, K., Montalto, F. and J. Kleyman. 2019. Turf Field Stormwater Retention. In WEFTEC 2019 Conference Proceedings, pp 3624-3643. Water Environment Federation. Alexandria, VA.

Ohio EPA. 2023. General Permit Authorization for Storm Water Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System. Ohio EPA Permit Number OHC000006. Ohio Environmental Protection Agency. Columbus, OH.

Schwartz, Stu. 2010. Effective Curve Number and Hydrologic Design of Pervious Concrete Storm-Water Systems. In J. of Hyd. Eng. June 2012:465-474. American Society of Civil Engineers. Reston, VA.

SportsEdge. 2017. Technical Bulletin, Synthetic Turf Athletic Field Drainage Design Assistance. Accessed November 29, 2023 from www.sportsedge.com/wp-content/uploads/Drainage-Design-Assistance_Syn_Turf_Fields.pdf.

Strohman, B. 2018. Topic Brief Drainage Investigations of Artificial Turf Field Systems. Accessed November 29, 2023 from www.sgh.com/insight/drainage-investigations-of-artificial-turf-field-systems.

Synthetic Turf Council. 2013. Guidelines for Maintenance of Infilled Synthetic Turf Sports Fields. Synthetic Turf Council. Forest Hill, MD.

Synthetic Turf Council. 2017. Guidelines for Synthetic Turf Base Systems. Synthetic Turf Council. Forest Hill, MD.