Rehbein
ENVIRONMENTAL SOLUTIONS

DRAINAGE DYNAMICS IN EPIC SYSTEMS

Prior to EPIC technology the aspects of drainage were surface events. Fields were crowned with a slope and suitable storm drain catch basins were installed in selected low points to collect and move water. Native soils contained clays and silt, thus readily compacted and prevented any significant water migration in the soil structure. Sub surface drainage infrastructures using conventional slitted pipe, gravel wrapped pipe or geo-fabrics were inefficient “feel good “ designs that plugged quickly or drained so slowly that the bulk of water management still relied on the surface flow of crowned fields.

EPIC structures use an 11” washed sand, and a 2” fine gravel as its growing media. The porous substrate readily absorbs and transfers surface water to the underlying EPIC chamber and connection pipes to the desired final discharge points in the field. To understand the drainage perspectives in EPIC systems it is important to understand the interconnected dynamics and functions of the different underground structures.

The EPIC profile has a water retention capacity of **2.5 gal/square foot**. When perfectly dry the system will absorb this field capacity before any discharges occur. As such 2.5 gallons/sq.ft ÷ 0.62 gallons/inch/square foot = **4”** of rainfall events. This condition however is only present in a new “uncharged” field, or achieved in about three weeks after supplementary water is shut down and no outside rain events occur.

During normal operating levels, the bottom 4” of the profile is at saturation, leaving a partially saturated profile of the upper 9” which is above the water line. The void capacity of this 9” profile is graduated due to the upward movement of capillary physics. Since rain water comes from above, the 9” sand profile has the capacity to absorb prior to attaining its field holding capacity and initiating drainage. The **void capacity** of this 9” layer of sand is about **0.2 cu.ft**. per square foot. As such 0.2 cubic feet x 7.48 gallons per cubic feet = 1.49 gallons/ square foot. Then 1.49 gallons/sq.ft. ÷ 0.62 gallons /inch/square foot = **2.4”** of absorbable rainfall.

Sand will not drain until its **field capacity** (capillary adhesion) is overcome by gravity (drainage flow). In controlled experiments with growing turf in sand, the field capacity is always smaller than the void capacity. As such the just calculated void capacity of 2.4” of rain is only about **1”** of rain before drainage flow is initiated. The void capacity is only available as storage in closed systems where drainage loss is not allowed to happen. While **EPIC designs** can be manipulated to provide a closed system, normal designs are **open systems which allow drainage.**

Once drainage flow is initiated, the flow rate of water through the sand profile is dictated by friction, particle size, and occlusions in the profile. This is termed the **percolation**

rate. The flow is not sudden, due to the resistance imposed by capillary adhesion that tends to reverse the direction of flow. This phenomenon then imposes a certain variable detention time to the flow rate. Sand approved for EPIC profiles demonstrate percolation rates greater than **1" per 10 minutes**. As such the sand can physically transmit 6" per hour or 144" per 24 hours. However since the sand is not overlain over a bottomless void, the percolation rate in EPIC systems is actually mitigated by two other factors a.) the rate at which water **transfers through the interface** between sand and fine gravel and the openings into the EPIC chamber itself, and b) the rate the receiving EPIC chambers can get rid of excess water **through the 2" connector pipes**.

The measured infiltration rate into the EPIC chamber through the sand gravel interface is **0.25 gal./minute/ chamber**. Since each chamber is designed to drain 25 square feet, then 0.25 gal/minute x 60 minutes x 24 hours ÷ 25 square feet = 14.4 gal/square foot. Accordingly 14.4 gal/square foot ÷ 0.62 gal/ inch/sq.ft. = **23.3 inches per 24 hours**.

At saturation the approximate 1 foot sand profile will produce a head pressure of one foot. At this passive pressure water movement through a 2" diameter pipe is **20 gallons per minute**. Interconnecting an array of EPIC cells (Pan and Chamber) then limits drainage capacity of the field to move water through a 2" opening.

As an example the Cambria athletic field connects **88 cells** that terminate to a 2" by 4" side connection point on the side lines. The array drains **2200 square feet**. The 2" diameter connection point then has the potential to move 20 gal/min. x 60 min/hr. x 24 hours = 28,800 gallons per 24 hours. 28,800 gallons ÷ 2200 square feet = 13 gallons/sq.ft. As such the large array and 13 gal./sq.ft. ÷ 0.62 gal./sq.ft./inch equals a drainage limiting capacity of the 88 cell array to **21.1" of rain per 24 hours**.

In the overall Cambria field the **39** arrays terminate at a 4" drainage pipe on the sidelines. At one foot head pressure a 4" diameter pipe can move 4 times the water of a 2" pipe. As such a single 4" outlet can discharge 28,800 x 4 = 115,200 gallons per 24 hours. The final limiting factor for each of the 39 arrays is 115,200 ÷ 39 = **2954** gallons per array. Since each array covers 2200 square feet, 2954 ÷ 2200 = **1.34** gallons per square foot. The final drainage capacity of the system is thereby limited by the capacity at the final discharge point of the 4" pipe, 1.34 gallons/sq.ft. ÷ 0.62 gallons/sq.ft./inch = **2.16 inches per 24 hour period.**

As previously discussed, the **first inch** of rain fall is likely to be **absorbed** prior to initiating drainage, so the field design capacity is actually **3.16** inches before temporary backup conditions in the field are noticed.

However since there are four outlet vaults on the field, and each outlet vault can have a 4" outlet to the underlying storage reservoir, the field capacity to drain can be increased to **12.64"** of rainfall per 24 hour period by the addition of three more outlet points.

As such by manipulating the number and size of the final discharge points one can achieve whatever drainage capacity event needed and desired.