



## STORM BULLETIN 3

# TREATING STORMWATER USING CHAMBERS WITH BAFFLES

Concrete vaults and manholes are commonly used for oil-water separators and septic tanks. These structures can also be adapted for use in stormwater pretreatment by installing baffles that have been configured to provide flow control. As an example, stormwater treatment capability can be evaluated by using a 4'W x 10'L household septic tank as an analogy.

### SIZING PARAMETERS

- Septic tank sizing is based on the number of bedrooms being treated and by a reasonable value for the average daily water usage generated by the bedrooms. A 4'W x 10'L vault can treat 2-3 bedrooms.
- Stormwater treatment sizing is based on the size of the impervious area being treated and by a reasonable value for the first flush generated from that area. For this example a 4' W x 10' L vault (40 ft<sup>2</sup> of floor area) would be used for treating 2.0+/- impervious acres.

### INLET PIPE SIZE

- The wastewater treatment the inlet pipe is typically 4" Polyvinyl Chloride (PVC).
- The stormwater treatment the inlet pipe could be 12" PVC, Corrugated Metal Pipe (CMP), Reinforced Concrete Pipe (RCP) or High Density Polyethylene (HDPE).

### TREATMENT FLOW RATE

- The average wastewater treatment flow during a typical 24-hr cycle is 0.20 gallons per minute (gpm) or 288 gallons per day.
- The average stormwater treatment flow, for a reasonable pavement wash-off event (first flush), could be as much as 200 gpm. This flow rate, which is 1000 times higher per minute than for wastewater treatment, usually 3-6 minutes.

### RESIDENCE TIME DURING TREATMENT

- The residence time for wastewater treatment is approximately 24 hours.
- The residence time for stormwater treatment, for the Water Quality Event, will be approximately 10-40 seconds.

### TOTAL SUSPENDED SOLIDS (TSS) REMOVAL EFFICIENCY

- The TSS removal efficiency, for the predictable and consistent daily cycle of "human wash-off events, for a septic tank is 40-50%".
- The TSS from "pavement wash-off events" is not predictable, consistent, or well defined. The EPA standard for TSS removal, assuming the use of adequate ponds or sand filters which provide several hours of residence time, is for 80% removal of clays and/or silts.
- The sandy sediment removal for a chamber with baffles is estimated to be 80%.



- Flow monitoring has been used to provide Regulatory Agency “Certifications” of chamber configurations. Flow monitoring data is data of limited use because it is so scattered and questionable that results must be correlated using regression analysis based on studies completed by the University of Minnesota. This data scatter is not surprising considering the inconsistent sediment composition that will exist in flowing stormwater, and the impracticability of calibrating flow monitoring protocols for the large pipes found in storm sewer systems.
- Since flow monitoring data is too inconsistent and scattered to be reviewed for sedimentation science, sizing methodology, and volume of sediment accumulated in the sediment storage sump some agencies are now requiring testing using controlled laboratory conditions to develop meaningful data,.

### **DESIGN STORM EVENT**

- There is no design storm event for a septic tank.
- The design storm peak flow will be approximately 6-8 times the normal peak flow for storm-water treatment.

### **SEDIMENT RE-ENTRAINMENT AND CARRYOVER DURING DESIGN STORM EVENT**

A key concern is to limit re-entrainment and carryover of accumulated sediment caused by the turbulence and mixing during a Design Storm Event. One approach is to provide annual pump-out to reduce the amount of sediment available for carryover. Another way is to bypass the sediment pile during a design storm. The proposed treatment configuration can be evaluated using laboratory models operated at different flow rates and sediment pile sizes.

### **UPSTREAM PONDING DURING DESIGN STORM EVENT**

Internal piping, baffles, screens, and weirs all add flow restriction that could cause ponding at upstream structures. A hydraulic analysis must be provided to determine whether or not upstream ponding will occur. This analysis should be based on the water surface elevation downstream from the treatment system.