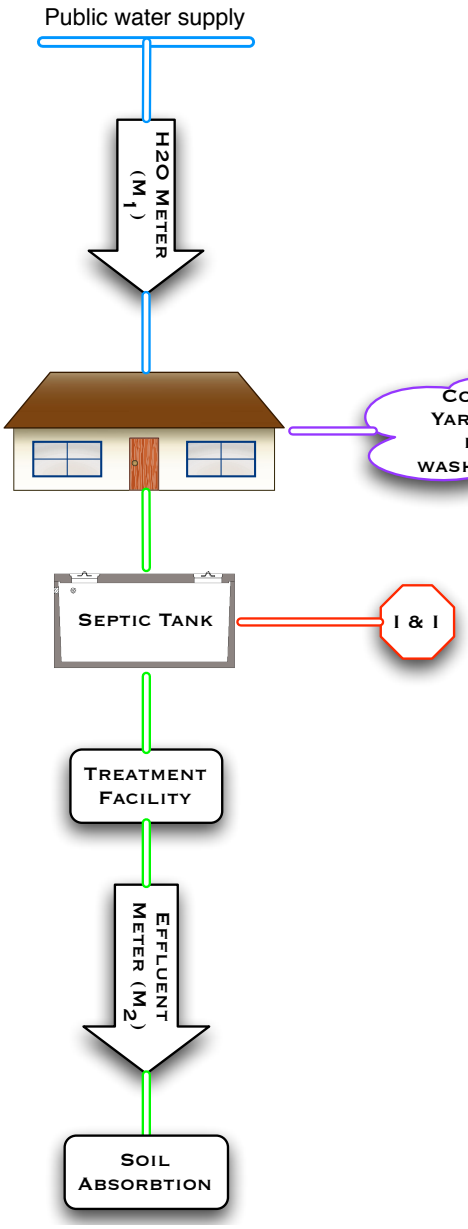
Analysis of Inflow and Infiltration from Unsealed Septic Tank Access Ports



Introduction

Watertight tanks are generally overlooked as a solution to inflow and infiltration (I&I) problems in municipal and decentralized wastewater systems. The use of watertight tanks can dramatically reduce treatment costs, reduce overflow events, and help contain the ever increasing problem of inflow and infiltration. An ideal scenario would show the treated sewage effluent to be less than the total purchased water. Watering yards, washing cars, consumption, etc., all dispose of water outside the sewage collection system and account for effluent wastewater being less than purchased water.

The two systems being analyzed in this document are decentralized on-site wastewater collection systems. The collection and treatment processes for both systems are handled by a recirculating sand filter (RSF). Both systems are serviced by a public utility that provides the public drinking water and sewer collection for each house. The drinking water is metered (M_1) at each house and monitored monthly for billing purposes. The sewage effluent is pumped to a central treatment facility where the total treated effluent is metered (M_2).

During a six-month period, water meter readings and treated sewage effluent were carefully monitored for Systems 1 and 2. At the end of the six-month period, the total purchased water and treated effluent for each system were evaluated to determine the treated effluent as a percentage of water purchased. This data provides a basis for predicting future performance while giving a monthly performance snapshot, which allows the utility to be proactive in combating inflow and infiltration along with other issues that may arise.

System evaluation

Two decentralized on-site wastewater collection systems, Systems 1 and 2, were monitored for six months. Both systems are comparable in physical size, customers served, weather patterns, and geographical location. Since recirculating sand filters are not significantly impacted by rainfall events, it is assumed that all effluent treated originates from the septic tanks.

System 1 showed an excess of sewage effluent that entered and was treated in the recirculating sand filter (see Table 1). The total water exiting the recirculating sand filter was greater than the purchased water amount. This increase in water being treated could only be explained by inflow and infiltration entering the collection system.

System 1 – Trouble System	
Total water purchased	253,800 gallons
Total sewer treated	327,432 gallons
Percent purchased water treated	**129% (bad)**

During the same time period, System 2 showed the total treated sewage effluent to be less than half the purchased water. Only 44% of the

purchased water was entering the recirculating sand filter (see Table 2). System 2 had a low treated effluent to purchased water ratio, which demonstrated the system was not experiencing inflow and infiltration of any significance.

System 2 – Good System	
Total water purchased	164,700 gallons
Total sewer treated	73,202 gallons
Percent purchased water treated	**44% (good)**

Diagnosing the problem

With System 1 experiencing severe inflow and infiltration problems, the system was analyzed for failures. Tanks used in both systems were provided by a National Precast Concrete Association (NPCA) certified plant, ensuring proven quality construction methods for producing watertight tanks. Having tanks designed and constructed to be watertight from a NPCA certified manufacturing facility helped reduce the areas to inspect for inflow and infiltration due to the high confidence level earned from the plant accreditation program.

If a manufacturer without a recognized quality assurance program had supplied the tanks, the cause of the inflow and infiltration could be more difficult to find. Common types of failure that lead to inflow and infiltration are cracked tanks due to no reinforcement, inferior permeable low strength concrete, or the total lack of a high quality sealant in the joint line. A combination of these problems would require replacing the entire tank with a watertight design that had a plant accreditation program behind it.

A review of the specifications for the two systems revealed only one difference in the tank requirements. The qualifying difference between the two systems was the specification for sealing of the inlet access port lid on the sewage collection tanks at each house. System 1 did not require the concrete inlet access port lid to be sealed during installation, while System 2 required the concrete inlet access port lid to be sealed prior to installation. Because of the large quantity of inflow and infiltration, this differing specification was considered not to be the primary cause of the problem before going into the field to do an inspection of each tank.

After a brief discussion and consultation with the tank manufacturer, engineer, and field personnel, it was decided that the first place to check in the collection system would be the tanks. Specifically, the access ports that were not sealed would be uncovered and inspected first. If the access ports had not shown any signs of inflow and infiltration, the inspection would be expanded. The expanded inspection would uncover and visually inspect any and all seams and joints on the tanks, risers, and inspection ports.

When the first tank was uncovered, it was immediately apparent that the inlet side access port lid (see Figure 1) was allowing surface water to enter the tank. The first tank uncovered for inspection exhibited major problems with water leaking into the tank around the inlet end access port lid seam. The access port lids measured

eighteen inches in diameter. All of the tanks showed varying degrees of inflow and infiltration while being inspected.

The fix

The next step was to seal each of the inlet access port lids on each tank in System 1 with a high quality butyl sealant to ensure a watertight seal. Fortunately, the unsealed lid was close to ground level, allowing the problem to be fixed within a few minutes with a butyl sealant. System 1 and System 2 tank specifications were now identical to each other and should perform equally well against inflow and infiltration into the collection system. With the only apparent problem being fixed on the tanks, the decision was made to wait for the following month's meter readings to evaluate the impact sealing the access port lids had on the volume of treated effluent. The success of applying the butyl sealant on the inlet access port lids became evident when the meter readings were totaled. The resulting flow numbers for the following month after the access port lids were sealed in System 1 showed a dramatic decrease in treated sewage. Sixty percent of the total purchased water was entering the sewage treatment facility, cutting the treated wastewater by more than half. This validated that the inflow and infiltration problem originated from the unsealed access port lids. Table 3 shows the purchased water and treated effluent comparisons.

System 3 – Trouble System Post-Fix	
Total water purchased	245,600 gallons
Total sewer treated	147,300 gallons
Percent purchased water treated	**60% (good)**

Conclusion

Sewer collection systems are only as good as the weakest component. In this case, failure of the utility to specify proper sealing of the tank totally negated the tank's watertight design and construction and resulted in the tank being the weakest component in the entire system. Overlooking such a simple precaution to both specify and properly seal a watertight tank can be catastrophic for all sewage collection systems, resulting in system overloads and significantly increased operating cost.

Systems with 1,000 septic tanks and/or grease traps that each contain at least one unsealed access port lid could produce as much as 20 million gallons per year of added liquid effluent into the treatment system.

Breakdown in system performances, such as inflow and infiltration, can result in overloaded sewage treatment facilities. Based on data collected in this study, systems with 1,000 septic tanks and/or grease traps that each contain at least one unsealed access port lid could produce as much as 20 million gallons per year of added liquid effluent into the treatment system. To provide long-term system improvement, utilities should ensure that properly designed, properly sealed, durable watertight tanks are installed for wastewater applications.

Author: Eric Barger, C.R. Barger & Sons, Inc.; www.BargerAndSons.com

Utility Representative: Wesley Barger, Watts Bar Utility District; www.WBUD.org