OYSTER SHELL STORMWATER TREATMENT SYSTEM

OYSTER SHELL TREATMENT – DOWNSPOUT BARRELS

The Port of Seattle (Port) works hard to protect and improve Puget Sound's water quality. When stormwater runs off buildings and pavement, it can carry metals, oils and other pollutants into storm drains and waterways. The Port's Terminal 102 commercial building is close to a busy elevated highway, and its roof was identified as a potential stormwater source of copper and zinc, metals that are associated with vehicles and harmful to salmon.

In 2017 during a re-roofing project at Terminal 102, the Port constructed and installed 20 oyster shell barrels (see Figures 1 and 2) on drainage downspouts to treat approximately 2-million gallons of roof run-off a year. The treatment action of oyster shells is attributed to the structure, which filters solids, and calcium content, which promotes adsorption of metals from stormwater.

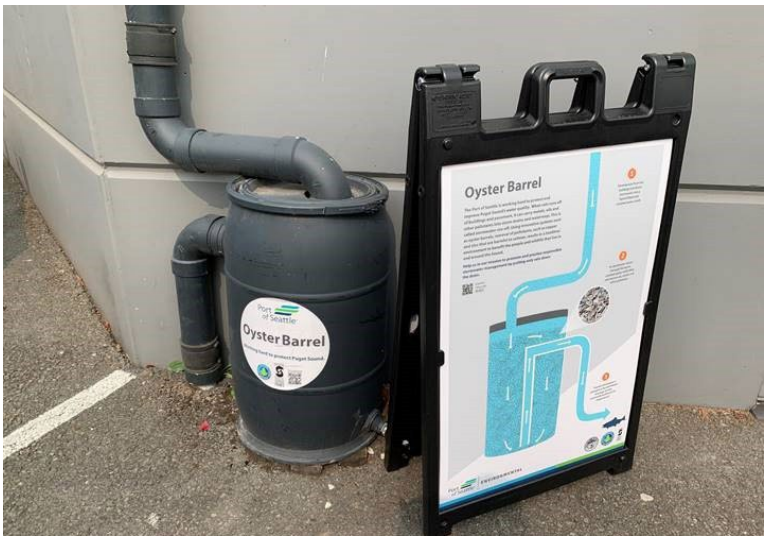

Figure 1. Oyster shell downspout barrel system and information sign at Terminal 102

The Port monitors and maintains the systems, including the following:

- Samples stormwater inlet (influent) and outlet (effluent) to track concentrations of metals and turbidity
- Replaces oyster shells when the shells lose their capacity to remove pollutants, approximately once per year
- Evaluates washing the used oyster shells so they can be reused in the treatment systems

OYSTER SHELL BARREL SCHEMATIC

Figure 2. Information sign for oyster shell downspout barrels at Terminal 102

Each oyster shell treatment system has an inlet pipe that connects to the roof downspout, an outlet pipe that extends from the barrel bottom to about one-third from the top, and a pipe that connects to the stormwater system (Figure 2). The stormwater runoff from 88,000 square feet of roof area seeps through 25 to 30 gallons of crushed oyster shells to the bottom of the barrel, and then flows up the outlet pipe and into the stormwater system. Each of the 20 oyster barrels treat an average of 100,000 gallons of roof runoff each year.

OYSTER SHELL BARREL MONITORING

To determine the effectiveness of this stormwater treatment, water quality monitoring is conducted and has been ongoing since the barrels were first installed in 2017. Two barrels were selected for sampling [Points A and B (Figure 3)] to represent effectiveness of the treatment system.

In September 2020, we began washing and reusing oyster shells using a media washing machine developed to remove sediment and 'refresh' the shells. To evaluate effectiveness of this effort, a new sampling point was added (Point C). The shells used in the Point C barrel are new oyster shells (i.e., have not been used for treatment prior to being put in barrels). The shells used in the barrels monitored as Points A and B, and all other barrels, have been refreshed. Monitoring data from this effort suggests that new shells perform better at reducing pollutants, showing a 14% higher average reduction of copper and zinc compared with reused shells. Monitoring will continue to determine if and when the reused oyster shells should be replaced due to loss of effectiveness.

Figure 3. Oyster barrel locations at Terminal 102 displaying the three sample locations (numbered stars are downspouts)

EFFECTIVENESS OF SYSTEM

Stormwater treatment effectiveness is determined by analyzing stormwater collected before (influent) and after (effluent) flowing through the oyster shell barrels. As shown in Figures 4 and 5, testing results spanning 15 sampling events, dating back to 2017, show that oyster shell treatment significantly reduces pollutants from roof runoff, with effectiveness for zinc in the range of 57%, copper in the range of 48%, and 34% for turbidity.

Over time, the effectiveness of the oyster shells to reduce pollutants decreases and they must be replaced or refreshed by washing. Through stormwater monitoring data, we have found that the treatment systems are effective for approximately one year. After one year, effectiveness of the system appears to decrease and metal concentrations in effluent increase.

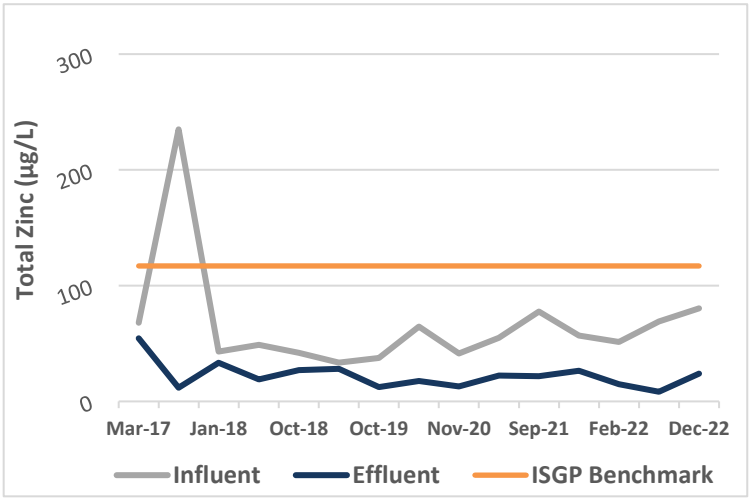

Figure 4. Average zinc concentration in roof runoff before treatment (influent) and after treatment (effluent) at Terminal 102 between March 2017 and December 2022

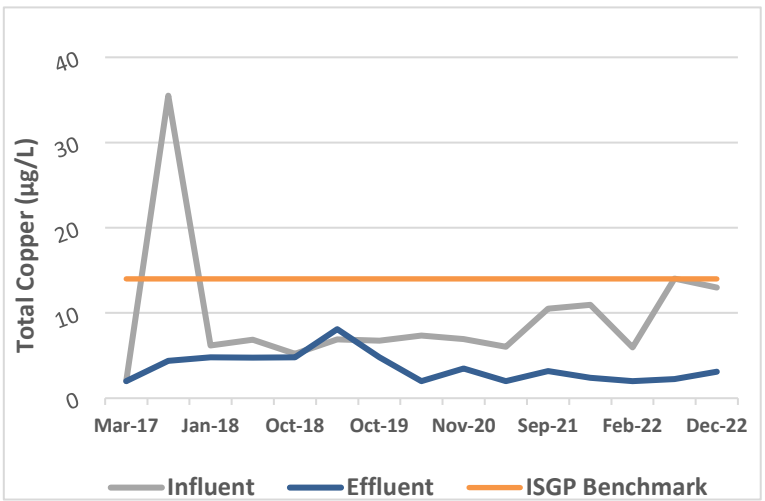

Figure 5. Average copper concentration in roof runoff before treatment (influent) and after treatment (effluent) at Terminal 102 between March 2017 and December 2022