

SPOKANE COUNTY SAND FILTER SIDEWALK VAULT BMP EFFECTIVENESS STUDY



Study Introduction

This project is one of eight Eastern Washington stormwater effectiveness studies conducted to meet Spokane County's NPDES MS4 2014-2019 permit requirements (S8. Monitoring and Assessment). An effectiveness study evaluates the effectiveness of permit-required stormwater management program activities and best management practices (BMPs). The purpose of this study was to evaluate the stormwater treatment performance of a new sand filter BMP, the **sand filter sidewalk vault**. The results of the study were intended to be used to justify the development of a new BMP approved for general use on future projects, if Technology Assessment Protocol – Ecology (TAPE) treatment performance goals were met.

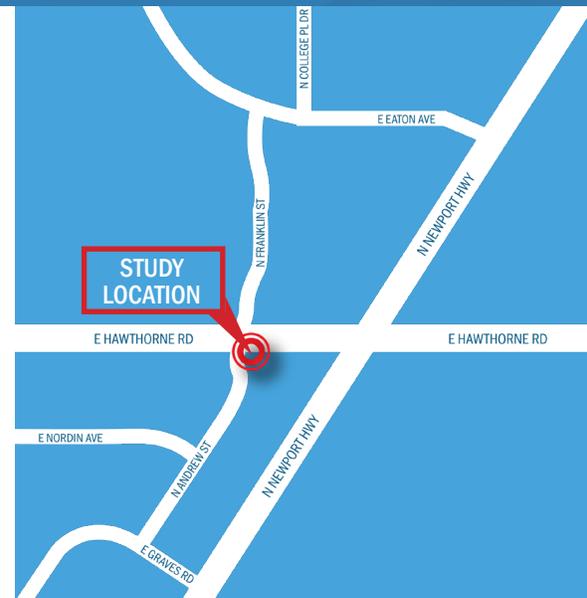
Constructing BMPs at sites with space constraints is a challenge for projects located in built urban areas, where the right-of-way abuts property lines or where there is limited space between the sidewalk and roadway. The proposed **sand filter sidewalk vault** BMP is a variation of the basic sand filter vault BMP defined by the Ecology stormwater manuals for Washington State. The 4-foot by 5-foot **sand filter sidewalk vault** is installed below the sidewalk and receives runoff through a curb cut located in the street gutter. Since the BMP is contained and provides treatment within the vault, it can be connected to existing (or new) storm drain networks. This BMP could eliminate (or reduce) the need for constructing a treatment BMP downstream and subsequently reduce the overall cost of stormwater management on future projects.

Preliminary BMP Design and Maintenance Guidance

Prior to the field study, BMP design and maintenance guidance was developed for the proposed **sand filter sidewalk vault** BMP. The guidance was based on the results from column testing and modifying the design guidance defined in the Eastern Washington Stormwater Management Manual for the basic sand filter BMP (Ecology, 2019). The column test included simulated rainfall events using a synthetic stormwater solution. The column testing system was designed to be representative of the new BMP constructed in the field. Results from the column test indicated that a design infiltration rate of 50 inches/hour and a hydraulic loading of 1.6 gallons/minute were appropriate for the sand filter media.

Water Quality Sampling

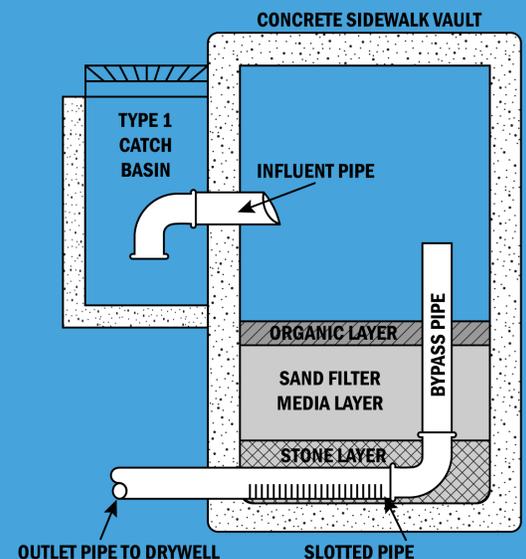
Automated monitoring equipment was installed at the **sand filter sidewalk vault** BMP site in 2018 to collect composite influent and effluent water quality samples, flow rate, temperature, and precipitation depth. Through two wet seasons, a total of 24 storm events were collected. The storm events were evaluated to determine whether the TAPE storm event guidelines and sample collection requirements were met. The water quality data obtained was used to evaluate the reduction of the following stormwater runoff target pollutants: total suspended solids (TSS), dissolved copper and zinc, and oils.



STUDY LOCATION:

The test site is located near the intersection of East Hawthorne Road and US 2 (Newport Highway) in Spokane, Washington. At this location, the land use is a mix of residential and commercial. The contributing basin area is approximately 0.41 acres, of which 0.32 acres is impervious surfaces (roadway and sidewalks) and 0.09 acres is pervious surfaces (lawns). The contributing roadway is primarily an urban arterial with some runoff from a residential road.

RECOMMENDED SAND FILTER SIDEWALK VAULT



Water Quality Treatment Performance

The water quality treatment performance of the **sand filter sidewalk vault** was evaluated against Ecology treatment performance goals for basic, dissolved metals, and oil treatment using the bootstrap statistical method per TAPE. The results are summarized in the table below:

| ECOLOGY TREATMENT PERFORMANCE GOALS | | | | |
|-------------------------------------|------------------------------|---|----------------------------------|-------------------------------------|
| Performance Goal | Pollutant | Treatment Performance Criteria ¹ | Study Water Quality Data Results | Treatment Performance Goal Achieved |
| Basic Treatment | Total Suspended Solids (TSS) | Effluent <20 mg/L | 31.9 mg/L | No |
| Dissolved Metals Treatment | Dissolved Copper (Cu) | 30% Reduction | — ² | No |
| | Dissolved Zinc (Zn) | 60% Reduction | 16.7% | No |
| Oil Treatment | NWTPH-Dx | Daily average effluent conc. < 10 mg/L | — ² | No |

¹ Treatment performance criteria shown reflects the criteria for typical influent concentration ranges at the site.

² Insignificant difference was found between influent and effluent concentrations.

Operation and Maintenance Cycle

The infiltration and sediment accumulation data collected during the study provided an estimate of operation and maintenance frequency for the **sand filter sidewalk vault**. An analysis of infiltration over time indicated that maintenance would be required twice per year for a basin area of 0.41 acres and once every 2.5 years for an area of 0.08 acres. An estimate of sediment accumulation rate indicated a rate of 1.66 lb sediment/inch precipitation could be anticipated.

Recommendations

If the study is repeated, the test site should be modified to include a catch basin with a sump upstream of the BMP (see Recommended Sand Filter Sidewalk Vault figure on previous page) to reduce the sediment accumulation rate, which will ultimately reduce the maintenance cycle frequency. Including a sump in the BMP design allows a vactor truck to clean the catch basin, a practice that maintenance staff often perform.

Based on the PSD results, the sand filter media can be improved by reducing the media pore size distribution (i.e. the different sizes of empty spaces in the media). For example, instead of using coarse sand media, a mix of medium grain and coarse sand could be used to reduce the pore size distribution. Alternatively, adding high carbon fly ash to the sand mix will reduce the media pore size distribution while still allowing for high infiltration rates and enhance the dissolved metals removal.

COLUMN TESTING CONFIGURATION



SAND FILTER VAULT & DRY WELL



SPOKANE COUNTY CONTACT:

Jake Saxon, Project Manager
509.477.7245
jsaxon@spokanecounty.org

OSBORN CONSULTING RESEARCH TEAM:

Aimee Navickis-Brasch, PhD, PE
509.867.3654 Ext. 301
aimeen@osbornconsulting.com

Taylor Hoffman-Ballard, PE
509.867.3654 Ext. 302
taylorh@osbornconsulting.com

Nicole Chen, EIT
206.628.9133 Ext. 232
nicolec@osbornconsulting.com