WASHINGTON STATE DEPARTMENT OF ECOLOGY

October 2021

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), ENHANCED (DISSOLVED METALS), AND PHOSPHORUS

For

StormTree®
StormTree® Biofiltration Practice

Ecology's Decision:

Based on the StormTree® application submissions for the StormTree® Biofiltration Practice (StormTree), Ecology hereby issues the following use level designation:

1. General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus Treatment:
    - Sized at a hydraulic loading rate of no more than 1.25 gallons per minute (gpm) per square foot (sq ft) of media surface area.
    - Constructed with a minimum media thickness of 24-inches (2-feet).
2. Ecology approves the StormTree at the hydraulic loading rate listed above, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:
    - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
    - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
    - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.
3. The GULD has no expiration date, but may be amended or revoked by Ecology.

Ecology's Conditions of Use:

The StormTree shall comply with these conditions:

1. Applicants shall design, assemble, install, operate, and maintain the StormTree installations in accordance with StormTree®'s applicable manuals and the Ecology Decision.
2. Applicants shall determine the minimum size filter surface-area for use in Washington by using the design water quality flow rate (as determined in Ecology Decision, Item 2 above) and the Infiltration Rate (as identified in Ecology Decision, Item 1, above). Calculate the required area by dividing the water quality design flow rate (cu-ft/sec) by the Infiltration Rate (converted to ft/sec) to obtain required surface area (sq ft) of the StormTree unit.
3. StormTree media shall conform to the specifications submitted to and approved by Ecology.
4. Evaluate site characterization and suitability, as outlined in the Stormwater Management Manual for Western Washington Volume III or Stormwater Management Manual for Eastern Washington Chapter 6, before installing any StormTree that infiltrates a portion or all of the treated flow.
5. Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent on the efficiency of the device and the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.
    - StormTree designed their product for a target maintenance interval of 6 to 12 months, depending on site conditions. Maintenance includes evaluating plant material, removing any trash and debris, replacing the surface mulch layer, and raking the top of the engineered media layer.
    - A StormTree tested at Lake Union Ship Canal Test Facility in Seattle, WA demonstrated it could go 5 months, or 18.4% of a water year, without needing maintenance. Monitoring personnel observed similar maintenance issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may not be indicative of maintenance requirements for all sites.
    - Owners/operators must inspect StormTree systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to the SWMMEW, the wet season in eastern Washington is October 1 to June 30.) After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.
    - Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.
6. Install the StormTree in such a manner that you bypass flows exceeding the maximum operating rate and you will not resuspend captured sediment.

7. Discharges from the StormTree shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: StormTree®

Applicant's Address: 24 Corliss Street, Suite 9092
Providence, RI 02940

Application Documents:

Technical Evaluation Report, StormTree® Stormwater Bio-Filtration Performance Verification Project, Prepared for StormTree, Inc., Prepared by Herrera Environmental Consultants, Inc. October 2021

Quality Assurance Project Plan, StormTree® Stormwater Bio-Filtration Performance Verification Project, Prepared for MMT Inc., Prepared by Herrera Environmental Consultants, Inc. September 2020

Application for Pilot Use Level Designation, StormTree® Biofiltration Practice, StormTree®, July 2017

Evaluation Report for StormTree® Stormwater Treatment Systems, Laboratory Testing Results in Support of Application for Pilot Use Level Designation, StormTree®, June 2017

Applicant's Use Level Request:

- General Use Level Designation as a Basic, Enhanced, and Phosphorus Treatment device in accordance with Ecology's *Stormwater Management Manual for Western Washington*

Applicant's Performance Claims:

Based on results from laboratory and field-testing, the applicant claims the StormTree®, operating at an infiltration rate of 120 inches per hour, is able to remove:

- 80% of Total Suspended Solids (TSS) for influent concentrations greater than 100 mg/L and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L
- 60% dissolved zinc for influent concentrations 0.02 to 0.3 mg/L
- 30% dissolved copper for influent concentrations 0.005 to 0.02 mg/L
- 50% total phosphorus for influent concentrations 0.1 to 0.5 mg/L

Ecology's Recommendations:

Ecology finds that:

- StormTree® has shown Ecology, through laboratory and field-testing, that the StormTree® is capable of attaining Ecology's Basic, Total Phosphorus, and Enhanced treatment goals.

Findings of Fact:

Field Testing

Herrera Environmental Consultants, Inc. conducted monitoring of the StormTree® at the Lake Union Ship Canal Test Facility in Seattle, Washington between March 2020 and May 2021. Herrera collected flow-weight composite samples during 29 separate storm events.

- The system was sized at an infiltration rate of 120 inches per hour or a hydraulic loading rate of 1.25 gpm/ft^2.
- The D_{50} of the influent PSD ranged from 72 microns to 94 microns, with an average D_{50} of 83 microns.
- Influent samples from 26 of the 29 events had influent concentrations greater than 20 mg/L. The concentrations of these samples ranged from 20 mg/L to 131 mg/L, with a mean concentration of 46 mg/L. For the 25 samples with concentrations between 20 mg/L to 100 mg/L the bootstrap estimate of the upper 95 percent confidence limit (UCL 95) of the mean TSS effluent concentration was 3.5 mg/L. There was one sample with an influent concentration greater than 100 mg/L and this sample had a percent TSS reduction of 91 percent.
- Influent samples from 15 of the 29 events met the influent range for dissolved copper. The influent concentrations from these samples ranged from 6.72 µg/L to 18.9 µg/L. A bootstrap estimate of the lower 95 percent confidence limit (LCL 95) of the mean dissolved copper reduction was 31.4%.
- Influent samples from 14 of the 29 events met the influent range for dissolved zinc. An additional three samples had concentrations below the range, but were included per the TAPE guidance document. The influent concentrations from these samples ranged from 18 µg/L to 63.3 µg/L. A bootstrap estimate of the LCL 95 of the median dissolved zinc reduction was 66.7%.
- Influent samples from 17 of the 29 events met the influent range for total phosphorus. The influent concentrations from these samples ranged from 0.062 mg/L to 0.338 mg/L. A bootstrap estimate of the LCL 95 of the median total phosphorus reduction was 61.6%.
- The system experienced rapid sediment loading and was able to treat 18.4% of a water year before needing maintenance. Monitoring personnel observed similar sediment loading issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may not be indicative of maintenance requirements for all sites.

Lab Testing

Herrera Environmental Consultants, Inc. and University of Washington Tacoma conducted laboratory testing between January and June 2017. The evaluation tested five 4-inch diameter columns. Three columns (Columns 1 – 3) were built in replicate, with a 3-inch layer of bark mulch, a 6-inch layer of amendment media, a 24-inch layer of base media, and a 3-inch layer of pea stone at the effluent end. One column (Column 4) replaced the pea stone layer with a mesh screen on the effluent end. One column (Column 5) was built with the 24-inch layer of base media above the 6-inch layer of amendment media. The columns were tested at infiltration rates ranging from 21 to 211 inches per hour. Based on the lab test results:

- The system was evaluated using stormwater runoff collected at the Lake Union Ship Canal Research Facility.

- TSS removal efficiency was evaluated over 12 events each in columns 1 – 4 (infiltration rates 35 – 211 inches per hour), and 3 events in column 5 (infiltration rates 21-29 inches per hour). The median influent concentration for all events was 90 mg/L. Combined results from all columns demonstrated a median effluent concentration ≤ 5 mg/L and a median removal efficiency 94%. Column 5 removed a median of 99% TSS, with a median effluent concentration < 2 mg/L.
- Dissolved copper removal efficiency was evaluated over 4 events each in columns 1-4 (infiltration rates 35-105 inches per hour), and 3 events in column 5 (infiltration rates 21-29 inches per hour). Combined results from all columns demonstrated a median removal efficiency of 54%. Column 5 removed a median of 57%.
- Dissolved zinc removal efficiency was evaluated over 4 events each in columns 1-4 (infiltration rates 35-105 inches per hour), and 3 events in column 5 (infiltration rates 21-29 inches per hour). Combined results from all columns demonstrated a median removal efficiency of 72%. Column 5 removed a median of 93%.
- Total phosphorus removal efficiency was evaluated over 6 events in column 1 (infiltration rates 89-176 inches per hour), 4 events each in column 2-4 (infiltration rates 35-195 inches per hour), and 5 events in column 5 (infiltration rates 33-115 inches per hour). Columns 1-4 exported total phosphorus over the first 3 events, then demonstrated a median removal efficiency of 38%. Column 5, which included the amendment media at the effluent end, demonstrated a median removal efficiency of 94%.

Other StormTree Related Issues to be Addressed by the Company:

1. Conduct hydraulic testing to obtain information about maintenance requirements on a site with runoff that is more typical of the Pacific Northwest.

Technology Description: Download at http://www.storm-tree.com/

Contact Information:

Applicant: Paul Iorio
StormTree®

24 Corliss Street, Suite 9092
Providence, RI 02940
piorio@storm-tree.com

Applicant website: http://www.storm-tree.com/

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
August 2017	PULD Granted
September 2020	Revised TER and Expiration dates
September 2021	Revised Owner name from MMT Inc., dba StormTree to StormTree
October 2021	GULD granted for Basic, Enhanced, and Phosphorus Treatment