

# **Appendix J:**

## **Monitoring Water Depth in Bioretention Facilities**

## **APPENDIX J – MONITORING WATER DEPTH MONITORING IN BIORETENTION FACILITIES**

Water level loggers were installed in the bioretention facilities to determine when water was pooling, and potentially overflowing, from each facility. As described in the Quality Assurance Project Plan (QAPP; King County 2016), a HOBO U20L-04 water level logger was placed in each of the bioretention facilities, and a third logger used to record air pressure was placed in a tree on site. These loggers recorded barometric pressure (in psi) every 15 minutes, and water level was calculated per manufacturer's instructions as (water logger psi – air logger psi)\*2.307.

Water levels were monitored continuously throughout the storm sampling interval (3/1/16 - 4/25/17). Water level accuracy was generally within the manufacturer's specifications (maximum error  $\pm 0.8$  cm or 0.03 feet [ft.]), though during two field checks the level measurement error was as much as +0.06 ft. In addition, daily maximum levels occasionally measured  $\pm 0.67$  ft., even when there had been no recent precipitation. Therefore, accuracy is assumed to be closer to  $\pm 0.07$  ft. Because the primary objective was to determine if the facilities were retaining water and overflowing, and not to track exact depth, data were deemed usable if they were within  $\pm 0.07$  ft. of field measured values.

Over the entire storm sampling interval, 100% of the data from the east bioretention facility (EB) and 98% of the data from the west bioretention facility (WB) were usable. The rejected WB data were almost exclusively collected on days when temperatures were below freezing and the logger appeared to malfunction (e.g., values were erratic, often negative, and as much as  $\pm 1.5$  ft. from field measurements). The EB logger appeared to function regardless of occasional sub-freezing temperatures. During sampled storm events (Table 1), 100% and 99.9% of the data were usable from EB and WB, respectively. Two WB data points recorded during Storm 13 were rejected because they exceeded  $\pm 0.07$  ft. of the true level.

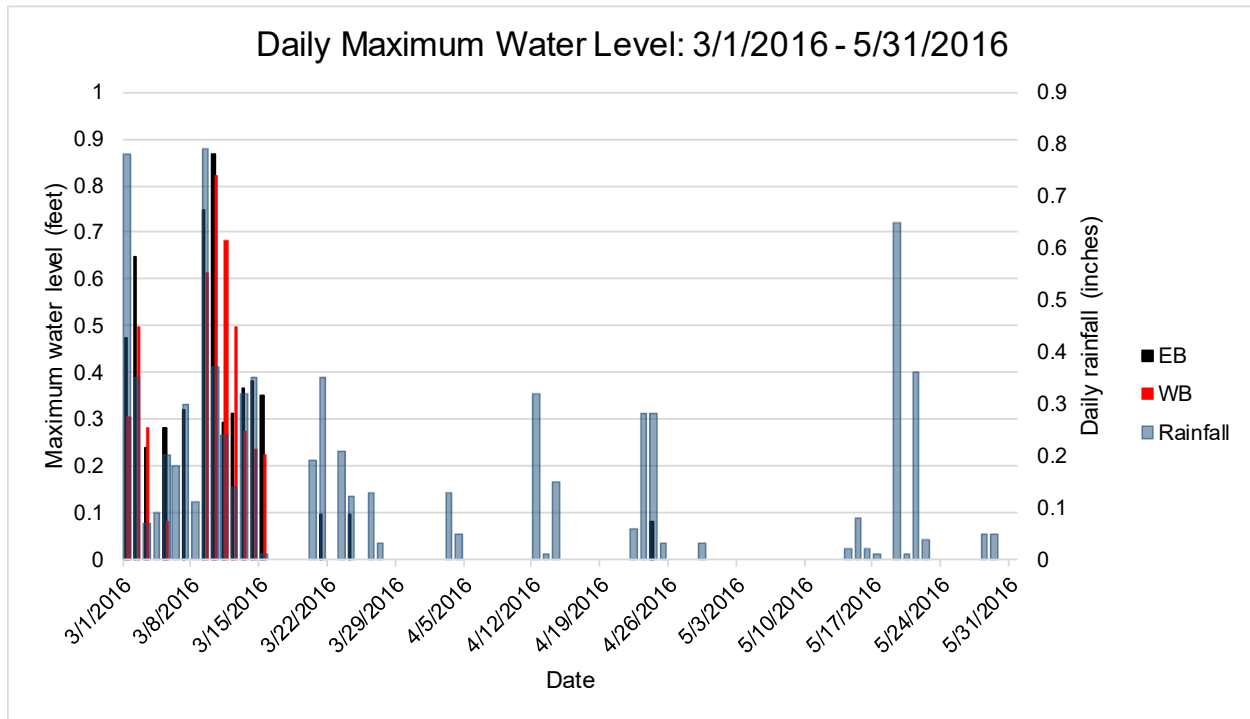
Overflow occurred when water levels exceeded 0.85 ft. in EB and 1.30 ft in WB (Table 1). Water level data corroborated the flow data and indicated EB retained water for a shorter time and was less likely to overflow than WB. From 3/1/16 through 4/25/17, EB overflowed once and WB overflowed four times. These overflow events corresponded with sampled storms (Table 1). Figures 1 – 3 illustrate the maximum daily water levels and rainfall during times when water pooled in the bioretention facilities. For clarity, daily maximum values  $< 0.07$  ft. are not plotted.

The implications of overflow differ by bioretention facility. Overflow from WB goes into the new pond and is not accounted for by measurements at the west bioretention outlet (WBO). Thus, volume and loading estimates for WB may overestimate treatment, because the overflow is not measured chemically or volumetrically. In contrast, EB overflow goes into the pipe discharging from EB and is accounted for by measurements at the east bioretention outlet (EBO). Thus, EB volume and loading estimates include overflow and thus accurately reflect the net treatment between EBI and EBO.

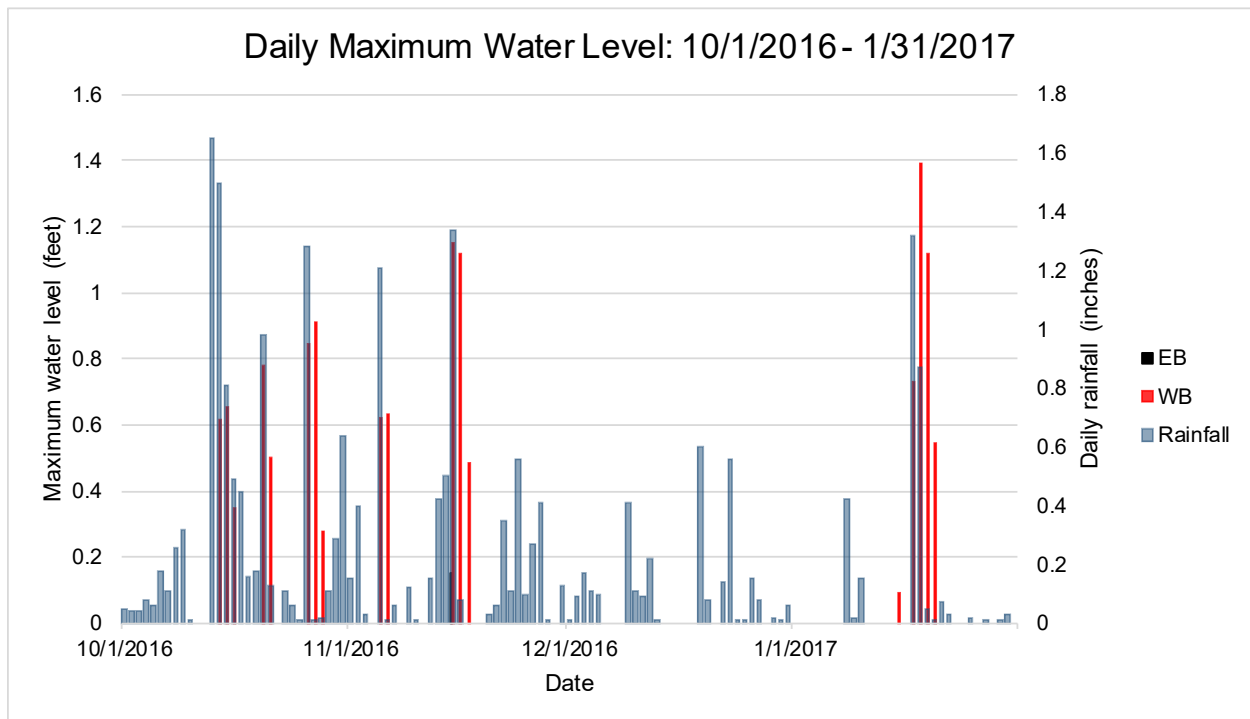
**Table 1. Maximum water level in bioretention facilities during sampled storms, and whether facilities had untreated overflows during sampling events.**

Storm	Date storm started	East Bioretention Facility		West Bioretention Facility	
		Max water level, ft	Facility overflowed	Max water level, ft	Facility overflowed
1	3/9/2016	0.87	yes	0.82	no
2	3/23/2016	0.10	no	*	no
3	10/19/2016	*	no	*	no
4	10/26/2016	*	no	0.91	no
5	10/31/2016	*	no	*	no
6	12/19/2016	*	no	*	no
7	1/17/2017	*	no	1.39	yes
8	2/8/2017	0.31	no	1.39	yes
9	2/15/2017	0.47	no	1.51	yes
10	3/7/2017	*	no	0.30	no
11	3/9/2017	*	no	0.71	no
12	3/13/2017	*	no	0.54	no
13	3/14/2017	0.14	no	1.35	yes
14	3/26/2017	*	no	*	no
15	3/29/2017	*	no	0.43	no
16	4/5/2017	*	no	*	no
17	4/19/2017	*	no	*	no
18	4/23/2017	*	no	*	no

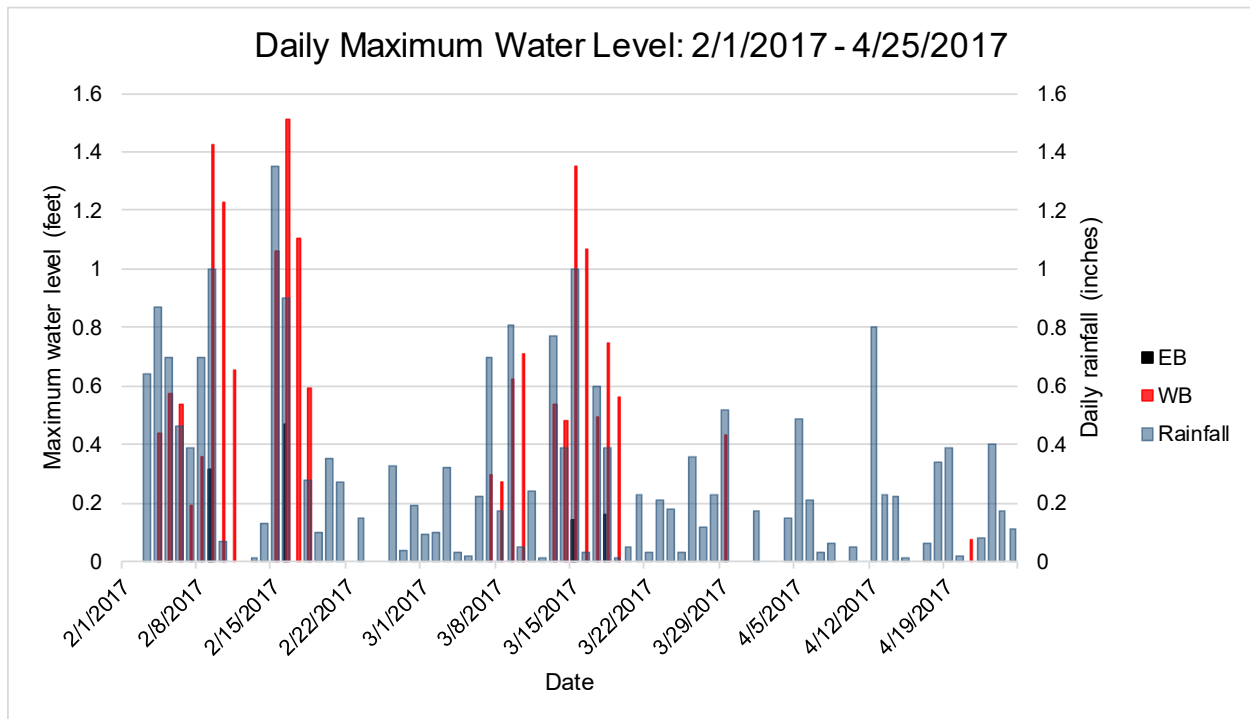
\* Water level did not exceed 0.07 ft during storm.



**Figure 1. Maximum daily water levels in the bioretention facilities and daily rainfall, from 3/1/16 – 5/31/16.**



**Figure 2. Maximum daily water levels in the bioretention facilities and daily rainfall, from 10/1/2016 – 1/31/2017.**



**Figure 3. Maximum daily water levels in the bioretention facilities and daily rainfall, from 2/1/2017 – 4/25/2017.**