

**TECHNICAL MEMORANDUM**

October 11, 2023

To:	Jenny Saltonstall Associated Earth Sciences, Inc. 911 5 <sup>th</sup> Avenue Kirkland, WA 98033
From:	William J. Taylor BHP Phase III Principal Investigator Raedeke Associates, Inc.
RE:	Olympia Bioretention Hydrologic Performance Study Phase III Deliverable 3.3, Maintenance Survey Results Memo (RAI Project No. 2023-02-002)

**INTRODUCTION**

As part of the vegetation assessment of the performance of ten-year-old or older bioretention facilities, we conducted a telephone survey with the project owners to characterize the various types of maintenance practices at these facilities. Comparing maintenance practices and plant community change may provide insight on long-term field infiltration performance. This data may be important for future planning of bioretention facilities, maintenance practices, and costs related to implementation of facility management. These factors are likely to influence owners' willingness to utilize bioretention as a stormwater treatment option.

The following document offers a summary of current maintenance practices utilized for stormwater facility management and observations on which are most effective for long-term management of these facilities. The maintenance survey results are one set of variables that affect facility performance. The final report will include analysis and discussion of the individual facilities' performance relative to the maintenance survey results and other measured variables including vegetation, geotechnical parameters, field

infiltration rate.

## **METHODS AND APPROACH**

We developed a telephone survey of 13 questions reviewed by the City of Olympia and the Washington State Department of Ecology to be used as a combined quantitative and qualitative approach to documenting the maintenance activity at as many of the facilities studied as possible. The survey questions utilized for this study are included in Attachment 1. The facility owners were contacted to identify the appropriate maintenance manager with whom to conduct the survey.

Many of the owners had multiple facilities involved in the study and in almost all cases where multiple facilities were involved the same maintenance activities were generally applied.

While some of the questions posed were intended to be quantitative (e.g. as a yes/no or frequency of activity) with explanatory comments, many of the questions required qualitative explanations (e.g. what type of maintenance; or what challenges have you observed, etc.?). As such the following description of the survey findings incorporates a discussion of both the qualitative and quantitative data that was obtained during our investigations.

## **PARTICIPATION**

For this study, fifty different bioretention cells were assessed in the field for plant community composition and infiltration rates and were included in the project survey sample size. Of the 50 bioretention facilities, 23 are owned and maintained by separate jurisdictions, with two additional jurisdictions interviewed with candidate bioretention facilities, but were ultimately disqualified from consideration for a total of 25 possible interviews. Of these, two studied sites were individual residents or commercial owners that did not reply to the survey or involved very limited maintenance. Attachment 1 provides the full list of the jurisdictions interviewed, and a summary of the responses provided by each. The following discussion provides a question-by-question summary of the findings and identifies apparent themes and direct quotes to help provide overall survey conclusions.

In virtually all cases (22 of 25) the interviewee was a grounds maintenance supervisor or stormwater maintenance and/or operations supervisor responsible for assigning work crews that conduct the maintenance activities in the bioretention facilities. Three of the

respondents were professional project managers responsible for oversight of the facility or residential owners of the facility. Completion of the telephone survey generally took between 15 to 30 minutes.

The following summary presents the individual questions posed to the surveyed staff with a summary of their responses. Reference Attachment 1 for individual responses and tallies of quantitative replies.

### **SURVEY QUESTIONS AND RESPONSE SUMMARIES**

*Question 1. Is there a planting plan goal for the cell to be sustained? If so, what is the source of the plan?*

The intent of this question was to discern whether the owner used a planting plan on site to guide the installation and maintenance activities since construction of the facility (over ten years ago).

Only 5 of the 23 respondents followed a planting plan during maintenance to replace plants in accordance with the original plan. These five sites were in areas of high public visibility with an expectation that they be aesthetically well presented.

In all the remaining sites the maintenance leads said sites were replanted as needed with like or more appropriate plants, but as the site plant communities were generally self-sustaining for ten years with the plants that had survived initial planting, little replanting was conducted (see also question 8 below).

*Question 2. Is maintenance conducted in the bioretention cell/s and do you keep maintenance records?*

We did not assume that maintenance was conducted at all at the bioretention sites. Twenty-one of the 23 respondents confirmed that the bioretention facilities were maintained and nearly all were tracked through a work order asset management system that tracked staff level of effort and general notes for budgeting purposes, but with little detail on the maintenance activity conducted.

*Question 3. What type of maintenance is conducted?*

Weeding and trimming/pruning with some trash collection especially in exposed locations were the typical extent of maintenance activities reported by the respondents.

One site was maintained frequently by mowing (twice per month during growing season) due to proximity to an airport runway.

Of the 23 respondents, 8 provided irrigation and 15 did not. As expected, irrigation resulted in more above ground growth needing trimming, while sites were still successful without irrigation after long-term establishment. One respondent noted that herbicides were applied during the dry season once a year in the bioretention facilities. At four sites adjacent to and maintained by the resident or commercial building owner, maintenance was left to their discretion rather than by a jurisdictions' field crew and thus was sporadic and unplanned.

*Question 4. How frequently is maintenance conducted?*

Frequency of maintenance was expected to help inform whether there was a change from the original planting plans. Frequency of foot access also may influence compaction at the site. Frequency of maintenance at the facilities ranged from “none at all” at one private residential site to a “very frequently” maintained at sites requiring aesthetic maintenance or safety (visibility) requirements, such as at an airport. Fifteen of the remaining sites were seasonally maintained generally spanning the growing season.

Table 1. Frequency of maintenance conducted by grounds staff at 23 responding bioretention facility owners.

Frequency of Maintenance	Number of Respondents
0	1
1 - 2x / mo.	6
1 - 4x/ yr.	15
1/5 years.	1

*Question 5. What challenges have you observed in maintenance of bioretention facilities?*

This open-ended question was intended to gather information regarding concerns encountered by the grounds keeping supervisors when addressing maintenance of bioretention facilities. In general, staffing, staff training, and guidance, as well as weeding were the primary challenges noted. Other responses included pedestrian traffic through the facilities, impeded vehicle visibility, trash, overgrowth, beaver activity, and

disposal of organic waste generated from weeding. One respondent found maintenance was excessively expensive for a low-income homeowner's association.

*Question 6. Have you observed plant mortality or volunteers?*

While this question combines whether plant mortalities and volunteers occurred at the site(s), it was intended to get a sense of the degree to which the original planting plans remained successful over time, influenced through mortality or volunteer competition, or even their own spreading. Sixteen of the 23 surveyed landscape maintenance supervisors questioned noted some degree of either or both mortalities and volunteers (including spreading of original plantings) occurred at the sites while 6 believed there were none of either.

*Question 7. Which plants were involved in mortalities or as volunteers?*

As a follow-on to Question 6, this question aimed to identify any plants that may have commonly become mortalities, or which were volunteers. None of the respondents identified typical mortalities, rather noted the common volunteers they observed, either as spreading native species (cottonwood, alder, salal) or nuisance weeds (Scots broom, reed canarygrass, Himalayan blackberry, and various grass species.).

*Question 8. Have you replanted?*

This question was again related to the degree to which the original planting plan was augmented through planting even in the typical case that the original planting plan was not followed to maintain a given pallet of plants. Results indicated that 16 of the respondents did not conduct any replanting while 7 had. The result appeared to suggest that the plant communities appeared to largely sustain themselves over time with or without irrigation. Recent drought conditions may have moderated this perception with some of the respondents expressing concern for possible mortalities occurring during increasing summer droughts.

*Question 9. Have you done anything to the bioretention soil?*

The intent of this question was to recognize that soil conditions are a key component of the site performance and to reveal whether any maintenance was conducted specifically

related to the soil in the facilities. In all but one case there was no substantial change to the soil in the bioretention facility. For the one example where soils were modified, the respondent reported that “six inches of the bioretention soil was removed and replaced 5 to 7 years ago”. In many of the other cases periodic wood chip mulching was conducted on some of the side slopes or even in the bottoms of the facilities to help reduce weed growth, but this was not considered a substantial change to the bioretention soil media (BSM) soil itself. Some raking of facilities was also reported which may have influenced the accumulation of organic matter and provided surface scarifying but was not considered substantial change to the BSM soil itself. No mention was made of the addition of compost or other soil materials.

*Question 10. Do you observe any extended ponding in the cells?*

The infiltration rate is a measure of the ability of the bioretention facility to infiltrate water through the BSM. Repeated observations of ponding would help confirm a potentially failing condition at a facility (where the bioretention facility may not readily allow water to infiltrate through the BSM or subgrade soil). All but one of the respondents indicated that no ponding at the study facilities was observed. The one facility noting ponding was reportedly a substantially failed cell for a long period of time suggesting compromised construction techniques or a poorly-draining subgrade at the time of construction.

*Question 11. Do the inlets and into the cells get clogged or back up?*

Bioretention cell performance depends on efficient flow of the contributing drainage area into the cell without impedances. Half of the respondents indicated that inlets become clogged while the other half indicated they did not. One respondent indicated the overflow structure may get clogged with debris during high ponding conditions. Local leaf fall in the autumn was noted as a seasonal source of clogging. Of the respondents indicating that clogging did not occur, they often noted it was because of regular street cleaning or related maintenance on the street side of curb cuts to the facility. Of the clogging situations, curb cuts could be clogged on either side of the curb cut (i.e., on the street side with street debris, or on the inside of the facility with sedimentation or growth of vegetation causing an impedance). Clogging of piped inflows to bioretention cells were seen in a few cases to occur even in splash pads where sedimentation within the splash pad quarry spalls allowed growth of vegetation hindering flow into the facility.

Clogging or lack of clogging was clearly connected to regularity or lack of street and drainage infrastructure maintenance rather than vegetation maintenance.

*Question 12. If there are underdrains do those get clogged or the cell back up with water?*

Like the question above regarding inlet clogging, this question was posed to query whether underdrains appeared to flow unimpeded. It was clear from the respondents that virtually all were not aware of whether underdrains were present, except in one case where the underdrains were scheduled for cleaning within the asset management system used to schedule and track asset management efforts on the facilities.

*Question 13. Any other issues observed or addressed at the sites?*

This final question was intended to discover any additional topics of concern or issues the respondent wished to reiterate if not previously mentioned. A wide range of comments were provided. See Table 1 for a list of the various comments provided.

## **CONCLUSIONS**

The maintenance survey results revealed a few relatively consistent responses especially in the frequency and the nature of the maintenance. Most of the sites were maintained two to four times per year and largely limited to weeding, trimming, and garbage collection, with little replanting. Irrigation of the cells was less common than no irrigation. The greatest differentiator of sites from a maintenance perspective appeared to be whether the site had public exposure and priority for aesthetic presentation. The surveys responses state that little maintenance was conducted on the soil itself, indicating the soil was principally composed of the original BSM.

Possible results of these maintenance conditions could be related to the degree of spreading of planted or volunteer plants into weeded areas and avoiding potential compaction of soil during foot access for maintenance. The BSM may also have reduced inputs of organic matter as weeded and trimmed material is raked and removed. Overall, a vast majority of the respondents found the sites are otherwise “self-maintaining” and successful for the purpose of stormwater treatment. Respondents’ recommendations for

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future bioretention design largely revolved around selecting plant palates representing low growing and native vegetation that needs little maintenance or irrigation.



Attachment 1. Compiled summary of Bioretention Hydrologic Performance Study III maintenance survey responses.

Question #	1	2	3	4	5	6	7	8	9	10	11	12	13			
Owner	# of cells	Sustain a Planting Plan?	Cell Maintained?	What Type?	Irrigation?	How Frequently?	Challenges?	Plant Mortality/Volunteers?	Which Plants?	Replanted?	Activity with Soil?	Extended Ponding?	Inlets Clogged?	Under-drains Clogged?	Anything else?	
1	Arlington	2	No	Yes	Weed/trim	No	2/mo.	Staffing	Yes	No	No	No	No	No		
2	Auburn, Quick Pick (a)	1	--	--	--	--	--	--	--	--	--	--	--	--	--	
3	Bainbridge Island, CO (b)	0	No	yes	Weed/trim	Yes	4x/yr	Site line	No	No	New soil and plants in 2015	No	No	No	Irrigation improves aesthetics but more trimming	
4	Bainbridge Island SD	2	No	Yes	Weed/trim	Yes	2x/yr	Org. waste	Yes	Alder/ weeds esp bb	No	No	No	No		
5	Bellevue, CO	1	Yes	Yes	Weed/trim/rake	Yes	1-2x/mo	Training/pedestrians	Yes	No	No	No	Some	Yes		
6	Bellevue SD	6	No	Yes	Weed/trim	Yes	1-2x/yr	Staffing	Yes	Natives	No	No	Some	No	Maintain drainage structures	
7	Bellingham	2	No	Yes	Weed/trim	No	2x/yr	Staffing	Yes	Varies	Yes	No	No	Some	No	Other sites downtown have been designed too small.
8	Ferndale	1	No	Yes	Weed/trim	No	1x/mo	Training	Yes	No	No	No	Some	No	Shading	
9	Issaquah, CO	2	No	Yes	Weed/trim/trash	No	1x/mo	Staffing	Yes	Yes	No	No	Yes	No		
10	Issaquah SD	3	No	Yes	Weed/trim	Yes	2x/yr	Duo-culture	Yes	Volunteer trees	No	No	Some	No	Some are too big.	
11	Monroe, AJ residence	1	No	Yes	Prune/ weed bb	No	1x/yr	Overgrown	Yes	Invasives	No	No	No	No	Lack guidance	
12	Monroe, Barron residence	1	No	No	none	No	0	None	Yes	Volunteers	No	No	No	No	Lack guidance	
13	Mukilteo	1	No	Yes	Weed/trim	No	2-3x/yr	Guidance	No	No	No	No	No	No		
14	Olympia - public sites	4	No	Yes	Weed/trim	No	2x/yr	Beaver/traffic	Yes	Scotts Br./ bb/ rcg	Some	No	No	Yes	No	Three sites differ from each other.
15	Olympia - private sites	1	--	--	--	--	--	--	--	--	--	--	--	--	--	
16	Pierce Co. CMF (b)	0	No	Yes	Weed/trim	Yes	2-3x/yr	Too much guidance	No	No	Some	No	No	No	No	Design for success rather than aesthetics
17	Pierce Co. Spanaway Pk.	1	Yes	Yes	Weed/prune	No	2x/mo	Overgrown	No	No	No	No	Yes	No	Need to thin	
18	Poulsbo	4	No	Yes	Weed/trim	No	1x/yr	Staffing/training	Yes	Alder/bb/ weeds	No	No	Yes	No		
19	Redmond	2	Yes	Yes	Weed/trim/trash	No	3-4x/yr	Trash/leaves	No	No	Yes	No	No	No	No	One site doesn't receive much water
20	Shoreline	4	No	Yes	Weed/trim/rake/inlet	No	1x/mo	Weed invasives	Yes	Grasses/trees	Yes	No	No	Yes	No	Id. Plants that work or don't work
21	Skagit Co.	1	Yes	Yes	Weed/trash	Yes	4x/yr	Weed/trash	No	No	No	No	Unsure	No	Easy site	
22	Snohomish Co.	4	Yes	Yes	Weed/mulch	No	1x/yr	Site visibility/Sediment/Irrigation	Yes	Cottonwood/alder	Yes	No	No	Yes	No	Smaller plants for better site distance.
23	Sumner	2	No	No	NA	Yes	1x/5yrs	None	NA	NA	No	No	No	No	No	
24	Whatcom Co.	2	No	Yes	Weed/trim	No	3x/yr	Staffing/RCG/encroachment	Yes	RCG	No	No	No	No	No	Overflow adjusted higher
25	Woods at Golden Garden, residence	2	No	Yes	Weed/trim	No	as needed	Expensive/inflow misdirected	Yes	Grasses	No	No	Yes	No	No	Expensive

Respondents	23	Total Cells	50	5 yes	21 yes	8 yes	16 yes	7 yes	1 yes	1 yes	11 yes	1 yes
				18 No	2 no	15 no	6 no	16 no	22 no	22 no	11 no	22 no

Footnotes

- a. Not interviewed for maintenance activity
- b. Interviewed but candidate site subsequently disqualified