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Final
TECHNICAL MEMORANDUM

Date: December 31, 2024

To: Don McQuilliams, City of Bellevue Utilities

From: James Packman, Herrera Environmental Consultants

Subject: Pilot Data Analysis of Stormwater BMP Inspection and Maintenance Data

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Abstract

This technical memorandum provides a summary of a pilot level data analysis performed as part of a Stormwater Action Monitoring (SAM) study (Study). The SAM Study is evaluating operations and maintenance (O&M or O-M) of stormwater best management practices (BMPs) and is being implemented by the City of Bellevue, Herrera Environmental Consultants, and Aspect Consulting. The SAM studies are administered by the Washington State Department of Ecology (Ecology) and funded cooperatively by municipal permittees of the National Pollutant Discharge Elimination System (NPDES) in Washington State. Guidance for the Study is provided by a technical advisory committee (TAC) comprised of Phase I and Phase II municipal NPDES permittees.

The goal of the pilot data analysis is to evaluate stormwater BMP inspection and maintenance data collected by permittees and relate it to the maintenance standards. This was done by analyzing the frequency of BMP visits for inspection and/or maintenance and the associated maintenance issues recorded. The analysis is intended to better understand how maintenance efforts can be used to evaluate the efficacy of the maintenance standards.

The BMPs and associated maintenance standards evaluated cover three main types of BMPs that are the focus of the Study - ponds, trenches, and vaults. Among these, the data represented 5 types of stormwater ponds, 7 types of trenches, which includes swales, and 12 types of vaults, which includes tanks. The analysis supports municipal NPDES permittees with identifying how O&M data can be collected and analyzed in relation to maintenance standards.

As a pilot level effort, data from three western Washington NPDES permittees (who are also TAC members) was analyzed, including from the cities of Bellevue, Redmond, and Tacoma. The period of analysis was 2019 to 2023, which aligns with the most recent previous reissuance of the 5-year municipal stormwater permits.

The data available from the pilot cities was limited in detail and covered varying time periods from one to four years. Bellevue and Tacoma provided four years of data each, but Redmond provided just one year of data (the most recent, 2023), which is a reflection of the limited digital BMP maintenance records available in that jurisdiction. Significant variability was also present among the data sets about the detail of what maintenance needs were observed during BMP inspections. This was a result of several factors, especially the varying emphasis among the cities for recording certain information about BMP status and maintenance. Despite these limitations, a pilot-level data analysis was possible that helps inform permittees and Ecology regarding BMP maintenance and maintenance standards.

While the NPDES permits articulate required maintenance timeframes after an issue with a BMP has been identified, the permits also allow permittees to alter the timeframes based on data and/or experience by the jurisdiction. To the extent possible, the findings were compared among the participating cities and to the relevant maintenance standards for how the frequencies of BMP visits could be altered while maintaining BMP functionality.

The analysis of inspection frequencies indicated that visits to most BMPs occur on a yearly cycle consistent with permit requirements. However, notable upticks in BMP visit frequencies were seen for all BMP types within 100 days of a previous visit and at approximately the two-year mark. The shorter frequencies are presumed to be associated with urgent needs for maintenance, such as spot-checks after big storm events. The longer visit frequencies are presumed to be associated with capital construction projects. But the data available did not support a detailed analysis of what drove the BMP visits that were shorter or longer than a year. The reasons for the shorter and longer times between visits to a given BMP bear further investigation to evaluate the BMP status at those time intervals.

The analysis of maintenance needs indicated that relatively few maintenance issues were recorded in the data records. When they were recorded, it was mostly in notes and comments from the inspector, which required a time-consuming process to read through and extract relevant information for the data analysis. The limited detail about BMP maintenance issues observed is a function of the pilot cities' varying approaches to recordkeeping for BMP O&M, with Redmond focusing on items related to the maintenance standards and Bellevue and Tacoma focusing on pass/fail status to indicate if maintenance is needed or not. The most common maintenance need recorded was related to clearing trash, debris, and sediment, which is done as a routine preventative measure by Bellevue. Other maintenance needs highlighted by the data analysis include issues at the BMP inlet or outlet, noxious weeds, and reduction in stormwater storage capacity.

The comparison of BMP maintenance records to the maintenance standards was limited by the relatively few instances of maintenance needs documented and the overall limited detail about inspection outcomes available in the data. However, the presence of maintenance needs associated with maintenance standards was documented and ties to the maintenance standards generally speaking. But specific and quantitative observations from BMP inspections were lacking in the data available, thus limiting the comparison to specific standards.

Recommendations based on the outcomes of this data analysis include ideas for both permittees and for Ecology. For permittees, these include suggestions on recordkeeping and identifying how maintenance data can be used to assess BMP maintenance efforts, including:

- Collect information about BMP inspection and maintenance that is tied directly to the maintenance standards. This is key information that can help with assessing the efficacy of the standards and of the maintenance activities.
- Use comments and notes sparingly and instead capture details in data fields that are easily searchable and can be represented in reports.
- Perform routine assessment of the frequency of visits to adaptively inform BMP inspection and maintenance efforts.

For Ecology, it is recommended to review the BMP maintenance standards in the SWMMWW for potential updates and provide references for the standards that don't have citations noted. Currently, few citations are present in the Ecology maintenance standards, which has trickled down to permittees who

have created their own stormwater manuals based on Ecology's. This data analysis pointed to a few priority maintenance standards that would benefit from a review and update.

- Sediment accumulation in pipes, vaults, ponds, and other storage and conveyance features of BMPs. Several sediment criteria exist in the SWMMWW and include varying sediment depth criteria depending on the BMP. Preventative maintenance could be considered, with schedules varying by BMP type and local conditions.

- Vegetation growth, especially tall grasses and trees, which is expressed by area of coverage and growth height, depending on the BMP. Since vegetation is closely linked with habitat, the updated standards could take into consideration habitat benefits, which may increase the allowable vegetation growth.

- Water ponding and associated storage area. This affects all BMPs considered in this analysis and can be associated with sediment deposition and vegetation coverage for varying acceptable fluctuation in storage.

1 Introduction

This technical memorandum provides a summary of a pilot level data analysis performed for a Stormwater Action Monitoring (SAM) study (Study). The SAM Study focuses on operations and maintenance (O&M or O-M) of stormwater best management practices (BMPs) and is being implemented by the City of Bellevue (City), Herrera Environmental Consultants (Herrera), and Aspect Consulting (Aspect). The SAM studies are administered by the Washington State Department of Ecology (Ecology) and funded cooperatively by municipal permittees of the National Pollutant Discharge Elimination System (NPDES) in Washington State.

The Study is guided by a technical advisory committee (TAC) with representatives from several municipal stormwater permittee jurisdictions in western Washington. These include:

- Don McQuilliams, City of Bellevue
- Scott McQuary, City of Redmond
- Ann Bustamante[1], City of Sumner
- Bonnie McLeod[1], City of Tacoma
- Sammie Howe, City of Woodinville

1.1 Goals of the Study

The Study goal is to evaluate the maintenance standards, also referred to as maintenance criteria or thresholds, for selected stormwater best management practices (BMPs) in the 2019 Stormwater Management Manual for Western Washington (SWMMWW, Ecology, 2019a). This Study topic was identified as a priority related to stormwater BMPs by the SAM Effectiveness Subgroup and the Stormwater Work Group (SWG) for Puget Sound, both administered by Ecology.

The maintenance standards evaluated are from the SWMMWW, specifically Appendix V-A: BMP Maintenance Tables of Volume V, which has standards for BMPs for runoff treatment, flow control, and low impact development (LID) BMPs (Ecology, 2019b). The BMP Maintenance Tables cover 23 types of BMPs and define the minimum maintenance requirements for permittees to follow. The SWMMWW BMP Maintenance Tables are included in Appendix A of this memorandum for reference.

For the Study, we focused on three general types of BMPs that are in widespread use and cover most of the BMPs in the Ecology BMP Maintenance Tables (Ecology, 2019b)— ponds, trenches, and vaults. For purposes of this Study, trenches includes swales, and vaults are grouped with tanks. More detail is provided about these BMPs in section 2 below.

[1] No longer with City as of October 2024.

1.2 Goals and Objectives of the Pilot Data Analysis

The goal of the pilot data analysis is to evaluate BMP inspection and maintenance data collected by permittees and relate it to the maintenance standards. The analysis of BMP inspection and maintenance data is intended to better understand how the maintenance efforts can be used to evaluate the efficacy of the maintenance standards.

The objective for this goal is to analyze data on the frequency of maintenance and inspection activities and the associated maintenance issues observed. The findings were compared to the relevant maintenance standards, and recommendations are provided for the consideration of adjusting maintenance frequencies and activities in relation to permit requirements and BMP intended use.

1.3 BMP Maintenance Standards

The requirements for the O&M of stormwater BMPs by municipal stormwater permittees are in section S5.C.10 of the Phase I permit (Ecology, 2019c) and identical section S5.C.7 of the Phase II permit (Ecology, 2019d). The minimum performance measures in these permit sections cover stormwater facilities that are regulated, owned, and/or operated by the permittee, and the need for maintenance standards is indicated in the first minimum performance measure:

> a. *Each Permittee shall implement maintenance standards that are as protective, or more protective, of facility function than those specified in the Stormwater Management Manual for Western Washington or a Phase I program approved by Ecology. For facilities which do not have maintenance standards, the Permittee shall develop a maintenance standard.*

As the permit notes, a permittee can develop their own BMP maintenance standards or implement Ecology's or those of a Phase I permittee. Many Phase I permittees in western Washington have developed their own standards based largely on Ecology's, and almost all Phase II permittees have adopted standards from Ecology or a Phase I permittee.

2 Pilot Data Analysis

The pilot data analysis was based on a limited number of data sets that were requested from selected municipal permittees and the associated maintenance standards used by those permittees.

2.1 Data Sources and Data Request

The data for the pilot analysis was provided by the cities of Bellevue and Redmond – both Phase II municipal permittees - and by the city of Tacoma, a Phase I permittee. These three cities are also TAC members for the study, and per the scope of work for this task, TAC members were asked to provide data for the pilot analysis.

The type of maintenance records available was identified in discussion with the TAC along with how records were kept and preliminary ideas for data analysis. This culminated in a data request memorandum (Aspect, 2024), which had lists of specific types of maintenance information desired, if available. This included specifying the time period (2019-2023), the data format, inspection and maintenance issues observed, activity dates, and other recorded information specifically related to the maintenance standards.

After receiving and reviewing the data, follow-up occurred with each city with questions to confirm and/or clarify their data. In total, 4,397 relevant records were provided of BMP inspection and/or maintenance activities in the last five years from 2019-2024 (see Table 1).

Table 1. BMP Inspection and Maintenance Records Provided.

	Ponds	Trenches/Swales	Vaults/Tanks	TOTAL	Period
Bellevue	469	237	2,761	**3,467**	2019-2023
Redmond	95	151	308	**554**	2023
Tacoma	105	107	164	**376**	2019-2023
TOTAL	**669**	**495**	**3,233**	**4,397**	

Variable names for BMPs were present among the data sets. Table 2 lists what types of BMPs are represented in the data provided, respectively, for ponds, trenches/swales, and vaults/tanks among the three cities represented. Notably, vaults and tanks do not include catch basins (CB) since CBs represent a special subset of structures with specific permit requirements and are much more numerous than other BMPs.

Table 2. BMP Terminology Used in Data Records

	BELLEVUE	REDMOND	TACOMA
PONDS			
Pond		x	
Detention Pond	x		x
Combined Detention & Stormwater Wetland			x
Combined Detention & Wetpond			x
Stormwater Treatment Wetland			x
TRENCHES/SWALES			
Bioretention Cell	x		
Bioretention Planter	x		
Bioretention Swale	x		
Infiltration Trench			x
Dispersion Trench			x
Silva Cell			x
Trench/Swale		x	

Table 2. BMP Terminology Used in Data Records			
	BELLEVUE	**REDMOND**	**TACOMA**
VAULTS/TANKS			
Coalescing Plate	x		
Detention Vault	x		
Filterra	x		
Oil/Water Separator	x		
Sand Filter	x		
Storm Filter	x		
Tank	x		
Vortex	x		
Detention Tank			x
Wetvault			x
Infiltration Tank			x
Vault		x	

2.1.1 Relevant Maintenance Standards

There are two sets of maintenance standards relevant to the data analyzed. Ecology's SWMMWW is the stormwater manual adopted by the cities of Bellevue and Redmond, and the City of Tacoma has its own stormwater management manual (SWMM, Tacoma, 2021). The maintenance standards in these stormwater manuals—along with standards in the manuals from King County, the City of Seattle, and the Washington State Department of Transportation—were compared as part of this SAM Study in a literature review of stormwater manuals (Aspect, 2023).

The maintenance standards are mostly identical among the SWMMWW the City of Tacoma's SWMM, which are provided in the appendices of this memorandum. However, differences and gaps exist for some specific standards, and these are discussed below in section 3.3 relevant to the pilot data analysis.

2.1.2 Notes on Recordkeeping

The City of Redmond's records on BMP inspection and maintenance were available digitally only for 2023, and the TAC member from Redmond noted they are in the process of switching over to digital recordkeeping for this activity. This is noteworthy to highlight the different methods permittees use to keep records of inspection and maintenance activities. TAC members noted using a range of paper and/or digital methods for recordkeeping and field notes. Some TAC members mentioned archives of paper files of BMP inspections and maintenance.

Other noteworthy differences in discussion with pilot data cities include:

- The software used to track BMP O&M activities varies widely. Each pilot city uses a different combination of software and GIS and/or asset management programs with unique sets of data fields for tracking O&M activities. This requires the process to be tailored for both entering and reporting data.
- The detail recorded of maintenance issues observed varies widely.
    - For Bellevue, a pass/fail approach is used with optional comments by the inspector. No comment indicates a routine cleaning was done for sediment or trash/debris buildup in places sensitive to blockage.
    - For Redmond, the observations are tied to the Ecology maintenance standards, which are captured in questions on a field form.
    - For Tacoma, the recorded observations represent the status of the asset, whether it is awaiting inspection or not based on set time intervals or previous inspection findings.
- The types of similar facilities in use and the terminology used to describe facilities varies. This includes especially trenches, swales, and cells used for infiltration or bioinfiltration.

2.2 Data Compilation and Standardization

The inspection and maintenance records were reviewed and standardized to be comparable among the jurisdictions represented in this data analysis. The review and standardization included several steps to create a common database. Steps included:

- Establishing common formats for text, dates, and numbers
- Assigning each record a BMP type using consistent descriptions based on variable BMP names, facility types, and categories
- Adding data fields for each maintenance elements per the maintenance standards
- Interpreting notes, especially comments and abbreviations, to determine BMP issues or maintenance activities
- Mapping terminology of maintenance outcomes to terminology used in maintenance standards

The data review and standardization process required a significant effort since all three pilot participants use different methods for tracking BMP inspection and maintenance as noted above. This included follow up with each city for help interpreting records.

2.3 Frequencies and Timelines of BMP Maintenance

The permit specifies timing for maintenance as a minimum performance measure when an inspection identifies a maintenance need (Ecology, 2019c). This includes performing maintenance within:

- 1 year, the typical frequency for most facilities
- 6 months, special frequency for catch basins
- 2 years, for maintenance that requires capital construction less than $25,000
- Spot checks at facilities for damage after storms of 10-year recurrence or greater

The specific basis for these maintenance timeframes is not referenced in the SWWMM. However, the permittees are given the leeway to revise inspection and maintenance visit frequencies based on either a period of record twice as long as the revised frequency or, in absence of such records, based on written statements of inspection and maintenance experience.

As permit requirements, the maintenance timelines in the permit have an understandably strong influence on the frequency of BMP visits. However, variability exists as indicated in the data analyzed here, and it is these differences that can highlight alternate strategies and timeframes.

For this data analysis, the frequency of visits to BMPs was calculated as the number of days between successive visits to the same BMP (identified by asset ID), be it for inspection or maintenance. The distribution of time periods between BMP visits is instructive for assessing the overall maintenance effort, changes over time, and for comparison among jurisdictions.

But this analysis is not intended to assess compliance with permit requirements or validate the reasons for maintenance at individual BMP facilities. Rather, data from a variety of BMPs are grouped together for this analysis by the three main BMP categories being evaluated in this Study (ponds, trenches/swales, and vaults/tanks) to provide a high-level picture of the frequency and range of time between visits to those BMPs types. Spot checks were not designated as such in the maintenance records nor are they evaluated explicitly here. In addition, the analysis of BMP visit frequencies was limited to Bellevue's and Tacoma's data as Redmond's data was provided for just one year and no repeat visits to individual BMPs were identified.

2.3.1 Pond Maintenance Frequencies

The frequency distributions of pond BMP visits show a peak near the one-year time (Figure 1 for Bellevue and Figure 2 for Tacoma). However, the distributions also all show small secondary peaks within 100 days from the previous visit and at approximately the two-year mark giving the distributions a balanced bell-shaped curve.

Figure 1. BMP Visit Frequencies: Bellevue Ponds.

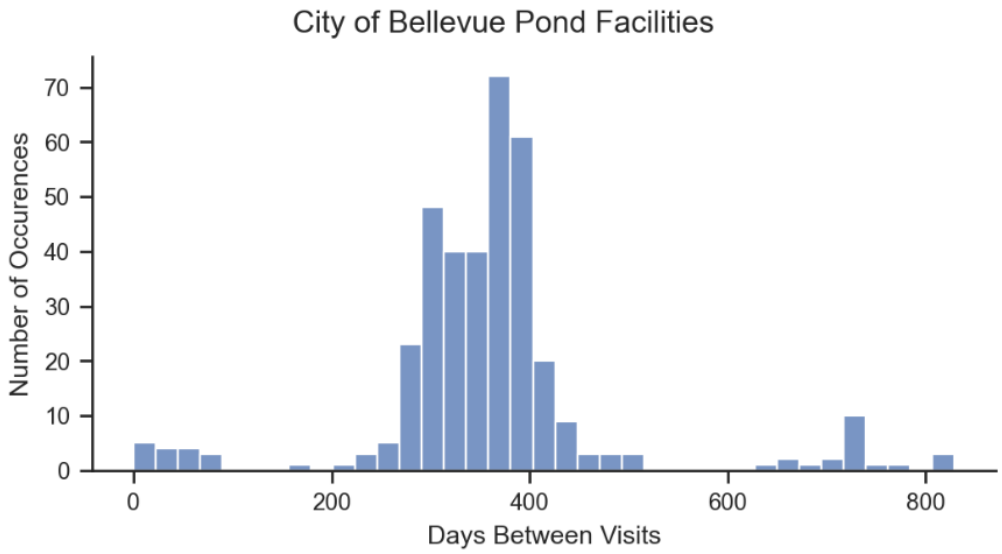
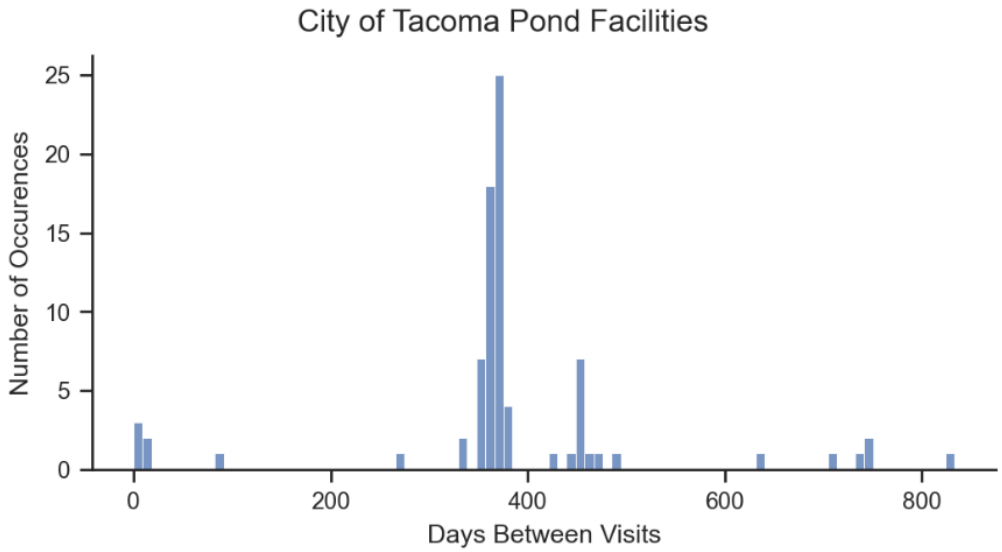


Figure 2. BMP Visit Frequencies: Tacoma Ponds.



2.3.2 Trench/Swale Maintenance Frequencies

The frequency distributions for trench and swale BMPs show a peak near the one-year time (Figure 3 for Bellevue and Figure 4 for Tacoma). However, while Tacoma's data shows a single strong peak at the one-year time and an even bell-shaped curve distribution, Bellevue's data shows a peak between 250 and 300 days and a positively skewed distribution. Few return visits to the same trench/swale BMP occurred in Bellevue between 0 and 200 days, and a roughly consistent number of return visits occurred in 50-day periods between 300 and 500 days.

Figure 3. BMP Visit Frequencies: Bellevue Trenches/Swales

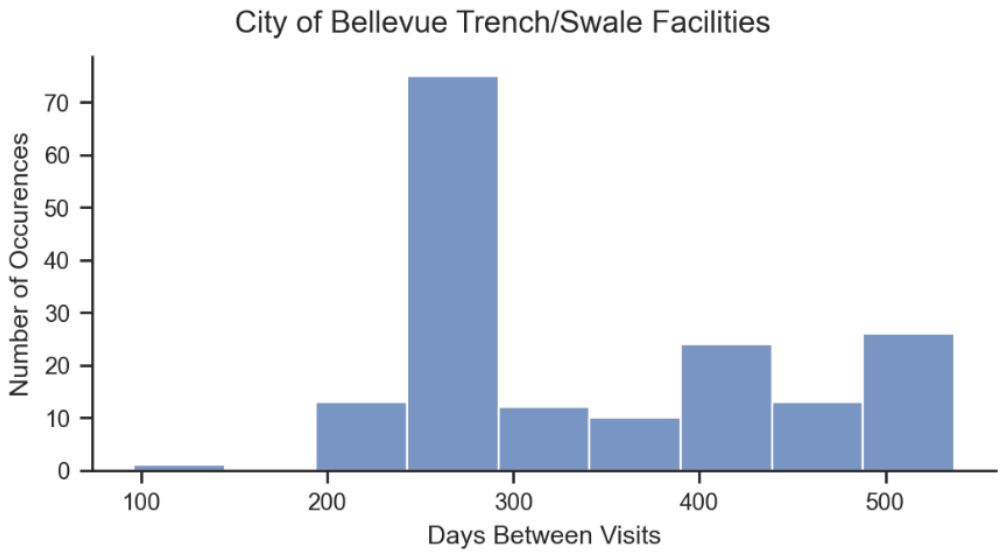
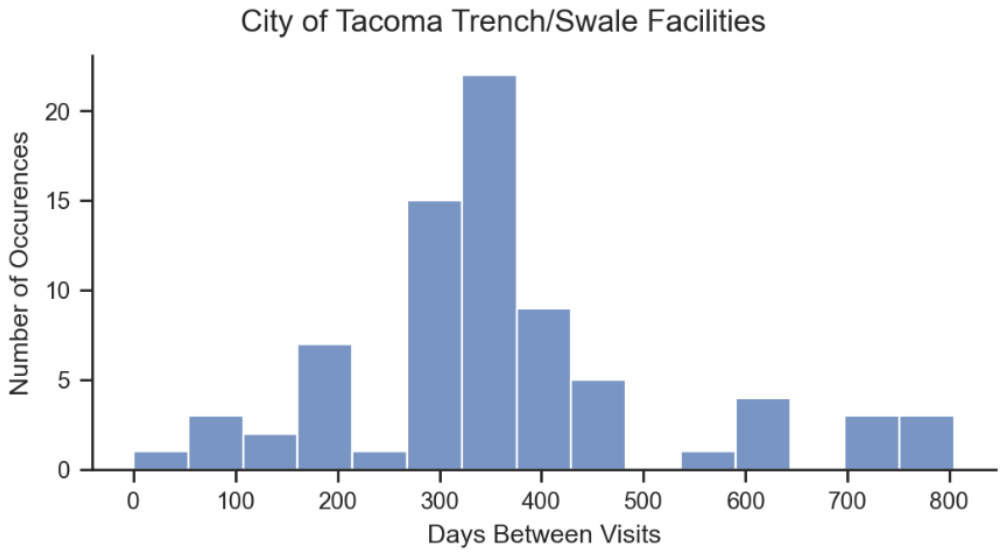


Figure 4. BMP Visit Frequencies: Tacoma Trenches/Swales.



2.3.1 Vault/Tank Maintenance Frequencies

The frequency distributions for vault and tank BMPs show a peak near the one-year time (Figure 5 for Bellevue and Figure 6 for Tacoma). However, while Bellevue's data are closely clustered between 200 and 500 days, Tacoma's data shows a wider range with more representation of return visits in the low range (0-100 days) and in the high range (550-650 days).

Figure 5. BMP Visit Frequencies: Bellevue Vaults/Tanks.

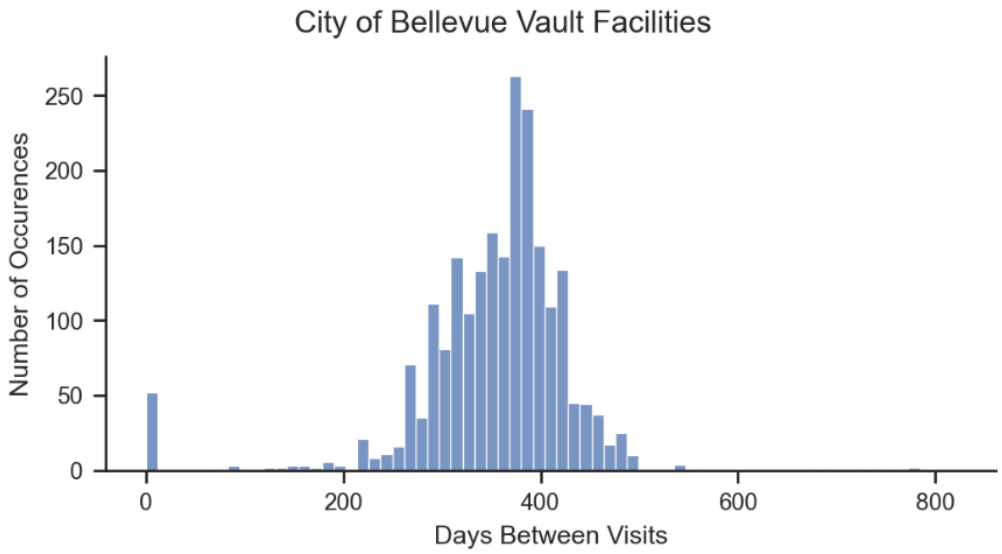
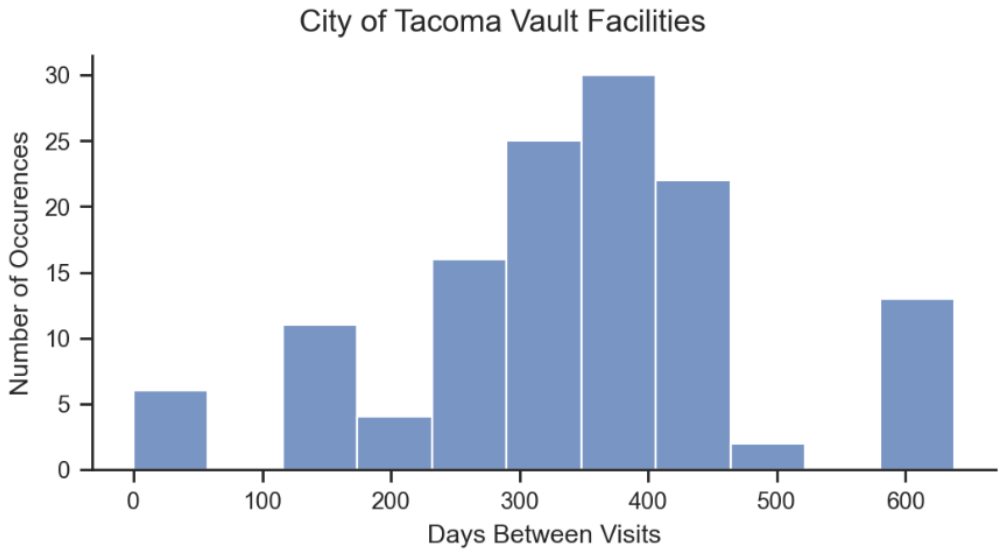


Figure 6. BMP Visit Frequencies: Tacoma Vaults/Tanks.



2.4 BMP Maintenance Issues Observed

The issues observed and the status of the BMPs after inspections or maintenance were evaluated to better understand what drives BMPs maintenance and what associated information is recorded. The data

request included information, if available, on what maintenance needs were observed associated with 29 maintenance standards that were grouped into 18 maintenance categories.

The pilot cities' different approaches to BMP recordkeeping influenced the available data that was available and reportable as requested for this analysis. Only Redmond's data explicitly reflected the approach in the data request following the maintenance standards. Bellevue's data focuses on documenting a pass/fail status, and, similarly, Tacoma's data focuses on if maintenance is required or not following the visit. The details for what maintenance is needed if an inspection fails are captured in work orders but not explicitly recorded or reportable in Bellevue's and Tacoma's data. Some detail was able to be extracted from the notes and comments in Bellevue's records, which had numerous abbreviations and shorthand references.

The figures presented below are for Bellevue's data and Redmond's data and show the categories of maintenance on the x-axis that relate to the maintenance standards. The figures for Tacoma, however, show just if maintenance was or was not needed after a visit but the data doesn't indicate what maintenance is needed.

Despite the limitations in record detail, an analysis was possible by looking at the data available on maintenance needs observed. This was done by bar graphs indicating the frequency of occurrence of specific issues being recorded. The issues evaluated were those that aligned with 18 maintenance standard categories for issues related to:

- Access
- Animals
- Berms
- Bollards
- Energy Dissipators
- Fence/Gate
- Filterbag Full
- Inlet/Outlet
- Liner or Structure
- Noxious Weeds
- Overflow Spillway
- Pollution
- Slope/Erosion
- Storage Capacity Reduction
- Trash Racks

- Trash/Debris/Sediment Accumulation
- Trees
- Vegetation Blockage

2.4.1 Pond Maintenance

Pond BMP maintenance issues were observed in several categories associated with maintenance standards. For Bellevue (Figure 7), the primary pond BMP issues was accumulation of trash, debris, or sediment, which reflects a routine practice of cleaning out sediment when inspecting BMPs. Only two other pond maintenance issues were recorded in Bellevue's data, which included issues associated with trees and vegetation.

For Redmond (Figure 8), pond BMP issues observed included primarily inlet/outlet issues associated with blockage and also issues related to access, presence of trash, and noxious weeds, trees.

For Tacoma (Figure 9), an approximately even number of pond BMP visits resulted in maintenance required than not. No further detail was provided in Tacoma's records, so comparison to specific maintenance standards is not possible for Tacoma's data.

Figure 7. BMPs Maintenance Issues: Bellevue Ponds.

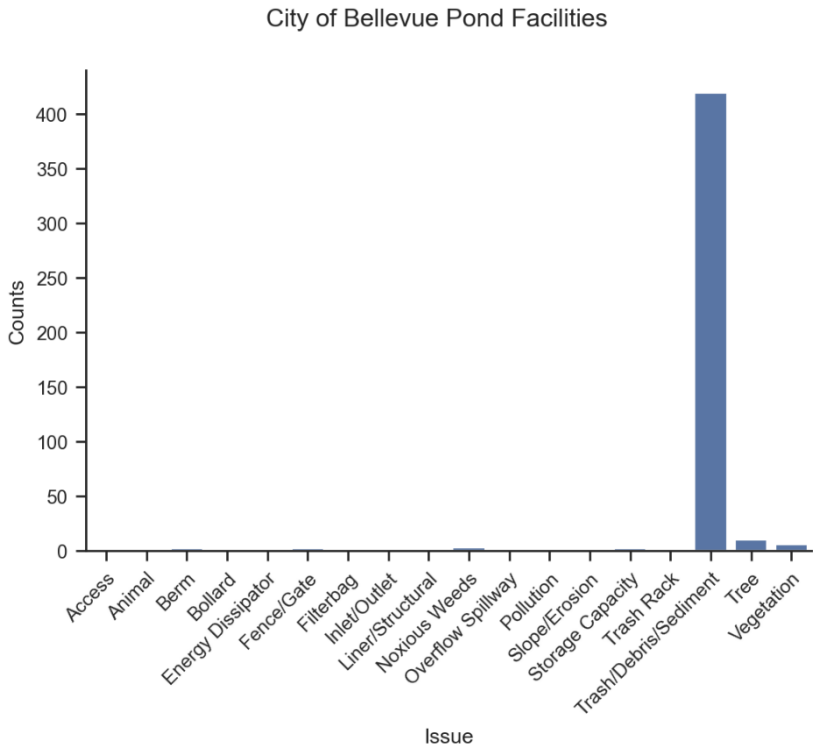


Figure 8. BMPs Maintenance Issues: Redmond Ponds.

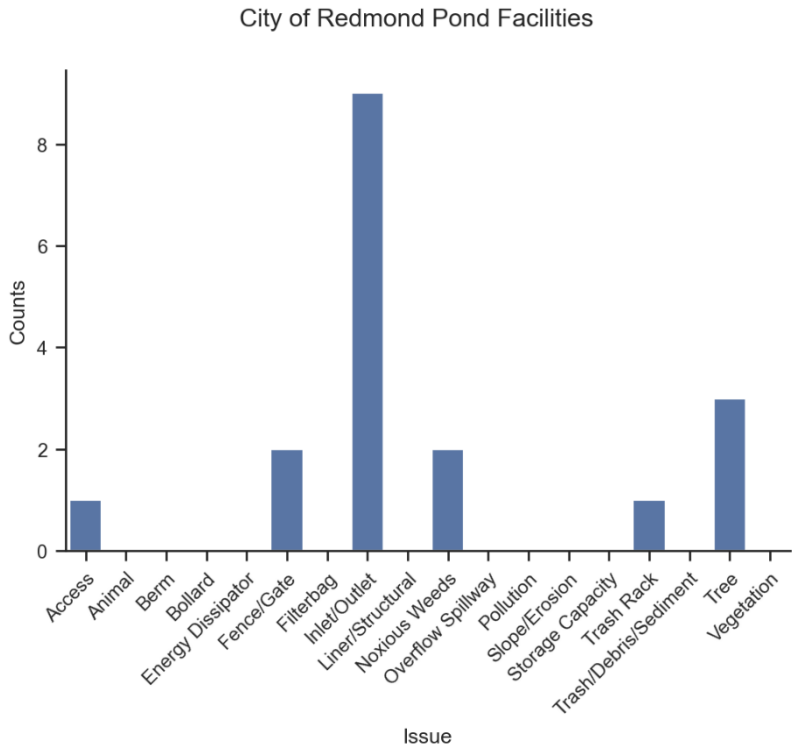
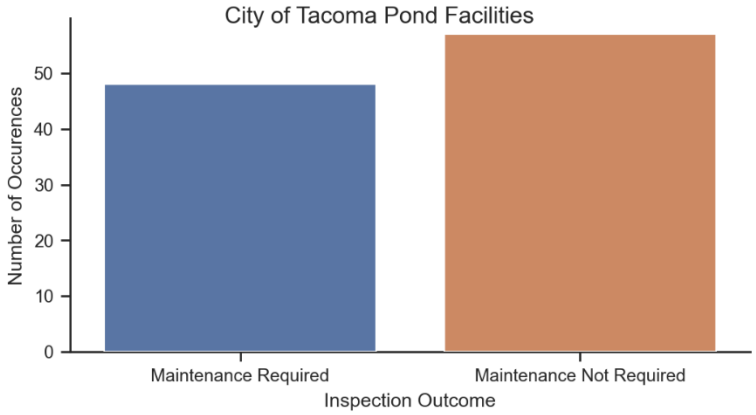


Figure 9. BMP Maintenance Required or Not: Tacoma Ponds



2.4.2 Trench/Swale Maintenance

Maintenance issues at trench and swale BMPs were observed in just one category in Bellevue's data (Figure 10), the accumulation of trash, debris, or sediment, which reflects the routine practice of cleaning out sediment soon after inspecting BMPs (within a few days or weeks). For Redmond (Figure 11), maintenance issues observed at trench and swale BMPs included inlet/outlet issues and noxious weeds.

For Tacoma (Figure 12), approximately one third as many trench/swale BMP visits resulted in maintenance required than not. No further detail was provided in Tacoma's records, so comparison to specific maintenance standards is not possible for Tacoma's data.

Figure 10. BMPs Maintenance Issues: Bellevue Trenches/Swales.

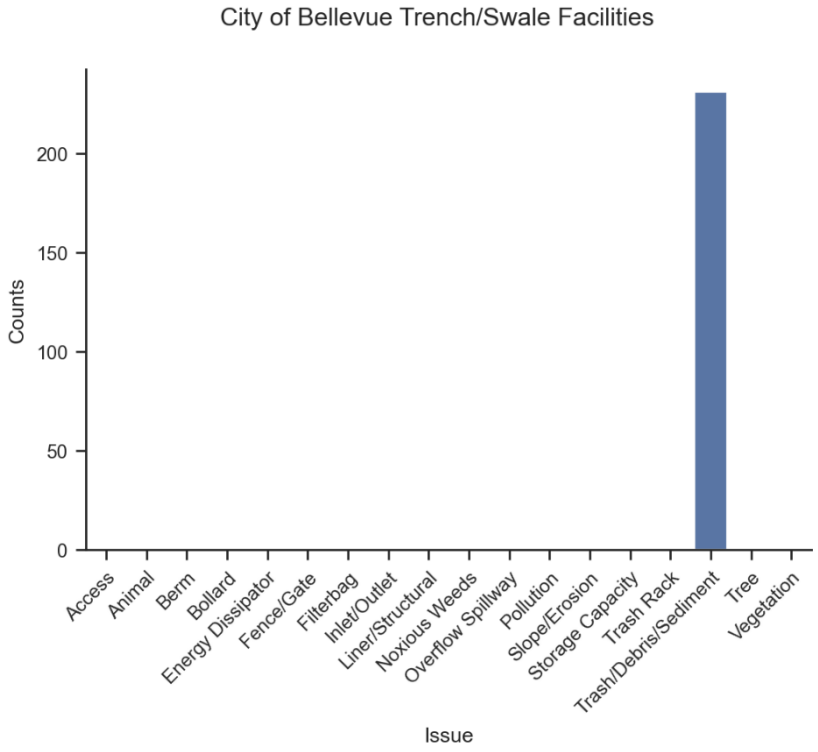


Figure 11. BMPs Maintenance Issues: Redmond Trenches/Swales.

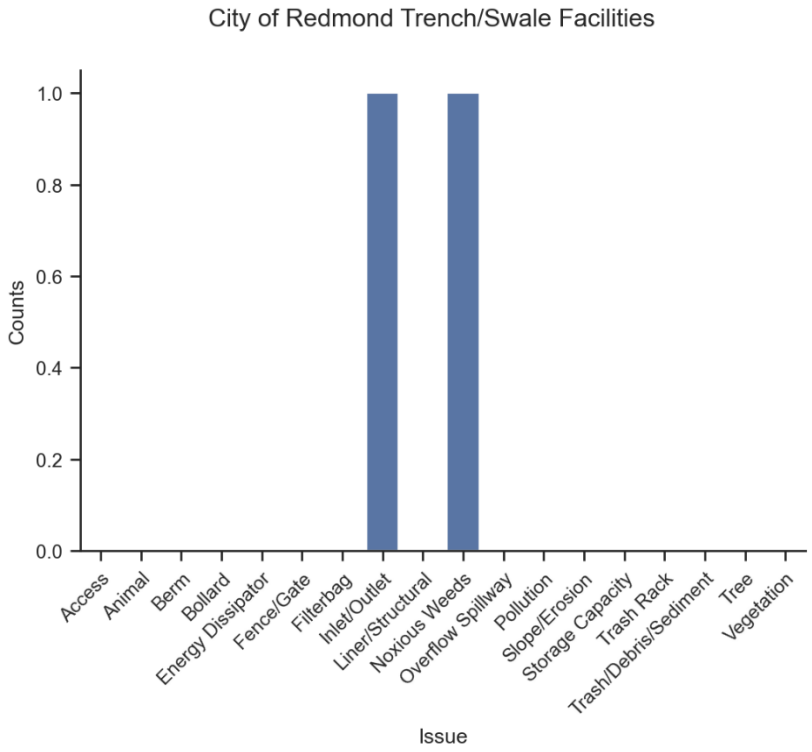
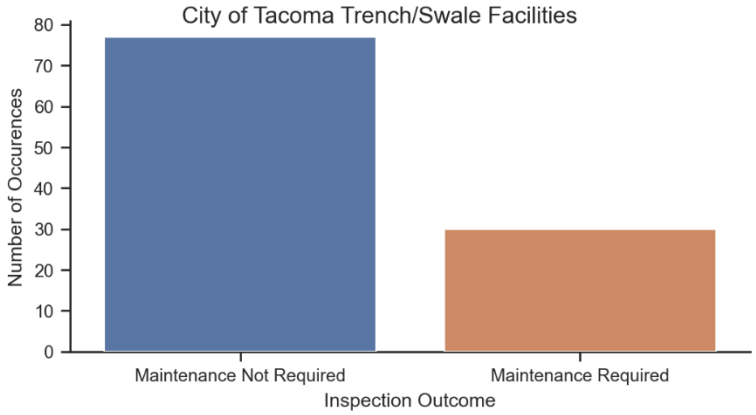


Figure 12. BMP Maintenance Required or Not: Tacoma Trenches/Swales.



2.4.3 Vault/Tank Maintenance

Maintenance issues at vault and tank BMPs were observed in Bellevue's data primarily for trash/debris/sediment accumulation and a few instances of issues related to access, inlet/outlet, storage area reduction, and trees (Figure 13). For Redmond (Figure 14), vault and tank BMP maintenance issues observed were related to access and trash/debris/sediment accumulation.

For Tacoma (Figure 15), several times as many vault/tank BMP visits resulted in maintenance required versus not. No further detail was provided in Tacoma's records, so comparison to specific maintenance standards is not possible for Tacoma's data.

Figure 13. BMPs Maintenance Issues: Bellevue Vaults/Tanks.

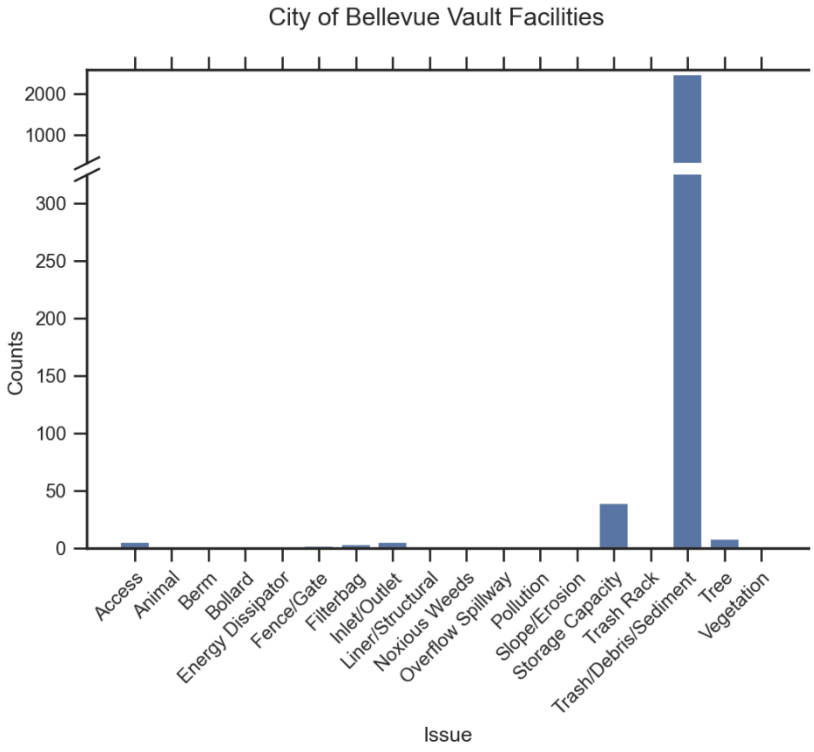


Figure 14. BMPs Maintenance Issues: Redmond Vaults/Tanks.

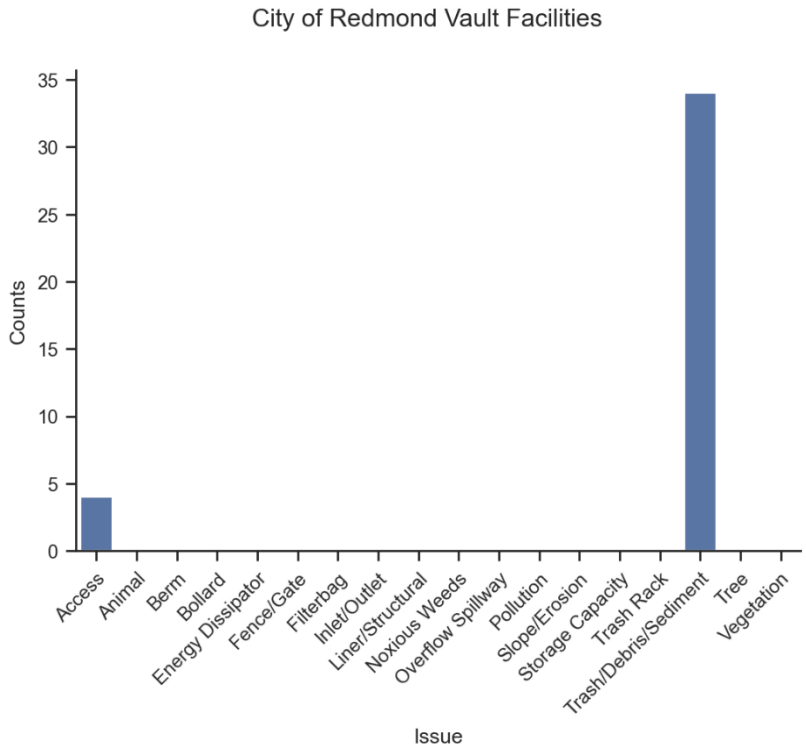
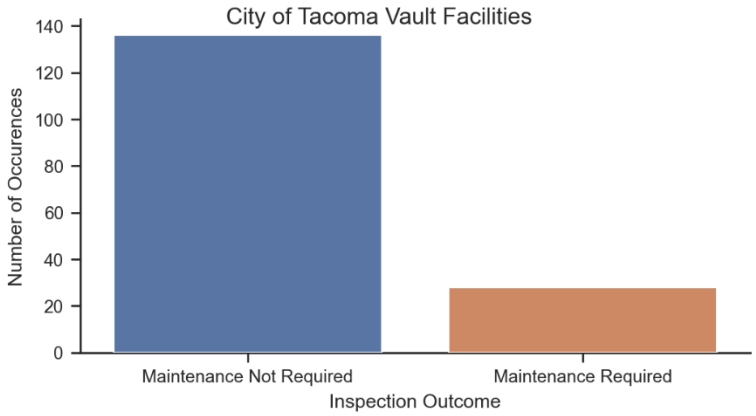


Figure 15. BMP Maintenance Required or Not: Tacoma Vaults/Tanks.



3 Discussion and Conclusions

A discussion of the pilot data analysis results is provided below along with recommendations. Recommendations are related to: the frequency of inspection and maintenance activity; the associated

maintenance issues observed; and the relation of maintenance frequencies and outcomes to maintenance standards.

3.1 Maintenance Frequency

The analysis of the frequency of BMP visits for inspection and/or maintenance indicates that most visits occur approximately one year after the prior visit. Some visits, however, occurred within 100 days of the prior visit and others occurred closer to the two-year mark. This was a consistent pattern seen among the pilot cities' data for most BMPs, which had normal-shaped bell curve distributions of visit frequencies. The BMP visit frequency analysis was on data from just Bellevue and Tacoma; Redmond's data was for just one year and no repeat visits to specific BMPs (i.e. asset IDs) were found.

The BMP visits frequency analysis indicates a strong association with one-year intervals. However, the BMPs with shorter or longer frequencies highlight opportunities to consider different visit schedules, and those BMPs could be investigated to determine the cause of the visits and the conditions of the BMP after variable amounts of time between inspections. This approach can be used by permittees who wish to consider changing their permit-required BMP visit frequencies. This could be achieved by reviewing the outcomes (i.e. maintenance needs observed) of visits that occurred outside of the one-year interval, especially in context of the relevant maintenance standards.

The details in the records analyzed did not include specifics about what prompted a particular visit to a BMP, be it for inspection or maintenance. Thus, it was not possible to tie BMP visits to the specific reasons for the visit. Instead, the frequency of visits was assessed for overall patterns and time intervals. While most visits align with the permit requirement for a one-year frequency at most facilities, the visits at shorter frequencies are presumed to be either spot checks in response to storm events or for other unplanned reasons or in response to reported maintenance needs. The visits at two-year frequencies are presumed to be for either capital projects or at BMPs for which longer intervals are acceptable and have been identified as such.

For trench/swale BMPs in Bellevue, however, the visit intervals curve is skewed right with the peak between 250 and 300 days indicating visit frequencies of less than one year on average for trenches and swales. While the reasons for the differences in visit intervals were not directly explored in this data analysis, the less than one year average for trenches/swales in Bellevue may be related to how visible the BMP is being above ground (easier to observe maintenance needs).

To assess changing inspection and maintenance frequencies, some permittees including Bellevue and Tacoma, would need to collect additional data to indicate the specific issues that drive maintenance at a given BMP or a given type of BMPs. Connecting the visit frequency to the reasons for the visit and to the maintenance need(s) identified can serve as the basis for making a case for alternate time intervals between BMP visits.

3.2 Maintenance Needs

The analysis of maintenance needs was done by assessing the frequency of occurrence of various BMP maintenance issues or outcomes documented in the data provided. The maintenance needs considered were those associated with 18 maintenance standards categories as noted above.

Relatively few maintenance needs were noted in the records provided. An exception is the cleaning out of sediment at BMPs by Bellevue, which is done routinely as a preventative maintenance measure. Per the explanation provided by Bellevue, maintenance records without a comment or other maintenance need identified indicate that sediment was cleaned out of the BMP. Thus, this maintenance outcome eclipses all others in Bellevue's data by the sheer number of occurrences. The relatively few other maintenance needs identified in Bellevue's data include tree issues at ponds and storage capacity issues in vaults. Mowing at ponds is also done routinely in Bellevue (not related to emergent maintenance needs) and is not represented in the data analyzed here.

For Redmond's data, the maintenance needs were captured in the format of the reported data that was provided. The assessment of Redmond's data is limited to just one year and limited conclusions can be drawn. Maintenance issues were associated with relatively few maintenance topics. For ponds, maintenance topics included noxious weeds, trees, trash racks, inlet/outlet issues, and access via fence/gate/road. For trenches and swales, just noxious weeds and inlet/outlet issues were represented, and for vaults and tanks, just trash/debris/sediment accumulation and access road issues were represented.

For Tacoma's data, records indicated if maintenance was or was not required following a BMP visit. While no detail was provided about what maintenance items may need attention, the data indicate that pond BMP inspections resulted in maintenance not required slightly more often than when maintenance was required. For trench/swale BMPs in Tacoma, however, data indicated that inspections resulted in maintenance being required less than half of the time that maintenance was not required. For vault/tank BMPs, maintenance was required approximately five times more frequently as when maintenance was not required after inspection.

The analysis of maintenance needs showed relatively few instances of maintenance needed following a BMP visit for all BMP types evaluated here. The exception was cleaning out sediment as a preventative measure, which Bellevue does routinely at all applicable BMPs. While the BMP visit outcomes were tied generally to maintenance standards, no data was available (or is recorded by the pilot cities) that indicates a specific measurement to compare to the standards. Rather, the instances where maintenance needs were identified were often captured in qualitative comments by the inspector.

3.3 Comparison to Maintenance Standards

As noted above, the recordkeeping for specific BMP maintenance needs observed was only generally relatable to the relevant maintenance standards. While Redmond's data was formatted to follow the maintenance standards, Bellevue's and Tacoma's data were not and focused instead on an overall

pass/fail status to indicate generally if maintenance was needed. None of the records reviewed for this analysis included quantitative measures that could be directly compared to the maintenance standards.

The comparison of the data to maintenance standards was limited by the relatively few recorded occurrences of a maintenance issue being present. Based on the data available, the accumulation of trash, debris, or sediment was the most prevalent maintenance issue for Bellevue for all BMPs and for Redmond for vault/tank BMPs. Second-most prevalent was the presence of inlet/outlet issues for Redmond for pond and trench/swale BMPs. Few other specific maintenance issues were noted in the data.

Because of the lack of detail available on if a maintenance standard may have been exceeded or by how much, this data analysis compared just the presence of a maintenance need with an established standard. The analysis could not, however, compare quantitative standards to the maintenance records. As an example, sediment depth standards cover several BMP elements among ponds, trenches/swales, and vaults/tanks (Table 3). Some of the records analyzed indicated where a sediment issue occurred (what BMP element), but only in notes and comments. The standards for sediment accumulation in the Ecology SWMMWW are often the same as in the Tacoma SWMM but sometimes vary and sometimes are absent.

Table 3. Sediment Maintenance Standards

BMP Element	Ecology SWMMWW*	Tacoma SWMM
Depth	≥6"	same as Ecology SWMMWW
Filter Bags	Bag 50% full	not included
Rock Filters	Any blockage	same as Ecology SWMMWW
Presettling	>6" design depth	same as Ecology SWMMWW
Inlet/Outlet	not included	not included
Drain Rock	Water ponding	not included
General Accumulation	>10% of design depth	same as Ecology SWMMWW
Area	Ponding present 48 hrs after rain	≥2" or percolation test <90%
Storage	>10% of diameter for half the length of structure	same as Ecology SWMMWW
Pipes	Any blockage	not included

* The Ecology SWMMWW is the stormwater manual used by Bellevue and Redmond.

The outcomes from the comparison to maintenance standards points to a few likely conclusions:

- The relatively few maintenance issues observed indicates that most BMP elements are hardly ever maintenance issues. Examples of rare or non-existent issues in the data analyzed are maintenance associated with the BMP structure or slope erosion, overflow/spillway concerns, and damage to a pond liner.

- The relatively little detail in the data records about what maintenance issues were observed indicates that a few issues need chronic maintenance, including the ongoing accumulation and cleaning of trash, debris, or sediment that could cause blockages and the yearly growth of plants.

- The direct comparison to maintenance standards is not always necessary to effectively inspect a BMP, and preventative maintenance instead can be an effective strategy to minimize common issues occurring.

- BMP status alone (i.e., pass/fail or yes/no maintenance needed) is not sufficient to assess specific maintenance standards. Additional information is necessary about the maintenance needs observed and in which BMP element maintenance to specifically compare to the maintenance standards.

3.4 Recommendations

Recommendations for permittee and for Ecology are provided below based on the findings from this pilot data analysis.

3.4.1 Recommendations for Permittees

1. Collect information about BMP inspection and maintenance that is tied directly to the maintenance standards. This is key information that can help with assessing the efficacy of the standards.

    - Information in some records was directly related to the maintenance standards, especially City of Redmond records. But information in records from the cities of Bellevue and Tacoma was not able to be compared directly to the maintenance standards.

    - The use of pass/fail status for a BMP inspection is useful to indicate the overall status. But additional information could be recorded without significant extra effort that would provide a more complete picture of the BMP status.

        - An example is indicating key conditions from the maintenance standards associated with a pass or fail observation, such as if vegetation growth in a detention pond is diminishing stormwater storage capacity.

2. Use comments and notes sparingly. Instead, capture details in data fields that area searchable and can be represented in reportable/exportable data.

    - For example, issues that occur frequently can be represented by a checkbox or pull-down list of preset options rather than noted or abbreviated in comments.

    - Much of the time in this data analysis to standardize the data records among the three pilot participants was spent reading and interpreting notes and comments.

- Note if the inspection or maintenance activity occurred as a spot check following a big storm event. Spot checks are sometimes also done for sites with known risk of issues after big storms, such as flooding or erosion. Collecting and sharing this information among departments can help with tracking the effort associated with the permit requirement for performing spot checks following 10-year (or greater) storms.

3. Perform routine assessment of the frequency of visits to adaptively inform BMP inspection and maintenance efforts.

   - One of the goals of this Study was to evaluate how BMP O&M data could be used to adjust maintenance timeframes. As discussed above, this can be done using maintenance records and/or based on permittee experience.

   - Variation in the frequency of maintenance visits is to be expected. The analysis of frequencies can be used to highlight certain needs, changes over time, and also to support the permittee experience used to justify the adjustment of maintenance frequencies.

3.4.2 Recommendations for Ecology

1. Update the BMP maintenance standards in the SWMMWW, specifically some of the quantitative maintenance criteria.

   - Ideally this would be a systematic update from field testing to provide a referenced basis for the standards. Currently, few citations and references are present in the Ecology maintenance standards, and this lack of reference information has flowed down into other stormwater manuals, which are based on Ecology's. These manuals and maintenance standards were compared in this Study (Aspect 2023), including City of Tacoma's (City of Tacoma, 2021), the City of Seattle's (City of Seattle, 2021), King County's (King County, 2021), and the Washington State Department of Transportation's Highway Runoff Manual (WSDOT, 2019).

   - The analysis from this Study indicates a few priority maintenance standards that would benefit from a review and update. This includes:

     - Sediment accumulation in pipes, vaults, ponds, and other storage and conveyance features of BMPs. Several sediment criteria exist in the SWMMWW and include varying sediment depth criteria depending on the BMP. Preventative maintenance of sediment accumulation could be considered as a routine practice outside of scheduled maintenance, and the timing could vary based on BMP type with flexibility for local conditions.

     - Vegetation growth, especially tall grasses and trees, which is expressed by area of coverage and growth height, depending on the BMP. Since vegetation is closely linked with habitat, the updated standards could take into consideration habitat benefits, which may increase the allowable vegetation growth.

- Water ponding and associated storage area. This affects all BMPs considered in this analysis and can be associated with sediment deposition and vegetation coverage for varying acceptable fluctuation in storage.

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Appendix A-1

Ecology SWMMWW
Appendix V-A BMP Maintenance Tables

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Appendix V-A: BMP Maintenance Tables

Ecology intends the facility-specific maintenance standards contained in this section to be conditions for determining if maintenance actions are required as identified through inspection. Recognizing that Permittees have limited maintenance funds and time, Ecology does not require that a Permittee perform all these maintenance activities on all their stormwater BMPs. We leave the determination of importance of each maintenance activity and its priority within the stormwater program to the Permittee. We do expect, however, that sufficient maintenance will occur to ensure that the BMPs continue to operate as designed to protect ground and surface waters.

Ecology doesn't intend that these measures identify the facility's required condition at all times between inspections. In other words, exceedance of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the Permittee shall adjust inspection and maintenance schedules to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table V-A.1: Maintenance Standards - Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance and inspection access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g.,rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed engineer in the state of Washington should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (if Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Ponds Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation If settlement is apparent, measure berm to determine amount of settlement Settling can be an indication of more severe problems with the berm or outlet works. A licensed engineer in the state of Washington should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway and Berms over 4 feet in height	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed engineer in the state of Washington should be consulted for proper berm/spillway restoration.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/Spillway	Emergency Overflow/Spillway	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	See "Side Slopes of Pond"	

Table V-A.2: Maintenance Standards - Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Poisonous/Noxious Vegetation	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Contaminants and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Rodent Holes	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events. (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.4: Maintenance Standards - Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall. Structure is not in upright position (allow up to 10% from plumb). Connections to outlet pipe are not watertight and show signs of rust. Any holes - other than designed holes - in the structure.	Structure securely attached to wall and outlet pipe. Structure in correct position. Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. Structure has no holes other than designed holes.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)
Catch Basin	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.5: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

Table V-A.6: Maintenance Standards - Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches. Bars are missing or entire barrier missing. Bars are loose and rust is causing 50% deterioration to any part of barrier.	Bars in place with no bends more than 3/4 inch. Bars in place according to design. Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

Table V-A.7: Maintenance Standards - Energy Dissipators

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow"□ of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.8: Maintenance Standards - Typical Biofiltration Swale

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the bio-swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
	Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.
	Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea-gravel drain the length of the swale or by-pass the baseflow around the swale.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or re-seed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back over-hanging limbs and remove brushy vegetation on adjacent slopes.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from bioswale.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

Table V-A.9: Maintenance Standards - Wet Biofiltration Swale

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation	Sediment depth exceeds 2-inches in 10% of the swale treatment area.	Remove sediment deposits in treatment area.
	Water Depth	Water not retained to a depth of about 4 inches during the wet season.	Build up or repair outlet berm so that water is retained in the wet swale.
	Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail, which do not allow water to flow through the clumps.	Determine cause of lack of vigor of vegetation and correct. Replant as needed. For excessive cattail growth, cut cattail shoots back and compost off-site. Note: normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters.
	Inlet/Outlet	Inlet/outlet area clogged with sediment and/or debris.	Remove clogging or blockage in the inlet and outlet areas.
	Trash and Debris Accumulation	See Table V-A.1: Maintenance Standards - Detention Ponds	Remove trash and debris from wet swale.
	Erosion/Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.	Check design flows to assure swale is large enough to handle flows. By-pass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as Juncus effusus (soft rush) in wet areas or snowberry (Symphoricarpos albus) in dryer areas.

Table V-A.10: Maintenance Standards - Filter Strips

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits, re-level so slope is even and flows pass evenly through strip.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow grass, control nuisance vegetation, such that flow not impeded. Grass should be mowed to a height between 3-4 inches.
	Trash and Debris Accumulation	Trash and debris accumulated on the filter strip.	Remove trash and Debris from filter.
	Erosion/Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width.

Table V-A.11: Maintenance Standards - Wetponds

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Water level	First cell is empty, doesn't hold water.	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Trash and Debris	Accumulation that exceeds 1 CF per 1000-SF of pond area.	Trash and debris removed from pond.
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
	Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6-inches, usually in the first cell.	Sediment removed from pond bottom.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as Juncus effusus (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom, that exceeds 6-inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.
	Settlement of Pond Dike/Berm	Any part of these components that has settled 4-inches or lower than the design elevation, or inspector determines dike/berm is unsound.	Dike/berm is repaired to specifications.
	Internal Berm	Berm dividing cells should be level.	Berm surface is leveled so that water flows evenly over entire length of berm.
	Overflow Spillway	Rock is missing and soil is exposed at top of spillway or outside slope.	Rocks replaced to specifications.

Table V-A.12: Maintenance Standards - Wetvaults

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris from vault.
	Sediment Accumulation in Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	Remove sediment from vault.
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened or removed, especially by one person.	Cover repaired or replaced to proper working specifications.
	Ventilation	Ventilation area blocked or plugged.	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection staff.	Baffles repaired or replaced to specifications.
	Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.

Table V-A.13: Maintenance Standards - Sand Filters (Above Ground/Open)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Above Ground (open sand filter)	Sediment Accumulation on top layer	Sediment depth exceeds 1/2-inch.	No sediment deposit on grass layer of sand filter that would impede permeability of the filter section.
	Trash and Debris Accumulations	Trash and debris accumulated on sand filter bed.	Trash and debris removed from sand filter bed.
	Sediment/ Debris in Clean-Outs	When the clean-outs become full or partially plugged with sediment and/or debris.	Sediment removed from clean-outs.
	Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24-hours, and/or flow through the overflow pipes occurs frequently.	Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material).
	Prolonged Flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities.	Low, continuous flows are limited to a small portion of the facility by using a low wooden divider or slightly depressed sand surface.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Short Circuiting	When flows become concentrated over one section of the sand filter rather than dispersed.	Flow and percolation of water through sand filter is uniform and dispersed across the entire filter area.
	Erosion Damage to Slopes	Erosion over 2-inches deep where cause of damage is prevalent or potential for continued erosion is evident.	Slopes stabilized using proper erosion control measures.
	Rock Pad Missing or Out of Place	Soil beneath the rock is visible.	Rock pad replaced or rebuilt to design specifications.
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

Table V-A.14: Maintenance Standards - Sand Filters (Below Ground/Enclosed)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault.	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 1/2-inch.	No sediment deposits on sand filter section that which would impede permeability of the filter section.
	Sediment Accumulation in Pre-Settling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	No sediment deposits in first chamber of vault.
	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault and inlet/outlet piping.
	Sediment in Drain Pipes/Cleanouts	When drain pipes, cleanouts become full with sediment and/or debris.	Sediment and debris removed.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover. Maintenance person cannot remove cover using normal lifting pressure.	Cover repaired to proper working specifications or replaced.
	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.

Table V-A.15: Maintenance Standards - Manufactured Media Filters

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault	Sediment Accumulation on Media.	Sediment depth exceeds 0.25-inches.	No sediment deposits which would impede permeability of the compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6-inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

Table V-A.16: Maintenance Standards - Baffle Oil/Water Separators (API Type)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with out thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth.	No sediment deposits on vault bottom that would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Oil Accumulation	Oil accumulations that exceed 1-inch, at the surface of the water.	Extract oil from vault by vactoring. Disposal in accordance with state and local rules and regulations.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	See Table V-A.5: Maintenance Standards - Catch Basins Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-A.17: Maintenance Standards - Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1-inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-A.18: Maintenance Standards - Catch Basin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with sheet flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There should be no areas of standing water once inflow has ceased.
	No-vegetation zone/flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean to spread flows evenly over entire embankment width.
	Poor vegetation coverage	Grass is sparse or bare, or eroded patches are observed in more than 10% of the grass strip surface area.	Determine why grass growth is poor and correct the offending condition. Reseed into loosened, fertile soil or compost; or, replant with plugs of grass from the upper slope.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow vegetation or remove nuisance vegetation to not impede flow. Mow grass to a height of 6 inches.
	Media filter drain mix replacement	Water is seen on the surface of the media filter drain mix long after the storms have ceased. Typically, the 6-month, 24-hour precipitation event should drain within 48 hours. More common storms should drain within 24 hours. Maintenance also needed on a 10-year cycle and during a preservation project.	Excavate and replace all of the media filter drain mix contained within the media filter drain.
	Excessive shading	Grass growth is poor because sunlight does not reach embankment.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes.
	Trash and debris	Trash and debris have accumulated on embankment.	Remove trash and debris from embankment.
	Flooding of Media filter drain	When media filter drain is inundated by flood water	Evaluate media filter drain material for acceptable infiltration rate and replace if media filter drain does not meet long-term infiltration rate standards.

Table V-A.20: Maintenance Standards - Compost Amended Vegetated Filter Strip (CAVFS)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass	Sediment depth exceeds 2 inches.	Remove sediment deposits. Relevel so slope is even and flows pass evenly through strip.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow grass and control nuisance vegetation so that flow is not impeded. Grass should be mowed to a height of 6 inches.
	Trash and debris	Trash and debris have accumulated on the vegetated filter strip.	Remove trash and debris from filter.
	Erosion/scouring	Areas have eroded or scoured due to flow channelization or high flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with a 50/50 mixture of crushed gravel and compost. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the vegetated filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width

Table V-A.21: Maintenance Standards - Bioretention Facilities

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility Footprint				

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Earthen side slopes and berms	B, S		Erosion (gullies/ rills) greater than 2 inches deep around inlets, outlet, and alongside slopes	• Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made. • Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention facility sizing; (2) flow velocities and gradients within the facility; and (3) flow dissipation and erosion protection strategies at the facility inlet.
	A		Erosion of sides causes slope to become a hazard	Take actions to eliminate the hazard and stabilize slopes
	A, S		Settlement greater than 3 inches (relative to undisturbed sections of berm)	Restore to design height
	A, S		Downstream face of berm wet, seeps or leaks evident	Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)
	A		Any evidence of rodent holes or water piping in berm	• Eradicate rodents (see "Pest control") • Fill holes and compact (may require consultation with engineer, particularly for larger berms)
Concrete sidewalls	A		Cracks or failure of concrete sidewalls	• Repair/ seal cracks • Replace if repair is insufficient
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility area		All maintenance visits (at least biannually)	Trash and debris present	Clean out trash and debris
Facility bottom area	A, S		Accumulated sediment to extent that infiltration rate is reduced (see "Ponded water") or surface storage capacity significantly impacted	• Remove excess sediment • Replace any vegetation damaged or destroyed by sediment accumulation and removal • Mulch newly planted vegetation • Identify and control the sediment source (if feasible) • If accumulated sediment is recurrent, consider adding presettlement or installing berms to create a forebay at the inlet
		During/after fall leaf drop	Accumulated leaves in facility	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded
Low permeability check dams and weirs	A, S		Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice	Clear the blockage
	A, S		Erosion and/or undercutting present	Repair and take preventative measures to prevent future erosion and/or undercutting
	A		Grade board or top of weir damaged or not level	Restore to level position

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Ponded water	B, S		Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.	Determine cause and resolve in the following order: 1. Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris. 2. Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain. 3. Check for other water inputs (e.g., groundwater, illicit connections). 4. Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem, the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with an engineer is recommended.

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Bioretention soil mix	As needed		Bioretention soil mix protection is needed when performing maintenance requiring entrance into the facility footprint	• Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils. • Never drive equipment or apply heavy loads in facility footprint. • Because the risk of compaction is higher during saturated soil conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions. • Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction. • If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the facility and away from the inlet structure	Reconfigure/ repair blocks to direct water to facility and away from structure
Curb cut inlet/outlet	M during the wet season and before severe storm is forecasted	Weekly during fall leaf drop	Accumulated leaves at curb cuts	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
Pipe inlet/outlet	A		Pipe is damaged	Repair/ replace
	W		Pipe is clogged	Remove roots or debris
	A, S		Sediment, debris, trash, or mulch reducing capacity of inlet/outlet	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
		Weekly during fall leaf drop	Accumulated leaves at inlets/outlets	Clear leaves (particularly important for key inlets and low points along long, linear facilities)

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
		A	Maintain access for inspections	• Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Erosion control at inlet	A		Concentrated flows are causing erosion	Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb cut or swale)
Trash rack	S		Trash or other debris present on trash rack	Remove/dispose
	A		Bar screen damaged or missing	Repair/replace
Overflow	A, S		Capacity reduced by sediment or debris	Remove sediment or debris/dispose
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	• Plant roots, sediment or debris reducing capacity of underdrain • Prolonged surface ponding (see "Ponded water"	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.
Vegetation				

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility bottom area and upland slope vegetation	Fall and Spring		Vegetation survival rate falls below 75% within first two years of establishment (unless project O&M manual or record drawing stipulates more or less than 75% survival rate).	• Determine cause of poor vegetation growth and correct condition • Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jurisdictional species list for appropriate plant replacements (See Appendix 3 - Bioretention Plant List, in the *LID Technical Guidance Manual for Puget Sound*, (Hinman and Wulkan, 2012)). • Confirm that plant selection is appropriate for site growing conditions • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Vegetation (general)	As needed		Presence of diseased plants and plant material	• Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • See the *Pacific Northwest Plant Disease Management Handbook* (Pscheidt and Ocamb, 2016) for information on disease recognition and for additional resources • Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".
Trees and shrubs		All pruning seasons (timing varies by species)	Pruning as needed	• Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques • All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist
	A		Large trees and shrubs interfere with operation of the facility or access for maintenance	• Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. • Remove trees and shrubs, if necessary.

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	Fall and Spring		Standing dead vegetation is present	• Remove standing dead vegetation • Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season) • If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately. • Determine cause of dead vegetation and address issue, if possible • If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.
	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.
	Fall and Spring		Presence of or need for stakes and guys (tree growth, maturation, and support needs)	• Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage • Monitor tree support systems: Repair and adjust as needed to provide support and prevent damage to tree. • Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year. • Backfill stake holes after removal.

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	A		Vegetation causes some visibility (line of sight) or driver safety issues	• Maintain appropriate height for sight clearance • When continued, regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location. • Remove or transplant if continual safety hazard • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Flowering plants		A	Dead or spent flowers present	Remove spent flowers (deadhead)
Perennials		Fall	Spent plants	Cut back dying or dead and fallen foliage and stems
Emergent vegetation		Spring	Vegetation compromises conveyance	Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning)
Ornamental grasses (perennial)		Winter and Spring	Dead material from previous year's growing cycle or dead collapsed foliage	• Leave dry foliage for winter interest • Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow
Ornamental grasses (evergreen)		Fall and Spring	Dead growth present in spring	• Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring • Clean, rake, and comb grasses when they become too tall • Cut back to ground or thin every 2-3 years as needed

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Noxious weeds		M (March - October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions • Apply mulch after weed removal (see "Mulch")
Weeds		M (March - October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management (see "Additional Maintenance Resources" section for more information on IPM protocols)
Excessive vegetation		Once in early to mid- May and once in early- to mid-September	Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil	• Edge or trim groundcovers and shrubs at facility edge • Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks • While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	As needed		Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety	• Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics • Determine if planting type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow) • Remove plants that are weak, broken or not true to form; replace in-kind • Thin grass or plants impacting facility function without leaving visual holes or bare soil areas • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
	As needed		Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass	Remove vegetation and sediment buildup
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Replenish mulch per O&M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels) • Keep all mulch away from woody stems
Watering				
Irrigation system (if any)		Based on manufacturer's instructions	Irrigation system present	Follow manufacturer's instructions for O&M
	A		Sprinklers or drip irrigation not directed/located to properly water plants	Redirect sprinklers or move drip irrigation to desired areas

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		

Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree
				• 3 to 5 gallons per shrub
				• 2 gallons water per square foot for groundcover areas
				• Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist
				• Use soaker hoses or spot water with a shower type wand when irrigation system is not present
				  ○ Pulse water to enhance soil absorption, when feasible
				  ○ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff
				• Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present

Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree
				• 3 to 5 gallons per shrub
				• 2 gallons water per square foot for groundcover areas
				• Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist
				• Use soaker hoses or spot water with a shower type wand when irrigation system is not present
				  ○ Pulse water to enhance soil absorption, when feasible
				  ○ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear • Water during drought conditions or more often if necessary to maintain plant cover
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • To facilitate maintenance, manually remove standing water and direct to the storm drainage system (if runoff is from non pollution-generating surfaces) or sanitary sewer system (if runoff is from pollution-generating surfaces) after getting approval from sanitary sewer authority. • Use of pesticides or *Bacillus thuringiensis israelensis* (Bti) may be considered only as a temporary measure while addressing the standing water cause. If overflow to a surface water will occur within 2 weeks after pesticide use, apply for coverage under the Aquatic Mosquito Control NPDES General Permit.

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	• Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.) • Place predator decoys • Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" section for more information on IPM protocols) • Remove pet waste regularly • For public and right-of-way sites consider adding garbage cans with dog bags for picking up pet waste.
Insect pests	Every site visit associated with vegetation management		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	• Reduce hiding places for pests by removing diseased and dead plants • For infestations, follow IPM protocols (see "Additional Maintenance Resources"□ section for more information on IPM protocols)

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

IPM - Integrated Pest Management

ISA - International Society of Arboriculture

Table V-A.22: Maintenance Standards - Permeable Pavement

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Permeable Pavements, all	A, S		Runoff from adjacent pervious areas deposits soil, mulch or sediment on paving	• Clean deposited soil or other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface

Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods:
				• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves)
				• Vacuum/sweep permeable paving installation using:
				  ○ Walk-behind vacuum (sidewalks)
				  ○ High efficiency regenerative air or vacuum sweeper (roadways, parking lots)
				  ○ ShopVac or brush brooms (small areas)
				• Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		

	A_b		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility)
				• Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet.
				• If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods:
				  ○ Combined pressure wash and vacuum system calibrated to not dislodge wearing course aggregate.
				  ○ Hand held pressure washer or power washer with rotating brushes
				  ○ Pure vacuum sweepers
				Note: If the annual/biannual routine maintenance standard to clean the pavement surface is conducted using equipment from the list above, corrective maintenance may not be needed.

	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Pressure wash, vacuum sweep, or use a combination of the two for cleaning moss from pavement surface. May require stiff broom or power brush in areas of heavy moss.
	A		Major cracks or trip hazards and concrete spalling and raveling	• Fill potholes or small cracks with patching mixes • Large cracks and settlement may require cutting and replacing the pavement section. Replace in-kind where feasible. Replacing porous asphalt with conventional asphalt is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function. • Take appropriate precautions during pavement repair and replacement efforts to prevent clogging of adjacent porous materials

Interlocking concrete paver blocks and aggregate pavers		A or B	None (routine maintenance)	Clean pavement surface using one or a combination of the following methods:
				• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves)
				• Vacuum/sweep permeable paving installation using:
				  ○ Walk-behind vacuum (sidewalks)
				  ○ High efficiency regenerative air or vacuum sweeper (roadways, parking lots)
				  ○ ShopVac or brush brooms (small areas)
				Note: Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints. Vacuum surface openings in dry weather to remove dry, encrusted sediment.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	A_b		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. • Clogging is usually an issue in the upper 2 to 3 centimeters of aggregate. Remove the upper layer of encrusted sediment, and fines, and/or vegetation from openings and joints between the pavers by mechanical means and/or suction equipment (e.g., pure vacuum sweeper). • Replace aggregate in paver cells, joints, or openings per manufacturer's recommendations
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding, then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Vacuum sweep or stiff broom/power brush for cleaning moss from pavement surface
	A		Paver block missing or damaged	Remove individual damaged paver blocks by hand and replace or repair per manufacturer's recommendations

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	A		Loss of aggregate material between paver blocks	Refill per manufacturer's recommendations for interlocking paver sections
	A		Settlement of surface	May require resetting
Open-celled paving grid with gravel		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A[b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Use vacuum truck to remove and replace top course aggregate • Replace aggregate in paving grid per manufacturer's recommendations
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace gravel • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Loss of aggregate material in paving grid	Replenish aggregate material by spreading gravel with a rake (gravel level should be maintained at the same level as the plastic rings or no more than 1/4 inch above the top of rings). See manufacturer's recommendations.
		A	Weeds present	• Manually remove weeds • Presence of weeds may indicate that too many fines are present (refer to Actions Needed under "Aggregate is clogged"□ to address this issue)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Open-celled paving grid with grass		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A_b		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	Rehabilitate per manufacturer's recommendations.
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace grass • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Poor grass coverage in paving grid	• Restore growing medium, reseed or plant, aerate, and/or amend vegetated area as needed • Traffic loading may be inhibiting grass growth; reconsider traffic loading if feasible
		As needed	None (routine maintenance)	Use a mulch mower to mow grass
		A	None (routine maintenance)	• Sprinkle a thin layer of compost on top of grass surface (1/2"□ top dressing) and sweep it in • Do not use fertilizer
		A	Weeds present	• Manually remove weeds • Mow, torch, or inoculate and replace with preferred vegetation
Inlets/Outlets/Pipes				

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Inlet/outlet pipe	A		Pipe is damaged	Repair/replace
	A		Pipe is clogged	Remove roots or debris
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain (may cause prolonged drawdown period)	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Raised subsurface overflow pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain	• Jet clean or rotary cut debris/roots from under-drain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Outlet structure	A, S		Sediment, vegetation, or debris reducing capacity of outlet structure	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
Overflow	B		Native soil is exposed or other signs of erosion damage are present at discharge point	Repair erosion and stabilize surface
Aggregate Storage Reservoir				
Observation port	A, S		Water remains in the storage aggregate longer than anticipated by design after the end of a storm	If immediate cause of extended ponding is not identified, schedule investigation of subsurface materials or other potential causes of system failure.
Vegetation				

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Adjacent large shrubs or trees		As needed	Vegetation related fallout clogs or will potentially clog voids	• Sweep leaf litter and sediment to prevent surface clogging and ponding • Prevent large root systems from damaging subsurface structural components
		Once in May and Once in September	Vegetation growing beyond facility edge onto sidewalks, paths, and street edge	Edging and trimming of planted areas to control groundcovers and shrubs from overreaching the sidewalks, paths and street edge improves appearance and reduces clogging of permeable pavements by leaf litter, mulch and soil.
Leaves, needles, and organic debris		In fall (October to December) after leaf drop (1-3 times, depending on canopy cover)	Accumulation of organic debris and leaf litter	Use leaf blower or vacuum to blow or remove leaves, evergreen needles, and debris (i.e., flowers, blossoms) off of and away from permeable pavement

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

a Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

b Inspection should occur during storm event.

Table V-A.23: Maintenance Standards - Vegetated Roofs

Activity	Objective	Schedule	Notes
Structural and Drainage Components			
Clear inlet pipes: Remove soil substrate, vegetation or other debris.	Maintain free drainage of inlet pipes.	Twice annually.	
Inspect drain pipe: Check for cracks settling and proper alignment, and correct and re-compact soils or fill material surrounding pipe, if necessary.	Maintain free drainage of inlet pipes.	Twice annually.	

Activity	Objective	Schedule	Notes
Inspect fire ventilation points for proper operation	Fire and safety.	Twice annually.	
Maintain egress and ingress: Clear routes of obstructions and maintained to design standards.	Fire and safety.	Twice annually.	
Insects: (see note)			Roof garden design should provide drainage rates that do not allow pooling of water for periods that promote insect larvae development. If standing water is present for extended periods correct drainage problem. Chemical sprays should not be used.
Prevent release of contaminants: Identify activities (mechanical systems maintenance, pet access, etc.) that can potentially release pollutants to the roof garden and establish agreements to prevent release.	Water quality protection.	During construction of roof and then as determined by inspection.	Any cause of pollutant release should be corrected as soon as identified and the pollutant removed.
Vegetation and Growth Medium			
Invasive or nuisance plants: Remove manually and without herbicide applications.	Promote selected plant growth and survival, maintain aesthetics.	Twice annually.	At a minimum, schedule weeding with inspections to coincide with important horticultural cycles (e.g., prior to major weed varieties dispersing seeds).
Removing and replacing dead material: (see note)	See note.	Once annually.	Normally, dead plant material will be recycled on the roof; however specific plants or aesthetic considerations may warrant removing and replacing dead material (see manufacturer's recommendations).
Fertilization: If necessary apply by hand (see note)	Plant growth and survival.	Determined by inspection.	Extensive roof gardens should be designed to not require fertilization after plant establishment. If fertilization is necessary during plant establishment or for plant health and survivability after establishment, use an encapsulated, slow release fertilizer (excessive fertilization can contribute to increased nutrient loads in the stormwater system and receiving waters).
Mulching: (see note)			Avoid application of mulch on extensive roof gardens. Mulch should be used only in unusual situations and according to the roof garden provider guidelines. In conventional landscaping mulch enhances moisture retention; however, moisture control on a vegetated roof should be through proper soil/growth media design. Mulch will also increase establishment of weeds.

Activity	Objective	Schedule	Notes
Irrigate: Use subsurface or drip irrigation.		Determined by inspection and only when absolutely necessary for plant survival.	Surface irrigation systems on extensive roof gardens can promote weed establishment, root development near the drier surface layer of the soil substrate, and increase plant dependence on irrigation. Accordingly, subsurface irrigation methods are preferred. If surface irrigation is the only method available, use drip irrigation to deliver water to the base of the plant.
Source: Eastern Washington LID Guidance Manual (June 2013)			

Appendix A-2

City of Tacoma SWMM
Appendix C Operation and Maintenance

Appendix C Operation and Maintenance

The following pages contain maintenance standards for typical stormwater facilities that may be required for stormwater mitigation. The maintenance standards should be included in the project Operations and Maintenance Manual. If the proposed stormwater system contains facilities or components that are not contained within this Volume, the applicant is responsible for developing additional maintenance standards for the proposed facility or component. If there are components listed on the maintenance standard that are not applicable to the proposed design, those components shall be removed. The operation and maintenance standards shall accurately reflect the proposed design. The Maintenance Standard includes recommended timeframes for inspection. Maintenance frequency is project site specific depending on factors such as use of the site and traffic volumes. Maintenance frequencies shall be based upon inspections. It is recommended to conduct monthly inspections during the first few years after installation to develop maintenance frequencies. At a minimum, inspections of all components of the stormwater system shall occur yearly.

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceeding these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

Note: Maintenance checklist #29 - General Maintenance Concerns for Stormwater Facilities contains maintenance concerns that may be applicable to any stormwater facility. This checklist must be included in all Operation and Maintenance manuals as applicable.

Appendix C Contents

#1 - Maintenance Standard for Detention Ponds

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris	Any trash and debris which exceeds 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold, all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
Annually (preferably Sept.)	General	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or Local Regulations (Apply requirements of adopted integrated pest management policies for the use of herbicides.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Complete eradication of noxious weeds may not be possible. Compliance with state or local eradication policies required. (Coordinate with the Pierce County Noxious Weed Control Board.)
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants.	No contaminants or pollutants present. (Coordinate removal/ cleanup with Environmental Services at 253.502.2222 and/or DOE Spill Response 800.424.8802.)
Monthly from Oct. – Apr.	General	Rodent Holes	If the facility is constructed with a dam or berm, look for rodent holes or any evidence of water piping through the dam or berm.	Rodents removed and dam or berm repaired. (Coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
Monthly from Oct. – Apr.	General	Beaver Dams	Beaver dam results in an adverse change in the functioning of the facility.	Facility is returned to design function. (Contact WDFW Region 6 to identify the appropriate Nuisance Wildlife Control Operator)

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site in compliance with adopted integrated pest management policies.
Annually (preferably Sept.)	General	Tree Growth and Dense Vegetation	Tree growth and dense vegetation which impedes inspection, maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements).	Trees and vegetation that do not hinder inspection or maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses.
Annually (preferably Sept.)	General	Hazard Trees	If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements).	Remove hazard trees
Monthly from Oct. – Apr.	Side Slopes of Pond	Erosion	Erosion damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Side Slopes of Pond	Erosion	Any erosion observed over 2” deep on a compacted berm embankment.	If erosion is occurring on compacted berms a Washington State Licensed Professional Engineer should be consulted to resolve source of erosion.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr.	Storage Area	Sediment	Accumulated sediment that exceeds 10 percent of the design pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to design pond shape and depth; pond reseeded if necessary to control erosion. (If sediment contamination is a potential problem, sediment should be tested regularly to determine leaching potential prior to disposal.)
Monthly from Oct. – Apr.	Storage Area	Liner (If Applicable)	Liner is visible and has more than three 1/4 inch holes in it.	Liner repaired or replaced. Liner is fully covered.
Annually (preferably Sept.)	Pond Berms (Dikes)	Settlement	Any part of berm which has settled 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. A Washington State Licensed Professional Engineer should be consulted to determine the source of the settlement.	Dike is restored to the design elevation.
Annually (preferably Sept.)	Pond Berms Over 4 ft in height (Dikes)	Tree Growth	Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A Washington State Licensed Professional Engineer should be consulted for proper berm/spillway restoration.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Pond Berms (Dikes)	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Washington State Licensed Professional Engineer be called in to inspect and evaluate condition and recommend repair.)	Piping eliminated. Erosion potential eliminated.
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A Washington State Licensed Professional Engineer should be consulted for proper berm/spillway restoration.
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Rock Missing	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil at the top of outflow path of spillway. (Riprap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Erosion	Erosion damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment over 2“ deep.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a Washington State Licensed Professional Engineer should be consulted to resolve source of erosion.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#2 - Maintenance Standard for Infiltration Ponds/Basins

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris	Any trash and debris which exceeds 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
Annually (preferably Sept.)	General	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or Local Regulations. (Apply requirements of adopted integrated pest management policies for the use of herbicides.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with the Pierce County Noxious Weed Control Board) Complete eradication of noxious weeds may not be possible. Compliance with state or local eradication policies required.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants.	No contaminants or pollutants present. (Coordinate removal/ cleanup with Environmental Services at 253.502.2222 and/or DOE Spill Response 800.424.8802.)
Monthly from Oct. – Apr.	General	Rodent Holes	If the facility is constructed with a dam or berm, look for rodent holes or any evidence of water piping through the dam or berm.	Rodents removed and dam or berm repaired. (Coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
Monthly from Oct. – Apr.	General	Beaver Dams	Beaver dam results in an adverse change in the functioning of the facility.	Facility is returned to design function. (Contact WDFW to identify the appropriate Nuisance Wildlife Control Operator)

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.
Monthly from Oct. – Apr.	Storage Area	Water Not Infiltrating	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration (24 hours or design infiltration time). (A percolation test pit or test of facility indicates facility is only working at 90 percent of its designed capabilities. If 2 inches or more sediment is present, remove).	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Monthly from Oct. – Apr.	Ponds	Vegetation	Exceeds 18 inches.	Mow or remove vegetation as necessary. Remove all clippings.
Monthly from Oct. – Apr.	Ponds	Vegetation	Bare spots.	Revegetate and stabilize immediately. Do not apply fertilizers.
Monthly from Oct. – Apr.	Side Slopes of Pond	Erosion	Erosion damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Pond Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or piping. A Washington State Licensed Professional Engineer should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
Annually (preferably Sept.)	Pond Berms (Dikes)	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Washington State Licensed Professional Engineer be called in to inspect and evaluate condition and recommend repair.)	Piping eliminated. Erosion potential eliminated.
Annually (preferably Sept.)	General	Hazard Trees	If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Remove hazard trees
Annually (preferably Sept.)	General	Tree Growth and Dense Vegetation	Tree growth and dense vegetation which impedes inspection, maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements).	Trees and vegetation that do not hinder inspection or maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Pond Berms (Dikes)	Tree Growth	Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A Washington State Licensed Professional Engineer should be consulted for proper berm/spillway restoration.
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A Washington State Licensed Professional Engineershould be consulted for proper berm/spillway restoration.
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Rock Missing	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil at the top of out flowpath of spillway. (Riprap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Erosion	Erosion damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a Washington State Licensed Professional Engineer should be consulted to resolve source of erosion.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#3 - Maintenance Standard for Infiltration Trenches

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris	Trash and debris in presettling basin, sump, or observation well/port.	Trash and debris cleared from site.
Annually (preferably Sept.)	General	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or Local Regulations. (Apply requirements of adopted integrated pest management policies for the use of herbicides.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with the Pierce County Noxious Weed Control Board) Complete eradication of noxious weeds may not be possible. Compliance with state or local eradication policies required.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants	No contaminants or pollutants present. (Coordinate removal/ cleanup with Environmental Services at 253.502.2222 and/or DOE Spill Response 800.424.8802.)
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.
Monthly from Oct. – Apr.	General	Water Not Infiltrating	Water ponding on surface or visible in observation well 24 hours after storm event.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design. Remove any sediment from surface inlet if applicable.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.) and after any major storm event (1" in 24 hours)	Trenches	Observation Well (Use surface of trench if well is not present)	Water ponds at surface during storm events. Water visible in observation well 48 hours after storm event.	Remove and Replace rock layer and geomembrane or clean rock and geomembrane. Check underdrain pipe for sediment accumulation and remove sediment.
Annually (preferably Sept.)	General	Tree Growth and Dense Vegetation	Tree growth and dense vegetation which impedes inspection, maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements).	Trees and vegetation that do not hinder inspection or maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses.
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Erosion	Erosion damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a Washington State Licensed Professional Engineer should be consulted to resolve source of erosion.
Monthly from Oct. – Apr.	Presettling Sump	Facility or sump filled with sediment and/or debris	6 inches or designed sediment trap depth of sediment.	Sediment is removed.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#4 - Maintenance Standard for Closed Detention Systems (Tanks/Vaults)

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Storage Area	Plugged Air Vents	One-half of the cross-section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Storage Area	Debris and Sediment	Accumulated sediment depth exceeds 10 percent of the diameter of the storage area for one-half length of storage vault or any point depth exceeds 15 percent of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than one-half length of tank.)	All sediment and debris removed from storage area.
Annually (preferably Sept.)	Storage Area	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability.)	All joints between tank/ pipe sections are sealed.
Annually (preferably Sept.)	Storage Area	Tank/Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10 percent of its design shape. (Will require engineering analysis to determine structural stability.)	Tank/pipe repaired or replaced to design.
Annually (preferably Sept.)	Storage Area	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than one-half inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications and is structurally sound.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Storage Area	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than one-half inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than one-fourth inch wide at the joint of the inlet/ outlet pipe.
Annually (preferably Sept.)	Maintenance Hole	Cover Not in Place	Cover is missing or only partially in place. Any open maintenance hole requires maintenance.	Maintenance hole cover is in place.
Annually (preferably Sept.)	Maintenance Hole	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than one-half inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
Annually (preferably Sept.)	Maintenance Hole	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
Annually (preferably Sept.)	Maintenance Hole	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Tanks and vaults are a confined space. Visual inspections should be performed aboveground. If entry is required it should be performed by qualified personnel.

Comments:

#5 - Maintenance Standard for Control Structure/Flow Restrictor

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris (Includes Sediment)	Material exceeds 25 percent of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
Annually (preferably Sept.)	General	Structural Damage	Structure is not securely attached to maintenance hole wall.	Structure securely attached to wall and outlet pipe.
Annually (preferably Sept.)	General	Structural Damage	Structure is not in upright position (allow up to 10 percent from plumb).	Structure in correct position.
Annually (preferably Sept.)	General	Structural Damage	Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are watertight; structure repaired or replaced and works as designed.
Annually (preferably Sept.)	General	Structural Damage	Any holes–other than designed holes–in the structure.	Structure has no holes other than designed holes.
Annually (preferably Sept.)	Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
Annually (preferably Sept.)	Cleanout Gate	Damaged or Missing	Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
Annually (preferably Sept.)	Cleanout Gate	Damaged or Missing	Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
Annually (preferably Sept.)	Cleanout Gate	Damaged or Missing	Gate is rusted over 50 percent of its surface area.	Gate is repaired or replaced to meet design standards.
Annually (preferably Sept.)	Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Orifice Plate	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Maintenance Hole	Cover Not in Place	Cover is missing or only partially in place. Any open maintenance hole requires maintenance.	Maintenance hole is closed.
Annually (preferably Sept.)	Maintenance Hole	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than one-half inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
Annually (preferably Sept.)	Maintenance Hole	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
Annually (preferably Sept.)	Maintenance Hole	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Control structures are usually considered a confined space. Visual inspections should be performed aboveground. If entry is required it should be performed by qualified personnel.

Comments:

#6 - Maintenance Standard for Catch Basins/Manholes

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	General	"Dump no pollutants" Stencil or stamp not visible	Stencil or stamp should be visible and easily read	Warning signs (e.g., "Dump No Waste-Drains to Stream") shall be painted or embossed on or adjacent to all storm drain inlets.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inlet capacity of the basin by more than 10 percent.	No trash or debris located immediately in front of catch basin or on grate opening.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris	Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris	Trash or debris in any inlet or outlet pipe blocking more than one-third of its height.	Inlet and outlet pipes free of trash or debris.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris	Dead animals or vegetation that could generate odors and cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.
Annually (preferably Sept.)	General	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than one-fourth inch (intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
Annually (preferably Sept.)	General	Structure Damage to Frame and/or Top Slab	Frame not sitting flush on top slab, i.e., separation of more than three-fourth inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
Annually (preferably Sept.)	General	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
Annually (preferably Sept.)	General	Fractures or Cracks in Basin Walls/ Bottom	Grout fillet has separated or cracked wider than one-half-inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
Annually (preferably Sept.)	General	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Vegetation	Vegetation growing across and blocking more than 10 percent of the basin opening.	No vegetation blocking opening to basin.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Vegetation	Vegetation growing in inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart.	No vegetation or root growth present.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Contamination and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants.	No contaminants or pollutants present. (Coordinate removal/ cleanup with Environmental Services at 253.502.2222 and/or DOE Spill Response 800.424.8802.)
Annually (preferably Sept.)	Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place.	Catch basin cover is in place.
Annually (preferably Sept.)	Catch Basin Cover	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than one-half-inch of thread.	Mechanism opens with proper tools.
Annually (preferably Sept.)	Catch Basin Cover	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Annually (preferably Sept.)	Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Annually (preferably Sept.)	Grates	Grate opening Unsafe	Grate with opening wider than seven-eighths of an inch.	Grate opening meets design standards.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Grates	Trash and Debris	Trash and debris that is blocking more than 20 percent of grate surface inletting capacity.	Grate free of trash and debris.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Grates	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place , meets design standards, and is installed and aligned with flowpath.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#7 - Maintenance Standard for Debris Barriers (e.g., Trash Racks)

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris	Trash or debris that is plugging more than 20 percent of the openings in the barrier.	Barrier cleared to design flow capacity.
Annually (preferably Sept.)	General	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than three-fourth inch.
Annually (preferably Sept.)	General	Damaged/ Missing Bars.	Bars are missing or entire barrier missing.	Bars in place according to design.
Annually (preferably Sept.)	General	Damaged/ Missing Bars.	Bars are loose and rust is causing 50 percent deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
Annually (preferably Sept.)	General	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe.	Barrier firmly attached to pipe.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#8 - Maintenance Standard for Energy Dissipaters

Recommended Inspection Frequency	Stormwater System Feature	Problem	Conditions When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
External:				
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Rock Pad	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Monthly from Oct. - Apr. and after any major storm event (1" in 24 hours)	Rock Pad	Missing or Moved Rock	Only one layer of rock exists above soil in area 5 square feet or larger, or any soil exposure.	Rock pad replaced to design standards.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20 percent of the design depth.	Pipe cleaned/flushed so that it matches design.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Dispersion Trench	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a ”sheet flow” of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Dispersion Trench	Perforations Plugged	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Dispersion Trench	Water Flows Out Top of ”Distributor” Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or the trench is causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Dispersion Trench	Receiving Area Over-Saturated	Water in receiving area is causing or has potential to cause landslide problems.	No danger of landslides.
Spring and Summer	Flowpath	No or minimal vegetation	Vegetation removed or dead. Vegetation replaced by hard surface.	Design vegetated flowpath is restored.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Conditions When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Internal:				
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Maintenance Hole/ Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to one-half of original size or any concentrated worn spot exceeding 1 square foot which would make structure unsound	Structure replaced to design standards.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Maintenance Hole/ Chamber	Trash and Debris	Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Maintenance Hole/ Chamber	Trash and Debris	Trash or debris in any inlet or outlet pipe blocking more than one-third of its height.	Inlet and outlet pipes free of trash or debris.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Maintenance Hole/ Chamber	Trash and Debris	Dead animals, trash or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals, trash or vegetation present within the catch basin.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	Maintenance Hole/ Chamber	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Conditions When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Maintenance Hole/ Chamber	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than one-fourth inch (intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
Annually (preferably Sept.)	Maintenance Hole/ Chamber	Structure Damage to Frame and/or Top Slab	Frame not sitting flush on top slab, i.e., separation of more than three-fourth inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
Annually (preferably Sept.)	Maintenance Hole/ Chamber	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
Annually (preferably Sept.)	Maintenance Hole/ Chamber	Fractures or Cracks in Basin Walls/ Bottom	Grout fillet has separated or cracked wider than one-half-inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
Annually (preferably Sept.)	Maintenance Hole/ Chamber	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Maintenance Hole/ Chamber	Contamination and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants.	No contaminants or pollutants present. (Coordinate removal/ cleanup with Environmental Services at 253.502.2222 and/or DOE Spill Response 800-424-8802.)
Annually (preferably Sept.)	Catch Basin/ Maintenance Hole Cover	Cover Not in Place	Cover is missing or only partially in place.	Any open catch basin/ maintenance hole requires maintenance. Catch basin cover is closed.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Conditions When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Catch Basin/ Maintenance Hole Cover	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than one-half-inch of thread.	Mechanism opens with proper tools.
Annually (preferably Sept.)	Catch Basin/ Maintenance Hole Cover	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#9 - Maintenance Standard for Typical Biofiltration Swales

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the bioswale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Standing Water	Water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale. Consult the design engineer if underdrains are proposed to be removed or conversion is proposed.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea-gravel drain the length of the swale or by-pass the baseflow around the swale.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10 percent of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals or re-seed into loosened, fertile soil.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Vegetation	When the grass becomes excessively tall (greater than 10 inches); when nuisance weeds and other vegetation start to take over.	Mow vegetation or remove nuisance vegetation so that flow is not impeded. Grass should be mowed to a height of 3 to 8 inches, but not below design flow level. Remove grass clippings.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back over-hanging limbs and remove brushy vegetation on adjacent slopes.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Inlet/Outlet/ Underdrain	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area. If underdrain, avoid vehicular traffic on swale bottom.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris Accumulation	Trash and debris accumulated in the bioswale.	Remove leaves, litter, and oily materials, and re-seed or resod, and regrade, as needed. Clean curb cuts and level spreaders as needed.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Erosion/ Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#10 - Maintenance Standard for Wet Biofiltration Swales

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Sediment Accumulation	Sediment depth exceeds 2 inches in 10 percent of the swale treatment area.	Remove sediment deposits in treatment area.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Water Depth	Water not retained to a depth of about 4 inches during the wet season.	Build up or repair outlet berm so that water is retained in the wet swale.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail, which do not allow water to flow through the clumps.	Determine cause of lack of vigor of vegetation and correct. Replant as needed. For excessive cattail growth, cut cattail shoots back and compost offsite. Dig out roots as necessary. Note: Normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters. Fall harvesting of Juncus species is not recommended.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Inlet/Outlet	Inlet/outlet area clogged with sediment and/or debris.	Remove clogging or blockage in the inlet and outlet areas.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris Accumulation	Any trash and debris which exceeds 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Remove trash and debris from wet swale.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Erosion/ Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.	Check design flows to assure swale is large enough to handle flows. By-pass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as Juncus effusus (soft rush) in wet areas or snowberry (Symphoricarpos albus) in drier areas, or as recommended by a wetland specialist.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#11 - Maintenance Standard for Filter Strips

Recommended Inspection Frequency	Stormwater System Feature	Problem	Conditions When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits, re-level so slope is even and flows pass evenly through strip.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Vegetation	When the grass becomes excessively tall (greater than 10 inches); when nuisance weeds and other vegetation start to take over.	Mow grass, control nuisance vegetation, such that flow not impeded. Grass should be mowed to a height between 3-4 inches.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris Accumulation	Trash and debris accumulated on the filter strip.	Remove trash and Debris from filter.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Erosion/ Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width

Recommended Inspection Frequency	Stormwater System Feature	Problem	Conditions When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#12 - Maintenance Standard for Wet Ponds

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Water level	First cell is empty, doesn't hold water.	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)		Trash and Debris	Accumulation that exceeds 1 cubic foot per 1000 square feet of pond area.	Trash and debris removed from pond
Biannually (Spring & Fall)	General	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined in State and Local Regulations. (Apply requirements of adopted integrated vegetation management (IVM) policies for the use of herbicides.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with the Pierce County Noxious Weed Control Board). Complete eradication of noxious weeds may not be possible, however compliance with state or local eradication policies are required.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)		Inlet/Outlet Pipe	Inlet and/or outlet pipe clogged with sediment and/or debris material	No clogging or blockage in the inlet and outlet piping.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)		Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6 inches, usually in the first cell.	Sediment removed from pond bottom.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly		Vegetation	Vegetation is overgrown or sparse.	Trim vegetation as necessary to keep pond free of leaves and maintain aesthetic appearance. Revegetate bare sloped areas. Regrade before revegetation as needed.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)		Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as Juncus effusus (soft rush) which can uptake small concentrations of oil.
Annually (preferably Sept.)		Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom that exceeds 6 inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.
Annually (preferably Sept.)		Settlement of Pond Dike/ Berm	Any part of these components that has settled 4 inches or lower than the design elevation, or inspector determines dike/berm is unsound.	Dike/berm is repaired to specifications
Annually (preferably Sept.)		Internal Berm	Berm dividing cells should be level.	Berm surface is leveled so that water flows evenly over entire length of berm.
Annually (preferably Sept.)		Overflow Spillway	Rock is missing and soil is exposed at top of spillway or outside slope.	Rocks replaced to specifications.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#13 - Maintenance Standard for Treatment Wetlands

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (Spring & Fall)	General	Trash and Debris	Any trash and debris accumulations which exceed 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If there is less than the threshold, remove all trash and debris as part of the next scheduled maintenance.	Trash and debris cleared from site.
Biannually (Spring & Fall)	General	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined in State and Local Regulations. (Apply requirements of adopted integrated vegetation management (IVM) policies for the use of herbicides.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with the Pierce County Noxious Weed Control Board). Complete eradication of noxious weeds may not be possible, however compliance with state or local eradication policies are required.
Biannually (Spring & Fall)	General	Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant emergent wetland plants such as Juncus effusus (soft rush) which can assist filtering small concentrations of oil.
Biannually (Spring & Fall) and after any major storm event (1” in 24 hours)	General	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material or damaged.	No clogging or blockage in the inlet and outlet piping.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (Spring & Fall)	General	Rodent Holes	If the facility is constructed with a dam or berm, look for rodent holes or any evidence of water piping through the dam or berm.	Rodents removed and dam or berm repaired. (Coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
Biannually (Spring & Fall)	General	Beaver Dams	Beaver dam results in an adverse change in the functioning of the facility.	Facility is returned to design function. Contact WDFW to identify the appropriate Nuisance Wildlife Control Operator.
Biannually (Spring & Fall)	General	Tree Growth and Hazard Trees	Tree growth that impedes maintenance access.	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses.
Biannually (Spring & Fall)	General	Tree Growth and Hazard Trees	If dead, diseased, or dying trees are identified, use a Certified Arborist to determine the health of tree and whether removal is required.	Remove hazard trees.
Biannually (Spring & Fall)	General	Liner	Liner is visible and has more than three one-fourth inch holes in it.	Liner is repaired or replaced. Liner is fully covered.
Biannually (Spring & Fall)	Forebay	Sediment Accumulation	Sediment accumulation in forebay exceeds the design depth of the sediment zone plus 6 inches.	Accumulated sediment is removed from forebay bottom to the design depth of the sediment zone.
Biannually (Spring & Fall)	Side Slopes of Wetland	Erosion	Erosion damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes should be stabilized using appropriate erosion control measure(s) such as rock reinforcement, planting of grass, or additional compaction.
Biannually (Spring & Fall) and after any major storm event (1” in 24 hours)	Side Slopes of Wetland	Erosion	Any erosion observed on a compacted berm embankment over 2” deep.	If erosion is occurring on compacted berms a Washington State Licensed Professional Engineer should be consulted to resolve source of erosion.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (Spring & Fall)	Wetland Cell	Wetland Vegetation	20 percent or more of the constructed wetland area has dead or dying vegetation, as measured by stem counts relative to the design plant coverage.	Dead or dying vegetation is replaced by like species, unless recommended otherwise by the Wetlands Consultant and approved by the City. (Watering, physical support, mulching, and weed removal may be required on a regular basis especially during the first 3 years.)
Biannually (Spring & Fall)	Wetland Cell	Wetland Vegetation	Percent vegetated cover of constructed wetland bottom area, excluding exotic and invasive species, is less than 50 percent after 2 years.	Remove exotic/ invasive species, additional plantings may be required.
Biannually (Spring & Fall)	Wetland Cell	Wetland Vegetation	Decaying vegetation produces foul odors.	Decaying vegetation is removed, preferably in late summer.
Once in mid summer (July or August)	Wetland Cell	Wetland Vegetation	Wetland vegetation is blocking flowpaths causing flow back-up and flooding.	Areas of blocking vegetation are cut back sufficient to allow design flows and prevent flooding.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Wetland Cell	Wetland Vegetation	Water quality monitoring indicates that wetland vegetation is contributing phosphorus and metals to downstream waters rather than sequestering them. Environmental Services will determine when water quality monitoring is required.	To maximize removal of wetland pollutants, vegetation must be periodically harvested, particularly with respect to phosphorus and metals removal. Harvesting should occur by mid-summer before plants begin to transfer phosphorus from the aboveground foliage to subsurface roots, or begin to lose metals that desorb during plant die off. Every 3 to 5 years the entire plant mass including roots should be harvested because the below ground biomass constitutes a significant reservoir (as much as half) of the nutrients and metals that are removed from stormwater by plants.
Biannually (Spring & Fall)	Wetland Cell	Sediment Accumulation	Sediment accumulation inhibits growth of wetland plants or reduces wetland volume (greater than 1 foot of sediment accumulation).	Dredge to design depth.
Annually (preferably Sept.)	Wetland Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. A Washington State Licensed Professional Engineer should be consulted to determine the source of the settlement.	Dike restored to the design elevation.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Wetland Berms (Dikes)	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Washington State Licensed Professional Engineer be called in to inspect and evaluate condition and recommend repairs.	Piping eliminated. Erosion potential eliminated.
Annually (preferably Sept.)	Wetland Berms over 4 ft in height (Dikes)	Tree Growth	Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A Washington State Licensed Professional Engineer should be consulted for proper berm/spillway restoration.
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Obstruction	Tree growth or other blockage on emergency spillways may cause failure of the berm due to uncontrolled overtopping.	Obstruction should be removed. A Washington State Licensed Professional Engineer should be consulted for proper berm/spillway restoration.
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Rock Missing	Only one layer of rock exists above native soil in an area 5 square feet or larger, or any exposure of native soil at the top of outflow path of spillway. (Riprap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Emergency Overflow/ Spillway	Erosion	Erosion damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a Washington State Licensed Professional Engineer should be consulted to resolve source of erosion.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#14 - Maintenance Standard for Wetvaults

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris from vault.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Sediment Accumulation in Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	Remove sediment from vault. (If sediment contamination is a potential problem, sediment should be tested regularly to determine leaching potential prior to disposal.)
Annually (preferably Sept.)	General	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
Annually (preferably Sept.)	General	Access Cover Damaged/Not Working	Cover cannot be opened or removed, especially by one person.	Pipe repaired or replaced to proper working specifications.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Ventilation	Ventilation area blocked or plugged.	Blocking material removed or cleared from ventilation area. A specified percentage of the vault surface area must provide ventilation to the vault interior (see design specifications).
Annually (preferably Sept.)	Vault Structure	Damage - Includes Cracks in Walls/Bottom, Damage to Frame and/or Top Slab	Maintenance/inspection personnel determine that the vault is not structurally sound	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
Annually (preferably Sept.)	Vault Structure	Damage - Includes Cracks in Walls/Bottom, Damage to Frame and/or Top Slab	Cracks wider than one-half-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than one-fourth inch at the joint of the inlet/ outlet pipe.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Vault Structure	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection staff.	Baffles repaired or replaced to specifications.
Annually (preferably Sept.)	Access Ladder	Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel. Replace sign warning of confined space entry requirements.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

A vault is a confined space. Visual inspections should be performed aboveground. If entry is required it should be performed by qualified personnel.

Comments:

#15 - Maintenance Standard for Sand Filters (above ground/open)

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Sediment Accumulation on top layer	Sediment depth exceeds one-half inch.	No sediment deposit on grass layer of sand filter that would impede permeability of the filter section.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Trash and Debris Accumulations	Trash and debris accumulated on sand filter bed.	Trash and debris removed from sand filter bed.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Sediment/ Debris in Clean-Outs	When the clean-outs become full or partially plugged with sediment and/or debris.	Sediment removed from clean-outs.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24-hours, and/or flow through the overflow pipes occurs frequently.	Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material).
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Prolonged Flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities. (Consider 4-8 hour drawdown tests)	Low, continuous flows are limited to a small portion of the facility by using a low wooden divider or slightly depressed sand surface.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Short Circuiting	Drawdown greater than 12 inches per hour. When flows become concentrated over one section of the sand filter rather than dispersed. (Consider 4-8 hour drawdown tests)	Flow and percolation of water through sand filter is uniform and dispersed across the entire filter area. Inspect periphery and cleanouts for leakage.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Erosion Damage to Slopes	Erosion over 2 inches deep where cause of damage is prevalent or potential for continued erosion is evident.	Slopes stabilized using proper erosion control measures.
Annually (preferably Sept.)	Above ground (open sand filter)	Rock Pad Missing or Out of Place	Soil beneath the rock is visible.	Rock pad replaced or rebuilt to design specifications.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter. Rills and gullies on the surface of the filter can indicate improper function of the inlet flow spreader.	Spreader leveled and cleaned so that flows are spread evenly over sand filter. Refill rills and gullies with sand.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Above ground (open sand filter)	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20 percent or any other failure to the piping.	Pipe repaired or replaced.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.
Every other year	General	Drawdown		Every two years conduct a drawdown test by filling the filter with water and measuring the decline in water level over a 4 - 8 hour period.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.
Comments:

#16 - Maintenance Standard for Sand Filters (below ground/enclosed)

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Below Ground Vault	Sediment Accumulation on Sand Media Section	Sediment depth exceeds one-half inch.	No sediment deposits on sand filter section that would impede permeability of the filter section.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Below Ground Vault	Sediment Accumulation in Presettling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	No sediment deposits in first chamber of vault.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Below Ground Vault	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault and inlet/outlet piping.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Below Ground Vault	Sediment in Drain Pipes/ Cleanouts	When drain pipes, cleanouts become full with sediment and/or debris.	Sediment and debris removed.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Below Ground Vault	Clogged Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24-hours, and/or flow through the overflow pipes occurs frequently. (Consider 4-8 hour drawdown tests.)	Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material).
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Below Ground Vault	Short Circuiting	Drawdown greater than 12 inches per hour. When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area. (Consider 4-8 hour drawdown tests.)	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
Annually (preferably Sept.)	Below Ground Vault	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Below Ground Vault	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Below Ground Vault	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. A specified percentage of the vault surface area must provide ventilation to the vault interior (see design specifications).
Annually (preferably Sept.)	Below Ground Vault	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/ deformation of cover. Maintenance person cannot remove cover using normal lifting pressure.	Cover repaired to proper working specifications or replaced.
Annually (preferably Sept.)	Below Ground Vault	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than one-half inch or evidence of soil particles entering the structure through the cracks, or maintenance/ inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
Annually (preferably Sept.)	Below Ground Vault	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than one-half inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than one-fourth inch at the joint of the inlet/ outlet pipe.
Annually (preferably Sept.)	Below Ground Vault	Baffles/ Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Below Ground Vault	Access Ladder	Damaged ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

A below ground enclosed sand filter is a confined space. Visual inspections should be performed aboveground. If entry is required it should be performed by qualified personnel.

Comments:

#17 - Maintenance Standard for Baffle Oil/Water Separators - American Petroleum Institute (API) Type

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Sheen, obvious oil present in discharge.	Effluent discharge from vault should be clear without visible sheen.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Monitoring	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth.	No sediment deposits on vault bottom that would impede flow through the vault and reduce separation efficiency.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Monitoring	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	Monitoring	Oil Accumulation	Oil accumulations that exceed 1 inch, at the surface of the water or 6 inches of sludge in the sump.	Extract oil/sludge from vault by vactoring. Dispose of in accordance with state and local rules and regulations. Clean separators after spills. Replace wash water with clean water before returning to service.
Annually (preferably Sept.)	Structure	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.
Annually (preferably Sept.)	Structure	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/ deformation of cover.	Cover repaired to proper working specifications or replaced.
Annually (preferably Sept.)	Structure	Vault Structure Damage Includes Cracks in Walls/Bottom, Damage to Frame and/or Top Slab	Maintenance person judges that structure is unsound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Structure	Vault Structure Damage Includes Cracks in Walls/Bottom, Damage to Frame and/or Top Slab	Cracks wider than one-half inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than one-fourth inch at the joint of the inlet/ outlet pipe.
Annually (preferably Sept.)	Structure	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
Annually (preferably Sept.)	Structure	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

An oil/water separator vault is a confined space. Visual inspections should be performed aboveground. If entry is required it should be performed by qualified personnel.

Comments:

#18 - Maintenance Standard for Coalescing Plate Oil/Water Separators

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Inspection of discharge water for obvious signs of poor water quality.	Sheen, obvious oil present in discharge.	Effluent discharge from vault should be clear with no visible sheen.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Oil Accumulation	Oil accumulation that exceeds 1 inch at the water surface.	Oil is extracted from vault using vactoring methods. Dispose of in accordance with state and local rules and regulations. Coalescing plates are cleaned by thoroughly rinsing and flushing. Direct wash-down effluent to the sanitary sewer system where permitted. Should be no visible oil depth on water. Clean separators by October 15 to remove material accumulated during the dry season. Clean separators after spills. Replace wash water with clean water before returning to service.
Annually (preferably Sept.)	Structure	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/ or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Structure	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
Annually (preferably Sept.)	Structure	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced per specifications.
Annually (preferably Sept.)	Structure	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than one-half inch or evidence of soil particles entering the structure through the cracks, or maintenance/ inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
Annually (preferably Sept.)	Structure	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than one-half inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than one-fourth inch at the joint of the inlet/ outlet pipe.
Annually (preferably Sept.)	Structure	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

An oil/water separator vault is a confined space. Visual inspections should be performed aboveground. If entry is required it should be performed by qualified personnel.

Comments:

#19 - Maintenance Standard for Fencing/Shrubbery Screen/Other Landscaping

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr.	General	Missing or broken parts/ dead shrubbery	Any defect in the fence or screen that permits easy entry to a facility.	Fence is mended or shrubs replaced to form a solid barrier to entry.
Monthly from Oct. – Apr. and after any major storm event (1" in 24 hours)	General	Erosion	Erosion has resulted in an opening under a fence that allows entry by people or pets.	Replace soil under fence so that no opening exceeds 4 inches in height.
Monthly from Oct. – Apr.	General	Unruly Vegetation	Shrubbery is growing out of control or is infested with weeds.	Shrubbery is trimmed and weeded to provide appealing aesthetics. Do not use chemicals to control weeds.
Annually (preferably Sept.)	Fences	Damaged Parts	Posts out of plumb more than 6 inches.	Posts are within 1.5 inches of plumb.
Annually (preferably Sept.)	Fences	Damaged Parts	Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
Annually (preferably Sept.)	Fences	Damaged Parts	Any part of fence (including posts, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
Annually (preferably Sept.)	Fences	Damaged Parts	Missing or loose tension wire.	Tension wire in place and holding fabric.
Annually (preferably Sept.)	Fences	Damaged Parts	Missing or loose barbed wire that is sagging more than 2.5 inches between posts.	Barbed wire in place with less than three-fourth inch sag between posts.
Annually (preferably Sept.)	Fences	Damaged Parts	Extension arm missing, broken, or bent out of shape more than 1.5 inches.	Extension arm in place with no bends larger than three-fourth inch.
Annually (preferably Sept.)	Fences	Deteriorated Paint or Protective Coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#20 - Maintenance Standard for Gates

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr.	General	Damaged or Missing Components	Gate is broken, jammed, or missing.	Pond has a functioning gate to allow entry of people and maintenance equipment such as mowers and backhoe. If a lock is used, make sure the City field staff have a key.
Monthly from Oct. – Apr.	General	Damaged or Missing Components	Broken or missing hinges such that gate cannot be easily opened and closed by one maintenance person.	Hinges intact and lubed. Gate is working freely.
Annually (preferably Sept.)	General	Damaged or Missing Components	Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical.
Annually (preferably Sept.)	General	Damaged or Missing Components	Missing stretcher bands, and ties.	Stretcher bar, bands, and ties in place.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#21 - Maintenance Standard for Grounds (Landscaping)

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr.	General	Weeds (non-poisonous)	Weeds growing in more than 20 percent of the landscaped area (trees and shrubs only).	Weeds present in less than 5 percent of the landscaped area.
Biannually (Spring & Fall)	General	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined in State and Local Regulations. (Apply requirements of adopted integrated vegetation management (IVM) policies for the use of herbicides.)	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with the Pierce County Noxious Weed Control Board). Complete eradication of noxious weeds may not be possible, however compliance with state or local eradication policies are required.
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	General	Trash and Debris	Any trash and debris which exceeds 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
Monthly from Oct. – Apr. and after any major storm event (1” in 24 hours)	General	Erosion of Ground Surface	Noticeable rills are seen in landscaped areas.	Causes of erosion are identified and steps taken to slow down/ spread out the water. Eroded areas are filled, contoured, and seeded.
Annually (preferably Sept.)	Trees and shrubs	Damage	Limbs or parts of trees or shrubs that are split or broken which affect more than 25 percent of the total foliage of the tree or shrub.	Trim trees/shrubs to restore shape. Replace severely damaged trees/shrubs.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly from Oct. – Apr.	Trees and shrubs	Damage	Trees or shrubs that have been blown down or knocked over.	Replant tree, inspecting for injury to stem or roots. Replace if severely damaged.
Annually (preferably Sept.)	Trees and shrubs	Damage	Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Place stakes and rubber-coated ties around young trees/ shrubs for support.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#22 - Maintenance Standard for Bioretention Facilities

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually and After Major Storm Events	Earthen side slopes and berms	Failure in earthen reservoir	Erosion (gullies/rills) greater than 2 inches deep around inlets, outlet and alongside slopes.	Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting). For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made. Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention facility sizing; (2) flow velocities and gradients within the facility; and (3) flow dissipation and erosion protection strategies at the facility inlet.
Annually	Earthen side slopes and berms	Failure in earthen reservoir	Erosion of sides causes slope to become a hazard.	Take actions to eliminate the hazard and stabilize slopes.
Annually and After Major Storm Events	Earthen side slopes and berms	Failure in earthen reservoir	Settlement greater than 3 inches (relative to undisturbed sections of the berm).	Restore to design height.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually and After Major Storm Events	Earthen side slopes and berms	Failure in earthen reservoir	Downstream face of berm wet, seeps or leaks evident.	Plug any holes and compact berm (may require consultation with a Washington State Licensed Professional Engineer, particularly for larger berms).
Annually	Earthen side slopes and berms	Failure in earthen reservoir	Any evidence of rodent holes or water piping in berm.	Eradicate rodents (see “Pest control”). Fill holes and compact (may require consultation with a Washington State Licensed Professional Engineer, particularly for larger berms).
Annually	Concrete sidewalls	Failure in sidewalls	Cracks or failure of concrete sidewalls.	Repair/seal cracks. Replace if repair is insufficient.
Annually	Rockery sidewalls	Failure in sidewalls	Rockery side walls are insecure.	Stabilize rockery sidewalls (may require consultation with a Washington State Licensed Professional Engineer particularly for walls 4 feet or greater in height).
As Needed	Facility area	Accumulation of sediment or debris	Trash and debris present.	Clean out trash and debris.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually and After Major Storm Events	Facility bottom area	Accumulation of sediment or debris	Accumulated sediment to the extent that infiltration rate is reduced (See "Ponded water") or surface storage capacity significantly impacted.	Remove excess sediment. Replace any vegetation damaged or destroyed by sediment accumulation and removal. Mulch newly planted vegetation. Identify and control the sediment source (if feasible). If accumulated sediment is recurrent, consider adding presettlement or installing berms to create a forebay at the inlet.
As Needed During and After Fall Leaf Drop	Facility bottom area	Accumulation of sediment or debris	Accumulated leaves in facility.	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded.
Annually and After Major Storm Events	Low permeability check dams and weirs	Accumulation of sediment or debris	Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice.	Clear the blockage.
Annually and After Major Storm Events	Low permeability check dams and weirs	Failure of check dams and weirs	Erosion and/or undercutting present.	Repair and take preventative measures to prevent future erosion and/or undercutting.
Annually	Low permeability check dams and weirs	Failure of check dams and weirs	Grade board or top of weir damaged and not level.	Restore to level position.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually and After Major Storm Events	Ponded water	Water remains in bioretention facility after storm event	Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.	Determine cause and resolve in the following order: 1) Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris. 2) Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain. 3) Check for other water inputs (e.g., groundwater, illicit connections). 4) Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem, the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with a Washington State Licensed Professional Engineer is recommended.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
As needed	Bioretention soil media		Bioretention soil media protection is needed when performing maintenance requiring entrance into the facility footprint.	Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils. Never drive equipment or apply heavy loads in facility footprint. Because the risk of compaction is higher during saturated soil conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions. Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction. If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.
Annually	Splash block inlet	Inlet Failure	Water is not being directed properly to the facility and away from the inlet structure.	Reconfigure/repair blocks to direct water to facility and away from structure.
Monthly during the wet season and before severe storm is forecasted	Curb cut inlet/ outlet	Inlet Clogged	Accumulated leaves at curb cuts.	Clear leaves (particularly important for key inlet and low points along long, linear facilities).
Annually	Pipe inlet/outlet	Inlet Pipe Structure Failure	Pipe is damaged.	Repair/replace.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually During the Wet Season	Pipe inlet/outlet	Inlet Pipe Clogged	Pipe is clogged.	Remove roots or debris.
Annually and After Major Storm Events	Pipe inlet/outlet	Inlet Pipe Clogged	Sediment, debris, trash or mulch reducing capacity of inlet/outlet.	Clear the blockage. Identify the source of the blockage and take actions to prevent future blockages.
Weekly During Fall Leaf Drop	Pipe inlet/outlet	Inlet Clogged	Accumulated leaves at the inlets/outlets.	Clear leaves (particularly important for key inlets and low points along long, linear facilities).
Annually	Pipe inlet/outlet	Inlet Blocked	Maintain access for inspections.	Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways. Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants.
After Major Storm Events	Trash rack	Trash Rack clogged	Trash or other debris present on trash rack.	Remove/dispose.
Annually	Trash rack	Trash Rack Damaged	Bar screen damaged or missing.	Repair/replace.
Annually and After Major Storm Events	Overflow	Overflow clogged	Capacity reduced by sediment or debris.	Remove sediment or debris/dispose.
As Needed Clean Orifice as Needed, At Least Biannually	Underdrain pipe	Prolonged surface ponding (see “Ponded water”)	Plant roots, sediment or debris reducing capacity of underdrain.	Jet clean or rotary cut debris/roots from underdrain(s). If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (Fall and Spring)	Facility bottom area and upland slope vegetation	Dead vegetation	Vegetation survival rate falls below 75% within first two years of establishment (unless project O&M manual or record drawing stipulates more or less than 75% survival rate).	Determine cause of poor vegetation growth and correct condition. Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jurisdictional species list for appropriate plant replacements (See Appendix 3 - Bioretention Plant List, in the LID Technical Guidance Manual for Puget Sound). Confirm that plant selection is appropriate for site growing conditions. Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
As needed	Vegetation (general)	Diseased Vegetation	Presence of diseased plants and plant material.	Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants. Disinfect gardening tools after pruning to prevent the spread of disease. See Pacific Northwest Plant Disease Management Handbook for information on disease recognition and for additional resources. Replant as necessary according to recommendations provided for “facility bottom area and upland slope vegetation”.
All Pruning Seasons	Trees and shrubs	Oversized trees and shrubs	Pruning as needed.	Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques. All pruning of mature trees should be performed by or under the direct guidance of an ISA Certified Arborist.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Trees and Shrubs	Oversized trees and shrubs	Large trees and shrubs interfere with operation of the facility or access for maintenance.	Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. Remove trees and shrubs, if necessary.
Biannually (Fall and Spring)	Trees and shrubs	Dead trees or shrubs	Standing dead vegetation is present.	Remove standing dead vegetation. Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season). If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately. Determine cause of dead vegetation and address issue, if possible. If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (Fall and Spring)	Trees and shrubs		Planting beneath mature trees.	When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.
Biannually (Fall and Spring)	Trees and shrubs	Tree support	Presence of or need for stakes and guys (tree growth, maturation, and support needs).	Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage. Monitor tree support systems: Repair and adjust as needed to provide support and prevent damage to tree. Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year. Backfill stake holes after removal.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	Line of sight	Vegetation causes some visibility (line of sight) or driver safety issues.	Maintain appropriate height for sight clearance. Regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location. Remove or transplant if continual safety hazard. Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants.
Annually	Flower plants	Dead flowers	Dead or spent flowers present.	Remove spent flowers (deadhead).
Annually (Fall)	Perennials	Dead plants	Spent plants.	Cut back dying or dead and fallen foliage and stems.
Annually (Spring)	Emergent vegetation	Slow moving or ponded water	Vegetation compromises conveyance.	Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning).

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (Winter and Spring	Ornamental grasses (perennial)	Dead plant material	Dead material from previous year's growing cycle or dead collapsed foliage.	Leave dry foliage for winter interest. Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow.
Biannually (Winter and Spring	Ornamental grasses (evergreen)	Dead plant material	Dead growth present in spring.	Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring. Clean, rake, and comb grasses when they become too tall. Cut back to ground or thin every 2-3 years as needed.
Monthly (March - October, preceding seed dispersal)	Vegetation	Noxious weeds	Listed noxious vegetation is present (refer to current Pierce County Noxious Weed Control Board noxious weed list).	By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately. Reasonable attempts must be made to remove and dispose of class C noxious weeds. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions. Apply mulch after weed removal (see "Mulch").

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly (March - October, preceding seed dispersal)	Vegetation	Weeds	Weeds are present.	Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate. Follow IPM protocols for weed management.
Once in early to mid-May and once in early to mid-September	Vegetation	Excessive vegetation	Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil.	Edge or trim groundcovers and shrubs at facility edge. Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks. While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
As needed	Vegetation	Excessive vegetation	Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety.	Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics. Determine if plant type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow) . Remove plants that are weak, broken or not true to form; replace in-kind. Thin grass or plants impacting facility function without leaving visual holes or bare soil areas. Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants.
As needed	Vegetation	Excessive Vegetation	Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass.	Remove vegetation and sediment buildup.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Following weeding	Vegetation	Mulch	Bare spots (without mulch cover) are present or mulch depth less than 2 inches.	Supplement mulch with hand tools to a depth of 2 to 3 inches. Replenish mulch per O&M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels). Keep all mulch away from woody stems.
Based on manufacturer instructions	Irrigation system (if any)	Plant Watering	Irrigation system present.	Follow manufacturer's instructions for O&M.
Annually	Irrigation system (if any)	Plant Watering	Sprinklers or drip irrigation not directed/ located to properly water plants.	Redirect sprinklers or move drip irrigration to desired areas.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Once every 1-2 weeks or as needed during prolonged dry periods	summer watering (first year)	Plant Watering	Trees, shrubs and ground cover in the first year of establishment period.	10 to 15 gallons per tree. 3 to 5 gallons per shrub. 2 gallons water per square foot for groundcover areas. Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist. Use soaker hoses or spot water with a shower type wand when irrigation system is not present. • Pulse water to enhance soil absorption, when feasible. • Pre-moisten soil to break surface tension of dry or hydrophobic soils/ mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff. Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Once every 2 -4 weeks or as needed during prolonged dry periods	Summer watering (second and third years)	Plant Watering	Trees, shrubs and groundcovers in the second or third year of establishment period.	10 to 15 gallons per tree. 3 to 5 gallons per shrub. 2 gallons water per square foot for groundcover areas. Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist. Use soaker hoses or spot water with a shower type wand when irrigation system is not present. • Pulse water to enhance soil absorption, when feasible. • Pre-moisten soil to break surface tension of dry or hydrophobic soils/ mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
As needed	Summer watering (after establishment)	Plant Watering	Established vegetation (after 3 years).	Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established. Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear. Water during drought conditions or more often if necessary to maintain plant cover.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually and After Major Storm Events	Pest Control	Mosquitoes	Standing water remains for more than 3 days after the end of a storm.	Identify the cause of the standing water and take appropriate actions to address the problem (see “Ponded water”). To facilitate maintenance, manually remove standing water and direct to the stormwater system (if runoff is from non pollution-generating surfaces) or wastewater (if runoff is from pollution-generating surfaces) after getting approval from The City of Tacoma. Use of pesticides or *Bacillus thuringiensis israelensis* (Bti) may be considered as a temporary measure only. Obtain Aquatic Mosquito Control NPDES General Permit as necessary.
As needed	Pest Control	Nuisance animals	Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces.	Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.). Place predator decoys. Follow IPM protocols for specific nuisance animal issues . Remove pet waste regularly. For public and right-of-way sites consider adding garbage cans with dog bags for picking up pet waste.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Every site visited associated with vegetation management	Pest Control	Insect pests	Signs of pests, such as wilting leaves, chewed leaves, and bark spotting or other indicators.	Reduce hiding places for pests by removing diseased and dead plants. For infestations, follow IPM protocols.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#23 - Maintenance Standard for Rain Gardens

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (During Wet Season)	Earthen side slopes and berms	Failure in earthen reservoir	Persistent soil erosion on slopes.	If erosion persists, water may be flowing into the garden too rapidly. In this case, the slope of the pipe or swale directing water to the garden, or the amount of water may need to be reduced (see "Erosion control at inlet").
Annually	Rockery sidewalls	Failure in sidewalls	Rockery sidewalls are insecure.	Stabilize rockery sidewalls (may require consultation with a Washington State Licensed Professional Engineer particularly for walls 4 feet or greater in height.
Biannually	Rain Garden Footprint	Accumulation of sediment or debris	Trash and debris present.	Clean out trash and debris.
Annually	Facility bottom area	Accumulation of sediment or debris	Visible sediment deposition in the rain garden that reduces drawdown time of water in the rain garden.	Remove sediment accumulation. If sediment is deposited from water entering the rain garden, determine the source and stabilize the area or provide pretreatment.
As Needed, During and After Fall Leaf Drop	Facility Bottom Area	Accumulation of leaves	Accumulated leaves in rain garden may reduce infiltration capacity of rain garden or clog overflow.	Remove Leaves.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually and After Major Storm Events	Ponded Water	Water remains in bioretention facility 3 days after storm event	Excessive ponding water. Ponded water remains in the basin more than 3 days after the end of a storm.	Confirm leaf, debris or sediment buildup in the bottom of the rain garden is not impeding infiltration. If necessary, remove leaf litter/debris/ sediment. If this does not solve the problem, consultation with a professional with rain garden expertise is recommended to evaluate the following: • Check for other water inputs (e.g., groundwater, illicit connections). • Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. • Determine if the soil is clogged by sediment accumulation at the surface or if the soil has become overly compacted.
Annually	Splash Block Inlet	Inlet Failure	Water is not being directed properly to the rain garden and away from the building.	Reconfigure/repair splash blocks to direct water to the rain garden and away from the building.
Annually	Pipe inlet/outlet	Inlet Pipe Structure Failure	Damaged/cracked pipes.	Repair/seal cracks. Replace when repair is insufficient.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Pipe inlet/outlet	Inlet Pipe Clogged	Pipe capacity is reduced by sediment or debris (can cause backups and flooding).	Clear pipes of sediment and debris.
Annually	Erosion control at inlet	Excessive Sedimentation	Rock or cobble is removed or missing and concentrated flows are contacting soil.	Maintain a cover of rock or cobbles to protect the ground where concentrated water flows into the rain garden from a pipe or swale.
As needed	Vegetation	Diseased Vegetation	Dying, dead, or unhealthy plants.	Maintain a healthy cover of plants. Remove any diseased plants or plant parts and dispose of in commercial landfill to avoid risk of spreading the disease to other plants. Disinfect gardening tools after pruning to prevent the spread of disease. Re-stake trees if they need more support, but plan to remove stakes and ties after the first year. Cars can damage roots – protect root areas of trees and plants from vehicle traffic.
As needed	Vegetation	Line of Sight	Vegetation inhibits sight distances and sidewalks.	Keep sidewalks and sight distances on roadways clear.
As needed	Vegetation	Dead Vegetation	Broken, dead, or sucker vegetation is present.	Remove broken or dead branches and suckers.
As needed	Vegetation	Localized Ponding or Obstruction of flow	Vegetation is crowding inlets and outlets.	Keep water inlets and outlines in the rain garden clear or vegetation.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
One time March through June	Vegetation	Dead/ diseased plants	Yellowing: possible Nitrogen (N) deficiency. Poor growth: possible Phosphorous (P) deficiency. Poor flowering, spotting or curled leaves, or weak roots or stems: possible Potassium (K) deficiency.	Test soil to identify specific nutrient deficiencies. Consult with a professional knowledgeable in the area of natural amendments or refer to Natural Lawn and Garden Care resources and avoid synthetic fertilizers. Consider selecting different plants for soil conditions.
As needed, Preceding seed dispersal	Vegetation	Weeds Present	Problem weeds are present.	Remove weeds by hand, especially in spring when the soil is moist and the weeds are small. Dig or pull weeds out by the roots before they go to seed. Apply mulch after weeding (see “Mulch”).
Monthly March - October, preceding seed dispersal	Vegetation	Noxious Weeds	Listed noxious vegetation is present (refer to current Pierce County Noxious Weed Control Board noxious weed list).	By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately. Reasonable attempts must be made to remove and dispose of class C noxious weeds. It is strongly encouraged that herbicides not be used in order to protect water quality; use of herbicides may be prohibited in some jurisdictions. Apply mulch after weed removal (see “Mulch”).

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Following weeding	Vegetation	Mulch	Bare spots (without mulch cover) are present or mulch depth less than 2 inches.	Supplement mulch, using hand tools, to a depth of 2 to 3 inches. Use coarse compost in the bottom of the rain garden and arborist wood chips on side slopes and rim (above typical water levels). Keep all mulch from being in contact with woody stems.
Once every 1-2 weeks or as needed during prolong dry periods	Summer watering (first year)	Plant Watering	Tree, shrubs and groundcovers in first year of establishment.	10 to 15 gallons per tree. 3 to 5 gallons per shrub. 2 gallons water per square foot for groundcover areas. Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist. Use soaker hoses or spot water with a shower type wand when irrigation system is not present. Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Once every 2-4 weeks or as needed during prolonged dry periods	Summer watering (second and third years)	Plant Watering	Tree shrubs and groundcovers in the second or third year of establishment.	10 to 15 gallons per tree. 3 to 5 gallons per shrub. 2 gallons water per square foot for groundcover areas. Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist. Use soaker hoses or spot water with a shower type wand when irrigation system is not present.
As needed	Summer watering (after establishment)	Plant Watering	Established vegetation (after 3 years).	Water during drought conditions or more often if necessary to maintain plant cover. Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different rain garden species and water immediately after initial signs of stress appear.
Biannually and After Major Storm Events	Pest Control	Mosquitoes	Standing water remains for more than 3 days after the end of a storm.	Identify the cause of the standing water and take appropriate actions to address the problem (see “Ponded water”). Use of pesticides or *Bacillus thuringiensis israelensis* (Bti) may be considered as a temporary measure only. Obtain Aquatic Mosquito Control General Permit as necessary.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#24 - Maintenance Standard for Cisterns

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (Spring & Fall)	Roof	Low flow into cistern or excessive overflow	Debris has accumulated.	Remove debris.
Biannually (Spring & Fall)	Gutter	Low flow into cistern or excessive overflow	Debris has accumulated.	Clean gutters (the most critical cleaning is in mid- to late-spring to flush the pollen deposits from surrounding trees).
Annually (preferably Sept.)	Screens	Excessive sediment accumulation in cistern	Screen has deteriorated.	Replace.
Monthly from Oct. – Apr.	Screens	Low flow into cistern or excessive overflow	Accumulation of material on screen.	Clear screen of any accumulated debris.
Monthly from Oct. – Apr.	Low Flow Orifice	Low or no flow out of cistern.	Material clogging orifice.	Clean low flow orifice.
Biannually (Spring & Fall)	Overflow pipe	Low or no flow out of cistern.	Pipe is damaged.	Repair/replace.
Biannually (Spring & Fall)	Overflow pipe	Low or no flow out of cistern.	Pipe is clogged.	Remove debris.
Annually (preferably Sept.)	Cistern	Excess overflow	Debris has accumulated at bottom of tank.	Remove debris.
At startup	Training and Documentation	Training / written guidance	Training / written guidance is required for proper O&M.	Provide property owners and tenants with proper training and a copy of the O&M manual.
Ongoing	Safety	Access and Safety	Access to cistern required for maintenance or cleaning.	Any cistern detention system opening that could allow the entry of people must be marked: “DANGER—CONFINED SPACE".
Ongoing	Cistern	Leaking Cistern	Excess water around cistern. Damage to cistern.	Disconnect inlets. Contact design engineer.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted integrated pest management policies.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#25 - Maintenance Standard for Compost Amended Soil

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Soil Media (maintain high organic soil content)	Potential Erosion	Vegetation not fully covering ground surface or vegetation health is poor.	Maintain 2 to 3 inches of mulch over bare areas in landscape beds. Add plants if sufficient space. Re-seed bare turf areas until the vegetation fully covers ground surface.
Ongoing	Soil media (maintain high organic soil content)	Routine Maintenance	None. (routine maintenance)	Return leaf fall and shredded woody materials from the landscape to the site when possible in order to replenish soil nutrients and structure.
Ongoing	Soil media (maintain high organic soil content)	Routine Maintenance	None. (routine maintenance)	On turf areas, “grasscycle” (mulch-mow or leave the clippings) to improve turf health.
Ongoing	Soil media (maintain high organic soil content)	Routine Maintenance	None. (routine maintenance)	Avoid use of pesticides (bug and weed killers) and herbicides, like “weed & feed”, which damage the soil.
Annually	Soil media (maintain high organic soil content)	Routine Maintenance	None. (routine maintenance)	Where fertilization is needed (mainly turf and annual flower beds), a moderate fertilization program should be used which relies on compost, natural fertilizers or slow-release synthetic balanced fertilizers. Follow IPM protocols for fertilization procedures.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (inspect during storm event)	Soil media (maintain infiltration)	Wet Soils Ponding	Soils become waterlogged, do not appear to be infiltrating.	To remediate compaction, aerate soil, till to at least 8-inch depth, or further amend soil with compost and re-till. If areas are turf, aerate compacted areas and topdress them with 1/4 to 1/2 inch of compost to renovate them. If drainage is still slow, consider investigating alternative causes (e.g., high wet season groundwater levels, low permeability soils). Also consider site use and protection from compacting activities.
Annually (at least once during the wet season) and after major storm events)	Erosion/ Scouring	Visible Erosion	Areas of potential erosion are visible.	Identify and address cause of erosion (e.g., concentrated flow entering area, channelization of runoff) and stabilize damaged area (regrade, rock, vegetation, erosion control matting). For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Grass/ vegetation	Unhealthy Vegetation	Less than 75% of planted vegetation is healthy with a generally good appearance.	Take appropriate maintenance actions (e.g., remove/replace plants). If problem persists, evaluate if vegetation is appropriate for the location (e.g., exposure, soil, soil moisture).
Monthly (March - October, preceding seed dispersal)	Vegetation	Noxious weeds	Listed noxious vegetation is present (refer to current Pierce County Noxious Weed Control Board noxious weed list).	By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately. Reasonable attempts must be made to remove and dispose of class C noxious weeds. Watch for and respond to new occurrences of especially aggressive weeds such as Himalayan blackberry, Japanese knotweed, morning glory, English ivy, and reed canary grass to avoid invasions. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly (March - October, preceding seed dispersal)	Vegetation	Weeds	Weeds are present.	Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate. Follow IPM protocols for weed management.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#26 - Maintenance Standard for Vegetated Roofs

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (Inspect During Rain Event)	Growth Medium	Ponding or slow infiltration	Water does not permeate growth media (runs off soil surface) or crusting is observed.	Aerate (e.g., rake) or replace medium taking care not to damage the waterproof membrane.
Annually	Growth Medium	Thin growth medium	Growth medium thickness is less than design thickness (due to erosion and plant uptake).	Supplement growth medium to design thickness.
Biannually (at least once during wet season)	Growth Medium	Leaf/Debris Buildup	Fallen leaves or debris are present.	Remove/dispose of debris and fallen leaves.
Annually (at least once during the wet season and after major storm events	Growth Medium	Erosion and sedimentation	Growth media erosion/ scour is visible (e.g., gullies).	Take steps to repair or prevent erosion. Fill, hand tamp, or lightly compact, and stabilize with additional soil substrate/growth medium (similar in nature to the original material) and additional plants.
Biannually (inspect during plant establishment)	Erosion Control Measures	Erosion	Mat or other erosion control is damaged or depleted during plant establishment period.	Repair/replace erosion control measures until 90% vegetation coverage attained. Avoid application of mulch on extensive vegetated roofs.
Biannually and after major storm events	Roof Drain	Water Flow Issues	Sediment, vegetation, or debris reducing capacity of inlet structure.	Clear blockage. Identify and correct any problems that led to blockage.
Annually	Roof Drain	Water Flow Issues	Pipe is clogged.	Remove roots or debris.
Annually	Roof Drain	Damaged roof drain	Inlet pipe is in poor condition.	Repair/replace.
Annually	Border Zone	Aesthetics	Vegetation is encroaching into border zone aggregate.	Remove and dispose of weeds and transplant desirable vegetation to growth medium area.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Flashing, gravel, stops, utilities, or other structures on roof	Deteriorating roof components	Flashing, utilities or other structures on roof are deteriorating (can serve as source of metal pollution in vegetated roof runoff).	Repair (e.g., recoat) or replace to eliminate potential pollutant source. Note that any work done around flashings and drains should be done with care to protect the waterproof membrane.
Biannually	Access and Safety	Access Concerns	Insufficient egress/ ingress routes and fall protection.	Maintain egress and ingress routes to design standards and fire codes. Ensure appropriate fall protection.
Biannually	Vegetation	Plant Coverage	Vegetative coverage falls below 90% (unless design specifications stipulate less than 90% coverage).	Plant bare areas with vegetation. If necessary, install erosion control measures until percent coverage goal is attained.
Annually (first 2 years in spring, as needed thereafter)	Vegetation	Sedum Coverage	Extensive roof with low density sedum population.	Mulch mow sedums-creating cuttings from existing plants to encourage colonization.
Biannually (Fall and Spring)	Dead Plants	Dead Vegetation	Dead vegetation is present.	Normally dead plant material can be recycled on the roof; however, specific plants or aesthetic considerations may warrant removing and replacing dead material (see manufacturer's recommendations).
All pruning seasons (timing varies by species)	Trees and shrubs - intensive vegetated roof	Plants Overgrown	Pruning as needed.	All pruning of mature trees should be performed by or under the direct guidance of an ISA Certified Arborist.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Vegetation - extensive vegetated roof	Fertilization	Poor plant establishment and possible nutrient deficiency in growth medium.	Allow organic debris to replenish and maintain long-term nutrient balance and growth medium structure. Conduct annual soil test 2-3 weeks prior to the spring growth flush to assess need for fertilizer. Utilize test results to adjust fertilizer type and quantity appropriately. Apply minimum amount slow-release fertilizer necessary to achieve successful plant establishment. Apply fertilizer only after acquiring required approval from facility owner and operator. Note that extensive vegetated roofs are designed to require zero to minimal fertilization after establishment (excess fertilization can contribute to nutrient export).

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Vegetation	Fertilization - intensive vegetated roof	Fertilization may be necessary during establishment period or for plant health and survivability after establishment.	Conduct annual soil test 2-3 weeks prior to the spring growth flush to assess need for fertilizer. Utilize test results to adjust fertilizer type and quantity appropriately. Apply minimum amount slow-release fertilizer necessary to achieve successful plant establishment. Apply fertilizer only after acquiring required approval from facility owner and operator. Intensive vegetated roofs may require more fertilization than extensive vegetated roofs.
Monthly (March-October) Preceding Seed Dispersal	Vegetation	Weeds	Weeds are present.	Remove weeds with their roots manually with pincer-type weeding tools or hot water weeders as appropriate. Follow IPM protocols for weed management.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Monthly (March-October Preceding Seed Dispersal)	Vegetation - intensive vegetated roof	Noxious Weeds	Listed Noxious vegetation is present (refer to the Pierce County Noxious Control Board noxious weed list).	By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately. Reasonable attempts must be made to remove and dispose of class C noxious weeds. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions.
Based on manufacturer's Instructions	Irrigation System (if any)	Irrigation	Irrigation system present and functioning.	Follow manufacturer's instructions for operation and maintenance.
Once every 1-2 weeks as needed during prolonged dry periods	Summer watering - extensive vegetated roof	Watering	Vegetation in establishment period (1-2 years).	Water weekly during periods of no rain to ensure establishment (30 to 50 gallons per 100 square feet).
Once every 1-2 weeks as needed during prolonged dry periods	Summer watering - intensive vegetated roof	Watering	Vegetation in establishment period (1-2 years).	Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist. Use soaker hoses or spot water with a shower type wand when irrigation system not present.
As needed	Summer watering - intensive vegetated roof	Watering	Established vegetation (after 2 years).	Water during drought conditions or more often if necessary to maintain plant cover.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually and After Major Storm Events	Pests	Mosquito	Standing water remains for more than 3 days after the end of a storm.	Identify the cause of the standing water and take appropriate actions to address the problem (e.g., aerate or replace medium, unplug drainage). Manually remove standing water and direct to stormwater system. Use of pesticides or Bacillus thuringiensis israelensis (Bti) may be considered as a temporary measure only. Obtain Aquatic Mosquito Control General Permit as necessary..
As Needed	Pests	Nuisance Animals	Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces.	Reduce site conditions that attract nuisance species. Place predator decoys. Follow IPM protocols for specific nuisance animal issues.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#27 - Maintenance Standard for Pervious Pavement

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually and After Major Storm Events	Permeable Pavements, All	Excessive Sedimentation	Runon from adjacent areas deposits soil, mulch or sediment on paving.	Clean deposited soil or other materials. Check if surface elevation of adjacent planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place). Mulch and/or plant all exposed soils that may erode to pavement surface.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually or Biannually	Porous asphalt or pervious concrete	Routine Maintenance	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods: Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves). Vacuum/sweep permeable paving installation using: • Walk-behind vacuum (sidewalks) • High efficiency regenerative air or vacuum sweeper (roadways, parking lots) • ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for determining when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (inspect during rain event	Porous asphalt or pervious concrete	Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	Surface is clogged.	Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility). Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods: • Combined pressure wash and vacuum system calibrated to not dislodge wearing course aggregate. Hand held pressure washer or power washer with rotating brushes. • Pure vacuum sweepers.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Porous asphalt or pervious concrete	Sedimentation	Sediment present at the surface of the pavement.	Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding then see above. Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
Annually (Summer)	Porous Asphalt or pervious concrete	Moss Growth	Moss growth inhibits infiltration or poses slip/ safety hazard.	Sidewalks: Use a stiff broom to remove moss in the summer when it is dry. Parking lots and roadways: Pressure wash, vacuum sweep, or use a combination of the two for cleaning moss from pavement surface. May require stiff broom or power brush in areas of heavy moss.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Porous Asphalt or pervious concrete	Damaged Pavement	Major cracks or trip hazards and concrete spalling and raveling.	Fill potholes or small cracks with patching mixes. Large cracks and settlement may require cutting and replacing the pavement section. Replace in-kind where feasible. Replacing porous asphalt with conventional asphalt is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function. Take appropriate precautions during pavement repair and replacement efforts to prevent clogging of adjacent porous materials.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually or Biannually	Interlocking concrete paver blocks and aggregate pavers	Routine Maintenance	None (routine maintenance)	Clean pavement surface using one or a combination of the following methods: Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves). Vacuum/sweep permeable paving installation using: • Walk-behind vacuum (sidewalks) • High efficiency regenerative air or vacuum sweeper (roadways, parking lots) • ShopVac or brush brooms (small areas) Note: Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints. Vacuum surface openings in dry weather to remove dry, encrusted sediment.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (inspect during rain event)	Interlocking concrete paver blocks and aggregate pavers	Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate).	Surface is clogged.	Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility). Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. Clogging is usually an issue in the upper 2 to 3 centimeters of aggregate. Remove the upper layer of encrusted sediment, and fines, and/or vegetation from openings and joints between the pavers by mechanical means and/or suction equipment (e.g., pure vacuum sweeper). Replace aggregate in paver cells, joints, or openings per manufacturer's recommendations.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Interlocking concrete paver blocks and aggregate pavers	Sedimentation	Sediment present at the surface of the pavement.	Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding, then see above. Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
Annually	Interlocking concrete paver blocks and aggregate pavers	Moss Growth	Moss growth inhibits infiltration or poses slip/ safety hazard.	Sidewalks: Use a stiff broom to remove moss in the summer when it is dry. Parking lots and roadways: Vacuum sweep or stiff broom/ power brush for cleaning moss from pavement surface.
Annually	Interlocking concrete paver blocks and aggregate pavers	Damaged Surface	Paver block missing or damaged.	Remove individual damaged paver blocks by hand and replace or repair per manufacturer's recommendations.
Annually	Interlocking Concrete paver blocks and aggregate pavers	Damaged Surface	Loss of aggregate material between paver blocks.	Refill per manufacturer's recommendations for interlocking paver sections.
Annually	Interlocking concrete paver blocks and aggregate pavers	Damaged Surface	Settlement of surface.	May require resetting.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually or Biannually	Open-celled paving grid with gravel	Routine Maintenance	None (routine maintenance).	Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves). Follow equipment manufacturer guidelines for cleaning surface.
Annually (inspect during rain event)	Open-celled paving grid with gravel	Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	Aggregate is clogged.	Use vacuum truck to remove and replace top course aggregate. Replace aggregate in paving grid per manufacturer's recommendations.
Annually	Open-celled paving grid with gravel	Damaged Surface	Paving grid missing or damaged.	Remove pins, pry up grid segments, and replace gravel. Replace grid segments where three or more adjacent rings are broken or damaged. Follow manufacturer guidelines for repairing surface.
Annually	Open-celled paving grid with gravel	Damaged Surface	Settlement of surface.	May require resetting.
Annually	Open-celled paving grid with gravel	Damaged Surface	Loss of aggregate material in paving grid.	Replenish aggregate material by spreading gravel with a rake (gravel level should be maintained at the same level as the plastic rings or no more than 1/4 inch above the top of rings). See manufacturer's recommendations.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Open-celled paving grid with gravel	Weeds	Weeds present.	Manually remove weeds. Presence of weeds may indicate that too many fines are present (refer to Actions Needed under "Aggregate is clogged" to address this issue).
Annually or Biannually	Open-celled paving grid with grass	Routine Maintenance	None (routine maintenance).	Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves). Follow equipment manufacturer guidelines for cleaning surface.
Annually (inspect during rain event)	Open-celled paving grid with grass	Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	Aggregate is clogged.	Rehabilitate per manufacturer's recommendations.
Annually	Open-celled paving grid with grass	Damaged Surface	Paving grid missing or damaged.	Remove pins, pry up grid segments, and replace grass. Replace grid segments where three or more adjacent rings are broken or damaged. Follow manufacturer guidelines for repairing surface.
Annually	Open-celled paving grid with grass	Damaged Surface	Settlement of surface.	May require resetting.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Open-celled paving grid with grass	Aesthetics, erosion potential	Poor grass coverage in paving grid.	Restore growing medium, reseed or plant, aerate, and/or amend vegetated area as needed. Traffic loading may be inhibiting grass growth; reconsider traffic loading if feasible.
As Needed	Open-celled paving grid with grass	Routine Maintenance	None (routine maintenance).	Use a mulch mower to mow grass.
Annually	Open-celled paving grid with grass	Routine Maintenance	None (routine maintenance).	Sprinkle a thin layer of compost on top of grass surface (1/2” top dressing) and sweep it in. Do not use fertilizer.
Annually	Open-celled paving grid with grass	Weeds	Weeds present.	Manually remove weeds. Mow, torch, or inoculate and replace with preferred vegetation.
Annually	Inlet/outlet pipe	Water Flow	Pipe is damaged.	Repair/replace.
Annually	Inlet/outlet pipe	Water Flow	Pipe is clogged.	Remove roots or debris.
As needed, clean orifice at least biannually	Underdrain pipe	Water Flow	Plant roots, sediment, or debris is reducing capacity of underdrain (may cause prolonged drawdown period).	Jet clean or rotary cut debris/roots from underdrain(s). If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
As needed, clean orifice at least biannually	Raised subsurface overflow pipe	Water Flow	Plant roots, sediment, or debris is reducing capacity of underdrain.	Jet clean or rotary cut debris/roots from under-drain(s). If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.
Annually and After Major Storm Events	Outlet structure	Water Flow	Sediment vegetation, or debris reducing capacity of outlet structure.	Clear the blockage. Identify the source of the blockage and take actions to prevent future blockages.
Biannually	Overflow	Erosion Potential	Native soil is exposed or other signs of erosion damage are present at discharge location.	Repair erosion and stabilize surface.
Annually and After Major Storm Events	Observation port	Water ponding or infiltrating slowly	Water remains in the storage aggregate longer than anticipated by design after the end of the storm.	If immediate cause of extended ponding is not identified, schedule investigation of subsurface materials or other potential causes of system failure.
As needed	Adjacent large shrubs or trees	Water ponding or infiltrating slowly	Vegetation related fallout clogs or will potentially clog voids.	Sweep leaf litter and sediment to prevent surface clogging and ponding. Prevent large root systems from damaging subsurface structural components.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Once in May and Once in September	Adjacent large shrubs or trees	Aesthetics	Vegetation growing beyond facility edge onto sidewalks, paths and street edge.	Edging and trimming of planted areas to control groundcovers and shrubs from overreaching the sidewalks, paths and street edge improves appearance and reduces clogging of permeable pavements by leaf litter, mulch and soil.
In fall (October to December) after leaf drop (1-3 times, depending on canopy cover)	Leaves, needles, and organic debris	Clog Potential	Accumulation of organic debris and leaf litter.	Use leaf blower or vacuum to blow or remove leaves, evergreen needles, and debris (i.e., flowers, blossoms) off of and away from permeable pavement.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#28 - Emerging Technologies

At a minimum all stormwater devices must be inspected every six months and after every major storm event. Use the manufacturer's recommendations as tailored to the use of the site and as outlined in the Operation and Maintenance Manual. Operations and Maintenance shall conform to any Ecology issued use level designation as applicable.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#29 - General Maintenance Concerns for Stormwater Facilities

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Based on manufacturers instructions	Irrigation	Irrigation system (if any)	Irrigation system present.	Follow manufacturer's instructions for O&M.
Weekly (May – September)	Irrigation	Plant watering	Plant establishment period (1-3 years).	Water weekly during periods of no rain to ensure plant establishment.
As Needed	Irrigation	Plant watering	Longer term period (3+ years).	Water during drought conditions or more often if necessary to maintain plant cover.
Ongoing	Spill Prevention and Response	Spill prevention	Storage or use of potential contaminants in the vicinity of facility.	Exercise spill prevention measures whenever handling or storing potential contaminants.
As needed	Spill Prevention and Response	Spill response	Release of pollutants. Call to report any spill to City of Tacoma Source Control 253.502.2222.	Cleanup spills as soon as possible to prevent contamination of stormwater.
At startup	Training and Documentation	Training / written guidance	Training / written guidance is required for proper O&M.	Provide property owners and tenants with proper training and a copy of the O&M manual.
Annually (preferably Sept.)	Safety	Safety (slopes)	Erosion of sides causes slope to exceed 1:4 or otherwise becomes a hazard.	Restore to design slope.
Annually (preferably Sept.)	Safety	Safety (hydraulic structures)	Hydraulic structures (pipes, culverts, vaults, etc.) become a hazard to children playing in and around the facility.	Take actions to eliminate the hazard (such as covering and securing any openings).
Annually (preferably Sept.)	Safety	Line of sight	Vegetation causes some visibility (line of sight) or driver safety issues.	Prune or replace plants as necessary.
Annually (preferably Sept.)	Aesthetics	Aesthetics	Damage/vandalism/ debris accumulation.	Clean, repair, and restore facility to original aesthetic conditions.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (preferably Sept.)	Aesthetics	Grass/ vegetation	Less than 75% of planted vegetation is healthy with a generally good appearance.	Take appropriate maintenance actions. (e.g., remove/replace plants, amend soil, etc.).
Annually (preferably Sept.)	Aesthetics	Edging	Grass is starting to encroach on facility.	Repair edging. Remove encroaching grass. Install additional measures to prevent encroachment.
Annually (preferably Sept.)	General	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation may constitute a hazard to maintenance personnel or to the public. Any evidence of noxious weeds as defined by the State or local regulations. The Washington State Noxious Weed Control Board has a list of common noxious weeds at www.nwcb.wa.gov.	No danger of poisonous vegetation. Compliance with state or local eradication policies is required. Apply requirements of adopted integrated pest management plan as necessary.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#30 - Maintenance Standard for Trees

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Once a year for the first three years	Trees	Future failure	Weak branch attachments; co-dominant stems.	Structural Pruning[a].
As needed	Trees	Threat to public safety	Low branches that may cause safety concerns if they remain.	Crown Raising[a].
As neeed, for safety	Trees	Threat to public safety	Dead, diseased and/or broken branches.	Pruning to remove dead, diseased and/or broken branches.
As needed	Trees	Threat to public safety	Dead, severely damaged or declining.	Replace per planting plan or acceptable substitute.

a. Trees shall be pruned according to industry standards, ANSI A300 Part 1 and the International Society of Arboriculture's Best Management Practices - Tree Pruning.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

Comments:

#31 - Maintenance Standard for Downspout Infiltration Trench or Drywell

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually (Fall and Spring)	Surface of trench/well (i.e., water enters through exposed aggregate)	Water not reaching facility	Accumulated trash, debris, or sediment on drain rock surface impedes sheet flow into facility.	Remove/dispose in accordance with local solid waste requirements.
Annually (At least one visit during the wet season)	Surface of trench/well (i.e., water enters through exposed aggregate)	Water not reaching facility	Vegetation/moss present on drain rock surface impedes sheet flow into facility.	Maintain open, freely draining drain rock surface.
Biannually (Fall and Spring)	Drain Rock	Ponding	If water enters the facility from the surface, inspect to see if water is ponding at the surface during storm events. If buried drain rock, observe drawdown through observation port or cleanout.	Clear piping through facility when ponding occurs. Replace rock/sand reservoirs as necessary. Tilling of subgrade below reservoir may be necessary (for trenches) prior to backfill.
Annually (at least once during the wet season)	Pipe(s)	Water flow issues	Accumulation of trash, debris, or sediment in roof drains, gutters, driveway drains, area drains, etc.	Remove/ dispose.
Annually (at least once during the wet season)	Pipe(s)	Sedimentation	Pipe from sump to trench or drywell has accumulated sediment or is plugged.	Clear sediment from inlet/outlet pipe screen and inlet/outlet pipe. Cleaning operation should not move sediment into rock layer. Remove and dispose of sediment.
Annually (at least once during the wet season)	Pipe(s)	Damaged piping, water flow impeded	Cracked, collapsed, broken, or misaligned drain pipes.	Repair/seal cracks. Replace when repair is insufficient.
Biannually (at least once during the wet season)	Roof Downspout	Erosion Potential	Splash pad missing or damaged.	Repair/ replace.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (at least once during the wet season)	Roof Downspout	Water flow impeded	Leaves or other debris plugging downspout.	Remove/ dispose.
Annually	Sump	Water flow impeded	Sediment in the sump.	Remove/ dispose in accordance with local solid waste requirements.
Annually	Access Lid	Damaged Lid	Cannot be easily opened.	Repair/ replace.
Annually	Access Lid	No lid	Buried.	Refer to record drawings for design intent. If the access lid was designed to be exposed, expose and restore to surface grade.
Annually	Access Lid	Missing lid	Lid not present.	Replace.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588.

#32 - Maintenance Standard for Downspout Dispersion

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Splashblocks				
Biannually	Splash Block	Water flow incorrect	Water is being directed towards building structure.	Reconfigure/ repair splash blocks to direct water away from building structure.
Biannually	Splash Block	Erosion Potential	Water disrupts soil media.	Reconfigure/ repair blocks, repair eroded soil, replant as necessary.
Sheet Flow Dispersion				
Annually	Transition Zone	Erosion Potential	Adjacent soil erosion; uneven surface creating concentrated flow discharge; or less than 2 feet of width.	Repair/replace transition zone to meet design criteria and eliminate concentrated flows.
Downspout Dispersion – Dispersion Trench				
Annually	Dispersion trench	Water flow issues	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” from edge of trench; intent is to prevent erosion damage).	Remove debris from trench surface, if necessary. Realign notched grade board or other distributor type, if possible. Rebuild trench to standards, if necessary.
Biannually (Fall and Spring)	Surface of Dispersion Trench	Flow impeded	Accumulated trash, debris, or sediment on drain rock surface impedes sheet flow from facility.	Remove/dispose in accordance with local solid waste requirements.
Annually (at least once during the wet season)	Surface of Dispersion Trench	Sheet flow impeded	Vegetation/moss present on drain rock surface impedes sheet flow from facility.	Maintain open, freely draining drain rock surface.
Annually (at least once during the wet season)	Pipe to dispersion trench	Flow impeded	Accumulation of trash, debris, or sediment in roof drains, gutters, driveway drains, area drains, etc.	Remove/ dispose.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually (at least once during the wet season)	Pipe to dispersion trench	Flow Impeded	Pipe from sump to trench or drywell has accumulated sediment or is plugged.	Clear sediment from inlet/outlet pipe screen and inlet/outlet pipe.
Annually (at least once during the wet season)	Pipe to dispersion trench	Flow Impeded	Cracked, collapsed, broken, or misaligned drain pipes.	Repair/seal cracks. Replace when repair is insufficient.
Annually	Sump	Sediment Buildup	Sediment in the sump.	Remove/ dispose in accordance with local solid waste requirements. Clear sediment from inlet/outlet pipe screen and/or inlet/outlet pipe. Do not flush sediment downstream.
Annually	Access Lid	Damaged Cover	Cannot be easily opened.	Repair/replace.
Annually	Access Lid	No Cover	Buried.	Refer to record drawings for design intent. If the access lid was designed to be exposed, expose and restore to surface grade.
Annually	Access Lid	Missing Cover	Cover missing.	Replace.
Rock Pad (Concentrated Flow Dispersion)				
Annually	Rock pad	Erosion Potential	Only one layer of rock exists above native soil in area 6 square feet or larger, or any exposure of native soil.	Replace/ repair rock pad to meet design standards. Enlarge pad size or add additional courses of rock, if necessary.
Annually	Rock pad	Erosion	Soil erosion in or adjacent to rock pad.	Repair/replace rock pad to meet design standards.
Dispersal Area				
Biannually and After Major Storm Events	Dispersal area (general)	Erosion	Erosion (gullies/ rills) greater than 2 inches deep in dispersal area.	Eliminate cause of erosion and stabilize damaged area (regrade, rock, revegetate).

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Biannually and After Major Storm Events	Dispersal area (general)	Flow impeded	Accumulated sediment or debris to extent that blocks or channelizes flowpath.	Remove excess sediment or debris. Identify and control the sediment source (if feasible).
Biannually and After Major Storm Events	Ponded water	Standing water	Standing surface water in dispersion area remains for more than 3 days after the end of a storm event.	Identify the cause of the standing water (e.g., grade depressions, compacted soil) and take appropriate actions to address the problem (e.g., regrade to eliminate depressions or aerate/ amend soils).
Biannually	Plant establishment		Dispersal area vegetation in establishment period (1-2 years, or additional 3rd year during extreme dry weather).	Water weekly during periods of no rain to ensure plant establishment.
As Needed	Vegetation	Vegetation cover inadequate	Poor vegetation cover such that erosion is occurring.	Ensure proper care (e.g., watering). Assess for nutrient deficiencies. Replant as needed with appropriate plant species for the soil and moisture conditions. Consider amending soils to promote plant health.
Biannually and After Major Storm Events	Vegetation	Flow impeded.	Vegetation inhibits dispersed flow along flowpath.	Trim, weed or replant to restore dispersed flowpath.
Storage Sump				
Annually	Sump	Sediment	Accumulated sediment in the sump.	Remove/ dispose in accordance with local solid waste requirements. Clear sediment from inlet/outlet pipe screen and/or inlet/outlet pipe.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
Annually	Access Lid	Lid Broken	Cannot be easily opened.	Repair/replace.
Annually	Access Lid	Cannot find lid.	Buried.	Expose and restore to surface grade.
Annually	Access Lid	Lid Missing	Lid missing.	Replace.
Pest Control				
As Needed	Pest Control	General Pests	Signs of pest infestations (IPM protocol threshold(s) are exceeded).	Follow IPM protocols for weed and pest management.
Biannually and After Major Storm Events	Pest Control	Mosquitoes	Standing surface water in dispersion area remains for more than 3 days after the end of a storm.	Identify the cause of the standing water and take appropriate actions to address the problem. Use of pesticides or *Bacillus thuringiensis israelensis* (Bti) may be considered as a temporary measure only. Obtain Aquatic Mosquito Control General Permit as necessary.
As Needed	Pest Control	Rodents	Rodent holes or mounds disturb dispersion flowpaths.	Fill and compact soil around the holes and vegetate to restore flowpath.

If you are unsure whether a problem exists, please contact Environmental Services at 253.591.5588

#33 - Maintenance Standard for Media Filter Drains

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
	General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with sheet flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There should be no areas of standing water once inflow has ceased.
	General	No-vegetation zone/flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean to spread flows evenly over entire embankment width.
	General	Poor vegetation coverage	Grass is sparse or bare, or eroded patches are observed in more than 10% of the grass strip surface area.	Determine why grass growth is poor and correct the offending condition. Reseed into loosened, fertile soil or compost; or, replant with plugs of grass from the upper slope.
	General	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow vegetation or remove nuisance vegetation to not impede flow. Mow grass to a height of 6 inches.
	General	Media filter drain mix replacement	Water is seen on the surface of the media filter drain mix long after the storms have ceased. Typically, the 6-month, 24-hour precipitation event should drain within 48 hours. More common storms should drain within 24 hours. Maintenance also needed on a 10-year cycle and during a preservation project.	Excavate and replace all of the media filter drain mix contained within the media filter drain.

Recommended Inspection Frequency	Stormwater System Feature	Problem	Condition When Maintenance is Required	Maintenance Activities and Conditions that Should Exist
	General	Excessive shading	Grass growth is poor because sunlight does not reach embankment.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes.
	General	Trash and debris	Trash and debris have accumulated on embankment.	Remove trash and debris from embankment.
	General	Flooding of Media filter drain	When media filter drain is inundated by flood water	Evaluate media filter drain material for acceptable infiltration rate and replace if media filter drain does not meet long-term infiltration rate standards.