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Carrie Graul
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RE: *2012 Draft Stormwater Management Manual for Western Washington* Comments

Dear Ms. Graul;

The Washington State Department of Transportation (WSDOT) appreciates the opportunity to respond to the Washington State Department of Ecology's solicitation for comments on the draft *Stormwater Management Manual for Western Washington* (SMMWW). The *WSDOT Highway Runoff Manual* (HRM) is required to be equivalent to the SMMWW and we are mindful that if some of the proposed changes are incorporated into the SMMWW could ultimately find their way into future revisions of the HRM and affect how WSDOT addresses stormwater treatment and flow control in a highway setting.

We recognize that the draft SMMWW proposes an approach requiring the application of Low Impact Development (LID) principles to the extent feasible for development and redevelopment at the site and subdivision scale. However, is seems to us that the proposed approach is trys to take a new paradigm and awkwardly "re-engineers" it to fit an old paradigm. In our view, this results in adding an unnecessary level of confusion and complexity to an already overly complex manual. Furthermore, applying the approach put forth would be problematic in the highway environment. We encourage Ecology to consider pursuing an approach similar to what WSDOT already employs for highway settings, as outlined below, that identifies LID techniques and have them be the first choices that a designer incorporates according to feasibility standards. These feasibility standards would be defined in the specific design criteria for each best management practice (BMP).

WSDOT oriented its HRM to apply LID principles to the maximum extent feasible even prior to the Pollution Control Hearings Board's (PCHB) ruling on the matter. *Section 2-5.2* in the manual describes the stormwater facility design strategy which is accomplished through the following steps:

- **Step 1** Avoid and minimize impacts on hydrology and water quality.
- **Step 2** Compensate for altered hydrology and water quality by mimicking natural processes.
- **Step 3** Compensate for altered hydrology and water quality by using end-of-pipe solutions.

This section of the manual goes on to explain that:

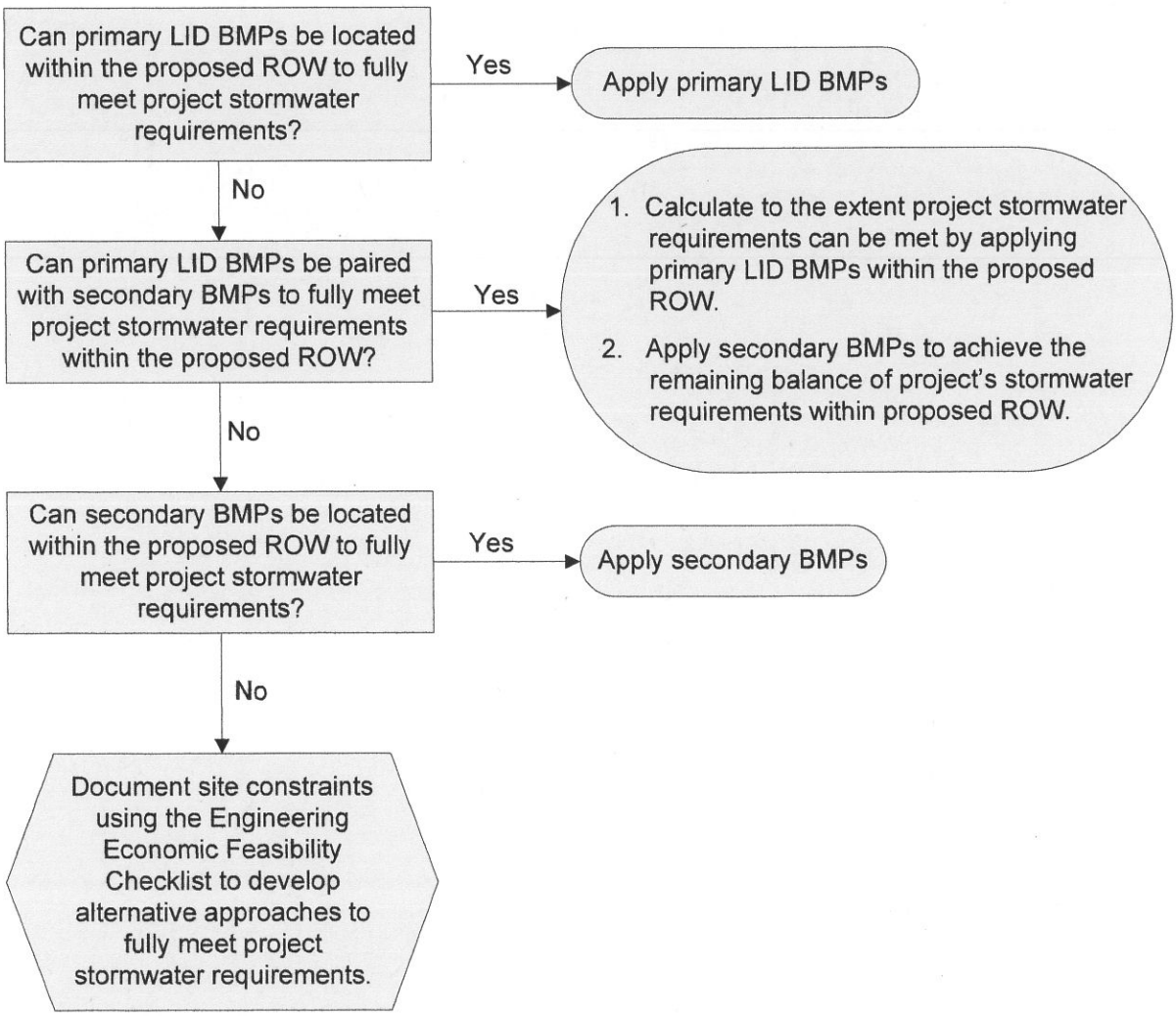
> *Steps 1 and 2 can be achieved by minimizing impervious cover; conserving or restoring natural areas; mimicking natural drainage patterns (for example, using sheet flow, dispersion, infiltration, or open channels); disconnecting drainage structures to avoid concentrating runoff; and using many small redundant facilities to treat, detain, and infiltrate stormwater. This approach to site design reduces reliance on the use of structural management techniques. Step 3 refers to the use of traditional engineering structural approaches (for example, detention ponds) to the extent that Steps 1 and 2 are not feasible.*
>
> *The methods listed for achieving Steps 1 and 2 above are commonly referred to as low impact development (LID) approaches. By using the project site's terrain, vegetation, and soil features to promote infiltration, the landscape can retain more of its natural hydrologic function. Low-impact development methods will not be feasible in all project settings, depending on the physical characteristics of the site, the adjacent development, and the availability and cost of additional right of way (if needed). However, the designer must always investigate the feasibility of using low-impact development methods. Low-impact development methods require understanding of soil characteristics, infiltration rates, water tables, native vegetation, and other site features. For this reason, it is important to gain the participation of design support services and others from the beginning through the end of the project development process.*

Furthermore, the HRM's BMP selection process (*Section 5-3*) guides designers through a procedure that favors LID techniques over other options. For instance, the BMP selection flow charts (*Figures 5.3.1* and *5.3.2*) direct designers to first consider the feasibility of natural and engineered dispersion and infiltration BMPs on a project. LID techniques are also incorporated in WSDOT's policy to minimize vegetation disturbance and to restore vegetation on disturbed areas in accordance with WSDOT's *Roadside Classification Plan*. Feasibility determinations occur using the HRM's *Engineering and Economic Feasibility* (EEF) *Evaluation Checklist*. This too provides a method to assist designers in determining and documenting when site-specific factors make constructing stormwater management facilities (LID or conventional end-of-pipe approaches) within or adjacent to the highway right of way infeasible.

WSDOT's HRM currently directs designers to use the HRM's LID approaches (i.e., dispersion, bioinfiltration pond/swale, bioretention soils, compost amended vegetative filter strips, media filter drain, and infiltration pond/trench) to meet project stormwater requirements. In situations where LID approaches can only partially meet project stormwater requirements, the process depicted in the flowchart below would guide designers to incorporate LID approaches to the maximize extent feasible.
WSDOT believes that the HRM's approach could also be successfully applied at the site and subdivision scale as a means of meeting the PCHB's directive to:

. . . require non-structural preventive actions and source reduction approaches, including Low Impact Development techniques (LID), to minimize the creation of impervious surfaces, and measures to minimize the disturbance of soils and vegetation where feasible."

The figure below represents an idea of how such a LID process could work.



Primary BMPs = Dispersion, bioinfiltration pond/swale, bioretention soils, compost-amended vegetative filter strips, media filter drain, and infiltration pond/trench.

Secondary BMPs = All the remaining HRM "non-primary BMPs.

The following are comments on specific sections of the SMMWW:

Volume I, Sections 1.6.2 and 1.6.4, pages 1-8 and 1-12 to 1-13: Section 1.6.2 says "the SMMWW is not a retrofit manual." However, Section 1.6.4 goes into great depth about how and where to do retrofits. Both sections mention retrofit, but give conflicting messages. We suggest providing references or a link to the Puget Sound Partnership's action plan in Section 1.6.4 and deleting any "cut and paste" language. This would clarify any conflicting messages in Sections 1.6.2 and 1.6.4 regarding retrofitting as it applies to the requirements in the SMMWW.

Volume I, Section 2.3, page 2-5: The draft manual defines "Hard surfaces" to include impervious surfaces, permeable pavements, and green roofs. This new definition appears in the redevelopment *Minimum Requirements* (MR) so if a project has more than 5,000 square feet of new "hard surfaces", then it triggers MR 5-9. This adds confusion and added complexity to the manual. Instead of creating the need for another key term (i.e., "Hard Surfaces"), we suggest adding permeable pavements and green roofs to the existing definition for *impervious surface*. This would help keep the triggers and key terms the same to the end user rather than adding more complexity.

Volume I, 2.5.6, page 2-38: Ecology proposes to delete the word "effective" as a part of the trigger for how much effective pollution-generating hard surfaces (PGIS) exist on a project. We suggest not deleting the term "effective" since *ineffective* PGIS could occur when runoff is dispersed through at least one hundred feet of native vegetation in accordance with BMP T5.30 – "Full Dispersion" as described in Chapter 5 of Volume V.

Volume I, Section 4.2, page 4-2: In Step 3 of Step III, there appears to be a conflict for in the definition of *permeable pavements*. Step 3 states that *permeable pavements* should be included as *pollution generating hard surfaces* (and not as *pollution generating pervious surfaces*). The Glossary calls out *permeable pavements* as a "pollution generating pervious surface (PGPS)" and also a "pervious surface". We suggest eliminating the term "hard surfaces" since creating the new term "hard surfaces" adds another layer of complexity to an already confusing decision making process. Rather, we suggest simply adding language stating *permeable pavements* and *green roofs* are considered *impervious surfaces* for the purposes of *Minimum Requirement* determination. Also add a statement that permeable pavements are considered pollution generating pervious surfaces (per the manual's Glossary) for *Minimum Requirement* determination.

Volume I, Glossary, page 8: The term "Certified Pervious Surface" should be deleted. It appears that this is already defined as "Converted Pervious Surface" on page 11 of the Glossary.

Volume III, Table of Contents: Delete one version of the Table of Contents since it is repeated twice.

Volume III, Section 2.1, page 2-5: The sentence just prior to Section 2.1.1 is awkward. We suggest deleting "The" at the beginning of the sentence.

Volume III, Section 2.2.2, page 2-8: The fifth bullet states that the time step used in WWHM is one hour, but that as 15-minute data becomes available, future versions of WWHM would likely use the shorter time step. This statement is ambiguous since it talks about things that may happen in the future. For instance, would the hour time step still be allowed or would the 15-minute or less time step be required? We suggest that stating this more clearly. For instance, the second sentence could read, "However, as 15-minute precipitation data becomes available, future WWHM versions would use the shorter computational step of 15-minutes or less.

Volume III, Section 2.2.2, page 2-10, last sentence of the second bullet: Please consider replacing "any credit due" with "credits" to improve readability.

Volume III, Section 2.2.2, page 2-12: The second to last paragraph of the section states: "*Minimum Requirement #8 specifies that total discharges to a wetland must not deviate by more than 20% on a single event basis, and must not deviate by more than 15% on a monthly*

basis. Flow components feeding the wetland under both Pre- and Post-development scenarios are assumed to be the sum of the surface, interflow, and groundwater flows from the project site." It is not completely clear what "*discharges to a wetland must not deviate by more than 20% .... and....15%"* means. Does this mean the post developed discharges must not be greater than 20% or 15% of the Pre-developed condition? Please clarify.

Volume III, Section 2.2.2, page 2-12: The second to last paragraph of the section states *"Ecology anticipates revising the WWHM to more easily allow this comparison."* Will this modification to the WWHM allow the designer to perform a hydroperiod analysis on an existing wetland?

Volume III, Section3.2 (and a general comment), page 3-28, Item #8: The word "that" frequently appears in the revision and could be deleted to improve readability and overall clarity. In Item 8, for example, "that" appears twice and both could be deleted. Please consider performing a word search for "that" and delete when appropriate to improve readability.

Volume III, Section3.3, page 3-69, #5: This paragraph is difficult to understand. Please consider re-writing. A suggestion is:

Estimate the long-term infiltration rate by:

1. *Estimate the initial saturated hydraulic conductivity by using the Large Scale or Small Scale Pilot Infiltration Test (PIT) method as described provided in Section 3.3.6 to estimate an initial saturated hydraulic conductivity. Alternately, for sites underlain with soils not consolidated by glacial advance (e.g., recessional outwash soils), the initial saturated hydraulic conductivity rate may be estimated using the grain size analysis method in Section 3.3.6.*
2. *Assume that the Saturated Hydraulic Conductivity is the initial (short-term) infiltration rate for the facility.*
3. *Adjust this short-term rate using the appropriate correction factors as explained in Section 3.3.6 for the PIT results and the Gradation Analysis results.*

Volume III, Section3.3, page 3-70: Item #7 states *"The constructed facility must be tested and monitored to demonstrate that the facility performs as designed. If the facility performance is not satisfactory, the facility will need to be modified or expanded as needed in order to make it function as designed."* Are there specific testing and/or monitoring methods that should be used? If so, please specify (or reference location) of testing and/or monitoring requirements.

Volume III, Section3.3, general comment: There does not appear to be any specific requirements for testing the infiltration rate for wetlands. Without specific testing requirements, the constructed stormwater wetland (CSW) may be constructed at a location where the soils cannot retain water. Also, current guidance requires ground water monitoring through one wet season for infiltration ponds. However this many not be adequate for CSW where water is required 10 months of the year (per Volume 5). Since dry periods are critical for CSW, currently requirements for "one wet season" may not provide adequate data to design a successful CSW. The success of CSW performance could be improved by specifying specifically which tests are required for a CSW design. Also, monitoring groundwater for all four seasons is recommended by other agencies to design a CSW and may be help improve the successful operation of this BMP.

Volume III, Section3.3, page 3-86: The second paragraph from the bottom provides very general guidance for soils subjected to heavy compaction. While this paragraph provides the designer with good general information about soil type and compaction, there is no specific guidance for what should be done if the soils have been subject to heavy compaction. Also, it is not clear what is considered "heavy compaction", so providing a definition regarding this would be helpful. It would also be helpful if there was more specific guidance (preferably a table), for example:

- *Clean, uniformly graded sands and gravels, K_{sat} should be reduced x% to x%.*
- *Well graded sands and gravels with moderate to high silt content, reduce K_{sat} by one magnitude.*

Dr. J. Massman wrote a paper, *Infiltration Pond Research Extension. Olympia, WA: WSDOT (2008),* that might provide some useful resources regarding this topic. Overall this is an area where both WSDOT and the Department of Ecology would benefit from more research. It would be helpful for designers to have a way to estimate K_{sat} using eqn 1 on page 3-86 with a component for estimating the effect of compaction on soils.

Volume III, Section3.3.6, page 3-88: The comment applies to this section and in general for the entire manual. Providing equation numbers for every equation would be helpful. Please provide equation numbers for all equations in the manual.

Volume III, Section3.3.6, page 3-88: It is not clear what CF_v stands for or how to apply it. It would be helpful to provide more guidance on page 3-89, Item #2. Specifically, how soil grain size affects this factor as well as the number of test sites required.

Volume III, Section3.3.8, page 3-94, Step 1-5: We like revision. Changes like this make the document more user-friendly.

Volume III, page 3-97 and 3-102: Both sections describe triggers for estimating infiltration rates using MODRET. The flow chart on page 3-97 states *"For unusually complex, critical design cases, perform computer simulation to obtain Q using MODRET...."* Then Item 10, on page 3-102 *"...larger than 1 acre....the final design infiltration rate shall be determined using an analytical groundwater model..."* Please clarify "complex and critical design cases". Also, is it the manual's intent that a groundwater model be used if more than 1 acre drains to an individual infiltration facility? For example, if there is a 2-acre site draining to two ponds. One pond has 1.5 acres draining to it and one has a 0.5 acre basin. Does only the pond draining the 1.5-acre basin require modeling; or do both? If only the one, designers will just set up multiple ponds to prevent triggering the groundwater model trigger, which could create a maintenance problem. Instead of a broad 1-acre trigger, perhaps there should be an exception or provision for local agencies designation critical groundwater areas to narrow the trigger to only those areas where there are demonstrated problems?

Volume III, Section 9, page 102: The first paragraph of this section is too restrictive and poorly worded. It is unclear how one ensures a desirable depth. We suggest it be revised to read: *"The desirable depth is three feet. The maximum pond depth shall be six feet or less. One foot minimum freeboard is recommended."*

Volume III, Section 9, page 102: The second paragraph states that it must drain the "treatment volume" in 48 hours and then latter on it says to drain maximum ponded depth in 24 hours. The two are incompatible. We suggest that the last should one should read "72 hours".

Section III, page 3-103, Part of item 10 in box: The box indicates Ecology is interested in receiving comments concerning the minimum project size triggering MODRET. Using a groundwater modeling program to determine infiltration rates is complicated and requires intensive geotechnical investigations to determine a representative infiltration rate. Some of this investigation could require work offsite that is not owned or controlled by the project proponent to gather sufficient data to accurately represent the groundwater flow. This proposed requirement represents a major change and most consultants or local agencies do not have staff with the specialized training and experience necessary to run these models. The current Massmans method, described in steps 1-9 for determining infiltration rates, are generally more conservative (based on steady state groundwater models) and give a smaller infiltration rate than a program like MODRET. WSDOT recommends Ecology reconsider the need for this new groundwater modeling requirement. Also, if the infiltration rate (estimated using steps 1-9) much greater than the design precipitation rate, using a groundwater model would not provide a benefit since runoff would be insignificant. For sheet flow BMPs we would strongly recommend an exemption where infiltration rate much greater than design precipitation rates.

Volume III, Section 3.3.8, page 3-103, Item 10, last paragraph: Testing and monitoring the constructed infiltration facility now appears to be required. That seems like a good idea. We wonder if this requires the use of specific testing and monitoring methods? If so, how often should testing be performed (based on facility square feet or length) and what type of test (e.g., Infiltrometer, Pit?)? Please specify the testing and monitoring requirements or provide a reference in this section to the appropriate location for these requirements.

Volume III, page 3-116, end of first paragraph: It would be helpful to reference the location where CF_v and CR_t are described by including a link/reference to Section 3.3 where CF is described.

Volume III, page 3-117, Text Box: We would like to see a setback criteria similar to other BMPs (more specifically dispersal trenches) included in the design criteria. The setback should include limits for basements and steep slopes. While we do not have a specific recommendation for the set back limit, it seems like it should be similar to dispersal trenches. See page 3-12, Item 3, *"A setback of at least 5 feet should be maintained between any edge of the trench and any structure or property line."*

Volume III, Appendix C, Section 7.1.2, page C-6: This calls for testing permeability of permeable pavement using a *"6-inch ring, sealed at the base to the road surface, or with a sprinkler infiltrometer."* Recently the American Society for Testing and Materials (ASTM) approved *ASTM C 1701/C 1701M – 09 Standard Test Method for Infiltration Rate of In Place Pervious Concrete* to test infiltration rates of permeable pavements. A standardized test method is needed to specify acceptance criteria for permeable pavement in construction specifications. We recommend allowing ASTM C 1701/C 1701M – 09 to test the infiltration rate of permeable pavement.

Volume III, Appendix C, Section 7.1.2, page C-7: This requires permeable pavement be cleaned with a vacuum sweeper and power washed at least one per year. However, this may be excessive on some permeable pavement installations. We feel that it would be better to set a performance standard (e.g., maintain the permeable pavement so it has a minimum infiltration rate of 10 inches/hour).

Volume V, general comment: There are multiple references to the Puget Sound Partnership LID manual. While I like that the information is not duplicated in both manuals, it is tough to comment on a section referencing a manual not yet been released.

Volume V, Section 2-1, page 2-1: Text box comment. We like the idea of reducing repetitive language and instead stating things as few a times as possible and providing references.

Volume V, Section 2-2, page 3-8, Last bullet in text box: There is a reference to the Media Filter Drain (MFD) write up, including the BMP number and page number. We anticipate that the revised 2011 HRM will be released prior to the revised SMMWW. The 2011 HRM revisions include an improved MFD section based on lessons learned. We suggest that the revised SMMWW use the revised MFD design criteria and new figures from the 2011 HRM manual.

Volume V, Section 2-1, page 2-4: Revise dead hyperlink: "See: http://www.ite.org/tripgen/trippubs.asp"

Volume V, Section 4.6, page 4-50: Per Department of Ecology's request, here is a link to the maintenance specifications for modified filter drains (MFD) and compost amended vegetated filter strips (CAVFS).

For MFD, see HRM, *Table 5.5.10. Maintenance standards for media filter drain.*
For CAVFS, see HRM, *Table 5.5.9. Maintenance standards for vegetated filter strip.*
http://www.wsdot.wa.gov/publications/fulltext/Hydraulics/HRM/Chapter5.pdf

Volume V, Section 5.3.1, page 5-3, last paragraph, second to last sentence: Correct typographical error – "Area" is spelled "aera".

Volume V, BMPs T5.30 and T9.40: The slope limit for dispersion and filter strips is listed at 15%. The Department of Ecology just approve WSDOT request to include the slope limit from 15% to 33% where level spreaders are located upstream of the dispersion area and at sites where vegetation can be established. This limit will be included in the 2011 revision to the *Highway Runoff Manual* (HRM). Limits also exist for contributing lateral and longitudinal slopes from the highway (i.e., 5% and 2%). The Department of Ecology also approved a resultant slope of 9.4% for both dispersion and filter strip BMPs. This change will also be included in the 2011revision to the HRM. We suggest that the revised SMMWW also adjust the slope limit for both dispersion and filter strips from 15% to 33%. Also, delete the contributing slope limits from 2% and 5% to 9.4% resultant. See the 2011 HRM, *Natural or Engineered Dispersion* and *Vegetative Filter Strips*, for the new revision. Justifications for these revisions appear in the following report:

http://www.wsdot.wa.gov/Research/Reports/700/771.1.htm

Volume V: Several references to under-drains and guidance for use exist. However there does not appear to be any guidance for how to size an under-drain. This guidance was recently

added to the HRM MFD design criteria and will appear in the 2011 HRM revision. We suggest including the under-drain design criteria from the HRM in the SMMWW revision.

Volume V, T8.40, page 8-24: The MFD section references the *"Postpublication Updates section of the HRM Resource web page."* However, these changes are incorporated in the 2011 HRM which will be most likely be released prior to the revised SMMWW. Also, *Figures 8.8*, *8.9*, and *8.10* are copied from the HRM and have since been updated based on lessons learned. We suggest that the revised SMMWW incorporate these updated figures in as well as all the MFD design criteria revisions. WSDOT can provide AutoCAD versions of these drawings to the Department of Ecology if needed.

Volume V, page 9-25, T9.40: Basic Filter Strip design guidance limits the slope to 15%. However, the Department of Ecology has recently approved increasing the limit to 33% in the HRM. We suggest that Ecology change their SMMWW to reflect this change.

Volume V, page 10-25, T10.30: WSDOT recently completed a study on existing stormwater treatment wetlands (see web link below). Based on findings from this study, The Department of Ecology approved many revisions made to the BMP design guidance that will appear in the 2011 revision to the HRM.The design criteria revisions include: moving the detention storage to the presettling cell, eliminating the naturalistic grading plan, revising the plant list, requiring a multidisciplinary team, and adding guidance for plant establishment.

The plant list shown in *Volume V, Table 10.1* previously appeared in the HRM, and was reviewed and references were cross-checked. Many of the references were found to be incorrectly represented. WSDOT has revised the list and reduced the available plants to 6-7 options.
ftp://ftp.wsdot.wa.gov/incoming/ER%20DP%20Best%20Practices/
We suggest incorporating these changes into the SWMMWW.

Sincerely,

Mark Maurer, LA, PE
Highway Runoff Program Manager

MM:pt
Enclosure

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