Western Washington 2005 Stormwater Manual Section 3.3 Comments

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1	III General	NA	**Stormwater infiltration impacts on groundwater:** For a variety of reasons, many municipalities in western Washington are implementing low impact development (LID) on a widespread scale. Since infiltration is a critical feature of these LID approaches, we can expect a significant increase in recharge to the subsurface. The effects of this additional recharge will be positive in many instances, including increased summer baseflow and higher groundwater levels in areas that rely on groundwater. However, there's also the potential for higher groundwater to have unintended consequences, including flooding in low lying areas, basement seepage, increased slope instability, etc. Therefore, we recommend that municipalities evaluate the potential impacts of increased infiltration on groundwater to identify potential negative impacts and either mitigate for these impacts or, at a minimum, monitor groundwater elevations to identify trends that may result in negative impacts.
2	III General	NA	**Dug or drilled drains in infiltration facilities:** The performance of infiltration facilities can be dramatically enhanced by the addition of gravel-filled dug or drilled drains in the base of the facilities. Dug drains can extend up to 30 feet deep depending on the digging equipment and drilled drains can extend 100 feet and deeper. Underground injection control (UIC) regulations are applicable if the depth of the drain is greater than the widest dimension of the infiltration facility or there is perforated pipe in the facility. These drains have been in widespread use across eastern and central Washington and as well as select areas in western Washington (e.g, Lakewood).
3	III General	NA	**Stand-alone dug or drilled infiltration drains**: These are the same as the drains discussed above except they are stand-alone facilities more akin to dry wells common used all over the United States, including over 40,000 in Spokane County alone. They are almost always subject to the UIC regulations.
4	III 3.3.3	3-65	Since infiltration is a critical componant of LID, it should be discussed in this section.
5	III 3.3.4	3-68	In certain situations, mounding analysis may be advisable for sites of less than 1 acre. In particular, if the seasonal high groundwater table or a low-permeability perching layer is within 10 feet of the base of the facility we would recommend a mounding analysis for small sites. A low permeability perching layer can be defined as any soil with an estimated permeability of less than 0.1 inches/hour.
6	III 3.3.5	NA	It's not clear if the level of site characterization differs depending on the size of the site and other factors (simplified versus detailed). A higher level of effort is warrented for large sites, sites near sensitive areas, and sites with challanging infiltration conditions. This should be clarified.

7	III 3.3.5	3-72	The recommendation that explorations extend at least 5 or 2.5 times the maximum design depth of ponded water below the base of the facility is not a useful guideline since the importance of understanding the subsurface conditions is not dependent on the depth of ponded water in the facility. We would also eliminate the reference to "2.5 times the maximum design water depth, or at least 2 feet into the saturated zone, but not less than 6 feet". Instead, we would recommend a depth of at least 10 feet below the base of the facility. The manual should also indicate that in areas with shallow groundwater or potential perching layers, subsurface explorations should be sufficient to provide the necessary information for mounding analysis. Limiting the explorations to no more than 2 ft below the groundwater table in high water table sites is not recommended since understanding the thickness of the saturated zone is important for groundwater mounding analysis.
8	III 3.3.5	3-72	One exploration per 5,000 ft2 of basin is adequate. Requiring a minimum of at least two per basin is not necessary (one would be sufficient) and would be costly if the design includes many small infiltration/bioretention facilities. For trenches, requiring at least one exploration per 50 ft of trench is too expensive (for a 10 foot wide trench this works out to one exploration for every 500 ft2 of infiltration area). One exploration per 200 ft of trench should be adequate.
9	III 3.3.5	3-73	The groundwater gradient and flow direction is typically not important for small sites (less than 1 acre) and monitoring wells are typically not necessary. Depth to groundwater or perching layer is the important performance issue and this can often be determined based on explorations without a well. For small sites (less than 1 acre) documenting the depth to groundwater or perching layer is generally not important if it can be shown or surmised to be at least 10 feet below the base of the facility based on subsurface explorations or information from nearby wells and explorations. For small sites, a monitoring well should only be necessary if the depth to groundwater/perching layer is unknown or if the licensed professional determines it is important to conduct the mounding analysis.
10	III 3.3.5	3-73	For large sites (> than 1 acre) documenting the depth to groundwater or perching layer is generally not important if it can be shown or surmised to be at least 50 feet below the base of the facility based on subsurface explorations or information from nearby wells and explorations. A single well is probably sufficient if the the depth to groundwater is less than 50 feet or the depth is unknown. The need to determine the groundwater gradient and flow direction and installation of 3 wells should only be conducted if determined necessary to document variability across the site or to allow assessment of groundwater impacts. This determination should be made by a licensed professional.
11	III 3.3.5	3-73	**Infiltration Rate Determination**: Although we do believe that grain-size analyses are important for characterizing the components of the soil, we do not believe that infiltration rates based on grain-size analysis should be sufficient for final design. In our experience, there is a poor correlation between grain-size distributions and infiltration, primarily because the presence of thin silt layers can dramatically decrease the infiltration rate even when the bulk texture of the soil is dominated by gravel and coarse sand.
12	III 3.3.5	3-74	Again, we would eliminate the reference to "2.5 times the maximum design water depth but not less than 6 feet" and replace with a "minimum of 10 feet below the base of the facility".
13	III 3.3.5	3-74	It can be difficult to estimate the amount of clay versus silt. A qualitative description of the clay content would be more realistic.
14	III 3.3.5	3-74	We would eliminate the suggestion that infiltration is ok in contaminated soils. This is potentially misleading.

15	III 3.3.5	3-75	**Infiltration Receptor:** The groundwater monitoriong requirements in this section are excessive for small sites and may even be unnecessary for large sites.
16	III 3.3.5	3-75	"Volumetric water holding capacity" is not used for design and seems unnecessary. We recommend eliminating this section.
17	III 3.3.5	3-75	This section should include a discussion of the potential for perching and possible mitigation measures (e.g., deep drains that penetrate the perching layers).
18	III 3.3.6	3-83	Large Scale PIT Test: Generally a good test, but the water level should be maintained between 6-12 inches above the bottom of the pit. Otherwise, we are significantly overestimating the vertical hydraulic conductivity. Furthermore, running tests overnight (i.e., 17 hours) is unreasonable from a cost perspective. Steady state can often be achieved is a much shorter time period, although requiring a minimum of 6 hours is probably reasonable to allow the test to be conducted in a single day.
19	III 3.3.6	3-86	Soil Grain Size Analysis Method: It is highly unlikely that facility performance will be affected by soil layers that are 100 feet below the base of the infiltration facility. This sentence should be deleted.
20	III 3.3.6	3-86	Again, I would eliminate the reference to "2.5 times the maximum design water depth but not less than 6 feet". The depth of the ponded water doesn't change the importance perching layers with depth. To be consistant with the rest of the manual we would recommend considering layers within 10 feet of the bottom of the facility for small sites and up to 50 feet (or no more than 10 feet below the water table) for large sites.
21	III 3.3.6	3-87	I would eliminate the reference to "20 times the depth of the pond" and replace with previous discussion.
22	III 3.3.6	3-88 to 89	Correction Factors: This discussion regarding correction factors is overly complicated and attempts to quantify factors with very little basis in scientific research. Furthermore, using these correction factors will result in highly conservative infiltration rates that will escalate costs. We recommend a range of correction factor between 0.25 to 0.5 (rather than 0.1 to 0.27) based on a qualitative evaluation of relevant factors by a licensed professional (such as site variabilty, testing frequency, test method, potential for thin perching layers, and expected degree of maintenance).
23	III 3.3.7	3-90	SSC-1: Setback criteria should be evaluated in light of many LID applications that tend to be low-intensity facilities.
24	III 3.3.7	3-91	SSC-4 seems somewhat arbitrary. There is very little evidence that infiltration rate is related to treatment capacity. We recommend deleting this portion of SSC-4. The 48-hr drawdown time seem appropriate for a variety of reasons.
25	III 3.3.7	3-92	SSC-5 calls out 5 or 3 ft of separation. It some cases, less separation can be workable as long as a proper mounding analysis is conducted.
26	III 3.3.7	3-92	SSC-6 lays out the treatment requirements. These requirements do not seem to be based on the latest science and should be reconsidered. Most of the treatment is likely provided by biofilms that develop on the soil grains over time and even a clean gravelly soil is likely to provide sufficient treatment capacity due to the addition of entrained fine grained particles over time and biofilms.
27	III 3.3.8	3-100	**Calculate the hydraulic gradient**: This approach results in a highly conservative estimate for the hydraulic gradient, particularly given the fact that the PIT test at steady state provides an infiltration rate that already accounts for the hydraulic gradient.
28	III 3.3.8	3-103	**Groundwater Mounding Analysis:** MODRET does not appear to be supported by the developer and can provide erroneous results if not used carefully. MODFLOW should also be mentioned as a suitable model.

29	III 3.3.8	3-103	Groundwater mounding should not be required for any small project where the groundwater table (or perching layer) is at least 10 feet below the base of the faciilty and for any large facility where the groundwater table is at least 50 ft below the base of the facility.
30	III 3.4	3-115	Groundwater mounding may be advisable if the facility is located in an area with shallow groundwater or perching layer. Previous guidelines in Section 3.3 should be sufficient.
31	App. III-C	C-2	We recommend using a correction factor of 0.25-0.5 to obtain design infiltration rates from measured infiltration rates.
32	App. III-C	C-18	The permeability of the bioretention soil mix can greatly impact the required size and cost of the bioretention facilities. A permeability spec is not appropriate since there is no evidence that permeability is related to treatment capacity and permeability can vary greatly with very small changes in compaction. Based on our experience, treatment and plant support functions can be achieved with organic content as low as 4-5% by weight and less than 2 percent passing the number 200 sieve. We recommend eliminating the permeability spec, changing the allowable range of organics to 4-10 percent, and changing the #200 spec to 1-4 percent.
33	App. III-C	C-20	**Groundwater clearance.** Less than 3 feet of groundwater clearance should be allowed if a mounding analysis demonstrates that the system can perform suitably.
34	App. III-C	C-23	With regards to use of infiltration correction factors we recommend the 0.25-0.5 range based on the same criteria as discussed in Section 3.3.6. Let keep it consistant within the Manual.
35	App. I-F	F-2	A waiver from the minimum of 3 ft seperation should be allowed if mounding analysis shows performance criteria can be achieved.
36	App. I-F	F-2	The 0.3 inches per hour infiltration rate is too low as a cutoff for requiring an underdrain. Assuming a correction factor of 0.5 this means it will take 40 hours to drain a 6-inch ponding depth. For consistancy, we recommend a measured rate of at least 0.5 inches per hour to be consistant with the 24 hour drainage time. In addition, we have seen issues with rain gardens in the Ballard neighborhood that drain at less than 0.25 inches per hour. you want to drain the facility in 24 hours this .
37	App. I-F	F-2	Another option for low permeable soils (such as glacial till) is to evaluate the potential for installing deep drains that allow the water to bypass the perching zone and flow into the deeper unsaturated zone. This approach has been used on several sites in western Washington and is the proposed solution for two retrofit projects in the City of Seattle.