POSITION PAPER OF THE CENTRAL TEXAS LAND AND WATER SUSTAINABILITY FORUM

A Proposal to Revise the City of Austin Stormwater Treatment Standards

Background

The objectives of this paper are to identify errors in the Environmental Criteria Manual (ECM) regarding the performance of sedimentation/filtration systems and to suggest a revised standard that provides a direct method to account for volume reductions within stormwater treatment practices. The errors in the ECM are of particular concern in that they are an impediment to the implementation of certain green infrastructure practices.

Many citizens of Austin, as well as civic leaders, have expressed an interest in promoting the use of Low Impact Development (LID) practices that include the use of green infrastructure (GI) for the conveyance and treatment of stormwater runoff. One impediment to the use of GI and the incorporation of these features in site landscaping are requirements in the Land Development Code (LDC) and ECM. Section 25-8-213 of the LDC requires that treatment controls must provide at least the treatment level of a sedimentation /filtration system as described in the ECM. The ECM then specifies a required level of performance in Section 1.6.5 C.

There are a variety of problems associated with this performance standard:

- Sedimentation/filtration systems constructed according to current ECM guidance do not meet the performance criteria for all constituents.
- The efficiency ratios presented in the ECM do not recognize the variability in performance observed in sedimentation/filtration systems.
- The efficiency ratios for constituents other than TSS are mostly an artifact of the characteristics of the runoff from the monitored land uses, rather than being intrinsic to the treatment system itself.
- Using pollutant removal efficiency (Efficiency Ratio) as a performance metric has been almost universally rejected by researchers who study treatment system performance.

At the time that the current performance standards were included in the ECM, efficiency ratio was widely recognized as a valid metric for treatment performance; however, this is no longer the case. The reason for this shift in opinion is that the efficiency ratio is strongly affected by the influent concentration to the treatment system. Identical systems located in watersheds with different runoff constituent concentrations will, even if they produce exactly the same effluent quality, have different efficiency ratios. A number of researchers have documented this phenomenon (e.g., Strecker et al., 2001; Barrett, 2005).

The City of Austin has monitored five sedimentation/filtration systems through the years. Of these, the facility at Barton Ridge is the one that conforms to the current design standards most closely. A comparison of the performance observed at Barton Ridge to the pollutant removal requirements in the ECM (Table 1), clearly indicates that Barton Ridge does not meet the performance standards for a variety of constituents including Chemical Oxygen Demand (COD), lead (Pb), fecal coliform (FC), fecal strep (FS), and zinc (Zn). In fact, only one of the five monitored systems (Jollyville) meets all the ECM performance criteria and it does not comply with current ECM design standards in a variety of aspects.

Table 1 Performance of Sedimentation/Filtration Systems (Barrett, 2010)

Constituent	ECM Assumed Removal	Barton Ridge Performance	Observed Range of All Systems
TSS	87	91	74 - 95
TP	61	69	-14 - 69
TN	31	32	-16 - 32
COD	67	58	25 - 68
BOD	51	55	-27 - 55
Pb	80	76	61 - 86
FC	36	-4	-70 - 54
FS	65	17	11 - 68
TOC	61	NA	NA
Zn	80	35	35 - 87

It is also clear that the observed range of efficiency ratios observed for all the monitored systems frequently is substantial – including many instances where the discharge concentration is higher than the untreated runoff concentration. For practically all the constituents, the ECM standard is near the very top of the observed range, rather than representing something close to the average performance.

These erroneous performance standards have had a number of adverse consequences. In particular, some green infrastructure practices are required to be so large that implementation within a site's landscaping has been effectively precluded. Consequently, the Central Texas Land and Water Sustainability Forum (CTLWSF) proposes that the ECM be revised, so that it accurately reports the expected performance of sedimentation/filtration systems as required by the LDC. This could result in a variety practices being recognized in the ECM as appropriate for use in the City of Austin.

Proposed Solution

It is important to recognize that sedimentation and filtration are particle removal processes. Consequently, TSS is an appropriate constituent to examine when evaluating performance. The extent to which these processes remove the other constituents in Table 1 is a function of how much of that constituent is attached to particles rather than occurring in the dissolved phase. Constituents found primarily associated with particles, such as lead, have very high removal, while those with a larger fraction in the dissolved phase, such as total nitrogen (TN), have a lower removal. Consequently, the observed performance for all the constituents except TSS is really a function of the runoff characteristics of the specific watershed where monitoring occurred rather than being a function of the treatment system itself. This is one of the reasons that the range of observed efficiency ratios in Table 1 is so large.

Rather than efficiency ratio, most researchers now characterize BMP performance based on the quality of the water discharged (See International BMP Database, www.bmpdatabase.org). This allows a better comparison of systems installed in watersheds with varied runoff characteristics. One also needs to consider the volume loss, so that credit can be given to those LID practices that infiltrate a meaningful amount of stormwater runoff. Monitoring of sand filters in Austin indicate that the median TSS effluent concentration is about 17 mg/L. Consequently, any BMP with effluent concentrations less than 17 mg/L could be considered equivalent to sedimentation/filtration. If we take as a starting point a requirement for 87% TSS load reduction as is assumed in Table 1, a calculation can be made of the amount of infiltration required for equivalency for those practices whose effluent concentration is higher. This relationship is presented in Figure 1. The CTLWSF suggests that the City of Austin consider using this relationship in place of the current table in the ECM as a more accurate representation of sedimentation/filtration performance.

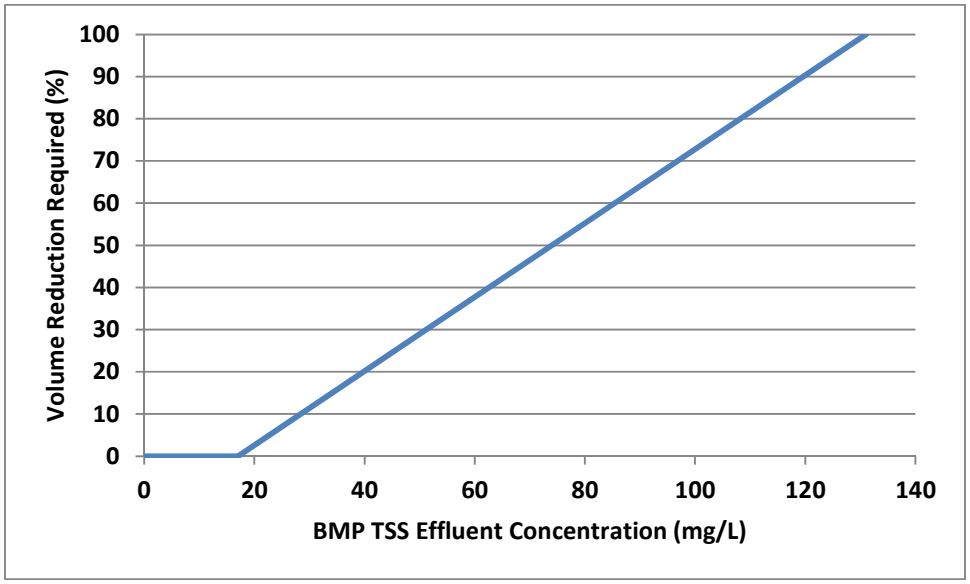

Figure 1 Relationship between Effluent Concentration and Volume Reduction

Vegetated filter strips (VFS) can be used to illustrate how this relationship can be applied. Monitoring of VFS indicate that the irreducible minimum TSS effluent concentration, which is the lowest concentration observed in a typical system, is roughly 25 mg/L (Barrett et al., 2004). Using the relationship presented in Figure 1, one can see that the VFS would have to be sized to infiltrate 7% of the annual volume treated. Under the current ECM requirements VFS must be sized to infiltrate 100% of the water quality volume, so it is easy to visualize how the new performance standard would allow a much smaller facility that could more easily be incorporated into site's landscaping, while still providing pollutant removal comparable to a sedimentation/filtration system.

References

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