Volume 3, Chapter-3 - Calculating the WQCV and Volume Reduction

Users' Guidance:

If a UDFCD *Section* number in this chapter is **skipped**:
It was adopted as is; please refer to that Section in the **corresponding UDFCD Manual**, Volume, Chapter and *Section.*

If a UDFCD *Section* number in this chapter is **amended or a new COFC *Section* in this Chapter is added**:
It is **listed below**; please refer to it in **this document**.

If a UDFCD *Section* in this chapter is **deleted then** it was **not** adopted by the City of Fort Collins;
The deleted UDFCD *Section* number will be **identified as deleted in the text below**.

(1) *Section 1.0* is amended to read as follows:

1.0 Introduction

This chapter presents the hydrologic basis and calculations for the Water Quality Capture Volume ("WQCV") and discusses the benefits of attenuating this volume. This chapter also describes various methods for quantifying volume reduction when using LID practices. Use of these methods should begin during the planning phase for preliminary sizing and development of the site layout. The calculations and procedures in this chapter allow the engineer to determine effective impervious area, calculate the WQCV, and more accurately quantify potential volume reduction benefits of BMPs.

(2) *Section 2.4* is deleted in its entirety.

(3) A new *Section 3.1* is added, to read as follows:

3.1 Low Impact Development (LID) Criteria

Once the WQCV has been calculated in accordance with the specifications of Section 3.0 of this chapter the total WQCV must be treated by one or more of the methods outlined in Volume 3, Chapter 4, *Treatment BMPs.* In addition, the requirements set forth below in this section, referred to as Low Impact Development (LID) Criteria must be met. For the purposes of this section, the LID methods and techniques described in Volume 3, Chapter 1, Section 4.1, *Runoff Reduction Practices,* together with any methods or techniques determined by the Executive Director to be functionally equivalent, shall be considered *LID techniques.*

(a) The LID Criteria are as follows:

(1) No less than fifty percent (50%) of any newly added impervious area must be treated using one or a combination of LID techniques; and

(2) No less than twenty five percent (25%) of any newly added pavement areas must be treated using a permeable pavement technology that is considered an LID technique.

(b) If, in the judgment of the Executive Director, one or more requirements of this section cannot be met due to site engineering constraints, then a design alternative will be

allowed, provided that the design results in equal or better stormwater quality than would compliance with the otherwise applicable requirement.

(4) *Section 4.2* is amended to read as follows:

4.2 Watershed-Level Volume Reduction Method

For a given value of total imperviousness, and depending on overall site imperviousness and typical development patterns there are two levels of LID implementation:

(a) Level 1: The primary intent is to direct the runoff from impervious surfaces to flow over grass-covered areas and/or permeable pavement, and to provide sufficient travel time to facilitate the removal of suspended solids before runoff leaves the site, enters a curb and gutter system, or enters another stormwater collection system. Thus, at Level 1, to the extent practical, impervious surfaces are designed to drain over grass buffer strips or other pervious surfaces before reaching a stormwater conveyance system.

(b) Level 2: As an enhancement to Level 1, Level 2 replaces solid street curb and gutter systems with no curb or slotted curbing, low-velocity grass-lined swales and pervious street shoulders, including pervious rock-lined swales. Conveyance systems and storm sewer inlets will still be needed to collect runoff at downstream intersections and crossings where stormwater flow rates exceed the capacity of the swales. Small culverts will be needed at street crossings and at individual driveways until inlets are provided to convey the flow to storm sewer. The primary difference between Levels 1 and 2 is that for Level 2, a pervious conveyance system (i.e., swales) is provided rather than storm sewer. Disconnection of roof drains and other lot-level impervious areas is essentially the same for both Levels 1 and 2.

Figure 3-7 and Figure 3-8 can be used to estimate effective imperviousness for Level 1 and Level 2. Because rainfall intensity varies with return interval, the effective imperviousness also varies, as demonstrated by the separate curves for the 2-, 10- and 100-year return intervals (see Figure 3-7 and Figure 3-8). The effective imperviousness determined from Figure 3-7 and Figure 3-8 can be used as input for calculation of the WQCV, as the basis for looking up runoff coefficients based on imperviousness in the Runoff chapter in Volume 1. Figure 3-7 and Figure 3-8 are intended for use at the planning level when specifics of the development patterns are not yet well established.

It is notable that the reductions in effective imperviousness shown in Figure 3-7 and Figure 3-8 are relatively modest, ranging from little to no benefit for large events up to approximately 12% for Level 2 for a total imperviousness of roughly 50% (reduced to about 38% for the 2-year event). When site-specific disconnected areas, receiving pervious areas, flow paths, and other design details are available, the site-level methods in Section 4.3 can be used to better quantify volume reduction, and results will typically show greater reductions in effective imperviousness for aggressive LID implementation. Even so, it is unlikely that conveyance-based BMPs alone will provide adequate pollutant removal and volume reduction for most project sites, and a storage-based BMP (i.e., WQCV) will also be required.

(5) *Section 4.3.1* is amended to read as follows:

4.3.1 SWMM Modeling Using Cascading Planes

Because of complexities of modeling LID and other BMPs using SWMM, the cascading planes alternative for site-level volume reduction analysis is recommended only for

experienced users. The following guidance for conveyance- and storage-based modeling must be followed:

(a) Each sub-watershed should be conceptualized as shown in Figure 3-6. Two approaches can be used in SWMM to achieve this:

- Create two SWMM sub-catchments for each sub-watershed, one with UIA 100% routed to RPA and the other with DCIA and SPA independently routed to the outlet, or
- Use a single SWMM sub-catchment to represent the sub-watershed and use the SWMM internal routing option to differentiate between DCIA and UIA. This option should only be used when a large portion of the pervious area on a site is RPA and there is very little SPA since the internal routing does not have the ability to differentiate between SPA and RPA (i.e., the UIA is routed to the entire pervious area, potentially overestimating infiltration losses).

(b) Once the sub-watershed is set up to represent UIA, DCIA, RPA and SPA in SWMM, the rainfall distribution should be directly input to SWMM.

(c) Parameters for infiltration, depression storage and other input parameters must be selected in accordance with the guidance in the Runoff Chapter,Volume 1 - Chapter 5, of this Manual.

(d) For storage-based BMPs, there are two options for representing the WQCV:

i. The pervious area depression storage value for the RPA can be increased to represent the WQCV. This approach is generally applicable to storage-based BMPs that promote infiltration such as rain gardens, permeable pavement systems with storage or sand filters. This adjustment should not be used when a storage-based BMP has a well-defined outlet and a stage-storage-discharge relationship that can be entered into SWMM.

ii. The WQCV can be modeled as a storage unit with an outlet in SWMM. This option is preferred for storage-based BMPs with well defined stage-storage-discharge relationships such as extended detention basins.

These guidelines are applicable for EPA SWMM Version 5.0.018 and earlier versions going back to EPA SWMM Version 5.0. EPA is currently developing a version of EPA SWMM with enhanced LID modeling capabilities. This Manual will be updated as newer SWMM modeling capabilities are developed and adopted.

(6) *Section 4.4* is deleted in its entirety.