Appendix B

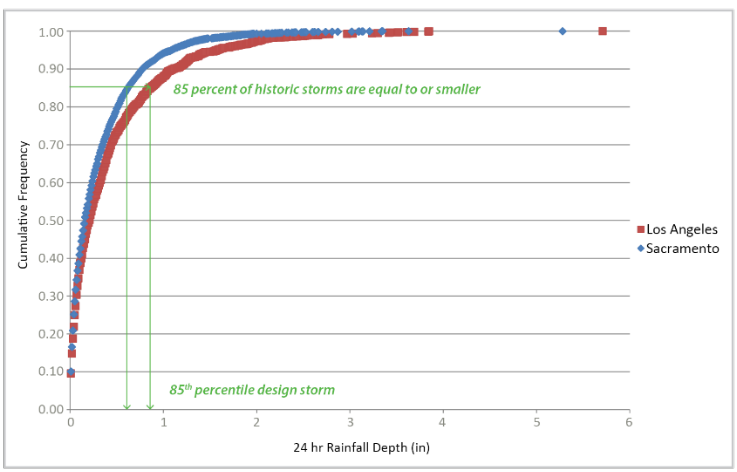
SCM Sizing Methods

1.0 RETENTION AND TREATMENT DESIGN METHODS

Retention and treatment design evaluates the required size and dimensions for a device to prevent or reduce discharges of runoff volumes and pollutants, while recognizing cost and other feasibility limitations. To balance water quality and costs, practitioners have generally accepted a handful of sizing methods, which fall into either volume-based or flow-based categories. The more common methods are summarized below. Complete descriptions, including calculations, are provided in the CA Phase II Sizing Tool documentation manual.

1.1 Volumetric Design Storm Method

The volumetric design storm method is an algebraic water balance in which the device must be able to capture the volume of runoff generated from a specific rain depth that falls onto a defined area. The depth is approximated by ranking several years of 24-hour rainfall data and calculating the depth at which a certain percent of the storms are smaller. The 85th percentile design storm (the depth at which 85% of the daily or 24-hour storms on record are equal to or smaller) is a common a rule of thumb based on research showing that more frequent, smaller storms have the greatest amount of pollutants. The design storm depth is multiplied by the drainage area and a runoff coefficient, the latter of which represents a fraction of the rainfall that becomes runoff (often 0.9 for impervious surfaces). The storage within the SCM— including within the void space of the media, ponding zone, or open space—must be large enough to hold this design storm volume. This method is documented in detail in many existing municipal design manuals, the CA Phase II LID Sizing Tool, and the CASQA New and Redevelopment BMP Handbook.



Design Storm Calculation

$V_{scm} = RF_{DS} \times R_V \times A_{IMP}$

Where:

V_{SCM} = required capture volume for SCM

RF_{DS} = depth of design storm

R_V = volumetric runoff coefficient

A_{IMP} = area of impervious surface draining to SCM

Figure IV–10. How a design storm is determined

1.2 Volumetric Percent Capture Method

The volumetric percent capture method models many rain events and the resulting runoff from a drainage area, as well as the infiltration, evapotranspiration, storage, and discharge from SCMs. The models use many years of historic rainfall and evaporation data (often in hourly time-steps), runoff coefficients appropriate for the drainage area land cover (representing the fraction of rainfall that becomes runoff), on-site soil properties (for infiltration estimates), and capture device characteristics (such as depths and media porosities) to calculate and record volumes of runoff that are generated and then evapotranspirated, infiltrated, and discharged from SCMs across each time step. The difference between the cumulative runoff volumes generated and that discharged is then divided by the total simulation period to determine an annual average volume retained. This average retained volume is divided by the annual average runoff generated to quantify the percent capture. Percent capture for various SCM sizes can be plotted to identify the point of diminishing returns—when higher percent captures start to require a much higher SCM size. Commonly diminishing returns affect cost-effectiveness around 80%.

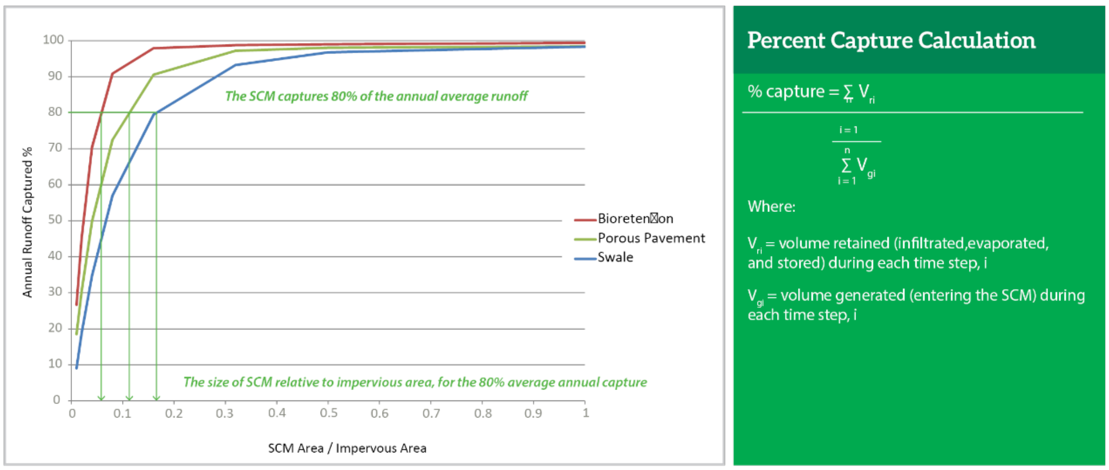


Figure IV–11. Sizing an SCM based on the percent capture method

1.3 Volumetric Baseline Bioretention Method

For the baseline bioretention method, a modification of the percent capture method, the size and other characteristics of a bioretention planter are pre-established without regard to local precipitation data. A common example is a planter that is 4% of the drainage area, with 18 inches of bioretention soil mix, 12 inches of gravel storage, an elevated underdrain, and other specified components. The percent capture for this bioretention SCM is determined, and sizing of other SCMs is based on this percent capture.

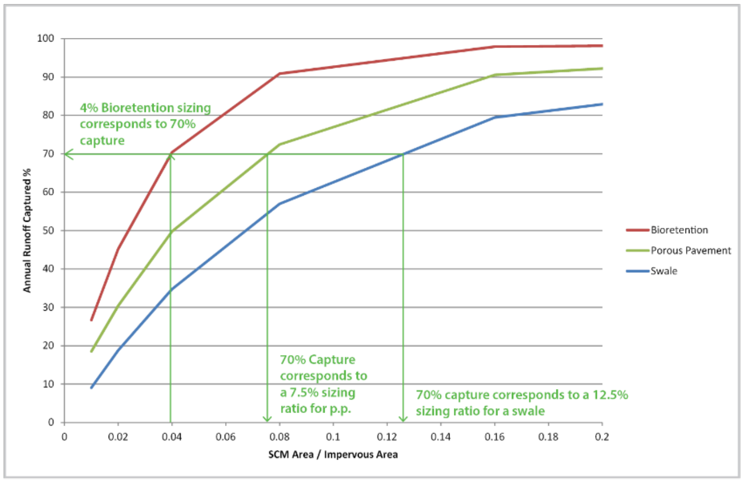


Figure IV–12. Sizing an SCM using the Volumetric Baseline Bioretention Method

1.4 Flow-Based Method

The flow-based method sizes an SCM to retain and treat the flow of runoff produced from a rain event of a specified intensity. Common intensities are 0.02 inches per hour or two times the 85th percentile rainfall intensity based on historic rainfall data. For flow-based design, a runoff model will simulate routing of flows through a single catchment (site-scale design) or multiple catchments (watershed-scale). As runoff moves through a site or watershed, it increases in volume and velocity. The time runoff takes to travel can be estimated through a number of methods. For instance, the rational method and modified rational method are typical, straightforward ways of estimating the travel time. While estimating large-scale flows across watersheds requires significant data, estimating flows and routing in a small catchment is usually less intensive.

1.5 Trash Sizing

Consult with the State Water Board's [Trash Implementation Program] for the latest guidelines on designing SCMs for trash policy compliance.

2.0 HYDROMODIFICATION DESIGN METHODS

Hydromodification design is intended to minimize impacts from higher runoff volumes and flow rates. The objective is to closely match post-construction flow rate discharge to that which occurred pre-construction. For this design, models are run to simulate pre-construction flow rates for a specified return interval such as the 2-year or 10-year storm; it is generally accepted that the greatest effects of hydromodification occur from these (or between these) recurrence intervals. The 2-year, storm represents the intensity of rainfall at which 50% (1/2) of the other historic rainfall intensities are equal to or greater than. This equates to a 50% probability that any storm in a given year will exceed that intensity. The 10-year storm is then the rainfall intensity at which 10% (1/10) of historical rainfall intensities are equal to or greater than, with a 10% likelihood of any storm in one year exceeding that intensity. The post-construction discharge rates cannot exceed these pre-project rates and durations by more than a specified percent. Other methods are more sophisticated, using statistical analysis to evaluate the probability of exceedance for the post-construction condition.