To size volume-based treatment measures, use the following steps, which may be performed using the "C.3 Sizing Worksheet for Volume Based Criteria" available on the SMCWPPP website: http://flowstobay.org/newdevelopment

1. **Identify the Rainfall Region**

   Determine which rainfall region the project site is located in by using the figure in Appendix C. San Mateo County has been divided into seven different regions based on local rainfall patterns.

2. **Determine the Effective Impervious Area for Each Drainage Management Area**

   - Based on the topography of the site and configuration of buildings, divide the site into drainage management areas (DMAs) which will drain to a treatment measure. Implement the steps below for each DMA with a volume-based treatment measure.

   - Minimize the amount of landscaping or pervious pavement that will contribute runoff to the treatment measures. Identify areas of landscaping or pervious pavement that can be considered "self-treating areas" or "self-retaining areas" and may be excluded from the DMAs for the treatment measures.

   - For each DMA that includes pervious surfaces (landscaping or pervious paving), multiply the pervious area by a factor of 0.1 and add to the impervious area to obtain the **effective impervious area**.

3. **Determine the Adjusted Unit Basin Storage Volume**

   - Refer to Table 5-2 (below) to determine the **unit basin storage volume** (UBSV) that corresponds to the site's rainfall region. When using the effective impervious area method, use the unit basin storage volume corresponding to a runoff coefficient of 1.0. For example, if the site is in Region 5 (San Francisco), the UBSV for that region is 0.73 inches.

   - Adjust the UBSV to the appropriate value for your project site by applying the following correction factor based on the ratio of the mean annual precipitation (MAP) of the project site to the MAP of the reference rain gage:

     Correction factor = $MAP_{site} \div MAP_{gage}$

     For example, if the MAP of the site is 23 inches, and the site is in Region 5 with a reference gage MAP of 21 inches, the correction factor would be (23 ÷ 21) = 1.10.

     Multiply the UBSV by the correction factor to get the **adjusted unit basin storage volume**. For the example site described above, the adjusted UBSV would be 1.10 X 0.73, or 0.80 inches.

4. **Calculate the Water Quality Design Volume**

   Calculate the **water quality design volume ("C.3.d volume")** by multiplying the effective impervious area of the drainage management area (in square feet), determined in Step 2, by the adjusted UBSV determined in Step 3 (in units of inches converted to feet). For example, for the adjusted UBSV of 0.80 inches, and an effective impervious area draining to the bioretention facility of 35,000 square feet, the water quality design volume would be 0.8 inches × (1 foot/12 inches) × 35,000 square feet = 2,332 cubic feet.

| | | **Table 5-2** Unit Basin Storage Volumes in Inches for 80 Percent Capture Using 48-Hour Drawdown Time | | |

Region[1]	Meteorological Station, and Mean Annual Precipitation (Inches)	Unit Basin Storage Volume for Effective Impervious Area of Drainage Management Area
		Coefficient of 1.00
1	Boulder Creek, 55.9"	2.04
2	La Honda, 24.4"	0.86
3	Half Moon Bay, 25.9"	0.82
4	Palo Alto, 14.6"	0.64
5	San Francisco, 21.0"	0.73
6	San Francisco Airport, 20.1"	0.85
7	San Francisco Oceanside, 19.3"	0.72

Source: CDM memo dated May 14, 2004

[1] See Appendix C to locate the applicable Treatment Measure Design Criteria Region.

To apply the combination flow and volume approach, use the following steps, which may be performed using the "C.3 Sizing Worksheet for Combination Flow and Volume Based Criteria" available on the SMCWPPP website: http://flowstobay.org/newdevelopment

1. ***Determine the Water Quality Design Volume***

   ▪ Calculate the ***water quality design volume*** using the methodology described on page 1 of this handout. Also note the ***adjusted unit basin storage volume*** (UBSV) that was determined as part of the methodology. For the example described on page 1, the water quality design volume is 2,332 cubic feet and the adjusted UBSV is 0.80 inches.

2. ***Estimate the Duration of the Rain Event***

   ▪ Assume that the rain event that generates the design volume of runoff occurs at a constant intensity of 0.2 inches/hour and that the rainfall intensity equals the runoff rate (i.e., assume a rectangular hydrograph). Calculate the duration of the rain event by dividing the adjusted UBSV by the intensity. In other words, determine the amount of time required for the UBSV to be achieved at a rate of 0.2 inches/hour. For example, if the adjusted UBSV is 0.80 inches, the rain event duration is: (0.80 inches ÷ 0.2 inches/hour) = 4.0 hours.

3. ***Make a Preliminary Estimate of the Surface Area of the Facility***

   ▪ Make a preliminary estimate of the surface area of the bioretention facility by multiplying the DMA's impervious surface area (or effective impervious area, if applicable) by a sizing factor of 0.04 (i.e., the 4 percent method). For example, a drainage area of 35,000 square feet of impervious surface × 0.04 = 1,400 square feet of bioretention treatment area.

   ▪ Assume a bioretention area that is about 25% smaller than the bioretention area calculated with the 4 percent method. Using the example above, 1,400 – (0.25 × 1,400) = 1,050 square feet.

   ▪ Calculate the volume of runoff that filters through the biotreatment soil at a rate of 5 inches per hour (the design surface loading rate for bioretention facilities), for the duration of the rain event calculated in Step 2. For example, for a bioretention surface area of 1,050 square feet, with an infiltration rate of 5 inches per hour for a duration of 4.0 hours, the volume of treated runoff = 1,050 square feet × 5 inches/hour × (1 foot/12 inches) × 4.0 hours = 1,750 cubic feet.

4. ***Determine the Ponding Depth for the Assumed Surface Area***

   ▪ Calculate the portion of the water quality design volume remaining after treatment is accomplished by filtering through the biotreatment soil. The result is the amount that must be stored in the ponding area above the biotreatment soil. For the example above, the amount remaining to be stored is: 2,332 cubic feet – 1,750 cubic feet = 582 cubic feet. If this volume is stored over a surface area of 1,050 square feet, the average ponding depth would be 582 cubic feet ÷1,050 square feet = 0.55 feet or 6.7 inches.

   ▪ Check to see if the average ponding depth is approximately 6 inches, which is the recommended ponding depth in a bioretention facility or flow-through planter.

5. ***Optimize the Size of the Treatment Measure***

   ▪ If the ponding depth is less than 6 inches, the bioretention design can be optimized with a smaller surface area. If the ponding depth is greater than 6 inches (or the depth allowed by the municipality), a larger surface area will be required. (In the above example, the recommended size of the bioretention area is 1,075 square feet with a ponding depth of 6.0 inches.)