6.1 Bioretention Areas

Figure 6-1. Bioretention Area.
Source: City of Brisbane

Best uses
- Any type of development
- Drainage area up to 2 acres
- Landscape design element

Advantages
- Detains low flows
- Landscape feature
- Low maintenance
- Reliable once established

Limitations
- Not appropriate where soil is unstable
- Requires irrigation
- Susceptible to clogging – especially if installed prior to construction site soil stabilization.

Bioretention areas[1], or "rain gardens," are concave landscaped areas that function as soil and plant-based filtration devices that remove pollutants through a variety of physical, biological, and chemical treatment processes. Bioretention areas can be any shape, including linear. Linear bioretention areas are sometimes referred to as bioretention swales. Bioretention areas normally consist of the following layers, starting from the top: a surface ponding area, a layer of mulch, planting soil and plants, and an underlying rock layer with an underdrain that connects to the municipal storm drain system.

Bioretention areas are designed to distribute stormwater runoff evenly within the surface ponding area. The water is temporarily stored in the ponding area and percolates through the planting soil, which is engineered to have a high rate of infiltration. From there, the water filters down into the underlying rock layer.

The rock layer of the bioretention area may be designed to either maximize infiltration or prevent infiltration to the underlying soils. In bioretention areas that maximize infiltration, the underdrain is raised 6 inches above the bottom of the rock layer, and there is no liner between the rock layer or planting soil and the surrounding soils. Maximizing infiltration is only allowed where conditions are suitable for infiltration – check with the geotechnical engineer. Where infiltration is precluded, the bioretention area is fully lined with waterproof material, and the underdrain is placed at the bottom of the rock layer.

Design and Sizing Guidelines

DRAINAGE AREA AND SETBACK REQUIREMENTS

- Set back from structures 10' or as required by structural or geotechnical engineer, or local jurisdiction.
- Area draining to the bioretention area does not exceed 2 acres.

[1] A bioretention area that is unlined and has a raised underdrain in the underlying rock layer to promote infiltration may also be called a "bioinfiltration area".

- Area draining to the bioretention area shall not contain a significant source of soil erosion, such as high velocity flows along slopes not stabilized with vegetation or hardscape.
- Areas immediately adjacent to bioretention area shall have slopes more than 0.5% for pavement and more than 1% for vegetated areas.
- Bioretention areas, including linear treatment measures, shall not be constructed in slopes greater than 4%, unless constructed as a series of bioretention cells. Separate bioretention cells by check dams up to 24 inches high and at least 25 feet apart. The slope within cells shall not exceed 4%. Bioretention cells are not recommended if overall slope exceeds 8%.
- If treatment measure is designed to infiltrate stormwater to underlying soils, a 50-foot setback is needed from septic system leach field.

TREATMENT DIMENSIONS AND SIZING

- Bioretention area may be sized to 4% of the impervious surface area on the project site. The area of impervious surface multiplied by 0.04 sizing factor will equal the footprint of the bioretention area. Alternatively, bioretention sizing may be calculated using the flow-based treatment standard, or the combination flow- and volume-based treatment standard described in Section 5.1 based on the flow entering the basin at the treatment flow rate over the initial hours of the storm until the treatment volume is attained.
- The bioretention area shall be sized to either:
  - Percolate the design treatment flow using a rate of 5 inches per hour. No additional allowance is provided for storage or for infiltration rates in excess of 5 inches per hour; or,
  - Store the 24-hour treatment volume based on inflow at the water treatment rate for the initial hours of the storm and outflow by infiltration.
- Where there is a positive surface overflow, bioretention areas shall have freeboard of at least 0.2 feet to the lowest structural member versus the 100-year storm water level in the bioretention area, unless local jurisdiction has other requirements.
- Where the bioretention area is in a sump that depends on outflow through a catch basin, the bioretention area shall have a freeboard of at least 0.5 feet to the lowest building finished floor elevation (including garage and excluding crawl space) for conditions with the outlet 50 percent clogged, unless local jurisdiction has other requirements. Where the freeboard cannot be provided, emergency pump may be allowed on a case-by-case basis.
- Minimum 2 inches between the crest of the emergency outfall riser and elevation of the surface area.
- The elevation of the surface area may vary as needed to distribute stormwater flows throughout the surface area.
- Side slopes do not exceed 3:1; downstream slope for overflow shall not exceed 3:1.
- Surface ponding depths should vary, with a maximum depth of 12 inches. If ponding depths exceed 6 inches, landscape architect shall approve planting palette for desired depth.
- The inlet to the overflow catch basin shall be at least 6 inches above the low point of the bioretention planting area.

INLETS TO TREATMENT MEASURE

Flow may enter the treatment measure (see example drawings in Section 5.13):

- As overland flow from landscaping (no special requirements)

  - As overland flow from pavement (cutoff wall required)
  - Through a curb opening (minimum 18 inches)
  - Through a curb drain
  - With drop structure through a stepped manhole (refer to Figure 5-3 in Chapter 5)
  - Through a bubble-up manhole or storm drain emitter
  - Through roof leader or other conveyance from building roof
- Where flows enter the biotreatment measure, allow a change in elevation of 4 to 6 inches between the paved surface and biotreatment soil elevation, so that vegetation or mulch build-up does not obstruct flow.
- Cobbles or rocks shall be installed to dissipate flow energy where runoff enters the treatment measure.

VEGETATION

- Plant species should be suitable to well-drained soil and occasional inundation. See planting guidance in Appendix A.
- Shrubs and small trees shall be placed to anchor the bioretention area cover.
- Tree planting shall be as required by the municipality. If larger trees are selected, plant them at the periphery of bioretention area.
- Underdrain trench shall be offset at edge of tree planting zone, as needed, to maximize distance between tree roots and underdrain.
- Use integrated pest management (IPM) principles in the landscape design to help avoid or minimize any use of synthetic pesticides and quick-release fertilizer. Check with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.
- Irrigation shall be provided to maintain plant life.
- Trees and vegetation do not block inflow, create traffic or safety issues, or obstruct utilities.

SOIL CONSIDERATIONS SPECIFIC TO BIORETENTION AREAS

- Planting soil shall have a minimum percolation rate of 5 inches per hour and a maximum percolation rate of 10 inches/hour. Soil guidance is provided in Appendix K. Check with municipality for any additional requirements.
- Bioretention areas shall have a minimum planting soil depth of 18 inches.
- Provide 3-inch layer of mulch in areas between plantings.
- An underdrain system is generally required. Depending on the infiltration rate of in situ soils, the local jurisdiction may allow installation without an underdrain on a case-by-case basis.
- Underdrain trench shall include a 12-inch thick layer of Caltrans Standard Section 68-1.025 permeable material Class 2, or similar municipality-approved material. A minimum 4-inch diameter perforated pipe shall be placed within the backfill layer. To help prevent clogging, two rows of perforation may be used.
- If there is at least a 10-foot separation between the base of the underdrain and the groundwater table, and geotechnical conditions allow, there shall be at least 6-inch separation between the perforated pipe and the base of the trench to allow percolation.

SOIL CONSIDERATIONS FOR ALL BIOTREATMENT SYSTEMS

- Filter fabric shall not be used in or around underdrain trench.
- If there is less than 10 feet separation to the groundwater table, an impermeable fabric shall be placed at the base of the underdrain and the perforated pipe shall be placed on the impermeable fabric.

- The underdrain shall include a perforated pipe with cleanouts and connection to a storm drain or discharge point. Clean-out shall consist of a vertical, rigid, non-perforated PVC pipe, with a minimum diameter of 4 inches and a watertight cap fit flush with the ground, or as required by municipality.
- There shall be adequate fall from the underdrain to the storm drain or discharge point.
- Beginning December 1, 2011, soils in the area of inundation within the facility shall meet biotreatment soil specifications approved by the Regional Water Board (Appendix K), which supersede other soil specifications. The minimum percolation rate for the biotreatment soil is 5 inches per hour. The long-term desired maximum infiltration rate is 10 inches per hour, although initial infiltration rate may exceed this to allow for tendency of infiltration rate to reduce over time.

CONSTRUCTION REQUIREMENTS FOR ALL BIOTREATMENT SYSTEMS

- When excavating, avoid spreading fines of the soils on bottom and side slopes. Remove any smeared soiled surfaces and provide a natural soil interface into which water may percolate.
- Minimize compaction of existing soils. Protect from construction traffic.
- Protect the area from construction site runoff. Runoff from unstabilized areas shall be diverted away from biotreatment facility.

MAINTENANCE CONSIDERATIONS FOR ALL TREATMENT MEASURES

- A Maintenance Agreement shall be provided.
- Maintenance Agreement shall state parties' responsibility for maintenance and upkeep.
- Prepare a maintenance plan and submit with Maintenance Agreement. Maintenance plan templates are in Appendix G.

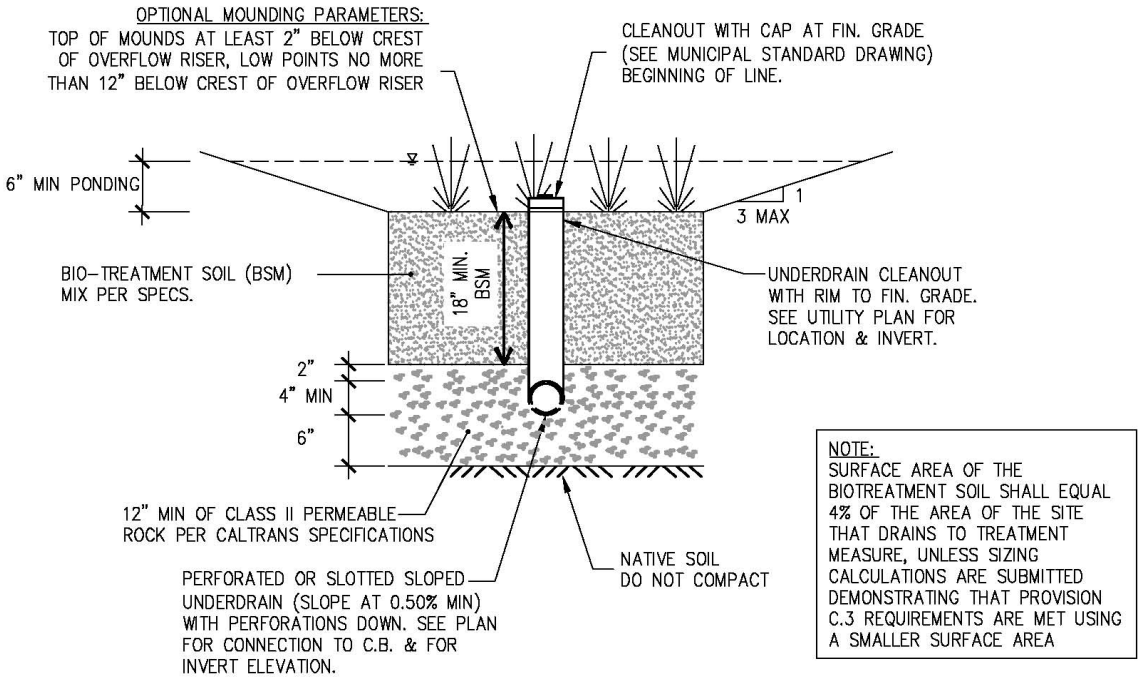

Figure 6-2: Cross Section, Bioretention Area

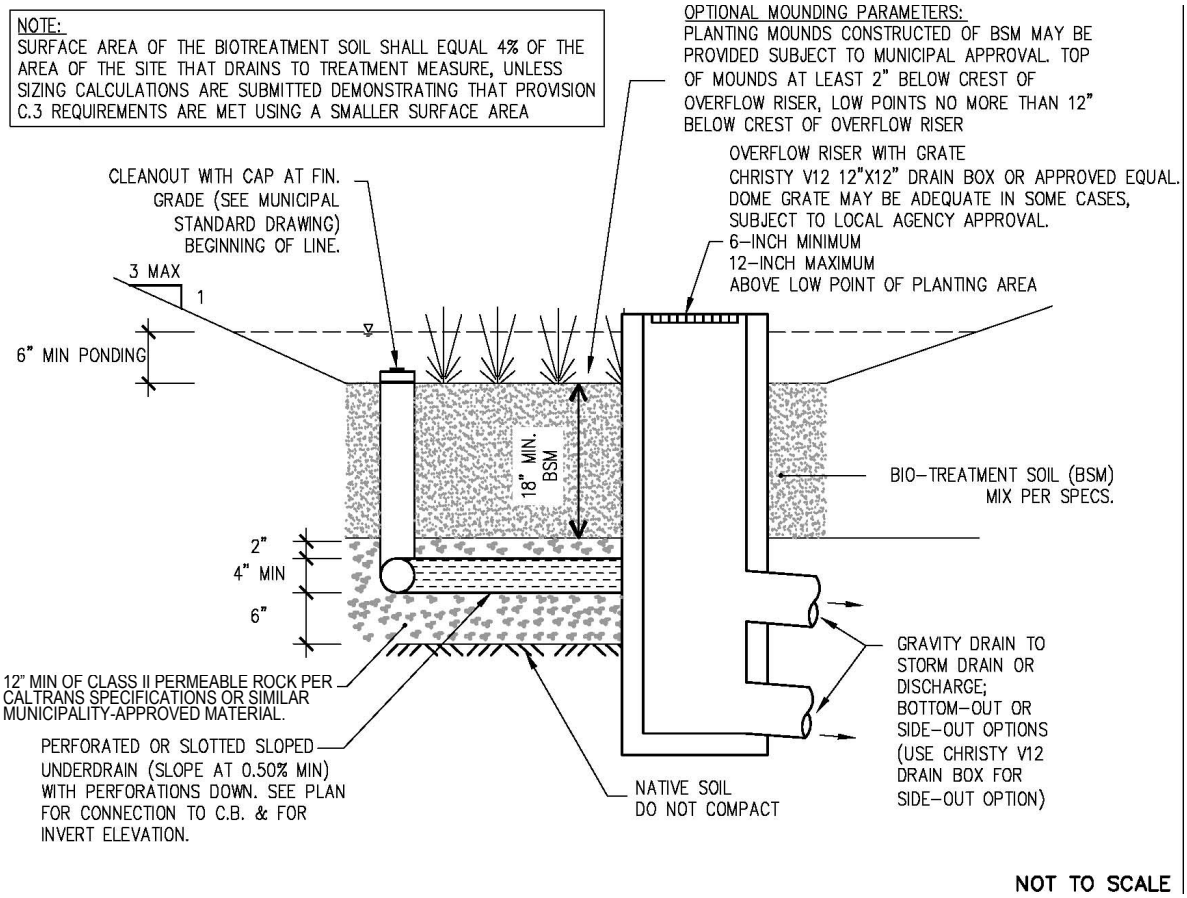

Figure 6-3: Cross Section, Bioretention Area (side view)

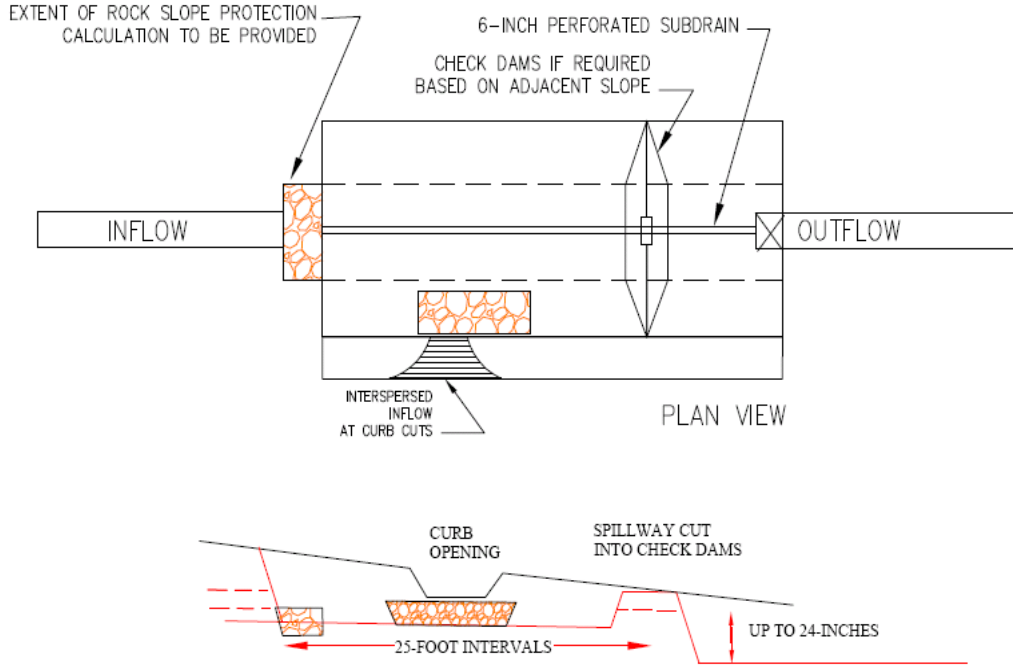

Figure 6-4: Check dam (plan view and profile) for installing a series of linear bioretention cells in sloped area

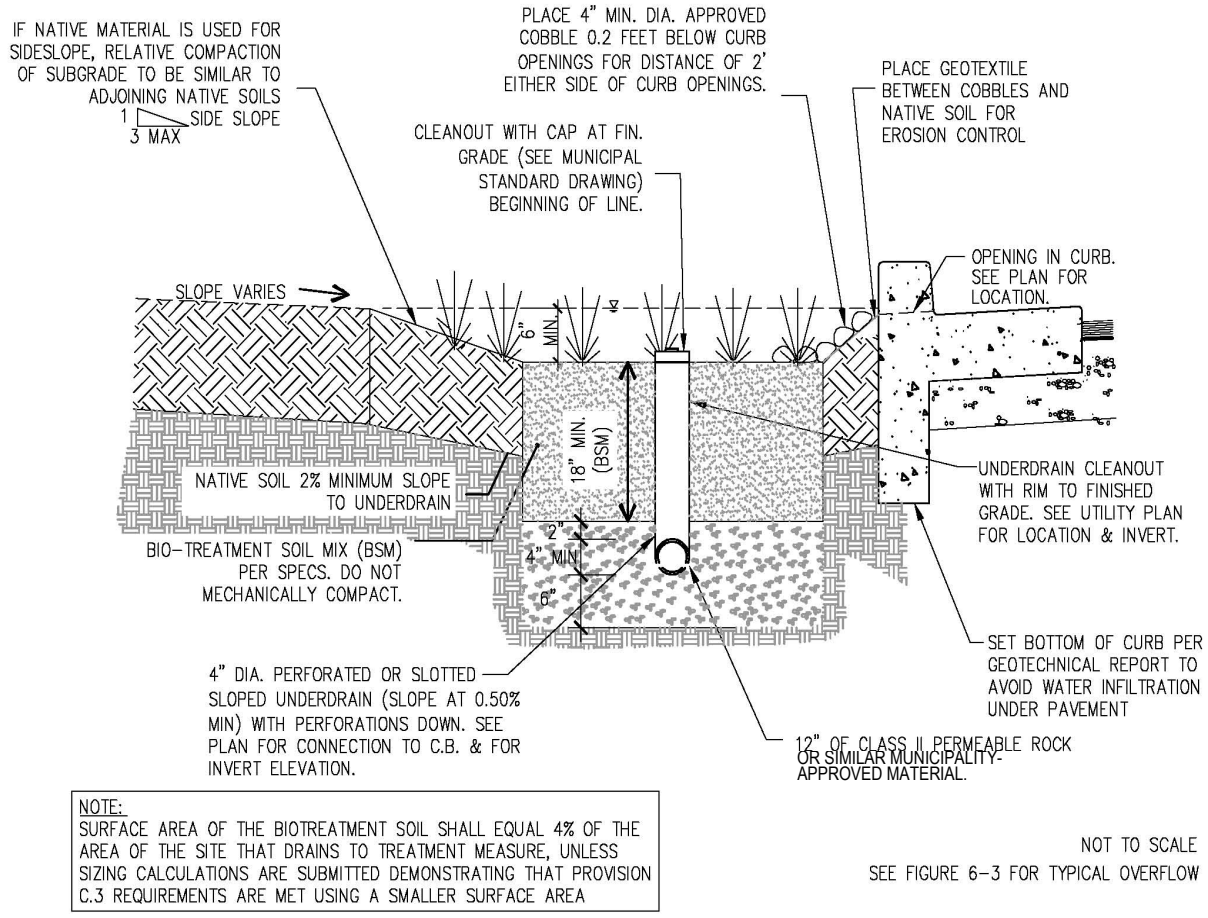

Figure 6-5: Cross section of bioretention area showing inlet from pavement.

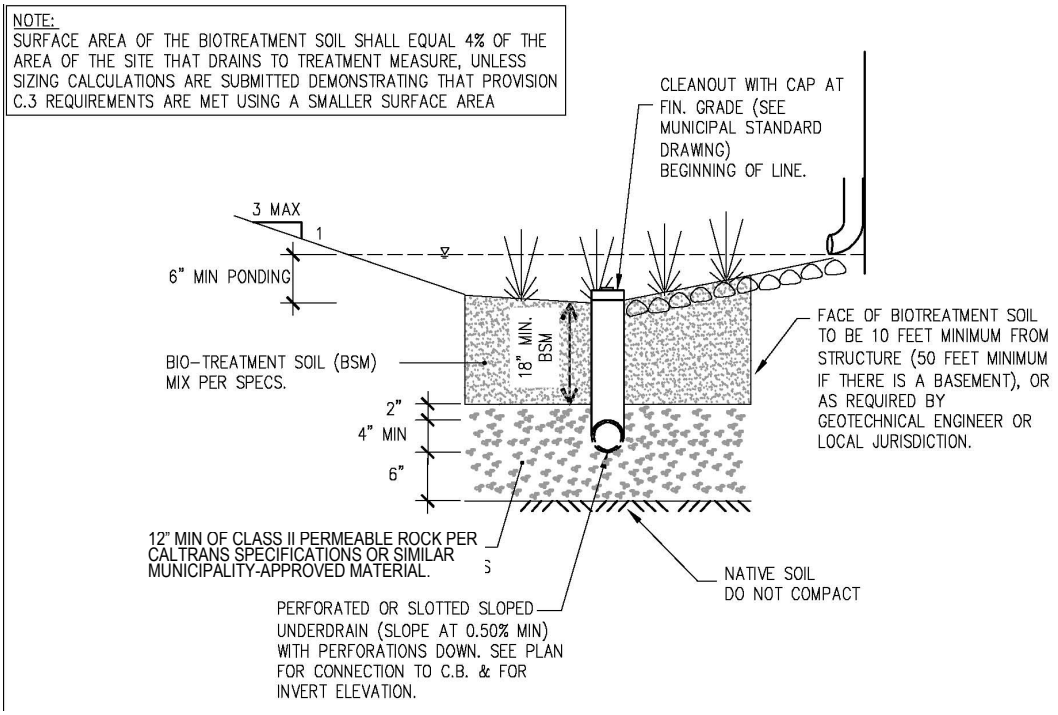

Figure 6-6: Bioretention area in landscaping to treat runoff from rainwater leaders (Not to Scale)

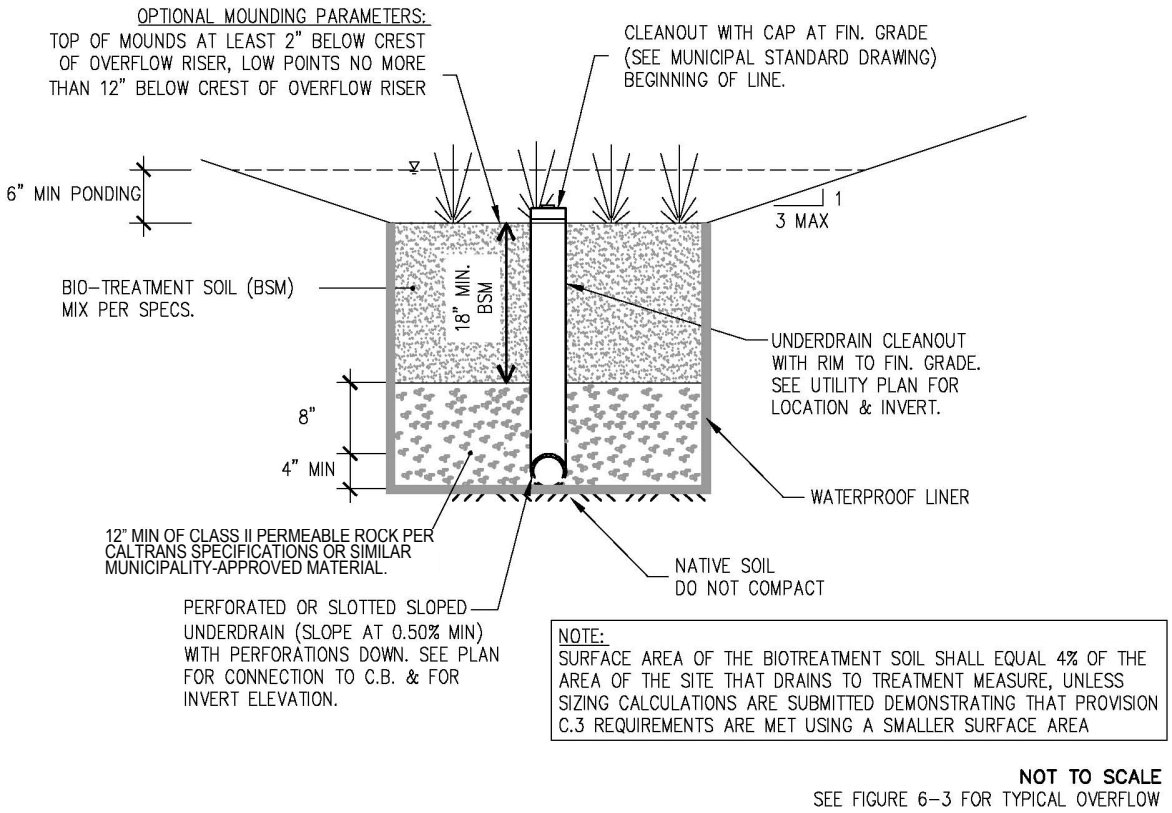

Figure 6-7: Cross section of lined bioretention area, for locations where infiltration is precluded.

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