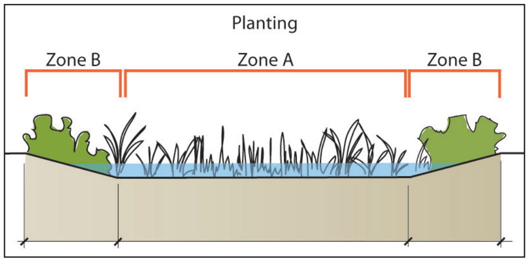
Central California Coast
**Technical Assistance Memo (TAM)**

# LID Bioretention Guidance

## Low Impact Development

**Bioretention facilities may look like conventional landscapes, but they are specially designed to slow, treat, and infiltrate stormwater runoff.** This Technical Assistance Memo (TAM) gives general guidance for designing, constructing, and maintaining bioretention facilities with a focus on designs used to address post-construction stormwater control regulations.

## Basic Bioretention Design Types



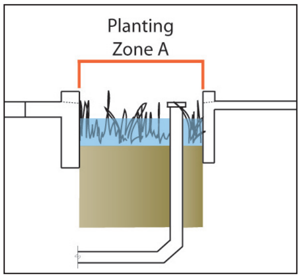

SLOPED-SIDED STYLE

### Characteristics

- Sloped surface with temporary ponded water
- Two planting zone types
- Forms: rain garden or linear swale

### Advantages

- Lower cost (less infrastructure)
- Multiple design configurations
- Sloped side provides gradual edge transition
- Example applications: street edge, multipurpose landscapes, curb bulb extensions




FLAT-BOTTOM STYLE

### Characteristics

- Flat planting surface with temporary ponded water
- Contained by walls or curbs
- Single plating zone
- Form: planter

### Advantages

- Good fit for constrained sites
- 100% of the facility functions
- Example applications: street edge between curb and sidewalk, plazas, narrow parking lot strips

## Site Suitability for Bioretention

Bioretention facilities must be designed to achieve the desired performance while addressing public health and safety, and infrastructure protection (both of the bioretention facility as well as surrounding infrastructure such as streets and parking lots). A critical first step of design is the site assessment, which informs the technical feasibility and overall site layout. This step involves investigating natural features, built features and other site characteristics. See "Resources" for links to detailed site assessment guidance. Bioretention feasibility constraints may include:

- High ground water
- Shallow bedrock layer
- Proximity to drinking wells
- Geotechnical hazards
- Polluted soil or groundwater
- Native soil infiltration rates
- Existing vegetation/trees
- Utilities
- Zoning and land use
- Setbacks
- Lack of incompatible drainage infrastructure

# Design Guidance for Bioretention Areas

Once bioretention is deemed feasible, it is important to use accurate bioretention design guidance. The key design features of a bioretention facility generally include:

## KEY DESIGN FEATURES

1. **Curb and gutter:** Where projects include curb and gutter, increased gutter width and curb depth provide structural support between the adjacent road or parking surface and bioretention soil media. A vertical liner keeps stormwater from migrating into the road base.
2. **Inlet curb cut:** Inlet design (e.g., curb cut) provides the width and geometry needed to direct flows into the facility.
3. **Overflow:** Facilities must incorporate a mechanism to bypass flows that exceed the design ponding depth. This mechanism may be a raised overflow structure connected via pipe to an approved discharge point, or a surface conveyance route (e.g., curb cuts, grate-covered channel, or culvert to another facility).
4. **Surface ponding:** Ponding provides additional stormwater capacity. The ponding depth and drawdown time is often dictated by public safety and vector control. The overflow elevation sets the ponding depth.
5. **Aggregate layer:** A specified aggregate layer increases the facility's water storage capacity (optional in systems without an underdrain; depth is per calculations). Specified aggregates omit the need for filter fabric, which is known to cause clogging.
6. **Bioretention soil media:** A specified mix of aggregate and compost provides targeted infiltration and water quality treatment, while supporting healthy plant growth.
7. **Mulch:** The specified mulch is a well-aged compost or fine bark; not wood chips or other material that will float and clog overflow structures.

Features not shown:

**Underdrain:** An underdrain may be needed if site conditions do not adequately support infiltration. With an underdrain, runoff not infiltrated into the native soil enters a perforated pipe, which discharges to the conventional stormwater system. If an underdrain must be used, it should be placed to optimize stormwater retention, consistent with regulatory requirements.

**Energy dissipation:** To prevent stormwater runoff from eroding the soil surface as it enters the facility, a concrete splash pad or rock cobble (3"-5"-size rounded rock, 6" depth) is placed at the inlets.

**Plants:** Appropriate plants for bioretention include native plants, or adaptable non-natives, that tolerate periodic inundation and summer drought (see the LIDI Plant Guidance for Bioretention TAM).

## LIDI STANDARD DETAILS

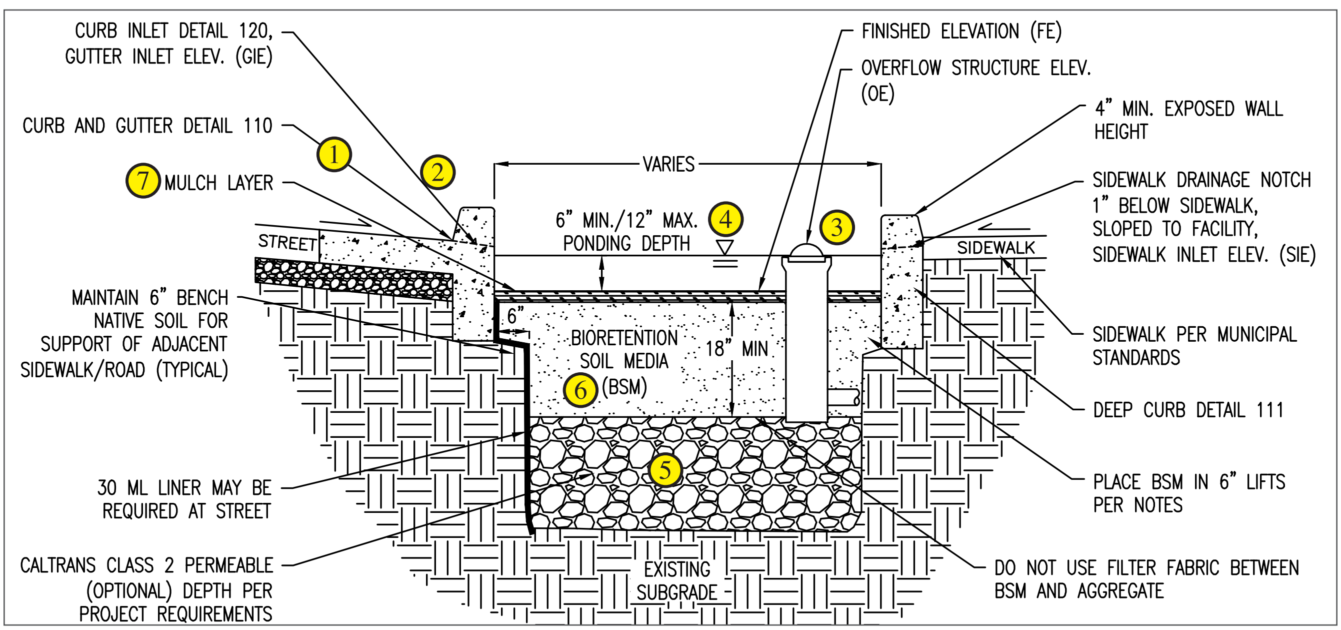



Figure 1: **Sample standard detail available on the LIDI web site in PDF and DWG native file format**

The Central Coast LIDI Standard Details and supporting Technical Specifications provide design guidance for several bioretention design types. Some modifications to these details can be made without negative impact, while other modifications may result in project failure. Before changing the standard details, it is important to fully understand the consequences of modifications; if uncertain, seek guidance from someone knowledgeable in bioretention design. The designer should also evaluate whether the design requires pretreatment for sediment, which can clog the bioretention infiltration media. Designs for conventional sediment removal (e.g., filter strips, settling basins and forebays) are available on-line, see "Resources."

# Bioretention Construction

## 1) PROTECTION AND EXCAVATION

Protecting bioretention areas during all phases of construction is a top priority. In project specifications, and during pre-bid and pre-construction meetings, communicate requirements and expectations to the contractor. From the start of construction, areas should be fenced to define limits and keep heavy equipment out. Erosion and sediment control measures should be placed so that construction sediment and wastes cannot enter the facility. Excavation activities should avoid compacting the facility base and sidewalls and should not take place during wet weather. Inlets should be blocked until construction sediment sources are removed and plants are sufficiently established to hold up to stormwater flows.


Source: Cannon


Source: Kevin Robert Perry


Source: Cannon

## 2) HARD INFRASTRUCTURE

Structures such as curbs, gutters, inlets, and planter walls are critical to facility function. During construction, verify that elevations for these elements (e.g., gutter inlets, overflows, check dams, and adjacent sidewalks) match civil plans. For example, the raised overflow structures used in bioretention facilities may look like a plan error to contractors not experienced with LID. Clearly communicating design objectives will help avoid uninformed field adjustments.


Source: Kevin Robert Perry


Source: Kevin Robert Perry

## 3) FACILITY MEDIA

The bioretention soil mix and optional aggregate layer are also critical to facility function. During pre-bid and pre-construction meetings explain the characteristics and purpose of bioretention soil and aggregate to contractors; follow up by thoroughly reviewing construction material submittals. To ensure that the installation meets the design intent, the contractor and landscape installer must coordinate on excavation, media depth, and finished grades. Clear design direction and communication is needed to illustrate special conditions at tree planting locations (e.g., deepened soil and no aggregate under trees).


Source: Dan Cloak

## 4) LANDSCAPE INSTALLATION

Bioretention areas differ from traditional landscapes. Plants and trees placed within the ponding zone must be tolerant of periodic inundation and drought. Avoid installing plants where they can block inlets. If the area will be mulched, initial excavation depth must anticipate the total combined media depth, to avoid having to reduce soil depth during construction to accommodate mulch at final grades. Mulch should not be installed just before or during the rainy season.


Source: Kevin Robert Perry


Source: Seattle Public Utilities

# Most Common Mistakes

The following examples highlight some common bioretention design and construction mistakes:

Source: City of Portland Environmental Services

**Inlet design:** The asphalt berm shown here was installed in the gutter as a retrofit, to keep stormwater from flowing past the inlet. Inlet designs have evolved, incorporating elements such as depressed gutters and rounded curbs, to more effectively direct and convey flows.

**Overflow location and elevation:** The area drain to the right is directly aligned with the curb cut inlet and located at the bottom of the planter. Most of the runoff entering the facility will flow directly into the stormdrain. Similarly an overflow drain set near the bottom of a depressed planting area (below), reduces the opportunity for stormwater to pond and to infiltrate into the native soil.

**Floating mulch:** This inlet is being clogged by bark mulch that floats and washes into the drain during storms. It is important to use a non floating mulch, such as compost or fine, aged bark, and to avoid installing mulch just before or during the rainy season.

# Operations and Maintenance

Bioretention facilities must be managed for stormwater performance, plant health, and aesthetics. Routine maintenance falls into three categories:

**Hard infrastructure:** removing sediment and other materials from structures and trash racks.

**Soft components:** caring for plants; removing dead or diseased vegetation, weeds, and leaf litter; replacing dead plants; moving plants that block inlets; adding mulch; and topdressing with compost.

**Overall function:** taking measures to reduce erosion (e.g., by adding cobble); removing sediment buildup within the bioretention facility, and trash removal.

Critical for long-term success, a maintenance plan serves to educate and guide those responsible for keeping LID systems functioning and aesthetically pleasing. Examples of maintenance plans for bioretention facilities are available by searching on-line.

# Resources

Examples of bioretention resources:

LID Site Assessment

**City of Santa Barbara, Storm Water BMP Guidance Manual:** http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf

Sediment Pretreatment BMPs

**County of Los Angeles Stormwater BMP Design Manual:** http://dpw.lacounty.gov/ldd/publications/Stormwater%20BMP%20Design%20and%20Maintenance%20Manual.pdf

**Stormwater Quality Design Manual for the Sacramento and South Placer Regions:** http://www.waterresources.saccounty.net

**Caltrans Stormwater Quality Handbook: Project Planning and Design Guide (July 2010):** http://www.dot.ca.gov/hq/oppd/stormwtr/ppdg.htm

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