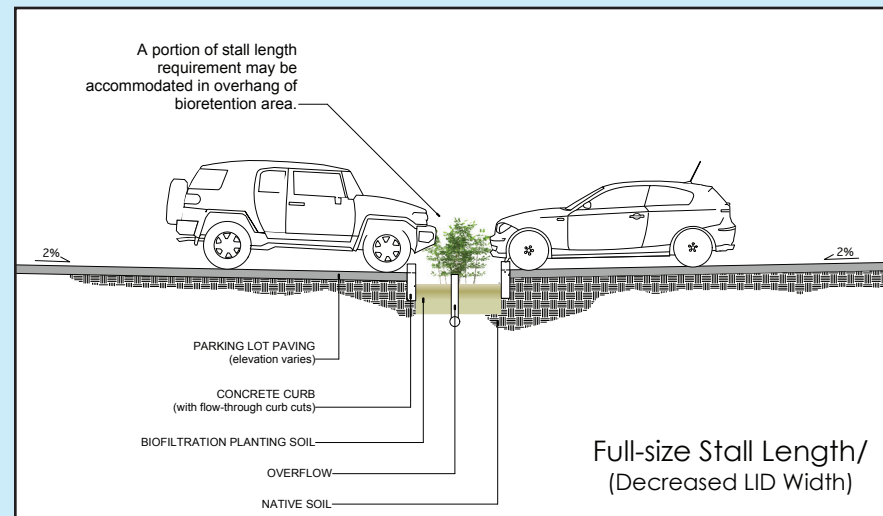
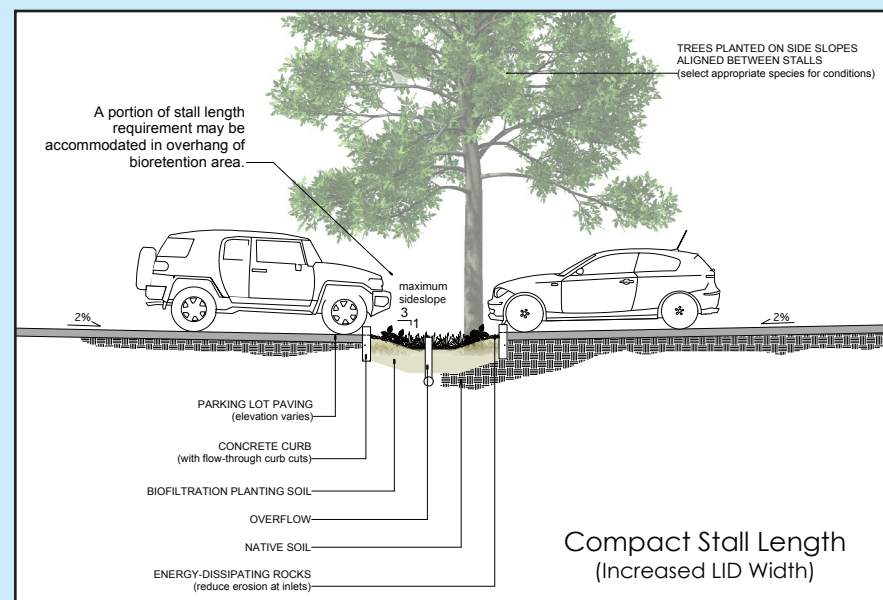
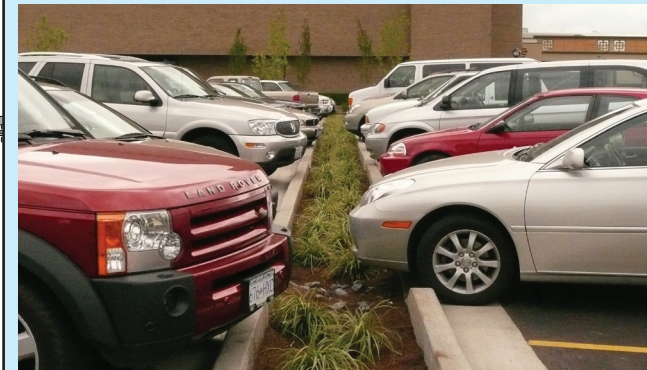


Parking Configurations for LID parking lots can include the elimination of unneeded parking stalls and careful sizing and layout of planned stalls. Parking configurations can be adapted to meet both parking and stormwater management needs by sizing bioretention swales to fit with compact and full-sized parking stalls.



In this retrofit example, a narrow bioretention planting strip replaces pavement under the vehicle overhang space, accommodating full-size parking stalls. Some bioretention planting strips may be too narrow to include trees.



Considerations for tree placement in bioretention areas:

- Locate trees on side slopes, above areas that pond.
- Select trees that will tolerate seasonally wet soils.
- Do not specify trees with invasive roots.



This parking lot has both full and compact length stalls. The width of the bioretention area increases where parking stall size is decreased to compact.

Additional Resources

There is a wealth of information available on-line related to LID. The references below are good starting points for LID site planning and design.

- The Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies
<http://www.casqa.org/LID/tabid/186/Default.aspx>
- The California Stormwater Quality Association (CASQA) BMP Handbook for New Development and Redevelopment
<http://www.cabmphandbooks.com/>
- Contra Costa Clean Water Program (C3 Guidebook)
<http://www.cccleanwater.org/c3.html>
- City of Santa Barbara: Storm Water BMP Guidance Manual
http://www.santabarbaraca.gov/Resident/Major_Planning_Efforts/Storm_Water_Management_Program/



LEGAL DISCLAIMER: This Technical Assistance Memo (TAM) is intended as guidance only and should not be used as a substitute for site specific design and engineering. Applicants are responsible for compliance with all code and rule requirements, whether or not described in this TAM.

California Technical Assistance Memo

LID Parking Lots

Low Impact Development

slow flow
reduce runoff
improve water quality

Before California was developed, the natural landscape, vegetation, and soils were virtually undisturbed. Under these pre-development conditions, as much as 50% of rainwater was infiltrated into the soil replenishing groundwater supplies, contributing to stream flows and sustaining vegetation; another 40% was released into the atmosphere through evapotranspiration. Only about 10% of rainwater contributed to stormwater runoff (rainwater that flows over the land surface). Today, our urban landscape has more impervious surfaces (hard surfaces that do not allow water to pass through) such as roofs, streets, sidewalks and parking areas. The increase in impervious surfaces has caused the amount and rate of stormwater runoff to be greater than pre-development conditions. These increased stormwater flows can cause flooding, road damage and erosion to natural streams and rivers. Runoff also carries pollutants from the surrounding watershed such as pesticides, bacteria, oils, metals and sediments that can make waters unsafe for recreational use and wildlife.

One of the ways to reduce the negative impacts of stormwater runoff is to change the way we approach development. The use of Low Impact Development (LID) strategies can help to protect and enhance the environmental quality of our rivers, creeks and watersheds. LID is a site design approach that uses techniques to slow and infiltrate stormwater, mimicking the natural, pre-development hydrology. LID design strategies can be applied to most new or redevelopment projects to meet stormwater regulations, reduce downstream flooding and protect natural resources.

This Technical Assistance Memo (TAM) provides guidance for designing LID or "green" parking lots. The amount of impervious surface and heavy automobile use associated with parking lots makes them a significant source of stormwater runoff and pollutants. Incorporating LID strategies into new or retrofit parking lots supports our community and environment.

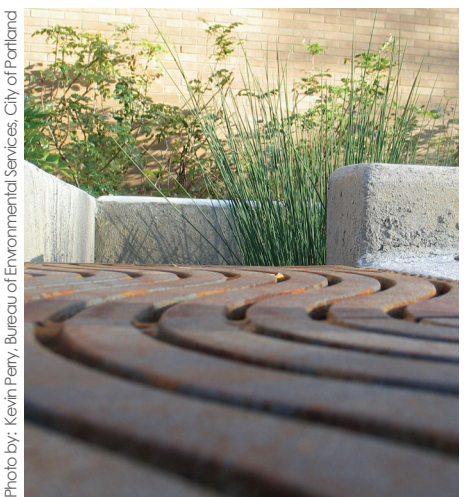







Photo by: Kevin Perry, Bureau of Environmental Services, City of Portland

Source: City of Paso Robles, Salinas River, Aerial

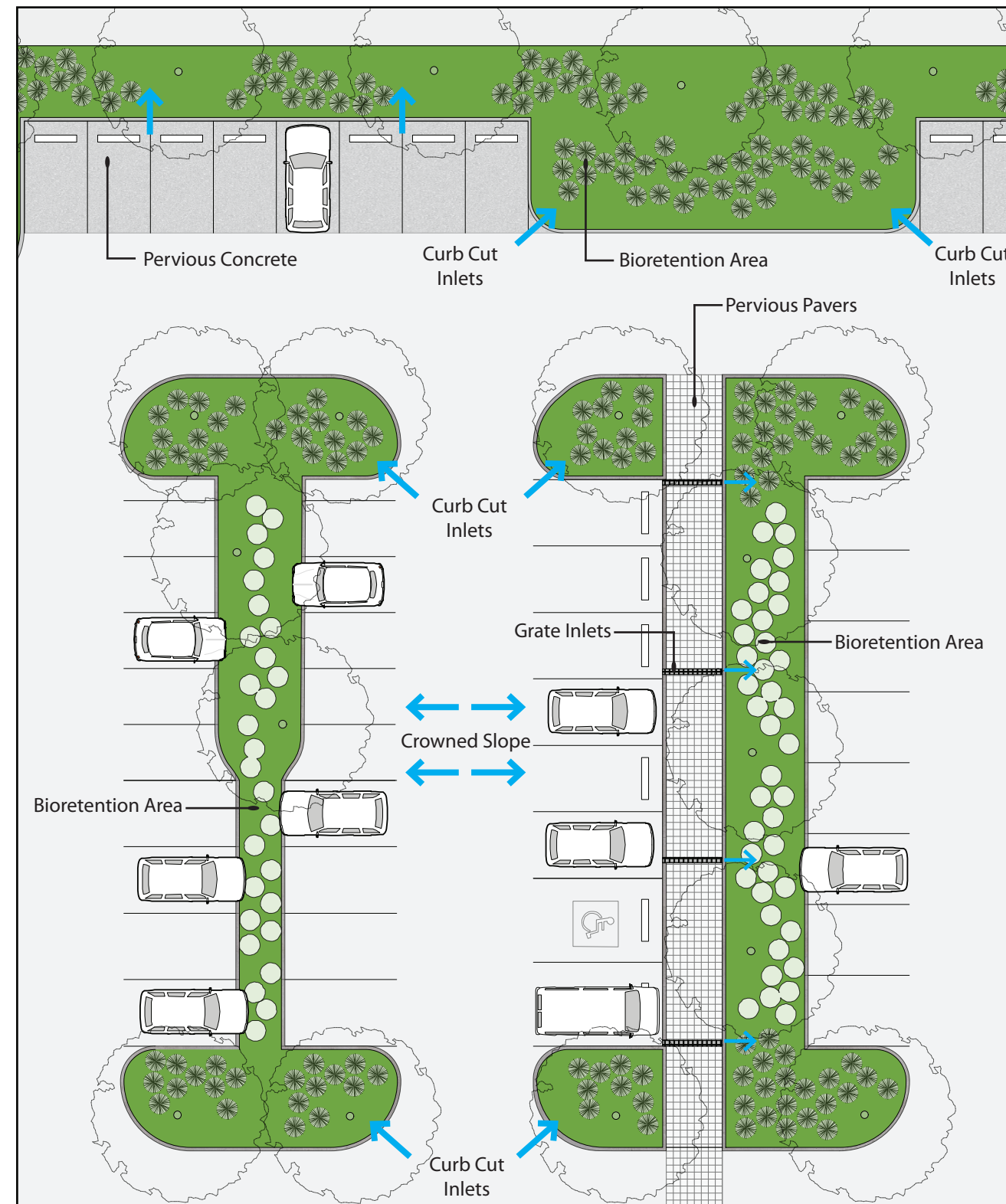
Design Strategy: Structural Controls

Bioretention and pervious pavements are the most common LID features utilized for parking lot stormwater management. Bioretention facilities can be configured in nearly any shape and pervious pavements come in a variety of styles, colors and finishes making them flexible ways to achieve the desired performance.

Bioretention	<p>Bioretention systems: Planted areas designed to filter, store and infiltrate stormwater, utilizing mulch, soil and plant root systems, to retain, degrade and absorb pollutants. The use of an engineered soil mix and appropriate vegetation is crucial to performance. Generally, three feet of separation is required between the lowest elevation of the bioretention system and the seasonal high groundwater elevation. Where infiltration into underlying native soils is not appropriate, a perforated underdrain can convey treated runoff to a storm drain or surface drainage. Note that systems using perforated underdrains provide limited flow control. Bioretention areas may be stand-alone features, or linked in a treatment train.</p>
	 <p>Bioretention swales and rain gardens: Shallow bioretention areas with sloped sides. Bioretention swales are long and narrow with a gradual longitudinal slope that conveys stormwater. Rain gardens have a flat bottom with sloped sides and can be designed in many shapes and sizes.</p> <p><small>Photo Source: Franco Associates Architects, Dr. Roberto Cruz Alum Rock Branch, San Jose Library</small></p>
	 <p>Bioretention or stormwater planters: Small, contained bioretention areas where treated stormwater is infiltrated into the ground (Infiltration Planter) or, discharged to a traditional stormwater drainage system (Flow-Through Planter). Bioretention planters are flat bottomed with consistent soil depth and inundation across the planter. They are often used where space is limited.</p>
Pervious Paving	<p>Pervious pavement systems: Pavement comprised of a permeable surface with an underlying aggregate base course. Stormwater infiltrates through the surface and is either stored, or infiltrates where soils permit. For example, a 4-inch deep base course provides approximately 1.6 inches of rainfall storage. Pervious pavements installed over clay soils may require a deeper aggregate base and an underdrain system.</p>
	 <p>Pervious concrete: A mixture of coarse aggregate, portland cement, water and little to no sand results in concrete pavement with 15% to 25% void spaces, allowing stormwater to infiltrate at a rate of 200 – 400 inches/hour, depending upon fines included in the mix. The texture looks coarser than conventional concrete.</p>
	 <p>Pervious asphalt: An open graded asphalt concrete poured over a free draining aggregate base. It looks like traditional asphalt, but the fine grains have been screened and removed to achieve a void space of approximately 16%, allowing for stormwater infiltration.</p> <p><small>Photo Source: SvR Design</small></p>
	 <p>Pervious pavers: Unit pavers that lock together to form a durable and stable driving surface. When installed over free draining bedding material, the sub-surface allows for water quality treatment, stormwater storage and infiltration, where soils permit.</p> <p><small>Photo Source: Friends of Five Creeks</small></p>

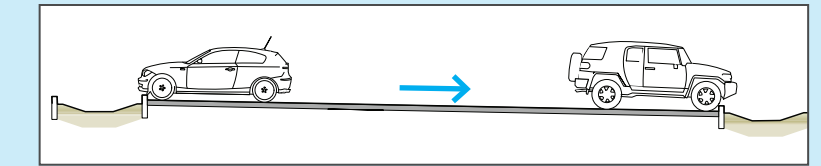
Anatomy of a LID Parking Lot

The design of a LID parking lot begins with a thorough site analysis taking into consideration existing conditions such as soils, site grades and mature trees. Using this information, LID parking lot design emphasizes an efficient layout to minimize impervious surfaces and uses site grading to direct runoff to landscaped areas where LID strategies can be utilized. It is important to integrate LID early in the project planning process to achieve the most cost effective design. Also, applicants should coordinate with their city planning staff to integrate the LID design with a project's development application. After project construction, regular maintenance of LID features is crucial for long-term performance and aesthetics. For further information related LID design and maintenance requirements, see the Resources section on the back page of this TAM.

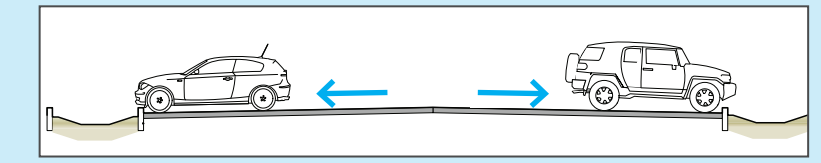


Design Strategy: Site Design

Grading and drainage for LID parking lots directs runoff to bioretention and pervious pavement areas. When designing large parking lots, it is best to break up and direct flows to multiple LID features. During the grading process, care should be taken to avoid compaction of areas identified for bioretention areas.



Continuous cross slope conveys the full aisle to an adjacent swale.



Crowned slope conveys half of each aisle to the adjacent swale.

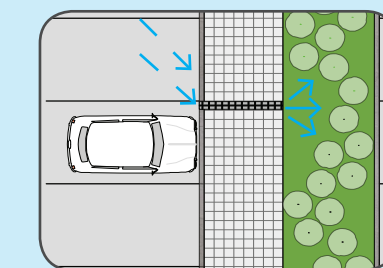
Inlets and outlets direct runoff into, and out of, bioretention areas. Proper placement of inlets helps to spread runoff over the bioretention planting areas, which slows the flow and reduces erosion. Outlet, including overflow, structures direct excess runoff to the storm drain system or street. During construction, avoid placing overflow structures flush with the soil, which prevents the desired retention of stormwater in the bioretention area.



A curb cut inlet directs stormwater runoff into a biofiltration planter.



An overflow outlet conveys runoff that exceeds the bioretention area capacity.



A patterned steel grate inlet conveys flow under a pedestrian walkway.



Photo Source: Kevin Perry, Bureau of Environmental Services, City of Portland