



Santa Clara Valley Urban Runoff Pollution Prevention Program  
Green Stormwater Infrastructure Case Study

# HACIENDA AVENUE

GREEN STREET PROJECT  
CAMPBELL, CALIFORNIA

## Project Description

The goals of the project were to reconstruct the asphalt pavement, increase pedestrian and cyclist safety, improve connectivity between neighborhoods, install better lighting, encourage more active transportation along the improved linear parkway connecting to Los Gatos Creek County Park and Trail and reduce the roadway carbon footprint. After undergoing the “road diet” project, the pavement width on Hacienda Avenue went from 65-70 feet to 52 feet, accommodating 11-foot vehicle lanes, parking lanes, and new bike lanes.

## Key Elements

- Hacienda Avenue is a high capacity, residential collector street
- The project addressed 1.1 miles of road with an 18-acre drainage area.
- 63 biotreatment areas were installed along both sides of the street for a total surface area of 26,000 sq. ft.
- New bulb-outs at intersections calm traffic and improve pedestrian safety by reducing crosswalk distance



**Completion Date**  
November 2015

**Project Duration**  
3 years (design: 2012 - 2014 & construction: 2014-2015)

**Costs**  
Total Project Cost  
\$6,779,115

Construction  
- \$5,837,997

Design  
- \$448,608

Project Management  
- \$492,510

**Funding**  
\$4,145,115  
- City Funds (60%)

\$2,634,000  
- Grants (40%)

**Grants**  
State Department of Water Resources  
Proposition 84  
Chapter 2 Integrated Regional Water Management (IRWM) Grant Program

Valley Transportation Authority's Community Design and Transportation Program

## Stormwater Control Measures

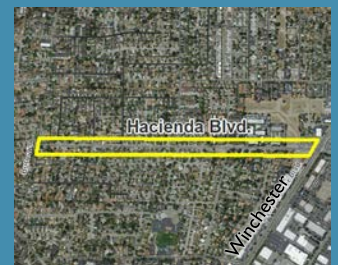


### Biotreatment

63 biotreatment areas treat stormwater runoff from the street and sidewalk

### Other Project Features

- Recycled materials
- Low H<sub>2</sub>O landscaping
- New street trees
- Bike lanes & bus stops
- Traffic calming



## LOCATION

Hacienda Avenue from Winchester Boulevard to Burrows Road  
**Campbell, CA**

# HACIENDA AVENUE

## Key Elements (continued)

- Original roadway had a very wide right of way, no cycling facilities, and discontinuous sidewalks
- Area has highly infiltrative underlying soils
- A flush curb allows roadway runoff to sheet flow into the biotreatment areas sized using SCVURPPP methodology (combination flow and volume approach)
- Roadway pavement was reconstructed with in-place recycled material
- 60 new street trees installed in tree wells in parking lanes reduce roadway heat island effect
- Bay-Friendly low maintenance and drought resistant landscaping
- Continuous sidewalks were added on both sides, separated from roadway by planting areas

## Additional Benefits

- Reduced localized flooding
- Energy efficient, durable LED street lighting
- New bike lanes and improved bus stops
- Educational signage
- Project earned Greenroads Silver Certification (Score 43, Silver) and is a Bay-Friendly Rated Landscape (Score 97)

## Project Outcomes and Lessons Learned

- Reduced roadway width required driveway extensions. Construction activities were coordinated with property owners to minimize access disruptions.
- Biotreatment areas required lowering of sewer and underground utility service laterals. Utility relocation work was completed before street work to minimize potential delays.
- Biotreatment areas constructed directly above native soils without media fabric. Underdrain not required due to highly infiltrative underlying soils. An overflow system connects to storm drain system. Biotreatment areas are lined along the sides to prevent engineered soil from mixing with native soil.
- Cobbles found in the roadway subgrade and biotreatment areas were crushed onsite for use in the roadway base. Excessive size and quantity of cobblestones meant adding rock crushing process and two weeks of roadway closure.
- Full depth reclamation (FDR) approach saved the City half the cost of the conventional alternative to remove and replace the old street by reusing more than 80% of what was there.

## Additional Information

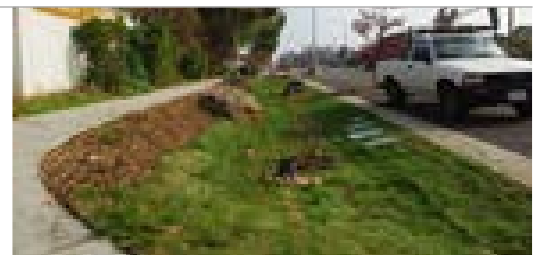
### City Website

[www.cityofcampbell.com/567/Hacienda-Avenue-Green-Street-Improvement](http://www.cityofcampbell.com/567/Hacienda-Avenue-Green-Street-Improvement) Project background, Greenroads and Bay Friendly certification links, and SFEI monitoring report.

### Other Project Information

Presentation from SCVURPPP Site Design Awards 2016

[www.scvurppp-w2k.com/pdfs/1516/wshop\\_c3\\_2016/3\\_Atre\\_2016\\_Site\\_Design\\_Awards\\_final.pdf](http://www.scvurppp-w2k.com/pdfs/1516/wshop_c3_2016/3_Atre_2016_Site_Design_Awards_final.pdf)



### PROJECT CONTACTS

#### Public Works Department

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# SOUTHGATE NEIGHBORHOOD

GREEN STREET PROJECT  
PALO ALTO, CALIFORNIA

## Project Description

The Southgate Neighborhood Storm Drain Improvement and Green Street Project was a partnership project between the Southgate Neighborhood residents and the City of Palo Alto to help alleviate localized drainage issues while providing opportunities for improved water quality. In addition, the project integrated elements of the City of Palo Alto Bicycle and Pedestrian Transportation Plan to allow for traffic calming and safer pedestrian and bicycle access for the neighborhood.

## Key Elements

- Project site is residential neighborhood with narrow streets and on-street parking.
- Two types of biotreatment areas used -- with underdrain and with infiltration columns -- for a total surface area of approx. 3,200 sq. ft.
- Permeable pavers were used in crosswalks and along a walkway, covering approx. 3,200 sq. ft.
- Biotreatment area planter designs minimized the impact to mature trees
- Biotreatment bulb-outs were also utilized for traffic calming and to minimize parking loss
- Project included new storm drain inlets, pipelines, and pavement resurfacing in some areas



**Completion Date**  
February 2015

**Project Duration**  
Community Meetings:  
2012 – 2013

Construction:  
May – Oct. 2014

Construction of crosswalks:  
February 2015

**Funding and Costs**  
Project funded by City of Palo Alto Stormwater Management Fees  
Total Cost  
\$1,894,025

Construction Cost  
- \$1,589,025

Design Cost (Design Consultant Services Fee)  
- \$305,000

*Photo: Curb cuts allow stormwater to enter depressed biotreatment areas, which are installed in curb bulb-outs at multiple street corners and intersections in the neighborhood.*

## Stormwater Control Measures



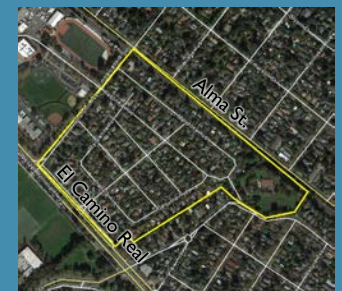
### Biotreatment

16 biotreatment areas (approx. 3,200 sq. ft. of bulb-outs and planter strips) treat stormwater runoff



### Pervious Pavement

Permeable concrete pavers covering approx. 3,200 sq. ft. are used along crosswalks and a pedestrian walkway



## LOCATION

Neighborhood between El Camino Real and Alma St. (east of Palo Alto High School)

**Palo Alto, CA**

## SOUTHGATE NEIGHBORHOOD

### Project Outcomes and Lessons Learned

- Utility conflicts, existing trees, and flat slope affected shape of some biotreatment areas.
- Shallower aggregate layer was used in biotreatment areas with underdrains due to conflicts with the storm drain system (existing drain depth).
- Early community outreach helped shape the streetscape design to address rideability and concerns regarding potential reductions in on-street parking.
- Early coordination with City Arborist on street trees and coordination with other city projects within the neighborhood were keys to success.
- Potholing was used to identify potential utility conflicts; however, more utility relocations occurred than anticipated.
- Sand layers below the concrete interlocking pavers enhance pollutant removal and protect groundwater quality.
- Installation of concrete bands prevents paver migration in crosswalks.
- Use of infiltration columns allows stormwater to infiltrate into a more porous soil layer.



### Additional Information

#### City Website

[www.cityofpaloalto.org/news/displaynews.asp?NewsID=1872&TargetID=109](http://www.cityofpaloalto.org/news/displaynews.asp?NewsID=1872&TargetID=109)

Project updates, community meeting agendas / presentations.

#### Other Project Information

SCVURPPP C.3 Workshop Presentation on Southgate Neighborhood:

[http://www.scvurppp-w2k.com/pdfs/1314/workshop060414/12\\_Carlet\\_Southgate%20Neighborhood\\_%20une%204%202014.pdf](http://www.scvurppp-w2k.com/pdfs/1314/workshop060414/12_Carlet_Southgate%20Neighborhood_%20une%204%202014.pdf)

### PROJECT CONTACTS

**Public Works Department -  
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Project Engineer:

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# MARTHA GARDENS GREEN ALLEYS

GREEN STREET PROJECT  
SAN JOSE, CALIFORNIA

## Project Description

Three residential alleys in the Martha Gardens neighborhood near downtown San Jose, which were previously covered with deteriorated asphalt and bare soil, now feature permeable pavement and concrete made from recycled content. A trench constructed underneath the permeable pavement collects stormwater runoff. The project improves drainage and aesthetics while adding stormwater storage, infiltration, and filtration to remove pollutants.

## Key Elements

- Three residential alleys totaling over 35,000 square feet have been replaced with recycled content concrete and permeable pavers.
- Aggregate-filled trench beneath pavers stores and infiltrates runoff to reduce flows to the storm drain system.
- A layer of porous sand and gravel within the trench provide filtration of pollutants.
- New pavement provides proper drainage in areas with localized flooding prior to the project.
- Lighter colored paving absorbs less sunlight and lowers temperatures.



**Completion Date**  
August 2015

**Project Duration**  
3 years (planning, design: Aug. 2013 – Jan 2015 & construction: Jan. – Aug. 2015)

**Costs**  
Total Project Cost  
~ \$1.23 million

Construction  
- \$ 860,271  
Design, Project Planning & Admin.  
- \$304,853  
Monitoring & Outreach  
- \$68,640

**Funding**  
\$945,000 State Water Board Proposition 84 Stormwater Grant

*Additional project support from:*

City of San Jose  
Public Works and Environmental Services  
Departments

*Photo: Design allows for better parking, improves bike/ pedestrian access, and reduces flooding in the alley.*

## Stormwater Control Measures



**Infiltration Trench**  
Trenches beneath the alley infiltrate runoff



**Permeable Pavement**  
Trenches are covered by a strip of permeable pavers (approximately 5,000 sq. ft. total)



## LOCATION

Three alleys in the Martha Gardens neighborhood of San José (1<sup>st</sup> to 3<sup>rd</sup> St / Margaret to Martha St)

**San Jose, CA**

## MARTHA GARDENS GREEN ALLEYS

### Project Outcomes and Lessons Learned

- Street sweeping is restored (previously not feasible due to poor pavement).
- Improved pavement is pedestrian and cyclist friendly.
- Infiltration trench is 4 ft. wide by 6 ft. deep, is fabric-lined on the sides, and is filled with porous stone.
- Concrete used is made from recycled flyash.
- The City created a “Green Streets Blue Bay” medallion installed on the street, a fact sheet, and video for public outreach about this project and stormwater runoff pollution in general. (Images at right are from the City’s fact sheet.)
- A block party was held to celebrate project completion.
- The project provides benefits to an area considered a disadvantaged community.

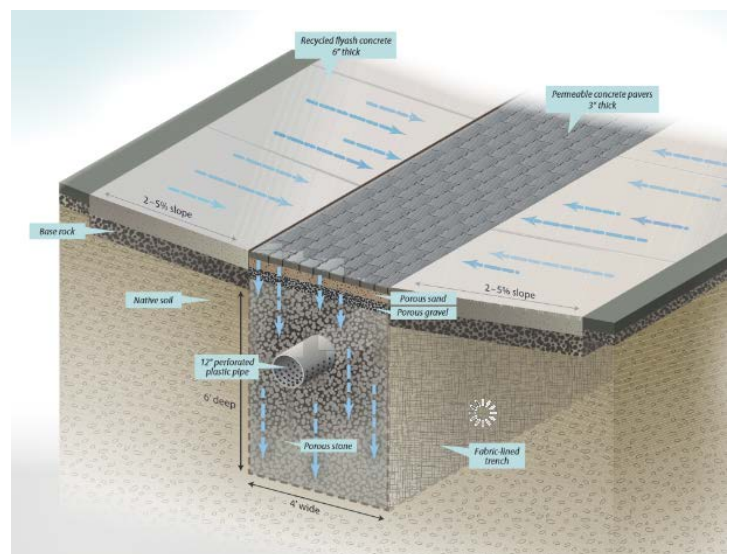


*“The alley seems like a different place. Now, it looks like a nice place to live. ... When the winter rains come, all the improvements will really make a difference.”*

– Tony May, Neighbor (San Jose Fact Sheet)

### Operation and Maintenance

- City staff performs wet-weather inspections for clogging, ponding, and other conditions in need of additional maintenance.
- The City specifies use of regenerative air street sweepers within the alleys to maintain the permeability of the pavers.



### Additional Information

#### City Website

Project video and fact sheet <http://www.sanjoseca.gov/index.aspx?NID=4781>

#### Other Project Information Links

Project presentation on SCVURPPP website [http://www.scvurppp-w2k.com/pdfs/1213/c3\\_workshop/07\\_Aguilar\\_San\\_Jose\\_Green\\_Street\\_Demonstration\\_Projects\\_Presentation.pdf](http://www.scvurppp-w2k.com/pdfs/1213/c3_workshop/07_Aguilar_San_Jose_Green_Street_Demonstration_Projects_Presentation.pdf)

### PROJECT CONTACTS

#### San Jose Environmental Services Division:

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# ALLSTON WAY

GREEN STREET PROJECT  
BERKELEY, CALIFONRIA

## Project Description

The Allston Way project replaced aging pavement with a durable alternative to asphalt that also reduces stormwater runoff and associated pollution—pervious pavement. The project is also intended to function as a demonstration for future green infrastructure projects. It is the first public street in the Bay Area to install interlocking concrete pavers from curb to curb. Joint space filled with aggregate between the pavers allows rainwater to infiltrate.

## Key Elements

- Project site is a public street with a total project surface area of 29,145 square feet
- Interlocking concrete pavers are installed in a herringbone pattern across the full width of Allston Way
- Design challenges include clay soil infiltration concerns and the street's 3% longitudinal slope
- Underdrain was raised 6 inches above the sub-base to create some detention storage and allow infiltration into clay soil
- Yellow pavers were used in crosswalks and centerlines (instead of thermoplastic striping)



**Completion Date**  
Winter 2014

**Project Duration**  
Project Approved  
April 29, 2014

Construction  
Summer 2014

Monitoring  
2015/2016

**Costs**  
Total Project Cost  
\$ 2,000,315

Construction  
- \$ 1,739,315

Water-line  
construction  
(Reimbursed by  
East Bay MUD)  
- \$ 261,000

Monitoring Cost  
- \$ 174,000

**Funding**  
Project funding  
from gas tax money  
and City's capital  
improvement fund

*Photo: Cars and buses  
drive along interlocking  
pavers installed to  
infiltrate rainwater.*

## Stormwater Control Measures



### Pervious Pavement

Interlocking concrete  
pavers cover the full width  
of Allston Way  
(29,145 sq. ft.)

## Other Project Features

Yellow pavers at  
crosswalks instead of  
thermoplastic striping



## LOCATION

Allston Way between  
Martin Luther King Jr. Way  
and Milvia Street  
**Berkeley, CA**

## ALLSTON WAY

### Project Outcomes and Lessons Learned

- Post-installation monitoring shows infiltration rate is better than estimated prior to project and initial data show the project is effective in reducing pollutants and peak flows.
- A roadway location with few driveways was selected so that the road could be closed for 3 months continuously during construction as installment in sections would be less economical.
- Reduced excavation depth required below pavement from 41 in. to 29 in. by altering design to include an 8-in. cellular confinement for the aggregate base to increase structural stability and strength. This saved time, off-haul cost, carbon emissions, and minimized risk to underlying utilities.
- Initial community concerns came from cyclist, wheelchair and skateboarding communities regarding street roughness. However, these communities did not report problems after installation. Today, many wheeled users travel the new ADA-compliant roadway daily.
- City Forestry Department is monitoring street tree health for signs of change or improvement.



### Operation and Maintenance

- Maintenance plan and procedure manuals were created by the project consultants.
- Long-term cost of permeable interlocking concrete pavement estimated to be almost the same as a traditional pavement (<2% difference in 40-year life-cycle cost analysis).

### Additional Information

#### Interlocking Concrete Pavement Institute Article

<http://interlockdesign.org/tag/projects> Scroll to “Why Aren’t All Streets Like This?” for a narrative article about project planning and construction details

Berkeleyside News Articles <http://www.berkeleyside.com/2014/08/08/berkeley-installs-first-permeable-pavers-downtown/>

<http://www.berkeleyside.com/2015/10/29/staff-measure-m-has-berkeley-streets-in-better-shape/>

### PROJECT CONTACTS

#### City of Berkeley Public Works Department

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#### AECOM Engineer

Tom Sweet, P.E., LEED AP

Email:

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# SAN PABLO AVENUE

GREEN STREET PROJECT  
EL CERRITO, CALIFORNIA

## Project Description

The El Cerrito Green Streets Pilot Project consisted of installing a series of biotreatment areas (i.e. bioretention or rain garden cells) at two locations along San Pablo Avenue in the City of El Cerrito as part of a street improvement project. The project also included water quality monitoring and community education. The purpose of this pilot project was not only to directly improve water quality, but also to promote the public's awareness of stormwater pollution, and expand local governments' existing stormwater management strategies to include green infrastructure approaches.

## Key Elements

- Installed biotreatment areas by retrofitting about 750 linear feet of City-owned sidewalk in a commercial area along a Caltrans highway
- Estimated total treatment volume of 20,700 cubic feet (minimal infiltration)
- Underdrains are plumbed to existing storm drain system
- Depressed biotreatment areas receive runoff from the street and sidewalk through curb cuts
- Outreach program engaged multiple target audiences throughout the project using video podcasts, interpretive signage in multiple languages, and educational pamphlets



**Completion Date**  
July 2010

**Project Duration**  
Begin Construction:  
March 2010

End Construction:  
July 2010

**Costs**  
Total Project Cost  
\$392,000

Construction  
- \$215,295

Project  
Management &  
Coordination  
- \$67,119

Monitoring  
- \$97,712

Outreach  
- \$11,871

**Funding**  
\$392,000 American  
Recovery and  
Reinvestment Act  
(ARRA)

*Photo: Individual biotreatment areas are separated by walkways to provide access between curbside parking and the sidewalk.*

## Stormwater Control Measures



### Biotreatment

19 biotreatment areas treat approximately 1.3 acres of existing impervious area

### Other Project Features

Outreach program

Water quality monitoring study



## LOCATION

San Pablo Avenue at  
Madison St. and at Eureka  
St. intersections

**El Cerrito, CA**

## SAN PABLO AVENUE

### Project Outcomes and Lessons Learned

- Treatment cells are set back from the curb to allow pedestrians to step into or out of parked cars. Grate-covered inlets transport runoff to the treatment cells.
- Original wide sidewalk made siting possible.
- During construction, a water main was uncovered and designs had to be adjusted.
- Water quality monitoring results show rain garden cell is successful in reducing pollutant concentrations for most pollutants analyzed (with mixed results for mercury).
- Poor water conveyance through some curb cuts was identified in monitoring and is attributed, in part, to the location of plantings in the rain garden with respect to curb cuts.
- Outreach program reached more than 50 local stakeholders.
- Plants in rain gardens are thriving, adding aesthetic value that has been well received by the local community.



### Operation and Maintenance

- The City maintenance staff continues landscape maintenance of the rain gardens using Bay Friendly techniques covered at a training session. *(Staff training photo, lower right)*
- City staff is trained on LID maintenance.

### Additional Information

#### Final Project Certification Report:

<http://www.sfestuary.org/wp-content/uploads/2013/05/FINAL-ECRG-Project-Certification-Report.pdf>

#### SF Estuary - summary and links (including video podcasts):

<http://www.sfestuary.org/our-projects/water-quality-improvement/elcerrito/>

### PROJECT CONTACTS

**City of El Cerrito:**  
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