

Developments Protecting Water Quality

A Guidebook of Site Design Examples





**Santa Clara Valley
Urban Runoff
Pollution Prevention Program**

Campbell • Cupertino • Los Altos • Los Altos Hills • Los Gatos • Milpitas • Monte Sereno • Mountain View • Palo Alto
San Jose • Santa Clara • Saratoga • Sunnyvale • Santa Clara County • Santa Clara Valley Water District

Developments Protecting Water Quality

A Guidebook of Site Design Examples

Prepared by:
EOA, Inc.

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CREDITS

This document was prepared by the Santa Clara Valley Urban Runoff Pollution Prevention Program (Program) for use by the Program Co-permittees, other local agencies, and the land development community. The Program expresses its appreciation to all those who contributed to this document.

Program Management Consultant:

Eisenberg, Olivieri, & Associates, Inc.
1410 Jackson Street
Oakland, CA 94612
(510) 832-2852

Technical Review/Quality Assurance

Jill Bicknell, P.E., Assistant Program Manager

Project Manager

Wendy Edde, Senior Scientist, Program Staff

Project Engineer

Carina Chen, Associate Engineer, Program Staff

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C3PO Ad Hoc Task Group – Active Members

Joe Teresi	Palo Alto	Kristy McCumby-Hyland	Sunnyvale
Paramjit Uppal	Milpitas	Erin Walters	Sunnyvale
Fariborz Heydari	Milpitas	Christine Cannizzo	Sunnyvale
Cheri Donnelly	WVCWP	Liliana Price	Sunnyvale
Imad Baiyasi	Los Gatos	Eric Anderson	Mountain View
Sandy Baily	Los Gatos	Genevieve Fire (consultant)	Cupertino
Kevin Riley	Santa Clara	Ann Welsh	Saratoga
Judith Silva	Santa Clara	Lynn Penoyer	Campbell
Melody Tovar	San Jose	Steve Homan	Santa Clara Co.
Anastazia Aziz	San Jose	Pamela Wu	Santa Clara Co.
Joe Vafa	San Jose	Larry Lind	Los Altos
Ebrahim Sohrabi	San Jose	Mike Campbell	RBF Consulting
Maria Angeles	San Jose	Daniel Strickman	Santa Clara Co.
Jenny Nusbaum	San Jose		Vector Control
Dipankar Sen	SCVWD	Jan O'Hara	Regional Board
Roger Narsim	SCVWD		

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EOA, Inc., as the Program management consultant, coordinated and compiled the information, took photographs (most photographs were taken by Wendy Edde or Carina Chen unless otherwise noted) and was responsible for the overall preparation of this document.

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Acronyms and Abbreviations

BASMAA	Bay Area Stormwater Management Agencies Association
CO	Commercial
DCIA	Directly Connected Impervious Area
LEED	Leadership in Energy & Environmental Design
HVAC	Heating, Venting, and Air Conditioning
MF	Multi-Family Residences
MU	Mixed Use Residential/Commercial
PA	Public Areas
PROGRAM	Santa Clara Valley Urban Runoff Pollution Prevention Program
REGIONAL BOARD	San Francisco Bay Regional Water Quality Control Board
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SF	Single Family Residences
USGBC	United States Green Building Council



**Santa Clara Valley
Urban Runoff
Pollution Prevention Program**

Site Design Examples

SECTION I

Introduction

BACKGROUND

On October 17, 2001, the San Francisco Bay Regional Water Quality Control Board (Regional Board) adopted Order 01-119, amending the Santa Clara Valley Urban Runoff Pollution Prevention Program's (Program's) Permit Provision C.3. (New and Redevelopment Requirements). Per Provision C.3.j of the permit, the Co-permittees¹ recently reviewed their local design standards and guidance for opportunities to make revisions that would help reduce impacts to water quality. The Co-permittees must revise and fully implement their standards and guidance by September 15, 2004. For more information on permit requirements, see the Program's C.3. *Stormwater Handbook*.

This Guidebook has been created as part of the effort to encourage the use of site design measures that benefit water quality in project designs. It is intended to serve as a reference during the conceptual design and review stage and to be used by both project applicants and municipal staff. This document provides examples of innovative site design elements, primarily in the Santa Clara Valley. In some instances, exceptional sites outside of the Santa Clara Valley but within the greater Bay Area are also used to illustrate the wide variety of techniques that are available.

SITE PLANNING CONCEPTS

Site design measures integrate basic stormwater management and hydrologic concepts into site planning to create developments that mitigate their impact on stormwater quality. Examples include working with the natural topography of a site, clustering the development on the least sensitive portions of a site while protecting sensitive areas, and using design techniques to minimize impervious surface area and infiltrate runoff. This document presents examples of site designs that incorporate the following approaches.

Protect Sensitive Areas from Encroachment

This concept includes such techniques as ensuring adequate protective setbacks from creeks, wetlands, and riparian areas; preserving significant trees and native or significant vegetation to protect soil structure, increase soil permeability and reduce the volume and velocity of rainwater runoff; and avoiding construction on and disturbance of erosive soils and slopes, such as steep or large continuous slopes, soils high in silt or fine sand, or soils lacking vegetative cover.

¹ The Co-permittees are the thirteen (13) Cities and Towns together with Santa Clara County and the Santa Clara Valley Water District that share a common permit to discharge storm water to South San Francisco Bay. (Refer to Credits for a full listing of the Co-permittees.)

Minimize Impervious Surface Area

❖ Street and right-of-way widths

Streets make up about 25% of a development's total land area, and street pavement makes the largest contribution to a site's impervious land coverage. Designing streets with less surface area by reducing widths, incorporating parking pullouts, or using permeable pavements for low use or parking areas can protect water quality while preserving the street's primary function. (BASMAA, 1999)

Fire department requirements for minimum street widths and cul-de-sac radii can conflict with better site design goals. In addition, street and parking areas need to be designed to withstand the impacts of heavy load vehicles (i.e., fire, garbage and delivery trucks). For these reasons, the fire department should be included in the development of design standards to ensure safety while allowing measures such as narrow streets, alternative turnarounds, and permeable pavement such as turf block.

❖ Cluster or infill development

Clustering high density development on a portion of the site while preserving high quality open space elsewhere on the site can improve overall watershed health. Although the densely developed area has a high percentage of impervious land coverage, the total impervious area is reduced and land disturbance is minimized. (BASMAA, 1999)

❖ Parking lots

Parking lots make up a large portion of land use and are constructed mostly of impervious pavement. Some municipal zoning codes and standards mandate that parking exceed the usual parking demand. (BASMAA, 1999) In order to provide adequate, but not excessive parking supply, site design features such as overflow parking and landscaped reserve areas can be used. Also, curb cuts allowing drainage into swales and landscaping; trees; and permeable pavement materials can be installed in order to reduce and treat parking lot runoff.

Use Drainage as a Design Element

Landscaping combined with site engineering (grading and drainage) can improve stormwater quality. Runoff draining to landscaping can be filtered by biota and infiltrated into the soil. Site design features that can be included are areas that drain to a detention basin; streets and parking lots draining to vegetated and rocky swales, biofilters (vegetated channels), vegetated cul-de-sacs or turnarounds; and roof downspouts that drain to landscaping (“disconnected downspouts”). Disconnecting impervious surface areas (i.e., allowing runoff to drain to pervious surfaces in between impervious surfaces) reduces the velocity and amount of water, lowers downstream peak flows and reduces flood and erosion potential.

Promote Alternatives to Automobiles

Automobiles are a major source of water pollution. Designing sites that promote a variety of transportation alternatives has the potential to reduce automobile trips. Design examples are provided that promote bicycling, walking, carpooling, and mass transit.

ADDITIONAL RESOURCES

For more detailed descriptions and guidelines on these topics, refer to the Bay Area Stormwater Management Agencies Association’s (BASMAA’s) *Start at the Source Manual* (1999) and its companion document *Using Site Design Techniques to Meet Development Standards for Stormwater Quality* (2003) (available at the Program’s website www.scvurppp.org). Of substantial benefit to project proponents, using site design techniques to help meet the requirements of Provision C.3. can also result in fewer or smaller-sized treatment controls required and a corresponding savings in the operation and maintenance costs over the life of the project. Additional information regarding stormwater quality-friendly site designs is available on the Program’s website and in the Program’s *C.3. Stormwater Handbook*.

CONTENTS OF MANUAL

This document provides examples of local site design measures that control storm water quality impacts. The examples are organized into Sections II through VII, based on type of development. For each site, the design examples provide the location, features with pictures, cost information and lessons learned (where available), and contact information. Contacts were asked for additional information including construction and maintenance costs and considerations, project size and completion date. This information is provided where available.

Section I contains the background and introduction to the Santa Clara Valley Urban Runoff Pollution Prevention Program's Guidebook of Site Design Examples.

Section II focuses on single-family residences, where many site design techniques can be integrated for maximum effectiveness.

Section III focuses on multi-family residences. For the purposes of this document, the distinguishing factor between single- and multi- family houses is that in the latter, the residences share adjoining walls.

Section IV focuses on mixed-use developments, generally high density residential units combined with commercial businesses.

Section V focuses on commercial and industrial developments. This section is divided into campus/industrial parks and other areas. Generally campus/industrial parks are on large sites dedicated for one or more businesses and include common areas that provide opportunities for features that can improve water quality.

Section VI focuses on projects that are on publicly owned and managed land. These include greenbelts, bike paths to parks, and public buildings.

Section VII includes two indices to assist the user in locating: 1) particular site design techniques illustrated in this document; and 2) all the examples within a specific municipality.

REFERENCES

Bay Area Stormwater Management Agencies Association, *Start at the Source*, 1999.



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Site Design Examples

SECTION II

Single Family Residences

Basking Ridge SF-1

Site Location:

Basking Ridge Avenue
San Jose, CA

Features:

- Two detention ponds
- Wetland vegetation
- Parking pullouts and narrower streets

Stormwater Benefits:

- Natural treatment of runoff
- Reduced velocity of flows
- Reduced impervious surface area



Photograph courtesy of Sheila Tucker (BASMAA)

Parking pullouts allow narrower streets that require less land area and provide more space for trees and grass. These landscaped areas reduce the volume and velocity of rainwater and maximize infiltration. Properties on narrow streets with tree-lined landscapes typically have higher property values. The use of narrow streets also reduces construction costs.

Municipal Contact:

Jenny Nusbaum
City of San Jose
(408) 277-4576

Jenny.Nusbaum@sanjoseca.gov



Photograph courtesy of Sheila Tucker (BASMAA)

Stormwater runoff is directed into the detention pond which temporarily holds the water, allowing for settling of sediments and pollutant removal to occur. The system releases runoff slowly to reduce downstream peak flows.



Photograph courtesy of Sheila Tucker (BASMAA)

Wetland vegetation helps to remove dissolved metals and nutrients. A walking trail bordering the pond on Dana Court demonstrates how a stormwater treatment device can benefit the environment and be attractive, thereby enhancing the neighborhood character.

Site Contact:

Phil Alne
Shea Homes
(925) 245-3600

Note: Some text courtesy of Sheila Tucker (BASMAA)

**Dana Street
SF-2**

Site Location:

235 & 239 Dana Street
Mountain View, CA

Feature:

- Shared driveway
- Flared driveway

Stormwater Benefit:

- Reduced impervious surface area



These two (2) houses share a driveway leading towards a shared garage area. This reduces the amount of impervious surface area required per home. The driveway is also flared – allowing for a wider area for parking than the single-lane entrance/exit way.

Municipal Contact:

Eric Anderson
City of Mountain View
(650) 903-6225

Eric.Anderson@ci.mtnview.ca.us

**Shelley Avenue 1
SF-3**

Site Location:

63 & 65 Shelley Avenue
Campbell, CA

Feature:

- Shared driveway serving multiple houses

Stormwater Benefits:

- Reduced impervious surface area



Two (2) single-family houses share a driveway. Shared driveways reduce the amount of impervious surface required per home, especially when houses are set back far from the street. Shared driveways are often used for hillside developments but can be incorporated into many subdivisions.

Municipal Contact:

Geoff Bradley
City of Campbell
(408) 866-4140

Ortega Avenue SF-4

Site Location:

North End of Ortega Avenue (adjacent to railroad tracks)
Mountain View, CA

Features:

- Landscaped parking and turnaround area located at the end of a dead end street

Stormwater Benefit:

- Reduced impervious surface area



Landscaping, including a street tree, is provided in a center island where there is also an area for parking. The design allows adequate room for a turnaround, providing easier access for fire and other service vehicles.



This is an alternative view of the turnaround, as you would approach it if driving.

Other Opportunities:

- To improve the site design from a stormwater quality perspective, the island could have been designed to accept runoff from the street through such features as concave landscaping with pavement protection, curb cuts, and grading the street to drain to the island.

Municipal Contact:

Eric Anderson
City of Mountain View
(650) 903-6225

Eric.Anderson@ci.mtnview.ca.us

**Bourbon Court
SF-5**

Site Location:

South End of Bourbon Court
Mountain View, CA

Features:

- Landscaped recreational and turnaround area in a cul-de-sac

Stormwater Benefit:

- Reduced impervious surface area



Landscaping around this center island allows for some infiltration to occur while allowing easier access for public service vehicles such as fire and garbage trucks. Also within the island is a recreational area with a pool and associated facilities for nearby residents.

Other Opportunities:

- To improve the site design from a stormwater quality perspective, the island could have been designed to accept runoff from the street through such features as concave landscaping with pavement protection, curb cuts, and grading the street to drain to the island.

Municipal Contact:

Eric Anderson
City of Mountain View
(650) 903-6225

Eric.Anderson@ci.mtnview.ca.us



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Site Design Examples

SECTION III

Multi-Family Residences

Communications Hill/Helzer Ranch MF-1

Site Location:

3000 Narvaez Avenue
San Jose, CA

Features:

- Landscaped areas provide detention for floods and stormwater
- Downspouts disconnected
- Higher density housing

Stormwater Benefit:

- Reduced impervious surface area
- Reduced directly-connected impervious area (DCIA)
- Natural treatment of runoff
- Reduced velocity runoff



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Rooftop runoff drains through downspouts to landscaping for treatment and infiltration.



Photograph courtesy of Jenny Nusbaum (City of San Jose)

This large grassy swale provides area for runoff to percolate into the soil, reduce downstream peak flows, and to receive treatment via settling and filtration.

**Communications Hill/Helzer Ranch
MF-1 (cont.)**



Photograph courtesy of Jenny Nusbaum (City of San Jose)

This outdoor space for the community to enjoy also acts as a detention basin for stormwater.

Municipal Contact:

Jenny Nusbaum

City of San Jose

(408) 277-4576

Jenny.Nusbaum@sanjoseca.gov



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Infiltration is allowed to occur in this detention basin before entering the drainage system.

Site Contact:

Matt Steinle

Development Director

(408) 993-2908

**Los Padres and Homestead Condominiums
MF-2**

Site Location:

Los Padres and Homestead Road
Santa Clara, CA

Features:

- Turf block fire lanes are used for fire access
- Narrow 20-foot wide streets
- Higher density housing

Stormwater Benefit:

- Reduced impervious surface area.



Close-up picture shows the concrete turf block matrix not covered in grass.



Fire access is marked where the fire truck can drive up over the curb across the turf block to access this housing development.



Signs clearly posted in order to prevent people from blocking access to the turf block fire lanes in emergencies.

**Los Padres and Homestead Condominiums
MF-2 (cont.)**



The narrow streets within the complex provide only 20 feet of access, thereby reducing the amount of impervious surface area. With this narrow access, any parked vehicles can impede fire access. Red curb paint and signs can be used to denote fire lanes throughout complexes. (This driver remained in his vehicle.)

Municipal Contact:

Judith Silva

City of Santa Clara

(408) 615-2456

jsilva@ci.santa-clara.ca.us

Fire Department Contact:

Steve Silva

Santa Clara Fire Department

(408) 615-4978

ssilva@ci.santa-clara.ca.us

**Stanford West
MF-3**

Site Location:

700 Clark Way (off Sand Hill Road)
Palo Alto, CA

Features:

- Apartment development was planned with cul-de-sacs, but redesigned to use a grid system
- Area dedicated as a covered car wash area plumbed to the sanitary sewer
- Detention basin on the east end that also serves as a recreational playing field



Photograph courtesy of Joe Teresi (City of Palo Alto)

This covered car-washing area drains water to the sanitary sewer system. This prevents car wash water, soap, and pollutants from entering storm drains.

Stormwater Benefit:

- Washwater treatment
- Natural treatment of runoff in recreational area
- Reduced velocity of flows discharged to nearby creek
- Transportation-related pollution reduction (grid street system reduces vehicle miles traveled)



Photograph courtesy of Joe Teresi (City of Palo Alto)

A recreational play field also serves as a detention basin for runoff. The detention basin temporarily holds runoff, allowing for settling, infiltration and pollutant removal to occur, such as allowing fine sediments to settle out. The system releases runoff slowly to reduce downstream peak flows.

Municipal Contact:

Joe Teresi

City of Palo Alto
(650) 329-2129

Joe_teresi@cityofpaloalto.org

Site Contact:

Dave Richwood

Brian-Kangas-Foullk
(408) 467-9100

dreichwood@bkf.com

**Ryland Mews
Transit-Oriented Development Corridor
MF-4**

Site Location:

4115 North 2nd Street
San Jose, CA

Features:

- High density housing near First Street Light Rail Line
- Located near downtown
- Disconnected downspouts drain to landscaping
- Multi-story buildings reduce the building footprint

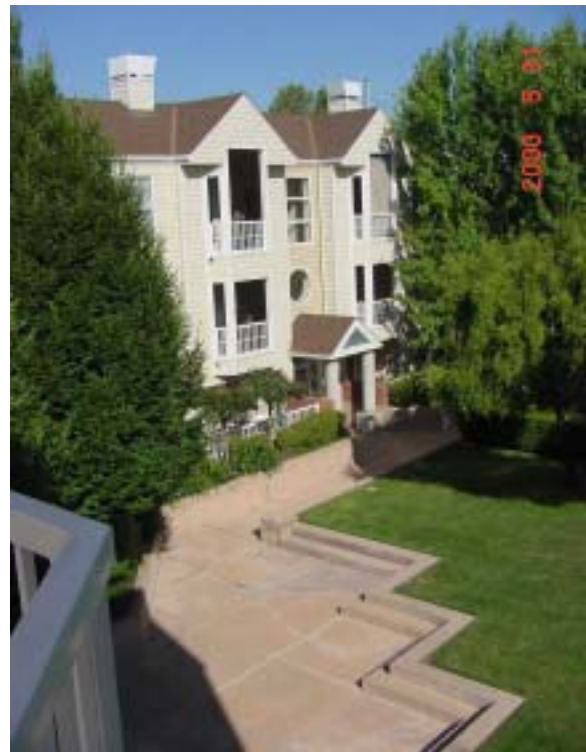


Photograph courtesy of Jenny Nusbaum (City of San Jose)

Light Rail runs nearby, promoting the use of alternative transportation. Motor vehicles can be the sources of metals, oil, and grease which can be harmful to aquatic organisms and, in high enough quantities, can contaminate drinking water supplies. (BASMAA, 1999) Using alternate transportation can reduce the amount of these pollutants from entering waterways.

Stormwater Benefits:

- Reduced impervious surface area
- Reduced directly-connected impervious area (DCIA)
- Transportation-related pollution reduction



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Open space surrounding high density housing allows residents to enjoy the outdoors (e.g., grass and trees) and also provides good drainage areas.

**Ryland Mews
Transit-Oriented Development Corridor
MF-4 (cont.)**



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Rooftop runoff drains through downspouts to landscaping where it has the opportunity to be filtered by plant material and infiltrate into the soil. Disconnecting impervious surface area reduces the speed and amount of water which can result in benefits such as lower peak flows downstream and reduced flood and erosion potential.

Municipal Contact:

Jenny Nusbaum

City of San Jose

(408) 277-4576

Jenny.Nusbaum@sanjoseca.gov

Site Contact:

Dan Sell

Barry Swenson Builder

(408) 983-6338

dsell@barryswensonbuilder.com

Blossom River Apartments MF-5

Site Location:

1000 Blossom River Way
San Jose, CA

Features:

- High density residential area
- Rocky swale

Stormwater Benefits:

- Reduced impervious surface
- Natural treatment of runoff
- Reduced velocity of runoff
- Reduced directly-connected impervious area (DCIA)



Photograph courtesy of Mike Campbell (RBF Consulting)



Photograph courtesy of Mike Campbell (RBF Consulting)

Runoff enters the rocky swale from the parking lot and is filtered before entering the storm drain.

Turf landscaping around the rocky swale provides an area for infiltration. Multi-story buildings reduce the building footprint.

Municipal Contact:

Jenny Nusbaum
City of San Jose
(408) 277-4576

Jenny.Nusbaum@sanjoseca.gov

**Le Mirador Senior Housing
MF-6**

Site Location:

1191 Coleman Road
San Jose, CA

Features:

- High density multi-story senior housing area
- Vegetative swale

Stormwater Benefits:

- Reduced impervious surface area
- Natural treatment of runoff
- Reduced velocity of runoff
- Reduced directly-connected impervious area (DCIA)

Before



Photograph courtesy of Mike Campbell (RBF Consulting)

This photo illustrates the swale when plant growth was hindered by the native clay soil. The parking lot is graded to drain to the swale.

After



Photograph courtesy of Mike Campbell (RBF Consulting)

The densely landscaped vegetative swale was made possible by replacing the native clay soil with sandy loam soil.

Lessons Learned:

- Over 2 feet of the native clay soil was replaced with sandy loam, which improved growth and infiltration.

Municipal Contact:

Jenny Nusbaum
City of San Jose
(408) 277-4576

**801 Homestead
MF-7**

Site Location:

801 to 827 Homestead Road
Santa Clara, CA

Features:

- Narrow shared driveway
- “Tucked under” parking reduces the building footprint
- Street trees

Stormwater Benefits:

- Reduced impervious surface area
- Reduced volume and velocity of runoff



Because the long, narrow, dead-end driveway, exceeds the maximum 150 feet required for fire truck access, fire sprinklers were installed in the rear units to provide additional response time.

Municipal Contact:

Judith Silva
City of Santa Clara
(408) 615-2456
jsilva@ci.santa-clara.ca.us

Fire Department Contact:

Steve Silva
Santa Clara Fire Department
(408) 615-4978
ssilva@ci.santa-clara.ca.us

**Shelley Avenue 2
MF-8**

Site Location:

Shelley Avenue near White Oaks Avenue
Campbell, CA

Feature:

- “Tucked under” parking reduces the building footprint
- Shared driveway

Stormwater Benefit:

- Reduced impervious surface area



This site features “tucked under” parking for multi-family houses. This design reduces the impervious surface area per unit by reducing the building footprint. More land would be required if the parking garages were separate, not underneath the living areas.

Municipal Contact:

Lynn Penoyer
City of Campbell
(408) 866-2747

lynnp@ci.campbell.ca.us



**Santa Clara Valley
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Site Design Examples

SECTION IV

Mixed Use Residential/Commercial

The Crossings MU-1

Site Location:

2255 Showers Drive
Mountain View, CA

Features:

- High density (multi-story) housing with reduced building footprints integrated with commercial areas
- Located near mass transit including bus lines and CalTrain station
- Disconnected downspouts drain into landscaping
- Turf block fire lanes
- Landscaped center of driving circle

Stormwater Benefits:

- Transportation-related pollutant reduction
- Reduced impervious surface area
- Reduced velocity of runoff
- Reduced directly-connected impervious area (DCIA)
- Natural treatment of runoff



“The Crossings” is conveniently located across the street from the San Antonio CalTrain Rail Station.



Turf block fire lane provides access during emergencies. The bollards can be removed for emergency access.

**The Crossings
MU-1 (cont.)**



Multi-story housing reduces the building footprint and, thus, impervious surface area. Rooftop runoff drains into landscaping rather than directly to the storm drain system.



This rain gutter drains into landscaping reducing the amount of directly-connected impervious area (DCIA).



Drive around circle has a landscaped island, providing an area for infiltration.



The Crossings is located within walking distance to major commercial areas for groceries and other shopping needs, thereby reducing the need for auto use.

The Crossings MU-1 (cont.)



Municipal Contact:

Eric Anderson

City of Mountain View
(650) 903-6225

Eric.Anderson@ci.mtnview.ca.us

Site Contact:

Betina Schessow

Hudson Management Group
(925) 827-2200

Designer Contact:

Peter Calthorpe

Calthorpe Associates
(510) 548-6800

peter@calthorpe.com

Mixed use commercial businesses located within the Crossings encourage residents to walk to shops thereby reducing the reliance on motor vehicles.

Other Opportunities:

- To improve the site design from a stormwater quality perspective, the island could have been designed to accept runoff from the street through such features as concave landscaping with pavement protection, curb cuts, and grading the street to drain to the island.

**Santana Row
MU-2**

Site Location:

360 South Winchester Blvd.
San Jose, CA

Features:

- Mixed-use high-density housing and regional commercial
- Encourages pedestrian activity and public use of outdoor space
- Preserved mature trees in redevelopment areas
- Use of multi-story buildings reduces building footprints
- Street trees

Stormwater Benefits:

- Transportation-related pollutant reduction
- Reduce impervious surface area
- Reduce volume and velocity of runoff



Photograph courtesy of Jenny Nusbaum (City of San Jose)



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Mixed-use, high-density multi-story housing combined with commercial areas, provide access to conveniences without the need to drive. Street trees have many benefits, including stormwater management.

Shops conveniently located below housing units promote pedestrian activity.

**Santana Row
MU-2 (cont.)**



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Trees in place before redevelopment were maintained for the new residents to enjoy. Trees reduce the volume and velocity of rainwater.

Municipal Contact:

Jenny Nusbaum
City of San Jose
(408) 277-4576

Jenny.Nusbaum@sanjoseca.gov

Site Contact:

Bruce Armiger
Federal Realty Investment Trust
(408) 551-4600

barminger@federalrealty.com

**North Park
MU-3**

Site Location:

155 & 175 River Oaks Parkway & 3491
Zanker Road
San Jose, CA

Features:

- High density housing near North First Street Light Rail Line
- Encourages pedestrian activity and public use of outdoor space
- Multi-story building reduces the building footprints

Stormwater Benefits:

- Reduced impervious surface area
- Transportation-related pollutant reduction



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Commercial areas conveniently located below housing units promote pedestrian activity.



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Open space surrounding high density housing for residents to enjoy also provides good drainage areas.



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Multi-story buildings reduce the amount of impervious surface.

North Park MU-3 (cont.)



Photograph courtesy of Jenny Nusbaum (City of San Jose)

Light rail runs within walking distance, conveniently located behind the park and adjacent to housing.

Other Opportunities:

- Disconnected downspouts could have been drained to landscaping to break up directly connected impervious area.

Municipal Contact:

Jenny Nusbaum
City of San Jose
(408) 277-4576

Jenny.Nusbaum@sanjoseca.gov

Site Contact:

Alison Covert-Mader
Irvine Company
(408) 392-4102

Amader@irvinecompany.com



**Santa Clara Valley
Urban Runoff
Pollution Prevention Program**

Site Design Examples

SECTION V

Commercial

**Agilent – Palo Alto
CO-1**

Site Location:

395 Page Mill Road
Palo Alto, CA

Features:

- Detention basin with native vegetation along banks
- Parking lot vegetated swales
- Roof downspouts draining to landscaping
- Promotes alternative transportation by providing bike racks and lockers, an onsite bus stop, and carpool/vanpool parking
- Structured parking lot (2 levels with top level draining to rock filter bed).



The detention basin, known as “The Swale” by Agilent employees, provides stormwater collection and treatment for the parking areas, visual amenities for employees, and a visual buffer for the neighboring residential community.

Stormwater Benefits:

- Reduced impervious surface area
- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced transportation related pollutants
- Reduced directly-connected impervious area (DCIA)



The parking lot is graded to drain into vegetated swales, shown here, and the detention basin.



Storm drains from the parking lot enter the detention basin through drains like this one.



The detention basin has two outlets to protect against localized flooding and to ensure that the basin drains within 72 hours for vector control.



Bike racks and showers encourage employees to bike to work. Additional bike lockers and a bus stop are located at the Page Mill Road entrance.



Agilent encourages employees to carpool by providing designated car/van pool areas. Reducing vehicle trips traveled reduces the amount of pollutants such as hydrocarbons and brake pad dust released to the environment.



Runoff from this parking structure drains to the filter bed, described below. The two-story parking structure allows for roughly twice the number of vehicles for the same area of a typical surface parking lot, while allowing enough room on-site for the detention basin.



The runoff drains from the top of the parking structure to this rock filter bed for treatment and then to the storm drain system via the detention basin.



This rocky swale is used to slow and treat rooftop runoff before draining to the storm drain. A minimum two percent (2%) slope away from the building protects the building foundation from water damage.



Storm drains are clearly labeled with an educational “no dumping” message.



The detention basin collects water from the parking lot. The concrete edging protects the asphalt from water damage while the bumper stops help prevent cars from traveling over the vegetated swales.

**Agilent – Palo Alto
CO-1 (cont.)**

Lessons Learned:

- The irrigation heads originally installed for the retention basin caused some ponding for greater than 72 hours until they were modified to target areas requiring water. The local vector control agency brought mosquito fish for mosquito control while the irrigation challenge was being diagnosed and addressed.
- During the rainy cloudy days, the water in the parking lot catch basins may take longer than 72 hours to drain. Maintenance staff must periodically clean debris from catch basins.
- The detention basin has also served as a useful indicator for irrigation leaks for sprinklers within the parking lot biofilter landscaping. When maintenance staff sees ponded water in the detention basin during a dry spell, they investigate for potential leaks.
- The landscape service provider must carefully control the scheduling of irrigation system to prevent overwatering and water build up in the detention basin.
- Shredded bark was installed initially along the detention basin banks to hold the soils without clogging the system until vegetation became established.
- The site designer highly recommends checking after the first rain to make sure the entire system is working correctly. For the roof downspouts, the rainwater initially started pooling behind the header boards at the bottom of the roof downspouts. Notches cut in the header board ensure proper drainage away from building with a minimum 2% slope.
- Maintenance costs and effort are comparable to that for typical landscaping according to Agilent maintenance staff.

Municipal Contact:

Joe Teresi
City of Palo Alto
(650) 329-2129
Joe.teresi@cityofpaloalto.org

Designer Contact:

Bill Southard, ASLA
DES Architects and Engineers
(650) 364-6453
bsouthard@des-ae.com

Environmental Site Contact:

Janice Nakao
Agilent Technologies
(408) 553-7817

Site Facility Contacts:

Joy Curl
Agilent Technologies
(650) 752-5226
and
Tom Flores
Agilent Technologies
(650) 752-5409

**Pacific Shores Center
CO-2**



Site Location:

1500 Seaport Boulevard
Redwood City, CA

Features:

- Multi-purpose detention basin and playing fields
- Second detention basin with cobble bottom
- Parking lot vegetated swales
- 3 miles of paved trails that are an extension of the Bay Trail

Stormwater Benefits:

- Reduced amount of impervious surface area
- Natural treatment of runoff
- Reduced volume and velocity of runoff
- Reduced directly-connected impervious area (DCIA)



This athletic field also serves as a detention basin. The basin is designed to fill up to a four-foot depth and drain within eight (8) hours.

**Pacific Shores Center
CO-2 (cont.)**



Photograph taken from: <http://www.pacificshores.com/>

This photograph offers an aerial view of baseball fields and detention basin.



Photograph taken from: <http://www.pacificshores.com/>

The multi-story buildings allow for vast landscaping that helps reduce the amount of runoff from the site.



Photograph taken from: <http://www.pacificshores.com/>

Aerial view of Pacific Shores Center shows an ideal area to enjoy the Bay Trail.



Parking lot dividers are used as infiltration areas with vegetated swales and trees. Boulders are used to prevent automobile encroachment across the swale.



The parking lot is graded to drain to these vegetated swales, planted with vegetation and trees. The swales were excavated and backfilled with imported sandy loam soil to increase porosity, and constructed with perforated sub-drains. The concrete strip protects the asphalt from water damage. This image was taken prior to grass establishment.

**Pacific Shores Center
CO-2 (cont.)**



Photograph courtesy of Bill Southard (DES, Architects and Engineers)

Cobbles along this detention basin run for several hundred feet to prevent channeling during high runoff.



Photograph courtesy of Bill Southard (DES, Architects and Engineers)

This photo shows the vegetated swale after the native vegetation has grown in.

Lessons Learned:

- Trees planted with only two (2) stakes for support in sandy loam soil within the vegetated swales blew over during a windstorm prior to root establishment. Using three (3) stakes per tree are now recommended.

Site Contact:

Jay Paul Company
pacificshores@jaypaul.com
(415) 263-7400 V
(415) 362-0698 F

Designer Contact:

Bill Southard, ASLA
DES Architects and Engineers
(650) 364-6453
bsouthard@des-ae.com

**Agilent – Santa Clara
CO-3**

Site Location:

5301 Stevens Creek Boulevard
Santa Clara, CA

Features:

- Roof garden
- Disconnected downspouts

Stormwater Benefits:

- Reduced impervious surface area
- Reduced volume and velocity of runoff

Large areas of vegetation are located on top of the second floor of the office building.

Photograph above courtesy of Scott Sidlow (Agilent).

The roof garden is located on the second floor of the Agilent building.

Trees are planted as part of the roof gardens.

Agilent – Santa Clara
CO-3 (cont.)



Rooftop runoff is directed to drain through the vegetation.



Exhaust vents for HVAC* systems are integrated into roof garden areas.

*HVAC = heating, venting, and air conditioning



Photograph above courtesy of Scott Sidlow (Agilent)

Another view of the roof garden shows a large shady tree that can reduce rainfall velocity and runoff.

**Agilent – Santa Clara
CO-3 (cont.)**

Lessons Learned:

- Leakage occurred due to roots penetrating the roof membranes, however after patching the barriers underneath the garden, leakage was prevented.
- The membrane integrity was also compromised by heavy vehicle traffic (for deliveries to the café on the roof garden level). The amount of deliveries was minimized to prevent more leaks.

Municipal Contact:

Judith Silva
City of Santa Clara
(408) 615-2456
jsilva@ci.santa-clara.ca.us

Site Contact:

Scott Sidlow
Agilent EH&S Specialist
(408) 553-3780
scott_sidlow@agilent.com