GI Design Guide – Sustainable Streets

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- Approaches and guidance for creating green and complete streets — *Sustainable Streets*

Green Infrastructure
Design Guide

First Edition | 2019

San Mateo Countywide Water Pollution Prevention Program

c d + a COMMUNITY DESIGN + ARCHITECTURE

SAN MATEO COUNTYWIDE
Water Pollution
Prevention Program
Clean Water. Healthy Community.

Relevant Sections for Sustainable Streets

Green Infrastructure Design Guide

1 – Introduction
2 – GI Measures and Opportunities
3 – Intro to Design Strategies & Guidelines
4 – Key Design & Construction Considerations
5 – Key Implementation Strategies
6 – Operations and Maintenance

Appendices

A1 – Glossary
A2 – Reference Documents
A3 – Sustainable Streets Typical Design Details
A4 – Sustainable Streets Specifications
A5 – Sample Maintenance Plan Forms
A6 – Potential GI Funding Source Analysis and Recommendations
A7 – Guidance for Sizing GI Facilities in Streets

GI Design Guide

Chapter 3

Design Strategies and Guidelines

◄ Green infrastructure measures can provide a range of benefits to communities.

3.4 Intro to Design Strategies & Guidelines

- **What is a Sustainable Green and Complete Street?**
- Combines two concepts for street design:

Complete Streets + Green Streets = Sustainable Streets

- Definitions
- Multiple benefits of streets
- MRP emphasis on integration of GI into streets


CHAPTER 3

3.4 Sustainable Streets Design Elements and Process
What is a Sustainable Street?

A sustainable street combines the ideas of mobility and access for all users and other aspects of complete street design with the stormwater and other environmental benefits of green streets which integrate green stormwater infrastructure into streets. The goal of sustainable streets design is to create streets that are comprehensively sustainable in terms of environmental, social, and economic impacts. The resulting streets will help communities address the stormwater requirements of the MRP while providing multiple benefits.

SMCWPPP is promoting sustainable streets in San Mateo County, and has widely and actively supported local projects including Safe Routes to Schools integrated with green infrastructure projects and the Caltrans funded Countywide Sustainable Streets Master Plan.

An on demand pedestrian flashing crossing, high visibility sidewalk, buffered bike lane, and stormwater curb extensions were implemented as part of this sustainable street retrofit project.

Stormwater planters provide a landscaped buffer between pedestrians and the roadway. Bike lanes provide a designated space for bicyclists, providing a more comfortable cycling experience.

Interaction will help:
- Better manage street runoff and flooding issues
- Result in consistent approach and appearance
- Improve city and neighborhood character
- Foster climate resiliency and adaptation
- Create more comfortable and safe streets

3.4 Intro to Design Strategies and Guidelines

- **What is a Sustainable Green and Complete Street?**
  - Summarizes Complete Street types
    - Base street types
    - Context
      - land use
      - character

Table 3.4a Complete Street Types – the Combination of Street and Place Types

Context Types		Base Street Types				
		Throughway	Connector	Access	Alley	Path
Use	Character	Complete Street Types				
Mixed Use	Downtown	Downtown Throughway	Downtown Connector	Downtown Access	Downtown Alley	Walkway
Commercial / Mixed Use	Urban	Mixed Use Throughway	Mixed Use Connector	Mixed Use Access	Mixed Use Alley	Walkway
	Suburban	Commercial Throughway	Commercial Connector			
	Rural / Semi-Rural	Parkway	Parkway Connector			
Neighborhood	Urban	Neighborhood Throughway	Neighborhood Connector	Neighborhood Access	Neighborhood Alley	Walkway
	Suburban					
	Rural / Semi-Rural	Parkway	Parkway Connector			Shared Use Path
Industrial	Urban	Industrial Throughway	Urban Industrial Connector	Industrial Access	Industrial Alley	Walkway
	Suburban		Industrial Connector			
	Rural /Semi-Rural					Shared Use Path

3.4 Intro to Design Strategies and Guidelines

- **What is a Sustainable Green and Complete Street?**
  - Summarizes Complete Street types
    - **Base street types**
    - Context
      - Land use types
      - Character types

CHAPTER 3

3.4 Sustainable Streets Design Elements and Process

Complete Street Types

The complete streets approach emphasizes identifying and designing for how people use a street, both in traveling along a street and how people access uses along it. For example, an industrial throughway would emphasize trucks over other users, and particularly emphasizing truck traffic traveling through the area. But a downtown access street would emphasize people walking to the uses along it. In addition to the base street types, different ways that people travel can be emphasized. So, the presence of a high-frequency bus route would increase the use of design treatments for movement of buses along the street, and to conveniently serve transit riders walking or cycling to bus stops. But in a downtown area, people walking would have more emphasis, and buses and other traffic might travel slower, to improve pedestrian safety and comfort.

Base Street Types

The base street types describe the primary transportation function of the complete street.

- **Throughway Streets** primarily focus on moving people through an area to their destination, including moving goods by truck, riders in a bus, people in vehicles, or people on bicycles. These streets can also provide access to uses along them, but when possible, vehicles should access uses from side streets rather than the throughway so as not to impede traffic flow. Sidewalks and a comfortable pedestrian environment are still needed, but vary in importance depending upon the context along the throughway and the type of transit using the street. A well-known throughway in San Mateo County is El Camino Real.
- **Connector Streets** are primarily used by people connecting between places over a moderate distance. Connector streets are often important for bus transit and for people who are bicycling, because these streets often connect important destinations. These streets are usually designed for moderate speeds – about 25 mph. Given this speed and importance for transit, uses can front directly onto and be accessible from the street. Examples in San Mateo County include Delaware Street in City of San Mateo and Roosevelt Avenue in Redwood City.
- **Access Streets** primarily provide access to adjacent uses or nearby destinations. In some cases they provide for longer, but more "family-friendly", trips by bicycle. Pedestrian comfort and safety are important for access streets.
- **Alleys** are streets that are typically located in the middle of a block. Not all, but several, communities in San Mateo County have alleys which provide access to parking, space for utilities and refuse collection, and provide alternative "short cuts" for people walking and bicycling. In some cases, alleys provide primary access to some employment uses and to accessory dwelling units.
- **Paths** are part of the multimodal network, and so are included as a street type. Paths are typically used by people walking, bicycling, or using other "rolling" modes – skateboards, scooters, roller blades, etc. They can be used both for transportation and for recreation, and they can also be active social and commercial spaces, such as Main Street in Downtown San Mateo, which is an alley that has been repurposed as an urban path.

Green Infrastructure in Sustainable Alleys

Older alleys often have drainage issues and can provide unique challenges (e.g., lack of space for landscape) and opportunities (e.g., relatively low traffic levels) for green infrastructure. Many communities around the country have utilized pervious paving in alleyways. Chicago has a program and a handbook specifically focused on Green Alleys[3] and Santa Monica has an Alley Renewal Program that includes installation of pervious concrete center 'V' gutters.[4]

[3] Information about Chicago's Green Alley program can be found at: https://www.cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html
[4] Information about Santa Monica's Alley Renewal Program can be found at: https://www.smgov.net/streets/alleyprogram/

3.4 Intro to Design Strategies and Guidelines

- **What is a Sustainable Green and Complete Street?**
  - Summarizes Complete Street types
    - – Base street types
    - – Context
      - – **Land use types**
      - – Character types

CHAPTER 3

3.4 Sustainable Streets Design Elements and Process

Complete Street Types

▲ *Acacia Avenue, San Bruno*

Neighborhood: These are primarily residential areas that can have a varied mix of single and multi-family housing, a variety of parcel sizes, and a range in the amount of landscaped (i.e., permeable) land area within private lots and within neighborhood streets. Typically, most neighborhood streets in urban and suburban areas have relatively narrow rights of way which can make the addition of green infrastructure challenging. So, the landscaped character of a residential neighborhood has a significant relationship to the potential for streets to be retrofitted to include green infrastructure.

▲ *Starlite Street, South San Francisco*

Industrial: Traditionally, these are the areas of communities where manufacturing, utility facilities, warehousing, storage, and generally messier uses have been allowed. As a result, concentrations of different pollutants, including PCBs, which is one of the pollutants that is required to be addressed through the MRP, are often found in older industrial areas. But, older industrial areas can be challenging to retrofit with green infrastructure because of other pollutants in the soil, and given the relatively narrow width of streets and high frequency of larger truck traffic. But many industrial areas in San Mateo County, and other parts of the Bay Area, are experiencing conversion of use, without a change in building or site design. Some locations, such as Menlo Park near the Facebook campus, are experiencing major reconstruction of industrial areas which can make it more feasible to include green infrastructure in the streets of former industrial areas.

▲ *San Francisco Avenue, Brisbane*

Park / Open Space: These are the landscaped recreational, civic, and natural spaces within San Mateo County. For parks that are integrated into urban and suburban areas, they may provide landscaped areas adjacent to streets that can be used for green infrastructure to treat and manage street runoff that is not feasible to accommodate within the street right of way.

3.4 Intro to Design Strategies and Guidelines

- **What is a Sustainable Green and Complete Street?**
  - Summarizes Complete Street types
    - Base street types
    - Context
      - Land use types
      - **Character types**

Character Types

The character of development along a street should have a direct relationship to the design of the street, including things such as posted speed, presence of on-street parking, and design of the pedestrian environment including landscaping, presence of seating, and other elements. In particular, how adjacent development interfaces with the street – storefront and other active uses at the sidewalk, a landscaped yard, a parking lot, a fence, rural farm land, or natural open space – should strongly influence the design of the street and its pedestrian environment. The character of the context along the street also affects the type, size, and design detail of green infrastructure within the street.

Downtown: Given the varied mix of uses and intensity of development in most San Mateo County downtowns, the character of these areas puts high demand on the limited space within the street. This includes space for all modes of transportation, transit stops, parking, and landscape and other streetscape elements such as outdoor seating. In these locations, green infrastructure needs to be efficiently designed to minimize or mitigate impacts to competing interests like on-street parking. Elements such as infiltration trenches or modular suspended pavement systems can be used to increase stormwater treatment and volume reduction while minimizing the surface area of the green infrastructure that is landscaped. In some cases, it may also be feasible to design treatment measures that do not provide full regulated projects levels of treatment, with the goal of building more infrastructure in public projects while receiving some credit towards achieving treatment targets.

▲ *Middlefield Rd, Redwood City*

Urban: This character type includes areas of communities with some vertical mix use, but also more single use areas with a moderate intensity of development. Urban areas tend to have a higher percentage of impervious surfaces, compared with suburban areas in the same community. They can include older residential neighborhoods, commercial districts, and industrial areas which can have higher levels of the pollutants of concern in the environment. Many urban areas in San Mateo County communities are experiencing reuse and redevelopment of parcels and public investment in transit and complete streets projects, all of which create opportunities for implementing green infrastructure.

▲ *South Delaware Street, San Mateo*

3.4 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Elements & Process**
- Implementation approach and phases
  - 1. Understand site considerations and project goals and needs
  - 2. Develop and Assess Sustainable Streets Concepts
  - 3. Prepare Construction Documents
  - 4. Construction Administration
  - 5. Operations and Maintenance

Phase 4 – Construction Administration

Once the construction documents are finalized the project can be put out to bid, or in some cases, smaller projects may be constructed by jurisdiction staff. In most cases, the project will be put out to bid, a contractor is selected, and once an agreement is in place construction begins. During construction, the jurisdiction's engineering staff reviews and approves the work of the contractor. If there was a design and engineering consultant team, they will typically provide construction administration assistance to jurisdiction staff. Once construction is complete and approved, the contractor will likely continue to have responsibility for establishment of landscape within the street, including the green infrastructure.

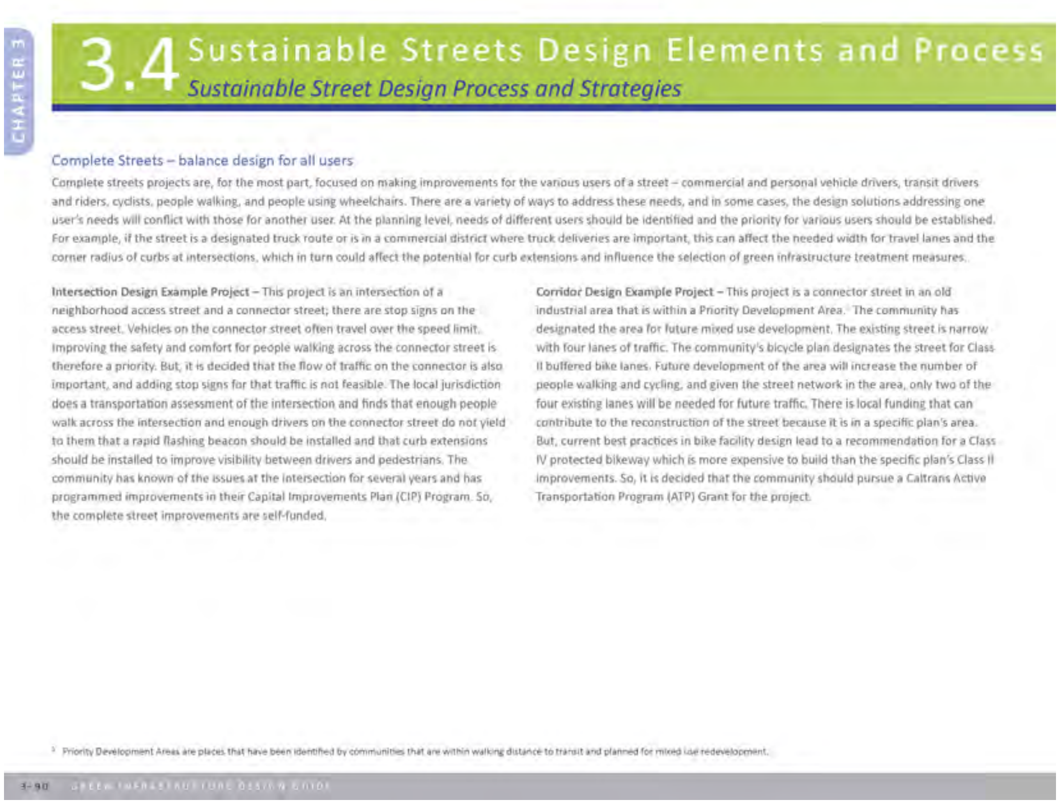
Intersection Design Example Project – The bidding and contractor agreement process goes smoothly. Minimal change orders are needed during construction, and construction is complete within a few months of the projected schedule.

Corridor Design Example Project – The bidding and contractor agreement process goes relatively smoothly. But during construction, it becomes clear that the general contractor and the landscape subcontractor are not as experienced with green infrastructure construction as they indicated in the bid documents. The consultant team and city engineer reject multiple submittals and shop drawings. After some delays, the general contractor replaces the landscape subcontractor and construction proceeds more smoothly. As with many street reconstruction projects in older areas, there are some major change orders because underground infrastructure is different than indicated from record documents and the site survey. Despite the complexities the project is completed within a few months of schedule. Construction of the private development has begun and over the next couple of years the on-site stormwater system is connected to the shared green infrastructure within the street as planned and designed.

▲ *Construction administration is important to ensure that the project is built according to the plans.*

3.4 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Elements & Process**
  - How to select complementary GI and Complete Street techniques



CHAPTER 3

3.4 Sustainable Streets Design Elements and Process

Sustainable Street Design Process and Strategies

Complete Streets – balance design for all users

Complete streets projects are, for the most part, focused on making improvements for the various users of a street – commercial and personal vehicle drivers, transit drivers and riders, cyclists, people walking, and people using wheelchairs. There are a variety of ways to address these needs, and in some cases, the design solutions addressing one user's needs will conflict with those for another user. At the planning level, needs of different users should be identified and the priority for various users should be established. For example, if the street is a designated truck route or is in a commercial district where truck deliveries are important, this can affect the needed width for travel lanes and the corner radius of curbs at intersections, which in turn could affect the potential for curb extensions and influence the selection of green infrastructure treatment measures.

Intersection Design Example Project – This project is an intersection of a neighborhood access street and a connector street; there are stop signs on the access street. Vehicles on the connector street often travel over the speed limit. Improving the safety and comfort for people walking across the connector street is therefore a priority. But, it is decided that the flow of traffic on the connector is also important, and adding stop signs for that traffic is not feasible. The local jurisdiction does a transportation assessment of the intersection and finds that enough people walk across the intersection and enough drivers on the connector street do not yield to them that a rapid flashing beacon should be installed and that curb extensions should be installed to improve visibility between drivers and pedestrians. The community has known of the issues at the intersection for several years and has programmed improvements in their Capital Improvements Plan (CIP) Program. So, the complete street improvements are self-funded.

Corridor Design Example Project – This project is a connector street in an old industrial area that is within a Priority Development Area.[1] The community has designated the area for future mixed use development. The existing street is narrow with four lanes of traffic. The community's bicycle plan designates the street for Class II buffered bike lanes. Future development of the area will increase the number of people walking and cycling, and given the street network in the area, only two of the four existing lanes will be needed for future traffic. There is local funding that can contribute to the reconstruction of the street because it is in a specific plan's area. But, current best practices in bike facility design lead to a recommendation for a Class IV protected bikeway which is more expensive to build than the specific plan's Class II improvements. So, it is decided that the community should pursue a Caltrans Active Transportation Program (ATP) Grant for the project.

[1] Priority Development Areas are places that have been identified by communities that are within walking distance to transit and planned for mixed use redevelopment.

3.4 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Elements & Process**
  - How to select complementary GI and Complete Street techniques

Green Infrastructure – both a stormwater management and broader community asset

There are a number of factors that play into the ability of a street to effectively include green infrastructure. C/CAG's **Stormwater Resource Plan (SRP)** utilized a range of high-level factors to screen-out and prioritize streets in San Mateo County that have some potential for the inclusion of green infrastructure. For instance, if streets have a slope of greater than 5% they were excluded. Communities may wish to include other factors not accounted for in the **SRP** such as complete streets modal priorities, economic development, public health, environmental justice, and other community values and priorities for the built environment. The key factors considered in the **SRP** and additional community benefit factors that may be considered in prioritizing streets that should include green infrastructure are listed in **Figure 3.4a**. Other factors may be included based on each community's specific conditions and goals.

Stormwater Resource Plan Key Factors

- How impervious is the right of way?
- What is the slope of the street, less than 5%?
- Is the street in proximity to flood-prone channels?
- Is the street in an area with potential for higher levels of PCBs?
- Is the street already identified for an improvement project?
- Is the street part of a Safe Routes to School project?
- Does the street drain to a TMDL water (Total Maximum Daily Load of the regulated pollutants)?

Additional Community Benefit Factor to consider

- Is the street in a Specific Plan or other focused planning area that defines street improvements and potential funding?
- Is the street in a Priority Development Area (PDA)[6]?
- Is the street in a Priority Conservation Area (PCA)[7]?
- Is the street located in an area that is a focus for economic development by the community?
- Is the street located in a Community of Concern[8] as identified by the community and (Metropolitan Transportation Commission) MTC?
- Is the street identified by the community for bicycle or pedestrian plan improvements or other complete streets improvements?
- Is the street in an area of concern that has been identified in relation to climate adaptation and community resilience?

[6] PDAs are places identified by Bay Area communities as areas for investment, new homes, and job growth. PDAs are the foundation for sustainable regional growth and Plan Bay Area. To become a PDA, an area must be: 1) within an existing community; 2) within walking distance of frequent transit service; 3) designated for more housing in a locally adopted plan or identified by a local government for future planning and potential growth; and 4) nominated through a resolution adopted by a City Council or County Board of Supervisors. See https://abag.ca.gov/priority/development/ for more information.

[7] PCAs are open spaces that provide agricultural, natural resource, scenic, recreational, and/or ecological values and ecosystem functions. These areas are identified through consensus by local jurisdictions and park/open space districts as lands in need of protection due to pressure from urban development or other factors. PCAs are categorized by four designations: Natural Landscapes, Agricultural Lands, Urban Greening, and Regional Recreation. Refer to https://abag.ca.gov/priority/conservation/ for greater detail.

[8] A "community of concern" is intended to represent a diverse cross-section of populations and a community that could be considered disadvantaged or vulnerable in terms of both current conditions and potential impacts of future growth. Plan Bay Area, and other land use and transportation policy documents, give consideration to increasing transportation and other public investment in communities of concern, because of historic disinvestment in these communities. For more information, see https://www.planbayarea.org/2040-plan/plan-details/equity-analysis.

3.4 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Elements & Process**
  - GI measure applicability by street type

3.4 Sustainable Streets Design Elements and Process

Sustainable Street Design Process and Strategies

In addition, where green street infrastructure is being considered, the community should evaluate existing storm drain infrastructure, such as the presence of storm drain inlets and storm drain pipes, and surface drainage patterns. Another condition to assess is whether adjacent properties or nearby streets contribute stormwater runoff to the project area. Other hydrologic and soil conditions should also be assessed to identify any issues that could affect green infrastructure feasibility or design, such as high ground water, inability to infiltrate stormwater, and contaminated soils.

Intersection Design Example Project – Both streets are identified as opportunities for green infrastructure in the Reasonable Assurance Analysis (RAA) and the local GI Plan. The GI Plan did not identify either street as high priority. Existing street drainage patterns flow to inlets that are at or near to the corners of the intersection. Like much of the bayside of San Mateo County, the soils have high clay content and do not infiltrate well. Surrounding properties do not add much runoff to the street, given the extent of on-site landscaping; existing streets have a landscape strip between sidewalk and the roadway.

Typical intersection between a collector and local street.

Corridor Design Example Project – This corridor was identified as a green infrastructure opportunity in the RAA, and the local GI Plan gives it a high priority, because it is within a specific plan and old industrial area. The area has some flooding issues brought about by the high percentage of impervious surface within the existing industrial development and deficiencies in the existing older stormwater drainage system. These were identified in the specific plan and storm drain improvements are included in the financing plan. However, the public works department is interested in reducing investment in the underground system by including green infrastructure in the area to spread peak stormwater flows. Future redevelopment is required to manage their stormwater on-site given C.3 regulations, therefore they will not contribute significant stormwater flows into the street. There are some contaminated soils in the project area.

Typical four-lane industrial corridor in Burlingame.

3.4 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Elements & Process**
  - GI measure applicability by street type

Table 3.4e - Green Infrastructure Measure Applicability by Street Type

		Green Infrastructure Measures									
		Bioretention/Bioinfiltration Area/Planter									
	Street Types	Stormwater Planter	Stormwater Curb Extension	Rain Garden	Tree Well	Infiltration Systems [1]	Pervious Pavement	Vegetated Swale	Green Gutter	Stormwater Tree	Interceptor Tree
Throughway	Downtown, Commercial or Mixed Use Throughway						2				
Throughway	Neighborhood or Industrial Throughway						2				
Throughway	Parkway					3	2		4		
Connector	Downtown, Mixed Use, Commercial, or Urban Industrial Connector						2				
Connector	Neighborhood or Industrial Connector					3	2		4		
Connector	Parkway Connector					3	2		4		
Access	Downtown Access										
Access	Mixed Use Access					3			4		
Access	Neighborhood Access					3			4		
Access	Industrial Access					3	2		4		
Access	Park Access					3			4		
Alley	Downtown Alley										
Alley	Mixed Use Alley					3			4		
Alley	Neighborhood Alley					3			4		
Alley	Industrial Alley					3			4		
Path	Walkway										
Path	Shared Use Path					3			4		

Table Notes

1. An infiltration system can be installed adjacent to other treatment measures to allow for secondary "storage" of treated stormwater to facilitate infiltration where native soils are slow to percolate.
2. Use pervious pavement only in parking lanes, shoulders, and medians.
3. Possible to use in Park, Semi-Rural or Rural contexts, but there are likely more cost-effective alternatives.
4. Possible to use in Park, Semi-Rural or Rural contexts, but narrowing the street right of way in these lower intensity and open space oriented contexts is more desirable in relation to complete streets and green infrastructure goals.

3.4 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Elements & Process**
  - GI measure applicability by street type

Table 3.4f - Green Infrastructure Measure Applicability by Context Types

Context Types		Green Infrastructure Measures									
		Bioretention/Bioinfiltration Area/Planter									
Use	Character	Stormwater Planter	Stormwater Curb Extension	Rain Garden	Tree Well	Infiltration System [1]	Pervious Pavement	Vegetated Swale	Green Gutter	Stormwater Tree	Interceptor Tree
Mixed Use	Downtown								2		
Commercial / Mixed Use	Urban								2		
	Suburban										
	Rural/Semi-Rural		3		3,4	4			5		
Neighborhood	Urban										
	Suburban										
	Rural / Semi-Rural		3		3,4	4	4		5		
Industrial	Urban						6				
	Suburban					4	6		5		
	Rural /Semi-Rural		3		3,4	4	4,6		5		
Park / Open Space	Urban		3		3	4			5		
	Suburban					4			5		
	Rural / Semi-Rural		3		3,4	4	4		5		

Table Notes

1. An infiltration system can be installed adjacent to other treatment measures to allow for secondary "storage" of treated stormwater to facilitate infiltration where native soils are slow to percolate.
2. Limited applicability given land area needed for measure, more area efficient measures will allow space for complete streets and public open space features within urban street rights of way.
3. On streets with curbs.
4. Possible to use in Park, Semi-Rural or Rural contexts, but there are likely more cost-effective alternatives.
5. Possible to use in Park, Semi-Rural or Rural contexts, but narrowing the street right of way in these lower intensity and open space oriented contexts is more desirable in relation to complete streets and green infrastructure goals.
6. Use pervious pavement only in parking lanes, shoulders, and medians.

3.4 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Elements & Process**
  - GI measure applicability by street type

Table 3.4g Possible Green Infrastructure Locations within the Street

	Green Infrastructure Measures									
	Bioretention/Bioinfiltration Area/Planter									
Street Zone	Stormwater Planter	Stormwater Curb Extension	Rain Garden	Tree Well	Infiltration System [1]	Pervious Pavement	Vegetated Swale	Green Gutter	Stormwater Tree	Interceptor Tree
Sidewalk										
Curb Lane										
Roadway										
Median	2		2	2	2		2		2	
Intersection										

Table Notes

1. Depending upon the type of infiltration system, it can be installed adjacent to other treatment measures to allow for secondary "storage" of treated stormwater to facilitate infiltration where native soils are slow to percolate.
2. Typical center crowned streets do not support this treatment measure in a median.

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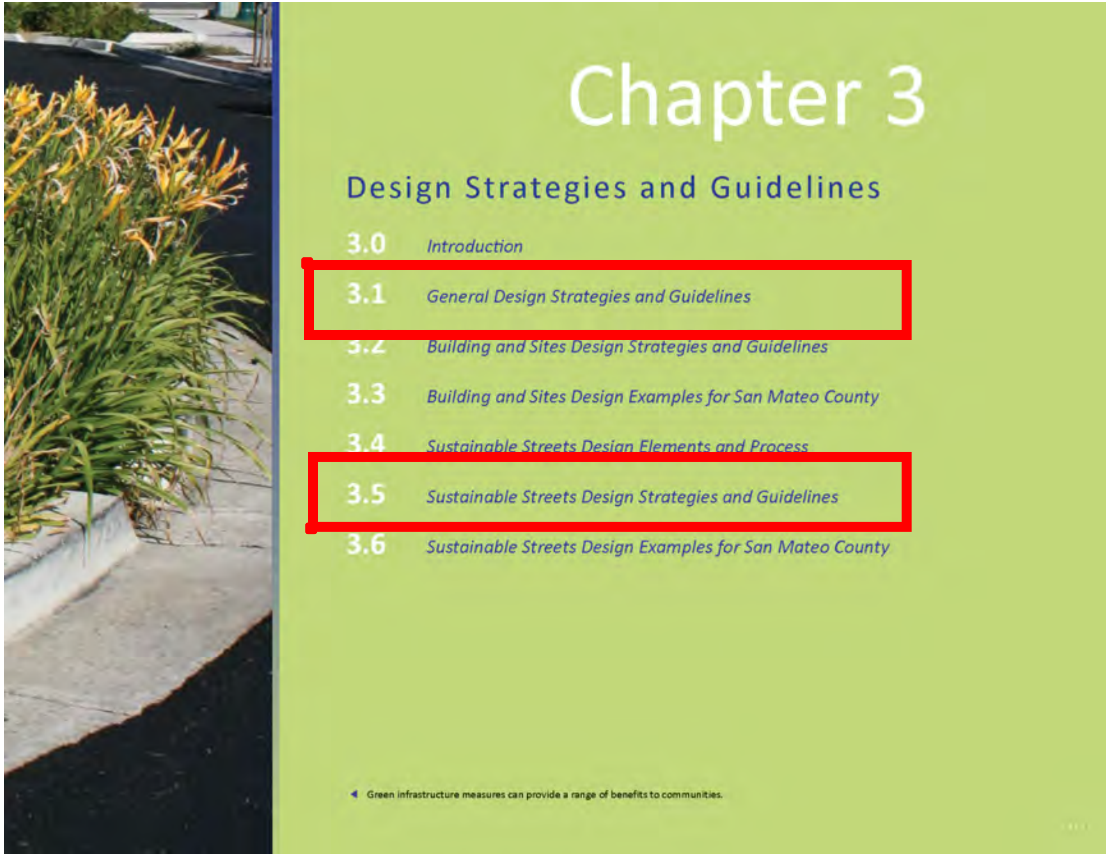

Chapter 3

Design Strategies and Guidelines

◄ Green infrastructure measures can provide a range of benefits to communities.

3.1 Intro to Design Strategies and Guidelines

- **General Design Strategies and Guidelines**
  - Design strategies and guidance applicable to most GI measures and locations
  - For: All Locations
  - Sections by General, Green Infrastructure, Sustainable Streets
  - Builds on Ch 2 and Ch 4 design considerations

3.1 Intro to Design Strategies and Guidelines

- **General Design Strategies and Guidelines**
  - Design strategies and guidance applicable to most GI measures and locations
  - For: All Locations
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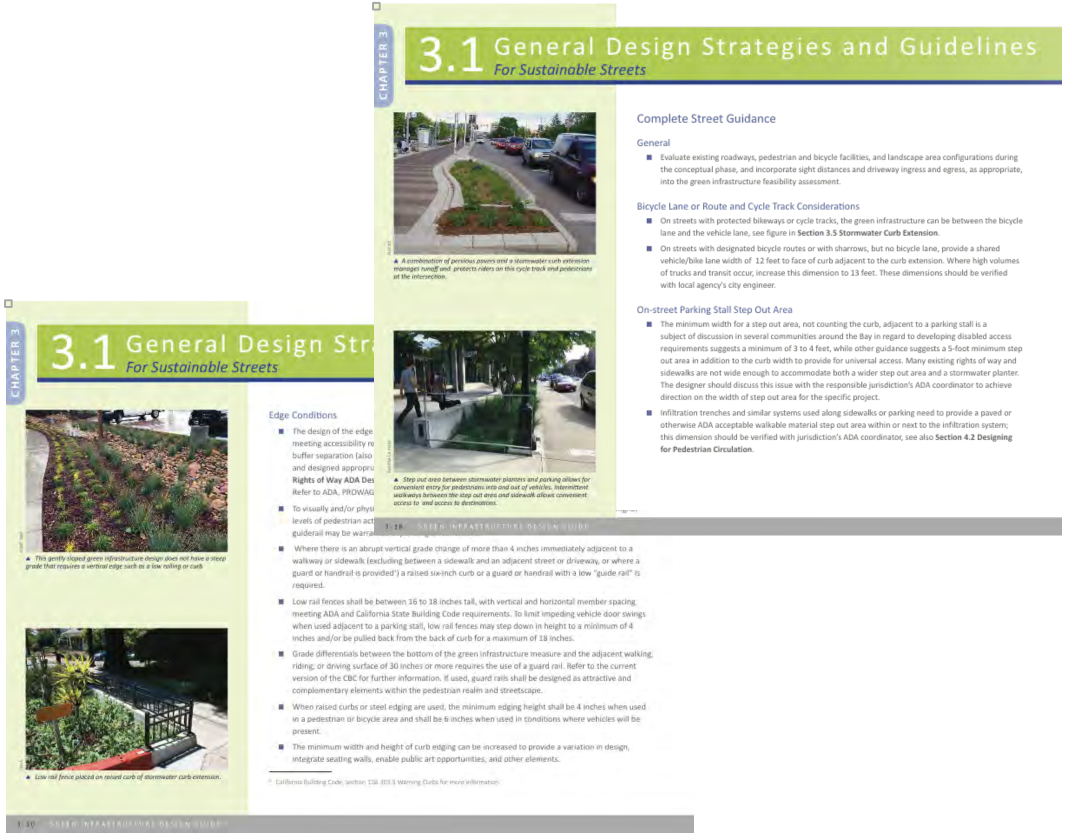

CHAPTER 3

3.1 General Design Strategies and Guidelines
For Sustainable Streets

▲ A combination of pervious pavers and a stormwater curb extension manages runoff and protects riders on this cycle track and pedestrians at the intersection.

▲ Step out area between stormwater planters and parking allows for convenient entry for pedestrians into and out of vehicles. Intermittent walkways between the step out area and sidewalk allows convenient access to and access to destinations.

Complete Street Guidance

General

- Evaluate existing roadways, pedestrian and bicycle facilities, and landscape area configurations during the conceptual phase, and incorporate sight distances and driveway ingress and egress, as appropriate, into the green infrastructure feasibility assessment.

Bicycle Lane or Route and Cycle Track Considerations

- On streets with protected bikeways or cycle tracks, the green infrastructure can be between the bicycle lane and the vehicle lane, see figure in **Section 3.5 Stormwater Curb Extension**.
- On streets with designated bicycle routes or with sharrows, but no bicycle lane, provide a shared vehicle/bike lane width of 12 feet to face of curb adjacent to the curb extension. Where high volumes of trucks and transit occur, increase this dimension to 13 feet. These dimensions should be verified with local agency's city engineer.

On-street Parking Stall Step Out Area

- The minimum width for a step out area, not counting the curb, adjacent to a parking stall is a subject of discussion in several communities around the Bay in regard to developing disabled access requirements suggests a minimum of 3 to 4 feet, while other guidance suggests a 5-foot minimum step out area in addition to the curb width to provide for universal access. Many existing rights of way and sidewalks are not wide enough to accommodate both a wider step out area and a stormwater planter. The designer should discuss this issue with the responsible jurisdiction's ADA coordinator to achieve direction on the width of step out area for the specific project.
- Infiltration trenches and similar systems used along sidewalks or parking need to provide a paved or otherwise ADA acceptable walkable material step out area within or next to the infiltration system; this dimension should be verified with jurisdiction's ADA coordinator, see also **Section 4.2 Designing for Pedestrian Circulation**.

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CHAPTER 3

3.1 General Design Str
For Sustainable Streets

▲ This gently sloped green infrastructure design does not have a steep grade that requires a vertical edge such as a low railing or curb.

▲ Low rail fence placed on raised curb of stormwater curb extension.

Edge Conditions

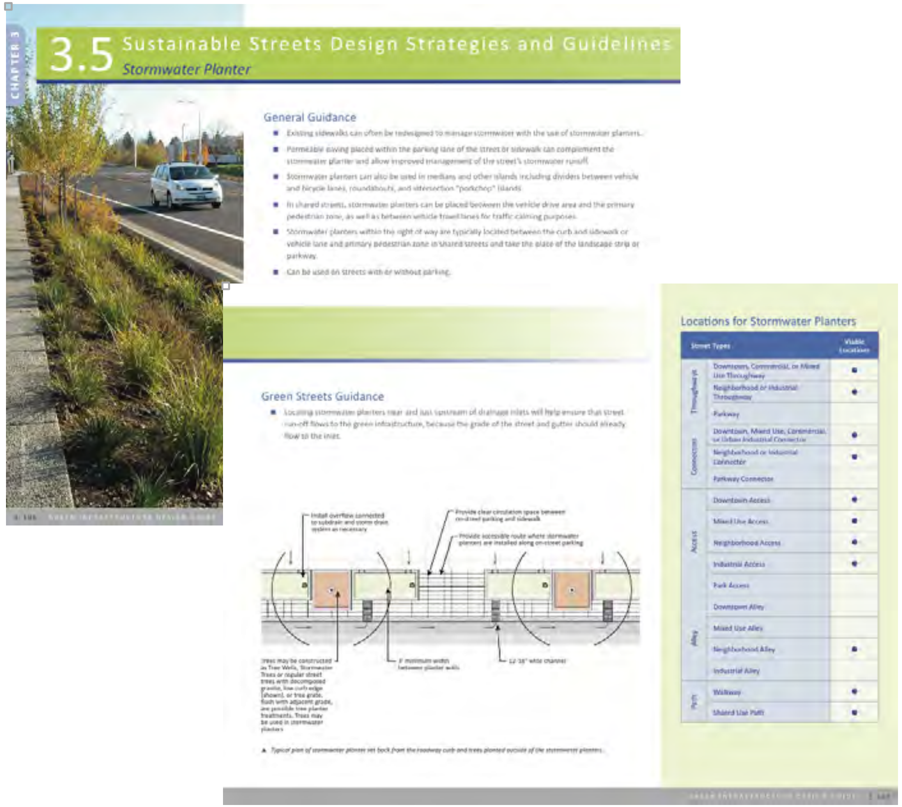
- The design of the edge … meeting accessibility re… buffer separation (also … and designed appropri… **Rights of Way ADA Des…** Refer to ADA, PROWAG…
- To visually and/or physi… levels of pedestrian act… guiderail may be warra…
- Where there is an abrupt vertical grade change of more than 4 inches immediately adjacent to a walkway or sidewalk (excluding between a sidewalk and an adjacent street or driveway, or where a guard or handrail is provided[1]) a raised six-inch curb or a guard or handrail with a low "guide rail" is required.
- Low rail fences shall be between 16 to 18 inches tall, with vertical and horizontal member spacing meeting ADA and California State Building Code requirements. To limit impeding vehicle door swings when used adjacent to a parking stall, low rail fences may step down in height to a minimum of 4 inches and/or be pulled back from the back of curb for a maximum of 18 inches.
- Grade differentials between the bottom of the green infrastructure measure and the adjacent walking, riding, or driving surface of 30 inches or more requires the use of a guard rail. Refer to the current version of the CBC for further information. If used, guard rails shall be designed as attractive and complementary elements within the pedestrian realm and streetscape.
- When raised curbs or steel edging are used, the minimum edging height shall be 4 inches when used in a pedestrian or bicycle area and shall be 6 inches when used in conditions where vehicles will be present.
- The minimum width and height of curb edging can be increased to provide a variation in design, integrate seating walls, enable public art opportunities, and other elements.

[1] California Building Code, section 11B-303.5 Warning Curbs for more information.

3-10 GREEN INFRASTRUCTURE DESIGN GUIDE

3.5 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Strategies and Guidelines**
  - Focused for GI within street environment
  - More detailed guidance building upon Ch 2 and 4, and Section 3.1
  - Organized by:
    - GI measure
    - General, Green Street, Complete Street, Special Conditions


CHAPTER 3
3.5 Sustainable Streets Design Strategies and Guidelines
Stormwater Planter
General Guidance
Green Streets Guidance
Locations for Stormwater Planters

3.5 Intro to Design Strategies and Guidelines

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GI Design Guide

Chapter 3

Design Strategies and Guidelines

◄ Green infrastructure measures can provide a range of benefits to communities.

3.6 Intro to Design Strategies and Guidelines

- **Sustainable Streets Design Examples for San Mateo County**
  - How can implement GI and what could can like
  - Different contexts & street types

CHAPTER 3

3.6 Sustainable Streets Design Examples

Neighborhood Connector Street with Rain Garden Intersections

Street intersections that are wide due to angled intersecting streets present opportunities to use rain gardens either within the center of the intersection as an island or roundabout, or to the side to expand a corner area for stormwater management and increasing public space and character. Street grades need to be considered to allow runoff to flow into the rain garden either from adjacent catch basins or sheet flow. Placing rain gardens within the roadway can aid in calming traffic and making a more comfortable and safer place for people to walk, bicycle, and drive. Where connectors and other streets are multi-lane or have a wide lane width, consider the ability to perform a lane reduction or add bicycle facilities. The illustration below shows rain gardens used to define vehicle circulation and calm traffic, and the addition of bicycle lanes. Corner curb extensions are placed at adjoining corners to increase pedestrian safety and comfort and shorten crossing distances.

▲ *EXISTING: A plan view of a typical wide intersection caused by offset street grids or curvilinear streets within an otherwise orthogonal street grid network in San Mateo County.*

▲ *EXAMPLE: The space created between three intersecting streets was designed into a large rain garden to reduce impervious pavement, capture and treat runoff, provide a sidewalk along the connector, and increase neighborhood identify.*

▲ *RETROFIT OPPORTUNITY: The same street intersection retrofitted with a rain garden to better define and calm vehicle traffic movement. Adjacent corners have corner stormwater curb extensions to shorten pedestrian crossings. Wide streets can be retrofitted to include bike lanes*

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3.6 Intro to Design Strategies and Guidelines

Neighborhood Connector Street with Terraced Stormwater Planters and Stormwater Curb Extensions

Often, rural connectors are designed with no curb or with gutters that double as mini-swales to collect and direct stormwater. Not only do impervious surfaces contribute to the runoff, but rolling hillsides and steep terrain where rainfall cannot fully infiltrate into the soil can also concentrate runoff. Where a street is adjacent to open space is an ideal location for a stormwater planter with check dams to collect both impervious and open space flows. Stormwater curb extensions within parking lanes can also collect and treat stormwater while providing traffic calming and a buffer between pedestrians and motorists and adding to the landscaped character of the surrounding rural open space context.

▲ *RETROFIT OPPORTUNITY: The same street with a combination of terraced stormwater planters and stormwater curb extensions.*

▲ *EXISTING: A typical rural residential street in San Mateo County.*

▲ *EXAMPLE: This neighborhood connector incorporates a bioretention planter with check dams to reduce velocities on a sloping street.*

Ch 2 GI Measures & Opportunities

- **GI Measures**
  - Definition and description
  - Why use and constraints
  - Opportunities for Buildings, Sites, and Streets
  - Special design considerations

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Ch 2 GI Measures & Opportunities

- **2.1 Introduction**
  - Toolbox of GI measures
  - Opportunities
  - GI Measure Applicability
    - locations
    - Type
    - Function

Table 2.1 Green Infrastructure Measure Applicability

Green Infrastructure Measures	Guidance Location	Suitable Green Infrastructure Location				C.3 Regulated Project Type		Primary and Secondary Functions[9]				
		Site	Parking Lot	Building	Street	Stand-alone Treatment	Element of Treatment Train	Infiltration[1]	Bio-Retention	Pollutant Removal	Interception	Detention
Treatment Measures												
Stormwater Planter[2]	2.1	●	●		●	●		■ / □	■	■	□[3]	■ / □
Stormwater Curb Extension	2.2		●		●	●		■ / □	■	■	□[3]	■ / □
Rain Garden	2.3	●	●		●	●		■ / □	■	■	□[3]	■ / □
Tree Well	2.4	●	●		●	●		■ / □	■	■	■	■ / □
Infiltration Systems	2.5	●	●		●	●	●[6]	■ / □	□	■		■ / □
Pervious Pavement	2.6	●	●		●	●	●			■		■ / □
Green Roof	2.7	●		●		●[4]			■	■	■	
Rainwater Harvesting[5]	2.8	●	●	●		●						■
Alternative Treatment Measures[7]												
Vegetated Swale	2.9	●	●		●		●	■ / □		□	■ / □	
Green Gutter	2.10	●	●		●			■ / □	□	□		
Stormwater Tree	2.11	●	●		●			■ / □	□		■	
Site Design Measures												
Interceptor Tree	2.12	●	●	●	●					□	■	
Green Wall[8]	2.13			●					□	□	■	

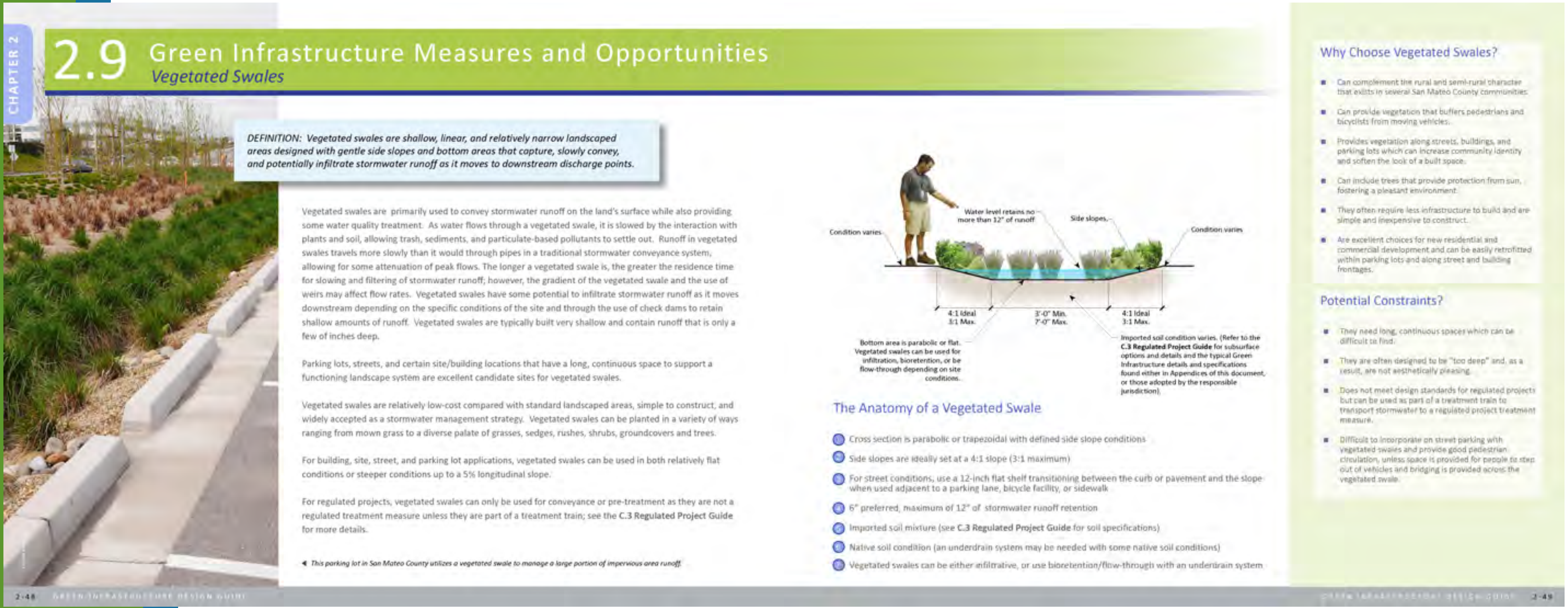
Endnotes

1. Where site-specific percolation tests confirm that an infiltration rate of 0.5/hour is realistic, see **C.3 Regulated Projects Guide** for further discussion.
2. Alternative Term: "Bioretention Swale" – linear bioretention areas, not the same as "Vegetated Swale".
3. Primary Function if trees are included in design.
4. If built to specifications approved by Regional Water Board.
5. Includes cisterns, rain barrels, and other measures and strategies for maximizing use of rain water for non-potable uses such as toilet flushing or landscape irrigation.
6. Some types of infiltration systems require pre-treatment.
7. Alternative Treatment Measures have limited, or currently, no credit towards C.3 regulated project treatment requirements.
8. Not identified as a site design measure in the MRP.
9. See page 1-30 for definitions of these functions.

Legend

- ● Applicable Green Infrastructure Measure
- ■ Primary Function
- □ Secondary Function
- ■ / □ Primary or Secondary Function Depending on Site Conditions and Design

Ch 2 GI Measures & Opportunities



CHAPTER 2

2.9 Green Infrastructure Measures and Opportunities
Vegetated Swales

DEFINITION: Vegetated swales are shallow, linear, and relatively narrow landscaped areas designed with gentle side slopes and bottom areas that capture, slowly convey, and potentially infiltrate stormwater runoff as it moves to downstream discharge points.

Vegetated swales are primarily used to convey stormwater runoff on the land's surface while also providing some water quality treatment. As water flows through a vegetated swale, it is slowed by the interaction with plants and soil, allowing trash, sediments, and particulate-based pollutants to settle out. Runoff in vegetated swales travels more slowly than it would through pipes in a traditional stormwater conveyance system, allowing for some attenuation of peak flows. The longer a vegetated swale is, the greater the residence time for slowing and filtering of stormwater runoff; however, the gradient of the vegetated swale and the use of weirs may affect flow rates. Vegetated swales have some potential to infiltrate stormwater runoff as it moves downstream depending on the specific conditions of the site and through the use of check dams to retain shallow amounts of runoff. Vegetated swales are typically built very shallow and contain runoff that is only a few of inches deep.

Parking lots, streets, and certain site/building locations that have a long, continuous space to support a functioning landscape system are excellent candidate sites for vegetated swales.

Vegetated swales are relatively low-cost compared with standard landscaped areas, simple to construct, and widely accepted as a stormwater management strategy. Vegetated swales can be planted in a variety of ways ranging from mown grass to a diverse palate of grasses, sedges, rushes, shrubs, groundcovers and trees.

For building, site, street, and parking lot applications, vegetated swales can be used in both relatively flat conditions or steeper conditions up to a 5% longitudinal slope.

For regulated projects, vegetated swales can only be used for conveyance or pre-treatment as they are not a regulated treatment measure unless they are part of a treatment train; see the **C.3 Regulated Project Guide** for more details.

◄ This parking lot in San Mateo County utilizes a vegetated swale to manage a large portion of impervious area runoff.

Condition varies

Water level retains no more than 12" of runoff

Side slopes.

Condition varies

4:1 Ideal
3:1 Max.

3'-0" Min.
7'-0" Max.

4:1 Ideal
3:1 Max.

Bottom area is parabolic or flat. Vegetated swales can be used for infiltration, bioretention, or be flow-through depending on site conditions.

Imported soil condition varies. (Refer to the **C.3 Regulated Project Guide** for subsurface options and details and the typical Green Infrastructure details and specifications found either in Appendices of this document, or those adopted by the responsible jurisdiction).

The Anatomy of a Vegetated Swale

1. Cross section is parabolic or trapezoidal with defined side slope conditions
2. Side slopes are ideally set at a 4:1 slope (3:1 maximum)
3. For street conditions, use a 12-inch flat shelf transitioning between the curb or pavement and the slope when used adjacent to a parking lane, bicycle facility, or sidewalk
4. 6" preferred, maximum of 12" of stormwater runoff retention
5. Imported soil mixture (see **C.3 Regulated Project Guide** for soil specifications)
6. Native soil condition (an underdrain system may be needed with some native soil conditions)
7. Vegetated swales can be either infiltrative, or use bioretention/flow-through with an underdrain system

Why Choose Vegetated Swales?

- Can complement the rural and semi-rural character that exists in several San Mateo County communities.
- Can provide vegetation that buffers pedestrians and bicyclists from moving vehicles.
- Provides vegetation along streets, buildings, and parking lots which can increase community identity and soften the look of a built space.
- Can include trees that provide protection from sun, fostering a pleasant environment.
- They often require less infrastructure to build and are simple and inexpensive to construct.
- Are excellent choices for new residential and commercial development and can be easily retrofitted within parking lots and along street and building frontages.

Potential Constraints?

- They need long, continuous spaces which can be difficult to find.
- They are often designed to be "too deep" and, as a result, are not aesthetically pleasing.
- Does not meet design standards for regulated projects but can be used as part of a treatment train to transport stormwater to a regulated project treatment measure.
- Difficult to incorporate on street parking with vegetated swales and provide good pedestrian circulation, unless space is provided for people to step out of vehicles and bridging is provided across the vegetated swale.

Ch 2 GI Measures & Opportunities

2.11 Green Infrastructure Measures and Opportunities

Stormwater Trees

Stormwater Tree. Note that the low railing is set back from the curb and is a lower height that transitions to a higher height. This allows for car doors to swing open without hitting the railing.

Opportunities for Streets

Any place a standard street tree could be located, a stormwater tree can be used. Stormwater trees are helpful in places that have limited or no storm drain systems, are in constrained and urban areas, and for retrofit projects. Even where on-street parking is highly utilized there may be opportunities for stormwater trees. Small planters may be added between parking spaces to provide some stormwater treatment and complete street benefits of shading sidewalks with trees and visually narrowing the street. The use of a tree grate can expand the walking or bicycling surface area. Stormwater trees can be used at the curb edge of sidewalk; within parking lanes; in wider buffers to cycle track facilities; with parallel or diagonal parking, and particularly where red curbs currently exist. Locating stormwater trees upstream of drainage inlets and catch basins will help ensure that street run-off flows to the green infrastructure first, because the grade of the street and gutter should already flow to the inlet. It is generally not recommended to retrofit an existing street tree into a stormwater tree due to existing planter grades and tree roots.

Stormwater trees can be linked together with pervious pavement, modular suspended pavement, and other techniques to expand runoff storage capacity.

Special Considerations for Stormwater Tree Design

- Ensure stormwater runoff can flow back out to the street when the stormwater tree planter area is at capacity.
- Provide adequate tree root volume of planter area to support long term tree health and vitality. This is especially important for trees sited in large extents of pavement. Adequate tree root volume can be met by a variety of techniques including a minimum tree planter area size based on the expected mature size of the tree; using modular pavement support cells; and using permeable pavement and/or infiltration trenches to link trees. These measures aid in allowing roots access to oxygen and water. Refer to **Section 3.5.11** for additional information on minimum tree planter sizes and related information.
- Stormwater tree planting areas can be planted with a variety of trees, shrubs, grasses and groundcovers, depending on site context and conditions.
- If considering turning existing street tree plantings into stormwater trees, work with an arborist to confirm the trees can tolerate the addition of new and/or larger amounts of water inundation.

The gravel band along the curb helps to dissipate stormwater runoff flows into the planter.

These stormwater trees are flanked by seating areas. A metal capped inlet should be provided across the face of the planter to prevent vehicles from entering the planters.

As with other green infrastructure measures, stormwater tree planters will need to be maintained to remove debris and sediment and replant vegetation that declines.

Ch 4 Intro to Design Strategies and Guidelines

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Ch 4 Intro to Design Strategies and Guidelines

4.9 Key Design and Construction Considerations

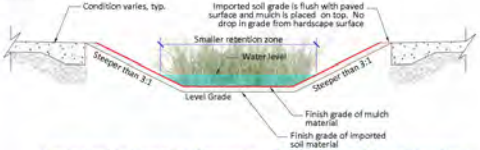
Soil Preparation, Landscape Grading, and Mulch Placement

▲ *This newly installed green infrastructure facility will have consistent problems with erosion control and plant health issues because of steep side slope conditions (steeper than 3:1 slope).*

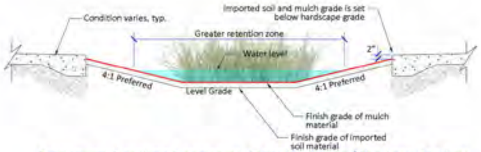
▲ *This rain garden is graded very shallow to allow ponding of water, but it is not excessively deep or have steep side slopes. Ultimately this rain garden will perform better over time and will be easier to maintain.*

Effective Landscape Grading

Many stormwater facilities built in San Mateo County are designed to be too deep and with very steep side slopes. These types of conditions have permanent operation and maintenance consequences including erosion issues, plant desiccation, and difficulty to physically access plant material. For future projects, it is best to design facilities with gradual side slopes and shallow depth facilities to help limit erosion, better mimic natural landscape conditions, and promote more flat space for water contact. The type of green infrastructure facility may need to be reconsidered to have curb walls rather than side slopes in narrow locations to limit the issues associated with erosion, constrained areas for tree planting, and other conditions. See below for grading comparisons.



Undesirable Grading Scenario: Steep Slopes/Deep Facility



Optimum Grading Scenario: Gentle Slopes/Shallow Facility

Rural and Semi-Rural Streets and Roads

Rural and semi-rural areas of San Mateo County, such as Atherton, Portola Valley, Hillsborough, Woodside, and parts of other communities and the unincorporated County, often have streets and roads that are not fully improved with sidewalks, curbs, gutters, street lights, non-channelized stormwater improvements, and other complete street and infrastructure elements. Roadsides may function as "informal" green infrastructure in their current state. However, if these areas also function as shoulders or informal parking, they can become compacted or damaged by vehicles which would impede their function as green infrastructure.

Rights of way are often narrow, topography can be steep and rolling, mature trees may be present, and soils may not be conducive to infiltration. Because of these factors, areas that are feasible for green infrastructure facilities may be limited. In these instances, right of way or easements may need to be acquired to place green infrastructure along streets and roads, and the use of check dams on steeper streets will need to be considered. Further, the type of green infrastructure measures may be limited as well. Opportunities to utilize excess right of way at intersections and other flatter areas for rain gardens can be a viable way to provide some green infrastructure that treats and manages run off from existing swales along roads. In some cases, existing swales along roads could be modified to become terraced or non-terraced stormwater planters or as vegetated swales that slow, pre-treat, and transport stormwater to a rain garden or infiltration system.

Remember that new trees planted along streets within a project area can be designed or considered as tree wells, stormwater trees, or interceptor trees. In addition, existing trees that are preserved as part of a project and meet C.3 guidance can be considered as interceptor trees. It may also be more efficient for communities with these conditions to identify watershed or sub-watershed scales public projects for green infrastructure

▲ *Linear landscape or swale areas along streets can be retrofitted into vegetated swales, pervious pavement parking areas, rain gardens, or other green infrastructure measures.*

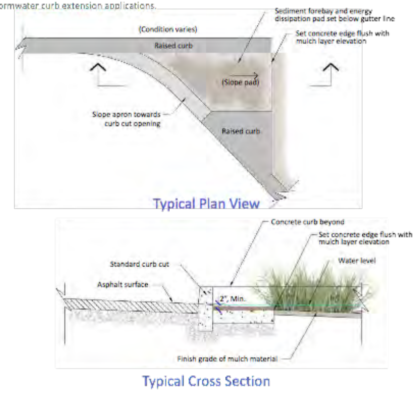
▲ *A shallow green gutter is retrofitted along a rural residential street. The project also incorporated a pervious concrete sidewalk that now allows children to safely walk to a nearby elementary school.*

▲ *Narrow rights of way and steeper terrain in rural and semi-rural areas limit the ability to use green infrastructure measures. Flatter intersections and cross streets may offer locations for green infrastructure.*

Ch 4 Intro to Design Strategies and Guidelines

Sediment Forebays for Stormwater Curb Extensions

Because streets are typically the primary conveyance system of stormwater runoff within the urban watershed, they often produce and transport the highest sediment load. For this reason, special consideration should be made to allow for a sizeable sediment forebay for stormwater curb extensions receiving gutter flow. The sketches below illustrate some basic guidance on sediment forebays for stormwater curb extension applications.



▲ *This stormwater curb extension has no concrete forebay. Sediment builds up and blocks runoff from entering.*

▲ *This stormwater curb extension has a concrete forebay that captures sediment that is removed regularly.*

▲ *While this is a good concrete pad, the elevation needs to be lowered at least 2 inches to allow for sediment capture.*

CHAPTER 4

4.12 Key Design and Construction Considerations
Sizing of Green Infrastructure Facilities

Standard Sizing Methodology

MRP Provision C.3.d specifies minimum hydraulic sizing requirements for stormwater treatment measures at regulated projects. Regulated projects must treat the water quality design flow or volume of stormwater runoff through infiltration, biotreatment, or capture and use. Certain regulated projects must also meet the sizing requirements for hydromodification management (HM) in Provision C.3.g, depending on the location and amount of impervious surface created and/or replaced on the site.

Chapter 5 of the **C.3 Regulated Project Guide** contains detailed procedures for sizing specific stormwater treatment measures using volume-based sizing criteria, flow-based sizing criteria, or a combination flow and volume approach. The volume-based design standard is capture and treatment of 80% of the annual runoff (the small, frequent storm events.) There is also a simplified sizing method for biotreatment in which the surface area of the treatment measure is equal to 4% of the contributing impervious area, i.e., a sizing factor of 0.04[1].

In general, green infrastructure facilities are required to meet the same sizing criteria as regulated projects: Green infrastructure should be sized to treat the C.3.d flow and/or volume of runoff from contributing impervious surface areas in the public realm (e.g., street, sidewalk, parking lot, etc.) as well as portions of adjacent parcels that drain to those areas if necessary. If site constraints in the public right of way prevent sizing green infrastructure to meet C.3.d sizing requirements, the alternative sizing methodology described below may be used.

Alternative Sizing Methodology for Street Projects

Recognizing that green infrastructure in the public right of way may not be able to meet the standard sizing methodology due to constraints such as lack of space, utility conflicts, or other factors, the MRP allows non-regulated green street projects with documented constraints to use an alternative sizing methodology. BASMAA has developed regional guidance for alternative sizing, based on a hydrologic modeling analysis, with sizing curves for the minimum bioretention surface area needed to provide treatment of 80% of annual runoff (per C.3.d) and design approaches to use when the C.3.d sizing requirements cannot be met[2].

The hydrologic analysis report provides an equation to calculate the minimum bioretention sizing factor to meet C.3.d based on the mean annual precipitation (MAP) of the project site:

Sizing Factor = 0.00060 x MAP + 0.0086

Where: Sizing Factor is the ratio of the surface area of the bioretention facility to the impervious area contributing runoff

Based on this equation, green street bioretention facilities in some areas of the County can be sized with as low as a 2% sizing factor and still meet the C.3.d sizing requirements.

If a green street opportunity is constrained such that the minimum sizing factor cannot be achieved, undersized green infrastructure measures may still be worth constructing to provide some water quality, runoff reduction, urban greening, or other community benefits. The sizing curves in the BASMAA guidance can be used to determine what percentages of the C.3.d volume are treated in smaller facilities. Refer to **Appendix 7** for the complete document, *Guidance for Sizing Green Infrastructure Facilities in Street Projects*, and its companion technical memorandum, *Green Infrastructure Facility Sizing for Non-regulated Street Projects*.

1 This sizing factor is based on a permeability of 5 inches per hour (in/hr) through the bioretention soil media and a rainfall intensity of 0.2 in/hr, as specified in MRP Provision C.3.d.

2 BASMAA, 2018. "Guidance for Sizing Green Infrastructure Facilities in Street Projects."

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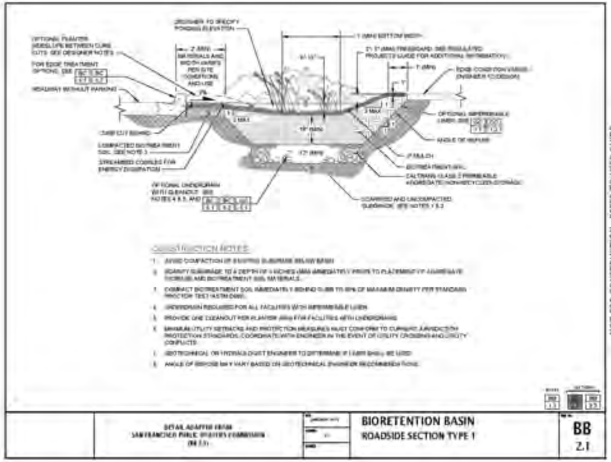
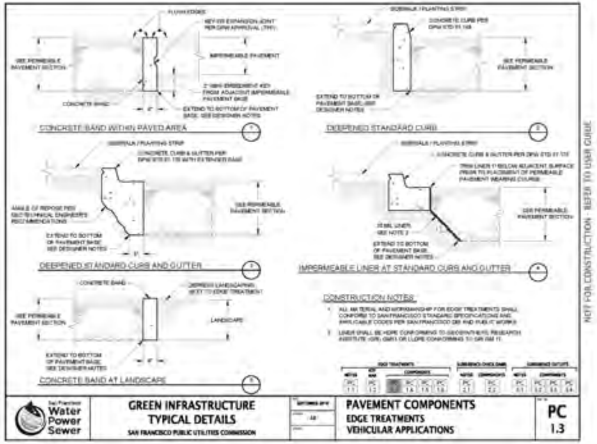
Appendices

- **Sustainable Streets Typical Design Details**
  - How to use
  - Customize for site specific conditions
  - Base details: SFPUC GI Typical Details
  - Verify most current version is used
  - Verify if jurisdiction where project is has different details
  - SMCWPPP modified/new typical details
  - References to other agency typical details





Appendices

- **Sustainable Streets Specifications**
  - How to use
  - For permeable pavements, biotreatment soil, and composted mulch
  - Plant palette and MWELO
  - Customize for site specific conditions
  - Design and functional considerations
  - Base specs: SF PUC or Bay Area Pervious Concrete
  - Verify most current version is used
  - Verify if jurisdiction where project is has different specifications

Appendices

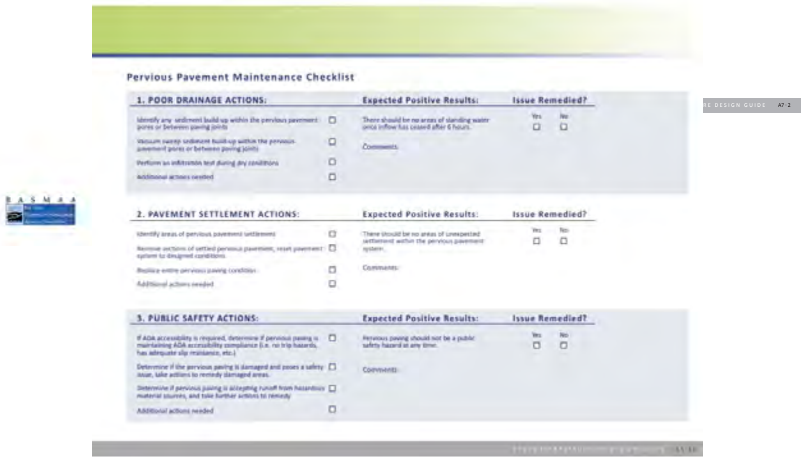
- **Ap 7 Guidance for Sizing GI Facilities in Streets**
  - BASMAA's regional approach for alternative sizing for constrained non-regulated street projects
- **Ap 5 Sample Maintenance Plan Forms**
  - Maintenance checklists for:
    - Landscaped Stormwater Facility
    - Pervious pavement


Guidance for Sizing Green Infrastructure Facilities in Street Projects

Bay Area Stormwater Management Agencies Association

Green Infrastructure Facility Sizing For Non-Regulated Street Projects

B A S M A A
Bay Area Stormwater Management Agencies Association


Pervious Pavement Maintenance Checklist

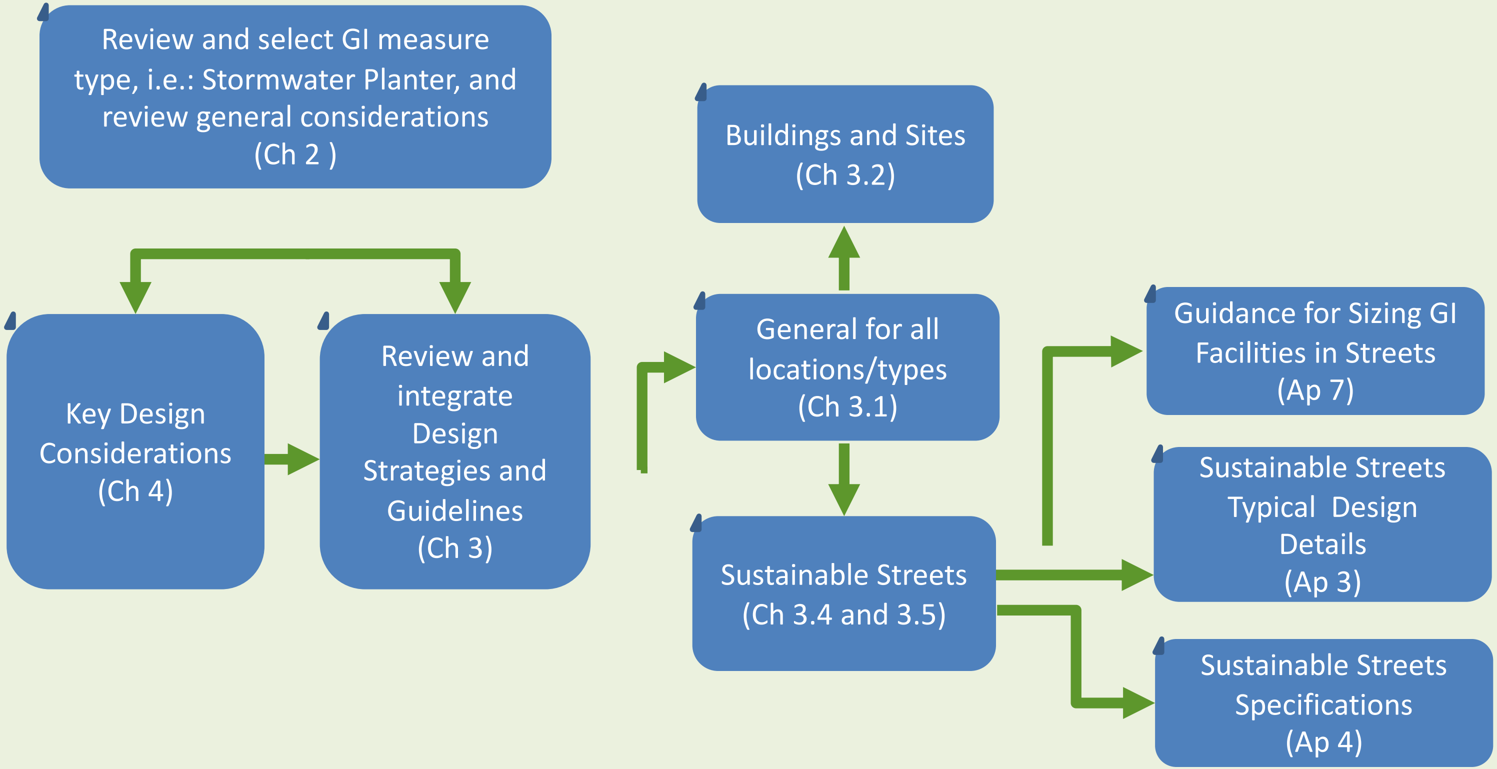
1. POOR DRAINAGE ACTIONS: | Expected Positive Results: | Issue Remedied?

2. PAVEMENT SETTLEMENT ACTIONS: | Expected Positive Results: | Issue Remedied?

3. PUBLIC SAFETY ACTIONS: | Expected Positive Results: | Issue Remedied?

How to Use the GI Design Guide

User Experienced with GI and Ready to Design



Green Infrastructure Design Guide

- Questions?

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