STUDY SESSION

Agenda Item # 1

AGENDA REPORT SUMMARY

Meeting Date: November 15, 2016

Subject: Shoulder Paving Policy

Prepared by: Susanna Chan, Public Works Director
Approved by: Chris Jordan, City Manager

Attachment:
1. Shoulder Paving Policy Memorandum, dated November 2, 2016, prepared by NCE

Initiated by:
City Council

Fiscal Impact:
None at this time

Environmental Review:
In accordance with CEQA Guidelines Section 15378(b)(5), this review is not a project because it is an administrative activity that will not impact the environment.

Policy Questions for Council Consideration:
- Does the Council support the proposed revisions to the Shoulder Paving Policy?
- What are the Council directions on other related issues raised as part of the Shoulder Paving Policy review?

Summary:
- Working with the Environmental Commission, staff and the Consultant developed proposed revisions to the existing Shoulder Paving Policy to address stormwater quality, aesthetic and other issues related to the implementation of the Policy
- A number of related policy questions were raised through the review process which require Council directions

Staff Recommendation:
Receive a report on the proposed revisions to the Shoulder Paving Policy and provide direction as needed

Subject: Shoulder Paving Policy

Purpose
Modify Shoulder Paving Policy to incorporate green infrastructure (GI) principles and address aesthetic and other concerns related to the existing Policy.

Background
Stormwater management is one of the core functions of the Public Works Department and is a goal on the 2016/17 Environmental Commission Work Plan. At the April 26, 2016 City Council meeting, Council adopted the Stormwater Master Plan and directed staff to work with the Environmental Commission to seek opportunities to incorporate current stormwater management best practices in the Shoulder Paving Policy and to address aesthetic and other concerns associated with the existing Policy.

Discussion/Analysis
Shoulder Paving Policy
The City adopted the Shoulder Paving Policy in 2001 with the primary goal to narrow streets, define the street edge, and provide traffic calming. The Council has considered the Policy on several occasions from 2009 to 2011 and made revisions to address public concerns. According to the current Policy, the shoulder of a newly constructed or 50% or greater square footage remodeled residence is required to be brought into compliance with current standards. The Policy has three main components, including a 3-foot wide asphalt concrete (AC) drainage swale, a 5-foot wide shoulder parking area, and a minimum 10-foot long landscape area.

More recently, residents and community groups have expressed the following concerns with the Policy:

- Asphalt materials in the drainage swale and/or shoulder parking area are not consistent with the City's preferred rural aesthetic
- The Policy is inherently implemented in a patchwork distribution which has led to localized drainage issues
- Shoulder improvements do not capitalize on opportunities to capture and infiltrate runoff to achieve stormwater benefits

Current Revision Recommendations
In accordance with Council directions, staff retained NCE, a qualified environmental and engineering consultant firm and engaged in discussion with the Environmental Commission to update the Shoulder Paving Policy. The Environment Commission appointed a subcommittee in May 2016 to provide timely support and resources to staff and the consultant. Under the guidance and support from the subcommittee, the consultant developed a draft report which recommended changes to all three major components of the Policy. The consultant's draft report was discussed at the September and October Environmental Commission meetings and the Commission provided

comments on the recommendations. Based on comments from the Commission, the Consultant developed three recommended revisions, including:

1. Retain the specification for an AC drainage swale

   The current policy specifies installation of a 3-foot wide AC drainage swale along the length of the property. To address concerns that the AC swale is not consistent with a rural aesthetic or does not provide stormwater quality benefits, alternative materials for use in lieu of AC were considered. However, due to concerns associated with costs, maintenance, and pedestrian safety, the final recommendation is to maintain the specification for a 3-foot wide AC drainage swale. Several clarifications are suggested regarding the AC swale, including clarifying the maximum width of 3-foot, specifying maximum cross slope of 5%, and requiring to direct flows into permeable parking area and GI features.

2. Specify permeable materials for use in parking area

   The current Policy specifies pervious pavers or compactable pervious material for the shoulder parking area. The recommendation is to detail which type of permeable materials are allowable. The recommended allowable materials include pervious concrete pavers, open cell concrete blocks, compacted aggregate base, and stabilized decomposed granite. These recommended materials can help to capture and treat a portion of the stormwater runoff, are more consistent with the desired aesthetic, and consistent with the City's Residential Design Guidelines. Pervious concrete and porous asphalt, while provide some stormwater quality benefits, are not recommended due to long-term maintenance and aesthetic concerns. Details of the recommended materials are provided in Table 1 of the Consultant report.

3. Require installation of a GI feature, such as rain garden or bioswale in landscape area

   Green Infrastructure is infrastructure that uses vegetation, soils, and natural processes to manage stormwater and create healthier urban environments. One of the goals of re-examining the Shoulder Paving Policy is to seek opportunities to incorporate current stormwater management features into the Policy. The existing Policy specifies landscaping in areas adjacent to the shoulder parking area or driveway. It is recommended to require a GI feature, such as rain gardens or bioswales, be installed in the landscape area. The GI feature should be installed to allow runoff from the shoulder parking area and AC swale to enter this area and the overflow would discharge back into the AC drainage swale. It is recommended that the size of the GI feature will be proportional to the length of the frontage for each property. The recommended size requirements are:

- Frontage < 75': 50 Square Feet (SF) minimum
- 75'< Frontage <100': 100 SF minimum
- 100' < Frontage < 150': 200 SF minimum
- Frontage > 150': 300 SF minimum

The Consultant provided quantitative evaluation on the effectiveness of various sizes of GI feature. The detailed information, including assumptions, calculations, and estimated construction cost, are presented in Appendix C of the report.

GI features can help to capture and treat a portion of stormwater runoff and create additional landscape features that can add aesthetic value. Additionally, if a portion of the flows are directed to GI features for detention and infiltration, it would minimize the potential downstream localized drainage issues created by the inherent patchwork implementation of the Policy.

Other Considerations

As part of the evaluation process, the Environmental Commission reviewed several related issues raised by individual commissioners and the members of the public.

- Should the Policy be renamed as Shoulder Improvements Policy?

  The Environmental Commission supported the idea of renaming the Policy to Shoulder Improvements Policy as it more accurately reflects the recommended changes to the existing Policy.

- Should the grandfathering provision for maintenance on existing shoulder be removed?

  The Environmental Commission confirmed that the Policy should not apply for repairs, resealing, and repaving in kind of existing shoulders. However, the Environmental Commission raised the question if the Policy should apply to major landscaping work in the front yard.

- Should there be a minimum setback requirement for street trees due to the potential impact from the roots to the streets and/or walking paths?

  The current Policy requires trees to be planted a minimum of 21' from the centerline of the street. The Environmental Commission recommended the consideration of specifying the minimum distance to the edge of the swale. Another approach is to require root barriers for street trees.

Although the Environmental Commission as a whole did not discuss the parking requirements, individual commissioners and a member of the public expressed the desire to change installation of a parking area from optional to a requirement.

Bicycle and Pedestrian Advisory Commission (BPAC) Input

Staff presented the proposed Policy revisions to the BPAC at its October 26, 2016 meeting. The BPAC felt that overall the proposed changes provide stormwater quality benefits and do not adversely affect pedestrian and bicycle activities. However, the BPAC expressed the following concerns related to the Policy:

- The City has no policies regarding acceptable landscaping for front yard and in the shoulder area which could potentially create issues for pedestrian and bicycle activities on the streets.
- Oversight and enforcement of improvements in the shoulder area, particular for those that are not related to building improvements, is a concern.
- The patchwork implementation of the Policy and the inconsistence of the shoulder area are concerning from pedestrian and bicycle safety perspective.
- The City should evaluate the impacts of the Shoulder Paving Policy to school routes and make adjustments as appropriate should negative impacts be identified.

Next Steps

Staff is seeking Council feedback on the proposed revisions and directions on next steps. If Council wishes to proceed with the recommended policy revisions, staff can work with the Consultant to finalize the Policy for Council adoption. Staff is also seeking Council directions on other policy questions raised during the review process, including:

- Should the Policy apply to major front yard landscape improvements?
- Should the City develop guidelines and requirements regarding acceptable landscaping for front yard and in the shoulder area?
- Should parking be a requirement in the Policy?
- Should the minimum distance between street trees and the edge of the swale be specified or should root barriers for street trees be required?

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MEMORANDUM

Date:	November 2, 2016
To:	Susanna Chan, PE
From:	Marcy Kamerath, CPSWQ, QSD/QSP, Franz Haidinger, PE
Subject:	Los Altos Shoulder Paving Policy (Standard Detail SU-20, May 2010)

Background

The City of Los Altos has contracted with NCE to review and make recommendations for revising the City's current Shoulder Paving Policy (Policy) (Standard Detail SU-20, May 2010) (Appendix A) to address more recent concerns related to aesthetics, stormwater, and prescribed materials. In 2001 the City adopted the Policy with the primary goal to narrow streets, define the street edge, and provide traffic calming[1]. The Policy specifies shoulder treatments for residential properties which must be installed for construction of a new residence or when 50% or more of the square footage of an existing residence is being remodeled.

The Policy has three main components, a 3-foot wide asphalt concrete (AC) drainage swale, and a 5-foot wide shoulder parking area with pervious pavers or compactable pervious material (at least 5 feet wide x 22 feet long), and a minimum 10-foot wide landscape area. In addition the Policy illustrates the addition of street trees, and location of existing or newly landscaped areas. The Policy does not apply if a homeowner is conducting repairs, resealing, and repaving in kind of existing shoulders. In addition, no shoulder improvements, other than landscaping and irrigation, are permitted on streets with a pavement width of 36 ft. or greater.

Review of Existing Information

To develop and recommend revisions to the Policy, which are outlined in this memorandum, NCE reviewed City Council reports and public concerns with the Policy; consulted with the City and Environmental Subcommittee; conducted a site visit; reviewed relevant stormwater manuals and design considerations; and qualitatively assessed alternative materials for use in the swale and parking areas.

[1] October 1, 2015 Agenda Item to Planning and Transportation Commission

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The City Council has considered the Policy on several occasions[2] and from 2009 to 2011 made the following revisions to address public concerns regarding the Policy:

- Specified compactable materials in shoulder parking areas to address the concern that loose materials, such as bark or mulch can be transported onto public streets which can be unsafe for bicyclists or pedestrians, or could be transported into the storm drain system[3]
- Upheld the specification for an AC drainage swale to promote positive drainage to address concerns related to ponding along the street edge or adjacent properties[3]
- Required a minimum 8-foot wide shoulder parking area regardless of street travel lane widths in order to maintain shoulder parking on narrow streets (i.e., street pavement width less than 36 feet)[4]
- Did not permit shoulder improvements, other than landscaping and irrigation, on the widest streets in Los Altos (i.e., streets with travel lanes of 36 feet or greater) to address concerns about the visual widening of streets[4]

More recently, residents and community groups have expressed the following concerns with the Policy:

- Asphalt materials in the drainage swale and/or shoulder parking area are not consistent with the City's preferred rural aesthetic
- The policy is inherently implemented in a patchwork distribution which has led to localized drainage issues
- Shoulder improvements do not capitalize on opportunities to capture and infiltrate runoff to achieve stormwater benefits
- Limited information and specificity on what compactable materials can be used in the shoulder parking area may result in use of materials that are not consistent with a rural aesthetic or create drainage related issues

Consultation with City, Subcommittee, and Site Visit

Following review of the Policy and associated public concerns, NCE met with the City and Environmental Subcommittee on July 8th, 2016 to discuss the goals of the Policy, review public concerns, and identify opportunities to clarify and improve the Policy. To find examples of existing shoulder paving practices, NCE searched for similar requirements from adjacent municipalities but found that no shoulder paving policies or standard specifications existed for shoulder improvements in residential

[2] November 13, 2001, January 27, 2009, February 24, 2009, March 10, 2009, March 24, 2009, December 8, 2009, March 22, 2015, and October 25, 2015
[3] March 22, 2011 City Council Agenda Report
[4] March 24, 2009 City Council Agenda Report

areas within the neighboring communities of the City of Los Altos Hills, Palo Alto, or Atherton. Based on the review of concerns and consultation with the City and Subcommittee, it was determined that a preferable revised Policy would uphold Policy requirements which address prior concerns, but also include new revisions which would result in a Policy that 1) specifies materials which are more consistent with the City's rural aesthetic and 2) can capitalize on opportunities to capture or infiltrate some stormwater runoff, where feasible[5].

On July 27th, 2016, NCE conducted a site visit to locations selected by the City, in consultation with the Environmental Subcommittee. This included 10 residences where the Policy had been implemented[6] in various ways and 2 locations where green infrastructure (GI) practices had been implemented to address post construction runoff[7]. Green infrastructure consists of rain gardens, bioswales, infiltration trenches, and other site design features which are sized to capture, store, and/or infiltrate a portion of stormwater runoff on-site, rather than conveying stormwater flows through conventional pipe and drainage swales to a central storm drain collection system. Observations from the site visit helped to characterize concerns, identify site constraints, observe typical street conditions, and identify opportunities to improve the Policy.

One prominent concern observed during the site visit is that misinterpretation of the Policy appears to result in AC being used in the shoulder parking area which creates a visual widening of the street (**Figure 1**). In some cases this increased the pavement width by up to 30%. Clarifying the Policy to specify which materials are suitable for use in the drainage area and shoulder parking area could improve implementation of the Policy and help address concerns related to aesthetics. In addition, the City recently improved its plan inspection and review procedures for implementation of the Shoulder Paving Policy which should help to minimize misinterpretation of the Policy.

A second concern is erosion occurring along shoulders where a swale is absent or not installed in a way to promote positive drainage. Clarifying the Policy to specify slopes for the drainage swale and parking area could improve drainage issues where the Policy is being implemented.

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[5] Quantification of runoff reduction or runoff quality is not addressed under the current scope of work
[6] 176 and 196 Angela Drive; 284 Frances Drive; 33 Yerba Buena Avenue; 225, 229, and 237 Del Monte Avenue; 610, 789, 932 Parma Way; Parma Way and Harrington Avenue
[7] Packard Foundation, on 2nd Street between Whitney and Lyell Streets; and Homestead and Grant Road to the City Limit

A third concern validated during the site visit was the presence of loose materials in the roadway and in downstream storm drain facilities where decomposed gravel or granite was adjacent to the pavement edge.

One opportunity identified in the field is the option to include Green Infrastructure (GI) features, such as a rain garden or bioswale, into landscaped areas. Example details and photographs of GI features are shown in **Appendix B**.

Based on site observations, connecting GI features with an underdrain to existing storm drain infrastructure will not be viable at most properties. Therefore GI features, if installed at locations without nearby storm drain infrastructure, should be designed to allow stormwater flows into and out of the GI feature. Overflows would be routed back to the drainage swale. An example of a flow-through GI feature was observed on 2nd Street (**Figure 2**). While curb and gutter would not be present when applying a rain garden as part of the Policy, this provides an example of an inflow and outflow which allows stormwater flows to be routed through the GI feature so a portion of flows can be captured, infiltrated, and excess flows are routed back to a conveyance feature (i.e., curb and gutter, or drainage swale).

Figure 1 - Asphalt used in shoulder parking and drainage swale area (NCE)

Other observations from the site visit worth noting include:

- Shoulder conditions vary widely on either side of properties that have implemented the Policy (e.g., asphalt, gravel, bare dirt)
- Stormwater conveyed from hardscape surfaces may collect and cause ponding, or erosion of unimproved shoulder areas
- Due to the patchwork implementation of the Policy and various shoulder conditions that will occur, some localized drainage issues will persist despite clarifications made to the Policy
- Potentially shallow underground utilities exist at several properties
- Due to presence of overhead powerlines along the frontage of some properties, engineering staff may grant exceptions regarding the planting requirement of street trees

Figure 2- Example Rain Garden on 2nd Street, Los Altos (NCE)

Recommended Revisions to the Policy

Based on known public concerns with the Policy, site visit observations, consultation with the City and Subcommittee, and NCE's qualitative assessment of alternative pavements, NCE developed three recommended revisions which are illustrated in **Figure 3** and discussed in detail below.

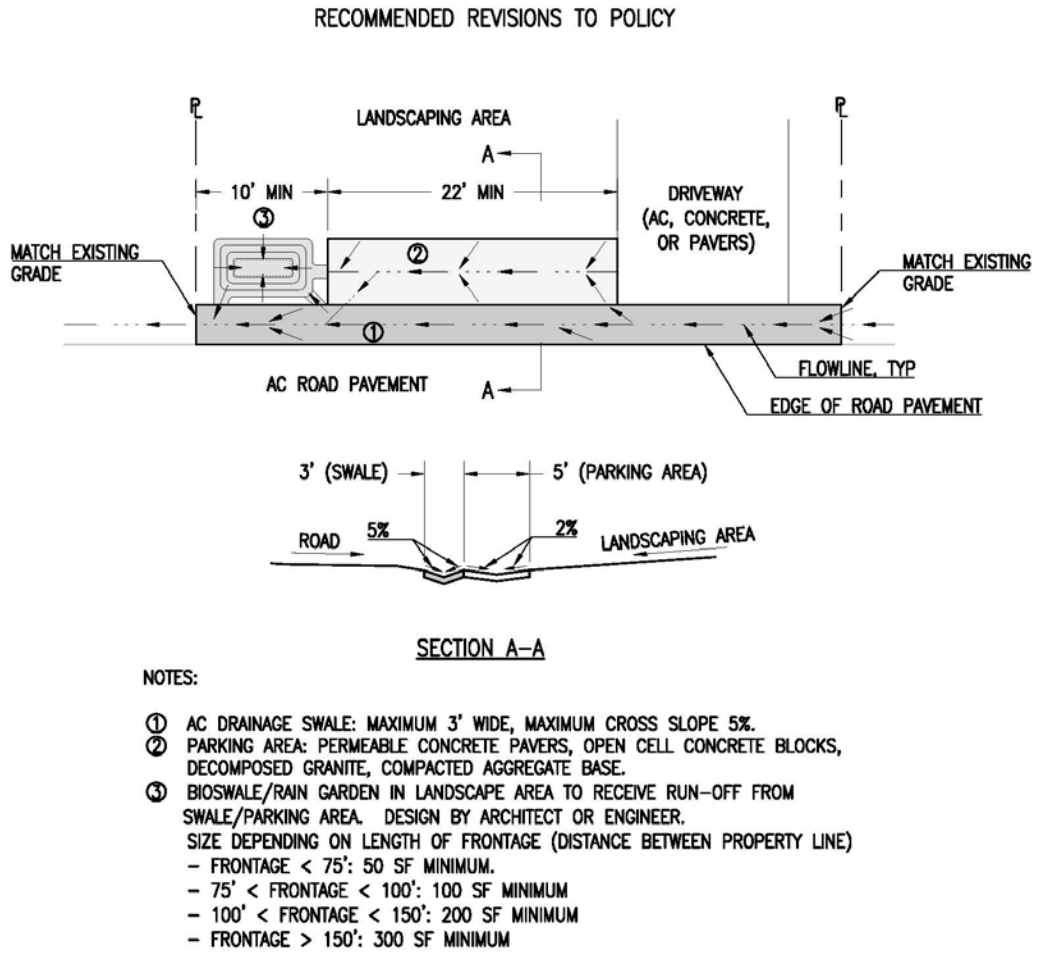


Figure 3 - Recommended revisions to the Policy

1. *Retain the Specification for an AC Drainage Swale*

Description: The current Policy specifies installation of a 3-foot wide AC drainage swale along the length of the property. To address recent concerns that the AC drainage swale is not consistent with a rural aesthetic or does not provide a stormwater quality benefit, the Environmental Subcommittee considered the use of

alternative materials for use in lieu of AC. However, due to concerns associated with costs, maintenance, and pedestrian safety, the final recommendation is to maintain the specification for a 3-foot wide AC drainage swale along the frontage of the property. For the purpose of this memorandum, the frontage is defined as the line where the property meets the street right of way.

Three clarifications should be made regarding the AC drainage swale. First, the policy should emphasize and clarify that the maximum width of the AC drainage swale to be installed is limited to 3-feet. The length of the AC drainage swale will be dictated by the length of the frontage of a given property. Second, the AC drainage swale should be installed with cross slopes that are a maximum of 5% to promote positive drainage, while considering accessibility recommendations. Finally, the AC swale should be installed so that stormwater flows are conveyed to the permeable parking area and Green Infrastructure (GI) features (e.g. bioswale or rain garden), and excess runoff is conveyed from these features back to the AC drainage swale.

2. *Specify Permeable Materials for use in Parking Area*

Description: The current Policy specifies pervious pavers or compactable pervious material for the shoulder parking area. The recommendation is to detail which type of permeable materials are allowable. Permeable materials suitable for use in the parking area include permeable pavers, open cell concrete blocks, compacted aggregate base, and compacted and stabilized decomposed granite. Porous asphalt or pervious concrete will not be allowed as these materials negatively impact aesthetics and require specialized maintenance (i.e. vacuuming) to sustain their permeability introducing additional costs. **Table 1** summarizes the permeable materials recommended for use in the parking area.

Table 1. Alternative Pavement Materials

Alternative Pavement Materials for Parking Area	Considerations					
	Structurally Adequate for Parking	Impacts on Adjacent Road Condition	Cost	Maintenance Needs	Stormwater Capture	Aesthetic
Permeable Concrete Pavers and Open Cell Concrete Blocks Concrete paver blocks both solid and gridded systems (with open cells for aggregate, gravel, or grass) have been developed in a large variety of shapes, textures, patterns, and colors. The concrete pavers and open cell blocks are installed with gaps filled with sand and open cells that can vary in size, based on block type, that is filled in with aggregate, gravel, or grass, allowing water to enter the subgrade. Open cell concrete blocks can be installed over a bedding course. Further water reservoir capacity can be added by installing open graded base and then stone subbase (optional underdrain), with geotextile on bottom and sides. Typically an edge constraint is installed at the perimeter of the pavers or locations subject to lateral loading. Minimum subgrade excavation depth required is approximately 8-12 inches, but can be greater in depth if additional reservoir capacity is required. A vertical barrier can be installed along the edge of concrete pavers to help prevent water infiltration into the subgrade of adjacent road structure.	Yes	• Impacts to adjacent pavement subgrade reduced if vertical treatment is installed (e.g., concrete wall and fabric)	• High, requires specialty contractor	• Moderate and infrequent, may require cleaning to maintain permeability • Maintenance needs vary depending on gap size between pavers. Small gaps may require specialized vacuum equipment to sustain permeability • Grass filled open cell concrete blocks may require mowing	• Allows stormwater infiltration but degree of infiltration and stormwater capture can vary greatly depending on subgrade characteristics and thickness of aggregate reservoir materials	• Different colors and patterns exist which can be specified further to meet desired aesthetic • Gridded system can be installed with grass or gravel with gridded system
Compacted Aggregate Base (AB) 1-1/2 inch or 3/4 inch Class 2 Aggregate Base (6 inches thick on compacted native soil)	Yes with maintenance	• AB can be loosened by vehicles and from water erosion and will require sweeping off of roadside swale • Impacts to adjacent pavement subgrade reduced if edge treatment is installed (e.g., geotextile fabric)	• Low to Moderate	• Simple but frequent sweeping of loose material off roadway and replacing lost AB where eroded • May require maintenance and cleaning of downstream storm drain inlets	• Allows stormwater infiltration but degree of infiltration and stormwater capture can very greatly depending on subgrade characteristics	• May be consistent with aesthetic, but washout of AB into AC swale and road is possible
Compacted Stabilized Decomposed Granite (DG) Small sized granite aggregate mixed with a stabilizing agent and compacted and placed over existing permeable surfaces and 6 inches of aggregate base if subgrade is less suitable. Minimum subgrade excavation required is approximately 8-12 inches, but can be greater in depth if additional reservoir capacity is considered. DG layer shall be minimum 4 inches thick.	Yes with maintenance	• DG can be loosened by vehicles and from water erosion and will require sweeping off of roadside swale • Impacts to adjacent pavement subgrade reduced if edge treatment is installed (e.g., geotextile fabric)	• Low to Moderate	• Simple but frequent sweeping of loose material off roadway and replacing lost DG where eroded • May require maintenance and cleaning of downstream storm drain inlets	• Allows stormwater infiltration but degree of infiltration and stormwater capture can very greatly depending on subgrade characteristics	• May be consistent with aesthetic, but washout of DG into AC swale and road is possible

Rationale: The Policy appears to be misinterpreted in some locations and the installation of AC in the parking area has a significant street-widening effect (e.g., Figure 1). Permeable materials can help to capture and treat a portion of stormwater runoff, and are more consistent with the desired aesthetic. Based on a qualitative review, pervious concrete pavers, open cell concrete blocks, compacted aggregate base, and stabilized decomposed granite are recommended for use in the parking area. While several alternatives exists, these materials are recommended because they are consistent with the desired rural aesthetic. In addition, these recommended materials are consistent with the City of Los Altos' Residential Design Guidelines, which suggest that residents consider paving materials other than plain concrete or asphalt. For driveways, the guidelines suggest the use of brick pavers, stone, gravel, interlocking pavers, and exposed aggregate, and special concrete for to provide visual interest[8]. These permeable materials provide some stormwater benefits, and are available in multiple color, texture, and patterns which the City can further specify to meet a desired aesthetic (**Figures 4 and 5**).

Important Considerations:

- Use of AC, porous AC and pervious concrete should be prohibited for use in the parking area to address aesthetic concerns
- Installation or permeable concrete pavers will require excavation into the subgrade to create storage for stormwater runoff and to match existing grades at the property line
- Existing clay soils are likely to occur in subgrade within the City of Los Altos and will limit infiltration capacity
- Maintenance requirements vary among permeable paver types. Material with smaller pore sizes may require a specialized vacuum truck
- Where utility conflicts or other factors, such as cost, prohibit the use of permeable pavers, decomposed granite or aggregate base provide a lower cost option that is consistent with the desired aesthetic
- Decomposed granite and aggregate base can be stabilized if there are significant concerns regarding rutting, or migration of loose materials into the AC drainage swale, roadway, or storm drains but still require periodic maintenance

[8] City of Los Altos. Single-Family Residential Design Guidelines: New Homes & Remodels. p. 19.

Figure 4 - Permeable concrete pavers with lateral edge confinement adjacent to road (NCE)

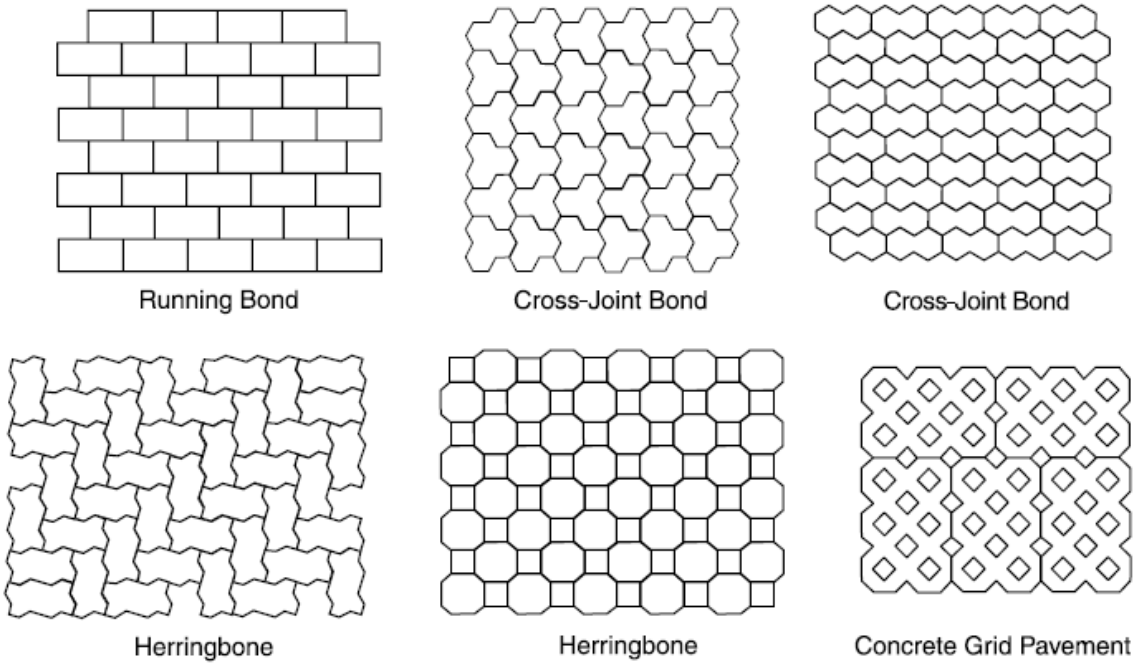


Figure 5 - Various patterns for installation of permeable concrete pavers (Interlocking Concrete Pavement Institute, 2004)

3. *Require Installation of a GI Feature, such as Rain Garden or Bioswale in Landscape Area*

Description: The current Policy specifies existing or new landscaping in areas adjacent to the shoulder parking area or driveways. Where shoulder parking area requirements are met, a GI feature, such as rain gardens or bioswales, shall be installed. These rain gardens or bioswales should be installed to allow runoff from the shoulder parking area and AC swale to enter this GI feature. Depending on existing storm drain infrastructure within the right of way, underdrains and bioswale overflows could be installed and connected to the existing storm drain system. Where there is no storm drain infrastructure in close proximity to these drainage features the overflow would discharge back into the AC drainage swale similar to the landscaped shoulders on 2nd Street between Whitney and Lyell Streets.

The sizing of the GI feature shall be dependent on the length of the frontage for each property. A query of the City's GIS system regarding the length of frontage showed that 18% of all parcels in the City have a frontage that is up to 75 feet long, 61% of all parcels in the City have a frontage that is between 75 feet and 150 feet long, and 21% of all parcels in the City have a frontage that is 150 feet or longer.

Based on the length of the frontage the following criteria for sizing a GI feature shall be considered by the Architect or Contractor:

- For parcels with a frontage shorter than 75 feet, the GI feature shall have a minimum area of 50 square feet
- For parcels with a frontage that is between 75 feet and 100 feet long, the GI feature shall have a minimum area of 100 square feet
- For parcels with a frontage that is between 100 feet and 150 long, the GI feature shall have a minimum area of 200 square feet
- For parcels with a frontage that is greater than 150 long, the GI feature shall have a minimum area of 300 square feet

A GI feature with an area of 100 square feet or more and a depth of 2.5 feet was selected, using volume-based sizing criteria, to correlate the GI treatment capacity to a stormwater event (the assumptions, calculations, and estimated construction cost are included in **Appendix C**). From these calculations it can be estimated that;

- A rain garden/bioswale with an area of approximately **100 square feet** and a depth of 2.5 feet (which consists of 1 foot thick gravel layer and a 1.5 foot thick engineered soil layer) may be able to retain the runoff originating from

half the road width in front of the property resulting from the **2-year, 15-min storm (approximately 0.25 inches rainfall depth)**

- A rain garden/bioswale with an area of approximately **200 square feet** and a depth of 2.5 feet (which consists of 1 foot thick gravel layer and a 1.5 foot thick engineered soil layer) may be able to retain the runoff originating from half the road width in front of the property resulting from the **2-year, 1-hour storm (approximately 0.5 inches rainfall depth)**
- A rain garden/bioswale with an area of approximately **300 square feet** and a depth of 2.5 feet (which consists of 1 foot thick gravel layer and a 1.5 foot thick engineered soil layer) may be able to retain the runoff originating from half the road width in front of the property resulting from the **10-year, 1-hour storm (approximately 0.7 inches rainfall depth)**

It should be noted that a 300 square foot rain garden/bioswale approximately provides the volume to treat the C.3 water quality design volume related to the impervious road area in front of a residence.

Rationale: GI features can help to capture and treat a portion of stormwater runoff and create additional landscape features that can add aesthetic value. If a portion of flows are directed to GI features these recommended revisions can assist the City with implementing applicable requirements in the Municipal Regional Permit (MRP). Provision C.3.i. of the MRP requires development projects for detached single-family home projects which create or replace between 2,500-10,000 square feet of impervious surface, to implement site design measures which will direct stormwater runoff from impervious surfaces to permeable or vegetated surfaces.

Important Considerations:

- Not all locations will be suitable for rain gardens or bioswales due to presence of utilities, high slopes (e.g. >12%), dense canopy cover, conditions on neighboring properties, or size limitations.
- Rain gardens must not contain ponded water for more than 48-72 hours for vector control; it is preferable to install a rain garden or bioswale that exhibits no ponding water by filling the GI feature with gravels and engineered soil that provide sufficient pore space for water storage
- Rain gardens should be installed such that excess flows are routed to the AC swale.
- Implementation and design of these GI features may have to be considered and assessed by the Architect or Contractor working on the new construction or remodeling project.

Additional Clarifications to Policy

Clarifications which could improve the Policy are included in **Figure 3** and include the following:

- Flow routing – Flow paths are presented in Figure 3 to provide clarification and guide contractors implementing the shoulder improvements. Constructing improvements consistent with the illustrated flow paths will promote positive drainage through the swale, allow the shoulder parking area to receive and capture some runoff, and route excess flows to the drainage swale.
- Specify slopes for drainage swale and shoulder parking area – A typical cross section specifies a 5% slope for the drainage swale to promote positive drainage away from the roadway. A 2% slope is specified for the parking area to promote positive drainage to landscaped areas where they are installed downgradient from the parking area, and/or to convey excess flows which do not infiltrate into the shoulder parking area into the drainage swale.
- Match existing grades – To reduce drainage issues associated with planned improvements, the Policy should specify that the up and downstream limit of improvements must match existing grade.

Conclusion

Recent feedback from residents and community groups prompted the City of Los Altos to revisit the Shoulder Paving Policy and make recommendations to address aesthetic concerns and, where possible, to achieve stormwater benefits. The recommendations presented in this memo reflect implicit trade-offs including: aesthetics, cost, stormwater benefits, and maintaining existing uses of the road shoulder.

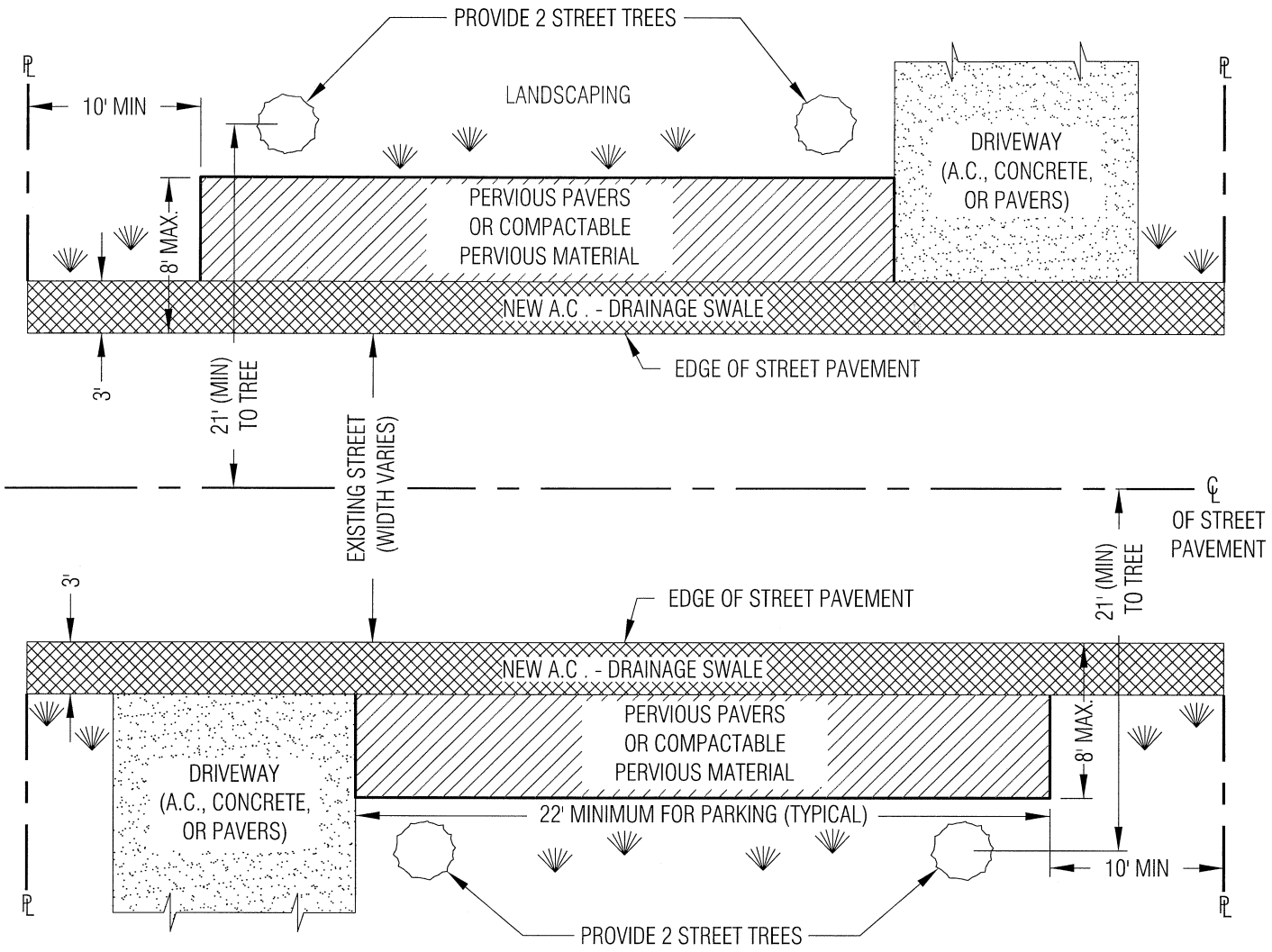
A recommendation was made to confine the installation of AC to 3 feet so as to minimize impacts on aesthetics, while still providing stormwater conveyance and a defined shoulder which is sometimes used by pedestrians and cyclists. Second, alternative pavement materials were recommended in the parking area to be consistent with a rural aesthetic and to be structurally adequate for parking. Lower cost materials provide an alternative to residents, though may have as great of a stormwater benefit as permeable pavers. Finally, to capitalize on opportunities to achieve stormwater benefits, a recommendation was made to require the installation of GI features which can help to capture and treat a portion of stormwater flows. Stormwater benefits achieved with the GI features will certainly vary in practice because the upstream and downstream conditions of a given residence will vary. However some estimates of stormwater benefits are made in

this memo based on the runoff which would come from the frontage of a median size property to provide a relative comparison of potential stormwater benefits.

This memo was prepared and reviewed by the Environmental Commission and it's Subcommittee and has been revised for review and consideration by City Council. There are several considerations and constraints which are important to consider prior to adopting revisions to the Policy and several were highlighted above, although this is not an exhaustive list of considerations. All recommendations were based on a limited sample size at representative field locations, as determined by the City, and do not constitute a review of the entire street network, and therefore may not capture all variations of street and shoulder conditions. Engineering staff may make exceptions to the Shoulder Paving Policy and these additional recommendations where site constraints exist. Before adopting the revised Policy the City may want to consider the implementation of a pilot project to evaluate implementation and cost implications of the recommendations discussed in this memo.

Appendix A

CITY OF LOS ALTOS SHOULDER PAVING POLICY - STANDARD DETAIL SU-20, MAY 2010



PLAN VIEW

LEGEND:

A.C.	ASPHALT CONCRETE
PL	PROPERTY LINE
CL	CENTERLINE
	EXISTING OR NEW LANDSCAPING
	STREET TREE (NEW OR EXISTING)
	NEW PERMEABLE SURFACE
	NEW A.C. - DRAINAGE SWALE

NOTES:

1. **IF THE STREET PAVEMENT WIDTH IS 36 FEET OR GREATER,** NO SHOULDER IMPROVEMENTS ARE PERMITTED WITH THE EXCEPTION OF LANDSCAPING AND IRRIGATION.
2. POLICY DOES NOT APPLY FOR REPAIRS, RESEALING, AND REPAVING IN KIND OF EXISTING SHOULDERS, NOR DOES IT REQUIRE THAT SHOULDERS MUST BE PAVED.
3. THE SHOULDER OF A NEWLY CONSTRUCTED OR 50% OR GREATER SQUARE FOOTAGE REMODELED RESIDENCE IS REQUIRED TO BE BROUGHT INTO COMPLIANCE WITH THIS POLICY.

Approved: _____ City Engineer 1/4/10 Date

CITY OF LOS ALTOS · CALIFORNIA · INCORPORATED DECEMBER 1, 1952

REVISION	
Description	Date

ENGINEERING DIVISION

SHOULDER PAVING POLICY

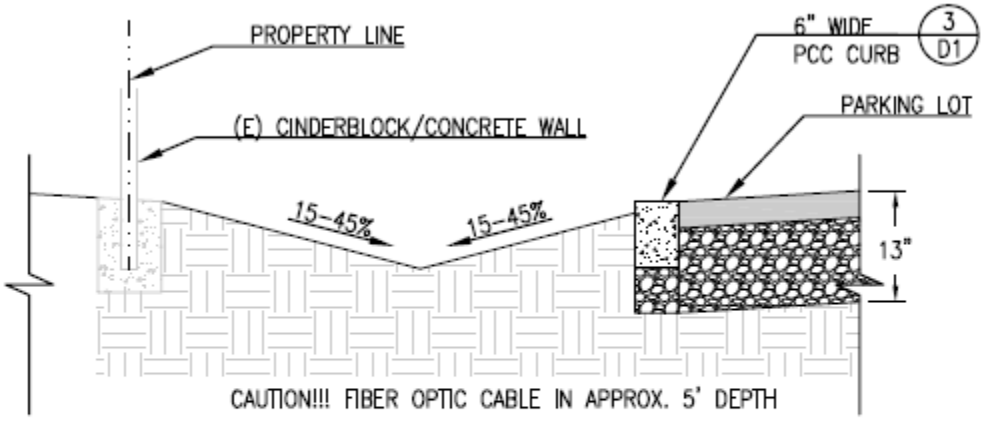
SU-20

Appendix B

Green Infrastructure Example Details and Photographs

EXAMPLE 1. GREEN INFRASTRUCTURE FEATURE WITHOUT UNDERDRAIN, FAIRFIELD, CA

Cross Section Detail



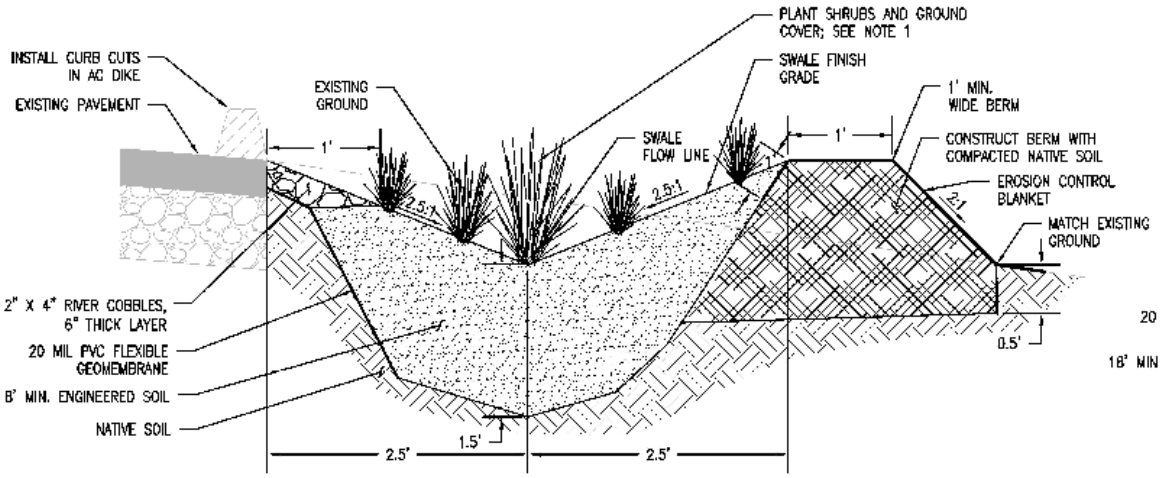
D / C4 CROSS SECTION D
NOT TO SCALE

NOTES;
1. PLANTING AND SOIL PREPARATION PER SPECIFICATIONS.

Post Construction

EXAMPLE 2. GREEN INFRASTRUCTURE FEATURE WITH ENGINEERED SOIL AND NO UNDERDRAIN, ORINDA, CA

Cross Section Detail

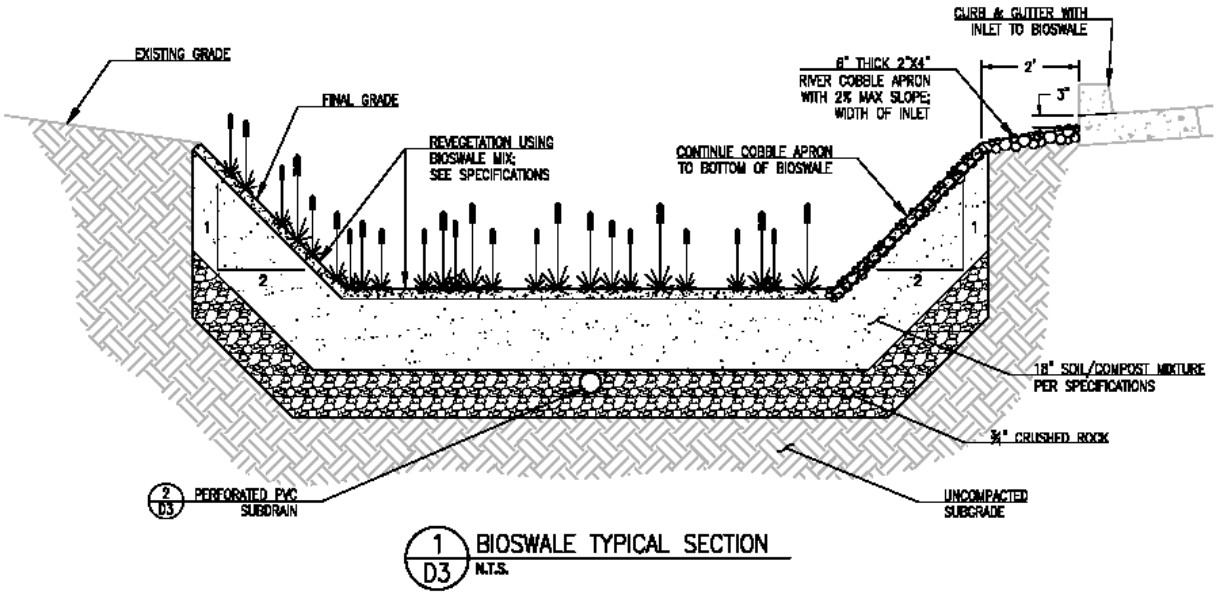


A / C8 SWALE CROSS SECTION A
N.T.S.

Under Construction

EXAMPLE 3. GREEN INFRASTRUCTURE FEATURE WITH ENGINEERED SOIL AND UNDERDRAIN CONNECTION TO STORM DRAIN SYSTEM, PLEASANT HILL, CA

Cross Section Detail



Post Construction

Appendix C

RAIN GARDEN / BIOSWALE SIZING AND ESTIMATED STORMWATER CAPTURE

Los Altos Shoulder Paving Policy
Rain Garden/Bioswale Sizing Considerations and Estimated Stormwater Treatment Benefit

Determine size for rain garden/bioswale using volume-based sizing criteria and correlate to a stormwater event:

Storm water runoff from the roadway being conveyed in the AC swale shall be directed into a rain garden/bioswale.

Assume that runoff from half the road width in front of a property shall be directed to the bioswale to be retained; runoff from upstream areas may flow through or by the rain garden/bioswale without retention.

Contributing area calculation:

Average width of properties:	100	ft
Average width of road:	30	ft
Contributing area to rain garden/bioswale (half the road width):	1500	sf

Selected reported rainfall depth and volume calculation (NOAA Atlas 14):

The **1-year, 6-hour** storm results in approx. **1 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **125 cf**

The **10-year, 1-hour** storm results in approx. **0.7 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **91 cf**

The **2-year, 1-hour** storm results in approx. **0.5 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **63 cf**

The **2-year, 15-min** storm results in approx. **0.25 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **31 cf**

Rain garden/bioswale geometry:

(assumes that the property is 90 to 100 feet wide, 24-foot wide driveway, 22 feet for parking if desired, and about 15 feet of buffer between driveway and property line and bioswale and property line)

Average space/length for rain garden/bioswale:	10	ft
Average width for rain garden/bioswale:	10	ft
Rain garden/Bioswale Area:	100	sf
Average total depth of rain garden/bioswale:	2.5	ft
Pore space of lower 1-foot thick gravel layer	30%	
Pore space of 1.5-foot thick engineered soil layer	10%	
Side slopes (basin is filled with gravel and soil)	1:1	

Assumes rain garden/bioswale has no underdrain and no open water surface

Raingarden/bioswale storage volume calculation:

Total cross sectional area	18.75	sf
Cross sectional area of bottom foot (gravel)	6	sf
Cross sectional area of top 1.5 feet (engineered soil)	12.75	sf
Total storage volume over length for bottom foot (gravel)	18	cf
Total storage volume over length for top 1.5 feet (engineered soil)	12.75	cf
Total Storage Volume	**30.75**	**cf**
Corresponding rainfall depth	**0.25**	**inches**

Conclusion: A rain garden/bioswale with an area of approximately 100 square feet and a depth of 2.5 feet may be able to retain the runoff originating from half the road width in front of the property resulting from the 2-year, 15-min storm (approximately 0.25 inches rainfall depth)

Estimate probable construction cost for rain garden/bioswale:

Cost for constructing rain gardens/bioswales may range from $100 to $200 per square yard depending on site constraint and materials used
An approximately 100 square foot rain garden/bioswale may cost between **$1,500 to $2,500**. It shall be noted that these are budgetary numbers and more representative cost can only be provided based on detailed design of rain gardens/bioswales.

C.3 Stormwater Handbook Considerations:

The parameters, values and calculation shown below are consistent with volume-based sizing criteria for treatment measures of the C.3 Stormwater Handbook. The drainage area represents half the road width in front of a 100-foot wide property. It shall be noted that it is not the intent to size the rain garden/bioswales according to C.3 guidelines. This calculation is merely an exercise to see how a rain grade/bioswale in the frontage of a private residence compares to C.3 guidelines.

Drainage Area	A=	1500	sf
Percent Impervious		100%	
Mean Annual Precipitation (C.3; Appendix B, Figure B-1)	MAP=	17	inches
Reference Rain Gage Precip Palo Alto (C.3; Table 5-2)	MAPref=	13.7	inches
Rain Gage Correction Factor	Cf=MAP/MAPref=	1.24	
Soil Type (C.3; Appendix B, Figure B-1)		Clay Loam (D)	
Average Slope		1%	
Unit Basin Storage Volume (C.3; Appendix B, Figure B-3)	Usv=	0.62	inches
C.3 Water Quality Design Volume	**WQv = A * Cf * Usv =**	**96**	**cf**

Conclusion: A 300 sf rain garden/bioswale approximately provides the volume to treat the C.3 water quality design volume related to the impervious road area in front of a residence.

Los Altos Shoulder Paving Policy
Rain Garden/Bioswale Sizing Considerations and Estimated Stormwater Treatment Benefit

Determine size for rain garden/bioswale using volume-based sizing criteria and correlate to a stormwater event:

Storm water runoff from the roadway being conveyed in the AC swale shall be directed into a rain garden/bioswale.

Assume that runoff from half the road width in front of a property shall be directed to the bioswale to be retained; runoff from upstream areas may flow through or by the rain garden/bioswale without retention.

Contributing area calculation:

Average width of properties:	100	ft
Average width of road:	30	ft
Contributing area to rain garden/bioswale (half the road width):	1500	sf

Selected reported rainfall depth and volume calculation (NOAA Atlas 14):

The **1-year, 6-hour** storm results in approx. **1 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **125 cf**

The **10-year, 1-hour** storm results in approx. **0.7 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **91 cf**

The **2-year, 1-hour** storm results in approx. **0.5 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **63 cf**

Rain garden/bioswale geometry:

(assumes that the property is 90 to 100 feet wide, 24-foot wide driveway, 22 feet for parking if desired, and about 15 feet of buffer between driveway and property line and bioswale and property line)

Average space/length for rain garden/bioswale:	20	ft
Average width for rain garden/bioswale:	10	ft
Rain garden/Bioswale Area:	200	sf
Average total depth of rain garden/bioswale:	2.5	ft
Pore space of lower 1-foot thick gravel layer	30%	
Pore space of 1.5-foot thick engineered soil layer	10%	
Side slopes (basin is filled with gravel and soil)	1:1	

Assumes rain garden/bioswale has no underdrain and no open water surface

Raingarden/bioswale storage volume calculation:

Total cross sectional area	18.75	sf
Cross sectional area of bottom foot (gravel)	6	sf
Cross sectional area of top 1.5 feet (engineered soil)	12.75	sf
Total storage volume over length for bottom foot (gravel)	36	cf
Total storage volume over length for top 1.5 feet (engineered soil)	25.5	cf
Total Storage Volume	**61.5**	**cf**
Corresponding rainfall depth	**0.49**	**inches**

Conclusion: A rain garden/bioswale with an area of approximately 200 square feet and a depth of 2.5 feet may be able to retain the runoff originating from half the road width in front of the property resulting from the 2-year, 1-hour storm (approximately 0.5 inches rainfall depth)

Estimate probable construction cost for rain garden/bioswale:

Cost for constructing rain gardens/bioswales may range from $100 to $200 per square yard depending on site constraint and materials used
An approximately 200 square foot rain garden/bioswale may cost between **$2,500 to $4,500**. It shall be noted that these are budgetary numbers and more representative cost can only be provided based on detailed design of rain gardens/bioswales.

C.3 Stormwater Handbook Considerations:

The parameters, values and calculation shown below are consistent with volume-based sizing criteria for treatment measures of the C.3 Stormwater Handbook. The drainage area represents half the road width in front of a 100-foot wide property. It shall be noted that it is not the intent to size the rain garden/bioswales according to C.3 guidelines. This calculation is merely an exercise to see how a rain grade/bioswale in the frontage of a private residence compares to C.3 guidelines.

Drainage Area	A=	1500	sf
Percent Impervious		100%	
Mean Annual Precipitation (C.3; Appendix B, Figure B-1)	MAP=	17	inches
Reference Rain Gage Precip Palo Alto (C.3; Table 5-2)	MAPref=	13.7	inches
Rain Gage Correction Factor	Cf=MAP/MAPref=	1.24	
Soil Type (C.3; Appendix B, Figure B-1)		Clay Loam (D)	
Average Slope		1%	
Unit Basin Storage Volume (C.3; Appendix B, Figure B-3)	Usv=	0.62	inches
C.3 Water Quality Design Volume	**WQv = A * Cf * Usv =**	**96**	**cf**

Conclusion: A 300 sf rain garden/bioswale approximately provides the volume to treat the C.3 water quality design volume related to the impervious road area in front of a residence.

Los Altos Shoulder Paving Policy
Rain Garden/Bioswale Sizing Considerations and Estimated Stormwater Treatment Benefit

Determine size for rain garden/bioswale using volume-based sizing criteria and correlate to a stormwater event:

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Assume that runoff from half the road width in front of a property shall be directed to the bioswale to be retained; runoff from upstream areas may flow through or by the rain garden/bioswale without retention.

Contributing area calculation:

Average width of properties:	100	ft
Average width of road:	30	ft
Contributing area to rain garden/bioswale (half the road width):	1500	sf

Selected reported rainfall depth and volume calculation (NOAA Atlas 14):

The **1-year, 6-hour** storm results in approx. **1 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **125 cf**

The **10-year, 1-hour** storm results in approx. **0.7 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **91 cf**

The **2-year, 1-hour** storm results in approx. **0.5 inch** of rainfall depth (NOAA Atlas 14, Volume 6, Version 2)
Rainfall volume over impervious contributing area: **63 cf**

Rain garden/bioswale geometry:

(assumes that the property is 90 to 100 feet wide, 24-foot wide driveway, 22 feet for parking if desired, and about 15 feet of buffer between driveway and property line and bioswale and property line)

Average space/length for rain garden/bioswale:	30	ft
Average width for rain garden/bioswale:	10	ft
Rain garden/Bioswale Area:	300	sf
Average total depth of rain garden/bioswale:	2.5	ft
Pore space of lower 1-foot thick gravel layer	30%	
Pore space of 1.5-foot thick engineered soil layer	10%	
Side slopes (basin is filled with gravel and soil)	1:1	
Assumes rain garden/bioswale has no underdrain and no open water surface		

Raingarden/bioswale storage volume calculation:

Total cross sectional area	18.75	sf
Cross sectional area of bottom foot (gravel)	6	sf
Cross sectional area of top 1.5 feet (engineered soil)	12.75	sf
Total storage volume over length for bottom foot (gravel)	54	cf
Total storage volume over length for top 1.5 feet (engineered soil)	38.25	cf
Total Storage Volume	**92.25**	**cf**
Corresponding rainfall depth	**0.74**	**inches**

Conclusion: A rain garden/bioswale with an area of approximately 300 square feet and a depth of 2.5 feet may be able to retain the runoff originating from half the road width in front of the property resulting from the 10-year, 1-hour storm (approximately 0.7 inches rainfall depth)

Estimate probable construction cost for rain garden/bioswale:

Cost for constructing rain gardens/bioswales may range from $100 to $200 per square yard depending on site constraint and materials used
An approximately 300 square foot rain garden/bioswale may cost between **$3,500 to $6,500**. It shall be noted that these are budgetary numbers and more representative cost can only be provided based on detailed design of rain gardens/bioswales.

C.3 Stormwater Handbook Considerations:

The parameters, values and calculation shown below are consistent with volume-based sizing criteria for treatment measures of the C.3 Stormwater Handbook. The drainage area represents half the road width in front of a 100-foot wide property. It shall be noted that it is not the intent to size the rain garden/bioswales according to C.3 guidelines. This calculation is merely an exercise to see how a rain grade/bioswale in the frontage of a private residence compares to C.3 guidelines.

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Rain Gage Correction Factor	Cf=MAP/MAPref=	1.24	
Soil Type (C.3; Appendix B, Figure B-1)		Clay Loam (D)	
Average Slope		1%	
Unit Basin Storage Volume (C.3; Appendix B, Figure B-3)	Usv=	0.62	inches
C.3 Water Quality Design Volume	**WQv = A * Cf * Usv =**	**96**	**cf**

Conclusion: A 300 sf rain garden/bioswale approximately provides the volume to treat the C.3 water quality design volume related to the impervious road area in front of a residence.