CITY COUNCIL STUDY SESSION

TUESDAY, SEPTEMBER 25, 2018 – 6:00 P.M.

Community Meeting Chambers
Los Altos City Hall
One North San Antonio Road, Los Altos, California

1. Street Shoulder Improvement Policy: Receive a report on the Street Shoulder Improvement Policy and provide direction on next steps (S. Chan)

ADJOURNMENT

SPECIAL NOTICES TO THE PUBLIC

In compliance with the Americans with Disabilities Act, the City of Los Altos will make reasonable arrangements to ensure accessibility to this meeting. If you need special assistance to participate in this meeting, please contact the City Clerk 72 hours prior to the meeting at (650) 947-2720.

Agendas, Staff Reports and some associated documents for City Council items may be viewed on the Internet at http://www.losaltosca.gov/citycouncil/online/index.html. Council Meetings are televised live and rebroadcast on Cable Channel 26.

On occasion the City Council may consider agenda items out of order.

All public records relating to an open session item on this agenda, which are not exempt from disclosure pursuant to the California Public Records Act, and that are distributed to a majority of the legislative body, will be available for public inspection at the Office of the City Clerk's Office, City of Los Altos, located at One North San Antonio Road, Los Altos, California at the same time that the public records are distributed or made available to the legislative body. Any draft contracts, ordinances and resolutions posted on the Internet site or distributed in advance of the Council meeting may not be the final documents approved by the City Council. Contact the City Clerk at (650) 947-2720 for the final document.

If you wish to provide written materials, please provide the City Clerk with **10 copies** of any document that you would like to submit to the City Council for the public record.

For other questions regarding the City Council meeting proceedings, please contact the City Clerk at (650) 947-2720.

STUDY SESSION

Agenda Item # 1

AGENDA REPORT SUMMARY

Meeting Date: September 25, 2018

Subject: Street Shoulder Improvement Policy

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

Attachment(s):
1. Existing Shoulder Paving Policy Detail
2. Shoulder Paving Policy Memorandum, dated November 2, 2016, prepared by NCE
3. Revised Policy Detail per 2016 update effort
4. Permeable swale options

Initiated by:
City Council

Previous Council Consideration:
November 15, 2016

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 Question(s) for Council Consideration:
- What are Council's priorities on implementing Street Shoulder Improvement Policy?

Summary:
- The existing Shoulder Paving Policy was developed in 2001 through a thorough public review process
- In 2016, the Council directed staff to review the Policy to incorporate green infrastructure principles and address aesthetic concerns and supported the proposed changes recommended by the Environmental Commission
- Concerns have been raised by community members regarding the proposed 2016 changes
- Staff and the consultant have developed more options for consideration

Staff Recommendation:
Receive a report on the Street Shoulder Improvement Policy and provide direction on next steps

Subject: Street Shoulder Improvement Policy

Purpose
Receive a report on the Street Shoulder Improvement Policy and provide direction on next steps.

Background
Approximately 37% (37 miles) of the streets in Los Altos do not have curbs and gutters along the edge of the street. These "unimproved" streets vary considerably in width and generally are dirt shoulders. Over the years, residents have modified the shoulder area (area between the edge of the paved roadway and the property line) in a variety of ways including paving the entire area with asphalt concrete (AC).

Shoulder Paving Policy Development
In April 2000, the City Council directed staff to develop a policy to address concerns about the negative appearance of large areas of AC and the environmental issue of creating more impervious surfaces. A significant effort was devoted to developing the policy, including the draft policy discussions at eight (8) Council meetings over a 20-month period, hiring a third-party consultant to review the draft policy, and forming a City Council Ad Hoc Subcommittee to review related issues. The environmental, aesthetic, safety, maintenance and enforcement issues related to the policy were thoroughly reviewed through this process. In November 2001, the Council accepted the Shoulder Paving Subcommittee's recommendations and adopted the Shoulder Paving Policy. Since the adoption, the Council has considered the Policy on several occasions from 2009 to 2011 and made minor revisions to address public concerns.

According to the current Policy, the shoulder of a newly constructed residence or of a residence that has undergone a remodel of 50% or more of its square footage is required to be brought into compliance with current standards. The Policy has three main components, including a 3-foot wide AC drainage swale, a minimum 10-foot long landscape area and a 5-foot wide shoulder parking area with permeable surface if residents choose to install one. The current adopted Policy Detail is included as Attachment 1.

2016 Policy Update Effort
In 2016, the Council directed staff to revisit the Shoulder Paving Policy due to the following concerns raised from residents and community groups:

- Asphalt materials in the drainage swale and/or shoulder parking area are not consistent with the 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 maximize storm water benefits

Subject: Street Shoulder Improvement Policy

Following Council direction, 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 Environmental Commission appointed a subcommittee to provide timely support and resources to staff and the consultant. Under the guidance and support of the subcommittee, the consultant developed the following recommendations:

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 and does not provide storm water 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 feet, specifying maximum cross slope of 5% and requiring directing flows into Green Infrastructure (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 materials can help to capture and treat a portion of the storm water runoff, consistent with the desired aesthetic, and consistent with the City's Residential Design Guidelines. Pervious concrete and porous asphalt, which provide some storm water 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 the landscape area

Green Infrastructure is infrastructure that uses vegetation, soils and natural processes to manage storm water and create healthier urban environments. One of the goals of re-examining the Shoulder Paving Policy is to seek opportunities to incorporate current storm water 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 be proportional to the length of the frontage for each property.

GI features can help capture and treat a portion of storm water 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.

The consultant's report is included as Attachment 2.

At the time, these recommendations were reviewed and supported by the Environmental Commission and the Bicycle and Pedestrian Advisory Commission. On November 16, 2016, staff reported these recommended changes to the Council at a study session and the Council also supported the recommendations.

Discussion/Analysis

Staff has since worked on updating the Shoulder Paving Policy Detail to reflect the 2016 policy update effort and have presented the updated Detail to the Environmental Commission and the Complete Street Commission. The revised Policy Detail is included as Attachment 3.

Environmental Commission Review

On May 14, 2018, staff presented the revised Policy Detail to the Environmental Commission. All six members were present with one vacant position. The Environmental Commission received public comment, engaged in discussion, requested some fine-tuning to the Detail and requested staff to return with a revised version at the following meeting. On June 11, 2018, staff presented the revised Detail, now titled Street Shoulder Improvement Policy based on input from the Environmental Commission at its May 14, 2018 meeting. The four Commissioners present at the June meeting received public comments on the topic and discussed the policy in detail with staff. There was no recommendation and no consensus reached by the Commission members present. Each Commissioner provided a statement of his/her views about the Policy Detail and provided comments for staff to consider in the staff report to Council. The four Commissioner's comments included concern about preservation of the roadway infrastructure and one Commissioner supported the developed Detail with the rain garden and the 3-foot AC swale. Other Commissioners preferred more environmentally sustainable design, such as limiting the width of the swale as narrow as possible (less than 3 feet), allowing greater use of permeable material such as pavers as alternatives, or eliminating the 3-foot swale completely.

Complete Streets Commission Review

Both City Council and staff continue to receive comments from residents and community groups regarding the Policy, primarily focusing on the 3-foot AC swale. The concerns are that the 3-foot AC swale does not capture and treat storm water and is not consistent with the preferred rural aesthetic of the City.

Subject: Street Shoulder Improvement Policy

In response to public feedback, staff revisited the Policy Detail to look for opportunities to address their comments. One of the concerns of using permeable materials in the shoulder area is the potential of moisture getting underneath the pavement and overtime weakening the ability of the base rock to support the street. One option to address this concern is to install a small concrete water barrier between the pavement edge and the shoulder area. The water barrier will be leveled with street surface, so it does not pose a tripping hazard. The installation of this water barrier opens the possibilities of using permeable materials in the shoulder area. Staff directed the consultant to develop permeable swale options for consideration, including:

- Compacted Aggregate Base
- Permeable Concrete Pavers
- HDPE Paver
- Cellular Concrete Blocks

The details of these options are included in Attachment 4. Costs for the options range from $90 to $200 per linear foot. Property owners will be responsible for maintaining improvements in the shoulder. The City will make temporary repairs to paved shoulders that present an immediate safety hazard to the public, but the property owners are expected to complete the permanent repairs.

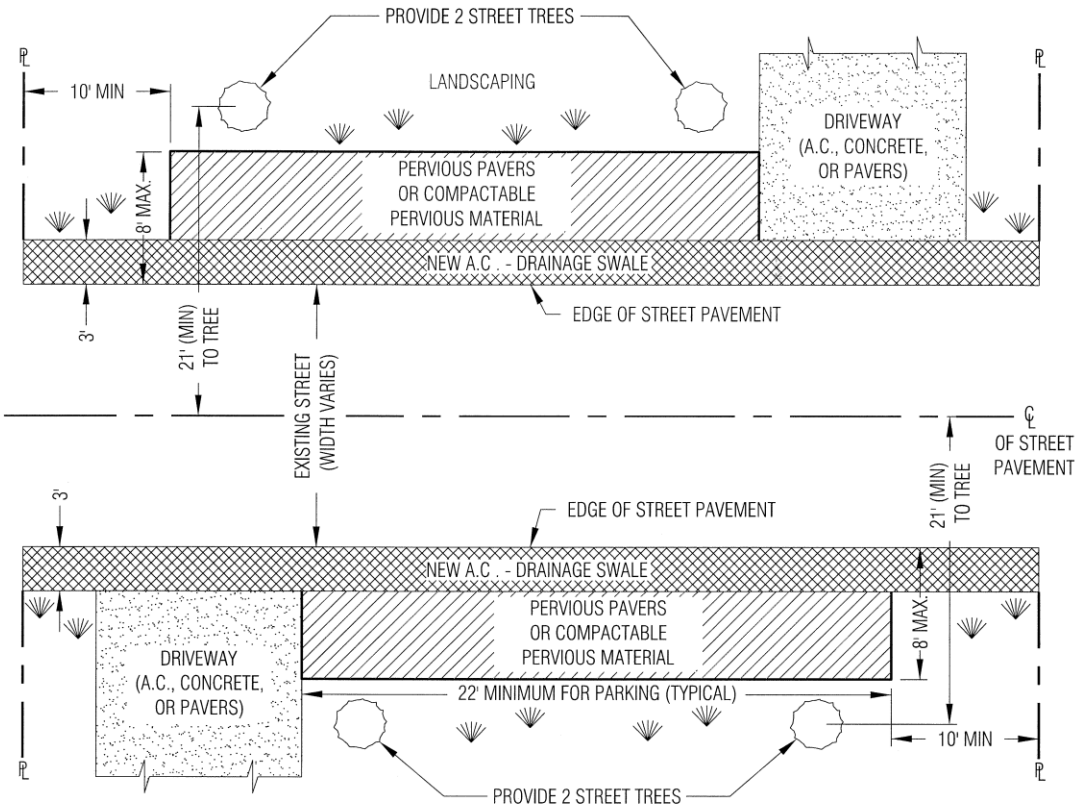
These options were presented to the Complete Streets Commission for their review at its August 22, 2018 meeting. Other options offered to the Commission for consideration included maintaining shoulder as unimproved, applying AC swale only on very narrow streets where the AC swale is the only refuge space for pedestrians or bicyclists, or keeping the AC swale as an across-the-board requirement in the Policy. GreenTown Los Altos was given the opportunity to provide a presentation at the meeting regarding their comments on the Policy.

Overall, the Commission was concerned about the potential safety hazards posed by the concrete barrier and permeable swale surfaces to wheel chair users, bicyclists and pedestrians. The Commission was also concerned about installation cost, potential liability and patchwork implementation intensified by allowing too many options. The majority of the Commissioners favored keeping the asphalt swale. Other comments from the Commissioners include:

- Not all streets are equal; implementation of the Policy should consider other factors such as school routes, traffic volume, accident data, street dimensions and characteristics
- Suggested school route shoulders should be treated differently from non-school routes
- Consider separating the policy into two; one addresses the interface between City streets and private property and one addresses landscape and hardscape requirements in the shoulder areas

Next Steps

A "complete street" should promote mobility and connectivity, enhance safety and security, and be sensitive to the environment and community values. With limited public right-of-way, often there is not enough space to accommodate all the community's interests. Deciding what improvements to install on our streets requires careful evaluation and prioritization. Staff and the consultant have done a thorough review and analysis on the Street Shoulder Improvement Policy and offered potential options to address various community concerns. Staff is seeking Council direction on prioritizing various community interests and next steps to finalize the Policy.



PLAN VIEW

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.

LEGEND:

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

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

STANDARD DETAILS MAY 2010

Collaboration. Commitment. Confidence.℠

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

Richmond, CA
501 Canal Blvd., Suite I
Richmond, CA 94804
(510) 215-3620
www.ncenet.com

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.

---

[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.

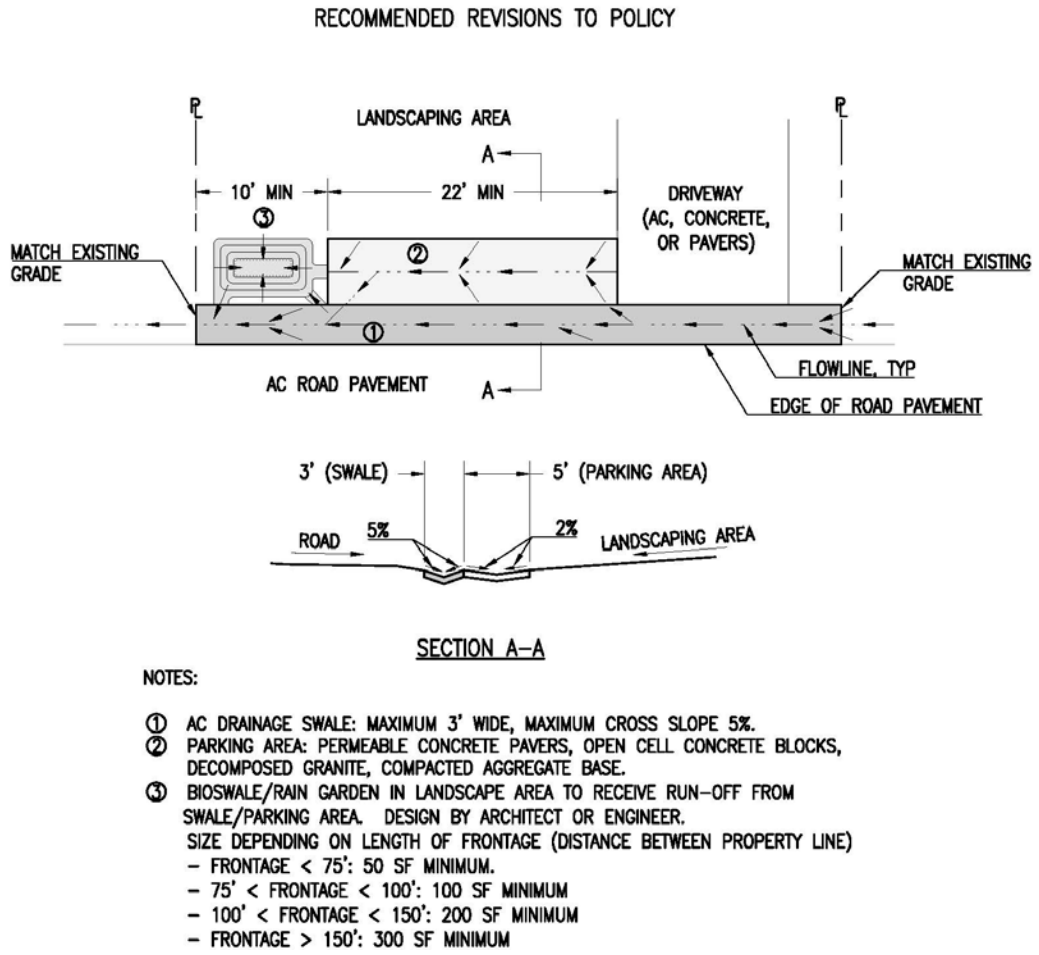


Figure 3 - Recommended revisions to the Policy

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)

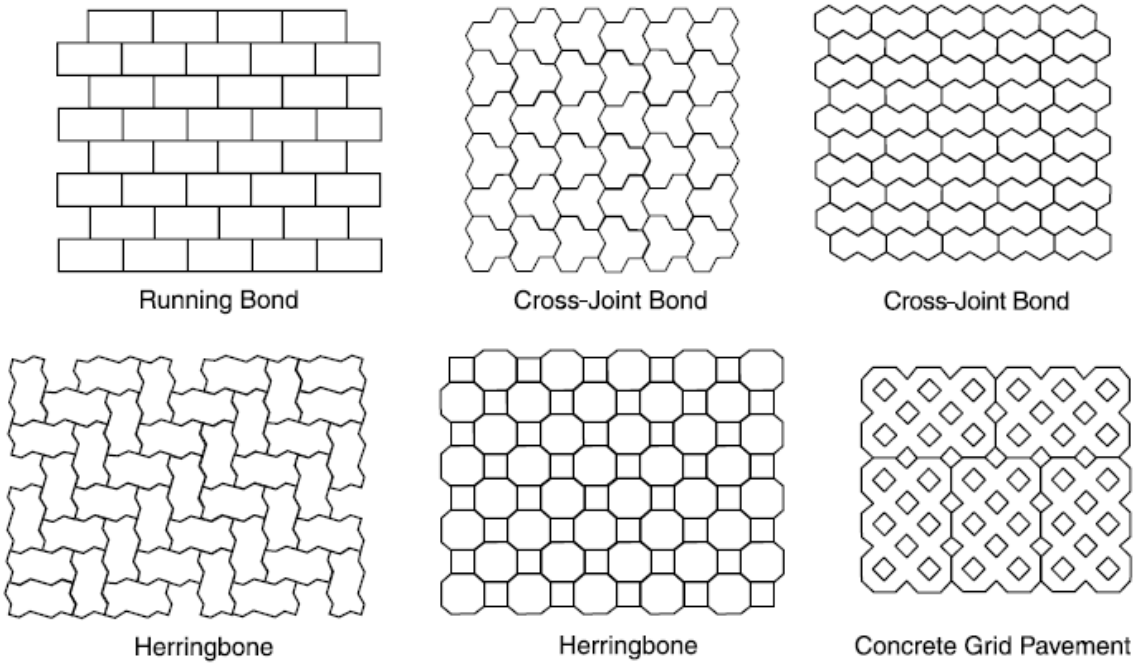


Figure 5 - Various patterns for installation of permeable concrete pavers (Interlocking Concrete Pavement Institute, 2004)

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.

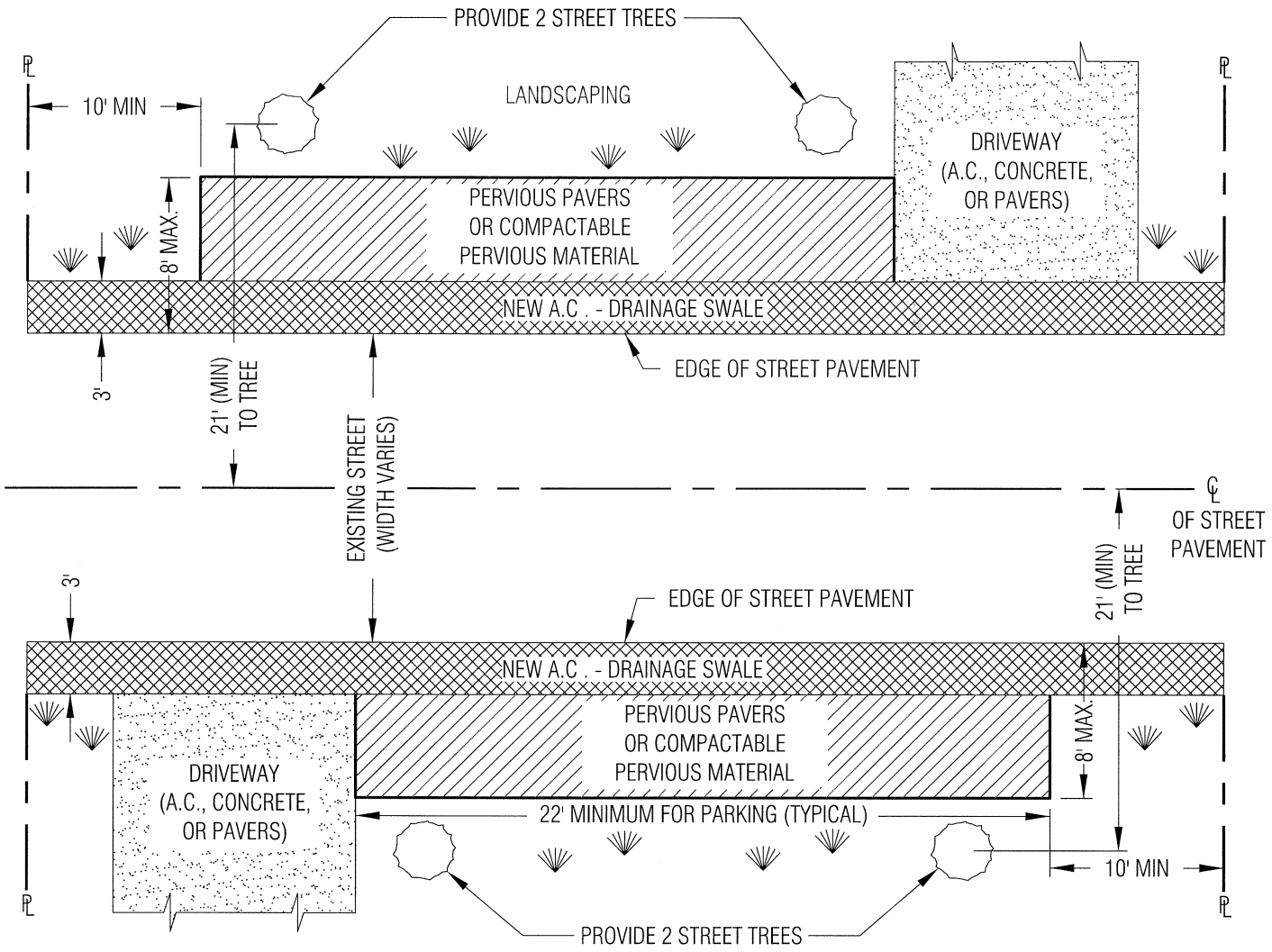
A recommendation was made to confine the installation of AC to 3 feet so as to minimize impacts on aesthetics, while still providing stormwater conveyance and a defined shoulder which is sometimes used by pedestrians and cyclists. Second, alternative pavement materials were recommended in the parking 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

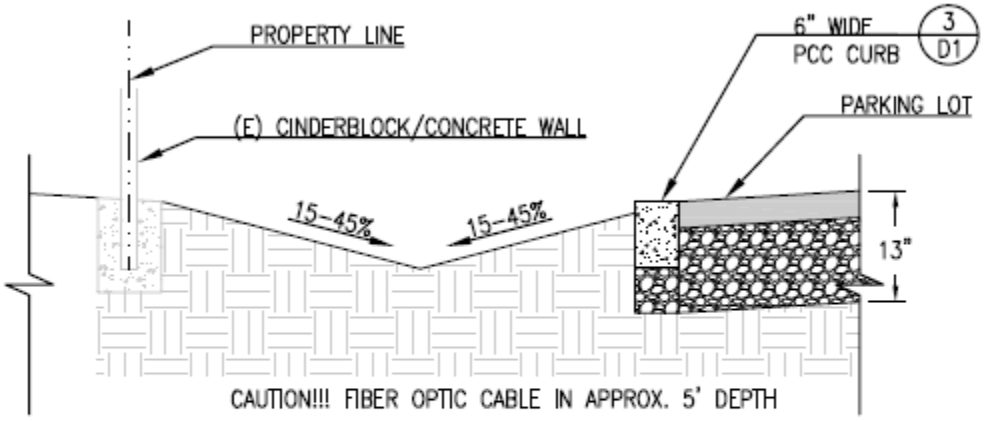
SU-20

Appendix B

Green Infrastructure Example Details and Photographs

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

Cross Section Detail



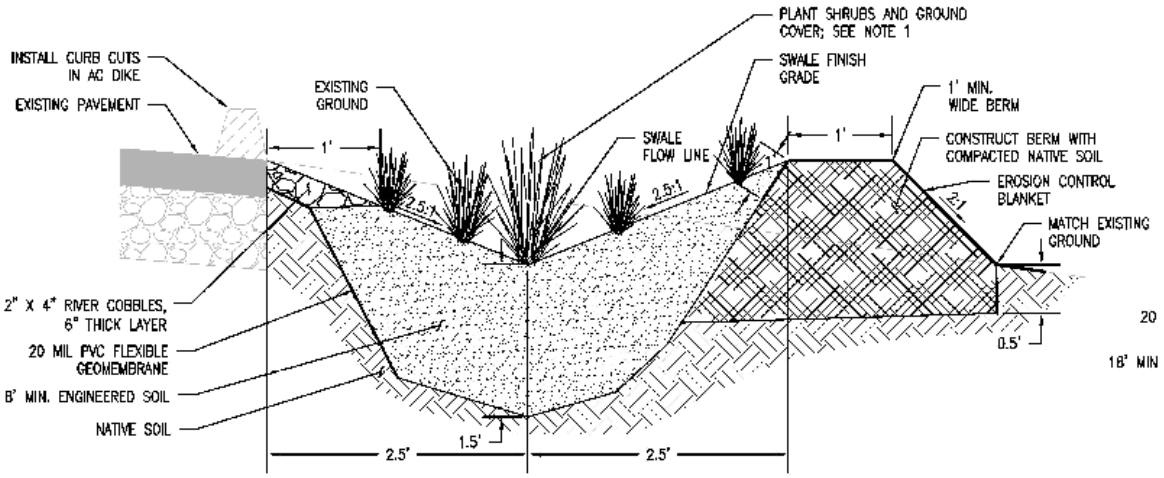
D / C4 CROSS SECTION D
NOT TO SCALE

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

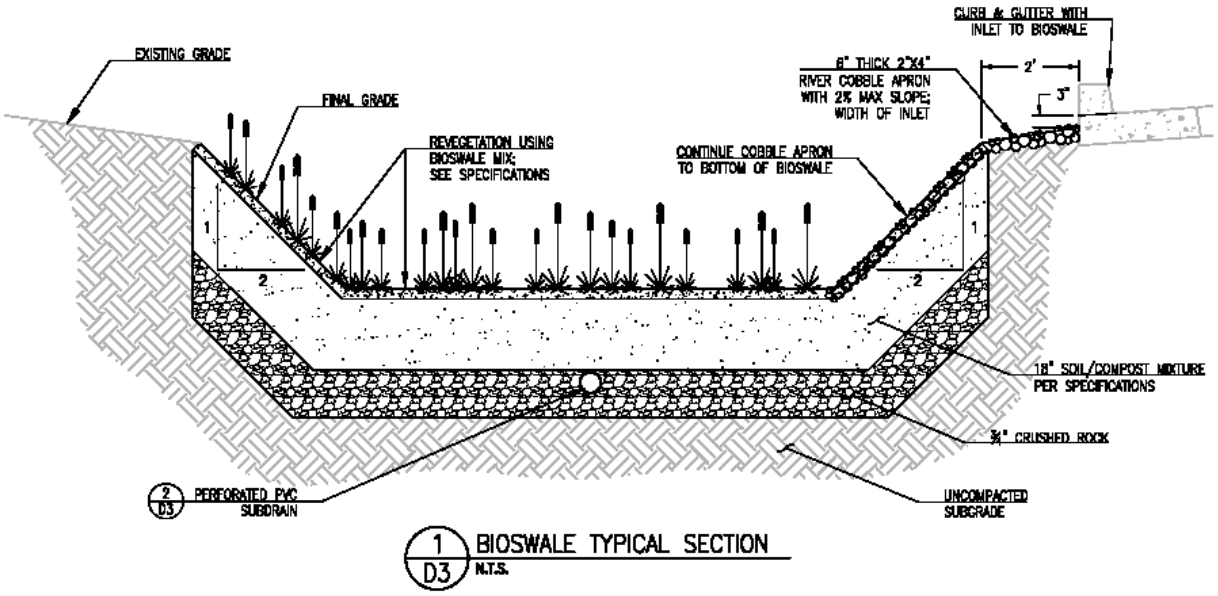


A / C8 SWALE CROSS SECTION A
N.T.S.

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:

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:	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:

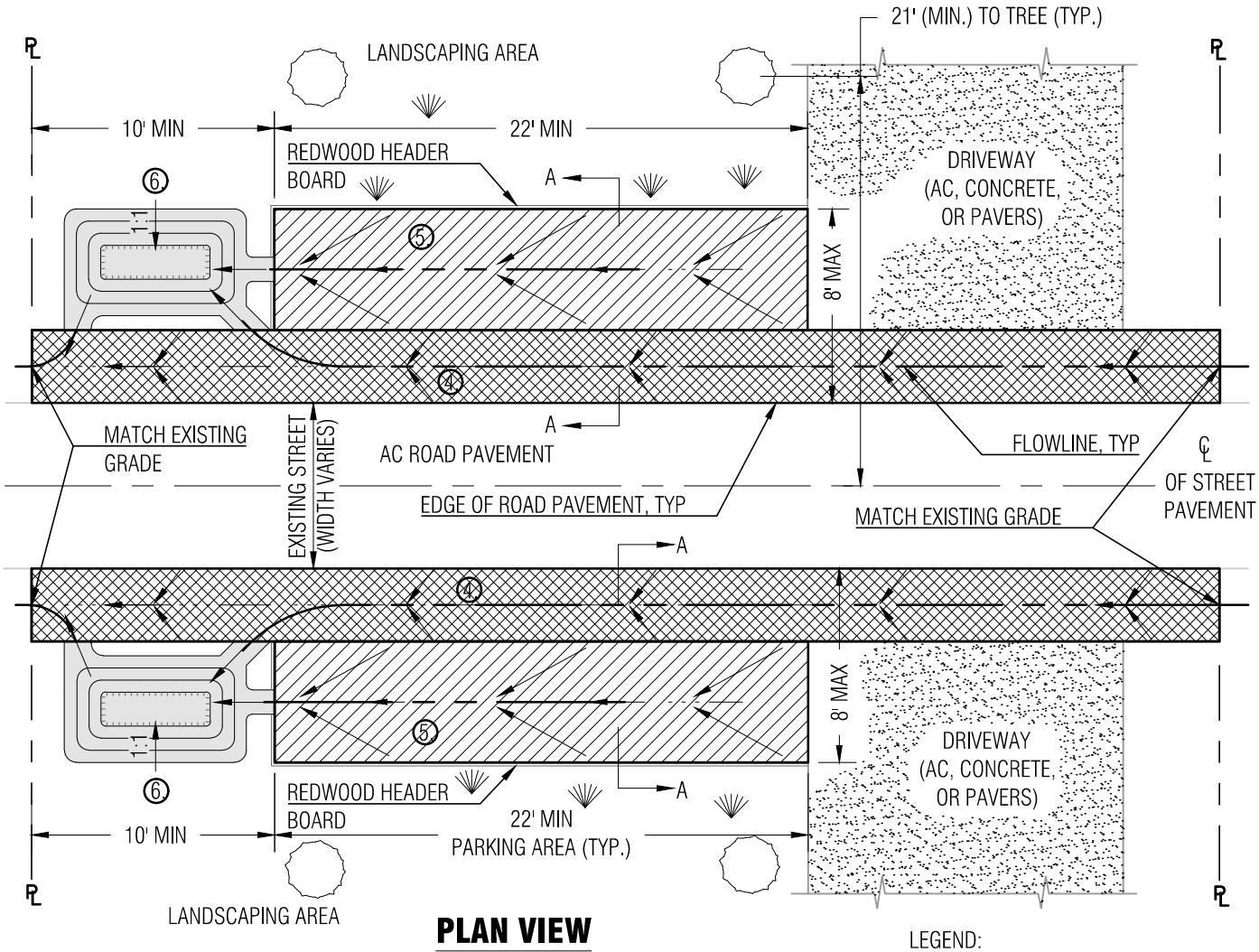
Cost for constructing rain gardens/bioswales may range from $100 to $200 per square yard depending on site constraint and materials used
An approximately 300 square foot rain garden/bioswale may cost between **$3,500 to $6,500**. It shall be noted that these are budgetary numbers and more representative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

C.3 Stormwater Handbook Considerations:

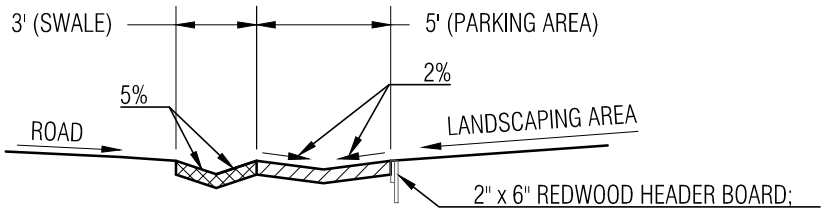
The parameters, values and calculation shown below are consistent with volume-based sizing criteria for treatment measures of the C.3 Stormwater Handbook. The drainage area represents half the road width in front of a 100-foot wide property. It shall be noted that it is not the intent to size the rain 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.

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.



PLAN VIEW



SECTION A-A

LEGEND:

- AC — ASPHALT CONCRETE
- ℙ — PROPERTY LINE
- ℄ — CENTERLINE
- EXISTING OR NEW LANDSCAPING
- STREET TREE (NEW OR EXISTING)
- BIOSWALE/RAIN GARDEN
- NEW PERMEABLE SURFACE
- NEW AC - DRAINAGE SWALE
- FLOWPATH
- ④ NOTES, SEE SU-20B

SEE STANDARD DETAIL SU-20B FOR NOTES RELATED TO THE STREET SHOULDER IMPROVEMENT POLICY.

Approved. _____ City Engineer _____ Date

CITY OF LOS ALTOS CALIFORNIA INCORPORATED DECEMBER 1, 1952

REVISION

Description	Date

ENGINEERING DIVISION

STREET SHOULDER IMPROVEMENT POLICY (SHEET 1 OF 2)

SU-20A

ATTACHMENT 3

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.
4. AC DRAINAGE SWALE:
   a. 3' WIDE;
   b. MAXIMUM CROSS SLOPE 5%;
   c. AC THICKNESS SHALL MATCH THE THICKNESS OF ROAD PAVEMENT OR 4" WHICHEVER IS THICKER.
   d. PLACE 6" COMPACTED AGGREGATE BASE UNDER AC; COMPACT TO 95% MAXIMUM DRY DENSITY.
5. PARKING AREA SHALL FEATURE ONE OF THE FOLLOWING MATERIALS:
   a. 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 CONCRETE BLOCKS SHALL BE INSTALLED PER MANUFACTURE'S RECOMMENDATIONS. GAPS OF CONCRETE PAVERS, IF FEATURED BY THE TYPE OF PAVER, SHALL BE FILLED WITH SAND. OPEN CELL CONCRETE BLOCKS VARY IN SIZE BASED ON BLOCK TYPE AND SHALL BE FILLED IN WITH GRAVEL OR GRASS, ALLOWING WATER TO ENTER THE SUBGRADE. CONCRETE PAVERS AND OPEN CELL CONCRETE BLOCKS SHALL BE INSTALLED OVER A SAND BEDDING COURSE (MINIMUM 1" THICK OR PER PAVER MANUFACTURER'S RECOMMENDATION). FURTHER WATER RESERVOIR CAPACITY CAN BE ADDED BY INSTALLING OPEN GRADED BASE AND STONE SUBBASE WITH AN OPTIONAL UNDERDRAIN (TO BE ROUTED TO THE BIOSWALE/RAIN GARDEN), WITH GEOTEXTILE ON BOTTOM AND SIDES. TYPICALLY AN EDGE CONSTRAINT IS INSTALLED AT THE PERIMETER OF THE PAVERS OR LOCATIONS SUBJECT TO LATERAL LOADING. SUBGRADE EXCAVATION DEPTH REQUIRED IS 8-12 INCHES, BUT CAN BE GREATER IN DEPTH IF ADDITIONAL RESERVOIR CAPACITY IS DESIRED.
   b. COMPACTED AGGREGATE BASE (AB):
      1-1/2 INCH OR 3/4 INCH CLASS 2 AGGREGATE BASE (6 INCHES THICK ON COMPACTED NATIVE SOIL)
   c. COMPACTED STABILIZED DECOMPOSED GRANITE (DG):
      SMALL SIZED GRANITE AGGREGATE MIXED WITH A STABILIZING AGENT, COMPACTED AND PLACED OVER EXISTING PERMEABLE SURFACES AND 6 INCHES OF AGGREGATE BASE IF SUBGRADE IS LESS SUITABLE. SUBGRADE EXCAVATION REQUIRED IS 8-12 INCHES, BUT CAN BE GREATER IN DEPTH IF ADDITIONAL RESERVOIR CAPACITY IS CONSIDERED. DG LAYER SHALL BE MINIMUM 4 INCHES THICK. GRADE TO DRAIN.
6. BIOSWALE/RAIN GARDEN IN LANDSCAPE AREA DESIGNED TO RECEIVE RUNOFF FROM AC SWALE/PARKING AREA. DESIGN AND SHAPE OF BIOSWALE/RAIN GARDEN BY ARCHITECT OR ENGINEER. MINIMUM DEPTH SHALL BE 2.5'. REFER TO THE C.3 STORMWATER HANDBOOK FOR DESIGN PARAMETERS AND SPECIFICATIONS OF SOILS OR PLANTS. AREA SHALL BE DEPENDING ON LENGTH OF FRONTAGE (DISTANCE MEASURED PARALLEL TO EDGE OF ROAD BETWEEN PROPERTY LINES) AS FOLLOWS:
   a. FRONTAGE < 75': 50 SF MINIMUM
   b. 75' < FRONTAGE < 100' 100 SF MINIMUM
   c. 100' < FRONTAGE < 150' 200 SF MINIMUM
   d. FRONTAGE > 150': 300 SF MINIMUM
7. LOTS LOCATED ALONG SUGGESTED ROUTES TO SCHOOL MAY REQUIRE MODIFICATION TO THIS STANDARD DETAIL AS APPROVED BY THE CITY ENGINEER.
8. DRAINAGE SWALE MAY BE CONSTRUCTED USING PERMEABLE CONCRETE PAVERS PER DETAIL SU-24.

Approved. _____ _____
City Engineer Date

CITY OF LOS ALTOS CALIFORNIA INCORPORATED DECEMBER 1, 1952

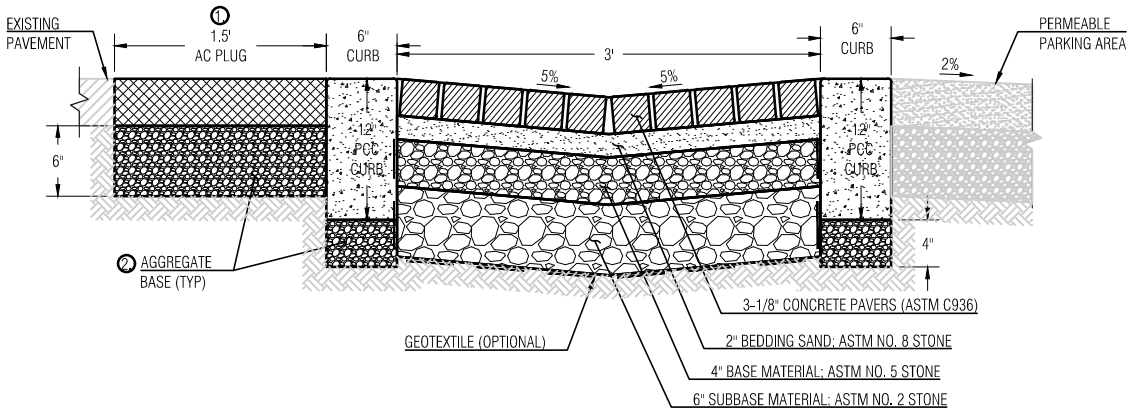
REVISION

Description	Date

ENGINEERING DIVISION

STREET SHOULDER IMPROVEMENT POLICY (SHEET 2 OF 2)

SU-20B



NOTES:

1. AC PLUG SHALL BE 4" THICK OR MATCH EXISTING PAVEMENT THICKNESS, WHICHEVER IS GREATER.
2. AGGREGATE BASE SHALL BE COMPACTED TO 95% OF MAXIMUM DRY DENSITY.
3. INSTALL PAVERS AND ALL BASE MATERIALS PER MANUFACTURER'S RECOMMENDATIONS.

LEGEND:

- CONCRETE PAVERS
- BEDDING SAND
- BASE MATERIAL
- SUBBASE MATERIAL
- PCC
- AGGREGATE BASE
- AC PLUG
- EXISTING PAVEMENT
- PERMEABLE PARKING AREA
- NATIVE MATERIAL
- 2 NOTES

Approved. _____ _____

City Engineer Date

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

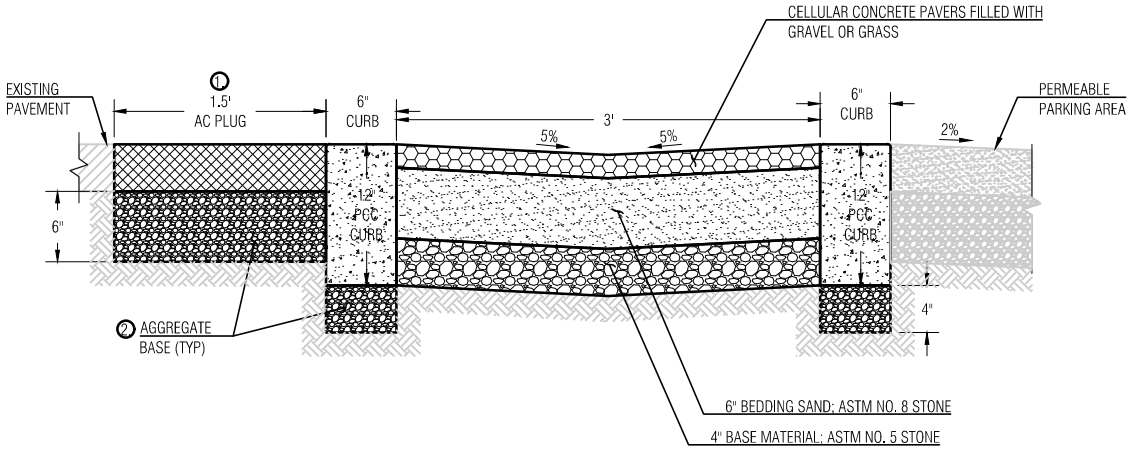
REVISION

Description	Date

ENGINEERING DIVISION

PERMEABLE CONCRETE PAVERS IN ROADSIDE DRAINAGE SWALE

ATTACHMENT 4



NOTES:

1. AC PLUG SHALL BE 4" THICK OR MATCH EXISTING PAVEMENT THICKNESS, WHICHEVER IS GREATER.
2. AGGREGATE BASE SHALL BE COMPACTED TO 95% OF MAXIMUM DRY DENSITY.
3. INSTALL CELLULAR CONCRETE PAVERS AND ALL BASE MATERIALS PER MANUFACTURER'S RECOMMENDATIONS.

LEGEND:

- CELLULAR CONCRETE PAVERS
- BEDDING SAND
- BASE MATERIAL
- SUBBASE MATERIAL
- PCC
- AGGREGATE BASE
- AC PLUG
- EXISTING PAVEMENT
- PERMEABLE PARKING AREA
- NATIVE MATERIAL
- (2) NOTES

Approved. _____ _____

City Engineer Date

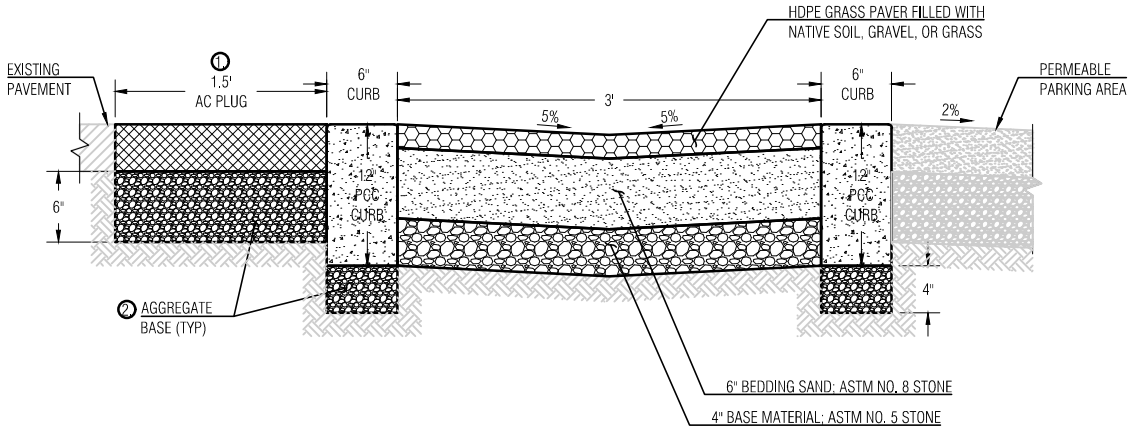
CITY OF LOS ALTOS · CALIFORNIA · INCORPORATED DECEMBER 1, 1952

REVISION

Description	Date

ENGINEERING DIVISION

CELLULAR CONCRETE BLOCKS IN ROADSIDE DRAINAGE SWALE



NOTES:

1. AC PLUG SHALL BE 4" THICK OR MATCH EXISTING PAVEMENT THICKNESS, WHICHEVER IS GREATER.
2. AGGREGATE BASE SHALL BE COMPACTED TO 95% OF MAXIMUM DRY DENSITY.
3. INSTALL HDPE GRASS PAVERS AND ALL BASE MATERIALS PER MANUFACTURER'S RECOMMENDATIONS.

LEGEND:

- HDPE PERMEABLE PAVERS
- BEDDING SAND
- BASE MATERIAL
- SUBBASE MATERIAL
- PCC
- AGGREGATE BASE
- AC PLUG
- EXISTING PAVEMENT
- PERMEABLE PARKING AREA
- NATIVE MATERIAL
- 2 NOTES

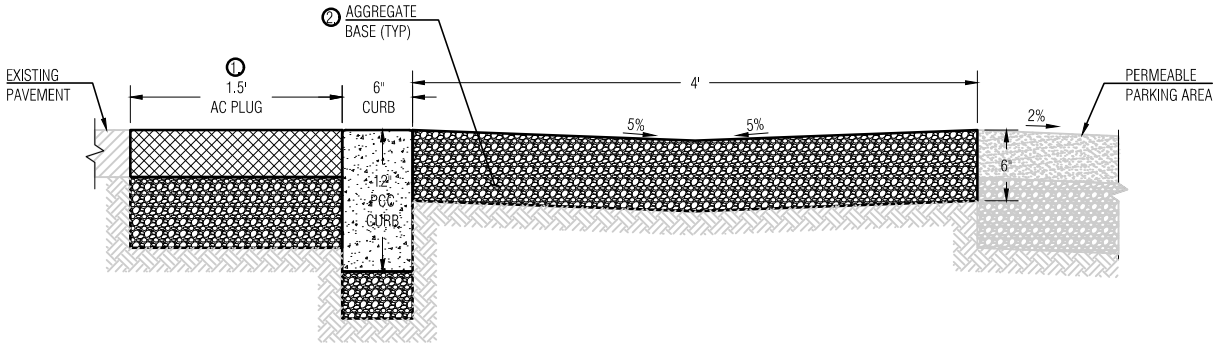
Approved. _____ City Engineer _____ Date

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

REVISION	
Description	Date

ENGINEERING DIVISION

HDPE PAVER IN ROADSIDE SWALE



NOTES:

1. AGGREGATE BASE SHALL BE COMPACTED TO 95% OF MAXIMUM DRY DENSITY.

LEGEND:

- CONCRETE PAVERS
- BEDDING SAND
- BASE MATERIAL
- SUBBASE MATERIAL
- PCC
- AGGREGATE BASE
- AC PLUG
- EXISTING PAVEMENT
- PERMEABLE PARKING AREA
- NATIVE MATERIAL
- 2 NOTES

Approved. _____ _____

City Engineer Date

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

REVISION

Description	Date

ENGINEERING DIVISION

COMPACTED AGGREGATE BASE IN ROADSIDE SWALE