CITY OF MENLO PARK

Engineering Division
701 Laurel Street
Menlo Park, CA 94025
Phone: (650) 330-6740
Fax: (650) 327-5497

GRADING AND DRAINAGE GUIDELINES FOR SINGLE FAMILY HOME PROJECTS

It is the responsibility of the property owner, their representative and designers to design and install proper site drainage.

A. FOR PROJECTS WITH **ADDITIONS** UP TO 500 SQUARE FEET ON THE FIRST FLOOR AND NOT LOCATED IN SHARON HEIGHTS:

1. All net new impervious area stormwater run-off shall be retained/detained on-site. Net new impervious area is impervious area that was previously pervious.
2. To alleviate the stress on the storm system, the owner is encouraged to retain/detain as much run-off as feasible onsite. This is in addition to the retention/detention requirement of net new impervious area run-off.
3. Plot and finished grading plans are **not** required.

B. ENGINEERING WILL REQUIRE AND REVIEW PLOT AND FINISHED GRADING PLANS FOR THE FOLLOWING PROJECTS:

1. All residential projects with brand new construction.
2. Projects with additions greater than 500 square feet on the first floor.
3. All new development projects or additions within the Sharon Heights neighborhood or projects located on sloped lots with unstable or unsafe soil conditions.

C. REQUIREMENTS FOR PLOT AND FINISHED GRADING PLANS:

1. Plot & finished grading plan must be submitted with Building Permit applications.
2. The drainage should be designed such that the post-development site run-off is equal to or less than the pre-development site run-off. See attachment A for impervious area worksheet. See Attachment B for sample retention area sizing.
3. The Architect or Engineer shall coordinate with the project Arborist and Landscape Designer to design the storm drain system to minimize adverse impacts to on-site trees and to trees in the public right-of-way. No grading and/or trenching shall be done within the dripline of any tree located within the project area without first obtaining the approval of a certified arborist.
4. Use Post-Construction Best Management Practices (BMP's). (See "Blueprint for a Clean Bay")

D. DESIGN CRITERIA:

1. If fill is to be added adjacent to the property lines, grades on neighboring properties will need to be obtained to document any potential impacts to these properties. Site grading shall not impede existing drainage from adjacent properties.
2. Design the drainage for sheet flow to lawn or pervious landscaped areas of the site, in lieu of area drains and pipe collection systems, wherever possible, without creating ponding and erosion.
3. Show where the roof downspouts are located. These downspouts should direct to approved splash blocks (minimum 2 feet long) that deflect the water away from the building. Show (with arrows) how the water is proposed to move away from the splash blocks.
4. If a basement is proposed for the project, a drainage plan for a separate subgrade drainage system must be included in this plan. Subgrade drainage system shall not be connected to surface storm drain piping. Subgrade drainage shall be treated as run-off and shall meet the retention/detention requirements.
5. Sites located lower than street grade shall make additional design considerations.
6. For sites exceeding 10% slope, an erosion control plan is required.
7. All new projects shall include a Construction BMP Plan Sheet as part of the plan submittal.
8. **For projects located within the designated FEMA flood zone area, see FEMA Plan Review Checklist for additional design criteria.**

E. FRONTAGE IMPROVEMENTS:

1. All existing frontage improvements that are damaged, cracked, uplifted or depressed during the course of construction, or that were damaged prior to construction, shall be removed, replaced and/or repaired. Replaced and repaired sections shall meet City standards along the entire property frontage. City will not bear the costs of reconstruction.
2. Pavers and/or stamped/decorative concrete shall not be installed in the public right of way.
3. All frontage improvement work shall be in accordance with the latest version of the City Standard Details.

F. LANDSCAPING:

1. Provide documentation with the building permit application indicating the amount of irrigated landscaping. Detailed information regarding the Water Efficient Landscape Ordinance can be found on the City's webpage at: http://www.menlopark.org/361/Water-Efficient-Landscaping-Ordinance

2. On May 5, 2015, the City Council passed Resolution 6241 in response to the 2014 Water Shortage Contingency Plan (WSCP), as required by the State of California, to address the present drought. The resolution requires that potable irrigation water be delivered only by drip or micro-spray irrigation devices.

G. PLOT AND FINISHED GRADING PLAN GUIDELINES:

1. The following requirements are based on guidelines listed in Chapter 33 of the Uniform Building Code. These are minimum standards, not maximum provisions, which can guarantee adequate drainage under all conditions. Depending on the topography, layout, or soil conditions, more restrictive requirements may be necessary as determined by the reviewing official.
2. The designer, in coordination with the soil engineer, must determine the necessities of each individual site on its own merits, and design for problems peculiar to the site. Long-term performance must be considered with enough conservatism in design to take into account the general lack of maintenance received by residential sites.
3. Grading and drainage plans must be signed, dated and stamped by a registered architect or civil engineer, on the original drawing.
4. For hillside lots, a geotechnical engineer must submit a certified soils report, and stamp the grading plan.

I. DRAINAGE GRADIENTS

A. The following minimum gradients for drainage are required for development of private property:

Dirt/Grass Swale ……..…… 2% (Longitudinal)
Slope Away from Structure on Pervious Surface……...5% (Within 10-Feet)
Slope Away from Structure on Impervious Surface…...2% (Within 10-Feet)
Terrace/Interceptor Drains ……..……..5%

B. The following are maximum gradients:

Graded earth swales …… 6%
Driveways …… 20%

II. CUT AND FILL SLOPES

A. All cut and fill slopes shall be no steeper than 2:1. For steeper slopes, a soils engineer must submit a soils report, and stamp, date and sign the original drawing of the grading plan.
B. Drainage standards for slopes are established to prevent excessive erosion and subsequent instability. No surface water from buildings or pads should be permitted to flow over the slopes. Drainage from the natural slopes above the graded cut slope should be diverted away by a terrace drain or a "V"ditch.

H. PLAN REQUIREMENTS

The following is a check list of items which as a minimum, must be shown on the plot and finished grading plans:

I. COVER SHEET

___ 1. The site address.

___ 2. The owner's name, address and phone number.

___ 3. The names, addresses and phone numbers of the architect, civil engineer, surveyor, or other designer.

___ 4. The volume of cut and fill needed and net new impervious area to be added.

___ 5. Vicinity map with enough detail so the site can be easily found.

___ 6. North arrow, scale and legend.

___ 7. General Notes

II. SITE PLAN

___ 8. Fully dimensioned property lines and boundaries.

___ 9. Existing and proposed easements, streets with center lines, sewer, storm drain, and access easements.

___ 10. Location, diameter and drip line of all existing trees both on the property and within the public right-of-way.

___ 11. Detailed plans of all drainage devices, walls, cribbing, or other protective devices to be constructed as part of the proposed work.

___ 12. All cut and fill slopes with continuous "daylight" lines.

___ 13. Location of any buildings, structures, driveways, drainage ditches, or element of the project such as pool, patio, tennis court, etc., on or within 15 feet of the property where the work is to be performed.

___ 14. Existing and proposed elevations of building pad and finished floor.

___ 15. Existing and proposed elevations of ground at property lines, relevant locations and spot elevations showing site grading and drainage paths.

___ 16. Existing and proposed elevations of flowline at street gutter or edge of pavement along property frontage to a point 50 feet beyond the property lines.

___ 17. Existing and proposed frontage improvements including curb, gutter, valley gutter, sidewalk and/or parking strips to be replaced.

___ 18. Location and height of all retaining walls (note: retaining walls with a height exceeding four feet from the bottom of footing require a special permit per Section 301 of the UBC.

___ 19. Top and toe of all cut and fill slopes.

___ 20. Existing and proposed impervious areas, with a tabulation of each type of surface (e.g., patio, roof, landscaping, pool, driveway) and its area in square feet. Clearly show these areas on the plans.

___ 21. Adequate drainage notes and specifications. Stromwater run-off shall be collected and conveyed to an onsite stormwater treatment/retention/detention facility. Grass swales shall be provided to drain side yards to front or rear yards. Provide design consideration for safe overflow discharge of a 100 year storm event.

___ 22. Details for storm drainage devices and stormwater treatment measures.

___ 23. Provisions for protecting adjacent properties.

___ 24. For hillside lots, erosion control and/or slope protection.

___ 25. Cleanouts at each bend in the underground drain pipe, including the bend at the downspout.

___ 26. Tree protection plan for all trees to be retained and a tree removal notes for trees to be removed. (See Heritage Tree Ordinance)

III. DRIVEWAY REQUIREMENTS

___ 27. Show driveway location, width and slope.

___ 28. Approach must conform to City Standard Details.

IV. SIDEWALK, CURB AND GUTTER REQUIREMENTS

___ 29. Show existing curb, gutter, driveways and ADA ramps.

___ 30. Broken or damaged sidewalk, curb, and gutter must be replaced.

___ 31. New sidewalk curb, & gutter must conform to City Standard Details.

___ 32. The construction of new sidewalks requires a permit from the City’s Engineering Division.

V. UTILITY REQUIREMENTS

___ 33. Show appropriate City Details for new water service and/or storm drains if proposed.

___ 34. Proposed locations of sanitary sewer and storm drain system cleanouts

___ 35. A separate encroachment permit is required for any work within the public right of way. The applicant/contractor shall obtain the permit from the City's Engineering Division prior to start of any work within the City's right-of-way or public easement areas. The applicant shall obtain permits from utility companies prior to applying for City encroachment permit.

___ 36. Show any easements affecting the property.

___ 37. Undergrounding all new utility services is encouraged.

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HOW TO DETERMINE THE SIZE OF A FILTRATION-RETENTION DEVICE

The drainage should be designed such that the post-development site run-off is equal to or less than the pre-development site run-off. If your project will increase the impervious area of a lot, then more rainfall is likely to runoff from the site than before. To prevent this extra runoff you will need to design and install a filtration-retention device large enough to retain/detain the added runoff.

PROCEDURE:

1. Calculate the rainfall flow rate for the 10-year storm before the project.
2. Calculate the flow rate after the project is completed
3. Use these data to calculate the volume and dimensions of a swale, basin or other storage facility to hold the added runoff

Start by using the equation **Q = C i A**

- Q = Flow rate (cfs)
- C = Runoff coefficient (C) related to the roughness of the surface over which the rain water is flowing
- i = Rainfall intensity (i) for a 10-year storm (in/hr)
- A = Lot area to be drained (acres)

Step 1: Determine what portion of the lot is impervious (roof, concrete, asphalt) and what portion is pervious (lawn & landscaping) **before** the project. For example, a typical lot might have:

1500 SF (roof) + 1000 sf* (driveway and concrete patio) = 2500 sf of impervious area
3000 SF (lawn) + 1500 sf (landscaping) = 4500 sf of pervious area
Total Lot Area 7000 sf

* sf means square feet

Step 2: Calculate the weighted runoff coefficient (C) for the proposed lot. See runoff coefficients table in the Hydrology Report Guidelines. For example:

Run-off Coefficient for roof, driveway and patio: a) 0.95
Run-off Coefficient for lawn & landscaping: b) 0.30
Calculate Weighted C:

$$\frac{0.95 \times 2500 \text{ sf} + 0.30 \times 4500 \text{ sf}}{7000 \text{ sf}} = \textbf{c) 0.46}$$

Step 3: Determine rainfall intensity (i): For most residential lots of 10,000 square feet, the rainfall intensity for a 10-year storm event is **i = 1.7 inches/hour**.

Step 4: Determine the flow rate (Q) for the 10-year storm:

$$Q_{10} = C \times i \times A \times \frac{1\ ft}{12\ in} \times \frac{1\ hr}{3600\ \text{sec}}$$

$$Q_{10}\ (\text{cfs}^*) \rightarrow 0.46 \times 1.70\ \frac{in}{hr} \times 7000\ \text{SF} \times \frac{1\ ft}{12\ in} \times \frac{1\ hr}{3600\ \text{sec}} = \textbf{d) 0.127 cfs}$$

*cfs means cubic feet per second

Step 5: Follow steps 1-4 above to determine the flow rate for the post-development 10-year storm. To determine the change in flow rate, subtract pre-development flow rate from the post-development rate. Assume post-development rate in this example is 0.153 cfs.

Q_{10} **after** - Q_{10} **before** → 0.153 cfs – 0.127 cfs = **e) 0.026 cfs**

Step 6: Using a safety factor of 1.5 and a rainfall duration of $\mathbf{t_c}$**=10** minutes, use the equation below to convert the flow rate to the volume of water required for detention/retention.

$$V = Q \times t_c$$

$$V\ (\text{cf}^*) \rightarrow 1.5 \times 0.067\ \text{cfs} \times 10\ \text{min} \times \frac{60\ \text{sec}}{1\ \text{min}} \approx$$ **f) 25 cf**

*cf means cubic feet

Design the Dimensions of the Filtration - Retention Device

City Standard Detail drawings for each of the devices described below can be found at:

DR-18 Vegetated Swale, Gravel Basin & Storage Pipe/Bubbler Box

DR-19 Storage Pipe and Bubbler Box with Site Plan

Option 1: Gravel Basin: A gravel basin has 40% capacity in its voids to store water therefore, the volume calculated in step 6 shall be divided by 0.4 to determine the side of the gravel basin.

$$\text{Volume of gravel basin} = \frac{V\ (\text{cf})}{0.4} \rightarrow \frac{25\ \text{cf}}{0.4} =$$ **g) 62 cf**

Generally, a 30 square foot gravel basin that is 2-feet deep (60 cf) will suffice for 1000 sf of new impervious area on a typically sized single family lot in Menlo Park.

Option 2: Lawn/Grass/Vegetated Area (Not appropriate for soils with high clay content): Choose an appropriate depth for the area. Determine the area required to detain the volume of water calculated in step 6. Assume a depressed area with depth equal to 6-inches or 0.5-feet.

Volume of depressed vegetated area = $\frac{\text{V (cf)}}{\text{D (ft)}} \rightarrow \frac{\text{25 cf}}{\text{0.5 ft}}$ = **h) 50 sf**

Therefore, a 25-feet long, 2-feet wide, 6-inch deep depressed area will provide the required detention volume.

Option 3: Storage Pipe/Bubbler Box: Storage pipe material shall be PVC with a maximum DR rating of 26. Minimum pipe diameter shall be 6-inch with a minimum slope of 0.05%. However, 4-inch pipe is allowed connecting downspouts to on-site storm drain pipes. All storage pipes require a minimum cover of 6-inches.

1. Select a trial pipe diameter. Assume 12-inch pipe in this scenario.

2. Calculate the cross sectional area of pipe using the selected diameter (divide by 144 to convert from square inches to square feet):

   $A = \frac{\pi r^2}{144 in^2}$

   A (sf) $\rightarrow \frac{3.14 \text{ x } (6 \text{ in})^2}{144 \text{ in}^2}$ = **i) 0.785 sf**

3. Calculate storage pipe length:

   $L = \frac{\text{V (from step 6)}}{\text{Cross Sectional Area (A)}}$

   L (ft) $\rightarrow \frac{\text{25 cf}}{\text{0.785sf}} \approx$ **j) 32 ft**

4. Check size to fit field conditions. Repeat steps above to determine the correct pipe size based on field conditions.

5. Determine the hydraulic head, the difference in height between the highest and the lowest point in a flow system:

   Δh = Highest Elevation Point – Lowest Elevation Point

   Assume highest upstream elevation at inlet is 100-feet and lowest pipe invert elevation at discharge orifice is 98-feet.

   Δh (ft) $\rightarrow$ 100 ft – 98 ft = **k) 2ft**

6. Velocity (v) of discharge through the orifice:

   $v = K\sqrt{2g(\Delta h)}$ (For pipes ≥ 10-inches K = 0.6 and K = 0.7 for pipes < 10-inches)

   v (ft/s) $\rightarrow 0.6 \, x \sqrt{2 \, x \, 32.2 \left(\frac{ft}{s^2}\right) x \, 2ft}$ = **l) 6.81ft/s**

7. Determine cross sectional area of discharge orifice to keep discharge rate the same as pre-development:

$$A = \frac{Q\ (from\ step\ 4)}{v}\ x\ \frac{144\ in^2}{1\ ft^2}$$

A → $\frac{0.127\ cfs}{6.81\ \frac{ft}{s}}\ x\ 144\ \frac{in^2}{ft^2}$ **m) $2.7 in^2$**

8. If using a small pipe orifice, determine diameter:

$$D_{orifice} = \sqrt{\frac{4\ A_{orifice}}{\pi}}$$

$D_{orifice}$ (in) → $\sqrt{\frac{4\ x\ 2.8 in^2}{3.14}}$ = **n) 1.8 in**

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IMPERVIOUS AREA WORKSHEET

FOR NEW DEVELOPMENT AND REDEVELOPEMENT PROJECTS

To comply with the City of Menlo Park Stormwater Ordinance 859 (Chapter 7.42) and the NPDES Permit issued by the California State Water Board, project applicants must report changes in impervious surface area resulting from their new development or redevelopment projects within the city. Therefore all new project applicants shall complete this worksheet, submit it to Engineering for plan review and include the relevant data on the site design plans.

Imperviousness refers to the inability of a surface to absorb water. Higher imperviousness causes more water to run off the surface. Imperviousness reduces the amount of ground water recharge and increases the amount of storm water flowing to local creeks and the Bay. Excessive stormwater causes erosion of creek banks and flooding. Storm water also carries pollutants normally found in pesticides, herbicides, engine oil, copper from brake dust, etc.

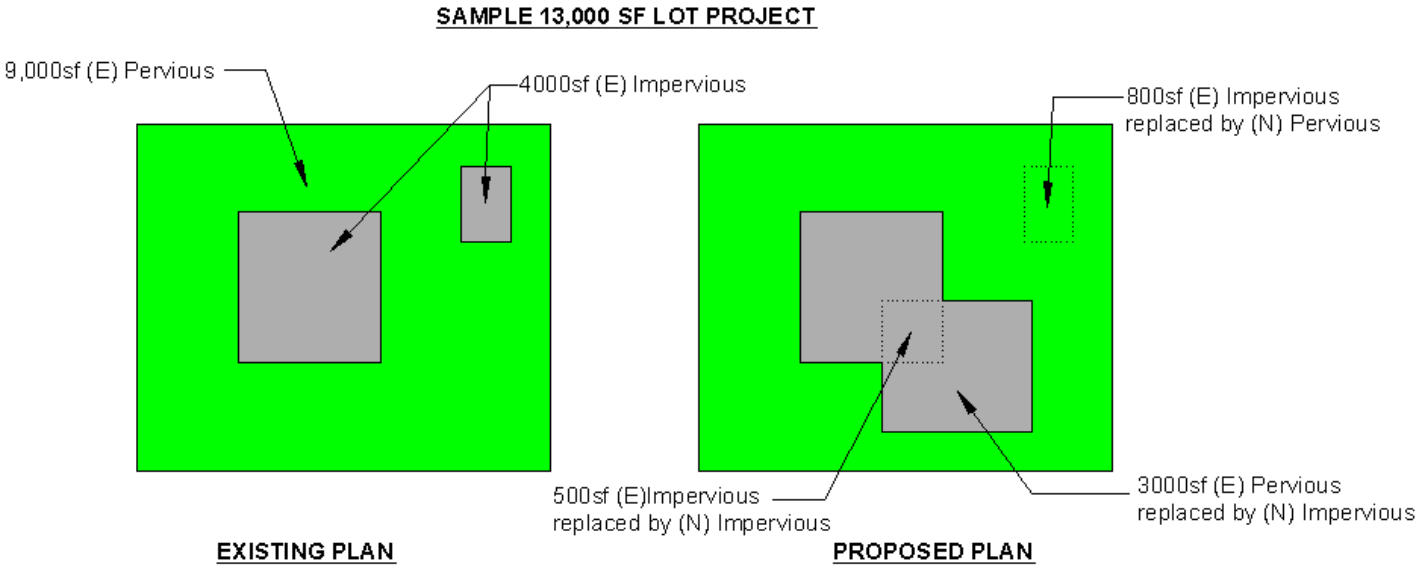
Impervious Surface is defined in this worksheet as any modified surface that **reduces** the land's natural ability to infiltrate or pass water into the soil. This includes any surface that causes storm water to run off in greater quantities than it would have under natural soil conditions given the same rain intensity.

TYPICAL PERVIOUS AND IMPERVIOUS SURFACES

Pervious Surfaces	Impervious Surfaces
Lawn/Vegetal Cover	Rooftops
Soil	Compacted Soil or Aggregate
Sand	Paved Walkways
Ponds	Swimming Pools
Streams/Creeks	Patios
Unpaved Gravel Driveways	Asphalt/Concrete
Pervious Concrete	Permanent Structures
Pervious Asphalt	Sidewalks
Permeable Pavers (Unit Pavers)*	Cobbles
Gravel Bed	

*****Permeable pavers are considered impervious if the underlying substrate is highly compacted soil or impermeable aggregate.

SAMPLE CALCULATION



IMPERVIOUS AREA SUMMARY		
Total Area of Parcel		**A** 13,000 ft^2
Existing Pervious Area		**B** 9,000 ft^2
Existing Impervious Area		**C** 4,000 ft^2
Existing % Impervious	$\frac{C}{A}$ **x 100**	**D** **30.8** **%**
Existing Impervious Area To Be Replaced W/ New Impervious Area		**E** 500 ft^2
Existing Pervious Area To Be Replaced W/ New Impervious Area		**F** 3,000 ft^2
New Impervious Area (Creating and/or Replacing)* *If greater than 10,000sqft, a hydrology report must be submitted	**E + F**	**G** 3,500 ft^2
Existing Impervious Area To Be Replaced W/ New Pervious Area		**H** 800 ft^2
Net Change In Impervious Area *This area is required to be detained/retained on-site	**F – H**	**I** **2,200** **ft^2**
Proposed Pervious Area	**B – I**	**J** 6,800 ft^2
Proposed Impervious Area* *Verify that J + K = A	**C + I**	**K** 6,200 ft^2
Proposed % Impervious	$\frac{K}{A}$ **x 100**	**L** **47.7** **%**

IMPERVIOUS AREA WORKSHEET

Submit this form with the improvement plan set to the City of Menlo Park Engineering Division.

Date:_____ APN:_____

Property Address:_____

Project Description:_____

_____

Contact Name:_____

Contact Telephone Number:_____

Contact Email:_____

Title And Sheet# of Submitted Drawing used For Calculations:_____

Land Use (Circle One):
Residential Commercial Industrial Professional Roadway

Drainage Basin (Circle One):
(See the *Hydrology Report Requirements* for a Drainage Basin map.)

Atherton Creek San Francisquito Creek San Francisco Bay

I certify that the calculations below accurately reflect the proposed changes and final impervious surfaces for the above project.

Calculations Performed By (Print):_____

Title: _____

Calculations Performed By (Signature):_____

Date:_____

IMPERVIOUS AREA WORKSHEET

IMPERVIOUS AREA TABLE		
Total Area of Parcel		**A** _____ ft^2
Existing Pervious Area		**B** _____ ft^2
Existing Impervious Area		**C** _____ ft^2
Existing % Impervious	$\frac{C}{A}$ **x 100**	**D** _____ **%**
Existing Impervious Area To Be Replaced W/ New Impervious Area		**E** _____ ft^2
Existing Pervious Area To Be Replaced W/ New Impervious Area		**F** _____ ft^2
New Impervious Area (Creating and/or Replacing)* *If greater than 10,000sqft, a hydrology report must be submitted	**E** + **F**	**G** _____ ft^2
Existing Impervious Area To Be Replaced W/ New Pervious Area		**H** _____ ft^2
Net Change In Impervious Area[1]	**F – H**	**I** _____ **ft^2**
Proposed Pervious Area	**B – I**	**J** _____ ft^2
Proposed Impervious Area* *Verify that J + K = A	**C** + **I**	**K** _____ ft^2
Proposed % Impervious	$\frac{K}{A}$ **x 100**	**L** _____ **%**

[1] Net change in impervious area is the area required by ordinance to be detained/retained on-site