Town of Ross
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DRAINAGE PLAN REQUIREMENTS

A drainage plan is required for all projects valued at $250,000 or more.

1. The plan shall consist of hydrologic/hydraulic analyses and site-scale design drawing(s) and sufficiently detailed to demonstrate that one of the following two standards will be met by the project:
    a. The plan shall be designed, at a minimum, to not increase peak runoff from the site compared to percentages of peak runoff from the site under pre-project conditions (minimum standard). To meet the minimum standard, a plan shall be prepared and submitted demonstrating all of the following:
        i. The post-project peak runoff for the two year one hour duration storm does not exceed 50 percent of the pre-project peak runoff for the two year one hour duration storm;
        ii. The post-project peak runoff for the 10 year one hour duration storm does not exceed 75 percent of the pre-project peak runoff for the 10 year one hour duration storm; and,
        iii. The post-project peak runoff for the 100 year one hour duration storm does not exceed 80 percent of the pre-project peak runoff for the 100 year one hour duration storm.
    b. Applicants are encouraged to optionally meet a higher standard by limiting post-project peak runoff from the site to peak runoff from the site under natural undeveloped conditions (i.e., no impermeable surfaces present) (natural standard). To meet the natural standard, a plan shall be prepared and submitted demonstrating all of the following:
        i. The post-project peak runoff for the two year one hour duration storm does not exceed 100 percent of the natural undeveloped peak runoff for the two year one hour duration storm;
        ii. The post-project peak runoff for the 10 year one hour duration storm does not exceed 100 percent of the natural undeveloped peak runoff for the 10 year one hour duration storm; and,
        iii. The post-project peak runoff for the 100 year one hour duration storm does not exceed 100 percent of the natural undeveloped peak runoff for the 100 year one hour duration storm.
2. The hydrologic/hydraulic analyses may use the rational method of computing peak runoff rates and so shall generally conform to methods developed by the Marin

County Department of Flood Control and Public Works as described in its Hydrology and Hydraulics Manual. If applicable, composite runoff coefficients and times of concentration for pre-project and post-project conditions shall be determined using formulae contained in the County Manual. If applicable, pre-project and post-project conditions rainfall intensities per pre-project and post-project times of concentration shall be determined using the maps and nomographs contained in the County Manual.

a. For meeting the minimum standard, the hydrologic/hydraulic analyses shall assume that existing and proposed natural areas have a runoff coefficient, C, of 0.7 and existing and proposed impermeable surfaces have a runoff coefficient of 1.0. If applicable, the Applicant may substantiate that existing or proposed permeable pavement surfaces have an intermediate value.

b. For meeting the natural standard, the hydrologic/hydraulic analyses shall assume that the entire site had a runoff coefficient of 0.6 under natural undeveloped conditions, proposed natural areas have a runoff coefficient of 0.7, and proposed impermeable surfaces have a runoff coefficient of 1.0. If applicable, the Applicant may substantiate that proposed permeable pavement surfaces have an intermediate value.

3. Projects that propose new impermeable surface areas not offset by removal of existing impermeable surface areas may require the plan include an above or below ground stormwater attenuation facility(ies) with sufficient total storage volume to limit post-project peak runoff rates to the above prescribed limits. Attenuation facilities are temporary stormwater storage containers which, when not full and overflowing, receive stormwater from the developed part of the site and discharge it at a reduced rate onto the landscape and/or to off-site. Properly sized and configured, attenuation facilities can prevent post-project runoff rates from exceeding prescribed limits required by the minimum and natural standards. Types of attenuation facilities include:

   a. Dissipation/infiltration facilities are below-ground gravel-filled trenches which discharge some amount of the stormwater into the ground (infiltration), and freely discharge the excess stormwater onto the natural landscape as shallow overland flow (dissipation). Bioretention facilities are open vegetated shallow land surface depressions or swales overlying below-ground gravel-filled trenches which infiltrate some stormwater and discharge excess stormwater onto the natural landscape as shallow overland flow and/or to off-site.

   b. Closed detention/attenuation facilities are constructed or pre-fabricated storage tanks set above or below ground which discharge at a design maximum rate through a small diameter low-level outlet, and freely discharge excess stormwater through a large diameter high-level outlet. Excess stormwater may be directed off-site or onto the natural landscape via a below-found gravel-filled trench type dissipater or bioretention facility. Closed detention/attenuation facilities can be compatible with rainwater harvesting for seasonal landscape irrigation water supply.

4. The initial plan's site-scale design drawing(s) shall, at a minimum, show pre- and post-project drainage area divides at the site; drainage areas tributary to the

facility(ies); post-project site topography and overland flow direction arrows; off-site drainage facilities receiving stormwater from the site; roof gutters and downspouts and flow directions; locations and dimensions of area drains and catch basins; locations, types, and sizes or dimensions of attenuation facility(ies); alignments, types, flow directions, design slopes, and dimensions of drainage pipes; inlet and outlet invert elevations; hydraulic profiles; and cross-section details.

5. If this initial plan includes attenuation facility(ies), the hydrologic/hydraulic analyses shall demonstrate that the facility(ies) provide minimum necessary storage volume for limiting post-project peak runoff from the site to the applicable limits for the two year one hour duration, 10 year one hour duration, and the 100 year one hour duration storms, and may use the following simplified calculation procedures:

    a. Determine the required amounts of peak flow reduction in cubic feet per second (cfs) required to meet each of the applicable limits for the two year one hour duration, 10 year one hour duration, and the 100 year one hour duration storms.

    b. Determine the initial design total attenuation volume (in cu. ft or gallons) by multiplying the largest of the three required peak flow reductions (cfs) by the post-project time of concentration (minutes). Multiply by 60 seconds/minute to convert to cubic feet (cu. ft). Multiply again by 7.48 gallons/cu. ft to convert to gallons.

    c. Locate one or more initially sized attenuation facility(ies) in the plan in parallel and/or series as necessary to comprise the initial design total attenuation volume, according to site plan constraints. Assume gravel-filled trenches have 30% void space.

    d. According to the initial plan, determine the post-project drainage area(s), post-project time(s) of concentration, post-project composite runoff coefficient(s), and post-project peak runoff rates tributary to the facility(ies) for the two year one hour duration, 10 year one hour duration, and the 100 year one hour duration storms.

    e. Determine the peak flow reductions (cfs) caused by the attenuation facility(ies) for the two year one hour duration, 10 year one hour duration, and the 100 year one hour duration storms, and adjust the configuration and design volume of the attenuation facility(ies) as necessary to collectively achieve each of the required peak flow reductions determined in 5a. The resulting design total attenuation volume may differ from the initial design total attenuation volume determined in 5b.

        i. For closed detention/attenuation facility(ies), use an orifice discharge formula to select a nominal diameter of the low-level outlet for limiting the peak discharge from the facility to meet the total or target portion of the total required peak flow reduction, according to the low-level outlet diameter and its depth when the facility is full to the level of the free flowing high-level outlet. Use an inlet control orifice discharge formula for outlets discharging under free-flowing gravity conditions. Use an outlet control orifice discharge formula for

submerged outlets, such as outlets discharging to a sump pump drained overflow storage tank, or a bubbler-type catch basin discharging to a bioretention facility or overland flow path on the landscape. Assume outlet head is the same as the sump pump inlet elevation or the bubbler rim or bioretention facility overflow elevation.

Determine the minimum design volume(s) for each of the facility(ies) by routing a simple triangular inflow hydrograph(s) through the facility(ies) discharging through the low-level outlet orifice diameter(s) selected in 5.e.i. The simple triangular inflow hydrograph(s) shall rise linearly from zero cfs at time equals zero minutes to the tributary post-project peak flow(s) at the post-project time(s)of concentration determined in 5.d. (or 10 minutes, whichever is less), then fall linearly to zero cfs at two times the post-project time(s) of concentration (or 20 minutes, whichever is less). Determine the minimum design volume(s) by subtracting the volume(s) under the resulting low-level outlet outflow hydrograph(s) from the volume(s) under the simple triangular inflow hydrograph(s).

Alternatively, the minimum design volume(s) can be determined without routing calculations by subtracting the orifice formula calculated maximum peak discharge(s) from selected nominal diameter low-level outlet (determined in 5.e.i.) from the tributary post-project peak inflow(s) to the facility(ies) determined in 5.d., and multiplying the difference(s) by the post-project time(s) of concentration determined in 5.d. Multiply by 60 seconds/minute to convert to cu. ft. Multiply again by 7.48 gallons/cu. ft to convert to gallons.

Pre-fabricated storage tanks are typically available in nominal sizes in increments of 500 gallons. Tanks larger than the minimum design volume offer a factor of safety but require more above or below-ground space. An alternative to pre-fabricated storage tanks are 18 inch diameter to 24 inch diameter solid-walled PVC storage pipes fitted to the side of a standard 24 inch by 24 inch to 30 inch by 30 inch catch basin fitted with low-level and high-level outlets. The storage pipe can be cut to any length for providing the minimum design volume, and laid horizontally within a 24 inch by 24 inch to 30 inch by 30 inch gravel-filled trench. Custom fitting the low-level and high-level outlets with specific diameters and invert elevations to the catch basin provide attenuation control.

Hydrology/hydraulic calculations shall be revised according to the selected storage tank/pipe size, volume, configuration, etc., in an iterative design process.

ii. For gravel-filled trench type infiltration/dissipation and bioretention facilities, assume zero infiltration unless the plan demonstrates the facilities are located on portions of the Corte Madera Creek floodplain or elsewhere USDA has mapped soils of a suitable Hydrologic Soil

unit. Assume 30% void ratio for calculating gravel-filled trench volume. Gravel-filled trenches may be sub-drained with a perforated pipe low-level outlet but assume zero outflow for sizing calculations.

f. Finalize the hydrologic/hydraulic analyses developed in 5.a. through 5.e. and the plan's site-scale design drawings developed in 4. according to the final selected locations, sizes, and configuration of drainage and attenuation facilities.

6. The Town may require a factor of safety be applied to the design total attenuation volume to offset potential for sedimentation, debris blockage, failed maintenance, failure to drain completely before subsequent storm, etc. to reduce design peak flow reduction performance. To avoid factor of safety, Applicants are encouraged to include redundancies in the plan, including but not limited to:

   a. Including in series rainwater harvesting storage tank(s) for actively used for winter landscape irrigation so that it can be expected to be partly empty at the onset of individual winter storms.

   b. Discharging from the low-level outlet(s) and or high-level outlet(s) to a perforated pipe t-outlet within a gravel-filled dissipation/infiltration trench;

   c. Discharging from the low-level outlet(s) and upper level outlet(s) to a bioretention facility or a vegetated swale not less than 20 feet long and not more than one half percent sloped.

7. The Town provides the above simplified calculation procedures to streamline the drainage system design process and minimize design costs to the Applicant. The Applicant can substitute more detailed calculation procedures if the Applicant believes that additional detail is warranted for characterizing site-specific stormwater runoff and drainage conditions or hydraulic effects of the proposed drainage and attenuation facilities.

8. The Town may require that construction of drainage facilities be supervised, inspected and accepted by a professional engineer. The Town may also require a letter of certification be provided to the Town prior to project final. The Town may also require preparation and submittal of certified as-built drawings of the constructed facilities.

9. Property owners shall be responsible for inspecting and maintaining drainage facilities. The Town may require an applicant to enter into and/or record a maintenance agreement for drainage facilities.

10. Facilities should be designed to minimize mosquito production.

Cost of Review

The drainage plan may be reviewed by a consultant for the Town. Applicants will be responsible for payment of all time spent by Town consultants to review their application. An estimate of the costs may be provided prior to the work and the Town may require a deposit to cover estimated expense.