

V. DRAINAGE

A. STORM DRAIN PLAN CHECKING PROCEDURES

For most developments Transportation will review the WQMP, drainage report and storm drain plans. If the project has a Flood condition requiring plan submittal and has facilities, Flood will maintain then they will review the drainage and WQMP for the project. If there is not a flood condition requiring plan submittal, Transportation will review and approve drainage report and storm drain plans.

When Flood Control is responsible for plan checking the drainage plans and calculations it includes all drainage facilities, including Flood Control non-maintained facilities.

The applicant is responsible to provide Transportation and Flood Control with street and storm drain plans. For projects with both Transportation and Flood Control facilities use Flood Control standard title block. For projects with Transportation facilities only, use the Transportation standard title block.

B. REPORT

A Drainage report is required for all developments in the County. It shall include a project description, project setting including discussion of existing and proposed conditions, any drainage issues related to the site, a summary of the findings or conclusions, offsite hydrology, onsite hydrology, hydraulic calculations and a hydrology map. Supporting materials must be included in the package, including all charts, tables, graphs and soil maps used to determine initial time of concentration, hydrologic values, and the like. Depending on the proposed facilities, the report may be reviewed and approved by Flood Control as well. If a bulking factor is required and is in dispute, a debris study will be required to justify the amount of bulking.

C. HYDROLOGY METHODS

For study areas less than 300 to 500 acres including offsite areas, use the Rational method. For larger areas and for routing drainage through detention or into retention basins, use the Synthetic Unit Hydrograph method. See Riverside County Flood Control Hydrology Manual for procedures and calculations.

D. HYDROLOGY CALCULATIONS

The Riverside County Flood Control Hydrology Manual has calculation worksheets that can be utilized for calculations. There are also a large variety of computer programs available for computing drainage runoff. The accepted programs are HEC-1 from the Hydraulic Engineering Center or authorized vendors, Rational or Synthetic Hydrograph from Advanced Engineering Software, or Rational, Synthetic Hydrograph, or Basin Routing from Civil Design. There may be others, please contact Flood Control Plan Check at (951) 955-1200 for verification. The analysis should include calculations of the existing and proposed conditions.

E. HYDRAULIC CALCULATIONS

All facilities that convey drainage must have calculations to support its use. The facilities include streets, culverts, storm drains, channels, catch basins, inlets, connector pipes, and others. Number and location of catch basins pipes and other drainage devices above the minimum requirement shall be at the discretion of the Transportation Department. When practical, intersections shall be designed to be dry.

All street section capacity calculations must be included using the Manning's equation. They should include depth, quantity, and velocity and can be hand or computer generated calculations. When streets are allowed to be used for drainage purposes, the 10-year frequency storm shall be contained below the tops of curbs (or dikes), and the 100-year frequency storm shall be contained within street right-of-way. If either of these criteria is exceeded, additional drainage facilities must be provided. (See Ordinance 460, Section 11.1 for additional information.) Use 6" curb max on road types including secondary and 8" curb max on road types wider than secondary. Allowable velocity within the street section shall be determined by the product of depth of flow in feet times velocity in FPS and must be less than or equal to 6. Concrete Dip Crossings shall not be allowed unless approved by Transportation. If allowed, Q100 exceeds 250 cfs and one all-weather route is provided, and all else is satisfied per Ordinance 460, Section 11.3, Concrete Dip Crossings may be allowed, with fire department approval. The maximum depth of water allowed over the roadway is 9 inches and the maximum velocity is 1.5 fps.

Culverts must include inlet or outlet control calculations per HEC-5, Hydraulic Design of Highway Culverts not just Manning's equation. Also provide structural calculations for the culvert if it falls within AASTO or Caltrans bridge criteria.

Storm drains require calculations of the hydraulic grade line that must be shown on the storm drain profile. This can be done using the worksheet in the Los Angeles County Flood Control Manual, Page G-1 or a computer program. Some of the accepted hydraulic programs are HEC-2 from the Hydraulic Engineering Center or authorized vendors, normal depth features of Hele from Advanced Engineering Software, or LA County WSPG, or Normal Depth Hydraulics from Civil Design. There may be others, please contact Flood Control Plan Check at (951) 955-1200 for verification. Also provide structural calculations for all pipes under the road way.

Open channels or open flow pipes can be sized with the Manning's equation. . In the Manning's Equation $Q=(1.485918/n)(A)(R^{2/3})(S^{1/2})$, [A=area, R=A/Pwet, S=CL Slope] the values of "n" shall be as follows: 0.013 for RCP; 0.014 for Cast In Place pipe; 0.014 for rectangular conc. channel; 0.015 for trapezoidal conc. channel; 0.015 for street sections; 0.020 for earth swales; 0.025 for CMP/CSP; 0.040 for grass.

Catch basins and inlets should be per Transportation Standards, not Flood Control, and sized per HEC-12, Drainage of Highway Pavements. Catch Basin sizing shall be calculated using the FHWA HEC 12 equations as follows: For on grade locations; $Lt=0.6 \times Q^{0.42} \times s^{0.3} [1/(n \times Sx)]^{0.6}$ for total length required. If length is excessive, also use $E=1-(1-L/Lt)^{1.8}$, acceptable efficiency is above 60%. For catch basins in a sump, use the weir equation if Q100 flow is below top of curb and the orifice equation for Q100 depths above top of curb. Grated catch basins are discouraged, but may be used on steep streets without debris. A minimum of 0.5 feet of free board is required in the catch basins for the Q100 flows. Acceptable lengths include 4', 7', 10', 14', 21', not to exceed 28'. Use multiple

catch basins if additional length is needed. Catch basins in series are not allowed unless approved by Transportation as an emergency overflow system; an emergency overflow route is required for some locations.

Connector pipes must be sized per LA County Hydraulic Manual section D. For on grade catch basins, the flow in the connector pipe is the flow intercepted by the catch basin in a 100-year event, not the Q100 in the street.

Any other facility being designed as part of the project must have support calculations. Note the reference and include tables, charts and other reference material if utilized.

F. HYDROLOGY MAP

All hydrology calculations must have a map. There may be multiple maps, one for existing and/or proposed development and for onsite and offsite areas.

- _____ 1. Hydrology maps shall be clear, legible (0.12" minimum text height), and to a scale large enough for their intended purpose, or they will not be accepted. USGS maps shall be avoided, but if used, shall be enlarged. RCFC Topo maps shall be used if they exist for the project area.
- _____ 2. The preferred sheet size is 24" x 36". A different size may be used provided it folds into 8" x 10" and fits into a pocket in the back of the report.
- _____ 3. Show contours, proposed and existing slopes. Flown, Flood Control or other mapping may be used and should cover the onsite and offsite watershed.
- _____ 4. Label all nodes, node elevations, area names and acreages, and flow directions, flow path lengths, all to match drainage report.
- _____ 5. Show proposed and existing street layout include high points and sumps, lots and lot numbers, drainage facilities including catch basins, storm drains, culverts, ditches, basins, etc.
- _____ 6. A legend, north arrow and scale, project number (tract, plot plan, parcel map), "IP" number, date and engineer's stamp. The applicant may include a vicinity map and other identifying information at their option
- _____ 7. Show watershed boundary, sub area boundary, flow length, node elevations, flow path, areas, 10 year and 100 year flows at concentration or confluence points such as structures and project entrances and exits.
- _____ 8. Show basins and provide volumes, inflow and outlet flows for the 10 and 100 year events at each structure.