



Section 102

Hydrology and Hydraulics

This section establishes the uniform policies and procedures for the preparation of the hydrology and hydraulic requirements in the City of Irvine.

It is not intended as a textbook, or substitute for engineering knowledge, experience, or judgment but rather as a guideline to uniformity and to provide the designer with sufficient information for the preparation of desired plans with a minimum amount of uncertainty.

Please refer to the latest posted amendment for any updates or modifications to the standards herein.



Public Works

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Public Works

Section 102 *Hydrology and Hydraulics*

102.1 GENERAL

Drainage design requirements shall be in accordance with the latest edition of the Hydrology Manual published by the Orange County Flood Control District and the Orange County Local Drainage Manual published by the County of Orange Environmental Management Agency.

Design calculations and flow maps for all contributory areas shall be submitted with the plans.

The use of underground storm drain systems shall be required:

- When flooding or street overflow will cause serious damage.
- When future upstream development will cause drainage problems.
- When a minimum of one through lane in each direction cannot be maintained above the theoretical design storm frequency.
- To eliminate the need for cross gutters.
- To eliminate nuisance water in residential areas (maximum surface flow between catch basins = 750 feet).
- When median drainage is required.
- To insure building protection for the 100-year storm.

Drainage systems shall be designed along with site grading to insure all building pads are a minimum of one-foot above the elevation of the theoretical 100-year storm flow.

102.2 HYDROLOGY

A. General

1. Criteria used for hydrology studies shall be as stated in the Hydrology Manual published by the Orange County Flood Control District and the Orange County Local Drainage Manual published by the County of Orange Environmental Management Agency, current editions, except as follows: The 25 year design frequency shall be used for all storm drains, unless otherwise approved by the City Engineer.
2. The hydrology map, grading, and street plans shall agree as to the grades, drainage areas, etc.

B. Hydrology Map

1. The hydrology map shall be on a topographic map of sufficient scale to show legible elevations, drainage patterns and quantities of runoff.
2. The site must be shown on the hydrology map including on-site and off-site topography showing the entire tributary drainage area.
3. Show all Q's (with time of concentration) flowing in the streets. Designate Q25 or Q10 as appropriate. If one side of a street carries more Q than the other side, show it.
4. Show all cross-over Q's and where they occur.
5. Show all street flow confluences and their calculations.
6. Show all Q's approaching, entering, and carried over from catch basins.
7. Identify all catch basins by numbers or letters.
8. Show and verify with legible contours or other adequate means, all Q's entering the project. If previous studies were used, reference them.
9. Show all Q's leaving the project.
10. Show north arrow and scale.
11. Show names or some other designation for all streets in and around the project.

12. Show the Tract or parcel number, if applicable.
13. Show name and telephone number of the engineer who performed the hydrology study.
14. Show and identify all storm drains (use same designations as improvement plans), their sizes, Q's and times of concentration.
15. If the project contains more than one soil group (A, B, C or D), delineate each group.
16. Indicate type of existing or proposed development for the site
17. The drainage areas shall close and the acreage shall be shown. Areas should close at all points of confluence and at pickup points.
18. All off-site drainage areas must be shown with a reasonable analysis of the interim and ultimate Q's from those areas. Include the necessary supporting calculations or reference a previous acceptable study, which is either already on file or will be supplied with the submittal.
19. Initial areas should be limited to a maximum of 3 to 4 acres in size with a maximum flow path of 300 feet.
20. Show Flood Hazard Zone designations, map panel number and effective date in accordance with the Flood Insurance Rate Maps (FIRM) published by FEMA.

C. Hydrology Calculations

Software shall be A.E.S. or equal and previously approved for use by the City of Irvine for Hydrology Calculations. Non-computer generated hydrology calculations must be in accordance with the Orange County Hydrology Manual using Q25 for the calculations.

102.3 HYDRAULICS

A. General

1. Hydraulic Design Criteria shall be stated in the Orange County Flood control District Design Manual, the Orange County Hydrology Manual, and the County of Orange Public Facilities and Resources Department (PRFD) Local Drainage Manual (with the exception of the City's Design Criteria and Manning's factor for RCP and CIPP be "n=0.013".)
2. Grate type catch basins not be allowed on public or private streets.
3. Parkway culverts are discouraged and must receive approval from the City Engineer prior to being used.

B. Hydraulic Calculations

Software used for hydraulic calculations shall be A.E.S. or equal and previously approved by the City of Irvine. Q25 or Q10, as appropriate, shall be used for calculations.

102.4 PLAN PREPARATION

A. Storm Drains

1. Show the 25 year or 10 year hydraulic grade line plot, as appropriate, all water surface elevations, top of curb elevation at catch basins and include all hydraulic elements: Q's, Vn, slopes, pipe size, F.L. elevations and pertinent stationing.

B. Catch Basins

1. Show sizes including L and H of opening and height of catch basin.
2. Show type.
3. Show street centerline stationing.

102.5 DESIGN CRITERIA

A. Pipes

1. D-loads shall be in conformance with the Orange County Flood Control Manual.
2. A bedding detail is required for all types of pipe. City of Irvine Standard Plan No. 318 may be used with R.C.P.
3. A minimum pipe size of 18 inches shall be used for all public storm drains and private storm drains within streets.
4. Use a factor of $n = 0.013$ for R.C.P. and cast-in-place pipe (C.I.P.P.)
5. Concrete collars shall be used as required in accordance with City of Irvine Standard Plan No. 310.
6. A minimum radius of 22-1/2 feet shall be used for any horizontal bend.
7. Slope anchors shall be provided at each ten foot change in elevation when the slope exceeds 33%.
8. When using A.C.P., the D-load shall be 150% of the D-load for R.C.P.
9. Thick wall R.C.P. with 1-1/2 inch minimum cover shall be used when velocity exceeds 20 feet per second. Maximum velocity shall not exceed 45 feet per second.
10. Minimum slope of a pipe shall be 0.001(0.1%).
11. C.I.P.P. may be used as an alternate. Accompanying soils report must confirm adaptability of soils to cast-in-place construction. Construction of the C.I.P.P. shall conform to the provisions of ACI Standard 346-90 and Title No. 66-22. Trench to accept C.I.P.P. shall be dug in undisturbed soil, and continuous inspection by the City will be required. Prior to the acceptance of any C.I.P.P. storm drain, an in-place loading test may be required at the discretion of the city Engineer. Such test shall be in conformance with Section 9.4 of the above-referenced ACI Standard 346-90 and performed solely at the expense of the contractor. If the storm drain is to become part of Orange County flood control system, written approval for C.I.P.P. will be required from the Orange County Flood Control District prior to start of construction.

B. Open P.C.C. Lined Channels

1. Are not allowed in the street right-of-way unless approved by the City Engineer.
2. Structural calculations will be required.
3. Structural details shall be shown on the plans.

C. Manholes

1. Manholes are required at the following locations:
 - a. Beginning or ending of curves.
 - b. Pipe size changes.
 - c. Angle points and as required at junctions.
 - d. Maximum 500 feet intervals (300 feet maximum for pipe less than 24 inches in diameter).
 - e. As required for maintenance.
2. Manholes shall be restricted to, in order of preference:
 - a. Parking lane.
 - b. Parkway.
 - c. Center of travel lane nearest right curb.
 - d. Center of travel lane to the left of the travel lane nearest right curb.

D. Easements

1. Public drainage devices shall be located entirely within an easement when encroaching on private property.
2. Easements parallel to lot lines are preferred to be on one lot only.
3. Surface structures shall not surcharge storm drain facilities.

E. Abandonment of Underground Facilities

1. If existing culverts, pipes or other facilities are abandoned or removed, provisions must be made for drainage.
2. If facilities are abandoned, it will be necessary to either backfill with sand or cement slurry and seal the ends with brick and mortar or crush in place. Treatment of abandoned facilities will be as directed by the City Inspector.

F. Surface Drainage Transitions

1. If it is necessary to grade to drain, the grade on the ditch shall be shown on the plan.
2. The length of ditch construction shall be shown on the plan.
3. A letter of consent (Drainage Acceptance Agreement) will be required where grading or drainage involves adjacent private property.
4. Keep mud and debris out of drainage by grading around improvements.
5. Provide AC swales or aprons to protect improvements.
6. The need for grading 50 feet to 100 feet upstream from proposed improvements must be checked.
7. Insure ponding does not occur upstream.
8. Insure water quality and erosion control. (File Notice Of Intent (NOI) with the State Water Resources Control Board for construction involving five (5) or more acres to comply with N.P.D.E.S. Construction Permit requirements).