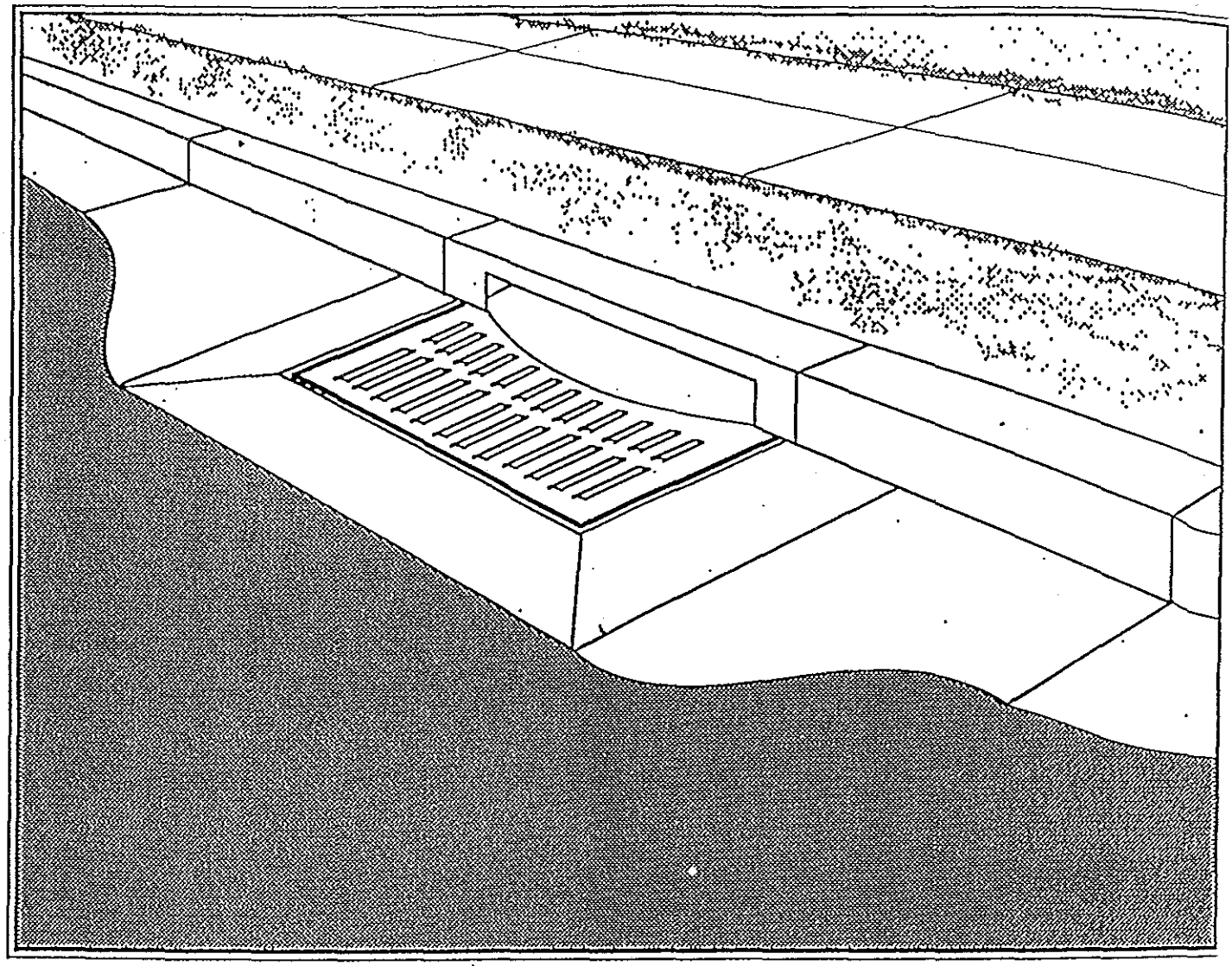


CITY OF SAN JOSE

DESIGN
FOR

# STORM DRAINS

Part III

Section 3. Storm Design Requirements

*Introduction: The following storm drainage design criteria have been prepared by the City of San Jose to standardize storm drainage design and quality assurance requirements. It is intended that these criteria be applied throughout the City on all projects; however, because of the complexity of development in San Jose, these criteria cannot be comprehensive in all situations. Therefore, in no case shall these criteria be used as a substitute for thorough engineering analysis, nor take precedence over such analysis where safety, or the preservation of property could be compromised by their application.*

3.01 Storm Drain Policy

3.01.01 Storm drainage systems shall be constructed with two distinct components as follows:

a. An underground piping system, including appropriately sized and positioned inlets, designed and constructed to convey the 10-year frequency or greater storm. Piping systems shall be designed for open channel flow.

b. Overland release conveyance for the 100-year frequency storm using a combination of pipe capacity and overland conveyance in the street section and other release channels. Overland conveyance shall comply with freeboard requirements. In all cases, a positive overland release is required. (Section 3.06.03)

3.01.02 Each development shall be responsible for mitigating its impact on the existing storm drain system adjacent to, and downstream of, the development site. Such mitigation will, in general, be to the extent shown on the current preliminary storm drain master plan. Greater mitigation may be required where impacts cause or aggrevate any situation that could be hazardous or cause property damage. Any new construction pursuant to such mitigation shall be designed and constructed to convey the runoff from the storms defined in Section 3.01.01 above.

Such mitigation shall be constructed with, or prior to, construction of the development. In no case shall this be construed to mean that development can proceed without a complete and operational storm drainage system in place or constructed concurrently. Further, in no case shall development proceed without mitigation if impacts cause or aggrevate any situation that could be hazardous or cause property damage.

3.02 Capacity Criteria

3.02.01 Complete storm drainage calculations shall be required for all storm drains, overland flows, and overland releases. Drainage shed maps shall show all upstream acreages and run-off coefficients for each tributary area. HGL and EGL shall appear on profile sheets but not necessarily on the construction plan. Surface storage for overland flow may be calculated but is not required. Calculations of microfilmable quality shall be annexed to the record plans sheets.

3.02.02 The Rational Method shall be used to determine design run-off rates (Q) for public storm drains.

$$Q = CIA$$

where:

Q = Peak run-off rate in cubic feet per second (cfs);
C = Run-off coefficient expressing the percentage of rainfall which is assumed to become direct storm run-off;
I = Average rainfall intensity in inches per hour for a duration equal to the time of concentration of the watershed; and
A = Drainage area in acres tributary to the design point.

3.02.03 Santa Clara County Drainage Manual Intensity-Duration-Frequency (IDF) curves shall be used (see Appendix 3.06.01).

Intensity values (I) shall be adjusted for specific locations to account for variations in mean annual precipitation (MAP) across the City. This shall be accomplished by applying the following formula:

$$I = (MAP/13.1)\ Ic$$

where:

I = Intensity at specific project site

MAP = Mean annual precipitation at specific project site as derived from the County MAP map. When a project is between two isohyets, the higher isohyet shall be used for design. i.e. if a project is between the 14 inch and 15 inch isohyets, 15 inches is the design MAP. (see Appendix3.10.02)

13.1 = Constant representing MAP used for "San Jose" IDF curves

Ic = Intensity as read from IDF curves

3.02.04 Time of Concentration:

a. Time of concentration (TC) consists of the inlet time plus the flow time in the pipe to the point of consideration.

b. Inlet time equals the sum of the overland flow time to reach the gutter and the flow time in the gutter to the inlet.

c. The following inlet times may be used as estimated inlet times at the beginning of pipe runs for the land uses shown.

Residential, zoned for less than 5du/AC: 15 minutes
Residential, zoned for 5du/AC to 8du/AC: 10 minutes
Residential, zoned for greater than 8du/AC: 5 minutes

Inlet times for all other land uses shall be calculated. In lieu of using the values shown, inlet times for the land use shown above may also be calculated.

3.02.05 Following is a list of weighted values for the run-off coefficient (C) to be used with the Rational Method. These values are to be applied when evaluating sheds on a gross acreage basis.

| Land Development | Dwelling Unit per Acre | "C" Coefficient |
|---|---|---|
| Rural Residential | (0.2) | See App. 3.10.03 |
| Estate Residential | (1.0) | 0.35 |
| Low Dens. Resid. | (2.0) | 0.45 |
| Med. Low Desn. Resid. | (5.0) | 0.60 |
| Med. Dens. Resid. | (8.0) | 0.70 |
| Med. High Dens. Resid. | (8-16) | 0.80 |
| High Dens. Resid. | (12-25) | 0.85 |
| Very High Dens. Resid. | (25-40) | 0.90 |
| Commercial | | 0.90 |
| Industrial | | 0.85 |
| School | | 0.50 |
| Park | | 0.40 |
| Public/Quasi-Public | | 0.90 (Var.) |
| Open Land | | See App. 3.10.03 |

As an alternate to using these standard run-off coefficients, site specific values of "C" may be calculated by the composite method. This shall be accomplished by first subdividing the subject area into surface classes. Coefficients shall be selected from the following table according to class, and weighted by the percentage of the total area encompassed by that class. The sum of the weighted values is the coefficient "C" to be used for gross acreage run-off calculations for the site. In no case shall a site specific coefficient be used for calculating run-off from any other site.

| Class | Coefficient |
|---|---|
| All hard surfaces including but not limited to streets, roofs, sidewalks, patios, driveways, decks, brick and rock. | 0.90 |
| All sandy soil including grass and landscape underlain by sandy soil. | 0.15 |
| All heavy soil including grass and landscape underlain by heavy soil. | 0.25 |

All maps, architectural drawings and calculations used in the derivation of composite coefficients shall be submitted for review by the City.

3.02.06 Minimum Full pipe flow velocity shall be 2.5 fps.

3.02.07 Minimum Roughness coefficients shall be 0.013 for reinforced concrete pipe and shall be 0.026 for corrugated metal pipe.

3.02.08 Manholes and other structures shall be designed in a manner such that all head losses resulting from inlet control, contraction, expansion, turbulence, bends, confluence and any other factor shall be calculated and accounted for in design. The HGL shall not be above an inlet pipe crown, or a backwater condition be induced in any reach of pipe entering a structure or manhole.

3.02.09 Hydraulic grade line analysis for storm drainage systems shall be based on the 10 year flood surface elevation of the receiving stream. (This elevation may be obtained from the Santa Clara Valley Water District.)

3.03 Storm Drain Mains and Laterals:

3.03.01 Storm mains shall be reinforced concrete pipe and shall be Class III or better with a minimum 'B' wall thickness conforming to ASTM C76 and shall have rubber gasketed joints conforming to the requirements of ASTM Designation C443.

3.03.02 Vertically or horizontally curved pipe alignments shall not be used.

3.03.03 The minimum inside diameter for storm drain mains shall be 15-inches.

3.03.04 Minimum cover over storm drain mains shall be 2 1/2 feet to street subgrade.

3.03.05 Maximum depth to invert shall be 30 feet.

3.03.06 Spacing between storm and sanitary lines shall leave five feet between nearest edges of adjacent pipes.

3.03.07 The minimum vertical pipe crossing clearance shall be one foot as measured from the outside walls of the pipes.

3.03.08 All laterals installed in existing streets shall have profiles locating utility crossings.

3.03.09 All storm drainage laterals shall be minimum 12-inch Class IV RCP.

3.03.10 Where applicable, laterals shall be stubbed and plugged at the property line for future development. The invert elevation at the property line shall be shown on the plans.

3.03.11 Non-rigid pipes abandoned in place shall be filled with sand slurry and plugged at ends.

3.03.12 Private inlets with rim elevations lower than street grades must utilize a privately maintained flapgate or other back flow protection device located on private property.

3.03.13 Public systems shall not connect low laying areas by an adverse grade pipe.

3.04 Manholes, Inlets, Basins, Pumps, Outfalls, and Gutters:

3.04.01 Manhole spacing shall be 450 feet maximum except when the storm main size equals or exceeds 60 inches in diameter in which case spacing shall be subject to approval by the Director of Public Works.

3.04.02 Manholes shall be used at:

a. All connections of laterals from storm water inlets located in a public right-of-way.
b. All changes in direction.
c. All changes of pipe size.
d. At all intersections of mains.
e. Where one lateral serves multiple lots.

3.04.03 Storm water inlet spacing shall not exceed 600' maximum.

3.04.04 Flat grate inlets shall not be used in lieu of hooded type inlets.

3.04.05 A slant grate with hood shall be used on inlets at the downstream ends of ditches. (Appendix 3.10.06)

3.04.06 The following storm water inlets are to be used with gutter grade:

| Gutter Grade | Storm Inlet Type |
|---|---|
| Less than 3.0% | Regular Hooded (Standard Plan Detail) |
| 3.0% to 6.0% | Large Hooded (Appendix 3.10.04) |
| Greater than 6.0% | GOL (Appendix 3.10.05) |

3.04.07 Minimum gutter grade around curb returns and cul-de-sac bulbs shall be 0.5 percent.

3.04.08 Maximum sags created within the public street system shall not exceed the depth at which ponding water extends beyond the right-of-way. If there is a series of sags, a minimum positive slope of 0.0005 feet per foot shall be required from the downstream release point to successive low points upstream.

3.04.09 Finished floor of structures (including garages) opposite downhill runs, such as downhill "T" intersections, shall be elevated to EGL of overland flow plus one foot freeboard. This is a minimum requirement only.

3.04.10 Gutter flow on public streets shall not be diverted into private streets or property.

3.04.11 All development shall set finished floors, including garages, at least one (1) foot above the controlling release flow line.

3.04.12 Detention basins are not City facilities. They may, however, impact City facilities. All detention basin designs and proposals shall be submitted to the City for review. Any detention basin having the potential to affect any City facility shall require approval by the Director of Public Works, shall meet Santa Clara Valley Water District requirements, and shall meet or exceed the following requirements:

a. Discharge shall be designed so that the capacity of any City facility is not exceeded. Calculations shall be required.
b. Maintenance responsibility shall be identified.
c. Overflow conditions shall be calculated and designed for safety and prevention of property damage.

3.04.13 Pump and lift stations shall be designed on a site specific basis. The following general criteria shall apply:

a. Plans shall be signed and sealed by registered engineers of the appropriate disciplines.
b. Drainage shed maps for both overland and underground pipe drainage shall be provided with plans and capacity calculations.
c. Flood information, if any, shall be provided.
d. No less than two pumps shall be used unless the station is a redundant system.
e. Maximum required pumping capacity shall be achieved with at least one main pump in reserve unless the station is a redundant system.
f. Emergency power shall be provided on site and shall be switched in automatically when needed. Alternately, if acceptable to the Director of Public Works, an auxiliary power hook-up may be provided at the control panel. The control panel shall be fully accessible during the 100-year storm and flood, and non-operation of the pumps shall not result in a safety threat or property damage.
g. Maintenance responsibility shall be designated on plans prior to plan approval.
h. Design capacity shall be for no less than the 100-year storm.

3.04.14 All basins, pumping stations and facilities requiring periodic maintenance shall be provided with all-weather access. Basins shall be provided with drive-in cleaning access.

3.04.15 Outfalls from public drainage system shall discharge into SCVWD or publicly maintained facilities only. Outfalls to SCVWD maintained channels shall be constructed according to district requirements, and shall be subject to approval and issuance of a permit by that agency. Permit number shall appear on improvement plans.

3.04.16 Bubble-up systems are not acceptable.

3.05 Private Connections to the Public Drainage System:

3.05.01 All storm drain connections will be subject to approval by the Director of Public Works and shall be in accordance with applicable standards and specifications. Permits shall be required.

3.05.02 A manhole shall be required for connection unless the City system to which the private system is being connected is of a diameter at least 2-1/2 times the diameter of the private system. A manhole shall be required whenever the lateral serves more than one property or lot.

3.05.03 Storm drain laterals from private properties shall not be connected to public storm water inlets.

3.05.04 Cross connections between sanitary and storm systems are prohibited.

3.05.05 Storm drain laterals shall be identified at the point which they cross the curb by the letter "D" scribed on the face of curb.

3.06 Overland Release and Channels:

3.06.01 Site planning shall yield street patterns and slopes that will accommodate a drainage plan in which the main storm drain is located in a public street, which in turn, is located in the lowest area of the site. Street patterns shall conform to topography so that pipes and overland flow will be contained within streets.

3.06.02 Overland releases shall be provided as a means of protection against storm frequencies greater than 10 years, and as an emergency backup in the event of a clogged inlet or malfunctioning drain. An overland release is an above ground channel or pathway in which water may flow. Calculations shall be provided to verify size and capacity in conformance with Section 3.01.

3.06.03 Streets shall serve as overland release channels. One foot minimum freeboard as measured from the flow line at the release point to the floor (including garage) of any structure shall be maintained.

3.06.04 Cul-de-sacs shall drain out toward the intersecting street. Cul-de-sacs that butt up to streets or other cul-de-sacs may drain toward the bulb end. A paved release path shall be designed, constructed, and marked as such.

3.06.05 When drainage or release is to cross under a fence line, a concrete channel and opening shall be provided and permanently marked "DRAINAGE CHANNEL."

3.06.06 All release paths other than public streets shall be constructed of concrete, turf stone, grouted cobbles, or similar materials approved by the Director of Public Works, and shall be permanently marked "DRAINAGE CHANNEL." Appropriate easement and agreements shall be recorded.

3.06.07 For cases in which overland release from a public area flows through private property, the following requirements shall apply:

a. Release channel rights-of-way shall be dedicated by recorded easement to the City of San Jose.

b. A concrete release channel with maintenance access shall be designed and constructed to convey the volume of water equal to the difference between the 10 year (underground) and the 100 year (overland).

c. One-half foot minimum freeboard to the floor (including garage) of any residential structure shall be maintained.

d. The energy grade line (EGL) for the flow shall not rise above any floor of any structure.

3.06.08 The following criteria apply to all releases and drainage facilities:

a. When natural flow remains natural and continues along its natural historic course, concrete ditches and easements will not be required unless they are associated with a specific channel improvement.

b. Whenever the nature of the natural drainage is altered with respect to location, quality, quantity, frequency, or any factor due to development, recorded easements or recorded agreements shall be obtained from all affected downstream properties prior to plan approval.

3.06.09 Complete calculations shall be provided for all channel designs. As a minimum the following factors shall be included:

a. Water shed map together with run-off calculations.
b. Channel capacity including run-up at bends.
c. Depth of flow and freeboard.
d. HGL and EGL at structures, confluences, grates, etc.

3.07 Easements and Agreements:

3.07.01 Storm drain easements (S.D.E.) for public drains:

a. Width of the easement shall conform to diagram (appendix 3.10.07) in either of the following cases:

1) When the easement is dedicated and the pipe is not installed with the project.

2) When the length of the easement spans more than the depth of 2 residential lots.

b. For cases other than those listed under item "a", the minimum width may be 15 feet providing:

1) The reinforced concrete pipe is class 4 or higher.

2) The pipe used is one size larger than that required for all other considerations.

3) There are no manholes, and lateral taps.

4) The pipe has a straight-line alignment.

5) The trench material is backfilled with Control Density Fill up to the pad grade.

3.07.02 Public easements shall be located within one property. Width shall be determined by chart (see Appendix 3.10.07).

3.07.03 Parcels may share drainage and release by recorded agreement or easement only.

3.07.04 Release from an adjacent parcel or public right-of-way must not be blocked. Easements or agreements shall be granted.

3.07.05 Release onto private property will require recorded agreement or easement.

3.07.06 When a storm drainage system (pipe, ditch, pump, etc.) is to be placed in a location other than a public street and is intended to serve private properties only, the system shall be designated as private on plans, and private easements shall be shown on the record map or recorded separately.

3.07.07 Manholes and structures located within easements shall be provided with all-weather access to accommodate maintenance vehicles and equipment.

3.08 Information Shown on Plans

3.08.01 A list of all City file numbers for all "City References" shall appear on all plans.

3.08.02 All calculations must be signed and sealed by a registered Civil Engineer, copied in microfilmable format onto a standard size plan sheet with project title block, and attached to the final plans.

3.08.03 "Drainage arrows" shall be used on plans only as a visual aid, and not as a substitution for elevations and cross sections.

3.08.04 All plans must clearly differentiate between existing and proposed features.

3.08.05 All water district, County, etc., permit numbers and dates shall appear on the final signed plans.

3.08.06 All easements and agreements shall be recorded. Book and page numbers shall appear on the final signed plans.

3.08.07 Controlling release point(s), whether on- or off-site, shall be shown on the plan.

3.08.08 All overland drainage and release features shall be shown.

3.09 Special Flood Hazard Areas

*The City of San Jose participates in the National Flood Insurance Program (NFIP). This enables the citizens of San Jose to purchase affordable flood insurance for protection against losses from flooding. San Jose is able to participate in the NFIP because it enforces the City of San Jose Special Flood Area regulations and the Federal Emergency Management Agency (FEMA) flood regulations.*

3.09.01 Any new construction or substantial improvements of buildings within the Special Flood Hazard Area shall comply with the City of San Jose Special Flood Hazard Area Regulations and Federal Emergency Management Agency (FEMA) flood regulations.

3.09.02 Complete flood information shall be supplied to the City Director of Public Works and the City Building Official.

3.09.03 No plan showing grades, elevations, structure location, improvements to a structure, or structure elevation in a Special Flood Hazard Area shall be approved prior to the City's determination that all flood requirements have been met. Elevations are to be based on the National Geodetic Vertical Datum (NGVD).

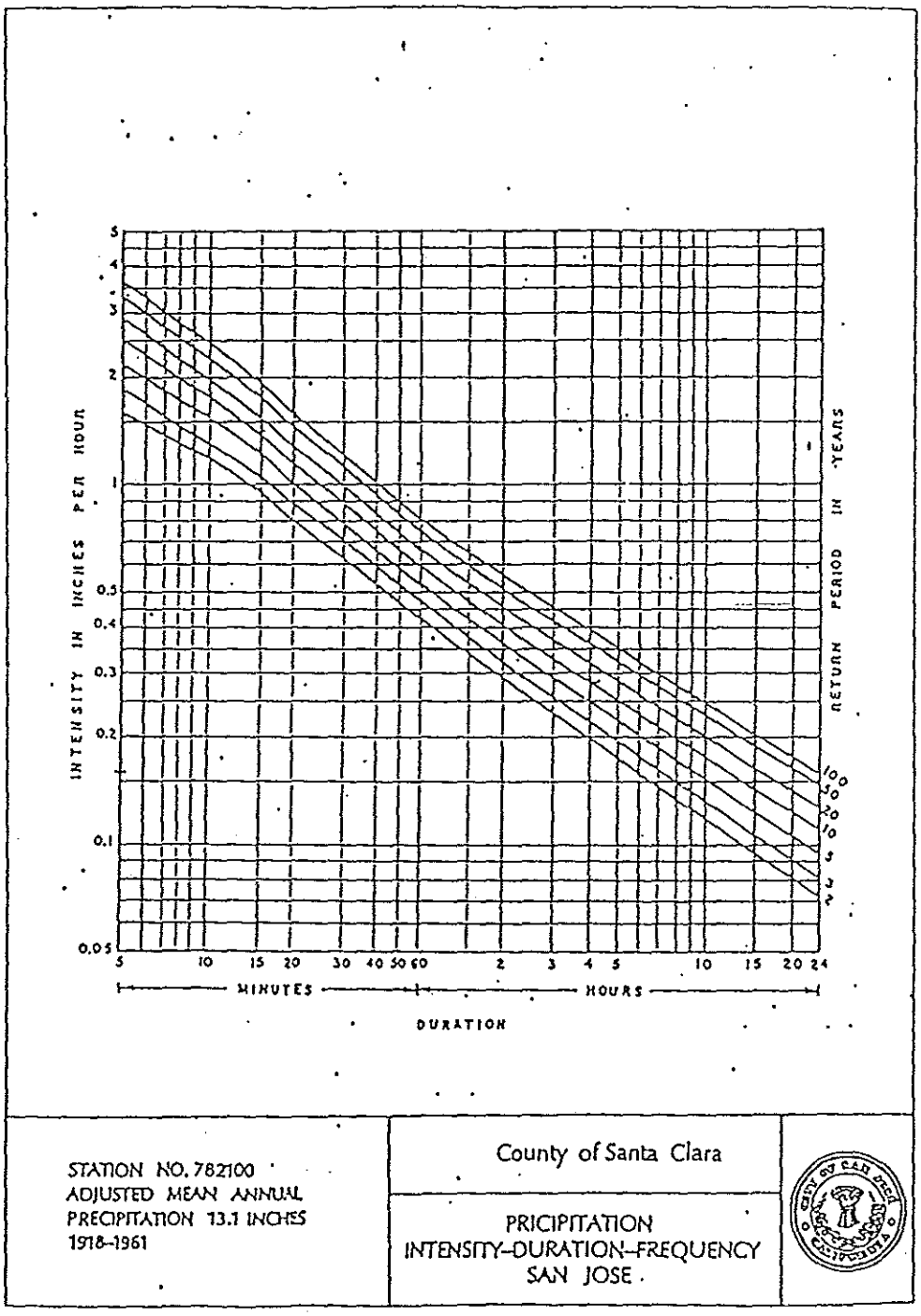
3.09.04 The City of San Jose Flood Plain Manager shall be contacted for flood related requirements.

3.10 Appendices. The following is a listing of the Appendices that apply to Section 3:

3.10.01 Intensity-Duration-Frequency (IDF) Curves
3.10.02 Mean Annual Precipitation (MAP) Map
3.10.03 Run-off Coefficients for Agricultural and Open Areas
3.10.04 Large Hooded Inlet
3.10.05 GOL Inlet
3.10.06 Slant Grate Inlet
3.10.07 Width of Storm Drain Easement

APPENDIX 3.10.01

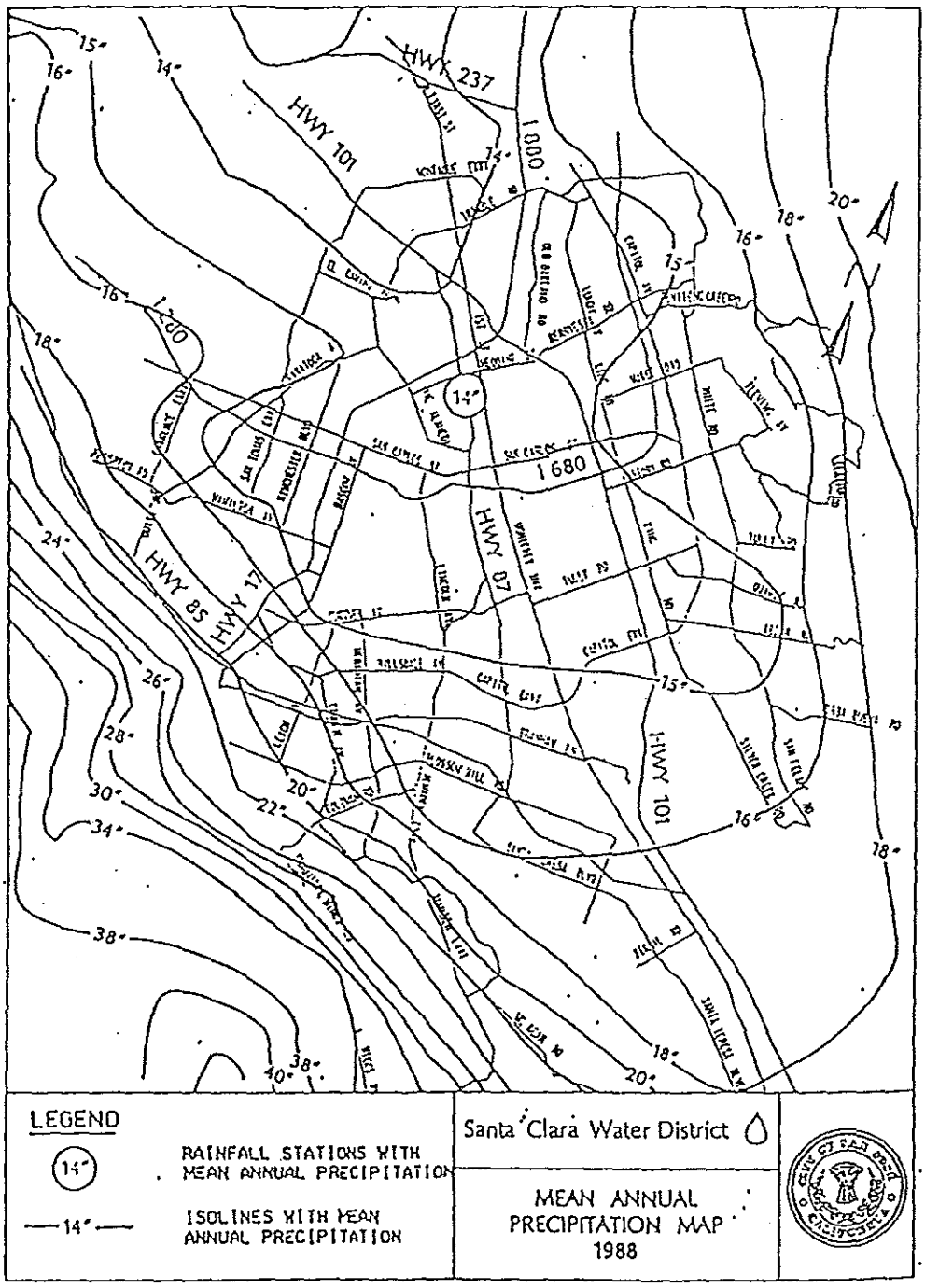
INTENSITY-DURATION-FREQUENCY (IDF) CURVES



Part III

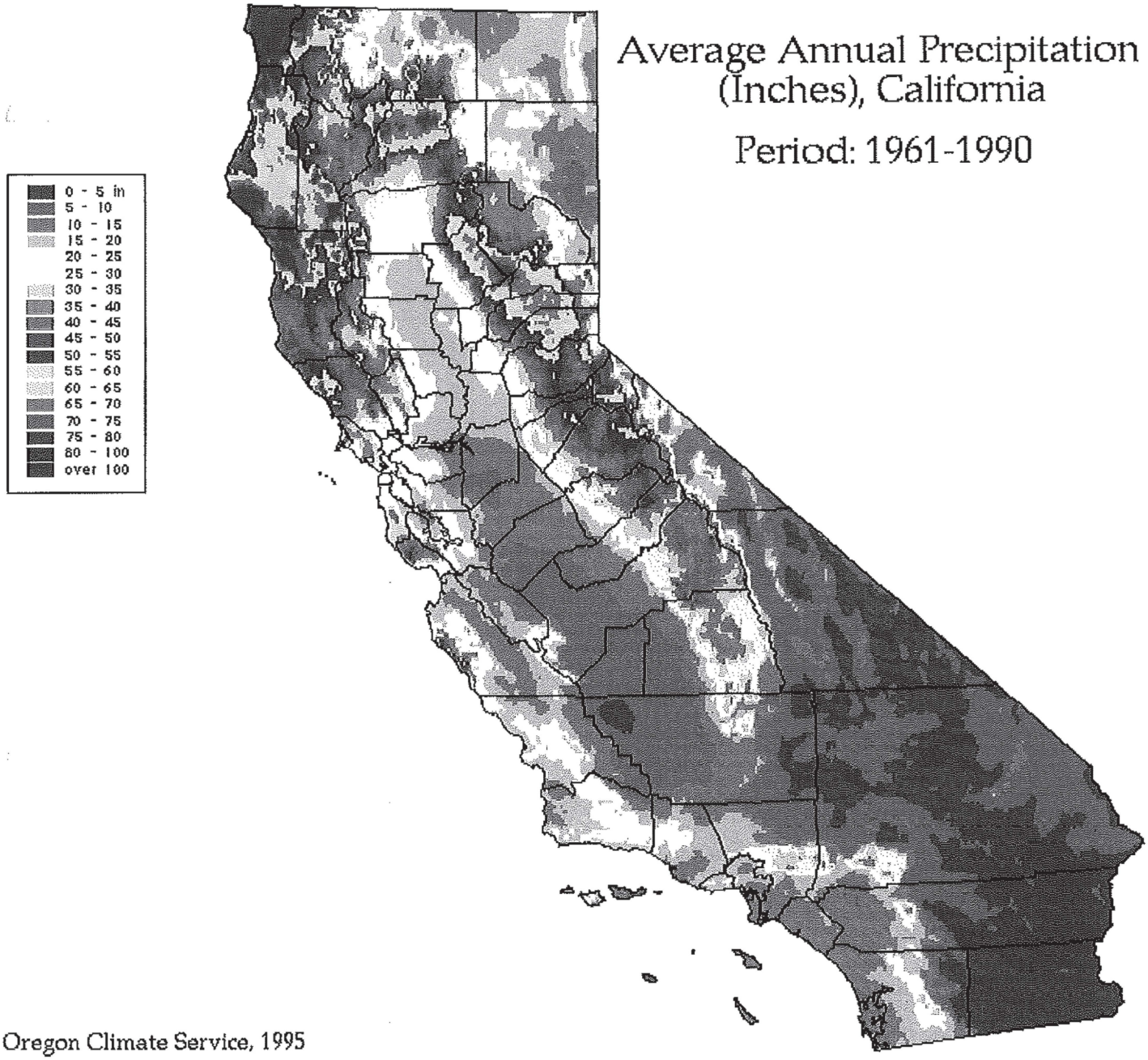
APPENDIX 3.10.02

MEAN ANNUAL PRECIPITATION (MAP) MAP



# Average Annual Precipitation (Inches), California

## Period: 1961-1990




Oregon Climate Service, 1995

APPENDIX 3.10.03

# RUN-OFF COEFFICIENTS FOR AGRICULTURAL AND OPEN AREAS

| RUNOFF PRODUCING CHARACTERISTICS | WATERSHED CHARACTERISTICS | | | |
|---|---|---|---|---|
| | A<br>RELIEF | B<br>SOIL INFILTRATION | C<br>VEGETAL COVER | D<br>SURFACE STORAGE |
| EXTREME | 0.40<br>STEEP RUGGED TERRAIN AVERAGE SLOPES GREATER THAN 30% | 0.20<br>NO EFFECTIVE SOIL COVER; EITHER ROCK OR THIN SOIL MANTLE NEGLIGIBLE INFILTRATION CAPACITY | 0.20<br>NO EFFECTIVE PLANT COVER; BARE OR VERY SPARSE SOIL COVER | 0.20<br>NEGLIGIBLE; SURFACE DEPRESSION FEW AND SHALLOW; DRAINAGE WAYS STEEP AND SMALL, NO PONDS OR MARSHES |
| HIGH | 0.30<br>HILLY WITH AVERAGE SLOPES OF 10 TO 30% | 0.15<br>SLOW TO TAKE UP WATER; CLAY OR OTHER SOIL OF LOW INFILTRATION CAPACITY SUCH AS HEAVY CUMBO | 0.15<br>POOR TO FAIR; CLEAN CULTIVATED CROPS OR POOR NATURAL COVER; LESS THAN 10% OF AREA UNDER GOOD COVER | 0.15<br>LOW; WELL DEFINED SYSTEM OF SMALL DRAINAGE WAYS; NO PONDS OR MARSHES |
| NORMAL | 0.20<br>ROLLING WITH AVERAGE SLOPES OF 5 TO 10% | 0.10<br>NORMAL, DEEP LOAM | 0.10<br>FAIR TO GOOD; ABOUT 50% OF AREA IN GOOD GRASS LAND, WOODLAND OR EQUIVALENT | 0.10<br>NORMAL; CONSIDERABLE SURFACE DEPRESSION STORAGE; TYPICAL OF PRAIRIE LANDS; LAKES, PONDS AND MARSHES LESS THAN 20% OF AREA |
| LOW | 0.10<br>RELATIVELY FLAT LAND AVERAGE SLOPES OF 0 TO 5% | 0.05<br>HIGH; DEEP SAND OR OTHER SOIL THAT TAKES UP WATER READILY AND RAPIDLY | 0.05<br>GOOD TO EXCELLENT; ABOUT 90% OF AREA IN GOOD GRASS LAND, WOODLAND OR EQUIVALENT COVER | 0.05<br>HIGH; SURFACE DEPRESSION STORAGE HIGH; DRAINAGE SYSTEM NOT SHARPLY DEFINED, I.E. FLOOD PLAIN STORAGE; LARGE NUMBER OF PONDS AND MARSHES |

NOTE: 1. Runoff coefficient is equal to sum of coefficients from the appropriate block in Rows A, B, C and D.

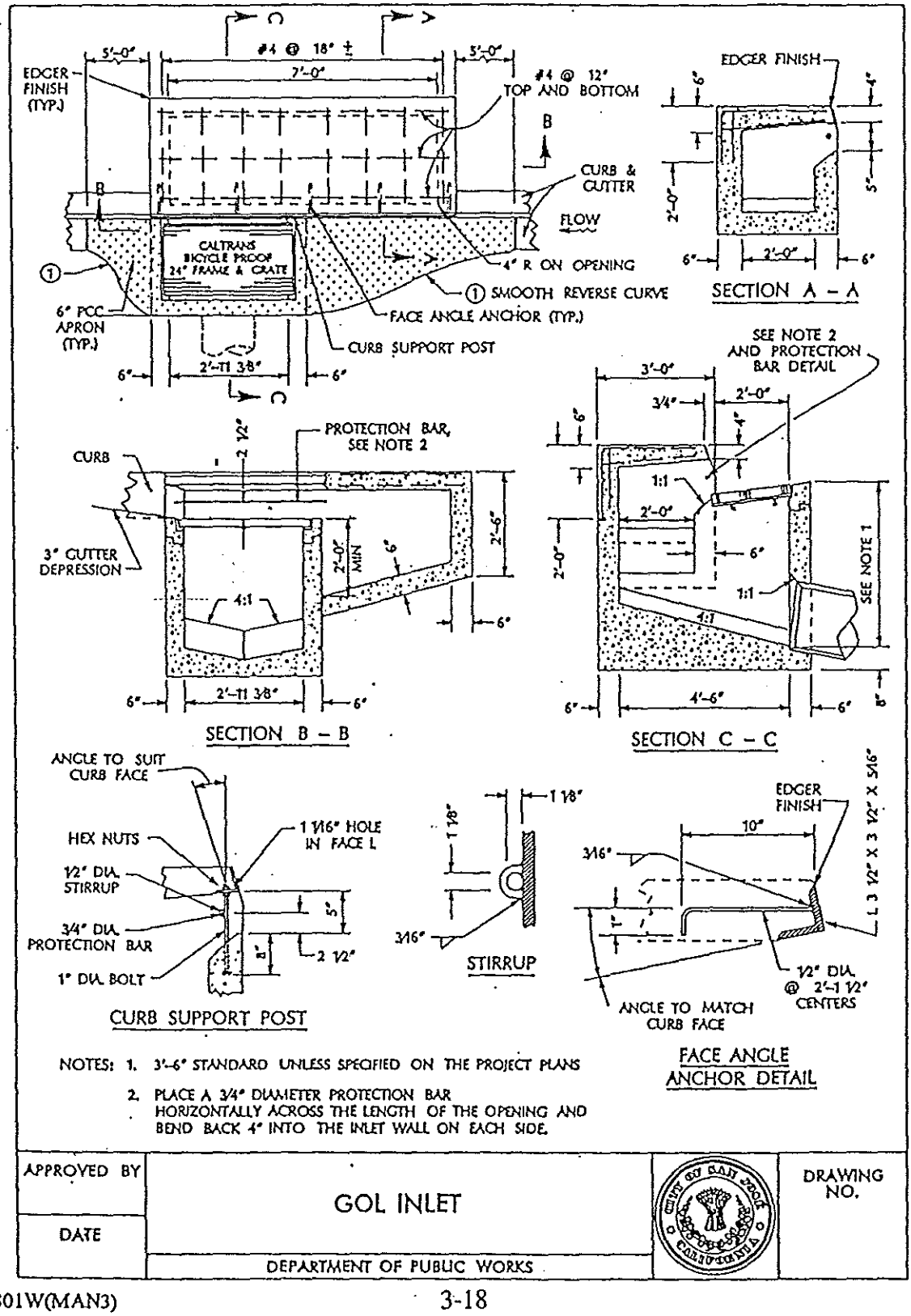
2. Table as published in Engineering for Agricultural Drainage, by Harry B. Roe and Quincy C. Ayres, McGraw-Hill Book Co., Inc., New York, 1954, p. 105.

County of Santa Clara

RUNOFF COEFFICIENTS FOR AGRICULTURAL AND OPEN AREAS

APPENDIX 3.10.05

# G O L INLET




NOTES: 1. 3'-6" STANDARD UNLESS SPECIFIED ON THE PROJECT PLANS

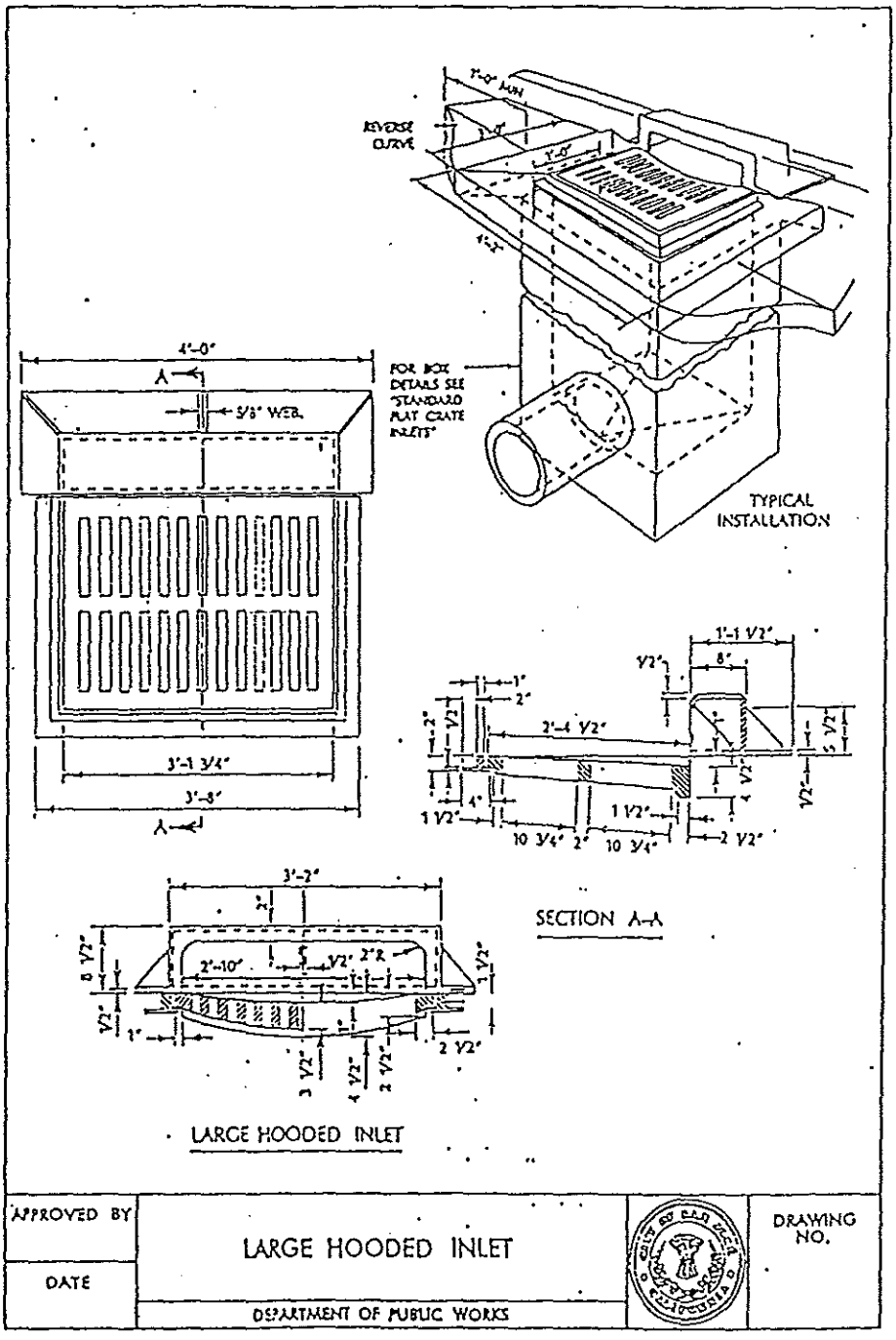
2. PLACE A 3/4" DIAMETER PROTECTION BAR HORIZONTALLY ACROSS THE LENGTH OF THE OPENING AND BEND BACK 4" INTO THE INLET WALL ON EACH SIDE.

| | | |
|---|---|---|
| APPROVED BY | GOL INLET | DRAWING NO. |
| DATE | DEPARTMENT OF PUBLIC WORKS | |

Part III

APPENDIX 3.10.04

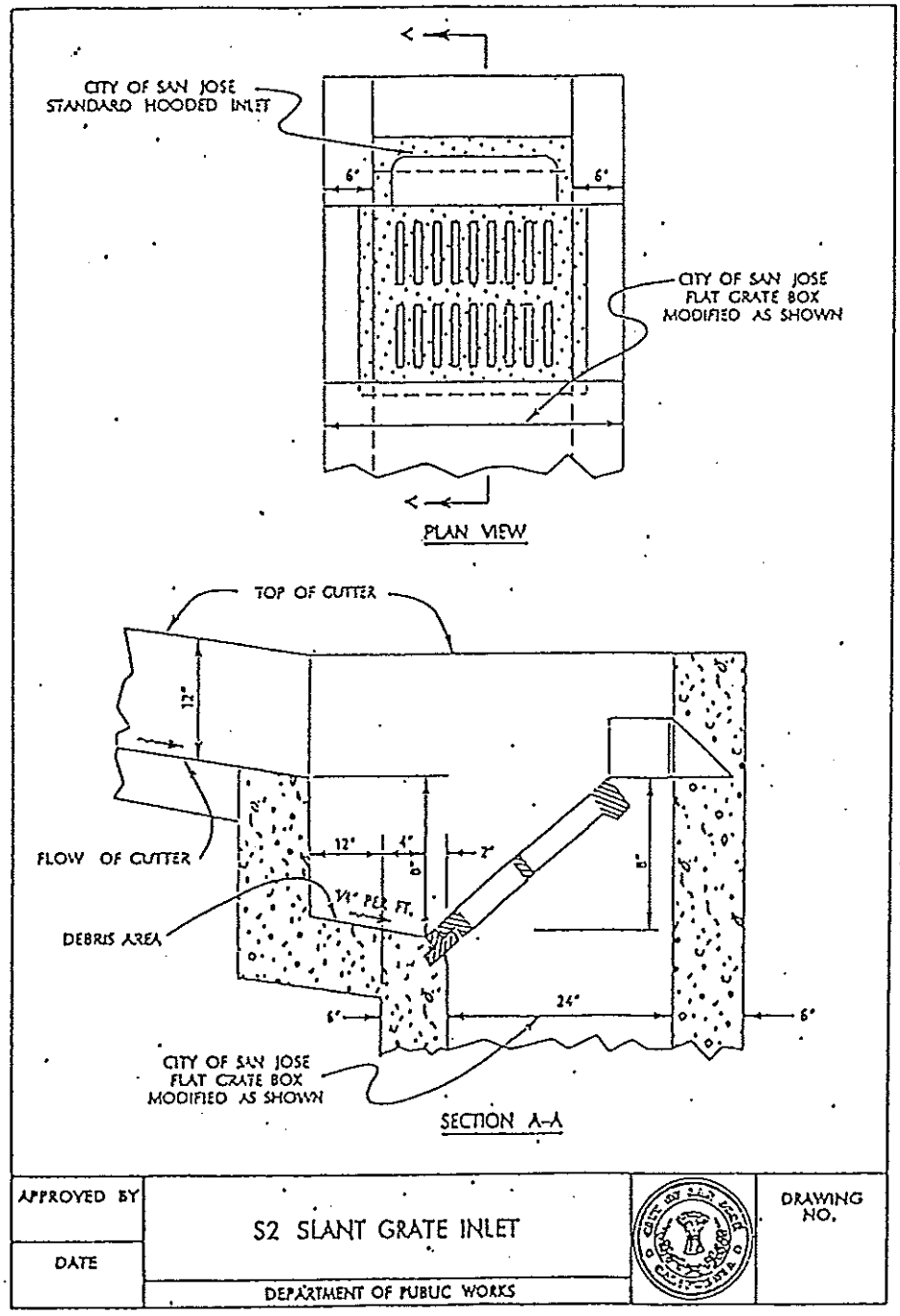
# LARGE HOOD INLET

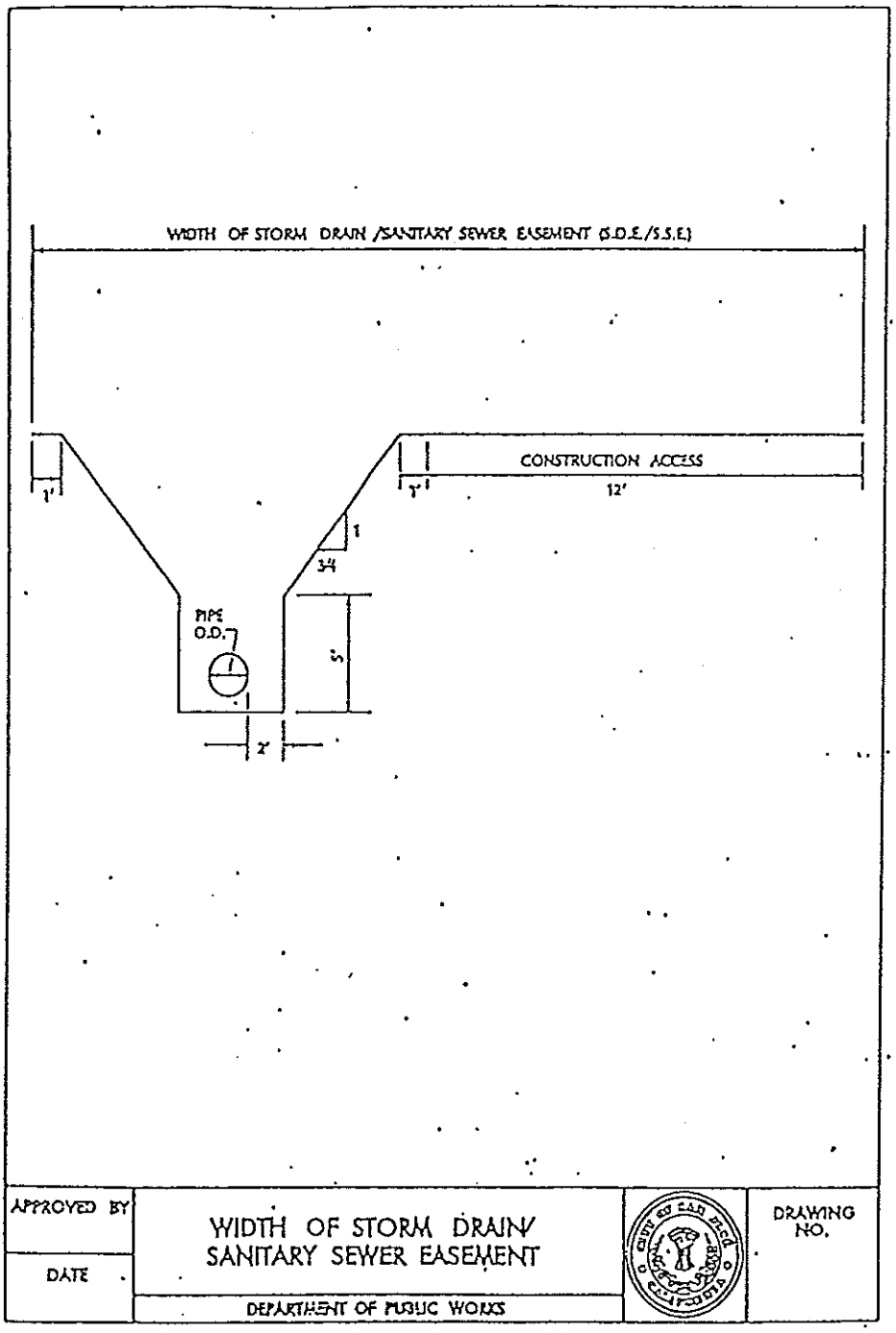


Part III

APPENDIX 3.10.06

## S2 SLANT GRATE INLET



APPENDIX 3.10.07

## WIDTH OF STORM DRAIN EASEMENT