

# **Appendix C**

City of Benicia Design Standards

**CITY OF BENICIA**

**PUBLIC WORKS DEPARTMENT**

**ENGINEERING DESIGN STANDARDS**

**AND STANDARD PLANS**

Sections 1, 2, 5

December 1992

**CITY OF BENICIA**  
**ENGINEERING DESIGN STANDARDS**

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Revised: April, 1992

**CITY OF BENICIA  
ENGINEERING DESIGN STANDARDS**

**SECTION 1**

**GENERAL**

**1.01 PURPOSE:**

The purpose of these standards is to provide certain minimum standards for the design, construction, repair, and alteration of public works facilities and all appurtenances thereto, within the City limits.

**1.01 DEFINITIONS:**

- A. CITY shall mean the City of Benicia, California.
- B. CITY ENGINEER shall mean the City Engineer of the City of Benicia, California.
- C. CONSULTING ENGINEER shall mean any person or persons, firm, partnership, or corporation legally authorized to practice civil engineering within the State of California who prepares and submits for approval improvement plans and specifications to the Department of Public Works of the City of Benicia.
- D. DESIGN shall mean alignment, grade, size and other details of construction for the sanitary sewer, water, and storm drainage systems, roadway and other miscellaneous improvements as required by the City Engineer.
- E. DEVELOPER shall mean any person, firm, corporation, partnership, or association engaged in the development of real property, in part or in whole, by the construction of improvements thereon.
- F. EASEMENT shall mean an easement dedicated to the City, or public utility which shall be continuing and irrevocable unless formally abandoned.
- G. ENCROACHMENT PERMIT shall mean the permit issued by the Public Works Department to all persons firms, corporations, partnerships, or associations proposing to construct improvements or do any work within the public right-of-way.

- H. IMPROVEMENTS refer to street work, sidewalks, curbs, gutters, driveways, water mains, sanitary sewers, storm drainage, public utilities, landscaping, and fences to be installed by the developer on land to be used for a public right-of-way.
- I. SOILS REPORT shall mean a report as prepared by any person or person, firm, partnership, or corporation legally licensed to prepare soils reports in the State of California.
- J. STANDARD PLANS AND SPECIFICATIONS shall mean the standard plans and specifications of the City of Benicia.
- K. SUBDIVISION ORDINANCE shall mean Title 16 of the Benicia Municipal Code.
- L. ZONING ORDINANCE shall mean Title 17 of the Benicia Municipal Code.

## SECTION 2

### IMPROVEMENT PLANS

#### 2.01 GENERAL

Complete plans and specifications for all proposed improvements, including any necessary easements, rights-of-entry, and/or dedications shall be submitted to the Public Works Department for review and must receive the required approvals prior to the start of construction. All plans shall be prepared by or under the direct supervision of a registered civil engineer in accordance with the provisions of Chapter 7 - Division 3 of the Business and Professions Code, the "Civil Engineer's Act".

#### 2.02 FORMAT

Improvement plans and specifications shall be prepared in accordance with the following requirements:

- A. **Dimensions:** Improvement plans shall be clearly and legibly drawn on sheets 24 by 36 inches in size with a 1 1/2 inch clear margin on the left edge and a minimum 1/2 inch margin on all other edges.
- B. **Scale:** Horizontal scale shall be 1 inch equal to 40 feet; vertical scale shall be 1 inch equal to 4 feet; or as approved by the City Engineer prior to submittal.
- C. **Content:**
  - 1. **Title Sheet.**
    - a. Plan view showing the entire street right-of-way layout at a scale of 1 inch equal to 100 feet, the proposed water and sewer mains, the storm drainage system, lot numbers and other miscellaneous improvements to be installed.
    - b. Index of sheets.
    - c. Complete legend.
    - d. Typical street sections(s).
    - e. Vicinity map.
    - f. Assesors Parcel Number and street address.
    - g. Title block located in the lower right-hand corner or the right edge of the sheet.
    - h. Full description of temporary and permanent benchmarks.
    - i. General and special notes relating to the construction.

- j. Signature blocks for the Design Engineer, the City Engineer and the Fire Chief.
- k. For grading plans, include additional signature blocks for Soils Engineer and Planning Director.
- l. For landscape/irrigation plans, include additional signature blocks for Planning Director and Director of Parks/Community Services.
- m. State of California registration seal, registration expiration date and signature of the design engineer on all sheets.

2. Street Plan and Profile Sheets.

- a. The plan view of each street to be improved shall be shown on separate sheets indicating existing improvements, proposed improvements and future improvements if known. Proposed improvements shall include sidewalk, curb, gutter, driveways, sewer mains and lateral locations, water mains and water service locations, storm drains, catch basins, manholes, valves, fire hydrants, fencing, barricades, monuments, lot lines, survey stationing and other data as required by the City Engineer. The survey stationing shall normally read from left to right with the north arrow pointing either to the top or left edge of the sheet. All stationing shall be a continuation of existing improvements where possible.
- b. When conforming to existing pavement, curb and gutter, or other facilities, detailed location and elevation information shall be provided on the improvement plans. Existing edge of pavement and street centerline shall be shown at 25 foot intervals for the length of the project and at least 100 feet beyond. Cross-sections at the same 25 foot intervals shall be accurately drawn to show the conform paving, indicating that the resultant cross-slope is no flatter than two percent (0.02) and no steeper than five percent (0.05). The cross-sections shall be drawn at a scale sufficiently large to clearly show the proposed conform work.
- c. A profile view of each street shall be shown immediately below or above its plan view. The profile shall include existing grade lines, sewer mains, storm drains, water mains, public utility mains, all utility crossings, and top of curb. Elevations shall be shown

for the top of curb at grade break points, at each full station, at 25 foot intervals through vertical curves, at manhole and catch basin inverts and rims, and at water main crossings with other utilities.

3. Site Development Plan (For On-site Development). The site development plan shall include building pad, floor and garage elevations, individual lot drainage patterns, adjacent land drainage, driveway locations, fencing, existing contours, existing trees, wells, ditches and other landmarks important to the construction of the improvements.
4. Small projects may involve a combination of the above sheets.
5. Due to the fact that all plans are planned to be microfilmed, all lettering shall have a minimum height of 1/8".

### 2.03 GENERAL NOTES

The following general notes as a minimum shall be included on plans, as applicable:

- A. All work is to be done in accordance with the standard plans and specifications of the City of Benicia, which are hereby incorporated into these plans.
- B. At least 48 hours notice to the Public Works Department is required for a pre-construction meeting prior to the start of construction. Phone (707) 746-4240.
- C. All revisions to these plans must be approved by the City Engineer prior to their construction, and shall be accurately shown on record drawings prior to the acceptance of the work as complete.
- D. An encroachment permit is required for all work within the public right-of-way and must be secured prior to the start of any work.
- E. The contractor shall notify Underground Service Alert at (800) 642-2444 at least 48 hours prior to the start of work to verify the location of existing underground utilities. The utilities shown on the plans are based upon record information, however the engineer assumes no responsibility for their accuracy or actual locations.

- F. The contractor shall leave a 24-hour emergency telephone number with the Police, Fire and Public Works Departments, and keep them informed daily of any detours.
- G. The contractor shall abide by the rules and regulations of the State of California Construction Safety Orders pertaining to excavations and trenches. A copy of the Construction Safety Orders is available in the Public Works Department for inspection.
- H. Public safety and traffic control shall be provided in accordance with the "WATCH" manual and as directed by the City Engineer.
- I. The contractor shall give at least 24 hours notice to the City Maintenance Superintendent prior to connecting to existing water facilities. At all times, the manipulation of existing valves shall be done under the direction of water division personnel.
- J. All underground utilities shall be completed prior to the placement of base rock unless otherwise approved by the City Engineer.
- K. Existing curb, gutter, sidewalk, survey monuments, and other public improvements within project site that are damaged or displaced shall be replaced at the contractors expense even if damage or displacement was not caused by actual work performed by the contractor.
- L. When the lowest finished floor level of a house is 12 inches or less above the top elevation of the nearest upstream sanitary sewer structure there shall be a backwater overflow device or check valve installed on the sewer lateral next to the cleanout.
- M. If paving and storm drain improvements are not completed by October 15, temporary silt and erosion control facilities shall be installed to control and contain silt deposits and to provide for the safe discharge of storm waters into existing storm drainage facilities. Design of the silt and erosion control facilities must be approved prior to their construction.
- N. All traffic signs and street name signs shall be high reflective grade and conform to CalTrans specifications and City standard ST-15.
- O. Approval of these plans by the City Engineer does not relieve the developer or his engineer from the responsibility for the design of the improvements and any deficiencies resulting from the design thereof.

- P. All City standard details referenced in these plans shall be the current version available from the Public Works Department.
- Q. The services of a registered civil engineer shall be retained to establish all lines, levels, grades and locations of all improvements; to verify the proper installation of all improvements; and to submit record drawings indicating all final improvements, with approved revisions, were accurately installed.
- R. Cut sheets shall be submitted to the City 48 hours prior to the start of construction of an improvement requiring them.
- S. The contractor shall perform the necessary tests in accordance with the City standards on newly installed storm drains, sewer, and water systems only after trenches are backfilled and street base is in place, compacted and ready for asphalt paving.
- T. The contractor shall adjust to final grade all manholes, valve and monument covers within the work area unless noted otherwise.
- U. The contractor shall place a "S" (for sewer) and a "W" (for water) in the wet concrete curb top at all new lateral locations.
- V. The contractor shall be responsible for contacting appropriate utilities and requesting verification of service points, field verification of location, size, depth, etc. for all their facilities and to coordinate work schedules.

#### **2.04 SUBMISSION AND CITY APPROVAL**

- A. Improvement plans shall be submitted in triplicate along with 2 copies of the subdivision final map (if applicable) to the City Engineer for checking to insure compliance with these standards, City of Benicia ordinances, and good engineering practice. Submittal shall include specifications, supporting calculations, lot closures, easement and right-of-way descriptions, rights-of-entry, and/or other materials as requested by the City Engineer.
- B. Plans shall not be considered as approved until both the City Engineer and the Fire Chief (and the Soils Engineer and City Planning Department for grading plans) have signed the plans in the approval block on the plans. No

changes shall be permitted to an approved set of plans unless such changes are first approved by the City Engineer as described above. Excepted from approval are any features of the plans that are contrary to, in conflict with, or do not conform to any California State Law, City of Benicia Ordinance or Resolution, or generally accepted good engineering practice, in keeping with the standards of the profession, even though such errors, omissions or conflicts may have been overlooked in the Department of Public Works review of plans.

- C. After formal approval of the improvement plans by the City Engineer has been received, 3 blueprint copies of the plans shall be forwarded to the Public Works Department. If additional copies of the improvement plans are requested by the City Engineer, they shall be furnished to the City. Prior to acceptance of the improvements by the City, the consulting engineer shall furnish to the City a full set of photo mylar copies (minimum of 3 mils thick) of the record "as built" drawings of the improvements to include all revisions.

## 2.05 IMPROVEMENT PLAN CHECKLIST

### A. General

1. Is all existing information shown in sufficient detail?
2. Are the plan sheets 24" x 36"?
3. Is there a 1 1/2 inch margin on the left edge and at least 1/2 inch margins on the other sides?
4. Is the horizontal scale one inch equal to 40 feet; the vertical scale one inch equal to 4 feet? Has approval been given for other scales?
5. Is the lettering at least 1/8 inch?
6. Did the design engineer stamp and sign each sheet?

### B. Title Sheet

1. Is the 100 scale system map shown?
2. Is there an index of plan sheets?
3. Is there a complete legend?
4. Are typical street sections shown?
5. Is the vicinity map shown?
6. Is the title block in the lower right-hand corner?
7. Is the benchmark described?
8. Are there general and special construction notes?
9. Do the plans have the signature and seal of the design engineer?
10. Are approval blocks provided for both the City Engineer and the Fire Chief?

11. Are additional approval blocks provided for the Soils Engineer and the City Planning Department on grading plans?
12. Are the APN and address shown?

C. **Plans and Profile Sheets**

1. Are the existing improvements accurately shown, and in sufficient detail?
2. Are planned improvements compatible, and shown in sufficient details?
3. Is the horizontal scale one inch equal to 40 feet, and the vertical scale one inch equal to 4 feet?
4. **Street Design:**
  - a. Are street widths and geometrics appropriate for the class of street?
  - b. Are street intersections at an angle of at least 70 degrees, and separated by at least 200 feet?
  - c. Are street grades between one-half percent and sixteen percent?
  - d. Has a two percent cross-slope been shown for all roads?
  - e. For grade differences greater than two percent are vertical curve lengths in conformance with the CalTrans Highway Design Manual , and at least 50 feet in length?
  - f. For conform pavements, does the pavement section match the existing?
  - g. For new streets is the pavement section shown to be based on R-value tests?
  - h. Is the minimum pavement section 3 inches of asphalt concrete on 6 inches of class 2 aggregate base?
  - i. Are the sidewalks shown of the proper width?
  - j. Are handicap ramps shown at each intersection curb return?
  - k. When required are redwood headerboards at least 2 inches by 8 inches?
  - l. Are street monuments located properly?
  - m. Are street signs and pavement markings of the proper material and adequate?

5. **Storm Drainage:**

- a. Are the supporting calculations in accordance with the County of Solano Hydrology and Drainage Design Procedure?
- b. Is the minimum freeboard of 1.0 foot maintained at all structures?
- c. Does gutter flow meet the maximum requirements?
- d. Are pipe types specified?

- e. Are minimum cover and clearance requirements satisfied?
- f. Is the minimum public storm drain pipe 15 inches in diameter?
- g. Are alignment criteria met?
- h. Do pipe crowns match within a structure?
- i. Is a 0.2 foot drop provided within any structure where the pipe deflection is 45 degrees or greater?
- j. Is the hydraulic grade line shown and labeled on the profile at each structure?
- k. Are easements of the proper width provided where necessary?

6. **Sanitary Sewer:**

- a. Is the minimum extendable main size 8 inches in diameter?
- b. Are laterals shown and sized properly?
- c. Are easements of the proper width provided where necessary?
- d. Are mains located 5 feet south and/or east of the street centerline, and separated by at least 5 feet from other parallel utility mains?
- e. Is the minimum slope three-quarters of one percent?
- f. Are cover requirements met?
- g. Are crossing clearance requirements satisfied?
- h. Is there no more than 45 degrees total deflection between structures?
- i. Are there no reverse curves?
- j. Are laterals stationed on the plan view?
- k. Is the maximum spacing between manholes 300 feet?
- l. Is the proper drop provided in manholes?
- m. Are there no more than 5 laterals between a rodding inlet and the next downstream manhole?

7. **Water System:**

- a. Is the system shown looped?
- b. Are mains located 10 feet north and/or west of the street centerline?
- c. Is the water main shown on the profile?
- d. Is the vertical clearance at crossings with other utilities adequate?
- e. Is the minimum cover from subgrade 2 feet?
- f. Is the minimum main size 8 inches in diameter?
- g. Are service lines specified as Type K Copper?
- h. Are the valving requirements satisfied?

8. **Street Lights:**

- a. Is the street lighting system shown on the improvement plans?
- b. Are electrolier locations shown?
- c. Are luminaire intensities specified?
- d. Are luminaire mounting heights and mast arm lengths specified?
- e. Are pole and luminaire type specified?
- f. Is electrical service point shown and approved by PG & E?
- g. Are conduit runs and pullboxes shown?

9. **Grading Plans:**

- a. Do the grading plans conform with the requirements in the project soils report?
- b. Are the additional general notes for grading included?
- c. Are the existing improvements accurately shown, and in sufficient detail?
- d. Are the planned improvements compatible, and shown in sufficient detail?
- e. Do the plans have the signature and seal of the design engineer?
- f. Are approval blocks provided for the City Engineer, Fire Chief, City Planning Department and project Soils Engineer?
- g. Does design of improvements comply with Chapter 70 of the Uniform Building Code?

## SECTION 5

### SANITARY SEWER

#### 5.01 GENERAL

##### A. Line Size

1. The minimum main size shall be 8 inch diameter, except that a last length of main which cannot be extended in the future may be 6 inches in diameter.
2. The minimum side sewer (lateral) size shall be:
  - a. 4 inches in diameter for single family residential use.
  - b. 6 inches in diameter for multi-family residential, commercial, or industrial uses.

##### B. Easements/Location

1. All public sanitary sewer mains should be located within the road right-of-way, or if unavoidable, centered upon a dedicated easement.
2. Easements for sanitary sewers shall meet the following requirements:
  - a) For sewer mains less than 12 inches in diameter, the minimum easement width shall be 10 feet.
  - b) For sewer mains 12 inches in diameter and larger, the minimum easement width shall be 15 feet.

#### 5.02 DESIGN

##### A. Flow Computation

1. The design sanitary sewer flow shall be equal to the sum of two and one-half times the average flow and the infiltration flow.
  - a. The average flow for residential areas is based on the following assumptions:
    - 1) A single family dwelling is composed of 3.5 persons.
    - 2) An allowance of 100 gallons per person per day.
  - b. For commercial areas the average flow shall be 1800 gallons per acre per day.
  - c. Light industrial areas shall utilize an average flow of 1600 gallons per acre per day.
  - d. Heavy industrial areas require special design and will be considered on a case-by-case basis.

e. Infiltration rates shall conform to the following:

- 1) For new construction: 1000 gallons per acre per day.
  - 2) For existing sewers: 3000 gallons per acre per day.
2. Pipe capacities shall be computed utilizing Manning's formula with an "n" value of either 0.013 or the pipe manufacturer's recommendation, whichever is greater, for pipes flowing full.

**B. Mains**

1. In general, sanitary sewer mains will be located 5 feet south and/or east of street centerline.
2. Minimum slope for mains shall be three-quarters of one percent. Where possible, slope shall provide for a velocity of at least 2 feet per second.
3. Minimum depth for sewer mains shall be 4 feet of cover from top of pipe to subgrade. Ductile iron mains may have as little as 18 inches of cover from subgrade.
4. A minimum of 12 inches of vertical clearance shall be maintained in crossings with water mains, and at least 6 inches vertical clearance in crossings with other utilities.
5. At least 5 feet clearance shall separate sewer mains from other parallel utility main installations.
6. Horizontal and/or vertical curves are allowed between structures, provided that:
  - a. The total deflection does not exceed 45 degrees, and
  - b. The deflection at each joint does not exceed 80 percent of the manufacturer's published recommended allowable maximum.
  - c. Reverse curves are not allowed.

**C. Side Sewers (Laterals)** are those portions of the sewerage system between the sewer main and the right-of-way line. The limit of City maintenance responsibility is the right-of-way line and is denoted by a clean-out. In all cases the City maintained facilities will lie within the limits of either the street right-of-way or the easement sidelines.

1. All 4-inch diameter sewer laterals shall have a minimum slope of two percent (0.02).
2. All 6-inch diameter sewer laterals shall have a minimum slope of one percent (0.01).
3. In all new work, the sewer lateral shall be installed concurrently with the sewer main, and shall be drawn to scale and stationed on the plan view of the improvement plan.

4. The angle of intersection between the side sewer and the upstream main sewer shall 90 degrees.

D. **Appurtenances**

1. **Manholes**

- a. Manholes shall be provided at all junctures of mains and at all changes of direction and main line size, but in no case more than 300 feet from the downstream manhole.
  - b. Manholes which are not located at a change of direction or size shall have the main extended straight through. In other situations match crowns of pipes of different sizes or allow for a 0.1 foot drop through the manhole. Channels shall be formed in the bottom of the manhole to provide positive direction for low flows.
  - c. A drop of more than 2.0 feet from the invert of one line to another will not be allowed within a manhole. Drop manholes, if unavoidable, require special design and approval by the City Engineer.
2. A rodding inlet may be used for the end structure of a section of main serving no more than 5 laterals since the last manhole.
  3. Pressure systems (pumps) require prior approval of the City Engineer and will be allowed only if a gravity system is not feasible. The pressure systems will be private and therefore will not be maintained by the City.

E. **Pipe Materials**

Sewer pipe shall be one of the following types:

1. Polyvinyl Chloride (PVC), extra strength minimum of SDR=35.
2. Ductile Iron Pipe (DIP) class 50 wrapped with polyethylene tubing.
3. Other types of pipe may be used but only with prior approval of the City Engineer.

**5.03 INSTALLATION**

A. **Installation**

1. The trench shall be excavated to the lines and grades established by the Engineer.
2. All mains and laterals must receive City inspection after installation to verify proper placement. Contractor must receive authorization from the City Inspector before placement of backfill.
3. Trench backfilling, placement of aggregate base material, and compaction shall be done in conformance with City standard plan ST-7.

B. Testing

1. The following tests shall be performed by the contractor after the sewer system is installed, backfilled, and street base is in place, compacted and ready for paving:
  - a. Air pressure test - All new main lines with connecting laterals shall be tested in separate sections. The main and laterals shall be pressurized under 4.0 psi for a minimum of 4 minutes with a maximum allowable pressure drop of 0.5 psi. If pressure drops more than this amount, then repressurize to 3.5 psi and hold for an additional 4 minutes. Pressure must not drop below 3 psi at the end of this retest.
  - b. Hydrostatic test - All manholes and isolated laterals shall be tested by plugging at the main connection(s) and then filling structure or lateral with water, (laterals require a 4 foot head). The water shall stand for a 4 hour period without exceeding the allowable loss as determined by the City Engineer.
  - c. Mandrel test - All mains shall be cleaned and then mandrelled to measure for obstructions. A rigid mandrel with a circular cross section of at least 98% of the inside pipe diameter shall be pulled through the pipe by hand.
2. Upon failure of any test as determined by the City Engineer the contractor shall, at his expense, remedy the cause and retest that portion of the system. Retesting may require that additional inspection fees be paid to the City.
3. For large subdivisions and for installations that fail to receive proper City inspection or fail any test, the City Engineer may require that the sewer mains be inspected internally by TV equipment using VHS tape format.

# STANDARD PLANS CITY OF BENICIA, CALIFORNIA

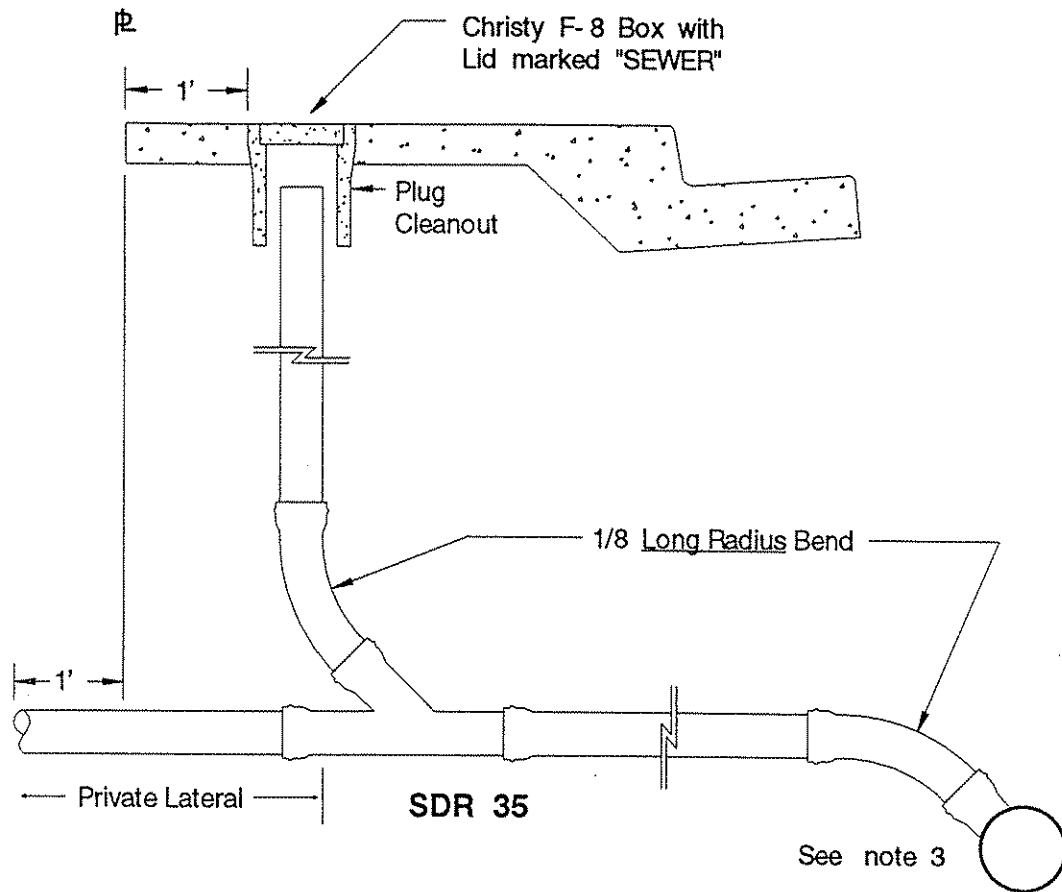
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**NOTES:**

1. Allowable minimum slopes for the following sewer lateral diameters: 4" - 2%, 6" - 1%, 8" - 0.5%.
2. Minimum cover shall be 30".
3. If the lateral is part of a main line construction use "wyes". If the lateral is to an existing main the connection shall be drill tapped.
4. In areas without sidewalk, the cleanout box shall be surrounded by a minimum of 12" of concrete.

**CITY OF BENICIA**

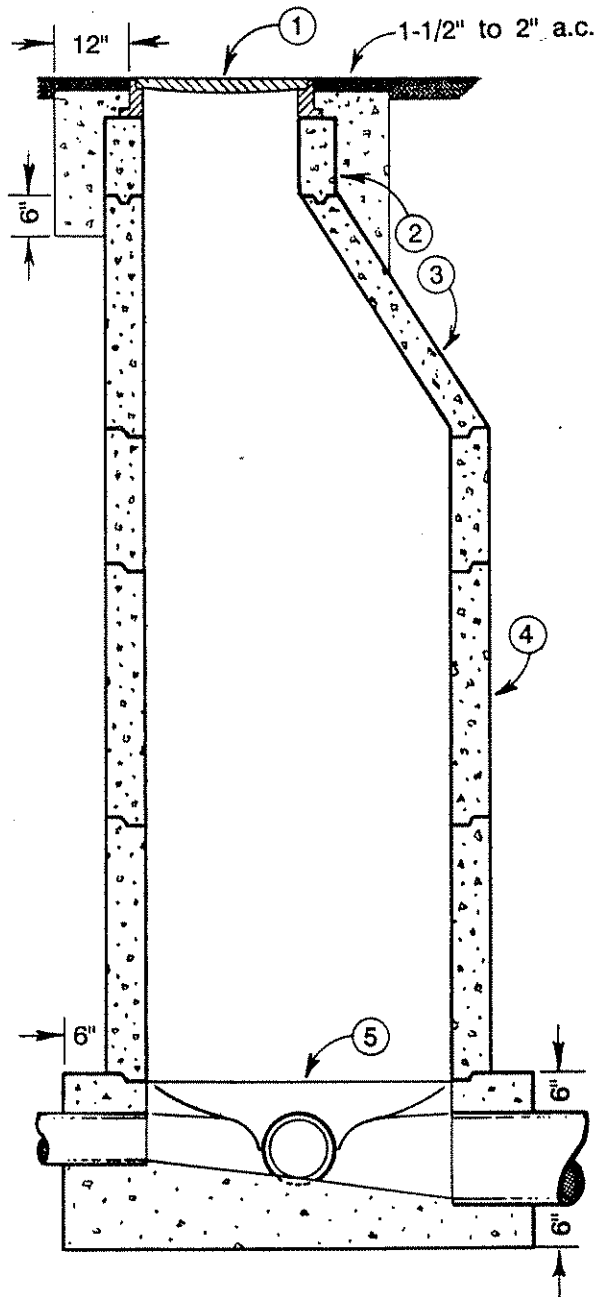
**DEPARTMENT OF  
PUBLIC WORKS**

**SEWER LATERAL**

*A.M. Bertolero*  
ANTOINETTE M. BERTOLERO, CITY ENGINEER

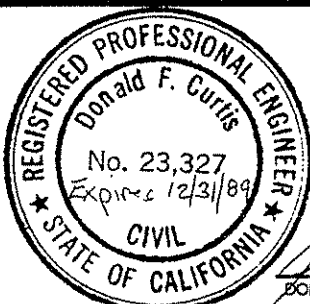
DATE: MARCH 1992  
REVISED:

**S - 1**



**NOTES:**

1. Manhole frame and cover to be D. & L. Supply A-1024 or an approved equal marked "Sanitary Sewer".
2. 24" diameter manhole rings, 12" maximum total height.
3. 24" to 48" eccentric manhole cone, 36" in height.
4. 48" diameter manhole barrel sections.
5. Form base to provide a smooth flow channel.
6. 1:3 grout mix or Ram-Nek joint compound to be used in all joints.
7. All concrete to be 560 - C - 3250.



**CITY OF BENICIA**

DEPARTMENT OF  
PUBLIC WORKS

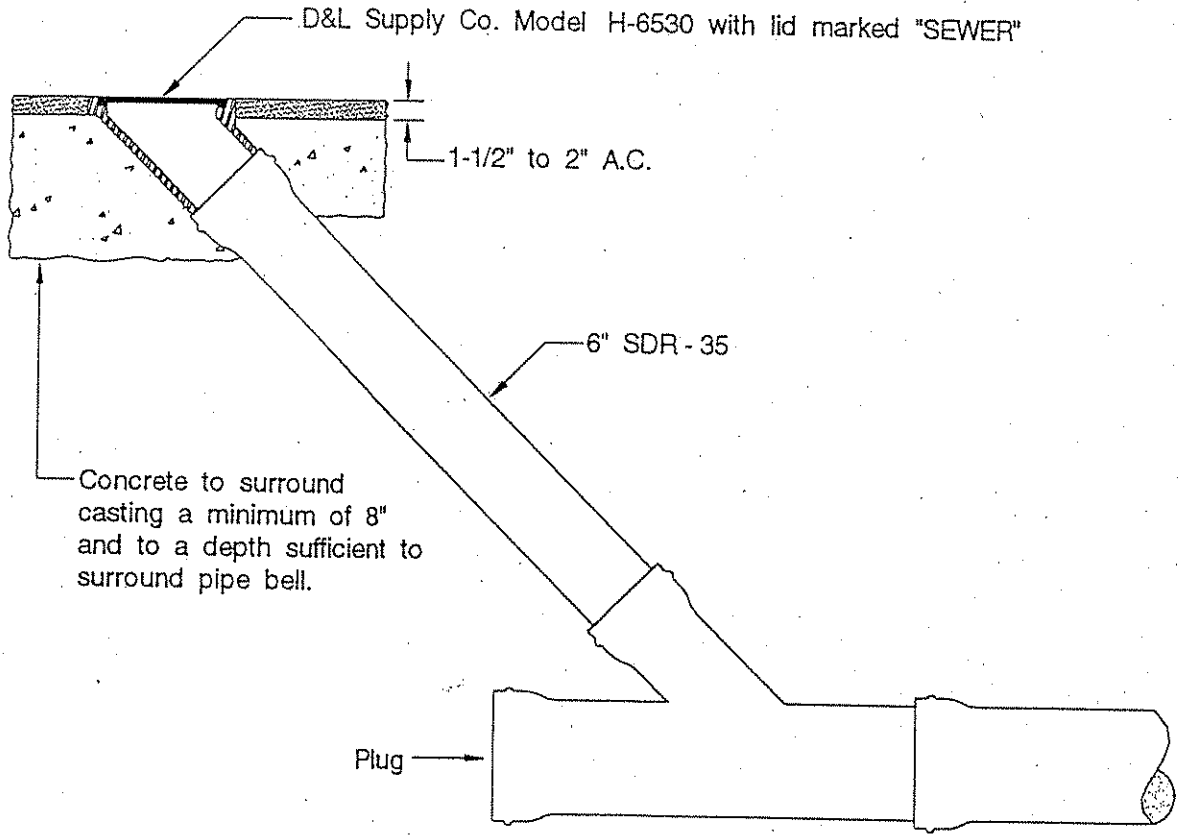
**SEWER MANHOLE**

*Donald F. Curtis*  
DONALD F. CURTIS CITY ENGINEER

DATE: SEPTEMBER 1988

REVISED: 4/92

**S - 2**



**CITY OF BENICIA**

DEPARTMENT OF  
PUBLIC WORKS

**RODDING INLET**

*A. M. Bertolero*  
ANTOINETTE M. BERTOLERO, CITY ENGINEER

DATE: MARCH 1992  
REVISED:

**S - 4**