COUNTY OF VENTURA

PUBLIC WORKS AGENCY

SEWERAGE MANUAL

APPROVED BY THE BOARD OF SUPERVISORS
(Dates as shown on Revision Sheets)

COUNTY OF VENTURA

GUIDE TO ENGINEERS, DEVELOPERS AND CONTRACTORS

The following publications have been adopted by the County for regulating the design and construction of public improvements constructed by developers; work performed under County or Watershed Protection District permits; land grading; water systems; and sanitary sewer systems:

1. Ventura County Road Standards (RdStd)
2. Ventura County Water Works Manual and Sewerage Manual (VCWWM & VCSM).
3. Standard Specifications for Public Works Construction (SSPWC).
4. Standard Land Development Specifications (SLDS) which adopt, supplement and modify SSPWC.
5. Ventura County Water Works Districts Nos. 1, 16, 17, and 19; Ventura County Service Areas 3, 4, 14, 29 and 30; and Lake Sherwood Community Services District Rules and Regulations (R&R).
6. Standard Plans for Public Works Construction (SPPWC).
7. State Standard Plans from CALTRANS (SSP).
8. Land Development Manual.
9. Standard cover sheets for grading.
10. Individual project plans and specifications (P&S).

The scope of each publication is contained within that publication. The publications should be used as follows:

Engineers - Use RdStd, VCWWM and VCSM (also R&R in Districts listed in 5 above) as the general requirements for design. Do not assume contractors have copies of these publications so don't make references to plates or formulas from these documents in the P&S. Material in SLDS, SSPWC, SPPWC, and SSP may be referred to in the P&S as contractors may be assumed to have copies of these publications.

NOTE: The Ventura County Standard Designs are no longer being published and should not be used as a reference. Use SPPWC in their place. Where SPPWC does not contain an appropriate design, SSP may be used.

Developers and Contractors - Use SLDS (which adopts and modifies SSPWC); SPPWC and SSP where specified in the P&S; Grading Cover Sheet and P&S.

FUTURE AMENDMENTS TO THIS MANUAL

Amendments to this manual may be issued from time to time.

Users of this publication may contact the Agency to determine the latest revision date. See the "Revision" pages herein that list the latest date for each page.

To ascertain the current purchase price and postage charge for the manual or to purchase an updated edition, contact the Agency at the address shown below. Individual pages may also be purchased at the standard price for Xerox copies.

The latest version of this manual is available free on the Agency's web site:
http://publicworks.countyofventura.org/eng_services/eng_serv.htm

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Phone: (805) 654-2068

FOREWORD

PURPOSE: THE VENTURA COUNTY SEWERAGE MANUAL ESTABLISHES UNIFORM POLICIES AND PROCEDURES FOR THE DESIGN AND CONSTRUCTION OF SANITARY SEWERAGE FACILITIES WITHIN COUNTY RIGHTS OF WAY AND ON PROJECTS SUBJECT TO APPROVAL BY THE COUNTY.

IT WAS NOT THE INTENT AT THE TIME OF ADOPTION OF THIS MANUAL, OR THE INTENT AT THIS TIME, THAT ANY STANDARD OF CONDUCT OR DUTY TOWARD THE PUBLIC SHALL BE CREATED OR IMPOSED BY THE PUBLICATION OF THIS MANUAL. THE MANUAL IS NOT A TEXTBOOK OR A SUBSTITUTE FOR ENGINEERING KNOWLEDGE, EXPERIENCE OR JUDGMENT. THE METHODS AND PROCEDURES CONTAINED HEREIN SHALL BE REVIEWED BY THE ENGINEER USING THEM TO SEE THAT THEY ARE APPLICABLE TO THE PROJECT ON WHICH HE IS WORKING. WHERE NOT CONSIDERED APPLICABLE, THE ENGINEER SHALL REQUEST A VARIANCE FROM THE STANDARDS AS PROVIDED IN THE MANUAL.

NOTE: In preparing this manual for reprinting, the original manual was scanned, the font changed, and the revision table & Table of Contents reformatted. The pages in the manual were also reformatted but not repaginated so as to maintain the history of revisions by page number.

Note added 03/12/99

SEWERAGE MANUAL
REVISIONS

From time to time, revisions to this manual become necessary. Each time a revision is made, the revision index sheet will be reissued showing the date of the currently active pages in the book. * Pages were not dated.

Page No.	Rev 0 Date App'd	Rev 1 Date App'd	Rev 2 Date App'd	Rev 3 Date App'd	Rev 4 Date App'd	Rev 5 Date App'd	Rev 6 Date App'd	Rev 7 Date App'd
1	07/06/65*	01/17/67	Deleted 10/01/68	11/16/82	08/26/86			
1-A	07/06/65*	Deleted 10/01/68						
2	07/06/65*	10/01/68	08/24/71	11/16/82	08/26/86			
2a	08/26/86							
3	07/06/65*	10/01/68	11/16/82	08/26/86				
4	07/06/65*	10/01/68	11/16/82	08/26/86				
5	07/06/65*	01/17/67	10/01/68	11/16/82	08/26/86			
6	07/06/65*	01/17/67	10/01/68	11/16/82				
7	07/06/65*	01/17/67	10/01/68	11/16/82				
8	07/06/65*	01/17/67	04/25/67	10/01/68	11/16/82			
9	07/06/65*	10/01/68	11/16/82	08/26/86				
10	07/06/65*	10/01/68	11/16/82	08/26/86				
11	07/06/65*	10/01/68	11/16/82	08/26/86				
12	07/06/65*	10/01/68	08/24/71	11/27/73	11/16/82	08/26/86		
13	07/06/65*	10/01/68	11/16/82	08/26/86				
14	07/06/65*	01/17/67	10/01/68	11/16/82				
15	07/06/65*	01/17/67	Deleted 10/01/68	11/16/82	08/26/86			
16	08/26/86	08/26/86						
I-1	10/01/68	11/16/82						
I-2	10/01/68	11/16/82						
II		11/16/82						
II-1	10/01/68	Deleted 09/16/81						
II-2	10/01/68	Deleted 09/16/81						
II-3	10/01/68	Deleted 09/16/81						

SEWERAGE MANUAL
REVISIONS

From time to time, revisions to this manual become necessary. Each time a revision is made, the revision index sheet will be reissued showing the date of the currently active pages in the book.

PLATE No.	Rev 0 Date App'd	Rev 1 Date App'd	Rev 2 Date App'd	Rev 3 Date App'd	Rev 4 Date App'd	Rev 5 Date App'd	Rev 6 Date App'd	Rev 7 Date App'd
1	07/06/65	10/01/68	11/27/73					
2	07/06/65	10/01/68	Deleted 09/22/70					
2A	11/27/73							
2B	11/27/73							
2C	11/27/73							
2D	11/27/73							
2E	11/27/73							
2F	11/27/73							
2G	11/27/73	02/08/77						
3	07/06/65	10/01/68	Deleted0 8/26/86					
4	07/06/65	10/01/68	11/27/73	Deleted 08/26/86				
5	07/06/65	10/01/68	11/12/69	11/12/69	11/27/73	Deleted 08/26/86		
6	07/06/65	10/01/68	11/27/73	Deleted 08/26/86				
7	07/06/65	10/01/68	11/27/73	Deleted 08/26/86				
8	07/06/65	10/01/68	11/27/73	Deleted 08/26/86				
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1.0 GENERAL PROVISIONS

1.1 General Requirements

1.11 Scope

The design and construction of sanitary sewers in the unincorporated area of Ventura County within public rights of way and sanitary sewers and sewage treatment plants subject to control or permit requirements of the County, shall be in accordance with good engineering practice. The work shall comply with these standards except where specific modifications have been approved by the Director of Public Works in writing. (See Appendix I - Administrative Information.)

1.12 Interpretation

The Director shall decide all questions of interpretation of "good engineering practice being guided by "Design and Construction of Sanitary and Storm Sewers" (ASCE Manual of Engineering Practice No. 37 or WPCF Manual No. 9), "Sewage Treatment Plant Design" (ASCE Manual of Engineering Practice No. 36 or WPCF Manual of Practice No. 8), and "Gravity Sanitary Sewer Design and Construction" (ASCE Manual, Engineering Practice No. 60 or WPCF Manual of Practice No. FD-5), all prepared by joint committees of the American Society of Civil Engineers and the Water Pollution Control Federation.

1.13 Plumbing Code

All work on house laterals and house sewers outside of public rights of way or sewer easements will be governed by the provisions of the Uniform Plumbing Code as amended by the Ventura County Ordinance Code and other applicable ordinances of the local sewerage agency.

1.14 Other Standards

Where a sewerage agency's requirements and standards are more restrictive than this manual, that agency's requirements shall govern.

1.2 Enforcement

Provisions of this "Sewerage Manual" shall be enforced by the Director of Public Works.

1.21 Deviations

Requests for deviations from the standards contained in this manual should be submitted to the Engineer. The Engineer shall make a recommendation to the Board of Supervisors on the deviation. The final decision on deviations from the standards will be decided by the Board of Supervisors.

1.3 Definitions

Wherever any of the following words, or expressions, or pronouns in place of them are used in these specifications, they shall be understood to have the meanings given as follows:

1.31 County: The County of Ventura, State of California.

1.32 Public Works Agency: The Public Works Agency of the County of Ventura, State of California.

1.33 Director of Public Works: The executive officer of the Public Works Agency of the County of Ventura as created by law, also referred to as the Engineer.

1.34 Engineer: The Director of Public Works of the County acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties delegated to them.

1.35 Owner's or Developer's Engineer: Civil Engineer Registered in the State of California employed by owner or developer.

1.36 Sewerage Agency: The public agency or private company who owns and operates the sewerage system.

1.37 Sewerage Agency's Engineer: Civil Engineer registered in California employed by the sewerage agency.

1.38 Reference to Standards and Publications: Any reference made in these standard specifications or on the drawings to any specifications, standard methods or publications or any scientific or technical society or other organization shall, in the absence of a specific designation to the contrary, be understood to refer to the specifications, standard, method or publication in effect on the date the plans are approved.

1.39 GBC-PWS: Greenbook Committee of Public Works Standards, Inc., whose publications are published by BNI Building News, Inc. of Los Angeles.

1.40 SPPWC: "Standard Plans for Public Works Construction" promulgated by GBC-PWS.

1.41 SSPWC: "Standard Specifications for Public Works Construction" promulgated by .GBC-PWS.

1.4 Plates

The following Plates are included as part of this Manual.

No.	Description
1	Pipe Bedding
2	Pipe Strength (7 Sheets)

2.0 DESIGN CRITERIA

2.1 SEWER CAPACITIES

2.11 General

Sewers shall be designed to carry the peak flow rates from all areas tributary to them. Sewers shall be designed for both size and depth to accommodate developments in upstream tributary areas which would logically be served by them. The peak flow rate at any point shall be the average flow of all tributary areas times the factor

$$(2.65 * (\text{AVE CFS})^{-0.1}).$$

Zoning shown in this section is that in effect in March 1986 as shown in the Ventura County Ordinance Code. Changes in zoning regulations shall be taken into consideration in computing flows.

2.12 Residential

2.121 Population Densities

The following population densities shall be used in establishing sewage flow:

Population per Residential Unit

Type of Development	
Trailers and mobile homes on lots under 3000 S.F. in area	2.0
Multiple unit buildings with 5 or more residential units	2.2
Multiple unit buildings with 3 or 4 residential units	2.4
Multiple unit buildings with 2 residential units	2.8
Mobile homes on lots of 3000 to 6000 S.F. in area	2.8
Single family units and mobile homes on lots larger than 6000 S.F.	3.5

2.122 Building Density

Residential building density for undeveloped areas shall be taken from the following table.

Zoning	Dwelling Units per Acre
R-O	1.9
R-1	4.8
R-2	9.6
R-A	0.9
R-E	3.5
R-P-D	30

Densities given in this table may be reduced for areas where the average slope of the land exceeds 5% by multiplying the values in the table by (1 - 0.025 * Slope in %).

Existing developments or proposed developments with approved plans shall use the actual number of units.

2.123 Average Flow Rate

The average flow rate in cubic feet per second (CFS) shall be 0.00012 times the number of persons to be served.

2.13 Commercial and Manufacturing

Average flow rates for design shall be taken from the following table unless special conditions require additional capacity or an approved study indicates less capacity is required.

Zoning	Average Flow Rate CFS per Acre
C-O	0.005
C-I	0.003
C-P-D	0.006
M-I	0.009
M-2	0.009
M-3	0.012
PC	0.008

2.14 Hydraulic Design

2.141 Pipe size, flow quantity and hydraulic slope relationships shall be computed using the Manning Formula with n=0.013 or Hazen-Williams Formula with C=100 for pipes running full with adjustment of results for partially filled pipe based on ASCE Manual No. 37 (See Section 1.12) curves for Discharge and velocity when varies with depth.

2.142 To use full flow pipe formulas to determine pipe diameter or slope, multiply design flow or Manning's "n" by Factor A from the table below.

To use full flow pipe formulas to determine flow for a given pipe diameter and slope with n=0.013, divide the resultant flow by Factor A from the table below.

Pipe Diameter	Maximum Depth at Design Peak Flow	Factor A for use with full pipe formula
Less than 12"	2/3 Pipe Diam.	1.54
12" & greater	3/4 Pipe Diam.	1.25

2.15 Minimum Size

Minimum street sewer size shall be 8", except that 6" pipe may be used where all of the following conditions are met:

a. The minimum slope is at least 0.8%.

b. The length does not exceed 200 feet with no possibility of extension.

c. Not more than 10 house laterals contribute to the 6" portion.

2.2 Minimum Sewer Slopes

2.21 Purpose

Minimum slope requirements are necessary to assure self-cleansing and self-oxidizing velocities in order to avoid significant generation of hazardous, odorous, and corrosive sulfur compounds.

2.22 Minimum Slopes

Slopes of sewers shall equal or exceed those set forth in the following table:

Pipe Diameter	Corrosion Resistant Sewer Pipe Material (Sec. 3.41)	Other Sewer Pipe Material (Sec. 3.42)
6"	0.0080	0.0100
8"	0.0040	0.0088
10"	0.0028	0.0060
12"	0.0024	0.0056
14"	0.0020	0.0048
15"	0.0020	0.0044
16"	0.0016	0.0040
18"	0.0016	0.0036
20"	0.0012	0.0032
21"	0.0012	0.0028
24"	0.0012	0.0024
27"	0.0012	0.0020
30"	0.0012	0.0016
33"	0.0012	0.0016
36"	0.0012	0.0012

2.23 Substandard Slopes

Slopes below the minimum slopes may be used in order to avoid pumping only upon specific approval of the Engineer. Such approval should be solicited well in advance of completion of design.

2.24 Pipe for Substandard Slopes

Pipe, in substandard slope areas and pipe in all areas downstream from substandard slope areas to the point where the peak flow rate is four times that in the section with substandard slope, shall be corrosion-resistant sewer pipe in accordance with Section 3.41.

2.3 Sewer Location

2.31 Roads

The centerline of sewers constructed in County roads shall not be closer than 4 feet to the centerline of the road nor closer than 4 feet to the curb. On divided highways, a separate sewer shall be installed to serve each side of the highway. Exceptions to these location requirements may be made only on approval of the Engineer.

2.32 Easements

2.321 The minimum width for sewer easements in feet shall be

$$2d + 4 + (12*D*d)^{0.5}$$

where d Inside diameter of pipe in feet
D = Depth to pipe invert in feet.

2.322 Where easements follow common lot lines, the full easement width shall be on one lot, in such a manner that access to manholes will not be obstructed by walls, trees, or permanent improvements. Where this requirement cannot be met without interfering with existing buildings, easements may straddle lot lines.

2.323 Deeds for easements shall provide for restrictions of permanent construction within easement to provide ingress and egress for maintenance.

2.33 Future Extensions

When an area outside the tract can be logically served by future extension of a tract sewer, the tract sewer shall extend to the tract boundary or to the end of a paved street in a manner to facilitate the future extension.

2.34 Alignment

2.341 Sewers shall be laid on a straight alignment and grade between manholes except that curved sewers may be used subject to the following requirements.

2.342 Curved Sewer Requirements

a. Minimum radius = 100 feet for horizontal curves.

b. Minimum invert slope of horizontally curved sewers shall be 0.01 except that sewers with a radius of 200 feet or more will have the same requirements as straight sewers.

c. Vertical curves may be used in combination with horizontal curves where invert slopes exceed 0.01 throughout the reach between manholes.

d. Maximum combined horizontal and vertical deflection at any joint shall be as recommended by the manufactures but in no case more than

e. The arithmetic sum of all horizontal and vertical deflection in curved sewers between adjacent manholes shall not exceed 60 .

2.35 Water-Sewer Separation

The State Department of Health requirements for separation shall be met in locating sewers. See Appendix II.

2.4 Depth of Sewers

2.41 Basic Requirement

Sewers shall be installed at a depth which will provide suitable service to the properties connected and will allow subsequent installation of water lines in accordance with the Water Sewer Separation Rules (Section 2.35) so as to require a minimum of special construction of the water lines other than joint spacing.

2.42 Standard Depths

Compliance with Subsection 2.41 will usually be assured if: The main sewer is located at a depth of #' to top of pipe below the flow line of the existing or proposed gutter; or where no gutter exists, from the elevation of the outermost edge of the traveled way; and the house laterals are located either, (1) 6' to top of pipe below the ground surface at the property line, or (2) at a depth below the ground surface at the property line that will provide for the construction of a straight run of private sewers at a slope of 0.02 from one foot below the surface at any point within the established building setback lines, excluding any areas steeper than 5 horizontally to one vertically, whichever depth is greater.

2.43 Exceptions

Designs not in accordance with Subsection 2.42 shall be submitted to the Engineer for approval together with evidence that it complies with Subsection 2.41.

2.5 Structures

2.51 Manholes

2.511 Locations

a. Manholes shall be located at all abrupt changes in alignment or grade and at all junctions.

b. Manholes shall be located at least every 400' along lines smaller than 24" in diameter. Spacing of manholes on lines 24" in diameter and larger will usually be at 400' but may be extended subject to the approval of the Engineer.

2.512 Drop Manholes

Drop manholes constructed in accordance with SPPWC 202 shall be used wherever sewers enter manholes at more than 12 inches above the outlet elevation of the manhole. vertical curves may be used to eliminate drop manholes in accordance with the requirements of Section 2.342.

2.513 Design

Manholes shall be constructed in accordance with SPPWC 200 where depth is 7.5' or greater from top of manhole to pipe invert and with SPPWC 201 where less than 7.5'. Manhole designs, which, in the opinion of the Engineer, provide access to the sewers, a stable working platform and freedom from splash and turbulence, equivalent to or better than the design shown herein, will be approved.

Grades of the channels within manholes shall be as follows except where the sewerage agency has different requirements:

(a) When the main channel flows straight through the manhole. Carry the upstream and downstream pipe grades to the center of the manhole.

(b) When the main channel curves through the manhole, in addition to the pipe grades, provide additional fall in the invert equal to the loss in energy head to be expected.

(c) For side inlets to manholes where the pipe size is less than the main line, align the pipe soffit of the side inlet with that of the main inlet.

(d) For side inlets to manholes when the pipe size is the same as the main, provide a drop of 0.1 feet between the inlet invert and the invert of the outlet of the main line.

2.514 Protection

Where new tract sewers are to be connected into a manhole which is in active use, the designer shall call for such protection as is necessary to prevent construction debris from being washed into the active sewers. Plugged inlets or other suitable protection shall be called for in the active manhole before beginning manhole modifications or tract sewer cleaning.

2.515 Elevations

Finished elevations of frames and covers shall be set in relation to finished grades of the completed road surface or finished surrounding grade when outside of roads.

2.52 Cleanouts

2.521 Requirements

Dead end sewers not over 200' in length shall terminate in standard manholes or cleanouts. Dead ends over 200' long shall terminate in standard manholes unless future extension of said dead end will include a manhole within 400' of the upper-most manhole, in which case a temporary cleanout is permitted. Where dead ends are on a slope of 0.01 or greater, the length for use of a cleanout may be extended to 300'.

5.522 Location

End structures shall be located 10' upgrade from the down grade lot line of the last lot served unless greater length is necessary to serve the property.

2.523 Design

Cleanouts shall be constructed generally in accordance with SPPWC 204.

2.53 Service Laterals

2.531 Requirements

Wherever it is known or can be reasonably assumed that a building sewer connection is required, a service lateral shall be shown on the plans and installed to the property line as a part of the street sewer construction, prior to paving. Service laterals shall be installed whenever possible during construction of the sewer main using prefabricated fittings.

2.532 Size

Service laterals for single dwellings and small single stores or offices shall be 4" or larger providing the Plumbing Code does not require the building sewer to be larger than 4". All other service laterals shall be 6" or larger and at least equal to the size of the building sewer.

2.533 Depth

Service laterals shall be at the minimum depths herein provided and in addition such depth shall be sufficient to provide a connection to any point on the lot within the established building setback lines (excluding any area steeper than 5 horizontally to one vertically) with a cover of one foot and a slope of not less than 0.02. Any exception to this requirement may be had only upon approval by the Director of Public Works.

2.534 Design

Service laterals shall be constructed in general conformity with SPPWC 222 and 223.

On SPPWC 222, Profile Type B may be modified to construct the chimney adjacent to the main sewer to avoid deep excavation across the street right of way for house connections. Each chimney so constructed shall provide inlets for both sides of the street unless a house connection is already available for one side.

2.535 Future Connections

Unused openings shall be tightly sealed and supported in a manner to facilitate their future location and use. Developer's engineer shall select appropriate service lateral locations and shall instruct contractor to locate laterals according to the design elevations and locations.

2.536 Backflow Prevention

Sewers shall be designed to preclude the backflow of sewage into laterals except when this is economically infeasible. Backflow of sewage into laterals may occur in any building that has waste receiving inlets which are lower than the rim elevation of the next upstream manhole or other structure providing hydraulic relief. While the Plumbing Code provides for the customer to install check valves under certain conditions, the conditions stated do not cover all possibilities of backflow and check valves frequently fail to operate properly. Causes of sewer stoppage include: the introduction of foreign objects into manholes; the buildup of grease in the sewer crown at locations where hydraulic jumps occur; high flow rates due to ground or surface water entering the sewer; difficulties while balling sewers; and undersized sewers.

2.537 Connection to Cesspools or Septic Tanks

Cesspool seepage pits or septic tanks shall not be connected to any public sewer except where part of an approved design.

2.538 Curb Markings

The location of all sewer service laterals shall be marked on the curb at completion of construction.

2.54 Structural

2.541 Roads

All structures and pipe placed under public roads shall be of sufficient strength to support with an adequate factor of safety the backfill, road surfacing and H-20 truck loading with impact.

2.542 Other Pipes and Structures

Sewers under other pipes and structures shall be protected from damage and shall be constructed so as not to endanger the other pipe or structure. Use methods shown on SPPWC 224 and 225 as appropriate. The concrete blanket method of SSPWC 225 is not required where the distance between the outside of crossing pipes exceeds 12" unless required by Section 2.35.

2.543 Flexible Joints

Flexible joints which will allow for differential settlements or other movement of sewer pipe, sewer structures, adjacent pipe and adjacent structures shall be provided where sewer lines enter encasements, manholes or other structures. Flexible joints shall be within 1 foot of such structures and shall be indicated on the plans.

2.544 Steep Grades

Sewers laid on grades steeper than 10%, which are not under pavements, shall have the trench backfill protected from erosion as provided for by SPPWC 221. Sewers laid on grades of 33% or more, shall also be anchored as provided by SPPWC 221.

2.55 Force Mains and Lift Stations

2.551 Requirements

All sewage shall reach the system by gravity flow, in a fresh condition susceptible to conventional sewage treatment processes. Where extreme hardship conditions prevail, and a substantial area cannot be sewered by gravity sewers in accordance with these requirements, a sewage pumping station may be installed. No pumping facilities shall be incorporated in sewer plans without approval of the Engineer.

2.552 Lift Stations Design

Lift stations, where allowed, shall be of the dry-pit type incorporating the following features:

a. Pumps or other devices shall be provided in duplicate, arranged for positive priming.

b. Capacity shall be provided to handle ultimate peak flow from the tributary area with the largest pump out of service. Stage installation of pumps is allowed providing space is provided for future installations.

c. Access shall be provided to site for removal and repair of equipment.

d. A means for dewatering force mains shall be provided.

e. An overflow to natural channel or storm drain shall be provided or an alternate method of protection approved by the Engineer.

f. The lift station shall not be in County road right-of-way except with permission from the Engineer.

2.553 Force Main Design

Force mains need not comply with the requirements for gravity sewers. Force mains shall be designed in accordance with good engineering practice.

3.0 MATERIALS

3.1 Requirements

Materials shall be chosen for their strength, durability, and ease of maintenance, with due consideration for dead and live loads, beam strength, and resistance to corrosion. Pipe joints shall be selected to provide positive protection against entrance of roots and groundwater, and sufficient flexibility to adjust to the trench bedding. In general, the joints shall be non-rigid, and the joint sealer shall be restrained against lateral and axial movement. The installed joint shall provide positive separation between adjoining pipe sections to prevent failure of rigid materials by axial expansion during wetting.

3.2 Plans

For each section of sewer, the plans shall show that materials and strengths are required in accordance with Plate 1. Pipe strength, pipe bedding, and trench width shall be specified on the plans (see Plate 1).

3.3 Materials Specifications

All materials for which specifications are provided by the Ventura County Standard Land Development Specifications shall meet those specifications. Specifications for materials not covered by the Standard Land Development Specifications are subject to the approval of the Engineer.

3.4 Pipe Material

3.41 Corrosion Resistant Sewer Pipe Material shall be: Vitrified Clay; Poly (vinyl Chloride), type PSM or PSP; Acrylonitrile-Butadiene-Styrene, solid or composite; Reinforced Plastic Mortar; Plastic Lined Asbestos Cement; or other material approved by the Engineer.

3.42 Other Sewer Pipe Material not required to be corrosion resistant shall be: Any of the materials listed in Subsection 3.41 above; Unlined Asbestos Cement; Reinforced Concrete; Unreinforced Concrete; Cast Iron; or other material approved by the Engineer.

3.5 Concrete

All concrete for sewer structures and sewer pipe encasement shall be class 6.0-C-3000 unless otherwise shown herein or approved by the Engineer.

4.0 CONSTRUCTION

4.1 Specifications

Construction shall be in accordance with the Standard Land Development Specifications and the requirements of sewerage agency.

4.2 Bench Marks

A system of bench marks on the National Vertical (NGV) Datum of 1929 or North American Vertical Datum of 1988 (NAVD88) and adequate to construct the work shall be shown on the profile sheet. The elevation of the sewer at the point where the system in to be discharged shall be shown as determined in the field from the datum.

4.3 Work and Plans Shall Conform

All plans required for the construction of main line sewers and house laterals shall conform to the standards of design prescribed. Construction shall conform to the plans unless a change is approved in writing by the Engineer.

4.4 Record Plans

4.41 Plans

The actual location and grade of all sewers shall be accurately determined after construction and shall be recorded on "Record" plans. Accurate locations and elevations of all service laterals, manholes, cleanouts, lift stations and other sewer appurtenances shall also be marked on the "Record" plans.

4.42 Certification

The "Record" plans shall be certified as being correct by the Sewerage Agency's Engineer or by the land developer's engineer.

4.43 Filing

A reproducible of the "Record" plans shall be filed with the Engineer.

ADMINISTRATIVE PROCEDURES

The following data is for general information only and is not a part of the Sewerage Manual requirements. It represents current practice which may be changed without notice.

1. All sanitary sewer construction in the unincorporated areas of Ventura County is regulated by one or more County ordinances and Board of Supervisors resolutions. These ordinances and resolutions are administered by various Divisions of the Public Works Agency (PWA). In addition, the Environmental Health Division of the Resource Management Agency and the Regional Water Quality Control Board and the State Health Department administer other laws and rules affecting sewers.

2. The ordinances and resolutions affecting sanitary sewer construction are as follows:

    a. The County Sewerage Manual (applicable to all construction within public rights-of-way of the unincorporated areas of Ventura County).

    b. The Uniform Plumbing Code as modified by County Ordinance (applicable to all construction off public rights of way).

    c. The Uniform Building Code as modified by County Ordinance (applicable to construction of treatment plants and to all grading off of the right of way).

    d. Subdivision Ordinance - County Ordinance Code, Section 8200 et seq (applicable to all work in subdivisions).

    e. Standard Land Development Specifications (applicable to all work in subdivisions and all work in public roads).

    f. The Encroachment Permit Ordinance, County Ordinance Code, Section 12000 et seq (applicable to all work in public road rights of way).

3. Administration of these ordinances and resolutions are handled in the following manner:

    a. Construction within subdivision street areas after a tentative map is filed: plans checked and construction inspected by Public Works Agency - Real Property Services Department.

    b. Sewers on private property where no tentative map exists: plan review and inspection by Resource Management Agency-Division of Building and Safety.

    c. Sewers in accepted County roads right-of-way. Plan review and inspection by Public Works Agency - Transportation Department.

d. Construction of treatment plants. Plan review and inspection by the Resource Management Agency - Division of Building and Safety. Review of plans in County operated sanitation districts will also be made by the Public Works Agency - Water Resources & Engineering Department.

e. Personnel of all Public Works Agency departments and the Resource Management Agency - Division Building and Safety, may act as consultants to others on technical problems and in some cases assist in the review of plans.

4. The County Sewerage Manual has mandatory regulations for all sanitary sewers constructed within public rights-of-way. Special districts may issue standard specifications and criteria more restrictive than those indicated in the County Sewerage Manual. Criteria less restrictive than in the County Sewerage Manual may be included only by special approval of the Director of Public Works.

5. While the County provides a certain amount of inspection when sewer lines are being installed, the inspection is mainly concerned with the compaction of trench above sewer line, and the degree of all inspection is generally cursory, making it necessary for the owner of the sewer to provide normal engineering inspection for the entire construction project.

6. The County's interest is to insure adequate quality to protect the County's roads from being disturbed and to minimize high sewer maintenance costs which would have to be paid by the citizens served by the sewer. The County will endeavor to work with sanitary districts to obtain this end and to modify the requirements where justified as provided for in Section 1.11 of the Sewerage Manual.

WATER-SEWER SEPARATION REQUIREMENTS

The following is an excerpt from Title 22 of the California Administrative Code:

64630. Water Main Installation.

(a) Water mains shall be installed below the frost line or shall otherwise be protected to prevent freezing.

(b) Water mains shall not have less than 30 inches (0.75 meters) of cover over the top of the pipe except where necessary to avoid underground obstructions or rocky conditions.

(c) Water mains shall be installed at least:

(1) Ten feet (3 meters) horizontally from and 1 foot (0.3 meters) higher than sanitary sewers located parallel to the main.

(2) One foot (0.3 meters) higher than sanitary sewers crossing the main.

(3) Ten feet (3 meters), and preferably 25 feet (7.5 meters), horizontally from sewage leach fields, cesspools, seepage pits and septic tanks.

(d) Separation distances specified in (c) shall be measured from the nearest edges of the facilities.

(e) Where the requirements of (c) and (d) cannot be met due to topography, inadequate right-of-way or easements or conflicts with other provisions of these regulations, lesser separation is permissible if:

(1) The water main and the sewer are located as far apart as feasible within the conditions listed above.

(2) The water main and the sewer are not installed within the same trench.

(3) The water main is appropriately constructed to prevent contamination of the water in the main by sewer leakage.

(f) Water mains shall be disinfected according to AWWA Standard C601-68 before being placed in service.

(g) Installation of water mains near the following sources of potential contamination shall be subject to written approval by the Department on a case-by-case basis:

(1) Storage ponds or land disposal sites for waste water or industrial process water containing toxic materials or pathogenic organisms.

(2) Solid waste disposal sites.

(3) Facilities such as storage tanks and pipelines where malfunction of the facility would subject the water in the main to toxic or pathogenic contamination.

NOTE: Authority cited: Sections 208 and 4010.1 (h), Health and Safety Code. Reference: Sections 4010.1 (h), 4012, 4013 and 4019, Health and Safety Code.

The following pages are the State Department of Health's current policy.

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF HEALTH SERVICES
714/744 P STREET
SACRAMENTO, CA 95814

CRITERIA FOR THE SEPARATION OF WATER MAINS AND SANITARY SEWERS

A. PUBLIC HEALTH CONSIDERATIONS

Waterborne disease outbreaks attributed to the entry of sewage-contaminated groundwater into the distribution systems of public water supplies continue to be a problem in the United States. A community with its buried water mains in close proximity to sanitary sewers is vulnerable to waterborne disease outbreaks.

Sanitary sewers frequently leak and saturate the surrounding soil with sewage. This is caused primarily by structural failure of the sewer line, improperly constructed joints, and subsidence or upheaval of the soil encasing the conduit. A serious public health hazard exists when the water mains are depressurized and no pressure or negative pressures occur. The hazard is further compounded when, in the course of installing or repairing a water main, existing sewer lines are broken. Sewage spills into the excavation and, hence, enters into the water main itself. Additionally, if a water main fails in close proximity to a sewer line, the resultant failure may distrub the bedding of the sewer line and cause it to fail. In the event of an earthquake or man-made disaster, simultaneous failure of both conduits often occurs.

The water supplier is responsible for the quality of the water delivered to consumers and must take all practical steps to minimize the hazard of sewage contamination to the public water supply. Protection of the quality of the water in the public water system is best achieved by the barrier provided by the physical separation of the water mains and sewer lines.

This document sets forth the construction criteria for the installation of water mains and sewer lines to prevent contamination of the public water supplies from nearby sanitary sewers.

B. BASIC SEPARATION STANDARDS

The "California Waterworks Standards" sets forth the minimum separation requirements for water mains and sewer lines. These Standards, contained in Section 64630, Title 22, California Administrative Code, specify:

(c) (1) Parallel Construction: The horizontal distance between pressure water mains and sewer lines shall be at least 10 feet.

(2) Perpendicular Construction (Crossing): Pressure water mains shall be at least one foot above sanitary sewer lines where these lines must cross.

(d) Separation distances specified in (c) shall be measured from the nearest edges of the facilities.

(e) (2) Common Trench: Water mains and sewer lines must not be installed in the same trench.

When water mains and sanitary sewers are not adequately separated, the potential for contamination of the water supply incrases. Therefore, when adequate physical separation cannot be attained an increase in the factor of safety should be provided by increasing the structural integrity of both the pipe materials and joints.

C. EXCEPTIONS TO BASIC SEPARATION STANDARDS

Local conditions, such as available space, limited slope, existing structures, etc., may create a situation where there is no alternative but to install water mains or sewer lines at a distance less than that required by the Basic Separation Standards. In such cases, alternative construction criteria as specified in Section E should be followed, subject to the special provisions in Section D.

Water mains and sewers of 24 inches diameter or greater may create special hazards because of the large volumes of flow. Therefore, installations of water mains and sewer lines 24 inches diameter or larger should be reviewed and approved by the health agency prior to construction.

D. SPECIAL PROVISIONS

1. The Basic Separation Standards are applicable under normal conditions for sewage collection lines and water distribution mains. More stringent requirements may be necessary if conitions, such as, high groundwater exist.

2. Sewer lines shall not be installed within 25 feet horizontally of a low head (5 psi or less pressure) water main.

3. New water mains and sewers shall be pressure tested where the conduits are located ten feet apart or less.

4. In the installation of water mains or sewer lines, measures should be taken to prevent or minimize disturbances of the existing line. Disturbance of the supporting base of this line could eventually result in failure of this existing pipeline.

5. Special consideration shall be given to the selection of pipe materials if corrosive conditions are likely to exist. These conditions may be due to soil type and/or the nature of the fluid conveyed in the conduit, such as a septic sewage which produces corrosive hydrogen sulfide.

6. Sewer Force Mains

a. Sewer force mains shall not be installed within ten feet (Horizontally) of a water main.

b. When a sewer force main must cross a water line, the crossing should be as close as practical to the perpendicular. The sewer force main should be at least one foot below the water line.

c. When a new sewer force main crosses under an existing water main, all portions of the sewer force main within ten feet (horizontally) of the water main shall be enclosed in a continuous sleeve.

d. When a new water main crosses over an existing sewer force main, the water main shall be constructed of pipe materials with a minimum rated working pressure of 200 psi or equivalent pressure rating.

E. ALTERNATE CRITERIA FOR CONSTRUCTION

The construction criteria for sewer lines or water mains where the Basic Separation Standards cannot be attained are shown in Figures 1 and 2. There are two situations encountered:

Case 1 -- New sewer line -- new or existing water main.

Case 2 -- New water main -- existing sewer line.

For Case 1, the alternate construction criteria apply to the sewer line.

For Case 2, the alternate construction criteria may apply to either or both the water main and sewer line.

The construction criteria should apply to the house laterals that cross above a pressure water main but not to those house laterals that cross below a pressure water main.

Case 1: New Sewer Being Installed (Figures 1 and 2)

Zone	Special Construction Required for Sewer
A	Sewer lines parallel to water mains shall not be permitted in this zone without approval from the responsible health agency and water supplier.
B	A sewer line placed parallel to a water line shall be constructed of: 1. Extra strength vitrified clay pipe with compression joints. 2. Class 4000, Type II, asbestos-cement pipe with rubber gasket joints. 3. Plastic sewer pipe with rubber ring joints (per ASTM D3034) or equivalent. 4. Cast or ductile iron pipe with compression joints. 5. Reinforced concrete pressure pipe with compression joints (per AWWA C302-74).
C	A sewer line crossing a water main shall be constructed of: 1. Ductile iron pipe with hot dip bituminous coating and mechanical joints. 2. A continuous section of Class 200 (DR 14 per AWWA C900) plastic pipe or equivalent, centered over the pipe being crossed. 3. A continuous section of reinforced concrete pressure pipe (per AWWA C302-74) centered over the pipe being crossed. 4. Any sewer pipe within a continuous sleeve.
D	A Sewer line crossing a water main shall be constructed of: 1. A continuous section of ductile iron pipe with hot dip bituminous coating. 2. A continuous section of Class 200 (DR 14 per AWWA C900) plastic pipe or equivalent, centered on the pipe being crossed. 3. A continuous section of reinforced concrete pressure pipe (per AWWA C302-74) centered on the pipe being crossed. 4. Any sewer pipe within a continuous sleeve. 5. Any sewer pipe separated by a ten-foot by ten-foot, four-inch-thick reinforced concrete slab.

Case 2: New Water Mains Being Installed (Figures 1 and 2)

Zone

A No water mains parallel to sewers shall be constructed without approval from the health agency.

B If the sewer paralleling the water main does not meet the Case 1, Zone B, requirements, the water main shall be constructed of:

1. Ductile iron pipe with hot dip bituminous coating.

2. Dipped and wrapped one-fourth-inch-thick welded steel pipe.

3. Class 200, Type II, asbestos-cement pressure pipe.

4. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.

5. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-74 or C301-79 or C303-70).

C If the sewer crossing the water main does not meet the Case 1, Zone C, requirements, the water main shall have no joints in Zone C and be constructed of:

1. Ductile iron pipe with hot dip bituminous coating.

2. Dipped and wrapped one-fourth-inch-thick welded steel pipe.

3. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.

4. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-74 or C301-79 or C303-70).

D If the sewer crossing the water main does not meet the requirements for Zone D, Case 1, the water main shall have no joints within four feet from either side of the sewer and shall be constructed of:

1. Ductile iron pipe with hot dip bituminous coating.

2. Dipped and wrapped one-fourth-inch-thick welded steel pipe.

3. Class 200 pressure rated plastic water pipe (DR 14 per AWWA C900) or equivalent.

4. Reinforced concrete pressure pipe, steel cylinder type, per AWWA (C300-74 or C301-79 or C303-70).

NOTES AND DEFINITIONS:

1. HEALTH AGENCY -- The Department of Health Services. For those water systems supplying fewer than 200 service connections, the local health officer shall act for the Department of Health Services.

2. WATER SUPPLIER -- "Person operating a public water system" or "Supplier of water" means any person who owns or operates a public water system.

3. LOW HEAD WATER MAIN -- Any water main which has a pressure of five psi or less at any time at any point in the main.

4. Dimensions are from outside of water main to outside of sewer line or manhole.

5. COMPRESSION JOINT -- A push-on joint that seals by means of the compression of a rubber ring or gasket between the pipe and a bell or coupling.

6. MECHANICAL JOINTS -- Bolted joints.

7. RATED WORKING WATER PRESSURE OR PRESSURE CLASS -- A pipe classification system based upon internal working pressure of the fluid in the pipe, type or pipe material, and the thickness of the pipe wall.

8. FUSED JOINT -- The jointing of sections of pipe using thermal or chemical bonding processes.

9. SLEEVE -- A protective tube of steel with a wall thickness of not less than one-fourth inch into which a pipe is inserted.

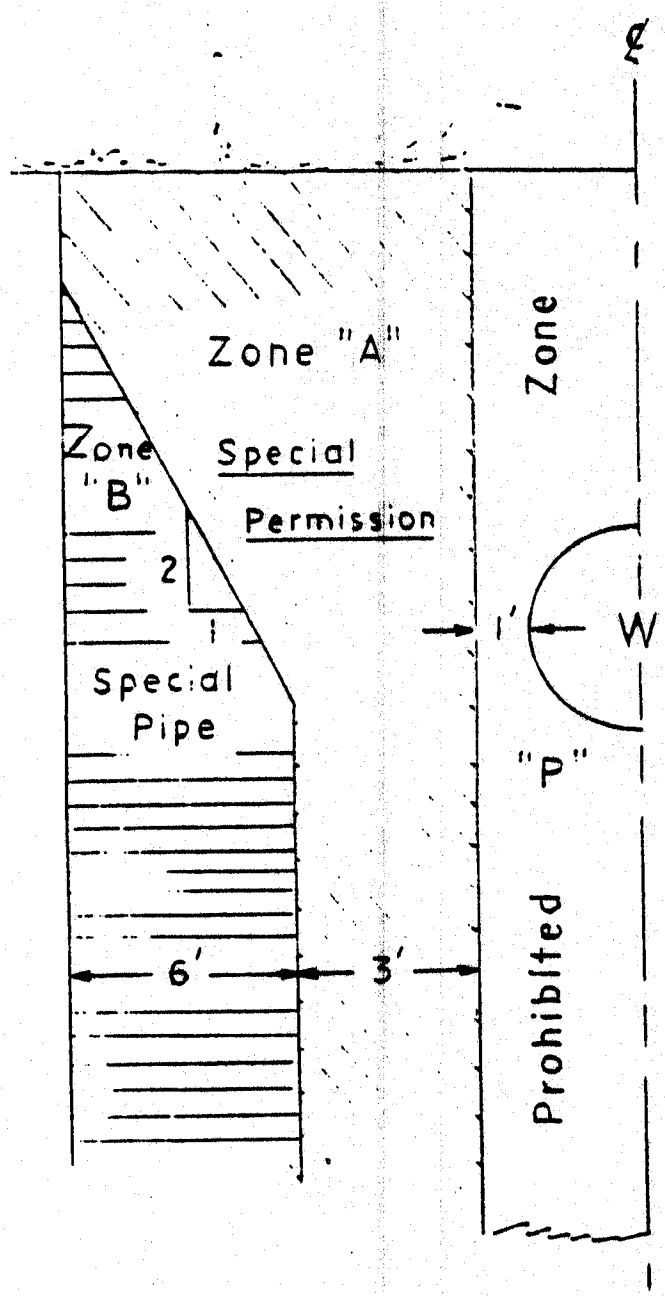
10. GROUND WATER -- Subsurface water found in the saturation zone.

11. HOUSE LATERAL -- A sewer connecting the building drain and the main sewer line.

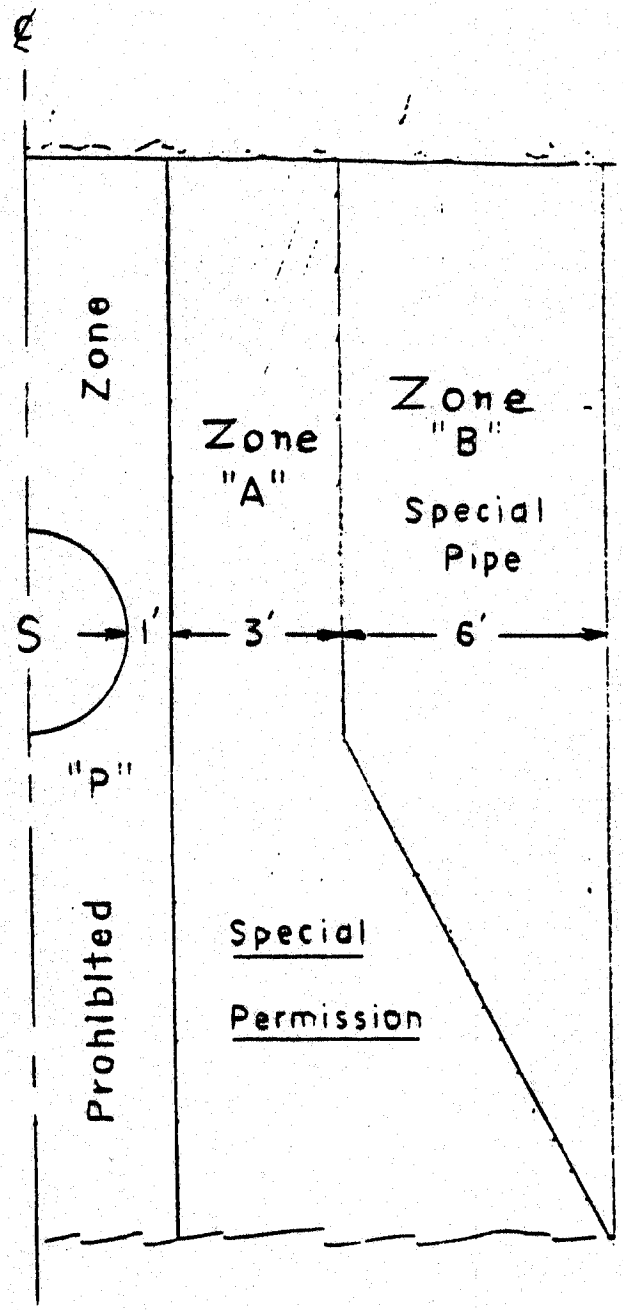
4/5/83

Figure 1

PARALLEL CONSTRUCTION



CASE 1
NEW SEWER

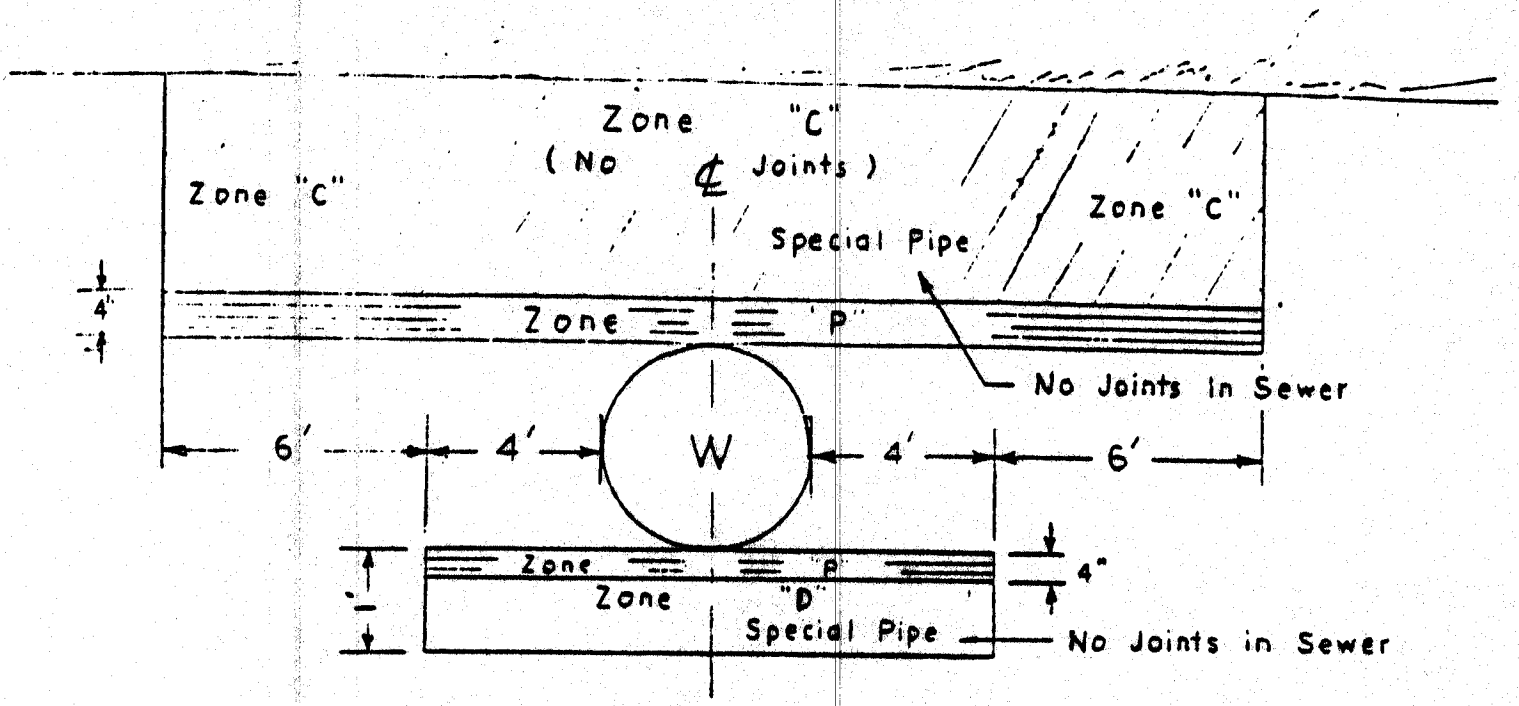


CASE 2
NEW WATER MAIN

Note: Zones identical on either side of center lines.
Zones "P" is a prohibited zone, Section 64630 (e) (2)
California Administrative Code, Title 22

Figure 2

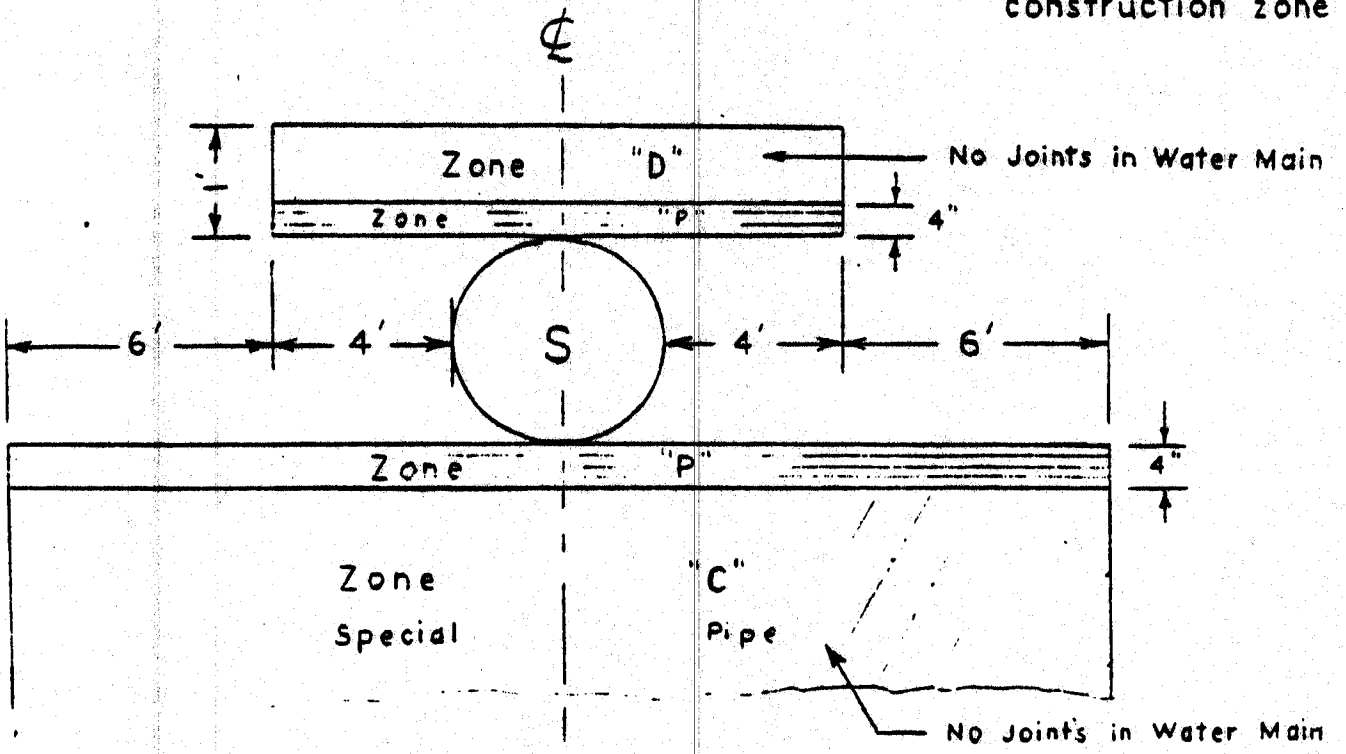
CROSSINGS



CASE 1

NEW SEWER

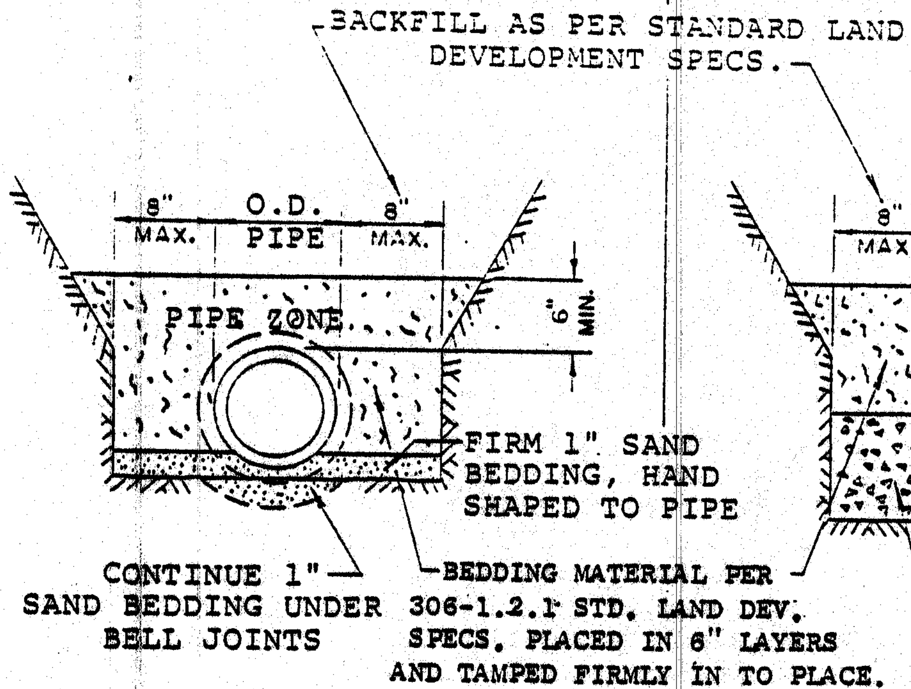
Note : "P" is a prohibited construction zone



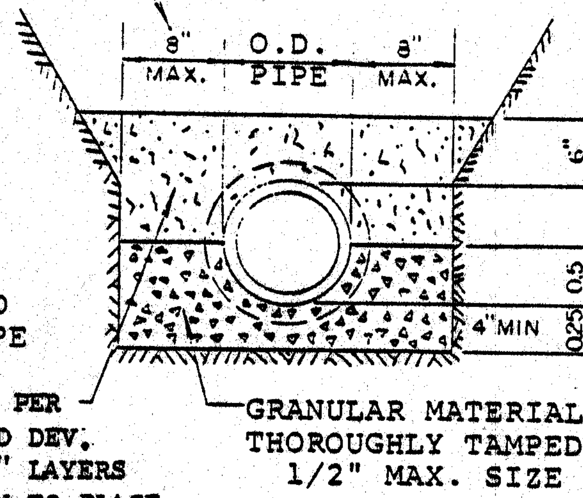
CASE 2

NEW WATER MAIN

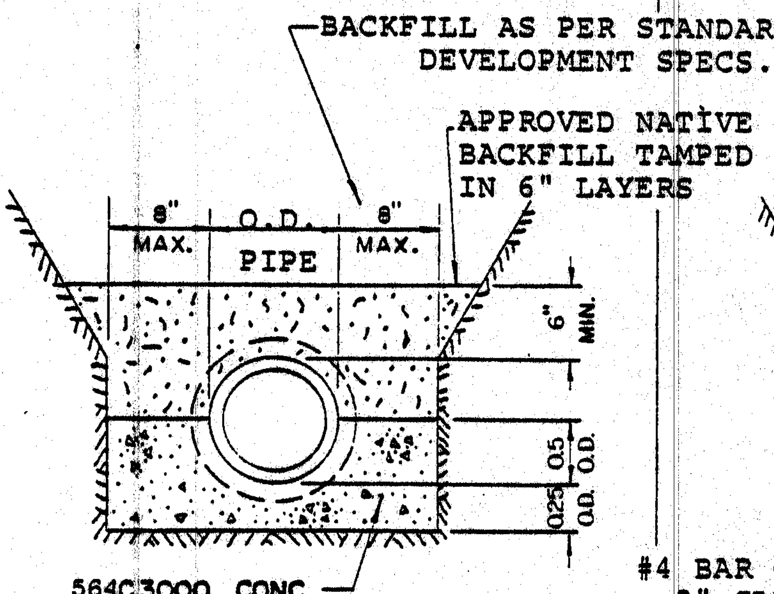
PLATE NO. 1
(Revision B)



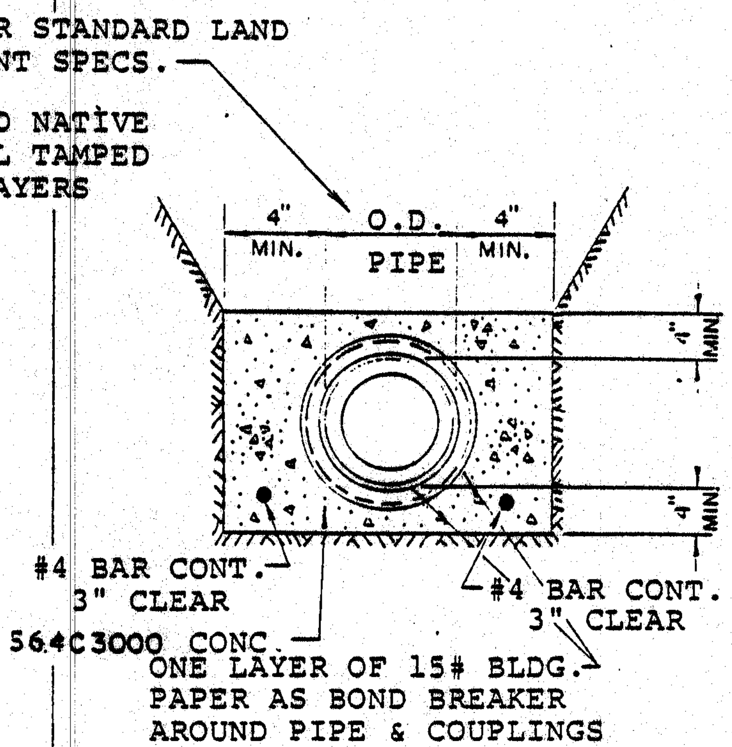
NORMAL BEDDING L.F. 1.5



BEDDING L.F. 1.9



CONCRETE CRADLE L.F. 3.0



CONCRETE ENCASEMENT L.F. 4.5

ADOPTED BY BOARD OF SUPERVISORS- 11-27-73

APPROVED:

DATE:

DIR. PUB. WKS.

R.C.E. No 8634
DEPUTY DIRECTOR

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS

SEWERAGE MANUAL

PIPE BEDDING

RIGID SEWER PIPE
6" to 15" Diameters
Maximum Allowable Depth of Cover Over Pipe in Feet

Pipe Diam.	Max. Trench Width	VCP**		NRCP				RCP								ACP									
				Class 2		Class 3		Class II		Class III		Class IV		Class V		Class 1500		Class 2400		Class 3300		Class 4000		Class 5000	
		LF		LF		LF		LF		LF		LF		LF		LF		LF		LF		LF		LF	
Inches	Inches	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9
6	19	30+	30+	30+	30+	30+	30+	NA	NA	NA	NA	NA	NA	NA	NA	30+	30+	30+	30+	30+	30+	30+	30+	30+	30+
6	25	30+	30+	30+	30+	30+	30+	NA	NA	NA	NA	NA	NA	NA	NA	16	30+	30+	30+	30+	30+	30+	30+	30+	30+
6	31	16	20	16	20	18	30+	NA	NA	NA	NA	NA	NA	NA	NA	14	18	22	30+	30+	30+	30+	30+	30+	30+
6	37+	16	20	16	20	18	22	NA	NA	NA	NA	NA	NA	NA	NA	14	18	22	28	30	30+	30+	30+	30+	30+
8	22	30+	30+	30+	30+	30+	30+	NA	NA	NA	NA	NA	NA	NA	NA	30+	30+	30+	30+	30+	30+	30+	30+	30+	30+
8	28	22	30+	14	30+	26	30+	NA	NA	NA	NA	NA	NA	NA	NA	10	22	30+	30+	30+	30+	30+	30+	30+	30+
8	34	12	16	12	14	12	18	NA	NA	NA	NA	NA	NA	NA	NA	10	12	16	30+	30+	30+	30+	30+	30+	30+
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10	48+	10	14	9	12	10	14	NA	NA	NA	NA	NA	NA	NA	NA	8	10	12	16	18	24	22	28	28	30+
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12	32	16	30+	10	18	14	28	*	6	7	12	16	30+	30+	30+	6	10	18	30+	30+	30+	30+	30+	30+	30+
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12	44	10	12	8	10	9	12	*	6	6	9	10	14	16	24	6	8	10	14	14	20	18	30+	30+	30+
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15	60	9	12	7	10	8	10	*	6	6	9	10	14	16	20	*	6	8	10	12	16	14	18	18	24

Accepted by Board of Supervisors 11-27-73

Director of Public Works — Date

Deputy Director R.C.E. No. 8634

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS

SEWERAGE MANUAL

RIGID PIPE STRENGTH TABLES

PLATE 2A

Adopted by Board of Supervisors 11-27-73

Director of Public Works — Date

Deputy Director R.C.E. No. 8634

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS

SEWERAGE MANUAL

RIGID PIPE STRENGTH TABLES

RIGID SEWER PIPE
16" to 24" Diameters
Maximum Allowable Depth of Cover Over Pipe in Feet

Pipe Diam. Inches	Max. Trench Width Inches	VCP**		NRCP Class 2		NRCP Class 3		RCP Class II		RCP Class III		RCP Class IV		RCP Class V		ACP Class 1500		ACP Class 2400		ACP Class 3300		ACP Class 4000		ACP Class 5000	
		LF		LF		LF		LF		LF		LF		LF		LF		LF		LF		LF		LF	
		1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9
16	31	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6	12	22	30+	30+	30+	30+	30+	30+	30+
16	37	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	7	10	18	24	30+	30+	30+	30+	30+
16	43	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	5	8	12	14	22	20	30+	30+	30+
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18	34	30+	30+	18	30+	20	30+	7	12	14	30+	30+	30+	30+	30+	*	8	16	30+	30+	30+	30+	30+	30+	30+
18	40	16	30+	10	16	12	18	*	8	9	14	20	30+	30+	30+	*	5	9	14	18	30+	30+	30+	30+	30+
18	46	10	16	7	12	8	12	*	6	6	10	12	22	30+	30+	*	*	6	10	12	18	16	30+	30	30+
18	52	9	12	7	9	7	10	*	6	6	9	10	14	20	30+	*	*	6	9	10	14	12	18	18	30+
18	58	9	12	7	9	7	10	*	6	6	9	10	14	16	24	*	*	6	9	10	12	12	16	16	22
18	64+	9	12	7	9	7	10	*	6	6	9	10	14	16	20	*	*	6	9	10	12	12	16	16	20
20	36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*	7	12	22	30	30+	30+	30+	30+	30+
20	42	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*	*	8	12	14	26	24	30+	30+	30+
20	48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*	*	6	9	10	16	14	24	24	30+
20	54	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*	*	6	8	9	12	10	16	16	26
20	60+	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*	*	6	8	9	12	10	14	14	18
21	37	30	30+	14	30	18	30+	7	12	14	30	30+	30+	30+	30+	NA	NA	10	18	24	30+	30+	30+	30+	30+
21	43	16	30+	9	16	12	20	5	8	9	14	22	30+	30+	30+	NA	NA	7	12	14	22	20	30+	30+	30+
21	49	12	18	7	10	9	14	*	6	7	10	14	24	30+	30+	NA	NA	5	8	10	14	14	22	22	30+
21	55	9	14	6	9	7	10	*	6	6	9	10	16	22	30+	NA	NA	5	7	8	12	10	16	16	24
21	61	9	12	6	9	7	10	*	6	6	9	10	14	16	26	NA	NA	5	7	8	10	10	12	12	18
21	67+	9	12	6	9	7	10	*	6	6	9	10	14	16	20	NA	NA	5	7	8	10	10	12	12	16
24	41	30+	30+	14	22	18	30+	7	12	14	26	30+	30+	30+	30+	*	*	8	14	16	30+	28	30+	30+	30+
24	47	16	30	9	14	12	20	5	9	10	16	22	30+	30+	30+	*	*	6	9	10	16	16	28	26	30+
24	53	12	18	7	10	9	14	*	7	8	12	14	24	30+	30+	*	*	*	7	8	12	12	18	16	30
24	59	10	14	6	9	8	12	*	6	6	9	12	18	24	30+	*	*	*	6	7	10	9	14	14	20
24	65	9	12	6	8	7	10	*	6	6	9	10	14	18	30	*	*	*	6	7	9	9	12	12	16
24	71	9	12	6	8	7	10	*	6	6	9	10	14	16	22	*	*	*	6	7	9	9	12	12	14
24	77+	9	12	6	8	7	10	*	6	6	9	10	14	16	20	*	*	*	6	7	9	9	12	12	14

PLATE 28

RIGID SEWER PIPE
27" to 36" Diameters
Maximum Allowable Depth of Cover Over Pipe in Feet

Pipe Diam. Inches	Max. Trench Width Inches	VCP** LF		NRCP Class 2 LF		NRCP Class 3 LF		RCP Class II LF		RCP Class III LF		RCP Class IV LF		RCP Class V LF		ACP Class 1500 LF		ACP Class 2400 LF		ACP Class 3300 LF		ACP Class 4000 LF		ACP Class 5000 LF	
		1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9
27	44	26	30+	NA	NA	NA	NA	8	12	14	24	30+	30+	30+	30+	*	*	6	10	12	20	18	30+	30+	30+
27	50	16	28	NA	NA	NA	NA	6	9	10	16	22	30+	30+	30+	*	*	*	8	9	14	12	20	20	30+
27	56	12	18	NA	NA	NA	NA	5	7	8	12	16	26	30+	30+	*	*	*	6	7	10	10	14	14	22
27	62	10	14	NA	NA	NA	NA	5	6	7	10	12	18	26	30+	*	*	*	5	6	9	8	12	12	16
27	68	9	12	NA	NA	NA	NA	5	6	6	9	10	16	20	30+	*	*	*	5	6	8	7	10	10	14
27	74	9	12	NA	NA	NA	NA	5	6	6	9	10	14	16	24	*	*	*	5	6	8	7	10	10	12
27	80+	9	12	NA	NA	NA	NA	5	6	6	9	10	14	16	20	*	*	*	5	6	8	7	10	10	12
30	48	20	30+	NA	NA	NA	NA	8	12	14	22	30+	30+	30+	30+	*	*	*	8	10	16	14	24	24	30+
30	54	14	24	NA	NA	NA	NA	6	9	10	16	22	30+	30+	30+	*	*	*	6	8	12	10	16	16	26
30	60	12	18	NA	NA	NA	NA	5	8	8	12	16	26	30+	30+	*	*	*	5	6	9	9	12	12	18
30	66	10	14	NA	NA	NA	NA	5	6	7	10	14	20	28	30+	*	*	*	5	6	8	7	10	10	14
30	72	8	12	NA	NA	NA	NA	5	6	7	9	12	16	22	30+	*	*	*	5	6	7	7	9	9	12
30	78	8	10	NA	NA	NA	NA	5	6	7	9	10	14	18	26	*	*	*	5	6	7	7	9	9	12
30	84	8	10	NA	NA	NA	NA	5	6	7	9	10	14	16	22	*	*	*	5	6	7	7	9	9	12
30	90+	8	10	NA	NA	NA	NA	5	6	7	9	10	14	16	20	*	*	*	5	6	7	7	9	9	12
33	52	18	30+	NA	NA	NA	NA	8	12	14	22	30+	30+	30+	30+	*	*	*	7	8	14	12	18	18	30+
33	58	14	22	NA	NA	NA	NA	6	9	10	16	22	30+	30+	30+	*	*	*	5	6	10	9	14	14	22
33	64	12	16	NA	NA	NA	NA	5	8	9	12	16	26	30+	30+	*	*	*	5	5	8	8	12	12	16
33	70	9	14	NA	NA	NA	NA	5	7	7	10	14	20	28	30+	*	*	*	5	5	7	6	9	9	14
33	76	8	12	NA	NA	NA	NA	5	6	7	9	12	16	22	30+	*	*	*	5	5	7	6	8	8	12
33	82	8	10	NA	NA	NA	NA	5	6	7	9	10	14	18	28	*	*	*	5	5	7	6	8	8	10
33	88	8	10	NA	NA	NA	NA	5	6	7	9	10	14	16	24	*	*	*	5	5	7	6	8	8	10
33	94+	8	10	NA	NA	NA	NA	5	6	7	9	10	14	16	20	*	*	*	5	5	7	6	8	8	10
36	55	18	30	NA	NA	NA	NA	8	12	14	22	30	30+	30+	30+	*	*	*	6	7	12	10	16	16	24
36	61	14	20	NA	NA	NA	NA	6	10	10	16	22	30+	30+	30+	*	*	*	*	6	9	8	12	12	18
36	67	12	16	NA	NA	NA	NA	5	8	9	14	16	26	30+	30+	*	*	*	*	5	7	7	10	10	14
36	73	10	14	NA	NA	NA	NA	5	7	8	12	14	20	28	30+	*	*	*	*	5	6	6	9	8	12
36	79	8	12	NA	NA	NA	NA	5	7	7	10	12	18	22	30+	*	*	*	*	5	6	6	8	7	10
36	85	8	10	NA	NA	NA	NA	5	7	7	9	10	16	20	30	*	*	*	*	5	6	6	7	7	9
36	91	8	10	NA	NA	NA	NA	5	7	7	9	10	14	16	24	*	*	*	*	5	6	6	7	7	9
36	97	8	10	NA	NA	NA	NA	5	7	7	9	10	14	16	22	*	*	*	*	5	6	6	7	7	9
36	105	8	10	NA	NA	NA	NA	5	7	7	9	10	14	16	20	*	*	*	*	5	6	6	7	7	9

Adopted by Board of Supervisors 11-27-73

Director of Public Works — Date

Deputy Director R.C.E. No 6034

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS

SEWERAGE MANUAL

RIGID PIPE STRENGTH TABLES

PLATE 2C

NOTES

1. TYPES OF PIPE:
   VCP** - EXTRA STRENGTH VITRIFIED CLAY PIPE (Standard Land Development Specifications, Section 207-8) SF 1.5
   NRCP - NON-REINFORCED CONCRETE PIPE (ASTM C-14) SF 1.5
   RCP - REINFORCED CONCRETE PIPE (ASTM C-76) SF 1.1 AT 0.01" CRACK
   ACP - ASBESTOS CEMENT PIPE (ASTM C-428) SF 1.3

2. TABLE BASED ON DRY CLAY BACKFILL AT 120 LBS. PER CUBIC FOOT.

3. MINIMUM DEPTH OF COVER OVER TOP OF PIPE IS 3 FEET.

4. WHERE 30+ IS SHOWN, IT INDICATES PIPE IS GOOD FOR OVER 30 FEET. STRENGTH COMPUTATION MUST BE SUBMITTED FOR OVER 30 FEET.

5. IF TRENCH AT ELEVATION OF TOP OF PIPE EXCEEDS DESIGN TRENCH WIDTH, GREATER PIPE STRENGTH MAY BE REQUIRED OR CONCRETE CRADLE ADDED.

*None

**This table applicable only to pipe meeting the requirements of both ASTM C-200 and Sec. 207-8 of the Standard Specifications.

Adopted by Board of Supervisors 11-27-73

Director of Public Works Date

Deputy Director R.C.E. No. 8634

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS

SEWERAGE MANUAL

RIGID PIPE STRENGTH TABLES

Adopted by Board of Supervisors 11-27-73

Director of Public Works — Date

Deputy Director R.C.E. No. 8834

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS

SEWERAGE MANUAL

FLEXIBLE PIPE STRENGTH TABLES

FLEXIBLE (PLASTIC) SEWER PIPE

Maximum Allowable Depth of Cover Over Pipe in Feet

Pipe Diam.	Max. Trench	ABS-Composite			PVC-PSM			PVC-PSP			RPM			ABS		
	Width	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=
Inches	Inches	300	500	700	300	500	700	300	500	700	300	500	700	300	500	700
6	18	30+	30+	30+	30+	30+	30+	30+	30+	30+	NA	NA	NA	30+	30+	30+
6	24	30+	30+	30+	14	30+	30+	6	30+	30+	NA	NA	NA	12	30+	30+
6	30	30+	30+	30+	8	30+	30+	None	26	30+	NA	NA	NA	7	30+	30+
6	36	22	30+	30+	6	20	30+	None	16	30+	NA	NA	NA	6	20	30+
6	42	16	30+	30+	6	16	30+	None	14	28	NA	NA	NA	6	16	30+
6	48	14	26	30+	5	14	26	None	12	22	NA	NA	NA	5	14	26
6	54	14	22	30+	5	12	22	None	12	20	NA	NA	NA	5	12	22
6	60	12	20	30+	5	12	20	None	12	18	NA	NA	NA	5	12	20
6	66	12	18	28	5	12	18	None	10	16	NA	NA	NA	None	12	18
6	72	12	18	26	None	12	18	None	10	16	NA	NA	NA	None	12	18
6	Any	8	12	14	None	8	12	None	7	10	NA	NA	NA	None	8	12
8	20	30+	30+	30+	30+	30+	30+	14	30+	30+	30+	30+	30+	None	30+	30+
8	26	30+	30+	30+	12	30+	30+	None	30+	30+	30+	30+	30+	None	30+	30+
8	32	30+	30+	30+	7	28	30+	None	20	30+	18	30+	30+	None	16	16
8	38	30+	30+	30+	6	18	30+	None	16	30+	14	30+	30+	None	14	14
8	44	24	30+	30+	6	16	30+	None	14	26	12	26	30+	None	12	12
8	50	20	30+	30+	5	14	24	None	12	20	12	20	30+	None	10	10
8	56	18	30	30+	5	12	22	None	12	18	10	18	30+	None	9	9
8	62	16	26	30+	5	12	20	None	10	16	9	16	28	None	9	9
8	68	16	24	30+	5	12	18	None	10	16	9	16	24	None	9	9
8	74	16	22	30	None	12	18	None	10	16	9	16	22	None	9	9
8	Any	10	14	16	None	8	12	None	7	10	7	10	14	None	7	7
10	23	30+	30+	30+	16	30+	30+	12	30+	30+	24	30+	30+	None	14	14
10	29	30+	30+	30+	8	30+	30+	None	30+	30+	12	30+	30+	None	7	7
10	35	30+	30+	30+	7	22	30+	None	18	30+	8	28	30+	None	6	6
10	41	28	30+	30+	6	16	30+	None	14	30+	7	18	30+	None	5	5
10	47	22	30+	30+	5	14	28	None	12	24	6	16	30+	None	5	5
10	53	18	30+	30+	5	14	24	None	12	20	6	14	26	None	None	None
10	59	18	28	30+	5	12	20	None	12	18	6	14	22	None	None	None
10	65	16	24	30+	5	12	18	None	10	16	6	12	20	None	None	None
10	71	16	22	30+	None	12	18	None	10	16	None	12	18	None	None	None
10	77	14	22	30	None	12	16	None	9	16	None	12	18	None	None	None
10	83	14	20	28	None	10	16	None	9	14	None	12	18	None	None	None
10	Any	10	14	16	None	8	12	None	7	10	None	9	12	None	None	None

PLATE 2E

FLEXIBLE (PLASTIC) SEWER PIPE

Maximum Allowable Depth of Cover Over Pipe in Feet

Pipe Diam	Max. Trench Width	ABS-Composite			PVC-PSM			PVC-PSP			RPM			ABS		
		E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=	E'=
Inches	Inches	300	500	700	300	500	700	300	500	700	300	500	700	300	500	700
12	25	30+	30+	30+	12	30+	30+	6	30+	30+	12	30+	30+	None	28	28
12	31	30+	30+	30+	8	30+	30+	None	24	30+	6	30+	30+	None	14	14
12	37	30+	30+	30+	6	20	30+	None	16	30+	None	18	30+	None	12	12
12	43	24	30+	30+	6	16	30+	None	14	28	None	16	30+	None	9	9
12	49	20	30+	30+	5	14	26	None	12	22	None	14	26	None	8	8
12	55	18	30	30+	5	12	22	None	12	18	None	12	22	None	8	8
12	61	16	26	30+	5	12	20	None	10	18	None	12	20	None	7	7
12	67	16	24	30+	5	12	18	None	10	16	None	12	18	None	7	7
12	73	16	22	30+	None	12	18	None	10	16	None	12	18	None	7	7
12	79	14	20	30	None	12	16	None	9	14	None	10	16	None	7	7
12	85	14	20	28	None	10	16	None	9	14	None	10	16	None	7	7
12	91	14	20	26	None	10	16	None	9	14	None	10	16	None	7	7
12	Any	10	14	16	None	8	12	None	7	10	None	8	12	None	5	5
15	28	30+	30+	30+	8	30+	30+	None	30+	30+	None	30+	30+	NA	NA	NA
15	34	30+	30+	30+	7	24	30+	None	18	30+	None	18	20	NA	NA	NA
15	40	28	30+	30+	6	18	30+	None	14	30+	None	14	16	NA	NA	NA
15	46	22	30+	30+	5	14	30	None	12	24	None	12	14	NA	NA	NA
15	52	18	30+	30+	5	14	24	None	12	20	None	12	12	NA	NA	NA
15	58	18	28	30+	5	12	20	None	12	18	None	10	12	NA	NA	NA
15	64	16	24	30+	5	12	20	None	10	16	None	10	10	NA	NA	NA
15	70	16	22	30+	None	12	18	None	10	16	None	9	10	NA	NA	NA
15	76	14	22	30	None	12	18	None	9	16	None	9	10	NA	NA	NA
15	82	14	20	28	None	10	16	None	9	14	None	9	9	NA	NA	NA
15	88	14	20	26	None	10	16	None	9	14	None	9	9	NA	NA	NA
15	94	14	20	26	None	10	16	None	9	14	None	9	9	NA	NA	NA
15	100	14	18	24	None	10	16	None	9	14	None	9	9	NA	NA	NA
15	Any	10	14	16	None	8	12	None	7	10	None	7	7	NA	NA	NA

Adopted by Board of Supervisors 11-27-73

Director of Public Works — Date

Deputy Director R.C.E. No. 8634

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS

SEWERAGE MANUAL

FLEXIBLE PIPE STRENGTH TABLES

PLATE 2F

NOTES

1. TYPES OF PIPE:
   PVC-PSM - - - - Poly(Vinyl Chloride) Type PSM ASTM D 3034, SDR 35.
   PVC-RSP - - - - Poly(Vinyl Chloride) Type PSP ASTM D 3033, SDR 41.
   ABS-Composite - Acrylonitrile-Butadiene-Styrene Composite ASTM D 2680. The 6-inch size under ABS-Composite is ABS, SDR=23.5 maximum.

   ABS - - - - - - Acrylonitrile-Butadiene-Styrene ASTM D 2751, SDR=42 maximum except 6" must have SDR=35 maximum.

   RPM - - - - - - Reinforced Plastic Mortar - Standard Land Development Specifications, Subsection 207-17.

2. Table based on Dry Clay Backfill at 120 lbs. per cubic foot and computed deflection of 3%.

3. E' is a measure of bedding stability.
   E'=300, bedding as required for LF 1.5 on Plate I.
   E'=500, bedding as required for LF 1.9 on Plate I with native material compacted to 85%.
   E'=700, bedding as required for LF 1.9 on Plate I with native material compacted to 90%.

4. Minimum cover under roads is 4 feet except where E' is 500 or greater, 3 feet minimum is allowed. For ABS, 10-inch pipe, minimum cover is 4 feet regardless of E'.

5. Designs other than those shown in the table may be submitted for the approval of the Engineer. All installations shall be made and tested in accordance with the Standard Land Development Specifications.

6. Where 30+ is shown, it indicates pipe is good for over 30 feet. Strength computation must be submitted for over 30 feet.

7. This table or any other approved design does not relieve the requirement of Standard Land Development Specifications, Subsection 306-1.4.6 which provides for a Go-Nogo test at 95% of the average diameter after installation, backfill and compaction is complete.

8. If trench at elevation of top of pipe exceeds design trench width, greater pipe strength may be required or concrete cradle needed.

Adopted by Board of Supervisors 2/28/77

Director of Public Works — Date

DEPUTY DIRECTOR — R.C.E. No. 8634

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS

SEWERAGE MANUAL

FLEXIBLE PIPE STRENGTH TABLES