

ENGINEERING DESIGN STANDARDS



ENGINEERING & OPERATIONS

July 2008

Approved by:

Rick Raives
Assistant Public Works Director/City Engineer

7-28-08

Date

TABLE OF CONTENTS

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
LIST OF TABLES		
1.	INTRODUCTION	1-1
2.	STREET THOROUGHFARE AND STREET CLASSIFICATIONS	2-1
2-1	Primary and Secondary Thoroughfares	2-1
2-2	Collector Thoroughfares	2-1
2-3	Industrial Thoroughfares	2-2
2-4	Local Streets	2-2
2-5	Hillside Streets	2-2
2-6	Alleys	2-3
2-7	Private Streets	2-3
3.	ACCESS	3-1
3-1	State Highways	3-1
3-2	City Streets	3-1
3-2.01	Access Points	3-2
3-2.02	Provision of Access	3-2
3-2.03	Number of Access Points.....	3-2
3-2.04	Left Turn Lanes.....	3-2
4.	SITE DESIGN	4-1
4-1	City R/W Access Spacing	4-1
4-2	Access Alignment	4-1
4-3	Access Design	4-2
4-4	Common Access.....	4-3
4-5	Vehicle Stacking Requirements	4-3
4-5.01	For Accesses Serving Off-Street Parking Lots.....	4-3
4-5.02	For Drive Through Uses.....	4-7
4-6	Mini-Storage Warehouse Access Design.....	4-8
4-7	Special Requirements for Access to Fast Food Restaurants	4-8
5.	THOROUGHFARE AND STREET DESIGN STANDARDS	5-1
5-1	General	5-1
5-2	Street Name Signs.....	5-1
5-3	Traffic Signs.....	5-2
5-4	Primary Arterial Thoroughfares	5-2
5-5	Secondary Arterial Thoroughfares	5-3
5-6	Collector Thoroughfares	5-4
5-7	Industrial Thoroughfares	5-5

5-8	Local Streets.....	5-6
5-9	Alleys.....	5-6
5-10	Private Streets.....	5-7
5-11	Frontage Improvements.....	5-7
5-12	Street Pavement Design.....	5-8
5-13	Curbs and Gutters.....	5-8
5-14	Sidewalk Repair.....	5-9
5-15.....	Street Lighting.....	5-9
5-16	Speed Bumps, Humps, and Cushions.....	5-9
5-17	Cross Walks and Curb Ramps.....	5-10
5-18	Utility Structures and Equipment within the Street Right-of-Way.....	5-10
6.	GEOMETRIC DESIGN STANDARDS.....	6-1
6-1	Lane Widths.....	6-1
6-2	Horizontal and Vertical Alignments.....	6-1
6-2.01	Horizontal Curves.....	6-1
6-2.02	Vertical Curves and Grades.....	6-3
6-3	Intersections.....	6-4
6-3.01	Spacing and Offsets.....	6-4
6-3.02	Corner Radii.....	6-4
6-4	Street Width Transition Tapers.....	6-5
6-5	Sight Distance.....	6-6
6-5.01	At Public Street Intersections.....	6-6
6-5.02	At Private Accesses to Public Street.....	6-7
6-5.03	Stopping and Passing Sight Distances.....	6-7
6-6	Bikeway and Sidewalk Clearances, Widths and Routes.....	6-9
6-7	Medians.....	6-10
6-8	Vertical Clearance Structures.....	6-11
6-9	Guardrails.....	6-11
7.	SUSTAINABLE STREET DESIGN.....	7-1
7.1	General.....	7-1
7.2	Elements.....	7-1
8.	STORM WATER DRAINAGE SYSTEMS.....	8-1
8-1	Storm Water Drainage System-Hydrology.....	8-1
8-2	Hydrology Map.....	8-1
8-3	Storm Water Drainage System Hydraulics.....	8-1
8-4	Storm Water Structures.....	8-2
8-5	National Pollution Elimination System (NPDES) Permit and Best Management Practices.....	8-2
8-6	Storm Drain Easements.....	8-2
9.	SEWER SYSTEMS.....	9-1
9-1	Sewer Main Design.....	9-1
9-2	Sewer Mains.....	9-2

9-3	Sewer Laterals	9-2
9-4	Manholes	9-2
9-5	Force Mains and Lift Stations	9-3
9-6	Sewer Easements.....	9-4
10.	WATER SYSTEMS.....	10-1
10-1	Water Distribution System Design	10-1
10-2	Service Connections	10-1
10-3	Water Mains.....	10-2
10-4	Water Mains Easements.....	10-3
10-5	Water Tanks/Reservoirs	10-4
10-6	Wells.....	10-6
10-7	Booster Pump Stations	10-7
10-8	Pressure Reducing Stations	10-8
10-9	Factory Witness Testing	10-8
11.	SURVEY MONUMENTATION	11-1
11-1	Exterior Monumentation.....	11-1
11-2	Street Monumentation.....	11-1
11-3	Lot Monumentation	11-1
11-4	Character of Monuments	11-1
11-5	Centerline Ties.....	11-1
11-6	Certificate of Correction	11-2
11-7	Bench Level Circuit.....	11-2
11-8	Additional Monumentation Requirements	11-2
11-9	Data in Digital Format	11-2
11-10	Real Property Descriptions	11-2
12.	DESIGN PLAN REQUIREMENTS.....	12-1
12-1	Introduction.....	12-1
12-2	Improvement Plan Requirements	12-1
12-2.01	Materials	12-1
12-2.02	Title Sheets.....	12-1
12-2-03	Sheet Dimensions.....	12-2
12-2.04	Plan and Plan Profile Sheets	12-3
12-2-05	“Record Drawing” Improvement Plans	12-6
12-2.06	CAD Drawings	12-6

LIST OF TABLES

TABLE NUMBERS		PAGE
1	Access Radii	4-2
2	On-site Stacking for Parking Lot Access	4-4
3	Vehicle Queuing Requirements for Drive-In Facilities	4-7
4	Minimum Lane Widths	6-1
5	Minimum Horizontal Curve Design Criteria	6-2
6	Minimum Vertical Curve Design Criteria	6-3
7	Minimum Intersection Corner Radii.....	6-5
8	Minimum Road Width Transition Tapers	6-6
9	Minimum Stopping Sight Distance	6-8
10	Effect of Grade on Stopping Distance.....	6-8
11	Recommended Minimum Median Widths	6-11

SECTION I

INTRODUCTION

SECTION 1. INTRODUCTION

The Engineering Design Standards contained in this manual provide standards for frequently used engineering related design practices for City capital improvement projects, new developments or the redevelopment of existing land in the City of Ventura. Some of the material contained in this manual has been drawn from previous City regulations as well as nationally established texts and publications. These standards are minimum standards, and do not preclude the engineer or designer from designing to a higher level. A failure to meet minimum standards can create a deficiency resulting in higher maintenance and operation costs and safety inadequacies. The high costs of maintenance necessitate that construction be done with adequate standards. These standards are intended to keep operating costs for public facilities at a reasonable level. It is recognized that certain improvements financed wholly or in part with State or Federal funds are subject to the standards prescribed by those agencies. Such standards may be different than City standards and may take priority over these standards.

Most standards in this manual are meant to apply to new public improvements, which are not constrained by existing improvements. Infill development in an urban area is often constrained by existing substandard improvements. To the extent deemed possible by the City Engineer, substandard improvements may be required to be reconstructed to match these standards. The City Engineer may allow modification of these standards when necessary to allow private and public construction, which is compatible with surrounding in-place improvements or other surrounding or adjacent special conditions.

The accuracy, sound design, and conformance with accepted engineering practice of all plans submitted to the City will remain the sole responsibility of the State of California Registered Engineer signing and stamping the plans.

These Engineering Design Standards supplement both the City's Municipal Code and the latest edition of the City's Standard Construction Details.

SECTION 2

THOROUGHFARE AND STREET CLASSIFICATIONS

SECTION 2. THOROUGHFARE AND STREET CLASSIFICATIONS

The following street design classifications and functional characteristics have been provided for use according to the City's General Plan. Typical Sections are provided in the City's Standard Construction Details.

2-1 Primary and Secondary Arterial Thoroughfares – Boulevards, Avenues and Streets

A primary and secondary arterial thoroughfare (boulevard and avenue) is a general term denoting a street used for cross-town travel and serve major centers of activity. They are generally designed or operating with the following characteristics:

- a. Speed limit (desirable speed) typically equal to or greater than 35 mph, but not more than 45 mph. In urban districts the desired traffic speeds are less than 35 mph.
- b. Expected minimum traffic volumes when the land, which the major street serves, is fully developed of 15,000 vehicles per day for two-lane streets. Expected maximum volumes of 35,000 vehicles per day for four-lane streets, and 50,000 vehicles per day for six lane streets.
- c. Limited or controlled access to adjacent parcels of land.
- d. Traffic control at higher volume intersections provided by traffic signals or roundabouts. Side street control by stop signs and/or turn restrictions.
- e. No new back-out driveways permitted (also see Subsection 4-3).

2-2 Collector Thoroughfares – Boulevards, Avenues, Streets, and Main Streets

A collector thoroughfare is a general term denoting a street that serves as links between local streets. They are generally designed or operating with the following characteristics:

- a. Speed limit (desirable speed) 25-30 mph.
- b. Traffic volumes generally less than 15,000 vehicles per day for two-lanes.
- c. Designed to handle traffic volumes loading from and onto other local, collector, and arterial streets.
- d. Traffic control on collector streets generally provided by stop signs or roundabouts.

2-2 Industrial Thoroughfares

An industrial thoroughfare is a general term denoting a local street designed to serve industrial land uses in a specific industrial district. These types of streets are designed or operating with the following characteristics:

- a. Speed limit (desirable speed) from 25-30 mph.
- b. Traffic volumes up to 10,000 vehicles per day with higher than average percentage of truck traffic.
- c. Designed to primarily serve as access to and from adjacent industrial development.
- d. Traffic control by stop signs and/or traffic signals where necessary.

2-4 Local Streets

A local street is a general term denoting a street designed or operating with the following characteristics:

- a. Fronting residential or pedestrian-scale commercial land uses.
- b. Curb to curb width that discourages travel speeds higher than 25 mph.
- c. Speed limit (desirable speed) 25mph or less.
- d. Traffic volumes up to 3,500 vehicles per day. Typical average daily volume of 800 - 1500 vehicles per day.
- e. Designed for the safety of pedestrians and bicyclists, and the ease of access to adjacent parcels of land.
- f. High level of connectivity with other local streets and to collector streets.
- g. Traffic control by stop signs, traffic circles, roundabouts, yield signs, or right-of-way rules for uncontrolled intersections.

2.5 Hillside Streets

Special standards apply for streets constructed in conjunction with hillside development. For details and maps of hillside areas, references should be made to the City's Hillside Management Program. The general objectives of these standards are:

- a. To minimize the adverse visual impact of streets on the hillside landscape.

- b. To establish internal street systems in future hillside developments, which permit safe and efficient travel for motor vehicles, bicycles, and pedestrians, and ensure ready access for emergency vehicles.
- c. Streets shall run with the natural contours of the land, and not at right angles to them, unless absolutely unavoidable. The burden will be upon the developer to show that streets running with the contours are not feasible.
- d. All subdivisions shall strive to provide public parking spaces at strategic vista points within the development. Developments shall also provide adequate private off-street parking to minimize the need for parking on narrow hillside streets.
- e. Traffic control by stop signs, traffic circles or roundabouts, yield signs, or right-of-way rules for uncontrolled intersections.
- f. Traffic volumes in the range of 200 to 1200 vehicles per day.
- g. Desirable speeds of 15 – 20 mph.

2.6 Alleys

An alley is a term denoting a local access right-of-way to serve as a primary vehicular and service access to residential and commercial development with the following general characteristics:

- a. Speed limit (desirable speed) of 10-15 mph.
- b. Traffic volumes up to 1000 vpd.
- c. Generally no traffic controls except prohibited parking.
- d. Full access to pedestrians and bicycles.

2.7 Private Streets

Private streets are not encouraged. However, if allowed, the following policies apply to private streets in the City:

- a. The width and grades of private streets may vary according to density and traffic impact on each site after appropriate review by the City's Community Development, Engineering, and Police/Fire staff.

- b. Appropriate signs stating that streets are privately owned and maintained must be posted at the entrance to the private street system that clearly indicate to the public, and to the City Police and street maintenance crew, that the street system is private property. The City's public street name signs (color or logo) shall not be used.

SECTION 3

ACCESS

SECTION 3. ACCESS

3-1 State Highways

Access to State Highways is regulated by State of California, Department of Transportation (Caltrans). The City will help coordinate requests for new access and changes to existing access with Caltrans. Encroachment permits for access to State Highways are available from Caltrans, and it is the responsibility of the developer or Contractor to obtain permits whenever construction within Caltrans' right- of-way is required.

3-2 City Streets and Thoroughfares

The design, number, and location of access points from private property to City streets shall be approved by the City Engineer, or designee, when the use of any property or its access operation is changed. The number of access points shall be kept to a minimum. No access points will be approved without an acceptable project site plan. Refer to Section 3-2.03.

All construction to connect driveways to City streets shall first be authorized by a valid Encroachment Permit with the City. The following information is presented as a general guideline for the location of access points to the public street system. When there are changes in property use which result in changes in the type of access operation, and the existing access is not in conformance with City Standards, the City Engineer may require reconstruction, relocation or conformance of the access to City Standards when any of the following access change criteria occur, or will occur as a result of changes in property use:

- a. The hourly use of the access increases in actual or proposed vehicular volume by 20% as determined by the City.
- b. A particular directional characteristic (such as left turns) increases by 20% per hour as determined by the City.
- c. The change in use of the property or modifications to the property causes the flow of vehicles entering the property to be restricted or to queue or hesitate on the street, thereby creating a hazard.
- d. The daily use of the access by vehicles exceeding 30,000 pounds gross vehicle weight increases by 20% or by 10 vehicles per day as determined by the City.

3-2.01 Access Points

Access points will not be approved for parking or loading areas that require backing maneuvers in a public street right of way except for local streets or where no other point of access is deemed feasible by the City Engineer. Refer to City Standard Construction Details for construction and size details.

3-2.02 Provision of Access

If a property has frontage on more than one street, access shall be permitted only on those street frontages where standards contained in this manual and other City Regulations can be met.

If a property cannot be served by any access point meeting these standards, the City Engineer may designate one or more access point(s) based on traffic safety, operational needs and conformance to as many of the requirements of these guidelines as possible. This does not constitute a guarantee by the City to provide access to a property.

3-2.03 Number of Access Points

Only one access point per residential property will generally be allowed, unless a development or circulation plan is provided to the City Engineer indicating that more than one access is needed and will not be detrimental to traffic flow or traffic safety on adjacent public roads. Conversion of existing single driveways to circular driveways on high volume streets are allowed and generally encouraged. Where a property has access to more than one street, access shall be limited to the lowest volume road where the impacts of a new access will be minimized. Access on other higher volume roads may be denied. This does not constitute a guarantee by the City to provide access to a property.

Temporary access may be granted to undeveloped property prior to development of a final development plan if access is needed for construction or preliminary site access. Temporary accesses are subject to removal, relocation, or redesign after final development plan approval.

Secondary access for emergency vehicles shall be provided for all multi-family, mixed use, and commercial developments.

3-2.04 Left Turn Lanes

Left turn lanes shall be provided where feasible on arterial and collector streets when needed for orderly traffic flow or traffic safety. Consideration for left turn lanes shall be given when the access volume meets or exceeds 50 turning movements per peak hour volumes for 25 to 35 mph streets, or 35 turning

movements per peak hour on 40 to 55 mph streets. The consideration shall include a review of pedestrian and bicycle accessibility and safety.

SECTION 4
SITE DESIGN

SECTION 4. SITE DESIGN

4-1 City R/W Access Spacing

Accesses to City R/W shall be located in conformance with the following provisions:

- a. No portion of an access shall be permitted within curb returns. The edge of the access shall not be less than five feet from the end of curb return for single-family or low-density residential developments. For all other developments, this distance shall not be less than 100 feet. Where the lot size does not permit the access to be located 100 feet from the end of curb return, the access shall be located the maximum distance possible from the end of the curb return. This distance does not include the three-foot transition or wing sections on each side of the driveway.
- b. The nearest edge of any driveway (beginning at 3 foot transition from 6" curb face to flow line of the street) shall be at least 3 feet from a property line, 5 feet from the edge of an above grade utility or 12 feet from a tree.
- c. Where two or more accesses serve adjacent single-family or low density residential property, the minimum distance between the nearest points of the two accesses shall be at least 20 feet . This does not include the 3-foot transition or wing sections on each side of the driveway. Where two or more accesses serve the same or adjacent non-single family or low-density residential development, the minimum distance between the center lines of accesses shall be at least 100-feet on streets with design speeds below 30 mph and 160-feet on streets with design speeds above 30 mph.
- d. The distance between the front wall or garage door of a single or multi family residential development to the back of the sidewalk along the length of a driveway shall be at least 20-feet in order to permit a vehicle to park in the driveway without blocking the sidewalk. This distance may be reduced to 17.5 feet if the appropriate type of roll up or sectional garage doors are provided.

4-2 Access Alignment

Where lots are not large enough to allow accesses on opposite sides of the street to be aligned, the center of driveways not in alignment shall normally be offset a minimum of 100-feet on all collector roads, and 200-feet on all arterial roads. Greater distances may be required if needed for additional left turn storage.

Minimum sight distance shall be provided at all access points. This requirement applies to both public road and private access locations.

Accesses shall intersect a public street at 90 degrees or as close to 90 degrees as topography permits (no less than 80 degrees) offsets with conflicting left turn movements should not be allowed and shall considered after a traffic safety analysis has been completed and accepted by the City.

4-3 Access Design

Generally, all new private property accesses shall be designed as driveways. Radii type curb returns may be allowed and required by the City for accesses meeting the criteria summarized in Table 1, and wherever islands are constructed in the driveway to control turning movements. All radii are quoted in feet as measured along the flowline or edge of pavement where no flowline exists. The design of accesses shall take into consideration the needs of truck traffic and pedestrian access and must be checked using the appropriate turning template. The maximum radius allowed is 45-feet unless a mountable median is provided as approved by the City Engineer in the case of a right turn bypass. Drainage patterns shall also be taken into consideration in the design of accesses as well as ADA accessibility and pedestrian safety/walkability.

TABLE 1 - ACCESS RADII

Road Class	Residential Single-Family	Residential Multi-Family	Service¹ Commercial	Shopping Center	Industrial
Local	Curb Cut ⁴	Curt Cut ²	Curb Cut	Curb Cut	Curb Cut
Collector	Curb Cut ⁴	Curb Cut ² 15 Radius ² 25 Radius ²	Curb Cut ² 15 Radius ² 25 Radius ²	Curb Cut ² 15 Radius ² 25 Radius ²	30 Radius 20 Radius ²
Industrial, Major or Arterial	Curb Cut ⁴	Curb Cut ² 15 Radius ² 20 Radius ^{2, 3}	Curb Cut ² 15 Radius ² 25 Radius ^{2,3}	Curb Cut ² 15 Radius ² 25 Radius ^{2,3}	45 Radius

¹ Banks, Offices, Fast Food Restaurants, Gas Stations, Single Business and Retail Outlets.

² For Residential Multi-family, Service Commercial, and Shopping Center uses on arterial streets, standard curb cut access cuts shall be used if the anticipated average daily volume is less than 500 vpd. Radius return type accesses shall be considered with a 15-foot radius if the driveway access average daily volume is between 500 vpd and 1000 vpd, or a 20-foot radius if the daily volume is greater than 1000 vpd. Accesses serving multi-family and commercial uses shall be a minimum of 20 feet in width and shall not exceed 35 feet in width.

- ³ A 45-foot radii shall be required for accesses when multi-unit vehicles or single unit vehicles exceeding 40-feet in length are intended to use the access on a sufficiently frequent basis as determined by the City Engineer.
- ⁴ For single-family residential property, curb cuts shall be a minimum of 10-feet and a maximum of 20-feet wide.

4-4 Common Access

Common access will be encouraged and required for new development or redevelopment projects where the City Engineer determines that shared access points serve land uses more efficiently than single non-shared driveways. An appropriate document providing reciprocal access easements shall be recorded and filed with the City prior to issuance of building permits for development projects. Common access within a minimum width of 25 feet shall be required for two adjacent developments where a proposed new access does not meet the spacing requirements of this manual.

4-5 Vehicle Stacking Requirements

When a development is located adjacent to a public street, the parking facility shall have full internal vehicular circulation and storage. Vehicular circulation shall be located completely within the property and vehicles within one portion of the development shall have access to all other portions without using the adjacent road system. For stacking purposes, where a proposed development includes a truck loading operation and has access to a public street, adequate space shall be provided such that all truck maneuvering is performed off street. Combined truck loading and through vehicle access is discouraged. Adequate queuing capacity shall be provided for both inbound and outbound vehicles to facilitate the safe and efficient movement between the road and the development. Inbound vehicle storage areas shall be of sufficient size to ensure that vehicles will not obstruct the adjacent road, sidewalk, or circulation within the facility. Outbound vehicle storage areas shall be provided to eliminate backup and delay of vehicles within the development. The following requirements for vehicle storage in parking lots and at drive-up type facilities are based on a typical vehicle length of 20-feet. Detailed studies of "model" facilities are acceptable as approved by the City Engineer in lieu of using the following requirements.

4-5.01 For Accesses Serving Off-Street Parking Lots

Recommended distances from the flow line of the road to the first parking stall or aisle for a parking lot design are presented in Table 2 and were developed by the City to provide for a storage area for outbound vehicles exiting a parking lot. Vehicle storage equivalent to the distances shown in Table 2 shall be provided at accesses serving the sites. The recommended vehicle storage

area needed for the entire site may be spread over several accesses if more than one access serves the site. The recommended distance may be further adjusted for accesses with two approach lanes and shall be subject to traffic volumes and site layout.

**TABLE 2
ON-SITE STACKING FOR PARKING LOT ACCESS¹**

LAND USE	PEAK EXIT TRIPS	SIZE	LOCAL (FT)	COLLECTOR OR INDUSTRIAL (FT)	ARTERIAL (FT)
APARTMENTS	0.5/Unit	0-30 Units	20	20	20
		31-60	20	20	40
		60-120	20	40	80
		121-240	40	60	120
		241-400	60	80	160
R.V. PARK	0.2/Unit	0-75 Units	20	20	20
		76-200	20	20	40
		201-375	20	40	60
CONDOMINIUMS	0.6/Unit	0-25 Units	20	20	20
		26-50	20	20	40
		51-100	20	40	80
		101-200	40	60	120
		201-300	60	80	160
MOBILE HOMES	0.3/Unit	0-50 Units	20	20	20
		51-100	20	20	40
		101-200	20	40	60
		201-300	40	60	80
QUALITY RESTAURANT	2.4/T.S.F. ²	0-7,000 S.F.	20	20	20
		7,001-13,000	20	20	40
		13,001-20,000	20	40	60
		20,001-35,000	40	60	80
HIGH TURNOVER/ SIT-DOWN RESTAURANT	2.4/T.S.F.	0-3,000 S.F.	20	20	20
		3,001-8,000	20	20	40
		8,001-14,000	20	40	60
		14,001-20,000	40	60	80
DRIVE-IN RESTAURANT	34.2/T.S.F.	0-2,000 S.F.	20	20	40
		2,001-3,000	20	40	80
		3,001-5,000	40	60	120
		5,001-7,000	60	80	160
MOTEL	0.4/Room	0-50 Rooms	20	20	20
		51-100	20	20	40
		101-200	20	40	80
		201-400	40	80	120
		401-800	80	120	200

LAND USE	PEAK EXIT TRIPS	SIZE	LOCAL (FT)	COLLECTOR OR INDUSTRIAL (FT)	ARTERIAL (FT)
CONVENTION HOTEL	0.35/Room	0-50 Rooms	20	20	20
		51-100	20	20	40
		101-200	20	40	80
		201-400	40	60	120
		401-800	80	100	180
NON-CONVENTION HOTEL	0.24/Room	0-60 Rooms	20	20	20
		61-120	20	20	40
		121-300	20	40	80
		301-500	40	60	120
		501-800	60	80	160
OFFICE PARK	1.2/T.S.F.	0-10,000 S.F.	20	20	20
		10,001-20,000	20	20	40
		20,001-50,000	20	40	60
		50,001-100,000	40	60	100
		100,001-150,000	60	100	160
		150,001-300,000	100	200	300
		300,001-500,000	160	320	500
GENERAL OFFICE	2.32/T.S.F. 2.32/T.S.F. 1.76/T.S.F. 1.76/T.S.F. 1.76/T.S.F. 1.28/T.S.F. 1.28/T.S.F. 1.28/T.S.F.	0-20,000 S.F.	20	20	40
		20,001-50,000	20	40	80
		50,001-100,000	40	60	140
		100,001-150,000	40	100	200
		150,001-200,000	60	120	250
		200,001-300,000	80	160	300
		300,001-400,000	100	200	400
		400,001-500,000	120	240	500
MANUFACTURING	0.4/T.S.F.	0-50,000 S.F.	20	20	20
		50,001-100,000	20	20	40
		100,001-200,000	20	40	60
		200,001-300,000	40	60	100
		300,001-400,000	40	60	120
		400,001-500,000	60	80	160
WAREHOUSE	1.0/T.S.F.	0-100,000 S.F.	20040	40	60
		100,001-200,000	60	80	140
		200,001-300,000	80	100	200
		300,001-400,000	100	140	280
		400,001-500,000		180	340
MINI-WAREHOUSE/ STORAGE	0.4/T.S.F.	0-50,000 S.F.	20	20	20
		50,001-100,000	20	20	40
		100,001-200,000	20	40	60
INDUSTRIAL PARK	0.8/T.S.F.	0-200,000 S.F.	40	60	100
		201,000-400,000	60	100	200
		401,000-600,000	80	160	300
		601,000-800,000	100	200	400
NEIGHBORHOOD SHOPPING	9.0/T.S.F.	0-3,000 S.F.	20	20	20
		3,001-6,000	20	20	40
		6,001-10,000	20	40	60

LAND USE	PEAK EXIT TRIPS	SIZE	LOCAL (FT)	COLLECTOR OR INDUSTRIAL (FT)	ARTERIAL (FT)
COMMUNITY SHOPPING	4.5/T.S.F.	10,000-20,000 S.F.	20	40	60
		20,001-30,000	40	60	100
		30,001-50,000	60	80	160
STRIP COMMERCIAL	3.1/T.S.F.	50,000-100,000 S.F.	60	120	200
		100,001-150,000	80	160	300
		150,001-200,000	100	200	400
REGIONAL SHOPPING	2.3/T.S.F.	200,001-300,000 S.F.	120	240	480
		300,001-400,000	160	300	600
		400,001-500,000	180	360	700
		500,001-600,000	200	400	800
		600,001-700,000	240	460	900
		700,001-800,000	260	500	1,000
		800,001-900,000	280	560	1,100
REGIONAL SHOPPING (Continued)	2.3/T.S.F.	900,001-1,000,000	300	600	1,200
		1,000,001-1,200,000	340	660	1,300
		1,200,001-1,500,000	380	700	1,500
DRIVE-IN BANK	25.0/T.S.F.	0-5,000 S.F.	20	40	60
		5001-10,000	40	60	120
		10,001-20,000	60	120	240
		20,001-30,000	100	180	360
		30,001-40,000	120	240	480
		40,001-50,000	140	280	560
WALK-IN BANK	12.0/T.S.F.	0-5,000 S.F.	20	20	40
		5,001-10,000	20	40	60
		10,001-20,000	40	60	100
		20,001-30,000	40	80	160
		30,001-40,000	60	100	220
		40,001-50,000	80	140	280
GROCERY STORE	5.0/T.S.F.	0-10,000 S.F.	20	20	40
		10,001-20,000	20	40	60
		20,001-30,000	40	60	100
		30,001-40,000	40	80	140
		40,001-50,001	40	80	160
MEDICAL OFFICE	3.5/T.S.F.	0-10,000 S.F.	20	20	40
		10,001-20,00	20	40	60
		20,001-40,00	40	60	100

¹ Distance is measured from the flow line of the street to the first parking stall or aisle. These distances are based on vehicle length of 20 feet.

² T.S.F. = Thousand square feet

4-5.02 For Drive Through Uses

Table 3 summarizes the vehicle storage area that shall be provided for drive through uses. These storage areas must be:

- a. Based on a vehicle size of 6-feet (width) by 20-feet (length).
- b. Separated from normal parking circulation aisles.
- c. Designed using the appropriate design vehicle turning template.
- d. Exclude the window space.

**TABLE 3: VEHICLE QUEUING REQUIREMENTS
FOR DRIVE-IN FACILITIES**

TYPE OF FACILITY	VEHICLE QUEUE
Drive-In Bank	10 spaces per window ¹
Drive-In Restaurant	10 spaces per window ²
Full-Service Car Wash	6 spaces per wash line
Self-Service Car Wash	3 spaces per wash line
Service Station	2 spaces per service positions
Drive-In Lube Service	3 spaces per bay

¹ This requirement shall be reduced to 3 spaces per window for savings and loan institutions and credit unions. A maximum of 30 spaces shall be required for banks with more than five drive-up windows.

² Measured from the pickup window. For some types of restaurant a shorter or longer queuing distance may be allowed or required, or as documented in a queuing study for a particular use.

4-6 Mini-Storage Warehouse Access Design

Mini-storage warehouse accesses shall be designed to permit single unit trucks (SU30) to enter and leave without experiencing any difficulty.

Aisle width between warehouse units must be 25-feet and the turning radius at the ends of the circulation aisles around the ends of warehouse units shall be large enough to accommodate fire trucks.

The Fire Department typically requires a 45-foot turning radius and have the characteristics of a WB40 truck. (See Glossary for definitions of a WB40 Truck.)

4-7 Special Requirements for Access to Fast Food Restaurants

Each site shall not have more than two accesses to any one street. However, the City Engineer may limit the number of accesses where a site has access from more than two streets and may further prescribe additional requirements if it is deemed that a change in the location, number or width of accesses will reduce traffic hazards so that neither streets nor sidewalks will be blocked or pedestrians or motorists be endangered by vehicular movement onto or from the use.

SECTION 5

THOROUGHFARE AND STREET DESIGN STANDARDS

SECTION 5. THOROUGHFARE AND STREET DESIGN STANDARDS

5-1 General

A map generally showing the locations and categories of various existing and future thoroughfares and streets is available in the Adopted 2005 General Plan. Various Specific Plans may supercede parts of the General Plan. The official thoroughfare designations are shown in the California Road System maps as approved by the City, the Ventura County Transportation Commission (VCTC), Caltrans and the Federal Highway Administration (FHWA) (http://www.dot.ca.gov/hq/tsip/hseb/crs_maps/). Right-of-way and curb-to-curb widths may vary depending on type of roadway, traffic volumes, whether parking or bike lanes are required and different parkway and sidewalk configurations. Designs are encouraged to incorporate “smart-growth” elements outlined in the City of Ventura’s Design Primer. Other “green street” or smart-growth elements are encouraged in the design of new and existing streets including but not limited to curbsless streets with drainage bioswales and permeable pavements with properly designed underdrain systems. The use of such alternatives shall be considered so long as adequate funds are committed for on-going maintenance via a maintenance assessment district (MAD) or similar funding mechanism.

5-2 Street Name Signs

Street name signs shall be installed on all new public and private streets and alleys or when existing streets are resurfaced as part of a Capital Improvement Project and the signs do not meet the current standard. Public street name signs shall follow the City Standard Detail. Private street name signs shall state that streets are privately owned and maintained and the signs must be posted at the entrance to the private street system that clearly indicate to the public, and to the City Police and street maintenance crew, that the street system is private property. The City’s public street name signs (color or logo) shall not be used for private streets.

A minimum of one street name sign per street shall be installed at each street intersection (See Standard Detail).

Signs for public streets shall be ordered and furnished by the City’s Streets Division. The respective Land Development or Capital Improvement Project will pay all costs for furnishing and installing Public Street Name Signs. Private street name signs will be the responsibility of the private property owner(s) to furnish and install. Private street name signs placed on public right-of-way shall be subject to an encroachment permit and may not be allowed if there is an available location on private property.

5-3 Traffic Signs

All necessary traffic regulatory warning and guide signs and any other traffic control device as specified by the City Engineer shall be installed as part of all new street improvements. All signage shall, at a minimum, meet State and Federal standards (California MUTCD).

Stop bars, markings and signs painted on the roadway surface shall be with sprayable thermoplastic paint. White markings on concrete streets surfaces shall be outlined in black for visibility.

5-4 Primary Arterial Thoroughfares – Boulevards, Avenues, and Streets

Primary arterial streets are a primary mechanism for cross-town and intercity travel, serve major centers of activity in the region, and are configured as (30-45) mph boulevards or avenues. The standards indicated here are general guidelines. Each street segment shall be designed within its context as appropriate. Some of the guidelines indicated below are designed to provide a six-lane street as follows:

- a. Context zone is typically C-3 through C-5 as defined by ITE Urban Thoroughfare design manual.
- b. Typical right-of-way varies from 84-feet to 115-feet in width. Where dual left turn lanes are to be provided at intersections, additional right-of-way will be provided at the intersection.
- c. Curb to curb width will typically be 64-feet to 92-feet. Travel lanes shall be at least 10-feet in width. 11-foot minimum lanes may be required on streets with high truck volumes. Parking lanes shall be at least 8-feet in width. The median for turn lanes and/or landscaping shall be 16-feet in width.
- d. Center median shall provide left turn storage lanes at street intersections and where openings have been approved by the City Engineer. Medians that are at least 4-feet in width shall be landscaped. Median areas less than 4-feet in width shall only have interlocking brick pavers.
- e. A minimum traffic index of 11 shall be used for pavement design.
- f. Striping or pavement markings shall provide for a minimum of two through lanes in each direction when daily traffic volumes exceed 25,000 vehicles per day. The street shall also provide a left-turn lane when high traffic volumes, turning movements, or safety needs exist. Where right-of-way is available and supported by the Bike Master Plan, a marked bike lane shall

be provided. No on-street parking is sometimes permitted depending on the context and available right-of-way at the approval of the City Engineer.

- g. Sidewalks shall either; be attached to the curb and be a minimum of 10-feet in width (including curb width) with 4-foot square tree wells located behind curb for 5.5-foot minimum clearance between tree well and edge of sidewalk, or separated from the curb by a parkway with a minimum sidewalk width of 6-feet. Parkway widths shall be a minimum of 5.5-feet (including curb width).
- h. Curbside bike lanes shall be a minimum of 5-foot wide when there is no parking next to the curb. Where parking is permitted and the bike lane is away from the curb, the minimum width shall be 6-foot.
- i. Surface cross slope of new or reconstructed arterials shall be 2% plus or minus ¼%. For resurfaced arterials, the surface cross slope may be up to 2.5%.
- j. Bulbouts for trees or similar protrusions are not permitted on primary arterial thoroughfares.
- k. The placement of trees, utility boxes, mail boxes, light poles and other obstacles within the parkway shall consider a safe line-of-site for motorists that access the thoroughfare from a driveway.

5-5 Secondary Arterial Thoroughfares – Boulevards, Avenues, and Streets

Secondary arterial streets are a primarily mechanisms for cross-town mobility, serve major centers of activity within the City, and can be configured as low speed (35 mph or less) boulevards or avenues. The street shall be designed to provide a two or four-lane street with bike lanes and a center left turn lane where needed as follows:

- a. Typical right-of-way varies from 78-feet to 97-feet in width.
- b. Curb to curb width will typically be 64-feet to 92-feet. Travel lanes shall be at least 10-feet in width. 11-foot minimum lanes may be required on streets with high truck volumes. Parking lanes shall be at least 8-feet in width. The median for turn lanes and/or landscaping shall be 14-feet in width.
- c. A minimum traffic index of 10 shall be used for pavement design.
- d. Striping or pavement markings shall provide for one or two through lanes in each direction. The street shall provide a left-turn lane when high traffic volumes, turning movements, or safety needs exist. Where right-of-way is

available and supported by the Bike Master Plan, a marked bike lane shall be provided. On-street parking may be allowed if supported by adjacent land use and right-of-way is available.

- e. Sidewalks shall either; be attached to the curb and be a minimum of 10-feet in width (including curb width) with 4-foot square tree wells located behind curb for 5.5-foot minimum clearance between tree well and edge of sidewalk, or separated from the curb by a parkway with a minimum sidewalk width of 6-feet. Parkway widths shall be a minimum of 5.5-feet (including curb width).
- f. Curbside bike lanes shall be a minimum of 5-foot wide when there is no parking next to the curb. Where parking is permitted and the bike lane is away from the curb, the minimum width shall be 6-foot.
- g. Surface cross slope of new or reconstructed arterials shall be 2% plus or minus ¼%. For resurfaced arterials, the surface cross slope may be up to 2.5%.
- h. The placement of trees, utility boxes, mail boxes, light poles and other obstacles within the parkway shall consider a safe line-of-site for motorists that access the thoroughfare from a driveway.

5-6 Collector Thoroughfares – Boulevards, Avenues, Streets and Main Streets

Collector streets shall be designed to provide at least a two-lane street with parking lanes and bike lanes as follows:

- a. Typical right-of-way varies from 70-feet to 87-feet in width.
- b. The curb-to-curb width will typically be 34-feet to 64-feet in width. Travel lanes shall be at least 11-feet in width. Parking lanes shall be at least 8-feet in width. Left turn lanes / median shall be at least 12-feet in width.
- c. A minimum traffic index of 9 shall be used for pavement design purposes.
- c. Striping or pavement markings shall provide for at least one through lane in each direction. Alternatively, a two-way left turn lane may be provided if necessary for traffic safety and additional right-of-way can be provided.
- d. Sidewalks shall either; be attached to the curb and be a minimum of 10-feet in width (including curb width) with 4-foot square tree wells located behind curb for 5.5-foot minimum clearance between tree well and edge of sidewalk, or separated from the curb by a parkway with a minimum sidewalk width of 6-feet. Parkway widths shall be a minimum of 5.5-feet (including curb width).

- e. Bike lanes shall be provided if designated in the Bike Master Plan. Curbside bike lanes shall be a minimum of 5-foot wide when there is no parking next to the curb. Where parking is permitted and the bike lane is away from the curb, the minimum width shall be 6-foot.
- f. On-street parking shall be provided.
- i. Surface cross slope of new or reconstructed arterials shall be 2% plus or minus ¼%. For resurfaced arterials, the surface cross slope may be up to 2.5%.
- j. The placement of trees, utility boxes, mail boxes, light poles and other obstacles within the parkway shall consider a safe line-of-site for motorists that access the thoroughfare from a driveway.

5-7 Industrial Thoroughfares

Industrial streets shall be designed to provide a two-lane street as follows:

- a. Typical right-of-way varies from 68 to 83-feet in width.
- b. The curb-to-curb width will typically be 48-feet to 60-feet in width. Travel lanes shall be at least 11-feet in width. Parking lanes shall be at least 8-feet in width. Left turn lanes / median shall be at least 10-feet in width.
- c. A minimum traffic index of 11 shall be used for pavement design.
- d. Striping shall provide for at least one travel lane in each direction with parking on each side.
- e. If the street is designated in the Bike Master Plan with Class II bike lanes, the curb-to-curb width shall be 60-feet in width.
- f. Sidewalks shall either; be attached to the curb and be a minimum of 10-feet in width (including curb width) with 4-foot square tree wells located behind curb for 5.5-foot minimum clearance between tree well and edge of sidewalk, or separated from the curb by a parkway with a minimum sidewalk width of 6-feet. Parkway widths shall be a minimum of 5.5-feet (including curb width).
- g. Bike lanes shall be provided if designated in the Bike Master Plan. Curbside bike lanes shall be a minimum of 5-foot wide when there is no parking next to the curb. Where parking is permitted and the bike lane is away from the curb, the minimum width shall be 6-foot.
- h. On-street parking shall be provided.

- k. Surface cross slope of new or reconstructed arterials shall be 2% plus or minus ¼%. For resurfaced arterials, the surface cross slope may be up to 2.5%.
- i. The placement of trees, utility boxes, mail boxes, light poles and other obstacles within the parkway shall consider a safe line-of-site for motorists at access points along the arterial.

5-8 Local Streets – Slow Streets (Residential), Yield Streets and Lanes

Local streets shall be designed to provide two-direction travel as follows:

- a. Typical right-of-way varies from 51 to 59-feet in width.
- b. The curb-to-curb width will typically be 28-feet to 36-feet in width depending on certain conditions (i.e. whether all building on the street have sprinklers, adequate turnouts/driveways, small blocks, grid street design, etc). Streets with a curb to curb width of less than 34-feet shall only be used for minor residential streets not exceeding 800-feet in length and providing access to no more than 40 single-family units or 60 multi-family dwelling units. Narrower curb-to-curb widths may be allowed at the approval of the City Engineer and Fire Chief.
- c. A minimum traffic index of 5.5 shall be used for pavement design.
- d. Parking on both sides shall be provided.
- e. Sidewalks shall be separated from the curb by a parkway with a minimum sidewalk width of 6-feet. Parkway widths shall be a minimum of 5.5-feet (including curb width).
- f. Bike lanes or route signs and designations shall be provided if designated in the Bike Master Plan. The minimum width shall be 5-foot.
- g. Surface cross slope of new or reconstructed arterials shall be 2% plus or minus ¼%. For resurfaced residential streets, the surface cross slope may be up to 3% in the driving lane and 4% in parking lanes.

5-9 Alleys

Alleys provide two-way service and parking access to residential, commercial or mixed use development as follows:

- a. Typical dedicated right-of-way is 20 feet in width. Distance from building face to building face should be at least 28 feet at ground level.
- b. The entire 20-foot alley shall have a structural section able to handle loading from trash truck and commercial truck usage. A minimum traffic index of 7 shall be used for pavement design.
- c. The 12-feet of structural section that is centered in the right-of-way shall be finished with either concrete, or brick pavers. No utilities shall be placed in this section.
- d. If a concrete drainage v-ditch is used, 2% polypropylene fibers shall be used in the mix design to inhibit cracking.
- e. Drivable 4-foot side areas on each side of the concrete paved width shall be finished with brick pavers or other structural material except asphalt or concrete. All alley utilities (dry only allowed) will be placed in these sections.
- f. No parking is allowed in alleys with right-of-ways of 20-feet or less. If parking is allowed, a minimum clearance of 20-feet must be maintained between parking areas. Parallel parking areas along alleys must be no less than 7-feet in width.
- g. A special design may be necessary to provide bicycle and pedestrian access through the alley or where development fronts onto the alley.

5-10 Private Streets

All private streets shall be designed to provide the following:

- a. A minimum traffic index of 5.5 shall be used for pavement design based on an approved soils analysis.
- b. Provide 6' wide sidewalks on both sides of the street.
- c. Street lighting shall be provided according to the City minimum street lighting standard for local streets.

5-11 Frontage Improvements

Minimum half width street improvements shall be constructed to provide for a safe passage of vehicles as follows:

- a. On existing substandard width streets, curb, gutter and sidewalk, plus up to 20 feet of paving, depending on the width of the existing pavement.
- b. On new streets, curb, gutter, sidewalk and a full one half width of the pavement, plus an additional 16 feet (11-foot lane and 5-foot shoulder).
- c. The traffic index used for pavement design shall correspond to the functional classification of the street being improved.

5-12 Street Pavement Design

- a. Street paving shall be designed using the Gravel Equivalent Method. Before actual analysis can be done, a minimum of two R-value tests shall be done by a qualified soils laboratory on the sub base material within the proposed paving areas of each street between intersections. A report containing the pavement design, R-value test data, and R-value test locations shall be submitted into the City Engineer for approval. Each street pavement section shall be designed using the lowest R-value test result of the two tests taken. The minimum thickness of new asphalt paving shall be three inches for local (residential) streets and four inches for all other standard arterial, collector and industrial streets. The base material shall be of a uniform material and a minimum thickness of six inches. Processed miscellaneous base (Gravel Factor = 1.1), as defined in the SSPWC shall be used for base material for all City Streets. New pavement design shall follow the County of Ventura Public Works Road Standards A.C. Pavement Design and the Caltrans Highway Design Manual.
- b. Geogrid/reinforcement fabrics are not permitted between asphalt layers. Geogrid fabrics may be used in gravel base layers but must be at least 6-inches below the bottom layer of asphalt.
- c. The use of rubberized asphalt is encouraged to reduce noise and for pavement longevity. Rubberized asphalt should not be used on streets that exceed a grade of 7%, in cul-d-sacs, or at knuckle intersections where workmanship is difficult and damage by turning vehicles is more likely to occur.

5-13 Curbs and Gutters

- a. New cross gutters will not be allowed on any public street. Limited exceptions may be allowed across a local residential street or across a private street where it intersects with a public street only in extreme cases as permitted by the City Engineer.

- b. New and replaced concrete gutters shall include 2% polypropylene fibers in the mix design to inhibit cracking.
- c. Root pruning of trees for the purpose of replacing damaged curbs and gutters should be coordinated with the City's Parks Division. The use of curb and gutter "bulbouts" is encouraged to eliminate the need to prune tree roots. Bulbouts should only be used where there are parking lanes. Considerations should be given to balancing the need for parking spaces and preserving mature trees that have large diameter trunks. If used, bulbouts shall adequately address drainage requirements.
- d. For street resurfacing/reconstruction projects, curbs and gutters should be replaced where excessive ponding occurs. Not all ponding needs to be eliminated and the extent of replacements may depend on the available budget. Priority should be given to locations where ponding is most severe.

5-14 Sidewalk Repairs

For street resurfacing/reconstruction projects, sidewalks shall be replaced or repaired where joints are vertically offset by more than ¼-inch. At locations where joints are vertically offset by more than 1-inch, sidewalks shall be removed and replaced. Where there is less than 1-inch of offset, the sidewalk may be repaired by grinding the concrete flush at the joint. Root pruning of trees for the purpose of replacing sidewalks should be coordinated with the City's Parks Division. Considerations for other types of repairs/replacements are encouraged (i.e. rubber sidewalk, "bridging", or cold-mix asphalt wedges).

5-15 Street Lighting

New or retrofitted streetlights should not be high-pressure sodium, incandescent, florescent, metal halide, or induction type lighting. Energy-efficient lights, such as LED's, shall be used. See City of Ventura Design Primer for various guidelines for streetlights.

5-16 Speed Bumps, Humps, and Cushions

The use of speed bumps in the street right-of-way is prohibited. Other means to reduce traffic speeds should be considered including but not limited to the use of traffic circles, speed cushions, narrower curb-to-curb widths, mid-block "chokers" or bulb-outs, tall and large canopy trees in the parkway, and striping for narrower lanes. All "traffic calming" design shall be subject to the City's Neighborhood Traffic Management Plan except for new development where they shall only be installed if identified in the environmental document as a mitigation measure, in a development agreement, or as a part of the project description.

5-17 Cross Walks and Curb Ramps

- a. Mid-block marked crosswalks should be avoided unless determined by the City Transportation Manager to be warranted. Marked crosswalks should be located at street intersections when the location meets City standards and is approved by the City Transportation Manager.
- b. Curb ramps are required to be installed as part of new construction, street resurfacing and reconstruction projects. Curb ramps shall be in accordance with the latest version of the City Standard Details. Curb ramps do not need to be installed where such installation may pose a danger to persons in a wheel chair (i.e. where there is a steep sidewalk grade on an existing street) and will not benefit other users.
- c. See City of Ventura Design Primer for other considerations at street intersections.

5-18 Utility Structures and Mechanical Equipment within the Street Right-of-Way

Utility structures and equipment should be screened from view. See City of Ventura Design Primer for various guidelines.

SECTION 6

GEOMETRIC DESIGN STANDARDS

SECTION 6. GEOMETRIC DESIGN STANDARDS

The geometric design criteria shall follow the latest edition of the AASHTO “Greenbook” unless otherwise shown here.

6-1 Lane Widths

Table 4 summarizes the minimum street lane widths to be used when widening existing City streets. All dimensions are in feet.

TABLE 4
MINIMUM LANE WIDTHS (FEET)

LANE TYPE	WIDTH
Parking Lane	8
Through Travel Lane	10 – 11 ¹
Left Turn Lane	10
Bike Lane	6

1 Curbside lanes should be 11-foot minimum where high volume of truck traffic or bus routes are expected.

6-2 Horizontal and Vertical Alignments

6-2.01 Horizontal Curves

Minimum Horizontal Curve Design Criteria for Streets in Urban Areas are summarized in Table 5.

TABLE 5
MINIMUM HORIZONTAL CURVE DESIGN CRITERIA

DESIGN CRITERIA	HILLSIDE STREETS	Local ² STREETS	COLLECTOR ³ STREETS	INDUSTRIAL ³ STREETS	ARTERIAL ^{3,5} STREETS
Minimum Design Speed (mph)	20	25	25	30	40
Minimum Center Line Radius (ft)	100	180	250	300	1000
Minimum Horizontal Sight Distance (ft) ^{1,4}	120	160	200	250	400
Minimum Reverse Curve Tangent (ft)	50	100	100	150	300
Minimum Tangent Approach at Intersections (ft) ¹	50	100	100	150	300

¹ Where a curved street approaches an intersection, straight tangent sections shall be provided on the approach to the intersection to provide for adequate sight distance for traffic control devices at the intersections.

² At the connection of two residential streets with different alignments where the connecting curve is less than the minimum radius, the outside flow line may be required to be flared to provide a knuckle.

³ Additional pavement width may be required on horizontal curves on collector and arterial streets to provide for vehicle maneuvers where no super-elevation is provided and the minimum horizontal curve design criteria in Table 5 have not been met. The method of calculation for widening will be as described in the AASHTO, "A Policy on Geometric Design of Highways and Streets," latest Edition.

⁴ Maximum super-elevation rates for arterial and collector streets of up to 0.06 feet/foot (6%) are required where horizontal curve radii do not meet the standards set forth in Table 5.

⁵ Reverse curves shall have equal radii on adjacent curves. Broken back curves will not be permitted.

6-2.02 Vertical Curves and Grades

Grades and vertical sight distance are subject to approval by the City Engineer to ensure proper drainage and/or safety for vehicles and pedestrians. Grades of all streets shall be as flat as reasonably possible consistent with adequate surface drainage requirements and the proper development of abutting property. The minimum longitudinal slope grade of streets having concrete curb and gutter required shall not be less than 0.4 %. Streets not having concrete curb and gutter shall have a minimum slope of 1%. The maximum gradient on any street shall be as follows:

Arterial Streets.....	7%
Collector Streets.....	12%
Local Streets.....	15%
Hillside Streets.....	15%
Industrial Streets.....	6%

TABLE 6
MINIMUM VERTICAL CURVE (FEET) DESIGN CRITERIA

DESIGN CRITERIA	HILLSIDE	RESIDENTIAL	COLLECTOR	INDUSTRIAL	ARTERIAL
Algebraic difference In Grades:					
Less than 0.5%	0	0	0	0	0
0.5% to 1%	20	20	20	30	50
1% to 2%	20	25	40	60	100
2% to 3%	30	40	60	90	150
3% to 4%	35	50	80	120	200
4% to 5%	50	60	100	150	250
5% or Greater ²	See ²	See ²	See ²	See ³	See ³
Minimum Vertical Sight Distance ⁴	120	160	200	250	400
Minimum Reverse Curve Tangent	50	100	100	150	300

¹ All vertical curves shall be symmetrical parabolic curves.

² An additional 10 foot length of vertical curve shall be provided for each additional 1 (or fraction thereof) change in grade above 5%.

³ An additional 50-foot length of vertical curve shall be provided for each additional 1 (or fraction thereof) change in grade above 5%.

⁴ All minimum stopping sight distances for vertical curves with crests shall be shown on the construction plans. All vertical curves shall provide for adequate stopping sight distance using headlights.

6-3 Intersections

6-3.01 Spacing and Offsets

For primary and secondary arterial streets, signalized intersections shall be spaced at least at half mile intervals. Non-signalized intersections shall be spaced at least 1,000 feet apart centerline to centerline.

For collector streets, signalized intersections shall be spaced at quarter mile intervals. Other locations may be approved by the City Engineer if adequate signal progression can be maintained. Non-signalized four legged intersections shall be spaced at least 500 feet apart centerline to centerline. When "tee" intersections are used, the center lines of streets not in alignment shall normally be off-set a minimum of 250 feet and be 250 feet from the nearest four legged intersection centerline to centerline. If the left turn storage requirements for adjacent intersections overlap, the minimum spacing shall be increased to provide adequate left turn storage in both directions.

Residential streets four legged intersections will normally be spaced at least 150 feet apart. Where "tee" intersections are used, the center lines of streets shall normally be offset a minimum of 150 feet centerline to centerline.

6-3.02 Corner Radii

At public street intersections, the minimum flow line radii will be as shown in Table 7.

The vehicle used for designing intersections shall be based on the following:

Local Streets	SU30
Collector Streets	WB40
Arterial	WB40
Industrial Streets	WB50

TABLE 7
MINIMUM INTERSECTION CORNER RADII¹ (FEET)

TYPE OF INTERSECTION	CURB FLOW LINE RADIUS
Local-Local ²	15
Local-Collector	25
Collector-Collector	25
Local-Arterial ³	30
Collector-Arterial ³	35
Arterial-Arterial ³	35

¹ Additional right-of-way or easement may be required for driveways or public street intersections where islands are being used to channel traffic and control turning movements. These radii do not apply in the area covered by any Specific Plan that specifies radii.

² Includes Alleys.

³ At signalized intersections where right turn channelization islands are provided or high truck and bus volumes may use the access, a larger flow line radius may be required.

6-4 Street Width Transition Tapers

When constructing a roadway that will directly connect with an existing roadway of a different width, transitions shall be installed between the two. The length of taper depends upon the offset difference between the outside traveled edge of the two sections and the ratios shown in Table 8. These ratios shall not to be used in the design of speed change or left turn storage lanes. These ratios apply to transitions from a narrower section of street to wider street and to transitions from a wider section of street to a narrow section of street.

Where tapers are located on a curve, the separate halves of the street shall be designed with different curves to create the taper, without angle points in the curvature. Where shorter tapers have to be used due to right-of-way constraints, striped tapers with delineators shall be used.

TABLE 8

MINIMUM ROAD WIDTH TRANSITION TAPERS

DESIGN SPEED (MPH)	TRANSITION RUN/OFFSET
25	15 feet/ 1 foot
30	20 feet/ 1 foot
35	25 feet/ 1 foot
40	30 feet/ 1 foot
45	45 feet/ 1 foot
50	50 feet/ 1 foot
55	55 feet/ 1 foot
60	60 feet/ 1 foot

6-5 Sight Distance

Before any access or street intersection is approved, adequate sight distance shall be provided so that vehicles can enter or exit from the proposed access or street with minimum hazard.

6-5.01 At Public Street Intersections

At any intersection approach of two public streets, a minimum 40-foot sight distance triangle shall provide for an unobstructed view across the triangle formed by joining points measured 40-feet distant along the property line from the intersection of the two streets. Within the area of the triangle there shall be no sight obscuring wall, fence, sign, foliage or berming higher than 24 inches above the curb grade or, in the case of trees, foliage lower than 8 feet. Vertical measurement shall be made from the flow lines of the two streets forming the triangle or, if no gutter exists, from the edge of the nearest traveled way.

Objects that may be located in the triangular area include hydrants, utility poles, utility junction boxes, and traffic control devices. These items shall be located to minimize visual obstruction. The above also applies to intersections of private streets and railroad right-of-way at railroad crossings not controlled by gates or flashing lights.

In addition to the above, at any intersection of two public streets, an unobstructed view shall be provided across the area formed by the flow line or edge of pavement on one street and the flow line or edge of pavement of the intersecting street and lines connecting them at 10 feet from their point of intersection. This area shall be used to ensure that drivers of vehicles exiting from the stopped approach have available the minimum sight distance. Minimum stopping sight distances are indicated below in Table 9.

6-5.02 At Private Accesses to Public Streets

At any intersection of a private property or parking lot access and a public street an unobstructed view shall be provided, as defined in Subsection 6-8.01 across the triangle formed by joining points measured 40 feet along both the property line on the public street and private access edge line from the point of intersection of the street and access. For rounded property corners, the triangular area shall be between the property line and access edge line extended and a diagonal line joining the points on the property and private access edge lines, 40 feet from the point of their intersection.

In addition to the above, at any intersection of a private property access and a public street, an unobstructed view, as defined in Subsection 6-8.01, shall be provided across the area formed by the flow line or edge of pavement on the public street and the private access drive edge line, and lines connecting them at 10 feet from their point of intersection. This area will be used to ensure that drivers of vehicles exiting from the stopped approach of an access have available the minimum sight distance provided in Subsection 6-8.03 of this manual. These sight distance criteria do not apply to single family back-out drives where sight distance will be provided based on location of the driver's eye when commencing the back-out maneuver.

6-5.03 Stopping and Passing Sight Distance

Sight distance is the length of roadway ahead, which is visible to the driver. The minimum stopping sight distance available on a roadway shall be sufficiently long to enable a vehicle traveling at or near the roadway design speed to stop before reaching a stationary object in its path, or react to a traffic control device such as a stop sign.

Table 9 summarizes the stopping sight distance for vehicles traveling on wet pavement at 0% grade. All roadway designs in the City shall provide the minimum appropriate stopping sight distance shown in Table 9 for level terrain conditions, depending on the design speed of the roadway.

TABLE 9

MINIMUM STOPPING SIGHT DISTANCE (FEET)¹

DESIGN SPEED (MPH)	STOPPING SIGHT DISTANCE
20	125 Feet
25	150 Feet
30	200 Feet
35	250 Feet
40	325 Feet
45	400 Feet
50	475 Feet
55	550 Feet
60	650 Feet

¹ Assumes a driver reaction time of 2.5 seconds; a driver's eye height of 3.0 feet and an object height of 0.5 feet for stopping sight distance.

To allow for the effect of grade on stopping distance, the factors in Table 10 shall be used.

TABLE 10

EFFECTS OF GRADE ON STOPPING DISTANCE

DESIGN SPEED	INCREASE FOR DOWNGRADE CORRECTION IN STOPPING DISTANCE (FEET)			ASSUMED ¹ SPEED	DECREASE FOR UPGRADES CORRECTION IN STOPPING DISTANCE (FEET)		
	3%	6%	8%		3%	6%	8%
20-30	10	20	30	20-28	10	10	20
31-40	20	40	70	29-36	10	20	30
41-50	30	70	110	37-44	20	30	40
51-60	50	110	170	45-52	30	50	70
61-65	60	130	200	53-55	30	60	90

¹ Average running speed is assumed to allow for the fact that vehicles normally travel at a slower speed on an upgrade.

6-6 Bikeway and Sidewalk Clearances, Widths and Routes

Any street having a Class I Bikeway specified by the City's adopted Bike Plan shall be designed to meet the requirements specified in the adopted Bike Plan and as follows:

Class I two-way bikeways shall include:

1. Culverts or bridges for crossing drainage channels.
2. A 20-foot minimum right-of-way width provided.
3. A minimum of 10-foot paved surface with a 2-foot unpaved, but rideable shoulder on each side.
4. Minimum clearance of 2-feet from edge of pavement to any horizontal obstructions.
5. Vertical clearance of 8-feet to overhead obstructions, including landscaping.
6. Minimum design speed of 20 mph. Minimum cross slope on tangents of 2%.
7. Minimum curve radius is 63' without super-elevation.
8. Maximum recommended grade is 5%, but can be exceeded for short sections if approved by the City Engineer.
9. Objects such as signal or utility poles, utility boxes, signs, bus benches, trees, bushes, fire hydrants, etc., shall not be located in the sidewalk or bikeway (or within 2-foot rideable shoulders) or near enough to conflict with users. Special lighting treatment may be required for bikeways that are not adjacent to public streets.
10. Where sidewalk and bikeways are located near major bus stops or transfer points, the City may require wider facilities to provide for adequate passenger storage areas.
11. Any time a sidewalk or bikeway is adjacent to a retaining wall having a vertical drop in excess of 30-inches, a pedestrian guard rail in conformance with City Uniform Building Codes, or a bicyclist guardrail with a height of 42-inches shall be provided to protect pedestrians and bicyclists.

6-7 Medians

Raised medians may be required on streets. All designs are subject to review and approval by the City Engineer and subject to the standards provided in the Caltrans Highway Design Manual and the AASHTO "Green Book". Median widths on new streets shall be a minimum of four feet and use an 8-inch minimum curb height. Medians placed on existing streets shall have a minimum 6-inch curb height wherever possible or shall match any existing adjacent median curb heights. If left turn lanes are installed in the median, the median shall be no less than 14 feet wide. See Table 11 for recommended median widths. Accesses through existing medians shall be approved by the City Engineer.

In new street designs, the minimum spacing of median openings will be kept to 500-feet and shall be designed to restrict through and left turn movements from the minor or cross street approaches unless the intersection or access is planned for signalization. Increased storage lengths and tapers may be required as determined by the City Engineer based on available turning movement volume data. Median openings that allow left turns in both directions shall be not less than 50-feet from median nose to median nose and shall not encroach into crosswalk areas. All median turn lanes and openings shall be designed for at least WB40 trucks. Tapers for left turn lanes in curbed medians should follow the provisions of the Caltrans Highway Design Manual.

Fixed objects, except signs, street lighting poles and landscape irrigation systems, shall not normally be permitted in medians unless otherwise approved by the City Engineer. Plantings shall be located so as not to violate the sight distance standards of this Manual. All landscape work shall be done in accordance with the Landscape and Irrigation Guidelines and Standard Park Details published by the City's Public Works Department. Landscape plans for medians shall show the location of signs and should be designed to avoid conflicts between the visibility and location of the signs and the placement of landscaping materials and vegetation.

TABLE 11

RECOMMENDED MINIMUM MEDIAN WIDTHS (FEET)

FUNCTION	WIDTH
Separation of opposing ¹ traffic – No included left turn lane	10
Pedestrian refuge and space for traffic control devices	10 - 14
Single Left Turn Storage	14 - 16
Double Left Turn Storage	24
Crossing/Entering Vehicles ² Storage	24

¹ This width cannot accommodate left-turn lanes within the median, which shall be prohibited. Median would have to be terminated prior to left turn movement.

² This width enables vehicles crossing a street with a median or turning left onto such a street to use the median area for storage so as to negotiate each half of the street separately.

6-8 Vertical Clearance of Structures

A minimum vertical clearance of 18-feet shall be provided for all overhead structures measured from the crown of the street to the lowest portion of the structure on all City streets.

6-9 Guardrails

Guardrails shall be designed in accordance with the Caltrans Highway Design Manual.

SECTION 7

SUSTAINABLE STREET DESIGN

SECTION 7. SUSTAINABLE STREET DESIGN

7-1 General

In order to improve the environment, increase the health of our residents, and improve community livability, the City wants to create beautiful, safe, quiet, and healthy streets. This includes improving the health of the City's watershed, reducing energy usage and adding more landscaping to the public realm. A sustainable street is an urban design and stormwater strategy that meets regulatory compliance and resource protection goals by using a natural systems approach to manage stormwater, reduce flows, improve water quality, enhance watershed health, improve aesthetics, increase walkability and bikeability, and slow traffic. This chapter provides an overview on ways to promote and incorporate the use of green street facilities in public and private development.

The City recognizes that a comprehensive sustainable street design approach is an important development strategy to:

- Reduce polluted stormwater entering barrancas and the ocean;
- Increase use of recycled materials
- Improve pedestrian and bicycle safety
- Reduce impervious surface so stormwater can infiltrate to recharge groundwater and reduce potable water usage
- Increase urban green space
- Improve air quality and reduce air temperatures
- Reduce demand on the city's storm drain system and the cost of constructing expensive pipe systems
- Address requirements of federal and state regulations to protect public health and restore and protect watershed health

7-2 Methods

Several methods can be used to meet the sustainable street goals. Throughout this document several sustainable design elements are incorporated into the individual standards. The following methods are examples of what should be considered in the design effort:

- Use rubberized asphalt or other recycled/recyclable materials
- Planting medium to large canopy tree species in the existing or new parkway
- Constructing permeable concrete or permeable pavers for sidewalks, alleys and/or parking lanes
- Provide inlet catch basins that treat storm runoff or allow storm runoff to percolate into the ground

- Widen sidewalks
- Create bioswales within the right-of-way
- Reduce street width
- Build gutter to parkway or public space stormwater detention areas
- Install energy efficient street lighting or eliminate street lighting

These and other methods will be further refined and developed over time and included in the City's Standard Details and these Engineering Design Standards.

SECTION 8

STORM WATER DRAINAGE SYSTEMS

SECTION 8. STORM WATER DRAINAGE SYSTEMS

All storm water drainage systems shall be designed in accordance with the City of Ventura Municipal Code.

8-1 Storm Water Drainage System - Hydrology

Prior to the final design of a storm water drainage system, a hydrology study of the watershed where the storm drain system is located shall be completed. The hydrology study shall include a report summary, conclusions, hydrology map, runoff calculations, proposed storm drain system, and list of references.

8-2 Hydrology Map

The hydrology map shall be of a reasonable size and scale to represent the topography and drainage patterns of the entire drainage area. Show all flows (Qs) with the time of concentration flowing in the streets, entering and carried over from the catch basins, and tributary flows entering and leaving the project. Locate the approximate location of each catch basin with its respective width. Identify the catch basin as either a sump or intercepting condition and whether or not the catch basin has a side opening, grate, or both. All drainage areas should be clearly identified with estimated acreage. Show all storm drain pipe locations and estimated pipe diameters.

8-3 Storm Water Drainage System Hydraulics

The Manning equation shall be used to analyze open channel flow, streets, and pipes flowing partially full. Pressure flow analysis shall be used for pipes flowing full and submerged culverts. Calculations for flow (Q) (storm frequency included), velocity (V), hydraulic grade line (HGL), energy grade line (EGL), shall be shown for storm drain pipes.

The minimum freeboard in catch basins shall be 0.5 feet below the flow line of the catch basin opening. The minimum freeboard allowed in manholes shall be one foot below the top of the manhole lid.

All sumps shall be designed with an overflow escape route with a 100-year flow capacity in the event that the sump condition catch basin clogs with debris.

All surface flow over land and within natural drainage swales shall be kept below a velocity of four feet per second.

8-4 Storm Water Structures

Open concrete lined channels shall be designed in accordance with Ventura County Flood Control District design standards.

Erosion control devices and/or energy dissipaters shall be placed at all storm drain outlets that discharge onto erosion surfaces and as determined by the City Engineer.

Pipe material used for storm drains in the public right-of-way shall be reinforced concrete pipe and a minimum diameter of 18 inches. Bedding material is required for all pipes in accordance with the City's Standard Construction Details. Alternative materials may be used at the approval of the City Engineer.

Slope anchors shall be constructed at intervals approved by the City Engineer depending on slope and size of pipe for all storm drain pipe placed on all slopes greater than 5:1. Thick wall RCP with a 1-1/2 inch minimum cover over steel reinforcement shall be used when flow velocities exceed 20 feet per second.

All structures shall be designed to prevent access from the public into the drainage structure, using grates or other approved devices, in a manner acceptable to the City Engineer.

8-5 National Pollution Elimination System (NPDES) Permit and Best Management Practices

Construction projects, private or public, shall conform with conditions and requirements of the Ventura County-wide Storm Water Quality Management Program, National Pollutant Discharge Elimination System (NPDES) Permit No. CAS063339, and any other NPDES permit issued by the State of California. All grading or construction activities that may create adverse impacts to storm water runoff quality shall incorporate "Best Management Practices" as recommended by the Ventura County Watershed Protection District. An NPDES permit from the California Regional Water Quality Control Board may be required. All grading and construction activities shall incorporate a storm water pollution prevention plan or storm water pollution control plan as approved by the City Engineer, Ventura County Watershed Protection District, and the California Regional Water Quality Control Board.

8-6 Storm Drain Easements

Storm drain easements should be avoided whenever possible, however, if they are approved by the City Engineer, the minimum width of a storm drain easement shall be 15 feet. The storm drain shall be located within the center of

the storm drain easement. If the storm drain is to be maintained by the City, then access shall be provided in a manner acceptable to the City Engineer. This may include placement of a drivable all weather material surface, placement of additional manholes, and access gates.

SECTION 9

SEWER SYSTEMS

SECTION 9. SEWER SYSTEMS

All sewer systems shall be designed in accordance with Division 22 – Public Utilities of the City of Ventura Municipal Code, Engineering Division's Standard Construction Details, Engineering Division's Design Standards, California Department of State Health Services requirements, Standard Specifications for Public Works Construction ("the SSPWC"), and City master plans.

9-1 Sewer Main Design

Sewer mains shall be designed for gravity flow using the Manning equation. Sewer mains shall be designed to handle peak flows. For pipes 15 inches or less in diameter and lines passing through casing, the design peak flow capacity shall be set at half the diameter of the pipe. For pipes greater than 15 inches, the design peak flow capacity shall be set at three quarters of the diameter of the pipe (see Figure 6 in Appendix). No surcharging will be allowed in any manhole or sewer main.

Peak flow should be determined by actual in-situ measurements at various manholes or by theoretical determinations as determined by the City Engineer. Existing land use and proposed land use information may be obtained from the City's Community Development Department. Equipment and in-situ test locations shall be approved by the City Engineer or Assistant Public Works Director/Environment and Water Resources Division.

All sewer pipes shall be designed with a minimum velocity of 2 feet per second. The minimum acceptable slope for a sewer is 0.01 ft./ft. unless otherwise approved by the City Engineer. Sewer pipe allowed for construction is PVC (SDR 35), high strength vitrified clay pipe, or PVC lined reinforced concrete pipe in accordance with SSPWC standards.

Sewer mains shall be constructed at street center line and run in a straight line between manholes unless otherwise approved by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division. Large horizontal radii are allowed provided that these minimum radii are met: 300 ft. for residential streets, 500 ft. for collector streets, and 1,000 ft. for major arterials. Compound curves or change in pipe material will not be allowed between manholes. A manhole shall be placed at all angle points, changes in pipe size, and at an end of all mains. The distance between manholes shall not exceed 350 ft. Concentric manholes shall be used.

If a proposed sewer design appears to be questionable in terms of its clearances with other utilities, the utilities shall be potholed and actual locations verified before the City will approve any sewer design plans.

9-2 Sewer Mains

Sewer lines shall be constructed in a straight line between manholes and at the street centerline unless otherwise approved by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division.

Minimum size for main line sewers is eight inches in diameter. All new sewers shall be designed to be self-cleansing with a flow rate of 2 feet/sec at D/2 for pipes 15" in diameter or less and 3/4D for pipes greater than 15 inches in diameter. Minimum curve radius shall be 300 feet for residential streets, 500 feet for collector and arterial streets and 1,000 feet for major streets. Curve deflections shall occur at pipe joints only. Joint deflections shall not exceed manufacturer's recommendation and shall be evenly distributed among the joints. Combined horizontal or vertical curves will not be allowed between manholes.

A stub out, of same size as the sewer main, shall be installed in the upstream side of the manhole if adjacent future development may take place.

9-3 Sewer Laterals

The minimum diameter of a sewer lateral shall be 6-inches. No saddle connections will be allowed on VCP or PVC main line 10 inches or less in diameter. Laterals shall tie into the sewer main using 6-inch tee or "Y" branch rotated 45 degrees from the horizontal. Laterals may tie into a manhole in cul-de-sacs or as approved by the City Engineer. Manhole base shall be channelized.

Sewer laterals shall be constructed in such a manner as not to interfere with the discharge of other laterals or sewer main flow. Sewer laterals shall be placed a minimum of 10 ft. from street trees and 10 ft. from water services. Backwater valves shall be placed on sewer laterals to protect structures from flooding if the upstream manhole is at a higher elevation than the finished floor elevation. The backwater valve shall be privately owned and maintained and shall be located on private property. All sewer laterals should be perpendicular to the receiving sewer main. Chimney laterals shall not be used. All connections to existing sewer mains and manholes shall be cut or cored.

Where sewer laterals in new development are to be located in close proximity to a street tree, the lateral shall have welded or fused joints.

9-4 Manholes

A manhole shall be constructed at the intersection of all sewer mains and interceptors discharging into a major trunk line. The maximum distance between sewer manholes shall not exceed 350 feet. A sewer manhole shall be

constructed at cul-de-sacs and street terminus. All manhole frame and covers shall be Alhambra #1170 or approved equal. All sewer manhole covers shall have a 1-1/2 inch "S" cast in the center. No drop manholes will be allowed. Where possible, all sewer manholes shall be constructed in the crown of the street. Manholes shall not be constructed in parking spaces or gutters.

All manhole covers located in unimproved areas shall be gasket sealed and shall have the rim elevated 2 feet above the finish grade with a location bollard placed adjacent to the manhole to protect it from damage.

All manholes shall be lined with PVC (T-Lock); including Barrel, Cone, and Grade Rings to protect it from hydrogen sulfide or other corrosive chemicals as determined by the City Engineer. When possible, channels shall be PVC lined. The Shelf and channel shall be coated with an approved epoxy coating except when the channel is PVC lined, then only the shelf shall be epoxy coated.

95 Force Mains and Lift Stations

All lift stations and force mains are subject to approval by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division. It is the City's goal to minimize maintenance costs by having a sewer system that operates under gravity flows. Private on-site lift stations are subject to the City Building Official's approval. No private force main lines may be placed in the public right-of-way. If a lift station is allowed and it is to be maintained by the City, it shall at a minimum include:

1. Wetwell design with appropriate internal coating protection (PVC T-Lock).
2. Stainless steel motor control cabinet with lockable door handles.
3. Two pump operation (submersible type) with inverter rated motor.
4. Minimum force main size 8" PVC designed for future loads plus 25 % .
5. 3 phase AC. power requirements, with a minimum 7.5 horsepower or greater to meet peak flow demands.
6. All hardware to be Type 316 stainless steel.
7. Pumps to be mounted on a stainless steel guide rail system for the full depth of the wet well.
8. Variable Frequency Drive (VFD) with optional bypass feature in the event that the VFD fails.

9. Alarm system to be advanced digital network that will respond to alarms from the Programmable Logic Controller (PLC).
10. Wet well capacity to contain volume at peak flow for 4 hours and/or provide alternative sources of electrical power to operate lift station.
11. Standby generator connection per UBC Electrical Code.
12. Bypass piping of a size capable of holding overflow in the event of total lift station failure.
13. Flow and time run meter to record flows and operating time of each pump.
4. Discharge piping to include isolation valves and check valves with outside lever and weight.
15. Spare parts will be provided to completely overhaul pump as recommended by the manufacturer.

9-6 Sewer Easements

Sewer easements are not encouraged and will only be allowed as approved by the City Engineer.

The minimum width of a sewer easement shall be fifteen feet. The sewer main shall be located within the middle of the sewer easement. If the sewer is to be maintained by the City, then access shall be provided in a manner acceptable to the City Engineer and Utilities Manger. Construction of the sewer easement may include placement of an all-weather drivable base material to facilitate access to the sewer collection system.

SECTION 10

WATER SYSTEMS

SECTION 10. WATER SYSTEMS

All distribution and transmission pipelines, tanks/reservoirs, wells, and booster pump stations shall be designed by a Civil Engineer, licensed in the State of California, in accordance with Division 4-Public Health of the City of Ventura Municipal Code Engineering Division's Standard Construction Details, Engineering Division's Design Standards, California Department of State Health Services Requirements, American Waterworks Association Standards, Standard Specifications for Public Works Construction ("the SSPWC"), and City master plans.

10-1 Water Distribution System Design

A project Civil Engineer responsible for the water distribution system design shall provide calculations acceptable to the City Engineer and Assistant Public Works Director/Environment and Water Resources Division showing the proposed design can meet anticipated demand. The sizing of the pipes shall be such that flow velocities within the pipe are near 8 feet per second (fps) with a maximum of 15 fps during fire-flow or flushing conditions. Water mains shall be designed so that maximum day domestic flow plus fire-flow demands can be met.

Minimum and maximum service pressure criteria include:

- Minimum residual pressure during fire flow = 20 psi
- Minimum allowable service pressure = 40 psi
- Maximum allowable service pressure = 120 psi
- Individual pressure regulators are required for all services at pressures higher than 80 psi.

10-2 Service Connections

Separate domestic water service shall be provided for each lot. Where any meter serves commercial, industrial or irrigation applications that service shall be provided with reduced pressure (RP) backflow protection (double check valve-type backflow device is not permitted). The minimum size water meter shall be 3/4-inch for domestic use and the minimum diameter of the copper or HDPE service shall be 1-inch nominal. Water services and pipelines shall be placed a minimum of 8-feet from any street tree and/or 10-feet from any sewer lateral unless otherwise approved by the City Engineer and Utilities Manger. The City's Water Division shall perform "Hot taps" and construction of new water services into an existing main.

10-3 Water Mains

All pipe materials shall be minimum 150-pressure class ductile iron, or poly vinyl chloride (PVC) C900 pipe in accordance with American Water Works Association (AWWA) Standards. For PVC pipe greater than 12 inches, the requirements of AWWA C905 shall be met. For pipe above 12-inches in diameter, PVC, HDPE, ductile iron pipe, or cement mortar lined and coated steel pipe with appropriate cathodic protection shall be used as approved by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division.

New residential areas where the structures are protected by fire sprinklers shall be protected by water mains providing a minimum 1,000 G.P.M. fire flow with a residual pressure of 20 psi or Fire Department requirements. For buildings other than residential, the size and construction type of each building determines the fire-flow as determined by the Fire Department. For large multiple commercial or residential unit projects such as a shopping center, the minimum fire-flow is 2000 G.P.M. at 20 psi or as approved by the Fire Department. Spacing of hydrants in sprinkled residential tracts is 600-feet with no structures further than 400 feet from a hydrant. In new industrial/commercial areas, commercial shopping areas, and mixed-use areas, the maximum spacing is 400 feet with no structure more than 300 feet from multiple hydrants (on-site included). New residential, industrial/commercial, and mixed use areas shall be fed by two or more looped water mains.

All fittings shall be cast iron or ductile iron mechanical joint type, unless otherwise approved by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division. Short body fittings are not acceptable. All new valves shall be resilient wedge (RW) gate valves. Isolation valves shall be placed at all pipe branch intersections. In long runs (800 feet or more) of water main without intersection branches, a gate valve shall be placed at the mid point of the main or at other locations as approved by the City Engineer. Maximum valve spacing criteria shall not exceed 600 feet for residential tracts and 1,500 feet for transmission mains.

The minimum diameter for a water main placed within the public right-of-way shall be 8 inches. The City Engineer and Assistant Public Works Director/Environment and Water Resources Division may require larger or smaller water mains if required by the cumulative demand of existing and planned development or operational considerations. Standard pipe diameters of 8 inch, 12 inch, 16 inch and 24 inch shall be used.

In new development and/or where the location of existing utilities allows, new water mains within streets shall be installed at 7 feet measured from face of

curb to centerline of pipe. In no case shall pipe within streets be installed closer than 5 feet from face of curb to centerline of pipe.

Combination air and vacuum valves shall be placed at all high points on a new water main or as required by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division. Blow offs shall be installed at low points as approved by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division.

A water sampling station may be required and shall be installed at locations as directed by the Water Superintendent. Sampling stations shall be in a locked cabinet.

Thrust blocks and/or pipe restrainers shall be placed at all tee connections, elbows, change in pipe direction and pipe reducer locations. The make and manufacture of mechanical pipe restrainers shall be approved by the City Engineer.

Roping of a water main is allowed provided that the radius bends do not exceed the pipe manufacturer's recommendations or as approved by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division.

Pipeline protective covering material for ductile iron pipe shall be 8 mil polyethylene tube type. All buried fittings, valves, and appurtenances shall be protected against corrosion with plastic sheeting and rubberized undercoat.

A location wire or tape shall be installed on all non-metallic water lines. A 4 mil thick blue plastic identification tape with the words "water line" printed on it shall be installed two feet above the pipe for the entire length of the line.

Specified pipe depths to the top of pipe from finished grade shall conform to the following schedule unless otherwise noted on the plans:

Pipe up to 6" = 36" cover
 8" = 40" cover
 10"-12" = 42" cover
Pipe 14" and above = 48" cover (or as specified on the plans)

Any water main placed in an unstable area such as a slope, hillside, or a location with poor soil conditions, as determined by the City Engineer, shall be constructed of a material to withstand pipe flexure. All connections shall be mechanically restrained or with concrete anchor blocks in a manner satisfactory to the City Engineer. Pipe "slope" anchors shall be installed where slopes are steeper than 2:1.

10-4 Water Main Easements

Water main easements are not encouraged and will only be allowed as approved by the City Engineer and Assistant Public Works Director/Environment and Water Resources Division.

The minimum width of a water main easement shall be fifteen feet. The water main shall be located within the middle of the water main easement. If the water main is to be maintained by the City, then access shall be provided in a manner acceptable to the City Engineer. Construction of the water main easement may include placement of a drivable all-weather material.

10-5 Water Tanks/Reservoirs

All water tanks/reservoirs shall be designed for domestic use and fire flow reserves in a manner acceptable to the City Engineer and Assistant Public Works Director/Environment and Water Resources Division. Storage requirements for all new reservoirs equal to 100% of the maximum daily demand (operational storage) plus 75% of the maximum daily demand (emergency storage) plus the maximum required fire flow volume. Prestressed concrete reservoirs or reinforced concrete reservoirs shall be used when site elevation restrictions require the reservoir to be partially or completely buried. All steel water reservoirs shall conform to AWWA, D-100 with the additional following requirements:

1. Steel reservoirs shall be placed on a concrete ring wall with anchor bolt supports designed to resist lateral stresses due to seismic loading.
2. Oiled sand shall be contained within the ring wall.
3. All tanks shall be built with a minimum two access ways. One access way shall be flush with the reservoir floor. The minimum diameter of the access ways shall be 42 inches.
4. All interior joints, laps, connections, fixtures, roof members, and plates within the interior of the tank shall be seal welded.
5. All interior bolted connections shall be caulked with approved material.
6. An approved exterior ladder with guardrails shall be placed on a tank/reservoir and shall run from the ground to the top of the reservoir/tank. The first 8-feet of steps shall have a solid metal cover to prevent access. Conventional ladder configurations should also be considered. A ladder access cage with lockable hatch shall be placed on the ladder 8-feet above the ground.
7. The reservoir shall be designed with an internal and external corrosion control system acceptable to the City Engineer.
8. The reservoir site shall be secured with galvanized chain-link fencing as per security design standards.

9. The reservoir site shall be designed with appropriate landscaping to visually screen the tank and the tank may be recessed in the ground for emergency containment in the event of a major failure.
10. An appropriate under drain leak detection system shall be installed under the reservoir.
11. All site drainage shall be directed away from the reservoir.
12. All piping connections to the reservoir shall be made with flexible connections for seismic protection. Connections shall allow for at least 6-inches of vertical or horizontal movement of tanks; even for tanks with anchors.
13. All tanks will have separate inlet and outlet piping at the same elevation.
14. A mixing system to provide for tank turnover every two days.
15. All vents shall be covered with stainless steel extruded metal screen.
16. Overflow drain piping shall have an air gap above ground of at least two times the pipe diameter with a fine mesh stainless steel screen.
17. Seismic valves shall be used to protect tank storage in zones with multiple tanks. At least one tank in each zone, or multiple tanks equaling a minimum (low-level) storage capacity of 1.5 million gallons shall be equipped with a seismic valve.
18. Catwalk with guardrails shall be provided from the top of the ladder with accommodations to access the tank vents and roof access hatch. Anti-slip paint or surfacing material shall be used in this area. Steel cable with clear vinyl coating and spring-snap attachments suitable of carrying a load of at least 1000 pounds shall be secured to the center vent of the tank the length of rope shall be equal to the radius of the tank minus 5-feet.
19. All gate valves shall be located above ground.
20. Multiple sampling ports shall be installed for tank profiling with 1 inch corporation stops ((use standard copper hose bib with a dielectric connection to tank 1-inch thread-o-let) starting at 2-feet above tank floor, half-tank height and $\frac{3}{4}$ tank height).
21. Two 2-inch corporation stops shall be installed on the tank inlet for emergency chlorine injection.
22. Exterior mounted pressure transducer is provided for tank level control.
23. SCADA control and monitoring system shall include a PLC, touch-screen interface with wireless radio communication equipment. This control equipment shall have a UPS for temporary backup power conditioning, located inside a NEMA 4X enclosure.
24. Flat roof with circular ventilation (mushroom style) vent on top.
25. Roof mounted temperature probes shall be provided.
26. Altitude valve shall be installed for level control. An alternative would be to use butterfly or gate valve with an actuator and fill tanks via SCADA.
27. Sites shall have power available for instrumentation and maintenance equipment.

10-6 Wells

A California State licensed hydrologist, hydrogeologist, or professional civil engineer shall design Wells. Inlet screen velocity should be considered when sizing the perforations to meet the desired capacity. A Drinking Water Source Assessment Study must be prepared before the final location and depth is established. An NPDES permit is required for pump to waste during major well maintenance.

Above ground appurtenances should include the following requirements:

- 1) Wellhead discharge recirculation piping shall be provided back to well casing.
- 2) Separate wellhead tubes for sounding, recirculation, and gravel pack replenishment shall be provided.
- 3) Connections to the storm drain shall be provided to permit pumping to waste.
- 4) Building or enclosure shall be provided to cover or enclose wellhead and electrical equipment. The cover for the wellhead shall be removable at ground level to provide adequate maintenance access.
- 5) HVAC is required in the building.
- 6) Well site shall have security fencing that has removable access panels for maintenance with large vehicles.
- 7) Well pump and motor shall be designed for variable speed using a variable frequency drive.
- 8) Removable access hatch shall be provided over the wellhead with fall protection guardrails.
- 9) Well pump shall be oil lubricated.
- 10) Pump head discharge shall have a gate valve for isolation.
- 11) 1-inch corporation stop port shall be provided for sampling in the discharge near wellhead.
- 12) 1-inch corporation stop shall be located as required for Edison testing.
- 13) Minimum instrumentation at each well shall consist of a magnetic flow meter, discharge pressure transducer, well level submersible transducer, and power-monitoring device.
- 14) All instrumentation shall have 4-20 ma outputs.
- 15) Flow meters shall include a discrete output to totalize flow.
- 16) Discharge piping shall include a pump-to-waste control valve and a check control valve.
- 17) Waste control valve shall include fully open and fully closed indications
- 18) All well pump stations are to include accommodations to expedite emergency generator connection. This includes connections for a generator and an automatic transfer switch.
- 19) All well sites shall be designed to provide adequate space around the wellhead to accommodate a well rig for well maintenance.
- 20) Surge analysis shall be performed to determine if a surge tank is needed.
- 21) A lighting pole shall be provided of sufficient height to mount a radio antenna.

- 22) The design engineer and a representative of the City shall attend a Factory Witness Test.

10-7 Booster Pump Stations

- 1) All pumps shall be vertical turbine style with top mounted motor, unless otherwise approved by the City Engineer.
- 2) Minimum static suction head shall be 40 psi.
- 3) Discharge head shall be sized for tank fill elevation.
- 4) Main suction and discharge isolation valves shall be a gate valves.
- 5) A building or enclosure shall be provided to enclose electrical equipment. Building shall have roof access hatches for motor/pump removal.
- 6) HVAC is required in the building.
- 7) Pumps shall be designed for variable speed using drive rated, premium efficiency motors using variable frequency drives.
- 8) Station design shall allow one pump to be taken out of service without affecting normal station operation.
- 9) Pump controls shall allow for lead lag operation.
- 10) SCADA control and monitoring system shall include a PLC, touch-screen interface with wireless radio communication equipment. This control equipment shall have a UPS for temporary backup and power conditioning.
- 11) 1-inch corporation stop shall be located as required for Edison testing.
- 12) 1-inch corporation stop shall be provided on the station discharge for water quality sampling.
- 13) Minimum instrumentation at each booster pump station shall consist of a propeller flow meter (unless the flow meter is also used for speed control of the pumps, in that case a magnetic flow meter), suction and discharge pressure transducer, individual pump pressure switches, power monitoring device.
- 14) All instrumentation shall have a 4-20 ma output.
- 15) Flow meter shall include a discrete output to totalize flow.
- 16) Each pump shall include a pump control valve with separate fully open and fully closed indications.
- 17) All booster pump stations shall include accommodations to expedite emergency generator connection. This includes connections for a generator and an automatic transfer switch.
- 18) All pumps shall be water lubricated.
- 19) A lighting pole shall be provided of sufficient height to mount a radio antenna.
- 20) All piping within pump station building shall be steel pipe. Above grade pipe shall be standard weight, cement mortar lined and epoxy coated. Below grade pipe shall be cement mortar lined and coated.
- 21) Flexible couplings shall be provided on the above grade piping and shall be either victaulic coupling or flexible coupling.

10-8 Pressure Reducing Stations

Design

Pressure Reducing Station design shall incorporate:

- 1) Parallel piping and valves to allow operation under low and high flow conditions.
- 2) Avoid vaults if possible by installing station above ground with appropriate view block. If a vault is necessary, location should be outside of traffic lanes and provide piping clearance of at least 2 feet to all vault walls.
- 3) Pressure instrumentation, radio data telemetry compatible with current SCADA standards, power source and antenna.
- 4) Drainage should be via sump discharging to curb or storm drain as appropriate.

Materials and Equipment

Pressure Reducing Stations shall include:

- 1) Steel pipe with epoxy coating inside vaults.
- 2) Stainless steel ladders shall be used where necessary with safety assist.
- 3) Vault lids, where used, should be double leaf, spring loaded and traffic rated Aluminum, Bilco style door.
- 4) Control valves shall be Cla-Val.

10-9 Factory Witness Testing

Factory Witness Test shall include the following:

- 1) Motor Control Center.
- 2) Control Panel, if not part of the Motor Control Center
- 3) SCADA/MMI interface design.
- 4) Well/Booster pump, motor and Variable Frequency Drive.
- 5) Variable Frequency Drives, if not part of a Motor Control Center or included with well pump and motor test.

SECTION 11.

SURVEY MONUMENTATION

SECTION 11. SURVEY MONUMENTATION

11-1 Exterior Monumentation

The tract boundary shall be monumented at each angle point and centerline of existing streets. Existing monuments on the exterior of the tract shall be protected or reset. Any that are subgrade (such as street centerlines), should have a monument well rim and cover set to grade over them.

11-2 Street Monumentation

All street intersections shall be monumented. The PI of major curves (or BC/EC) shall also be monumented. Not every point shown on the centerline of the street needs to be set, (See Standard Construction Detail for Knuckle Intersection).

If a manhole is at the intersection then the monument and well is set on a five foot offset line. In offsetting the monuments, consideration should be given to having the entire street on a 5 foot offset so that, for example, the north/south streets would have monuments offset 5 feet from centerlines while the east/west streets would have monuments on the centerline.

11-3 Lot Monumentation

Monuments shall be set in concrete sidewalk along lot line produced a specific distance from the true point at front lot corners between lots.

11-4 Character of Monuments

All monuments, lot line offsets, and ties shall be permanently and visibly tagged or marked with the certificate number of the surveyor or civil engineer setting it, each number to be preceded by the letters "L.S." or "R.C.E.," respectively.

Survey pipes are not allowed in the asphalt street paving. A monument in hand well (Standard Survey Monument) is required for any monuments within the asphalt street paving.

11-5 Centerline Ties

Subdivider shall submit a Tie sheet prepared under the Land Surveyors Act in a form approved by the City Surveyor.

11-6 Certificate of Correction

Certificates of Correction will be filed in conformance with the Subdivision Map Act to show the proper location or character of any monument which has been changed in location or character from the Final Map or Parcel Map.

11-7 Bench Level Circuit

Temporary bench marks shall be set within the tract. These shall be based on the elevation that was approved for construction. Sufficient temporary bench marks will be set throughout the tract to check the grade of the improvements.

11-8 Additional Monumentation Requirements

Offsite improvements shall require the setting of monuments to delineate the City's interest. An offsite road would generally be monumented as per streets monumentation. A record of survey shall be filed as required by the Professional Land Surveyors Act.

If a minor lot line adjustment is initiated by the subdivider before final acceptance, monuments shall be set to conform to the reconfigured lots and a record of survey shall be filed as required by the Professional Land Surveyors Act. Those monuments shown on the Final Map but not set, shall be so noted on a certificate of correction.

11-9 Data in Digital Format

Rights-of-way, lot lines, and easements as shown on the Final Map or Parcel Map shall be submitted to the City Surveyor in an acceptable CAD.

11-10 Real Property Descriptions

Real Property shall be signed and sealed under the authority of the Land Surveyors Act unless it has been prepared pursuant to one of the exceptions contained in the Act or the Act is not applicable because new property boundaries are not created. A Plat to accompany legal description, in the City approved format, shall be submitted with each real property description.

SECTION 12

DESIGN PLAN REQUIREMENTS

SECTION 12. DESIGN PLAN REQUIREMENTS

12-1 Introduction

Design plans are required for any proposed public improvements such as streets, storm drains, sewers, waterlines, and linear parks within the public right-of-way or within public utility easements.

This section has been developed to assist the preparation of improvement plans. It reflects established professional engineering practice for preparation of these plans.

12-2 Improvement Plan Requirements

12-2.01 Materials

Three-mil thick mylar plan material must be used for original drawings. "Sticky-back" transparencies will not be permitted to be used on any final drawings. Mylar original plans will be placed in the City Engineering Division's drawing file system.

12-2.02 Title Sheets

Each set of construction plans must have a Title Sheet, which includes:

- a. A label designating the Title Sheet must be Sheet 1 of each set of construction plans.
- b. A Vicinity Map. The Vicinity Map may be at a convenient standard scale preferably not smaller than one inch = 2,000 feet; including a north arrow.

The Vicinity Map must show the project location in reference to the City's major street pattern and be sufficiently identified so as to readily locate the project.

- c. Published benchmark used for project with designation, description, elevation, datum, and adjustment. Temporary benchmark (TBM) shall also be listed if permanent benchmark is not in close proximity to the project.
- d. General construction notes may be placed on the Title Sheet if space permits after all other items in this section have been provided. If space does not permit, there must be a reference on the title sheet to the sheet where the general notes are located.
- e. An index of all public improvement plans in the set for the project must be provided.

- f. An approval block on the title page next to the title block must be provided as follows for the City Clerk if these plans need approval from City Council.

(Drawn to scale)

APPROVED BY THE CITY COUNCIL OF THE CITY OF SAN BUENAVENTURA ON THE ____ DAY OF _____, 20____.
<hr style="border: 1px solid black;"/> CITY CLERK

- g. A Project Map must be accurately drawn on the Title Sheet to a scale not smaller than one inch = 200 feet and placed on the sheet so that north is directed to the top when practicable.

12-2.03 Sheet Dimensions

The improvement plans must be drawn on all City standard sheets, 24 inches vertical by 36 inches horizontal, with City title block in the lower right corner:

(Drawn to scale)

PUBLIC WORKS DEPARTMENT		ENGINEERING DIVISION	
CITY OF SAN BUENAVENTURA			
(PROJECT NAME)			
DRN. BY:	DES. BY:	CK'D BY:	
PROJECT ENGINEER: _____		DATE _____	
R.C.E.			
_____ LAND DEVELOPMENT ENGINEER	_____ R.C.E. NUMBER	_____ DATE	
SPEC NUMBER _____		PROJECT NUMBER _____	
F. B.:	PG.	SHEET	OF
		FILE NO.	

(Drawn to scale)

COMMUNITY DEVELOPMENT DEPARTMENT		LAND DEVELOPMENT	
CITY OF SAN BUENAVENTURA			
(PROJECT NAME)			
DRN. BY:	DES. BY:	CK'D BY:	
PROJECT ENGINEER: _____		DATE _____	
R.C.E.			
_____ LAND DEVELOPMENT ENGINEER	_____ R.C.E. NUMBER	_____ DATE	
F. B.:	PG.	SHEET OF	FILE NO.

12-2.04 Plan and Plan/Profile Sheets

a. The standard scale should be as follows:

1. The basic plan and profile scale, horizontal, one inch = 40 feet.
2. The basic profile scale, vertical, one inch = 4 feet.

Using other scales may be appropriate depending on improving how the information is presented on the plans. If non-standard scales are to be used, they shall be first approved in advance by the City Engineer.

b. Profile Layouts are required for street, sewer, and storm drain plans and must show as a minimum:

1. Scales, horizontal and vertical.
2. Datum elevations at each end of sheet and at stations where profile must be broken because of vertical grade changes.
3. Stationing must advance from left to right on the sheet, regardless of compass direction, or where north points in reference to the

sheet top. Stations in the profile must line up vertically with the same stations in the plan or as close as practicable.

4. Stations and elevations at all grade changes.
5. Pertinent information shown on storm drain plan and profile sheets shall include:
 - a. Size, class, and type of pipe.
 - b. Design Q, HGL (hydraulic grade line), EGL (energy grade line), and storm frequency.
 - c. Horizontal and vertical curve data.
 - d. Catch basin, junction structures, and manhole details.
 - e. Top of curb elevations and flow lines.
 - f. All profile view stationing should match plan view stationing.
6. Pertinent information shown on sewer plan and profile sheets shall include:
 - a. Size and type of pipe.
 - b. Horizontal and vertical curve data.
 - c. All slopes shall be labeled in the profile view between manholes. Label all slopes in decimal form, not percent.
 - d. Centerline bearings for all sewer pipes.
 - e. Existing and proposed lateral locations.
 - f. Show manhole rim and flowline elevations.
 - g. Sewer easements.
 - h. Stationing of sewer main should match street stationing.
7. Pertinent information shown on water improvement plans include:
 - a. Pipe material, size, and class of pipe.

- b. All valves, thrust blocks, blow-offs, services, and meter locations.
- 8. The local benchmark, which will remain in existence during and after construction of the project or the initial benchmark if a local benchmark was not set, must be described and its elevation stated on each plan profile sheet. It is desirable that this information be placed near the lower right-hand corner of the profile grid if space permits, or in this general area in the plan or profile if profile design must occupy this space
- 9. Profiles shall not extend into the margins of the plan.
- c. Plan Layout must show:
 - 1. Centerline of construction as the major line in the plans.
 - 2. Stationing must:
 - a. Increase in magnitude from left to right on the sheet, regardless of where north points in relation to the top of the sheet.
 - b. Increase from west to east and from south to north, excepting where stationing has previously been established contrary to this rule.
 - c. Established stationing must be used and continued, excepting where variations to this rule have been approved prior to presentation of plans.
 - 3. Names of all streets.
 - 4. Bearings on centerline of all streets, sewers, storm drains or water main plans.
 - 5. Right-of-way and improvement widths on street plans.
 - 6. Curb return data (delta, radius, length) on street plans.
 - 7. Centerline curve data (delta, radius, length) on street plans.
 - 8. Stations on all B.V.C.'s and E.V.C.'s.
 - 9. Stationing for all centerline P.C.'s and P.T.'s.

10. Stations for all centerline intersections (including stations of centerline of each street).
11. Equation stations with "Back" and "Ahead" references on street plans.
12. Existing utility locations, irrigation systems, drainage systems, street improvements, etc., with locations dimensioned and a note included as to their disposition if not in conformance with proposed improvements. See Figure 10 (Appendix) for general utility locations.
13. All private roads labeled.
14. Signals, signal controller details, striping details, and signal interconnect conduit on all street plans for collector and arterial streets. All signal designs shall conform to the Caltrans Manual on Uniform Traffic Control Devices (CMUTCD).
15. Other information as deemed necessary by the City Engineer.

12-2.05 "Record Drawing" Improvement Plans

All plans must be corrected to reflect the record condition of the improvements.

The following note must be added to all sheets of the improvement plans:

(Drawn to scale)

RECORD DRAWING	
BY	DATE

12-2.06 CAD Drawings

All public improvement plans should be done as a CAD drawing using AUTOCAD format. Plans done with ink may also be acceptable as determined by the City Engineer. The City Engineer has prepared a CADD Procedures Manual, which details how the drawings are to be submitted in electronic format with the hard copy originals.