

**SECTION 8**

**SANITARY SEWER (SS)**

- 8-1 DESIGN CRITERIA** - These criteria shall apply to the engineering design of any sanitary sewer system to be maintained by the City of Grass Valley or, with those exceptions as noted, to that within private multiple ownership residential or multi-parcel commercial and industrial developments.
- 8-2 AVERAGE FLOW DETERMINATION** - The determination of average dry weather flows for design purposes shall be based upon the best available information concerning land use and density as determined by the City Engineer. This information may include approved land use and density in accordance with current zoning in the absence of more specific information pertaining to expected development. Average dry weather flow factors are listed in Table 8-1.

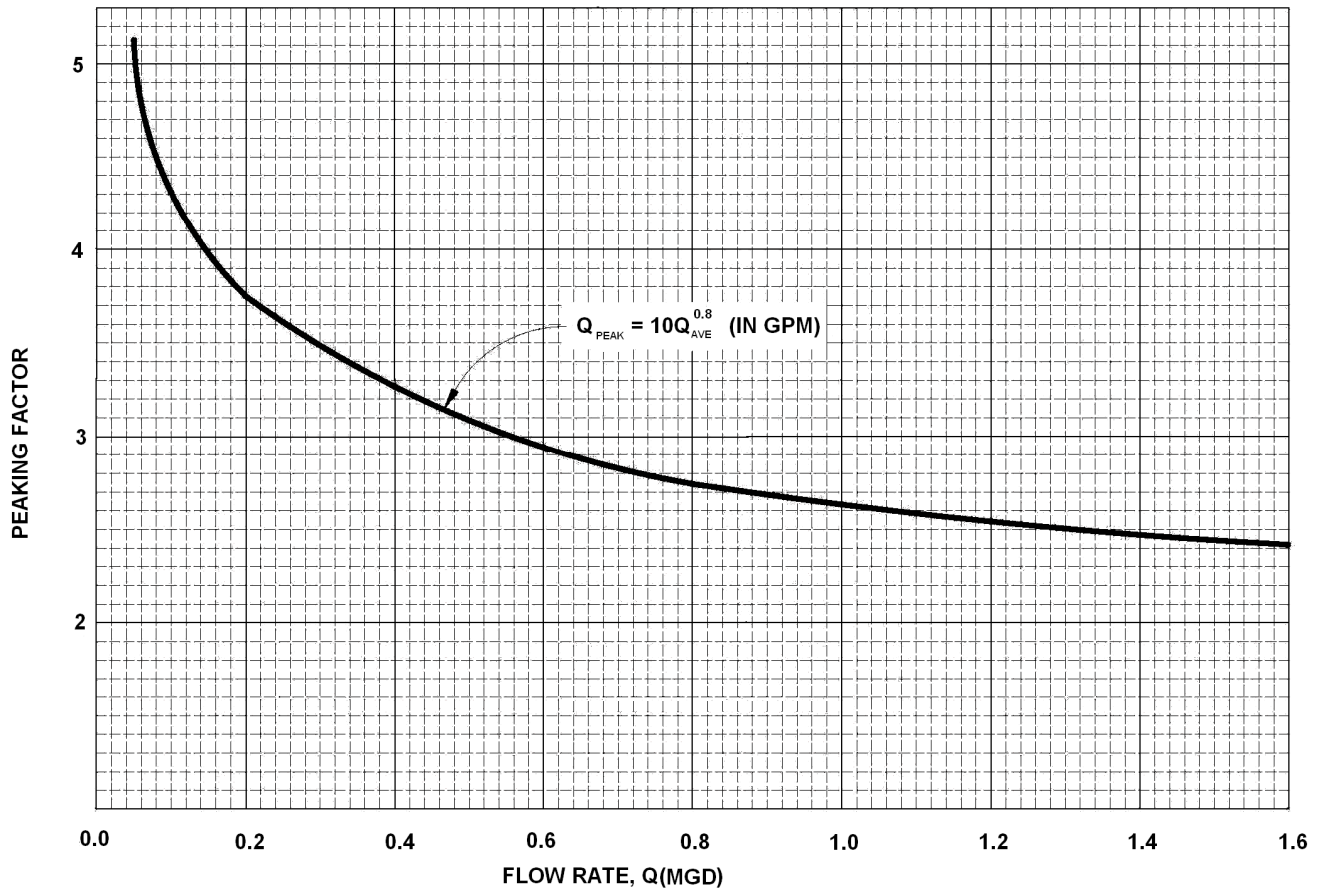
**Table 8-1 - Average Dry Weather Unit Flow Factors**

<b>Land Use Designation</b>	<b>Units</b>	<b>Wastewater Generation Factor (gpd/unit)</b>
Commercial/Industrial	Acre	850
Residential Single Family	Dwelling Unit	191
Residential Multiple Family	Dwelling Unit	135

Note: Flow factors for land use designations not listed, including Public lands, mixed use, and schools shall be determined on a case-by-case basis

- 8-3 DESIGN FLOW** - Design flow sizing of infrastructure 15-inches in diameter and smaller shall be calculated by using the average dry weather unit flow factor(s) listed in Table 8-1 for the upstream service area along with a safety factor of 2.0 and the appropriate peaking factor listed on Figure 1. For sizing trunk sewers 18-inches in diameter and larger, utilize the hydraulic model of the collection and conveyance system and consult with Engineering staff.

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**Figure 1 - Peaking Factor**

**8-4 PIPE CAPACITY, SLOPE, VELOCITY, SIZE, DEPTH AND MATERIAL** - Design criteria for the pipe system are as follows:

- A. Main Sizes** - The minimum size sewer main within a residential development shall be 6-inches in diameter. The minimum size sewer main for commercial and industrial developments shall be 8-inches in diameter.
- B. Slope and Velocity** - Manning’s formula shall be used to determine the relation of slope, design flow, velocity, diameter, and "n" value. The "n" value shall not be less than 0.013 for all pipe materials.
  - 1. Table 8-2 provides minimum slopes and design flow capacities for various pipe diameters. Pipe slopes less than those listed in this table shall not be used without the approval of the City Engineer. The slopes indicated are based on a velocity of two (2) feet per second with the pipe flowing full.

**Table 8-2 - Minimum Slopes and Flow Capacities**

<b>PIPE DIAMETER (IN)</b>	<b>SLOPE (ft/ft)</b>	<b>CAPACITY AT 0.7 DEPTH</b>	<b>CAPACITY FLOWING FULL</b>
6	0.0050	0.22 MGD	
8	0.0035	0.38 MGD	
10	0.0025	0.58 MGD	
12	0.0020	0.85 MGD	1.00 MGD
15	0.0015	1.32 MGD	1.60 MGD
18	0.0012	1.95 MGD	2.35 MGD

2. The maximum depth of flow at design conditions in all laterals shall be 70 percent of pipe diameter.
3. All sanitary sewer pipe shall be designed for a minimum scour velocity of 2-feet per second at peak flows. The volume of wastewater within the pipe system as determined above shall be used when designing pipe slopes.
4. Maximum design velocity shall not exceed 10-feet per second.

**C. Capacity** - Pipe capacity in all cases, shall be adequate to carry the design flow from the entire tributary shed area even though said area may not be within the project boundaries.

**D. Hydraulic Grade Line** - The hydraulic grade line shall be determined from the design flows, based upon 100 percent development of the tributary area. Hydraulic grade line calculations must be submitted for the design of all lines 12-inches in diameter or larger.

**E. Depth** - Sewer mains with service laterals shall not exceed a depth of 15-feet. The system shall be designed to provide a minimum slope for sewer services of ¼-inch per foot with a minimum cover of 24-inches at any buildable location within the properties to be served. Proposed building floor pad elevations shall be a minimum 6-inches above the lowest upstream manhole rim. Where the pad elevation cannot be raised, a backwater valve for the building shall be required. The backwater valve shall be noted on the improvement plans and building plans. Installation shall be made during construction of the underground improvements. Deed restrictions shall be put in place which hold the City harmless for failure of the backwater valves on such lots.

**8-5 SEWER LOCATION AND ALIGNMENT REQUIREMENTS** - Location and alignment criteria are as follows:

- A. General** - All sanitary sewers shall be placed in rights-of-way dedicated for public streets or within easements approved by the City Engineer. Developments with deep sewer mains or with trunk mains may require dual sewer mains. There shall be a minimum horizontal clearance of 10-feet between parallel water and sanitary sewer mains. A minimum horizontal clearance of 5-feet shall be maintained between sewer mains, parallel storm drains, and other utilities. On crossings, water lines shall be a minimum of 12-inches above the sewer line, unless otherwise approved by the City Engineer. Attention is directed to Sewer and Water Separation of the Standard Details.
- B. Location in New Streets** - In new streets, sewers shall be located 5-feet south or east of street centerlines, or as approved by the City Engineer.
- C. Location in Existing Streets** - When sanitary sewers are to be installed in an existing street, factors such as curbs, gutters, sidewalks, traffic conditions, traffic lane conditions, pavement conditions, future street improvement plans, and existing utilities shall be considered. The approval of the City Engineer shall be obtained in every instance.
- D. Location in Unpaved Areas** - All mains in unpaved areas shall be marked every 100-feet maximum between manholes with a green 5-foot, 6-inch composite utility marker. A decal shall be placed on marker stating "CAUTION SEWER PIPE." Utility marker shall be Carsonite or approved equal with anchor barb kit.
- E. Easement Sewer Lines** - Easement sewer lines outside of the public right-of-way, or within a narrow right-of-way shall require an easement dedication to the City. Sewer lines shall be centered within their easement. Easements shall be completely on one side of the property line or fence. The easement shall be clear of permanent structures, building eaves, roof lines, and the future trunk of large tree species. Temporary construction easements of adequate size shall also be provided. The proposed easement shall be the greater of the following:
1. Minimum width of easement shall be 15-feet.
  2. All easements shall have a minimum width equal to the required trench width according to the standard detail for trench backfill, plus two (2) additional feet for every 1-foot of depth of the pipe as measured from the bottom of the pipe to finished grade. All sewer lines shall be centered within their easement.
- F. Water Well Clearance** - Sewer lines shall maintain a minimum 100-foot separation from all public or private wells. (Properly abandoned wells are not included.) If a clearance of less than 100-feet is approved, the pipe material shall be approved by the City Engineer. In no case shall a clearance of less than 50-feet be allowed.
- G. Lines in Drainage Swales** - Sewer lines, public or private, shall not be located within a drainage swale. The horizontal distance between the sewer line and the top of the bank shall be sufficient to maintain the integrity of the drainage swale and provide access for maintenance to the sewer line.
- H. Alignment** - Sewer lines and structures shall be designed to provide a minimum 12-inch vertical clearance from all utilities and/or improvements, unless otherwise approved by the City Engineer.
1. Horizontal alignment of sewer lines shall be parallel to the street centerline. The location shall be 5-feet south or east of street centerlines, as needed to maintain separation from water and storm drain lines, or as approved by the City Engineer. Minimum radius for sanitary sewers 6-inches through 12-inches in diameter shall be 200-feet. For pipe 27-inches in diameter or larger, mitered

joints, fittings, or other methods as specified in the Construction Standards may be utilized to accomplish alignment changes.

2. Vertical alignment shall provide a constant slope between manholes. If a change in grade is necessary, construction of a manhole shall be required unless the use of a vertical curve is approved by the City Engineer. In such case, elevations shall be shown at 10-foot intervals throughout the length of the vertical curve. The maximum deflection permitted shall be two percent for each 10-foot interval.

- I. **Sewer Main Stub** - Sewer main stubs for future development which are perpendicular to the sewer main shall originate from a manhole and terminate 5-feet into the future development.

**8-6 TRENCH BACKFILL** - The trench backfill requirements for sanitary sewer pipe are as follows:

- A. **Bedding and Initial Backfill** - Unless otherwise noted on the plans, bedding and initial backfill shall be per the Construction Standards. Special backfill requirements shall be noted on the plans.
- B. **Special Pipe Strength Requirements** - For sewer mains greater than 20-feet deep or mains requiring extra support strength, pipe material shall be approved by the City Engineer. Ductile iron pipe shall be used if cover is less than 3-feet or insufficient clearance exists between the sewer pipe and the rigid load transmitting structures. Such structures include large diameter storm drains and other structures subject to settlement. The ductile iron pipe shall extend 5-feet each side of the structure crossing.

**8-7 MANHOLE CRITERIA** - The design criteria for manholes are as follows:

- A. **General** - Manholes shall be placed at the intersection of all sanitary sewer lines, at the upstream end of a pipe run, and at the end of all sewer mains. No more than three (3) lines may enter a manhole with one (1) line exiting. Medium-density single-family subdivisions may enter a manhole with up to 4 services with one exiting main line upon approval of the City Engineer. Summit manholes are not permitted.
- B. **Spacing** - Maximum spacing of manholes shall be 500-feet for all straight lines of 10-inches in diameter or less. A line with a radius greater than 400-feet shall be considered as straight for purposes of this section. Manhole spacing on curved lines of 200-foot radius (minimum allowable) shall be 200-feet. Manhole spacing on curved lines of radii between 200- and 400-feet, or where only a portion of the line is curved, shall be adjusted proportionately. Reverse curves require a manhole at the point of tangency of the curves or as determined by the City Engineer. A manhole shall be required at any change in vertical alignment unless use of a vertical curve is approved by the City Engineer.
- C. **Invert Elevations** - The invert elevation for pipe of the same diameter entering a manhole shall have a 0.10-foot drop between the entering and exiting pipe. For pipes of different diameters the crown of the entering pipe shall be at the same elevation or higher than the exit pipe.
- D. **Special Construction Requirements** - Epoxy coating of manholes shall be required in areas determined to have a potential of generating excessive sulfide gases. Such manholes shall include, but are not limited to, the first manhole originating from a sewer trunk main 15-inches in diameter or larger, force main transition manholes, manholes designed with inside drops, or as determined by the City Engineer.

- E. Manhole Access** - Provisions must be made to prevent vegetation from overgrowing the manholes. An all weather 10-ton vehicular access road shall be provided to each manhole as required by the City Engineer. Turning radii of 30-feet inside and 45-feet outside, and a vertical clearance of 14-feet are required.
- F. Connection to City Mains** - Improvement plans which require a connection to an existing City of Grass Valley sewer main or structure, shall specify that such connection be performed by City forces on a time and materials basis.

**8-8 DROP CONNECTION CRITERIA** - Outside drop connections shall be the preferred drop connection, if required. If an elevation difference of less than 3-feet exists, the slope of the incoming line shall be increased to eliminate the need for the drop. Inside drops may be permitted under special conditions with the approval of the City Engineer.

**8-9 SEWER SERVICE DESIGN** - The design criteria for sewer services are as follows:

**A. General** - Services shall be designed and constructed perpendicular to the main or as approved by the City Engineer. The service shall extend from the main to the edge of the public right-of-way or easement. A cleanout shall be constructed at the property line per the Construction Standard Details. Services shall extend 2-feet beyond edge of pavement of private roads. Easements of adequate width to accommodate the service shall be obtained. A plan and profile of services shall be supplied to the City Engineer on request.

**1.** Cleanouts shall be designed and constructed to grade with subdivision improvements or at the time connection is made to the building sewer. Unless otherwise noted on the plans, construction of the cleanout to grade is the responsibility of the contractor for the subdivision improvements. If installation of the cleanout is deferred, the plans shall call for the placement of a 4-inch by 4-inch post at the end of the service sewer extending from the flow line to not less than 12-inches above ground surface.

**B. Sizing** - The minimum size service for single-family developments shall be 4 inches in diameter. Schools, commercial, industrial and multiple residential properties shall be served by a minimum 6-inch diameter service.

**1. Connection to Sewer Mains** - Residential services shall connect to the sewer main by means of a factory fitting. Properties with services located at the end of cul-de-sacs shall enter a manhole. Services 8-inches in diameter and larger shall be connected to the main by use of a manhole. Connection to trunk mains shall be approved by the City Engineer. In no case shall a service connection be made with the use of a tee.

**2. Connection to Existing Sewer Mains** - The Public Works Department will make all sewer service taps onto existing mains upon completion of an application for a permit and payment of the required connection fees. Proposed work by the City shall be performed by City forces and payment made to the City for such work will be on a time and materials basis. A note to this effect shall be placed on the plan sheet which shows a detail of the area that requires such tapping. Connection fees shall be paid prior to submittal of the application. All excavation, backfill, and the installation of the remainder of the sewer service or stub, shall be performed by the Contractor.

3. **Connection Limitations** - Sewer services shall connect to 12-inch diameter and larger pipe or to lines more than 15-feet in depth at a manhole. Direct connection to trunk mains shall only be with the approval of the City Engineer.
4. **Material** -Sewer pipe installation shall conform to section 5-6 of the Construction standards.
5. **Location** - A sewer service shall be constructed to each lot. In new subdivisions or developed areas, unless specifically requested otherwise in writing, sewer services shall be placed on the low side of any typical subdivision lot or similar parcel with 2 percent or greater slope across the front, or shall be placed in the center of lots of lesser slope. The sewer service for lots with lesser frontage cross-slope shall be placed at the center of the lot. Consideration shall be given to trees, improvements, etc., so as to minimize interference when the service sewer is extended to service the house.

If the property is located such that service is available both to a line located in an easement and also in a right-of-way, service shall be at the latter location unless otherwise approved by the City Engineer. No service sewer shall be located such that future on-site construction will result in the line being in such proximity to a water well or water main or service that applicable health standards will be violated.

- C. **Depth** - Adequate depth of sewer service at the edge of easement or right-of-way to service the intended parcel shall be verified. A depth of 4-feet to crown of pipe, measured from existing ground surface or edge of adjacent roadway, whichever is lower, shall be considered the standard for service sewer depth, except where the water main is to be installed at back of sidewalk as part of the subdivision improvements. In such cases, service shall have a minimum depth of cover of 4-feet at the property line and the service shall be extended to a minimum of 7-feet back of sidewalk with the cleanout to grade remaining within 2-feet of back of sidewalk. When greater depth is required, the invert elevation of the service sewer at the edge of the right-of-way or easement shall be noted on the improvement plans. If a joint trench is being utilized for other utilities, the plans shall indicate that a joint trench will exist and service elevations shall be adjusted accordingly. Sewer service connection to the main shall not exceed 15-feet.
- D. **Special Requirements in Developed Areas** - In developed areas, a sewer service shall be provided to each parcel participating in the project which contains a source of sewage less than 200-feet from a lateral. A property owner's request for service location shall be honored whenever practical. Parcels which have two or more sources of sewage must have an independent sewer service provided for each sewage source which can be separated from the rest of the parcel and sold. A service shall be provided to each lot. During the design period, each property owner affected by the proposed work shall be contacted in writing to determine the preferred sewer service location. In absence of a response, a sewer service shall be provided in accordance with these standards. In addition, upon staking the location of the proposed sewer services prior to construction, each property owner shall be given a final opportunity to approve the proposed sewer service location. Compilation of this information shall be furnished to the City Engineer.
- E. **Connection to Existing Sewer Stubs** - Connection to existing sewer stubs shall be made upon conducting a TV inspection and pressure test of the stub. The TV inspection shall be performed by City crews and payment made to the City for such work on a time and materials basis. If the stub is found damaged, repairs shall be made at the Developer's expense. A note to this effect shall be placed on the improvement plans.

**F. Abandoning Existing Sewer Stubs** - Existing sewer stubs to be abandoned shall be abandoned per Section 91 of the Construction Standards.

**G. Grease, Fats and Oil Removal System**- A grease, fats and oil removal system shall be required for any business having the potential of producing grease, such as food service establishments.

2. 1. General Commercial/Retail buildings shall require dedicated grease lines for future use. A location for the future grease interceptor shall be identified on the improvement plans. The grease, fats, and oil removal system must be situated on the user's premises and located so that landscaping or parked vehicles will not obstruct access to the device for inspection, cleaning and removal of grease. Such a device shall not at any time pose a hazard or obstruction to public use of the street or sidewalk area.
3. Waste discharge from fixtures and equipment in establishments which may contain grease or other objectionable materials including, but not limited to, scullery sinks, pot and pan sinks, dishwashers, food waste disposals, soup kettles, and floor drains located in areas where such objectionable materials may exist, must be drained into the sanitary waste through the grease, fats, and oil removal system when approved by the director provided, however, toilets, urinals, wash basins, and other fixtures containing fecal material shall not flow through the grease removal device.
4. No discharge to interceptor of  $\geq 140^{\circ}\text{F}$ .
5. All removal systems shall be of a capacity sufficient to provide 90 percent removal of FOG for non-gravity grease interceptors (GGI). Engineering calculations are required to be submitted to confirm the size.
6. Grease interceptors shall be required for all new food service establishment (FSE) buildings and when possible for any building converted to a FSE or where a FSE is added. Grease traps may be approved by the City Engineer where the installation of a grease interceptor is not feasible. Typically, grease interceptor sizing will be as follows:
  - a. Basic FSE (NAICS Code 722513): 1,000 gallon
  - b. Full Service FSE (NAICS Code 722511): 1,500 gallon
  - c. Large/specialty facilities (NAICS Codes 72212 (cafeterias), 7223 (special food services like contractors and mobile food vendors)): 2,000 gallons

**H. Backflow Prevention Device** - An approved backflow prevention device shall be required on the building side of the property line cleanout per the Construction Standard Details. The backflow preventer shall be a check valve type device installed inline with the sewer lateral.

**I. Pressure Relief Device** - An approved pressure relief device shall be installed in the cap of the cleanout located in an area least likely to cause damage to property or contamination if activated. Relief devices shall be gravity or spring loaded to closed position.

**8-10 CREEK CROSSING DESIGN** - Advance approval of the City Engineer, and other appropriate agencies, is necessary to initiate design. The criteria for creek crossings are as follows:

**A. General** - In all cases, the proposed future creek bed elevation shall be used for design purposes. Crossing details of pipe, piers, anchorage, transition couplings, etc., shall be shown on a detail sheet of the plans. The top of pipe shall have a minimum 3-foot of cover at the lowest point of the crossing.

**B. Construction and Material** - For line sizes 10-inches and smaller, ductile iron pipe shall be used under the full creek width plus 10-feet each side. For line sizes 12-inches and larger, pipe used shall



be as determined by the City Engineer. Steel I-beam piles may be necessary to support the pipe as recommended by the Design Engineer or as required by the City Engineer. All exposed surfaces shall be coated with coal tar epoxy. Upon verifying the slope, passing a pressure test and TV inspection, the entire crossing except for 5-feet at each end of the crossing shall be encased in concrete a minimum of 6-inches thick. A layer of 4-inch to 8-inch cobbles shall be placed and compacted on the top surface of the trench area for the full width of the creek. A trench plug shall be required at the top of the pipe at the downstream side of the crossing. The plug shall be a minimum of 4-feet in length, and shall extend 24-inches beyond the width and depth of the trench.

**C. Design** - Calculations shall be submitted which clearly indicate the design of the pipe and supports regarding impact, horizontal and vertical forces, overturning, pier and anchorage reactions, etc.

**8-11 BORING AND JACKING REQUIREMENTS** - The requirements outlined in the Construction Standards shall be followed.

**8-12 PUMP STATION AND FORCE MAIN REQUIREMENTS** - Every phase of pump station design, including force main design, shall be closely coordinated with, and shall be under the direction of, the City Engineer. The pump station and force main shall be designed and submitted concurrently.

**A. Design and Approval** - An Engineering Report is required for all wastewater lift stations. The report shall describe the contributory areas, basis of design and other essential features. In addition, detailed plans and specifications shall be submitted for approval showing the station size, construction details, system design, controls, valves, piping, access, station location, force main location and pertinent elevations.

**B. Location and Site Plan** - The sewer lift station layout shall conform to the Standard Sewer Lift Station Site Plan detail as closely as possible. Any deviations shall be approved by the City Engineer. A block wall and chain link fence with locking gate surrounding the facility shall be required. The pump station and facilities shall maintain a minimum 100-foot separation from existing and proposed residential and commercial structures. Adequate maintenance access shall be provided to the pump station. The access design shall consider requirements for the removal of pump station equipment.

**C. Capacity** - The pump station shall be designed to accommodate ultimate buildout flows as well as initial flows. Allowances for larger or additional pumping equipment must be made for future requirements. If the design capacity is in excess of anticipated initial flow, the effects of the minimum flow condition must be estimated to prevent excessive retention of sewage in the wet well so it will not create a nuisance and the pumping equipment will operate within the manufacturer's guidelines. Table 8-3 provides planning level criteria for sizing and configuration of pump station and force main facilities.

**Table 8-3 - Planning Level Criteria for Pump Stations and Force Mains**

<b>Pump Stations</b>	
Capacity	PWWF (hydraulic modeling required for pipes 18 inches and larger)
Storage	24 hours, or 8 hours with an emergency generator for ADWF
Operation	Lead/lag for duty pump(s), plus 1 standby pump
Maximum Pump Cycles	6 cycles/hour
<b>Force Mains</b>	
Headloss	Hazen-Williams roughness coefficient (C-factor) of 120
Maximum Velocity	10 feet per second
Minimum Velocity	3.0 feet per second

- D. System** - Sewer lift stations shall be complete, pre-engineered and pre-fabricated Flygt pump stations or equivalent. Stations shall come fully equipped with pumps, discharge connections and piping, a valve vault with check valves and isolation valves and a control panel. Two sources of power shall be provided for each lift station. If a generator is selected as a power source, it shall be a Generac Industrial Series with a fuel tank of sufficient size to operate the lift station for 72 hours.
- E. Station Piping** - Suction, discharge, and header piping within the station shall be sized to adequately handle flows. Piping less than 4-inches in diameter shall not be used for conveying sewage. Valves shall be located to allow proper equipment maintenance and operation. The design shall provide a bypass configuration back to the wet well.
- F. Odor Control** - If required, the station shall have equipment and/or space provided for the purpose of introducing odor control chemicals into the wet well, upstream gravity line, and/or force main. Adequate provisions shall be made for the safe handling and storage of chemical containers. The force main shall be designed to maintain a continuous uphill grade, or, as a minimum, be level. All force mains shall have provisions for introduction of either air or odor control chemicals.
- G. Force Mains** - Force mains shall be designed such that velocities normally fall within a range from 3- to 5-feet per second. If initial capacity of the station is considerably less than ultimate, consideration should be given to the undesirable effect of extensive detention time within the force main. The feasibility of installing dual force mains to accommodate initial and ultimate flows shall be investigated in such situations. The design shall also include facilities to eliminate or sufficiently dampen transient forces and/or surging, in the event of an immediate station shutdown. Details shall be included in the improvement plans.

**8-13 SEWER IMPROVEMENT PLAN REQUIREMENTS** - Plans for the construction of sanitary sewers, whether in conjunction with other improvements or for a sewer project only, shall conform to these standards, the Construction Standards, and meet the following requirements.

- A. Sewer Study** - A sewer study or sewer master plan as determined by the City Engineer may be required prior to review of the sewer design if there is a possibility that upstream or adjacent areas might require service through the subject property. The map shall show the entire area including upstream tributary and adjacent areas, and all other data necessary to determine anticipated sewage flows. The method of providing service to the entire service area, including pipe sizes and slopes, shall be shown to the extent necessary to determine the requirements within the subject property.

- B. General Requirements** - Plans for sewer improvement projects shall include a layout sheet, plan and profile of each public sewer line, and necessary detail drawings. Reference to the Construction Standards shall be made for all standard details.
- C. Layout Sheet** - Improvement plans shall include an overall map which shows the project boundaries, sewer lines, manholes, backwater valves, and other important items of the work.
1. A parcel which benefits from and financially participates in a sewer construction project, but is not included within the project boundaries, shall have a note to this effect placed on the layout map and on the plan and profile sheet if the parcel appears thereon. Parcels which make use of those facilities may be subject to additional fees at the time of connection, if the participation has not been so noted.
- D. Plan and Profile Sheets** - Sewer lines to be owned and maintained by the City of Grass Valley shall be shown on both plan and profile. The following standards, with respect to drafting and the information to be included on the plan and profile sheets, generally apply to projects in developed areas.
1. Sewer lines to be constructed shall be indicated on profile by parallel lines spaced to show the pipe diameter to scale. Manholes shall also be indicated by parallel lines spaced according to scale. The slope, length, size, and type of pipe material between each manhole shall be printed parallel to the horizontal grid lines or parallel to the pipe lines. Pipe inverts, "IN and OUT," at manholes and other structures shall be indicated on the profile. The profile shall note all proposed manholes, special connections, and other appurtenances. Existing facilities shown on the profile shall be dashed or distinguishable from proposed improvements. Manhole identification on the plan view may be oblique. Stationing shall appear at the lower edge of the profile grid directly under the manhole. Each manhole shall be assigned a number that will appear in both plan and profile.
  2. Proposed sewer services shall be indicated on the plans by stationing, or an approved reference point such as a property line. The invert elevation of the service at its upstream end shall be shown on the plans whenever the standard depth is inadequate to serve the property. Standard depth shall conform to the conditions set forth in the Construction Standards.
  3. Improvements or lots shown on a plan sheet but served to a line shown on another plan sheet shall have the direction of service shown by a small triangle and letter "S." "Record drawings" shall also show the service sewer location measured from the nearest downstream manhole.
  4. Both permanent and working easements shall be shown to scale on the plans, with the width noted.
  5. Proposed sewer lines shall be adequately dimensioned from street centerline. If the sewer is to be located in an easement, sufficient dimensions and bearings from physical features to locate the line in the field shall be shown on the plans.
  6. Existing gas, water, storm drains, and all other utility lines above or below ground shall be shown on the plans.
  7. Trees and other objects within 10-feet of the limits of construction shall be dimensioned on the plans relative to the construction centerline. The diameter of tree trunks and interfering heavy tree branches shall be noted. Removal of a tree or object, or other special handling shall be noted.

Written documentation of any special arrangements regarding preservation of property shall be provided to the City Engineer if no easement document is involved. If an easement is negotiated, all special arrangements shall be included in the easement document. Tree removal must be approved by the Public Works Department.

8. Culverts shall be shown on both plan and profile when crossed by the construction or when parallel and within 20-feet of the construction line. Type, size, and invert elevations shall be called out.
9. No trees or permanent structures shall be placed within sewer easements without the approval of the City Engineer.

**E. Detail Drawings** - Details not covered by the Construction Standard Detail sheets shall be shown on the plans.

**F. Connection To Facilities Where Stoppage Of Existing Flow Will Be Required** - Upon approval of the application to connect to an existing sewer main by the Engineering Division, a coordination meeting to discuss the work plan shall be organized by the contractor a minimum of seven (7) days prior to the proposed connection or as permitted by the City's work schedule. Should the City Engineer determine that such work is to be performed by City forces, the work shall be performed on a time and material basis.

**8-14 MULTI-PARCEL COMMERCIAL AND INDUSTRIAL DEVELOPMENTS** - "On-site" sewer mains, to be accepted by the City, for new commercial and industrial developments containing more than one parcel, shall be designed in accordance with the requirements contained in these standards or as approved by the City Engineer. The sewer mains shall be installed within a dedicated public sewer easement in accordance with these standards. Each separate parcel within a multi-parcel commercial or industrial development shall have a separate connection to the public sewer line(s).

**8-15 EXAMPLE SEWER FLOW CALCULATIONS** - Example Design Flow Analysis for Sewers 15-Inches and Smaller

**Example calculation for application of safety factor and peaking factor curve for 400-unit single family subdivision:**

$$ADWF^a: \quad (400 \text{ DUs}) \cdot (190 \text{ gpd/DU}) = 76,000 \text{ gpd} = ADWF$$

$$Factored \text{ Flow}: \quad (ADWF) \cdot (2.0) = (76,000 \text{ gpd}) \cdot (2.0) = 152,000 \text{ gpd} = \text{Factored Flow}$$

$$PWWF: \quad (\text{Factored flow}) \cdot (3.95^b) = (152,000) \cdot (3.95) = 600,400 \text{ gpd} = PWWF$$

Size sewer for this flow based on Section 8-4.

Per Section 8-4, a 12-inch sewer line at minimum slope is adequate for this PWWF.

<sup>a</sup> Based on ADWF unit flow factors shown in Table 8-1

<sup>b</sup> From Figure 1- Peaking Factor