

**DIVISION II**  
**DESIGN STANDARDS**

**SECTION 21**

**FORCE MAINS**

**21.1 GENERAL**

**21.1.1 DESIGN PERIOD**

Force main systems shall be designed for the estimated ultimate tributary population, as delineated in the approved City of Sanford Comprehensive Plan (latest edition).

**21.1.2 LOCATION**

Force mains shall be located within dedicated rights-of-way, alleys, or established utility easements with sufficient width. Where this is not possible, a minimum of a twenty (20) foot wide CITY SERVICES EASEMENT shall be provided. If a force main is located outside and adjacent to an existing or at least a sixty (60) percent designed road right-of-way, a minimum of a fifteen (15) foot CITY SERVICES EASEMENT shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictates. In general, the additional width of the easement shall be calculated by adding fifteen (15) feet to the facility's greatest depth and rounding up to the nearest even whole foot.

No mains shall be placed under buildings, retention ponds, tennis courts, swimming pools, or other structures. Unless approved in writing by the DIRECTOR, mains shall not be located within side or rear lot lines. Placement of mains within side or rear lot line may be allowed on a case by case basis if such a configuration results in efficient placement and utilization of the system. This criteria shall also apply to placement of mains in retention pond berms. In general, air release valves and other valves shall not be placed on side or rear lot lines.

**21.2 DESIGN BASIS**

**21.2.1 AVERAGE DAILY FLOW**

Provisions of Section 20.2.1 shall apply.

**21.2.2 PEAK DESIGN FLOW**

Provisions of Section 22.2.1 shall apply.

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**21.2.3 DESIGN CALCULATIONS**

DEVELOPER's ENGINEER shall submit signed, sealed, and dated design calculations with the PLANS for all force main projects. Calculations shall show that force mains will have sufficient hydraulic capacity to transport all design flows.

**21.3 DESIGN AND CONSTRUCTION**

**21.3.1 VELOCITY AND DIAMETER**

At design pumping rates, a cleansing velocity of at least 2 feet per second should be maintained. Maximum velocity at design pumping rates should not exceed 8 feet per second for ductile iron pipe or 5 feet per second for PVC pipe. The minimum force main diameter shall be six (6) inches.

**21.3.2 DESIGN FRICTION LOSSES**

Friction losses through force mains shall be based on the Hazen and Williams formula. In the use of Hazen and Williams formula, the value for "C" shall be 120 for ductile iron pipe and 130 for PVC pipe. "C" values greater than 130 shall not be allowed.

When initially installed, force mains may have a significantly higher "C" factor. The higher "C" Factor should be considered only in calculating maximum power requirements and duty cycle time of the motor.

**21.3.3 DESIGN PRESSURE AND RESTRAINT**

The force main and fittings, including all restrained joint fittings and thrust blocking, shall be designed to withstand pump operating pressures and pressure surges, but not less than 150 psi.

Where restrained joints are used in lieu of thrust blocks, the restrained joint table in the STANDARD DRAWINGS shall be utilized. Bearing area of thrust blocks shall be adequate to prevent any movement of the fitting. The sizes and dimensions of the thrust blocks shall be shown utilizing the format shown on the STANDARD DRAWINGS.

**21.3.4 TERMINATION**

Force mains shall not terminate directly into a gravity sewer line. Force mains should enter the gravity sewer system at the flow line of the receiving manhole.

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21. 3. 5 AIR RELEASE AND VACUUM RELIEF VALVES

Air release valves, or air/vacuum relief valves, shall be provided, as necessary, to prevent air locking and vacuum formation. All such valves shall be clearly delineated on the force main profile in the DRAWINGS. The DEVELOPER's ENGINEER shall submit calculations to the CITY justifying the valve sizing. See additional requirements in Section 45.6.

21. 3. 6 AERIAL CROSSINGS

**STRUCTURAL SUPPORT**

Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent overturning, settlement, and corrosion. Exposed steel parts shall be hot dip galvanized or painted as specifies in Section 45.

**EXPANSION PROTECTION**

Expansion joints shall be provided between the aerial and buried sections of the pipe.

**FLOOD CLEARANCE**

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe shall be placed no lower than 1 foot above the 100 year flood elevation.

**PIPE MATERIAL AND JOINTS**

Flanged joints shall be used. Pipe and Flange material shall be ductile iron, minimum class 53. All above ground pipe shall be painted as specified in Section 45.4.4 for above ground wastewater force mains. Use of epoxy coated steel pipe may be allowed on a case by case basis.

**VALVES**

Underground valves shall be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding. An air release/vacuum relief valve shall be installed at the high point of the crossing.

**GUARDS**

Appropriate fan type guards, as approved by the DIRECTOR, shall be installed at both ends of the crossing to prevent pipe access to the public.

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**PERMITS AND REQUIREMENTS OF OTHER AGENCIES**

It shall be the responsibility of the DEVELOPER to obtain all applicable regulatory permits. When the Aerial Crossing is accomplished by attachment to a bridge or drainage structure, the DEVELOPER shall meet all requirements of the agencies who own or have jurisdiction over such structures.

**21. 3. 7 UNDERWATER CROSSINGS**

**PIPE MATERIAL AND COVER**

A minimum cover of three (3) feet plus a four (4) inch concrete slab shall be provided over the pipe. The pipe material shall meet appropriate AWWA Standards for use in submerged conditions.

**VALVES**

Valves shall be provided at both ends of the water crossings so that the section can be isolated for testing or repair. The valves shall be easily accessible, and not subject to flooding. Both valves shall be provided in a manhole or a valve vault.

**PERMIT**

It shall be the responsibility of the DEVELOPER to obtain all applicable regulatory permits, including dredge and fill permits.

**21. 3. 8 VALVES**

Sufficient valves shall be provided on force main systems to facilitate effective isolation of the pipe system for repairs and maintenance. On straight runs of force mains, valve spacing shall not exceed 2000 feet. Additional valves shall be provided where force mains intersect and extensions are anticipated so that isolation of pipe segments can be facilitated.

**21. 4 MATERIAL, INSTALLATION, AND TESTING**

Applicable provisions of Divisions III, IV, and V shall apply.

**21. 5 LOCATION AND IDENTIFICATION**

All lettering shall be legible and colors correct for the intended use. See the STANDARD DRAWINGS.

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**21.6 FUTURE SIZING REQUIREMENTS**

While designing force main systems, consideration shall be given to possible future connecting pumping stations. If applicable, this requirement shall be reviewed with the DIRECTOR prior to finalization of the design.

**21.7 PRIVATE FORCE MAIN TIE-INS**

Force mains from private pump stations shall be designed to CITY standards and connect to the City's force main system through an approved pressure switch assembly as specified in Section 22.5.1 of this MANUAL and the STANDARD DRAWINGS.