4.2.10 SLOPE AND VELOCITY CRITERIA

A. Minimum slope and velocity criteria are used for gravity sewer pipelines in order to provide velocities that resuspend solids under peak hour sewer flow rates. Maximum slope and velocity criteria for gravity sewer pipelines are used to prevent scour and liquid/solid separation. Slope and velocity criteria for gravity sewer pipelines shall be as listed or in the following ranges:

Pipe Diameter	Minimum Slope (%)	Minimum Velocity (ft/s)	Maximum Slope* (%)	Maximum Velocity** (ft/s)	@Min Slope Q(cfs)=
6	0.68	2.0	10.5	10	0.30
8	0.40	2.0	8.3	10	0.44
10	0.28	2.0	6.2	10	0.77
12	0.21	2.0	4.9	10	1.16
15	0.18	2.0	3.6	10	2.50
18	See Agency	See Agency	See Agency	See Agency	See Agency
21	See Agency	See Agency	See Agency	See Agency	See Agency

*Assumes sewer pipeline d/D=1. If pipeline Q is the same and d/D ratio is decreased, then the maximum slope increases. Engineer approval required for increasing maximum slope.

**Maximum velocity is based on calculated d/D ratio. Engineer approval required for increasing maximum slope.

B. In the upper reaches of gravity sewer systems in residential areas it may not be possible to achieve the minimum peak hour velocity without substantially increasing slope of pipelines, which would create undesirably deep gravity systems. In those cases, a minimum slope of 1% shall be used until there are fifty (50) equivalent dwelling units tributary to the gravity system.

C. Velocity criteria is used for pressure sewer pipelines (force mains) in order to provide velocities that resuspend solids when the duty pump is operating for a two-pump lift station or when two duty pumps are operating for a three-pump lift station. Maximum velocity criteria for pressure sewer pipelines are used to prevent scour, excessive water hammer, and minimize electrical usage. Velocity criteria for pressure sewer pipelines shall be as listed:

Pipe Diameter	Minimum Velocity (ft/s)	Maximum Velocity (ft/s)
Any Size	3.5	8

4.2.11 SEWER LIFT STATIONS

A. Sewer lift stations shall be avoided whenever possible. Gravity sewer systems are considered much more reliable and less costly from an operation and maintenance perspective. Deep gravity sewer pipelines that are open cut constructed and/or installed using trenchless technologies are preferred over sewer lift stations. The Engineer of Work shall perform an alternative analysis for Engineer approval, and even if a sewer lift station is the most economical alternative, the Engineer has final authority on selecting preferred alternative.

B. Sewer lift stations shall be designed to pump ultimate peak hour sewer flow rates. Figure 4-2-1 shall be used to obtain peak hour sewer flow rates.