

ZONING AND LAND DEVELOPMENT

94 Attachment 4

Borough of Shrewsbury

Table 2: Manning’s Roughness Coefficients

Closed Conduits	Smooth	Normal	Rough
Cast Iron			
Coated	0.010	0.013	0.014
Uncoated	0.011	0.014	0.016
Clay			
Vitrified sewer	0.011	0.014	0.017
Vitrified sewer with manholes	0.013	0.015	0.017
Common drainage tile	0.011	0.013	0.017
Concrete			
Culvert straight & free of debris	0.010	0.011	0.013
Culvert with bends, connections	0.011	0.013	0.014
Finished	0.011	0.012	0.014
Sewer with manhole inlets	0.013	0.015	0.017
Unfinished steel form	0.012	0.013	0.014
Unfinished smooth wood form	0.012	0.014	0.016
Unfinished rough wood form	0.015	0.017	0.020
Metal, Corrugated			
Sub-drain	0.017	0.019	0.021
Storm drain	0.021	0.024	0.030
Polyvinyl Chloride (PVC)	0.010	0.010	0.010
Polyethylene (PE)	0.008	0.009	0.011
Steel			
Lockbar and welded	0.010	0.012	0.014
Riveted and spiral	0.013	0.016	0.017
Wrought Iron			
Black	0.012	0.014	0.015
Galvanized	0.013	0.016	0.017
Lined or Built-Up Channels	Minimum	Normal	Maximum
Asphalt			
Smooth	0.013	0.013	
Rough	0.016	0.016	
Brick			
Glazed	0.011	0.013	0.015
In cement mortar	0.012	0.015	0.018

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Lined or Built-Up Channels	Minimum	Normal	Maximum
Cement			
Neat surface	0.010	0.011	0.013
Mortar	0.011	0.013	0.015
Concrete			
Trowel finish	0.011	0.013	0.015
Float finish	0.013	0.015	0.016
Finished with gravel on bottom	0.015	0.017	0.020
Unfinished	0.014	0.017	0.020
Gunit (good section)	0.016	0.019	0.023
Gunit (wavy section)	0.018	0.022	0.025
On good excavated rock	0.017	0.020	
On irregular excavated rock	0.022	0.027	
Concrete Bottom Float Finished with Sides of			
Dressed stone in mortar	0.015	0.017	0.020
Random stone in mortar	0.017	0.020	0.024
Cement rubble masonry, plastered	0.016	0.020	0.024
Cement rubble masonry	0.020	0.025	0.030
Dry rubble or riprap	0.020	0.030	0.035
Dressed Ashlar	0.013	0.015	0.017
Gravel Bottom Sides of			
Formed concrete	0.017	0.020	0.025
Random stone in mortar	0.020	0.023	0.026
Dry rubble or riprap	0.023	0.033	0.036
Masonry			
Cement rubble	0.017	0.025	0.030
Dry rubble	0.023	0.032	0.035
Metal, Corrugated	0.021	0.025	0.030
Steel, Smooth Surface			
Unpainted	0.011	0.012	0.014
Painted	0.012	0.013	0.017
Wood			
Planed, untreated	0.010	0.012	0.014
Planed, treated	0.011	0.012	0.015
Unplaned	0.011	0.013	0.015
Plank with battens	0.012	0.015	0.018
Lined with roofing	0.010	0.014	0.017
Vegetal Lining	0.030		0.500

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Excavated, Dredged or Natural Channels	Minimum	Normal	Maximum
Channels not Maintained and Brush Uncut			
Dense weeds high flow depth	0.050	0.080	0.120
Clean bottom, brush on sides	0.040	0.050	0.080
Same, highest stage of flow	0.045	0.070	0.110
Dense brush, high stage	0.080	0.100	0.140
Drag Line — Excavated or Dredged			
No vegetation	0.025	0.028	0.033
Light brush or banks	0.035	0.050	0.060
Earth, Straight and Uniform			
Clean, recently completed	0.016	0.018	0.020
Clean, after weathering	0.018	0.022	0.025
Gravel, uniform section, clean	0.022	0.025	0.030
Short grass, few weeds	0.022	0.027	0.033
Earth, Winding and Sluggish			
No vegetation	0.023	0.025	0.030
Grass, some weeds	0.025	0.030	0.033
Dense weeds or aquatic plants	0.030	0.035	0.040
Earth bottom and rubble sides	0.028	0.030	0.035
Stony bottom and weedy banks	0.025	0.035	0.040
Cobble bottoms and clean sides	0.030	0.040	0.050
Rock Cuts			
Smooth and uniform	0.025	0.035	0.040
Jagged and irregular	0.035	0.040	0.050
Minor Streams			
(Top Width at Flood Stage <100 feet.)			
(a) Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but some stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

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Excavated, Dredged or Natural Channels	Minimum	Normal	Maximum
(b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070