

**Manning Equation Coefficients of Roughness**

**Manning's n range**

**I. Closed Conduits:**

- A. Concrete Pipe ..... 0.011 - 0.013
- B. Corrugated-metal pipe or pipe arch:
  - 1. 2-2/3 by 1/2 in corrugation (riveted pipe):
    - a. Plain or fully coated..... 0.024
    - b. Paved invert (ranged values are for 25% and 50% of circumference paved):
      - (1) Flow full depth ..... 0.021 - 0.018
      - (2) Flow 08 depth ..... 0.021 - 0.016
      - (3) Flow 06 depth ..... 0.019 - 0.013
  - 2. 6 by 2-in corrugation (field bolted)..... 0.030
- C. Cast-iron pipe, uncoated ..... 0.013
- D. Steel pipe ..... 0.009 - 0.011
- E. Monolithic concrete:
  - 1. Wood forms, rough ..... 0.015 - 0.017
  - 2. Wood forms, smooth ..... 0.012 - 0.014
  - 3. Steel forms..... 0.012 - 0.025
- F. Cemented rubble masonry walls:
  - 1. Concrete floor and top ..... 0.017 - 0.022
  - 2. Natural floor ..... 0.019 - 0.025

**II. Open Channels, Lined (straight alignment):**

- A. Concrete with surfaces as indicated:
  - 1. Formed, no finish..... 0.013 - 0.017
  - 2. Trowel finish..... 0.012 - 0.014
  - 3. Float finish ..... 0.013 - 0.015
  - 4. Float finish, some gravel on bottom ..... 0.015 - 0.017
  - 5. Gunite, good section..... 0.016 - 0.019
  - 6. Gunite, wavy section ..... 0.018 - 0.022
- B. Concrete, bottom float finished, sides as indicated:
  - 1. Dressed stone in mortar ..... 0.015 - 0.017
  - 2. Random stone in mortar ..... 0.017 - 0.020
  - 3. Cement rubble masonry ..... 0.020 - 0.025
  - 4. Cement rubble masonry, plastered ..... 0.016 - 0.020
  - 5. Dry rubble (riprab) ..... 0.020 - 0.030

- C. Gravel bottom, sides as indicated:
  - 1. Formed concrete .....0.017 - 0.020
  - 2. Random stone in mortar .....0.020 - 0.023
  - 3. Dry rubble (riprap) .....0.023 - 0.033
- D. Asphalt
  - 1. Smooth ..... 0.013
  - 2. Rough ..... 0.016
- E. Concrete-lined excavated rock:
  - 1. Good section.....0.017 - 0.020
  - 2. Irregular section.....0.022 - 0.027

**III. Open Channels, Excavated (straight alignment, natural lining):**

- A. Earth, uniform section:
  - 1. Clean, recently completed .....0.016 - 0.018
  - 2. Clean, after weathering .....0.018 - 0.020
  - 3. With short grass, few weeds.....0.022 - 0.027
  - 4. In gravelly soil, uniform section, clean.....0.022 - 0.025
- B. Earth, fairly uniform section:
  - 1. No vegetation.....0.022 - 0.025
  - 2. Grass, some weeds .....0.025 - 0.030
  - 3. Dense weeds or aquatic plants in deep channels .....0.030 - 0.035
  - 4. Sides clean, gravel bottom .....0.025 - 0.030
  - 5. Sides clean, cobble bottom .....0.030 - 0.040
- C. Dragline excavated or dredged:
  - 1. No vegetation.....0.028 - 0.033
  - 2. Light brush on banks .....0.035 - 0.050
- D. Rock:
  - 1. Based on design section ..... 0.035
  - 2. Based on actual mean section:
    - a. Smooth and uniform.....0.035 - 0.040
    - b. Jagged and irregular .....0.040 - 0.045
- E. Channels not maintained, weeds and brush uncut:
  - 1. Dense weeds, high as flow depth.....0.080 - 0.120
  - 2. Clean bottom, brush on sides.....0.050 - 0.080
  - 3. Clean bottom, brush on sides, highest stage of flow.....0.070 - 0.110
  - 4. Dense brush, high stage.....0.100 - 0.140

**IV. Channels & Swales w/Maintained Vegetation (Values shown are for velocities of 2 & 6 fps):**

- A. Depth of flow up to 0.7 foot:
  - 1. Bermudagrass, Kentucky bluegrass, buffalograss
    - a. Mowed to 2 inches .....0.045 - 0.070
    - b. Length 4-6 inches.....0.050 - 0.090
  - 2. Good stand, any grass:
    - a. Length about 12 inches.....0.090 - 0.180
    - b. Length about 24 inches.....0.150 - 0.300
  - 3. Fair stand, any grass:
    - a. Length about 12 inches.....0.0800 - 0.140
    - b. Length about 24 inches.....0.1300 - 0.250
- B. Depth of flow 0.7 - 1.5 feet:
  - 1. Bermudagrass, Kentucky bluegrass, buffalograss
    - a. Mowed to 2 inches .....0.030 - 0.050
    - b. Length 4-6 inches.....0.040 - 0.060
  - 2. Good stand, any grass:
    - a. Length about 12 inches.....0.070 - 0.120
    - b. Length about 24 inches.....0.100 - 0.200
  - 3. Fair stand, any grass:
    - a. Length about 12 inches.....0.060 - 0.100
    - b. Length about 24 inches.....0.090 - 0.170

**V. Street and Expressway Gutters:**

- A. Concrete gutter, troweled finish ..... 0.012
- B. Asphalt pavement:
  - 1. Smooth texture .....0.013
  - 2. Rough texture .....0.016
- C. Concrete gutter with asphalt pavement
  - 1. Smooth .....0.013
  - 2. Rough .....0.015
- D. Concrete pavement:
  - 1. Float finish ..... 0.014
  - 2. Broom finish..... 0.016
- E. For gutters with small slope, where sediment may accumulate,  
 Increase the above values of x by ..... 0.002

**VI. Natural Stream Channels:**

- A. Minor streams (surface width at flood stage less than 100 feet):
  - 1. Fairly regular section:
    - a. Some grass & weeds, little or no brush .....0.030 - 0.035
    - b. Dense growth of weeds, depth of flow materially greater than weed height .....0.035 - 0.050
    - c. Some weeds, light brush on banks .....0.035 - 0.050
    - d. Some weeds, heavy brush on banks .....0.050 - 0.070
    - e. Some weeds, dense willows on banks.....0.060 - 0.080
    - f. For trees within channel with branches submerged at high stage, increase all above values by .....0.010 - 0.020
  - 2. Irregular sections, with pools, slight channel meander; increase values given in 1 a-e about.....0.010 - 0.020
  - 3. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage:
    - a. Bottom of gravel, cobbles and few boulders .....0.040 - 0.050
    - b. Bottom of cobbles, with large boulders .....0.050 - 0.070
- B. Flood plains (adjacent to natural streams):
  - 1. Pasture, no brush:
    - a. Short grass .....0.030 - 0.035
    - b. High grass .....0.035 - 0.050
  - 2. Cultivated areas:
    - a. No crop .....0.030 - 0.040
    - b. Mature row crops .....0.035 - 0.045
    - c. Mature field crops.....0.040 - 0.050
  - 3. Heavy weeds, scattered brush .....0.050 - 0.070
  - 4. Light brush and trees:
    - a. Winter .....0.050 - 0.060
    - b. Summer.....0.060 - 0.080
  - 5. Medium to dense brush:
    - a. Winter .....0.070 - 0.110
    - b. Summer.....0.100 - 0.160
  - 6. Dense willows, summer, not bent over by current.....0.150 - 0.200
  - 7. Cleared land w/ tree stumps, 100-150 per acre:
    - a. No sprouts .....0.040 - 0.050
    - b. With heavy growth of sprouts.....0.060 - 0.080

- 8. Heavy stand of timber, a few down trees, little undergrowth:
  - a. Flood depth below branches ..... 0.100 - 0.120
  - b. Flood depth reaches branches ..... 0.120 - 0.160
- C. Major streams (surface width at flood stage more than 100 ft.):  
 Roughness coefficient is usually less than for minor streams of similar description on account of less effective resistance offered by irregular banks or vegetation on banks. Values of n may be somewhat reduced. Follow recommendation in publication cited if possible. The value of n for larger streams of most regular section, with no boulders or brush, may be in the range of ..... 0.028 - 0.033

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**MANNING'S ROUGHNESS COEFFICIENTS FOR SHEET FLOW**

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<b>SURFACE DESCRIPTION</b> .....	<b>n<sup>1</sup></b>
Smooth Surfaces (concrete, asphalt, gravel, or bare soil) .....	0.011
Fallow (no residue) .....	0.05
Cultivated Soils:	
Residue cover 20% .....	0.06
Residue cover 20% .....	0.17
Grass:	
Short grass prairie .....	0.15
Dense grasses .....	0.24
Bermudagrass .....	0.41
Range (natural) .....	0.13
Woods:	
Light underbrush .....	0.40
Dense underbrush .....	0.80

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Source: Chow, V.T., 1959, Open Channel Hydraulics, McGraw-Hill, New York, NY

