

TR-55 Curve Number Tables

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Table 4B-1 Hydrologic soil series for selected soils in Washington State.

Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group
Agnew	C	Dimal	D
Ahl	B	Dragoon	C
Aits	C	Dupont	D
Alderwood	C	Earlmont	C
Arents, Alderwood	B	Edgewick	C
Arents, Everett	B	Eld	B
Ashoe	B	Eloika	B
Athena	B	Elwell	B
Baldhill	B	Emdent	D
Barneston	C	Esquatzel	B
Baumgard	B	Everett	A
Beausite	B	Everson	D
Belfast	C	Freeman	C
Bellingham	D	Galvin	D
Bellingham variant	C	Garfield	C
Bernhill	B	Garrison	B
Boistfort	B	Getchell	A
Bong	A	Giles	B
Bonner	B	Glenrose	B
Bow	D	Godfrey	D
Brickel	C	Green Bluff	B
Bridgeson	D	Greenwater	A
Briscot	D	Grove	C
Buckley	C	Hagen	B
Bunker	B	Hardesty	B
Cagey	C	Harstine	C
Caldwell	C	Hartnit	C
Carlsborg	A	Hesseltine	B
Casey	D	Hoh	B
Cassolary	C	Hoko	C
Cathcart	B	Hoodsport	C
Cedonia	B	Hoogdal	C
Centralia	B	Hoypus	A
Chehalis	B	Huel	A
Cheney	B	Indianola	A
Chesaw	A	Jonas	B
Cinebar	B	Jumpe	B
Clallam	C	Kalaloch	C
Clayton	B	Kapowsin	C/D
Coastal beaches	variable	Katula	C
Cocolalla	D	Kilchis	C
Colter	C	Kitsap	C
Custer	D	Klaus	C
Custer, Drained	C	Klone	B
Dabob	C	Konner	D
Dearyton	C	Lakesol	B
Delphi	D	Laketon	C
Dick	A	Lance	B
Larkin	B	Poulsbo	C
Latah	D	Prather	C
Lates	C	Puget	D

Table 4B-1 Hydrologic soil series for selected soils in Washington State (continued).

Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group
Lebam	B	Puyallup	B
Lummi	D	Queets	B
Lynnwood	A	Quilcene	C
Lystair	B	Ragnar	B
Mal	C	Rainier	C
Manley	B	Raught	B
Marble	A	Reardan	C
Mashel	B	Reed	D
Maytown	C	Reed, Drained or Protected	C
McKenna	D	Renton	D
McMurray	D	Republic	B
Melbourne	B	Riverwash	variable
Menzel	B	Rober	C
Mixed Alluvial	variable	Salal	C
Molson	B	Salkum	B
Mondovi	B	Sammamish	D
Moscow	C	San Juan	A
Mukilteo	C/D	Scamman	D
Naff	B	Schneider	B
Narcisse	C	Schumacher	B
Nargar	A	Seattle	D
National	B	Sekiu	D
Neilton	A	Semiahmoo	D
Newberg	B	Shalcar	D
Nez Perce	C	Shano	B
Nisqually	B	Shelton	C
Nooksack	C	Si	C
Norma	C/D	Sinclair	C
Ogarty	C	Skipopa	D
Olete	C	Skykomish	B
Olomount	C	Snahopish	B
Olympic	B	Snohomish	D
Orcas	D	Snow	B
Oridia	D	Solduc	B
Orting	D	Solleks	C
Oso	C	Spana	D
Ovall	C	Spanaway	A/B
Palouse	B	Speigle	B
Pastik	C	Spokane	C
Peone	D	Springdale	A
Pheeneey	C	Sulsavar	B
Phelan	D	Sultan	C
Phoebe	B	Sultan variant	B
Pilchuck	C	Sumas	C
Potchub	C	Swantown	D
Tacoma	D	Vailton	B
Tanwax	D	Vassar	B
Tanwax, Drained	C	Verlot	C
Tealwhit	D	Wapato	D
Tekoa	C	Warden	B
Tenino	C	Wethey	C

Table 4B-1 Hydrologic soil series for selected soils in Washington State (continued).

Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group
Tisch	D	Whidbey	C
Tokul	C	Wilkeson	B
Townsend	C	Winston	A
Triton	D	Wolfeson	C
Tukwila	D	Woodinville	B
Tukey	C	Yelm	C
Uhlig	B	Zynbar	B
Urbana	C		

Hydrologic Soil Group Classifications, as defined by the Soil Conservation Service:

- A** = (Low runoff potential): Soils having low runoff potential and high infiltration rates, even when thoroughly wetted. They consist chiefly of deep, well- to excessively drained sands or gravels, and have a high rate of water transmission (greater than 0.30 in/hr).
- B** = (Moderately low runoff potential): Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well- to well-drained soils, with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15–0.3 in/hr).
- C** = (Moderately high runoff potential): Soils having low infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine textures. These soils have a low rate of water transmission (0.05–0.15 in/hr).
- D** = (High runoff potential): Soils having high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential; soils with a permanent high water table; soils with a hardpan or clay layer at or near the surface; and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0–0.05 in/hr).

*From SCS, TR-55, Second Edition, June 1986, Exhibit A-1. Revisions made from SCS, Soil Interpretation Record, Form #5, September 1988 and various county soil surveys.

This information can also be found online at: websoilsurvey.nrcs.usda.gov/app/websoilsurvey.aspx

Table 4B-2 Runoff curve numbers for selected agricultural, suburban, and rural areas (western Washington).

Cover Type and Hydrologic Condition	CNs for hydrologic soil group			
	A	B	C	D
Curve Numbers for Predevelopment Conditions				
Pasture, Grassland, or Range – Continuous Forage for Grazing:				
Fair condition (ground cover 50% to 75% and not heavily grazed)	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Fair (woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Good (woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
Curve Numbers for Postdevelopment Conditions				
Open Space (lawns, parks, golf courses, cemeteries, landscaping, etc.):^[1]				
Fair condition (grass cover on 50% to 75% of the area)	77	85	90	92
Good condition (grass cover on >75% of the area)	68	80	86	90
Impervious Areas:				
Open water bodies: lakes, wetlands, ponds, etc.	100	100	100	100
Paved parking lots, roofs, ^[2] driveways, etc. (excluding right of way)	98	98	98	98
Porous Pavers and Permeable Interlocking Concrete (assumed as 85% impervious and 15% lawn):				
Fair lawn condition (weighted average CNs)	95	96	97	97
Good lawn condition (weighted average CNs)	94	95	96	97
Paved	98	98	98	98
Gravel (including right of way)	76	85	89	91
Dirt (including right of way)	72	82	87	89
Pasture, Grassland, or Range – Continuous Forage for Grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch)	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed)	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Poor (forest litter, small trees, and brush are destroyed by heavy grazing or regular burning)	45	66	77	83
Fair (woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Good (woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
Single Family Residential:^[3]				
Dwelling Unit/Gross Acre	Should only be used for subdivisions >50 acres		Average percent impervious area ^{[3][4]}	
1.0 DU/GA			15 Separate curve number	
1.5 DU/GA			20 must be selected for	
2.0 DU/GA			25 pervious & impervious	
2.5 DU/GA			30 portions of the site or	
3.0 DU/GA			34 basin	
3.5 DU/GA			38	
4.0 DU/GA			42	
4.5 DU/GA			46	
5.0 DU/GA			48	
5.5 DU/GA			50	
6.0 DU/GA			52	
6.5 DU/GA			54	
7.0 DU/GA			56	
7.5 DU/GA			58	
PUDs, condos, apartments, commercial businesses, industrial areas, and subdivisions <50 acres	% impervious must be computed		Separate curve numbers must be selected for pervious and impervious portions of the site	

For a more detailed and complete description of land use curve numbers, refer to Chapter Two (2) of the Soil Conservation Service’s Technical Release No. 55 (210-VI-TR-55, Second Ed., June 1986).

- [1] Composite CNs may be computed for other combinations of open space cover type.
- [2] Where roof runoff and driveway runoff are infiltrated or dispersed according to the requirements in Chapter 3, the average percent impervious area may be adjusted in accordance with the procedure described under “Flow Credit for Roof Downspout Infiltration” and “Flow Credit for Roof Downspout Dispersion.”
- [3] Assumes roof and driveway runoff is directed into street/storm system.
- [4] All remaining pervious area (lawn) is considered to be in good condition for these curve numbers.

Table 4B-3 Runoff curve numbers for selected agricultural, suburban, and rural areas (eastern Washington).

Cover Type and Hydrologic Condition	CNs for hydrologic soil group			
	A	B	C	D
Open Space (lawns, parks, golf courses, cemeteries, landscaping, etc.):^[1]				
Poor condition (grass cover on <50% of the area)	68	79	86	89
Fair condition (grass cover on 50% to 75% of the area)	49	69	79	84
Good condition (grass cover on >75% of the area)	39	61	74	80
Impervious Areas:				
Open water bodies: lakes, wetlands, ponds, etc.	100	100	100	100
Paved parking lots, roofs, driveways, etc. (excluding right of way)	98	98	98	98
Porous Pavers and Permeable Interlocking Concrete (assumed as 85% impervious and 15% lawn):				
Fair lawn condition (weighted average CNs)	95	96	97	97
Gravel (including right of way)	76	85	89	91
Dirt (including right of way)	72	82	87	89
Pasture, Grassland, or Range – Continuous Forage for Grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch)	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed)	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Cultivated Agricultural Lands:				
Row Crops (good), e.g., corn, sugar beets, soy beans	64	75	82	85
Small Grain (good), e.g., wheat, barley, flax	60	72	80	84
Meadow (continuous grass, protected from grazing, and generally mowed for hay):	30	58	71	78
Brush (brush-weed-grass mixture, with brush the major element):				
Poor (<50% ground cover)	48	67	77	83
Fair (50% to 75% ground cover)	35	56	70	77
Good (>75% ground cover)	30 ^[2]	48	65	73
Woods-Grass Combination (orchard or tree farm):^[3]				
Poor	57	73	82	86
Fair	43	65	76	82
Good	32	58	72	79
Woods:				
Poor (forest litter, small trees, and brush are destroyed by heavy grazing or regular burning)	45	66	77	83
Fair (woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Good (woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
Herbaceous (mixture of grass, weeds, and low-growing brush, with brush the minor element):^[4]				
Poor (<30% ground cover)		80	87	93
Fair (30% to 70% ground cover)		71	81	89
Good (>70% ground cover)		62	74	85
Sagebrush With Grass Understory:^[4]				
Poor (<30% ground cover)		67	80	85
Fair (30% to 70% ground cover)		51	63	70
Good (>70% ground cover)		35	47	55

For a more detailed and complete description of land use curve numbers, refer to Chapter Two (2) of the Soil Conservation Service's Technical Release No. 55 (210-VI-TR-55, Second Ed., June 1986).

- [1] Composite CNs may be computed for other combinations of open space cover type.
 [2] Actual curve number is less than 30; use CN = 30 for runoff computations.
 [3] CNs shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CNs for woods and pasture.
 [4] Curve numbers have not been developed for Group A soils.

Table 4B-4 Curve number conversions for different antecedent moisture conditions (case Ia = 0.2 S).

CN for AMC II	CN for AMC I	CN for AMC III	CN for AMC II	CN for AMC I	CN for AMC III
100	100	100	76	58	89
99	97	100	75	57	88
98	94	99	74	55	88
97	91	99	73	54	87
96	89	99	72	53	86
95	87	98	71	52	86
94	85	98	70	51	85
93	83	98	69	50	84
92	81	97	68	48	84
91	80	97	67	47	83
90	78	96	66	46	82
89	76	96	65	45	82
88	75	95	64	44	81
87	73	95	63	43	80
86	72	94	62	42	79
85	70	94	61	41	78
84	68	93	60	40	78
83	67	93	59	39	78
82	66	92	58	38	76
81	64	92	57	37	75
80	63	91	56	36	75
79	62	91	55	35	74
78	60	90	54	34	73
77	59	89	50	31	70

Source: SCS-NEH4, Table 10.1.

Table 4B-5 “n” and “k” values used in time calculations for hydrographs.

“n_s” Sheet Flow Equation Manning’s Values (for the initial 300 ft. of travel)	
Manning’s Values for sheet flow only; from Overton and Meadows 1976 (see TR-55, 1986)	n_s
Smooth surfaces (concrete, asphalt, gravel, or bare, hand-packed soil)	0.011
Fallow fields or loose soil surface (no residue)	0.05
Cultivated soil with residue cover ≤20%	0.06
Cultivated soil with residue cover >20%	0.17
Short prairie grass and lawns	0.15
Dense grasses	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods or forest with light underbrush	0.40
Woods or forest with dense underbrush	0.80
(210-VI-TR-55, Second Ed., June 1986)	
“k” Values Used in Travel Time/Time of Concentration Calculations	
Shallow Concentrated Flow (after the initial 300 ft. of sheet flow, R = 0.1)	k_s
1. Forest with heavy ground litter and meadows (n = 0.10)	3
2. Brushy ground with some trees (n = 0.060)	5
3. Fallow or minimum tillage cultivation (n = 0.040)	8
4. High grass (n = 0.035)	9
5. Short grass, pasture, and lawns (n = 0.030)	11
6. Nearly bare ground (n = 0.025)	13
7. Paved and gravel areas (n = 0.012)	27
Channel Flow (intermittent) (at the beginning of visible channels, R = 0.2)	k_c
1. Forested swale with heavy ground litter (n = 0.10)	5
2. Forested drainage course/ravine with defined channel bed (n = 0.050)	10
3. Rock-lined waterway (n = 0.035)	15
4. Grassed waterway (n = 0.030)	17
5. Earth-lined waterway (n = 0.025)	20
6. CMP pipe, uniform flow (n = 0.024)	21
7. Concrete pipe, uniform flow (0.012)	42
8. Other waterways and pipe	0.508/n
Channel Flow (continuous stream, R = 0.4)	k_c
9. Meandering stream with some pools (n = 0.040)	20
10. Rock-lined stream (n = 0.035)	23
11. Grass-lined stream (n = 0.030)	27
12. Other streams, manmade channels, and pipe	0.807/n

Table 4B-6 Values of the roughness coefficient, “n.”

Type of Channel and Description	Manning's "n" (Normal)	Type of Channel and Description	Manning's "n" (Normal)
A. Constructed Channels		6. Sluggish reaches, weedy deep pools	0.070
a. <i>Earth, straight and uniform</i>		7. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.100
1. Clean, recently completed	0.018		
2. Gravel, uniform selection, clean	0.025		
3. With short grass, few weeds	0.027		
b. <i>Earth, winding and sluggish</i>		b. <i>Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages</i>	
1. No vegetation	0.025		
2. Grass, some weeds	0.030		
3. Dense weeds or aquatic plants in deep channels	0.035	1. Bottom: gravel, cobbles, and few boulders	0.040
4. Earth bottom and rubble sides	0.030	2. Bottom: cobbles with large boulders	0.050
5. Stony bottom and weedy banks	0.035	B-2 Flood plains	
6. Cobble bottom and clean sides	0.040	a. <i>Pasture, no brush</i>	
		1. Short grass	0.030
		2. High grass	0.035
c. <i>Rock-lined</i>		b. <i>Cultivated areas</i>	
1. Smooth and uniform	0.035	1. No crop	0.030
2. Jagged and irregular	0.040	2. Mature row crops	0.035
d. <i>Channels not maintained, weeds and brush uncut</i>		3. Mature field crops	0.040
1. Dense weeds, high as flow depth	0.080	c. <i>Brush</i>	
2. Clean bottom, brush on sides	0.050	1. Scattered brush, heavy weeds	0.050
3. Same, highest stage of flow	0.070	2. Light brush and trees	0.060
4. Dense brush, high stage	0.100	3. Medium to dense brush	0.070
		4. Heavy, dense brush	0.100
		d. <i>Trees</i>	
		1. Dense willows, straight	0.150
		2. Cleared land with tree stumps, no sprouts	0.040
		3. Same as above, but with heavy growth of sprouts	0.060
		4. Heavy stand of timber, a few downed trees, little undergrowth, flood stage below branches	0.100
		5. Same as above, but with flood stage reaching branches	0.120
B. Natural Streams			
B-1 Minor streams (top width at flood stage < 100 ft.)			
a. <i>Streams on plain</i>			
1. Clean, straight, full stage, no rifts or deep pools	0.030		
2. Same as above, but more stones and weeds	0.035		
3. Clean, winding, some pools and shoals	0.040		
4. Same as above, but some weeds	0.040		
5. Same as 4, but more stones	0.050		

*Note: These “n” values are “normal” values for use in analysis of channels. For conservative design for channel capacity, the maximum values listed in other references should be considered. For channel bank stability, the minimum values should be considered.