



ENGINEERING DESIGN STANDARDS

City of Ramsey
Revised 4/27/2018

This document summarizes the City of Ramsey’s Engineering design standards. Further detail of City of Ramsey design standards can be found in City of Ramsey Standard Details, Standard Specifications, and City Codes. The City of Ramsey follows the most recent edition of the Minnesota Department of Transportation “Standard Specifications for Construction” and the most recent edition of the City Engineers Association of Minnesota (CEAM) Standard Specifications.

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STREETS

Pavement

Width (Rural)	24'
Width (Urban)	32' BOC to BOC
Width (MSA)	40' – 44' BOC to BOC
Cul-de-sacs	100' diameter BOC to BOC
Temporary Cul-de-sacs	90' diameter BOC to BOC
Maximum Cul-de-sac street length	600'

Minimum Pavement Section

Bituminous Wear Course (SP 9.5 Wearing Course Mixture SPWEA340C)	1.5"
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Utility castings cannot be raised more than 24 hours before paving.

Bituminous Base Course (SP 12.5 Non Wearing Course Mixture SPNWB330C)	2.0"
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Modified Class 5 Aggregate Base	4.0"
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Class 5 Aggregate Base shall be modified per City of Ramsey Standard Detail No. STR-26.

Pavement section may be required to be increased and bituminous mixture may need to be altered based upon existing subbase conditions and projected future traffic levels.

Subgrade..... must be approved granular

Intersection

Angle	Minimum 75°
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90° intersection preferred as measured 100 feet from the intersection.

Intersections of more than four (4) corners are prohibited.

Tangent (thoroughfare and collector)	Minimum 100' between reverse curves
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Tangent (all other streets)	Minimum 50' between reverse curves
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Radius (rural)	Minimum 30'
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Radius (urban)	Minimum 20'
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Radius (alley)	Minimum 10'
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Boulevard

Width.....5’ minimum, 8’ preferred

Minimum Slope..... 2%

Certificate of survey required for lots with less than 2% slope, minimum grade 1%.

Maximum Slope 4 Horizontal : 1 Vertical

Topsoil.....Minimum 4” in all disturbed areas

Topsoil must meet MnDOT Specifications 3877A common topsoil borrow.

Topsoil must come from a City approved source, a soil certification from a geotechnical firm must be provided verifying the topsoil meets specifications along with load tickets to verify the source of the material and quantity. Contact City of Ramsey Building Department for list of City approved topsoil sources.

See City of Ramsey Standard Detail No. ERO-6.

Sodding.....Required in all disturbed boulevard areas.

Alternate seeding methods may be used in areas not adjacent to the roadway upon Engineering Department approval.

Concrete Curb and Gutter

New Development..... Surmountable

Type B618 type curb to be used around radii and to transition to catch basin curb box.

Type B618 curb may be used with City Engineer’s approval if driveway locations are known.

See City of Ramsey Standard Detail No. STR-1.

Pedestrian Facilities

Concrete Sidewalks

Width..... 6’

Section..... 6” thick unreinforced

Placed on approved subgrade.

Finish..... Broom finish

Joints..... Place a crack control, ¼” radius trowel joint, at 6’ intervals

Maximum 100’ spacing between expansion joints. ½” expansion joint must meet MnDOT Specification 3702.

Private Utility Conduit Placed Under Sidewalk
Coordinate utility crossing locations with private utility owners prior to placing concrete sidewalk.

Bituminous Trail

Width..... 8’ minimum, 10’ maximum
Class 5 Shoulder Width..... 1’
Section.....City Standard Plate No. PARK-1
2.5” Type SP 12.5 Wearing Course Mixture (SPWEA340B).
4” Modified Class 5 Aggregate Base per City Standard Plate STR-26.
Select Granular Borrow (as required).
Geotextile Fabric (as required).

Pedestrian Curb Ramps

Pedestrian curb ramps must follow current MnDOT Pedestrian Curb Ramp Details, MnDOT Standard Plan 5-297.250 (6 sheets).

All pedestrian curb ramps require a detail showing; ramp length, slope, gutter spot elevations at zero height curb, full height curb, and mid ramp. Truncated domes must be provided, radial truncated domes shall be used on radial curb ramps.

Street Lighting Plan

Light Size Design Public Streets

Intersections..... 25’ LED light
Along streets 400 feet or more between intersections..... 25’ or 14’ LED light
Sharp curve and other unsafe sight obstructions 25’ or 14’ LED light
Cul-de-sac (case by case basis) 25’ LED light

Light Size Design Public Sidewalks and Trails

Crosswalks on public streets 14’ LED light
Along sidewalks and trails (case by case basis) 14’ LED light
Along desolate or wooded locations (case by case basis) 14’ LED light
Spacing Factors (case by case)

The proximity to vehicular traffic, projected vehicular and pedestrian traffic volumes and similar items will influence spacing.

Connexus Energy standard designs

25' LED lights	Low Profile
14' LED lights	Traditionaire

Design Process

The developer will be responsible for providing a street lighting layout to the City for review before sending the layout to Connexus Energy.

Miscellaneous Design

Crowned Road Cross-slope.....	2%
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Vertical Grades

Minor and Collector	0.4% minimum, 7.0% maximum
Arterial	0.4% minimum, 4.0% maximum
Intersection (within 30 feet)	3.0% maximum
Minimum Vertical Curve	100 feet or 20 times algebraic difference

State Aid roads must follow MnDOT State Aid Vertical Curve Design Charts.

Horizontal Curve Minimum Radius

Minor	100'
Collector and Arterial.....	310'
Collector and Arterial w/superelevation	240'
Street Jog Offsets	
Minor and Service	150'
Collector	300'

Right of Way (R1 Zone Classification)

State & County Highways.....	120'
Except where specified otherwise in City Comprehensive Plan.	
Collector (MSA)	80'
Rural Residential (Minor)	66'
Urban Residential (Minor)	60'
Cul-de-sac (Urban)	60' radius

- Cul-de-sac (Rural) 65’ radius
- Service..... 60’

Construction Staking

Cut Sheets and Staking Notes Provided prior to work

Station and cuts / fills must be marked on lath by staking crew. Offset distance must be sufficient to protect lath from construction and will vary depending upon depth of trench.

Private Streets (R2 Zone Classification)

- Width (No Parking Permitted)24’ BOC to BOC
- Width (Parking Permitted One Side)28’ BOC to BOC
- Width (Parking Both Sides)32’ BOC to BOC
- Width (Parking Aisle)24’ BOC to BOC
- Length (No Turnaround)Maximum 200’
- Length (Turning Provision)Maximum 300’
- Length (Cul-de-sac)Maximum 600’

Cul-de-sac width must be 32’ back to back where the cul-de-sac length is greater than 300’.

Parking Lots

Required Parking Stalls..... City Code Section 177-356

Contact City of Ramsey Planning Department for details.

<u>Parking Angle</u>	<u>Stall Width</u>	<u>Stall Depth</u>	<u>Aisle Width</u>
90°	9’	18’	24’
60°	9’	17’	17’
45°	9’	19’	11’

Surface..... Concrete or Bituminous with concrete curb and gutter

Setbacks..... Minimum 20’ from rights of way

Driveways

- Width (R1 Zone Classification)Maximum 30’, Cul-de-sac 24’
- Width (R2 Zone Classification)Maximum 20’
- Width (R3 Zone Classification)Maximum 20’
- Drive access angle to street Minimum 75°

Surface (Urban) Bituminous or Concrete

Surface (Rural) Bituminous, Concrete, or Class V Aggregate

Geotechnical

Submission Submitted with Pre Plat

Soil Boring

Spacing Roadway Maximum 400'

A soil boring is required in all infiltration areas and all septic field areas.

Depth Minimum 10'

Infiltration areas, minimum depth 15' or to a minimum 5' below bottom of infiltration basin.

SANITARY SEWER Trunk and Lateral Pipes

Material	PVC
Class (0-13' bury)	SDR 35
Class (13-25' bury)	SDR 26
Alignment.....	Center of Street
Tracer Wire	Green 10 Gage Solid Copper

Tracer wire shall be installed along the length of all sanitary sewer trunk lines, laterals, and services with vertical riser to the surface, at gate valve boxes, hydrants, curb boxes, and/or utility location boxes. Tracer wire shall be taped, clamped or affixed to the pipe in another manner as approved by the Engineer. Splicing tracer wire shall be by mechanical split bolt type or crimp type compression fitting fully encased in approved electrical insulation putty. A 12" tracer wire loop shall be provided on each side of a spliced connection.

Minimum Trunk and Lateral Pipe Slope

The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems. It is not acceptable to oversize pipe diameter for the purposes of reducing the pipe slope.

Minimum Pipe Slope Based on Pipe Diameter

<u>Pipe Diameter</u>	<u>Minimum Slope</u>	<u>Pipe Diameter</u>	<u>Minimum Slope</u>
8 inch	0.40 percent	15 inch	0.15 percent
10 inch	0.28 percent	16 inch	0.14 percent
12 inch	0.22 percent	18 inch	0.12 percent
14 inch	0.17 percent		

Testing

Air Test Method

The sewer section under test will be accepted as having passed the air leakage test when the rate of air loss, as measured by pressure drop, does not exceed a specified amount in a specified time. Pressure drop may be determined by using the table below, or calculated by use of the formulas provided below.

Minimum Specified Time Required for a 0.5 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015 CFM/SF

Pipe Diameter (inches)	Minimum Time (Min:Sec)	Length for Min. Time (Feet)	Time for increased Length (Sec)	Specification Time for Length (L) Shown (Min:Sec)

				100 Ft.	150 Ft.	200 Ft.	250 Ft.	300 Ft.	350 Ft.	400 Ft.	450 Ft.
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:50
8	3:42	298	0.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	28:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17

*NOTE – Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than twenty four inches (24”) in diameter.

Formula – The formula below calculates the specified minimum time required for a 1.00 psig pressure drop from a starting pressure of 3.5 psig to a final pressure of 2.5 psig using a leakage rate of 0.0015 cubic feet/minute/square foot of internal surface.

Calculate all test times by the following formula:

$$T = 0.085 DK/Q$$

Where:

T = shortest time allowed for the **air pressure to drop 1.0 psig**, sec.

K = 0.000419 DL but not less than 1.0,

Q = leak rate = 0.0015 CFM/SF,

D = measured average inside diameter of sewer pipe, in., and

L = length of test section, ft.

Deflection Test

The test shall be conducted after the sewer trench has been backfilled to the desired finished grade and has been in place for thirty (30) days or more.

The deflection test shall be performed by pulling a rigid ball or nine-point mandrel (MnDOT Technical Memorandum 98-24-B-01 or latest revision) through the pipe without the aid of mechanical pulling devices. The ball or mandrel shall have a minimum diameter equal to ninety five percent (95%) of the actual inside diameter of the pipe. The maximum allowable deflection shall not exceed five percent (5%) of the pipe’s internal diameter. The line will be considered acceptable if the mandrel can progress through the line without binding.

Manholes

Type..... Precast Sections

Joints shall be constructed with confined O-Ring Gaskets

See City of Ramsey Standard Detail No. SEW-1.

Invert0.10’ above outlet

Sloped and grouted to provide smooth flow from inlet to outlet.

Rubber waterproof gasket required for pipe inserts.

Base (less than 14' deep) 5" precast or 6" poured

Base (greater than 14' deep) Increase thickness 2" per 6' of depth

Inside Drop 2' separation from invert to outlet

Reliner / Duran Style or approved equal.

8" base for manholes less than 14' deep, increase thickness 2" per 6' of depth beyond 14'.

Ductile Iron Pipe from tee to undisturbed soil.

Casting Rings Minimum 2, maximum 7 – 2" rings

All interior joints shall be grouted to a smooth finish. Wrap outside of rings with water tight product.

Casting 1733 Series Watertight Casting

See City of Ramsey Standard Detail No. SEW-2.

Tracer Wire Green 10 Gage Solid Copper

Tracer wires are to end in structures at finished grade. Tracer wire shall have enough length to wrap around the top manhole step inside the structure.

Services

Material PVC

Class SDR 26

Size Minimum 4" diameter

WYEs 10 or 2 O'clock position

Bends Maximum 22.5°

City Engineer approval required for bends greater than 22.5°.

Slopes Minimum 2%

Riser Maximum 2:1 slope

Location End at ROW

Marker Minimum 2' above ground at ROW

Install 5' steel post painted green.

Tracer Wire 10 Gage Solid Copper

Tracer wire to end at finished grade on all services and stubs. Leave 10' of looped tracer wire at marker.

Cleanout Minimum 100' interval along the service
Interval distance includes the riser.

WATERMAIN

Trunk and Lateral Pipes

Material	Ductile Iron Pipe
Class (6" diameter or less)	53
Class (8" diameter or greater)	52

Alignment..... North and East side of street

Connection to Existing..... Pipe Sleeves not acceptable

 Connection to existing watermain must be made at valve, bend, or full section pipe.

Size..... 8" minimum residential, 12" minimum commercial and industrial

Minimum Cover..... 7.5'

 Insulation.....Cover less than 7.5'

 Insulation shall be used when the vertical clearance from the storm sewer is less than 2 feet.

 Material used shall be polystyrene or approved equal, two (2) 4' x 8' x 2" thick sheets with joints overlapping 4'.

Joint Connection..... Push on joint

 Copper jumper required sized to carry 600 amps.

 All rubber gasket joints shall be in accordance with A.W.W.A. Specification C111.

Restraints.....Retainer Glands

 American, US Pipe or Mega-Lug type, ductile iron, designed to withstand the design pressures indicated in the plans, specifications and special provisions.

 All nuts, bolts and tie rod type restraints shall be stainless steel or coated with an approved rustproofing material.

Testing

Hydrostatic Pressure

After the pipe has been laid and backfilled, including fittings and valves and blocking, all newly laid pipe or any section between valves thereof, unless directed otherwise by the Engineers, shall be subject to hydrostatic pressure of one hundred fifty (150) pounds per square inch. The duration of each such test shall be at least two (2) hours.

 The pressure gauge shall be a standard pressure gauge. The dial shall register from 0 – 200 psi and have a dial size of 4 1/2" with one (1) psi increments. The hydrostatic test,

pressure requirement for an acceptable test shall be a maximum pressure drop of zero (0) psi during the last hour of the two (2) hour pressure test. If this test requirement cannot be met, the Contractor shall investigate the cause, make corrections, and retest until the pressure drop requirement can be met.

Electrical Conductivity

The Contractor shall perform a conductivity test within one week after completion of pressure testing of the main on all watermains to ensure continuous conductivity for the purpose of tracing watermain for utility location. Sufficient conductivity shall be provided to allow for the location of watermain, services, hydrant leads, and laterals for mainline segments at least one thousand two hundred (1,200) lineal feet in length.

Disinfection of Watermain

Before being placed in service, the completed watermain shall be disinfected. Disinfection materials and procedures, and the collection and testing of water samples, shall be in accordance with the provision of AWWA C-651. After final flushing of watermain, the water shall be tested for bacteriologic quality and found to meet the standards prescribed by the Minnesota Department of Health. The Contractor shall furnish all materials and perform the disinfecting, flushing, and testing as necessary for meeting the water quality requirements.

Valves

Valves.....Resilient Seated Waterous 2500 Series or approved equal

Valve Boxes 3 piece adjustable screw type boxes 60” – 90” extension
5 ¼” shaft size required. The word “water” shall be imprinted on each lid.

One (1) valve wrench shall be supplied to the Public Works Department for each five (5) valves required on the Project.

Spacing Required at every intersection
Maximum spacing 500’ for single-family residential and 300’ for all other developments.

The City prefers a maximum of 11 lots to be served between valves.

Fittings

MaterialMechanical Joint Ductile Iron – Mega Lugs

The City does not allow 90° bends, except for hydrant leads.

Compact MJ Fittings Weight (LBS.) ANSI/AWWA C153/A21.53

NOM. SIZE	Thickness T	60° MJ x MJ	45° MJ x MJ	30° MJ x MJ	22 ½° MJ x MJ	11 ¼° MJ x MJ	5 ⅝° MJ x MJ
2"	0.30	-	13	-	9	8	-
3"	0.33	-	21	-	16	14	-
4"	0.34	-	23	-	18	16	16
6"	0.36	-	32	-	32	30	27
8"	0.38	-	46	44	46	42	38
10"	0.40	-	70	-	64	58	56
12"	0.42	-	86	-	84	74	73
14"	0.47	-	145	-	140	128	-
16"	0.50	-	202	-	178	148	150
18"	0.54	-	250	-	255	205	-
20"	0.57	-	305	-	262	245	239
24"	0.61	479	405	385	412	315	317
30"	0.66	843	798	692	665	568	568
36"	0.74	1350	1164	1080	860	840	825
42"	0.82	2150	1792	1465	1350	1319	1125
48"	0.90	2650	2390	2075	1886	1700	1600

Hydrants

Material5-1/4" WB67 Waterous Pacer or approved equal

One (1) hydrant wrench, one (1) break off section, and six (6) markers shall be supplied to the Public Works Department for each six (6) hydrants required on the Project.

Depth8'-0" bury

Barrel Section 16"

SpacingMaximum 300' radius

Marker Solid red 4' flex stake

Top nut height 2.5' above adjacent grade

Location..... Intersections, and on property lines

Hydrants shall be located at the high and low points on 12" + size watermain.

Hydrants shall be located within 150' of the Fire Department connection on non-residential sites.

Plugged..... wherever groundwater table is above drain outlet

The 5” cap shall be painted yellow on all plugged hydrants.

Services

Material 1” type K copper

Corporation Stops

Material.....Mueller H-15000, Ford F-600, or approved equal

SupportConcrete Base Required

Minimum dimensions 4” width x 6” length x 2” thickness.

Curb Stops

Material..... Ford B27-444M, Mueller 15154 Uniseal Valve, or approved equal

Boxes 12” adjuster to eight feet (8’) when fully extended

Curb Box

Material..... Ford EM2-80-56-69 R or approved equal

66” standard stationary rod or approved equal.

STORM SEWER

Pipe

Material RCP

HDPE may be used in greenspace with City Engineer approval.

Change in pipe material, grade, or direction must occur in a manhole.

Tracer Wire 10 Gage Solid Copper

Tracer wire shall be installed with all storm sewer lines. Conductivity is required on all tracer wire.

Side of Street South and West

Class MnDOT Drainage Manual Chapter 2

Diameter of catch basin leads..... Minimum 12”

Diameter of laterals and trunk line Minimum 15”

Culvert Material RCP or CMP

Diameter Minimum 15”

Apron..... Required on all storm sewer system inlets and outlets

Trash guards are required on all aprons larger than 18” and / or when trash guards exist downstream.

Aprons greater than 36” diameter require storm sewer piling and concrete end section.

Tracer wire shall end at grade.

Catch Basins and Manholes

MaterialPrecast Concrete Section

Use of concrete block requires City Engineer approval.

2’x3’ catch basin..... Maximum 4’ rim to sump height

Precast openings as required.

Tracer Wire 10 Gage Solid Copper

Tracer wire shall be installed with all storm sewer structures. Tracer wire shall end in the structure as close to finish grade as practical on manholes and catch basins. Tracer wire shall end at finish grade, at the grate on flared end sections.

Build 4’ minimum to prevent freezing

Steps Required for structures 4’ deep or greater

- Casting (Storm Manhole)Watertight Casting R-1733 Series or approved equal
- Casting (Non-Traffic Areas)R-2570 or approved equal
- Casting (Non-Traffic Areas)R-2560 Series or approved equal
 - Beehive Grates with frame suitable for drainage circumstances where clogging of a flat grate is probable.
- Casting (Surmountable Curb)R-3067 with Grated Back or approved equal (bicycle safe)
- Casting (Surmountable adjacent to radius)R-3246R or approved equal
- Casting (B Type Curb)R-3246R or approved equal
- Casting RingsMinimum 2, maximum 7 – 2” rings
 - All interior joints shall be grouted to a smooth finish. Wrap outside of rings with water tight product.

Design

- Frequency 10-Year design for lateral sewer
 - Catch basin spacing follow MnDOT maximum allowable spread table with the 10 year design frequency.
 - Detention basin.....Atlas 14 – 100 year event
 - Detention basin (land locked)Back to back Atlas 14 – 100 year event
- Frequency within the COR
 - All trunk storm sewer within the COR must be sized to convey the 100 year storm runoff from all new development.
- Velocity (self-cleaning)Minimum 3.0 fps
- Infiltration basinFirst 1” of runoff from new impervious surfaces
 - No infiltration is allowed within any municipal water supply well 10 year capture zone. Must contribute to the infiltration mitigation fund in such instances. Contact City Engineering Department for more information.
 - Water quality treatment providing annual removal efficiency of 60% total phosphorus and 90% total suspended solids.
- Pond outlets Skimmer manhole
- Rate control Atlas 14 – 2 year, 10 year, and 100 year storm events

Lowest floor elevation – highest of:

- Minimum 3 feet above highest anticipated groundwater table,
- 2 feet above the designated or designed 100-year flood elevation, or
- 1 foot above the emergency overflow

Methodologies

- Infiltration basin sizing.....1” rainfall event
Follow MPCA MIDS Calculator, latest version.
- Water quality pond sizing Walker Spreadsheet
- Water quality efficiency goal attainment MIDS Calculator or P8 model of site
- Rate control modeling Hydro CAD or other approved dynamic routing software
- Storm sewer sizing Rational method spreadsheet
- Stormwater report

Narrative describing site and treatment methods, tabular comparison of existing and proposed conditions and rate reductions provided for 2-year, 10-year, and 100-year storms. Hydro CAD printouts for the 1”, 2-year, 10-year, and 100-year storms. The project name and engineer name must be on the page header of the report.

Manning’s Roughness (n) for Pipes

<i>Conduit Material</i>		<i>Manning n</i>
Cast Iron Pipe	Coated	0.010 – 0.014
	Uncoated	0.011 – 0.016
Concrete	Culvert, straight and free of debris	0.010 – 0.013
	Sewer with manholes, inlet, etc., straight	0.013 – 0.017
	Finished	0.011 – 0.014
	Unfinished, steel form	0.012 – 0.014
	Unfinished, rough wood form	0.015 – 0.020
Corrugated Metal	Sub drain	0.017 – 0.021
	Storm drain	0.021 – 0.030
HDPE Pipe		0.011 – 0.015
Vegetated Channel		0.030 – 0.060

Source: Autodesk Hydra flow Storm Sewers Extension

Runoff Coefficients for Rational Formula

TYPE OF DRAINAGE AREA			RUNOFF COEFFICIENT
Business	Downtown areas		0.70 – 0.95
	Neighborhood areas		0.50 – 0.70
Residential	Single-family areas		0.30 – 0.50
	Multi-units	Detached	0.40 – 0.60
		Attached	0.60 – 0.75
	Suburban		0.25 – 0.40
	Apartment dwelling areas		0.50 – 0.70
Industrial	Light areas		0.50 – 0.80
	Heavy areas		0.60 – 0.90
Parks, Cemeteries			0.10 – 0.25
Playground			0.20 – 0.35
Railroad yard areas			0.20 – 0.40
Unimproved Urban areas			0.10 – 0.30
Lawns	Sandy Soil	Flat, 2%	0.05 – 0.10
		Average, 2 – 7%	0.10 – 0.15
		Steep, 7%	0.15 – 0.20
	Heavy Soil	Flat, 2%	0.13 – 0.17
		Average, 2 – 7%	0.18 – 0.22
		Steep, 7%	0.25 – 0.35
Streets	Asphaltic		0.70 – 0.95
	Concrete		0.80 – 0.95
	Brick		0.70 – 0.85
Drives and Walks			0.75 – 0.85
Roofs			0.75 – 0.95
Rural	Average infiltration rates sandy & gravel soils	Cultivated	0.20
		Pasture	0.15
		Woodlands	0.10
	Average infiltration rates; Loams and similar soils with no clay pans	Cultivated	0.40
		Pasture	0.35
		Woodlands	0.30
	Below average infiltration rates; heavy clay soils; soils with a clay pans near the surface; shallow soil above impervious rock	Cultivated	0.50
		Pasture	0.45
		Woodlands	0.40

Source: MnDOT Drainage Manual