

Appendix 7-A

Symbols and Acronyms

Revised September 2026

If you require assistance accessing this information or require it in an alternative format, contact the Michigan Department of Transportation's (MDOT) Americans with disabilities Act (ADA) coordinator at Michigan.gov/MDOT-ADA.

Symbols

Symbol	Definitions	Units
A	Drainage area	acres
A	Cross-sectional area of flow	sft
A _g	Clear opening area of grate	sft
A _o	Clear area of opening	sft
a	Gutter depression	in
C	Runoff coefficient	-
C _B	Energy loss coefficient for benching	-
C _P	Plunging flow coefficient	-
C _w	Weir coefficient	-
C _o	Orifice coefficient	-
C _Θ	Angled inflow coefficient	-
d	Average depth across the grade	ft
d	Depth of flow at curb	ft
d _c	Critical depth	ft
d _i	Depth of flow at curb with local depression	ft
d _n	Normal depth	ft
d _o	Effective head on the center of the orifice throat	ft
D	Diameter of pipe	ft
D _o	Outlet pipe diameter	ft
DI	Discharge intensity parameter	-
E	Efficiency of a grate	-
E _a	Revised manhole energy level	ft
E _{ai}	Initial manhole energy level	ft
E _{aio}	Estimated manhole energy level, outlet control	ft
E _{ais}	Estimated manhole energy level, inlet control submerged	ft
Symbol	Definitions	Units

E_{aiu}	Estimated manhole energy level, inlet control unsubmerged	ft
E_i	Outflow pipe energy head	ft
E_o	Ratio of frontal flow to total gutter flow	-
EGL_a	Revised manhole energy grade line	ft
EGL_i	Outflow pipe energy grade line (upstream end of pipe)	ft
EGL_o	Inflow pipe energy grade line (downstream end of pipe)	ft
EGL_{TW}	Tailwater energy grade line	ft
G_1, G_2	Approach grades	%
g	Acceleration due to gravity	ft/s ²
h	Curb opening height	ft
h_k	Relative plunge height	ft
H_a	Estimated energy loss in manhole	ft
H_b	Bend loss coefficient	ft
H_B	Additional energy loss for benching	ft
H_f	Friction loss	ft
H_i	Entrance loss assuming outlet control	ft
H_L	Head loss	ft
H_o	Inflow pipe exit loss	ft
H_P	Additional energy loss for plunging flows	ft
H_o	Exit loss	ft
H_θ	Additional energy loss for angled flows	ft
HGL_a	Revised manhole hydraulic grade line	ft
HGL_i	Outflow pipe hydraulic grade line (upstream end of pipe)	ft
HGL_o	Inflow pipe hydraulic grade line (downstream end of pipe)	ft
HGL_{TW}	Tailwater hydraulic grade line	ft
i	Rainfall intensity	in/hr
K	Vertical curve constant	ft/%

Symbol	Definitions	Units
---------------	--------------------	--------------

K	Manhole sizing factor	in/°
K	Conveyance factor	-
K _i	Entrance loss coefficient	-
K _o	Exit loss coefficient	-
K _Q	Unit conversion constant	-
K _u	Unit conversion constant	-
L _T	Curb opening length required to intercept 100% of gutter flow	ft
L	Length of grate or curb opening	ft
L	Pipe length	ft
L	Horizontal length of the vertical curve	ft
L	Distance from crest	ft
n	Manning's roughness coefficient	-
P	Perimeter of grate excluding side against curb	ft
p	Pressure of fluid	lb/ft ²
Q	Flow rate	cfs
Q _b	Bypass flow	cfs
Q _i	Intercepted flow	cfs
Q _i	Interception capacity of grate	cfs
Q _j	Contributing flow from inflow pipe for angled flow	cfs
Q _k	Plunging flow rate	cfs
Q _o	Flow in outflow pipe	cfs
Q _s	Gutter capacity above the depressed section (See Figure 7-1)	cfs
Q _t	Maximum allowable flow	cfs
Q _w	Flow rate in depressed section of the gutter (See Figure 7-2)	cfs
R ₁ , R ₂	Interior pipe radius	in
R _f	Ratio of frontal flow intercepted to total frontal flow	-
R	Hydraulic radius	ft
Symbol	Definitions	Units

R_s	Ratio of side flow intercepted to total side flow	-
S_x	Pavement cross slope	ft/ft
S	Slope of energy grade line	ft/ft
S_e	Equivalent cross slope	ft/ft
S_f	Friction slope	ft/ft
S_L	Longitudinal slope of pavement	ft/ft
S_w	Cross slope of depressed gutter (See Figure 7-2)	ft/ft
S'_w	Cross slope of the gutter measured from the pavement cross slope	ft/ft
T	Width of spread	ft
T_1, T_2	Pipe wall thickness	in
T_c	Time of concentration	min
V	Velocity	fps
V_o	Average outlet velocity	fps
V_d	Channel velocity downstream of outlet in the direction of the pipe flow	fps
V_o	Gutter velocity where splash over first occurs	fps
W	Width of contributing drainage area	ft
W	Width of depressed gutter or grate	ft
W	Unit weight of water	lb/ft ³
WP	Wetted perimeter	ft
X	Maximum distance from bottom of sag to flanking inlet	ft
y	Outflow pipe depth (potential head)	ft
Z_1, Z_2	Distance above chosen datum, elevation head	ft
z_a	Manhole invert elevation	ft
Z_i	Outflow pipe invert elevation	ft
z_k	Inflow pipe invert elevation	ft
Δ	Angle between pipes	°
Symbol	Definitions	Units

Δ	Angle of bend	°
Θ_j	Angle measured from the outlet pipe	°
Θ_w	Single flow weighted angle	°
P/γ	Outflow pipe pressure head	ft

Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AEP	Annual Exceedance Probability
ARI	Annual Recurrence Interval
CFD	Computational Fluid Dynamics
CMP	Corrugated Metal Pipe
CSP	Corrugated Steel Pipe
DEM	Digital Elevation Model
EGL	Energy Grade Line
EGLE	Michigan Department of Environment, Great Lakes, and Energy
FHWA	Federal Highway Administration
GLUMBR	Great Lakes–Upper Mississippi River Board
HEC	Hydraulic Engineering Circular
HGL	Hydraulic Grade Line
ITM	Illinois Transient Model
LAP	Local Agency Program
MCL	Michigan Compiled Laws
MDOT	Michigan Department of Transportation
MH	Manhole
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NPDES	National Pollutant Discharge Elimination System
OHWM	Ordinary High Water Mark
ORD	Open Roads Designer
ORD D&U	Open Roads Designer, Drainage and Utilities
RCP	Reinforced Concrete Pipe
ROW	Right-of-Way

Acronyms

TSC	Transportation Service Center
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey