raSmith
CREATIVITY BEYOND ENGINEERING

Storm Sewer Report for

Woodman's Car Wash

City of Waukesha, WI

raSmith Project No. 3240205

June 11, 2025

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06/23/2025

Storm Sewer Report for

Woodman's Car Wash

City of Waukesha, WI

Prepared by

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INTRODUCTION

The following storm sewer analysis is for the proposed Woodman's Car Wash site located along the north side of W Main Street in the south side of the Woodman's Food Market development in the City of Waukesha, WI. The proposed site improvements consist of a commercial car wash building, gas pumps, new driveways, and parking areas, along with utility infrastructure.

BASIS OF DESIGN

- **Peak Flow:** The peak flow of stormwater influent to the private exterior plumbing system has been calculated using the Rational Method.

- **Rainfall Intensity:** The rainfall intensity of stormwater influent has been calculated using NOAA Atlas 14 with the time of concentration being that of the tributary area of the inlet watershed.

- **Pipe Capacity (Conveyance):** Pipe capacity of stormwater influent has been calculated using Manning's equation, based on full flow design capacity.

- **Inlet Capacity Calculations:** Inlet capacity has been calculated using the Rational Method to determine peak flow rates. Manufacturer supplied capacity charts are referenced to determine inlet capacity, and a 25% clogging factor has been applied at each inlet when determining captured flow. Inlets in on-grade conditions (STO 115 and STO 145) had an assumed efficiency of 20%, with the rest of the flow going to the downstream inlet.

On-site storm sewer pipe capacity and inlet capacity calculations are sized for the 10-yr storm event, with all rainfall events in excess of the 10-yr storm being routed via overland flow to the detention basin within the Woodman's Food Market development.

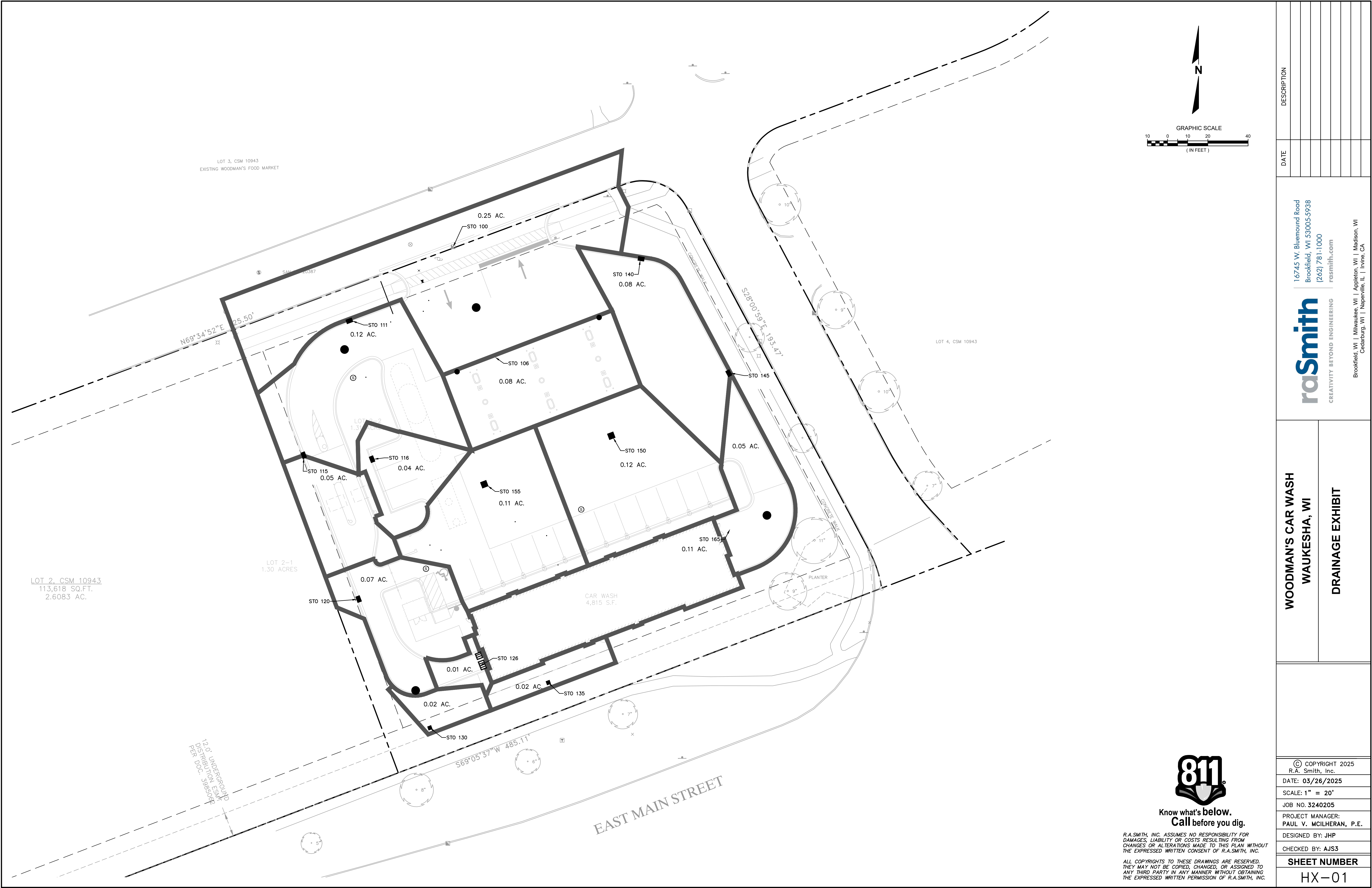Refer to the appendices described below for design calculations.

Appendices

A. Drainage Area Exhibit

B. Storm Sewer Pipe Design

C. Sewer Inlet Capacity Calculations

Appendix A

Drainage Area Exhibit

GRAPHIC SCALE
10 0 10 20   40
(IN FEET)

N

LOT 3, CSM 10943
EXISTING WOODMAN'S FOOD MARKET

0.25 AC.
STO 100

STO 140
0.08 AC.

STO 111
0.12 AC.

STO 106
0.08 AC.

STO 145

STO 150
0.12 AC.

0.05 AC.

LOT 4, CSM 10943

STO 116
0.04 AC.

STO 115
0.05 AC.

STO 155
0.11 AC.

STO 165
0.11 AC.

N69°34'52"E   25.50'

S28°00'59"E 193.47'

LOT 2, CSM 10943
113,618 SQ.FT.
2.6083 AC.

LOT 2-1
1.30 ACRES

0.07 AC.

STO 120

CAR WASH
4,815 S.F.

PLANTER

STO 126

0.01 AC.

0.02 AC.   0.02 AC.   STO 135

0.02 AC.

STO 130

S69°05'37"W 485.11'

12.0' UNDERGROUND
DISTRIBUTION ESMT
PER DOC. 3985047

EAST MAIN STREET

DESCRIPTION

DATE

WOODMAN'S CAR WASH
WAUKESHA, WI

DRAINAGE EXHIBIT

SHEET NUMBER

HX-01

Appendix B

Storm Sewer Pipe Design Hydraflow

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan
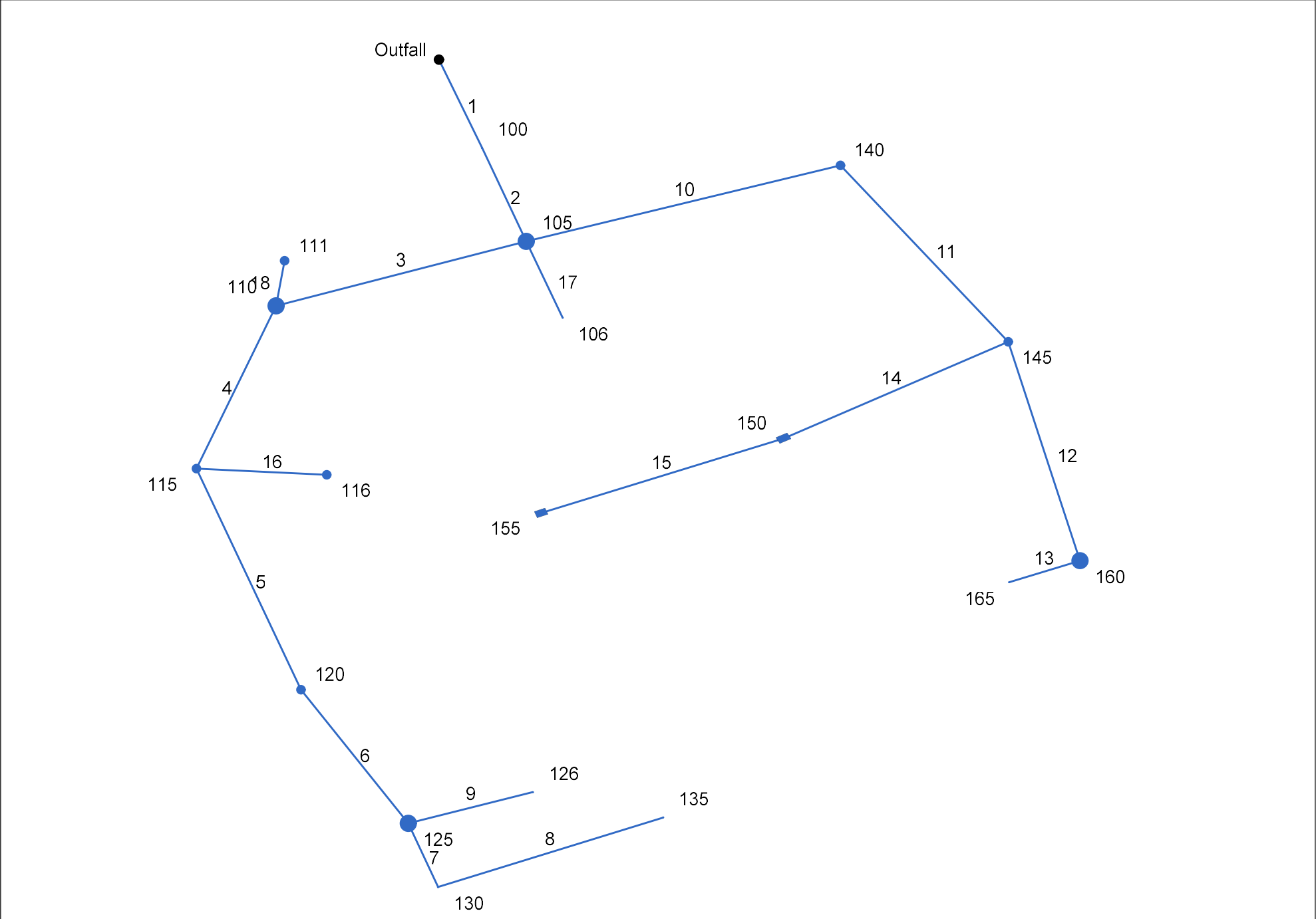
Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	30.783	68.240	MH	0.00	0.25	0.79	6.0	871.00	1.59	871.49	18	Cir	0.013	0.15	875.99	100-EXIST
2	1	32.261	1.017	MH	0.00	0.00	0.00	6.0	871.49	0.53	871.66	18	Cir	0.013	1.00	877.05	105-100
3	2	68.598	93.070	MH	0.00	0.00	0.00	6.0	872.16	0.54	872.53	12	Cir	0.013	1.00	877.06	110-105
4	3	56.495	-50.929	Grate	0.00	0.01	0.67	6.0	872.53	0.99	873.09	12	Cir	0.013	1.50	877.62	115-110
5	4	76.447	-42.287	Grate	0.00	0.07	0.73	6.0	873.09	0.98	873.84	12	Cir	0.013	0.50	878.15	120-115
6	5	51.391	-11.936	MH	0.00	0.00	0.00	6.0	873.84	0.98	874.34	12	Cir	0.013	0.97	880.00	125-120
7	6	22.043	11.918	MH	0.00	0.05	0.30	6.0	874.67	0.98	874.89	8	Cir	0.013	1.00	879.45	130-125
8	7	62.953	-90.000	MH	0.00	0.05	0.56	6.0	874.89	0.97	875.50	8	Cir	0.013	1.00	879.46	135-130
9	6	34.077	-74.353	MH	0.00	0.05	0.82	6.0	874.67	0.98	875.01	8	Cir	0.013	1.00	879.89	126-125
10	2	85.582	-85.943	Grate	0.00	0.13	0.88	6.0	871.66	0.63	872.20	18	Cir	0.013	1.42	877.32	140-105
11	10	71.874	69.162	Grate	0.00	0.01	0.84	6.0	872.70	0.63	873.15	12	Cir	0.013	1.50	878.42	145-140
12	11	73.140	22.805	MH	0.00	0.00	0.00	6.0	873.15	0.63	873.61	12	Cir	0.013	1.00	879.69	160-145
13	12	19.550	83.873	MH	0.00	0.11	1.00	6.0	873.61	0.61	873.73	12	Cir	0.013	1.00	879.99	165-160
14	11	66.444	99.508	DrGrt	0.00	0.12	0.90	6.0	873.15	0.63	873.57	12	Cir	0.013	0.50	878.00	150-145
15	14	67.500	7.128	DrGrt	0.00	0.11	0.90	6.0	873.57	0.64	874.00	12	Cir	0.013	1.00	878.00	155-150
16	4	33.993	-108.062	Grate	0.00	0.04	0.70	6.0	873.09	0.97	873.42	12	Cir	0.013	1.00	877.42	116-115
17	2	26.382	-0.146	MH	0.00	0.08	1.00	6.0	872.49	1.02	872.76	8	Cir	0.013	1.00	878.14	106-105
18	3	14.750	116.518	Grate	0.00	0.15	0.73	6.0	872.53	0.54	872.61	12	Cir	0.013	1.00	876.62	111-110

Project File: STO 100S.stm

Number of lines: 18

Date: 3/26/2025

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	30.783	0.25	1.23	0.79	0.20	1.00	6.0	12.3	4.9	4.84	13.25	5.24	18	1.59	871.00	871.49	871.72	872.33	875.85	875.99	100-EXIST
2	1	32.261	0.00	0.98	0.00	0.00	0.80	6.0	12.1	4.9	3.91	7.62	4.08	18	0.53	871.49	871.66	872.33	872.42	875.99	877.05	105-100
3	2	68.598	0.00	0.42	0.00	0.00	0.28	6.0	11.5	5.0	1.40	2.62	3.33	12	0.54	872.16	872.53	872.71	873.03	877.05	877.06	110-105
4	3	56.495	0.01	0.27	0.67	0.01	0.17	6.0	10.8	5.2	0.88	3.55	2.28	12	0.99	872.53	873.09	873.23	873.48	877.06	877.62	115-110
5	4	76.447	0.07	0.22	0.73	0.05	0.14	6.0	9.7	5.4	0.73	3.53	2.75	12	0.98	873.09	873.84	873.48	874.20	877.62	878.15	120-115
6	5	51.391	0.00	0.15	0.00	0.00	0.08	6.0	8.4	5.8	0.49	3.53	2.26	12	0.98	873.84	874.34	874.20	874.63	878.15	880.00	125-120
7	6	22.043	0.05	0.10	0.30	0.02	0.04	6.0	8.0	5.9	0.25	1.20	2.54	8	0.98	874.67	874.89	874.88	875.12	880.00	879.45	130-125
8	7	62.953	0.05	0.05	0.56	0.03	0.03	6.0	6.0	6.6	0.19	1.19	1.93	8	0.97	874.89	875.50	875.12	875.70	879.45	879.46	135-130
9	6	34.077	0.05	0.05	0.82	0.04	0.04	6.0	6.0	6.6	0.27	1.20	2.58	8	0.98	874.67	875.01	874.89	875.25	880.00	879.89	126-125
10	2	85.582	0.13	0.48	0.88	0.11	0.44	6.0	8.4	5.8	2.54	8.34	2.87	18	0.63	871.66	872.20	872.71	872.80	877.05	877.32	140-105
11	10	71.874	0.01	0.35	0.84	0.01	0.33	6.0	8.0	5.9	1.93	2.82	3.87	12	0.63	872.70	873.15	873.31	873.76	877.32	878.42	145-140
12	11	73.140	0.00	0.11	0.00	0.00	0.11	6.0	6.3	6.5	0.72	2.82	1.91	12	0.63	873.15	873.61	874.11	873.96	878.42	879.69	160-145
13	12	19.550	0.11	0.11	1.00	0.11	0.11	6.0	6.0	6.6	0.73	2.79	2.93	12	0.61	873.61	873.73	873.96	874.09	879.69	879.99	165-160
14	11	66.444	0.12	0.23	0.90	0.11	0.21	6.0	7.3	6.1	1.27	2.83	2.55	12	0.63	873.15	873.57	874.11	874.05	878.42	878.00	150-145
15	14	67.500	0.11	0.11	0.90	0.10	0.10	6.0	6.0	6.6	0.66	2.84	2.31	12	0.64	873.57	874.00	874.05	874.34	878.00	878.00	155-150
16	4	33.993	0.04	0.04	0.70	0.03	0.03	6.0	6.0	6.6	0.19	3.51	1.32	12	0.97	873.09	873.42	873.48	873.60	877.62	877.42	116-115
17	2	26.382	0.08	0.08	1.00	0.08	0.08	6.0	6.0	6.6	0.53	1.22	3.17	8	1.02	872.49	872.76	872.80	873.10	877.05	878.14	106-105
18	3	14.750	0.15	0.15	0.73	0.11	0.11	6.0	6.0	6.6	0.73	2.62	1.33	12	0.54	872.53	872.61	873.23	873.23	877.06	876.62	111-110

Project File: STO 100S.stm | Number of lines: 18 | Run Date: 3/26/2025

NOTES: Intensity = 35.56 / (Inlet time + 5.00) ^ 0.70; Return period = Yrs. 10 ; c = cir e = ellip b = box

Appendix C

Storm Sewer Inlet Capacity Calculations

Inlet capacity calculations are provided to demonstrate the various inlets across the project are able to pass tributary flow through the surface grates and into the storm sewer system without exceeding an allowable pavement ponding depth of 6-inches. The representative worst inlet ponding conditions are reviewed for each inlet type used across the project, with calculations detailed below.

INLET CAPACITY

Neenah Inlet Type: R-3067, Type C Grate
- STO INL 140 has the worst ponding conditions for this inlet type.
- Maximum ponding depth is 0.20-ft.
- Clogging factor of 25% has been included.

Neenah Inlet Type: R-1792-GG
- STO INL 150 has the largest tributary drainage area for this inlet type.
- Maximum ponding depth is 0.40-ft.
- Clogging factor of 25% has been included.

Neenah Inlet Type: R-3010, Type A Grate
- STO INL 100 has the largest tributary drainage area for this inlet type.
- Maximum ponding depth is 0.30-ft.
- Clogging factor of 25% has been included.

INLET CAPACITY CALCULATION RESULTS SUMMARY

Inlet capacity calculation 1
Inlet grate = Neenah R-3067, Type C Grate (INL 140)
Tributary area = 0.13 ac
C-factor = 0.88
Intensity = 6.75 in/hr (10 yr, 6 min. per min value in NOAA Atlas 14 Project Site)
Q_{actual} = (0.13 ac)*(0.88)*(6.75 in/hr) = 0.78 cfs
Q_{allow} = Inlet capacity (25% clogging factor and 0.20' ponding depth) = 1.30 cfs
Grate capacity exceeds flow to inlet (Q_{allow} > Q_{actual})

Inlet capacity calculation 2
Inlet grate = Neenah R-1792-GG Grate (INL 150)
Tributary area = 0.12 ac
C-factor = 0.90
Intensity = 6.75 in/hr (10 yr, 6 min. per min value in NOAA Atlas 14 Project Site)
Q_{actual} = (0.12 ac)*(0.90)*(6.75 in/hr) = 0.73 cfs
Q_{allow} = Inlet capacity (25% clogging factor and 0.40' ponding depth) = 4.57 cfs
Grate capacity exceeds flow to inlet (Q_{allow} > Q_{actual})

Inlet capacity calculation 3
Inlet grate = Neenah R-3010, Type A Grate (INL 100)
Tributary area = 0.25 ac
C-factor = 0.79
Intensity = 6.75 in/hr (10 yr, 6 min. per min value in NOAA Atlas 14 Project Site)
Q_{actual} = (0.25 ac)*(0.79)*(6.75 in/hr) = 1.34 cfs
Q_{allow} = Inlet capacity (25% clogging factor and 0.30' ponding depth) = 1.89 cfs
Grate capacity exceeds flow to inlet (Q_{allow} > Q_{actual})

<u>Inlet capacity calculation 4</u>
Inlet grate = Nyloplast 1099CGDF Grate (INL 135)
Tributary area = 0.05 ac
C-factor = 0.56
Intensity = 6.75 in/hr (10 yr, 6 min. per min value in NOAA Atlas 14 Project Site)
Q_{actual} = (0.05 ac)*(0.56)*(6.75 in/hr) = 0.19 cfs
Q_{allow} = Inlet capacity (25% clogging factor and 0.45' ponding depth) = 0.90 cfs
Grate capacity exceeds flow to inlet (Q_{allow} > Q_{actual}*)*

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GRATE CAPACITY CALCULATIONS FOR
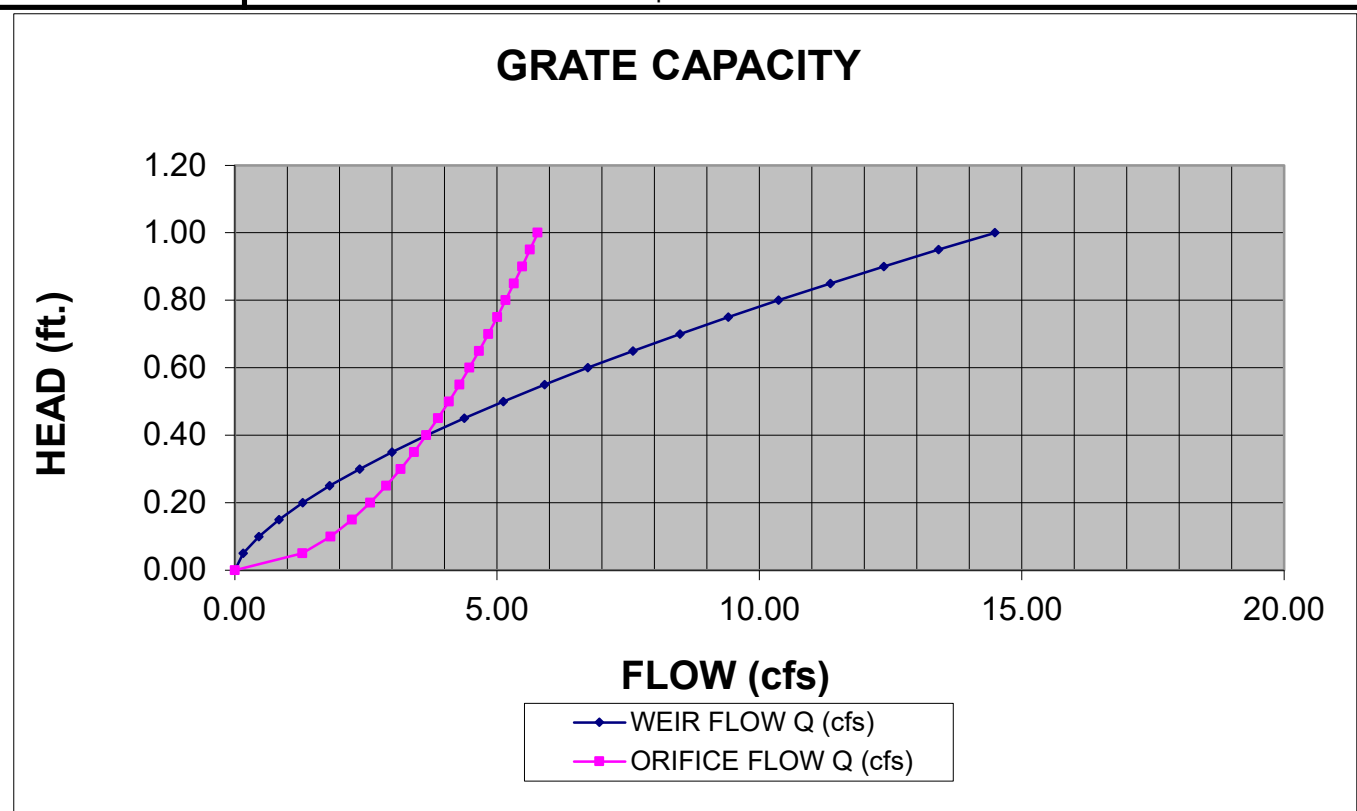INLETS IN A SAG (PONDING) CONDITION
Waukesha Car Wash Woodman's

SHEET NUMBER: 1 of 4
COMPUTED BY: JHP
CHECKED BY: AJS3
DATE: 6/11/2025

NEENAH GRATE NUMBER: R-3067, TYPE C Grate
INLET LENGTH OR PERIMETER: 5.8 ft.
GRATE OPEN END AREA: 1.6 sf.
CLOGGING FACTOR: 25%

Weir flow controls until a head of 0.399 feet is reached, where orifce flow takes over and controls. The flow at this transition is less efficient than what is indicated by either the weir or orifice flow equations. A flow of 20% less than the equated flow is a conservative estimate.

HEAD H (ft.)	WEIR FLOW Q (cfs)	ORIFICE FLOW Q (cfs)
0.00	0.00	0.00
0.05	0.16	1.29
0.10	0.46	1.83
0.15	0.84	2.24
0.20	1.30	2.58
0.25	1.81	2.89
0.30	2.38	3.16
0.35	3.00	3.42
0.40	3.66	3.65
0.45	4.37	3.87
0.50	5.12	4.08
0.55	5.91	4.28
0.60	6.73	4.47
0.65	7.59	4.66
0.70	8.48	4.83
0.75	9.41	5.00
0.80	10.36	5.16
0.85	11.35	5.32
0.90	12.37	5.48
0.95	13.41	5.63
1.00	14.49	5.77

GRATE CAPACITY

(Chart: HEAD (ft.) vs FLOW (cfs) — WEIR FLOW Q (cfs) and ORIFICE FLOW Q (cfs))

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GRATE CAPACITY CALCULATIONS FOR INLETS IN A SAG (PONDING) CONDITION
Waukesha Car Wash Woodman's

NEENAH GRATE NUMBER: R-1792-GG Grate
INLET LENGTH OR PERIMETER: 7.4 ft.
GRATE OPEN END AREA: 2 sf.
CLOGGING FACTOR: 25%

Weir flow controls until a head of 0.391 feet is reached, where orifce flow takes over and controls. The flow at this transition is less efficient than what is indicated by either the weir or orifice flow equations. A flow of 20% less than the equated flow is a conservative estimate.

HEAD H (ft.)	WEIR FLOW Q (cfs)	ORIFICE FLOW Q (cfs)
0.00	0.00	0.00
0.05	0.21	1.61
0.10	0.58	2.28
0.15	1.07	2.80
0.20	1.65	3.23
0.25	2.31	3.61
0.30	3.04	3.95
0.35	3.83	4.27
0.40	4.68	4.57
0.45	5.58	4.84
0.50	6.53	5.10
0.55	7.54	5.35
0.60	8.59	5.59
0.65	9.69	5.82
0.70	10.82	6.04
0.75	12.00	6.25
0.80	13.22	6.46
0.85	14.48	6.65
0.90	15.78	6.85
0.95	17.11	7.04
1.00	18.48	7.22
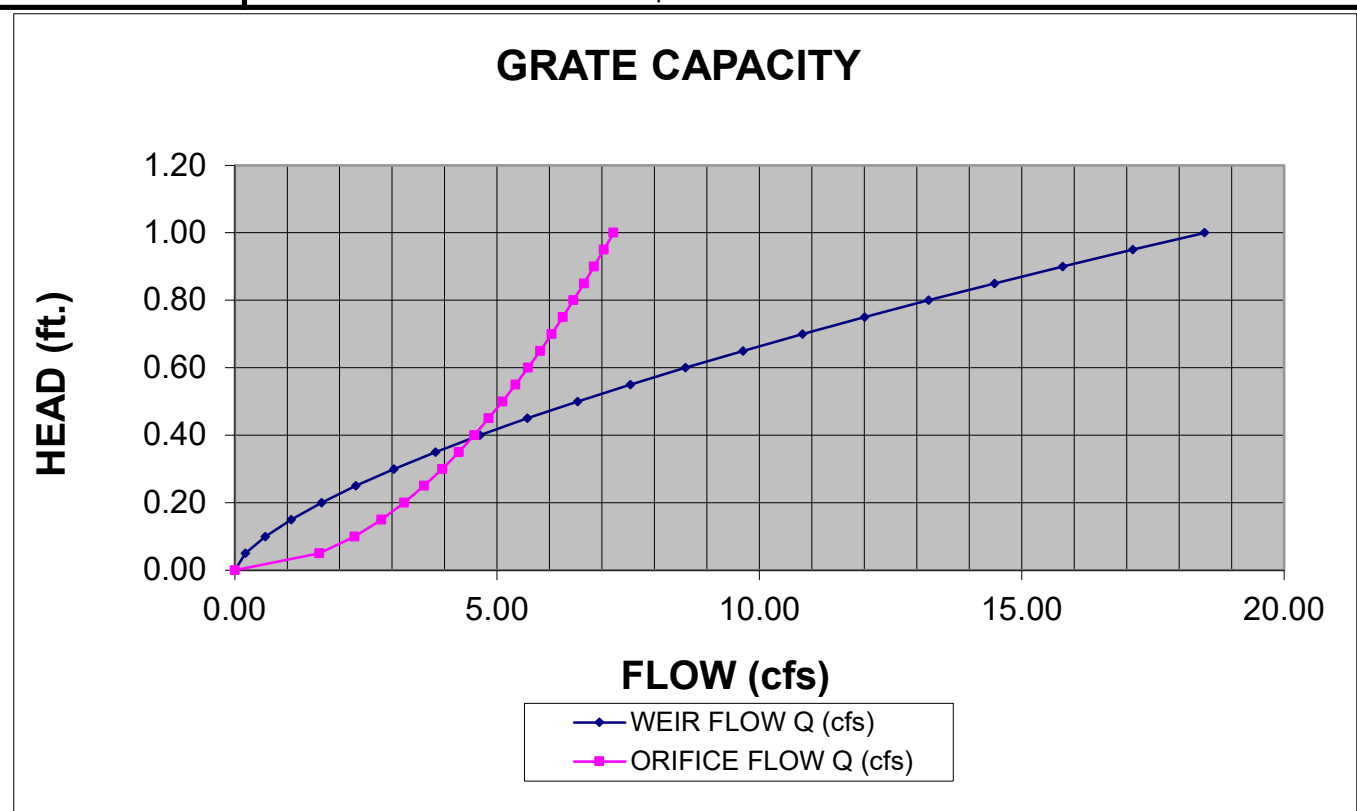
GRATE CAPACITY

(Chart: HEAD (ft.) vs FLOW (cfs), with WEIR FLOW Q (cfs) and ORIFICE FLOW Q (cfs) curves)

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CREATIVITY BEYOND ENGINEERING

**GRATE CAPACITY CALCULATIONS FOR
INLETS IN A SAG (PONDING) CONDITION**

Waukesha Car Wash Woodman's

NEENAH GRATE NUMBER: R-3010, TYPE A Grate
INLET LENGTH OR PERIMETER: 4.6 ft.
GRATE OPEN END AREA: 1 sf.
CLOGGING FACTOR: 25%

Weir flow controls until a head of 0.314 feet is reached, where orifce flow takes over and controls. The flow at this transition is less efficient than what is indicated by either the weir or orifice flow equations. A flow of 20% less than the equated flow is a conservative estimate.

HEAD H (ft.)	WEIR FLOW Q (cfs)	ORIFICE FLOW Q (cfs)
0.00	0.00	0.00
0.05	0.13	0.81
0.10	0.36	1.14
0.15	0.67	1.40
0.20	1.03	1.61
0.25	1.44	1.80
0.30	1.89	1.98
0.35	2.38	2.14
0.40	2.91	2.28
0.45	3.47	2.42
0.50	4.06	2.55
0.55	4.69	2.68
0.60	5.34	2.80
0.65	6.02	2.91
0.70	6.73	3.02
0.75	7.46	3.13
0.80	8.22	3.23
0.85	9.00	3.33
0.90	9.81	3.42
0.95	10.64	3.52
1.00	11.49	3.61
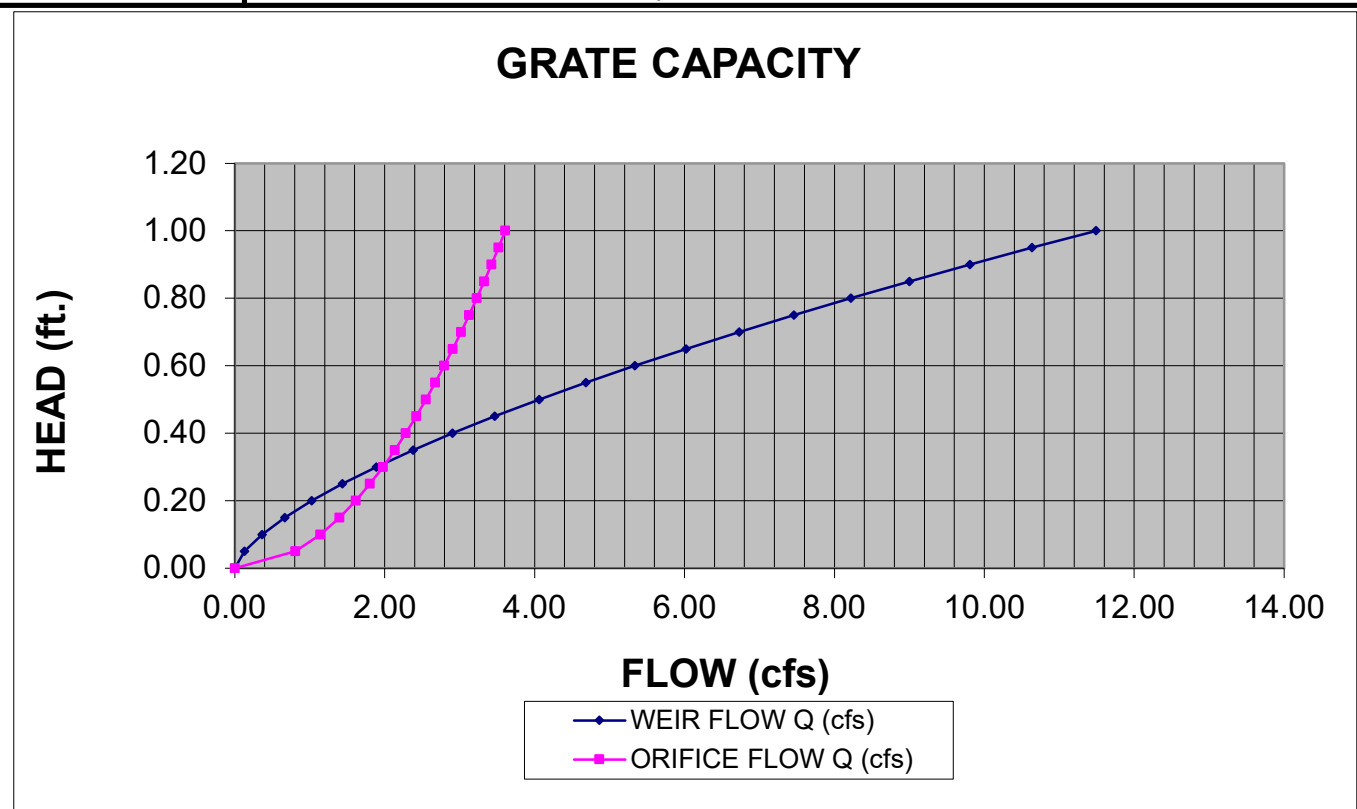
GRATE CAPACITY — HEAD (ft.) vs FLOW (cfs)
Legend: WEIR FLOW Q (cfs), ORIFICE FLOW Q (cfs)

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GRATE CAPACITY CALCULATIONS FOR INLETS IN A SAG (PONDING) CONDITION
Waukesha Car Wash Woodman's

NEENAH GRATE NUMBER: Nyloplast 1099CGDF Grate
INLET LENGTH OR PERIMETER: 2.69 ft.
GRATE OPEN END AREA: 0.37 sf.
CLOGGING FACTOR: 25%

Weir flow controls until a head of 0.199 feet is reached, where orifce flow takes over and controls. The flow at this transition is less efficient than what is indicated by either the weir or orifice flow equations. A flow of 20% less than the equated flow is a conservative estimate.

HEAD H (ft.)	WEIR FLOW Q (cfs)	ORIFICE FLOW Q (cfs)
0.00	0.00	0.00
0.05	0.08	0.30
0.10	0.21	0.42
0.15	0.39	0.52
0.20	0.60	0.60
0.25	0.84	0.67
0.30	1.10	0.73
0.35	1.39	0.79
0.40	1.70	0.84
0.45	2.03	0.90
0.50	2.38	0.94
0.55	2.74	0.99
0.60	3.12	1.03
0.65	3.52	1.08
0.70	3.93	1.12
0.75	4.36	1.16
0.80	4.81	1.19
0.85	5.26	1.23
0.90	5.74	1.27
0.95	6.22	1.30
1.00	6.72	1.34

GRATE CAPACITY

WEIR FLOW Q (cfs)
ORIFICE FLOW Q (cfs)

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