



985 American Rd

# CITY OF NAPOLEON

## ENGINEERING DEPARTMENT

255 W. Riverview Avenue, PO Box 151, Napoleon, OH 43545  
Phone: 419-592-4010 - Fax: 419-599-8393

*Storm Water  
Calcs.*

Mayor  
J. Andrew Small

Members of Council  
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David M. Grahm

City Engineer  
Chad Lulfs, P.E., P.S.

May 22, 2006

New Dimensions  
P.O. Box 174  
Napoleon, Ohio 43545

Attn: Ron Sonnenberg

Re: Ward Truck Repair  
Drainage Calculations

Dear Mr. Sonnenberg,

I have reviewed the drainage calculations for the above referenced project. The calculations for the drive pipe are approved. The calculations for the site need to be revised. The City of Napoleon requires that all parking areas be paved with either concrete or asphalt (1139.07 (a) (2)). This increases the runoff from the site and the detention requirements. Please revise the calculations for the site appropriately and resubmit.

If you have any questions or require additional information, please contact me at your convenience.

Yours truly,

Chad E. Lulfs, P.E., P.S.  
City of Napoleon Engineer

CEL/als

cc: Tom Zimmerman, Building & Zoning Inspector



SITEDRAINCALCS

Storm Water Calculations						
Project: WARD TRUCK REPAIR, AMERICAN DR., NAPOLEON, OHIO						
Storm Water Detention Calculations~TOTAL SITE						
By:RDS	Date: May 15, 2006					
Site Area:	3.630					
Weighted "C"	<del>0.599</del> 0.714					
"T"(min.)	"I"(in/hr)	"CA"	"Q" in (cfs)	"Q" out (cfs)	"Q" in-"Q"out (cfs)	Detention Volume(c.f.)
Time of Concentration	Intensity					
	10 Year Storm					
20	3.74	2.1754	8.14	3.303	4.83	5799
<u>30</u>	<u>3.00</u>	<u>2.1754</u>	<u>6.53</u>	<u>3.303</u>	<u>3.22</u>	<u>5801</u>
40	2.52	2.1754	5.48	3.303	2.18	5229
50	2.19	2.1754	4.76	3.303	1.46	4382
60	1.94	2.1754	4.22	3.303	0.92	3301
70	0.00	2.1754	0.00	3.303	-3.30	-13874
80	0.00	2.1754	0.00	3.303	-3.30	-15856
90	0.00	2.1754	0.00	3.303	-3.30	-17838
100	0.00	2.1754	0.00	3.303	-3.30	-19820
110	0.00	2.1754	0.00	3.303	-3.30	-21802
120	0.00	2.1754	0.00	3.303	-3.30	-23784
130	0.00	2.1754	0.00	3.303	-3.30	-25766
140	0.00	2.1754	0.00	3.303	-3.30	-27748
150	0.00	2.1754	0.00	3.303	-3.30	-29730
160	0.00	2.1754	0.00	3.303	-3.30	-31712
170	0.00	2.1754	0.00	3.303	-3.30	-33694
180	0.00	2.1754	0.00	3.303	-3.30	-35676
190	0.00	2.1754	0.00	3.303	-3.30	-37658
200	0.00	2.1754	0.00	3.303	-3.30	-39640
210	0.00	2.1754	0.00	3.303	-3.30	-41622
220	0.00	2.1754	0.00	3.303	-3.30	-43604
230	0.00	2.1754	0.00	3.303	-3.30	-45586
240	0.00	2.1754	0.00	3.303	-3.30	-47568
250	0.00	2.1754	0.00	3.303	-3.30	-49550
260	0.00	2.1754	0.00	3.303	-3.30	-51531
270	0.00	2.1754	0.00	3.303	-3.30	-53513
<b>Minimum Detention Volume Required =</b>						
Area required for 1' depth of storage =						5801 Cubic Feet
Area required for 1.5' depth of storage =						0.133 Acres
Area required for 2' depth of storage =						0.089 Acres
Area required for 2.5' depth of storage =						0.067 Acres
						0.053 Acres

RECURRENCE  
NEED TO

SITEDRAINCALCS

Storm Water Calculations				
Project: WARD TRUCK REPAIR, AMERICAN DR., NAPOLEON, OHIO				
Runoff flows & Coefficients, Pre & Post development				
By:RDS	Date: June 29, 2006			
<b>1) Existing (Pre-development) runoff:</b>				
Area(Ac.)	Land use description	"C"	"I" in/hr	"Q" cfs
3.630	Grass/Agri Area	0.35	2.60	3.303
0.000	Building roof	0.90	2.60	0.000
0.000	Concrete pavement	0.90	2.60	0.000
0.000	Gravel pavement	0.45	2.60	0.000
	Total Existing Runoff			3.303
<b>2) Proposed (Post-development) runoff:</b>				
Project Description:				
Calculations are based on a development with 24,000 s.f. of proposed & future building area and 78,145.5 s.f. of proposed & future concrete and asphalt pavement areas with the balance of the parcel area occupied by lawn, ditch or detention swales.				
Area(Ac.)	Land use description		"C"	"CA"
0.551	Building roof		0.90	0.496
1.794	Conc/Asph pavement		0.90	1.615
0.000	Gravel pavement		0.45	0.000
1.285	Lawn-grassed area		0.35	0.450
<b>3.630</b>	<b>TOTAL AREA</b>		<b>TOTAL</b>	<b>2.560</b>
Weighted "C" =	TOTAL "CA"	<b>2.560</b>		
	TOTAL "A"	<b>3.630</b>		
Weighted "C" =		<b>0.705</b>		
<b>3) Proposed (Post-development) runoff:</b>				
Area(Ac.)	Land use description	"C"	"I" in/hr	"Q" cfs
3.630	See "2" Above	0.705	2.60	6.657
	Total Proposed Runoff			6.657
<b>4) Critical Storm Determination:</b>				
(6.657-3.303)/(3.303)=1.015 or 101.50% therefore : Critical Storm = 25 Year				



SITEDRAINCALCS

Storm Water Calculations						
Project: WARD TRUCK REPAIR, AMERICAN DR., NAPOLEON, OHIO						
Required Storm Water Quantity Detention Calculations						
By:RDS		Date: June 29, 2006				
Acres in AREA #1:		2.659				
Weighted "C"		0.761				
"T"(min.) Time of Concentration	"I"(in/hr) Intensity 25 Year Storm	"CA"	"Q" in (cfs)	"Q" out (cfs)	"Q" in-"Q"out (cfs)	Detention Volume(c.f.)
20	4.20	2.0246	8.50	1.467	7.04	8443
<u>30</u>	<u>3.43</u>	<u>2.0246</u>	<u>6.94</u>	<u>1.467</u>	<u>5.48</u>	<u>9859</u>
40	2.82	2.0246	5.71	1.467	4.24	10181
50	2.37	2.0246	4.80	1.467	3.33	9994
60	2.05	2.0246	4.15	1.467	2.68	9660
70	1.78	2.0246	3.60	1.467	2.14	8974
80	1.65	2.0246	3.34	1.467	1.87	8993
90	1.55	2.0246	3.14	1.467	1.67	9024
100	1.42	2.0246	2.87	1.467	1.41	8447
110	1.34	2.0246	2.71	1.467	1.25	8223
120	1.25	2.0246	2.53	1.467	1.06	7659
130	1.18	2.0246	2.39	1.467	0.92	7191
140	1.12	2.0246	2.27	1.467	0.80	6724
150	1.08	2.0246	2.19	1.467	0.72	6476
160	1.04	2.0246	2.11	1.467	0.64	6130
170	0.98	2.0246	1.98	1.467	0.52	5274
180	0.92	2.0246	1.86	1.467	0.40	4272
190	0.00	2.0246	0.00	1.467	-1.47	-16724
200	0.00	2.0246	0.00	1.467	-1.47	-17604
210	0.00	2.0246	0.00	1.467	-1.47	-18484
220	0.00	2.0246	0.00	1.467	-1.47	-19364
230	0.00	2.0246	0.00	1.467	-1.47	-20245
240	0.00	2.0246	0.00	1.467	-1.47	-21125
250	0.00	2.0246	0.00	1.467	-1.47	--22005
260	0.00	2.0246	0.00	1.467	-1.47	-22885
270	0.00	2.0246	0.00	1.467	-1.47	-23765
<b>Minimum Detention Volume Required =</b>						
Area required for 1' depth of storage =						9859 Cubic Feet
Area required for 1.5' depth of storage =						0.226 Acres
Area required for 2' depth of storage =						0.151 Acres
Area required for 2.5' depth of storage =						0.113 Acres
						0.091 Acres

SITEDRAINCALCS

<b>Storm Water Calculations</b>			
<b>Project: WARD TRUCK REPAIR, AMERICAN DR., NAPOLEON, OHIO</b>			
<b>Proposed Drainage Area Flow Calculations</b>			
R.D.S.	Date: June 29, 2006	Critical Storm "I" in/hr=	<b>3.43</b>
<b>Area 1</b>		Time of Concentration "	<b>30</b>
Description:			
Westerly lot area draining through detention swale @ south end			
Area(Ac.)	Land use description	"C"	"I" in/hr
0.413	Building roof	0.9	3.43
1.576	Asphalt/Concrete pavement	0.90	3.43
0.000	Gravel pavement	0.45	3.43
0.670	Lawn-grassed area	0.35	3.43
		Total Flow ~ Area 1	6.944
<b>Area 2</b>			
Description:			
Northeasterly lot area draining to Front Catch Basin			
Area(Ac.)	Land use description	"C"	"I" in/hr
0.138	Building roof	0.9	3.43
0.218	Asphalt/Concrete pavement	0.90	3.43
0.000	Gravel pavement	0.45	3.43
0.119	Lawn-grassed area	0.35	3.43
		Total Flow ~ Area 2	1.240
<b>Area 3</b>			
Description:			
Easterly 40' of lot area draining to Adjacent Ditch			
Area(Ac.)	Land use description	"C"	"I" in/hr
0.000	Building roof	0.9	3.43
0.000	Asphalt/Concrete pavement	0.90	3.43
0.000	Gravel pavement	0.45	3.43
0.497	Lawn-grassed area	0.35	3.43
		Total Flow ~ Area 3	0.596
<b>Maximum discharge allowable per City of Napoleon @ Q2 = 3.303 cfs</b>			
<b>EXISTING &amp; PROPOSED STORM OUTLETS FROM PROPERTY:</b>			
1) Estimated surface runoff to Ditch @ East side	=	0.596	c.f.s.
2) Estimated runoff to Northeast (8" pipe)	=	1.240	c.f.s.
3) Runoff to Ditch from detention swale (12" meter line)	=	1.467	c.f.s.
<b>Total proposed discharge capacity from site</b>	<b>=</b>	<b>3.303</b>	<b>c.f.s.</b>

**DETENTION CALCULATIONS**  
**Ward Truck Repair**

Gross Area Drained by System                    3.630 ac.  
 Pavement & Building Area:                    2.345 s.f.                    Ci = 0.90  
 Net Pervious Area:                                1.285 s.f.                    Cp = 0.35  
 Weighted C = Cw = (CiAi+CpAp)/At =        0.705

Qallow = cia = Cp \* 2.6 \* A

Qallow =                    3.303                    c.f.s.

Tc (min.)	i25 (in/hr)	CwA (acres)	Qin (Q25)	Qout (Qallow)	Qin - Qout (R)	R x Tc x 60 (c.f.)	Detention Volume (c.f.)
20.0	4.20	2.560	10.753	3.303	7.450	8,940	
30.0	3.43	2.560	8.782	3.303	5.478	9,861	
40.0	2.82	2.560	7.220	3.303	3.917	9,400	9,861
50.0	2.37	2.560	6.068	3.303	2.764	8,293	
60.0	2.05	2.560	5.249	3.303	1.945	7,003	
70.0	1.78	2.560	4.557	3.303	1.254	5,267	
80.0	1.65	2.560	4.224	3.303	0.921	4,421	
90.0	1.55	2.560	3.968	3.303	0.665	3,591	
100.0	1.42	2.560	3.636	3.303	0.332	1,994	
110.0	1.34	2.560	3.431	3.303	0.127	841	
120.0	1.25	2.560	3.200	3.303	-0.103	-742	
130.0	1.18	2.560	3.021	3.303	-0.282	-2,201	
140.0	1.12	2.560	2.867	3.303	-0.436	-3,661	
150.0	1.08	2.560	2.765	3.303	-0.538	-4,844	
160.0	1.04	2.560	2.663	3.303	-0.641	-6,150	
170.0	0.98	2.560	2.509	3.303	-0.794	-8,101	
180.0	0.92	2.560	2.355	3.303	-0.948	-10,237	



**DETENTION METERING LINE DESIGN (CULVERT ANALYSIS)**

**Ward Truck Repair**

- 1. Length of Metering Line                    145 ft.
  
- 2. Size of Metering Line                    12 in                    Pipe Area =    0.7854
  
- 3. Pipe Type and "n" Value                0.012 ADS            Perimeter =    3.1416
  
- 4. Entrance Coefficient (Ke)                0.5                      Factor (F) =  $1+Ke+29*(n^2)*L/(R^{4/3})$
  
- 5. Invert Elev. Of Outlet                    671.50                    Factor (F) =    5.34
  
- 6. Assumed Max. Elev. Of Storage        676.00                     $V^2 = 2gH/F$
  
- 7. Assumed Maximum Head                4.50 ft.
  
- 8. Hydraulic Radius (R)                    0.25                       $R^{4/3} =$     0.1575

<b>Head</b>	<b>H x 2g</b>	<b>Factor</b>	<b>V<sup>2</sup></b>	<b>V</b>	<b>Pipe Area</b>	<b>Q</b>
4.50	289.8	5.34	54.22	7.36	0.7854	5.783

**Max. Allow. = 3.303 c.f.s.**

**Q Other Points = 1.836 c.f.s.**

**Adjusted Q Allow. = 1.467 c.f.s.**

**Q Proposed = 5.783 c.f.s.**

Please note that the drainage from the Truck Docks via the 6" storm sewer shall also be removed from this total.

**Does Not Meet City Requirements**

**BLOCKDRAINCALCS**

*D.K. OF 05-10-04*

Storm Water Calculations					
Project: WARD TRUCK REPAIR, AMERICAN DR., NAPOLEON, OHIO					
Drive Culvert Runoff flows & Coefficients, Pre & Post development					
By:RDS Date: May 15, 2006					
<b>1) Existing (Pre-development) runoff:</b>	Area(Ac.)	Land use description	"C"	"I" in/hr	"Q" cfs
	16.463	Grass/Agri Area	0.35	2.60	14.981
	0.000	Building roof	0.90	2.60	0.000
	0.000	Concrete pavement	0.90	2.60	0.000
	0.000	Gravel pavement	0.45	2.60	0.000
		Total Existing Runoff			14.981 ✓
<b>2) Proposed (Post-development) runoff:</b>					
Project Description:					
Calculations are based on lot area runoffs at undeveloped rate. Road pavement approaches and R/W-ditch areas calculated at a 25yr./20min. Storm intensity rate.					
	Area(Ac.)	Land use description	"C"	"I" in/hr	"Q" cfs
<b>(a)</b>	12.073	Lot areas		0.35	4.226
	<b>12.073</b>	TOTAL LOT AREA		TOTAL	4.226 ✓
<b>(b)</b>	1.861	Conc/Asph pavement		0.90	1.675
	2.529	Grass R/W-ditches		0.40	1.012
	0.000	x		0.35	0.000
	<b>4.390</b>	TOTAL RW AREA		TOTAL	2.687 ✓
	<b>16.463</b>	TOTAL RW AREA			
	Weighted "C" =	TOTAL "CA"		2.687	
		TOTAL "A"		4.390	
		RAW AREA, Weighted "C" =		0.612 ✓	
<b>3) Proposed (Post-development) runoff:</b>					
	Area(Ac.)	Land use description	"C"	"I" in/hr	"Q" cfs
	12.073	See "2-a" Above	0.350	2.60	10.986
	4.390	See "2-b" Above	0.612	4.20	11.283
		Total Proposed Runoff			22.270 ✓
	Exist. 30" W. of Industrial contributing - (est. flow @ 0.5%)=				31.420 ✓
		Total anticipated flow:			53.690 ✓
<b>4) Culvert Size Determination:</b>					
	Per Chart attached: N-12 pipe, 36" @ 0.6% ✓				
	or N-12 pipe, 42" @ 0.25% ✓				

*24" @ 0.85%  
27" @ 0.5%  
30" @ 0.28%*

CIRCULAR PIPE FLOW CAPACITY  
Full Flow (cubic feet per second)

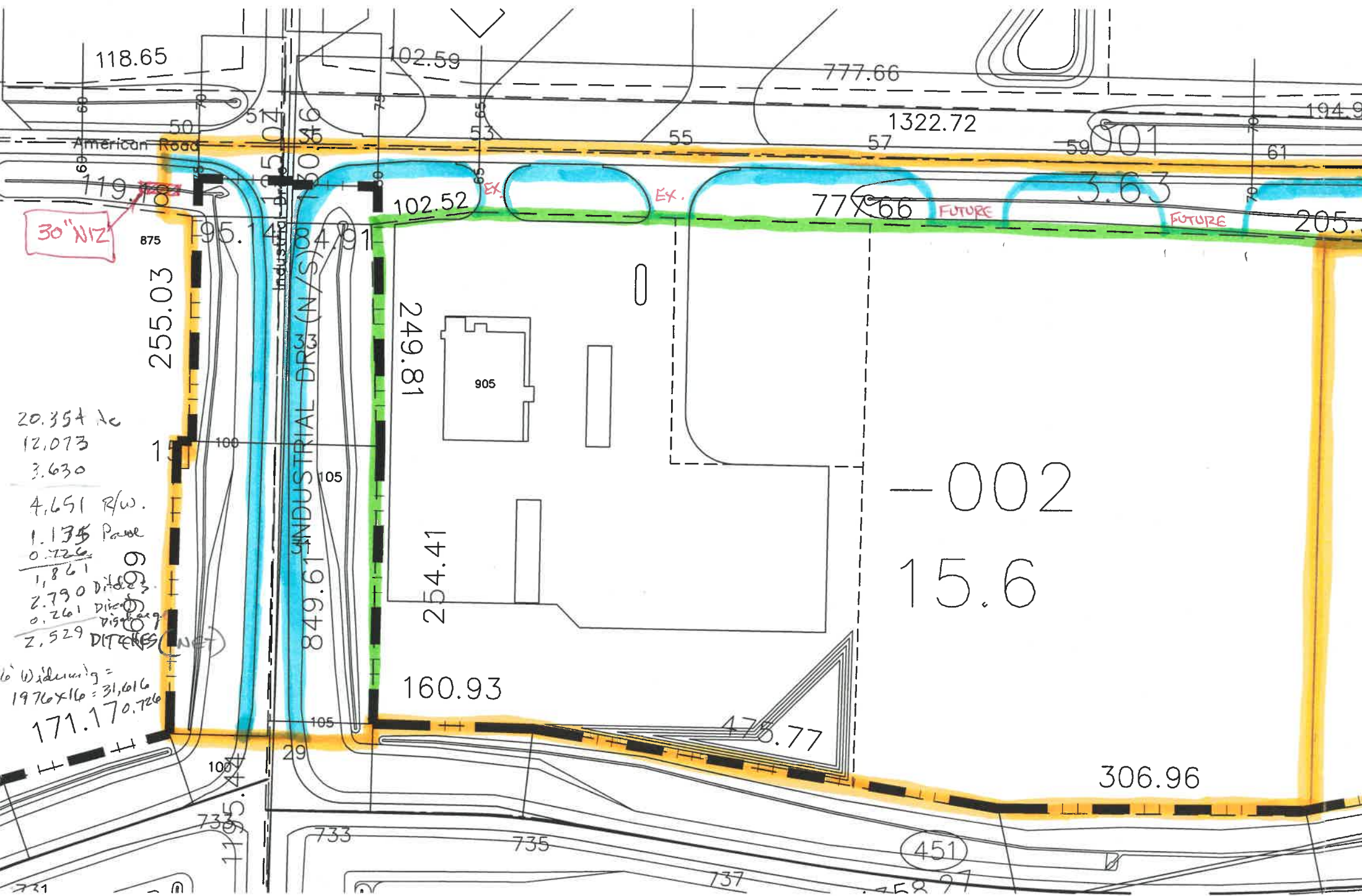
Mannings "n" = 0.012

TABLE 4

Di. \*Conv. (in.) Factor (c.f.g.)  
% Slope (feet per 100 feet) 1.75 2.0 2.5 5.0 10.0 20.0

3	0.957	0.014	0.021	0.030	0.043	0.057	0.068	0.083	0.096	0.107	0.12	0.13	0.14	0.15	0.21	0.30	0.43
4	2.062	0.029	0.046	0.065	0.092	0.122	0.146	0.179	0.206	0.231	0.25	0.27	0.29	0.33	0.46	0.65	0.92
5	3.738	0.053	0.084	0.118	0.167	0.221	0.264	0.324	0.374	0.418	0.46	0.49	0.53	0.59	0.84	1.18	1.67
6	6.079	0.086	0.136	0.192	0.272	0.360	0.430	0.526	0.608	0.680	0.74	0.80	0.86	0.96	1.36	1.92	2.72
8	13.091	0.185	0.293	0.414	0.585	0.774	0.926	1.134	1.309	1.464	1.60	1.73	1.85	2.07	2.93	4.14	5.85
10	23.74	0.34	0.53	0.75	1.06	1.40	1.68	2.06	2.37	2.65	2.91	3.14	3.36	3.75	5.31	7.51	10.61
12	38.60	0.55	0.86	1.22	1.73	2.28	2.73	3.34	3.86	4.32	4.73	5.11	5.46	6.10	8.63	12.21	17.26
15	69.98	0.99	1.56	2.21	3.13	4.14	4.95	6.06	7.00	7.82	8.57	9.26	9.90	11.06	15.65	22.13	31.30
18	113.80	1.61	2.54	3.60	5.09	6.73	8.05	9.86	11.38	12.72	13.94	15.05	16.09	17.99	25.45	35.99	50.89
21	171.65	2.43	3.84	5.43	7.68	10.16	12.14	14.87	17.17	19.19	21.02	22.71	24.28	27.14	38.38	54.28	76.77
24	245.08	3.47	5.48	7.75	10.96	14.50	17.33	21.22	24.51	27.40	30.02	32.42	34.66	38.75	54.80	77.50	109.60
27	335.51	4.74	7.50	10.61	15.00	19.85	23.72	29.06	33.55	37.51	41.09	44.38	47.45	53.05	75.0	106.1	150.0
30	444.35	6.28	9.94	14.05	19.87	26.29	31.42	38.48	44.44	49.68	54.42	58.78	62.84	70.26	99.4	140.5	198.7
36	722.57	10.22	16.16	22.85	32.31	42.75	51.09	62.58	72.26	80.79	88.50	95.59	102.19	114.25	161.6	228.5	323.1
42	1089.9	15.41	24.37	34.47	48.74	64.5	77.1	94.4	109.0	121.9	133.5	144.2	154.1	172.3	243.7	344.7	487.4
48	1556.1	22.01	34.80	49.21	69.59	92.1	110.0	134.8	155.6	174.0	190.6	205.9	220.1	246.0	348.0	492.1	695.9

\* Conveyance Factor =  $(1.486 \times R^{2/3} \times A) / n$



30" NIZ

20.354 Ac  
 12.073  
 3.630  
 4.651 R/W.  
 1.135 Pavl  
 0.726  
 1.861  
 2.790 Ditch  
 0.261 Ditch  
 2.529 DITCHES (NET)

16' Widening =  
 1976 x 16 = 31,616  
 171.17 0.726

255.03

INDUSTRIAL DRG (N/S)

249.81

905

254.41

160.93

-002

15.6

306.96

118.65

102.59

777.66

1322.72

194.9

119.78

102.52

777.66

3.63

205.5

875

95.1

4.95

4.91

1

100

105

100

29

733

735

(451)

137

458.97

American Road

INDUSTRIAL DRG (N/S)

FUTURE

FUTURE

Ex.

Ex.

475.77

901