Morley and Associates INC
CONSULTING ENGINEERS/LAND SURVEYORS/ARCHITECTS
605 S.E. MARTIN LUTHER KING, JR. BLVD.
EVANSVILLE, INDIANA 47713-1797
(812) 464-9585/FAX (812) 464-2514

LETTER OF TRANSMITTAL

DATE	JOB NO.
April 22, 1996	96-3310-4

ATTENTION: Mr. Bill Jeffers

RE: Cross Pointe - Section 4

TO Vanderburgh County Drainage Board
c/o Vanderburgh County Surveyor

WE ARE SENDING YOU BY ☒ MESSENGER ☐ US MAIL ☐ UPS ☐ OVERNIGHT SERVICE

☐ Shop drawings ☐ Prints ☐ Copies ☐ Plans ☐ Specifications

☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
3	04/22/96	1	Drainage Report (Revised)

THESE ARE TRANSMITTED as checked below:

☒ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

☐ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

☐ As requested ☐ Returned for corrections ☐ Return _____ corrected prints

☐ For review and comment ☐ _____

REMARKS

COPY TO David Wanninger
Regency Properties
File

SIGNED: Daryl J. Helfert

If enclosures are not as noted, kindly notify us at once.

Daryl J. Helfert, P.E. /djm

DRAINAGE REPORT

FOR:

CROSS POINTE - SECTION 4

DEVELOPER: CROSS POINTE COMMERCE CORPORATION
P.O. BOX 5189
EVANSVILLE, INDIANA 47716

BY:

ENGINEER: MORLEY AND ASSOCIATES, INC.
605 S.E. MARTIN LUTHER KING, JR. BLVD.
EVANSVILLE, INDIANA 47713-1797
(812) 464-9585

Daryl James Helfert

APRIL 1996

CROSS POINTE - SECTION 4

The site is located approximately 1200 feet north of the intersection of Lloyd Expressway (SR66) and Cross Pointe Blvd., bordered on the south side by Builders Square and the east side by Nurrenbern Ditch.

The 11.73 acre site is located on flat ground which has been cultivated for row crops. The extreme northern portion of the site, which is bordered by the existing Virginia Street, is partially drained by existing lawn drains placed during the construction of Virginia Street. The remaining portions of the site drain into an existing 3' paved ditch which drains directly into the Nurrenbern Ditch through an existing 27" RCP located on the southeastern portion of the site.

The majority of the storm water within the development will be conveyed to a proposed retention basin which will be located along the south property line. A small portion of the proposed road (.09 acres) will be conveyed to an existing curb inlet located along Virginia Street. Storm water from the rest of the site will enter the retention basin through the proposed storm sewers or by overland sheet flow.

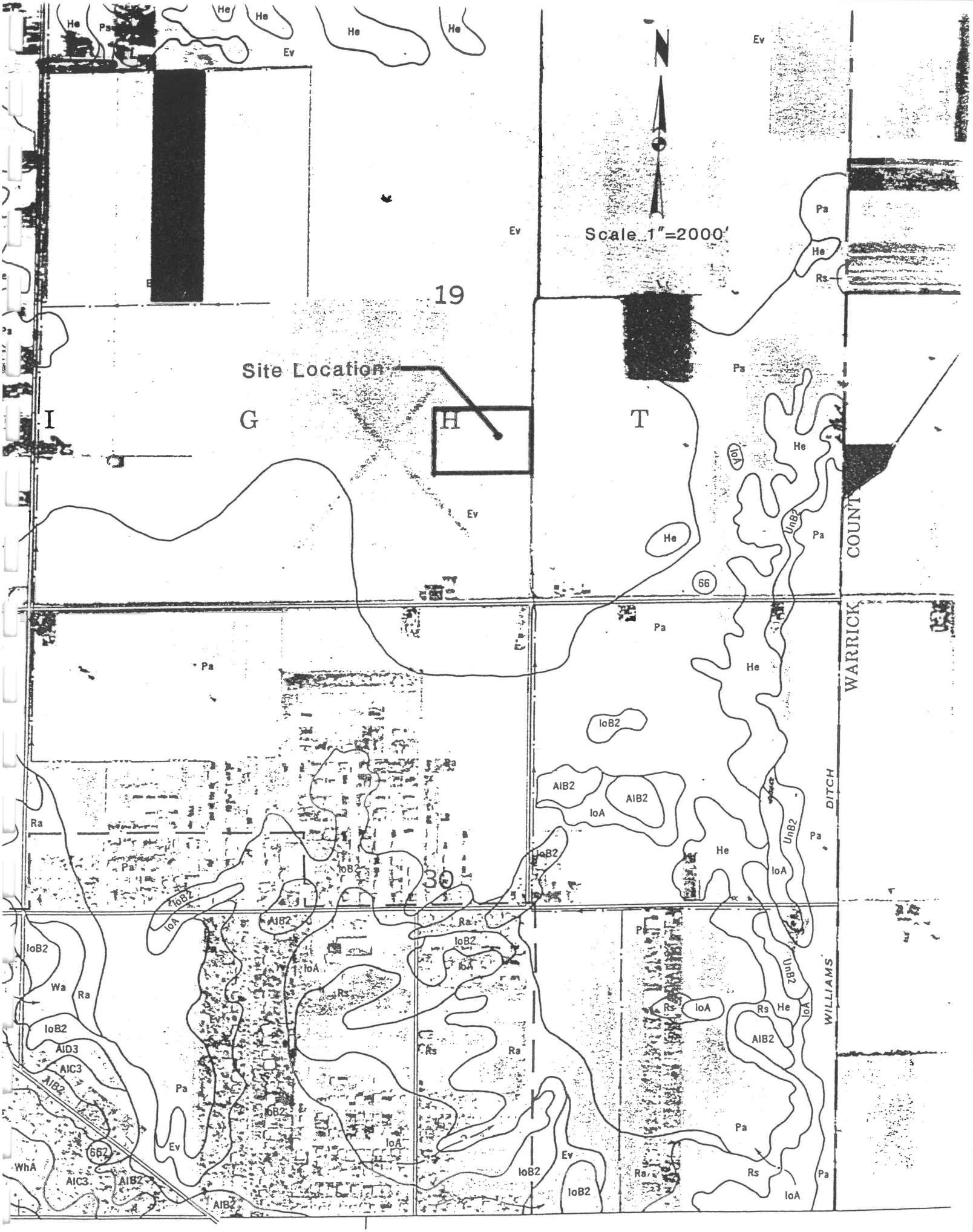
Storm water retention will be provided onsite by the construction of an incised basin near the south boundary of Section 4. The maximum allowable discharge rate from the basin for the Section 4 drainage area is equal to the undeveloped 10 year rate of 7.80 cfs for the 11.73 acre site. This is reduced by the 25 year developed rate of 0.60 cfs for Sub-basin No. 3, which exits the site undetained. The required detention volume for an allowable discharge rate of 7.20 cfs is 57,721 cubic feet, as determined using Form 800.

The existing 27" RCP shown on the drainage plan will serve as the restricting outlet for the Section 4 basin. The basin will receive the discharges from several other detention/retention basins in the Cross Pointe development. The retention basins for Cross Pointe Section 3 and Arbor Hospital discharge into an existing paved swale which will drain into the Section 4 basin from the west. Storm water from part of Cross Pointe Boulevard will also enter the basin via the paved swale. The discharges from Detention Basins A and B on the Builders Square site will enter the basin through the existing 27" RCP near the southeast corner of the basin. The total allowable peak discharge to Nurrenbern Ditch through the 27" RCP outlet was determined to be 23.66 cfs. The required headwater for the 27" RCP was calculated for conditions of inlet and outlet control. Under conditions of inlet control, the required headwater for the pipe was determined to be 2.66 feet. For outlet control conditions, maximum tailwater was determined by assuming a water elevation of 388.0 feet in the Nurrenbern Ditch. The required headwater was

calculated to be 4.39 feet for a discharge rate of 23.66 cfs, exceeding the available headwater of 3.26 feet at the pipe inlet. Therefore, the peak allowable discharge cannot occur when the water surface in the Nurrenbern Ditch is at or near its' peak during a storm. The discharge rate of 23.66 cfs from the 27" RCP pipe will occur either before or after the flow in the ditch is at its' peak. The retention basin will have 142,069 cubic feet of storage volume available to elevation 388.0 feet, which is more than twice the required storm storage of 66,994 cubic feet. The required storage volume includes 9,273 cubic feet for an area of Cross Pointe Boulevard, which presently flows directly into the existing swale.

Based on the most recent soil survey of Vanderburgh County, the 11.73 acre site contains the following soil type: Evansville silt loam (Ev).

The site is located within the Zone B flood boundary according to the FIRM Panel Number 180256 0050 B, dated March 19, 1982, for Vanderburgh County, Indiana.


N
Scale 1"=2000'
Site Location
19
30
I
G
H
T
COUNTY
WARRICK
DITCH
WILLIAMS
66
He
Pa
Ev
Rs
Ra
Wa
WhA
VoA
UnB2
loB2
loA
AlB2
AlC3
AlD3

SOIL SURVEY OF

Vanderburgh County, Indiana

United States Department of Agriculture
Soil Conservation Service
In cooperation with

Purdue University Agricultural
Experiment Station

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Map symbol	Mapping unit	Described on page	Capability unit		Tree and shrub group
			Symbol	Page	Number
AlB2	Alford silt loam, 2 to 6 percent slopes, eroded	11	IIe-3	41	III
AlC2	Alford silt loam, 6 to 12 percent slopes, eroded	11	IIIe-3	43	III
AlC3	Alford silt loam, 6 to 12 percent slopes, severely eroded	12	IVe-3	45	III
AlD3	Alford silt loam, 12 to 18 percent slopes, severely eroded	12	VIe-1	46	III
Ba	Bartle silt loam	15	IIw-3	42	II
Bd	Birds silt loam	16	IIIw-10	44	I
Bo	Bonnie silt loam	16	IIIw-10	44	I
Br	Borrow pits	16	VIIe-3	46	IV
Ev	Evansville silt loam	17	IIw-1	41	I
Gn	Ginat silt loam	17	IIIw-12	45	I
Gu	Gullied land	17	VIIe-4	47	IV
He	Henshaw silt loam	19	IIw-2	42	II
HoA	Hosmer silt loam, 0 to 2 percent slopes	20	IIw-5	43	II
HoB2	Hosmer silt loam, 2 to 6 percent slopes, eroded	20	IIe-7	41	II
HoB3	Hosmer silt loam, 2 to 6 percent slopes, severely eroded	20	IIIe-7	43	II
HoC2	Hosmer silt loam, 6 to 12 percent slopes, eroded	20	IIIe-7	43	II
HoC3	Hosmer silt loam, 6 to 12 percent slopes, severely eroded	21	IVe-7	45	II
HoD3	Hosmer silt loam, 12 to 18 percent slopes, severely eroded	21	VIe-1	46	II
Ht	Huntington silty clay loam	22	I-2	41	III
Hu	Huntington fine sandy loam, sandy variant	22	I-2	41	III
IoA	Iona silt loam, 0 to 2 percent slopes	23	I-1	41	III
IoB2	Iona silt loam, 2 to 6 percent slopes, eroded	23	IIe-3	41	III
Iv	Iva silt loam	23	IIw-2	42	II
Ln	Lindside silty clay loam	24	I-2	41	III
Ma	Made land	24	VIIe-3	46	IV
MkB2	Markland silt loam, 2 to 6 percent slopes, eroded	24	IIIe-11	43	II
MkC2	Markland silt loam, 6 to 18 percent slopes, eroded	24	IVe-11	45	II
MlC3	Markland silty clay loam, 6 to 18 percent slopes, severely eroded	25	VIe-1	46	II
Mr	McGary silt loam	26	IIIw-6	44	II
MuA	Muren silt loam, 0 to 2 percent slopes	27	I-1	41	III
MuB2	Muren silt loam, 2 to 6 percent slopes, eroded	27	IIe-3	41	III
Nw	Newark silty clay loam	28	IIw-7	43	I
Pa	Patton silty clay loam	28	IIw-1	41	I
PrB	Princeton fine sandy loam, 2 to 6 percent slopes	28	IIe-11	41	III
Ra	Ragsdale silt loam	29	IIw-1	41	I
Rh	Rahm silty clay loam	29	IIw-7	43	I
Rs	Reesville silt loam	30	IIw-2	42	II
ScA	Sciotoville silt loam, 0 to 2 percent slopes	30	IIw-5	43	II
ScB2	Sciotoville silt loam, 2 to 6 percent slopes, eroded	31	IIe-7	41	II
St	Stendal silt loam	31	IIw-7	43	I
UnB2	Uniontown silt loam, 2 to 6 percent slopes, eroded	32	IIe-3	41	III
Wa	Wakeland silt loam	32	IIw-7	43	I
Wb	Weinbach silt loam	33	IIw-3	42	II
WeD2	Wellston silt loam, 12 to 18 percent slopes, eroded	34	IVe-3	45	III
WeD3	Wellston silt loam, 12 to 18 percent slopes, severely eroded	34	VIe-1	46	III
WeE2	Wellston silt loam, 18 to 25 percent slopes, eroded	34	VIe-1	46	III

Map symbol	Mapping unit	Described on page	Capability unit		Tree and shrub group
			Symbol	Page	Number
WeF	Wellston silt loam, 25 to 50 percent slopes	34	VIIe-1	46	III
WhA	Wheeling loam, 0 to 2 percent slopes	35	I-1	41	III
WhB2	Wheeling loam, 2 to 6 percent slopes, eroded	35	IIe-3	41	III
Wm	Wilbur silt loam	36	I-2	41	III
Wo	Woodmere silty clay loam	36	I-2	41	III
ZaC2	Zanesville silt loam, 6 to 12 percent slopes, eroded	37	IIIe-7	43	II
ZaC3	Zanesville silt loam, 6 to 12 percent slopes, severely eroded	37	IVe-7	45	II
ZaD2	Zanesville silt loam, 12 to 18 percent slopes, eroded	38	IVe-7	45	II
ZaD3	Zanesville silt loam, 12 to 18 percent slopes, severely eroded	38	VIe-1	46	II
Zp	Zipp silty clay	38	IIIw-2	44	I

TABLE 807

RAINFALL INTENSITY-DURATION-FREQUENCY TABLE FOR EVANSVILLE

INTENSITY IN INCHES PER HOUR

STORM DURATION	STORM RETURN PERIOD IN YEARS				
	5	10	25	50	100
5 MIN	6.063	6.625	7.208	7.936	8.469
10 MIN	4.863	5.380	5.925	6.616	7.126
15 MIN	4.029	4.515	5.033	5.697	6.194
30 MIN	2.837	3.226	3.646	4.194	4.608
60 MIN	1.549	1.819	2.078	2.412	2.663
2.0 HRS	1.053	1.230	1.400	1.620	1.785
3.0 HRS	0.774	0.899	1.019	1.175	1.291
4.0 HRS	0.632	0.736	0.836	0.965	1.062
5.0 HRS	0.524	0.606	0.684	0.785	0.861
6.0 HRS	0.453	0.522	0.589	0.676	0.741
7.0 HRS	0.399	0.459	0.516	0.591	0.647
8.0 HRS	0.358	0.412	0.463	0.530	0.581
9.0 HRS	0.323	0.370	0.415	0.472	0.516
10 HRS	0.297	0.339	0.379	0.431	0.470
11 HRS	0.276	0.314	0.351	0.399	0.435
12 HRS	0.259	0.296	0.331	0.376	0.410
13 HRS	0.245	0.280	0.314	0.357	0.390
14 HRS	0.233	0.267	0.299	0.341	0.372
15 HRS	0.220	0.252	0.281	0.320	0.349
16 HRS	0.209	0.238	0.266	0.302	0.329
17 HRS	0.198	0.225	0.251	0.284	0.310

TABLE 803

UNDEVELOPED RUNOFF COEFFICIENTS (C_u)

SURFACE TYPE:

WOODLAND, TURFED MEADOWS
ROUGH PASTURE, FALLOW BRUSH:

SLOPE:	
Less than 2%	C = 0.12
2% to 5%	C = 0.24
5+% to 10%	C = 0.36
Over 10%	C = 0.48

CULTIVATED FIELDS:

Less than 2%	C = 0.20
2% to 5%	C = 0.35
5+% to 10%	C = 0.50
Over 10%	C = 0.65

TABLE 804

DEVELOPED RUNOFF COEFFICIENTS (C_d)

SURFACE TYPE:

PAVEMENT, ROOFTOP
OTHER IMPERVIOUS SURFACES:

Less than 2%	C = 0.92
2% to 5%	C = 0.94
5+% to 10%	C = 0.96
Over 10%	C = 0.98

LAWNS WITH TURF:

Less than 2%	C = 0.15
2% to 5%	C = 0.25
5+% to 10%	C = 0.40
Over 10%	C = 0.55

ALL WATER SURFACES
BASINS, PONDS & LAKES:

C = 1.00

Table 3.2.4 (cont'd)

Kerby (1959)

$$t_c = K\ (L\ N\ s^{-0.5})^{0.467}$$

where K is equal to 0.83 (US Customary units) or 1.44 (Metric units), L is the length of flow in ft (m), s is the average slope of overland flow, ft/ft (m/m), and N is the retardance roughness coefficient given in Table 3.2.5.

The length used in the equation is the straight-line distance from the most distant point of the watershed to the outlet, measured parallel to the slope of the land until a well-defined channel is reached. Watersheds of less than 10 acres were used to calibrate the model; slopes were less than 1%; N values were 0.8 and less and surface flow dominated (McCuen, 1989).

Izzard (1946)

$$t_c = \frac{K(Bi + c')\ L^{\frac{1}{3}}}{s^{\frac{1}{3}}\ i^{\frac{2}{3}}}$$

where K is equal to 41.025 for U.S. customary units (113.391 for metric), B is equal to 0.0007 for U.S custumary units (0.00027 for metric), c′ is the retardance coefficient given in Table 3.2.7, *i* is the rainfall intensity, in/hr (cm/hr), L is the length of flow path in ft (m), and s is the slope of overland flow path, ft/ft (m/m).

The product of *i* and L must be less than 500 in-ft/hr (390 cm-m/hr) to consider using this formula. In addition, well defined channels should **not** be present. This method was developed in laboratory experiments for the overland flow on roadway and turf surfaces.

Table 3.2.5
Values of N for Kerby's Formula (Kerby, 1959)

Type of Surface	N
Smooth impervious surface	0.02
Smooth bare packed soil	0.10
Poor grass, cultivated row crops or moderately rough bare surface	0.20
Deciduous timberland	0.60
Pasture or Overage grass	0.40
Conifer timberland, deciduous timberland with deep forest litter or dense grass	0.80

Cross Pointe - Section 4

3/26/96

Undeveloped

Watershed Area = 11.73 acres = 510959 sf

Runoff Coefficients

Surface	Area	c	n
Cultivated Fields	11.73	.20	.20

Time of Concentration

$$T_c = K\left[\frac{Ln}{\sqrt{s}}\right]^{.467} \qquad K = .827 \qquad L = 550' \qquad s = .3\% = .003$$

$$T_c = .827\left[\frac{550(.20)}{\sqrt{.003}}\right]^{.467} = 28.84 \text{ min.}$$

$\frac{15}{1.289} = \frac{13.84}{x}$

$i_{10} = 3.326$ in/hr.

$$Q_{10} = CiA = (.20)(3.326)(11.73) = 7.80 \text{ cfs}$$

CROSS POINTE - SECTION 4

DEVELOPED CONDITIONS

Assume 90% impervious surface coverage, except for retention basin area.

Weighted Runoff Coefficient - 11.73 Acres.

Surface Type	Acres	C
Impervious	9.11	0.92
Lawn, 0-2%	1.22	0.15
Basin w/ side slopes	1.22	1.00
Nurrenbern Ditch - bottom side slopes, T/Bank	0.18	0.80

Wt'd C = 0.846

Cross Pointe - Section 4

Storm Retention

Drainage Area = 11.73 acres
Weighted "c" = 0.846
Tc = 28.84 minutes
I(10) = 3.326 in/hr

Q(10) = Allowable Discharge = 7.80 - 0.60 = 7.20 cfs

Required Detention Volume (Form 800) = 57,721 cu. ft.

Basin Elevation/Area/Storage Information

Elev. (ft.)	Area (ac.)	Cumulative Volume (ac.-ft.)	(cu. ft.)	
384.7	0.800	-	-	Pool
385.0	0.833	0.245	10,670	
386.0	0.946	1.134	49,417	
387.0	1.063	2.139	93,173	
388.0	1.182	3.261	142,069	Peak Storage
388.5	1.243	3.868	168,477	

Storage Volume Provided = 142,069 cubic feet
(to Elevation 388.0)

Basin Discharge Rate

Existing 27" RCP must have capacity to discharge the peak allowable rate from Section 4 combined with the peak discharge rates from the basins upstream which are being routed through this basin prior to discharge into the Nurrenbern Ditch.

Drainage Area / Basin	Allowable Q (cfs)
Cross Pointe - Section 4	7.20
Cross Pointe - Section 3 Basin	4.68
Builders Square Basin A	2.45
Builders Square Basin B	2.60
Arbor Hospital Basin	5.44
Cross Pointe Blvd. - Direct	1.29
Total	23.66

Inlet Control
For Q = 23.66 cfs for 27" RCP, HW/D = 1.18
Req'd HW = 2.66 feet

Outlet Control
For Q = 23.66 cfs for 27" RCP with tailwater in Nurrenbern at Elev. 388.0 feet
Req'd HW = 4.39 feet > 3.26 feet = Available HW
Therefore , peak discharge cannot occur during peak tailwater in ditch. Peak discharge through the 27" RCP will occur when water level in ditch is low.

Req'd Storage Volume (Form 800) = 57,721 + 9,273
= 66,994 cu. ft. < 142,069 cu. ft. available

VANDERBURGH COUNTY DRAINAGE BOARD
FORM 800

PROJECT: **Cross Pointe** DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS
Section 4 Retention (Unrestricted Discharge Rate)
DESIGNER: MORLEY & ASSOC. RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA:	11.73	ACRES
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED):	28.84	MINUTES
RAINFALL INTENSITY (Iu):	3.326	INCHES/HR
UNDEVELOPED RUNOFF COEFFICIENT (Cu):	0.2	
UNDEVELOPED RUNOFF RATE (O = Cu*Iu*A):	7.80	CFS
DEVELOPED RUNOFF COEFFICIENT (Cd):	0.846	

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE Td)-O)*Td/12 (ACRE-FT)
0.08	7.208	71.53	7.80	63.73	0.443
0.17	5.925	58.80	7.80	50.99	0.708
0.25	5.033	49.95	7.80	42.14	0.878
0.33	4.571	45.36	7.80	37.55	1.043
0.42	4.108	40.77	7.80	32.97	1.145
0.50	3.646	36.18	7.80	28.38	1.182
0.58	3.385	33.59	7.80	25.79	1.253
0.67	3.123	30.99	7.80	23.19	1.288
0.75	2.862	28.40	7.80	20.60	1.287
0.83	2.601	25.81	7.80	18.01	1.250
0.92	2.339	23.21	7.80	15.41	1.177
1.00	2.078	20.62	7.80	12.82	1.068
1.25	1.909	18.94	7.80	11.14	1.160
1.50	1.739	17.26	7.80	9.45	1.182
1.75	1.570	15.58	7.80	7.77	1.133
2.00	1.400	13.89	7.80	6.09	1.015
2.50	1.210	12.00	7.80	4.20	0.875
3.00	1.019	10.11	7.80	2.31	0.577
4.00	0.836	8.30	7.80	0.49	0.164

PEAK STORAGE (ACRE/FT):	1.29
PEAK STORAGE (CUBIC FT):	56,124

VANDERBURGH COUNTY DRAINAGE BOARD
FORM 800

PROJECT: **Cross Pointe** DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS
Section 4 Retention (Discharge Restricted to 7.2 cfs)
DESIGNER: MORLEY & ASSOC. RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA:	11.73	ACRES
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED):	28.84	MINUTES
RAINFALL INTENSITY (Iu):	3.326	INCHES/HR
UNDEVELOPED RUNOFF COEFFICIENT (Cu):	0.2	
UNDEVELOPED RUNOFF RATE (O = Cu*Iu*A):	7.80	CFS
DEVELOPED RUNOFF COEFFICIENT (Cd):	0.846	

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	RESTRICTED OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE Td)-O)*Td/12 (ACRE-FT)
0.08	7.208	71.53	7.20	64.33	0.447
0.17	5.925	58.80	7.20	51.60	0.717
0.25	5.033	49.95	7.20	42.75	0.891
0.33	4.571	45.36	7.20	38.16	1.060
0.42	4.108	40.77	7.20	33.57	1.166
0.50	3.646	36.18	7.20	28.98	1.208
0.58	3.385	33.59	7.20	26.39	1.283
0.67	3.123	30.99	7.20	23.79	1.322
0.75	2.862	28.40	7.20	21.20	1.325
0.83	2.601	25.81	7.20	18.61	1.292
0.92	2.339	23.21	7.20	16.01	1.223
1.00	2.078	20.62	7.20	13.42	1.118
1.25	1.909	18.94	7.20	11.74	1.223
1.50	1.739	17.26	7.20	10.06	1.257
1.75	1.570	15.58	7.20	8.38	1.221
2.00	1.400	13.89	7.20	6.69	1.116
2.50	1.210	12.00	7.20	4.80	1.001
3.00	1.019	10.11	7.20	2.91	0.728
4.00	0.836	8.30	7.20	1.10	0.365

PEAK STORAGE (ACRE/FT):	1.33
PEAK STORAGE (CUBIC FT):	57,721

VANDERBURGH COUNTY DRAINAGE BOARD
FORM 800

PROJECT: **Cross Pointe Sec 4** DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS
Cross Pointe Blvd. - Direct to Retention Basin
DESIGNER: MORLEY & ASSOC. RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA:	2.00	ACRES
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED):	30.00	MINUTES
RAINFALL INTENSITY (Iu):	3.226	INCHES/HR
UNDEVELOPED RUNOFF COEFFICIENT (Cu):	0.2	
UNDEVELOPED RUNOFF RATE (O = Cu*Iu*A):	1.29	CFS
DEVELOPED RUNOFF COEFFICIENT (Cd):	0.82	

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE Td)-O)*Td/12 (ACRE-FT)
0.08	7.208	11.82	1.29	10.53	0.073
0.17	5.925	9.72	1.29	8.43	0.117
0.25	5.033	8.25	1.29	6.96	0.145
0.33	4.571	7.50	1.29	6.21	0.172
0.42	4.108	6.74	1.29	5.45	0.189
0.50	3.646	5.98	1.29	4.69	0.195
0.58	3.385	5.55	1.29	4.26	0.207
0.67	3.123	5.12	1.29	3.83	0.213
0.75	2.862	4.69	1.29	3.40	0.213
0.83	2.601	4.27	1.29	2.97	0.207
0.92	2.339	3.84	1.29	2.55	0.194
1.00	2.078	3.41	1.29	2.12	0.176
1.25	1.909	3.13	1.29	1.84	0.192
1.50	1.739	2.85	1.29	1.56	0.195
1.75	1.570	2.57	1.29	1.28	0.187
2.00	1.400	2.30	1.29	1.01	0.168
2.50	1.210	1.98	1.29	0.69	0.144
3.00	1.019	1.67	1.29	0.38	0.095
4.00	0.836	1.37	1.29	0.08	0.027

PEAK STORAGE (ACRE/FT):	0.21
PEAK STORAGE (CUBIC FT):	9,273

PROJECT NO. 96-3310-4 — CROSS POINTE - SECTION 4 — 27" RCP Outlet to Nurrenbern Ditch

DESIGNER Morley & Assoc. /DJH

DATE

HYDROLOGIC AND CHANNEL INFORMATION

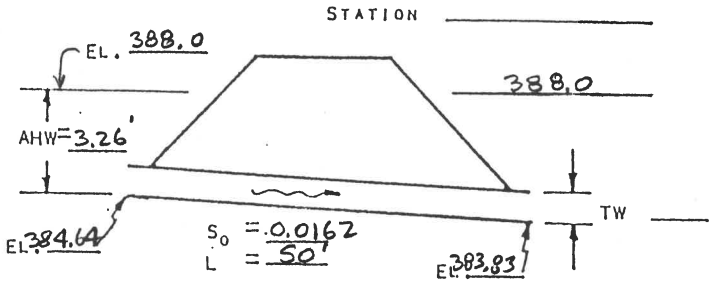
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

Q_1 = DESIGN DISCHARGE, SAY Q_{10}

Q_2 = CHECK DISCHARGE, SAY Q_{50}

SKETCH



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
27" FES RCP	19.5	27"	1.0	2.25	0.5	0.7	1.65	1.95	4.17	4.17	0.81	4.06	4.06			TW in Nurrenbern @ Peak
27" FES RCP	19.5	27"	1.0	2.25	0.5	0.7	1.65	1.95	1.95	1.95	0.81	1.84	2.25			TW from critical depth @ outlet
27" FES RCP	30.0	27"	1.45	3.26	0.5	1.65	1.89	2.07	4.17	4.17	0.81	5.01	5.01			TW in Nurrenbern @ peak
27" FES RCP	30.0	27"	1.45	3.26	0.5	1.65	1.89	2.07	2.07	2.07	0.81	2.91	3.26			TW from critical depth @ outlet
27" FES RCP	23.7	27"	1.18	2.66	0.5	1.03	1.76	2.01	4.17	4.17	0.81	4.39	4.39			TW in Nurrenbern @ peak
27" FES RCP	23.7	27"	1.18	2.66	0.5	1.03	1.76	2.01	2.01	2.01	0.81	2.23	2.66			TW from critical depth @ outlet

Q from HW/D=1.0 for inlet control

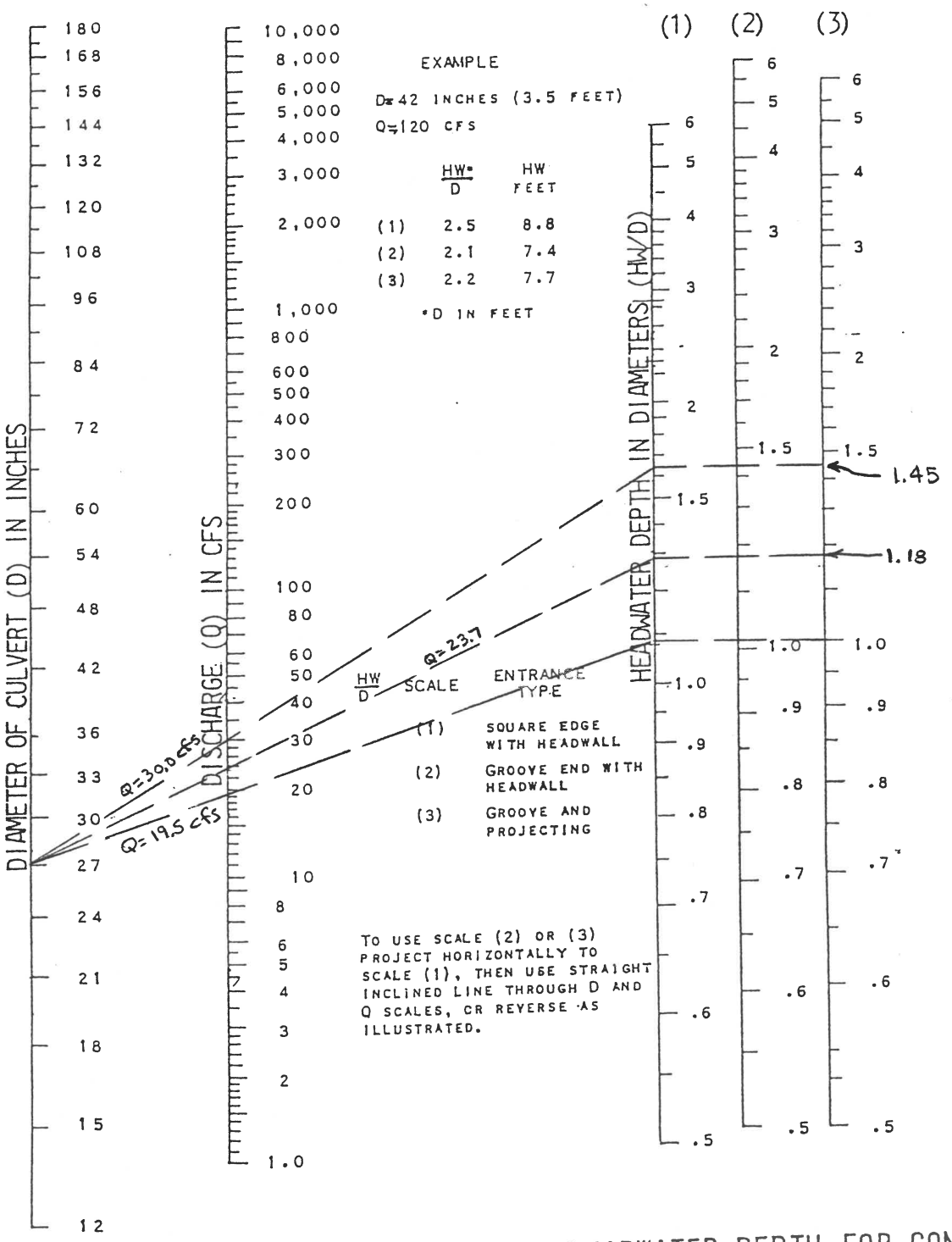
Q from max. AHW for inlet control

Allowable Q for basin discharge

SUMMARY AND RECOMMENDATIONS

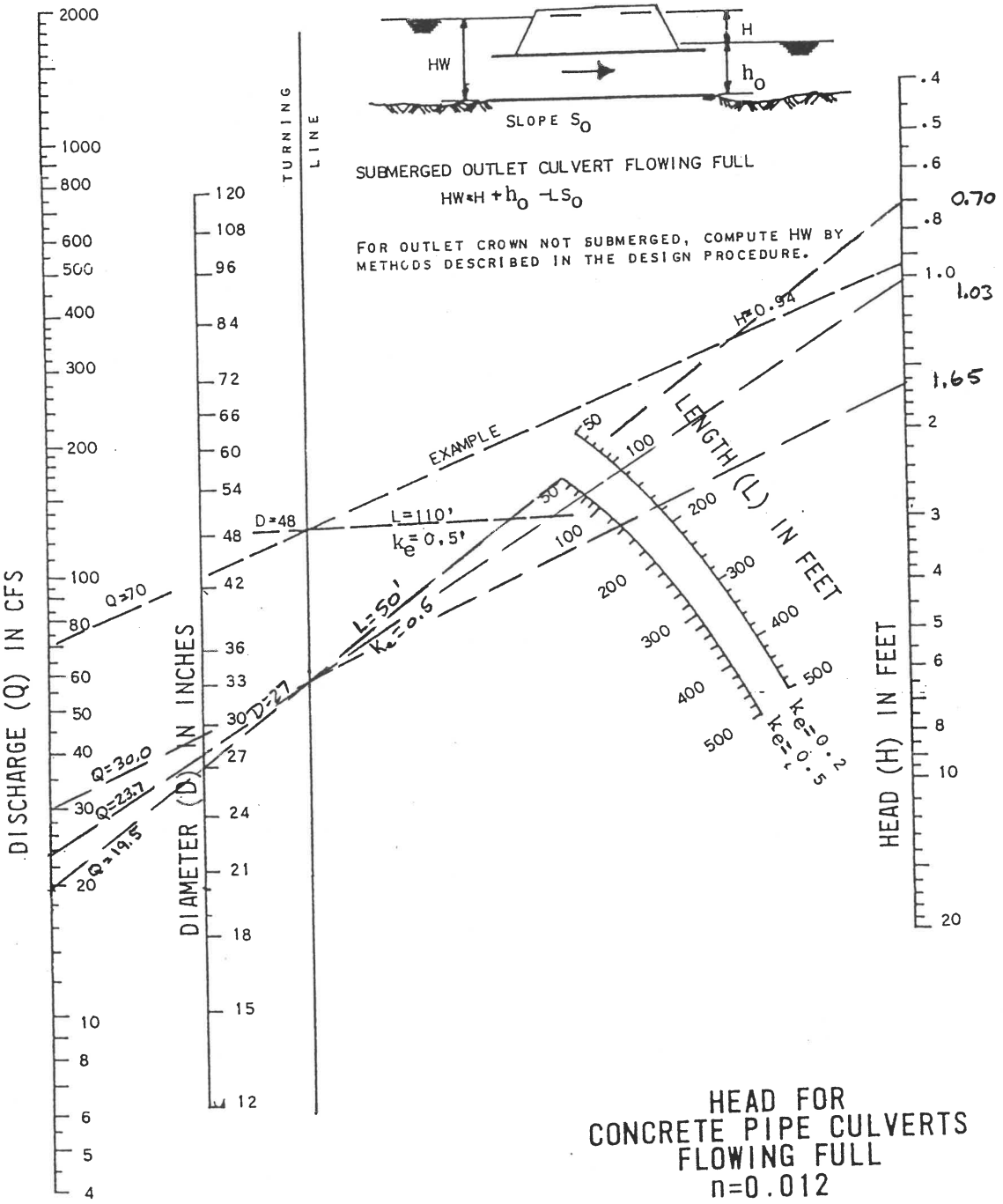
FIG. 7-430.01 A

7-430.01 F
JAN. 1971



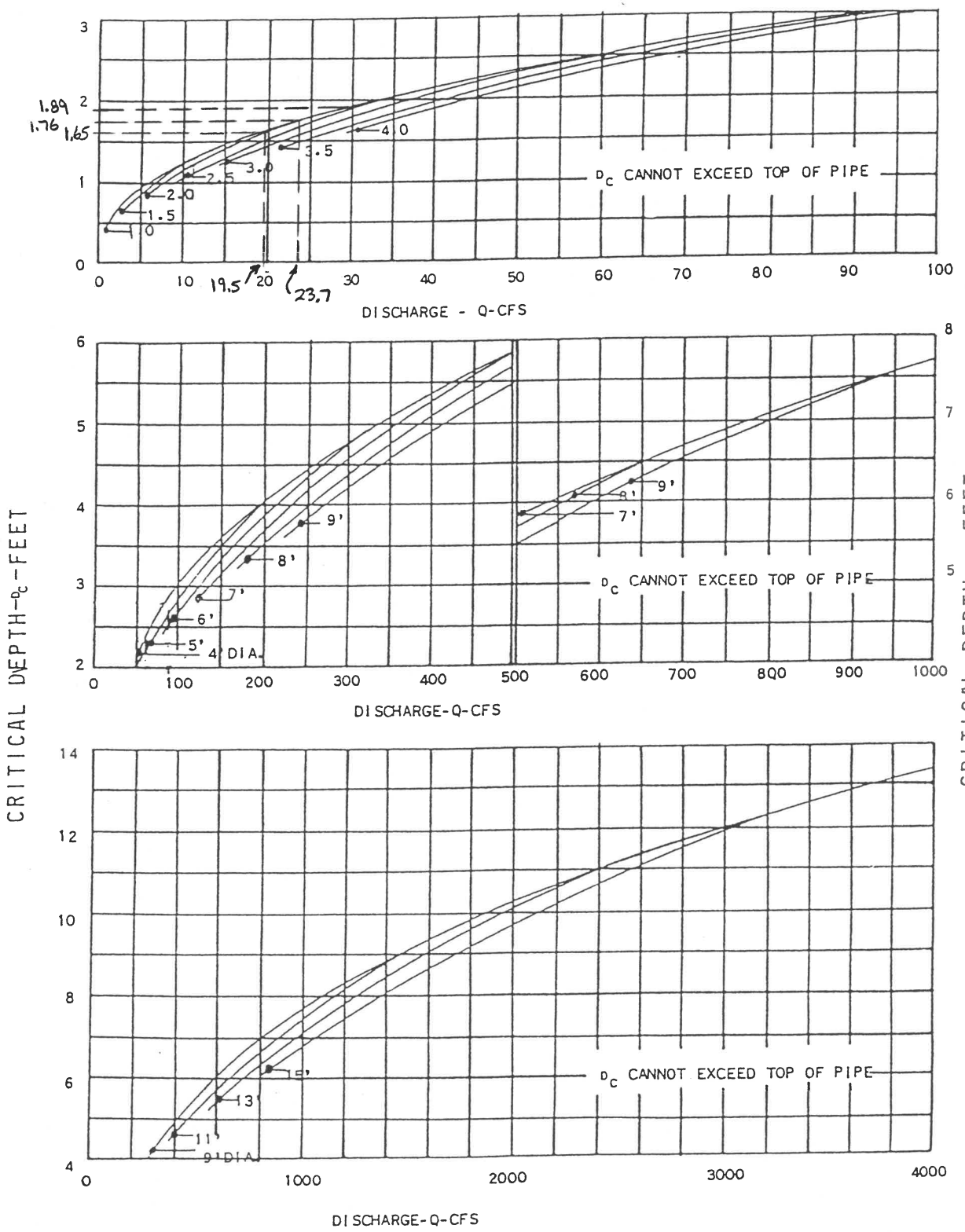
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

FIG. 7-430.01F



HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n=0.012

FIG. 7-430.01 W



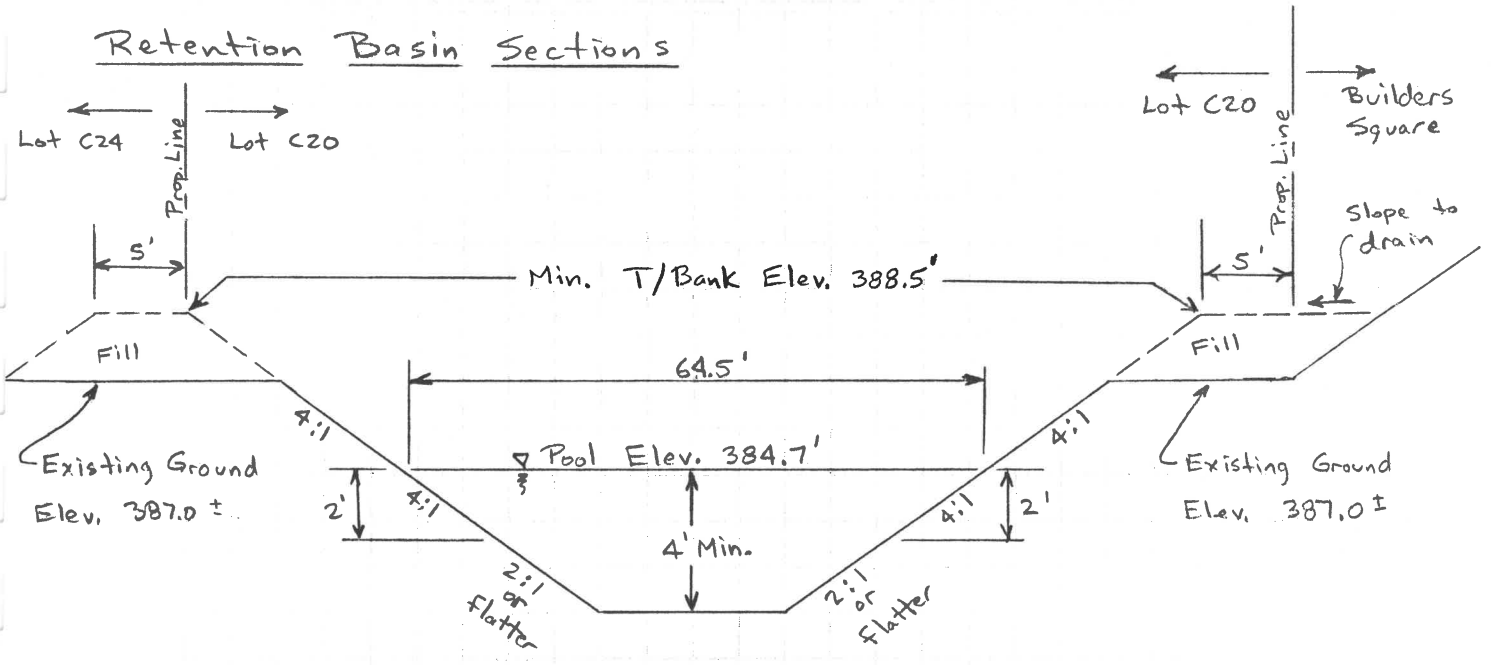
CRITICAL DEPTH
CIRCULAR PIPE

FIG. 7-430.01 L

Morley and Associates INC.
CONSULTING ENGINEERS/LAND SURVEYORS/ARCHITECTS
05 S.E. MARTIN LUTHER KING, JR. BLVD
VANSVILLE, IN. 47713 (812) 464-9585 FAX (812) 464-2514

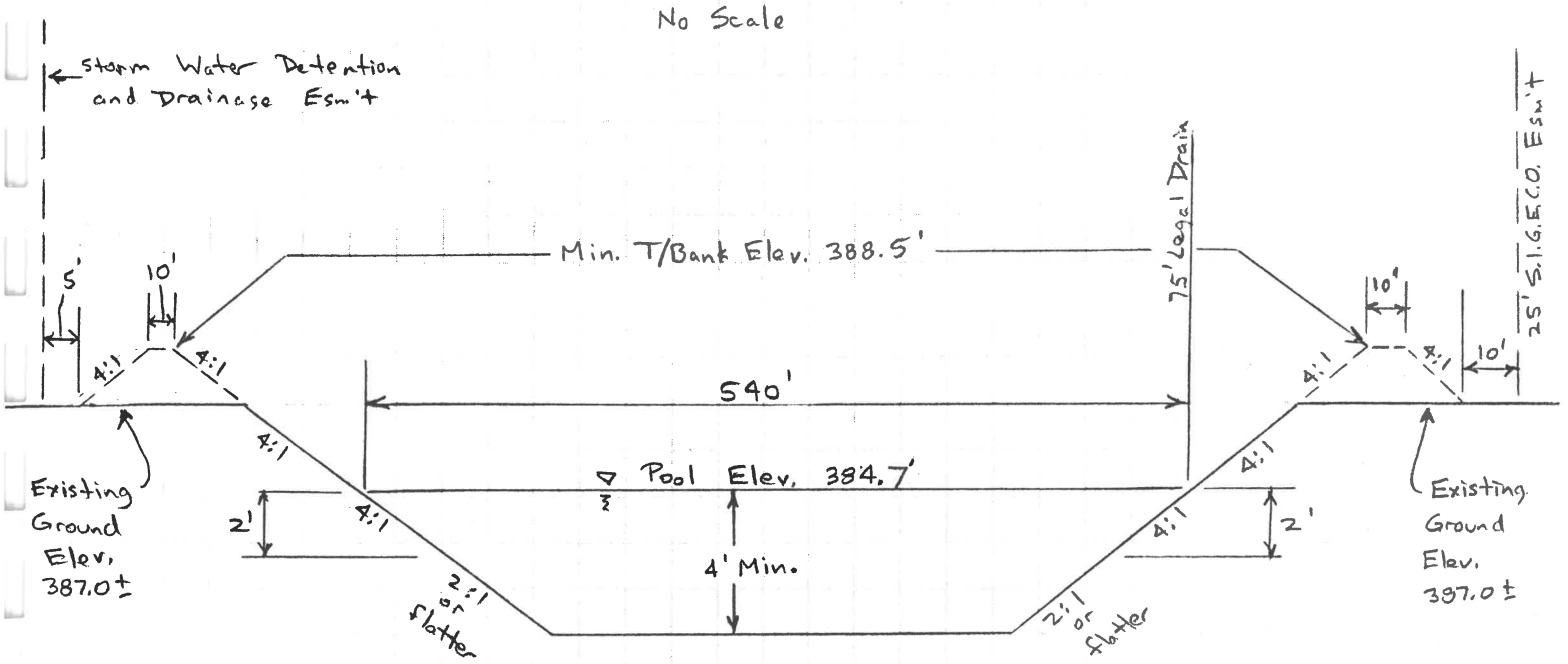
Project Cross Pointe - Section 4
Sheet ____ of ____
Project No. 3310-4 Date ____ By ____

Retention Basin Sections



SECTION A-A

No Scale



SECTION B-B

No Scale

MORLEY AND ASSOCIATES INC.

STORM SEWER DESIGN SHEET - RATIONAL METHOD

PROJECT: CROSS POINTE - SEC. 4
OUR PROJECT # 96-3310 DATE APRIL 1996
MANNINGS n 0.011 DESIGN PERIOD 25 YEARS

LINE NO.	UPSTREAM MANHOLE	DOWNSTREAM MANHOLE	LENGTH (ft)	Cj	Aj (ac.)	CjAj	SUM CjAj	Tj (min)	Tcum (min)	I (in/hr)	Q (cfs)	PIPE DIA. (in)	PIPE SLOPE (ft/ft)	PIPE CAP. (cfs)	VELOCITY (ft/sec)	TRAVEL TIME (min)
1	500	501	130	0.843	0.55	0.465	0.465	9.88	9.88	5.956	2.77	15	0.0020	3.41	2.78	0.78
1	501	505	130	0.843	0.55	0.465	0.931	9.88	10.66	5.807	5.40	18	0.0020	5.55	3.14	0.69
2	502	503	110	0.843	0.55	0.465	0.465	9.88	9.88	5.956	2.77	15	0.0020	3.41	2.78	0.66
2	503	504	110	0.843	0.55	0.465	0.931	9.88	10.54	5.829	5.42	18	0.0020	5.55	3.14	0.58
2	504	505	38	0.843	0.55	0.465	1.396	9.88	11.12	5.725	7.99	21	0.0020	8.37	3.48	0.18
3	505	506	216	-	-	0.000	2.327	-	11.35	5.684	13.23	24	0.0026	13.63	4.34	0.83
4	507	508	100	0.843	0.51	0.430	0.430	9.52	9.52	6.048	2.60	15	0.0020	3.41	2.78	0.60
4	508	511	62	0.843	0.51	0.430	0.860	9.52	10.12	5.904	5.08	18	0.0020	5.55	3.14	0.33
5	509	510	120	0.843	0.76	0.641	0.641	9.25	9.25	6.117	3.92	15	0.0030	4.18	3.41	0.59
5	510	511	120	0.843	0.76	0.641	1.281	9.25	9.84	5.967	7.65	21	0.0020	8.37	3.48	0.57
6	511	512	70	0.843	0.76	0.641	2.782	9.25	10.45	5.845	16.26	24	0.0037	16.26	5.18	0.23
6	512	513	184	0.843	0.40	0.337	3.119	8.27	10.67	5.805	18.11	24	0.0046	18.13	5.77	0.53

Cross Pointe - Section 4

Storm Sewer Design Data

U/S Inlet	D/S Inlet	Sub-basin	Area (Ac)
500	501	1/5 #5	0.55
501	505	2/5 #5	1.10
502	503	1/5 #5	0.55
503	504	2/5 #5	1.10
504	505	3/5 #5	1.66
505	506	#5	2.76
507	508	1/2 #1	0.51
508	511	1/2 #1	1.02
509	510	1/3 #2	0.76
510	511	2/3 #2	1.52
511	512	#1 & #2	3.30
512	513	#1, #2 & #4	3.70

Developed Drainage Sub-Basins

Sub-basin No.: 1 — Total Area = 44,431 S.F. = 1.02 Ac.

Surface								C	N
Structures	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Pavement	0	L.F.	0.0	Width =	39,988	S.F. =	0.92 Ac.	0.92	0.02
Patios	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0	L.F.	0	Width =	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			4,443	S.F. =			0.10 Ac.	0.15	0.40
Lawn (2-5%)				S.F. =			0.00 Ac.	0.25	0.40
Lawn (5-10%)				S.F. =			0.00 Ac.	0.40	0.40
Lawn (>10%)				S.F. =			0.00 Ac.	0.55	0.40
Water				S.F. =			0.00 Ac.	1.00	0.00
Misc.				S.F. =			0.00 Ac.		

Weighted c =	0.843	
Weighted N =	0.058	
L =	250	Ft.
H =	1.5	Ft.
S =	0.0060	Ft./Ft.
tc =	9.52	Minutes (Min. 5 minutes)
I(25) =	6.048	In./Hr.
Q(25) =	5.20	CFS

Developed Drainage Sub-Basins

Sub-basin No.: 2 — Total Area = 99,317 S.F. = 2.28 Ac.

Surface								C	N
Structures	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Pavement	0	L.F.	0.0	Width =	89,385	S.F. =	2.05 Ac.	0.92	0.02
Patios	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0	L.F.	0	Width =	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			9,932	S.F. =			0.23 Ac.	0.15	0.40
Lawn (2-5%)				S.F. =			0.00 Ac.	0.25	0.40
Lawn (5-10%)				S.F. =			0.00 Ac.	0.40	0.40
Lawn (>10%)				S.F. =			0.00 Ac.	0.55	0.40
Water				S.F. =			0.00 Ac.	1.00	0.00
Misc.				S.F. =			0.00 Ac.		

Weighted c =	0.843	
Weighted N =	0.058	
L =	240	Ft..
H =	1.5	Ft.
S =	0.0063	Ft./Ft.
tc =	9.25	Minutes (Min. 5 minutes)
I(25) =	6.117	In./Hr.
Q(25) =	11.76	CFS

Developed Drainage Sub-Basins

Sub-basin No.: 3 | Total Area = 3,920 S.F. = 0.09 Ac.

Surface							C	N
Structures	0 Total	0 S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Drives	0 Total	0 S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Pavement	0 L.F.	0.0 Width =	3,920	S.F. =	0.09	Ac.	0.92	0.02
Patios	0 Total	0 S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Sidewalks	0 L.F.	0 Width =	0	S.F. =	0.00	Ac.	0.92	0.02
Lawn (0-2%)		S.F. =			0.00	Ac.	0.15	0.40
Lawn (2-5%)		S.F. =			0.00	Ac.	0.25	0.40
Lawn (5-10%)		S.F. =			0.00	Ac.	0.40	0.40
Lawn (>10%)		S.F. =			0.00	Ac.	0.55	0.40
Water		S.F. =			0.00	Ac.	1.00	0.00
Misc.		S.F. =			0.00	Ac.		

Weighted c =	0.920	
Weighted N =	0.020	
L =	125	Ft.
H =	1.6	Ft.
S =	0.0128	Ft./Ft.
tc =	3.51	Minutes (Min. 5 minutes)
I(25) =	7.208	In./Hr.
Q(25) =	0.60	CFS

Developed Drainage Sub-Basins

Sub-basin No.: 4 | Total Area = 17,424 S.F. = 0.40 Ac.

Surface							C	N
Structures	0 Total	0 S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Drives	0 Total	0 S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Pavement	0 L.F.	0.0 Width =	15,682	S.F. =	0.36	Ac.	0.92	0.02
Patios	0 Total	0 S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Sidewalks	0 L.F.	0 Width =	0	S.F. =	0.00	Ac.	0.92	0.02
Lawn (0-2%)		1,742 S.F. =			0.04	Ac.	0.15	0.40
Lawn (2-5%)		S.F. =			0.00	Ac.	0.25	0.40
Lawn (5-10%)		S.F. =			0.00	Ac.	0.40	0.40
Lawn (>10%)		S.F. =			0.00	Ac.	0.55	0.40
Water		S.F. =			0.00	Ac.	1.00	0.00
Misc.		S.F. =			0.00	Ac.		

Weighted c =	0.843	
Weighted N =	0.058	
L =	200	Ft.
H =	1.4	Ft.
S =	0.0070	Ft./Ft.
tc =	8.27	Minutes (Min. 5 minutes)
I(25) =	6.369	In./Hr.
Q(25) =	2.15	CFS

Developed Drainage Sub-Basins

Sub-basin No.: 5 — Total Area = 120,226 S.F. = 2.76 Ac.

Surface								C	N
Structures	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Pavement	0	L.F.	0.0	Width =	108,203	S.F. =	2.48 Ac.	0.92	0.02
Patios	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0	L.F.	0	Width =	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			12,023	S.F. =			0.28 Ac.	0.15	0.40
Lawn (2-5%)				S.F. =			0.00 Ac.	0.25	0.40
Lawn (5-10%)				S.F. =			0.00 Ac.	0.40	0.40
Lawn (>10%)				S.F. =			0.00 Ac.	0.55	0.40
Water				S.F. =			0.00 Ac.	1.00	0.00
Misc.				S.F. =			0.00 Ac.		

Weighted c =	0.843	
Weighted N =	0.058	
L =	280	Ft.
H =	1.8	Ft.
S =	0.0064	Ft./Ft.
tc =	9.88	Minutes (Min. 5 minutes)
I(25) =	5.956	In./Hr.
Q(25) =	13.86	CFS

Developed Drainage Sub-Basins

Sub-basin No.: 6 — Total Area = 217,800 S.F. = 5.00 Ac.

Surface								C	N
Structures	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Pavement	0	L.F.	0.0	Width =	139,958	S.F. =	3.21 Ac.	0.92	0.02
Patios	0	Total	0	S.F. =	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0	L.F.	0	Width =	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			24,699	S.F. =			0.57 Ac.	0.15	0.40
Lawn (2-5%)				S.F. =			0.00 Ac.	0.25	0.40
Lawn (5-10%)				S.F. =			0.00 Ac.	0.40	0.40
Lawn (>10%)				S.F. =			0.00 Ac.	0.55	0.40
Water			53,143	S.F. =			1.22 Ac.	1.00	0.00
Misc.				S.F. =			0.00 Ac.		

Weighted c =	0.852	
Weighted N =	0.058	
L =	320	Ft.
H =	3.0	Ft.
S =	0.0094	Ft./Ft.
tc =	9.64	Minutes (Min. 5 minutes)
I(25) =	6.017	In./Hr.
Q(25) =	25.64	CFS

Developed Drainage Sub-Basins

Sub-basin No.: 7 (Direct to Nurrenbern)	Total Area = 7,841 S.F. = 0.18 Ac.							
Surface							C	N
Structures	0 Total	0 S.F. =	0 S.F. =	0.00 Ac.			0.92	0.02
Drives	0 Total	0 S.F. =	0 S.F. =	0.00 Ac.			0.92	0.02
Pavement	0 L.F.	0.0 Width =	0 S.F. =	0.00 Ac.			0.92	0.02
Patios	0 Total	0 S.F. =	0 S.F. =	0.00 Ac.			0.92	0.02
Sidewalks	0 L.F.	0 Width =	0 S.F. =	0.00 Ac.			0.92	0.02
Lawn (0-2%)		S.F. =		0.00 Ac.			0.15	0.40
Lawn (2-5%)		S.F. =		0.00 Ac.			0.25	0.40
Lawn (5-10%)		S.F. =		0.00 Ac.			0.40	0.40
Lawn (>10%)		3,481 S.F. =		0.08 Ac.			0.55	0.40
Water		4,360 S.F. =		0.10 Ac.			1.00	0.00
Misc.		S.F. =		0.00 Ac.				

Weighted c =	0.800	
Weighted N =	0.178	
L =	15	Ft.
H =	6.0	Ft.
S =	0.4000	Ft./Ft.
tc =	1.62	Minutes (Min. 5 minutes)
I(25) =	7.208	In./Hr.
Q(25) =	1.04	CFS