

# CARNEAL

*Drainage Report*

*For:*

*Carneal Commercial Section 2*

*Prepared For:*

*Jeff Carneal*

*Carneal Properties*

*2700 South Green River Road*

*Evansville, IN 47715*

**FINAL  
PLAN**

**PASSED  
2/23/98**

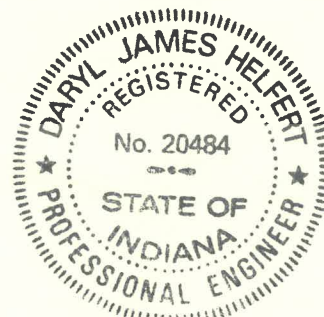
*By:*

*Morley and Associates, Inc.*

*600 S.E. Sixth Street*

*Evansville, IN 47713*

*(812) 464-9585*



*Daryl J. Helfert*

*November 1997*

## CARNEAL COMMERCIAL - SECTION 2

The site is located immediately southeast of Evansville, on the east side of south Green River Road, approximately 800 feet north of I-164, in Vanderburgh County, Indiana.

The 16.031 acre site is located on relatively flat ground which was previously used for pasture with an oval dirt track. The site drains generally to the east and northeast. The primary exit point for stormwater draining from the site is at the northeast corner. Stormwater leaving the site is conveyed north to the Akin Ditch, which then flows south into Eagle Creek.

The proposed development contains six separate lots and two streets ending in cul-de-sacs. Lots 5 through 9 range in size from 0.31 acres to 0.80 acres, while Lot 10 contains 12.00 acres. The site presently contains a few buildings, a dirt track and pasture/lawn type ground cover, resulting in an undeveloped runoff coefficient of 0.160. The runoff coefficient will increase greatly after development occurs. The developed coefficient was determined by combining the different expected components. The new streets will be 29 feet wide, B/C to B/C, with 40 foot radius cul-de-sacs and 4 foot wide sidewalks on both sides. The remaining area within the street R/W will be lawn. Based on previous developments, Lots 5 through 9 are being assumed to receive approximately 90% impervious surface coverage, while Lot 10 is assumed to receive about 75% impervious coverage. The remaining area on the lots will be lawn and landscaping. The resulting developed runoff coefficient for the entire site is 0.750.

The total drainage area of 16.031 acres produces a 10 year peak runoff rate of 7.56 cfs for undeveloped conditions. Using the Form 800 spreadsheet, the total required storm detention volume for a 25 year storm event is 73,097 cubic feet, or 1.678 acre-feet, with a peak allowable discharge rate of 7.56 cfs. The required storage volume for the 100 year storm event is 105,065 cubic feet, or 2.412 acre-feet.

Storm water detention will be provided onsite in a dry detention basin to be located in the northeast corner of Lot 10. The primary outlet for the basin will be at elevation 371.00 feet, with maximum allowable storage to elevation 375.00 feet. The configuration of the basin provides an available storage volume of 110,731 cubic feet to elevation 375.00. The necessary detention volume of 73,097 cubic feet for the 25 year storm would require storage to elevation 374.18 feet, or a headwater depth of 3.18 feet at the outlet structure. The detention volume of 105,065 cubic feet for the 100 year storm would require storage to elevation 374.88 feet, or a headwater depth of 3.88 feet.

The allowable discharge from the developed site for a 25 year storm is 7.56 cfs. The required detention volume for the 25 year storm results in a headwater depth of 3.18 feet. Under these conditions, the required primary outlet would be a 13.3 inch diameter orifice, or equivalent. To avoid the use of an orifice plate in a larger pipe, a 12 inch diameter RCP will be used for the primary spillway. Because the capacity of the 12

inch RCP will be less than 7.56 cfs for 3.18 feet of headwater, additional storage volume will be required to offset the decrease in the discharge rate. After several iterations, the design discharge rate for the 25 year storm was set at 6.90 cfs. Substituting this rate into Form 800 results in a required detention volume of 76,276 cubic feet. The 12 inch RCP requires 3.50 feet of headwater to produce an outflow rate of 6.90 cfs. At an elevation of 374.50 feet, or 3.50 feet of headwater, the detention basin provides 87,732 cubic feet of storage. Also, the required detention volume for the 100 year storm was 105,065 cubic feet at a discharge rate of 7.56 cfs. At the maximum allowable storage depth of 4.00 feet, the available storage volume is 110,731 cubic feet while producing a peak outflow rate of 7.45 cfs. Therefore, the proposed detention basin will provide sufficient storage volume for the design storm events while restricting the peak outflow rate to less than the allowable rate as calculated for the 10 year storm under undeveloped conditions.

The 12 inch RCP will discharge into the ditch along the east property line, which will be enlarged and deepened in accordance with the plan conditionally approved by the Vanderburgh County Surveyor's Office on October 17, 1996. A copy of the plan and approved letter is included in this drainage report. The outlet end of the 12 inch RCP will be constructed with a concrete headwall to facilitate installation of a flapgate to prevent possible backflow into the basin. Construction of the open waterway and 24 inch pipe will occur after final drainage approval has been granted for this development.

An emergency open channel spillway will be provided at elevation 375.00 feet. The channel will have a 10 foot bottom width and side slopes of 3:1 or flatter. The capacity of the emergency spillway is illustrated in a table included in this report.

All storm water runoff from the site will enter the basin as overland sheet flow or will be conveyed to the basin via a system of swales and storm sewers. Storm sewers to be located beneath the roadways will be reinforced concrete pipe (RCP), as well as the basin outlet pipe. Other storm sewers may be double-walled, smooth interior corrugated plastic pipe (CPP). Design of all storm sewers and swales is in accordance with the current Vanderburgh County Drainage Ordinance.

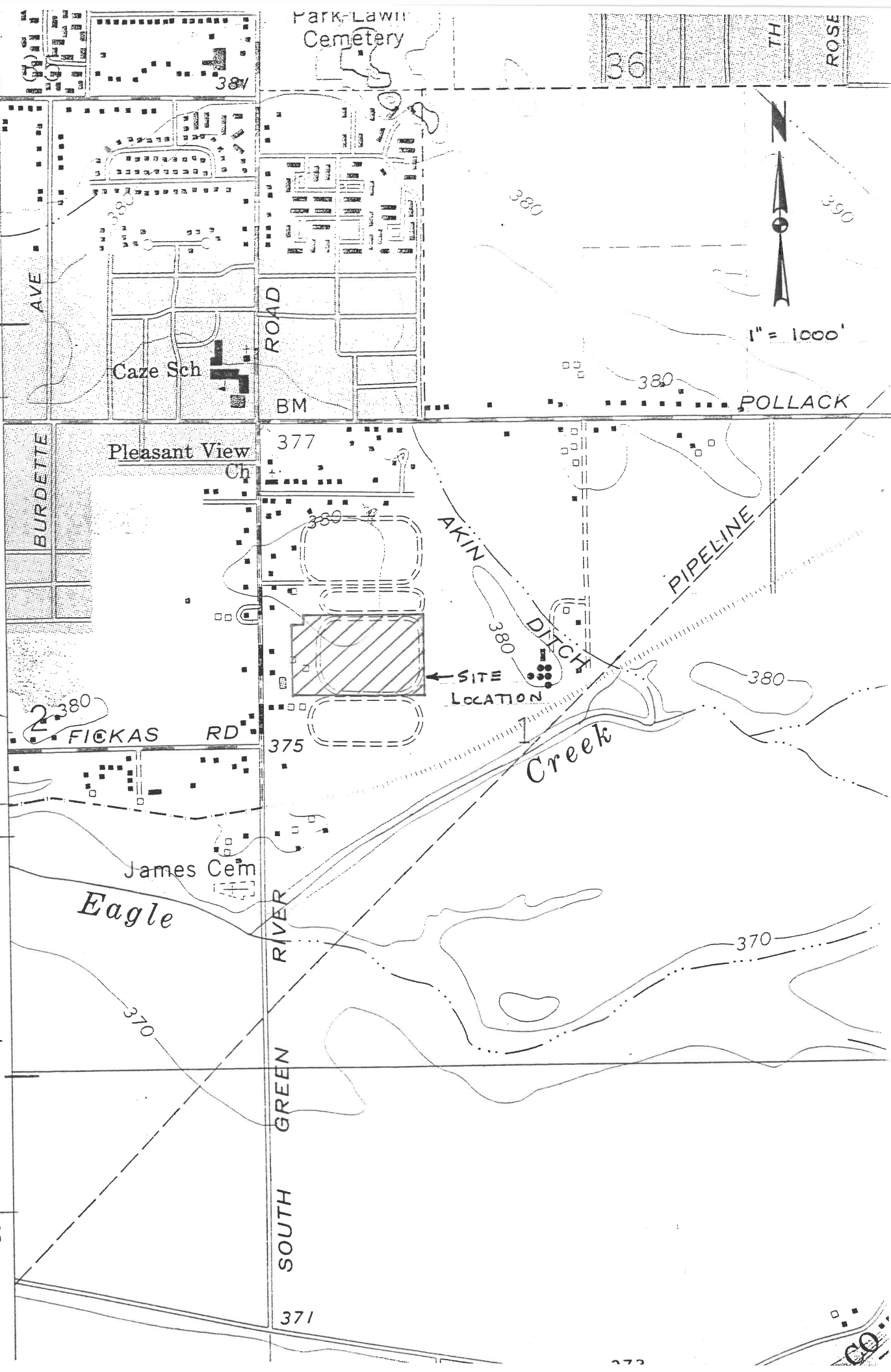
Based on the most recent soil survey of Vanderburgh County, the site contains the following soil types: Sciotoville silt loam (ScA), Weinbach silt loam (Wb), and Wheeling silt loam (WhB2).

According to FIRM Panel Number 180256 0050 B for Vanderburgh, dated March 19, 1982, no portion of the proposed subdivision lies within the boundaries of the 100 year flood zone.

401

Park-Lawrence Cemetery

36 TH ROSE



T. 6 S.

T. 7 S.

AVE

ROAD

Caze Sch

BM

1" = 1000'

POLLACK

BURDETTE

Pleasant View Ch

377

AKIN

PIPELINE

DITCH

SITE LOCATION

FICKAS RD

375

Creek

4199

James Cem

Eagle

RIVER

370

3459 / NE (EVANSVILLE SOUTH)

GREEN

4198

SOUTH

371

CO.



# EVANS

(county see)



(Joins sheet 36)

380 000 FEET

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 customary 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)

<u>Type of Surface</u>	<u>N</u>
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



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:

Acreage and extent, table 1, page 11.  
 Predicted yields, table 2, page 40.  
 Tree and shrub groups, table 3, page 50.

Wildlife, table 4, page 52.  
 Recreation, table 5, page 54.  
 Engineering, tables 6, 7, and 8, pages 58, 60, and 66.

Map symbol	Mapping unit	Described on page	Capability unit		Tree and shrub group Number
			Symbol	Page	
A1B2	Alford silt loam, 2 to 6 percent slopes, eroded-----	11	IIe-3	41	III
A1C2	Alford silt loam, 6 to 12 percent slopes, eroded-----	11	IIIe-3	43	III
A1C3	Alford silt loam, 6 to 12 percent slopes, severely eroded--	12	IVe-3	45	III
A1D3	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
M1C3	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	Iw-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

GUIDE TO MAPPING UNITS--Continued

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

CARNEAL COMMERCIAL - SECTION 2

Project No. 97-1961-4

Total Site Area = 16.031 acres

Undeveloped Conditions

<u>Surface Cover</u>	<u>Acres</u>	<u>c</u>	<u>n</u>
Pasture/Meadow	14.975	0.12	0.40
Impervious (bldgs.)	0.161	0.92	0.02
Bare ground (track)	<u>0.895</u>	<u>0.70</u>	<u>0.10</u>
Total / Wt'd Avg.	16.031	0.160	0.379

Time of Concentration, Tc

L = 800 ft.

H = 7.1 ft.

s = 0.0089

$$T_c = 0.827[(0.379)(800)/(0.0089)^{0.5}]^{0.467} = 35.92 \text{ minutes}$$

$$I(10) = 2.948 \text{ in./hr.}$$

Undeveloped Peak 10 year Runoff Rate

$$\text{Undev. } Q(10) = (0.160)(2.948)(16.031) = 7.56 \text{ cfs}$$

Developed Conditions

Street Right-of-Way - 1.028 acres = 44,763 S.F.

Streets

<u>Width</u> <u>(ft.)</u>	<u>Length</u> <u>(ft.)</u>	<u>Number</u> <u>(each)</u>	<u>Area</u> <u>(S.F.)</u>
29	377	-	10,933
29	225	-	6,525
40 radius	-	2	<u>10,053</u>
			27,511 S.F.

Sidewalks - 4 ft. width, both sides

Total Length = 1,707 L.F.

Area = 6,828 S.F.

Lawn - 0-2% slope

Area = 44,763 - 27,511 - 6,828 = 10,424 S.F.

CARNEAL COMMERCIAL - SECTION 2

Project No. 97-1961-4

Developed Conditions

Lots 5 thru 9 - 3.001 acres = 130,732 S.F.

Assume 90 % impervious coverage

$$Wt'd c = (0.90)(0.92) + (0.10)(0.15) = 0.843$$

Lot 10 - 12.002 acres = 522,796 S.F.

Assume 75 % impervious coverage

$$Wt'd c = (0.75)(0.92) + (0.25)(0.15) = 0.728$$

Total Weighted Developed Runoff Coefficient, Cd

<u>Surface Cover</u>	<u>Acres</u>	<u>c</u>
Street R/W		
Streets	0.632	0.920
Sidewalks	0.157	0.920
Lawn, 0-2 %	0.239	0.150
Lots 5 - 9	3.001	0.843
Lot 10	<u>12.002</u>	<u>0.728</u>
	16.031	0.750

Developed Runoff Coefficient, Cd = 0.750

Detention/Retention Requirements

Allowable Peak Site Discharge = Undev. Q(10) = 7.56 cfs

Required Storm Detention Volume (from Form 800)

25 Year Storm Event

Volume = 73,097 cu. ft. = 1.678 ac. - ft.

100 Year Storm Event

Volume = 105,065 cu. ft. = 2.412 ac. - ft.



CARNEAL COMMERCIAL - SECTION 2

Project No. 97-1961-4

Retention Basin

25 Year Storm

Primary Outlet - 12" RCP @ I.E. 371.0 ft.

Allowable Discharge Rate = 7.56 cfs

Storage Volume Req'd @ 7.56 cfs = 73,097 cubic feet = 1.678 ac.-ft.

Design Discharge Rate = 6.90 cfs w/ 3.5 ft. HW

25 Year Storage Elevation = 374.5 ft.

Available Storage Volume @ 374.5 ft. = 87,732 cubic feet = 2.014 ac.-ft.

100 Year Storm

Emergency Open Channel Spillway @ Elev. 375.0 ft.

Allowable Discharge Rate = 7.56 cfs

Storage Volume Req'd @ 7.56 cfs = 105,065 cubic feet = 2.412 ac.-ft.

Design Discharge Rate = 7.45 cfs w/ 4.0 ft. HW

100 Year Storage Elevation = 375.0 ft.

Available Storage Volume @ 375.0 ft. = 110,731 cubic feet = 2.542 ac.-ft.

**Basin Elevation - Area - Volume Table**

Elevation (ft.)	Area		Volume		
	(S.F.)	(ac.)	(cu. ft.)	(ac.-ft.)	
371.00	-	0.000	-	0	Outfall Invert
371.50	2,230	0.051	558	0.013	
372.00	8,835	0.203	3,324	0.076	
372.50	19,735	0.453	10,466	0.240	
373.00	34,985	0.803	24,146	0.554	
373.15	40,640	0.933	29,818	0.685	
373.50	41,810	0.960	44,247	1.016	
374.00	43,485	0.998	65,571	1.505	
374.50	45,160	1.037	87,732	2.014	25 Year
375.00	46,835	1.075	110,731	2.542	100 Year
375.50	48,510	1.114	134,567	3.089	
376.00	50,185	1.152	159,241	3.656	T/Bank

CALCULATIONS FOR PIPE FLOWING FULL  
(Pressure Conditions)

SOLVE FOR Q

INPUT	D=	1	FT.
INPUT	h' =	30	IN.
	h=	3	FT.
INPUT	Ke=	0.5	
INPUT	Kc=	1	
INPUT	n=	0.011	
INPUT	L=	45	FT.
	HW=	3.5	FT.
	Q=	6.89556	CFS

h' - ht. of water above top of pipe

CALCULATIONS FOR PIPE FLOWING FULL  
(Pressure Conditions)

SOLVE FOR Q

INPUT	D=	1	FT.
INPUT	h' =	36	IN.
	h=	3.5	FT.
INPUT	Ke=	0.5	
INPUT	Kc=	1	
INPUT	n=	0.011	
INPUT	L=	45	FT.
	HW=	4	FT.
	Q=	7.44805	CFS

h' - ht. of water above top of pipe

VANDERBURGH COUNTY DRAINAGE BOARD  
FCRM 800

PROJECT: Carneal Comm. DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS  
Green River Road  
DESIGNER: MORLEY & ASSOC. RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 16.031 ACRES  
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED): 35.92 MINUTES  
RAINFALL INTENSITY (Iu): 2.948 INCHES/HR  
UNDEVELOPED RUNOFF COEFFICIENT (Cu): 0.16  
UNDEVELOPED RUNOFF RATE (O = Cu\*Iu\*A): 7.56 CFS  
DEVELOPED RUNOFF COEFFICIENT (Cd): 0.75

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	36.56	7.56	79.10	0.549
0.17	5.925	71.24	7.56	63.68	0.884
0.25	5.033	60.51	7.56	52.95	1.103
0.33	4.571	54.95	7.56	47.39	1.316
0.42	4.108	49.40	7.56	41.83	1.453
0.50	3.646	43.84	7.56	36.28	1.511
0.58	3.385	40.62	7.56	33.13	1.611
0.67	3.123	37.55	7.56	29.99	1.666
0.75	2.862	34.41	7.56	26.85	1.678
0.83	2.601	31.27	7.56	23.71	1.646
0.92	2.339	28.13	7.56	20.56	1.571
1.00	2.078	24.98	7.56	17.42	1.452
1.25	1.909	22.95	7.56	15.38	1.603
1.50	1.739	20.91	7.56	13.35	1.668
1.75	1.570	18.87	7.56	11.31	1.649
2.00	1.400	15.83	7.56	9.27	1.545
2.50	1.210	14.54	7.56	6.98	1.454
3.00	1.019	12.25	7.56	4.69	1.173
4.00	0.836	10.05	7.56	2.49	0.830

PEAK STORAGE (ACRE/FT): 1.68  
PEAK STORAGE (CUBIC FT): 73.097

VANDERBURGH COUNTY DRAINAGE BOARD  
FORM 300

PROJECT: Carneal Comm.                      DETENTION FACILITY DESIGN RETURN PERIOD: 100 YRS  
           Green River Road  
 DESIGNER: MORLEY & ASSOC.                RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 16.031 ACRES  
 TIME OF CONCENTRATION (UNDEVELOPED WATERSHED): 35.92 MINUTES  
 RAINFALL INTENSITY (Iu): 2.948 INCHES/HR  
 UNDEVELOPED RUNOFF COEFFICIENT (Cu): 0.16  
 UNDEVELOPED RUNOFF RATE (O = Cu\*Iu\*A): 7.56 CFS  
 DEVELOPED RUNOFF COEFFICIENT (Cd): 0.75

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	8.469	101.82	7.56	94.26	0.655
0.17	7.126	85.68	7.56	78.12	1.085
0.25	6.194	74.47	7.56	66.91	1.394
0.33	5.665	68.12	7.56	60.55	1.682
0.42	5.137	61.76	7.56	54.20	1.882
0.50	4.608	55.40	7.56	47.84	1.993
0.58	4.284	51.51	7.56	43.94	2.136
0.67	3.960	47.61	7.56	40.05	2.225
0.75	3.636	43.71	7.56	36.15	2.259
0.83	3.311	39.81	7.56	32.25	2.240
0.92	2.987	35.92	7.56	28.35	2.166
1.00	2.663	32.02	7.56	24.46	2.038
1.25	2.444	29.38	7.56	21.82	2.273
1.50	2.224	26.74	7.56	19.18	2.397
1.75	2.005	24.10	7.56	16.54	2.412
2.00	1.785	21.46	7.56	13.90	2.317
2.50	1.538	18.49	7.56	10.93	2.277
3.00	1.291	15.52	7.56	7.96	1.990
4.00	1.062	12.77	7.56	5.21	1.736

PEAK STORAGE (ACRE/FT):	2.41
PEAK STORAGE (CUBIC FT):	105.065

VANDERBURGH COUNTY DRAINAGE BOARD  
FORM 800

PROJECT: Carneal Comm.      DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS  
           Green River Road  
 DESIGNER: MORLEY & ASSOC.      RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 16.031 ACRES  
 TIME OF CONCENTRATION (UNDEVELOPED WATERSHED): 35.92 MINUTES  
 RAINFALL INTENSITY (Iu): 2.948 INCHES/HR  
 UNDEVELOPED RUNOFF COEFFICIENT (Cu): 0.16  
 UNDEVELOPED RUNOFF RATE (O = Cu\*Iu\*A): 7.56 CFS  
 DEVELOPED RUNOFF COEFFICIENT (Cd): 0.75

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	RESTRICTED		STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE Td-O)*Td/12 (ACRE-FT)
			OUTFLOW RATE O (Cu*Iu*A) (CFS)			
0.08	7.208	86.66	6.90	79.76	0.554	
0.17	5.925	71.24	6.90	64.34	0.894	
0.25	5.033	60.51	6.90	53.61	1.117	
0.33	4.571	54.95	6.90	48.05	1.335	
0.42	4.108	49.40	6.90	42.50	1.476	
0.50	3.646	43.84	6.90	36.94	1.539	
0.58	3.385	40.69	6.90	33.79	1.643	
0.67	3.123	37.55	6.90	30.65	1.703	
0.75	2.862	34.41	6.90	27.51	1.719	
0.83	2.601	31.27	6.90	24.37	1.692	
0.92	2.339	28.13	6.90	21.23	1.621	
1.00	2.078	24.98	6.90	18.08	1.507	
1.25	1.909	22.95	6.90	16.05	1.671	
1.50	1.739	20.91	6.90	14.01	1.751	
1.75	1.570	18.87	6.90	11.97	1.746	
2.00	1.400	16.83	6.90	9.93	1.655	
2.50	1.210	14.54	6.90	7.64	1.592	
3.00	1.019	12.25	6.90	5.35	1.338	
4.00	0.836	10.05	6.90	3.15	1.050	

PEAK STORAGE (ACRE/FT):	1.75
PEAK STORAGE (CUBIC FT):	76.276



CARNEAL COMMERCIAL - SECTION 2

Project No. 97-1961-4

Open Channel Emergency Spillway

Flow capacity based on weir flow equation for rectangular weir.

$$Q = (C_w) \times (\text{Width}) \times (\text{Head})^{1.5}$$

$C_w$  - Weir constant = 2.6

Width = Avg. of bottom width and top width

Head - Hydraulic head = Basin elev. - spwly. elev

Bottom width = 10 ft.

Side slopes = 3 to 1 (Min.)

Spillway elev. = 375.0

Elevation (ft.)	Head (ft.)	Width (ft.)	Capacity (cfs)
375.0	0.0	10.0	0
375.1	0.1	10.3	0.85
375.2	0.2	10.6	2.47
375.3	0.3	10.9	4.66
375.4	0.4	11.2	7.37
375.5	0.5	11.5	10.57
375.6	0.6	11.8	14.26
375.7	0.7	12.1	18.42
375.8	0.8	12.4	23.07
375.9	0.9	12.7	28.19
376.0	1.0	13.0	33.80

Swale No. 1 Design

Drainage Area = 4.029 acres

Design Flow Rate (from FES 1021) = 17.18 cfs

Length = 130 ft.

Slope = 0.8 %

Bottom Width = 4.0 ft.

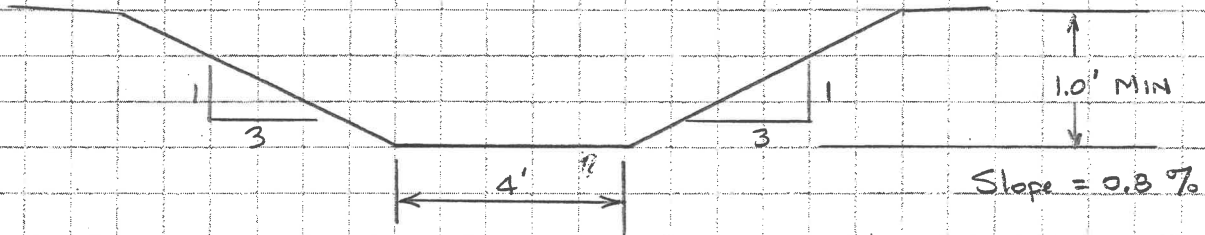
Side Slopes - 3:1

Minimum Depth = 1.0 ft.

Design Capacity = 20.57 cfs

Design Velocity = 2.94 fps

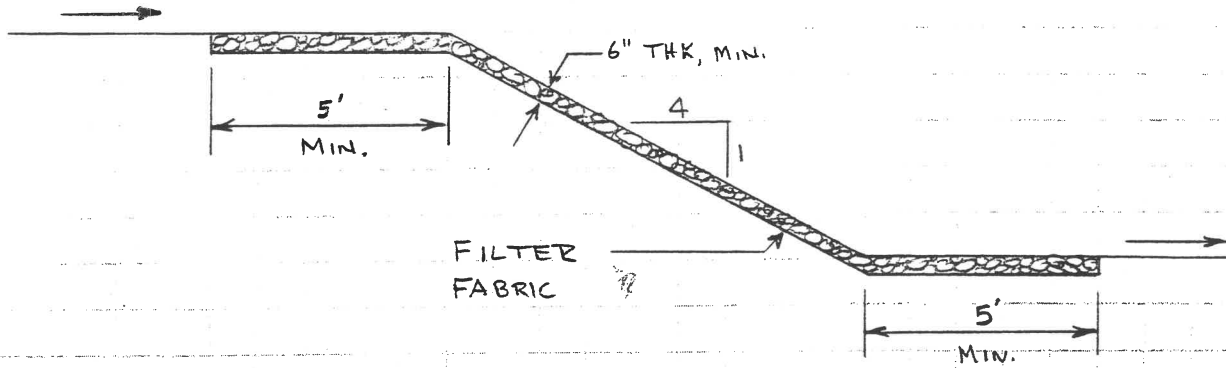
SWALE No. 1



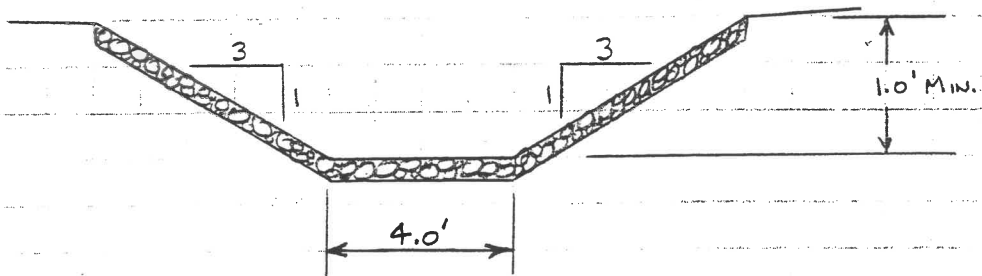
Design Flow Rate = 17.18 cfs

Design Flow Capacity = 20.57 cfs

ROCK CHUTE DETAIL



PROFILE



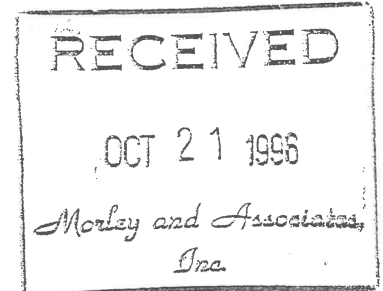
CROSS SECTION

Vanderburgh County Surveyor  
Drainage Plan Review Division

MEMO

10/17/96

Mr. Jeff Carneal  
Carneal Properties  
2700 South Green River Road  
Evansville, Indiana



RE: Carneal Commercial Subdivision

Sir:

This office has reviewed your plan to install 24 inch pipe and open waterway from above referenced project, through an off-site easement across land owned by Jerry Krietzler, and into Aiken Ditch, a regulated drain in Vanderburgh County, Indiana.

The plan to pipe and ditch storm water runoff from the project to Aiken Ditch was developed by Danny Leek of Morley Associates and is on file in our office.

The County Surveyor approves of said plan so long as it is accomplished as detailed, and so long as a twenty-five (25) foot wide, flat maintenance pathway is left along the top of the bank of Aiken Ditch where your easement and drain enters Aiken Ditch.

This approval also is conditioned upon:

1. Your proper maintenance of your drain within your easement.
2. Submittal of a site drainage plan for each lot or group of lots which will drain into your easement as those lots develop.

  
Bill Jeffers

CONSTRUCT 2' BOTTOM SWALE W/4:1 SIDE SLOPES

MINIMUM COVER OVER PIPE IS 2'

END ELEV. = 368.0

EXISTING AVEN DITCH

CONC. HEADWALL W/FLAP GATE

40' X 24" PIPE

N

NO SCALE

HANKINS

PRIVATE EASEMENT

DUNCAN

564.9'

24" DIA. PIPE

N.E. CORNER S.W. 1/4, N.W. 1/4 SEC. 1-7-10.

Attachment "A"

CONCRETE HEADWALL REQUIRED

ALVEY

251.0'

PRIVATE EASEMENT

KRIETZER

FUTURE STORM WATER RET. LAKE

Headwall & Flap Gate

ELEV. = 370.0

48" DIA. PIPE

GRANT 10' Underground drainage easement

10' In Property

McCARTY

1-164 R/W

ALVEY

EASEMENT LINE

PROPERTY LINE

EASEMENT LINE

KRIETZER

10' 20'

GRND. 374.9

SLOPE VARIES 2 1/2:1±

370.0

2'

FIBER EROSION CONTROL FABRIC REQ'D. SEED UPON COMPLETION OF INSTALLATION

Morley and Associates Inc. 605 S.E. SEVENTH STREET/EVANSVILLE, IN. 47713

Proj. No. 91-1961-4 Chk. By D.K.LEEK Drawn by J.E.WOOD Date 04/24/92



MORLEY AND ASSOCIATES INC.  
 STORM SEWER DESIGN SHEET - RATIONAL METHOD

PROJECT: CARNEAL COMMERCIAL - SECTION 2

OUR PROJECT # 97-1961-4

MANNINGS n 0.011

DATE: 11/06/97

DESIGN PERIOD: 25 YEARS

LINE NO.	UPSTREAM STRUCTURE	PIPE #	DOWNSTREAM STRUCTURE	LENGTH (ft)	Cj	Aj (ac.)	CjAj	CjAj	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	1000	1001	1002	29	0.77	0.51	0.39	0.39	0.39	11.88	11.88	5.590	2.20	12	0.0030	2.31	2.94	0.16
1	1002	1003	1004	55	0.77	0.76	0.59	0.98	0.98	11.88	12.04	5.560	5.45	15	0.0055	5.66	4.61	0.20
1	1004	1005	1011	207	-	-	0.00	0.98	0.98	-	12.24	5.525	5.42	15	0.0055	5.66	4.61	0.75
2	1007	1008	1009	137	0.84	0.79	0.67	0.67	0.67	10.25	10.25	5.880	3.92	15	0.0030	4.18	3.41	0.67
2	1009	1010	1011	130	0.84	0.50	0.42	1.09	1.09	7.56	10.92	5.761	6.26	15	0.0070	6.39	5.21	0.42
3	1011	1012	1013	95	0.84	0.45	0.38	2.45	2.45	7.56	12.99	5.391	13.20	21	0.0050	13.24	5.51	0.29
3	1013	1014	1015	30	0.84	0.21	0.18	2.62	2.62	7.27	13.28	5.340	14.02	21	0.0060	14.50	6.03	0.08
3	1015	1016	1017	60	0.79	0.29	0.23	2.85	2.85	9.99	13.36	5.325	15.20	24	0.0035	15.81	5.04	0.20
3	1017	1018	1019	63	0.79	0.29	0.23	3.08	3.08	9.99	13.56	5.290	16.32	24	0.0040	16.90	5.38	0.20
3	1019	1020	1021	400	0.84	0.22	0.19	3.27	3.27	7.61	13.76	5.255	17.18	24	0.0045	17.93	5.71	1.17

Project : CARNEAL COMMERCIAL - SECTION 2  
 Project No. : 97-1961-4

Developed Drainage Sub-Basins

Sub-basin : 1 Total Area = 55,495 S.F. = 1.27 Ac.

Surface			C	N
Impervious	44,715 S.F. =	1.03 Ac.	0.92	0.02
Drives	0 S.F. =	0.00 Ac.	0.92	0.02
Pavement	0 S.F. =	0.00 Ac.	0.95	0.02
Patios/Pool	0 S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0 S.F. =	0.00 Ac.	0.95	0.02
Lawn (0-2%)	10,780 S.F. =	0.25 Ac.	0.15	0.40
Lawn (2-5%)	0 S.F. =	0.00 Ac.	0.25	0.40
Lawn (5-10%)	0 S.F. =	0.00 Ac.	0.40	0.40
Lawn (>10%)	0 S.F. =	0.00 Ac.	0.55	0.40
Misc.	0 S.F. =	0.00 Ac.	0.00	0.40
Water	0 S.F. =	0.00 Ac.	1.00	0.00

Weighted c =	0.770	
Weighted N =	0.094	
L =	345 Ft.	
H =	4.0 Ft.	
S =	0.0116 Ft./Ft.	
tc =	11.88 Minutes	(Min. 5 minutes)
I(25) =	5.590 In./Hr.	
Q(25) =	5.49 CFS	

Developed Drainage Sub-Basins

Sub-basin : 2 Total Area = 34,543 S.F. = 0.79 Ac.

Surface			C	N
Impervious - 90%	31,039 S.F. =	0.71 Ac.	0.92	0.02
Drives	0 S.F. =	0.00 Ac.	0.92	0.02
Pavement	0 S.F. =	0.00 Ac.	0.95	0.02
Patios/Pool	0 S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0 S.F. =	0.00 Ac.	0.95	0.02
Lawn (0-2%) - 10%	3,454 S.F. =	0.08 Ac.	0.15	0.40
Lawn (2-5%)	0 S.F. =	0.00 Ac.	0.25	0.40
Lawn (5-10%)	0 S.F. =	0.00 Ac.	0.40	0.40
Lawn (>10%)	0 S.F. =	0.00 Ac.	0.55	0.40
Misc.	0 S.F. =	0.00 Ac.	0.00	0.40
Water	0 S.F. =	0.00 Ac.	1.00	0.00

Weighted c =	0.843	
Weighted N =	0.053	
L =	350 Ft.	
H =	3.0 Ft.	
S =	0.0086 Ft./Ft.	
tc =	10.25 Minutes	(Min. 5 minutes)
I(25) =	5.880 In./Hr.	
Q(25) =	3.93 CFS	

Project : CARNEAL COMMERCIAL - SECTION 2  
 Project No. : 97-1961-4

Developed Drainage Sub-Basins

Sub-basin : 3	Total Area =	21,824 S.F. =	0.50 Ac.		
Surface					
Impervious - 90%	19,642 S.F. =	0.45 Ac.	0.92	0.02	
Drives	0 S.F. =	0.00 Ac.	0.92	0.02	
Pavement	0 S.F. =	0.00 Ac.	0.95	0.02	
Patios/Pool	0 S.F. =	0.00 Ac.	0.92	0.02	
Sidewalks	0 S.F. =	0.00 Ac.	0.95	0.02	
Lawn (0-2%) - 10%	2,182 S.F. =	0.05 Ac.	0.15	0.40	
Lawn (2-5%)	0 S.F. =	0.00 Ac.	0.25	0.40	
Lawn (5-10%)	0 S.F. =	0.00 Ac.	0.40	0.40	
Lawn (>10%)	0 S.F. =	0.00 Ac.	0.55	0.40	
Misc.	0 S.F. =	0.00 Ac.	0.00	0.40	
Water	0 S.F. =	0.00 Ac.	1.00	0.00	

Weighted c =	0.843
Weighted N =	0.058
L =	180 Ft.
H =	1.5 Ft.
S =	0.0083 Ft./Ft.
tc =	7.56 Minutes
I(25) =	6.550 In./Hr.
Q(25) =	2.77 CFS

(Min. 5 minutes)

Developed Drainage Sub-Basins

Sub-basin : 4	Total Area =	19,646 S.F. =	0.45 Ac.		
Surface					
Impervious - 90%	17,681 S.F. =	0.41 Ac.	0.92	0.02	
Drives	0 S.F. =	0.00 Ac.	0.92	0.02	
Pavement	0 S.F. =	0.00 Ac.	0.95	0.02	
Patios/Pool	0 S.F. =	0.00 Ac.	0.92	0.02	
Sidewalks	0 S.F. =	0.00 Ac.	0.95	0.02	
Lawn (0-2%) - 10%	1,965 S.F. =	0.05 Ac.	0.15	0.40	
Lawn (2-5%)	0 S.F. =	0.00 Ac.	0.25	0.40	
Lawn (5-10%)	0 S.F. =	0.00 Ac.	0.40	0.40	
Lawn (>10%)	0 S.F. =	0.00 Ac.	0.55	0.40	
Misc.	0 S.F. =	0.00 Ac.	0.00	0.40	
Water	0 S.F. =	0.00 Ac.	1.00	0.00	

Weighted c =	0.843
Weighted N =	0.058
L =	180 Ft.
H =	1.5 Ft.
S =	0.0083 Ft./Ft.
tc =	7.56 Minutes
I(25) =	6.550 In./Hr.
Q(25) =	2.49 CFS

(Min. 5 minutes)

Project : CARNEAL COMMERCIAL - SECTION 2  
 Project No. : 97-1961-4

Developed Drainage Sub-Basins

Sub-basin : 5 Total Area = 9,143 S.F. = 0.21 Ac.

Surface			C	N
Impervious - 90%	8,233	S.F. = 0.19 Ac.	0.92	0.02
Drives	0	S.F. = 0.00 Ac.	0.92	0.02
Pavement	0	S.F. = 0.00 Ac.	0.95	0.02
Patios/Pool	0	S.F. = 0.00 Ac.	0.92	0.02
Sidewalks	0	S.F. = 0.00 Ac.	0.95	0.02
Lawn (0-2%) - 10%	915	S.F. = 0.02 Ac.	0.15	0.40
Lawn (2-5%)	0	S.F. = 0.00 Ac.	0.25	0.40
Lawn (5-10%)	0	S.F. = 0.00 Ac.	0.40	0.40
Lawn (>10%)	0	S.F. = 0.00 Ac.	0.55	0.40
Misc.	0	S.F. = 0.00 Ac.	0.00	0.40
Water	0	S.F. = 0.00 Ac.	1.00	0.00

Weighted c =	0.843	
Weighted N =	0.058	
L =	170 Ft.	
H =	1.5 Ft.	
S =	0.0088 Ft./Ft.	
tc =	7.27 Minutes	(Min. 5 minutes)
I(25) =	6.626 In./Hr.	
Q(25) =	1.17 CFS	

Developed Drainage Sub-Basins

Sub-basin : 6 Total Area = 12,632 S.F. = 0.29 Ac.

Surface			C	N
Impervious	10,537	S.F. = 0.24 Ac.	0.92	0.02
Drives	0	S.F. = 0.00 Ac.	0.92	0.02
Pavement	0	S.F. = 0.00 Ac.	0.95	0.02
Patios/Pool	0	S.F. = 0.00 Ac.	0.92	0.02
Sidewalks	0	S.F. = 0.00 Ac.	0.95	0.02
Lawn (0-2%)	2,095	S.F. = 0.05 Ac.	0.15	0.40
Lawn (2-5%)	0	S.F. = 0.00 Ac.	0.25	0.40
Lawn (5-10%)	0	S.F. = 0.00 Ac.	0.40	0.40
Lawn (>10%)	0	S.F. = 0.00 Ac.	0.55	0.40
Misc.	0	S.F. = 0.00 Ac.	0.00	0.40
Water	0	S.F. = 0.00 Ac.	1.00	0.00

Weighted c =	0.792	
Weighted N =	0.083	
L =	250 Ft.	
H =	2.5 Ft.	
S =	0.0100 Ft./Ft.	
tc =	9.99 Minutes	(Min. 5 minutes)
I(25) =	5.927 In./Hr.	
Q(25) =	1.36 CFS	

Project : CARNEAL COMMERCIAL - SECTION 2  
 Project No. : 97-1961-4

Developed Drainage Sub-Basins

Sub-basin : 7      Total Area = 12,632 S.F. = 0.29 Ac.

Surface			C	N
Impervious	10,537 S.F. =	0.24 Ac.	0.92	0.02
Drives	0 S.F. =	0.00 Ac.	0.92	0.02
Pavement	0 S.F. =	0.00 Ac.	0.95	0.02
Patios/Pool	0 S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0 S.F. =	0.00 Ac.	0.95	0.02
Lawn (0-2%)	2,095 S.F. =	0.05 Ac.	0.15	0.40
Lawn (2-5%)	0 S.F. =	0.00 Ac.	0.25	0.40
Lawn (5-10%)	0 S.F. =	0.00 Ac.	0.40	0.40
Lawn (>10%)	0 S.F. =	0.00 Ac.	0.55	0.40
Misc.	0 S.F. =	0.00 Ac.	0.00	0.40
Water	0 S.F. =	0.00 Ac.	1.00	0.00

Weighted c =	0.792	
Weighted N =	0.083	
L =	250 Ft.	
H =	2.5 Ft.	
S =	0.0100 Ft./Ft.	
tc =	9.99 Minutes	(Min. 5 minutes)
I(25) =	5.927 In./Hr.	
Q(25) =	1.36 CFS	

Developed Drainage Sub-Basins

Sub-basin : 8      Total Area = 9,627 S.F. = 0.22 Ac.

Surface			C	N
Impervious - 90%	8,664 S.F. =	0.20 Ac.	0.92	0.02
Drives	0 S.F. =	0.00 Ac.	0.92	0.02
Pavement	0 S.F. =	0.00 Ac.	0.95	0.02
Patios/Pool	0 S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0 S.F. =	0.00 Ac.	0.95	0.02
Lawn (0-2%) - 10%	963 S.F. =	0.02 Ac.	0.15	0.40
Lawn (2-5%)	0 S.F. =	0.00 Ac.	0.25	0.40
Lawn (5-10%)	0 S.F. =	0.00 Ac.	0.40	0.40
Lawn (>10%)	0 S.F. =	0.00 Ac.	0.55	0.40
Misc.	0 S.F. =	0.00 Ac.	0.00	0.40
Water	0 S.F. =	0.00 Ac.	1.00	0.00

Weighted c =	0.843	
Weighted N =	0.058	
L =	200 Ft.	
H =	2.0 Ft.	
S =	0.0100 Ft./Ft.	
tc =	7.61 Minutes	(Min. 5 minutes)
I(25) =	6.537 In./Hr.	
Q(25) =	1.22 CFS	

Project : CARNEAL COMMERCIAL - SECTION 2  
 Project No. : 97-1951-4

Developed Drainage Sub-Basins

Sub-basin : 9      Total Area = 522,796 S.F. = 12.00 Ac.

Surface			C	N
Impervious - 75%	392,097 S.F. =	9.00 Ac.	0.92	0.02
Drives	0 S.F. =	0.00 Ac.	0.92	0.02
Pavement	0 S.F. =	0.00 Ac.	0.95	0.02
Patios/Pool	0 S.F. =	0.00 Ac.	0.92	0.02
Sidewalks	0 S.F. =	0.00 Ac.	0.95	0.02
Lawn (0-2%) - 25%	130,699 S.F. =	3.00 Ac.	0.15	0.40
Lawn (2-5%)	0 S.F. =	0.00 Ac.	0.25	0.40
Lawn (5-10%)	0 S.F. =	0.00 Ac.	0.40	0.40
Lawn (>10%)	0 S.F. =	0.00 Ac.	0.55	0.40
Misc.	0 S.F. =	0.00 Ac.	0.00	0.40
Water	0 S.F. =	0.00 Ac.	1.00	0.00

Weighted c =	0.728
Weighted N =	0.115
L =	800 Ft.
H =	8.0 Ft.
S =	0.0100 Ft./Ft.
tc =	20.03 Minutes
I(25) =	4.568 In./Hr.
Q(25) =	39.89 CFS

(Min. 5 minutes)