NEW FACILITY FOR:
BUTLER CENTER
CITY OF BRYANT, AR
DRAINAGE CALCULATIONS – SUMMARY
3/2/2023

DESCRIPTION OF PROJECT

Butler center is an approximately 1.51 Acre development located in the City of Bryant, Arkansas approximately a mile south of Reynolds Road. There are three drainage basins on the site. Eastern and Southern basins are small and will not be detained. The large basin will be detained in a pipe network storage located in the western end of the site. The detention for the storage network will be underground in 30" HDPE pipe.

Stormwater Calculations were prepared with the intent to comply with the City of Bryant's Drainage Code. The primary intent of this analysis is to produce a drainage system adequately sized to convey post development runoff while attenuating post development discharge levels equal to or less than pre development flows.

Hydraulic calculations were made using the Rational Method. Design frequencies were analyzed for 2, 5, 10, 25, 50, and 100 year return periods.

These calculations are divided into the following sections:

Summary of Drainage Basins

Summary of Inlets

Summary of Pipes

Pipe Network Storage Summary

Appendices

Exhibit A – Pre-Development Drainage Basins

Exhibit B – Post-Development Drainage Basins

NEW FACILITY FOR:
BUTLER CENTER
CITY OF BRYANT, AR
DRAINAGE CALCULATIONS – SUMMARY
3/2/2023

SUMMARY OF DRAINAGE BASINS

PRE-DEVELOPMENT CONDITIONS

There are three drainage basins on the site. Basin 1 drains to east side and Basin 3 drains to south side of the site. This discharge will not be captured. Basin 2 is developed. This discharge will be captured. The existing site is a mixture of gravel, grass and a building.

POST-DEVELOPMENT CONDITIONS

As previously described, this site is being developed into a commercial facility. Slopes range from 1% to 8%. Runoff drains from the developed areas to underground detention in the south western section of the development.

SUMMARY OF INLETS

On the drainage plan you will see labels for all of the inlets for these calculations. The flows shown are for the 10-year return storm. The distance from the face of the curb to the center of the street is 15 feet.

SUMMARY OF PIPES

All pipes used in this project are HDPE and RCP. Therefore, a manning's of 0.012 was used on all pipes in the analysis.

PIPE NETWORK STORAGE SUMMARY

The pipe network storage in these calculations detains flows from all of the runoff of the site. The pipe network storage is located in the south western portion of the property. Water collected in the storm water system is discharged into the pipe network via curb inlets. The pipe network storage is made of 263 linear feet of 30" HDPE and RCP pipe and has a volume of 1,289 cf. A concrete control structure is constructed on the southern end of the pipe network storage. This control structure uses a slotted weir to limit the discharge through the structure to that of the 2, 10, 25, 50, and 100-year pre-development flow. The pipe network storage is designed to hold the 100-year storm event.

DATE	REVISION	BY

GNE Designing our client's success
GarNat Engineering, LLC
P.O. Box 116
Benton, AR 72018
Ph (501) 408-4650
3825 Mt Carmel Rd
Bryant, AR 72022
garnatengineering@gmail.com

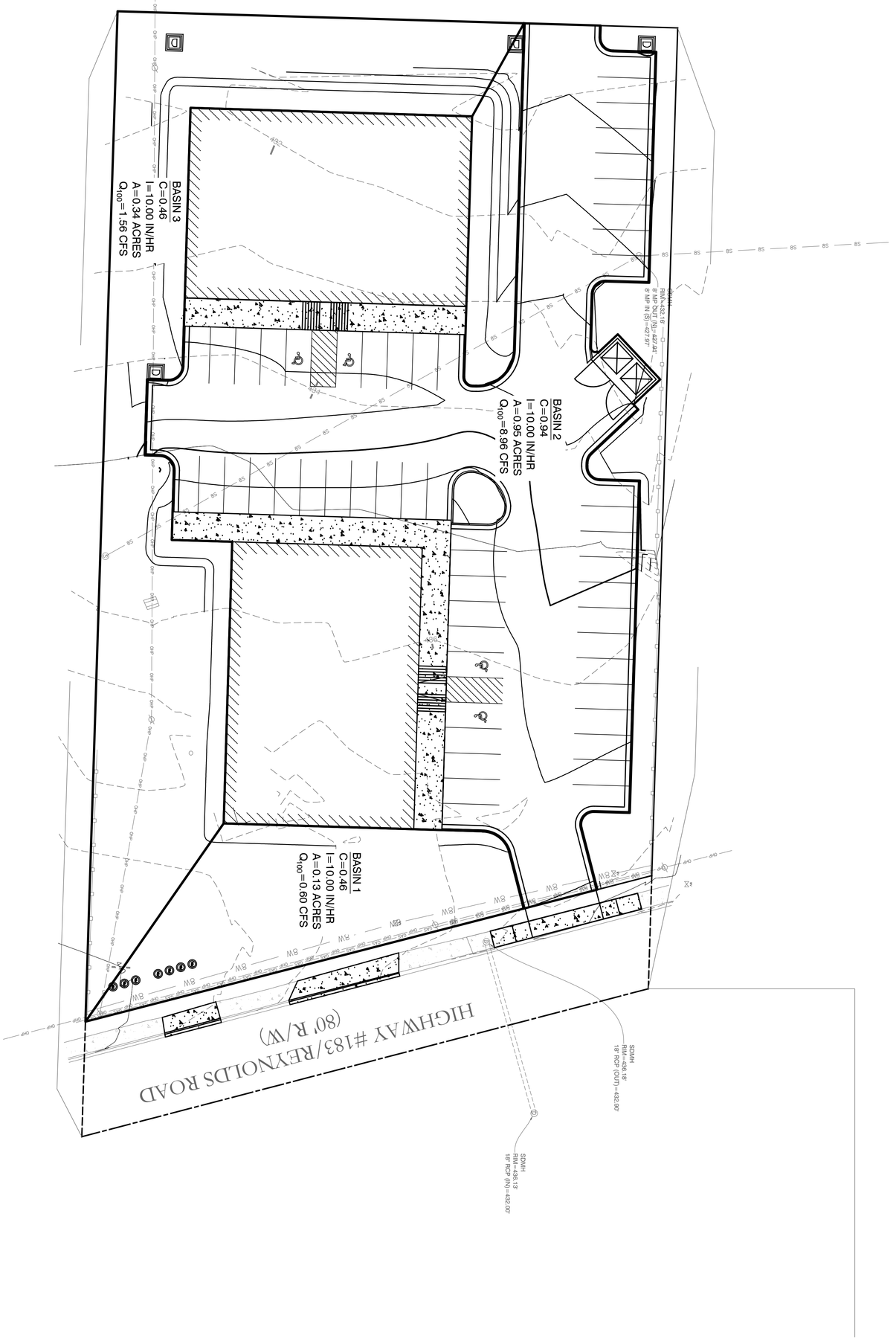
NEW FACILITY FOR:
BUTLER CENTER
CITY OF BRYANT, AR

CONTENTS:
PRE DRAINAGE PLAN

PROJECT NO: 22203

DATE: FEB 2023

SHEET NO: 1.0



NEW FACILITY FOR:
BUTLER CENTER
CITY OF BRYANT, AR

GNE Designing our client's success

GarNat Engineering, LLC

P.O. Box 116
Benton, AR 72018
Ph (501) 408-4650

3825 Mt Carmel Rd
Bryant, AR 72022
garnatengineering@gmail.com

DATE	REVISION	BY

CONTENTS: POST DRAINAGE PLAN

PROJECT NO: 22203

DATE: FEB 2023

SHEET NO: 2.0

J:\Projects\2022 Projects\22203 Butler Center 1109 North Reynolds Road Kenny Whitfield\Drawings\DWGs\Design\22203 1109 N Reynolds Rd Design.dwg

Stormwater Calcs - Butler Center
Using Rational Method

Pre-development

Calculated Tc values - Drainage Basin 1 & 3

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	100	feet
n1 =	0.03	
S1 =	0.032	ft/ft
$I_{assumed}$ =	8.40	inches
$Tc_{calculated}$	130	seconds
$Tc_{calculated}$	2.16	minutes

Tc =	2.16	minutes	Tc for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
I =	8.40	inches	i for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
Use Tc =	**5.00**	minutes	

I_{100} =	10	Inches	I_{10} =	7.2	Inches
I_{50} =	9.2	Inches	I_{5} =	6.5	Inches
I_{25} =	8.40	Inches	I_{2} =	5.6	Inches

Calculated Tc values - Drainage Basin 2

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	320	feet
n1 =	0.03	
S1 =	0.032	ft/ft
$I_{assumed}$ =	8.40	inches
$Tc_{calculated}$	261	seconds
$Tc_{calculated}$	4.35	minutes

Tc =	4.35	minutes	Tc for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
I =	8.40	inches	i for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
Use Tc =	**5.00**	minutes	

I_{100} =	10	Inches	I_{10} =	7.2	Inches
I_{50} =	9.2	Inches	I_{5} =	6.5	Inches
I_{25} =	8.40	Inches	I_{2} =	5.6	Inches

Stormwater Calcs - Butler Center
Using Rational Method

Post-development

Calculated Tc values - Drainage Basin 1, 2 & 3

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	320	feet
n1 =	0.013	
S1 =	0.035	ft/ft
$I_{assumed}$ =	8.40	inches
$Tc_{calculated}$	154	seconds
$Tc_{calculated}$	2.56	minutes

Tc =	2.56	minutes	Tc for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
I =	8.40	inches	i for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
Use Tc =	**5.00**	minutes	

I_{100} =	10 Inches	I_{10} =	7.2 Inches
I_{50} =	9.2 Inches	I_{5} =	6.5 Inches
I_{25} =	8.40 Inches	I_{2} =	5.6 Inches

Stormwater Calcs - Butler Center
using Rational Method

Pre-development

Calculated C values - Drainage Basin 1

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	0.08	0.47	0.43	0.4	0.36	0.34	0.31	Flat, 0-2%
Driveway	0.09	0.97	0.92	0.88	0.83	0.8	0.75	Road
Total Area =	**0.17**	**0.73**	**0.69**	**0.65**	**0.61**	**0.58**	**0.54**	

Calculated C values - Drainage Basin 2

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	1.09	0.47	0.43	0.4	0.36	0.34	0.31	Flat, 0-2%
Gravel	0.07	0.65	0.55	0.5	0.35	0.3	0.25	Gravel
Roof	0.02	0.97	0.92	0.88	0.83	0.8	0.75	Roof
Total Area =	**1.18**	**0.49**	**0.45**	**0.42**	**0.37**	**0.35**	**0.32**	

Calculated C values - Drainage Basin 3

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	0.16	0.47	0.43	0.4	0.36	0.34	0.31	Flat, 0-2%
Total Area =	**0.16**	**0.47**	**0.43**	**0.40**	**0.36**	**0.34**	**0.31**	

Stormwater Calcs - Butler Center
using Rational Method

Post-development

Calculated C values - Drainage Basin 1

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2
Greenspace	0.13	0.46	0.42	0.39	0.35	0.32	0.29
Total Area =	**0.13**	**0.46**	**0.42**	**0.39**	**0.35**	**0.32**	**0.29**

(C values taken from Table 400-2 of City of Bryant Drainage Manual)

Good Condition, Average 2-7%

Calculated C values - Drainage Basin 2

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2
Greenspace	0.05	0.46	0.42	0.39	0.35	0.32	0.29
Roof/Pavement	0.90	0.97	0.92	0.88	0.83	0.8	0.75
Total Area =	**0.95**	**0.94**	**0.89**	**0.85**	**0.80**	**0.77**	**0.73**

(C values taken from Table 400-2 of City of Bryant Drainage Manual)

Good Condition, Average 2-7%

Road

Calculated C values - Drainage Basin 3

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2
Greenspace	0.34	0.46	0.42	0.39	0.35	0.32	0.29
Total Area =	**0.34**	**0.46**	**0.42**	**0.39**	**0.35**	**0.32**	**0.29**

(C values taken from Table 400-2 of City of Bryant Drainage Manual)

Good Condition, Average 2-7%

Stormwater Calcs - Butler Center
using Rational Method

Pre-development

Drainage Basin 1

Q_{100} =	1.25 CFS	Q_{50}=	1.08 CFS	Q_{25} =	0.93 CFS	Q_{10} =	0.75 CFS	Q_5 =	0.64 CFS	Q_2 =	0.52 CFS
c =	0.73	c =	0.69	c =	0.65	c =	0.61	c =	0.58	c =	0.54
i=	10.00 in/hr	i=	9.20 in/hr	i=	8.40 in/hr	i=	7.20 in/hr	i=	6.50 in/hr	i=	5.60 in/hr
A=	0.17 acres	A=	0.17 acres	A=	0.17 acres	A=	0.17 acres	A=	0.17 acres	A=	0.17 acres

Drainage Basin 2

Q_{100} =	5.79 CFS	Q_{50}=	4.85 CFS	Q_{25} =	4.12 CFS	Q_{10} =	3.13 CFS	Q_5 =	2.66 CFS	Q_2 =	2.08 CFS
c =	0.49	c =	0.45	c =	0.42	c =	0.37	c =	0.35	c =	0.32
i=	10.00 in/hr	i=	9.20 in/hr	i=	8.40 in/hr	i=	7.20 in/hr	i=	6.50 in/hr	i=	5.60 in/hr
A=	1.18 acres	A=	1.18 acres	A=	1.18 acres	A=	1.18 acres	A=	1.18 acres	A=	1.18 acres

Drainage Basin 3

Q_{100} =	0.75 CFS	Q_{50}=	0.63 CFS	Q_{25} =	0.54 CFS	Q_{10} =	0.41 CFS	Q_5 =	0.35 CFS	Q_2 =	0.28 CFS
c =	0.47	c =	0.43	c =	0.40	c =	0.36	c =	0.34	c =	0.31
i=	10.00 in/hr	i=	9.20 in/hr	i=	8.40 in/hr	i=	7.20 in/hr	i=	6.50 in/hr	i=	5.60 in/hr
A=	0.16 acres	A=	0.16 acres	A=	0.16 acres	A=	0.16 acres	A=	0.16 acres	A=	0.16 acres

Post-development

Drainage Basin 1

Q_{100} =	0.60 CFS	Q_{50}=	0.50 CFS	Q_{25} =	0.43 CFS	Q_{10} =	0.33 CFS	Q_5 =	0.27 CFS	Q_2 =	0.21 CFS
c =	0.46	c =	0.42	c =	0.39	c =	0.35	c =	0.32	c =	0.29
i=	10.00 in/hr	i=	9.20 in/hr	i=	8.40 in/hr	i=	7.20 in/hr	i=	6.50 in/hr	i=	5.60 in/hr
A=	0.13 acres	A=	0.13 acres	A=	0.13 acres	A=	0.13 acres	A=	0.13 acres	A=	0.13 acres

Drainage Basin 2

Q_{100} =	8.96 CFS	Q_{50}=	7.81 CFS	Q_{25} =	6.82 CFS	Q_{10} =	5.50 CFS	Q_5 =	4.78 CFS	Q_2 =	3.86 CFS
c =	0.94	c =	0.89	c =	0.85	c =	0.80	c =	0.77	c =	0.73
i=	10.00 in/hr	i=	9.20 in/hr	i=	8.40 in/hr	i=	7.20 in/hr	i=	6.50 in/hr	i=	5.60 in/hr
A=	0.95 acres	A=	0.95 acres	A=	0.95 acres	A=	0.95 acres	A=	0.95 acres	A=	0.95 acres

Drainage Basin 3

Q_{100} =	1.56 CFS	Q_{50}=	1.31 CFS	Q_{25} =	1.11 CFS	Q_{10} =	0.86 CFS	Q_5 =	0.71 CFS	Q_2 =	0.55 CFS
c =	0.46	c =	0.42	c =	0.39	c =	0.35	c =	0.32	c =	0.29
i=	10.00 in/hr	i=	9.20 in/hr	i=	8.40 in/hr	i=	7.20 in/hr	i=	6.50 in/hr	i=	5.60 in/hr
A=	0.34 acres	A=	0.34 acres	A=	0.34 acres	A=	0.34 acres	A=	0.34 acres	A=	0.34 acres

Detention Volume

Pond-1
for Q100

Cundev=	0.49	
Iundev=	10.00	in/hr
Cdev=	0.94	
Idev=	10.00	in/hr
R=	4.52	
A=	0.95	acres
Tc=	5.00	minutes
	60	sec/min

Detention Volume= 1,289 cubic feet

R= (Cdev*Idev)-(Cundev*Iundev)
Detention Volume= R*A*Tc*60

Stormwater Calcs - Butler Center
using Rational Method
Weir & Detention Pond Sizing

Storm Event	Flow (cfs)
Q2 - Pre Basin 2	2.08
Q10 - Pre Basin 2	3.13
Q25 - Pre Basin 2	4.12
Q50 - Pre Basin 2	4.85
Q100 - Pre Basin 2	5.79
Q10 - Post Basin 2	5.50
Q25 - Post Basin 2	6.82
Q100 - Post Basin 2	8.96

Rectangular Weir

Q2

Q (cfs)	**CLH^1.5**
C	**2.5**
L	**0.5** 6"
H	**1.33**
Q (cfs)	**1.92**

Q10

Q (cfs)	**CLH^1.5**
C	**2.5**
L	**0.5** 6"
H	**1.75**
Q (cfs)	**2.89**

Q25

Q (cfs)	**CLH^1.5**
C	**2.5**
L	**0.5** 6"
H	**2.17**
Q (cfs)	**4.00**

Q50

Q (cfs)	**CLH^1.5**
C	**2.5**
L	**0.5** 6"
H	**2.33**
Q (cfs)	**4.45**

Q100

Q (cfs)	**CLH^1.5**
C	**2.5**
L	**0.5** 6"
H	**2.5**
Q (cfs)	**4.94**

Pond Volume
Volume Required 1289 CF

Use 36" Pipe

Dia = 30.00
A = 4.91 SF
L (required) = 262.61 FT

Stormwater Calcs - Butler Center
Detention Culverts

PIPE NAME	DIAMETER (IN)	LENGTH (FT)	AREA (SF)	VOLUME (CF)
PIPE 141	30.00	117	4.91	574.47
PIPE 139	30.00	121	4.91	594.11
PIPE 140	30.00	46	4.91	225.86
TOTAL		284		**1394.44**

Stormwater Calcs - Butler Center
Outlet Pipe Capacity

OUTLET CULVERT

Pipe	From	To	Design Flow (cfs):	Slope (ft/ft):	Diameter (inches)	No. Pipes	Manning's	Area Full (sf)	Wetted Perimeter Full (ft)	Hydraulic Radius Full (ft)	Flow Capacity (cfs)	% Capacity
18" HDPE	East	West	5.79	0.0050	18	1	0.012	1.77	4.712	0.375	8.05	72%

Stormwater Calcs - Butler Center

Ditch Capacity

Mannings equation for ditch

n= 0.022 based on n for open channel earth with short grass, few weeds

Depth (ft)	Width Bottom (ft)	Top (ft)	area (ft^2)	rH	slope (ft/ft)	Velocity (ft/s)	Q (cfs)
0.75	0.00	4.50	1.69	0.36	1.000%	3.40	5.74

BY	REVISION	DATE

GNE Designing our client's success

GarNat Engineering, LLC
P.O. Box 116
Benton, AR 72018
3825 Mt Carmel Rd
Bryant, AR 72022
Ph (501) 408-4650
garnatengineering@gmail.com

NEW FACILITY FOR:
BUTLER CENTER
CITY OF BRYANT, AR

..\..\..\Document Scans\PE Stamps\ARKINS NEW TEMPLATE.jpg

CONTENTS:

INLET BASIN PLAN

PROJECT NO:
22203

DATE:
FEB 2023

SHEET NO:

3.0

Stormwater Calcs - Butler Center
Using Rational Method

Post-development Basin

Calculated Tc values - Drainage Basin CI-1

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	700		feet
n1 =	0.013		Smooth Concrete/Asphalt
S1 =	0.031		ft/ft
$I_{assumed}$ =	7.20		inches
$Tc_{calculated}$		271	seconds
$Tc_{calculated}$		4.52	minutes
Tc =	4.52		minutes
I =	7.20		inches
Use Tc =	**5.00**		minutes

Stormwater Calcs - Butler Center
using Rational Method
POST-DEV C VALUES

CI-1

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.41	0.83	0.88	0.97	Asphalt/Roof
Total Area =	**0.41**	**0.83**	**0.88**	**0.97**	

CI-2

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.09	0.83	0.88	0.97	Asphalt/Roof
Total Area =	**0.09**	**0.83**	**0.88**	**0.97**	

CI-4

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.29	0.83	0.88	0.97	Asphalt/Roof
Total Area =	**0.29**	**0.83**	**0.88**	**0.97**	

Stormwater Calcs - Butler Center
using Rational Method
Post Development Flowrates

CI-1

Q_{10} =	2.45	CFS
c =	0.83	
i=	7.20	in/hr
A=	0.41	acres

CI-2

Q_{10} =	0.54	CFS
c =	0.83	
i=	7.20	in/hr
A=	0.09	acres

CI-4

Q_{10} =	1.73	CFS
c =	0.83	
i=	7.20	in/hr
A=	0.29	acres

Stormwater Calcs - Butler Center GUTTER SPREAD 10-YR STORM

CI-1

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

			Q= Flowrate(cfs)
Q	2.45	cfs	n=manning's number
n	0.012		k=0.56
k_u	0.56		S_x= cross slope
S_x	0.028		S_L= longitudinal slope
S_L	0.031		T= Gutter Spread
T	**5.96**	ft	

CI-2

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

Q	0.54	cfs
n	0.012	
k_u	0.56	
S_x	0.03	
S_L	0.017	
T	**3.62**	ft

CI-4

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

Q	1.73	cfs
n	0.012	
k_u	0.56	
S_x	0.028	
S_L	0.03	
T	**5.34**	ft

Stormwater Calcs - Butler Center - CURB INLETS

10-YEAR STORM

Area #	Area	I	C	Q (cfs)	Weir Q=3.0LY^1.5 Q (cfs)	Y (ft)	Required L (ft)	Actual L (ft)	
CI-1	0.41	7.20	0.83	2.45	2.45	0.49	**2.38**	**5**	5' box
CI-2	0.09	7.20	0.83	0.54	0.54	0.49	**0.52**	**5**	5' box
CI-4	0.29	7.20	0.83	1.73	1.73	0.49	**1.68**	**5**	5' box