BROWNING MANOR
FINAL DRAINAGE PLAN
(With Preliminary)

APPROVED OCTOBER 30, 2018

Mueller, Jeffrey

From:	Glen Meritt <GMeritt@cashwaggner.com>
Sent:	Thursday, October 25, 2018 5:07 PM
To:	Mueller, Jeffrey
Subject:	Browning Manor
Attachments:	doc07816220181025165901.pdf

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Jeff,

Attached is the revised drainage report with the updated tree easement language for Browning Manor.

Glen Meritt Jr.
Project Engineer
CASH WAGGNER & ASSOCIATES, PC
414 Citadel Circle, Suite B
Evansville, IN 47715
Main: 812-401-5561 Cell: 812-774-2988

Browning Manor-Final Drainage Plan

The final drainage plan was submitted on Submitted September 17, 2018 with revisions submitted on October 9, 2018 and October 24, 2018 along with emails October 13, 16, 22 and 25, 2018, The plan that is requested to be approved consists of the submitted document and revisions and emails on the respective submitted dates along with the following drawings.

Drawings submitted September 17th, 2018

- Drawing 1 Undeveloped Basins

Drawings submitted October 9th, 2018

- Drawing 2 Developed Subbasins

Drawings submitted October 24th, 2018

- C-101
- C-110
- Drawing 1-Existing Stream Profiles
- C-108
- C-111

Road plans for Reference Only

- C-104
- C-105

CASH WAGGNER & ASSOCIATES, PC

CONSULTING ENGINEERS • LAND SURVEYORS

October 25, 2018

Mr. Jeff Mueller
Vanderburgh County Surveyor
Room 325 Civic Center - 1 NW Martin Luther King Jr. Blvd.
Evansville, IN 47708

RE: **Final Drainage Report**
Browning Manor
Browning Road
Our Project #: 18-3294

Mr. Mueller:

Below is a summary of the drainage calculations for the above-referenced project.

SITE DESCRIPTION

This development will consist of 13 single family residential lots, 18 additional lots that will be part of a PUD development containing 18 duplex townhomes and their associated improvements (i.e. roads, utilities). This development is located on a 17.74-acre parcel that lies on the west side of Browning Road approximately 1500 feet south of the Browning Road and Boonville New Harmony Road intersection. This project will be constructed and platted in one phase. Roughly half of the property will be disturbed during construction of the subdivision. The majority of the existing trees along the north and south property lines will remain undisturbed except for the wooded areas where detention basin #1 and the sanitary sewer main that will be constructed along the south property line. The original 75' tree easement along the south property line remains in the same general location roughly 75' north of the south property line. The dimension was reduced from 75' to 45' to account for the 30+/- easement that was required by EWSU adjacent to the south property line. The two existing ditches located on the southern portion of Lots 6 & 7 will remain undisturbed.

No regulated drains, inlets or outfalls exist on this site. An existing force main is located along the entire southern property line. No known wells, septic tank systems or outfalls exist on this site. No seeps, springs, sinkholes, caves, shafts, faults or other such geological features are visible or of record on this site.

The proposed sanitary sewer mains and 8" water main will be public and maintained by EW&SU.

The developer will be utilizing Repair Fund "B" for the maintenance and repair of all storm water drainage systems and facilities outside the county accepted road right-of-way. Upon the completion of the earthwork activities and utility construction, Tenbarge – Green Alliance seed mixture will be used for permanent seeding all green space areas and the earthen side slopes of detention basins #1 & #2. No tree limbs,

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EVANSVILLE, IN 47715   E-MAIL: GMERITT@CASHWAGGNER.COM
PH: 812.401.5561
FAX: 812.401.5563

Submitted by email October 26, 2018-Correction to Easement Langauge

refuse from legally burnt vegetation, nor construction waste, demolition materials or other man-made material may be buried within detention basins #1 or #2. Any existing trees from the proposed top of bank to the bottom of detention basin #2 will be removed. Neither Army Corp or IDEM required the native seed mix planting around detention basin #2. It is for aesthetic purposes and to provide a natural vegetative buffer around the basin. The native seed mix area can be mowed once or twice each year.

The following statements will be included on the recorded plat for Browning Manor Subdivision and Browning Manor PUD:
The individual lot owners shall be responsible, including financially, for maintaining that part of the storm water system and its easements which exist on his or her property in proper working order including:

1. Mowing grass, controlling weeds and maintaining the designed cover of waterways, storage basins and easements in accordance with all applicable ordinances.
2. Keeping all parts of the storm water system operating as designed and as constructed and free of all trash, debris and obstructions to the flow of water.
3. Keeping the channels, embankments, shorelines and bottoms of waterways and basins free from erosion and sedimentation.
4. Maintaining that part of the storm water system which lies on his or her property in accordance with the conditions described on the approved street and/or drainage plans on file in the County Surveyor's Office and/or in the County Engineer's Office and in compliance with the County Drainage Ordinance.

The following tree easement language will also be added to both plats: Tree Easements are hereby set aside as an area in which existing trees are to remain in place as a natural buffer and which are protected from removal. This easement is in favor of the Vanderburgh County, as required by the Vanderburgh County Drainage Board. Fences, landscaping and trails are permitted in this area provided that existing trees over eight inches in diameter, will not be removed. The underlying lot owner is responsible for maintenance of this easement on their lot, which includes the removal of dead or fallen trees. Any modification to this easement, as granted by this plat, must have the approval of the Vanderburgh County Drainage Board.

DRAINAGE PATTERNS

The existing site is rolling with 60' of relief to the south and 54' of relief to the north. The existing ground cover consists of 5.08-acres of pasture and 12.66-acres of woods. UN-1 consists of 6.30-acres located on the north end of the site. Runoff sheet flows north to an existing ditch that flows west off-site. UN-2 consists of 8.11-acres located in the southwest corner of the site. Runoff sheet flows south to an existing ditch that flows west off-site. UN-3 consists of 3.33-acres located in the southeast corner of the site. Runoff sheet flows south to an existing 12" R.C.P. pipe that drains into an existing lake that is located on the adjoining property to the south. See attached Undeveloped Sub-basin Exhibit for the location of each sub-basin.

The 25-year and 100-year flows were calculated for the entire 17.74-acre development. This development was divided into 14 developed sub-basins and three off-site sub-basins. Sub-basins #3 - #9, OS-1, OS-2 and OS-3 will be collected by Detention Basin #1. The primary spillway of detention basin #1 will sheet flow to the southwest off-site to the existing ditch. Sub-basins #1, #2, #13 and #14 will be collected by Detention Basin #2. The primary spillway of detention basin #2 will sheet flow west to the existing low point at the southeast corner of Lot #3 and then flow south to the existing 12" R.C.P. pipe that drains into an existing lake off-site. Sub-basin #12 sheet flows off-site undetained to the existing ditch located along the southwest property line. Sub-basin #11 sheet flows off-site undetained to the south to the existing 12" R.C.P. pipe. Sub-basin #12 sheet flows off-site undetained to the existing ditch located along the north property line. See attached Developed Sub-basin Exhibit for the locations of each sub-basin.

A drainage swale and storm sewer network will be installed within the development to capture the storm water runoff and convey it to detention basins #1 and #2. Storm sewers will be constructed with reinforced concrete pipe and N-12 Watertight HDPE. P-535 will require a 12" diameter culvert under Road #1. The primary outlet and emergency spillway of Detention Basin #1 will discharge to the existing ditch that is located along the southwest property line. The primary outlet and emergency spillway of Detention Basin #2 will discharge southwest towards the existing 12" R.C.P. pipe. All runoff ultimately discharges to Little Pigeon Creek.

CALCULATIONS

The Rational Method and HERPICC Manual were utilized in performing the drainage calculations for this project. All storm sewers and swales were designed to carry the 25-year developed runoff. The outlet structure for the detention basin was sized for the 25-year design storm event while allowing a discharge rate less than the undeveloped 10-year storm event from the system. The emergency spillways for both detention basins were designed to convey the 100-year storm flow.

Below is a summary of the detention basin design elements:

Detention Basin #1		NOTES
Detention Basin #1 Developed Q(25)	21.24 – cfs	#3 - #9
Detention Basin #1 Developed Q(100)	25.80 - cfs	#3 - #9
Detention Basin #1 Undeveloped Q(10)	16.39 – cfs	UN-2
Undetained Developed Q(25)	11.04 – cfs	#10
Off-Site Developed Q(25)	2.88 - cfs	OS-1, OS-2 & OS-3
25-year Req'd Storage Volume	15,088 - cf	
25-year Provided Storage Volume	16,497 - cf	
Allowable Detention Basin #1	8.23 – cfs	Undeveloped Q(10) –

CASH WAGGNER & ASSOCIATES, PC

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EVANSVILLE, IN 47715

PH: 812.401.5561
FAX: 812.401.5563

Release Rate		Undetained Developed Q(25) + Off-Site Developed Q(25)
Proposed Detention Basin #1 Release Rate	*4.83 - cfs*	*Detention Basin #1 Primary Spillway*
Outlet Structure	*43-LF of 12" R.C.P.*	*P-525*
Outlet I.E.	453.00	
25-year Storage Vol. Elev.	455.05	
HW (25-yr. elev. – I.E.)	2.05 – ft.	
Minimum Top/Bank	456.00	

Detention Basin #2		**NOTES**
Detention Basin #2 Developed Q(25)	5.08 – cfs	#1, #2, #13, #14
Detention Basin #2 Developed Q(100)	6.12 - cfs	#1, #2, #13, #14
Detention Basin #2 Undeveloped Q(10)	6.82 – cfs	UN-3
Undetained Developed Q(25)	4.73 – cfs	#11
Off-Site Developed Q(25)	0.00 - cfs	
25-year Req'd Storage Volume	3,790 - cf	
25-year Provided Storage Volume	4,692 - cf	
Allowable Detention Basin #2 Release Rate	2.09 – cfs	Undeveloped Q(10) – Undetained Developed Q(25) + Off-Site Developed Q(25)
Proposed Detention Basin #2 Release Rate	*0.94 - cfs*	*Detention Basin #2 Primary Spillway*
Outlet Structure	*32-LF of 8" HDPE*	*P-539*
Outlet I.E.	499.50	
25-year Storage Vol. Elev.	500.16	
HW (25-yr. elev. – I.E.)	0.66 – ft.	
Minimum Top/Bank	501.00	

Submitted by email October 26, 2018-Correction to Easement Langauge

DATE:	10.24.18	
PROJECT NO.:	18-3294	
REFERENCE:	Browning Manor	
YOUR FILE NO.:		

ATTENTION:	Jeff Mueller
COMPANY:	Vanderburgh County Surveyor
ADDRESS:	Civic Center Complex – Room 325
CITY, ST, ZIP:	Evansville, IN 47708
PHONE:	

LETTER OF TRANSMITTAL

THE FOLLOWING ITEMS:

COPIES:	ORIG./LAST REV. DATE:	DESCRIPTION:
1	10.24.18	Revised Drainage Plan & Details
1	10.24.18	Revised Road Plans & Details
1	10.24.18	Revised Final Drainage Report

ARE TRANSMITTED:

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COMMENTS:

Please review the attached final drainage plan and report. If you have any questions or comments, please give me a call. Thank you

FROM:

GLEN MERITT, JR., P.E.

Cc: File

T:\EVANSVILLE\3294\DOCUMENTS\181024 MUELLER.DOC

Trapezoidal Riprap-Lined Waterway Design.xlsm

	A	B	C	D	E	F	G	H	I
2	Landowner	Browning Manor		County	Vanderburgh			V 1.2015	
3	Computed By	Glen Meritt		Date	10/23/2018			1/15/2015	
4	Checked by	Swale #7		Date					
5	*Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.*								
6	Design flow, Q=	4	cfs			WW horiz. Length=		95.0	ft
7	Slope, S=	0.1088	ft/ft =	9.19	:1	U/S WW F.L. elev=		465.3	ft
8	Bottom Width, W=	1	ft			D/S WW F.L. elev=		455.0	ft
9	Side slope, Z=	3	:1			Waterway drop=		10.3	ft
10	Safety factor=	1		Typically 1.2		WW length along slope=		95.6	ft
11	Rock shape =	Angular							
12	Min. req'd D50=	5.86	in			Spreadsheet formatting key:			
13	D50 used=	6.00	in			XXX	=Input cells		
14	n=	0.044				X.XX	=Output from "Solve" button		
15	Freeboard=	0.00	ft			X.XX	=Other computed output		
16						Red text	=Instructions, warnings, info		
17	Flow depth, d=	0.41	ft	Calculated					
18	Critical depth, d_c=	0.50	ft						
19	Critical slope, S_c=	0.044	ft/ft	$0.7S_c$ =	0.0307	ft/ft			
20				$1.3S_c$ =	0.0571	ft/ft			
21	Design slope, S=	0.1088	ft/ft	Design slope OK. Flow is Supercritical.					
22	Velocity=	4.44	fps			Est. riprap unit wt=			Tons/CY
23				Rock shape = Angular			Rock Gs =		

Required riprap gradation for D50 selected

% Smaller	Rock dia., inches		Rock weight, lb	
	min.	max.	min.	max.
100	9.0	12.0	0	0
85	7.8	10.8	0	0
50	6.0	9.0	0	0
10	4.8	7.8	0	0

WW CROSS SECTION

WW PROFILE

Quantities:

Riprap volume=	37.7	CY
Approx. weight=	0.0	Tons
Geotextile area=	220.0	SY*

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)

10/24/2018

Trapezoidal Riprap-Lined Waterway Design.xlsm

	A	B	C	D	E	F	G	H	I
2	Landowner	Browning Manor		County	Vanderburgh			V 1.2015	
3	Computed By	Glen Meritt		Date	10/23/2018				
4	Checked by	Swale #8A		Date				1/15/2015	

Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.

	A	B	C	D	E	F	G	H	I
6	Design flow, Q=	3.25	cfs				WW horiz. Length=	70.0	ft
7	Slope, S=	0.1214	ft/ft =	8.24	:1		U/S WW F.L. elev=	488.0	ft
8	Bottom Width, W=	1	ft				D/S WW F.L. elev=	479.5	ft
9	Side slope, Z=	3	:1				Waterway drop=	8.5	ft
10	Safety factor=	1		Typically 1.2			WW length along slope=	70.5	ft
11	Rock shape =	Angular							
12	Min. req'd D50=	5.43	in				Spreadsheet formatting key:		
13	D50 used=	6.00	in				XXX	=Input cells	
14	n=	0.045					X.XX	=Output from "Solve" button	
15	Freeboard=	0.00	ft				X.XX	=Other computed output	
16							Red text	=Instructions, warnings, info	
17	Flow depth, d=	0.36	ft	Calculated					
18	Critical depth, d_c=	0.45	ft						
19	Critical slope, S_c=	0.047	ft/ft	$0.7S_c$ =	0.0326	ft/ft			
20				$1.3S_c$ =	0.0606	ft/ft			
21	Design slope, S=	0.1214	ft/ft	Design slope OK. Flow is Supercritical.					
22	Velocity=	4.33	fps				Est. riprap unit wt=		Tons/CY
23				Rock shape = Angular			Rock Gs =		

	Required riprap gradation for D50 selected				
%	Rock dia., inches		Rock weight, lb		
Smaller	min.	max.	min.	max.	
100	9.0	12.0	0	0	
85	7.8	10.8	0	0	
50	6.0	9.0	0	0	
10	4.8	7.8	0	0	

WW CROSS SECTION

WW PROFILE

	A	B	C
36	Quantities:		
37	Riprap volume=	27.8	CY
38	Approx. weight=	0.0	Tons
39	Geotextile area=	163.5	SY*

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)

10/24/2018

Trapezoidal Riprap-Lined Waterway Design.xlsm

	A	B	C	D	E	F	G	H	I
2	Landowner	Browning Manor		County	Vanderburgh			V 1.2015	
3	Computed By	Glen Meritt		Date	10/23/2018			1/15/2015	
4	Checked by	Swale #8B		Date					
5	Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.								
6	Design flow, Q=	3.25	cfs			WW horiz. Length=		94.0	ft
7	Slope, S=	0.1506	ft/ft =	6.64	:1	U/S WW F.L. elev=		479.5	ft
8	Bottom Width, W=	1	ft			D/S WW F.L. elev=		465.3	ft
9	Side slope, Z=	3	:1			Waterway drop=		14.2	ft
10	Safety factor=	1		Typically 1.2		WW length along slope=		95.1	ft
11	Rock shape =	Angular							
12	Min. req'd D50=	5.80	in			Spreadsheet formatting key:			
13	D50 used=	6.00	in			XXX =Input cells			
14	n=	0.046				X.XX =Output from "Solve" button			
15	Freeboard=	0.00	ft			X.XX =Other computed output			
16						Red text =Instructions, warnings, info			
17	Flow depth, d=	0.35	ft	Calculated					
18	Critical depth, d_c=	0.45	ft						
19	Critical slope, S_c=	0.050	ft/ft	$0.7S_c$ =	0.0348	ft/ft			
20				$1.3S_c$ =	0.0646	ft/ft			
21	Design slope, S=	0.1506	ft/ft	Design slope OK. Flow is Supercritical.					
22	Velocity=	4.58	fps			Est. riprap unit wt=			Tons/CY
23				Rock shape = Angular			Rock Gs =		

Required riprap gradation for D50 selected

%	Rock dia., inches		Rock weight, lb	
Smaller	min.	max.	min.	max.
100	9.0	12.0	0	0
85	7.8	10.8	0	0
50	6.0	9.0	0	0
10	4.8	7.8	0	0

3.0 ft — 1.0 ft — 1.0 ft — 2.0 ft — Riprap — 1.3 ft — 6.3 ft — Geotextile

WW CROSS SECTION

Quantities:

Riprap volume=	37.5	CY
Approx. weight=	0.0	Tons
Geotextile area=	218.9	SY*

95.1 ft — 1.0 ft — 1 — 6.64 — Riprap — Geotextile

WW PROFILE

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)

Trapezoidal Riprap-Lined Waterway Design.xlsm

	A	B	C	D	E	F	G	H	I
2	Landowner	Browning Manor		County	Vanderburgh			V 1.2015	
3	Computed By	Glen Meritt		Date	10/23/2018				
4	Checked by	Swale #10		Date				1/15/2015	
5	Note: Macros must be enabled in this spreadsheet in order for the "Solve" button to work.								
6	Design flow, Q=	14.5	cfs				WW horiz. Length=	74.0	ft
7	Slope, S=	0.2297	ft/ft =	4.35	:1		U/S WW F.L. elev=	472.0	ft
8	Bottom Width, W=	1	ft				D/S WW F.L. elev=	455.0	ft
9	Side slope, Z=	3	:1				Waterway drop=	17.0	ft
10	Safety factor=	1		Typically 1.2			WW length along slope=	75.9	ft
11	Rock shape =	Angular							
12	Min. req'd D50=	14.59	in				Spreadsheet formatting key:		
13	D50 used=	15.00	in				XXX	=Input cells	
14	n=	0.056					X.XX	=Output from "Solve" button	
15	Freeboard=	0.00	ft				X.XX	=Other computed output	
16							Red text	=Instructions, warnings, info	
17	Flow depth, d=	0.69	ft	Calculated					
18	Critical depth, d_c=	0.93	ft						
19	Critical slope, S_c=	0.060	ft/ft	$0.7S_c$ =	0.0422	ft/ft			
20				$1.3S_c$ =	0.0784	ft/ft			
21	Design slope, S=	0.2297	ft/ft	Design slope OK. Flow is Supercritical.					
22	Velocity=	6.82	fps				Est. riprap unit wt=		Tons/CY
23				Rock shape = Angular			Rock Gs =		

Required riprap gradation for D50 selected

% Smaller	Rock dia., inches		Rock weight, lb	
	min.	max.	min.	max.
100	22.5	30.0	0	0
85	19.5	27.0	0	0
50	15.0	22.5	0	0
10	12.0	19.5	0	0

WW CROSS SECTION

Quantities:		
Riprap volume=	109.9	CY
Approx. weight=	0.0	Tons
Geotextile area=	357.5	SY*

*Geotextile area includes actual covered surfaces only (no extra for laps or anchorage)

WW PROFILE

DRAWINGS

C-101

C-108

C-111

1

C-110

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
REGULATORY DIVISION, SOUTH BRANCH
6855 STATE ROAD 66
NEWBURGH, INDIANA 47630

October 15, 2018

Regulatory Division
South Branch
ID No. LRL-2018-503-tmb

Ms. Jina Lancaster
BNL Real Properties LLC
2205 Duffers Lane
Evansville, IN 47725

Dear Ms. Lancaster:

This is in response to your application received in our office on September 18, 2018 for authorization to permanently impact approximately 130' of an ephemeral stream in order to construct a roadway and building site for a residential subdivision known as Browning Manor. The project is located off of Browning Road in Evansville, Vanderburgh County, Indiana. The information supplied by you was reviewed to determine whether a Department of the Army (DA) permit will be required under the provisions of Section 10 of the Rivers and Harbors Act of 1899 or Section 404 of the Clean Water Act.

Under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (CWA), the Louisville, Detroit, and Chicago Districts issued Regional General Permit (RGP) No. 1 on December 15, 2014, for certain activities having minimal impact in Indiana. We have verified that your proposed work shown on the submitted plans and described below is authorized under the RGP. Therefore, you may proceed with the work subject to the enclosed general conditions and the Indiana Department of Environmental Management (IDEM) Section 401 Water Quality Certification (WQC) dated December 12, 2014.

The following work is authorized:

1. To permanently impact approximately 130' of an ephemeral stream (stream #5) in order to install a 109' culvert and approximately 21' of an energy dissipater. In addition, temporary impacts of 10' of an ephemeral stream (stream #5) and 10' of an ephemeral stream (stream #7) would be necessary for the installation of a sanitary sewer line.

Special Conditions:

1. The permittee shall not further cut, remove, or clear any trees within the project area between April 1st and September 30th (of each year) in order to avoid impacting the federally endangered Indiana bat (*Myotis sodalis*) and threatened northern long-eared bat (*Myotis septentrionalis*). If tree clearing is necessary during this timeframe, then the permittee must contact the United States Fish and Wildlife Service (USFWS) and the Corps for further coordination on potential impacts to these federally listed species.

EMAIL
10/22/2018

Mueller, Jeffrey

From:	Driscoll Farid, Aileen <ADriscol@idem.IN.gov>
Sent:	Tuesday, October 16, 2018 8:58 AM
To:	Mike Steiner
Cc:	jeff.jina@yahoo.com; Barron, Tre M CIV USARMY CELRL (US)
Subject:	RE: Browning Manor – proposed culvert

Good Morning,

The Browning Manor project has been processed and approved under the RGP, its IDEM ID # is 2018-677-82-ADF-X. Please let me know if you have any questions.

Best,

Aileen

From: Driscoll Farid, Aileen
Sent: Friday, October 12, 2018 8:45 AM
To: 'Mike Steiner' <msteiner@cashwaggner.com>
Cc: jeff.jina@yahoo.com; Barron, Tre M CIV USARMY CELRL (US) <Tre.M.Barron@usace.army.mil>
Subject: RE: Browning Manor – proposed culvert

Mike,

That is fine on IDEM's end since there will be no impacts to the waterways.

Best,

Aileen

From: Mike Steiner [mailto:msteiner@cashwaggner.com]
Sent: Thursday, October 11, 2018 5:06 PM
To: Driscoll Farid, Aileen <ADriscol@idem.IN.gov>
Cc: jeff.jina@yahoo.com; Barron, Tre M CIV USARMY CELRL (US) <Tre.M.Barron@usace.army.mil>
Subject: RE: Browning Manor – proposed culvert

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Good afternoon,

While we are waiting on the final authorizations for this project would it be possible for the applicant to put down rock on the roadbed? This would include still staying out of the jurisdictional waters and would occur only on the upland area of the site where the proposed roadbed would be located. I only ask because our clients were hoping to have the site ready for future potential homeowners to be able to drive through and view the available lots during the Southwestern Indiana Builders Association – 2018 Fall Tour of Homes on October 27th and 28th. With this approval the client would have sufficient time to prepare for the fall tour. My clients and I greatly appreciate your willingness to help get this project quickly back on track. Thank you for your time.

1

EMAIL 10/16/2018

Best,

Aileen

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Hello Aileen,

Per our conversation this is how we envisioned the culvert and its alignment. At the end of the culvert the stream has a slight bend that was of concern. We can either run the culvert past the bend or install the dissipator in the area of the bend. Illustration shows the culvert being past the bend with energy dissipator following. I believe this would make the encapsulation of approximately 115 LF with a respective 15 LF energy dissipator, totaling 130 LF of stream impact in this area. Let me know your thoughts. Thanks.

Regards,

Michael Steiner, AWB®
Senior Ecologist
CASH WAGGNER & ASSOCIATES, PC
414 Citadel Circle, Suite B
Evansville, IN 47715
Main: 812-401-5561 Cell: 812-455-3098

Click Here to send large files

3

Mueller, Jeffrey

From:	Barron, Tre M CIV USARMY CELRL (US) <Tre.M.Barron@usace.army.mil>
Sent:	Tuesday, October 16, 2018 2:57 PM
To:	Mike Steiner
Cc:	jeff.jina@yahoo.com; 'Driscoll Farid, Aileen'
Subject:	RE: Browning Manor - proposed culvert

Mike,

We have verified what was submitted to our office and issued. I will drop the authorization in the mail tomorrow. You all are free to proceed from the Corps stand point.

Thank you,

Tre Barron
U.S. Army Corps of Engineers
812-853-9713

-----Original Message-----
From: Mike Steiner [mailto:msteiner@cashwaggner.com]
Sent: Tuesday, October 16, 2018 9:14 AM
To: 'Driscoll Farid, Aileen' <ADriscol@idem.IN.gov>
Cc: jeff.jina@yahoo.com; Barron, Tre M CIV USARMY CELRL (US) <Tre.M.Barron@usace.army.mil>
Subject: [Non-DoD Source] RE: Browning Manor - proposed culvert

Good morning,

Aileen, this is great news. I appreciate all your help to move this project forward.

Tre - Since we have been cleared in regards to Section 7 and 106 is there anything else that we are needing from Corps for this project to proceed or are we good to go with the IDEM approval of the RGP?

Regards,

From: Driscoll Farid, Aileen [mailto:ADriscol@idem.IN.gov]
Sent: Tuesday, October 16, 2018 8:58 AM
To: Mike Steiner <msteiner@cashwaggner.com>
Cc: jeff.jina@yahoo.com; Barron, Tre M CIV USARMY CELRL (US) <Tre.M.Barron@usace.army.mil>

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EMAIL 10/16/2018

Good afternoon,

While we are waiting on the final authorizations for this project would it be possible for the applicant to put down rock on the roadbed? This would include still staying out of the jurisdictional waters and would occur only on the upland area of the site where the proposed roadbed would be located. I only ask because our clients were hoping to have the site ready for future potential homeowners to be able to drive through and view the available lots during the Southwestern Indiana Builders Association - 2018 Fall Tour of Homes on October 27th and 28th. With this approval the client would have sufficient time to prepare for the fall tour. My clients and I greatly appreciate your willingness to help get this project quickly back on track. Thank you for your time.

Regards,

From: Driscoll Farid, Aileen [mailto:ADriscol@idem.IN.gov]
Sent: Thursday, October 11, 2018 11:59 AM
To: Mike Steiner <msteiner@cashwaggner.com <mailto:msteiner@cashwaggner.com> >
Cc: jeff.jina@yahoo.com <mailto:jeff.jina@yahoo.com> ; Barron, Tre M CIV USARMY CELRL (US)
<Tre.M.Barron@usace.army.mil <mailto:Tre.M.Barron@usace.army.mil> >
Subject: RE: Browning Manor - proposed culvert

Mike,

To summarize our phone call, I am routing this project through for approval under the RGP. It will likely be the end of next week until it is officially processed because our Administrative Assistant is out of town. If you have any questions, please just let me know.

Best,

Aileen

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Best,

Aileen

**** This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email. ****

Hello Aileen,

Per our conversation this is how we envisioned the culvert and its alignment. At the end of the culvert the stream has a slight bend that was of concern. We can either run the culvert past the bend or install the dissipator in the area of the bend. Illustration shows the culvert being past the bend with energy dissipator following. I believe this would make the encapsulation of approximately 115 LF with a respective 15 LF energy dissipator, totaling 130 LF of stream impact in this area. Let me know your thoughts. Thanks.

Regards,

Michael Steiner, AWB(r)

Senior Ecologist

CASH WAGGNER & ASSOCIATES, PC

414 Citadel Circle, Suite B

Evansville, IN 47715

Main: 812-401-5561 Cell: 812-455-3098

Low-Profile Prairie

This prairie seed mix provides a wide range of shorter prairie grass, sedge, and wildflower species. Most species will grow to 4 feet or less, making this an ideal mix for areas where taller forbs and grasses are not appropriate. Once established, this wildflower community displays a variety of colors, blooming from early spring to fall, creating a diverse habitat for birds, butterflies, moths, and other pollinators. This seed mix is suitable for medium-to-dry sites. This seed mix includes at least 5 of 6 native permanent grass and sedge species and 29 of 34 native forb species. Apply at 38.67 PLS pounds per acre.

Botanical Name	Common Name	PLS Oz/Acre
Permanent Grasses/Sedges		
Bouteloua curtipendula	Side Oats Grama	16.00
Carex spp.	Prairie Sedge Mix	4.00
Elymus canadensis	Canada Wild Rye	32.00
Koeleria pyramidata	June Grass	1.00
Panicum virgatum	Switch Grass	1.00
Schizachyrium scoparium	Little Bluestem	36.00
	Total	**90.00**
Temporary Cover		
Avena sativa	Common Oat	360.00
Lolium multiflorum	Annual Rye	100.00
	Total	**460.00**
Forbs		
Amorpha canescens	Lead Plant	0.50
Anemone cylindrica	Thimbleweed	0.50
Asclepias syriaca	Common Milkweed	2.00
Asclepias tuberosa	Butterfly Weed	2.00
Baptisia alba	White Wild Indigo	2.00
Chamaecrista fasciculata	Partridge Pea	12.00
Coreopsis lanceolata	Sand Coreopsis	5.00
Coreopsis palmata	Prairie Coreopsis	1.00
Dalea candida	White Prairie Clover	1.50
Dalea purpurea	Purple Prairie Clover	1.50
Desmanthus illinoensis	Illinois Sensitive Plant	3.00
Echinacea purpurea	Broad-Leaved Purple Coneflower	7.00
Eryngium yuccifolium	Rattlesnake Master	3.00
Lespedeza capitata	Round-Head Bush Clover	2.00
Liatris aspera	Rough Blazing Star	0.50
Lupinus perennis	Wild Lupine	4.00
Monarda fistulosa	Wild Bergamot	0.75
Oligoneuron rigidum	Stiff Goldenrod	1.00
Parthenium integrifolium	Wild Quinine	1.00
Penstemon digitalis	Foxglove Beard Tongue	0.50
Penstemon hirsutus	Hairy Beard Tongue	0.50
Pycnanthemum virginianum	Common Mountain Mint	1.00
Ratibida pinnata	Yellow Coneflower	4.00
Rudbeckia hirta	Black-Eyed Susan	5.00
Rudbeckia subtomentosa	Sweet Black-Eyed Susan	1.00
Silphium terebinthinaceum	Prairie Dock	0.50
Solidago speciosa	Showy Goldenrod	0.50
Symphyotrichum ericoides	Heath Aster	0.25
Symphyotrichum laeve	Smooth Blue Aster	1.00
Symphyotrichum novae-angliae	New England Aster	0.50
Tradescantia ohiensis	Common Spiderwort	0.75
Verbena stricta	Hoary Vervain	1.00
Vernonia spp.	Ironweed Mix	1.75
Veronicastrum virginicum	Culver's Root	0.25
	Total	**68.75**

Prairie Seed Mixes

Dalea purpurea, **Purple Prairie Clover**

Oligoneuron rigidum, **Stiff Goldenrod**

Tradescantia ohiensis,
Common Spiderwort

For current pricing, availability, and information on our full installation and management services, visit
cardnonativeplantnursery.com

CASH WAGGNER & ASSOCIATES, PC
CONSULTING ENGINEERS • LAND SURVEYORS

DATE:	10.09.18
PROJECT NO.:	18-3294
REFERENCE:	Browning Manor
YOUR FILE NO.:	

ATTENTION:	Jeff Mueller
COMPANY:	Vanderburgh County Surveyor
ADDRESS:	Civic Center Complex – Room 325
CITY, ST, ZIP:	Evansville, IN 47708
PHONE:	

LETTER OF TRANSMITTAL

THE FOLLOWING ITEMS:

COPIES:	ORIG./LAST REV. DATE:	DESCRIPTION:
1	10.04.18	Drainage Plan & Details
1	10.04.18	Developed Sub-basin Exhibit
1	10.08.18	Final Drainage Report

ARE TRANSMITTED:

☐ PER YOUR REQUEST
☐ FOR YOUR FILES
☒ FOR REVIEW & COMMENT
☐ OTHER

FOR YOUR:

☒ APPROVAL
☐ USE
☐ INFORMATION
☐ OTHER

VIA:

☐ COURIER
☐ FOR PICK UP
☐ USPS
☐ NEXT DAY   ☐ FED EX   ☐ UPS   ☐ DHL
☐ SATURDAY DELIVERY
☐ TRACKING # _____
☒ OTHER   DELIVERED

COMMENTS:

Please review the attached final drainage plan and report. If you have any questions or comments, please give me a call. Thank you

414 CITADEL CIRCLE
SUITE B
EVANSVILLE, IN 47715
PH: 812.401.5561
FAX: 812.401.5563
GMERITT@CASHWAGGNER.COM

FROM:

GLEN MERITT, JR., P.E.

CC: File

RECEIVED BY THE VANDERBURGH COUNTY SURVEYOR'S OFFICE 10-9-18

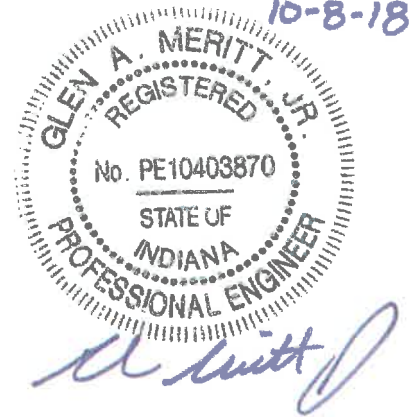T:\EVANSVILLE\3294\DOCUMENTS\181009 MUELLER.DOC

CASH WAGGNER
& ASSOCIATES, PC
CONSULTING ENGINEERS • LAND SURVEYORS

October 8, 2018

Mr. Jeff Mueller
Vanderburgh County Surveyor
Room 325 Civic Center - 1 NW Martin Luther King Jr. Blvd.
Evansville, IN 47708

RE: Final Drainage Report
Browning Manor
Browning Road
Our Project #: 18-3294

Mr. Mueller:

Below is a summary of the drainage calculations for the above-referenced project.

SITE DESCRIPTION

This development will consist of 13 single family residential lots, 18 additional lots that will be part of a PUD development containing 18 duplex townhomes and their associated improvements (i.e. roads, utilities). This development is located on a 17.74-acre parcel that lies on the west side of Browning Road approximately 1500 feet south of the Browning Road and Boonville New Harmony Road intersection. This project will be constructed and platted in one phase. Roughly half of the property will be disturbed during construction of the subdivision. The majority of the existing trees along the north and south property lines will remain undisturbed except for the wooded areas where detention basin #1 and the sanitary sewer main will be constructed along the south property line.

No regulated drains, inlets or outfalls exist on this site. An existing force main is located along the entire southern property line. No known wells, septic tank systems or outfalls exist on this site. No seeps, springs, sinkholes, caves, shafts, faults or other such geological features are visible or of record on this site.

The proposed sanitary sewer mains and 8" water main will be public and maintained by EW&SU.

The developer will be utilizing Repair Fund "B" for the maintenance and repair of all storm water drainage systems and facilities outside the county accepted road right-of-way. Upon the completion of the earthwork activities and utility construction, Tenbarge – Green Alliance seed mixture will be used for permanent seeding all green space areas and the earthen side slopes of detention basins #1 & #2. No tree limbs, refuse from legally burnt vegetation, nor construction waste, demolition materials or other man-made material may be buried within detention basins #1 or #2.

The following statements will be included on the recorded plat for Browning Manor Subdivision and Browning Manor PUD:

The individual lot owners shall be responsible, including financially, for maintaining that part of the storm water system and its easements which exist on his or her property in proper working order including:

1. Mowing grass, controlling weeds and maintaining the designed cover of waterways, storage basins and easements in accordance with all applicable ordinances.
2. Keeping all parts of the storm water system operating as designed and as constructed and free of all trash, debris and obstructions to the flow of water.
3. Keeping the channels, embankments, shorelines and bottoms of waterways and basins free from erosion and sedimentation.
4. Maintaining that part of the storm water system which lies on his or her property in accordance with the conditions described on the approved street and/or drainage plans on file in the County Surveyor's Office and/or in the County Engineer's Office and in compliance with the County Drainage Ordinance.

DRAINAGE PATTERNS

The existing site is rolling with 60' of relief to the south and 54' of relief to the north. The existing ground cover consists of 5.08-acres of pasture and 12.66-acres of woods. UN-1 consists of 6.30-acres located on the north end of the site. Runoff sheet flows north to an existing ditch that flows west off-site. UN-2 consists of 8.11-acres located in the southwest corner of the site. Runoff sheet flows south to an existing ditch that flows west off-site. UN-3 consists of 3.33-acres located in the southeast corner of the site. Runoff sheet flows south to an existing 12" R.C.P. pipe that drains into an existing lake that is located on the adjoining property to the south. See attached Undeveloped Sub-basin Exhibit for the location of each sub-basin.

The 25-year and 100-year flows were calculated for the entire 17.74-acre development. This development was divided into 14 developed sub-basins and three off-site sub-basins. Sub-basins #3 - #9, OS-1, OS-2 and OS-3 will be collected by Detention Basin #1. The primary spillway of detention basin #1 will sheet flow to the southwest off-site to the existing ditch. Sub-basins #1, #2, #13 and #14 will be collected by Detention Basin #2. The primary spillway of detention basin #2 will sheet flow west to the existing low point at the southeast corner of Lot #3 and then flow south to the existing 12" R.C.P. pipe that drains into an existing lake off-site. Sub-basin #12 sheet flows off-site undetained to the existing ditch located along the southwest property line. Sub-basin #11 sheet flows off-site undetained to the south to the existing 12" R.C.P. pipe. Sub-basin #12 sheet flows off-site undetained to the existing ditch located along the north property line. See attached Developed Sub-basin Exhibit for the locations of each sub-basin.

A drainage swale and storm sewer network will be installed within the development to capture the storm water runoff and convey it to detention basins #1 and #2. Storm sewers will be constructed with reinforced concrete pipe and N-12 Watertight HDPE. P-535 will require a 12" diameter culvert under Road #1. The primary outlet

and emergency spillway of Detention Basin #1 will discharge to the existing ditch that is located along the southwest property line. The primary outlet and emergency spillway of Detention Basin #2 will discharge southwest towards the existing 12" R.C.P. pipe. All runoff ultimately discharges to Little Pigeon Creek.

CALCULATIONS

The Rational Method and HERPICC Manual were utilized in performing the drainage calculations for this project. All storm sewers and swales were designed to carry the 25-year developed runoff. The outlet structure for the detention basin was sized for the 25-year design storm event while allowing a discharge rate less than the undeveloped 10-year storm event from the system. The emergency spillways for both detention basins were designed to convey the 100-year storm flow.

Below is a summary of the detention basin design elements:

Detention Basin #1		NOTES
Detention Basin #1 Developed Q(25)	21.24 – cfs	#3 - #9
Detention Basin #1 Developed Q(100)	25.80 - cfs	#3 - #9
Detention Basin #1 Undeveloped Q(10)	16.39 – cfs	UN-2
Undetained Developed Q(25)	11.04 – cfs	#10
Off-Site Developed Q(25)	2.88 - cfs	OS-1, OS-2 & OS-3
25-year Req'd Storage Volume	15,088 - cf	
25-year Provided Storage Volume	16,497 - cf	
Allowable Detention Basin #1 Release Rate	8.23 – cfs	Undeveloped Q(10) – Undetained Developed Q(25) + Off-Site Developed Q(25)
Proposed Detention Basin #1 Release Rate	*4.83 - cfs*	*Detention Basin #1 Primary Spillway*
Outlet Structure	*43-LF of 12" R.C.P.*	*P-525*
Outlet I.E.	453.00	
25-year Storage Vol. Elev.	455.05	
HW (25-yr. elev. – I.E.)	2.05 – ft.	
Minimum Top/Bank	456.00	

Detention Basin #2		NOTES
Detention Basin #2 Developed Q(25)	5.08 – cfs	#1, #2, #13, #14
Detention Basin #2 Developed Q(100)	6.12 - cfs	#1, #2, #13, #14
Detention Basin #2 Undeveloped Q(10)	6.82 – cfs	UN-3

Undetained Developed Q(25)	4.73 – cfs	#11
Off-Site Developed Q(25)	0.00 - cfs	
25-year Req'd Storage Volume	3,790 - cf	
25-year Provided Storage Volume	4,692 - cf	
Allowable Detention Basin #2 Release Rate	2.09 – cfs	Undeveloped Q(10) – Undetained Developed Q(25) + Off-Site Developed Q(25)
Proposed Detention Basin #2 Release Rate	*0.94 - cfs*	*Detention Basin #2 Primary Spillway*
Outlet Structure	*32-LF of 8" HDPE*	*P-539*
Outlet I.E.	499.50	
25-year Storage Vol. Elev.	500.16	
HW (25-yr. elev. – I.E.)	0.66 – ft.	
Minimum Top/Bank	501.00	

EMAIL 10/13/2018

Undetained Developed Q(25)	4.73 – cfs	#11
Off-Site Developed Q(25)	0.00 - cfs	
25-year Req'd Storage Volume	3,790 - cf	
25-year Provided Storage Volume	4,692 - cf	
Allowable Detention Basin #2 Release Rate	2.09 – cfs	Undeveloped Q(10) – Undetained Developed Q(25) + Off-Site Developed Q(25)
Proposed Detention Basin #2 Release Rate	0.94 - cfs	Detention Basin #2 Primary Spillway
Outlet Structure	32-LF of 12" R.C.P. With 8" Orifice	P-539
Outlet I.E.	499.50	
25-year Storage Vol. Elev.	500.16	
HW (25-yr. elev. – I.E.)	0.66 – ft.	
Minimum Top/Bank	501.00	

Revised
BY 10/13/2016

DRAWING 2

DETENTION FACILITY DESIGN VOLUME CALCULATIONS

PROJECT: **Browning Manor Detention Basin #1**

DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS

RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 5.87 ACRES
DEVELOPED RUNOFF COEFFICIENT (C_d): 0.638

STORM DURATION T_d (HRS)	RAINFALL INTENSITY I_d (INCH/HR)	INFLOW RATE $I(T_d)$ (C_d*I_d*A) (CFS)	OUTFLOW RATE O (C_u*I_u*A) (CFS)	STORAGE RATE ΔS $I(T_d)-O$ (CFS)	REQUIRED STORAGE S_d $(I(T_d)-O)*T_d/12$ (ACRE-FT)
0.08	7.810	29.25	4.83	24.42	0.170
0.17	6.320	23.67	4.83	18.84	0.262
0.25	5.240	19.62	4.83	14.79	0.308
0.33	4.597	17.21	4.83	12.38	0.344
0.42	3.953	14.81	4.83	9.98	0.346
0.50	3.310	12.40	4.83	7.57	0.315
0.58	3.083	11.55	4.83	6.72	0.327
0.67	2.857	10.70	4.83	5.87	0.326
0.75	2.630	9.85	4.83	5.02	0.314
0.83	2.403	9.00	4.83	4.17	0.290
0.92	2.177	8.15	4.83	3.32	0.254
1.00	1.950	7.30	4.83	2.47	0.206
1.25	1.805	6.76	4.83	1.93	0.201
1.50	1.660	6.22	4.83	1.39	0.173
1.75	1.515	5.67	4.83	0.84	0.123
2.00	1.370	5.13	4.83	0.30	0.050
3.00	1.020	3.82	4.83	-1.01	-0.253

PEAK STORAGE (ACRE/FT):	0.35
PEAK STORAGE (CUBIC FT):	15,088

10/9/2018

Browning Manor

Detention Basin #1

PROPOSED 25-YR DESIGN RELEASE RATE
P-525

CALCULATIONS FOR PIPE FLOWING FULL

(Pressure Conditions)

SOLVE FOR Q

Ø=	1	FT.
h'=	12.6	IN.
h=	1.55	FT.
Ke=	0.5	
Ko=	1	
n=	0.012	
L=	43	FT.
HW=	2.05	FT.

Q=   **4.83**   **CFS**

Ø= diameter of orifice (pipe)   h= h' + Ø/2
Ke= entrance coefficient   h'= ht. of water
Ko= outfall coefficient   above orifice
n= manning's 'n'   HW= h' + Ø
L= length of orifice (pipe)
Q= allowable release rate

10/7/2016

DETENTION FACILITY DESIGN VOLUME CALCULATIONS

PROJECT: **Browning Manor Detention Basin #1**

DETENTION FACILITY DESIGN RETURN PERIOD: 100 YRS

RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 5.87 ACRES
DEVELOPED RUNOFF COEFFICIENT (C_d): 0.638

STORM DURATION T_d (HRS)	RAINFALL INTENSITY I_d (INCH/HR)	INFLOW RATE $I(T_d)$ (C_d*I_d*A) (CFS)	OUTFLOW RATE O (C_u*I_u*A) (CFS)	STORAGE RATE ΔS $I(T_d)-O$ (CFS)	REQUIRED STORAGE S_d $(I(T_d)-O)*T_d/12$ (ACRE-FT)
0.08	9.950	37.26	5.56	31.70	0.220
0.17	8.050	30.15	5.56	24.59	0.341
0.25	6.680	25.02	5.56	19.46	0.405
0.33	5.857	21.93	5.56	16.37	0.455
0.42	5.033	18.85	5.56	13.29	0.461
0.50	4.210	15.77	5.56	10.21	0.425
0.58	3.935	14.74	5.56	9.18	0.446
0.67	3.660	13.71	5.56	8.15	0.453
0.75	3.385	12.68	5.56	7.12	0.445
0.83	3.110	11.65	5.56	6.09	0.423
0.92	2.835	10.62	5.56	5.06	0.386
1.00	2.560	9.59	5.56	4.03	0.336
1.25	2.380	8.91	5.56	3.35	0.349
1.50	2.200	8.24	5.56	2.68	0.335
1.75	2.020	7.57	5.56	2.01	0.292
2.00	1.840	6.89	5.56	1.33	0.222

PEAK STORAGE (ACRE/FT):	0.46
PEAK STORAGE (CUBIC FT):	20,101

10/19/2018

Browning Manor

Detention Basin #1

PROPOSED 100-YR DESIGN RELEASE RATE
P-525

CALCULATIONS FOR PIPE FLOWING FULL

(Pressure Conditions)

SOLVE FOR Q

Ø=	1	FT.
h'=	18.7	IN.
h=	2.0583	FT.
Ke=	0.5	
Ko=	1	
n=	0.012	
L=	43	FT.
HW=	2.5583	FT.

Q= 5.56 CFS

Ø= diameter of orifice (pipe)   h= h' + Ø/2
Ke= entrance coefficient   h'= ht. of water
Ko= outfall coefficient   above orifice
 n= manning's 'n'   HW= h' + Ø
 L= length of orifice (pipe)
Q= allowable release rate

10/9/2015

Browning Manor

Detention Basin #1

PROVIDED DETENTION VOLUMES
(per ACAD)

	Elevation	Area (s.f.)	Avg. Area (s.f.)	Inc. Vol. (c.f.)	Cumulative Vol. (c.f.)
Pool	453.00	5,682			
	454.00	7,303	6,493	6,493	6,493
	455.00	9,025	8,164	8,164	14,657
E.O.S.	455.20	9,381	9,203	1,841	16,497
T.B.	456.00	10,847	10,114	8,091	24,588

Detention volume provided at Elev. 455.20 = 16,497 *c.f.*

Total, required 25-YR detention volume = 15,088 c.f.

25-YR Req'd detention volume provided @ Elev. = 455.05 ft.

Req'd HW= 2.05 ft.

Detention volume provided at Elev. 456.00 = 24,588 *c.f.*

Total, required 100-YR detention volume = 20,101 c.f.

100-YR Req'd detention volume provided @ Elev. = 455.56 ft.

Req'd HW= 2.56 ft.

10/9/2016

Weighted c calculations for sub-basins captured by Detention Basin #1

DEVELOPED WEIGHTED c CALCULATIONS				
	Total Area =	5.87	Acres	
Sub-basin	**Area (A)**		**c**	**c x A**
#3	0.90 Ac.		0.666	0.102
#4	0.52 Ac.		0.692	0.061
#5	0.80 Ac.		0.602	0.082
#6	1.11 Ac.		0.536	0.101
#7	0.54 Ac.		0.737	0.068
#8	0.81 Ac.		0.702	0.097
#9	1.43 Ac.		0.612	0.149
OS-1	0.35 Ac.		0.772	0.046
OS-2	0.05 Ac.		0.550	0.005
OS-3	0.26 Ac.		0.658	0.029

Weighted c = 0.638

10/9/2018

Open Channel Flow Calculations

							Swale #:	**Emergency Spillway** Basin #1
		Side slope =		4				
		Bottom width =		25				
		Manning's coefficient =		0.035				
		Slope of channel =		0.05				

Depth (ft)	Wetted Perimeter (ft)	Area (ft^2)	Hydraulic Radius (ft)	Hydraulic Depth (ft)	Flowrate (cfs)	Velocity (ft/s)	F value
0.0	25.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	25.82	2.54	0.10	0.10	5.15	2.03	1.1
0.2	26.65	5.16	0.19	0.19	16.44	3.19	1.2
0.30	27.47	7.86	0.29	0.29	32.49	4.13	1.3
0.4	28.30	10.64	0.38	0.38	52.76	4.96	1.4
0.5	29.12	13.50	0.46	0.47	76.97	5.70	1.5

DETENTION FACILITY DESIGN VOLUME CALCULATIONS

PROJECT: **Browning Manor Detention Basin #2**

DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS

RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 1.54 ACRES

DEVELOPED RUNOFF COEFFICIENT (C_d): 0.566

STORM DURATION T_d (HRS)	RAINFALL INTENSITY I_d (INCH/HR)	INFLOW RATE $I(T_d)$ (C_d*I_d*A) (CFS)	OUTFLOW RATE O (C_u*I_u*A) (CFS)	STORAGE RATE ΔS $I(T_d)-O$ (CFS)	REQUIRED STORAGE S_d $(I(T_d)-O)*T_d/12$ (ACRE-FT)
0.08	7.810	6.81	0.94	5.87	0.041
0.17	6.320	5.51	0.94	4.57	0.063
0.25	5.240	4.57	0.94	3.63	0.076
0.33	4.597	4.01	0.94	3.07	0.085
0.42	3.953	3.45	0.94	2.51	0.087
0.50	3.310	2.89	0.94	1.95	0.081
0.58	3.083	2.69	0.94	1.75	0.085
0.67	2.857	2.49	0.94	1.55	0.086
0.75	2.630	2.29	0.94	1.35	0.085
0.83	2.403	2.09	0.94	1.15	0.080
0.92	2.177	1.90	0.94	0.96	0.073
1.00	1.950	1.70	0.94	0.76	0.063
1.25	1.805	1.57	0.94	0.63	0.066
1.50	1.660	1.45	0.94	0.51	0.063
1.75	1.515	1.32	0.94	0.38	0.055
2.00	1.370	1.19	0.94	0.25	0.042
3.00	1.020	0.89	0.94	-0.05	-0.013

PEAK STORAGE (ACRE/FT):	**0.09**
PEAK STORAGE (CUBIC FT):	**3,790**

Browning Manor

Detention Basin #2

PROPOSED 25-YR DESIGN RELEASE RATE
P-539

CALCULATIONS FOR PIPE FLOWING FULL

(Pressure Conditions)

SOLVE FOR Q

Ø=	0.667	FT.
h'=	0.0	IN.
h=	0.3335	FT.
Ke=	0.5	
Ko=	1	
n=	0.012	
L=	32	FT.
HW=	0.667	FT.
Q=	**0.94**	**CFS**

Ø= diameter of orifice (pipe)   h= h' + Ø/2
Ke= entrance coefficient   h'= ht. of water
Ko= outfall coefficient   above orifice
n= manning's 'n'   HW= h' + Ø
L= length of orifice (pipe)
Q= allowable release rate

DETENTION FACILITY DESIGN VOLUME CALCULATIONS

PROJECT: **Browning Manor Detention Basin #2**

DETENTION FACILITY DESIGN RETURN PERIOD: 100 YRS

RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 1.54 ACRES
DEVELOPED RUNOFF COEFFICIENT (C_d): 0.566

STORM DURATION T_d (HRS)	RAINFALL INTENSITY I_d (INCH/HR)	INFLOW RATE $I(T_d)$ (C_d*I_d*A) (CFS)	OUTFLOW RATE O (C_u*I_u*A) (CFS)	STORAGE RATE ΔS $I(T_d)-O$ (CFS)	REQUIRED STORAGE S_d $(I(T_d)-O)*T_d/12$ (ACRE-FT)
0.08	9.950	8.67	1.15	7.52	0.052
0.17	8.050	7.02	1.15	5.87	0.081
0.25	6.680	5.82	1.15	4.67	0.097
0.33	5.857	5.10	1.15	3.95	0.110
0.42	5.033	4.39	1.15	3.24	0.112
0.50	4.210	3.67	1.15	2.52	0.105
0.58	3.935	3.43	1.15	2.28	0.111
0.67	3.660	3.19	1.15	2.04	0.113
0.75	3.385	2.95	1.15	1.80	0.113
0.83	3.110	2.71	1.15	1.56	0.108
0.92	2.835	2.47	1.15	1.32	0.101
1.00	2.560	2.23	1.15	1.08	0.090
1.25	2.380	2.07	1.15	0.92	0.096
1.50	2.200	1.92	1.15	0.77	0.096
1.75	2.020	1.76	1.15	0.61	0.089
2.00	1.840	1.60	1.15	0.45	0.076

PEAK STORAGE (ACRE/FT):	**0.11**
PEAK STORAGE (CUBIC FT):	**4,937**

Browning Manor

Detention Basin #2

PROPOSED 100-YR DESIGN RELEASE RATE
P-539

CALCULATIONS FOR PIPE FLOWING FULL

(Pressure Conditions)

SOLVE FOR Q

Ø=	0.667	FT.
h'=	2.0	IN.
h=	0.5002	FT.
Ke=	0.5	
Ko=	1	
n=	0.012	
L=	32	FT.
HW=	0.8337	FT.
Q=	**1.15**	**CFS**

Ø= diameter of orifice (pipe)   h= h' + Ø/2
Ke= entrance coefficient   h'= ht. of water
Ko= outfall coefficient   above orifice
n= manning's 'n'   HW= h' + Ø
L= length of orifice (pipe)
Q= allowable release rate

Browning Manor

Detention Basin #2

PROVIDED DETENTION VOLUMES
(per ACAD)

	Elevation	Area (s.f.)	Avg. Area (s.f.)	Inc. Vol. (c.f.)	Cumulative Vol. (c.f.)
Pool	499.50	5,286			
	500.00	6,007	5,647	2,823	2,823
E.O.S.	500.30	6,451	6,229	1,869	4,692
T.B.	501.00	7,524	6,988	4,891	9,583

Detention volume provided at Elev. 500.30 =   4,692   c.f.

Total, required 25-YR detention volume =   3,790   c.f.

25-YR Req'd detention volume provided @ Elev. =   500.16 ft.

Req'd HW=   0.66 ft.

Detention volume provided at Elev. 501.00 =   9,583   c.f.

Total, required 100-YR detention volume =   4,937   c.f.

100-YR Req'd detention volume provided @ Elev. =   500.34 ft.

Req'd HW=   0.84 ft.

Weighted c calculations for sub-basins captured by Detention Basin #2

DEVELOPED WEIGHTED c CALCULATIONS			
	Total Area = 1.54 Acres		
Sub-basin	Area (A)	c	c x A
#1	0.69 Ac.	0.492	0.220
#2	0.34 Ac.	0.610	0.135
#13	0.09 Ac.	0.683	0.040
#14	0.42 Ac.	0.627	0.171

Weighted c = **0.566**

Open Channel Flow Calculations

Swale #:	**Emergency Spillway**
	Basin #2

	Side slope =	4		
	Bottom width =	10		
	Manning's coefficient =	0.035		
	Slope of channel =	0.05		

Depth (ft)	Wetted Perimeter (ft)	Area (ft²)	Hydraulic Radius (ft)	Hydraulic Depth (ft)	Flowrate (cfs)	Velocity (ft/s)	F value
0.0	10.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	10.82	1.04	0.10	0.10	2.08	2.00	1.1
0.2	11.65	2.16	0.19	0.19	6.69	3.10	1.2
0.3	12.47	3.36	0.27	0.27	13.34	3.97	1.3
0.4	13.30	4.64	0.35	0.35	21.89	4.72	1.4
0.5	14.12	6.00	0.42	0.43	32.28	5.38	1.5