FINAL DRAINAGE REPORT
for
The Reserve at Hidden Lake Subdivision
Vanderburgh County, Indiana

Project No.: 8716.4.002-B
September 03, 2014

Prepared For:

The First National Bank of Carmi
7500 Eagle Crest Blvd.
Evansville, IN 47715

Prepared By:

Morley and Associates, Inc.
4800 Rosebud Lane
Newburgh, Indiana 47630
Phone: (812) 464-9585
Fax: (812) 464-2514

Lee A. McClellan, P.E.

APPROVED

OCT 2 8 2014

VANDERBURGH COUNTY
DRAINAGE BOARD

Morley and Associates Inc.

Morley and Associates Inc.

4800 Rosebud Lane
Newburgh, IN 46730
Ph: 812-464-9585
Fax: 812-464-2514

Memo

To: **Jeff Mueller, P.E.**
Vanderburgh County Surveyor

From: **James E. Morley, P.E., P.L.S.**

Date: **October 24, 2014**

Re: **The Reserve at Hidden Lake Subdivision**
Our Project 8716.4.002-B

Jeff,
We are responding to an e-mail comment received on Tuesday, October 21, 2014. Per our discussion today, a 6' wide gabion mattress shall be installed at the outfall of P1010. The gabion mattress shall start two feet before the end of the pipe and end at the concrete ribbon in front of the pipe. This gabion mattress shall be used to dissipate energy.

Thank you,
Jim Jr.

CC: File, John Stoll, First Bank

J:\8000s\8700-8799\8716\Civil\Civil 3D\Subdivision March 2014\Documents\Outgoing\Memo Mueller Drainage Comment Responses 10-21-14.doc

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OCT 2 8 2014
VANDERBURGH COUNTY
DRAINAGE BOARD

Letter of Transmittal

Attn: Mr. Jeffrey D. Mueller, County Surveyor
Re: The Reserve at Hidden Lake Subdivision

Date: October 15, 2014
Job No: 8716.4.002-B

If enclosures are not as noted, please notify us at once. Thank you!

To: **Vanderburgh County Drainage Board**
Civic Center Complex
Room 325
Evansville, IN. 47708

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OCT 2 8 2014

VANDERBURGH COUNTY DRAINAGE BOARD

We are sending you by:

☑ **Messenger** ☐ US Mail ☐ US Mail, Certified ☐ Pick-up ☐ Overnight Service ☐ Email

We are sending:

☐ Shop Drawings ☑ **Prints** ☐ Specifications ☑ **Report** ☐ Copy of Letter ☐ Other

Copies	Doc. Date	Description
1	10/15/14	Memo of Responses for Comments dated September 15, 2014 w/attachments

These are Transmitted as Checked Below:

☑ **For Approval** ☐ Approved as Submitted ☐ Resubmit ☐ Copies for Approval
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Remarks:

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VANDERBURGH COUNTY
SURVEYOR'S OFFICE
2:30pm
10/16/14 CA

Copies To:
FILE
JOHN STOLL, MIKE WATHEN-VC ENGINEER-1 EA
DEAN ACKERMAN-FIRST BANK-1EA
JEFF OSBORNE-1 EA

Signed:

Lee A. McClellan, PE

4800 Rosebud Lane ~ Newburgh, Indiana 47630 ~ Ph: (812) 464-9585 ~ Fax: (812) 464-2514
E-mail: info@morleyandassociates.com ~ www.morleyandassociates.com

Morley and Associates Inc.

4800 Rosebud Lane
Newburgh, IN 46730
Ph: 812-464-9585
Fax: 812-464-2514

Memo

To: **Jeffrey Mueller, P.E.**
Vanderburgh County Surveyor

From: **Lee A. McClellan, P.E.**

Date: **October 15, 2014**

Re: **The Reserve at Hidden Lake Subdivision**
Our Project 8716.4.002-B

CC: **John Stoll-VC Engineer**
Mike Wathen-VC Storm Water Compliance
Dean Ackerman

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OCT 2 8 2014

VANDERBURGH COUNTY
DRAINAGE BOARD

Jeffrey, We are responding to e-mail comments received on Monday, September 15, 2014 in the same order as your bullet items. We will call the first bullet item as #1, etc. to #n.

#1 Our survey crew has collected the field data for all the existing storm drainage structures and pipes installed by Stemaly Excavating in 2010 for the Condominium project. They are indicated on Sheet C101 dated 10/13/14. This emergency spillway is lined with riprap and the spillway will discharge into the existing roadside ditch of Jobes Lane and will be lined with Turf Reinforcement Mat (TRM).

#2 The elevations and location of emergency spillway for existing Detention Basin #2 is indicated on Sheet C101 dated 10/13/14.

#3 A Storm Swale Data Table has been added to Sheet C101 dated 10/13/14.

#4 Turf reinforcement mat (TRM) has been added to the top, sides, and backslope of the emergency spillways for existing Detention Basin #1.

#5 The existing swales that were constructed by Stemaly Excavating in 2010 have been re-designed and re-graded during the summer of 2014 when Allen Rellecke Excavating performed major erosion/sedimentation control repairs to the site. These stabilized swales are incorporated into the overall drainage plan and are indicated in the Storm Swale Data Table on Sheet C101 dated 10/13/14..

#6 Our original detail provided to Allen Rellecke Excavating in the spring of 2013 for the reconstruction of the washed out existing steep slope at the rear of Lots 19 and 20, he was to install a flared end section at the end of the slope drain at the elevation of the bottom of existing Detention Basin #2. He installed the slope drain pipe and stabilized the steep bank, and then he excavated all the silt and sediment out of the basin. By the time he got to the proper elevation for the bottom of the existing Detention Basin #2, the end of the inlet pipe was 2.34 feet higher than the basin bottom elevation at the beginning of the concrete ribbon. He reviewed it with the Owner and was given approval to leave it as he had installed it. Our original thought pattern was to replace this HDPE slope drain with concrete when the Subdivision was being constructed, but after discussing it with Allen Rellecke Excavating and Sherman-Dixie, it was decided that the likelihood of keeping a heavy RCP from sliding down the steep embankment at 19.7 % (+/-) without great expense of concrete lugs, anchors, and deadman that would just add additional weight, destroy the heavily vegetated steep sloped that had finally stabilized the steep slope, and working on the slope would just exacerbate the situation of holding the steep slope, it was decided to leave the HDPE and not disturb the dense vegetation that had been established on the steep embankment. Rip rap was added to act as a wearing/splash pad at the end of the inlet pipe. See enclosed photograph. Should this constructed inlet pipe with a vertical drop not be acceptable, the existing inlet pipe could be cut off by moving back further into the steep slope and dropping the elevation down to the bottom of the existing Detention Basin #2, or cutting off the inlet pipe further back into the steep slope, installing a FES, and installing a Rock Lined Chute down the bank of the existing Detention Basin to minimize the head cutting to drop the stormwater leaving the inlet pipe P#1010 down the 3.24 vertical drop to a lower elevation at the bottom of the basin for grade stabilization.

#7 Turf reinforcement mat (TRM) has been placed in the channel bottom and sides of Swale S-4 in its' entirety and where it enters the northwest corner of existing Detention Basin #2. TRM's is proposed to be used in lieu of riprap required per Section 13.04.360 C as TRMs can withstand the channel velocities and can assist the re-vegetation of the channel with grasses without the maintenance issue of constantly removing weeds and other volunteer vegetation that always grows up within riprap that is un-sightly and normally requires spraying with a herbicide that can be detrimental to water quality.

#8 The outlet velocity of Pipe #1010 is at 23.79 fps due to the fact that the pipe is actually a slope drain that is buried in the extremely steep existing hill slope that drops runoff from the curb inlets up along the roadway at elevation 441.35 down to its' outlet in the existing Detention Basin #2 which is at an elevation of 415.31. The calculated velocity of 23.79 fps is for P 1010 flowing full. A storm event that would be of sufficient intensity to cause the pipe to flow full would also generate sufficient flow from yards, downspouts, driveways, overland sheet flow and concentrated flows in the collecting ditches/swales that there should be sufficient stormwater in existing Detention Basin #2 that would be impounded up and over the bottom of the channel and the riprap spash pad to minimize erosion as the stormwater from the inlet will be cascading down onto the top surface of the impounded water, dissipating the energy from the cascading stormwater.
We are cognizant that the outlet velocity exceeds the maximum velocity of 15 fps for a pipe flowing full in accordance with Section 13.04.230. We are respectfully equesting approval for

this special condition as a Discretionary Decision per The Boards' Rights to Discretionary Decisions Section 13.04.025A; Materials and Methods Other Than Included Herein Section 13.04.285; and Submittal of a Written Drainage Design Report per Section13.04.175C; and Controlled Release Rate Required Section 13.04.020 B.2. due to the existing topography.

#9 Yes, it should have read Basin #2 and not Basin #1. Those individual pages have been revised and are attached.

#10. Turf reinforcement mat (TRM) has been placed in the channel bottoms and sides of Swales S-2, S-4, S-5, S-6, and S-7 due to the steep grades of the swales; and the emergency overflow swales EO-Swale 1 and EO-Swale 2 from the curb lines. See Sheet C101 dated 10/13/14 for locations.

#11 A purge pool is not being proposed for this Project. The purge pool is indicated on our Standard Detail Drawing in the event there are locations within a project that it is required. If a purge pool had been required for this Project, it would have been indicated on Sheet C101 dated 10/13/14. Since the inlet pipe to existing Detention Basin #2 has a 2.34 foot vertical drop down to the riprap in the bottom of the basin, the vertical drop will help to dissipate the energy of the pipe discharge as it cascades down over the riprap at the early being of a rain event or a small rain event when the basin will not have impounded stormwater in the basin.

file: J\8714\Civil\Civil 3D\Subdivision\Memo Mueller Drainage Comment Responses 09-23-14.doc

REVISED 10/15/2014

Post-Developed Runoff Calculations, Per Morley and Associates, Inc.

Runoff to the Southeast (UN-1): Subbasins #1, 2, 3A, 3B, 4A, 4B, 10 & 11		
Undetained Area	0.35 Acres	Subbasin #1
Undetained Runoff, Q25	2.92 cfs	Subbasin #1
Detained Area	3.23 Acres	Subbasins #2, 3A, 3B, 4A, 4B, 10 & 11
Ex. Detention Basin #1 Outlet Structure	15" RCP	Per Cash Waggner & Associates
Ex. Detention Basin #1 Discharge Rate, Q25	5.83 cfs	
Ex Detention Basin #1 Volume	3,163 cuft	Field determined by Morley & Assoc.
Ex Detention Basin #1 Design Volume	3,869 cuft	Per Cash Waggner & Associates
Peak Storage Volume	3,631 cuft	Peak volume exceeds existing volume
Total Discharge, Q25	8.75 cfs	(5.83 cfs + 2.92 cfs)
Runoff to the Northeast (UN-2): Subbasins #8, 9, 12A, 12B & 12C		
Undetained Area	0.17 Acres	Subbasin #9
Undetained Runoff, Q25	0.47 cfs	Subbasin #9
Detained Area	3.40 Acres	Subbasins #8, 12A, 12B & 12C
Ex. Detention Basin #2 Outlet Structure	12" RCP	Per Cash Waggner & Associates
Ex. Detention Basin #2 Discharge Rate, Q25	5.98 cfs	
Ex Detention Basin #2 Volume	7,198 cuft	Field determined by Morley & Assoc.
Ex Detention Basin #2 Design Volume	7,798 cuft	Per Cash Waggner & Associates based on Q100 Storm Event
Peak Storage Volume	3,483 cuft	
Total Discharge, Q25	6.48 cfs	(0.47cfs + 5.98 cfs)
Runoff to the West (UN-3): Subbasins #5, 6, 7, 13A & 13B		
Undetained Area	19.33 Acres	Subbasin #5, 6, 7, 13A & 13B
Undetained Runoff, Q25	46.02 cfs	Subbasin #5, 6, 7, 13A & 13B

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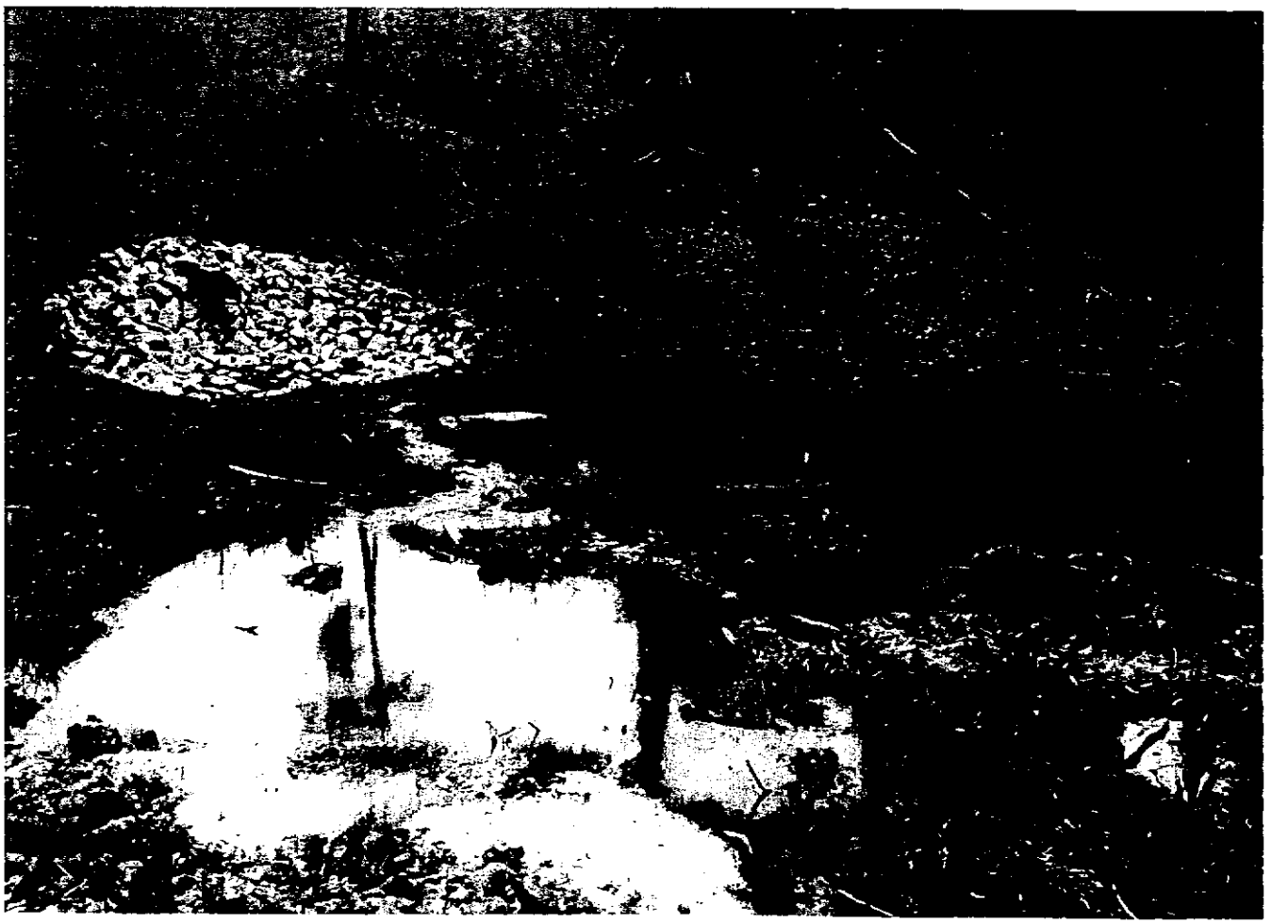
OCT 2 8 2014

VANDERBURGH COUNTY
DRAINAGE BOARD

Φ7/29 / ZΦ13



PRODUCT DATA SHEET

LANDLOK® 450

LANDLOK 450 turf reinforcement mat (TRM) ***features X3™ technology*** *that* consists of a dense web of crimped, interlocking, multi-lobed polypropylene fibers positioned between two biaxially oriented nets and mechanically bound together by parallel stitching with polypropylene thread. The TRM is designed to accelerate seedling emergence, exhibit high resiliency, and possess strength and elongation properties to limit stretching in a saturated condition. Every component of **LANDLOK 450** is stabilized against chemical and ultraviolet degradation which are normally found in a natural soil environment. Furthermore, the TRM contains no biodegradable components.

LANDLOK 450 conforms to the property values listed below[1] and is manufactured at a Propex facility having achieved ISO 9001:2000 certification. Propex performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP).

PROPERTY	TEST METHOD	MARV[2] ENGLISH	MARV[2] METRIC
Physical			
Mass/Unit Area	ASTM D-6566	10.0 oz/yd²	340 g/m²
Thickness	ASTM D-6525	0.40 in	10.1 mm
Light Penetration (% Passing)	ASTM D-6567	20%	20%
Color	Visual	Green or Tan	
Mechanical			
Tensile Strength (Grab)	ASTM D-6818	400 x 300 lb/ft	5.8 x 4.3 kN/m
Elongation	ASTM D-6818	50% (max)	50% (max)
Resiliency	ASTM D-6524	90%	90%
Flexibility	ASTM D-6575	0.026 in-lb (avg)	30,000 mg-cm (avg)
Endurance			
UV Resistance @ 1000 hours	ASTM D-4355	80%	80%
Performance			
Velocity[3] (Vegetated)	Large Scale	18 ft/s	5.5 m/s
Shear Stress[3] (Vegetated)	Large Scale	10 lb/ft²	479 Pa
Manning's "n"[4] (Unvegetated)	Calculated	0.025	0.025
Seedling Emergence	ECTC Draft Method #4	409%	409%
Roll Sizes		6.5 ft x 138.5 ft	2.0 m x 42.2 m

NOTES

1. The property values listed are effective 08/2006 and are subject to change without notice.
2. MARV indicates minimum average roll value calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed the value reported.
3. Maximum permissible velocity and shear stress has been obtained through vegetated testing programs featuring specific soil types, vegetation classes, flow conditions, and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Please contact Propex for further information.
4. Calculated as typical values from large-scale flexible channel lining test programs with a flow depth of 6 to 12 inches.

The opening size (aperture) of the netting on our Landlok® 450 is 0.5 in x 0.5 in.

PROPEX GEOSYNTHETICS | THE ADVANTAGE CREATORS.™

Propex Inc.
6025 Lee Highway, Suite 425
PO Box 22788
Chattanooga, TN 37422

PH: 423 899 0444
PH: 800 621 1273
FAX: 423 899 7619
www.geotextile.com

Mueller, Jeffrey

From: Mueller, Jeffrey
Sent: Monday, September 15, 2014 8:17 AM
To: Lee McClellen
Cc: Stoll, John
Subject: FW: Reserve at Hidden Lake

Contacts: Lee A. McClellan

Lee,

Please find listed below a combination of John Stoll and my comments regarding the Reserve at Hidden Lake.

- Provide the existing elevations on existing storm drainage facilities so that we have a complete picture of what is going on
- Show the location of the emergency spillway of basin #2 as well as the swale data and emergency overflow data for this basin on the plans.
- The typical section shown on sheet C502 for emergency overflow swales refers to "Overflow Swales Table" on sheet C101, but this table does not exist.
- What type of ground cover will there be on emergency overflow swales #1 and #2? Do the steep grades require any extra erosion protection?
- Provide a swale data table for all swales in the subdivision. The swale typical section on sheet C502 refers to swale information on sheet C101, but no swale data is provided on C101.
- There is no end section on pipe #1010. Is the riprap lined chute adequate to control erosion at the outlet end of this pipe since the flow velocity is 23.79 ft/sec? Is this where the energy dissipater will be used?
- Is any erosion protection required where swale #4 enters basin #2?
- The outlet velocity on pipe #1010 is 23.79 ft/sec which exceeds the code.
- Appendix 5-Post-Developed Runoff Calculations (2 different locations) under "Runoff to the Northeast (UN-2) there are four lines under this section that refer to Basin # 1, should this not be Basin #2?
- There are a number of steep slope swales that will require stake sod or rip rap. No notation is shown on the plans regarding requirements or highlighting where this will be required.
- Sheet C502-Energy Dissipator shows an optional plunge pool. When or at what locations will this option be utilized?

John also told me that Dave from his office was going to meet with Pat on the issue of existing 15" pipe, so that we can get you a response to your question regarding this issue.

Jeffrey D Mueller, PE
Vanderburgh County Surveyor
1 NW M L King Blvd Room 325
Evansville, IN 47708
(812) 435-5117

Letter of Transmittal

Attn: Mr. Jeffrey D. Mueller, County Surveyor
Re: The Reserve at Hidden Lake Subdivision

Date: September 04 , 2014
Job No: 8716.4.002-B

If enclosures are not as noted, please notify us at once. Thank you!

To: **Vanderburgh County Drainage Board**
Civic Center Complex
Room 325
Evansville, IN. 47708

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OCT 2 8 2014

VANDERBURGH COUNTY
DRAINAGE BOARD

We are sending you by:

☑ **Messenger** ☐ US Mail ☐ US Mail, Certified ☐ For Pick Up ☐ Overnight Service ☐ Email

We are sending:

☐ Shop Drawings ☑ **Prints** ☐ Specifications ☑ **Report** ☐ Copy of Letter ☐ Other

Copies	Doc. Date	Description
1	09/03/14	**Final Drainage Report**
1	09/03/14	**24" x 36" Prints-C101 & C-102 (bound)**
1	09/02/14	**Memo by Morley and Associates, Inc.**

These are Transmitted as Checked Below:

☑ **For Approval** ☐ Approved as Submitted ☐ Resubmit ☐ Copies for Approval
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VANDERBURGH COUNTY
SURVEYOR'S OFFICE
9/5/14

Remarks:

Please let us know when this will go in front of the Drainage Board so we can send Notices to the adjoiners ince Notices were not sent out at the Preliminary Plan approval process.

Received by

Date

Copies To:
FILE
JOHN STOLL, MIKE WATHEN-VC ENGINEER-1 EA
DEAN ACKERMAN-FIRST BANK-1EA
JEFF OSBORNE-1 EA

Signed:

Lee A. McClellan, PE

4800 Rosebud Lane ~ Newburgh, Indiana 47630 ~ Ph: (812) 464-9585 ~ Fax: (812) 464-2514
E-mail: info@morleyandassociates.com ~ www.morleyandassociates.com

Morley and Associates Inc.

4800 Rosebud Lane
Newburgh, IN 46730
Ph: 812-464-9585
Fax: 812-464-2514

Memo

To: **Jeffrey Mueller, P.E.**
Vanderburgh County Surveyor

From: **Lee A. McClellan, P.E.** Lee

Date: **September 02, 2014**

Re: **The Reserve at Hidden Lake Subdivision**
Our Project 8716.4.002-B

CC: **John Stoll-VC Engineer**
Mike Wathen-VC Storm Water Compliance
Dean Ackerman

APPROVED
OCT 2 8 2014
VANDERBURGH COUNTY
DRAINAGE BOARD

Jeffrey, We have compared our Drainage Computations to the Final Drainage Report prepared by Cash Waggner & Associates, P.C. (Cash Waggner) submitted to your office dated September 13, 2010 and the drainage drawings dated September 22, 2010 and offer the following comments. Since we have been provided all the documents for Cash Waggner's previous project from your office and John Stoll's office, we are under the assumptions that there are no other documents available, nor were we privy to past discussions that were implemented/integrated into that final design, or their rational as to how they approached their design for the Project.

1. When they calculated their pre-developed areas, they had three (3) Un-developed areas (UN-1, UN-2, and UN-3 totaling 26.88 acres. When our survey crew went out and performed a boundary retracement, a discrepancy was found along the west line of the Project which changed the pre-developed area to really be 27.25 acres. Our total post developed area for this proposed 10.5 acre Subdivision is very close to their total post developed area of 10 acres used in their Final Drainage Report for their Phase 1 Condominiums.

2. The Final Drainage report states that their post developed area #14 leaves the site un-detained. When performing a field investigation of previous infrastructure construction, we

The Reserve at Hidden Lake

Site Location

The site is located on the west side of Jobes Lane north of the intersection of Jobes Lane and Shady Court. The site is a part of the Northeast Quarter of the Southeast Quarter of Section 28, Township 6 South, Range 11 West in Vanderburgh County, Indiana. The site is bordered by an undeveloped wooded land to the west, Jobes Lane and Hidden Lake to the east, single family residences to the north and single family residences to the south.

See USGS Quadrangle in Exhibit 1. Quadrangle Map

Soil Properties

The most recent USDA Soil Survey for Vanderburgh County indicates the presence of the following soil types for the 10.49 acres for Lots #1 through #5, and Lots #7 through #41: Alford silt loam, 2 to 6 percent slopes, eroded (AlB2) approximately 17.6%/1.9 acres; Wellston silt loam, 12 to 18 percent slopes, severely eroded (WeD3) approximately 43.9%/4.8 acres; Wellston silt loam, 25 to 50 percent slopes (WeF) approximately 14.3%/1.6 acres; and Wakeland silt loam (Wa) approximately 20.1%/2.2 acres.

Lot #6 containing 16.08 acres is not being developed at this time and will remain in the un-developed state. The USDA Soil Survey for Vanderburgh County indicates the following soil types: Alford silt loam, 2 to 6 percent slopes, eroded (AlB2) approximately 9.8%/1.6 acres; Wellston silt loam, 12 to 18 percent slopes, severely eroded (WeD3) approximately 57.4%/9.2 acres; Wellston silt loam, 25 to 50 percent slopes (WeF) approximately 26.1%/4.2 acres; and Wakeland silt loam (Wa) approximately 6.7%/1.1 acres.

See Soil Survey in Exhibit 2. Soil Survey for Vanderburgh County

Flood Plain Data

The proposed 10.49 acre subdivision does not lie within the limits of the 1% (aka100-year) flood zone as plotted on the Flood Insurance Rate Map for Vanderburgh County, Indiana, Community Panel Number 18163C0157D and 18163C0159D dated March 17, 2011.

See Flood Plain Data in Exhibit 3. FIRM Map

Existing Drainage Conditions

The site was previously utilized, prior to 2010/2011 partially as a small amount of open pasture and mainly woodland. The Drainage Report filed by Cash Waggner & Associates, PC dated September 13, 2010 indicated that the site was divided into three (3) undeveloped subbasins (UN-1 of 4.08 acres, UN-2 of 3.11 acres, and UN-3 of 19.69 acres) for a total of 26.88 acres. For locations of the undeveloped subbasins, see un-

noticed that a culvert pipe with FES #540A had been constructed. Upon further review of all the supplied documents, we located a Drainage Drawing C-101 which is dated almost a week after the Final Drainage report was dated and submitted. This culvert pipe with FES #540A as constructed now drains the post developed area #14 and routes it thru Detention Basin #1, where it was initially indicated as being un-detained. The primary outlet structure (commencing at FES #500 down to Area Drain #500A was constructed per a field check as a 15" RCP. Here again, review of the September 22, 2010 drawing C-101 indicated that the pipe sizes had been changed to 15". But the Final Drainage report dated September 13, 2010 indicates that this is all 12" RCP pipe. We can only assume that some computations were performed to upsize the designed 12" RCP to a 15" RCP due to their inclusion of post developed area #14 being routed thru Detention Basin #1, but we do not possess any computations or changes to the Final Drainage report other than this single Drainage Drawing C-101.

3. The storage volume for Cash Wagner's Detention Basin #1 was calculated to a volume of 3,869 cubic feet to the elevation of the secondary spillway/emergency spillway. The Detention Basin #1 was re-worked last summer by Alan Relleke and the concrete ribbons were installed in the bottom of the basin. We checked his 'as-built' volume at completion of his work and determined it to be approximately 3,163 cubic feet to the elevation of the secondary spillway/emergency spillway. As you can see from the attached "Re-construction Detention Basin #1 Record Drawing in Exhibit 5, his backslopes of the basin is steeper than the designed 4:1 and the toe at that bottom of said slope is too high in elevation. All three deficiencies noted are contributing to the 'as-built' volume being less that designed by Cash Waggner and will need to be corrected to achieve the required storage volume. For us to get the Detention Basin #1 to work, we would need to impound the water within the detention basin to within 0.04' of the as-built elevation of the secondary spillway/emergency spillway. This 0.04' is less than the 6" 'freeboard' that is indicated in the Vanderburgh County Stormwater Drainage Control , Chapter 13.04 paragraph M.2 in Section 13.04.440. The top of the berm and the secondary spillway/emergency spillway will each have to be raised 6 inches in height to comply with the freeboard requirement, and the sideslopes will need to be flattened from 3:1 to 4:1

3. We noticed in the Final Drainage Report that the Detention Basin #2 was calculated to determine the 25 year storm event, but was sized for the 100 year storm event (1% probability), yet the VC Drainage Ordinance only requires detaining for a 25 year storm event. Their report makes no mention the rationale for sizing it for the 100 year storm event (1% probability). The storage volume for Cash Wagner's Detention Basin #2 was calculated to a volume of 7,798 cubic feet to the elevation of the secondary spillway/emergency spillway for the 100 year hydrograph. The Detention Basin #2 was re-worked last summer by Alan Relleke and the concrete ribbons were installed in the bottom of the basin. We checked his 'as-built' volume at completion of his work and determined it to be 7,198 cubic feet to the elevation of the secondary spillway/emergency spillway. As you can see from the attached "Re-construction Detention Basin #2 Record Drawing in Exhibit 5, his backslope along the west side of the basin is flatter than the designed 4:1 and the toe at that bottom of said slope is too high in elevation. Both deficiencies are contributing to the 'as-built' volume being less that designed by Cash Waggner and will need to be corrected to achieve the required storage volume. The Detention Basin #2 will work if we impound the water within the detention basin to within 6" of the secondary spillway/emergency spillway elevation. This 6" of 'freeboard' does comply with the freeboard requirement indicated in the Vanderburgh County Stormwater Drainage Control , Chapter 13.04 paragraph M.2 in Section 13.04.440. Our Final Drainage Report which is attached, has been evaluated for compliance with the Vanderburgh County Stormwater Drainage Control, Chapter

13.04 paragraph entitled 'Steps Procedure' in Section 13.04.435 which is for the 25 year hydrograph.

4. We noticed in Cash Waggner's post developed computations in their Final Drainage Report, that they had assumed particular impervious areas for rooftop, driveways, walks, and patios. Since that 2010 assumptions, several structures have actually been constructed and the true areas of impervious surfaces was field measured to indicate the type of structure that would fit on the new subdivision lots. Therefore, they assumed a total un-detained release of 47.07 cfs and a detained release of 9.81 cfs for a total of 56.88 cfs from their 26.88 acres. Then changes were made that upsized primary outlet pipes from Detention Basin #1 without computation. With us having determined a larger Project limits and a more accurate imperious area for development, and using the existing infrastructure constructed as part of the Phase 1 Condominium, we determined the un-detained release to be 49.41 cfs and a detained release of 11.81 cfs for a total of 61.22 cfs. With some minor modifications to Detention Basin #1 and Detention Basin #2 as noted previously in this Memo, the new infrastructure and the existing infrastructure shall function properly and be in compliance with the Vanderburgh County Drainage Control Chapter 13.04.

5. Last fall when we were out at the site during the installation of the primary and secondary outfalls from Detention Basin #2, it was noted that water ponded in Jobes Lane roadside ditch between the existing 15" FES beneath Jobes Lane and the primary outfall from Detention Basin #2. At the time, Mr. Wathen stated that the Clients project would never get accepted as long as the water ponded in the ditch along Jobes Lane. After considerable expense incurred by our Client to investigate the cause, we prepared a written report with photographs and sketches dated November 06, 2013 and copies were distributed to Mr. Wathen, Mr. Stoll, and your office. During the previous 4 or 5 months we have inquired as to what response we were going to receive from the County to our report and findings. All we've been told when inquiring of Mr. Stoll is that it has been turned over to Mr. Seib out at the County Garage to look into it. We are still inquisitive as to what is, has, or might have happened to this. We certainly don't want the Applicant of the Final Drainage to be held up in getting final drainage approval so he can record the Primary Plat and start selling lots due to something that might have fallen through the cracks for the last 10 months. We also need to know what action is going to be taken by the County or have to be taken by the Client so we can finish the Storm Water Pollution Prevention Plan (SWPPP) and get it filed with the Indiana Department of Environmental Management (IDEM) agency. prior to actual earth disturbing activities.

file: J\8714\Civil\Civil 3D\Subdivision\Memo Mueller Drainage Chgs 08-21-14.doc

developed drainage information in Exhibit 4. Un-developed Drainage Information. UN-1 drains to the east and southeast and discharges at the southeast corner of the site. UN-2 drains to the east and northeast and discharges easterly into Hidden Lake through an existing 15" CMP beneath Jobes Lane. The discharge of Hidden Lake drains south and connects to the discharge of UN-1 on the east side of Jobes Lane before flowing southwesterly back under Jobes Lane. UN-3 flows westerly into an un-named tributary of Bayou Creek, then south in the un-named tributary to Middle Mt. Vernon Road, then southeasterly where flows from UN-1, UN-2 and UN-3 combine and flow southerly into Bayou Creek.

Cash Wagner & Associates, PC developed a 'C' (coefficient of runoff) of 0.48 for UN-1, UN-2, and UN-3 and calculated the 10 year un-developed runoff for UN-1 to be 8.75 cfs, UN-2 to be 7.02 cfs, and UN-3 to be 41.11 cfs, see Exhibit 4 Undeveloped Drainage Information. The discharge to the east and south would be the sum of the 10 year un-developed runoff from UN-1 and UN-2 which totals 15.77 cfs. The discharge to the west for the 10 year un-developed runoff from UN-3 is 41.11 cfs. See Exhibit 4 Un-developed Drainage Information. Their total discharge was calculated as being 56.88 cfs.

As part of developing the first portion of the condominium project into approximately 10 acres Phase 1 Condominiums, approximately 9.1 acres of woodlands were cleared, leaving only approximately 0.90 acres today. The site currently drains in the same general direction as prior to development: to the northeast into Hidden Lake through an existing culvert beneath Jobes Lane at Outlot "A' (1.34 acres), southeast onto Jobes Lane, and west across undeveloped Lot #6 (16.08 acres). A small amount of offsite runoff comes onto the site from the roadside ditch of Jobes Lane along the east side of Lot #19 from the off-site single family lots to the north of the proposed subdivision from the existing roadside ditches on Jobes Lane which bisects the Project site on the east side. This existing Jobes Lane roadside ditch flow is just 'pass-through' drainage as it lies totally within Jobes Lane right-of-way, as it passes directly through the existing 15" CMP culvert beneath Jobes Lane prior to discharging into Hidden Lake.

Existing Storm Drainage Infrastructure

The site was originally disturbed in 2010/2011 per Cash Waggner & Associates, PC design for a Phase 1 Condominium project. A series of storm drainage pipes P#511, P#513, P#515, P#517, P#540B, P#541, P#543, P#545, P#501; curb inlets C.I. #512, C.I. #514, C.I. #540, and C.I. #542; flared end sections FES #500, FES #502, FES #518, FES #540A, and FES #546; area drains AD #500A, AD #506, AD #504, AD #510, AD #516, and AD #544; and storm manholes MH #504, and MH #506A. Storm pipe P#540B and flared end section FES#540A were added to the design plans by Cash Waggner & Associates, PC after the storm water drainage plans were approved. Two storm water detention basins, Detention Basin #1 and Detention Basin #2, were also part of Phase I. Detention Basin #1 was constructed, but failed, and Detention Basin #2 was partially constructed, never finished, and also failed. See Exhibit 6. Un-developed Drainage Plan.

Cash Waggner & Associates, PC utilized a Post-Developed Q25 year storm event for their design of Detention Basins #1 & #2 complete with primary outlet structures and emergency overflow swales, and the storm drainage system of pipes, curb inlets, area drains, manholes, and flared end sections.

During the spring of 2013 work was designed by Morley and Associates, Inc. for the site to satisfy the issues involved with control of erosion, sedimentation, and maintenance of erosion/sedimentation practices. Detention Basin #1 and Detention Basin #2 were reconstructed; the continuous concrete ribbons installed on the floor of the two basins; and FES #1011, Pipe #1012, and FES #1013 were installed as an outlet for Detention Basin #2. Curb Inlets #1000, Pipe #1001, Curb Inlet #1002, and a portion (96 lineal feet) of Pipe #1004 were installed. The fore mentioned drainage structures will be re-used and incorporated into the final infrastructure for the Subdivision. Temporary HDPE drop inlets, pipes, and impoundment berms were constructed to collect runoff from the top of the hill at Lots #27, #28, #19, and #20 as a slope drain allowing the runoff (concentrated flow) to flow from a higher elevation to a lower elevation into Detention Basin #2 without eroding and washing out of the extremely steep (approx. 2.5 h:1 v) slope southwest of Detention Basin #2 on Lots #19 and #20. The slope drain constructed within the embankment down the extremely steep (approx. 2.5 h:1 v) slope will be re-used and incorporated into the final infrastructure for the Subdivision.

Proposed Development

The proposed development (10.49 acres) will contain 40 single family residences Lots #1 through #5, and Lots #7 through #41; 1 large Lot #6 for future development (16.08 acres); Jobes Lane right-of-way (0.72 acres); and one un-buildable Outlot "A" (1.34 acres) which extends out into Hidden Lake. Of the thirteen (13) onsite un-develped drainage subbasins, a total of six (6) subbasins (Subbasins #1, #5, #6, #7, #9, #13A and #13B) will discharge off of the 10.49 acre proposed development un-detained. Subbasin #1 will discharge un-detained to the south east from UN-1; Subbasins #5, #6, #7, and #13a and #13b will discharge un-detained to the west from UN-3; and Subbasin #9 will discharge un-detained to the east from UN-2. The project will include single family residential homes with attached garages, driveways, patios, landscaped areas, streets, a network of drainage swales, storm sewer system, and two dry detention basins. Subbasins #2, #3a, #3b, #4a, #4b, #8, #10, #11, and #12a, #12b, and #12c will have its discharge captured and diverted to the two dry detention basins. Detention Basin #1 will capture runoff from Subbasins #2, #3a, #3b, #4a, #4b, #10, and #11, where Detention Basin #2 will capture runoff from Subbasin #8, and #12a, #12b, and #12c.

Proposed Storm Drainage Infrastructure

The proposed development and drainage design requires for very minor changes within the subbasins designed by Cash Waggner Associates, PC. which will allow the existing storm water drainage system with structures which were approved by the Drainage Board for Phase 1 Condominium project and constructed in 2010/2011, to be re-used and incorporated into the Subdivision project. These previously constructed storm water drainage systems for Phase 1 Condominiums will carry the storm flow/runoff for

which they were originally designed, and the existing Detention Basins #1 and #2, primary outlet structures, and emergency overflow swale which was reconstructed in the summer/fall 2013 to be also re-used and incorporated into the Subdivision project.

Thirteen (13) onsite post-developed drainage subbasins were used to estimate the post-developed onsite runoff.

Runoff from on-site Subbasin #1 will leave the site un-detained to the existing roadside ditch of Jobes Lane, and will not be captured in existing Detention Basin #1from UN-1. Existing Detention Basin #1 will capture runoff from Subbasins #2, #3, #4, #10, and #11. Runoff from Subbasins #5, #6, #7, and #13a and #13b will leave the site un-detained to the west from UN-3. Runoff from Subbasin #9 will leave the site un-detained to the existing roadside ditch of Jobes Lane and through an existing 15" CMP culvert beneath Jobes Lane into Hidden Lake, and will not be captured in existing Detention Basin #2 from UN-2. Existing Detention Basin #2 will capture runoff from Subbasins #8 and #12a, #12b, and #12c.

The total allowable Q25 release rate from the two existing Detention Basins #1 and #2 for the 10.49 acre development is required to be equal to or less than the un-developed Q10 year runoff rate from UN-1, UN-2, and UN-3 minus the un-detained post developed runoff rate from Subbasin #1, #5, #6, #7, #9 and #13a and #13b to bring the runoff from the entire developed site to a 'net zero' state of Q25 Post-developed=/<Q10 Un-developed

The Form 800 was used to calculate the required storage capacity of the existing Detention Basins #1 and #2 based on the peak discharge controlled by the existing outlet structures for each basin.

Project Summary:

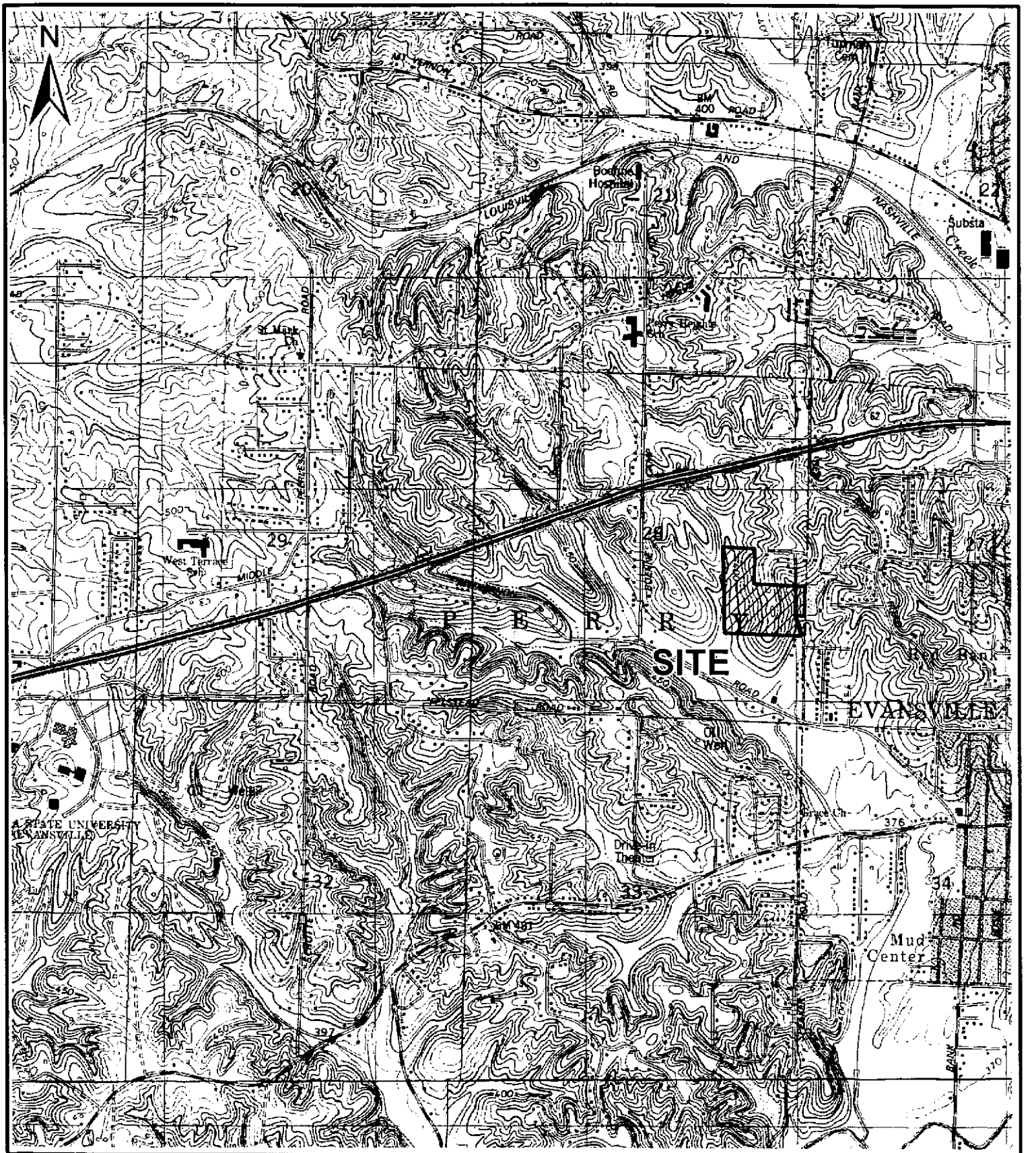
Un-Developed Runoff Calculations, Per Cash Waggner & Associates

Runoff to the Southeast: UN-1		
Area	4.08 Acres	Per Cash Waggner & Associates
Runoff Rate: Q10	8.75 cfs	Per Cash Waggner & Associates
Runoff to the Northeast: UN-2		
Area	3.11 Acres	Per Cash Waggner & Associates
Runoff Rate: Q10	7.02 cfs	Per Cash Waggner & Associates
Runoff to the West: UN-3		
Area	19.69 Acres	Per Cash Waggner & Associates
Runoff Rate: Q10	41.11 cfs	Per Cash Waggner & Associates

Exhibits

1) USGS Quad Map
2) Soil Survey for Vanderburgh County
3) Flood Insurance Rate Map (FIRM), Two Sheets
4) Un-Developed Drainage Information
    a) Un-Developed Sub-Basin Exhibit (Prepared by Cash Waggner & Associates)
    b) Un-Developed Drainage Sub-Basin Calculations
5) Post-developed Drainage Information
    a) Post-Developed Drainage Exhibit
    b) Developed Drainage Sub-Basin Calculations
    c) Storm Sewer Pipe Sizing
    d) Storm Swale Sizing
    e) Project Runoff to the Southeast
        i) Detention Basin #1 Outlet Structure Sizing
        ii) Detention Basin #1 FORM 800
        iii) Detention Basin #1 Record Drawing
    f) Project Runoff to the Northeast
        i) Detention Basin #2 Outlet Structure Sizing
        ii) Detention Basin #2 FORM 800
        iii) Detention Basin #2 Record Drawing
    g) Project Runoff to the West
6) Excerpts from the Approved Drainage Report Prepared by Cash Waggner and Associates

1. Quadrangle Map



NOTE: Boundary is Approximate.

Morley and Associates Inc.

Engineering
Surveying
Architecture
Construction Management

4800 Rosebud Lane
Newburgh, IN 47630

Evansville, IN
(812) 464-9585

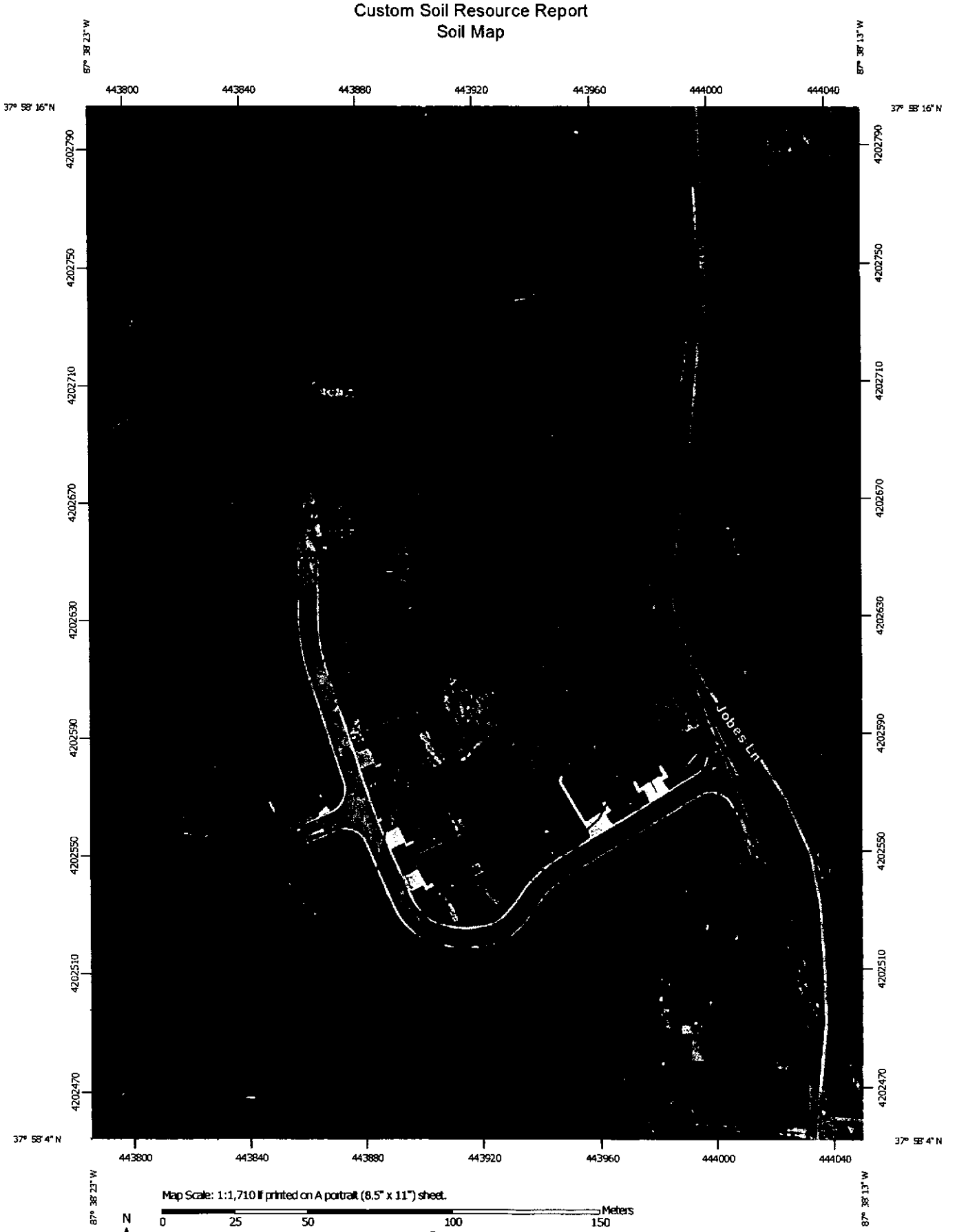
www.morleyandassociates.com

The Reserve at Hidden Lake
Vicinity Map

Designed By	Job Number
LAM	8716.4.002
Drawn By	Date
MJS	01 APR 2014
Filename: QuadMap 01Apr2014.mxd	

2. Soil Survey for Vanderburgh County

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Vanderburgh County, Indiana
Survey Area Data: Version 13, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 3, 2011—Feb 12, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Vanderburgh County, Indiana (IN163)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AlB2	Alford silt loam, 2 to 6 percent slopes, eroded	1.9	17.6%
W	Water	0.5	4.1%
Wa	Wakeland silt loam	2.2	20.1%
WeD3	Wellston silt loam, 12 to 18 percent slopes, severely eroded	4.8	43.9%
WeF	Wellston silt loam, 25 to 50 percent slopes	1.6	14.3%
Totals for Area of Interest		11.0	100.0%

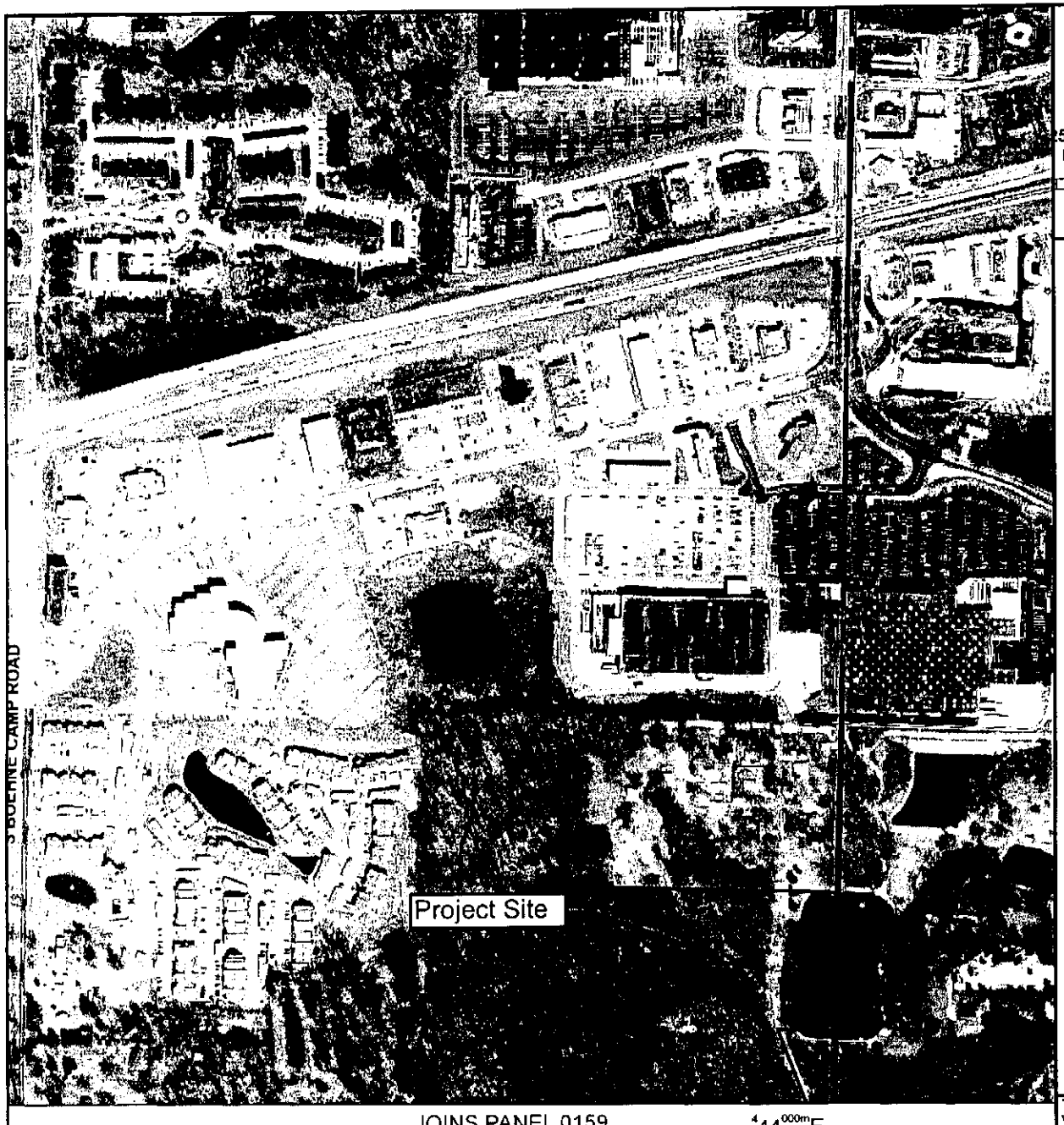
Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

3. FIRM Map



MAP SCALE 1" = 500'

250 0 500 1000

FEET

METER

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0157D

FIRM

FLOOD INSURANCE RATE MAP

VANDERBURGH COUNTY, INDIANA

AND INCORPORATED AREAS

PANEL 157 OF 275

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
EVANSVILLE, CITY OF	180257	0157	D
VANDERBURGH COUNTY	180155	0157	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
18163C0157D

EFFECTIVE DATE
MARCH 17, 2011

Federal Emergency Management Agency

MAP SCALE 1" = 500'

250 0 500 1000

FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0159D

FIRM

FLOOD INSURANCE RATE MAP

VANDERBURGH COUNTY, INDIANA
AND INCORPORATED AREAS

PANEL 159 OF 275

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EVANSVILLE, CITY OF	180157	0159	D
VANDERBURGH COUNTY	180156	0159	D

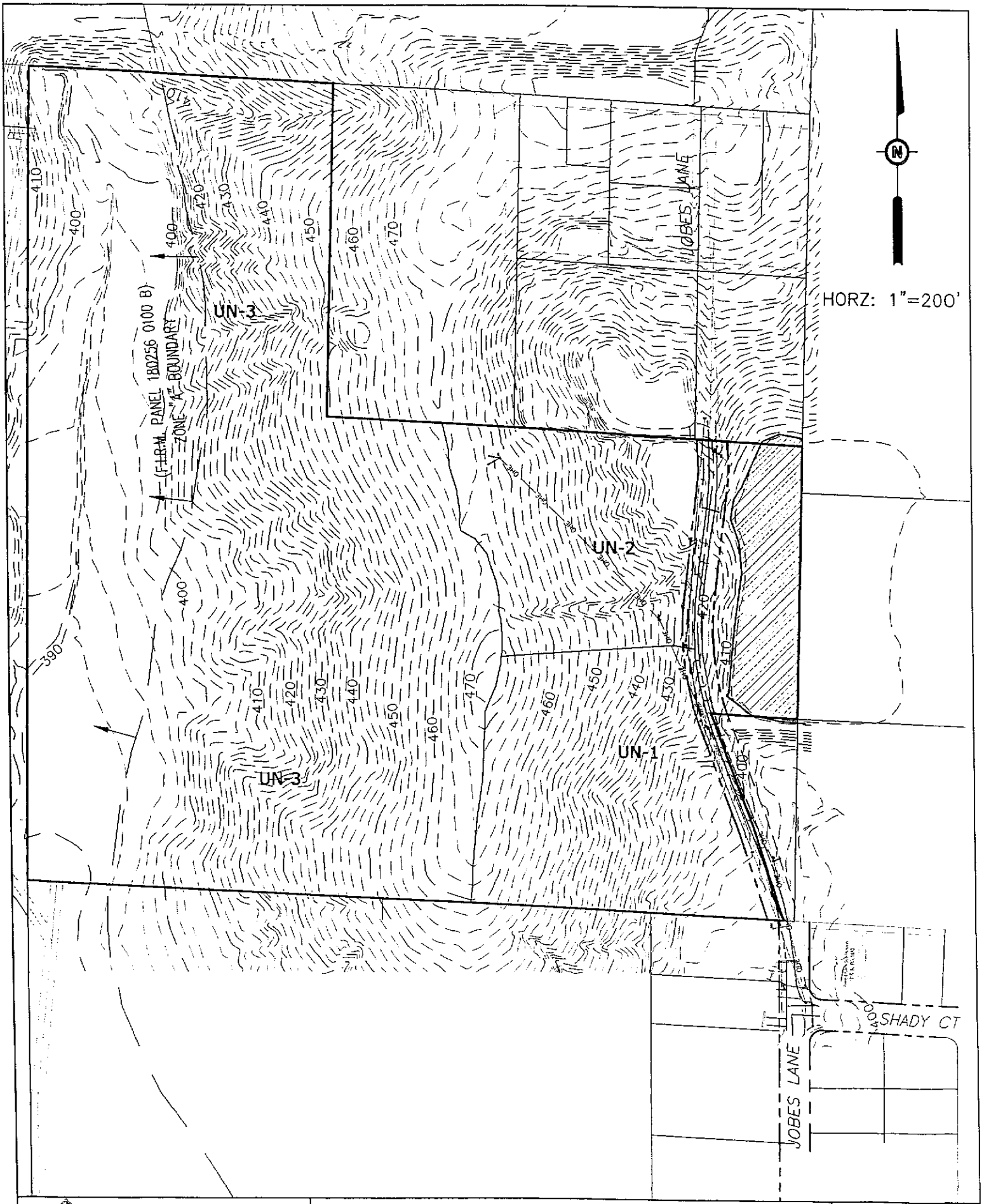
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
18163C0159D

EFFECTIVE DATE
MARCH 17, 2011

Federal Emergency Management Agency

4. Un-developed Drainage Information



CASH WAGGNER & ASSOCIATES, PC
CONSULTING ENGINEERS • LAND SURVEYORS
414 CITADEL CIRCLE, SUITE B, EVANSVILLE, IN 47715

THE RESERVE AT HIDDEN LAKE
UNDEVELOPED SUB-BASINS
JOBES LANE
EVANSVILLE, INDIANA

SHEET NO.: 1
FILENAME: 0769 BASE.dwg
PROJECT NO.: 10-0769
DATE: 08.03.10

UNDEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: UN-1

Total Area = 177,745 S.F.
4.08 Acres

Surface						C	N
Structures		=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives (Asphalt)		=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives (Gravel)		=	0	S.F. =	0.00 Ac.	0.92	0.15
Pavement		=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios		=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks		=	0	S.F. =	0.00 Ac.	0.92	0.02
Pasture (> 10%	0 S.F.	=			0.00 Ac.	0.48	0.40
Woods (0-2%)	0 S.F.	=			0.00 Ac.	0.12	0.60
Woods (2-5%)	0 S.F.	=			0.00 Ac.	0.24	0.60
Woods (5-10%)	0 S.F.	=			0.00 Ac.	0.36	0.60
Woods (>10%)	177,745 S.F.	=			4.08 Ac.	0.48	0.60
Water	S.F.	=			0.00 Ac.	1.00	0.00
Misc.	S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.480**	
Weighted N =	0.600	
Sheet Flow		
L =	300 Ft.	
H =	53.0 Ft.	
S =	0.1767 Ft./Ft.	
t1 =	14.01 Minutes	(Min. 5 minutes)
Shallow Concentrated Flow		
L =	152 Ft.	
H =	19.0 Ft.	
S =	0.1250 Ft./Ft.	
v =	5.70 Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.44 Minutes	
Open Channel Flow		
L =	201 Ft.	
H =	7.0 Ft.	
S =	0.0348 Ft./Ft.	
v =	3.00 Ft./sec.	(From HERPICC Figure 3.4.5)
t3=	1.12 Minutes	
tc =	15.57	
I(10) =	4.466 In./Hr.	
I(25) =	0.000 In./Hr.	
I(50) =	0.000 In./Hr.	
I(100) =	0.000 In./Hr.	
Q(10) =	**8.75 CFS**	
Q(25) =	**0.00 CFS**	
Q(50) =	**0.00 CFS**	
Q(100) =	**0.00 CFS**	

UNDEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: UN-2

Total Area = 135,417 S.F.
3.11 Acres

Surface						C	N
Structures		=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives (Asphalt)		=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives (Gravel)		=	0	S.F. =	0.00 Ac.	0.92	0.15
Pavement		=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios		=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks		=	0	S.F. =	0.00 Ac.	0.92	0.02
Pasture (> 10%	0 S.F.	=			0.00 Ac.	0.48	0.40
Woods (0-2%)	0 S.F.	=			0.00 Ac.	0.12	0.60
Woods (2-5%)	0 S.F.	=			0.00 Ac.	0.24	0.60
Woods (5-10%)	0 S.F.	=			0.00 Ac.	0.36	0.60
Woods (>10%)	135,417 S.F.	=			3.11 Ac.	0.48	0.60
Water	S.F.	=			0.00 Ac.	1.00	0.00
Misc.	S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.480**	
Weighted N =	0.600	
Sheet Flow		
L =	234 Ft.	
H =	30.0 Ft.	
S =	0.1282 Ft./Ft.	
t1 =	13.45 Minutes	(Min. 5 minutes)
Shallow Concentrated Flow		
L =	170 Ft.	
H =	24.0 Ft.	
S =	0.1412 Ft./Ft.	
v =	6.00 Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.47 Minutes	
Open Channel Flow		
L =	0 Ft.	
H =	0.0 Ft.	
S =	#DIV/0! Ft./Ft.	
v =	4.80 Ft./sec.	(From HERPICC Figure 3.4.5)
t3=	0.00 Minutes	
tc =	13.92	
I(10) =	4.702 In./Hr.	
I(25) =	0.000 In./Hr.	
I(50) =	0.000 In./Hr.	
I(100) =	0.000 In./Hr.	
Q(10) =	**7.02 CFS**	
Q(25) =	**0.00 CFS**	
Q(50) =	**0.00 CFS**	
Q(100) =	**0.00 CFS**	

UNDEVELOPED DRAINAGE BASIN CALCULATIONS

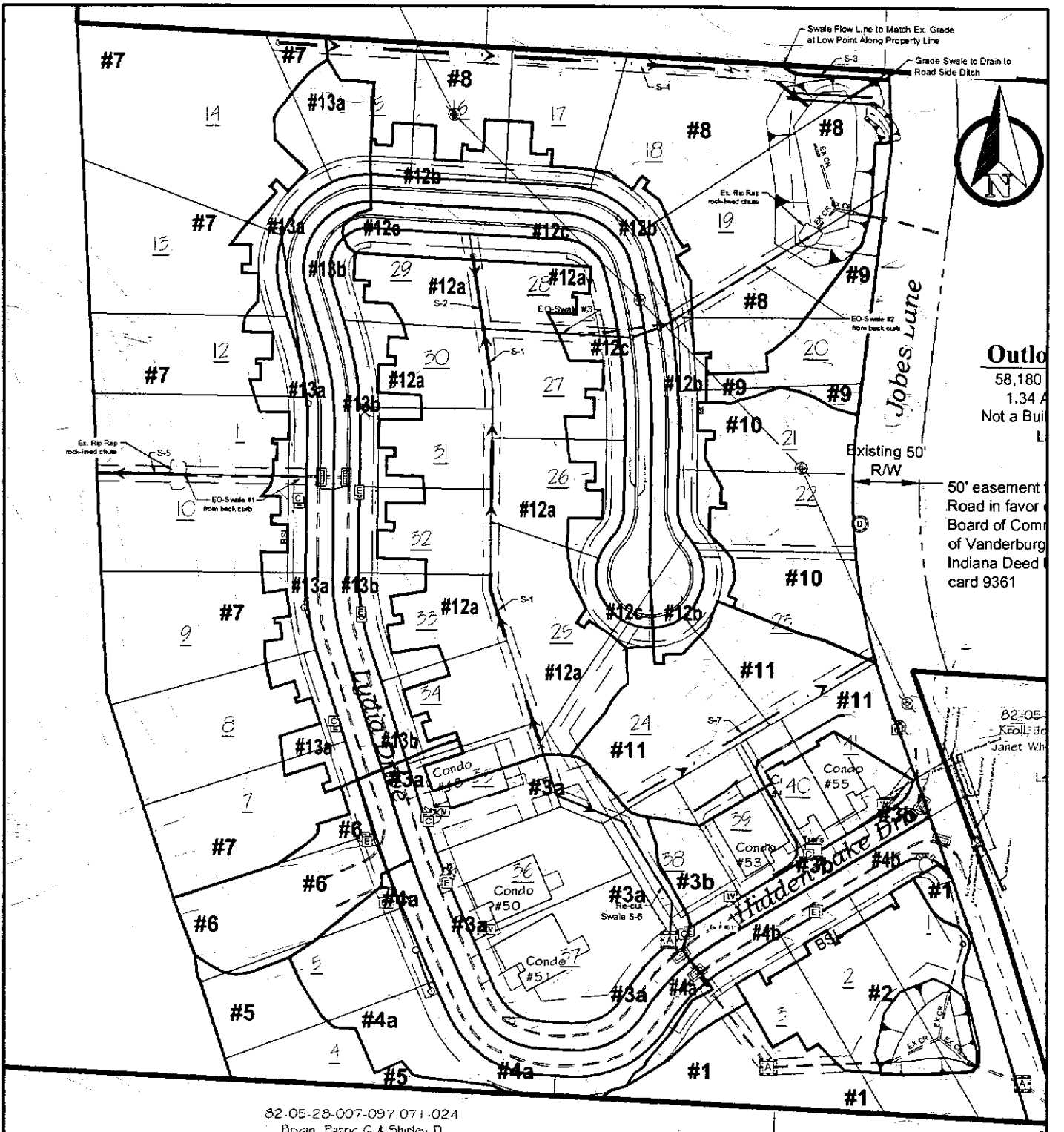
Basin No.: UN-3

Total Area = 857,703 S.F.
19.69 Acres

Surface						C	N
Structures		=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives (Asphalt)		=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives (Gravel)		=	0	S.F. =	0.00 Ac.	0.92	0.15
Pavement		=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios		=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks		=	0	S.F. =	0.00 Ac.	0.92	0.02
Pasture (> 10%	0 S.F.	=			0.00 Ac.	0.48	0.40
Woods (0-2%)	0 S.F.	=			0.00 Ac.	0.12	0.60
Woods (2-5%)	0 S.F.	=			0.00 Ac.	0.24	0.60
Woods (5-10%)	0 S.F.	=			0.00 Ac.	0.36	0.60
Woods (>10%)	857,703 S.F.	=			19.69 Ac.	0.48	0.60
Water	S.F.	=			0.00 Ac.	1.00	0.00
Misc.	S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.480**		
Weighted N =	0.600		
Sheet Flow			
L =	300	Ft.	
H =	44.0	Ft.	
S =	0.1467	Ft./Ft.	
t1 =	14.63	Minutes	(Min. 5 minutes)
Shallow Concentrated Flow			
L =	300	Ft.	
H =	35.0	Ft.	
S =	0.1167	Ft./Ft.	
v =	5.50	Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.91	Minutes	
Open Channel Flow			
L =	174	Ft.	
H =	3.0	Ft.	
S =	0.0172	Ft./Ft.	
v =	2.10	Ft./sec.	(From HERPICC Figure 3.4.5)
t3=	1.38	Minutes	
tc =	16.92		
I(10) =	4.350	In./Hr.	
I(25) =	0.000	In./Hr.	
I(50) =	0.000	In./Hr.	
I(100) =	0.000	In./Hr.	
Q(10) =	**41.11**	**CFS**	
Q(25) =	**0.00**	**CFS**	
Q(50) =	**0.00**	**CFS**	
Q(100) =	**0.00**	**CFS**	

5. Post-developed Drainage Information



82-05-28-007-097.071-024
Bryan, Patric G & Shirley D
5245 Middle Mt Vernon Road
Evansville, IN 47712

82-05-28-007-097.032-024
Knepper, John Walter
801 Jobes Lane
Evansville, IN 47712

Deed Doc 2003200019692 Right-of-Way

Morley and Associates Inc.

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4800 Rosebud Lane
Newburgh, IN 47630
(812) 464-9585
www.morleyandassociates.com

The Reserve at Hidden Lake

Post-Developed Drainage Exhibit

Designed By	Job Number
LAM	8716.4.002
Drawn By:	Date:
MTC	06/26/14
Filename	
8716 Civil Base.dwg	

Developed OnSite Subbasin #1

Surface	15091 Area (S.F.)				C	N
Structures		0	=	0.00 Ac.	0.92	0.02
Drives		0	=	0.00 Ac.	0.92	0.02
Pavement		0	=	0.00 Ac.	0.92	0.02
Patios		0	=	0.00 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		3,000	=	0.07 Ac.	0.48	0.60
Lawn	12,091					
Less then 2%	9%	1,080	=	0.02 Ac.	0.15	0.40
2% to 5%	16%	2,000	=	0.05 Ac.	0.25	0.40
5% to 10%	16%	2,000	=	0.05 Ac.	0.40	0.40
Over 10%	59%	7,011	=	0.16 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
Total Area		15,091	=	0.35 Ac.	0.45	0.44

Sheet Flow		
L =	100	Ft.
H =	24.0	Ft.
S =	0.240	Ft./Ft.
t1 =	6.75	Minutes
Shallow Concentrated Flow		
L =	223	Ft.
H =	24.0	Ft.
S =	0.108	Ft./Ft.
V =	5.29	Ft./Sec.
t2 =	0.70	Minutes
tc =	7.46	Minutes
I(25) =	6.578	In./Hr.
Q(25) =	2.92	CFS

Developed OnSite Subbasin #2

Surface	16277 Area (S.F.)				C	N
Structures		5,520 =	0.13	Ac.	0.92	0.02
Drives		0 =	0.00	Ac.	0.92	0.02
Pavement		0 =	0.00	Ac.	0.92	0.02
Patios		675 =	0.02	Ac.	0.92	0.02
Sidewalks		0 =	0.00	Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0 =	0.00	Ac.	0.20	0.20
2% to 5%		0 =	0.00	Ac.	0.35	0.20
5% to 10%		0 =	0.00	Ac.	0.50	0.20
Over 10%		0 =	0.00	Ac.	0.65	0.20
Woodland						
Less then 2%		0 =	0.00	Ac.	0.12	0.60
2% to 5%		0 =	0.00	Ac.	0.24	0.60
5% to 10%		0 =	0.00	Ac.	0.36	0.60
Over 10%		0 =	0.00	Ac.	0.48	0.60
Lawn	10,082					
Less then 2%	0%	0 =	0.00	Ac.	0.15	0.40
2% to 5%	45%	1,500 =	0.03	Ac.	0.25	0.40
5% to 10%	5%	6,422 =	0.15	Ac.	0.40	0.40
Over 10%	50%	2,160 =	0.05	Ac.	0.55	0.40
Water		0 =	0.00	Ac.	1.00	0.00
Total Area		16,277 =	0.37	Ac.	0.60	0.26

Sheet Flow		
L =	90	Ft.
H =	12.0	Ft.
S =	0.133	Ft./Ft.
t1 =	5.72	Minutes
Shallow Concentrated Flow		
L =	10	Ft.
H =	3.0	Ft.
S =	0.300	Ft./Ft.
V =	8.83	Ft./Sec.
t2 =	0.02	Minutes
tc =	5.74	Minutes
I(25) =	7.018	In./Hr.
Q(25) =	1.58	CFS

Developed OnSite Subbasin #3a

Surface		35216 Area (S.F.)				C	N
Structures		4,488	=	0.10	Ac.	0.92	0.02
Drives		1,620	=	0.04	Ac.	0.92	0.02
Pavement		4,752	=	0.11	Ac.	0.92	0.02
Patios		450	=	0.01	Ac.	0.92	0.02
Sidewalks		0	=	0.00	Ac.	0.92	0.02
Cultivated Field							
Less then 2%		0	=	0.00	Ac.	0.20	0.20
2% to 5%		0	=	0.00	Ac.	0.35	0.20
5% to 10%		0	=	0.00	Ac.	0.50	0.20
Over 10%		0	=	0.00	Ac.	0.65	0.20
Woodland							
Less then 2%		0	=	0.00	Ac.	0.12	0.60
2% to 5%		0	=	0.00	Ac.	0.24	0.60
5% to 10%		0	=	0.00	Ac.	0.36	0.60
Over 10%		0	=	0.00	Ac.	0.48	0.60
Lawn	23,906						
Less then 2%	17%	4,000	=	0.09	Ac.	0.15	0.40
2% to 5%	19%	4,500	=	0.10	Ac.	0.25	0.40
5% to 10%	34%	8,100	=	0.19	Ac.	0.40	0.40
Over 10%	30%	7,306	=	0.17	Ac.	0.55	0.40
Water		0	=	0.00	Ac.	1.00	0.00
Total Area		35,216	=	0.81	Ac.	0.55	0.28

Sheet Flow		
L =	50	Ft.
H =	1.5	Ft.
S =	0.030	Ft./Ft.
t1 =	6.41	Minutes
Shallow Concentrated Flow		
L =	396	Ft.
H =	32.0	Ft.
S =	0.081	Ft./Ft.
V =	5.78	Ft./Sec.
t2 =	1.14	Minutes
tc =	7.55	Minutes
I(25) =	6.553	In./Hr.
Q(25) =	2.92	CFS

Developed OnSite Subbasin #3b

Surface	16847 Area (S.F.)				C	N
Structures		7,360	=	0.17	Ac.	0.92	0.02
Drives		2,160	=	0.05	Ac.	0.92	0.02
Pavement		2,580	=	0.06	Ac.	0.92	0.02
Patios		900	=	0.02	Ac.	0.92	0.02
Sidewalks		0	=	0.00	Ac.	0.92	0.02
Cultivated Field							
Less then 2%		0	=	0.00	Ac.	0.20	0.20
2% to 5%		0	=	0.00	Ac.	0.35	0.20
5% to 10%		0	=	0.00	Ac.	0.50	0.20
Over 10%		0	=	0.00	Ac.	0.65	0.20
Woodland							
Less then 2%		0	=	0.00	Ac.	0.12	0.60
2% to 5%		0	=	0.00	Ac.	0.24	0.60
5% to 10%		0	=	0.00	Ac.	0.36	0.60
Over 10%		0	=	0.00	Ac.	0.48	0.60
Lawn	3,847						
Less then	24%	1,600	=	0.04	Ac.	0.15	0.40
2% to 5%	8%	300	=	0.01	Ac.	0.25	0.40
5% to 10%	19%	722	=	0.02	Ac.	0.40	0.40
Over 10%	49%	1,225	=	0.03	Ac.	0.55	0.40
Water		0	=	0.00	Ac.	1.00	0.00
Total Area		16,847	=	0.39	Ac.	0.79	0.11

Sheet Flow		
L =	96	Ft.
H =	5.0	Ft.
S =	0.052	Ft./Ft.
t1 =	4.89	Minutes
Shallow Concentrated Flow		
L =	218	Ft.
H =	23.0	Ft.
S =	0.106	Ft./Ft.
V =	6.60	Ft./Sec.
t2 =	0.55	Minutes
tc =	5.44	Minutes
I(25) =	7.095	In./Hr.
Q(25) =	2.16	CFS

Developed OnSite Subbasin #4a

Surface	20160 rea (S.F.)				C	N
Structures		3,708 =	0.09	Ac.	0.92	0.02
Drives		1,080 =	0.02	Ac.	0.92	0.02
Pavement		4,416 =	0.10	Ac.	0.92	0.02
Patios		225 =	0.01	Ac.	0.92	0.02
Sidewalks		0 =	0.00	Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0 =	0.00	Ac.	0.20	0.20
2% to 5%		0 =	0.00	Ac.	0.35	0.20
5% to 10%		0 =	0.00	Ac.	0.50	0.20
Over 10%		0 =	0.00	Ac.	0.65	0.20
Woodland						
Less then 2%		0 =	0.00	Ac.	0.12	0.60
2% to 5%		0 =	0.00	Ac.	0.24	0.60
5% to 10%		0 =	0.00	Ac.	0.36	0.60
Over 10%		0 =	0.00	Ac.	0.48	0.60
Lawn	10,731					
Less then 2%	11%	1,200 =	0.03	Ac.	0.15	0.40
2% to 5%	9%	1,000 =	0.02	Ac.	0.25	0.40
5% to 10%	5%	531 =	0.01	Ac.	0.40	0.40
Over 10%	75%	8,000 =	0.18	Ac.	0.55	0.40
Water		0 =	0.00	Ac.	1.00	0.00
Total Area		20,160 =	0.46	Ac.	0.68	0.22

Sheet Flow		
L =	100	Ft.
H =	2.0	Ft.
S =	0.020	Ft./Ft.
t1 =	8.77	Minutes
Shallow Concentrated Flow		
L =	273	Ft.
H =	30.0	Ft.
S =	0.110	Ft./Ft.
V =	6.74	Ft./Sec.
t2 =	0.68	Minutes
tc =	9.45	Minutes
I(25) =	6.066	In./Hr.
Q(25) =	1.91	CFS

Developed OnSite Subbasin #4b

Surface	9440 rea (S.F.)				C	N
Structures		0	=	0.00 Ac.	0.92	0.02
Drives		1,620	=	0.04 Ac.	0.92	0.02
Pavement		2,520	=	0.06 Ac.	0.92	0.02
Patios		0	=	0.00 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		0	=	0.00 Ac.	0.48	0.60
Lawn	5,300					
Less then 2%	11%	500	=	0.01 Ac.	0.15	0.40
2% to 5%	3%	300	=	0.01 Ac.	0.25	0.40
5% to 10%	6%	600	=	0.01 Ac.	0.40	0.40
Over 10%	80%	3,900	=	0.09 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
Total Area		9,440	=	0.22 Ac.	0.67	0.23

Sheet Flow		
L =	100	Ft.
H =	10.0	Ft.
S =	0.100	Ft./Ft.
t1 =	6.16	Minutes
Shallow Concentrated Flow		
L =	205	Ft.
H =	23.0	Ft.
S =	0.112	Ft./Ft.
V =	6.81	Ft./Sec.
t2 =	0.50	Minutes
tc =	6.67	Minutes
I(25) =	6.781	In./Hr.
Q(25) =	0.99	CFS

Developed OnSite Subbasin #5

Surface	9049	Area (S.F.)			C	N
Structures		0	=	0.00 Ac.	0.92	0.02
Drives		0	=	0.00 Ac.	0.92	0.02
Pavement		0	=	0.00 Ac.	0.92	0.02
Patios		225	=	0.01 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		1,000	=	0.02 Ac.	0.48	0.60
Lawn	7,824					
Less then 2%	0%	3,300	=	0.08 Ac.	0.15	0.40
2% to 5%	45%	900	=	0.02 Ac.	0.25	0.40
5% to 10%	5%	3,624	=	0.08 Ac.	0.40	0.40
Over 10%	0%	0	=	0.00 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
Total Area		9,049	=	0.21 Ac.	0.32	0.41

Sheet Flow		
L =	90	Ft.
H =	3.5	Ft.
S =	0.039	Ft./Ft.
t1 =	9.55	Minutes
Shallow Concentrated Flow		
L =	10	Ft.
H =	3.0	Ft.
S =	0.300	Ft./Ft.
V =	8.83	Ft./Sec.
t2 =	0.02	Minutes
tc =	9.57	Minutes
I(25) =	6.036	In./Hr.
Q(25) =	0.40	CFS

Developed OnSite Subbasin #6

						C	N
Surface	12064	rea (S.F.)					
Structures		0	=	0.00	Ac.	0.92	0.02
Drives		0	=	0.00	Ac.	0.92	0.02
Pavement		2,650	=	0.06	Ac.	0.92	0.02
Patios		0	=	0.00	Ac.	0.92	0.02
Sidewalks		0	=	0.00	Ac.	0.92	0.02
Cultivated Field							
Less then 2%		0	=	0.00	Ac.	0.20	0.20
2% to 5%		0	=	0.00	Ac.	0.35	0.20
5% to 10%		0	=	0.00	Ac.	0.50	0.20
Over 10%		0	=	0.00	Ac.	0.65	0.20
Woodland							
Less then 2%		0	=	0.00	Ac.	0.12	0.60
2% to 5%		0	=	0.00	Ac.	0.24	0.60
5% to 10%		0	=	0.00	Ac.	0.36	0.60
Over 10%		0	=	0.00	Ac.	0.48	0.60
Lawn	9,414						
Less then 2%	5%	500	=	0.01	Ac.	0.15	0.40
2% to 5%	95%	8,914	=	0.20	Ac.	0.25	0.40
5% to 10%	0%	0	=	0.00	Ac.	0.40	0.40
Over 10%	0%	0	=	0.00	Ac.	0.55	0.40
Water		0	=	0.00	Ac.	1.00	0.00
Total Area		12,064	=	0.28	Ac.	0.39	0.32

Sheet Flow		
L =	100	Ft.
H =	3.5	Ft.
S =	0.035	Ft./Ft.
t1 =	9.08	Minutes
Shallow Concentrated Flow		
L =	86	Ft.
H =	3.0	Ft.
S =	0.035	Ft./Ft.
V =	3.80	Ft./Sec.
t2 =		Minutes
tc =	9.08	Minutes
I(25) =	6.161	In./Hr.
Q(25) =	0.67	CFS

Developed OnSite Subbasin #7 and Lot #6

Surface	778538	Area (S.F.)				C	N
Structures		14,832	=	0.34	Ac.	0.92	0.02
Drives		0	=	0.00	Ac.	0.92	0.02
Pavement		0	=	0.00	Ac.	0.92	0.02
Patios		1,800	=	0.04	Ac.	0.92	0.02
Sidewalks		0	=	0.00	Ac.	0.92	0.02
Cultivated Field							
Less then 2%		0	=	0.00	Ac.	0.20	0.20
2% to 5%		0	=	0.00	Ac.	0.35	0.20
5% to 10%		0	=	0.00	Ac.	0.50	0.20
Over 10%		0	=	0.00	Ac.	0.65	0.20
Woodland							
Less then 2%		0	=	0.00	Ac.	0.12	0.60
2% to 5%		0	=	0.00	Ac.	0.24	0.60
5% to 10%		0	=	0.00	Ac.	0.36	0.60
Over 10%		692,168	=	15.89	Ac.	0.48	0.60
Lawn	69,738						
Less then 2%	0%	0	=	0.00	Ac.	0.15	0.40
2% to 5%	45%	31,382	=	0.72	Ac.	0.25	0.40
5% to 10%	5%	3,487	=	0.08	Ac.	0.40	0.40
Over 10%	50%	34,869	=	0.80	Ac.	0.55	0.40
Water		0	=	0.00	Ac.	1.00	0.00
Total Area		778,538	=	17.87	Ac.	0.48	0.57

Sheet Flow		
L =	100	Ft.
H =	1.5	Ft.
S =	0.015	Ft./Ft.
t1 =	14.56	Minutes
Shallow Concentrated Flow		
L =	563	Ft.
H =	32.0	Ft.
S =	0.057	Ft./Ft.
V =	3.85	Ft./Sec.
t2 =	2.44	Minutes
tc =	17.00	Minutes
I(25) =	4.848	In./Hr.
Q(25) =	41.84	CFS

Developed OnSite Subbasin #8

Surface	48235	Area (S.F.)				C	N
Structures		15,528	=	0.36	Ac.	0.92	0.02
Drives		0	=	0.00	Ac.	0.92	0.02
Pavement		0	=	0.00	Ac.	0.92	0.02
Patios		1	=	0.00	Ac.	0.92	0.02
Sidewalks		0	=	0.00	Ac.	0.92	0.02
Cultivated Field							
Less then 2%		0	=	0.00	Ac.	0.20	0.20
2% to 5%		0	=	0.00	Ac.	0.35	0.20
5% to 10%		0	=	0.00	Ac.	0.50	0.20
Over 10%		0	=	0.00	Ac.	0.65	0.20
Woodland							
Less then 2%		0	=	0.00	Ac.	0.12	0.60
2% to 5%		0	=	0.00	Ac.	0.24	0.60
5% to 10%		0	=	0.00	Ac.	0.36	0.60
Over 10%		14,000	=	0.32	Ac.	0.48	0.60
Lawn	18,707						
Less then 2%	40%	7,482	=	0.17	Ac.	0.15	0.40
2% to 5%	25%	4,676	=	0.11	Ac.	0.25	0.40
5% to 10%	15%	2,806	=	0.06	Ac.	0.40	0.40
Over 10%	20%	3,741	=	0.09	Ac.	0.55	0.40
Water		0	=	0.00	Ac.	1.00	0.00
Total Area		48,235	=	1.11	Ac.	0.55	0.34

Sheet Flow		
L =	100	Ft.
H =	12.0	Ft.
S =	0.120	Ft./Ft.
t1 =	7.00	Minutes
Shallow Concentrated Flow		
L =	260	Ft.
H =	44.0	Ft.
S =	0.169	Ft./Ft.
V =	6.64	Ft./Sec.
t2 =	0.65	Minutes
tc =	7.65	Minutes
I(25) =	6.527	In./Hr.
Q(25) =	3.97	CFS

Developed OnSite Subbasin #9

Surface	7548	Area (S.F.)			C	N
Structures		0	=	0.00 Ac.	0.92	0.02
Drives		0	=	0.00 Ac.	0.92	0.02
Pavement		0	=	0.00 Ac.	0.92	0.02
Patios		0	=	0.00 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		5,648	=	0.13 Ac.	0.48	0.60
Lawn						
Less then 2%		600	=	0.01 Ac.	0.15	0.40
2% to 5%		900	=	0.02 Ac.	0.25	0.40
5% to 10%		400	=	0.01 Ac.	0.40	0.40
Over 10%		0	=	0.00 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
	Total Area	7,548	=	0.17 Ac.	0.42	0.55

Sheet Flow		
L =	100	Ft.
H =	20.0	Ft.
S =	0.200	Ft./Ft.
t1 =	7.82	Minutes
Shallow Concentrated Flow		
L =	100	Ft.
H =	14.0	Ft.
S =	0.140	Ft./Ft.
V =	6.04	Ft./Sec.
t2 =		Minutes
tc =	7.82	Minutes
I(25) =	6.484	In./Hr.
Q(25) =	0.47	CFS

Developed OnSite Subbasin #10

Surface	18532	Area (S.F.)			C	N
Structures		4,412	=	0.10 Ac.	0.92	0.02
Drives		0	=	0.00 Ac.	0.92	0.02
Pavement		0	=	0.00 Ac.	0.92	0.02
Patios		450	=	0.01 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		9,450	=	0.22 Ac.	0.48	0.60
Lawn	4,220					
Less then 2%		0	=	0.00 Ac.	0.15	0.40
2% to 5%	14%	300	=	0.01 Ac.	0.25	0.40
5% to 10%	26%	1,100	=	0.03 Ac.	0.40	0.40
Over 10%	60%	2,820	=	0.06 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
Total Area		18,532	=	0.43 Ac.	0.60	0.40

Sheet Flow		
L =	100	Ft.
H =	16	Ft.
S =	0.160	Ft./Ft.
t1 =	7.12	Minutes
Shallow Concentrated Flow		
L =	185	Ft.
H =	6.0	Ft.
S =	0.032	Ft./Ft.
V =	2.90	Ft./Sec.
t2 =		Minutes
tc =	7.12	Minutes
I(25) =	6.664	In./Hr.
Q(25) =	1.69	CFS

Developed OnSite Subbasin #11

Surface	23972	Area (S.F.)			C	N
Structures		2,928	=	0.07 Ac.	0.92	0.02
Drives		0	=	0.00 Ac.	0.92	0.02
Pavement		0	=	0.00 Ac.	0.92	0.02
Patios		450	=	0.01 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		4,200	=	0.10 Ac.	0.48	0.60
Lawn						
Less then 2%		0	=	0.00 Ac.	0.15	0.40
2% to 5%		10,400	=	0.24 Ac.	0.25	0.40
5% to 10%		2,500	=	0.06 Ac.	0.40	0.40
Over 10%		3,494	=	0.08 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
Total Area		23,972	=	0.55 Ac.	0.44	0.38

Sheet Flow		
L =	100	Ft.
H =	3.0	Ft.
S =	0.030	Ft./Ft.
t1 =	10.27	Minutes
Shallow Concentrated Flow		
L =	170	Ft.
H =	22.0	Ft.
S =	0.129	Ft./Ft.
V =	5.80	Ft./Sec.
t2 =	0.49	Minutes
tc =	10.76	Minutes
I(25) =	5.249	In./Hr.
Q(25) =	1.28	CFS

Developed OnSite Subbasin #12a

Surface	53477 Area (S.F.)				C	N
Structures		19,684	=	0.45 Ac.	0.92	0.02
Drives		2,160	=	0.05 Ac.	0.92	0.02
Pavement		0	=	0.00 Ac.	0.92	0.02
Patios		2,475	=	0.06 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		0	=	0.00 Ac.	0.48	0.60
Lawn	29,158					
Less then 2%	0%	0	=	0.00 Ac.	0.15	0.40
2% to 5%	57%	16,558	=	0.38 Ac.	0.25	0.40
5% to 10%	17%	5,000	=	0.11 Ac.	0.40	0.40
Over 10%	26%	7,600	=	0.17 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
Total Area		53,477	=	1.23 Ac.	0.61	0.23

Sheet Flow		
L =	43	Ft.
H =	2.0	Ft.
S =	0.047	Ft./Ft.
t1 =	4.91	Minutes
Shallow Concentrated Flow		
L =	335	Ft.
H =	3.5	Ft.
S =	0.010	Ft./Ft.
V =	2.08	Ft./Sec.
t2 =	2.69	Minutes
tc =	7.60	Minutes
I(25) =	6.542	In./Hr.
Q(25) =	4.91	CFS

Developed OnSite Subbasin #12b

Surface	24037 Area (S.F.)				C	N
Structures		0 =	0.00	Ac.	0.92	0.02
Drives		5,400 =	0.12	Ac.	0.92	0.02
Pavement		6,895 =	0.16	Ac.	0.92	0.02
Patios		0 =	0.00	Ac.	0.92	0.02
Sidewalks		0 =	0.00	Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0 =	0.00	Ac.	0.20	0.20
2% to 5%		0 =	0.00	Ac.	0.35	0.20
5% to 10%		0 =	0.00	Ac.	0.50	0.20
Over 10%		0 =	0.00	Ac.	0.65	0.20
Woodland						
Less then 2%		0 =	0.00	Ac.	0.12	0.60
2% to 5%		0 =	0.00	Ac.	0.24	0.60
5% to 10%		0 =	0.00	Ac.	0.36	0.60
Over 10%		0 =	0.00	Ac.	0.48	0.60
Lawn	11,742					
Less then 2%	2%	202 =	0.00	Ac.	0.15	0.40
2% to 5%	98%	11,540 =	0.26	Ac.	0.25	0.40
5% to 10%	0%	0 =	0.00	Ac.	0.40	0.40
Over 10%	0%	0 =	0.00	Ac.	0.55	0.40
Water		0 =	0.00	Ac.	1.00	0.00
Total Area		24,037 =	0.55	Ac.	0.59	0.21

Sheet Flow		
L =	30	Ft.
H =	2.0	Ft.
S =	0.067	Ft./Ft.
t1 =	3.64	Minutes
Shallow Concentrated Flow		
L =	295	Ft.
H =	14.5	Ft.
S =	0.049	Ft./Ft.
V =	4.51	Ft./Sec.
t2 =	1.09	Minutes
tc =	4.73	Minutes
I(25) =	7.208	In./Hr.
Q(25) =	2.35	CFS

Developed OnSite Subbasin #12c

Surface	22145 Area (S.F.)				C	N
Structures		0	=	0.00 Ac.	0.92	0.02
Drives		2,160	=	0.05 Ac.	0.92	0.02
Pavement		6,895	=	0.16 Ac.	0.92	0.02
Patios		0	=	0.00 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		0	=	0.00 Ac.	0.48	0.60
Lawn	13,090					
Less then 2%	81%	10,600	=	0.24 Ac.	0.15	0.40
2% to 5%	19%	2,490	=	0.06 Ac.	0.25	0.40
5% to 10%	0%	0	=	0.00 Ac.	0.40	0.40
Over 10%	0%	0	=	0.00 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
Total Area		22,145	=	0.51 Ac.	0.48	0.24

Sheet Flow		
L =	50	Ft.
H =	1.0	Ft.
S =	0.020	Ft./Ft.
t1 =	6.64	Minutes
Shallow Concentrated Flow		
L =	295	Ft.
H =	14.5	Ft.
S =	0.049	Ft./Ft.
V =	4.51	Ft./Sec.
t2 =	1.09	Minutes
tc =	7.73	Minutes
I(25) =	6.508	In./Hr.
Q(25) =	1.58	CFS

Developed OnSite Subbasin #13a

Surface	27009	Area (S.F.)			C	N
Structures		1,060	=	0.02 Ac.	0.92	0.02
Drives		4,320	=	0.10 Ac.	0.92	0.02
Pavement		5,246	=	0.12 Ac.	0.92	0.02
Patios		0	=	0.00 Ac.	0.92	0.02
Sidewalks		0	=	0.00 Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0	=	0.00 Ac.	0.20	0.20
2% to 5%		0	=	0.00 Ac.	0.35	0.20
5% to 10%		0	=	0.00 Ac.	0.50	0.20
Over 10%		0	=	0.00 Ac.	0.65	0.20
Woodland						
Less then 2%		0	=	0.00 Ac.	0.12	0.60
2% to 5%		0	=	0.00 Ac.	0.24	0.60
5% to 10%		0	=	0.00 Ac.	0.36	0.60
Over 10%		0	=	0.00 Ac.	0.48	0.60
Lawn	16,383					
Less then 2%	59%	9,614	=	0.22 Ac.	0.15	0.40
2% to 5%	41%	2,490	=	0.06 Ac.	0.25	0.40
5% to 10%	59%	0	=	0.00 Ac.	0.40	0.40
Over 10%	0%	0	=	0.00 Ac.	0.55	0.40
Water		0	=	0.00 Ac.	1.00	0.00
Total Area		22,730	=	0.52 Ac.	0.52	0.22

Sheet Flow		
L =	59	Ft.
H =	1.0	Ft.
S =	0.017	Ft./Ft.
t1 =	7.13	Minutes
Shallow Concentrated Flow		
L =	183	Ft.
H =	2.0	Ft.
S =	0.011	Ft./Ft.
V =	2.12	Ft./Sec.
t2 =	1.44	Minutes
tc =	8.57	Minutes
I(25) =	6.293	In./Hr.
Q(25) =	1.71	CFS

Developed OnSite Subbasin #13b

Surface	19764	Area (S.F.)			C	N
Structures		0 =	0.00	Ac.	0.92	0.02
Drives		3,240 =	0.07	Ac.	0.92	0.02
Pavement		5,246 =	0.12	Ac.	0.92	0.02
Patios		0 =	0.00	Ac.	0.92	0.02
Sidewalks		0 =	0.00	Ac.	0.92	0.02
Cultivated Field						
Less then 2%		0 =	0.00	Ac.	0.20	0.20
2% to 5%		0 =	0.00	Ac.	0.35	0.20
5% to 10%		0 =	0.00	Ac.	0.50	0.20
Over 10%		0 =	0.00	Ac.	0.65	0.20
Woodland						
Less then 2%		0 =	0.00	Ac.	0.12	0.60
2% to 5%		0 =	0.00	Ac.	0.24	0.60
5% to 10%		0 =	0.00	Ac.	0.36	0.60
Over 10%		0 =	0.00	Ac.	0.48	0.60
Lawn	11,278					
Less then 2%	74%	8,360 =	0.19	Ac.	0.15	0.40
2% to 5%	26%	2,918 =	0.07	Ac.	0.25	0.40
5% to 10%	59%	0 =	0.00	Ac.	0.40	0.40
Over 10%	0%	0 =	0.00	Ac.	0.55	0.40
Water		0 =	0.00	Ac.	1.00	0.00
Total Area		19,764 =	0.45	Ac.	0.50	0.24

Sheet Flow		
L =	59	Ft.
H =	1.0	Ft.
S =	0.017	Ft./Ft.
t1 =	7.34	Minutes
Shallow Concentrated Flow		
L =	183	Ft.
H =	2.0	Ft.
S =	0.011	Ft./Ft.
V =	2.12	Ft./Sec.
t2 =	1.44	Minutes
tc =	8.78	Minutes
I(25) =	6.238	In./Hr.
Q(25) =	1.40	CFS

MORLEY AND ASSOCIATES INC.

STORM SEWER DESIGN - RATIONAL METHOD

PROJECT: The Reserve at Hidden Lake

OUR PROJECT # 8716.4.002-B

MANNINGS n 0.011 (Table 13.04.220)

DATE: July 25, 2014

DESIGN PERIOD: 25 YEARS

SUB NO.	UPSTREAM MANHOLE	PIPE #	DOWNSTREAM MANHOLE	LENGTH (ft)	Cj	Aj (ac.)	CjAj	SUM CjAj	Tj (min)	Tcum (min)	I (in/hr)	Q (cfs)	PIPE DIA. (in)	PIPE IE U.S.	PIPE IE D.S	PIPE SLOPE (ft/ft)	PIPE CAP. (cfs)	VELOCITY (ft/sec)	TRAVEL TIME (min)	PERCENT CAPACITY (%)
12a	AD#1005	P#1006	CI#1007	110.9	0.61	1.23	0.750	0.750	7.60	7.60	6.542	4.91	12	446.00	443.12	0.0260	6.78	8.64	0.21	72.4
12c	CI#1007	P#1008	CI#1009	22.3	0.48	0.51	0.245	0.995	7.73	7.81	6.487	6.46	12	443.12	442.35	0.0345	7.82	9.96	0.04	82.5
12b	CI#1009	P#1010		132.3	0.59	0.55	0.325	1.075	4.73	7.85	6.477	6.96	12	441.35	415.31	0.1968	18.67	23.79	0.09	37.3

Storm Swale's

Manning's Coefficient = 0.035 (Table 13.04.220)

Slope (ft/ft)	Slope (%)	Side Slope (X:1)	Length (ft)	Channel Depth (MIN) (ft)	Bottom Width (ft)	Wetted Perimeter (ft)	Area (ft^2)	Hydraulic Radius (ft)	Hydraulic Depth (ft)	Channel Capacity (cfs)	Full Depth Velocity (ft/s)	Travel Time (min)	US Elev.	DS Elev
S-1														
0.010	1.01	3.0	123.2	1.00	1.00	7.32	4.00	0.55	0.57	11.46	2.86	0.72	453.00	451.75
0.014	1.39	3.0	151.4	1.00	1.00	7.32	4.00	0.55	0.57	13.40	3.35	0.75	451.75	449.65
0.014	1.43	3.0	45.6	1.00	1.00	7.32	4.00	0.55	0.57	13.58	3.40	0.22	449.65	449.00
S-2														
0.070	7.04	3.0	56.8	1.00	1.00	7.32	4.00	0.55	0.57	30.19	7.55	0.13	453.00	449.00
S-3														
0.020	2.04	3.0	208.0	1.00	1.00	7.32	4.00	0.55	0.57	16.26	4.07	0.85	416.18	411.93
S-4														
0.038	3.82	3.0	104.8	1.00	1.00	7.32	4.00	0.55	0.57	22.23	5.56	0.31	466.00	462.00
0.194	19.44	3.0	72.0	1.00	1.00	7.32	4.00	0.55	0.57	50.17	12.54	0.10	462.00	448.00
0.118	11.75	3.0	85.1	1.00	1.00	7.32	4.00	0.55	0.57	39.00	9.75	0.15	448.00	438.00
0.189	18.92	3.0	105.7	1.00	1.00	7.32	4.00	0.55	0.57	49.49	12.37	0.14	438.00	418.00
0.097	9.73	3.0	41.1	1.00	1.00	7.32	4.00	0.55	0.57	35.49	8.87	0.08	418.00	414.00
S-5														
0.147	14.68	3.0	66.0	1.00	1.00	7.32	4.00	0.55	0.57	43.59	10.90	0.10	444.69	435.00
S-6														
0.055	5.46	3.0	36.6	1.00	1.00	7.32	4.00	0.55	0.57	26.60	6.65	0.09	453.00	451.00
0.205	20.52	3.0	53.6	1.00	1.00	7.32	4.00	0.55	0.57	51.54	12.89	0.07	451.00	440.00
0.143	14.29	3.0	70.0	1.00	1.00	7.32	4.00	0.55	0.57	43.00	10.75	0.11	440.00	430.00
0.144	14.42	3.0	26.0	1.00	1.00	7.32	4.00	0.55	0.57	43.21	10.80	0.04	430.00	426.25
S-7														
0.115	11.47	3.0	122.1	1.00	1.00	7.32	4.00	0.55	0.57	38.52	9.63	0.21	440.00	426.00
0.063	6.32	3.0	95.0	1.00	1.00	7.32	4.00	0.55	0.57	28.59	7.15	0.22	426.00	420.00
EO-Swale #1 (Emergency Overflow Swale)														
0.109	10.94	3.0	96.0	0.25	5.00	6.58	1.44	0.22	0.22	7.34	5.11	0.31	458.50	448.00
EO-Swale #2 (Emergency Overflow Swale)														
0.236	23.62	3.0	124.0	0.25	5.00	6.58	1.44	0.22	0.22	10.79	7.50	0.28	446.29	417.00
EO-Swale #3 (Emergency Overflow Swale)														
0.035	3.50	3.0	106.0	0.25	5.00	6.58	1.44	0.22	0.22	4.15	2.89	0.61	450.00	446.29

Post-Developed Runoff Calculations, Per Morley and Associates, Inc.

Runoff to the Southeast (UN-1): Subbasins #1, 2, 3A, 3B, 4A, 4B, 10 & 11		
Undetained Area	0.35 Acres	Subbasin #1
Undetained Runoff, Q25	2.92 cfs	Subbasin #1
Detained Area	3.23 Acres	Subbasins #2, 3A, 3B, 4A, 4B, 10 & 11
Ex. Detention Basin #1 Outlet Structure	15" RCP	Per Cash Waggner & Associates
Ex. Detention Basin #1 Discharge Rate, Q25	5.83 cfs	
Ex Detention Basin #1 Volume	3,163 cuft	Field determined by Morley & Assoc.
Ex Detention Basin #1 Design Volume	3,869 cuft	Per Cash Waggner & Associates
Peak Storage Volume	3,631 cuft	Peak volume exceeds existing volume
Total Discharge, Q25	8.75 cfs	(5.83 cfs + 2.92 cfs)
Runoff to the Northeast (UN-2): Subbasins #8, 9, 12A, 12B & 12C		
Undetained Area	0.17 Acres	Subbasin #9
Undetained Runoff, Q25	0.47 cfs	Subbasin #9
Detained Area	3.40 Acres	Subbasins #8, 12A, 12B & 12C
Ex. Detention Basin #1 Outlet Structure	12" RCP	Per Cash Waggner & Associates
Ex. Detention Basin #1 Discharge Rate, Q25	5.98 cfs	
Ex Detention Basin #1 Volume	7,198 cuft	Field determined by Morley & Assoc.
Ex Detention Basin #1 Design Volume	7,798 cuft	Per Cash Waggner & Associates based on Q100 Storm Event
Peak Storage Volume	3,483 cuft	
Total Discharge, Q25	6.48 cfs	(0.47cfs + 5.98 cfs)
Runoff to the West (UN-3): Subbasins #5, 6, 7, 13A & 13B		
Undetained Area	19.33 Acres	Subbasin #5, 6, 7, 13A & 13B
Undetained Runoff, Q25	46.02 cfs	Subbasin #5, 6, 7, 13A & 13B

TYPOS CORRECTED IN REVISED SHEET

Runoff to the Southeast (UN-1)

Sub-Basin #	Area (sqft)	Area (Ac)	C	A*C	Tc (min)	Q10 (cfs)
UN-1	177,745	4.08	0.48	1.96	15.57	8.75

Detention Basin #1

Sub-Basin #	Area (sqft)	Area (Ac)	C	A*C	Tc (min)
2	16,277	0.37	0.6	0.22	5.74
3A	35,216	0.81	0.55	0.44	7.55
3B	16,847	0.39	0.79	0.31	5.44
4A	20,160	0.46	0.68	0.31	9.45
4B	9,440	0.22	0.67	0.15	6.67
10	18,532	0.43	0.6	0.26	7.12
11	23,972	0.55	0.44	0.24	10.76
		3.22		1.93	

Developed C = 0.60

Outlet Structure: 15" HDPE
Max Flow Rate from Outlet Structure = 5.83 cfs

Undetained Runoff

Sub-Basin #	Area (sqft)	Area (Ac)	C	A*C	Tc (min)	Q25 (cfs)
1	15,091	0.35	0.45	0.16	7.46	2.92

Total Discharge from Site: 8.75 cfs equals or less than 8.75 cfs (5.83 c

VANDERBURGH COUNTY DRAINAGE

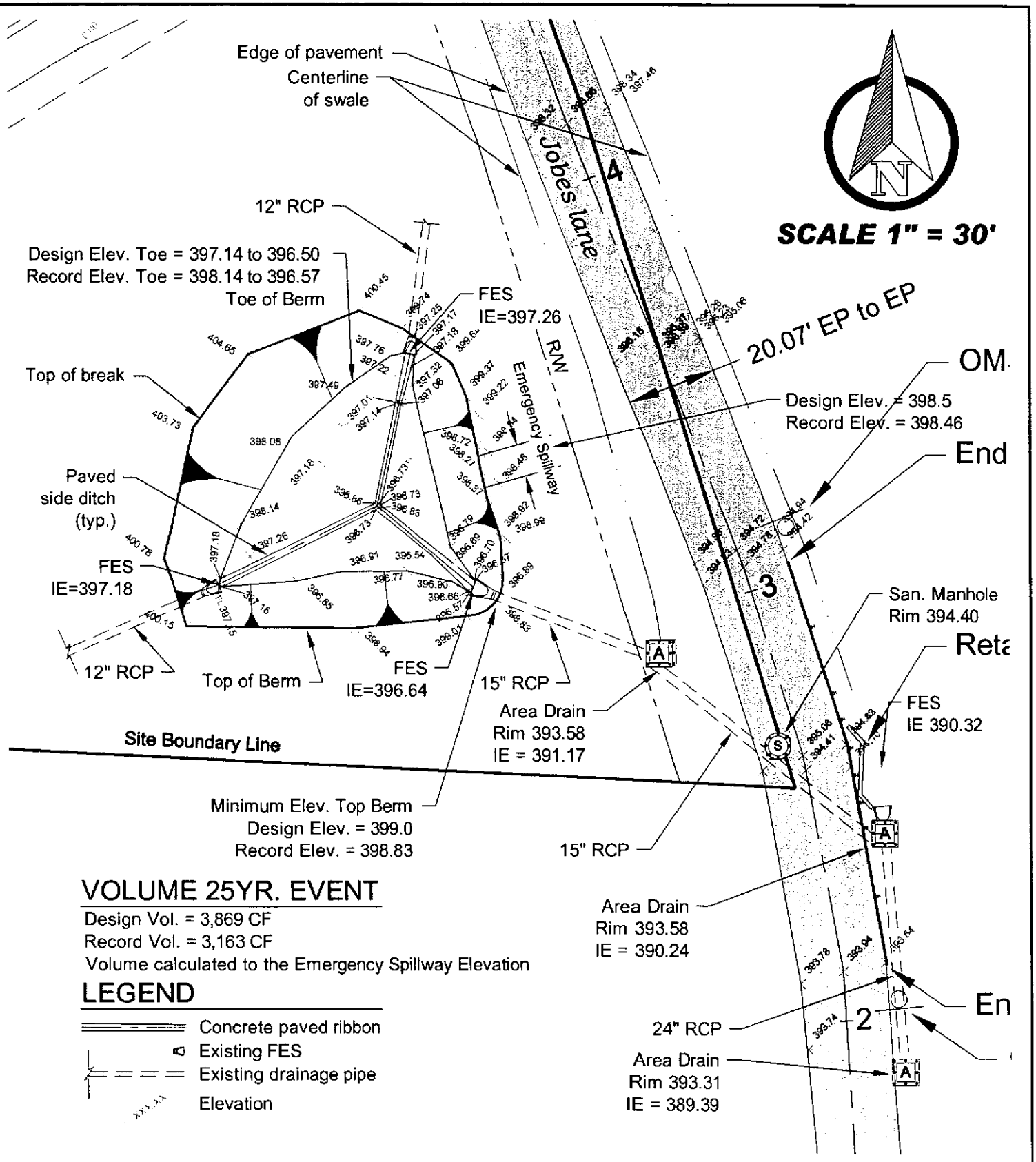
FORM 800

PROJECT: **The Reserve at Hidden Lake** DESIGN RETURN PERIOD: 25 YRS
Detention Basin #1
DESIGNER: Morley and Assoc. 8716.4.002 RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA:	3.22	ACRES
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED):	15.57	MINUTES
RAINFALL INTENSITY (Iu):	4.466	INCHES/HR
UNDEVELOPED RUNOFF COEFFICIENT (Cu):	0.48	
UNDEVELOPED RUNOFF RATE (Qu)	6.90	CFS
DEVELOPED RUNOFF COEFFICIENT (Cd):	0.6	

STORM DURATION Td	RAINFALL INTENSITY Id	INFLOW RATE I(Td) (Cd*Id*A)	OUTFLOW RATE O (Qu)	STORAGE RATE I(Td)-O	REQUIRED STORAGE (I(Td)-O)*Td/12
min	(INCH/HR)	(CFS)	(CFS)	(CFS)	(ACRE-FT)
5.00	7.208	13.93	5.83	8.10	0.056
10.00	5.925	11.45	5.83	5.62	0.078
15.00	5.033	9.72	5.83	3.89	0.081
20.00	4.571	8.83	5.83	3.00	0.083
25.00	4.108	7.94	5.83	2.11	0.073
30.00	3.646	7.04	5.83	1.21	0.051
35.00	3.385	6.54	5.83	0.71	0.035
40.00	3.123	6.03	5.83	0.20	0.011
45.00	2.862	5.53	5.83	-0.30	-0.019
50.00	2.601	5.03	5.83	-0.80	-0.056
55.00	2.339	4.52	5.83	-1.31	-0.100
60.00	2.078	4.01	5.83	-1.82	-0.151
75.00	1.909	3.69	5.83	-2.14	-0.223
90.00	1.739	3.36	5.83	-2.47	-0.309
105.00	1.570	3.03	5.83	-2.80	-0.408
120.00	1.400	2.70	5.83	-3.13	-0.521

PEAK STORAGE (ACRE/FT):	0.08
PEAK STORAGE (CUBIC FT):	3,631



VOLUME 25YR. EVENT

Design Vol. = 3,869 CF
Record Vol. = 3,163 CF
Volume calculated to the Emergency Spillway Elevation

LEGEND

- Concrete paved ribbon
- Existing FES
- Existing drainage pipe
- XXX.XX Elevation

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Re-construction Detention Basin # 1 Record Drawing

Designed By:	Job Number:
LAM	8716.4.001-A
Drawn By:	Date:
DWN	11/12/2013

Filename: J:\8716\Surveying 3D\8716 As-Built Base.dwg

8716 **Detention Basin #1 Outlet Structure**

Friction Loss Calculations

Q= Flowrate (cfs)
Ke= Entrance Loss coefficient
Ko= Outlet Loss coefficient
g= Gravity (ft/sec2)
h= Height of water above the centerline of the pipe (ft)
d= Diameter of the pipe (ft)
A= Area of the pipe (ft2)
L= Length of pipe
n= Mannings roughness coefficient

$$Q = A \times [h/((Ke+Ko)/2g) + ((2.87*n2*L)/d4/3)]1/2$$

Q=	5.827	cubic feet per second
Ke=	0.50	see table
Ko=	1.0	assumed
g=	32.20	ft^2 per second
h=	1.17	ft (To Elevation 398.43, 0.03' Below Record Spillway)
d=	1.25	ft
A=	1.23	ft^2 (12-inch Dia. Pipe)
L=	110.0	ft
n=	0.011	(HDPE Pipe)

Post-Developed Runoff Calculations, Per Morley and Associates, Inc.

Runoff to the Southeast (UN-1): Subbasins #1, 2, 3A, 3B, 4A, 4B, 10 & 11		
Undetained Area	0.35 Acres	Subbasin #1
Undetained Runoff, Q25	2.92 cfs	Subbasin #1
Detained Area	3.23 Acres	Subbasins #2, 3A, 3B, 4A, 4B, 10 & 11
Ex. Detention Basin #1 Outlet Structure	15" RCP	Per Cash Waggner & Associates
Ex. Detention Basin #1 Discharge Rate, Q25	5.83 cfs	
Ex Detention Basin #1 Volume	3,163 cuft	Field determined by Morley & Assoc.
Ex Detention Basin #1 Design Volume	3,869 cuft	Per Cash Waggner & Associates
Peak Storage Volume	3,631 cuft	Peak volume exceeds existing volume
Total Discharge, Q25	8.75 cfs	(5.83 cfs + 2.92 cfs)
Runoff to the Northeast (UN-2): Subbasins #8, 9, 12A, 12B & 12C		
Undetained Area	0.17 Acres	Subbasin #9
Undetained Runoff, Q25	0.47 cfs	Subbasin #9
Detained Area	3.40 Acres	Subbasins #8, 12A, 12B & 12C
Ex. Detention Basin #1 Outlet Structure	12" RCP	Per Cash Waggner & Associates
Ex. Detention Basin #1 Discharge Rate, Q25	5.98 cfs	
Ex Detention Basin #1 Volume	7,198 cuft	Field determined by Morley & Assoc.
Ex Detention Basin #1 Design Volume	7,798 cuft	Per Cash Waggner & Associates based on Q100 Storm Event
Peak Storage Volume	3,483 cuft	
Total Discharge, Q25	6.48 cfs	(0.47cfs + 5.98 cfs)
Runoff to the West (UN-3): Subbasins #5, 6, 7, 13A & 13B		
Undetained Area	19.33 Acres	Subbasin #5, 6, 7, 13A & 13B
Undetained Runoff, Q25	46.02 cfs	Subbasin #5, 6, 7, 13A & 13B

VANDERBURGH COUNTY DRAINAGE

FORM 800

PROJECT: **The Reserve at Hidden Lake** DESIGN RETURN PERIOD: 25 YRS

Detention Basin #2

DESIGNER: Morley and Assoc. 8716.4.002 RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA:	3.4	ACRES
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED):	13.92	MINUTES
RAINFALL INTENSITY (Iu):	4.702	INCHES/HR
UNDEVELOPED RUNOFF COEFFICIENT (Cu):	0.48	
UNDEVELOPED RUNOFF RATE (Qu)	7.67	CFS
DEVELOPED RUNOFF COEFFICIENT (Cd):	0.57	

STORM DURATION Td	RAINFALL INTENSITY Id	INFLOW RATE I(Td) (Cd*Id*A)	OUTFLOW RATE O (Qu)	STORAGE RATE I(Td)-O	REQUIRED STORAGE Td)-O)*Td/12
min	(INCH/HR)	(CFS)	(CFS)	(CFS)	(ACRE-FT)
5.00	7.208	13.97	5.98	7.99	0.055
10.00	5.925	11.48	5.98	5.50	0.076
15.00	5.033	9.75	5.98	3.77	0.079
20.00	4.571	8.86	5.98	2.88	0.080
25.00	4.108	7.96	5.98	1.98	0.069
30.00	3.646	7.07	5.98	1.09	0.045
35.00	3.385	6.56	5.98	0.58	0.028
40.00	3.123	6.05	5.98	0.07	0.004
45.00	2.862	5.55	5.98	-0.43	-0.027
50.00	2.601	5.04	5.98	-0.94	-0.065
55.00	2.339	4.53	5.98	-1.45	-0.111
60.00	2.078	4.03	5.98	-1.95	-0.163
75.00	1.909	3.70	5.98	-2.28	-0.238
90.00	1.739	3.37	5.98	-2.61	-0.326
105.00	1.570	3.04	5.98	-2.94	-0.428
120.00	1.400	2.71	5.98	-3.27	-0.544

PEAK STORAGE (ACRE/FT):	0.080
PEAK STORAGE (CUBIC FT):	3,483

Runoff to the Northeast (UN-2)

Sub-Basin #	Area (sqft)	Area (Ac)	C	A*C	Tc (min)	Q10 (cfs)
UN-2	135,417	3.11	0.48	1.49	13.92	7.02

Detention Basin #2

Sub-Basin #	Area (sqft)	Area (Ac)	C	A*C	Tc (min)
8	48,235	1.11	0.55	0.61	7.65
12A	53,477	1.23	0.61	0.75	7.60
12B	24,037	0.55	0.59	0.33	4.73
12C	22,145	0.51	0.48	0.24	7.73
		3.40		1.93	

Developed C = 0.57

Outlet Structure: 12" HDPE
Max Flow Rate From Outlet Structure = 5.98 cfs

Undetained Runoff

Sub-Basin #	Area (sqft)	Area (Ac)	C	A*C	Tc (min)	Q25 (cfs)
9	7,548	0.17	0.42	0.07	7.82	0.46

Total Discharge from Site: 6.44 cfs < 7.02 cfs

8716 **Detention Basin #2 Outlet Structure**

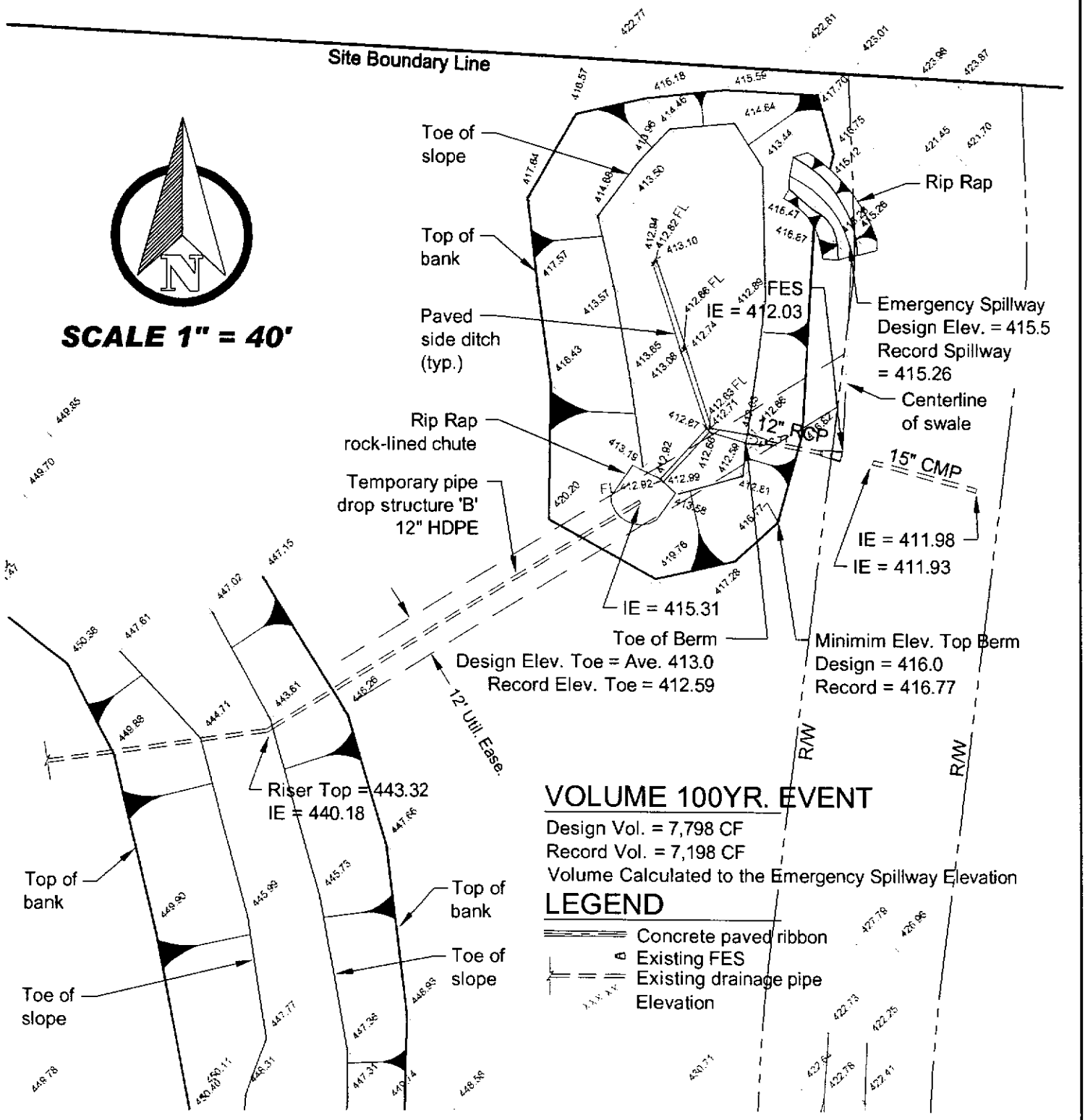
Friction Loss Calculations

Q= Flowrate (cfs)
Ke= Entrance Loss coefficient
Ko= Outlet Loss coefficient
g= Gravity (ft/sec2)
h= Height of water above the centerline of the pipe (ft)
d= Diameter of the pipe (ft)
A= Area of the pipe (ft2)
L= Length of pipe
n= Mannings roughness coefficient

$$Q = A \times [h/((Ke+Ko)/2g) + ((2.87*n2*L)/d4/3)]1/2$$

Q=	5.976	cubic feet per second

Ke=	0.50	see table	
Ko=	1.0	assumed	
g=	32.20	ft^2 per second	
h=	1.67	ft	(To 0.5' Below Record Spillway)
d=	1.000	ft	
A=	0.79	ft^2 (12-inch Dia. Pipe)	
L=	16.0	ft	
n=	0.011	(HDPE Pipe)	



VOLUME 100YR. EVENT

Design Vol. = 7,798 CF
Record Vol. = 7,198 CF
Volume Calculated to the Emergency Spillway Elevation

LEGEND

- Concrete paved ribbon
- Existing FES
- Existing drainage pipe
- Elevation

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Jasper, In
(812) 634-9990

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Re - Construction Basin # 2 Record Drawing

Designed By:	Job Number
LAM	8716.4.001-A
Drawn By:	Date:
DWN	11/12/2013

Filename: J:\8716\Surveying 3D\8716 As-Built Base.dwg

Post-Developed Runoff Calculations, Per Morley and Associates, Inc.

Runoff to the Southeast (UN-1): Subbasins #1, 2, 3A, 3B, 4A, 4B, 10 & 11		
Undetained Area	0.35 Acres	Subbasin #1
Undetained Runoff, Q25	2.92 cfs	Subbasin #1
Detained Area	3.23 Acres	Subbasins #2, 3A, 3B, 4A, 4B, 10 & 11
Ex. Detention Basin #1 Outlet Structure	15" RCP	Per Cash Waggner & Associates
Ex. Detention Basin #1 Discharge Rate, Q25	5.83 cfs	
Ex Detention Basin #1 Volume	3,163 cuft	Field determined by Morley & Assoc.
Ex Detention Basin #1 Design Volume	3,869 cuft	Per Cash Waggner & Associates
Peak Storage Volume	3,631 cuft	Peak volume exceeds existing volume
Total Discharge, Q25	8.75 cfs	(5.83 cfs + 2.92 cfs)
Runoff to the Northeast (UN-2): Subbasins #8, 9, 12A, 12B & 12C		
Undetained Area	0.17 Acres	Subbasin #9
Undetained Runoff, Q25	0.47 cfs	Subbasin #9
Detained Area	3.40 Acres	Subbasins #8, 12A, 12B & 12C
Ex. Detention Basin #1 Outlet Structure	12" RCP	Per Cash Waggner & Associates
Ex. Detention Basin #1 Discharge Rate, Q25	5.98 cfs	
Ex Detention Basin #1 Volume	7,198 cuft	Field determined by Morley & Assoc.
Ex Detention Basin #1 Design Volume	7,798 cuft	Per Cash Waggner & Associates based on Q100 Storm Event
Peak Storage Volume	3,483 cuft	
Total Discharge, Q25	6.48 cfs	(0.47cfs + 5.98 cfs)
Runoff to the West (UN-3): Subbasins #5, 6, 7, 13A & 13B		
Undetained Area	19.33 Acres	Subbasin #5, 6, 7, 13A & 13B
Undetained Runoff, Q25	46.02 cfs	Subbasin #5, 6, 7, 13A & 13B

Runoff to the West (UN-3)

Sub-Basin #	Area (sqft)	Area (Ac)	C	A*C	Tc (min)	i(10)	Q10 (cfs)
UN-3	857,703	19.69	0.48	9.45	16.92	4.35	41.11

Undetained Runoff

Sub-Basin #	Area (sqft)	Area (Ac)	C	A*C	Tc (min)	i(10)	Q25 (cfs)
5	9,049	0.21	0.32	0.07	9.57	6.036	0.40
6	12,064	0.28	0.39	0.11	9.08	6.161	0.67
7 & Lot 6	778,538	17.87	0.48	8.63	17.00	4.848	41.84
13A	27,009	0.62	0.52	0.32	8.57	6.293	2.03
13B	19,764	0.45	0.5	0.23	8.78	6.238	1.42
		19.43		9.35			

Developed C = 0.48

Total Discharge from Site: 46.02 cfs > 41.59 cfs

6. Excerpts from the Approved Drainage Report Prepared by Cash Waggner and Assocaites

emergency spillways for both detention basins were designed to carry the 100-year storm flow.

Below is a summary of the detention basin design elements:

		NOTES
Detention Basin #1 Developed Q(25)	9.83 – cfs	
Detention Basin #1 Developed Q(100)	11.64 – cfs	
Detention Basin #1 Undeveloped Q(10)	8.75 – cfs	
10/25-yr. Req'd Volume	3,755 c.f.	
Undetained Developed Q(25)	4.43 – cfs	Sub-basin 14 & 16
Allowable Release Rate	4.32 – cfs	Undeveloped Q(10) – Undetained Developed Q(25)
Outfall Structure	*101-LF of 12" RCP*	
Outfall I.E.	396.50	
25-year Storage Vol. Elev.	398.29	
HW (25-yr. elev. – I.E.)	1.79 – ft.	
Minimum Top/Bank	399.00	

		NOTES
Detention Basin #2 Developed Q(25)	13.14 – cfs	
Detention Basin #2 Developed Q(100)	15.73 – cfs	
Detention Basin #2 Undeveloped Q(10)	7.02 – cfs	
10/25-yr. Req'd Volume	5,624 c.f.	
Undetained Developed Q(25)	1.53 – cfs	Sub-basin #19
Allowable Release Rate	5.49 – cfs	Undeveloped Q(10) – Undetained Developed Q(25)
Outfall Structure	*36-LF of 12" RCP*	
Outfall I.E.	412.50	
25-year Storage Vol. Elev.	414.61	
HW (25-yr. elev. – I.E.)	2.11 – ft.	
Minimum Top/Bank	416.00	

9-13-10

GLEN A. MERITT, JR. REGISTERED No. PE10403870 STATE OF INDIANA PROFESSIONAL ENGINEER

CASH WAGGNER & ASSOCIATES, PC

414 CITADEL CIRCLE, STE. B
EVANSVILLE, IN 47715

PH: 812.401.5561
FAX: 812.401.5563

Open Channel Flow Calculations

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

Side slope = 4
Bottom width = 10
Manning's coefficient = 0.035
Slope of channel = 0.01

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*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	0.93	0.89	1.1
0.2	11.65	2.16	0.19	0.19	2.99	1.38	1.2
0.3	12.47	3.36	0.27	0.27	5.97	1.78	1.3
0.4	13.30	4.64	0.35	0.35	9.79	2.11	1.4
0.5	14.12	6.00	0.42	0.43	14.44	2.41	1.5

Open Channel Flow Calculations

Swale #: **Emergency Spillway**
Basin #1

Side slope =	4
Bottom width =	10
Manning's coefficient =	0.035
Slope of channel =	0.01

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*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	0.93	0.89	1.1
0.2	11.65	2.16	0.19	0.19	2.99	1.38	1.2
0.3	12.47	3.36	0.27	0.27	5.97	1.78	1.3
0.4	13.30	4.64	0.35	0.35	9.79	2.11	1.4
0.5	14.12	6.00	0.42	0.43	14.44	2.41	1.5