FIELDSTONE

CASH WAGGNER
& ASSOCIATES, PC
CONSULTING ENGINEERS • LAND SURVEYORS

February 23, 2015

Vanderburgh County Drainage Board
Civic Center Complex – Room 305
Evansville, IN 47708

RE: Fieldstone Subdivision
Variance Request
Project No.: 14-1906

On behalf of the owner, Fieldstone Development, LLC, we request a variance to allow homes to be constructed within 10 feet of the lake maintenance and storm drainage easement for Detention Basin #1 within Fieldstone Subdivison.

If you have any questions or require additional information, please contact our office.

Sincerely,

Glen Meritt, Jr.
Project Engineer

cc: File

W:\141906\Documents\Drainage Variance Ltr.doc

Approved by the Vanderburgh County Drainage Board on this 3RD day of MARCH, 2015.

Bruce Ungethiem, President

Stephen Melcher, Vice President

Joe Kiefer, Member

RECEIVED BY THE VANDERBURGH COUNTY SURVEYOR'S OFFICE
2/24/15

414 CITADEL CIRCLE, SUITE B
EVANSVILLE, IN 47715

PH: 812.401.5561
FAX: 812.401.5563

FIELDSTONE-FINAL DRAINAGE PLAN

13.04.095 Conditions of drainage plan approval.

In order for an applicant to obtain approval of a final drainage plan, the following requirements must be met:

A. The applicant shall be eligible under the terms of this chapter to apply for and obtain drainage plan approval.

B. The drainage plan and supporting submittals required by this chapter shall have been prepared and submitted in a timely and proper manner in accordance with the provisions of this chapter. **Final Drainage Plan submitted on 1/29/2015 Revisions submitted 2/24/2015**

C. The drainage plan and supporting submittals shall reflect compliance with the requirements of this chapter, and compliance with any conditions of approval applied to the plan by the drainage board. **Required Revisions are shown in red.**

D. The submitted data shall be gathered, analyzed, assembled into the drainage plan and supporting submittals; and shall be certified, and presented to the drainage board all by a civil engineer or land surveyor regularly engaged in stormwater drainage design, and registered to practice in the state of Indiana. **Drawings 1 and 2 were not certified Revised drawings that were submitted were certified**

E. An easement has been dedicated to house any off-site drainage facilities if such facilities are required to serve the project's stormwater drainage system. **No Offsite Easements Required**

F. The person, persons, partnership, corporation, or other entity to whom approval of the drainage plan is granted must be the person, persons, partnership, corporation, or entity who will be responsible for accomplishing the project for which the drainage plan is developed. **Fieldstone Development LLC, 7432 Brycen Lane, Evansville, IN 47725 812-426-0425**

13.04.125 Building permits conditioned.

The Vanderburgh County building commissioner shall not allow construction of buildings, or other impervious structures or facilities to commence at the site of a project requiring final drainage plan approval until:

A. Such approval has been expressed by the drainage board;

B. And all storm drainage facilities are constructed. **See comment under Section 13.04.130**

13.04.130 Phased development of large projects allowed.

Large projects may be divided into phases for the purpose of constructing drainage facilities and obtaining permits in accordance with the requirements of this chapter. **Please describe if all facilities**

will be constructed prior to the construction of any buildings or if the project is to be phased. If the project is to be phased, please describe what facilities will be constructed prior to proceeding forward. To be developed in phases with first phase to consist of lots 1-23 plus lot 49 (north half of subdivision)

13.04.160 Contents of preliminary drainage plan. APPROVED 10/14/2014

13.04.165 Contents of the final drainage plan.

The contents of the final drainage plan shall include all the items listed above for a preliminary drainage plan, plus:

A. Soils Map. A soils map indicating soils names and their hydrologic classification must be provided for a proposed project. **Provided in Preliminary**

B. Location and Topographic Map. In addition, a location and topographic map must be provided showing the land to be developed, and such adjoining land whose location and topography may affect or be affected by the layout or drainage of the project. **Provided**

C. Contour Intervals.

1. The contour intervals shown on the topographic map shall be two and one-half feet for slopes less than four percent; and five feet for slopes four percent or greater; or best available; **2' Contours**

2. The location of streams and other stormwater conveyance channels, both natural and man-made; and the vertical and horizontal limits of the one hundred (100) year floodplain, according to FIRM panels, and/or the building commissioner; all properly identified; . **Scaled from FIRM Maps**

3. The normal shoreline of lakes, ponds, swamps, and basins, their floodplains, and lines of inflow and outflow; **Provided**

4. The location of exiting regulated drains, farm drains, inlets and outfalls; **Not addressed Responses to comments state that 'none located within project limits"**

5. Storm, sanitary, and combined sewers, and outfalls; **No Combined sewers**

6. Wells, septic tank systems, and outfalls, if any; **Not addressed Responses to comments state that 'none located within project limits"**

7. Seeps, springs, sinkholes, caves, shafts, faults, or other such geological features visible, or of record;. **Not addressed Responses to comments state that 'none located within project limits"-see also SWP3 that was submitted with revisions**

8. The limits of the entire proposed project and the limits of the expected extent of land disturbance required to accomplish the project; **From the plans, it would appear that almost 100% would be disturbed; please verify Verified in response to comments**

9. The location of the streets, lot lines, and easements; **Provided**

10. A scale, preferably one inch equals fifty (50) feet; **1"=50'**

11. An arrow indicating North. **Provided**

D. On-Site Bench Mark Required. A benchmark determined by "Mean Sea Level Datum 1929," is required to be located within the project limits. **None Shown TBM #1 has been added to lot 46 and shown on revised sheet 101**

13.04.170 Final drainage plan layout.

A. In addition to the requirements listed for a preliminary drainage plan, the final drainage plan shall depict the following:

1. The extent and area of each watershed tributary to the drainage facilities within the project; **Provided**

2. The final layout and design of proposed storm sewers, their inlet and outfall locations and elevations, the receiving streams or channels; all with the basis of their design; **Provided-what is the design for pipe 545? Pipe 525 carries the water from basin 9 and 9A; should the flow for this pipe not be the combined flow from both of these subbasins? Likewise for pipe 537? Design for 545 provided. Flows for 525 and 537 revised; original pipe sizes can carry recalculated capacity.**

3. The location and design of the proposed street system, including depressed pavements used to convey or detain overflow from storm sewers and over-the-curb runoff resulting from heavier rainstorms, and the outlets for such overflows; all with their designed elevations; **Provided**

4. The locations, cross sections, and profiles of existing streams, floodways, and floodplains to be maintained, and the same for all new channels to be constructed; **Provided-need calculations for swale 4A. Also will a swale of 1' depth be sufficient for swales 4/4A as it approached the southeast corner of the property? Per comments, 1' of Depth can handle 9.25 cfs; design flow is 6.17 cfs**

Please provide a swale for the outflow from pipe 541 (basin discharge) to the point where it will enter the existing ditch Swale 9 added

Does the swale along the east side of lots 33 and 34 need to be improved in order to convey the additional runoff from the south half of lots 34 through 44 since the back half of these lots is not routed to the basin? It looks like their new swales are planned to stop at the southeast corner

of lot 34. Since there isn't any data on the size of the existing ditch along the east side of lots 33 and 34, I didn't know if this ditch had the capacity to handle the extra runoff. Section B-B and calculations show that an existing ditch will handle the proposed flow

5. The materials, elevations, waterway openings, size, and basis for design of the proposed culverts and bridges; **Provided**

6. Existing ponds and basins to be altered, enlarged, filled, or maintained; and new ponds, basins, swales, to be built, and the basis of their design **No Existing ponds or Basins**

7. The location and percentage of impervious surfaces existing and expected to be constructed; **Provided**

8. The material types sizes slopes grades and other details of all the stormwater drainage facilities; **Provided**

9. The estimated depth and amount of storage required in the new ponds or basins, the freeboard above the normal pool and highwater pool of wet basins, and details of the emergency overflows from the basins **Provided-How is the emergency overflow to be handled once it discharges until it reaches existing ditch? Swale 9 added**

10. For all controlled release basins, a plot or tabulation of the storage volumes with corresponding water surface elevations, and a plot or tabulation of the basin outflow rates for those water surface elevations; **Provided-outflow for 25 year developed 2.11 cfs**

11. The location of any applicable "impacted drainage areas" or other areas designated to remain totally undisturbed, natural, or for common and/or recreational use. **None shown**

B. Protection of Structures From One Hundred Year Flooding. All structures to be occupied as residences or businesses shall have finished floor elevations two feet above the high water calculated to occur during a one hundred (100) year return period storm for the subject building site; and the required floor elevations shall be depicted on the plan drawings for such affected sites. **Elevation not provided FPG's were added on sheet C101**

13.04.175 Submittal of a written drainage design report.

The final drainage plan shall be accompanied by a written report containing the following:

A. Any significant stormwater drainage problems existing or anticipated to be associated with the project; **Previous concerns have been made from adjoining property owners along Oak Hill Road during the Preliminary Proposal-most of these concerns were in regard to concern with flooding of the existing field and a general misunderstanding that material will be hauled to raise the existing ground above flood elevation. In regards to David Smith (south of the entrance) can you provide one cross section that will show their property, the proposed swale to be constructed and the general elevation of lot 49 so that they understand that drainage will not be blocked on their**

property as a result of additional fill being place in the subdivision? Information provided in response states that area to the east of Smith property will be lowered. According to information provided elevation on Smith property is approximately 392 and that the swale elevation will range from 386.82 to 387.42.

B. The analysis procedure used to identify and evaluate the drainage problems associated with the project; **Rational**

C. Any assumptions or special conditions associated with the use of the procedures, especially hydrologic or hydraulic methods, used to identify and evaluate drainage problems associated with the project; **Provided**

D. The proposed design of the drainage control system; **Provided**

E. The results of the analysis of the proposed drainage control system showing that it does solve the project's identified and anticipated drainage problems; **Provided**

F. A detailed description, depiction, and log of all hydrologic and hydraulic calculations or modeling, and the results obtained thereby; together with the input and output files for all computer runs; **Provided**

G. Maps showing individual drainage areas within the project subdivided for use in the analysis thereof **Provided**

13.04.180 Typical cross sections of the drainage facilities.
One or more typical cross sections must be provided for each existing and proposed channel, basin, pond, or other open drainage facility, which cross sections: **Cross Section provided for basin and typical provided for swales.**

A. Must show the elevation of the existing land immediately adjacent to all drainage facilities;

B. Must show the high water elevations adjacent to all waterways and impoundments as expected from the one hundred (100) year storm in relationship to permanent structures

13.04.440 General detention/retention basin design requirements.
The following design principles shall be observed for detention and retention basins:

A. Duration of Storage. The maximum volume of water stored and subsequently released at the design release rate shall not result in a storage duration in excess of forty-eight (48) hours, unless additional storms occur within the period **Not provided Calculations provided in response state 10.66 hours, so requirement is met.**

B. Depth of Stored Water. The maximum depth of stormwater to be stored, without a permanent pool shall not exceed four feet; and the maximum depth of stormwater to be stored above a permanent pool shall not exceed four feet. **Requirement met**

C. Basin Distance From Dwellings. All stormwater detention facilities shall be separated by not less than fifty (50) feet from any building or structure to be occupied by humans. **Unless a Variance is requested, no building may be built within 50' of the lake Variance is being requested.**

D. Earthen Side Slopes 4:1 Maximum Steepness for Basins. All detention and retention basins with grassed, earthen side slopes shall have side slopes no steeper than four horizontal units of measurement to one vertical unit of measurement (4:1) to the base of dry basins, and to the typical low waterline of wet basins. **Cross Section shows that basin meets this requirement**

E. Riprap Side Slopes 2:1 Maximum Steepness for Basins. Wet retention basins with riprap armored side slopes shall have slopes no steeper than two horizontal units of measurements to one vertical unit of measurement (2:1) at any point in the side slope. **No rip rap required**

F. Riprap to Extend Two Vertical Feet Below Waterline. The armored portion of the side slope must extend to a minimum depth below the permanent pool elevation of two vertical feet. **No rip rap required**

G. Underwater Earthen Side Slopes 2:1 Maximum Steepness. Nonarmored earthen side slopes shall have slopes no steeper than two horizontal units of measurement to one vertical unit of measurements from a point two vertical feet below permanent pool, thence downward. **Wet Basins 2:1 below water**

H. Minimum Depth of Riprap Application. Riprap side slope armor shall be a minimum twelve (12) inches in depth at all points of application. **Not applicable**

I. Drain Recommended for Maintenance of Wet Basins. If possible, a drain should be installed to lower the pool of wet basins to a level sufficient to repair any wave action erosion along the waterline, and to perform other periodic maintenance. **Not provided nor is it required**

J. Safety Ledges and/or Fencing of Wet Basins. Safety fencing surrounding the basin, and/or shallow safety ledges shall be provided if deemed necessary by the design engineer or the board.

K. Outlet Controls to Operate Automatically. Outlet control structures shall be designed to operate as simply as possible, and shall require little or no maintenance for proper operation. **No controls**

L. Designed Water Level Control Required. A controlled positive outlet shall be required to maintain the designed water level in wet basins, and provide the required detention storage above the designed low water level. **12" Diameter Pipe set at pool elevation**

M. Emergency Spillway Requirements.

1. An emergency overflow spillway shall be provided for the release of storm runoffs exceeding the designed maximum detention volume, or all overflow volumes in emergency conditions, should the normal discharge devices become totally or partially inoperative. **Provided**

2. A minimum freeboard of one-half foot above the calculated elevation of the design storm detention high water level to the elevation of the spillway flowline peak is required as a safety factor for all basins. Provided

N. Automatically Operating Emergency Spillway Required. The emergency overflow spillway shall be designed so that it operates openly, automatically, does not require manual attention, and will pass all the one hundred (100) year return period storm flow with a one-half foot vertical minimum above the one hundred (100) year return storm flow to the lowest dirt elevation in the surrounding earthwork. Open Channel

O. All Permanent Pools Require Water Quality Provisions. Designers of basins with permanent pools shall consult available manuals from the soil and water conservation district, and incorporate provisions therefrom for maintaining water quality, safety, and soil stability.

P. Dry Basin Cover and Maintenance. Dry basins shall be planted and maintained in vegetative cover equal to that of residential lawns Wet Basin, not applicable

Q. Side Slopes to Remain Stable. All side slopes of a basin shall be constructed stable and shall be maintained in a stable condition by the same criteria as specified herein for open channels.

R. Wet Basin Cover and Maintenance. The earthen side slopes of wet basins shall be provided with grass cover above the low water elevation, which shall be maintained equal to turfed residential lawns, and in no case shall the cover growth exceed twelve (12) inches in height, or the most current county standard. **Provide information of seeding of side slopes and any erosion control (straw, netting, etc.) to be utilized on side slopes SWP3 Sheet submitted (C—112) that contains this information**

S. Maintenance Pathway for Basins. A flat pathway with a minimum width of ten (10) feet shall be constructed completely around the top of the embankment of all detention/retention basins. There appears to be sufficient space to maintain.

T. Maintenance Easement for Basins. An easement dedicated for the purpose of accessing and maintaining the basin and its appurtenances shall be provided, and the easement shall be configured so that it includes the entire basin, the entire earthwork encompassing the basin, the maintenance pathways into and around the basin, and all inletting and outletting appurtenances of the basin. Provided

U. Maintenance Report Required for Basin.

1. A brief and concise report shall be prepared, by the design engineer, consisting of a description of the location, intended function of all parts appurtenant to the basin, together with a description of the ways in which the basin and its appurtenances should be maintained, all worded in language easily understood by residential or commercial property owners; and; Not Provided General notes on plat-copy of typical language provided

2. The report shall be attached to the restrictions for the property on which the basin and its parts are located.

3. Such restrictions shall be shown to exist prior to the board's final approval of the drainage plan for a project whose plans include a basin. **The drainage plan is being prior to final plat. See note under 13.04.460.**

V. Copy of Report Must be Submitted With the As-Builts. A copy of the maintenance report described above shall be included with the as-built plans required to be submitted hereinabove.

W. Elevation of Dry Basin Bottom Marked. A continuous concrete liner at least equal in characteristics to that described in Section 13.04.315F shall be installed in all dry basins from the point of inflow of each channel entering a basin to the point of outflow from the basin. The concrete liner shall be installed at an elevation slightly lower than the earthen floor of the basin, so that it may serve as a trickle trough or low flow liner. **Wet Basin, not applicable**

13.04.460 Responsibility for drainage facility maintenance.
The installation, maintenance, repair, and replacement of all stormwater drainage facilities, and erosion and siltation control measures for a project during the period of construction, and until final approval by the county engineer, shall be the responsibility of the land developer(s), and/or the property owner(s) of record.

The assignment of responsibility for the maintenance and repair of all stormwater drainage systems and facilities outside of county accepted road rights-of-way after the completion of the project, and final approval thereof by the county engineer, shall be determined before the final drainage plan is approved; and shall be documented by appropriate covenants and restrictions applied to the subdivision and to the property deeds thereof, and shall be printed clearly upon all recorded plats of the project.

The Drainage Plan needs to address whether a Plan A (Lot Owners) or Plan B (Repair Fund held by County) will be utilized. Plan B Repair Fund is to be utilized.

COMMENTS

The easements shown north of Lot 33 are confusing. The SIGECO easement line forms a triangle with a 15' Drainage Easement line. It is hard to determine where the LM&SDE easement ends; it almost appears as if there is a triangular shaped area where the outlet from the detention pond and emergency spillway discharge to an area in which there is no easement for water-please check the easements in this area. The Lake Maintenance Easement ends at the SIGECO easement. A 25' Drainage Easement was added to handle the outflow from the basin

Streets – terminate the curbs at a minimum of 2' off the edge of the Oak Hill pavement. .

CASH WAGGNER & ASSOCIATES, PC
CONSULTING ENGINEERS • LAND SURVEYORS

DATE: 02.23.15
PROJECT NO.: 14-1906
REFERENCE: Fieldstone
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	02.23.15	Revised Drainage Plan & Report

ARE TRANSMITTED:

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

FOR YOUR:

- ☒ APPROVAL
- ☐ USE
- ☐ INFORMATION
- ☐ OTHER

APPROVED
MAR 0 3 2015
VANDERBURGH COUNTY DRAINAGE BOARD

VIA:

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

COMMENTS:

Please review the final drainage plan and report and if acceptable, please take to the next available Drainage Board meeting. 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

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RECEIVED BY THE VANDERBURGH COUNTY SURVEYOR'S OFFICE
2/23/15

FIELDSTONE-FINAL DRAINAGE PLAN

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B. The drainage plan and supporting submittals required by this chapter shall have been prepared and submitted in a timely and proper manner in accordance with the provisions of this chapter. **Final Drainage Plan submitted on 1/29/2015**

C. The drainage plan and supporting submittals shall reflect compliance with the requirements of this chapter, and compliance with any conditions of approval applied to the plan by the drainage board. **Required Revisions are shown in red.**

D. The submitted data shall be gathered, analyzed, assembled into the drainage plan and supporting submittals; and shall be certified, and presented to the drainage board all by a civil engineer or land surveyor regularly engaged in stormwater drainage design, and registered to practice in the state of Indiana. **Drawings 1 and 2 were not certified** Revised

E. An easement has been dedicated to house any off-site drainage facilities if such facilities are required to serve the project's stormwater drainage system. **No Offsite Easements Required**

F. The person, persons, partnership, corporation, or other entity to whom approval of the drainage plan is granted must be the person, persons, partnership, corporation, or entity who will be responsible for accomplishing the project for which the drainage plan is developed. **Fieldstone Development LLC, 7432 Brycen Lane, Evansville, IN 47725 812-426-0425**

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A. Such approval has been expressed by the drainage board;

B. And all storm drainage facilities are constructed. **See comment under Section 13.04.130**

13.04.130 Phased development of large projects allowed.

Large projects may be divided into phases for the purpose of constructing drainage facilities and obtaining permits in accordance with the requirements of this chapter. **Please describe if all facilities**

will be constructed prior to the construction of any buildings or if the project is to be phased. If the project is to be phased, please describe what facilities will be constructed prior to proceeding forward. See drainage report narrative.

13.04.160 Contents of preliminary drainage plan. APPROVED 10/14/2014

13.04.165 Contents of the final drainage plan.

The contents of the final drainage plan shall include all the items listed above for a preliminary drainage plan, plus:

A. Soils Map. A soils map indicating soils names and their hydrologic classification must be provided for a proposed project. **Provided in Preliminary**

B. Location and Topographic Map. In addition, a location and topographic map must be provided showing the land to be developed, and such adjoining land whose location and topography may affect or be affected by the layout or drainage of the project. **Provided**

C. Contour Intervals.

1. The contour intervals shown on the topographic map shall be two and one-half feet for slopes less than four percent; and five feet for slopes four percent or greater; or best available; **2' Contours**

2. The location of streams and other stormwater conveyance channels, both natural and man-made; and the vertical and horizontal limits of the one hundred (100) year floodplain, according to FIRM panels, and/or the building commissioner; all properly identified; . **Scaled from FIRM Maps**

3. The normal shoreline of lakes, ponds, swamps, and basins, their floodplains, and lines of inflow and outflow; **Provided**

4. The location of exiting regulated drains, farm drains, inlets and outfalls; **Not addressed** None located within project limits.

5. Storm, sanitary, and combined sewers, and outfalls; **No Combined sewers**

6. Wells, septic tank systems, and outfalls, if any; **Not addressed** None located within project limits.

7. Seeps, springs, sinkholes, caves, shafts, faults, or other such geological features visible, or of record;. **Not addressed** None located within project limits. See A12 on sheet C110.

8. The limits of the entire proposed project and the limits of the expected extent of land disturbance required to accomplish the project; **From the plans, it would appear that almost 100% would be disturbed; please verify** 100% disturbed

9. The location of the streets, lot lines, and easements; **Provided**

10. A scale, preferably one inch equals fifty (50) feet; **1"=50'**

11. An arrow indicating North. **Provided**

D. On-Site Bench Mark Required. A benchmark determined by "Mean Sea Level Datum 1929," is required to be located within the project limits. **None Shown** Add TBM #1 (new concrete monument)

13.04.170 Final drainage plan layout.

A. In addition to the requirements listed for a preliminary drainage plan, the final drainage plan shall depict the following:

1. The extent and area of each watershed tributary to the drainage facilities within the project; **Provided**

2. The final layout and design of proposed storm sewers, their inlet and outfall locations and elevations, the receiving streams or channels; all with the basis of their design; **Provided-what is the design for pipe 545? Pipe 525 carries the water from basin 9 and 9A; should the flow for this pipe not be the combined flow from both of these subbasins? Likewise for pipe 537?** Revised

3. The location and design of the proposed street system, including depressed pavements used to convey or detain overflow from storm sewers and over-the-curb runoff resulting from heavier rainstorms, and the outlets for such overflows; all with their designed elevations; **Provided**

4. The locations, cross sections, and profiles of existing streams, floodways, and floodplains to be maintained, and the same for all new channels to be constructed; **Provided-need calculations for swale 4A. Also will a swale of 1' depth be sufficient for swales 4/4A as it approached the southeast corner of the property?** Yes - 1' depth can handle 9.25 cfs Sub-basin #15 - 25-yr. flow = 6.17 cfs

Please provide a swale for the outflow from pipe 541 (basin discharge) to the point where it will enter the existing ditch. Added

Does the swale along the east side of lots 33 and 34 need to be improved in order to convey the additional runoff from the south half of lots 34 through 44 since the back half of these lots is not routed to the basin? It looks like new swales are planned to stop at the southeast corner of lot 34. Since there isn't any data on the size of the existing ditch along the east side of lots 33 and 34, it is unclear if this ditch has the capacity to handle the extra runoff. See Section B-B + spreadsheet calculations

5. The materials, elevations, waterway openings, size, and basis for design of the proposed culverts and bridges; **Provided**

6. Existing ponds and basins to be altered, enlarged, filled, or maintained; and new ponds, basins, swales, to be built, and the basis of their design **No Existing ponds or Basins**

7. The location and percentage of impervious surfaces existing and expected to be constructed; **Provided**

8. The material types sizes slopes grades and other details of all the stormwater drainage facilities; **Provided**

9. The estimated depth and amount of storage required in the new ponds or basins, the freeboard above the normal pool and highwater pool of wet basins, and details of the emergency overflows from the basins **Provided-How is the emergency overflow to be handled once it discharges until it reaches existing ditch?** Swale #9

10. For all controlled release basins, a plot or tabulation of the storage volumes with corresponding water surface elevations, and a plot or tabulation of the basin outflow rates for those water surface elevations; **Provided-outflow for 25 year developed 2.11 cfs**

11. The location of any applicable "impacted drainage areas" or other areas designated to remain totally undisturbed, natural, or for common and/or recreational use. **None shown**

B. Protection of Structures From One Hundred Year Flooding. All structures to be occupied as residences or businesses shall have finished floor elevations two feet above the high water calculated to occur during a one hundred (100) year return period storm for the subject building site; and the required floor elevations shall be depicted on the plan drawings for such affected sites. **Elevation not provided**

Added FPG's

13.04.175 Submittal of a written drainage design report.

The final drainage plan shall be accompanied by a written report containing the following:

A. Any significant stormwater drainage problems existing or anticipated to be associated with the project; **Previous concerns have been made from adjoining property owners along Oak Hill Road during the Preliminary Proposal-most of these concerns were in regard to concern with flooding of the existing field and a general misunderstanding that material will be hauled to raise the existing ground above flood elevation. In regards to David Smith (south of the entrance) can you provide one cross section that will show their property, the proposed swale to be constructed and the general elevation of lot 49 so that they understand that drainage will not be blocked on their property as a result of additional fill being place in the subdivision?** We will be removing dirt in this area. [illegible]

B. The analysis procedure used to identify and evaluate the drainage problems associated with the project; **Rational**

C. Any assumptions or special conditions associated with the use of the procedures, especially hydrologic or hydraulic methods, used to identify and evaluate drainage problems associated with the project; **Provided**

D. The proposed design of the drainage control system; **Provided**

E. The results of the analysis of the proposed drainage control system showing that it does solve the project's identified and anticipated drainage problems; **Provided**

F. A detailed description, depiction, and log of all hydrologic and hydraulic calculations or modeling, and the results obtained thereby; together with the input and output files for all computer runs; **Provided**

G. Maps showing individual drainage areas within the project subdivided for use in the analysis thereof **Provided**

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One or more typical cross sections must be provided for each existing and proposed channel, basin, pond, or other open drainage facility, which cross sections: **Cross Section provided for basin and typical provided for swales.**

A. Must show the elevation of the existing land immediately adjacent to all drainage facilities;

B. Must show the high water elevations adjacent to all waterways and impoundments as expected from the one hundred (100) year storm in relationship to permanent structures

13.04.440 General detention/retention basin design requirements.
The following design principles shall be observed for detention and retention basins:

A. Duration of Storage. The maximum volume of water stored and subsequently released at the design release rate shall not result in a storage duration in excess of forty-eight (48) hours, unless additional storms occur within the period **Not provided** 80,971 ft³ (max storage) 80,971 / 2.11 = 38,375 ft³ 2.11 ft³/sec (release rate) 10.66 hr.

B. Depth of Stored Water. The maximum depth of stormwater to be stored, without a permanent pool shall not exceed four feet; and the maximum depth of stormwater to be stored above a permanent pool shall not exceed four feet. **Requirement met**

C. Basin Distance From Dwellings. All stormwater detention facilities shall be separated by not less than fifty (50) feet from any building or structure to be occupied by humans. **Unless a Variance is requested, no building may be built within 50' of the lake** Requesting variance

D. Earthen Side Slopes 4:1 Maximum Steepness for Basins. All detention and retention basins with grassed, earthen side slopes shall have side slopes no steeper than four horizontal units of measurement to one vertical unit of measurement (4:1) to the base of dry basins, and to the typical low waterline of wet basins. **Cross Section shows that basin meets this requirement**

E. Riprap Side Slopes 2:1 Maximum Steepness for Basins. Wet retention basins with riprap armored side slopes shall have slopes no steeper than two horizontal units of measurements to one vertical unit of measurement (2:1) at any point in the side slope. **No rip rap required**

F. Riprap to Extend Two Vertical Feet Below Waterline. The armored portion of the side slope must extend to a minimum depth below the permanent pool elevation of two vertical feet. **No rip rap required**

G. Underwater Earthen Side Slopes 2:1 Maximum Steepness. Nonarmored earthen side slopes shall have slopes no steeper than two horizontal units of measurement to one vertical unit of measurements from a point two vertical feet below permanent pool, thence downward. **Wet Basins 2:1 below water**

H. Minimum Depth of Riprap Application. Riprap side slope armor shall be a minimum twelve (12) inches in depth at all points of application. **Not applicable**

I. Drain Recommended for Maintenance of Wet Basins. If possible, a drain should be installed to lower the pool of wet basins to a level sufficient to repair any wave action erosion along the waterline, and to perform other periodic maintenance. **Not provided nor is it required**

J. Safety Ledges and/or Fencing of Wet Basins. Safety fencing surrounding the basin, and/or shallow safety ledges shall be provided if deemed necessary by the design engineer or the board. **Fence not feasible; 4:1 slope to 2' below water is shown; any additional safety measures shall be the responsibility of the developer and will be noted in the final approval to the developer.**

K. Outlet Controls to Operate Automatically. Outlet control structures shall be designed to operate as simply as possible, and shall require little or no maintenance for proper operation. **No controls**

L. Designed Water Level Control Required. A controlled positive outlet shall be required to maintain the designed water level in wet basins, and provide the required detention storage above the designed low water level. **12" Diameter Pipe set at pool elevation**

M. Emergency Spillway Requirements.

1. An emergency overflow spillway shall be provided for the release of storm runoffs exceeding the designed maximum detention volume, or all overflow volumes in emergency conditions, should the normal discharge devices become totally or partially inoperative. **Provided**

2. A minimum freeboard of one-half foot above the calculated elevation of the design storm detention high water level to the elevation of the spillway flowline peak is required as a safety factor for all basins. **Provided**

N. Automatically Operating Emergency Spillway Required. The emergency overflow spillway shall be designed so that it operates openly, automatically, does not require manual attention, and will pass all the one hundred (100) year return period storm flow with a one-half foot vertical minimum above the one hundred (100) year return storm flow to the lowest dirt elevation in the surrounding earthwork. **Open Channel**

O. All Permanent Pools Require Water Quality Provisions. Designers of basins with permanent pools shall consult available manuals from the soil and water conservation district, and incorporate provisions therefrom for maintaining water quality, safety, and soil stability.

P. Dry Basin Cover and Maintenance. Dry basins shall be planted and maintained in vegetative cover equal to that of residential lawns **Wet Basin, not applicable**

Q. Side Slopes to Remain Stable. All side slopes of a basin shall be constructed stable and shall be maintained in a stable condition by the same criteria as specified herein for open channels.

R. Wet Basin Cover and Maintenance. The earthen side slopes of wet basins shall be provided with grass cover above the low water elevation, which shall be maintained equal to turfed residential lawns, and in no case shall the cover growth exceed twelve (12) inches in height, or the most current county standard. **Provide information of seeding of side slopes and any erosion control (straw, netting, etc.) to be utilized on side slopes** See SWPP (Sheet C-112)

S. Maintenance Pathway for Basins. A flat pathway with a minimum width of ten (10) feet shall be constructed completely around the top of the embankment of all detention/retention basins. **There appears to be sufficient space to maintain.**

T. Maintenance Easement for Basins. An easement dedicated for the purpose of accessing and maintaining the basin and its appurtenances shall be provided, and the easement shall be configured so that it includes the entire basin, the entire earthwork encompassing the basin, the maintenance pathways into and around the basin, and all inletting and outletting appurtenances of the basin. **Provided**

U. Maintenance Report Required for Basin.

1. A brief and concise report shall be prepared, by the design engineer, consisting of a description of the location, intended function of all parts appurtenant to the basin, together with a description of the ways in which the basin and its appurtenances should be maintained, all worded in language easily understood by residential or commercial property owners; and; **Not Provided** Provided on plat.

2. The report shall be attached to the restrictions for the property on which the basin and its parts are located.

3. Such restrictions shall be shown to exist prior to the board's final approval of the drainage plan for a project whose plans include a basin. **The drainage plan is being prior to final plat. See note under 13.04.460.**

V. Copy of Report Must be Submitted With the As-Builts. A copy of the maintenance report described above shall be included with the as-built plans required to be submitted hereinabove.

W. Elevation of Dry Basin Bottom Marked. A continuous concrete liner at least equal in characteristics to that described in Section 13.04.315F shall be installed in all dry basins from the point of inflow of each

channel entering a basin to the point of outflow from the basin. The concrete liner shall be installed at an elevation slightly lower than the earthen floor of the basin, so that it may serve as a trickle trough or low flow liner. **Wet Basin, not applicable**

13.04.460 Responsibility for drainage facility maintenance.

The installation, maintenance, repair, and replacement of all stormwater drainage facilities, and erosion and siltation control measures for a project during the period of construction, and until final approval by the county engineer, shall be the responsibility of the land developer(s), and/or the property owner(s) of record.

The assignment of responsibility for the maintenance and repair of all stormwater drainage systems and facilities outside of county accepted road rights-of-way after the completion of the project, and final approval thereof by the county engineer, shall be determined before the final drainage plan is approved; and shall be documented by appropriate covenants and restrictions applied to the subdivision and to the property deeds thereof, and shall be printed clearly upon all recorded plats of the project.

The Drainage Plan needs to address whether a Plan A (Lot Owners) or Plan B (Repair Fund held by County) will be utilized. Plan B - Repair Fund

COMMENTS

The easements shown north of Lot 33 are confusing. The SIGECO easement line forms a triangle with a 15' Drainage Easement line. It is hard to determine where the LM&SDE easement ends; it almost appears as if there is a triangular shaped area where the outlet from the detention pond and emergency spillway discharge to an area in which there is no easement for water-please check the easements in this area. Added 25' drainage easement. Lake maintenance easement stops at Sigeco easement.

Streets – terminate the curbs at a minimum of 2' off the edge of the Oak Hill pavement; provide updated sight distance profiles for the Heseman – Oak Hill intersection.

CASH WAGGNER
& ASSOCIATES, PC
CONSULTING ENGINEERS • LAND SURVEYORS

February 23, 2015

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

RE: Drainage Report
Fieldstone Subdivision
Oak Hill Road
Our Project #: 14-1906

Mr. Mueller:

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

SITE DESCRIPTION

This development consists of a single family residential subdivision with 48 lots and its associated improvements (i.e. roads, utilities). The site is located on a 19.77-acre parcel approximately 825 feet north of the Oak Hill Road and Eastview Drive intersection and on the east side of Oak Hill Road. The entire limits of the property will be disturbed during construction of this subdivision. The subdivision will be constructed in two phases. Phase 1 will consist of Lots 1 -23 and 49. The entire detention basin will be excavated during Phase 1 construction.

DRAINAGE PATTERNS

The existing site was previously utilized as a cultivated field. The entire site drains in an easterly direction and runoff sheet flows to an existing ditch located near the southeast corner of the subdivision. This ditch flows east off-site and ultimately drains to Firlick Creek. See attached Undeveloped Sub-basin Exhibit.

The proposed development has been divided into fifteen (15) developed and four (4) off-site drainage sub-basins with the 25-year and 100-year flows calculated for each sub-basin. See attached Developed Sub-basin Exhibit for locations of each sub-basin. A drainage swale and storm sewer network will be installed within the development to capture the majority of the storm water runoff and convey it to the detention basin. The primary and emergency spillway of the detention basin discharge to the existing ditch located along the east property line.

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. Detention basin #1 was designed to contain the peak 25-year developed runoff from the site while allowing a release rate less than the peak

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10-year undeveloped runoff rate from the site. The emergency spillway for the detention basin was 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)	51.35 – cfs	
Detention Basin #1 Developed Q(100)	62.12 – cfs	
Detention Basin #1 Undeveloped Q(10)	19.58 – cfs	UN-1
Off-Site Q(25)	3.52 – cfs	OS-1, OS-2 & OS-3
10/25-yr. Req'd Volume	80,971 c.f.	
Undetained Developed Q(25)	6.17 – cfs	#15
Allowable Release Rate	16.93 – cfs	Undeveloped Q(10) – Undetained Developed Q(25) + Off-Site Q(25)
Proposed 25-yr. Detention Basin #1 Release Rate	2.11 - cfs	Primary Spillway 12" RCP
Proposed 25-yr. Overall Project Release Rate	8.28 - cfs	Detention Basin #1 + Undetained Runoff (#15)
Outfall Structure	*44-LF of 12" RCP*	*P-541*
Outfall I.E.	380.35	
25-year Storage Vol. Elev.	381.01	
HW (25-yr. elev. – I.E.)	0.66 – ft.	
Minimum Top/Bank	384.00	

2-23-15

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

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CASH WAGGNER & ASSOCIATES, PC

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General Notes

Basement: Any basement must be approved by the Vanderburgh County Building Commissioner.

Grades: First floor grades shall be set to allow for proper drainage away from houses. All first floor grades shall conform to local and state enforced building codes.

Storm Maintenance: Per Plan B of the County Drainage Ordinance, 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.
5. Preventing all persons or parties from causing any unauthorized alterations obstructions or detrimental actions from occuring to any part of the storm water system and easement which lies on his or her property.
6. The Repair Fund established for this project will pay the costs of repairing structural failures in the storm sewer pipes, pipe collars, drop boxes, aprons, inlets, manholes, junction boxes and the piped or paved outlet structures of the storm water control basins, all of which are parts of the approved and constructed storm water drainage system shown on the as-built plans for this subdivision and which are in drainage easements or lake maintenance and storm drainage easements and outside of the county accepted road right-of-way as shown on the plat of this subdivision.
7. Any pipe, fence, wall, building, pool, patio, planting, stored material, excavation, fill, or other construction, improvement, addition to, or alteration of the land within a drainage easement in this subdivision requires the prior written approval of the County Drainage Board.

DETENTION FACILITY DESIGN VOLUME CALCULATIONS

PROJECT: Fieldstone Subdivision

DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS

RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 16.32 ACRES

DEVELOPED RUNOFF COEFFICIENT (C_d): 0.580

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	7.208	68.23	2.11	66.12	0.459
0.17	5.925	56.08	2.11	53.97	0.750
0.25	5.033	47.64	2.11	45.53	0.949
0.33	4.571	43.26	2.11	41.15	1.143
0.42	4.108	38.89	2.11	36.78	1.277
0.50	3.646	34.51	2.11	32.40	1.350
0.58	3.385	32.04	2.11	29.93	1.455
0.67	3.123	29.56	2.11	27.45	1.525
0.75	2.862	27.09	2.11	24.98	1.561
0.83	2.601	24.62	2.11	22.51	1.563
0.92	2.339	22.14	2.11	20.03	1.530
1.00	2.078	19.67	2.11	17.56	1.463
1.25	1.909	18.07	2.11	15.96	1.662
1.50	1.739	16.46	2.11	14.35	1.794
1.75	1.570	14.86	2.11	12.75	1.859
2.00	1.400	13.25	2.11	11.14	1.857

PEAK STORAGE (ACRE/FT):	**1.86**
PEAK STORAGE (CUBIC FT):	**80,971**

$$\frac{80,971\ ft^3}{2.11\ ft^3/sec} = 38,375\ sec. \times \frac{1\ min.}{60\ sec.} \times \frac{1\ hr.}{60\ min.}$$

$$= 10.66\ hrs.$$ to get to normal pool elev

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: OS-4				Total Area = 27,101 S.F. 0.62 Acres		
Surface					***C***	***N***
Impervious		=	10,378 S.F. =	0.24 Ac.	0.92	0.02
Lawn (0-2%)	0 S.F.	=		0.00 Ac.	0.15	0.40
Lawn (2-5%)	16,723 S.F.	=		0.38 Ac.	0.25	0.40
Lawn (5-10%)	0 S.F.	=		0.00 Ac.	0.40	0.40
Lawn (>10%)	0 S.F.	=		0.00 Ac.	0.55	0.40
Woods (>10%)	0 S.F.	=		0.00 Ac.	0.48	0.60
Water	0 S.F.	=		0.00 Ac.	1.00	0.00
Misc.	0 S.F.	=		0.00 Ac.	0.92	0.02

Weighted c =	**0.507**		
Weighted N =	0.254		
Sheet Flow			
L =	300	Ft.	
H =	7.9	Ft.	
S =	0.0262	Ft./Ft.	
t1=	14.66	Minutes	(Min. 5 minutes)
Shallow Concrentrated Flow			
L =		Ft.	
H =		Ft.	
S =	#DIV/0!	Ft./Ft.	
v =	2.00	Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.00	Minutes	
Shallow Concentrated Flow			
L =		Ft.	
H =		Ft.	
S =	0.0000	Ft./Ft.	
v =	1.65	Ft./sec.	(From HERPICC Figure 3.4.5)
t3=	0.00	Minutes	
tc=	14.66	Minutes	
I(10) =		In./Hr.	
I(25) =	5.094	In./Hr.	
I(50) =		In./Hr.	
I(100) =	6.257	In./Hr.	
Q(10) =	**0.00**	**CFS**	
Q(25) =	**1.61**	**CFS**	
Q(50) =	**0.00**	**CFS**	
Q(100) =	**1.97**	**CFS**	

STORM SEWER CALCULATIONS

Design Return Period: 25 Year

Mannings 'n': 0.012

Project Name: **Fieldstone Subdivision**

Project #: 14-1906

Date: 2/23/15

1 NO.	SUB-BASIN NO.	UPSTREAM STRUCTURE	PIPE #	DOWNSTREAM STRUCTURE	LENGTH (ft)	Cj	Aj (ac.)	CjAj	SUM CjAj	Tj (min)	Tcum (min)	I (in/hr)	PIPE Q (cfs)	PIPE DIA. (in)	PIPE SLOPE (ft/ft)	I.E. (Upstream)	I.E. (Downstream)	CAP. (cfs)	TRAVEL VELOCITY (ft/sec)	TIME (min)
1	1	503	501	504	34	0.610	0.73	0.45	0.45	14.52	14.52	5.119	2.28	12	0.0138	381.93	381.46	4.53	5.77	0.10
1	2 & OS-1	502	503	504	46	0.505	0.49	0.25	0.25	14.96	14.96	5.040	1.25	12	0.0054	381.71	381.46	2.84	3.61	0.21
1	3	504	505	510	128	0.613	0.29	0.18	0.87	12.57	15.17	5.017	4.37	18	0.0038	381.46	380.97	7.01	3.97	0.54
1	4 & OS-2	506	507	508	155	0.449	1.32	0.59	0.59	15.25	15.25	5.010	2.97	12	0.0334	386.82	381.64	7.05	8.98	0.29
1	5	508	509	510	26	0.586	0.83	0.49	1.08	17.31	17.31	4.819	5.21	12	0.0260	381.64	380.97	6.22	7.93	0.05
1	6	510	511	512	56	0.596	0.30	0.18	2.13	16.41	17.36	4.815	10.26	18	0.0111	380.97	380.35	11.98	6.79	0.14
3	10	514	515	516	139	0.370	1.34	0.50	0.50	18.52	18.52	4.708	2.33	12	0.0046	383.44	382.80	2.62	3.33	0.69
3	7	516	517	518	26	0.579	0.46	0.27	0.76	14.13	19.21	4.644	3.54	15	0.0060	382.56	382.40	5.42	4.42	0.10
3	8	518	519	520	147	0.579	0.46	0.27	1.03	14.11	19.31	4.634	4.77	15	0.0140	382.40	380.35	8.28	6.75	0.36
4	9	522	523	524	26	0.600	0.53	0.32	0.32	14.92	14.92	5.047	1.60	12	0.0100	382.81	382.55	3.86	4.92	0.09
4	9A	524	525	526	147	0.600	0.53	0.32	0.64	14.92	15.01	5.032	3.20	12	0.0150	382.55	380.35	4.73	6.02	0.41
5	11	528	529	530	26	0.597	0.66	0.39	0.39	16.68	16.68	4.878	1.92	12	0.0080	383.74	383.53	3.45	4.40	0.10
5	12	530	531	532	147	0.617	0.66	0.41	0.80	16.25	16.78	4.868	3.90	12	0.0216	383.53	380.35	5.68	7.23	0.34
6	13	534	535	536	26	0.624	0.45	0.28	0.28	13.49	13.49	5.302	1.49	12	0.0101	382.70	382.44	3.88	4.94	0.09
6	13A	536	537	538	147	0.624	0.45	0.28	0.56	13.49	13.58	5.286	2.97	12	0.0142	380.35	378.26	4.60	5.86	0.42
7	OS-4	544	545	546	79	0.507	0.62	0.31	0.60	14.66	14.66	5.094	3.03	12	0.0120	388.90	387.95	4.23	5.38	0.24

Open Channel Flow Calculations

Swale #: **4A**

Side slope = 3
Bottom width = 1
Manning's coefficient = 0.035
Slope of channel = 0.0095

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.10	0.77	1.1
0.2	2.26	0.32	0.14	0.15	0.36	1.13	1.2
0.3	2.90	0.57	0.20	0.20	0.80	1.40	1.3
0.32	3.02	0.63	0.21	0.21	0.91	1.45	1.4
0.4	3.53	0.88	0.25	0.26	1.45	1.64	1.4
0.5	4.16	1.25	0.30	0.31	2.33	1.86	1.5
0.6	4.54	1.50	0.33	0.34	2.98	1.98	1.6
0.7	5.17	1.97	0.38	0.40	4.28	2.18	1.7
0.8	5.81	2.49	0.43	0.45	5.89	2.36	1.8
0.9	6.44	3.08	0.48	0.50	7.81	2.54	1.9
1.0	7.07	3.72	0.53	0.55	10.08	2.71	2.0

Open Channel Flow Calculations

Swale #: **8**

Side slope = 3
Bottom width = 1
Manning's coefficient = 0.035
Slope of channel = 0.008

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.09	0.70	1.1
0.2	2.26	0.32	0.14	0.15	0.33	1.03	1.2
0.3	2.90	0.57	0.20	0.20	0.73	1.29	1.3
0.32	3.02	0.63	0.21	0.21	0.84	1.33	1.4
0.4	3.53	0.88	0.25	0.26	1.33	1.51	1.4
0.5	**4.16**	**1.25**	**0.30**	**0.31**	**2.13**	**1.71**	**1.5**
0.6	4.79	1.68	0.35	0.37	3.18	1.89	1.6
0.7	5.43	2.17	0.40	0.42	4.48	2.07	1.7
0.8	6.06	2.72	0.45	0.47	6.07	2.23	1.8
0.9	6.69	3.33	0.50	0.52	7.96	2.39	1.9
1.0	**7.32**	**4.00**	**0.55**	**0.57**	**10.18**	**2.54**	**2.0**

Open Channel Flow Calculations

Swale #: 9

Side slope = 3
Bottom width = 1
Manning's coefficient = 0.035
Slope of channel = 0.0323

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.18	1.42	1.1
0.2	2.26	0.32	0.14	0.15	0.66	2.08	1.2
0.3	2.90	0.57	0.20	0.20	1.48	2.59	1.3
0.32	3.02	0.63	0.21	0.21	1.68	2.68	1.4
0.4	3.53	0.88	0.25	0.26	2.67	3.03	1.4
0.5	**4.16**	**1.25**	**0.30**	**0.31**	**4.29**	**3.43**	**1.5**
0.6	4.79	1.68	0.35	0.37	6.39	3.80	1.6
0.7	5.43	2.17	0.40	0.42	9.01	4.15	1.7
0.8	6.06	2.72	0.45	0.47	12.20	4.49	1.8
0.9	6.69	3.33	0.50	0.52	16.00	4.80	1.9
1.0	**7.32**	**4.00**	**0.55**	**0.57**	**20.45**	**5.11**	**2.0**

Open Channel Flow Calculations

Swale #: **Exist. Ditch**
Section B-B

Side slope = 2.5
Bottom width = 2
Manning's coefficient = 0.035
Slope of channel = 0.0026

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	2.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	2.54	0.23	0.09	0.09	0.10	0.43	1.1
0.2	3.08	0.50	0.16	0.17	0.32	0.65	1.2
0.3	3.62	0.83	0.23	0.24	0.67	0.81	1.3
0.32	3.72	0.90	0.24	0.25	0.75	0.84	1.4
0.4	4.15	1.20	0.29	0.30	1.14	0.95	1.4
0.5	4.59	1.63	0.35	0.36	1.74	1.07	1.5
0.6	5.02	1.90	0.38	0.40	2.17	1.14	1.6
0.7	5.55	2.41	0.43	0.45	3.00	1.24	1.7
0.8	6.09	2.96	0.49	0.51	3.98	1.34	1.8
0.9	6.63	3.57	0.54	0.57	5.13	1.44	1.9
1.0	7.17	4.22	0.59	0.62	6.44	1.53	2.0
1.1	7.71	4.93	0.64	0.68	7.94	1.61	2.1
1.2	8.25	5.68	0.69	0.73	9.63	1.69	2.2
1.3	8.79	6.49	0.74	0.78	11.51	1.77	2.3
1.4	9.32	7.34	0.79	0.83	13.60	1.85	2.4
1.5	9.86	8.25	0.84	0.89	15.90	1.93	2.5
1.6	10.40	9.20	0.88	0.94	18.42	2.00	2.6
1.7	10.94	10.21	0.93	0.99	21.16	2.07	2.7
1.8	11.48	11.26	0.98	1.04	24.15	2.14	2.8
1.9	12.02	12.37	1.03	1.09	27.37	2.21	2.9
2.0	12.55	13.52	1.08	1.15	30.85	2.28	3.0

CASH WAGGNER & ASSOCIATES, PC
CONSULTING ENGINEERS • LAND SURVEYORS

LETTER OF TRANSMITTAL

DATE:	01.28.15	ATTENTION:	Jeff Mueller
PROJECT NO.:	14-1906	COMPANY:	Vanderburgh County Surveyor
REFERENCE:	Fieldstone	ADDRESS:	Civic Center Complex – Room 325
YOUR FILE NO.:		CITY, ST, ZIP:	Evansville, IN 47708
		PHONE:	

THE FOLLOWING ITEMS:

COPIES:	ORIG./LAST REV. DATE:	DESCRIPTION:
1	01.27.15	Final Drainage Plan & 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 final drainage plan and report and if acceptable, please take to the next available Drainage Board meeting. 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

W:\141906\DOCUMENTS\150128 MUELLER.DOC

RECEIVED BY THE VANDERBURGH COUNTY SURVEYOR'S OFFICE
1/29/15

Fieldstone Subdivision

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	380.35	118,697			0.00
	381.35	127,983	123,340	123,340	123,340
	382.35	137,370	132,677	132,677	256,017
E.O.S.	383.50	143,525	140,448	161,515	417,531
T.B.	384.00	153,077	148,301	74,151	491,682

Detention volume provided at Elev. 383.5 = *417,531* *c.f.*

Total, required 25-YR detention volume = 80,971 c.f.

25-YR Req'd detention volume provided @ Elev. = 381.01 ft.

Req'd HW= 0.66 ft.

Detention volume provided at Elev. 384.0 = *491,682* *c.f.*

Total, required 100-YR detention volume = 102,808 c.f.

100-YR Req'd detention volume provided @ Elev. = 381.19 ft.

Req'd HW= 0.84 ft.

DETENTION FACILITY DESIGN VOLUME CALCULATIONS

PROJECT: **Fieldstone Subdivision** DETENTION FACILITY DESIGN RETURN PERIOD: 100 YRS

RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 16.32 ACRES

DEVELOPED RUNOFF COEFFICIENT (C_d): 0.580

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	8.469	80.16	2.79	77.37	0.537
0.17	7.126	67.45	2.79	64.66	0.898
0.25	6.194	58.63	2.79	55.84	1.163
0.33	5.665	53.63	2.79	50.84	1.412
0.42	5.137	48.62	2.79	45.83	1.591
0.50	4.608	43.62	2.79	40.83	1.701
0.58	4.284	40.55	2.79	37.76	1.836
0.67	3.960	37.48	2.79	34.69	1.927
0.75	3.636	34.41	2.79	31.62	1.976
0.83	3.311	31.34	2.79	28.55	1.983
0.92	2.987	28.28	2.79	25.49	1.947
1.00	2.663	25.21	2.79	22.42	1.868
1.25	2.444	23.13	2.79	20.34	2.119
1.50	2.224	21.05	2.79	18.26	2.283
1.75	2.005	18.97	2.79	16.18	2.360
2.00	1.785	16.90	2.79	14.11	2.351

PEAK STORAGE (ACRE/FT):	**2.36**
PEAK STORAGE (CUBIC FT):	**102,808**

14-1906
12-8-14
-GAM-

Fieldstone

P-537

$d/D = \frac{0.66'}{1.0'} = 0.66'$ From Appendix 16.3 (see next page)

$\frac{area}{D^2} = 0.5499$ $\frac{W_p}{D} = 1.8965$ $\frac{r_h}{D} = 0.2899$

$S = 0.50\%$; $n = 0.012$

$Q = (1.49/n) A r_h^{2/3} S^{1/2}$

$Q = (1.49/0.012)\, 0.5499\, (0.2899)^{2/3} (0.005)^{1/2}$

$Q = 2.11$ cfs (25-year)

$d/D = \frac{0.84'}{1.0'} = 0.84'$

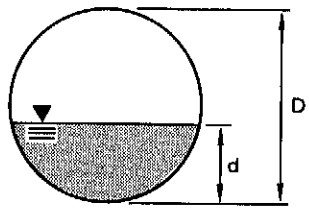
$area/D^2 = 0.7043$ $W_p/D = 2.3186$ $r_h/D = 0.3038$

$S = 0.50\%$; $n = 0.012$

$Q = (1.49/0.012)\, 0.7043\, (0.3038)^{2/3} (0.005)^{1/2}$

$Q = 2.79$ cfs (100-year)

APPENDIX 16.C
Area, Wetted Perimeter, and Hydraulic Radius
of Partially Filled Circular Pipes



$\frac{d}{D}$	$\frac{\text{area}}{D^2}$	$\frac{\text{wetted perimeter}}{D}$	$\frac{r_h}{D}$	$\frac{d}{D}$	$\frac{\text{area}}{D^2}$	$\frac{\text{wetted perimeter}}{D}$	$\frac{r_h}{D}$
0.01	0.0013	0.2003	0.0066	0.51	0.4027	1.5908	0.2531
0.02	0.0037	0.2838	0.0132	0.52	0.4127	1.6108	0.2561
0.03	0.0069	0.3482	0.0197	0.53	0.4227	1.6308	0.2591
0.04	0.0105	0.4027	0.0262	0.54	0.4327	1.6509	0.2620
0.05	0.0147	0.4510	0.0326	0.55	0.4426	1.6710	0.2649
0.06	0.0192	0.4949	0.0389	0.56	0.4526	1.6911	0.2676
0.07	0.0242	0.5355	0.0451	0.57	0.4625	1.7113	0.2703
0.08	0.0294	0.5735	0.0513	0.58	0.4723	1.7315	0.2728
0.09	0.0350	0.6094	0.0574	0.59	0.4822	1.7518	0.2753
0.10	0.0409	0.6435	0.0635	0.60	0.4920	1.7722	0.2776
0.11	0.0470	0.6761	0.0695	0.61	0.5018	1.7926	0.2797
0.12	0.0534	0.7075	0.0754	0.62	0.5115	1.8132	0.2818
0.13	0.0600	0.7377	0.0813	0.63	0.5212	1.8338	0.2839
0.14	0.0688	0.7670	0.0871	0.64	0.5308	1.8546	0.2860
0.15	0.0739	0.7954	0.0929	0.65	0.5404	1.8755	0.2881
0.16	0.0811	0.8230	0.0986	0.66	0.5499	1.8965	0.2899
0.17	0.0885	0.8500	0.1042	0.67	0.5594	1.9177	0.2917
0.18	0.0961	0.8763	0.1097	0.68	0.5687	1.9391	0.2935
0.19	0.1039	0.9020	0.1152	0.69	0.5780	1.9606	0.2950
0.20	0.1118	0.9273	0.1206	0.70	0.5872	1.9823	0.2962
0.21	0.1199	0.9521	0.1259	0.71	0.5964	2.0042	0.2973
0.22	0.1281	0.9764	0.1312	0.72	0.6054	2.0264	0.2984
0.23	0.1365	1.0003	0.1364	0.73	0.6143	2.0488	0.2995
0.24	0.1449	1.0239	0.1416	0.74	0.6231	2.0714	0.3006
0.25	0.1535	1.0472	0.1466	0.75	0.6318	2.0944	0.3017
0.26	0.1623	1.0701	0.1516	0.76	0.6404	2.1176	0.3025
0.27	0.1711	1.0928	0.1566	0.77	0.6489	2.1412	0.3032
0.28	0.1800	1.1152	0.1614	0.78	0.6573	2.1652	0.3037
0.29	0.1890	1.1373	0.1662	0.79	0.6655	2.1895	0.3040
0.30	0.1982	1.1593	0.1709	0.80	0.6736	2.2143	0.3042
0.31	0.2074	1.1810	0.1755	0.81	0.6815	2.2395	0.3044
0.32	0.2167	1.2025	0.1801	0.82	0.6893	2.2653	0.3043
0.33	0.2260	1.2239	0.1848	0.83	0.6969	2.2916	0.3041
0.34	0.2355	1.2451	0.1891	0.84	0.7043	2.3186	0.3038
0.35	0.2450	1.2661	0.1935	0.85	0.7115	2.3462	0.3033
0.36	0.2546	1.2870	0.1978	0.86	0.7186	2.3746	0.3026
0.37	0.2642	1.3078	0.2020	0.87	0.7254	2.4038	0.3017
0.38	0.2739	1.3284	0.2061	0.88	0.7320	2.4341	0.3008
0.39	0.2836	1.3490	0.2102	0.89	0.7384	2.4655	0.2995
0.40	0.2934	1.3694	0.2142	0.90	0.7445	2.4981	0.2980
0.41	0.3032	1.3898	0.2181	0.91	0.7504	2.5322	0.2963
0.42	0.3130	1.4101	0.2220	0.92	0.7560	2.5681	0.2944
0.43	0.3229	1.4303	0.2257	0.93	0.7612	2.6061	0.2922
0.44	0.3328	1.4505	0.2294	0.94	0.7662	2.6467	0.2896
0.45	0.3428	1.4706	0.2331	0.95	0.7707	2.6906	0.2864
0.46	0.3527	1.4907	0.2366	0.96	0.7749	2.7389	0.2830
0.47	0.3627	1.5108	0.2400	0.97	0.7785	2.7934	0.2787
0.48	0.3727	1.5308	0.2434	0.98	0.7816	2.8578	0.2735
0.49	0.3827	1.5508	0.2467	0.99	0.7841	2.9412	0.2665
0.50	0.3927	1.5708	0.2500	1.00	0.7854	3.1416	0.2500

Open Channel Flow Calculations

Swale #: **Emergency Spillway**

Side slope =	4
Bottom width =	22
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	22.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	22.82	2.24	0.10	0.10	4.54	2.03	1.1
0.2	23.65	4.56	0.19	0.19	14.49	3.18	1.2
0.3	24.47	6.96	0.28	0.29	28.65	4.12	1.3
0.4	25.30	9.44	0.37	0.37	46.58	4.93	1.4
0.5	26.12	12.00	0.46	0.46	68.01	5.67	1.5

Weighted c calculations for sub-basins captured by Detention Basin

DEVELOPED WEIGHTED c CALCULATIONS

Total Area = 16.32 Acres

Sub-basin	*Area (A)*	*c*	*c x A*
#1	0.73 Ac.	0.610	0.027
#2	0.33 Ac.	0.566	0.011
#3	0.29 Ac.	0.613	0.011
#4	0.80 Ac.	0.345	0.017
#5	0.83 Ac.	0.588	0.030
#6	0.30 Ac.	0.596	0.011
#7	0.46 Ac.	0.579	0.016
#8	0.46 Ac.	0.579	0.016
#9	0.53 Ac.	0.600	0.019
#9A	0.53 Ac.	0.600	0.019
#10	1.34 Ac.	0.370	0.030
#11	0.66 Ac.	0.597	0.024
#12	0.66 Ac.	0.617	0.025
#13	0.45 Ac.	0.624	0.017
#13A	0.45 Ac.	0.624	0.017
#16	6.82 Ac.	0.631	0.264
OS-1	0.16 Ac.	0.379	0.004
OS-2	0.52 Ac.	0.610	0.019

Weighted c = 0.580

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 1

Total Area = 31,796 S.F.
0.73 Acres

Surface								C	N
Structures	2.5	@	2000	=	5,000	S.F. =	0.11 Ac.	0.92	0.02
Pavement				=	7,902	S.F. =	0.18 Ac.	0.92	0.02
Drives	6	@	700	=	4,200	S.F. =	0.10 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			14,694 S.F.	=			0.34 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00 Ac.	0.55	0.40
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.610**	
Weighted N =	0.196	
Sheet Flow		
L =	300 Ft.	
H =	6.3 Ft.	
S =	0.0208 Ft./Ft.	
t1=	13.68 Minutes	(Min. 5 minutes)
Shallow Concentrated Flow		
L =	112 Ft.	
H =	1.4 Ft.	
S =	0.0123 Ft./Ft.	
v =	2.20 Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.85 Minutes	
tc=	14.52 Minutes	
I(10) =	In./Hr.	
I(25) =	5.119 In./Hr.	
I(50) =	In./Hr.	
I(100) =	6.283 In./Hr.	
Q(10) =	**0.00 CFS**	
Q(25) =	**2.28 CFS**	
Q(50) =	**0.00 CFS**	
Q(100) =	**2.80 CFS**	

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 2

Total Area = 14,232 S.F.
0.33 Acres

Surface								C	N
Structures	0	@	2000	=	0	S.F. =	0.00 Ac.	0.92	0.02
Pavement				=	6,711	S.F. =	0.15 Ac.	0.92	0.02
Drives	0	@	700	=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			7,521 S.F.	=			0.17 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.566**	
Weighted N =	0.221	
Sheet Flow		
L =	300 Ft.	
H =	6.0 Ft.	
S =	0.0200 Ft./Ft.	
t1=	14.62 Minutes	(Min. 5 minutes)
Shallow Concentrated Flow		
L =	70 Ft.	
H =	1.9 Ft.	
S =	0.0270 Ft./Ft.	
v =	3.40 Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.34 Minutes	
tc=	14.96 Minutes	
I(10) =	In./Hr.	
I(25) =	5.040 In./Hr.	
I(50) =	In./Hr.	
I(100) =	6.201 In./Hr.	
Q(10) =	**0.00 CFS**	
Q(25) =	**0.93 CFS**	
Q(50) =	**0.00 CFS**	
Q(100) =	**1.15 CFS**	

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 3 — Total Area = 12,829 S.F. = 0.29 Acres

Surface								*C*	*N*
Structures	1	@	2000	=	2,000	S.F. =	0.05 Ac.	0.92	0.02
Pavement				=	3,547	S.F. =	0.08 Ac.	0.92	0.02
Drives	2	@	700	=	1,400	S.F. =	0.03 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2			0	S.F.	=		0.00 Ac.	0.15	0.40
Lawn (2-5%)			5,882	S.F.	=		0.14 Ac.	0.25	0.40
Lawn (5-10%)			0	S.F.	=		0.00 Ac.	0.40	0.40
Lawn (>10%)			0	S.F.	=		0.00 Ac.	0.55	0.40
Water			0	S.F.	=		0.00 Ac.	1.00	0.00
Misc.			0	S.F.	=		0.00 Ac.	0.92	0.02

Weighted c =	**0.613**	
Weighted N =	0.194	
Sheet Flow		
L =	196	Ft.
H =	2.5	Ft.
S =	0.0126	Ft./Ft.
t1=	12.57	Minutes (Min. 5 minutes)
Open Channel Flow		
L =		Ft.
H =		Ft.
S =	#DIV/0!	Ft./Ft.
v =	2.00	Ft./sec.
t2=	0.00	Minutes
tc=	12.57	Minutes
I(10) =		In./Hr.
I(25) =	5.467	In./Hr.
I(50) =		In./Hr.
I(100) =	6.647	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**0.99**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**1.20**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 4 — Total Area = 34,926 S.F. = 0.80 Acres

Surface								*C*	*N*
Structures	2.25	@	2000	=	4,500	S.F. =	0.10 Ac.	0.92	0.02
Pavement				=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	@	700	=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios	4.5	@	100	=	450	S.F. =	0.01 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0	S.F.	=		0.00 Ac.	0.15	0.40
Lawn (2-5%)			29,976	S.F.	=		0.69 Ac.	0.25	0.40
Lawn (5-10%)			0	S.F.	=		0.00 Ac.	0.40	0.40
Lawn (>10%)			0	S.F.	=		0.00 Ac.	0.55	0.40
Woods (>10%)			0	S.F.	=		0.00 Ac.	0.48	0.60
Water			0	S.F.	=		0.00 Ac.	1.00	0.00
Misc.			0	S.F.	=		0.00 Ac.	0.92	0.02

Weighted c =	**0.345**	
Weighted N =	0.346	
Sheet Flow		
L =	99	Ft.
H =	1.0	Ft.
S =	0.0097	Ft./Ft.
t1=	12.72	Minutes (Min. 5 minutes)
Open Channel Flow		
L =	273	Ft.
H =	2.2	Ft.
S =	0.0080	Ft./Ft.
v =	1.80	Ft./sec.
t2=	2.53	Minutes
tc=	15.25	Minutes
I(10) =		In./Hr.
I(25) =	5.010	In./Hr.
I(50) =		In./Hr.
I(100) =	6.168	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**1.39**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**1.71**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 5

Total Area = 36,074 S.F.
0.83 Acres

Surface								C	N
Structures	3.5	@	2000	=	7,000	S.F. =	0.16 Ac.	0.92	0.02
Pavement				=	6,285	S.F. =	0.14 Ac.	0.92	0.02
Drives	7	@	700	=	4,900	S.F. =	0.11 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0	S.F.	=		0.00 Ac.	0.15	0.40
Lawn (2-5%)			17,889	S.F.	=		0.41 Ac.	0.25	0.40
Lawn (5-10%)			0	S.F.	=		0.00 Ac.	0.40	0.40
Lawn (>10%)			0	S.F.	=		0.00 Ac.	0.55	0.40
Woods (>10%)			0	S.F.	=		0.00 Ac.	0.48	0.60
Water			0	S.F.	=		0.00 Ac.	1.00	0.00
Misc.			0	S.F.	=		0.00 Ac.	0.92	0.02

Weighted c =	**0.588**	
Weighted N =	0.208	
Sheet Flow		
L =	300	Ft.
H =	3.4	Ft.
S =	0.0113	Ft./Ft.
t1=	16.25	Minutes (Min. 5 minutes)
Shallow Concentrated Flow		
L =	127	Ft.
H =	1.2	Ft.
S =	0.0097	Ft./Ft.
v =	2.00	Ft./sec.
t2=	1.06	Minutes
tc=	17.31	Minutes
I(10) =		In./Hr.
I(25) =	4.819	In./Hr.
I(50) =		In./Hr.
I(100) =	5.950	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**2.35**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**2.90**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 6

Total Area = 13,166 S.F.
0.30 Acres

Surface								C	N
Structures	0.25	@	2000	=	500	S.F. =	0.01 Ac.	0.92	0.02
Pavement				=	5,955	S.F. =	0.14 Ac.	0.92	0.02
Drives	0.5	@	700	=	350	S.F. =	0.01 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0	S.F.	=		0.00 Ac.	0.15	0.40
Lawn (2-5%)			6,361	S.F.	=		0.15 Ac.	0.25	0.40
Lawn (5-10%)			0	S.F.	=		0.00 Ac.	0.40	0.40
Lawn (>10%)			0	S.F.	=		0.00 Ac.	0.55	0.40
Woods (>10%)			0	S.F.	=		0.00 Ac.	0.48	0.60
Water			0	S.F.	=		0.00 Ac.	1.00	0.00
Misc.			0	S.F.	=		0.00 Ac.	0.92	0.02

Weighted c =	**0.596**	
Weighted N =	0.204	
Sheet Flow		
L =	300	Ft.
H =	3.8	Ft.
S =	0.0127	Ft./Ft.
t1=	15.65	Minutes (Min. 5 minutes)
Shallow Concentrated Flow		
L =	82	Ft.
H =	0.8	Ft.
S =	0.0098	Ft./Ft.
v =	1.80	Ft./sec.
t2=	0.76	Minutes
tc=	16.41	Minutes
I(10) =		In./Hr.
I(25) =	4.903	In./Hr.
I(50) =		In./Hr.
I(100) =	6.045	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**0.88**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**1.09**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 7 — Total Area = 19,980 S.F. / 0.46 Acres

Surface									C	N
Structures	1.75	@	2000	=	3,500	S.F. =	0.08	Ac.	0.92	0.02
Pavement				=	3,863	S.F. =	0.09	Ac.	0.92	0.02
Drives	3.5	@	700	=	2,450	S.F. =	0.06	Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00	Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00	Ac.	0.92	0.02
Lawn (0-2			0 S.F.	=			0.00	Ac.	0.15	0.40
Lawn (2-5%)			10,167 S.F.	=			0.23	Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00	Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00	Ac.	0.55	0.40
Water			0 S.F.	=			0.00	Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00	Ac.	0.92	0.02

Weighted c =	**0.579**	
Weighted N =	0.213	
Sheet Flow		
L =	199	Ft.
H =	1.9	Ft.
S =	0.0095	Ft./Ft.
t1=	14.13	Minutes (Min. 5 minutes)
Open Channel Flow		
L =	0	Ft.
H =	0.0	Ft.
S =	#DIV/0!	Ft./Ft.
v =	2.10	Ft./sec.
t2=	0.00	Minutes
tc=	14.13	Minutes
I(10) =		In./Hr.
I(25) =	5.188	In./Hr.
I(50) =		In./Hr.
I(100) =	6.356	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**1.38**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**1.69**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 8 — Total Area = 19,980 S.F. / 0.46 Acres

Surface									C	N
Structures	1.75	@	2000	=	3,500	S.F. =	0.08	Ac.	0.92	0.02
Pavement				=	3,863	S.F. =	0.09	Ac.	0.92	0.02
Drives	3.5	@	700	=	2,450	S.F. =	0.06	Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00	Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00	Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00	Ac.	0.15	0.40
Lawn (2-5%)			10,167 S.F.	=			0.23	Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00	Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00	Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00	Ac.	0.48	0.60
Water			0 S.F.	=			0.00	Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00	Ac.	0.92	0.02

Weighted c =	**0.579**	
Weighted N =	0.213	
Sheet Flow		
L =	199	Ft.
H =	1.9	Ft.
S =	0.0095	Ft./Ft.
t1=	14.11	Minutes (Min. 5 minutes)
Shallow Concentrated Flow		
L =	0	Ft.
H =	0.0	Ft.
S =	#DIV/0!	Ft./Ft.
v =	1.95	Ft./sec. (From HERPICC Figure 3.4.5)
t2=	0.00	Minutes
tc=	14.11	Minutes
I(10) =		In./Hr.
I(25) =	5.192	In./Hr.
I(50) =		In./Hr.
I(100) =	6.360	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**1.38**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**1.69**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 9

Total Area = 22,903 S.F.
0.53 Acres

Surface								C	N
Structures	2.25	@	2000	=	4,500	S.F. =	0.10 Ac.	0.92	0.02
Pavement				=	4,314	S.F. =	0.10 Ac.	0.92	0.02
Drives	4.5	@	700	=	3,150	S.F. =	0.07 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			10,939 S.F.	=			0.25 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.600**	
Weighted N =	0.201	
Sheet Flow		
L =	241	Ft.
H =	2.4	Ft.
S =	0.0098	Ft./Ft.
t1=	14.92	Minutes (Min. 5 minutes)
Open Channel Flow		
L =	0	Ft.
H =	0.0	Ft.
S =	#DIV/0!	Ft./Ft.
v =	1.80	Ft./sec.
t2=	0.00	Minutes
tc=	14.92	Minutes
I(10) =		In./Hr.
I(25) =	5.047	In./Hr.
I(50) =		In./Hr.
I(100) =	6.209	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**1.59**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**1.96**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 10

Total Area = 58,440 S.F.
1.34 Acres

Surface								C	N
Structures	4.75	@	2000	=	9,500	S.F. =	0.22 Ac.	0.92	0.02
Pavement				=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	@	700	=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios	9.5	@	100	=	950	S.F. =	0.02 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			47,990 S.F.	=			1.10 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.370**	
Weighted N =	0.332	
Sheet Flow		
L =	141	Ft.
H =	1.5	Ft.
S =	0.0106	Ft./Ft.
t1=	14.40	Minutes (Min. 5 minutes)
Open Channel Flow		
L =	445	Ft.
H =	3.6	Ft.
S =	0.0080	Ft./Ft.
v =	1.80	Ft./sec.
t2=	4.12	Minutes
tc=	18.52	Minutes
I(10) =		In./Hr.
I(25) =	4.708	In./Hr.
I(50) =		In./Hr.
I(100) =	5.822	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**2.34**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**2.89**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 9A

Total Area = 22,903 S.F.
0.53 Acres

Surface								C	N
Structures	2.25	@	2000	=	4,500	S.F. =	0.10 Ac.	0.92	0.02
Pavement				=	4,314	S.F. =	0.10 Ac.	0.92	0.02
Drives	4.5	@	700	=	3,150	S.F. =	0.07 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			10,939 S.F.	=			0.25 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.600**	
Weighted N =	0.201	
Sheet Flow		
L =	241	Ft.
H =	2.4	Ft.
S =	0.0098	Ft./Ft.
t1=	14.92	Minutes
Open Channel Flow		
L =	0	Ft.
H =	0.0	Ft.
S =	#DIV/0!	Ft./Ft.
v =	1.80	Ft./sec.
t2=	0.00	Minutes
tc=	14.92	Minutes
I(10) =		In./Hr.
I(25) =	5.047	In./Hr.
I(50) =		In./Hr.
I(100) =	6.209	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**1.59**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**1.96**	**CFS**

(Min. 5 minutes)

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 11

Total Area = 28,808 S.F.
0.66 Acres

Surface								C	N
Structures	2.75	@	2000	=	5,500	S.F. =	0.13 Ac.	0.92	0.02
Pavement				=	5,570	S.F. =	0.13 Ac.	0.92	0.02
Drives	5.5	@	700	=	3,850	S.F. =	0.09 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			13,888 S.F.	=			0.32 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.597**	
Weighted N =	0.203	
Sheet Flow		
L =	280	Ft.
H =	2.3	Ft.
S =	0.0084	Ft./Ft.
t1 =	16.68	Minutes (Min. 5 minutes)
Shallow Concentrated Flow		
L =	0	Ft.
H =	0.0	Ft.
S =	#DIV/0!	Ft./Ft.
v =	3.00	Ft./sec. (From HERPICC Figure 3.4.5)
t2=	0.00	Minutes
tc=	16.68	Minutes
I(10) =		In./Hr.
I(25) =	4.878	In./Hr.
I(50) =		In./Hr.
I(100) =	6.016	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**1.93**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**2.38**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 12

Total Area = 28,808 S.F.
0.66 Acres

Surface								C	N
Structures	3	@	2000	=	6,000	S.F. =	0.14 Ac.	0.92	0.02
Pavement				=	5,570	S.F. =	0.13 Ac.	0.92	0.02
Drives	6	@	700	=	4,200	S.F. =	0.10 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			13,038 S.F.	=			0.30 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.617**	
Weighted N =	0.192	
Sheet Flow		
L =	280	Ft.
H =	2.3	Ft.
S =	0.0084	Ft./Ft.
t1 =	16.25	Minutes (Min. 5 minutes)
Shallow Concentrated Flow		
L =	0	Ft.
H =	0.0	Ft.
S =	#DIV/0!	Ft./Ft.
v =	3.00	Ft./sec. (From HERPICC Figure 3.4.5)
t2=	0.00	Minutes
tc=	16.25	Minutes
I(10) =		In./Hr.
I(25) =	4.917	In./Hr.
I(50) =		In./Hr.
I(100) =	6.062	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**2.01**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**2.47**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 13

Total Area = 19,711 S.F.
0.45 Acres

Surface								C	N
Structures	1.75	@	2000	=	3,500	S.F. =	0.08 Ac.	0.92	0.02
Pavement				=	3,696	S.F. =	0.08 Ac.	0.92	0.02
Drives	3.5	@	700	=	2,450	S.F. =	0.06 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			7,065 S.F.	=			0.16 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			3,000 S.F.	=			0.07 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.624**	
Weighted N =	0.214	
Sheet Flow		
L =	177	Ft.
H =	1.6	Ft.
S =	0.0092	Ft./Ft.
t1=	13.49	Minutes (Min. 5 minutes)
Shallow Concentrated Flow		
L =		Ft.
H =		Ft.
S =	#DIV/0!	Ft./Ft.
v =	3.60	Ft./sec. (From HERPICC Figure 3.4.5)
t2=	0.00	Minutes
tc=	13.49	Minutes
I(10) =		In./Hr.
I(25) =	5.302	In./Hr.
I(50) =		In./Hr.
I(100) =	6.475	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**1.50**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**1.83**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 14

Total Area = 3,341 S.F.
0.08 Acres

Surface								C	N
Structures	0	@	2000	=	0	S.F. =	0.00 Ac.	0.92	0.02
Pavement				=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	@	700	=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			3,341 S.F.	=			0.08 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			0 S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.250**	
Weighted N =	0.400	
Sheet Flow		
L =	20	Ft.
H =	0.5	Ft.
S =	0.0250	Ft./Ft.
t1=	5.17	Minutes (Min. 5 minutes)
Open Channel Flow		
L =	120	Ft.
H =	1.0	Ft.
S =	0.0080	Ft./Ft.
v =	1.60	Ft./sec.
t2=	1.25	Minutes
tc=	6.42	Minutes
I(10) =		In./Hr.
I(25) =	6.844	In./Hr.
I(50) =		In./Hr.
I(100) =	8.088	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**0.13**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**0.16**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 13A

Total Area = 19,711 S.F.
0.45 Acres

Surface								C	N
Structures	1.75	@	2000	=	3,500	S.F. =	0.08 Ac.	0.92	0.02
Pavement				=	3,696	S.F. =	0.08 Ac.	0.92	0.02
Drives	3.5	@	700	=	2,450	S.F. =	0.06 Ac.	0.92	0.02
Patios	0	@	100	=	0	S.F. =	0.00 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			7,065 S.F.	=			0.16 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			3,000 S.F.	=			0.07 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.624**		
Weighted N =	0.214		
Sheet Flow			
L =	177	Ft.	
H =	1.6	Ft.	
S =	0.0092	Ft./Ft.	
t1=	13.49	Minutes	(Min. 5 minutes)
Shallow Concentrated Flow			
L =		Ft.	
H =		Ft.	
S =	#DIV/0!	Ft./Ft.	
v =	3.60	Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.00	Minutes	
tc=	13.49	Minutes	
I(10) =		In./Hr.	
I(25) =	5.302	In./Hr.	
I(50) =		In./Hr.	
I(100) =	6.475	In./Hr.	
Q(10) =	**0.00**	**CFS**	
Q(25) =	**1.50**	**CFS**	
Q(50) =	**0.00**	**CFS**	
Q(100) =	**1.83**	**CFS**	

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 15

Total Area = 176,436 S.F.
4.05 Acres

Surface								C	N
Structures	6	@	2000	=	12,000	S.F. =	0.28 Ac.	0.92	0.02
Pavement				=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	@	700	=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios	12	@	100	=	1,200	S.F. =	0.03 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			138,236 S.F.	=			3.17 Ac.	0.25	0.40
Lawn (5-10%)			0 S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			25,000 S.F.	=			0.57 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			0 S.F.	=			0.00 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.343**	
Weighted N =	0.372	
Sheet Flow		
L =	99	Ft.
H =	0.9	Ft.
S =	0.0093	Ft./Ft.
t1=	13.28	Minutes (Min. 5 minutes)
Open Channel Flow		
L =	1,256	Ft.
H =	12.3	Ft.
S =	0.0098	Ft./Ft.
v =	2.60	Ft./sec.
t2=	8.05	Minutes
tc=	21.33	Minutes
I(10) =		In./Hr.
I(25) =	4.448	In./Hr.
I(50) =		In./Hr.
I(100) =	5.525	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**6.17**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**7.67**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 16

Total Area = 297,192 S.F.
6.82 Acres

Surface								C	N
Structures	11.75	@	2000	=	23,500	S.F. =	0.54 Ac.	0.92	0.02
Pavement				=	0	S.F. =	0.00 Ac.	0.92	0.02
Drives	0	@	700	=	0	S.F. =	0.00 Ac.	0.92	0.02
Patios	23.5	@	100	=	2,350	S.F. =	0.05 Ac.	0.92	0.02
Sidewalks				=	0	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)			126,367 S.F.	=			2.90 Ac.	0.25	0.40
Lawn (5-10%)			S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)			28,400 S.F.	=			0.65 Ac.	0.55	0.40
Woods (>10%)			0 S.F.	=			0.00 Ac.	0.48	0.60
Water			116,575 S.F.	=			2.68 Ac.	1.00	0.00
Misc.			0 S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.631**	
Weighted N =	0.210	
Sheet Flow		
L =	97	Ft.
H =	2.0	Ft.
S =	0.0206	Ft./Ft.
t1=	8.37	Minutes (Min. 5 minutes)
Open Channel Flow		
L =	0	Ft.
H =	0.0	Ft.
S =	#DIV/0!	Ft./Ft.
v =	2.30	Ft./sec.
t2=	0.00	Minutes
tc=	8.37	Minutes
I(10) =		In./Hr.
I(25) =	6.343	In./Hr.
I(50) =		In./Hr.
I(100) =	7.564	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**27.31**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**32.57**	**CFS**

Open Channel Flow Calculations

Swale #: **1**

Side slope =	3
Bottom width =	1
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	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.10	0.79	1.1
0.2	2.26	0.32	0.14	0.15	0.37	1.15	1.2
0.3	2.90	0.57	0.20	0.20	0.82	1.44	1.3
0.4	3.53	0.88	0.25	0.26	1.48	1.69	1.4
0.5	4.16	1.25	0.30	0.31	2.38	1.91	1.5
0.55	4.48	1.46	0.33	0.34	2.94	2.01	1.6
0.7	5.11	1.92	0.38	0.39	4.25	2.21	1.7
0.8	5.74	2.44	0.42	0.44	5.86	2.40	1.8
0.9	6.38	3.02	0.47	0.49	7.80	2.59	1.9
1.0	7.01	3.66	0.52	0.55	10.09	2.76	2.0

Open Channel Flow Calculations

Swale #: **2**

Side slope =	3
Bottom width =	1
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	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.10	0.79	1.1
0.2	2.26	0.32	0.14	0.15	0.37	1.15	1.2
0.3	2.90	0.57	0.20	0.20	0.82	1.44	1.3
0.32	3.02	0.63	0.21	0.21	0.94	1.49	1.4
0.4	3.53	0.88	0.25	0.26	1.48	1.69	1.4
0.5	4.16	1.25	0.30	0.31	2.39	1.91	1.5
0.6	4.79	1.68	0.35	0.37	3.55	2.12	1.6
0.7	5.43	2.17	0.40	0.42	5.01	2.31	1.7
0.8	6.06	2.72	0.45	0.47	6.79	2.50	1.8
0.9	6.69	3.33	0.50	0.52	8.90	2.67	1.9
1.0	7.32	4.00	0.55	0.57	11.38	2.84	2.0
1.1	7.96	4.73	0.59	0.62	14.24	3.01	2.1
1.2	8.59	5.52	0.64	0.67	17.50	3.17	2.2
1.3	9.22	6.37	0.69	0.72	21.19	3.33	2.3
1.4	9.85	7.28	0.74	0.77	25.33	3.48	2.4
1.5	10.49	8.25	0.79	0.83	29.90	3.63	2.5
1.6	11.12	9.28	0.83	0.88	35.02	3.77	2.6
1.7	11.75	10.37	0.88	0.93	40.61	3.92	2.7
1.8	12.38	11.52	0.93	0.98	46.73	4.06	2.8
1.9	13.02	12.73	0.98	1.03	53.39	4.19	2.9
2.0	13.65	14.00	1.03	1.08	60.62	4.33	3.0
2.1	14.28	15.33	1.07	1.13	68.42	4.46	3.1
2.2	14.91	16.72	1.12	1.18	76.82	4.59	3.2
2.3	15.55	18.17	1.17	1.23	85.83	4.72	3.3
2.4	16.18	19.68	1.22	1.28	95.47	4.85	3.4
2.5	16.81	21.25	1.26	1.33	105.78	4.98	3.5
2.6	17.44	22.88	1.31	1.38	116.71	5.10	3.6
2.7	18.08	24.57	1.36	1.43	128.35	5.22	3.7
2.8	18.71	26.32	1.41	1.48	140.68	5.34	3.8
2.9	19.34	28.13	1.45	1.53	153.73	5.46	3.9
3.0	19.97	30.00	1.50	1.58	167.50	5.58	4.0
3.1	20.61	31.93	1.55	1.63	182.02	5.70	4.1
3.2	21.24	33.92	1.60	1.68	197.30	5.82	4.2
3.3	21.87	35.97	1.64	1.73	213.36	5.93	4.3
3.4	22.50	38.08	1.69	1.78	230.20	6.05	4.4
3.5	23.14	40.25	1.74	1.83	247.86	6.16	4.5
3.6	23.77	42.48	1.79	1.88	266.33	6.27	4.6
3.7	24.40	44.77	1.83	1.93	285.65	6.38	4.7
3.8	25.03	47.12	1.88	1.98	305.81	6.49	4.8
3.9	25.67	49.53	1.93	2.03	326.84	6.60	4.9
4.0	26.30	52.00	1.98	2.08	348.74	6.71	5.0
4.1	26.93	54.53	2.02	2.13	371.55	6.81	5.1
4.2	27.56	57.12	2.07	2.18	395.26	6.92	5.2
4.3	28.20	59.77	2.12	2.23	419.89	7.03	5.3
4.4	28.83	62.48	2.17	2.28	445.46	7.13	5.4
4.5	29.46	65.25	2.21	2.33	471.98	7.23	5.5
4.6	30.09	68.08	2.26	2.38	499.47	7.34	5.6
4.7	30.73	70.97	2.31	2.43	527.93	7.44	5.7
4.8	31.36	73.92	2.36	2.48	557.39	7.54	5.8
4.9	31.99	76.93	2.40	2.53	587.85	7.64	5.9
5.0	32.62	80.00	2.45	2.58	619.33	7.74	6.0
5.1	33.26	83.13	2.50	2.63	651.84	7.84	6.1
5.2	33.89	86.32	2.55	2.68	685.40	7.94	6.2
5.3	34.52	89.57	2.59	2.73	720.01	8.04	6.3
5.4	35.15	92.88	2.64	2.78	755.70	8.14	6.4
5.5	35.79	96.25	2.69	2.83	792.47	8.23	6.5
5.6	36.42	99.68	2.74	2.88	830.34	8.33	6.6
5.7	37.05	103.17	2.78	2.93	869.32	8.43	6.7
5.8	37.68	106.72	2.83	2.98	909.43	8.52	6.8
5.9	38.31	110.33	2.88	3.03	950.67	8.62	6.9
6.0	38.95	114.00	2.93	3.08	993.06	8.71	7.0

Open Channel Flow Calculations

Swale #: **3**

Side slope =	3
Bottom width =	1
Manning's coefficient =	0.035
Slope of channel =	0.0109

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.11	0.82	1.1
0.2	2.26	0.32	0.14	0.15	0.39	1.21	1.2
0.3	2.90	0.57	0.20	0.20	0.86	1.50	1.3
0.32	3.02	0.63	0.21	0.21	0.98	1.56	1.4
0.4	3.53	0.88	0.25	0.26	1.55	1.76	1.4
0.5	4.16	1.25	0.30	0.31	2.49	1.99	1.5
0.6	4.79	1.68	0.35	0.37	3.71	2.21	1.6
0.7	5.43	2.17	0.40	0.42	5.23	2.41	1.7
0.8	6.06	2.72	0.45	0.47	7.09	2.61	1.8
0.9	6.69	3.33	0.50	0.52	9.29	2.79	1.9
1.0	7.32	4.00	0.55	0.57	11.88	2.97	2.0

Open Channel Flow Calculations

Swale #: **4**

Side slope =	3
Bottom width =	1
Manning's coefficient =	0.035
Slope of channel =	0.008

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.09	0.70	1.1
0.2	2.26	0.32	0.14	0.15	0.33	1.03	1.2
0.3	2.90	0.57	0.20	0.20	0.73	1.29	1.3
0.32	3.02	0.63	0.21	0.21	0.84	1.33	1.4
0.4	3.53	0.88	0.25	0.26	1.33	1.51	1.4
0.5	4.16	1.25	0.30	0.31	2.13	1.71	1.5
0.6	4.54	1.50	0.33	0.34	2.73	1.82	1.6
0.7	5.17	1.97	0.38	0.40	3.93	2.00	1.7
0.8	5.81	2.49	0.43	0.45	5.40	2.17	1.8
0.9	6.44	3.08	0.48	0.50	7.17	2.33	1.9
1.0	7.07	3.72	0.53	0.55	9.25	2.48	2.0

Open Channel Flow Calculations

Swale #: **5**

Side slope =	3
Bottom width =	1
Manning's coefficient =	0.035
Slope of channel =	0.008

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.09	0.70	1.1
0.2	2.26	0.32	0.14	0.15	0.33	1.03	1.2
0.3	2.90	0.57	0.20	0.20	0.73	1.29	1.3
0.32	3.02	0.63	0.21	0.21	0.84	1.33	1.4
0.4	3.53	0.88	0.25	0.26	1.33	1.51	1.4
0.5	4.16	1.25	0.30	0.31	2.13	1.71	1.5
0.6	4.79	1.68	0.35	0.37	3.18	1.89	1.6
0.7	5.43	2.17	0.40	0.42	4.48	2.07	1.7
0.8	6.06	2.72	0.45	0.47	6.07	2.23	1.8
0.9	6.69	3.33	0.50	0.52	7.96	2.39	1.9
1.0	7.32	4.00	0.55	0.57	10.18	2.54	2.0

Open Channel Flow Calculations

Swale #: **6**

Side slope = 3
Bottom width = 1
Manning's coefficient = 0.035
Slope of channel = 0.0101

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.10	0.79	1.1
0.2	2.26	0.32	0.14	0.15	0.37	1.16	1.2
0.3	2.90	0.57	0.20	0.20	0.82	1.45	1.3
0.32	3.02	0.63	0.21	0.21	0.94	1.50	1.4
0.4	3.53	0.88	0.25	0.26	1.49	1.69	1.4
0.5	4.16	1.25	0.30	0.31	2.40	1.92	1.5
0.6	4.79	1.68	0.35	0.37	3.57	2.13	1.6
0.7	5.43	2.17	0.40	0.42	5.04	2.32	1.7
0.8	6.06	2.72	0.45	0.47	6.82	2.51	1.8
0.9	6.69	3.33	0.50	0.52	8.95	2.69	1.9
1.0	7.32	4.00	0.55	0.57	11.43	2.86	2.0

Open Channel Flow Calculations

Swale #: 7

Side slope = 3
Bottom width = 1
Manning's coefficient = 0.035
Slope of channel = 0.008

Depth (ft)	*Wetted Perimeter (ft)*	*Area (ft^2)*	*Hydraulic Radius (ft)*	*Hydraulic Depth (ft)*	*Flowrate (cfs)*	*Velocity (ft/s)*	*F value*
0.0	1.00	0.00	0.00	0.00	0.00	#DIV/0!	1.0
0.1	1.63	0.13	0.08	0.08	0.09	0.70	1.1
0.2	2.26	0.32	0.14	0.15	0.33	1.03	1.2
0.3	2.90	0.57	0.20	0.20	0.73	1.29	1.3
0.32	3.02	0.63	0.21	0.21	0.84	1.33	1.4
0.4	3.53	0.88	0.25	0.26	1.33	1.51	1.4
0.5	4.16	1.25	0.30	0.31	2.13	1.71	1.5
0.6	4.79	1.68	0.35	0.37	3.18	1.89	1.6
0.7	5.43	2.17	0.40	0.42	4.48	2.07	1.7
0.8	6.06	2.72	0.45	0.47	6.07	2.23	1.8
0.9	6.69	3.33	0.50	0.52	7.96	2.39	1.9
1.0	7.32	4.00	0.55	0.57	10.18	2.54	2.0

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: OS-1

Total Area = 6,830 S.F.
0.16 Acres

Surface							*C*	*N*
Impervious			=	1,316	S.F. =	0.03 Ac.	0.92	0.02
Lawn (0-2%)	0	S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)	5,514	S.F.	=			0.13 Ac.	0.25	0.40
Lawn (5-10%)	0	S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)	0	S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)	0	S.F.	=			0.00 Ac.	0.48	0.60
Water	0	S.F.	=			0.00 Ac.	1.00	0.00
Misc.	0	S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.379**		
Weighted N =	0.327		
Sheet Flow			
L =	45	Ft.	
H =	1.0	Ft.	
S =	0.0222	Ft./Ft.	
t1=	7.06	Minutes	(Min. 5 minutes)
Shallow Concrentrated Flow			
L =		Ft.	
H =		Ft.	
S =	#DIV/0!	Ft./Ft.	
v =	2.00	Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.00	Minutes	
Shallow Concentrated Flow			
L =		Ft.	
H =		Ft.	
S =	0.0000	Ft./Ft.	
v =	1.65	Ft./sec.	(From HERPICC Figure 3.4.5)
t3=	0.00	Minutes	
tc=	7.06	Minutes	
I(10) =		In./Hr.	
I(25) =	6.679	In./Hr.	
I(50) =		In./Hr.	
I(100) =	7.916	In./Hr.	
Q(10) =	**0.00**	**CFS**	
Q(25) =	**0.40**	**CFS**	
Q(50) =	**0.00**	**CFS**	
Q(100) =	**0.47**	**CFS**	

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: OS-2

Total Area = 22,690 S.F.
0.52 Acres

Surface							*C*	*N*
Impervious			=	12,192	S.F. =	0.28 Ac.	0.92	0.02
Lawn (0-2%)	0	S.F.	=			0.00 Ac.	0.15	0.40
Lawn (2-5%)	10,498	S.F.	=			0.24 Ac.	0.25	0.40
Lawn (5-10%)	0	S.F.	=			0.00 Ac.	0.40	0.40
Lawn (>10%)	0	S.F.	=			0.00 Ac.	0.55	0.40
Woods (>10%)	0	S.F.	=			0.00 Ac.	0.48	0.60
Water	0	S.F.	=			0.00 Ac.	1.00	0.00
Misc.	0	S.F.	=			0.00 Ac.	0.92	0.02

Weighted c =	**0.610**	
Weighted N =	0.196	
Sheet Flow		
L =	90	Ft.
H =	1.7	Ft.
S =	0.0189	Ft./Ft.
t1=	7.98	Minutes (Min. 5 minutes)
Shallow Concrentrated Flow		
L =		Ft.
H =		Ft.
S =	#DIV/0!	Ft./Ft.
v =	2.00	Ft./sec. (From HERPICC Figure 3.4.5)
t2=	0.00	Minutes
Shallow Concentrated Flow		
L =		Ft.
H =		Ft.
S =	0.0000	Ft./Ft.
v =	1.65	Ft./sec. (From HERPICC Figure 3.4.5)
t3=	0.00	Minutes
tc=	7.98	Minutes
I(10) =		In./Hr.
I(25) =	6.443	In./Hr.
I(50) =		In./Hr.
I(100) =	7.669	In./Hr.
Q(10) =	**0.00**	**CFS**
Q(25) =	**2.05**	**CFS**
Q(50) =	**0.00**	**CFS**
Q(100) =	**2.44**	**CFS**

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: OS-3

Total Area = 15,335 S.F.
0.35 Acres

Surface							*C*	*N*
Impervious		=	5,419	S.F. =	0.12	Ac.	0.92	0.02
Lawn (0-2%)	0	S.F.	=		0.00	Ac.	0.15	0.40
Lawn (2-5%)	9,916	S.F.	=		0.23	Ac.	0.25	0.40
Lawn (5-10%)	0	S.F.	=		0.00	Ac.	0.40	0.40
Lawn (>10%)	0	S.F.	=		0.00	Ac.	0.55	0.40
Woods (>10%)	0	S.F.	=		0.00	Ac.	0.48	0.60
Water	0	S.F.	=		0.00	Ac.	1.00	0.00
Misc.	0	S.F.	=		0.00	Ac.	0.92	0.02

Weighted c =	**0.487**		
Weighted N =	0.266		
Sheet Flow			
L =	90	Ft.	
H =	2.0	Ft.	
S =	0.0222	Ft./Ft.	
t1=	8.86	Minutes	(Min. 5 minutes)
Shallow Concentrated Flow			
L =		Ft.	
H =		Ft.	
S =	#DIV/0!	Ft./Ft.	
v =	2.00	Ft./sec.	(From HERPICC Figure 3.4.5)
t2=	0.00	Minutes	
Shallow Concentrated Flow			
L =		Ft.	
H =		Ft.	
S =	0.0000	Ft./Ft.	
v =	1.65	Ft./sec.	(From HERPICC Figure 3.4.5)
t3=	0.00	Minutes	
tc=	8.86	Minutes	
I(10) =		In./Hr.	
I(25) =	6.218	In./Hr.	
I(50) =		In./Hr.	
I(100) =	7.432	In./Hr.	
Q(10) =	**0.00**	**CFS**	
Q(25) =	**1.07**	**CFS**	
Q(50) =	**0.00**	**CFS**	
Q(100) =	**1.27**	**CFS**	