FINAL DRAINAGE REPORT
for
Store-N-Lock
7007, 7027, 7037 US 41 N.
Evansville, Indiana 47725

Project No.: 11586.4.001-B
November 29, 2022

Prepared For:
CWK Investments – Airport, LLC
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7007, 7027, 7037 US 41 N.

13.04.085 Request by applicant for plan review and approval.

A. All requests for drainage plan approval shall be made by the applicant to the drainage board through the county surveyor's office by the presentation to the surveyor of the drainage plan and the supporting data, all in duplicate, by the close of the business day two full weeks prior to the meeting at which approval of the drainage plan shall be sought.

Drainage Plan resubmitted with this report on 11-29-2022

C. Included with the Drainage Plan shall be the following information regarding the applicant that shall be provided on FORM 801.

☐ 1. For an individual(s), legal name, current mailing address, email address, name of project and general location of the project. The application must be signed by the individual(s) making such application.

2. For a partnership, corporation or other private entity the legal name of the partnership, corporation or other private entity, mailing address, email address, name of project and general location of the project. For a partnership, the application must be signed by the managing or senior partner or if none exists by all partners. For a Limited Liability Company (LLC), the application must be signed by the manager, or senior member or if one does not exist, by all members. For a corporation, the application must be signed by;

☑ i) the President or Vice-President of the corporation or

☐ ii) by a person whose authority has been delegated to sign such application. If the signature is by a person with a delegation of authority, a copy of such delegation must be included with the application.

D. In all cases the person signing the application will affirm that;

i) the information provided on the application FORM 801 is true and correct and

ii) that the applicant is committing with their signature that an as built plan or record drawing or certification statement will be provided upon completion of the project and that failure to provide an as built plan or record drawing or certification could result in fines under Section 13.04.110 and/or declaring the applicant ineligible for future drainage plan approvals for any project within the County Drainage Board's jurisdiction until such time as an as built drawing or certification is submitted. The County Surveyor or other Technical Advisors to the Board will inform the Drainage Board of any applicants that are not in compliance with submittal of an as built drawing or certification statement prior to any action being taken against such applicant.

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.

Drainage Plan resubmitted with this report on 11-29-2022

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.

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. ☑

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.

This project does not contain any off-site drainage facilities that necessitate an easement to be dedicated.

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.

CWK Investments - Airport, LLC

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.

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.

This project will not be phased.

13.04.140 Information submittal and review schedule.

The required drainage plan and supporting data shall be submitted and reviewed by a schedule as follows:

H. For all new major subdivisions as defined in Title 16 of this code, which major subdivisions are shown to discharge an amount of stormwater in addition to that which is discharged prior to new development and all minor subdivisions, C-0 Through M-3, as defined in Title 16 of this code, which minor subdivisions are zoned for commercial use, the applicant shall notify all adjoining landowners and Registered Neighborhood Associations within 1/2 mile of any development of the proposed Drainage Plan.

This project is not a major subdivision.

13.04.165 Contents of the final drainage plan.

A. Soils Map. The soil types based on the most current information available from the SWCD. A soils map indicating soils names and their hydrologic classification must be provided for a proposed project.

See Appendix A of Drainage Report.

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. The map must also identify all adjoining landowners.

See Grading and Drainage Plans submitted with this report.

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;

Contour intervals are every one foot.

2. Zone “A” floodplain based on the current FIRM panels. 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**;**

See Appendix A of Drainage Report.

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

See Grading and Drainage Plans submitted with this report.

4. The location of exiting regulated drains, farm drains, inlets and outfalls;

See Grading and Drainage Plans submitted with this report.

5. Storm, sanitary, and combined sewers, and outfalls;

See Grading and Drainage Plans submitted with this report.

6. Wells, septic tank systems, and outfalls, if any;

There will be no wells, septic tank systems, or outfalls on this project.

7. Seeps, springs, sinkholes, caves, shafts, faults, or other such geological features visible, or of record;

No geological features are present within project's limits of disturbance.

8. The limits of the entire proposed project and the limits of the expected extent of land disturbance required to accomplish the project;

See Grading and Drainage Plans submitted with this report.

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

See Grading and Drainage Plans submitted with this report.

10. A scale, preferably one inch equals fifty (50) feet; ☑

11. An arrow indicating North.; ☑

D. On-Site Bench Mark Required. A benchmark determined by “Mean Sea Level Datum 1929,” is required to be located within the project limits.

See Grading and Drainage Plans submitted with this report.

13.04.170 Final drainage plan layout (Includes information from preliminary).

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 affecting the design of the drainage facilities for the project; The extent and area of each watershed tributary to the drainage facilities within the project; The existing man-made and natural waterways, ponds, basins, pipes, culverts, and other drainage facilities or features within or affecting the project.

See Appendix B of the Drainage Report for watershed exhibits.

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**;**

See Grading and Drainage Plans and Appendix B of this Drainage Report.

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;

See Grading and Drainage Plans submitted with this report.

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**;**

See Grading and Drainage Plans submitted with this report.

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

Not applicable.

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;

See Grading and Drainage Plans and Appendix B of this Drainage Report.

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

See Appendix B for location and percentage of impervious surfaces existing and expected to be constructed.

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

See Grading and Drainage Plans submitted with this report.

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;

See Grading and Drainage Plans submitted with this report.

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;

See Grading and Drainage Plans submitted with this report.

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.

There are no "impacted drainage areas" near the project site.

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.

All structures are above the 100 year floodplain shown on plans. Plans also show building floor elevations.

13.04.175 Submittal of a written drainage design report. ☑

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:

See Grading and Drainage Plans submitted with this report.

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

Provided — 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.

Provided — 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.

Provided — C. Finished Floor Elevations Adjacent to Basins. The lowest floor of any building or structure occupied by humans must be at least two (2) feet above the one-hundred (100) year storm water elevation of detention/retention basins.

Provided — 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.

N/A

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.

N/A

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.

N/A

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.

N/A

H. Minimum Depth of Riprap Application. Riprap side slope armor shall be a minimum twelve (12) inches in depth at all points of application.

N/A

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.

N/A

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.

Provided

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.

N/A

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. Wet basins shall have a minimum depth of 6 feet over 50% of the basin area and no extensive shallow areas shall be allowed except as required for the safety ledge.

M. Emergency Spillway Requirements.

Provided

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.
N/A	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.
Provided	P. Dry Basin Cover and Maintenance. Dry basins shall be planted and maintained in vegetative cover equal to that of residential lawns.
Provided	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.
N/A	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.
Provided	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.
N/A	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. The basins and maintenance easements shall not be located with the right of way of any county, state or federal road or highway.
	U. Maintenance Report Required for Basin.
See Report	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;
See Report	2. The report shall be attached to the restrictions for the property on which the basin and its parts are located.

See Report	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.
N/A	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.
Provided	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.
Provided	X. No tree limbs, trunks, refuse from legally burnt vegetation, nor construction waste, demolition materials, or other man made material may be buried within the area in which an impounding structure will be located. Notice shall be placed on construction drawings noting the prohibition to the burying of any such materials. Certain natural materials such as large rocks may be located in the bottom of wet basins in order to provide fish habitat or habitat breeding areas provided that such materials are not included within the calculations for required storage volumes and will not block outlet structures.
N/A	Y. For small sites of less than 5 acres, infiltration trenches may be utilized instead of a wet or dry basin. In utilizing an infiltration trench, the storage volume is equal to the void ratio multiplied by the total volume of the trench. Information must be provided in advance validating the void ratio as well as testing proposal to validate the void ratio. The infiltration trench must have an outlet that restricts the flow per code provisions.
N/A	Z. No retention basin shall be allowed within the flowline of a Regulated Drain of Vanderburgh County. The Drainage Board cannot use its rights to discretionary decisions granted under Section 13.04.025 to exempt this restriction.

Other comments:

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;

There are no known or anticipated storm water drainage problems to be associated with this project.

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

Runoff conditions from a 10-year pre-developed and 25-year post-developed storm were analyzed using the Rational Method. The Rational Method is appropriate for estimating peak discharges for small drainage areas of up to 50 acres. The design of stormwater detention facilities is based on a return period of 25 years. The design of the emergency spillway is based on the depth of flow of the 100 year return period storm flow (assuming that the normal discharge device becomes totally inoperative).

Runoff coefficients used were those found in the Vanderburgh County Technical Memorandum #1 of the Vanderburgh County Drainage Ordinance, effective January 1 2018. These show on the subbasin drainage calculations in Appendix B.

The Rational Method was also used to appropriately size the storm pipe network. Pipes were sized to a 25 year return period, and assumed a Manning's Roughness, n, equal to 0.012 for HDPE storm sewer pipes.

The Form 800 was used to size the required on-site detention volume in accordance with the Vanderburgh County Drainage Ordinance. The form is attached in Appendix B

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;

All assumptions for peak discharge estimates were based on runoff coefficients found in the Vanderburgh County Technical Memorandum #1 of the Vanderburgh County Drainage Ordinance, effective January 1 2018. These show on the subbasin drainage calculations in Appendix B.

D. The proposed design of the drainage control system;

The proposed drainage control system revolves around the use of storm inlets and HDPE storm pipes to convey runoff to a proposed dry retention basin along the south property line. Storm water runoff will sheet flow over pavement into the proposed area drains, which will convey water to the proposed dry retention basin. Storm water will ultimately be detained in the dry retention basin and in underground storm sewer pipes serving as additional retention and discharged to an existing roadside itch along US 41 to the west. Storm sewer components were analyzed per the procedures outlined in Appendix B of this report.

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;

The analysis of the undeveloped site shows 7.20 CFS of storm water runoff during a 10-year pre-developed storm event with. Once developed, analysis suggests that the site will create 7.08 CFS

of storm water runoff during the 25-year post-developed storm event, with 5.29 CFS discharging to the west into the roadside ditch along US 41 N and 1.79 CFS leaving the site undetained.The storm water runoff will be detained in the proposed dry retention basin and discharge less than the allowable release rate. Form 800 calculations show a required storage of 16,829 cu. ft., and a provided storage volume of 18,840 cu. ft. provided by the proposed dry retention basin and underground storm sewer pipes serving as additional retention.

F. Descriptive data sufficient to support the feasibility of the drainage plan including calculations of the predevelopment and post development runoff rates using rainfall data supplied herein. 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;

Appendix B shows a log of all calculations and modeling to estimate the pre-developed and post-developed runoff rates. The pre-developed site has a 10-year runoff rate of 7.20 CFS and the post developed site has a 25-year runoff rate of 7.08 CFS.

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

Appendix B contains exhibits showing the individual drainage areas within the project subdivided for the use in the analysis thereof.

APPENDIX ‘A’

Site Location Map A.01
USDA Soil Survey A.02
Flood Insurance Rate Map (FIRM) A.03
Wetlands Inventory Map A.04
HUC 14 Map A.05
IDNR Assessment Documents A.06


Project Site
Google Earth
100 m
Camera: 945 m 38°02'34"N 87°32'25"W 115 m

Map Scale: 1:2,050 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Vanderburgh County, Indiana
Survey Area Data: Version 21, Sep 9, 2021

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

Date(s) aerial images were photographed: Feb 12, 2016—Nov 8, 2019

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

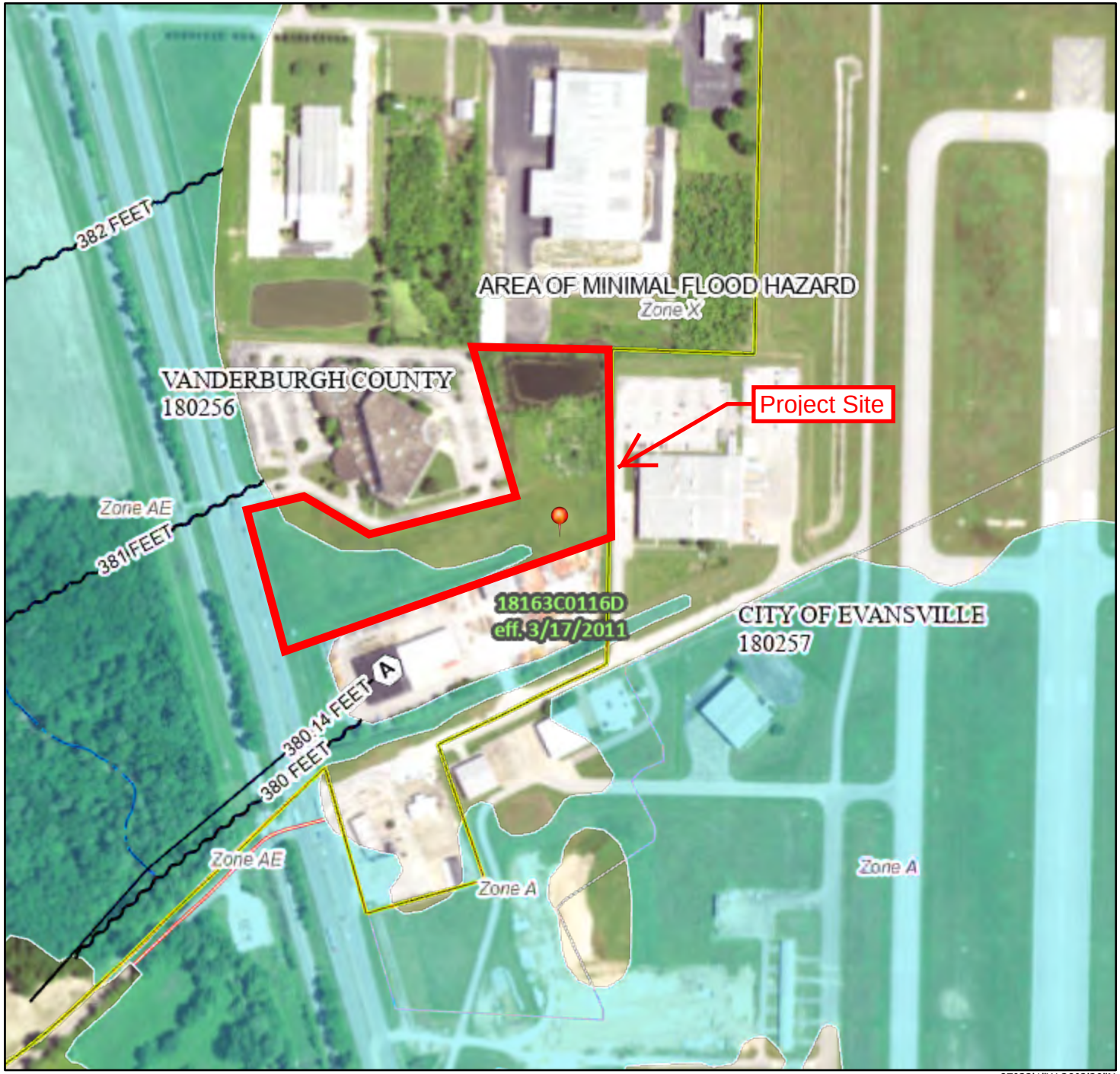
Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Bd	Birds silt loam, 0 to 2 percent slopes, frequently flooded	0.7	8.8%
Mr	McGary silt loam, 0 to 2 percent slope	1.3	17.6%
Zp	Zipp silty clay, 0 to 2 percent slopes	5.7	73.6%
Totals for Area of Interest		**7.7**	**100.0%**

National Flood Hazard Layer FIRMette

FEMA

87°32'39"W 38°2'49"N



87°32'1"W 38°2'20"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/31/2022 at 10:33 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

U.S. Fish and Wildlife Service
National Wetlands Inventory

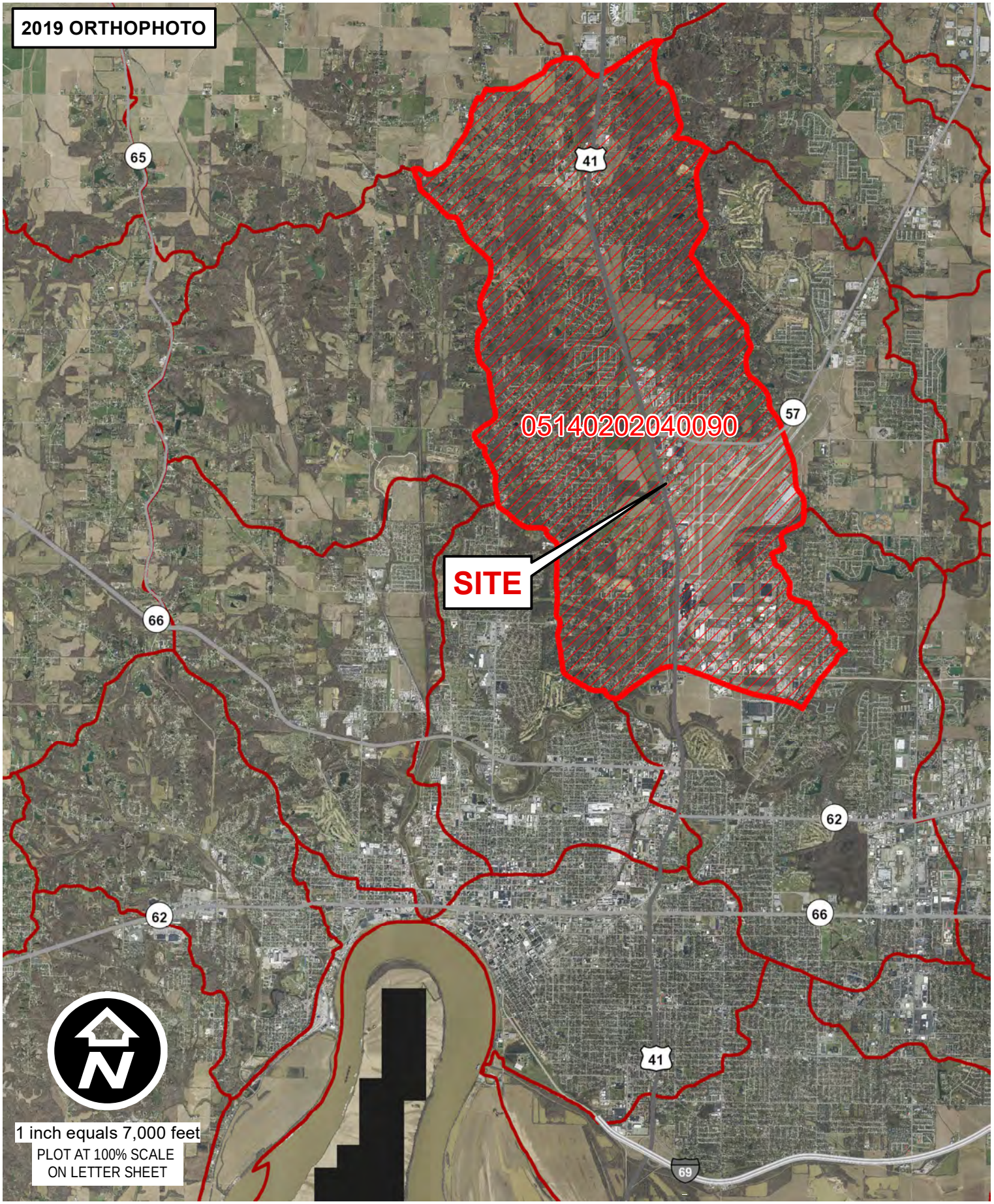
Wetlands Map

May 31, 2022

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.



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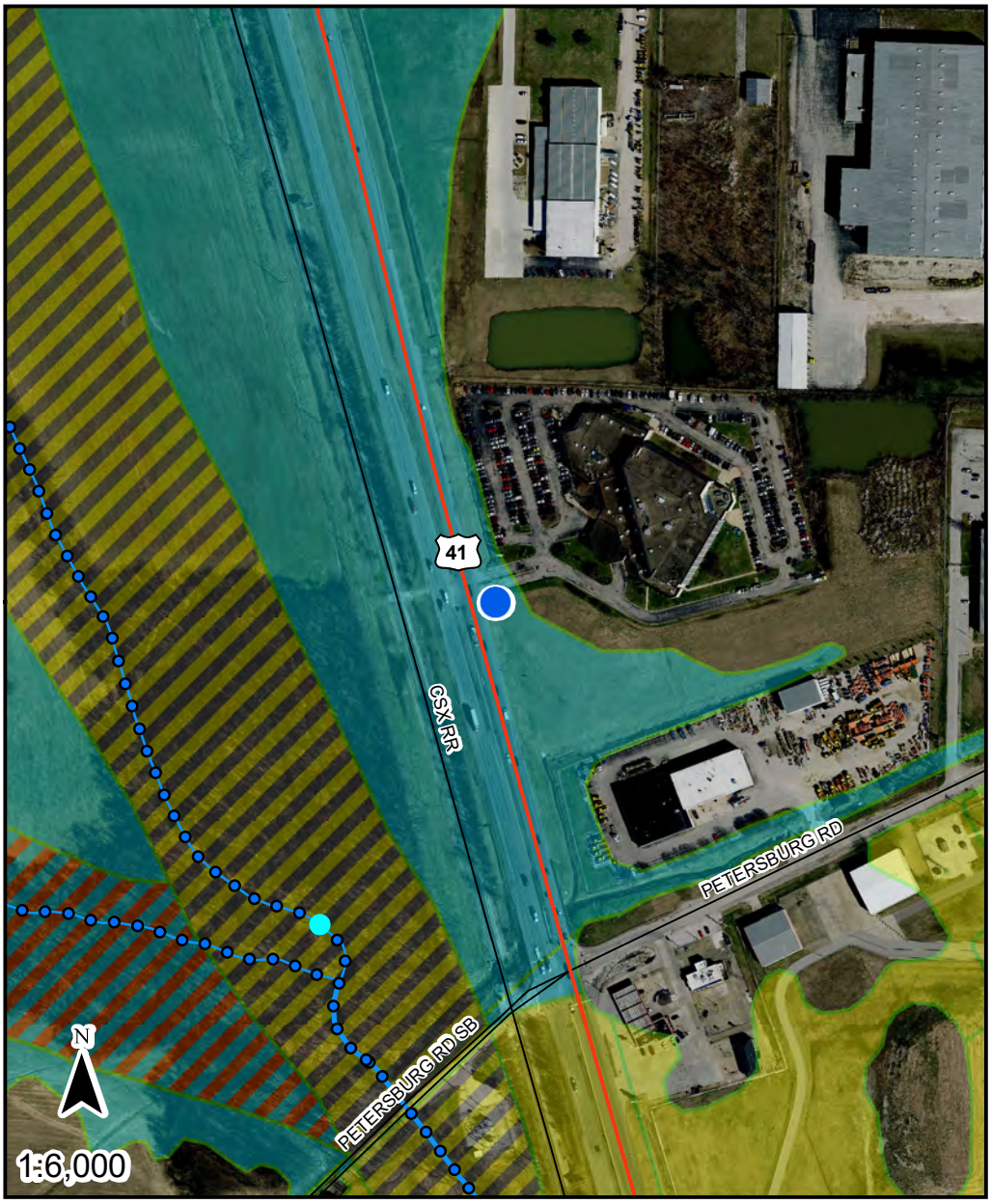
USGS HUC 14 WATERSHEDS

Designed By:	Job Number:
N / A	11586
Drawn By:	Date:
MJS	10-03-2022
Filename:	
HUC14.mxd	

DNR Indiana Department of Natural Resources

Floodplain Analysis & Regulatory Assessment (FARA)



Point of Interest

Base Flood Elevation Point

Flood Elevation Points

STUDIED STREAM

Rivers and Streams at least 1 square mile

Drainage Area (sq. miles)

1 - 10

10 - 100

FEMA Zone AE Floodway; FEMA Administrative Floodway

DNR Detailed Floodway

FEMA Zone AE

DNR Detailed Fringe

Point of Interest Coordinates (WGS84)

Long: **-87.5417708199**

Lat: **38.0430658364**

The information provided below is based on the point of interest shown in the map above.

County: **Vanderburgh**

Stream Name: **Little Pigeon Creek**

Approximate Ground Elevation: **379.3 feet (NAVD88)**

Base Flood Elevation: **380.5 feet (NAVD88)**

Drainage Area: **Not available**

Best Available Flood Hazard Zone: **FEMA Zone AE**

National Flood Hazard Zone: **FEMA Zone AE**

Is a Flood Control Act permit from the DNR needed for this location? **See following pages**

Is a local floodplain permit needed for this location? **yes-**

Floodplain Administrator: **David Ballew, Building Commissioner**

Community Jurisdiction: **Vanderburgh County Unincorporated Areas, County proper**

Phone: **(812) 436-7872**

Email: **dballew@evansville.in.gov**

US Army Corps of Engineers District: **Louisville**

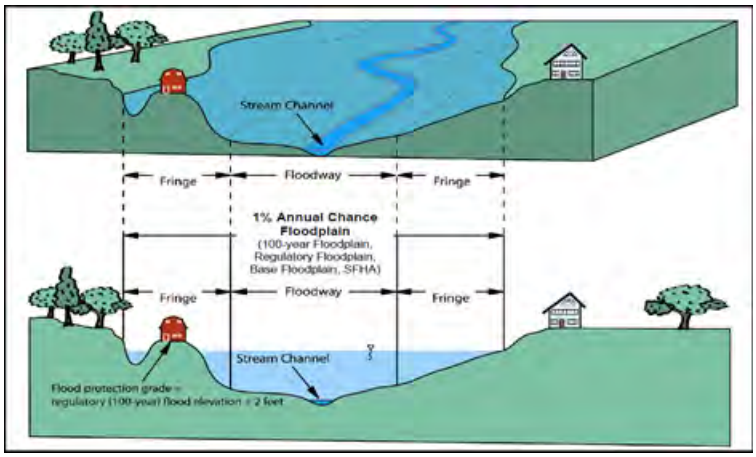
Date Generated: 9/22/2022

About the Floodplain Analysis and Regulatory Assessment (FARA):

All streams have a floodplain, whether mapped or not. This FARA, and the information provided herein, is designed for sites along streams with a mapped floodplain that delineates the floodway portion of the floodplain; see the image below for a visual guide to the floodplain, floodway, and flood fringe. The information in this document was determined using an automated mapping tool. The DNR has high confidence in the tool, but there are scenarios where the floodplain information provided requires additional review from the DNR.

All streams in DNR jurisdiction (streams that have a drainage area one square mile or greater) are shown by a blue line on the map on page 1. However, a floodplain/floodway may or may not be mapped for every stream. In any of the following scenarios, or if you have more detailed floodplain information, use the link at the bottom of this page to request a staff review of the site. Please note that staff review may take several weeks to complete.

Scenarios that require additional DNR review:
•The base flood elevation on page 1 is not available
•The tool selects the nearest flood elevation point for a stream outside the floodplain associated with the point of interest
•There is not a delineated floodway for the stream nearest your point of interest
•The point of interest is along a stream without a mapped floodplain
•The point of interest is in a mapped floodplain of another stream, but the stream nearest the point of interest does not have a mapped floodplain with a floodway of its own



If DNR review is required, do not use this FARA for your site's determination.
If you have questions about DNR permitting requirements, you can contact DNR, Division of Water toll-free at 1-877-928-3755 and select option 1 to speak to a Technical Services staff member. You can also write to the division at water_inquiry@dnr.IN.gov or use the Indiana Waterways Inquiry Request tool at waterways.IN.gov to submit a permitting determination request to both DNR and the Indiana Department of Environmental Management at once.

We recommend keeping a copy of this FARA for your records as the DNR will not have a copy on file.

LINK:

https://survey123.arcgis.com/share/3293526dfdca453e95c19b08fb7bdcfb?FIELD:LAT1=38.0430658364&FIELD:LON1=-87.5417708199&FIELD:DNR_PERMIT=See%20following&FIELD:STREAM=LITTLE%20PIGEON%20CREEK&FIELD:INIT_DATE=09/22/2022&FIELD:BFE=380.5

If the link above does not work, send a copy of this FARA to infipinquiry@dnr.IN.gov and describe the reason you are requesting a staff review. Include your name and contact information so that staff can follow-up with you.

The loss of lives and property caused by floods and the damage resulting from floods is a matter of deep concern to Indiana affecting the life, health, and convenience of the people and the protection of property. The Indiana Floodplain Information Portal is designed to show flood risk associated with Indiana waterbodies and provide information specifically for local and state floodplain permitting. The information provided is based on the regulatory floodplain limits; floods exceeding the regulatory floodplain can and do occur. If you are seeking information regarding lake or dam permitting, see the corresponding section below, under the permitting information section.

Floodplain Information:

All streams have a floodplain, whether mapped or not. This FARA, and the information provided herein, is designed for sites along streams with a mapped floodplain. See page 2 for scenarios where this FARA should not be used and additional review from the DNR may be required.

The Best Available Floodplain Layer (BAFL) is the mapping developed by the DNR that provides the best flood risk information currently available. This information should be used for construction, planning, and flood risk assessment. The BAFL incorporates the National Flood Hazard Layer (NFHL) from FEMA's Flood Insurance Rate Maps (FIRMs) for AE zones. The layer has completed modeling and more detailed studies using more recent LiDAR data for areas designated as A zone on the FIRM or areas that were not identified on the FIRM. BAFL mapping exists for over 80% of streams in Indiana. BAFL mapping should not be used for insurance rating purposes or for mandatory flood insurance purchase requirements related to the National Flood Insurance Program. See the Flood Insurance Information section on the following pages for information on flood insurance requirements. Common flood hazard zones are described below; to find the flood hazard zones associated with your point of interest, see the legend on page 1.

- Floodway (FEMA Zone AE Floodway, DNR Detailed, DNR Approximate): The floodway includes the stream channel and the overbank area necessary to carry the 1% annual chance flood, also known as the base flood, which has a 1% chance of being equaled or exceeded in any given year. The water surface at this level is referred to as the Base Flood Elevation (BFE). Land in this area is considered to have a high flood risk. Construction in the floodway area requires a permit from the DNR, Division of Water. Local floodplain ordinances require local construction permits. Flood insurance is strongly recommended and may be required by FEMA. See the Permitting Information and Flood Insurance Information sections of this document for more information.

- Special Flood Hazard Area (FEMA Zone A, FEMA Zone AE without floodway, DNR Approximate without floodway): Any natural ground levels that have an elevation lower than the Base Flood Elevation are considered floodway area. The floodway includes the stream channel and the overbank area necessary to carry the 1% annual chance flood, also known as the base flood, which has a 1% chance of being equaled or exceeded in any given year. The water surface at this level is referred to as the Base Flood Elevation (BFE). Land in this area is considered to have a high flood risk. Construction in the floodway area requires a permit from the DNR, Division of Water. Local floodplain ordinances require local construction permits. Flood insurance is strongly recommended and may be required by FEMA. See the Permitting Information and Flood Insurance Information sections of this document for more information.

- Special Flood Hazard Area (FEMA Zone AH – Ponding, FEMA Zone AO – Sheet Flow): Land in this area is considered to have a high flood risk. These areas are subject to the 1% annual chance flood with average

depths of 1 to 3 feet. A Construction in the Floodway permit is not required from the DNR, Division of Water. Local floodplain ordinances require local construction permits. Do not use the BFE generated by this tool for zones AH and AO; please refer to the FEMA Flood Insurance Study or FIRM for the depth or flood elevation. Flood insurance is strongly recommended and may be required by FEMA. See the Permitting Information and Flood Insurance Information sections of this document for more information.

- Fringe (DNR Detailed, DNR Approximate, FEMA Zone AE): Area outside the floodway but still subject to flooding during the 1% annual chance flood. The 1% annual chance flood, also known as the base flood, has a 1% chance of being equaled or exceeded in any given year. Land in this area is considered to have a high flood risk. A Construction in the Floodway permit is not required from the DNR, Division of Water. Local floodplain ordinances require local construction permits. Flood insurance is strongly recommended and may be required by FEMA. See the Permitting Information and Flood Insurance Information sections of this document for more information.

- Additional Floodplain Area (0.2% Annual Chance Flood): Land in this area is considered to have a moderate risk of flooding. These areas are subject to the 0.2% annual chance (500-year) flood. A Construction in the Floodway permit is not required from the DNR, Division of Water. Local floodplain ordinances may require local construction permits; contact the local Floodplain Administrator for more information. Flood insurance is strongly recommended.

- Additional Floodplain Area (Zone X – Protected by Levee): This zone includes areas protected from the 1% annual chance flood by levee, dike, or other structure subject to failure during larger floods. A Construction in the Floodway permit is not required from the DNR, Division of Water. Local floodplain ordinances may require local construction permits; contact the local Floodplain Administrator for more information. Flood insurance is strongly recommended.

Permitting Information:

Flood Control Act (Construction in the Floodway):

- The Flood Control Act (IC 14-28-1) requires the prior approval of the DNR, Division of Water for any construction in the floodway area including an obstruction, fill, excavation, or the construction of a building.

  A permit application form and permit application assistance manual can be obtained from our website at: https://www.in.gov/dnr/water/regulatory-permit-programs/. You may choose to file an electronic application through our website at: https://www.in.gov/dnr/water/regulatory-permit-programs/file-a-permit-application-online/. Please be aware that in addition to the application fee, there is a $15.00 Enhanced Access Fee to submit an electronic application.

- Local Ordinances / Permitting: For proposed construction at the point of interest marked on the map, you may also be required to obtain permits from or coordinate with the local floodplain administrator, plan commission, zoning office, and county drainage board.

  Construction permitting by local government entities is independent of the State's permitting authority. Local floodplain ordinances require that the lowest floor of a new building or an addition to

an existing building proposed in the Special Flood Hazard Area (SFHA) be elevated at least 2 feet above the Base Flood Elevation (BFE). Some communities in the state regulate to the additional floodplain area also known as the 0.2% chance flood. If a basement is included, the basement floor shall be considered the lowest floor. Special Flood Hazard Area (SFHA) means the land in the floodplain within a community subject to a 1% or greater chance of flooding in any given year. The area may be designated as Zone A, AE, AH, AO, AR, A99 or VE on the Flood Insurance Rate Map (FIRM). The area may also be designated on the DNR best available floodplain layer or designated by the community as a flood prone area.

- Indiana Department of Environmental Management: You may also be required to obtain a construction stormwater general permit from the Indiana Department of Environmental Management (IDEM) if the proposed project will disturb one acre or more. Inquiries may be sent to Stormwat@idem.IN.gov. IDEM permits may also be required for impacts to wetlands and streams especially if any work is proposed below the ordinary high-water mark of a waterbody. Go to waterways.IN.gov to submit a permitting determination request, call (317) 233-8488 or (800) 451-6027, or visit the IDEM webpage at https://www.in.gov/idem/cleanwater/ for more information.

- Indiana Department of Health: The state rules which address on-site sewage systems in a floodplain are IDOH Rule 410 IAC 6-8.3-63(e), 70(c)(2), and 72(c)(2) for residential systems and 410 IAC 6-10.1-71(e), 77(c)(2), and 80(c)(2) for commercial systems. The Indiana Department of Health (IDOH) is responsible for administering 410 IAC 6-10.1 and County Health Departments are responsible for administering 410 IAC 6-8.3. The Department of Natural Resources requires that all septic systems in a floodway meet IDOH requirements. Both subsurface trench systems and mound systems are prohibited in all areas below the BFE; it is highly likely that either a connection to a public sewer system or an off-site cluster system will be required. It is recommended that you contact IDOH for compliance with commercial system requirements and your County Health department for compliance with residential system requirements. If you have questions regarding the state rules, you may wish to contact:

  Alice Quinn, Senior Environmental Manager
  Environmental Public Health Division
  Indiana Department of Health
  100 N. Senate Ave., N855
  Indianapolis, IN 46204
  Telephone: (317) 518-4388
  Email: alquinn@isdh.in.gov

- Indiana State Chemist: You may also be required to obtain permits from the Indiana State Chemist, especially if any work is proposed involving pesticide or fertilizer applications. To contact the Office of Indiana State Chemist call (765) 494-1492; or visit their webpage at https://www.oisc.purdue.edu/index.html for more information.

Lake Preservation Act:

- The Lake Preservation Act (IC 14-26-2) requires the approval of the DNR, Division of Water for any construction or project that is proposed below the legal or normal water level, and located over, along, or lakeward of the shoreline of a public freshwater lake, or within 10 feet landward of the shoreline for construction of a wall whose lowest point is below the legal lake level. A list of public freshwater lakes can be found in the "Public Freshwater Lake List" document at https://www.in.gov/nrc/nonrule-policy-documents-npd/. Contact the DNR, Division of Water for more information on permitting requirements if working near a public freshwater lake or near or on a lake not on the Public Freshwater Lake list.

Regulation of Dams:

- A permit under the Flood Control Act (IC 14-28-1) and Regulation of Dams (IC 14-27-7.5) is required for a proposed dam, or work to an existing dam, if any one of the following criteria is met:
    - the drainage area above the dam is greater than one square mile, or;
    - the height of the dam is more than 20 feet as measured from the lowest point in the natural streambed under the centerline of the dam to the crest of the dam, or;
    - the maximum volume of water impounded by the dam to the crest (high pool level during the design storm event) is more than 100 acre-feet, or;
    - upon receiving a petition from a downstream property owner or resident, the DNR, Division of Water deems the dam a high hazard dam

  If a permit is required for a proposed dam, or work to an existing dam, it will be necessary for you to obtain the services of a registered professional engineer experienced in dam design and construction to make a complete geotechnical and hydrologic/hydraulic engineering evaluation of the project, develop plans and specifications, and submit the technical documentation to the DNR, Division of Water with an application for review. Your engineer will need to work with other technical professionals (i.e. geotechnical, engineering geologists, structural engineers, etc.) to develop safe, adequate plans and specifications.

  In order to expedite the permitting process, the Project Engineer should meet with the DNR, Division of Water staff to discuss details of the project before work commences on the plans, specifications, and engineering report. It is important that all survey, hydrology/hydraulic, geotechnical, structural, and mechanical engineering evaluations are complete and accurate prior to submitting the application for a permit.

  If a dam does not require a permit, we would suggest the following action:
    - consult with a professional engineer experienced in dams design, maintenance, and repair to develop a design that will minimize the risk to the downstream properties; the DNR, Division of Water does not offer design services.
    - upon completion of the project, obtain a set of as-built plans signed and stamped by a Professional Engineer certifying that the dam was constructed in accordance with acceptable engineering standards.

  For information on erosion control, proper maintenance, regulation, etc., the applicant is encouraged to follow the Indiana Dam Safety Inspection Manual and General Guidelines for New Dams and Improvements to Existing Dams in Indiana found on the DNR, Division of Water Web page at https://www.in.gov/dnr/water/dams-and-levees/.

Residential Construction in a Floodway:

- New residential construction in the floodway area is prohibited under the Flood Control Act, except in the floodway of the Ohio River. New non-residential buildings proposed in the floodway area will be required to be constructed at least 2 feet above the Base Flood Elevation (BFE). If a basement is included, the basement floor shall be considered the lowest floor. New building construction, including residential and non-residential, proposed in the floodway area of the Ohio River will be required to have the lowest floor constructed at least 2 feet above the Base Flood Elevation (BFE). If a basement is included, the basement floor shall be considered the lowest floor.

- An addition to an existing lawful residence that's located in the floodway does not require a permit from the DNR, Division of Water if the structure was constructed prior to January 1, 1973, and the cost of the addition, in combination with all other additions to the residence since the residence was originally built, does not equal or exceed 50% of the market value of the original, pre-altered residence. The cost of repair should be based on a cost of material that is equal to average retail value and labor that is based on average contractor's fees. The market value of a residence does not include the value of the land on which the residence is built.

  If fill is proposed in the floodway to elevate an addition that meets the above criteria, prior approval from the DNR, Division of Water is required for the fill.

- The reconstruction of a residence in the floodway area is authorized by a general license if specific criteria of the Flood Control Act, IC 14-28-1-24(B)(2), is met. To ensure that the proposed reconstruction project fulfills these requirements, please contact the DNR, Division of Water for more details.

Flood Insurance Information:

- Under the federal regulations of FEMA, the National Flood Insurance Program (NFIP) requires the purchase of flood insurance on buildings in the FEMA mapped Special Flood Hazard Area (Zones A, AE, AH, AO, AR, A99, or VE) that have a federally backed mortgage. DNR-developed Best Available Floodplain Layer mapping should not be used for insurance rating purposes or for mandatory flood insurance purchase requirements related to the NFIP. The National Flood Hazard Zone associated with your point of interest is listed on page 1. Flooding is the most frequent and costly disaster in Indiana. The risk for flooding changes over time due to erosion, land use, weather events, and other factors. Flooding occurs not only in the high-risk Special Flood Hazard Areas, but also in low to moderate-risk areas. About 42% of flood insurance claims nationwide come from areas designated as having a low or moderate flood risk. Therefore, it is strongly recommended to obtain a flood insurance policy even if it is not federally required on your property.

- If the property owner wishes to have the federal requirement to purchase flood insurance waived, they must prove that 1) the structure or property is on natural ground levels with an elevation higher than the Base Flood Elevation (BFE); or that 2) the structure or property is located outside of a Special Flood Hazard Area (SFHA). If one of those conditions exists, the property owner can apply for a Letter of Map Amendment (LOMA) from the Federal Emergency Management Agency (FEMA). A LOMA is a letter which allows a mortgage lender to waive federal flood insurance requirements by stating that an existing structure, property, or portion of a property that has not been elevated by fill is not located in the SFHA. The final decision regarding flood insurance is left to the mortgage lending institution.

  If the structure or property is located inside of the SFHA, the property owner may apply for a LOMA if it can be demonstrated that it is located on natural ground levels with an elevation higher than the Base Flood Elevation (BFE). Specific elevation information must be submitted with the LOMA application, typically documented by a licensed surveyor or engineer.

  If the structure or property is located outside of the Special Flood Hazard Area (SFHA), the property owner may apply for a Letter of Map Amendment Out-As-Shown (LOMA-OAS). Elevation information is not required in this review process. If requesting a LOMA-OAS, please write "Out-As-Shown" at the top of the application form.

Visit https://www.fema.gov/flood-maps/change-your-flood-zone/paper-application-forms to submit a LOMA application online or to obtain the LOMA application forms and instructions. These can also be obtained by contacting FEMA toll-free at 1-877-336-2627. There is no fee for a LOMA application, although fees may be associated with hiring a surveyor to obtain the elevation information for the Elevation Certificate or LOMA application form.

If the LOMA is issued by FEMA and the mortgage lender accepts the LOMA determination, the property owner may be reimbursed up to one year of flood insurance payments. Be aware that regardless of if FEMA issues a LOMA, the mortgage lender has the final decision regarding flood insurance requirements. Finally, note that if a LOMA is issued by FEMA, flood insurance may still be purchased and is encouraged. The policy may have a lower premium and can provide coverage for events larger than the 1% annual chance flood.

Disclaimer:

This Floodplain Analysis and Regulatory Assessment (FARA) should not be construed as a local building permit, nor is it a waiver of the provisions of any local building or zoning ordinances. Additionally, this FARA does not relieve the permittee of the responsibility of obtaining permits, approvals, easements, etc. under other regulatory programs administered by, but not limited to, the U.S. Army Corps of Engineers, County Drainage Board, Indiana Department of Environmental Management, Indiana Department of Health, and local, city, or county floodplain management, planning or zoning commissions.

When using this FARA for a determination of permitting requirements, the user shall maintain a copy of the FARA for documentation purposes. The DNR, Division of Water will not have a record of this FARA.

The approximate ground elevation shown on page 1 of this FARA is based on the latest available ground elevations available to the state. This elevation is provided for your information but may not be detailed or accurate enough to be used for purposes of applying for a Letter of Map Amendment.

APPENDIX ‘B’
Final Drainage Plan

Drainage Narrative B.01
Pre-Developed Drainage Information B.02
Developed Drainage Information B.03
Drainage Calculations B.04
Detention Calculations B.05
Form 800 B.06
Emergency Overflow Information B.07

Introduction

The project is a proposed storage unit development of fully enclosed units. The site is located at 7007, 7027, and 7037 US 41 N, Evansville, IN 47725. The site part of the Northwest Quarter and part of the Southwest Quarter of Section Thirty-three (33), Township Five (5) South, Range Ten (10) West all in Vanderburgh County. Please refer to the location map provided within this report for further details.

Existing Conditions

Site Conditions

The approximate 7.67-acre tract was previously an undeveloped lot. Currently, the site is made up of lawn areas, fill areas of various materials, an existing pond in the northeast corner of the site, and an existing drainage swale along the south property line. The aerial photo enclosed shows the existing conditions of the site.

The existing site has two (2) predominant watersheds of surface drainage. The southern portion of the site currently sheet flows to the south to an existing ditch running along the south property line, and the northern portion of the site sheet flows to the north to an existing pond for which little information is known and no outlet pipe was found. Both watersheds ultimately discharge to an existing roadside ditch along US 41 to the west.

Soils Information

The Soil Survey of Vanderburgh County indicates the soils to be Birds silt loam (Bd) with 0 to 2 percent slopes, McGary silt loam (Mr) with 0 to 2 percent slopes, and Zipp silty clay (Zp) with 0 to 2 percent slopes. Please refer to the attached soils map.

Floodplain Information

The property lies within two flood zones: Zone X in the northern and eastern portions of the site, and Zone AE in the southern and western portions of the site. The site was scaled on the Flood Insurance Rate Map (FIRM) for Vanderburgh County, Indiana, Community Panel Number 18163C0116D, dated March 17, 2011. The FEMA FIRMette panel is included in this report. Additionally, a floodplain analysis and regulatory assessment (eFARA) was requested from DNR and has been included in this report.

Proposed Development

The proposed development includes eleven (11) proposed storage unit buildings. All storage units will be enclosed. All drive aisles will be paved in accordance with the local ordinance and a storm sewer system will be installed to convey and store site runoff. The expected total impervious surface included within the development is approximately 189,485 SF.

Site Drainage Constraints

Multiple factors unique to the project site had an effect on the approach to site drainage and retention considerations.

The first major factor effecting the drainage approach for the site was existing grade on site and its relation to the existing floodplain. All proposed buildings have been proposed with a finish floor elevation above the respective flood protection grade, and these buildings lie above existing grade to varying degrees. In order to maximize the usable area of the site, buildings have been proposed as close as possible to property lines so as to maintain acceptable slopes and grading patterns. Due to this approach, runoff between the proposed buildings and property lines will largely leave the site undetained in the proposed condition.

Another factor effecting the drainage and retention for the site was the existing basin in the northern portion of the site. Evidence suggests that the basin was not installed to provide detention for the project site or any of the adjoining properties, but instead was used as a borrow pit. The basin discharges to the north into an existing swale north of the existing hotel property. The basin has a substantial footprint within the project property. Due to these constraints and in order to minimize impacts on the existing drainage patterns in the northern portion of the site where the basin occupies, this basin was not utilized for retention for the proposed site and will be minimally altered to accommodate the proposed buildings.

The proposed design of the drainage control system

The storm system is designed to capture a large portion of the runoff created from the site and discharge only a minimal amount of runoff undetained. Due to site and elevation constraints previously mentioned, the use of a dry retention basin along with underground retention was found to be the most feasible option to detain storm water runoff. Only portions of the site along property lines are expected to leave the site undetained.

The storm system is comprised of inlets and storm sewer that work together to direct runoff to the proposed dry retention basin. In general, runoff will enter the storm sewer through area drains and discharge into the proposed dry retention basin or will sheet flow directly into the proposed dry retention basin. Proposed storm sewer pipes have been oversized as needed to contribute additional storage volume to compliment the proposed dry retention basin volume. The basin will function along with the underground retention pipe system to collectively reduce the amount of post-developed runoff leaving the site to the allowable release rate, as determined by the associated pre-developed subbasins.

Analysis of runoff conditions from a 10-year pre-developed and 25-year post-developed storm event were analyzed using the Rational Method. The Rational Method is appropriate for estimating peak discharges for small drainage areas of up to 50 acres. Where applicable, guidance for all calculations comes from the Indiana LTAP Stormwater Drainage Manual, previously known as the HERPIC manual. Additionally, all calculations were prepared in accordance with the Vanderburgh County Drainage Ordinance.

The 10-year pre-developed runoff rate (Q_{10}) was determined utilizing USDA NRCS TR-55 methodology for urban hydrology for small watersheds (less than 50 acres).

Determination of specific rainfall intensities for each developed subbasin were calculated using the IDF equation 2.2.13 from LTAP, where the recurrence interval is equal to the design storm. The regional coefficients for Evansville, Indiana were used for storm durations less than 1 hour.

For the developed site, times of concentration were calculated using the Federal Aviation Administration method for overland flow. This method originates from airfield drainage design by the Corps of Engineers but has been used for overland flow in urban areas. The FAA method for overland flow time of concentration is generally a more conservative estimate as compared to Kerby or TR-55 methods for developed conditions. The FAA method is an allowed method by Indiana LTAP.

Overland flow is typically limited to a maximum of 100 feet, after which the flow is considered shallow concentrated flow. Typical areas where shallow flow occurs are in swales between houses and the gutter section of a roadway. USDA NRCS 630.1502 is the guiding source for determining shallow concentrated flow.

Runoff coefficients used were those found in Table 13.04.205-A and Table 13.04.205-B of the Vanderburgh County Drainage Ordinance. These show on the subbasin drainage calculations in the appendix.

The storm pipe network is sized to the 25-year storm using the Rational Method using a Manning's Roughness, n, equal to 0.012 for HDPE pipe.

Results of the Analysis

Analysis of the pre-developed site delineated 2 subbasins, as shown on the pre-developed subbasin exhibit. The Time of Concentration calculations and Q_{10} values are shown for each of the pre-developed subbasins. Detailed calculations are included as an attachment.

Pre-Developed Subbasin 1:

- Area = 4.401 acres
- C = 0.25
- T_c = 16.10 mins
- Q_{10} = 4.75 CFS

Pre-Developed Subbasin 2:

- Area = 1.327 acres
- C = 0.31
- T_c = 7.98 mins
- Q_{10} = 2.45 CFS

Once the project is fully developed, twenty-four (24) new sub-basins will be created resulting in a total drainage area of approximately 5.73 acres. 5.17 acres will be captured and detained, and 0.56 acres will leave the site undetained. The weighted runoff coefficient, C, for the detained and undetained portions of the site is 0.88 and 0.40, respectively.

Developed Sub-basin Summary:

- Sub-basins 1-22 will be collected and retained in the proposed dry retention basin.
- Sub-basin 23 and 24 will sheet flow undetained off-site.

The following analysis is provided using the Technical Memorandum for undetained drainage areas:

Developed Subbasin 23

- Area = 0.302 acres
- C = 0.41

Developed Subbasin 24

- Area = 0.264 acres
- C = 0.40

Criteria #1

- 0.302 acres + 0.264 acres = 0.566 acres
  5.73 Ac. * 0.1 = 0.573 Ac.
  0.566 Ac. < 0.573 Ac.

Criteria # 2

- Pre-Developed Subbasin 23
  - Existing Undetained Area = 4.401 acres
  - Proposed Undetained Area = 0.302 acres
  - 0.302 Ac. < 4.401 Ac.
- Pre-Developed Subbasin 24
  - Existing Undetained Area = 1.327 acres
  - Proposed Undetained Area = 0.264 acres
  - 0.264 Ac. < 1.327 Ac.

Criteria #3

- Pre-Developed Subbasin 1
  - $A * c_u = (4.401 * 0.25) = 1.100$
  - $A * c_d = (0.302 * 0.41) = 0.124$
  - Therefore, $A * c_d < A * c_u$
- Pre-Developed Subbasin 2
  - $A * c_u = (1.327 * 0.31) = 0.411$
  - $A * c_d = (0.264 * 0.40) = 0.106$
  - Therefore, $A * c_d < A * c_u$

The Form 800 included shows the required retention volume, after considering the developed watershed which leaves undetained. The undetained watershed matches the existing natural drainage course of this previously developed area. It was not feasible in the design to capture and storage this portion. The undetained 25-yr runoff was deducted from the allowable runoff.

All pipes were sized using the Rational Method and do not exceed 90% capacity.

The available volume resulting from the proposed dry retention basin and the proposed storm pipes serving as underground retention exceeds the required retention volume (see calculation provided).

Details for the proposed dry retention basin are provided below. The proposed dry retention basin was designed, along with storm sewer pipes serving as underground retention as previously mentioned, to detain and release the runoff from Developed Subbasins 1-22. The collective release rate of the proposed dry retention basin from the 25-year storm will not exceed the 10-year storm runoff rate from Pre-developed Subbasins 1 and 2.

Dry Retention Basin Details:

- Outlet Elevation = 374.10
- 25-Yr Storage Elevation = 376.75
- Emergency Overflow = 377.27
    - Depth of Flow through spillway = 4”
- 12” Discharge
- Q_{25} Release = 5.29 CFS

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

All calculations, logs, exhibits, and modeling are enclosed within this report.

Maps showing individual drainage areas within the project subdivided for use in the analysis thereof

All calculations, logs, exhibits, and modeling are enclosed within this report.

Post Construction Water Quality

Post construction water quality will be addressed by the use of vegetated filter strips and the onsite dry retention basin.

Storm Sewer and Retention Basin Maintenance

All proposed storm sewer structures, pipes, and apparatuses are to be maintained by the landowner. Area drains are located throughout the project site and are intended to capture storm water runoff. The storm water runoff captured by the area drains will then be conveyed to the dry retention basin. All area drains and storm pipes shall be kept clean of debris and obstructions that would prevent the capture and routing of storm water runoff from the site.

This brief report will highlight the dry retention basin design and maintenance in accordance with the latest Vanderburgh County Drainage Ordinance Section 13.04.440, Technical Memorandums and supplements. The proposed dry retention basin will have a maintenance path, slopes leading to the water's edge, an emergency overflow weir, and an outlet pipe. Per the approved drainage plan, the outlet pipe will serve to discharge excess stormwater stored at a controlled rate. The emergency overflow weir will act as an automatic spillway should the outlet pipe be obstructed or capacity exceeded.

Maintenance of the proposed dry retention basin shall include but is not limited to: mowing, removing debris and obstructions, removal of overgrown vegetation, mitigating erosion, and any other requirements set forth by the Vanderburgh County Drainage Board. Over time, the retention basins' bottom will fill up with sediment. This excess sediment will need to be removed as directed by the latest Vanderburgh County Drainage Ordinance or as needed.

No restrictions are present for this property, however, a copy of this report has been provided to the property owner.

Permanent Vegetative Stabilization

- Seeding from November 15 to February 29:
  - Seed mixture will be applied at a rate of 3 to 4 pounds of Bluegrass and 1 pound of Tall Fescue per 1000 square feet.
  - Mulch will be placed at a rate of 100 pounds per 1000 square feet and crimped into place.
  - Fertilizer having a composition of 12-12-12 will not be applied until the following March. Fertilizer will be applied at a rate of 19 pounds per 1000 square feet.
- Seeding from March 1 to November 14:
  - Seed mixture will be applied at a rate of 6 1/2 pounds of Kentucky 31 Fescue and 1 1/2 pounds of Perennial Rye per 1000 square feet.
  - Fertilizer having a composition of 12-12-12 will be applied at a rate of 19 pounds per 1000 square feet.
  - Mulch will be placed at a rate of 100 pounds per 1000 square feet and crimped into place. Schedule when each disturbed area will be stabilized.

Summary

This report has provided analysis and proposed conditions which ultimately lessen the overall drainage impact of the project site and its downstream adjoiners.

Total Pre-Developed Release Q_{10} = 7.20 CFS

Onsite Basin Developed Release Q_{25} = 5.29 CFS

Undetained Sub-Basins 23 and 24 Developed Release Q_{25} = 1.79 CFS

Total Developed Release Q_{25} = 7.08 CFS

Overall, the developed project will release less stormwater runoff during the 25-year storm than its pre-developed area during the 10-year storm.

SCALE 1" = 150'

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Pre-Developed Subbasins

Store-N-Lock
7007,7027,7037 US 41 N.

Designed By: JEM	Job Number: 11586.4.001-B
Drawn By: KJL	Date: 11-29-2022
Filename: 11586 - Civil Base	

Peak Runoff Calculation

Pre-Developed Subbasin 1

11586 - Store-N-Lock

Area (Ac) = **4.40** **Area (Sf) =** **191,725**

Weighted Runoff Coefficient

Surface	Area					c	A*c
Structures & Pavement (<2%)		S.F.	=	0.00	AC.	0.92	0.00
Structures & Pavement (2-5%)		S.F.	=	0.00	AC.	0.94	0.00
Structures & Pavement (5-10%)		S.F.	=	0.00	AC.	0.96	0.00
Structures & Pavement (>10%)		S.F.	=	0.00	AC.	0.98	0.00
Gravel (10 yr Storm)		S.F.	=	0.00	AC.	0.50	0.00
Gravel (25 yr Storm)		S.F.	=	0.00	AC.	0.60	0.00
Gravel (50-100 yr Storm)		S.F.	=	0.00	AC.	0.65	0.00
Lawn (<2%)	118,856	S.F.	=	2.73	AC.	0.15	0.41
Lawn (2-5%)	25,806	S.F.	=	0.59	AC.	0.25	0.15
Lawn (5-10%)	13,769	S.F.	=	0.32	AC.	0.40	0.13
Lawn (>10%)	30,585	S.F.	=	0.70	AC.	0.55	0.39
Woodland Flat (<2%)		S.F.	=	0.00	AC.	0.12	0.00
Woodland Flat (2-5%)		S.F.	=	0.00	AC.	0.24	0.00
Woodland Rolling (5-10%)	2,709	S.F.	=	0.06	AC.	0.36	0.02
Woodland Hilly (10-30%)		S.F.	=	0.00	AC.	0.48	0.00
Pasture Flat (<2%)		S.F.	=	0.00	AC.	0.12	0.00
Pasture Flat (2-5%)		S.F.	=	0.00	AC.	0.24	0.00
Pasture Rolling (5-10%)		S.F.	=	0.00	AC.	0.36	0.00
Pasture Hilly (>10%)		S.F.	=	0.00	AC.	0.48	0.00
Cultivated (<2%)		S.F.	=	0.00	AC.	0.20	0.00
Cultivated (2-5%)		S.F.	=	0.00	AC.	0.35	0.00
Cultivated (5-10%)		S.F.	=	0.00	AC.	0.50	0.00
Cultivated (>10%)		S.F.	=	0.00	AC.	0.65	0.00
Bare Soil		S.F.	=	0.00	AC.	0.72	0.00
Water		S.F.	=	0.00	AC.	1.00	0.00
	191,725			4.40			1.09

Wc = **0.25**

Time of Concentration

Overland Flow

Length, L (max 100ft)		=	100	feet	t_o	=	Overland Flow Tc
Slope, S		=	3.37%		t_o	=	$[0.42*(L^{0.8})*(n^{0.8})]/[P^{0.5})*(S^{0.4})]$
Manning Coefficient, n	Lawn	=	0.240		t_o	=	11.41 min
$P_{2/24}$		=	3.3				

Shallow Flow

Length, L (Paved or Unpaved)	Unpaved	=	200	feet	V	=	16.1345*(S0.5)
Slope, S		=	1.00%			=	1.613 ft/s = 96.81 ft/min
Velocity, V		=	1.61	ft/sec	t_s	=	Shallow Flow Tc
					t_s	=	(L/V) = 2.07 min

Channel Flow

Length, L		=	612	feet	V	=	$(1.49/n)*R^{0.67}*S^{0.5}$
Difference in Elevation		=	379.25	to 373		=	3.880 ft/s = 232.78 ft/min
Slope, S		=	1.02%		t_c	=	Channel Flow Tc
Manning Coefficient, n		=	0.240		t_c	=	(L/V) = 2.63 min
Wetted Perimeter, Wp		=	8.24	feet			
Area, A		=	125	sqft			
Hydraulic Radius, R		=	15.17				
Velocity, V		=	3.88	ft/s			

t = Total Time of Concentration

t = Σto + Σts + Σtc

t = 16.10 (Min 5 Minutes)

0.27 Hour

Intensity (Vanderburgh Co.)

I_{10} = 4.35 in/hr

I_{25} 5.10 in/hr

I_{100} = 6.50 in/hr

Peak Runoff Rate

Q_{yr} = CiA

Q_{10} = 4.75 cfs

Q_{25} = 5.57 cfs

Q_{100} = 7.10 cfs

Peak Runoff Calculation

Pre-Developed Subbasin 2 — 11586 - Store-N-Lock

Area (Ac) = **1.33** **Area (Sf) =** **57,806**

Weighted Runoff Coefficient

Surface	Area					c	A*c
Structures & Pavement (<2%)		S.F.	=	0.00	AC.	0.92	0.00
Structures & Pavement (2-5%)		S.F.	=	0.00	AC.	0.94	0.00
Structures & Pavement (5-10%)		S.F.	=	0.00	AC.	0.96	0.00
Structures & Pavement (>10%)		S.F.	=	0.00	AC.	0.98	0.00
Gravel (10 yr Storm)		S.F.	=	0.00	AC.	0.50	0.00
Gravel (25 yr Storm)		S.F.	=	0.00	AC.	0.60	0.00
Gravel (50-100 yr Storm)		S.F.	=	0.00	AC.	0.65	0.00
Lawn (<2%)	19,898	S.F.	=	0.46	AC.	0.15	0.07
Lawn (2-5%)	3,668	S.F.	=	0.08	AC.	0.25	0.02
Lawn (5-10%)		S.F.	=	0.00	AC.	0.40	0.00
Lawn (>10%)		S.F.	=	0.00	AC.	0.55	0.00
Woodland Flat (<2%)		S.F.	=	0.00	AC.	0.12	0.00
Woodland Flat (2-5%)		S.F.	=	0.00	AC.	0.24	0.00
Woodland Rolling (5-10%)	19,098	S.F.	=	0.44	AC.	0.36	0.16
Woodland Hilly (10-30%)	15,142	S.F.	=	0.35	AC.	0.48	0.17
Pasture Flat (<2%)		S.F.	=	0.00	AC.	0.12	0.00
Pasture Flat (2-5%)		S.F.	=	0.00	AC.	0.24	0.00
Pasture Rolling (5-10%)		S.F.	=	0.00	AC.	0.36	0.00
Pasture Hilly (>10%)		S.F.	=	0.00	AC.	0.48	0.00
Cultivated (<2%)		S.F.	=	0.00	AC.	0.20	0.00
Cultivated (2-5%)		S.F.	=	0.00	AC.	0.35	0.00
Cultivated (5-10%)		S.F.	=	0.00	AC.	0.50	0.00
Cultivated (>10%)		S.F.	=	0.00	AC.	0.65	0.00
Bare Soil		S.F.	=	0.00	AC.	0.72	0.00
Water		S.F.	=	0.00	AC.	1.00	0.00
	57,806			1.33			0.41

Wc = **0.31**

Time of Concentration

Overland Flow

Length, L (max 100ft)		=	100	feet	t_o =	Overland Flow Tc
Slope, S		=	10.00%		t_o =	$[0.42*(L^{0.8})*(n^{0.8})]/[P^{0.5})*(S^{0.4})]$
Manning Coefficient, n	Lawn	=	0.240		t_o =	7.38 min
$P_{2/24}$		=	3.3			

Shallow Flow

Length, L (Paved or Unpaved)	Unpaved	=	130	feet	V =	16.1345*(S0.5)
Slope, S		=	5.00%		=	3.608 ft/s = 216.47 ft/min
Velocity, V		=	3.61	ft/sec	t_s =	Shallow Flow Tc
					t_s =	(L/V) = 0.60 min

t = Total Time of Concentration

t = Σto + Σts + Σtc

t = 7.98 (Min 5 Minutes)

0.13 Hour

Intensity (Vanderburgh Co.)

I_{10} = 5.90 in/hr

I_{25} 6.92 in/hr

I_{100} = 8.82 in/hr

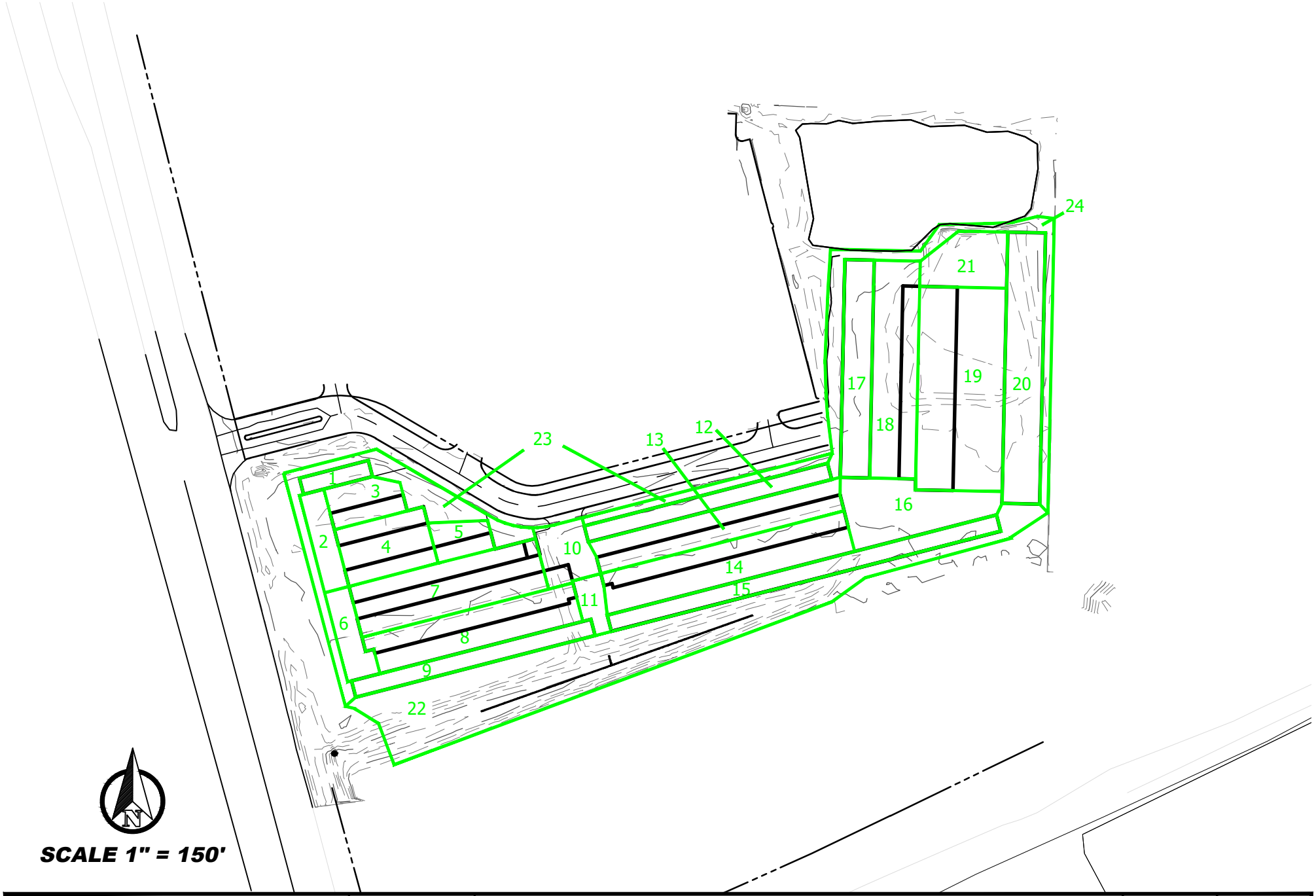
Peak Runoff Rate

$Q_{yr} = CiA$

Q_{10} = 2.45 cfs

Q_{25} = 2.87 cfs

Q_{100} = 3.65 cfs



SCALE 1" = 150'

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Post-Developed Subbasins

Store-N-Lock

7007, 7027, 7037 US 41 N

Designed By: JEM	Job Number: 11586.4.001-B
Drawn By: KJL	Date: 11-29-2022
Filename: 11586 - Civil Base	

POST-DEVELOPED WEIGHTED RUNOFF COEFFICIENTS

Project: **Airport Storage Units**
Project # 11586
Engineer: JEM

County: **Vanderburgh**
Date: **11/29/22**

POST DEVELOPED SUB-BASINS (S.F.)

Surface	C	1	2	3	4	5	6	7	8	9	10
Structures & Pavement (<2%)	0.92		3,600	2,475	3,300	1,575	3,600				3,781
Structures & Pavement (2-5%)	0.94							4,600	6,300		
Structures & Pavement (5-10%)	0.96										
Structures & Pavement (>10%)	0.98	1,700		1,800	4,400	1,400		9,796	5,726	5,900	678
Gravel (10 yr storm)	0.50										
Gravel (25 yr storm)	0.60										
Gravel (50-100 yr storm)	0.65										
Lawn (<2%)	0.15										
Lawn (2-5%)	0.25										
Lawn (5-10%)	0.40										
Lawn (>10%)	0.55										
Woodland Flat (<2%)	0.12										
Woodland Flat (2-5%)	0.24										
Woodland Rolling (5-10%)	0.36										
Woodland Hilly (>10%)	0.48										
Pasture Flat (<2%)	0.12										
Pasture Flat (2-5%)	0.25										
Pasture Rolling (5-10%)	0.36										
Pasture Hilly (>10%)	0.48										
Cultivated Flat (<2%)	0.20										
Cultivated Flat (2-5%)	0.35										
Cultivated Rolling (5-10%)	0.50										
Cultivated Hilly (>10%)	0.65										
Bare Soil	0.72										
Water	1.00										
Total SF		1,700	3,600	4,275	7,700	2,975	3,600	14,396	12,026	5,900	4,459
Total Acres		0.04	0.08	0.10	0.18	0.07	0.08	0.33	0.28	0.14	0.10
Weighted C		0.98	0.92	0.95	0.95	0.95	0.92	0.97	0.96	0.98	0.93

POST-DEVELOPED WEIGHTED RUNOFF COEFFICIENTS

Project: **Airport Storage Units**
Project # 11586
Engineer: JEM

County: **Vanderburgh**
Date: **11/29/22**

POST DEVELOPED SUB-BASINS (S.F.)

Surface	C	11	12	13	14	15	16	17	18	19	20
Structures & Pavement (<2%)	0.92	2,063					10,757		9,700	14,264	
Structures & Pavement (2-5%)	0.94			6,104	9,138						
Structures & Pavement (5-10%)	0.96										
Structures & Pavement (>10%)	0.98		6,000	6,000	5,950	9,600		9,100	4,600	10,935	14,580
Gravel (10 yr storm)	0.50										
Gravel (25 yr storm)	0.60										
Gravel (50-100 yr storm)	0.65										
Lawn (<2%)	0.15										
Lawn (2-5%)	0.25										
Lawn (5-10%)	0.40										
Lawn (>10%)	0.55										
Woodland Flat (<2%)	0.12										
Woodland Flat (2-5%)	0.24										
Woodland Rolling (5-10%)	0.36										
Woodland Hilly (>10%)	0.48										
Pasture Flat (<2%)	0.12										
Pasture Flat (2-5%)	0.25										
Pasture Rolling (5-10%)	0.36										
Pasture Hilly (>10%)	0.48										
Cultivated Flat (<2%)	0.20										
Cultivated Flat (2-5%)	0.35										
Cultivated Rolling (5-10%)	0.50										
Cultivated Hilly (>10%)	0.65										
Bare Soil	0.72										
Water	1.00										
Total SF		2,063	6,000	12,104	15,088	9,600	10,757	9,100	14,300	25,199	14,580
Total Acres		0.05	0.14	0.28	0.35	0.22	0.25	0.21	0.33	0.58	0.33
Weighted C		0.92	0.98	0.96	0.96	0.98	0.92	0.98	0.94	0.95	0.98

POST-DEVELOPED WEIGHTED RUNOFF COEFFICIENTS

Project: **Airport Storage Units** County: **Vanderburgh**
Project # 11586 Date: **11/29/22**
Engineer: JEM

POST DEVELOPED SUB-BASINS (S.F.)

Surface	C	21	22	23	24
Structures & Pavement (<2%)	0.92	6,117		226	
Structures & Pavement (2-5%)	0.94				
Structures & Pavement (5-10%)	0.96				
Structures & Pavement (>10%)	0.98				
Gravel (10 yr storm)	0.50				
Gravel (25 yr storm)	0.60				
Gravel (50-100 yr storm)	0.65				
Lawn (<2%)	0.15				
Lawn (2-5%)	0.25				
Lawn (5-10%)	0.40			12,926	11,521
Lawn (>10%)	0.55		39,545		
Woodland Flat (<2%)	0.12				
Woodland Flat (2-5%)	0.24				
Woodland Rolling (5-10%)	0.36				
Woodland Hilly (>10%)	0.48				
Pasture Flat (<2%)	0.12				
Pasture Flat (2-5%)	0.25				
Pasture Rolling (5-10%)	0.36				
Pasture Hilly (>10%)	0.48				
Cultivated Flat (<2%)	0.20				
Cultivated Flat (2-5%)	0.35				
Cultivated Rolling (5-10%)	0.50				
Cultivated Hilly (>10%)	0.65				
Bare Soil	0.72				
Water	1.00				
Total SF		6,117	39,545	13,152	11,521
Total Acres		0.14	0.91	0.30	0.26
Weighted C		0.92	0.55	0.41	0.40

POST-DEVELOPED SUB-BASIN CALCULATIONS

Indiana LTAP Stormwater Drainage Manual

Project: **Aiport Storage Units** County: **Vanderburgh**
Project # 11586 Date: **11/29/22**
Engineer: JEM Design Period: **25 year**

Sub-basin	Area (ac.)	Weighted C	Overland Flow L (ft)	Overland Flow △H (ft)	Overland Flow S (%)	Overland Flow t_o (mins)	Shallow Flow L (ft)	Shallow Flow △H (ft)	Shallow Flow Type (Paved/Unpaved)	Shallow Flow S (%)	Shallow Flow t_s (mins)	Total Time of Conc. t_c (mins)	I(10) (in/hr)	Q(10) (CFS)	I(25) (in/hr)	Q(25) (CFS)	I(100) (in/hr)	Q(100) (CFS)
1	0.04	0.98	25	2.50	10.0%	0.50	0	0.0	-	0.00%	0.00	5.00	6.66	0.25	7.81	0.30	9.95	0.38
2	0.08	0.92	100	2.00	2.0%	2.57	0	0.0	-	0.00%	0.00	5.00	6.66	0.51	7.81	0.59	9.95	0.76
3	0.08	0.95	20	2.00	10.0%	0.58	60	0.6	P	1.00%	0.49	5.00	6.66	0.50	7.81	0.59	9.95	0.75
4	0.18	0.95	20	2.00	10.0%	0.54	65	0.7	P	1.00%	0.53	5.00	6.66	1.12	7.81	1.32	9.95	1.68
5	0.07	0.95	20	2.00	10.0%	0.57	20	2.0	P	10.00%	0.05	5.00	6.66	0.43	7.81	0.51	9.95	0.64
6	0.08	0.92	70	1.40	2.0%	0.00	0	0.0	-	0.00%	0.00	5.00	6.66	0.51	7.81	0.59	9.95	0.76
7	0.33	0.97	20	2.00	10.0%	0.50	120	1.2	P	1.00%	0.98	5.00	6.66	2.13	7.81	2.50	9.95	3.18
8	0.28	0.96	20	2.00	10.0%	0.53	140	1.4	P	1.00%	1.15	5.00	6.66	1.76	7.81	2.07	9.95	2.63
9	0.14	0.98	20	2.00	10.0%	0.45	0	0.0	-	0.00%	0.00	5.00	6.66	0.88	7.81	1.04	9.95	1.32
10	0.10	0.93	50	0.50	1.0%	2.17	0	0.0	-	0.00%	0.00	5.00	6.66	0.63	7.81	0.74	9.95	0.95
11	0.05	0.92	20	0.20	1.0%	1.45	0	0.0	-	0.00%	0.00	5.00	6.66	0.29	7.81	0.34	9.95	0.43
12	0.14	0.98	20	2.00	10.0%	0.45	300	10.0	P	3.33%	1.35	5.00	6.66	0.90	7.81	1.05	9.95	1.34
13	0.28	0.96	20	2.00	10.0%	0.52	150	1.5	P	1.00%	1.23	5.00	6.66	1.78	7.81	2.08	9.95	2.65
14	0.35	0.96	20	2.00	10.0%	0.54	170	1.7	P	1.00%	1.39	5.00	6.66	2.20	7.81	2.59	9.95	3.29
15	0.22	0.98	20	2.00	10.0%	0.45	0	0.0	-	0.00%	0.00	5.00	6.66	1.44	7.81	1.69	9.95	2.15
16	0.25	0.92	100	2.00	2.0%	2.57	20	0.4	P	2.00%	0.12	5.00	6.66	1.51	7.81	1.77	9.95	2.26
17	0.21	0.98	35	3.50	10.0%	0.59	0	0.0	-	0.00%	0.00	5.00	6.66	1.36	7.81	1.60	9.95	2.04
18	0.33	0.94	20	2.00	10.0%	0.60	125	1.3	P	1.00%	1.02	5.00	6.66	2.05	7.81	2.41	9.95	3.07
19	0.58	0.95	45	4.50	10.0%	0.86	155	1.6	P	1.00%	1.27	5.00	6.66	3.64	7.81	4.27	9.95	5.45
20	0.33	0.98	45	4.50	10.0%	0.67	0	0.0	-	0.00%	0.00	5.00	6.66	2.18	7.81	2.56	9.95	3.26
21	0.14	0.92	100	1.50	1.5%	2.83	0	0.0	-	0.00%	0.00	5.00	6.66	0.86	7.81	1.01	9.95	1.29
22	0.90	0.55	100	1.00	1.0%	9.90	670	6.7	U	1.00%	6.92	16.82	4.19	2.08	4.92	2.44	6.27	3.11
23	0.30	0.41	10	1.00	10.0%	1.83	0	0.0	-	0.00%	0.00	5.00	6.66	0.82	7.81	0.96	9.95	1.23
24	0.26	0.40	10	1.00	10.0%	1.85	0	0.0	-	0.00%	0.00	5.00	6.66	0.70	7.81	0.83	9.95	1.05

*Subbasins 23 and 24 will leave the site undetained in the proposed condition.

**Subbasin 19 will generate the greatest amount of direct runoff to a storm structure in the proposed condition.

11586 - Store-N-Lock
Area Drain Calculations
Completed by: KJL

Flow Capacities of Inlet Grates

- Limiting Case for Q ⇒ AD408 Q_{25} = 4.27 cfs (Max. for site)
- Limiting Case for Ponding Depth ⇒ AD115 Depth = 382.6' - 382.03'
  = 0.57'
  ≈ 6.84"

- Grate/Frame Capacity ⇒ $Q = (0.0108)(A)(\sqrt{d})$ where

  A = Open Area of Grate (in^2)
  d = Ponding Depth (in)

- Grate/Frame Capacity will be lowest at limiting case for Ponding Depth, therefore, for an EJ #8306 Grate Frame (215 in^2 = A):

$$Q_{allowable} = (0.0108)(215\ in^2)(\sqrt{6.84"}) = \underline{6.07\ cfs}$$

$Q_{allowable}$ > Max. Q_{25}	, Therefore the EJ #8306, or any Frame and Grate with A > 215 in^2 will be sufficient in limiting ponding.
(6.07 cfs) (4.27 cfs)	

STORM SEWER DESIGN SHEET

Rational Method

MORLEY
ARCHITECTS | ENGINEERS | SURVEYORS

Project	**Airport Storage Units**			County:		**Vanderburgh**										
Project #	**11586**			Date:		**11/29/2022**										
Engineer	**JEM**			Design Period:		**25**	Years			Mannings n		**0.012**	HDPE N-12			

Pipe # or Swale	Length (ft)	Sub-Basin no.	Cj	Aj (ac.)	CjAj	Sum CjAj	Tj (min) (5.0)	Tcum (min) (5.0)	I(25) (in/hr)	Q(25) (cfs)	Pipe Diameter (in) Or Swale Depth (Ft)	Pipe Slope (ft/ft)	Pipe or Swale Cap. (cfs)	Velocity (ft/sec) at Capacity	Travel Time (min)	% Of Capacity
P114	60	**3**	0.95	0.08	0.08	0.08	5.00	5.00	7.81	0.59	12	0.15%	1.49	1.90	0.53	0.40
P112	70	**-**	-	-	-	0.11	-	5.53	7.63	0.87	12	0.15%	1.49	1.90	0.61	0.58
P110	65	**2**	0.92	0.08	0.08	0.42	5.00	6.62	7.27	3.08	18	0.15%	4.41	2.49	0.43	0.70
P108	130	**6**	0.92	0.08	0.08	0.50	5.00	7.06	7.14	3.56	48	0.15%	60.25	4.80	0.45	0.06
P106	155	**7**	0.97	0.33	0.32	0.82	5.00	7.51	7.00	5.73	48	0.10%	49.19	3.92	0.66	0.12
P104	66	**10**	0.93	0.10	0.10	1.32	5.00	8.17	6.81	8.96	48	0.10%	49.19	3.92	0.28	0.18
P102	55	**11**	0.92	0.05	0.04	3.70	5.00	9.07	6.56	24.27	48	0.10%	49.19	3.92	0.23	0.49
P203	125	**5**	0.95	0.07	0.06	0.06	5.00	5.00	7.81	0.51	12	0.15%	1.49	1.90	1.09	0.34
P201	70	**4**	0.95	0.18	0.17	0.23	5.00	6.09	7.44	1.74	15	0.15%	2.71	2.21	0.53	0.64
P301	170	**13**	0.96	0.28	0.27	0.27	5.00	5.00	7.81	2.08	48	0.10%	49.19	3.92	0.72	0.04
P409	153	**21**	0.92	0.14	0.13	0.13	5.00	5.00	7.81	1.01	12	0.15%	1.49	1.90	1.34	0.68
P407	142	**19**	0.95	0.58	0.55	0.68	5.00	6.34	7.36	4.98	18	0.25%	5.69	3.22	0.73	0.88
P405	100	**-**	-	-	-	1.00	-	7.07	7.13	7.16	48	0.10%	49.19	3.92	0.43	0.15
P403	190	**16**	0.92	0.25	0.23	1.74	5.00	7.50	7.00	12.22	48	0.10%	49.19	3.92	0.81	0.25
P401	180	**14**	0.96	0.35	0.33	2.08	5.00	8.31	6.77	14.05	48	0.10%	49.19	3.92	0.77	0.29
P501	150	**8**	0.96	0.28	0.26	0.26	5.00	5.00	7.81	2.07	48	0.10%	49.19	3.92	0.64	0.04
P601	178	**18**	0.94	0.33	0.31	0.31	5.00	5.00	7.81	2.41	15	0.15%	2.71	2.21	1.34	0.89
RD101	139	**1**	0.98	0.04	0.04	0.04	5.00	5.00	7.81	0.30	8	1.00%	1.31	2.21	0.37	0.23
RD106	343	**12**	0.98	0.14	0.13	0.13	5.00	5.00	7.81	1.05	8	1.00%	1.31	3.75	1.52	0.81
RD109	346	**17**	0.98	0.21	0.20	0.20	5.00	5.00	7.81	1.60	10	1.00%	2.37	4.35	1.32	0.67
RD111	411	**20**	0.98	0.33	0.33	0.33	5.00	5.00	7.81	2.56	12	0.60%	2.99	3.81	1.80	0.86

Swale Capacity Table

Side slope = 3
Manning's Coefficient = 0.035

Swale	Subbasin no.	Q(100) cfs	Channel Capacity (cfs)	Full Depth Velocity (ft/s)	% of Capacity	Slope (ft/ft)	Slope (%)	Length (ft)	Channel Depth (ft)	Bottom Width (ft)	Wetted Perimeter (ft)	Area (ft^2)	Hydraulic Radius (ft)	Hydraulic Depth (ft)	Travel Time (min)	US Elev.	DS Elev.
S-1	Portion of 22	0.30	1.03	1.50	0.29	0.011	1.13	360.0	0.25	2.00	3.58	0.69	0.19	0.20	3.99	380.29	376.24

STORM SEWER UNDERGROUND DETENTION

Pipe	Length	Downstream Area Under 25-yr Elev.	Upstream Area Under 25-yr	Storage Volume (CF)
P102	59.44	4.616	4.382	267
P104	65.76	4.382	4.111	279
P106	155	4.111	3.542	593
P108	130	3.542	2.809	413
P301	170	4.111	3.467	644
P401	180	4.382	3.692	727
P403	180	3.692	3.061	608
P405	99.92	3.061	2.631	284
P501	150	4.382	3.806	614
P601	178.2	1.194	0.946	191
			TOTAL	***4620***

Peak Runoff Calculation

Post Developed Detained Area

11586 - Store-N-Lock

Area (Ac) = **5.17** **Area (Sf) =** **225,084**

Weighted Runoff Coefficient

Surface	Area					c	A*c
Structures & Pavement (<2%)	61,232	S.F.	=	1.41	AC.	0.92	1.29
Structures & Pavement (2-5%)	26,142	S.F.	=	0.60	AC.	0.94	0.56
Structures & Pavement (5-10%)	0	S.F.	=	0.00	AC.	0.96	0.00
Structures & Pavement (>10%)	98,165	S.F.	=	2.25	AC.	0.98	2.21
Gravel (10 yr Storm)	0	S.F.	=	0.00	AC.	0.50	0.00
Gravel (25 yr Storm)	0	S.F.	=	0.00	AC.	0.60	0.00
Gravel (50-100 yr Storm)	0	S.F.	=	0.00	AC.	0.65	0.00
Lawn (<2%)	0	S.F.	=	0.00	AC.	0.15	0.00
Lawn (2-5%)	0	S.F.	=	0.00	AC.	0.25	0.00
Lawn (5-10%)	0	S.F.	=	0.00	AC.	0.40	0.00
Lawn (>10%)	39,545	S.F.	=	0.91	AC.	0.55	0.50
Woodland Flat (<2%)	0	S.F.	=	0.00	AC.	0.12	0.00
Woodland Flat (2-5%)	0	S.F.	=	0.00	AC.	0.24	0.00
Woodland Rolling (5-10%)	0	S.F.	=	0.00	AC.	0.36	0.00
Woodland Hilly (10-30%)	0	S.F.	=	0.00	AC.	0.48	0.00
Pasture Flat (<2%)	0	S.F.	=	0.00	AC.	0.12	0.00
Pasture Flat (2-5%)	0	S.F.	=	0.00	AC.	0.24	0.00
Pasture Rolling (5-10%)	0	S.F.	=	0.00	AC.	0.36	0.00
Pasture Hilly (>10%)	0	S.F.	=	0.00	AC.	0.48	0.00
Cultivated (<2%)	0	S.F.	=	0.00	AC.	0.20	0.00
Cultivated (2-5%)	0	S.F.	=	0.00	AC.	0.35	0.00
Cultivated (5-10%)	0	S.F.	=	0.00	AC.	0.50	0.00
Cultivated (>10%)	0	S.F.	=	0.00	AC.	0.65	0.00
Bare Soil	0	S.F.	=	0.00	AC.	0.72	0.00
Water	0	S.F.	=	0.00	AC.	1.00	0.00
	225,084			5.17			4.57

Wc = **0.88**

VANDERBURGH COUNTY DRAINAGE BOARD
FORM 800

PROJECT: **Airport Storage Units** 11586
DESIGNER: **JEM**

DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS
RELEASE RATE RETURN PERIOD: 10 YRS

UNDEVELOPED WATERSHED AREA (Au)	See Narrative		ACRES
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED)	See Narrative		MINUTES
RAINFALL INTENSITY (Iu):	See Narrative		INCHES/HR
UNDEVELOPED RUNOFF COEFFICIENT (Cu):	See Narrative		
UNDEVELOPED RUNOFF RATE (Q = Cu*Iu*A):		7.20	CFS
DEVELOPED WATERSHED AREA (Ad)	5.17		ACRES
DEVELOPED RUNOFF COEFFICIENT (Cd):	0.88		
UNDETAINED DEVELOPED RUNOFF RATE (DEVELOPED SUBBASINS 23 & 24)		1.79	CFS
ALLOWABLE PIPE RELEASE RATE		5.41	CFS
ACTUAL DISCHARGE PIPE OUTFLOW		5.29	CFS

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*Ad) (CFS)	OUTFLOW RATE Q (actual) (CFS)	STORAGE RATE I(Td)-Q (CFS)	REQUIRED STORAGE (I(Td)-Q)*Td/12 (ACRE.FT)			
0.08	7.811	35.68	5.29	30.39	0.21			
0.17	6.321	28.87	5.29	23.58	0.32			
0.25	5.241	23.94	5.29	18.65	0.39			
0.58	2.923	13.35	5.29	8.06	0.39			
0.67	2.581	11.79	5.29	6.50	0.36			
0.75	2.310	10.55	5.29	5.26	0.33			
1.00	2.174	9.93	5.29	4.64	0.38			
1.50	1.668	7.62	5.29	2.33	0.29			
2.00	1.366	6.24	5.29	0.95	0.16			
2.50	1.163	5.31	5.29	0.02	0.00			
3.00	1.017	4.65	5.29	-0.64	-0.16			
4.00	0.820	3.74	5.29	-1.55	-0.51			
5.00	0.691	3.16	5.29	-2.13	-0.88			
6.00	0.600	2.74	5.29	-2.55	-1.26			
7.00	0.532	2.43	5.29	-2.86	-1.65			
8.00	0.480	2.19	5.29	-3.10	-2.05			
9.00	0.437	2.00	5.29	-3.29	-2.45			
10.00	0.402	1.84	5.29	-3.45	-2.85			

PEAK STORAGE (ACRE-FT)	0.39
PEAK STORAGE (CUBIC FT)	16,829

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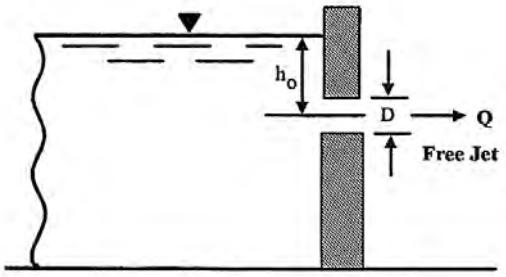
BASIN DISCHARGE AND STORAGE VOLUME

Orifice: $Q = C_d A_0 \sqrt{2gh_0}$ LTAP 6.3.2



Pipe Dia.	12	(inch)
D (inch)	0.00	Orifice diameter
A_o (s.f.)	0.00	Area of orifice
g (f/s^2)	32.2	Acceleration due to gravity
H (ft)	0.00	Head at Inlet
h_o (ft)	0.00	Head at center of orifice
C_d	0.61	Discharge coefficient

Q= 0.00 CFS

[X] Not used

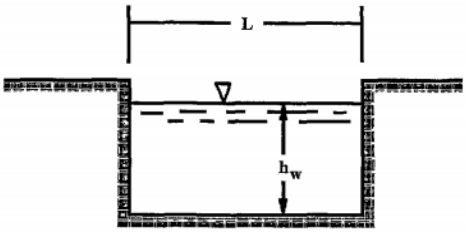
Pipe Flow: $Q = A_P \left(\frac{h_P}{\frac{K_e + K_0}{2g} + \frac{2.87 n^2 L}{D^{4/3}}} \right)^{1/2}$ LTAP 6.3.5

Pipe Dia.	12	(inch)
Ap (s.f.)	0.79	Area of Pipe
n	0.012	Manning roughness coef.
g (f/s^2)	32.2	Acceleration due to gravity
H (ft)	2.65	Head at invert
h_p (ft)	2.15	Head at center of pipe
L (ft)	45	Length of pipe
K_e	0.85	Entrance Loss
K_o	1.00	Outlet Loss

Q= 5.29 CFS @ 25 year water elevation

[ ] Not used

Rectangular Weir: $Q = \frac{2}{3} C_d \sqrt{2g} L h_w^{3/2}$ LTAP 6.3.3



L (ft)	0	Length of the weir
g (f/s^2)	32.2	Acceleration due to gravity
h_w (ft)	0.00	Head above weir
C_d	0.61	Discharge coefficient

Q= 0.00 CFS

[X] Not used

Storage:

Stage	Surface Area (S.F.)	Cum. Storage Vol. (C.F.)	Notes
374.1	0	0	Outlet Invert
375	3,600	1,620	
376	7,950	7,395	
376.75	10,250	14,220	25-Year Water Elevation
		4,620	Underground Detention Vol.

Available Storage:	18,840	0.43	AC-FT
Required Storage:	16,829	0.39	AC-FT
	89%	Basin Capacity	

VANDERBURGH COUNTY DRAINAGE BOARD
100-Year Emergency Overflow (Discharge entirely inoperative)

PROJECT: **Airport Storage Units** DETENTION FACILITY DESIGN RETURN PERIOD: 100 YRS
11586
DESIGNER: **JEM** RELEASE RATE RETURN PERIOD: 2 YRS

DEVELOPED WATERSHED AREA (Ad) 5.17 ACRES
DEVELOPED RUNOFF COEFFICIENT (Cd): 0.88

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*Ad) (CFS)	OUTFLOW RATE Q (actual) (CFS)	STORAGE RATE I(Td)-Q (CFS)	REQUIRED STORAGE (I(Td)-Q)*Td/12 (ACRE.FT)	AVAILABLE STORAGE (ACRE.FT)		
1.00	2.936	13.42	0.00	13.42	1.11	0.43		
	I(100)	2.936						
	C	0.88						
	A	5.17						
	Q(100)	13.42						

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See following sheet for emergency overflow channel capacity.

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 29 2022

Emergency Overflow Report

Trapezoidal

Bottom Width (ft)	= 25.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 0.83
Invert Elev (ft)	= 377.27
Slope (%)	= 2.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 13.42

Highlighted

Depth (ft)	= 0.24
Q (cfs)	= 13.42
Area (sqft)	= 6.23
Velocity (ft/s)	= 2.15
Wetted Perim (ft)	= 26.98
Crit Depth, Yc (ft)	= 0.21
Top Width (ft)	= 26.92
EGL (ft)	= 0.31