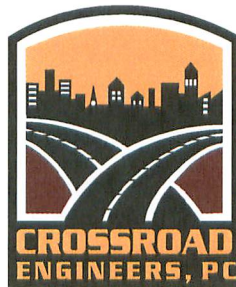


Stormwater Calculations

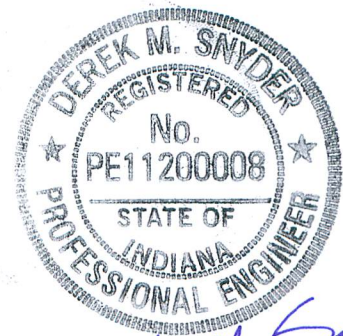
**Marriott Fairfield Inn & Suites
350 Paris Drive
Franklin, Indiana**

**Submitted:
September 15, 2017**

By:



**CrossRoad Engineers, PC
3417 Sherman Dr.
Beech Grove, IN 46107
Phone No.: (317) 780-1555
Fax No.: (317) 780-6525
Email: info@crossroadengineers.com**



*Derek M. Snyder
9.15.17*

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Section 1: Stormwater Calculations Summary

Pre-Development Conditions

The project site is located in the northwest corner of the Paris Drive roundabout in the City of Franklin, Johnson County, Indiana (see Exhibit 1: Vicinity and Location Map). The existing site is a ± 11.28 acre tract consisting of cultivated agricultural field with landscape mounds along the west and north perimeter. By graphic plotting, the project site lies within Zone 'X', areas outside of the 0.2% annual chance floodplain, as shown on the Flood Insurance Rate Map (FIRM) for Johnson County, Indiana, Community Panel No. 18081 C 0232D, dated August 2, 2007. (see Exhibit 2: FEMA FIRM Map)

Under pre-development conditions, runoff exits the site at three (3) different outlet points. Runoff from the southern portion of the site drains south towards Longest Drive. Runoff from the eastern portion of the site drains east into the roadside ditch along the northwest side of the Paris Drive roundabout which drains northeast towards I-65. Runoff from the northwest portion of the site drains north over a spillway and into an existing detention pond located in the Fairway Lakes – Section 1 subdivision (see Exhibit 3: Pre-Development Watershed Map). For the runoff and detention analysis, the enclosed calculations focus entirely on the pre-development basin draining north into Fairway Lakes since it is anticipated that the entire property will drain north in the post-development condition.

Post-Development Conditions

This project involves the construction of a $\pm 12,813$ -square foot Marriott Fairfield Inn & Suites with 81 rooms. All curbs, sidewalks, and parking areas necessary for the development shall be constructed with the hotel. All stormwater runoff shall be collected via a storm sewer network and directed towards a wet detention pond which will be constructed in the northwest corner of the site. The wet detention pond will provide stormwater quantity and quality treatment in accordance with Section 6.19 of the City of Franklin Subdivision Control Ordinance. In addition to the proposed hotel, it is anticipated that the remaining tract owned by JART Properties, Inc. may be subdivided into commercial lots for future development. As such, the proposed wet detention pond has been designed to accommodate runoff from future commercial developments to the southwest of the hotel site (see Exhibit 4: Post-Development Watershed Map).

As indicated in the “Pre-Development Conditions” above, it is anticipated that the entire property will drain into the proposed wet detention pond in the post-development conditions. Runoff exiting the detention pond will be discharged into the existing Fairway Lakes – Section 1 pond which is consistent with the pre-development conditions. To achieve water quantity detention standards, the pond and outlet structure will be sized to restrict the peak discharge rate of the 10-year post-developed storm to the peak 2-year pre-developed rate for pre-development watershed basin. Likewise, the peak discharge rate of the 100-year post-developed storm will be restricted to the peak 10-year pre-developed rate.

It should be noted that, in the post-development condition, runoff from a portion of the site immediately east of the hotel cannot be directed into the detention pond due to topographical constraints. Although the area in question cannot be detained, it will remain an unimproved,

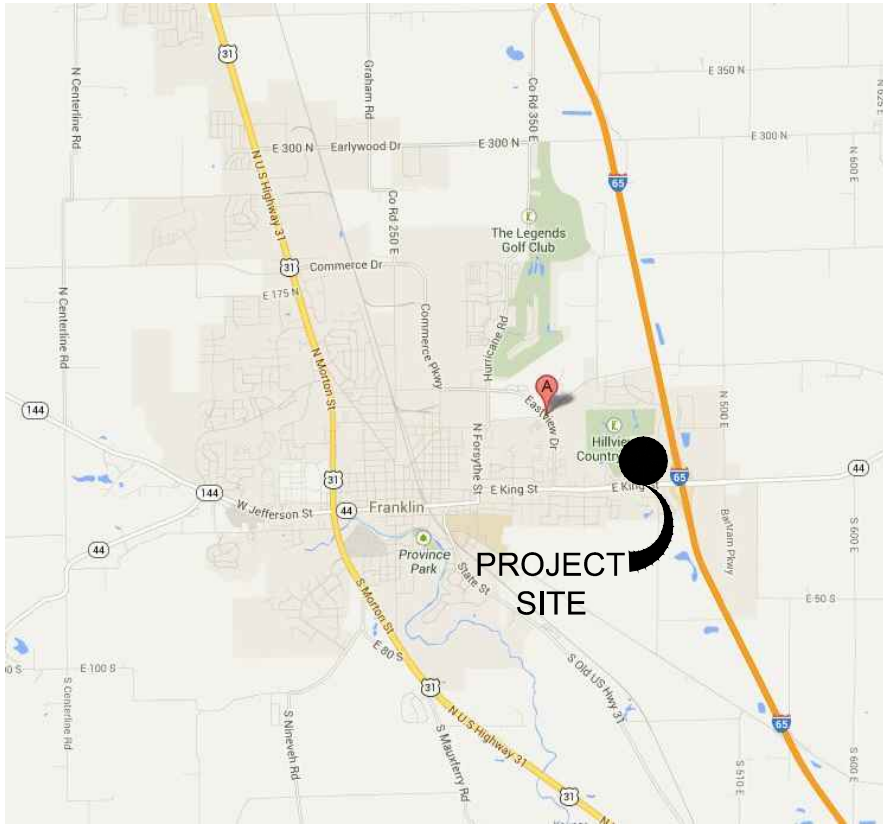
grass area after development. Furthermore, the outlet point for said area will be maintained between the pre- and post-development conditions; therefore, no negative impacts to downstream drainage facilities will be realized as a result of this direct discharge. As such, the direct discharge area will not be analyzed as a part of this report.

In addition to water quantity, the ponds will also be designed to detain, for over 24 hours after the peak runoff from a 24-hour storm, at least 20% of the runoff from either a 1-1/4 inch rainfall depth storm or 1/2 inch direct runoff, whichever is greater, for water quality treatment. The minimum water quality outlet orifice shall be two (2) inches in diameter. The pond will also be designed to include an emergency overflow spillway facility that is sufficient to convey 1.25 times the peak discharge resulting from the 100-year post-developed design storm. The wet detention pond will be designed to meet the requirements of Section 6.19, G and H of the Franklin SCO.

Storm Sewer Design

The proposed storm sewer network is designed to accommodate a 10-year storm event. The Rational Method was used to perform the storm sewer pipe sizing calculations. Structures and grates in the parking lot were designed and placed so that the depth of ponding above the inlet does not exceed 9 inches with the inlet grate 50% plugged.

EXHIBIT 1: VICINITY & LOCATION MAPS



VICINITY MAP
NOT TO SCALE



LOCATION MAP
NOT TO SCALE

NOTE: MAP AREA SHOWN
ON THIS PANEL IS LOCATED
WITHIN TOWNSHIP 12 NORTH,
RANGE 4 EAST AND
TOWNSHIP 12 NORTH,
RANGE 5 EAST

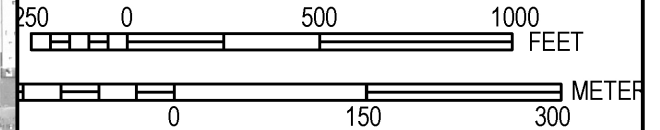
City of Franklin
180114

18

44



MAP SCALE 1" = 500'



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0232D

FIRM

FLOOD INSURANCE RATE MAP

JOHNSON COUNTY,
INDIANA

AND INCORPORATED AREAS

PANEL 232 OF 352

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FRANKLIN, CITY OF	180114	0232	D
JOHNSON COUNTY	180111	0232	D

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



MAP NUMBER

18081C0232D

EFFECTIVE DATE

AUGUST 2, 2007

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EXHIBIT 3: PRE-DEVELOPMENT WATERSHED MAP

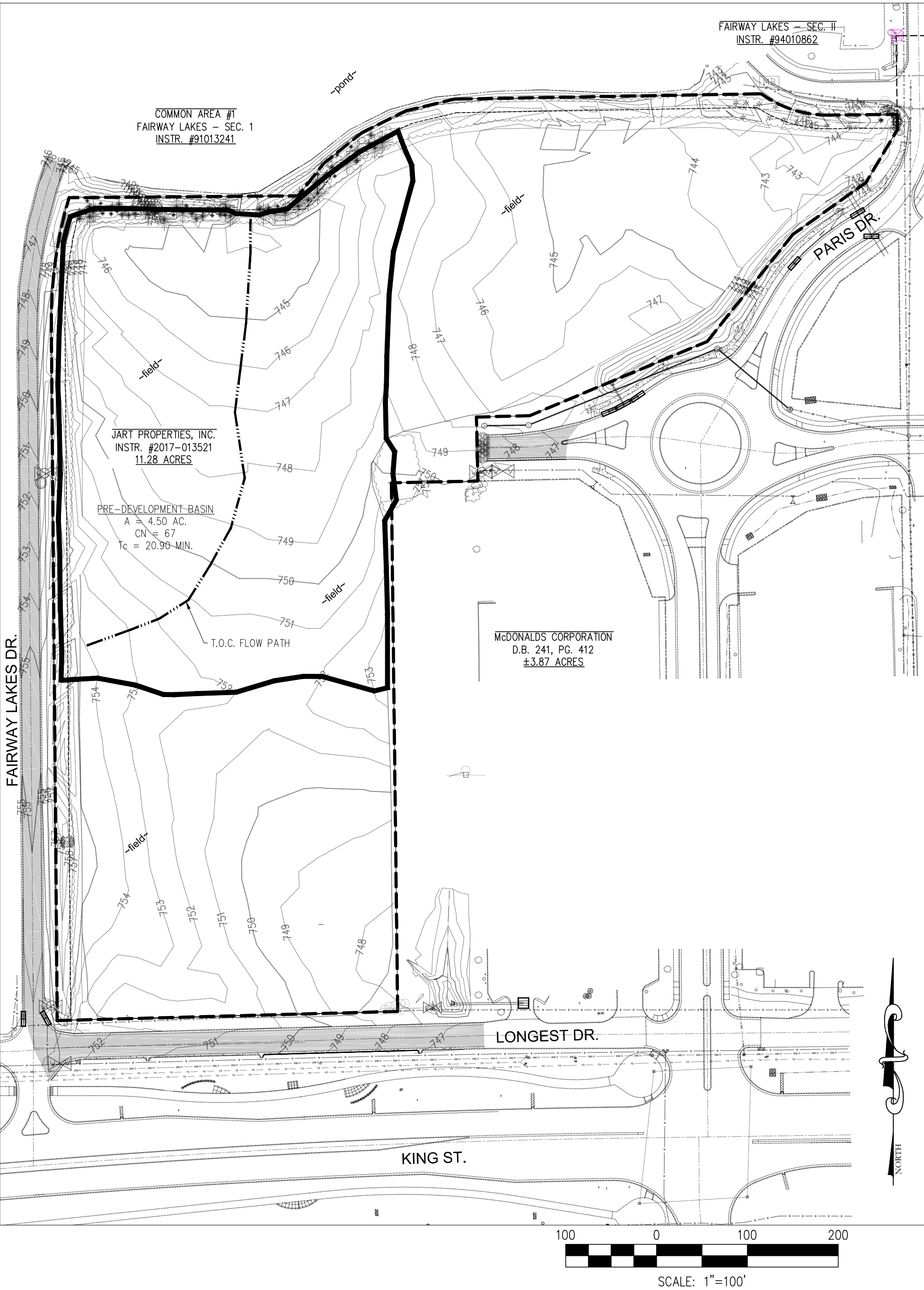
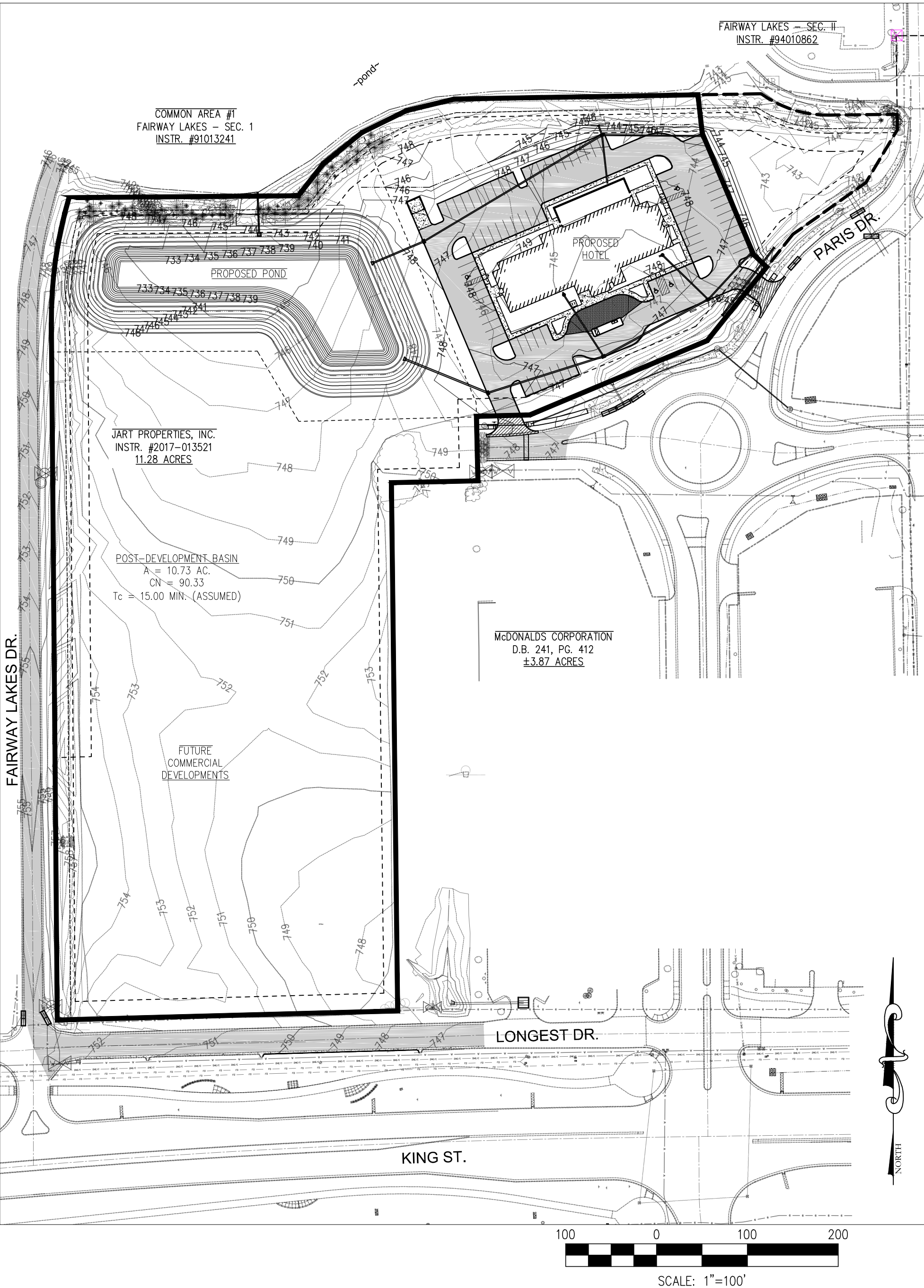


EXHIBIT 4: POST-DEVELOPMENT WATERSHED MAP



Section 2: Hydrologic Modeling Calculations

All drainage calculations were completed using Autodesk Storm and Sanitary Analysis software. The SCS Curvilinear method utilizing SCS II rainfall distribution was used to calculate the hydrographs. The TR-55 Method was used to calculate times of concentration. Curve numbers were computed based on the applicable cover for fully developed urban areas and the percentage by area of each hydrologic soil type obtained from the USDA Web Soils Survey for the project area. Per Section 6.19.C.6 of the City of Franklin SCO, pre-developed runoff rates shall be based on pasture, meadow, brush or woods ground cover in good hydrologic conditions. As the existing site is predominately cultivated field, the existing ground cover for the entire site will be considered to be pasture cover in good hydrologic condition.

Soil Hydrologic Group Percentage Calculations

Table 1 Soil Hydrologic Group Percentage Calculations		
Soil Type	Hydrologic Group – B (acres)	Hydrologic Group – C (acres)
Brookston, Br	3.2	--
Crosby, CrA	--	5.7
Miami, MnB2	2.2	--
Miami, MnC2	1.7	--
Miami, MnD2	0.1	--
Totals	7.2	5.7
Percentages of Hydrologic Groups	56%	44%

Runoff Curve Number Calculations

Pre-Development Conditions

Table 2 Pre-Development Runoff Curve Number Calculations - PRE #1						
Land Use Description	Runoff Curve No. For Hydrologic Group – B		Runoff Curve No. For Hydrologic Group – C		Average Runoff Curve Number	Land Use Area
	Percentage Used*	56%	Percentage Used*	44%		
Pasture/Open Space	61		74		67	4.50 ac.
						67

*See Soil Hydrologic Group Percentage Calculations, Table 1.

Post-Development Conditions

Table 3 Post-Development Runoff Curve Number Calculations						
Land Use Description	Runoff Curve No. For Hydrologic Group – B		Runoff Curve No. For Hydrologic Group – C		Average Runoff Curve Number	Land Use Area
	Percentage Used*	56%	Percentage Used*	44%		
Wet Pond	98		98		98	0.77 ac.
Open Space	61		74		67	1.25 ac.
Commercial	92		94		93	8.71 ac.
						90.33

*See Soil Hydrologic Group Percentage Calculations, Table 1.

Hydrologic Modeling Runoff Summary

Pre-Development Conditions

The City of Franklin Subdivision Control Ordinance requires a detention design that outlets stormwater at the following rates:

$$\begin{array}{ll}
 \text{Post-Development:} & \text{Pre-Development:} \\
 \text{Post 10-yr Q} & \leq \text{Pre 2-yr Q} \\
 \text{Post 100-yr Q} & \leq \text{Pre 10-yr Q}
 \end{array}$$

The 2-year, 10-year and 100-year storm events are calculated at durations of 1, 2, 3, 6, 12 and 24 hours to identify the critical storm events which are to be used for the respective limiting pre-development rates. Table 4 summarizes the peak runoff rates (cfs) resulting from the hydrologic modeling of the Pre-Development Watershed Basin which is representative of the contributing watershed area in the existing condition. Entries in bold indicate the critical storm event for the respective return period. See Appendix 'A' for the pre-development hydrograph and peak storm event analysis results.

Table 4 Pre-Development Hydrograph Peak Runoff Rate Summary						
Return Period (years)	Storm Duration					
	1 Hour	2 Hours	3 Hours	6 Hours	12 Hours	24 Hours
2	0.02	0.07	0.11	0.44	1.07	2.10
10	0.40	0.96	1.24	2.33	3.58	5.41

Basin Allowable Discharge:

Allowable discharge for the critical 10-year post-development storm=
 Pre-Development 2-year Peak = **2.10 cfs**

Allowable discharge for the critical 100-year post-development storm=
 Pre-Development 10-year Peak = **5.41 cfs**

Post-Development Conditions

Table 5 summarizes the peak runoff rates (cfs) resulting from the hydrologic modeling of the Post-Development Watershed Basin which is representative of the contributing watershed area in the proposed condition. See Appendix 'B' for the post-development hydrographs and peak storm event analysis results.

Table 5						
Post-Development Hydrograph Peak Runoff Rate Summary						
Return Period (years)	Storm Duration					
	1 Hour	2 Hours	3 Hours	6 Hours	12 Hours	24 Hours
10	14.44	18.34	20.10	25.77	31.53	39.14
100	25.57	32.94	36.16	45.70	52.49	59.93

Soil Map—Johnson County, Indiana




**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey


8/28/2017
Page 1 of 3

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: Johnson County, Indiana

Survey Area Data: Version 24, Sep 15, 2016

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

Date(s) aerial images were photographed: Sep 24, 2014—Mar 20, 2017

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

Johnson County, Indiana (IN081)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Br	Brookston silty clay loam, 0 to 2 percent slopes	3.2	24.9%
CrA	Crosby silt loam, fine-loamy subsoil, 0 to 2 percent slopes	5.7	43.9%
MnB2	Miami silt loam, 2 to 6 percent slopes, eroded	2.2	17.1%
MnC2	Miami silt loam, 6 to 12 percent slopes, eroded	1.7	13.1%
MnD2	Miami silt loam, 12 to 18 percent slopes, eroded	0.1	0.9%
Totals for Area of Interest		12.9	100.0%



NOAA Atlas 14, Volume 2, Version 3
Location name: Franklin, Indiana, USA*
Latitude: 39.5167°, Longitude: -86.0667°
Elevation: 764.49 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.373 (0.333-0.422)	0.444 (0.396-0.502)	0.532 (0.472-0.601)	0.602 (0.533-0.679)	0.693 (0.609-0.782)	0.764 (0.666-0.864)	0.833 (0.720-0.945)	0.906 (0.775-1.03)	1.00 (0.844-1.15)	1.08 (0.892-1.24)
10-min	0.580 (0.517-0.656)	0.694 (0.618-0.783)	0.827 (0.734-0.934)	0.929 (0.822-1.05)	1.06 (0.931-1.20)	1.16 (1.01-1.31)	1.25 (1.08-1.42)	1.35 (1.16-1.54)	1.48 (1.24-1.69)	1.57 (1.30-1.81)
15-min	0.711 (0.634-0.804)	0.848 (0.755-0.958)	1.02 (0.902-1.15)	1.14 (1.01-1.29)	1.31 (1.15-1.48)	1.43 (1.25-1.62)	1.56 (1.35-1.77)	1.68 (1.44-1.92)	1.84 (1.55-2.11)	1.96 (1.62-2.26)
30-min	0.940 (0.839-1.06)	1.14 (1.01-1.28)	1.39 (1.24-1.57)	1.59 (1.41-1.79)	1.85 (1.62-2.09)	2.05 (1.79-2.32)	2.25 (1.94-2.55)	2.46 (2.10-2.80)	2.73 (2.30-3.13)	2.94 (2.43-3.39)
60-min	1.15 (1.02-1.30)	1.39 (1.24-1.57)	1.75 (1.55-1.97)	2.02 (1.79-2.28)	2.40 (2.11-2.71)	2.70 (2.35-3.05)	3.01 (2.60-3.41)	3.33 (2.85-3.80)	3.77 (3.17-4.33)	4.12 (3.42-4.76)
2-hr	1.34 (1.20-1.52)	1.63 (1.45-1.85)	2.04 (1.82-2.32)	2.38 (2.10-2.69)	2.85 (2.50-3.22)	3.24 (2.82-3.65)	3.65 (3.13-4.12)	4.08 (3.45-4.61)	4.68 (3.89-5.33)	5.17 (4.23-5.94)
3-hr	1.42 (1.27-1.62)	1.72 (1.53-1.95)	2.17 (1.93-2.46)	2.53 (2.24-2.86)	3.05 (2.67-3.44)	3.48 (3.01-3.93)	3.93 (3.37-4.46)	4.42 (3.73-5.02)	5.11 (4.21-5.85)	5.68 (4.59-6.54)
6-hr	1.70 (1.51-1.94)	2.05 (1.82-2.35)	2.59 (2.29-2.95)	3.03 (2.67-3.45)	3.66 (3.19-4.16)	4.19 (3.62-4.75)	4.76 (4.05-5.40)	5.37 (4.50-6.12)	6.25 (5.11-7.14)	6.98 (5.59-8.02)
12-hr	2.03 (1.82-2.30)	2.44 (2.19-2.77)	3.04 (2.72-3.44)	3.53 (3.14-3.98)	4.21 (3.71-4.73)	4.77 (4.17-5.35)	5.36 (4.63-6.02)	5.98 (5.09-6.74)	6.86 (5.72-7.78)	7.56 (6.21-8.64)
24-hr	2.43 (2.24-2.65)	2.91 (2.68-3.18)	3.57 (3.28-3.89)	4.08 (3.74-4.45)	4.77 (4.36-5.20)	5.32 (4.84-5.81)	5.87 (5.32-6.42)	6.44 (5.81-7.05)	7.21 (6.44-7.92)	7.81 (6.92-8.73)
2-day	2.84 (2.63-3.08)	3.41 (3.15-3.69)	4.15 (3.83-4.50)	4.73 (4.36-5.12)	5.51 (5.05-5.97)	6.12 (5.59-6.64)	6.74 (6.12-7.32)	7.37 (6.66-8.02)	8.21 (7.35-8.96)	8.86 (7.88-9.71)
3-day	3.05 (2.84-3.28)	3.64 (3.39-3.92)	4.42 (4.11-4.75)	5.02 (4.66-5.39)	5.82 (5.39-6.26)	6.45 (5.95-6.94)	7.09 (6.51-7.63)	7.73 (7.07-8.33)	8.59 (7.80-9.28)	9.25 (8.36-10.0)
4-day	3.26 (3.05-3.48)	3.88 (3.63-4.15)	4.68 (4.38-5.00)	5.30 (4.95-5.66)	6.13 (5.72-6.55)	6.78 (6.31-7.23)	7.44 (6.90-7.93)	8.10 (7.48-8.64)	8.98 (8.26-9.59)	9.65 (8.83-10.3)
7-day	3.86 (3.60-4.14)	4.59 (4.28-4.92)	5.50 (5.13-5.89)	6.23 (5.80-6.67)	7.21 (6.70-7.71)	7.99 (7.40-8.54)	8.78 (8.11-9.39)	9.58 (8.82-10.2)	10.7 (9.76-11.4)	11.5 (10.5-12.3)
10-day	4.40 (4.12-4.71)	5.23 (4.90-5.59)	6.25 (5.85-6.68)	7.06 (6.60-7.54)	8.16 (7.61-8.70)	9.02 (8.39-9.61)	9.89 (9.18-10.5)	10.8 (9.96-11.5)	12.0 (11.0-12.8)	12.9 (11.8-13.8)
20-day	6.03 (5.68-6.42)	7.14 (6.72-7.60)	8.42 (7.92-8.96)	9.41 (8.84-10.0)	10.7 (10.1-11.4)	11.7 (11.0-12.5)	12.8 (11.9-13.5)	13.7 (12.8-14.6)	15.0 (13.9-16.0)	16.0 (14.8-17.0)
30-day	7.43 (7.00-7.87)	8.74 (8.24-9.27)	10.2 (9.58-10.8)	11.3 (10.6-11.9)	12.7 (12.0-13.5)	13.8 (13.0-14.6)	14.9 (13.9-15.8)	15.9 (14.9-16.9)	17.3 (16.1-18.4)	18.3 (16.9-19.5)
45-day	9.42 (8.87-9.98)	11.1 (10.4-11.7)	12.8 (12.0-13.5)	14.0 (13.2-14.9)	15.7 (14.7-16.6)	17.0 (15.9-17.9)	18.2 (17.0-19.2)	19.3 (18.0-20.4)	20.8 (19.3-22.0)	21.8 (20.2-23.2)
60-day	11.3 (10.6-11.9)	13.2 (12.4-14.0)	15.1 (14.2-16.0)	16.6 (15.6-17.6)	18.5 (17.4-19.6)	19.9 (18.7-21.1)	21.3 (19.9-22.6)	22.6 (21.1-24.0)	24.2 (22.6-25.7)	25.4 (23.7-27.1)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

Section 3: Water Quality Calculations

The City of Franklin Subdivision Control Ordinance requires all paved areas to be routed through a water quality detention system. The water quality detention system shall be designed to detain, for over 24 hours after peak runoff, at least 20% of the volume of runoff from either a 1 ¼" rainfall depth storm or 0.5" of direct runoff, whichever is greater. The minimum water quality outlet shall be 2" in diameter. See Appendix B for the water quality hydrograph and water quality storm event analysis results. See Appendix C for additional water quality data and routed water quality hydrograph.

Water Quality Volume

Volume of Runoff from 1 ¼" Rainfall Depth Storm, $V_1 = 5.46 \text{ ac.-in.} = \underline{0.455 \text{ ac.-ft.}}$

Volume of Runoff from 0.5" Direct Runoff,

$$V_2 = 10.73 \text{ ac.} * (0.5"/12) = \underline{0.447 \text{ ac.-ft.}}$$

Water Quality Volume, $WQ_v = 20\% * V_2 = 0.2 * 0.455 \text{ ac.-ft.} = \underline{0.091 \text{ ac.-ft.}}$

At a time of 24 hours after the peak runoff rate of the inflow hydrograph, the detention pond must have at least 0.091 ac.-ft. remaining in the basin.

Routed Water Quality Storm Hydrograph

The 1 ¼" storm event is routed through the proposed detention pond with a 7.5" diameter circular water quality orifice. The Routed 1.25" Storm Event Hydrograph (see following page) is used to verify the water quality volume, WQ_v , is remaining after 24 hours after peak runoff.

Time to Peak Runoff = 925 min.

Time of 24 hours Past Peak Runoff = 925 min. + 1,440 min. = 2,365 min.

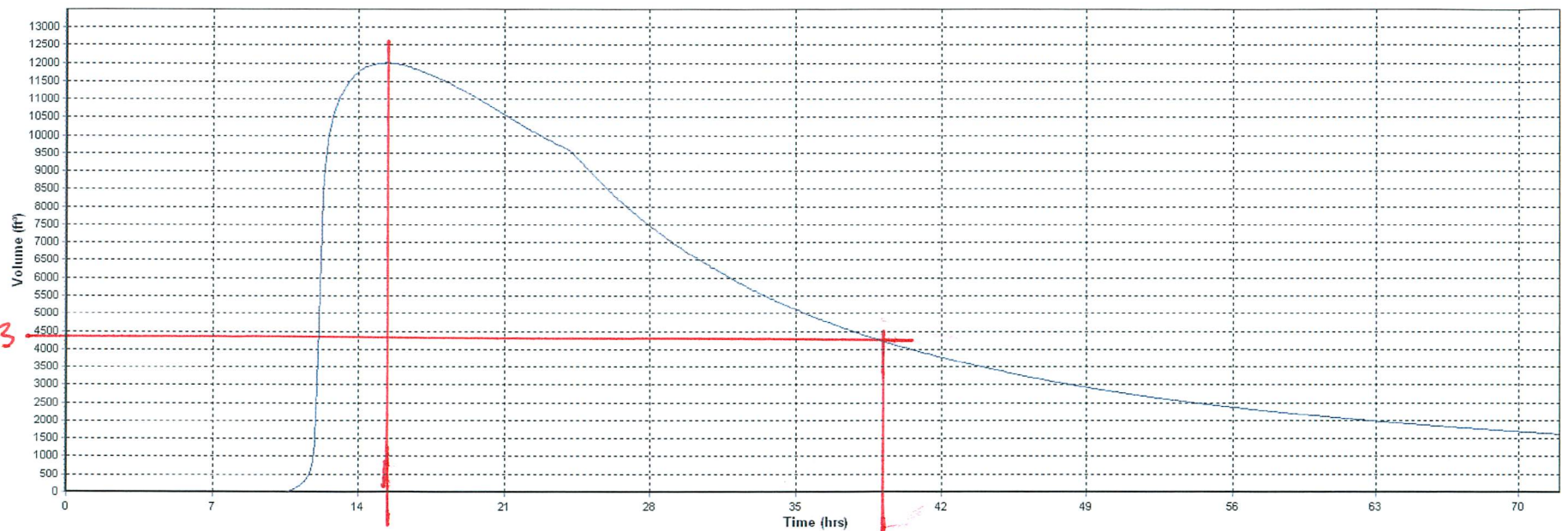
Storage Volume at Time 2,365 min. = 4,181.43 c.f. = **0.096 ac.-ft.** > **0.091 ac.-ft.** (WQ_v)

The storage volume 24 hours after peak runoff is greater than the required water quality volume due to using the minimum size water quality orifice of 7.5".

The water quality orifice is discussed further in Section 4: Detention Calculations.

Routed 1.25" Storm Event Hydrograph

Volume: Node - Stor-01 (Thompson Farms - Detention 2017-08-31 15:10:18)



$V = 4,181.43$

Time to Peak
= 15.4166 HRS
= 925 MINUTES

24 HRS AFTER PEAK = 2,365 MINUTES

Section 4: Detention Calculations

Per ordinance, stormwater detention is addressed by restricting the release rate of runoff as previously described in Section 2: Hydrologic Modeling Calculations. The following information is provided as verification that the proposed wet detention pond and outlet structure are capable of detaining and restricting the release rate of runoff from the post-development site.

Allowable Discharge Rate (see Section 2: Hydrologic Modeling Calculations, Hydrologic Modeling Runoff Summary)

Allowable discharge for the critical 10-year post-development storm=
Pre-Development 2-year Peak = **2.10 cfs**

Allowable discharge for the critical 100-year post-development storm=
Pre-Development 10-year Peak = **5.41 cfs**

Post-Development Peak Flowrate (see Section 2: Hydrologic Modeling Calculations, Hydrologic Modeling Runoff Summary)

$Q_{10} = 39.14$ cfs
 $Q_{100} = 59.93$ cfs

Outlet Structure Summary (see Appendix C: Post-Development Runoff & Routed Storm Data)

The proposed outlet structure shall utilize a Modified Inlet Type “E” with one (1) circular 7.5” diameter orifice to meet the detention and allowable discharge requirements for the water quality and 10-year critical storm events. One (1) 8” (H) x 24” (W) rectangular orifice shall be utilized to meet the detention and allowable discharge requirements for 100-year critical storm events. Discharge will be conveyed to the existing Fairway Lakes detention pond via a 12” diameter outlet pipe leaving the control structure. (See Exhibit 5: Detention Details).

Routed Storm Hydrographs (see Appendix C: Post-Development Runoff & Routed Storm Data)

Peak 10 Year Post-Development Discharge Rate = **1.75 cfs** < 2.10 cfs (allowable)
Peak Water Surface Elev. = **744.28** < 745.25 (top of emergency spillway)

Peak 100 Year Post-Development Discharge Rate = **5.40 cfs** < 5.41 cfs (allowable)
Peak Water Surface Elev. = **745.09** < 745.25 (top of emergency spillway)

All post-development storms are discharged at a flowrate less than their respective allowable discharge rates. All post-development storms produce a peak water surface elevation below the maximum detention pond elevation.

Emergency Scenario

An emergency spillway will be constructed on the north side of the detention pond. The emergency spillway was designed to convey $1.25 \times Q_{100}$ where Q_{100} equals the peak 100-year inflow to the basin from the entire contributing watershed. The spillway will discharge into the existing Fairway Lakes – Section 1 detention pond as shown which is consistent with the existing drainage patterns. Below are calculations for the emergency spillway:

$$L = 1.25Q_{100} / (CDH^{1.5}) = 1.25 \times 59.93 / (3.08 \times 1.0^{1.5}) = 24.32' \text{ use } 25'$$

Q_{100} Inflow = 59.93 cfs

Top of Detention Basin Elevation = 748.25

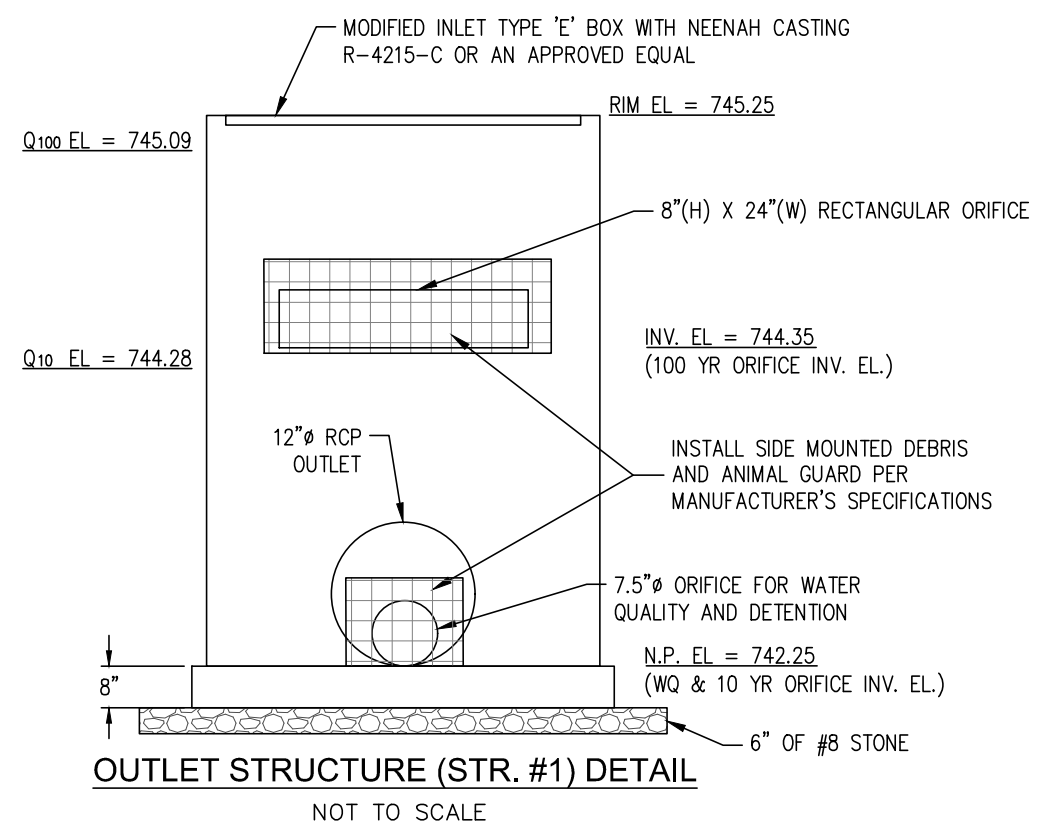
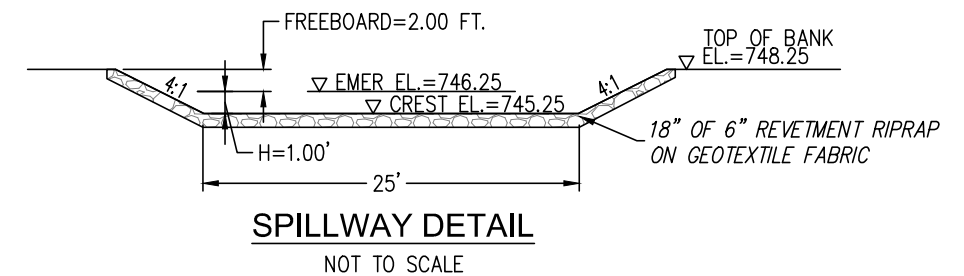
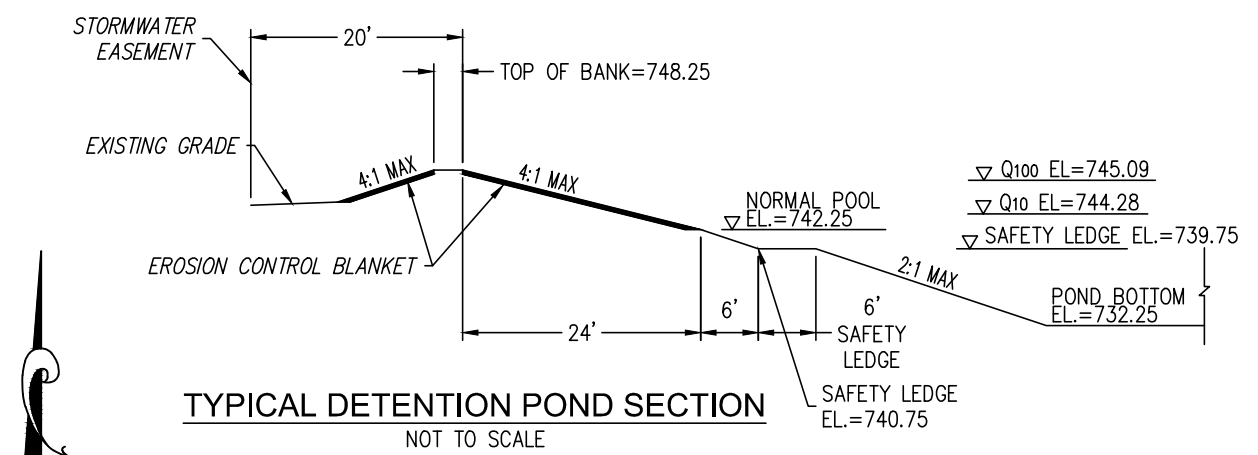
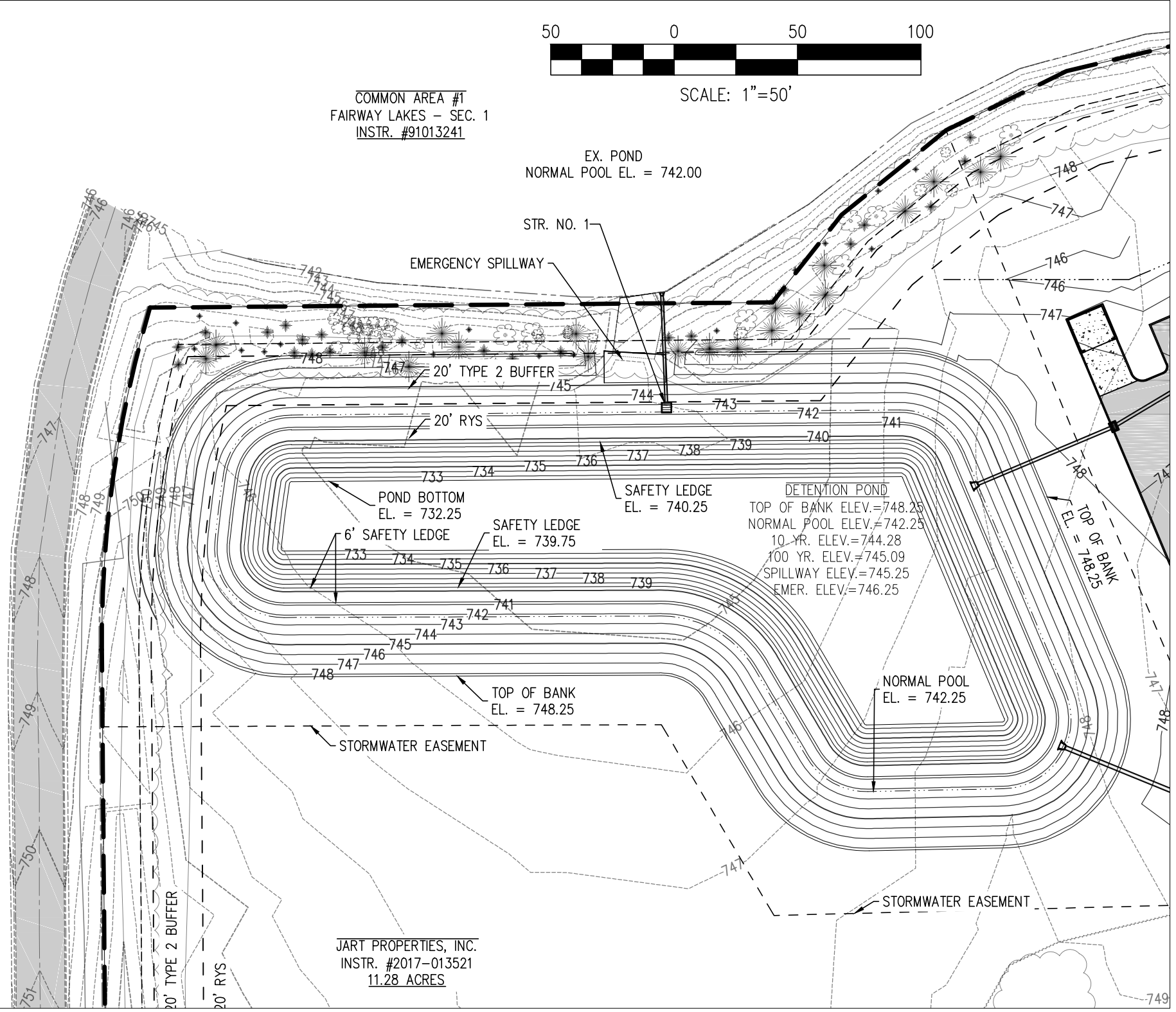
Spillway Crest Elevation = 745.25

Water Surface Elevation = 746.25

Max. Head, $H = 746.25 - 745.25 = 1.0$ ft.

Freeboard = $748.25 - 746.25 = 2.0$ ft.

EXHIBIT 5: DETENTION DETAILS



Section 5: Storm Sewer & Pipe Culvert Sizing Calculations

Storm Sewer Sizing Summary

The Rational Method was used to calculate the peak runoff to be conveyed by the onsite storm sewer during the 10-year storm event. The rainfall data table, composite runoff coefficient calculations, 10-year storm event pipe sizing calculations, Hydraflow Schematic Layout, and Exhibit 6: Inlet Basin Watershed Map are included within this section. Please note that the “Line ID” shown in the Hydraflow Storm Sewer Tabulations (see right column) corresponds to the structure number shown on Exhibit 6: Inlet Basin Watershed Map.

Pipe Culvert Sizing Summary

Using the Rational Method, the peak runoff resulting from the 100-year storm event can be determined as follows:

$$Q = C \times A \times I$$

$$C \times A = 0.412 \text{ (see composite runoff calculations)}$$

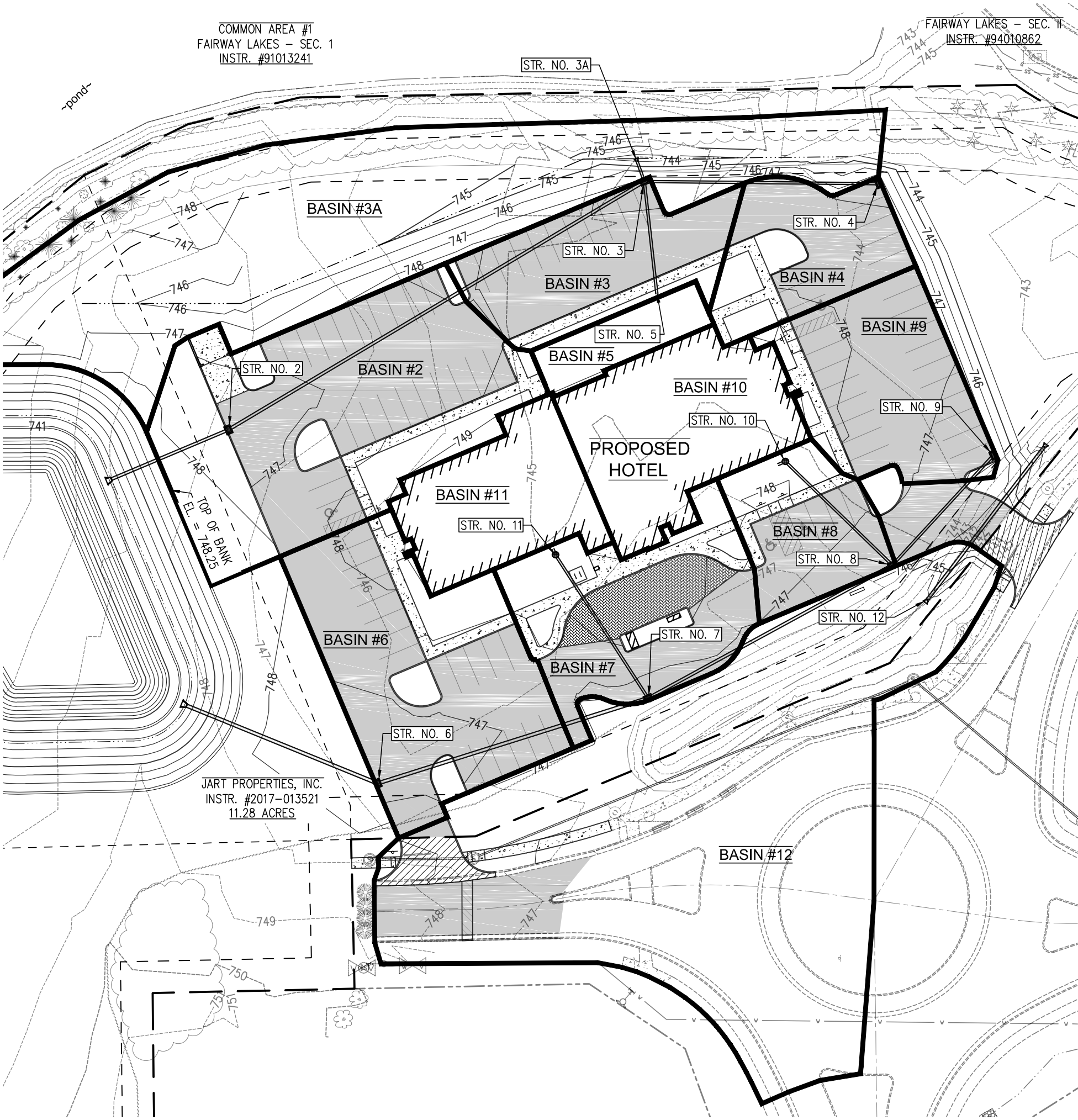
$$T_c = 5 \text{ min. (assumed)}$$

$$I = 9.69 \text{ in/hr}$$

$$\mathbf{Q = 3.99 \text{ cfs}}$$

Using HY-8 software, the pipe culvert design was utilized to verify that no overtopping of the new driveway occurs during the 100-year storm event. The rainfall data table, composite runoff coefficient calculations, and HY-8 printouts are included within this section.

EXHIBIT 6: INLET BASIN WATERSHED MAP



INLET BASIN WATERSHED DATA					
BASIN NO.	AREA (AC.)	'C'	BASIN NO.	AREA (AC.)	'C'
2	0.365	0.62	7	0.188	0.70
3	0.144	0.79	8	0.098	0.68
3A	0.593	0.20	9	0.162	0.81
4	0.113	0.71	10	0.171	0.85
5	0.044	0.85	11	0.124	0.85
6	0.257	0.75	12	0.810	0.51

NOTE: ALL TIME OF CONCENTRATION VALUES ASSUMED TO BE 5 MINUTES EXCEPT
BASIN NO. 3A (CALCULATED T.O.C. = 7.21 MINUTES)

Marriott Fairfield Inn & Suites
Composite Runoff Coefficient Calculations

Cover	Runoff Coefficient 'C'
Grass	0.20
Pavement/Roof	0.85

Str. No.	Total Area	Grass	Pavement/Roof	Composite 'C'	C x A
2	0.365	0.128	0.237	0.62	0.227
3	0.144	0.012	0.132	0.79	0.115
3A	0.593	0.593		0.20	0.119
4	0.113	0.024	0.089	0.71	0.080
5	0.044		0.044	0.85	0.037
6	0.257	0.040	0.218	0.75	0.193
7	0.188	0.044	0.144	0.70	0.131
8	0.098	0.025	0.073	0.68	0.067
9	0.162	0.011	0.151	0.81	0.131
10	0.171		0.171	0.85	0.145
11	0.124		0.124	0.85	0.105
12	0.810	0.425	0.385	0.51	0.412
TOTALS =	3.069	1.303	1.766	N/A	1.762

Overall Weighted Runoff Coefficient 'C' =

0.597 (excludes Str. No. 12)

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Fairfield - Franklin

Designer: DMS

Date: 9/13/2017

Scenario/Structure: 3A

Sheet Flow

1. Surface Description	grass		pvm		grass
2. Manning's Roughness Coeff., (n)	0.170		0.011		0.170
3. Flow Length, (L) **total L<= 100 ft	60.00 ft.				ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64 in.		2.64 in.		2.64 in.
5. Land Slope, (s)	0.0350 ft./ft.		0.0200 ft./ft.		0.2500 ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.106 hr	+	0.000 hr	+	0.000 hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved		unpaved		unpaved
8. Flow Length, (L)	ft.		ft.		0.00 ft.
9. Watercourse Slope, (s)	0.0050 ft./ft.		0.0135 ft./ft.		0.0060 ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	1.437 ft./s		1.875 ft./s		1.250 ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	+	0.000 hr	+	0.000 hr

Watershed or
Subarea Tc or Tt =

0.120 hr

or

7.21 min

Channel Flow

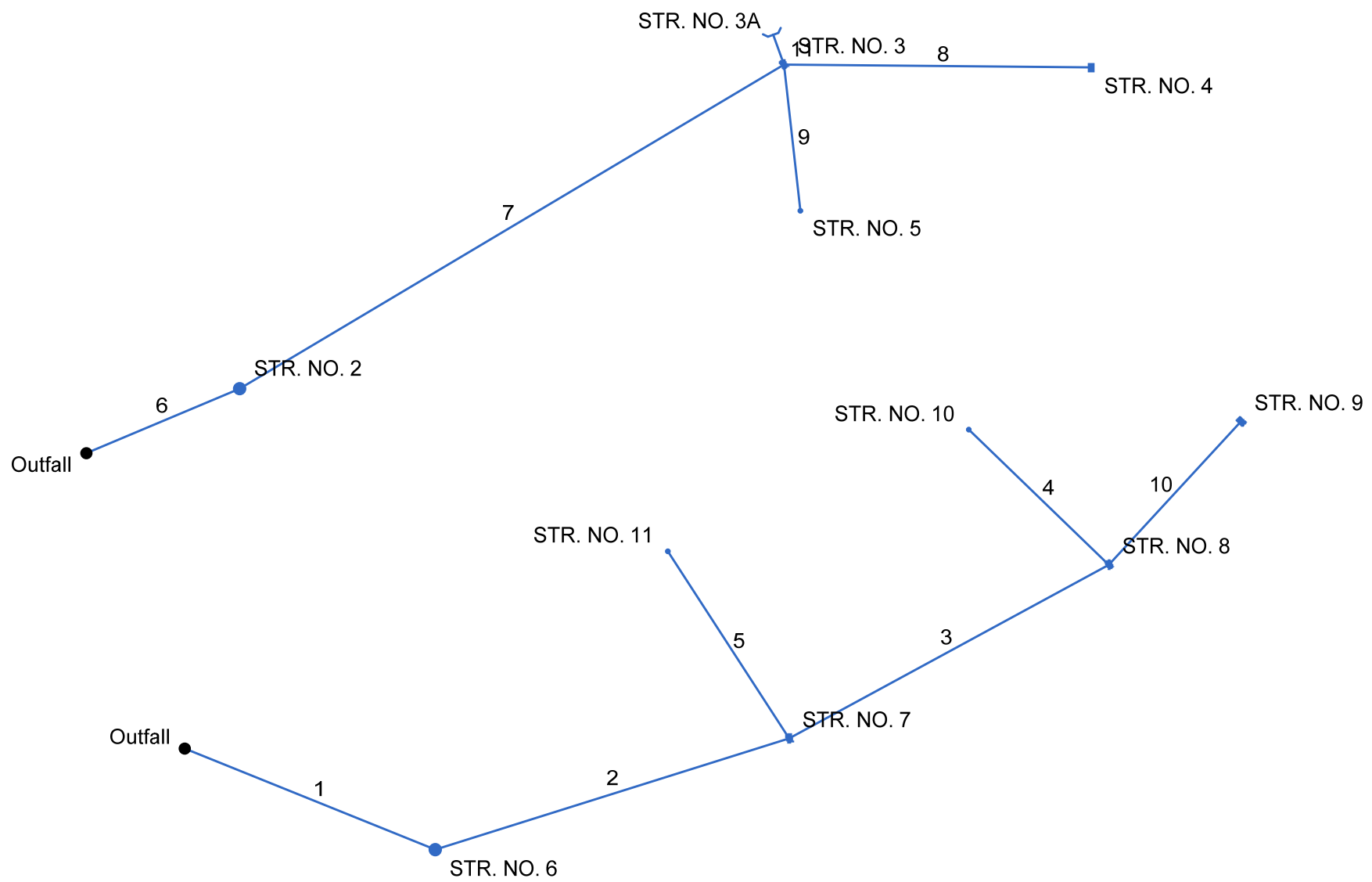
12. Cross Sectional Flow Area, (a)	16.30 ft.^2		132.12 ft.^2		174.24 ft.^2
13. Wetted Perimeter, Pw	32.71 ft.		30.71 ft.		43.74 ft.
14. Hydraulic Radius, (r) (r = a/Pw)	0.498 ft.		4.302 ft.		3.984 ft.
15. Channel Slope, (s)	0.0150 ft./ft.		0.0050 ft./ft.		0.0084 ft./ft.
16. Manning's Roughness Coeff., (n)	0.030		0.012		0.027
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	3.815 ft./s		23.338 ft./s		12.769 ft./s
18. Flow Length, (L)	200.00 ft.		ft.		0.00 ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.015 hr	+	0.000 hr	+	0.000 hr

Hours	Minutes	Return Period - Rainfall Intensity (in/hr)					
		2	5	10	25	50	100
0.08	5	4.75	6.14	6.99	8.08	8.83	9.69
0.17	10	3.63	4.75	5.48	6.40	7.07	7.77
0.25	15	2.97	3.92	4.55	5.34	5.94	6.53
0.5	30	1.98	2.64	3.09	3.65	4.10	4.50
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	0.76	1.02	1.20	1.40	1.59	1.75
3	180	0.56	0.75	0.88	1.03	1.17	1.29
6	360	0.33	0.44	0.52	0.60	0.68	0.75
12	720	0.20	0.26	0.30	0.35	0.39	0.43
24	1440	0.11	0.15	0.17	0.20	0.22	0.25

Hours	Minutes	Return Period - Rainfall Depth (in)					
		2	5	10	25	50	100
0.08	5	0.40	0.51	0.58	0.67	0.74	0.81
0.17	10	0.61	0.79	0.91	1.07	1.18	1.30
0.25	15	0.74	0.98	1.14	1.34	1.49	1.63
0.5	30	0.99	1.32	1.55	1.83	2.05	2.25
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	1.52	2.04	2.40	2.80	3.18	3.50
3	180	1.68	2.25	2.64	3.09	3.51	3.87
6	360	1.98	2.64	3.12	3.60	4.08	4.50
12	720	2.40	3.12	3.60	4.20	4.68	5.16
24	1440	2.64	3.60	4.08	4.80	5.28	6.00

TABLE 202-02: IDF and IDD Tables for Indianapolis, IN

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Storm Sewer Tabulation

Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (I) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr (ac)	Total (ac)		Incr (min)	Total (min)	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
11	7	11.453	0.59	0.59	0.20	0.12	0.12	7.2	7.2	6.2	0.73	2.79	2.29	12	0.52	743.44	743.50	743.99	743.86	746.50	744.50	3A
10	3	70.506	0.16	0.16	0.81	0.13	0.13	5.0	5.0	7.0	0.91	2.11	1.89	12	0.30	743.61	743.82	744.28	744.35	746.18	746.50	9
9	7	53.149	0.04	0.04	0.85	0.03	0.03	5.0	5.0	7.0	0.24	3.96	1.33	12	1.05	743.44	744.00	743.99	744.20	746.50	748.50	5
8	7	110.611	0.11	0.11	0.71	0.08	0.08	5.0	5.0	7.0	0.55	2.11	1.72	12	0.30	743.44	743.77	743.99	744.12	746.50	746.75	4
7	6	228.395	0.14	0.88	0.79	0.11	0.34	5.0	7.9	6.0	2.05	3.85	2.88	15	0.30	742.50	743.19	743.33	743.81	746.50	746.50	3
6	End	59.954	0.37	1.25	0.62	0.23	0.57	5.0	10.1	5.4	3.11	4.52	4.05	15	0.42	742.25	742.50	742.96	743.29	743.75	746.50	2
5	2	80.499	0.12	0.12	0.85	0.10	0.10	5.0	5.0	7.0	0.71	2.72	2.15	12	0.50	743.35	743.75	743.96	744.10	746.35	748.25	11
4	3	70.196	0.17	0.17	0.85	0.14	0.14	5.0	5.0	7.0	1.01	2.88	2.50	12	0.56	743.61	744.00	744.28	744.42	746.18	748.25	10
3	2	131.106	0.10	0.43	0.68	0.07	0.34	5.0	6.0	6.6	2.26	3.12	2.60	15	0.20	743.10	743.36	743.96	744.17	746.35	746.18	8
2	1	133.694	0.19	0.74	0.70	0.13	0.58	5.0	7.2	6.2	3.59	5.82	2.68	18	0.26	742.50	742.85	743.68	743.82	746.50	746.35	7
1	End	97.372	0.26	1.00	0.75	0.20	0.77	5.0	8.2	5.9	4.58	5.76	4.00	18	0.26	742.25	742.50	743.08	743.56	743.75	746.50	6
Project File: Fairfield Franklin-Storm Sewer.stm																Number of lines: 11				Run Date: 9/14/2017		
NOTES:Intensity = 57.92 / (Inlet time + 9.10) ^ 0.80; Return period =Yrs. 10 ; c = cir e = ellip b = box																						

HY-8 Culvert Analysis Report

Str. No. 12

15" Pipe Culvert

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 4 cfs

Maximum Flow: 10 cfs

Table 1 - Summary of Culvert Flows at Crossing: Fairfield

Headwater Elevation (ft)	Total Discharge (cfs)	Str. No. 12 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
741.80	0.00	0.00	0.00	1
742.41	1.00	1.00	0.00	1
742.68	2.00	2.00	0.00	1
742.91	3.00	3.00	0.00	1
743.12	4.00	4.00	0.00	1
743.34	5.00	5.00	0.00	1
743.73	6.00	6.00	0.00	1
744.23	7.00	7.00	0.00	1
744.77	8.00	8.00	0.00	1
745.37	9.00	9.00	0.00	1
746.00	10.00	9.94	0.02	53
746.00	9.94	9.94	0.00	Overtopping

Rating Curve Plot for Crossing: Fairfield

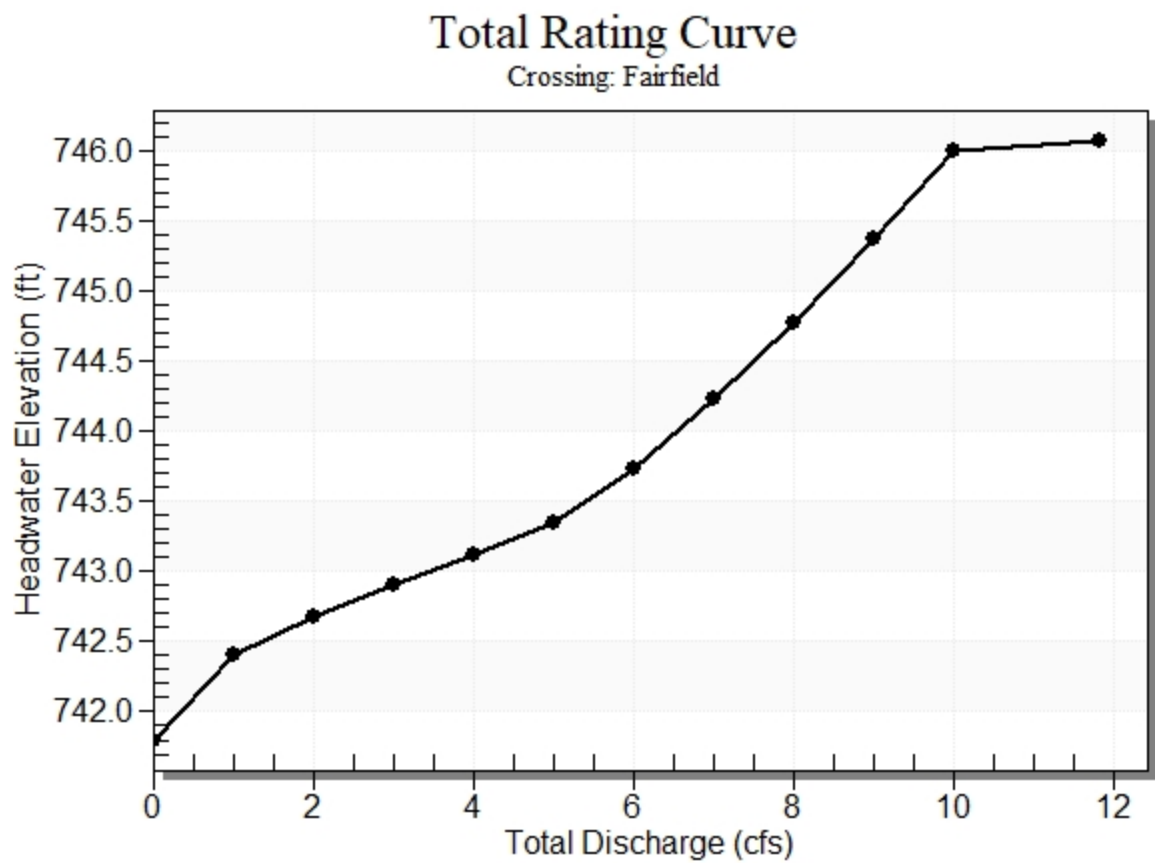


Table 2 - Culvert Summary Table: Str. No. 12

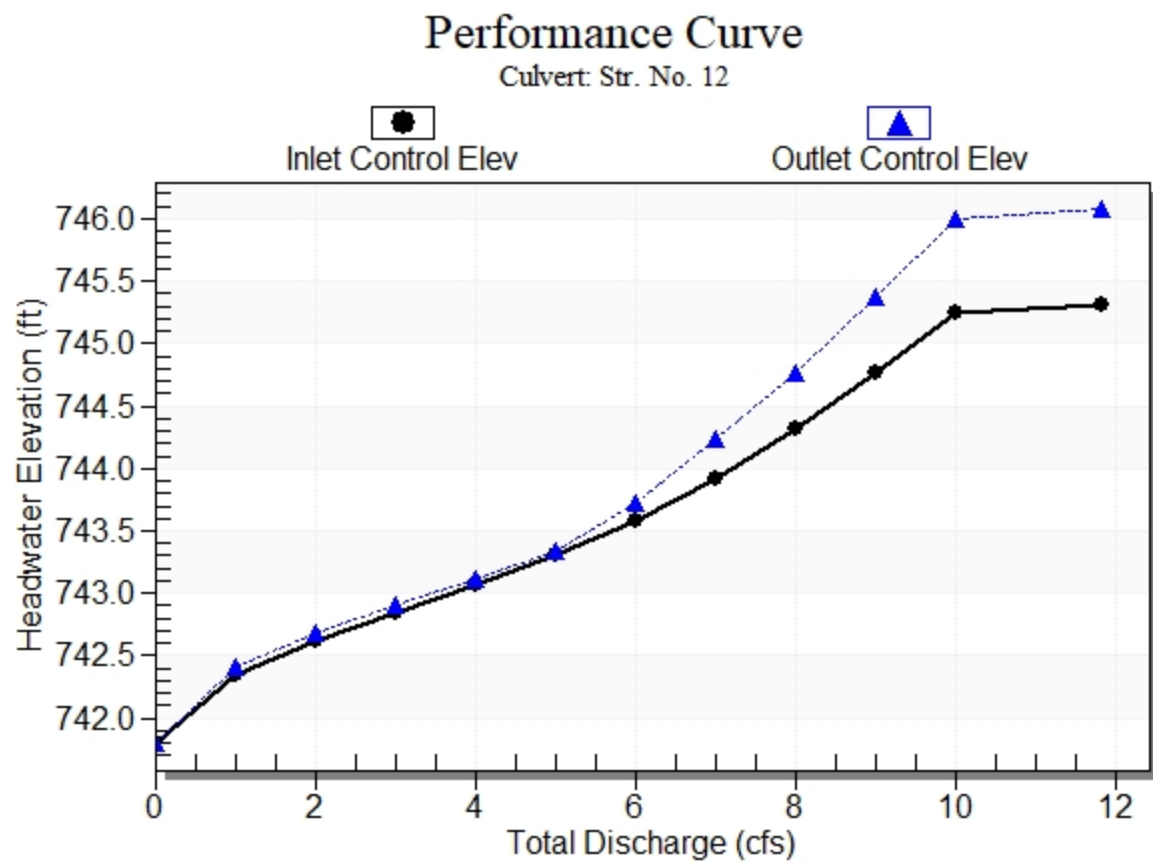
Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	741.80	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.00	1.00	742.41	0.544	0.606	3-M1t	0.393	0.389	0.420	0.420	2.761	1.133
2.00	2.00	742.68	0.814	0.881	2-M2c	0.577	0.563	0.563	0.545	3.728	1.347
3.00	3.00	742.91	1.045	1.107	2-M2c	0.737	0.694	0.694	0.634	4.289	1.491
4.00	4.00	743.12	1.262	1.317	7-M2c	0.903	0.805	0.805	0.707	4.790	1.602
5.00	5.00	743.34	1.501	1.544	7-M2c	1.250	0.904	0.904	0.768	5.264	1.694
6.00	6.00	743.73	1.782	1.928	7-M2c	1.250	0.987	0.987	0.823	5.775	1.773
7.00	7.00	744.23	2.118	2.433	7-M2c	1.250	1.057	1.057	0.872	6.322	1.843
8.00	8.00	744.77	2.512	2.972	7-M2c	1.250	1.115	1.115	0.916	6.925	1.905
9.00	9.00	745.37	2.965	3.573	7-M2c	1.250	1.155	1.155	0.958	7.598	1.962
10.00	9.94	746.00	3.441	4.204	7-M2c	1.250	1.179	1.179	0.996	8.290	2.015

Straight Culvert

Inlet Elevation (invert): 741.80 ft, Outlet Elevation (invert): 741.41 ft

Culvert Length: 91.00 ft, Culvert Slope: 0.0043

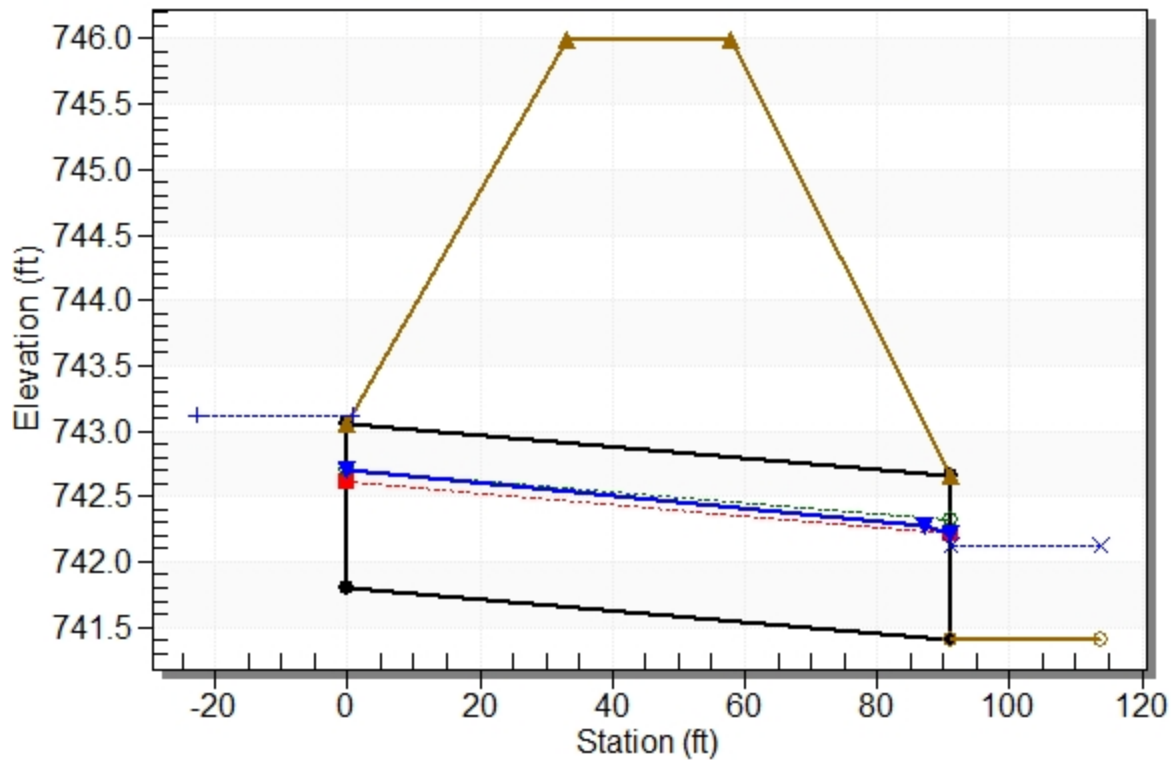
Culvert Performance Curve Plot: Str. No. 12



Water Surface Profile Plot for Culvert: Str. No. 12

Crossing - Fairfield, Design Discharge - 4.0 cfs

Culvert - Str. No. 12, Culvert Discharge - 4.0 cfs



Site Data - Str. No. 12

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 741.80 ft

Outlet Station: 91.00 ft

Outlet Elevation: 741.41 ft

Number of Barrels: 1

Culvert Data Summary - Str. No. 12

Barrel Shape: Circular

Barrel Diameter: 1.25 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Fairfield)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	741.41	0.00	0.00	0.00	0.00
1.00	741.83	0.42	1.13	0.11	0.44
2.00	741.95	0.54	1.35	0.15	0.45
3.00	742.04	0.63	1.49	0.17	0.47
4.00	742.12	0.71	1.60	0.19	0.48
5.00	742.18	0.77	1.69	0.21	0.48
6.00	742.23	0.82	1.77	0.22	0.49
7.00	742.28	0.87	1.84	0.23	0.49
8.00	742.33	0.92	1.91	0.25	0.50
9.00	742.37	0.96	1.96	0.26	0.50
10.00	742.41	1.00	2.01	0.27	0.50

Tailwater Channel Data - Fairfield

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 5.00 (1:1)

Channel Slope: 0.0043

Channel Manning's n: 0.0300

Channel Invert Elevation: 741.41 ft

Roadway Data for Crossing: Fairfield

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 25.00 ft

Crest Elevation: 746.00 ft

Roadway Surface: Paved

Roadway Top Width: 25.00 ft

Section 6: Storm Inlet/Grate Calculations

Storm Inlet Summary

Storm inlets were placed throughout the site to ensure that sag inlets will be adequate to pass the design 10-year flow with 50% of the sag inlet clogged with the maximum depth of water not exceeding nine (9) inches. The castings used for all parking lot inlets, located in a sag, are Neenah R-3287-10V. Each inlet grate has a perimeter of 5.5 ft. and an open area of 2.1 ft.². To simulate a clogged inlet, these dimensions would be reduced by 50%. Using the weir equation, the actual depth over each grate based on the watershed runoff can be calculated as follows:

$$Q = 3.3P(h)^{1.5}$$

Where: P = perimeter of the grate; h = head above the casting; Q = Capacity

Using the orifice equation, the maximum grate capacity with 9 inches of ponding can be calculated as follows:

$$Q = 0.6A\sqrt{2gh}$$

Where: A = open area of the grate, h = head above the casting; Q = Capacity

The following table indicates inlet capacity and corresponding ponding at each inlet. Please refer to Exhibit 6: Inlet Basin Watershed Map for additional information.

Structure No.	Casting Type	Watershed Runoff	Actual Depth Over Grate	Max. Grate Capacity @ 50% Clogged	Depth Over Grate @ 50% Max. Capacity
2	R-3287-10V	1.61 cfs	0.33'	4.40 cfs	0.75'
3	R-3287-10V	0.77 cfs	0.19'	4.40 cfs	0.75'
4	R-3287-10V	0.55 cfs	0.16'	4.40 cfs	0.75'
6	R-3287-10V	1.36 cfs	0.29'	4.40 cfs	0.75'
7	R-3287-10V	0.93 cfs	0.23'	4.40 cfs	0.75'
8	R-3287-10V	0.48 cfs	0.15'	4.40 cfs	0.75'
9	R-3287-10V	0.91 cfs	0.22'	4.40 cfs	0.75'

Section 7: General Model Setup

The following information provides detailed explanations of the general model setup, input and output reports for each of the Autodesk Storm and Sanitary Analysis hydrologic models (pre-development, post-development, and detention) utilized to design the stormwater detention system.

A. Project Description / Analysis Options

The “Project Description” spreadsheets indicate the general network analysis options, number of network items (i.e. subbasins, links, junctions, storage nodes, etc.), and rainfall details utilized for each network design.

B. Subbasin Summary

Drainage areas for each subbasin were delineated using survey data collected, GIS contours, the construction plans and site visit investigations. The “Subbasin Summary” spreadsheets indicate the user defined input data for each individual subbasin including the subbasin ID, area, weighted curve number or weighted runoff coefficient, and time of concentration.

As previously stated, the analysis uses the SCS TR-55 method to calculate subbasin time of concentrations.

The “Subbasin Summary” spreadsheets indicate the subbasin ID, total subbasin area, weighted curve number or weighted runoff coefficient, total rainfall, total runoff, total runoff volume, peak runoff, and time of concentration for each subbasin.

The respective subbasins, “Sub-Pre” and “Sub-Post”, correspond to the drainage basins in each individual model (i.e. Pre-Development, Post-Development, and Detention Models).

C. Node Summary

The “Node Summary” spreadsheets indicate the user defined input data for each individual junction, outfall or storage node including the node ID, type, invert elevation, rim elevation and initial water surface elevation. User defined input data for each node was entered based on topographic survey information.

The “Node Summary” spreadsheets also indicate the surcharge elevation (if applicable), pond area (if applicable), peak inflow, maximum HGL elevation attained, maximum surcharge depth (if applicable), minimum freeboard.

In the pre-development conditions model, the node listed in the “Node Summary” corresponds to the outlet point where runoff leaves the existing site (“Out-1”).

In the post-development conditions model, the node listed in the “Node Summary” corresponds to the outlet point where runoff will leave the proposed pond (“Out-1”).

In the detention model, the nodes listed in the “Node Summary” correspond to the actual detention pond outlet (“Out-1”) which is the pipe end section at the downstream end of Str. No. 1, the detention pond outlet structure (“Jun-01”), and the proposed detention pond (“Stor-01”).

D. Link Summary

The “Link Summary” spreadsheets indicate the user defined input data for each individual pipe, orifice or weir link including the link ID, type, inlet node, outlet node, length, inlet invert elevation, outlet invert elevation, slope, diameter and Manning’s roughness coefficient.

The “Link Summary” spreadsheets also indicate the peak flow, design flow capacity, peak flow to design flow ratio, peak flow velocity, peak flow depth, peak flow depth to design flow depth, total time the link is surcharged and the condition of the link at peak flow.

In the detention model, the links listed in the “Link Summary” spreadsheet correspond to the 12” RCP leaving the detention pond outlet structure (“Link-01”) and the outlet structure orifices (“Orifice-WQ” and “Orifice-100yr”).

E. Subbasin Hydrology

The “Subbasin Hydrology” spreadsheets include the detailed composite curve number and time of concentration calculations for each subbasin. The “Subbasin Hydrology” spreadsheets also include the subbasin runoff results, rainfall intensity graph and runoff hydrograph for each subbasin.

F. Junction Input

The “Junction Input” spreadsheets indicate the user defined input data for each individual junction including the ID, invert elevation, rim elevation, initial water surface elevation, surcharge elevation and ponded area.

G. Junction Results

The “Junction Results” spreadsheets include modeling results at the user defined junctions as a result of the storm event being routed through the system. The “Junction Results” spreadsheets include the peak inflow, peak lateral inflow, maximum HGL elevation attained, maximum HGL depth attained, maximum surcharge depth attained, minimum freeboard attained, average HGL elevation attained, average HGL depth attained, time of maximum HGL occurrence, time of peak flooding occurrence, total flooded volume and total time flooded.

H. Pipe Input

The “Pipe Input” spreadsheets indicate the user defined input data for each individual pipe including the ID, length, inlet invert elevation, outlet invert elevation, average slope, pipe shape, diameter, Manning’s roughness coefficient, losses and the number of barrels.

I. Pipe Results

The “Pipe Results” spreadsheets include modeling results at the user defined pipes as a result of the storm event being routed through the system. The “Pipe Results” spreadsheets include the peak inflow, time of peak flow occurrence, design flow capacity, peak flow to design flow ratio, peak flow velocity, travel time, peak flow depth, peak flow depth to total depth ratio, total time surcharged and reported condition of the pipe at peak flow.

J. Storage Nodes

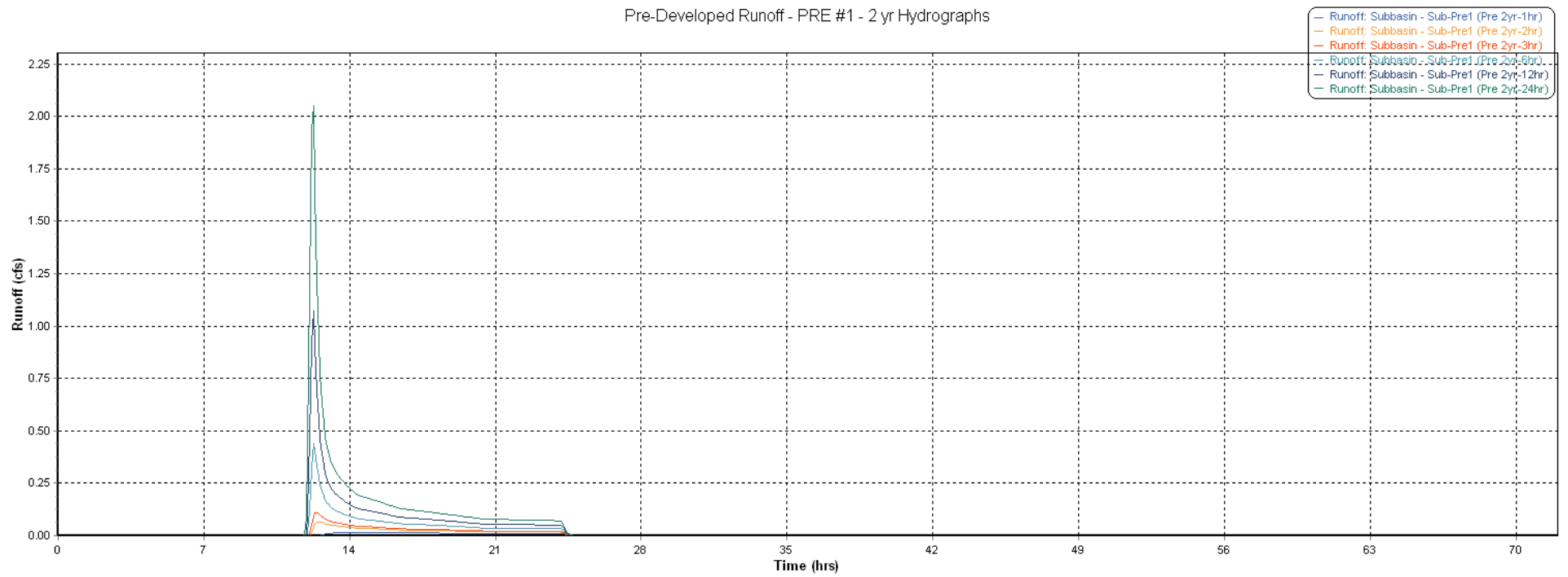
In the detention model, the “Storage Nodes” spreadsheets indicate the user defined input data for the storage node (i.e. detention pond) including the invert elevation, maximum elevation, initial water elevation, ponded area and the outflow weir or orifice for the storage node. The “Storage Nodes” spreadsheets also include the user defined Storage Area Volume Curves which calculates the storage volume at a defined stage depth using the storage area. The Storage Area Volume Curves were defined using the proposed contours from the construction plans.

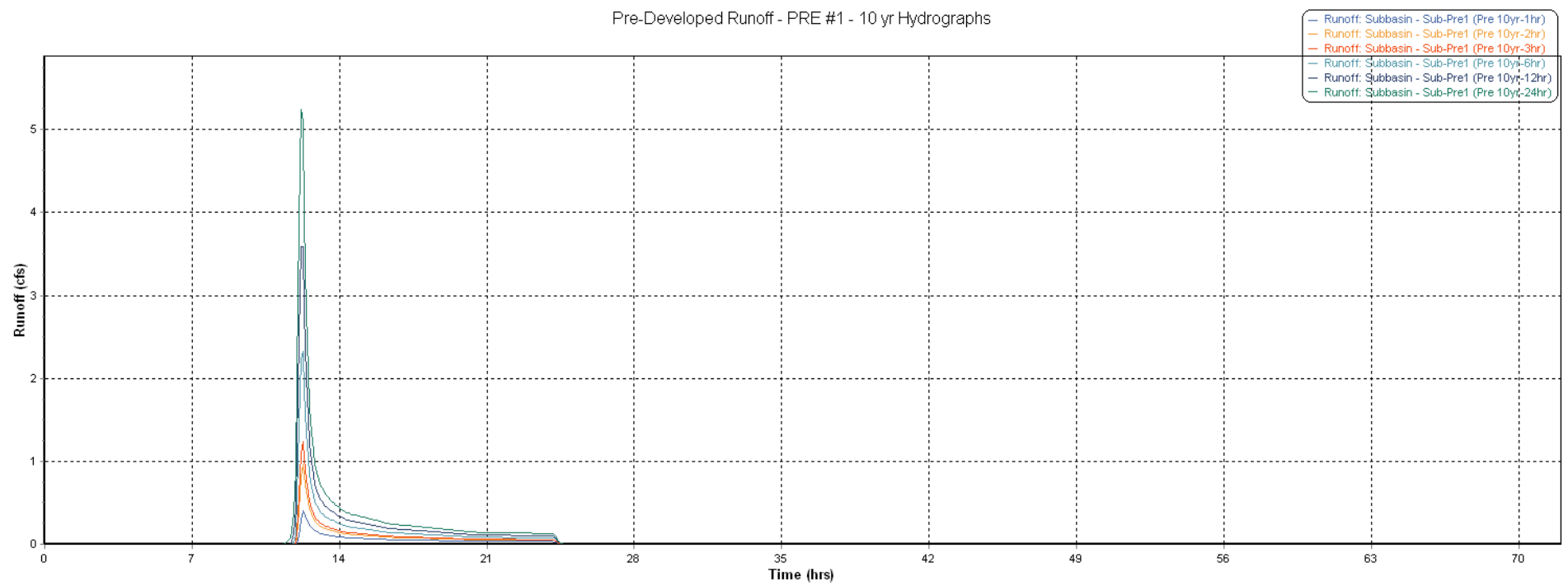
The “Storage Nodes” spreadsheets also include the output summary results obtained by routing the storm event through the system. The critical results included in the spreadsheet are the peak inflow, peak lateral inflow, peak outflow and maximum HGL attained.

Appendix A: Pre-Development Runoff Data

□ 2 yr Hydrographs.....	A-1
□ 10 yr Hydrographs.....	A-2
□ 2 yr-24 hr Peak Storm Event Analysis Results.....	A-3 – A-8
□ 10 yr-24 hr Peak Storm Event Analysis Results.....	A-9 – A-14

Pre-Developed Runoff - PRE #1 - 2 yr Hydrographs





Project Description

File Name Thompson Farms - Pre Developed.SPF
Description
Pre-Developed Conditions

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-20
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Aug 28, 2017 00:00:00
End Analysis On Aug 31, 2017 00:00:00
Start Reporting On Aug 28, 2017 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	2
Subbasins.....	1
Nodes.....	1
<i>Junctions</i>	0
<i>Outfalls</i>	1
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	0
<i>Channels</i>	0
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	2yr-24hr	Cumulative	inches	Indiana	Johnson	2	2.91	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Pre1	4.50	67.00	2.91	0.54	2.43	2.10	0 00:20:54

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Pre1

Input Data

Area (ac) 4.50
Weighted Curve Number 67.00
Rain Gage ID

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture/OpenSpace	4.50	-	67.00
Composite Area & Weighted CN	4.50		67.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

T_c = Time of Concentration (hr)
 n = Manning's roughness
 L_f = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

$V = 16.1345 * (S_f^{0.5})$ (unpaved surface)
 $V = 20.3282 * (S_f^{0.5})$ (paved surface)
 $V = 15.0 * (S_f^{0.5})$ (grassed waterway surface)
 $V = 10.0 * (S_f^{0.5})$ (nearly bare & untilled surface)
 $V = 9.0 * (S_f^{0.5})$ (cultivated straight rows surface)
 $V = 7.0 * (S_f^{0.5})$ (short grass pasture surface)
 $V = 5.0 * (S_f^{0.5})$ (woodland surface)
 $V = 2.5 * (S_f^{0.5})$ (forest w/heavy litter surface)
 $T_c = (L_f / V) / (3600 \text{ sec/hr})$

Where:

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)

Channel Flow Equation :

$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$
 $R = A_q / W_p$
 $T_c = (L_f / V) / (3600 \text{ sec/hr})$

Where :

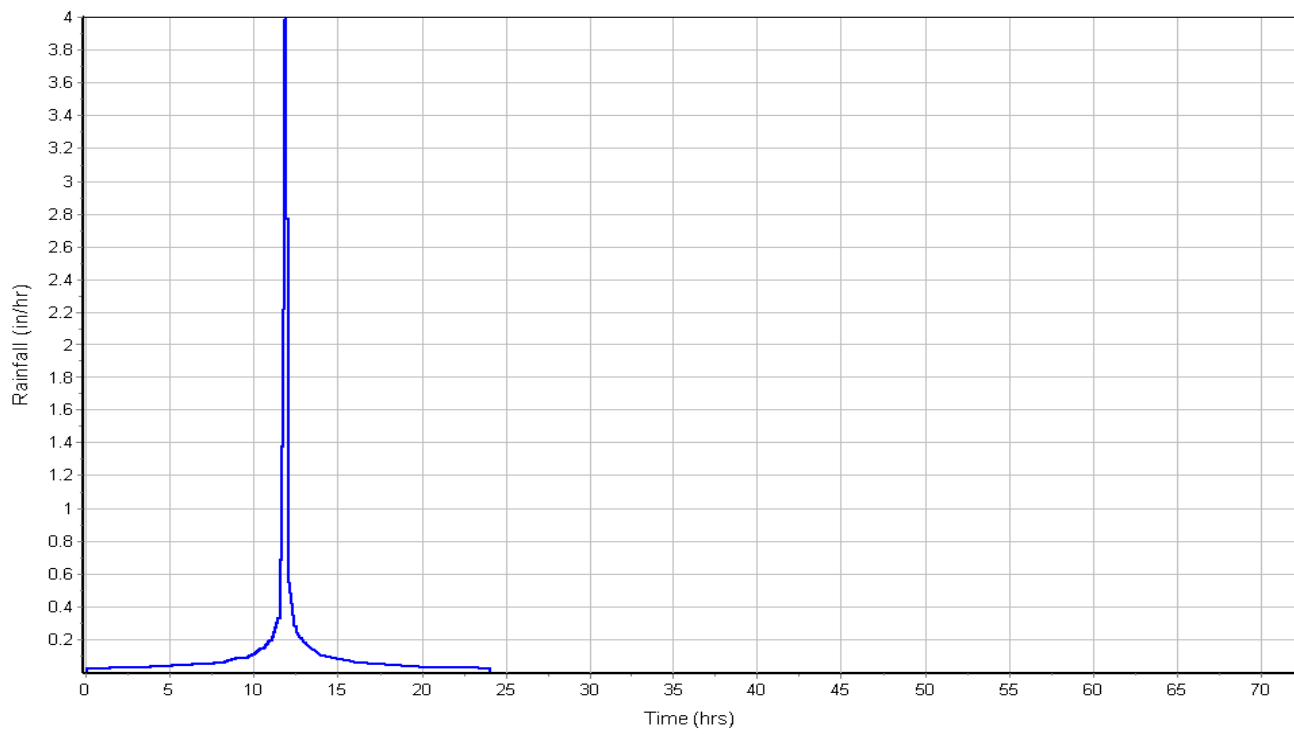
T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 R = Hydraulic Radius (ft)
 A_q = Flow Area (ft²)
 W_p = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)
 n = Manning's roughness

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.20	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2.50	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.64	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.42	0.00	0.00
Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	458	0.00	0.00
Slope (%) :	1.65	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.90	0.00	0.00
Computed Flow Time (min) :	8.48	0.00	0.00
Total TOC (min)	20.90		

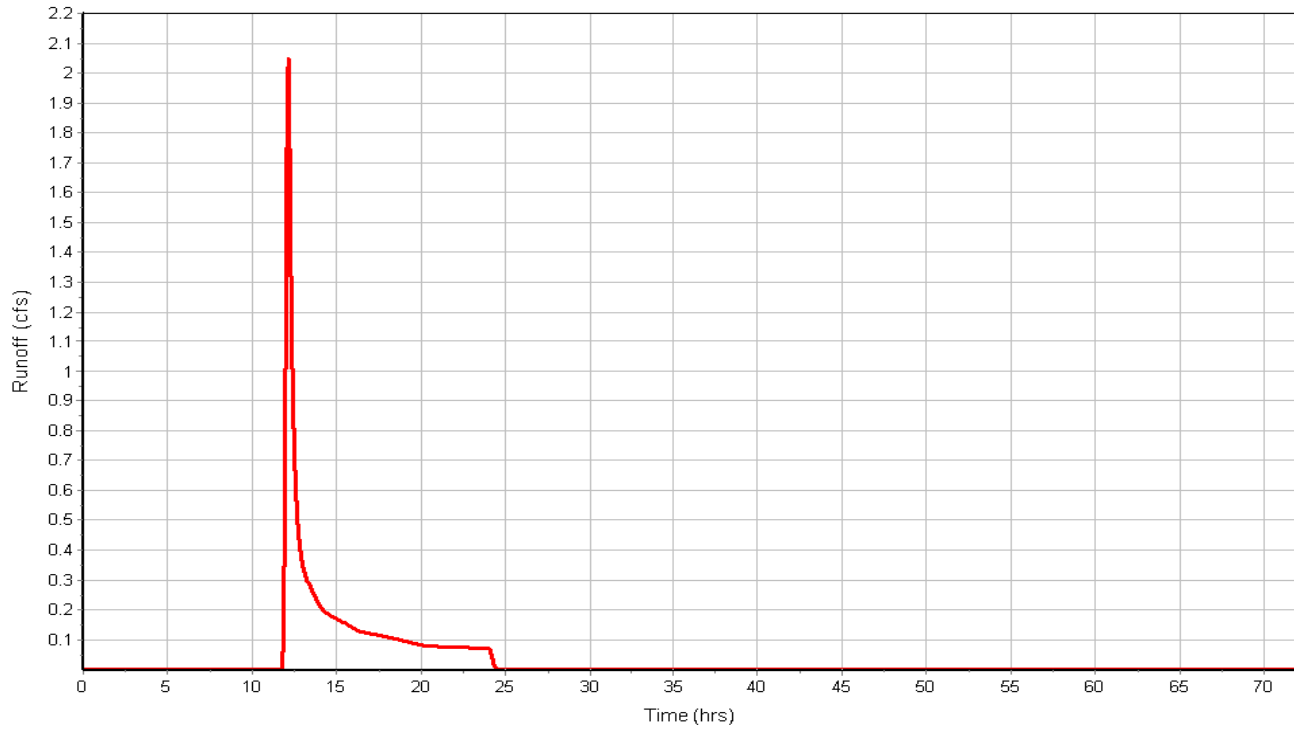
Subbasin Runoff Results

Total Rainfall (in)	2.91
Total Runoff (in)	0.54
Peak Runoff (cfs)	2.10
Weighted Curve Number	67.00
Time of Concentration (days hh:mm:ss)	0 00:20:54

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name	Thompson Farms - Pre Developed.SPF
Description	Pre-Developed Conditions

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	2
Subbasins.....	1
Nodes.....	1
<i>Junctions</i>	0
<i>Outfalls</i>	1
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	0
<i>Channels</i>	0
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	10yr-24hr	Cumulative	inches	Indiana	Johnson	10	4.08	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Pre1	4.50	67.00	4.08	1.19	5.37	5.41	0 00:20:54

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Pre1

Input Data

Area (ac) 4.50
Weighted Curve Number 67.00
Rain Gage ID

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture/OpenSpace	4.50	-	67.00
Composite Area & Weighted CN	4.50		67.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
 n = Manning's roughness
 L_f = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

$V = 16.1345 * (S_f^{0.5})$ (unpaved surface)
 $V = 20.3282 * (S_f^{0.5})$ (paved surface)
 $V = 15.0 * (S_f^{0.5})$ (grassed waterway surface)
 $V = 10.0 * (S_f^{0.5})$ (nearly bare & untilled surface)
 $V = 9.0 * (S_f^{0.5})$ (cultivated straight rows surface)
 $V = 7.0 * (S_f^{0.5})$ (short grass pasture surface)
 $V = 5.0 * (S_f^{0.5})$ (woodland surface)
 $V = 2.5 * (S_f^{0.5})$ (forest w/heavy litter surface)
 $T_c = (L_f / V) / (3600 \text{ sec/hr})$

Where:

T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)

Channel Flow Equation :

$V = (1.49 * (R^{2/3})) * (S_f^{0.5}) / n$
 $R = A_q / W_p$
 $T_c = (L_f / V) / (3600 \text{ sec/hr})$

Where :

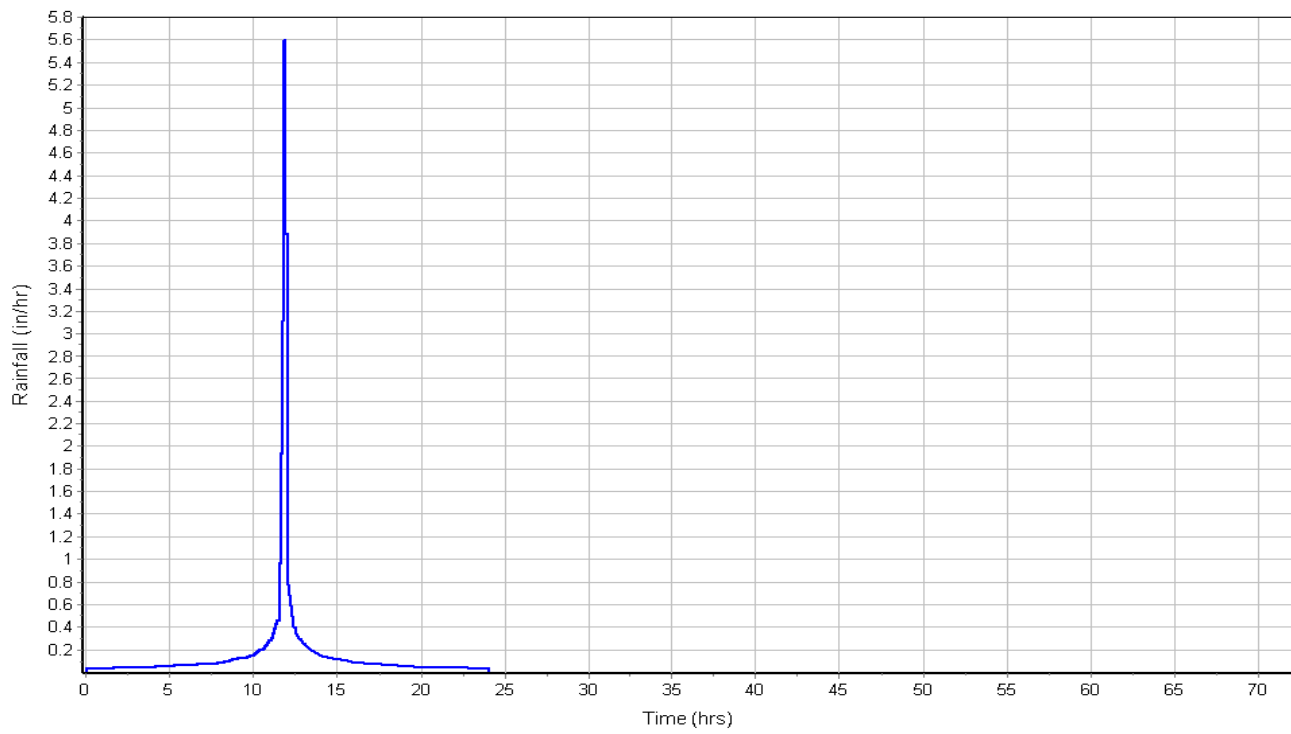
T_c = Time of Concentration (hr)
 L_f = Flow Length (ft)
 R = Hydraulic Radius (ft)
 A_q = Flow Area (ft²)
 W_p = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 S_f = Slope (ft/ft)
 n = Manning's roughness

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.20	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2.50	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.64	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.42	0.00	0.00
Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	458	0.00	0.00
Slope (%) :	1.65	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.90	0.00	0.00
Computed Flow Time (min) :	8.48	0.00	0.00
Total TOC (min)	20.90		

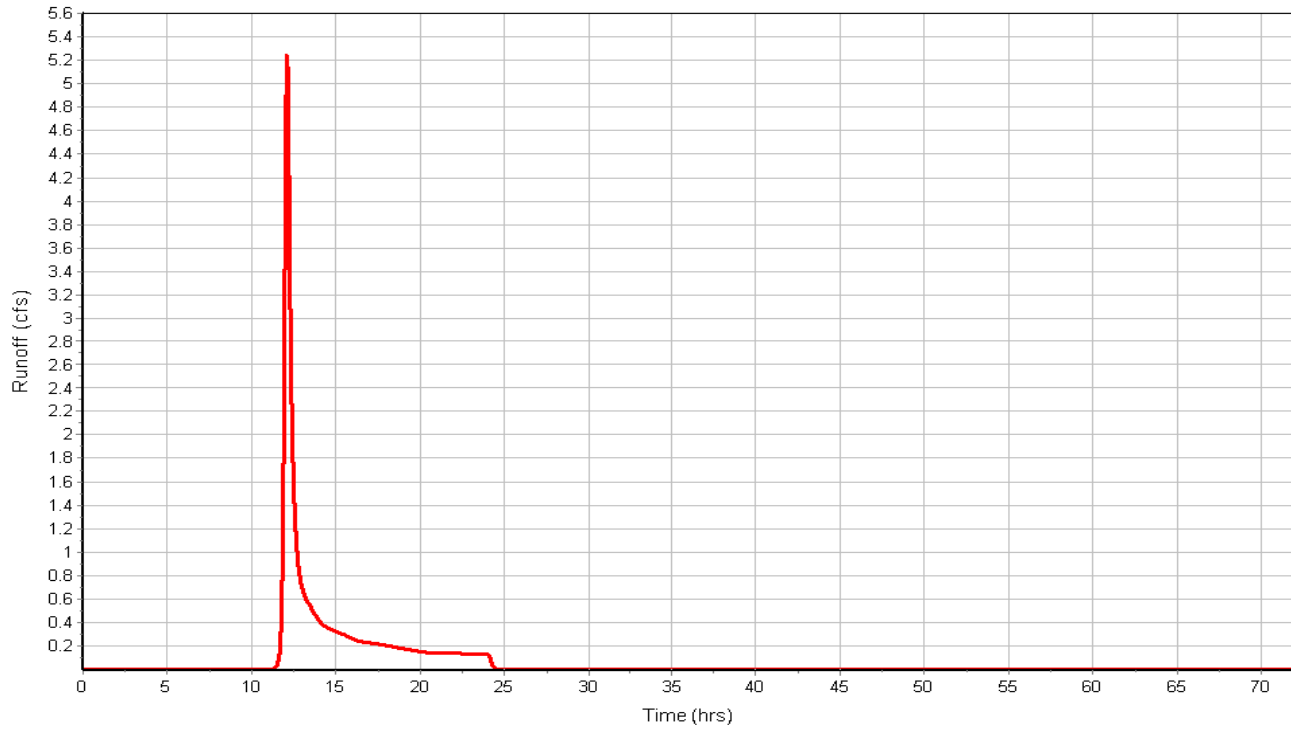
Subbasin Runoff Results

Total Rainfall (in)	4.08
Total Runoff (in)	1.19
Peak Runoff (cfs)	5.41
Weighted Curve Number	67.00
Time of Concentration (days hh:mm:ss)	0 00:20:54

Rainfall Intensity Graph

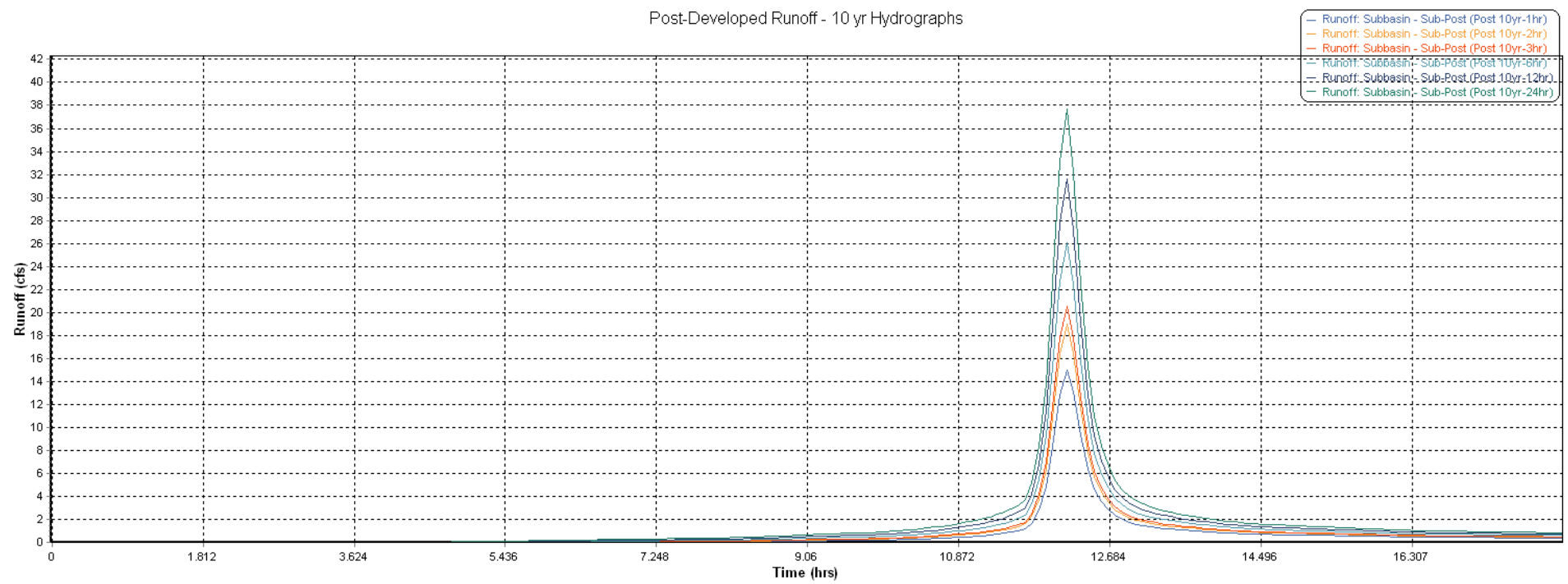


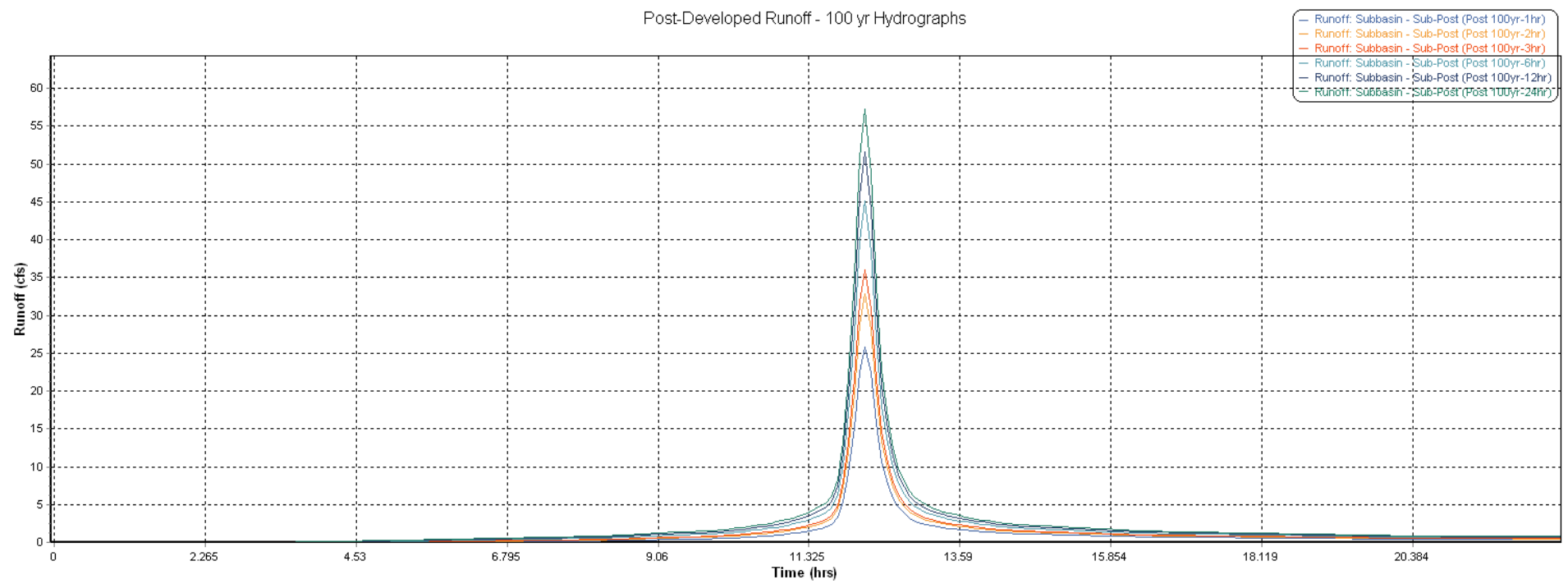
Runoff Hydrograph



Appendix B: Post-Development Runoff Data

□ 10 yr Hydrographs.....	B-1
□ 100 yr Hydrographs.....	B-2
□ 1.25” Storm Event Analysis Results.....	B-3 – B-7
□ 10 yr-24 hr Peak Storm Event Analysis Results.....	B-8 – B-12
□ 100 yr-24 hr Peak Storm Event Analysis Results.....	B-13 – B-17





Project Description

File Name Thompson Farms - Post Developed.SPF
Description
Thompson Farms
Post-Developed Conditions

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-20
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Aug 28, 2017 00:00:00
End Analysis On Aug 31, 2017 00:00:00
Start Reporting On Aug 28, 2017 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	3
Subbasins.....	1
Nodes.....	1
<i>Junctions</i>	0
<i>Outfalls</i>	1
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	0
<i>Channels</i>	0
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	1.25" Storm	Cumulative	inches	Indiana	Johnson	1	1.25	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-Post	10.73	90.33	1.25	0.51	5.46	6.74	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

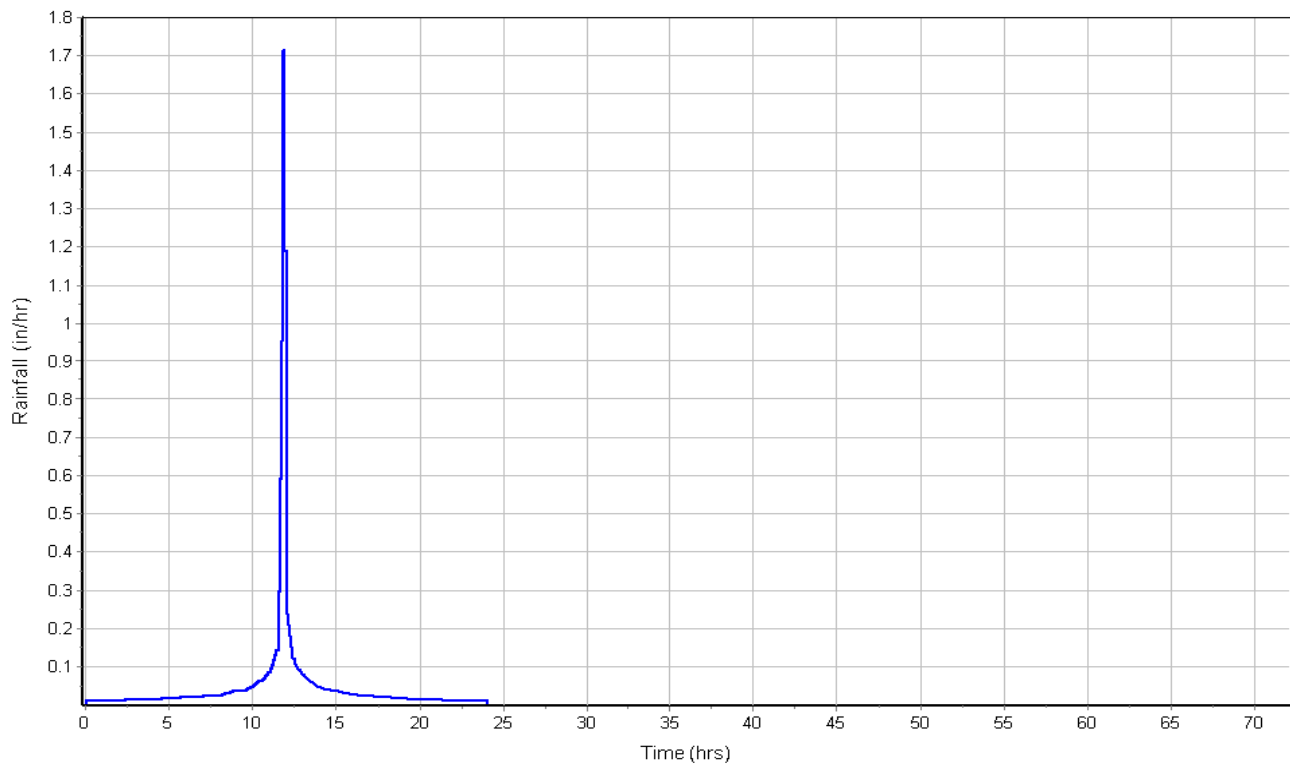
T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 15.00

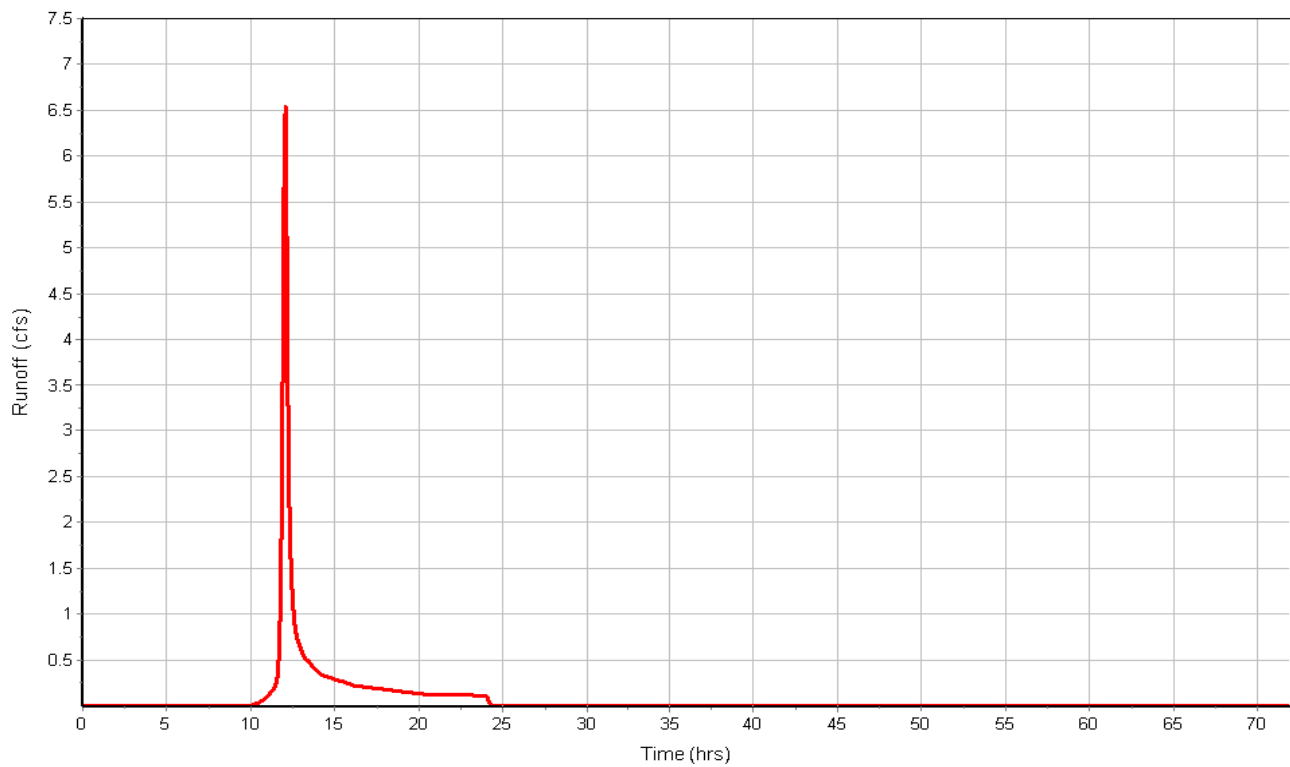
Subbasin Runoff Results

Total Rainfall (in) 1.25
Total Runoff (in) 0.51
Peak Runoff (cfs) 6.74
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name Thompson Farms - Post Developed.SPF
Description Thompson Farms
Post-Developed Conditions

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-20
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Aug 28, 2017 00:00:00
End Analysis On Aug 31, 2017 00:00:00
Start Reporting On Aug 28, 2017 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	2
Subbasins.....	1
Nodes.....	1
<i>Junctions</i>	0
<i>Outfalls</i>	1
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	0
<i>Channels</i>	0
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	10yr-24hr	Cumulative	inches	Indiana	Johnson	10	4.08	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-Post	10.73	90.33	4.08	3.03	32.49	39.14	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

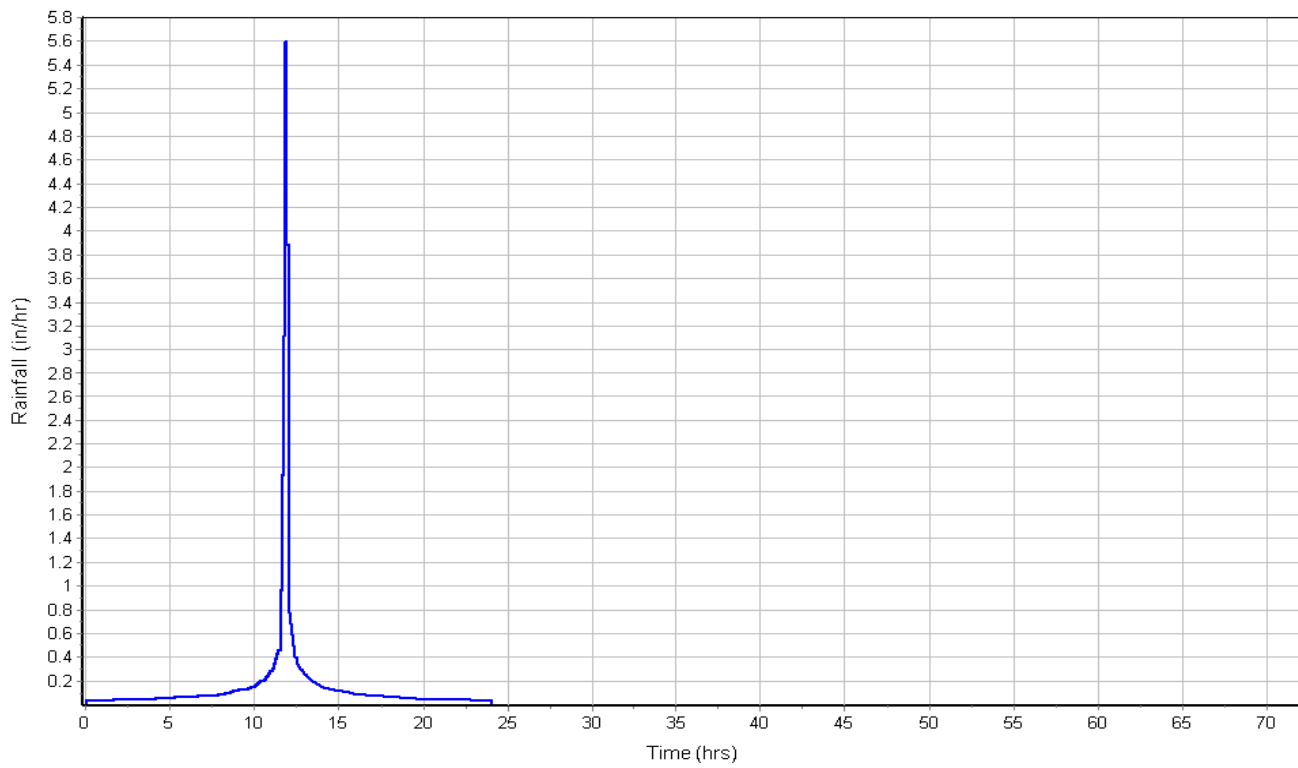
T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 15.00

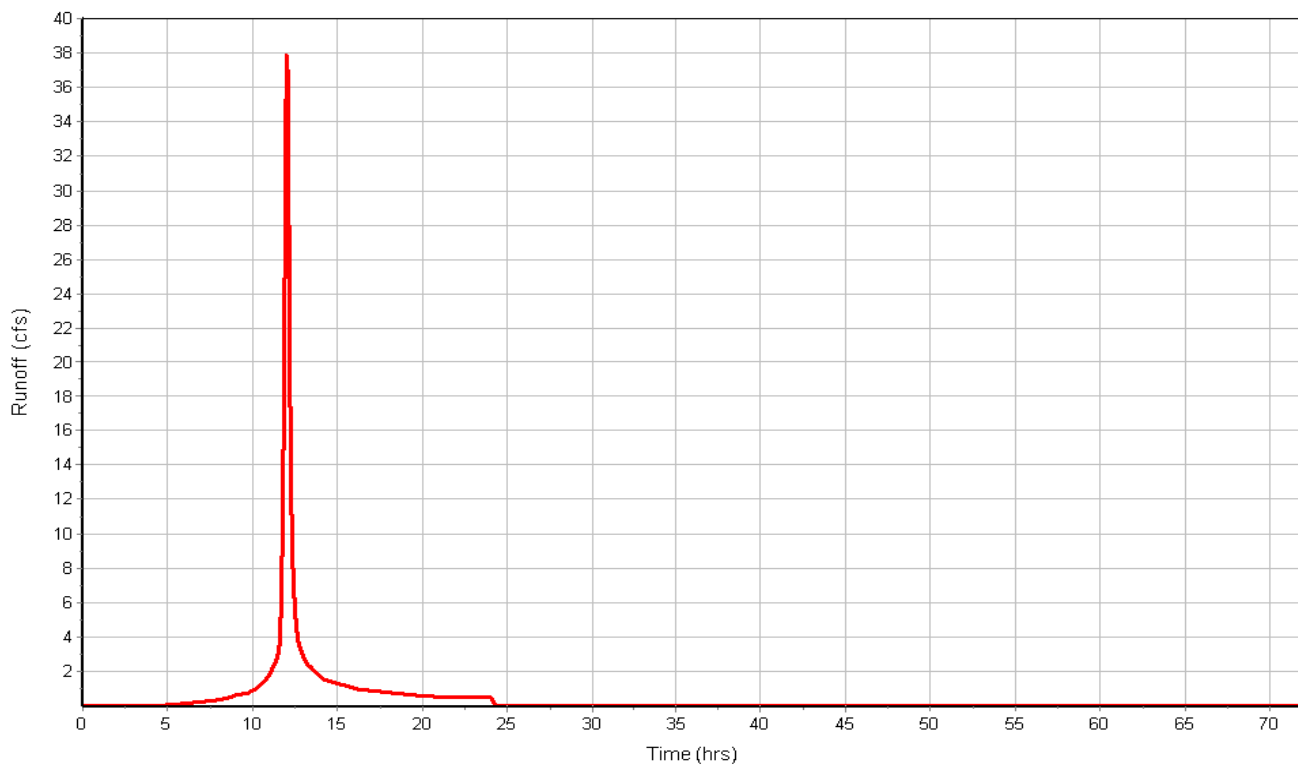
Subbasin Runoff Results

Total Rainfall (in) 4.08
Total Runoff (in) 3.03
Peak Runoff (cfs) 39.14
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name Thompson Farms - Post Developed.SPF
Description
Thompson Farms
Post-Developed Conditions

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-20
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Aug 28, 2017 00:00:00
End Analysis On Aug 31, 2017 00:00:00
Start Reporting On Aug 28, 2017 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	2
Subbasins.....	1
Nodes.....	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links.....	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	100yr-24hr	Cumulative	inches	Indiana	Johnson	100	5.87	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-Post	10.73	90.33	5.87	4.76	51.03	59.93	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

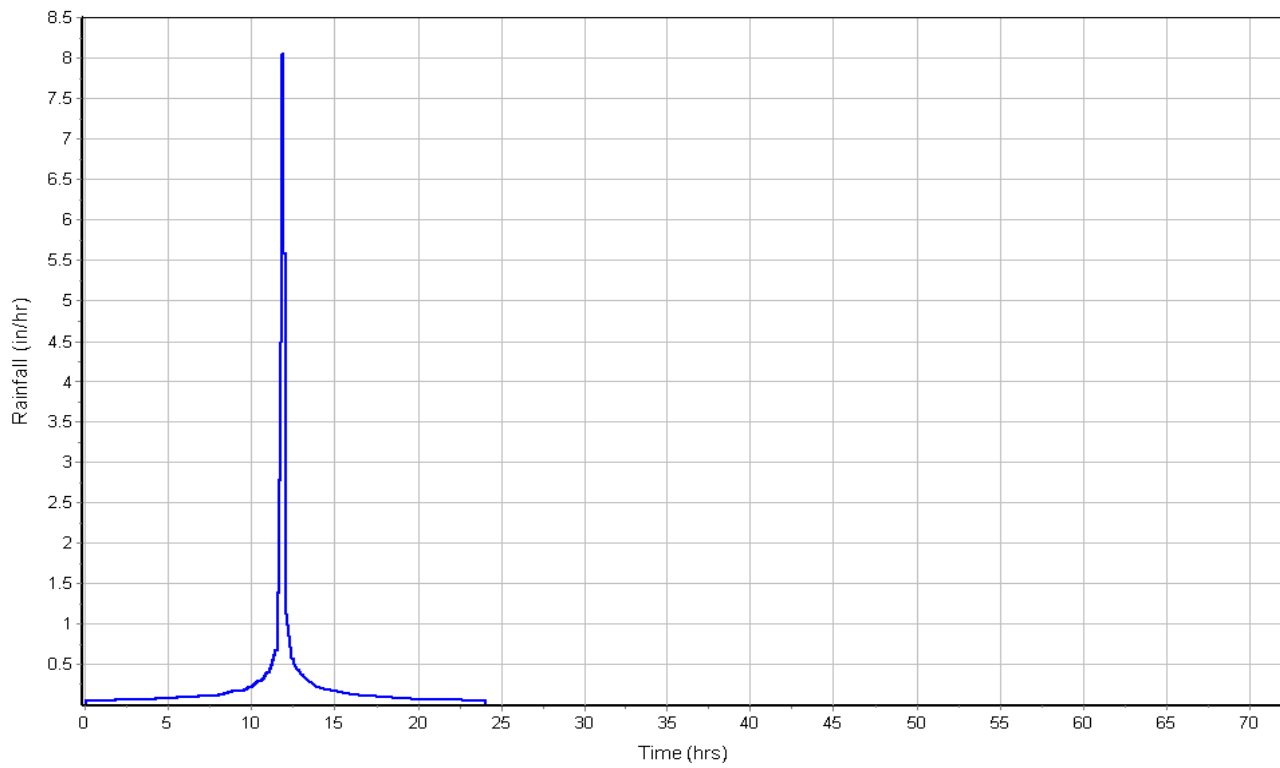
T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 15.00

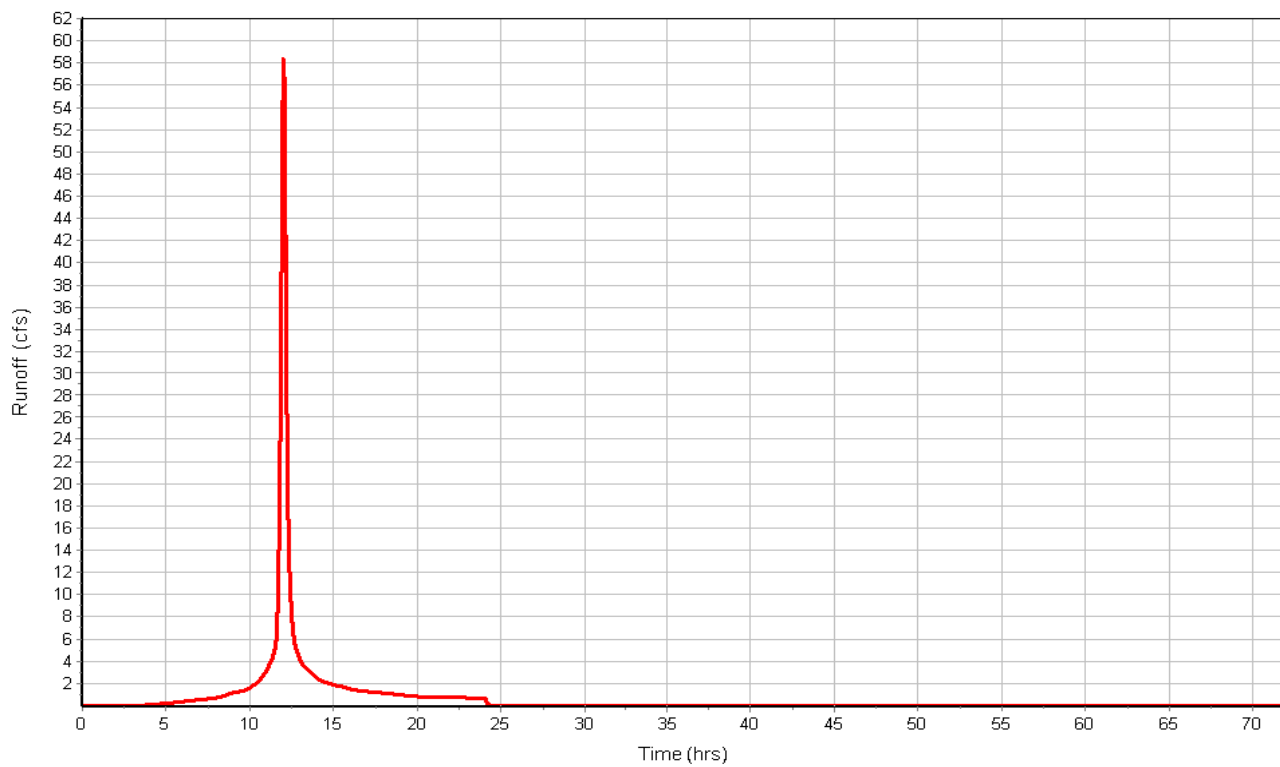
Subbasin Runoff Results

Total Rainfall (in) 5.87
Total Runoff (in) 4.76
Peak Runoff (cfs) 59.93
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Rainfall Intensity Graph



Runoff Hydrograph



Appendix C: Proposed Pond & Routed Storm Event Data

- **1.25” Storm Event Analysis Results.....C-1 – C-13**
- **10 yr-24 hr Peak Storm Event Analysis Results.....C-14 – C-26**
- **100 yr-24 hr Peak Storm Event Analysis Results.....C-27 – C-39**

Project Description

File Name Thompson Farms - Detention.SPF
Description
Thompson Farms
Detention Model

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-20
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Aug 28, 2017 00:00:00
End Analysis On Aug 31, 2017 00:00:00
Start Reporting On Aug 28, 2017 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	3
Subbasins.....	1
Nodes.....	3
<i>Junctions</i>	1
<i>Outfalls</i>	1
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	2
<i>Channels</i>	0
<i>Pipes</i>	1
<i>Pumps</i>	0
<i>Orifices</i>	1
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	1.25" Storm	Cumulative	inches					User Defined

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-Post	10.73	90.33	1.25	0.51	5.46	6.74	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	742.25	748.25	742.25	0.00	33539.00	0.27	742.47	0.00	5.78	0 00:00	0.00	0.00
2	Out-1	Outfall	742.00					0.27	742.21					
3	Stor-01	Storage Node	742.25	748.25	742.25		33539.00	6.54	742.60				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-1	46.00	742.25	742.00	0.5400	12.000	0.0120	0.27	2.85	0.10	2.16	0.22	0.22	0.00	Calculated
2	Orifice-WQ	Orifice	Stor-01	Jun-01		742.25	742.25		7.500		0.27							

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

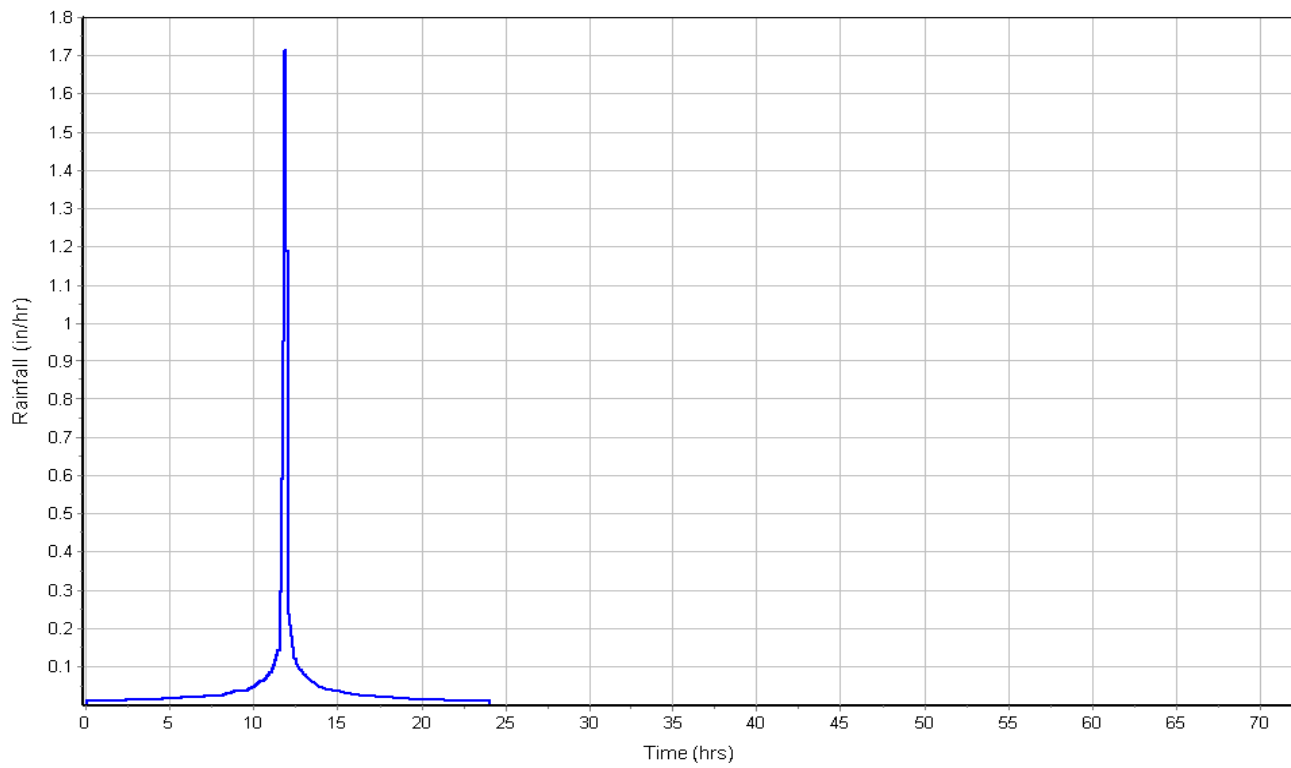
T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 15.00

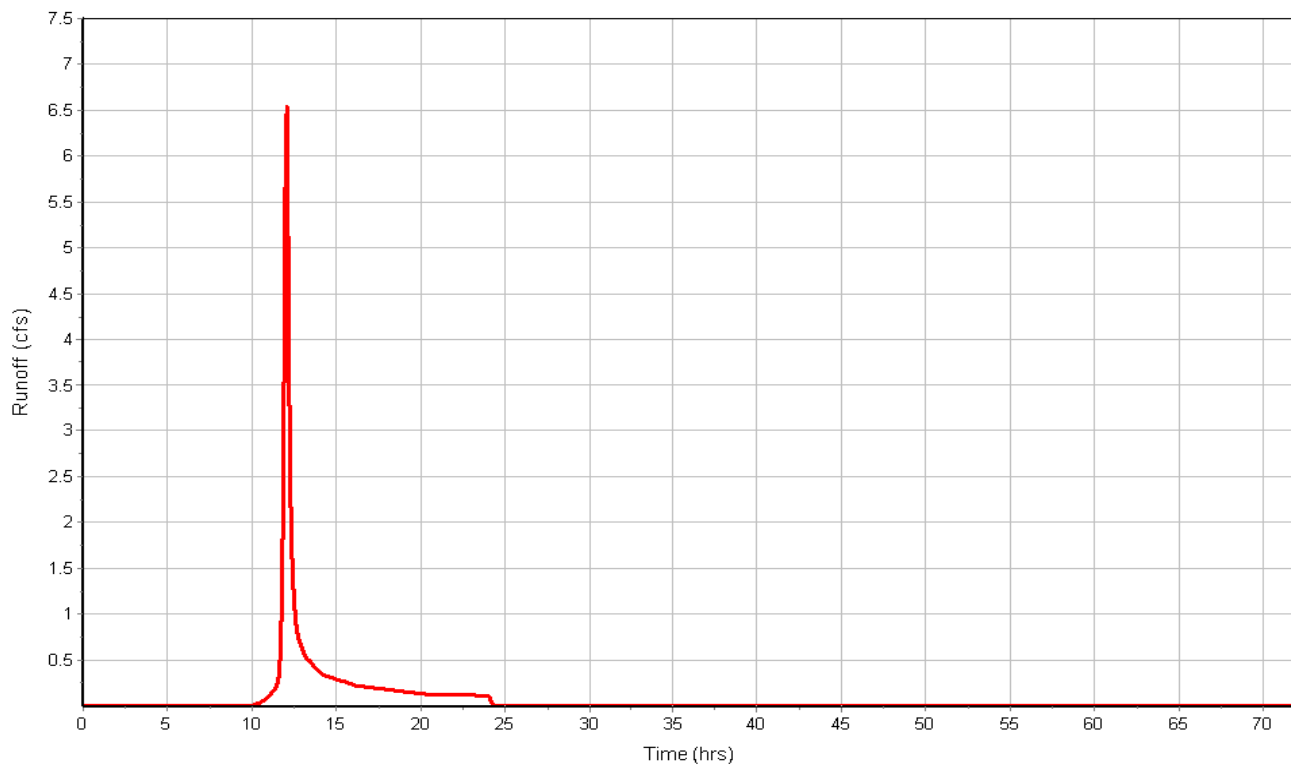
Subbasin Runoff Results

Total Rainfall (in) 1.25
Total Runoff (in) 0.51
Peak Runoff (cfs) 6.74
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1 Jun-01	742.25	748.25	6.00	742.25	0.00	0.00	-748.25	33539.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 Jun-01	0.27	0.00	742.47	0.22	0.00	5.78	742.34	0.09	0 15:27	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	46.00	742.25	0.00	742.00	0.00	0.25	0.5400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	0.27	0 15:28	2.85	0.10	2.16	0.35	0.22	0.22	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

Input Data

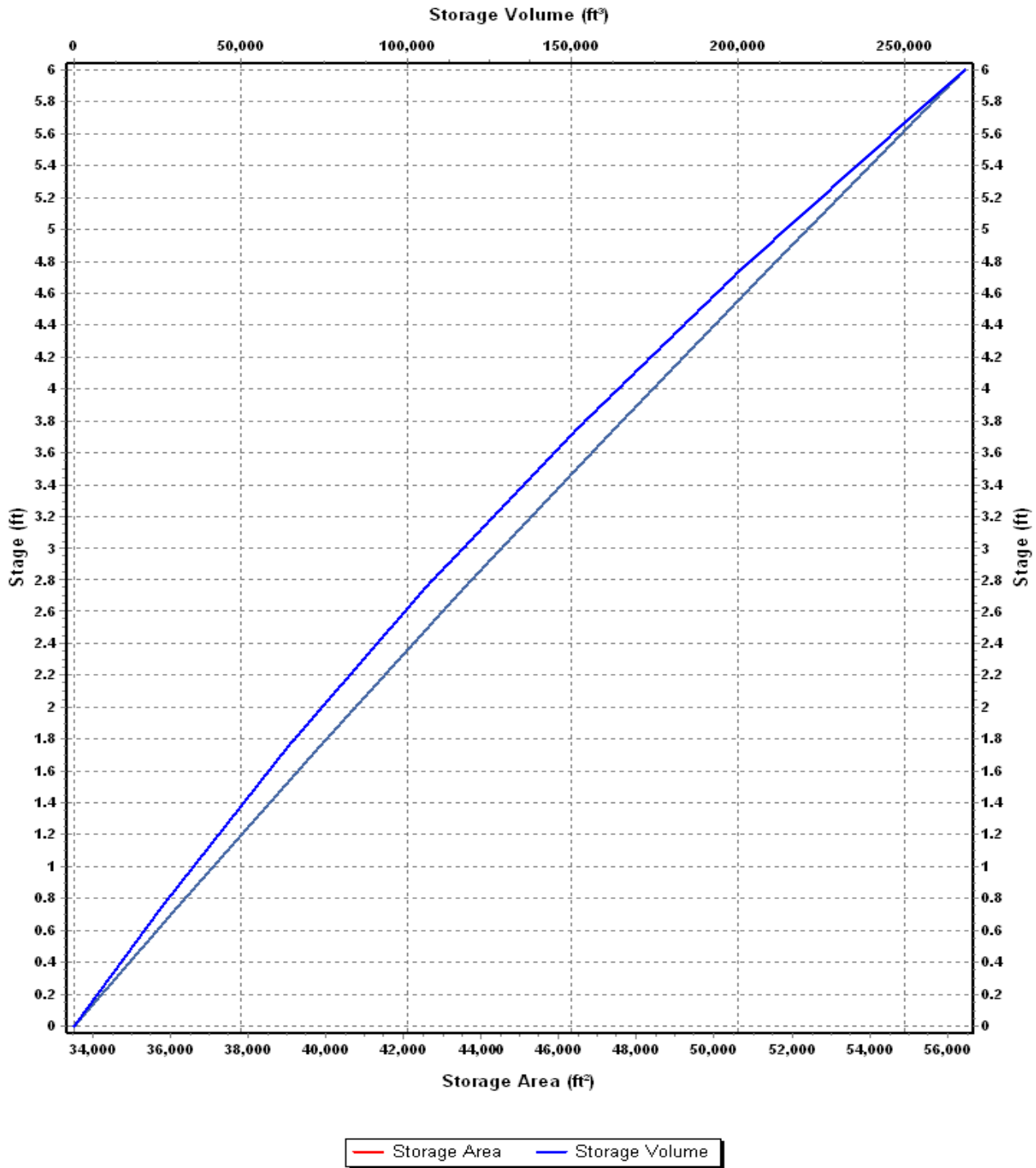
Invert Elevation (ft)	742.25
Max (Rim) Elevation (ft)	748.25
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	742.25
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	33539.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : WetPond

Stage	Storage Area	Storage Volume
(ft)	(ft²)	(ft³)
0	33538.98	0.000
0.75	36203.77	26153.53
1.75	39844.78	64177.81
2.75	43586.33	105893.37
3.75	47428.40	151400.74
4.75	51371.01	200800.45
5.75	55414.14	254193.03
6	56440.64	268174.88

Storage Area Volume Curves



Storage Node : Stor-01 (continued)

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-WQ	Side	CIRCULAR	No	7.50			742.25	0.61

Output Summary Results

Peak Inflow (cfs)	6.54
Peak Lateral Inflow (cfs)	6.54
Peak Outflow (cfs)	0.27
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	742.60
Max HGL Depth Attained (ft)	0.35
Average HGL Elevation Attained (ft)	742.38
Average HGL Depth Attained (ft)	0.13
Time of Max HGL Occurrence (days hh:mm)	0 15:26
Total Exfiltration Volume (1000-ft ³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name Thompson Farms - Detention.SPF
Description
Thompson Farms
Detention Model

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-20
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Aug 28, 2017 00:00:00
End Analysis On Aug 31, 2017 00:00:00
Start Reporting On Aug 28, 2017 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	3
Subbasins.....	1
Nodes.....	3
<i>Junctions</i>	1
<i>Outfalls</i>	1
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	3
<i>Channels</i>	0
<i>Pipes</i>	1
<i>Pumps</i>	0
<i>Orifices</i>	2
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	10yr-24hr	Cumulative	inches	Indiana	Johnson	10	4.08	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-Post	10.73	90.33	4.08	3.03	32.49	39.14	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Jun-01	Junction	742.25	748.25	742.25	0.00	33539.00	1.75	742.93	0.00	5.32	0 00:00	0.00	0.00
2	Out-1	Outfall	742.00					1.75	742.56					
3	Stor-01	Storage Node	742.25	748.25	742.25		33539.00	37.86	744.28				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Reported	Surcharged Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-1	46.00	742.25	742.00	0.5400	12.000	0.0120	1.75	2.85	0.62	3.42	0.62	0.62	0.00	Calculated
2	Orifice-100yr	Orifice	Stor-01	Jun-01		742.25	742.25		8.000		0.00							
3	Orifice-WQ	Orifice	Stor-01	Jun-01		742.25	742.25		7.500		1.75							

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID *

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

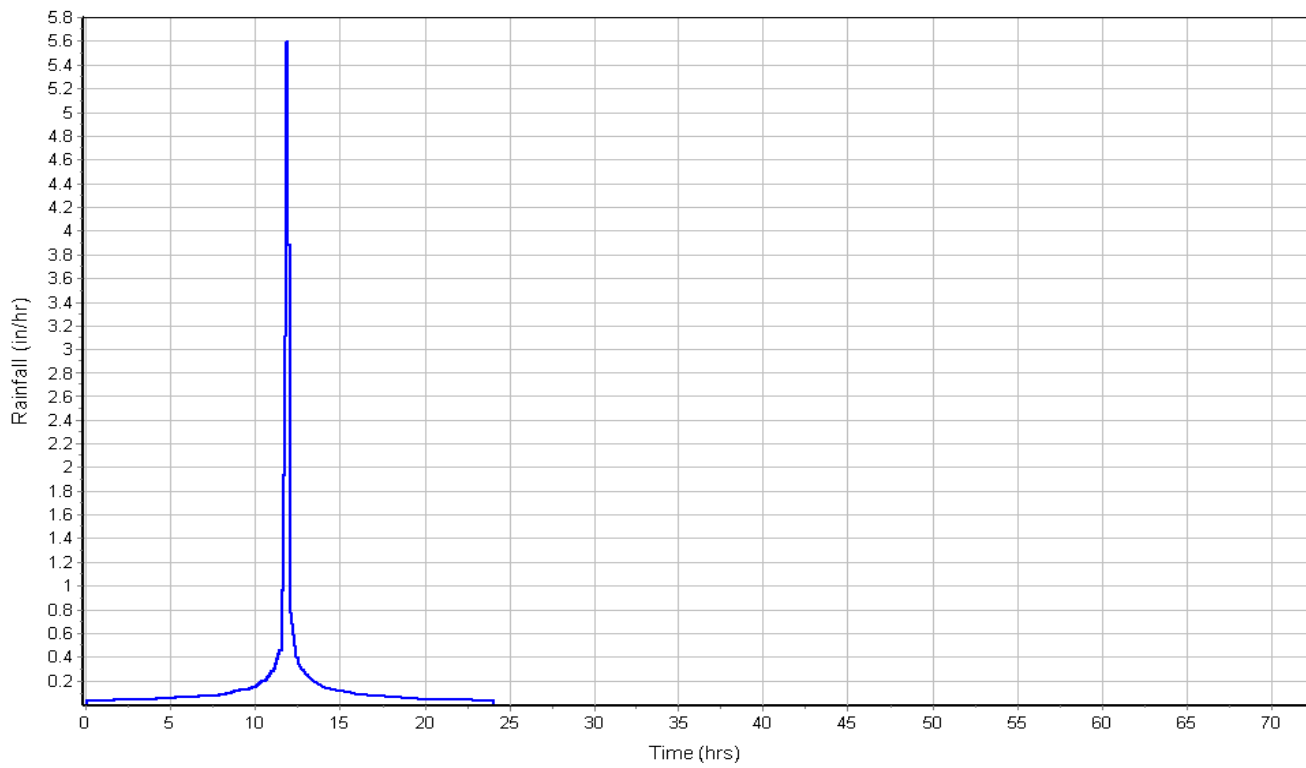
T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 15.00

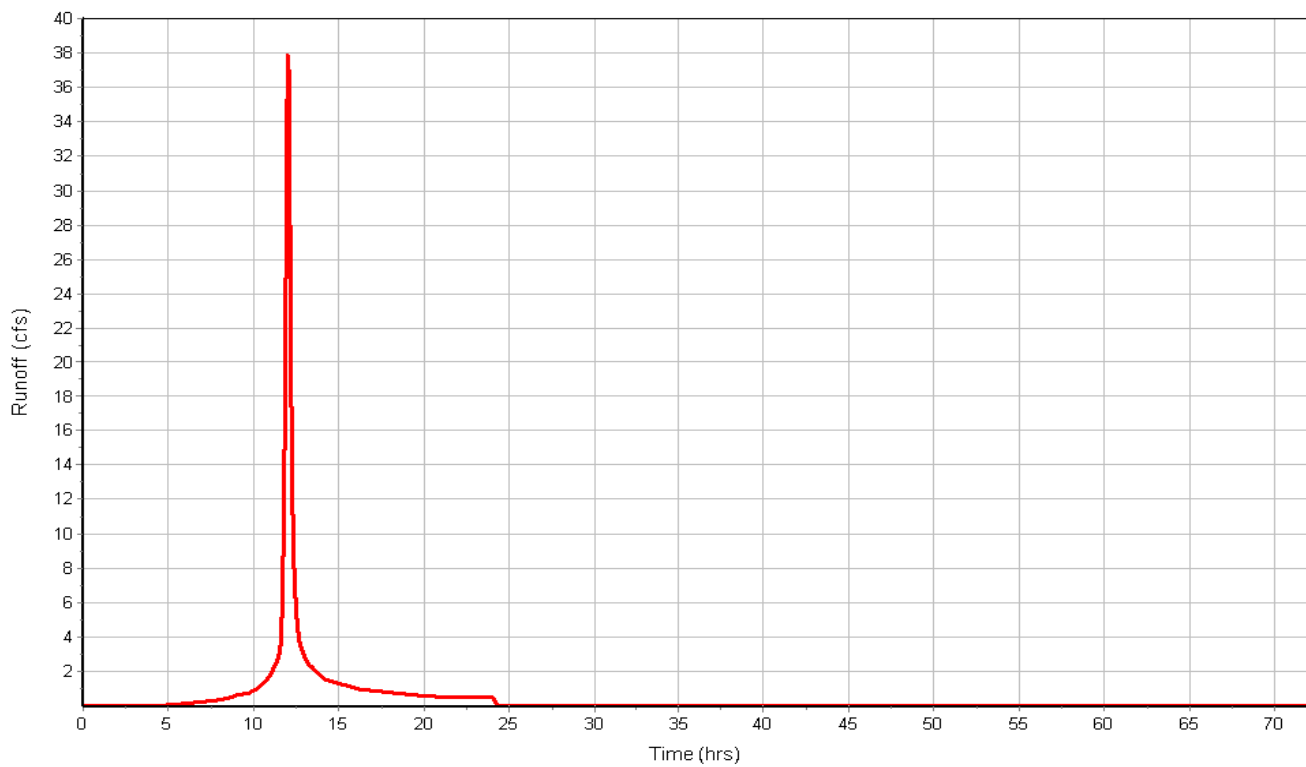
Subbasin Runoff Results

Total Rainfall (in) 4.08
Total Runoff (in) 3.03
Peak Runoff (cfs) 39.14
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Jun-01	742.25	748.25	6.00	742.25	0.00	0.00	-748.25	33539.00	0.00

Junction Results

SN	Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
		(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1	Jun-01	1.75	0.00	742.93	0.68	0.00	5.32	742.49	0.24	0 14:00	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Pipe Shape	Pipe Diameter or Height	Pipe Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow	Flap Gate	No. of Barrels
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(in)	(in)					(cfs)		
1	Link-01	46.00	742.25	0.00	742.00	0.00	0.25	0.5400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	1.75	0 14:01	2.85	0.62	3.42	0.22	0.62	0.62	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

Input Data

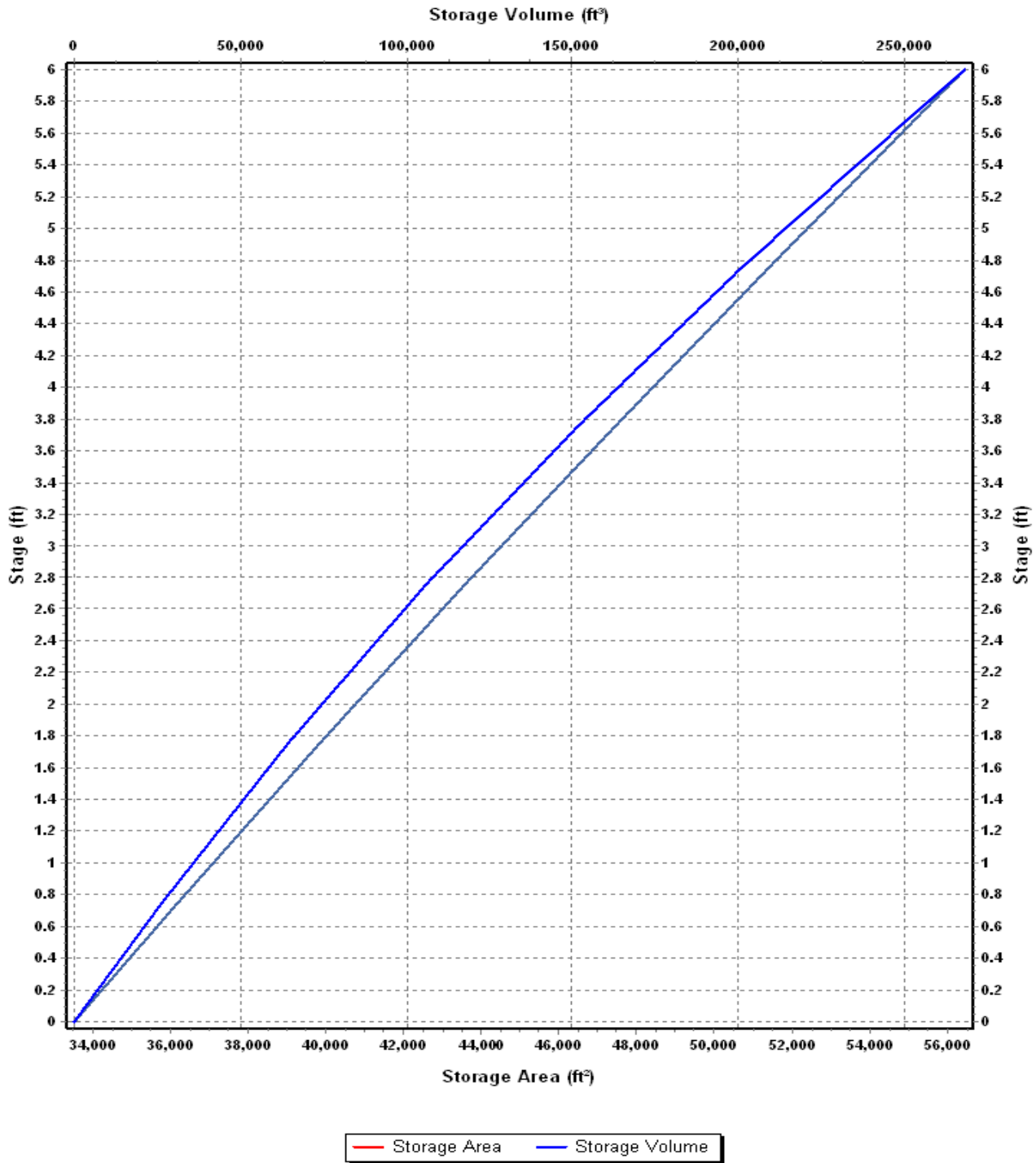
Invert Elevation (ft)	742.25
Max (Rim) Elevation (ft)	748.25
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	742.25
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	33539.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : WetPond

Stage	Storage Area	Storage Volume
(ft)	(ft²)	(ft³)
0	33538.98	0.000
0.75	36203.77	26153.53
1.75	39844.78	64177.81
2.75	43586.33	105893.37
3.75	47428.40	151400.74
4.75	51371.01	200800.45
5.75	55414.14	254193.03
6	56440.64	268174.88

Storage Area Volume Curves



Storage Node : Stor-01 (continued)

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Orifice-100yr	Side	Rectangular	No		8.00	24.00	744.35	0.63
2 Orifice-WQ	Side	CIRCULAR	No	7.50			742.25	0.61

Output Summary Results

Peak Inflow (cfs)	37.86
Peak Lateral Inflow (cfs)	37.86
Peak Outflow (cfs)	1.75
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	744.28
Max HGL Depth Attained (ft)	2.03
Average HGL Elevation Attained (ft)	742.77
Average HGL Depth Attained (ft)	0.52
Time of Max HGL Occurrence (days hh:mm)	0 14:00
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name Thompson Farms - Detention.SPF
Description
Thompson Farms
Detention Model

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-20
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Aug 28, 2017 00:00:00
End Analysis On Aug 31, 2017 00:00:00
Start Reporting On Aug 28, 2017 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	3
Subbasins.....	1
Nodes.....	3
<i>Junctions</i>	1
<i>Outfalls</i>	1
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	3
<i>Channels</i>	0
<i>Pipes</i>	1
<i>Pumps</i>	0
<i>Orifices</i>	2
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	100yr-24hr	Cumulative	inches	Indiana	Johnson	100	5.87	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-Post	10.73	90.33	5.87	4.76	51.03	59.93	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Jun-01	Junction	742.25	748.25	742.25	0.00	33539.00	5.40	744.56	0.00	3.69	0 00:00	0.00	0.00
2	Out-1	Outfall	742.00					5.40	742.93					
3	Stor-01	Storage Node	742.25	748.25	742.25		33539.00	58.25	745.09				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)
1	Link-01	Pipe	Jun-01	Out-1	46.00	742.25	742.00	0.5400	12.000	0.0120	5.40	2.85	1.90	6.95	0.97	0.97	0.00 > CAPACITY
2	Orifice-100yr	Orifice	Stor-01	Jun-01		742.25	742.25		8.000		4.29						
3	Orifice-WQ	Orifice	Stor-01	Jun-01		742.25	742.25		7.500		1.83						

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

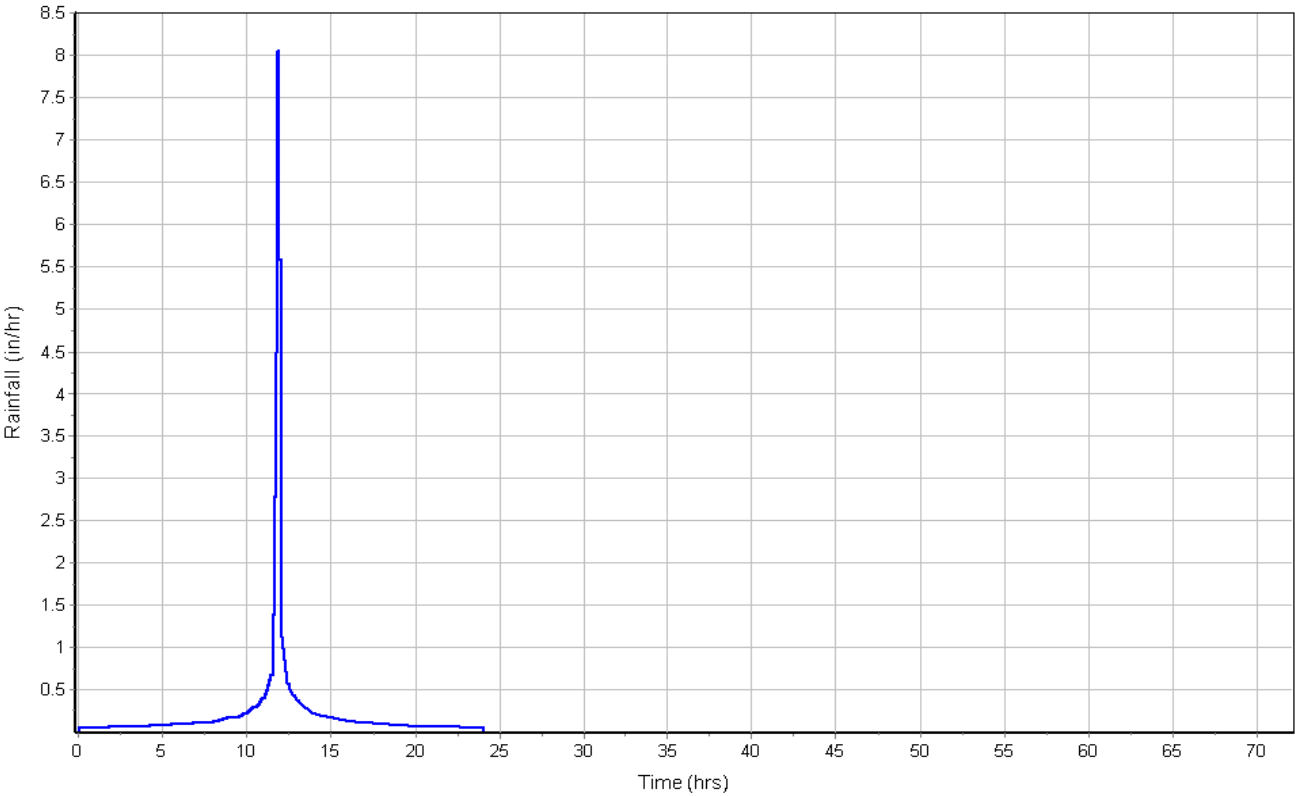
T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 15.00

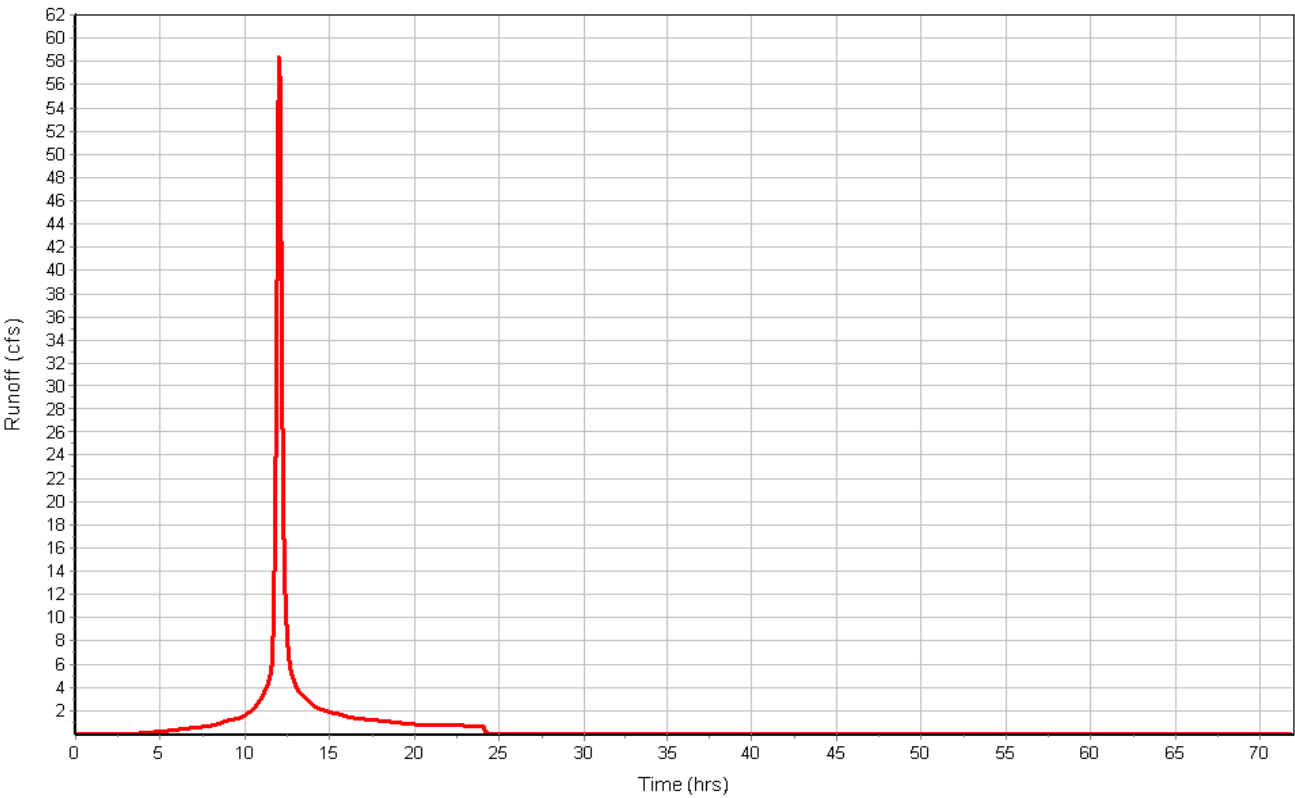
Subbasin Runoff Results

Total Rainfall (in) 5.87
Total Runoff (in) 4.76
Peak Runoff (cfs) 59.93
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation	Ground/Rim (Max) Elevation	Ground/Rim (Max) Offset	Initial Water Elevation	Initial Water Depth	Surcharge Elevation	Surcharge Depth	Ponded Area	Minimum Pipe Cover
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft²)	(in)
1 Jun-01	742.25	748.25	6.00	742.25	0.00	0.00	-748.25	33539.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 Jun-01	5.40	0.00	744.56	2.31	0.00	3.69	742.66	0.41	0 12:52	0 00:00	0.00	0.00

Pipe Input

SN Element ID	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Pipe Shape	Pipe Diameter or Height	Pipe Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow	Flap Gate	No. of Barrels
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(in)	(in)					(cfs)		
1 Link-01	46.00	742.25	0.00	742.00	0.00	0.25	0.5400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	5.40	0 12:52	2.85	1.90	6.95	0.11	0.97	0.97	0.00		> CAPACITY

Storage Nodes

Storage Node : Stor-01

Input Data

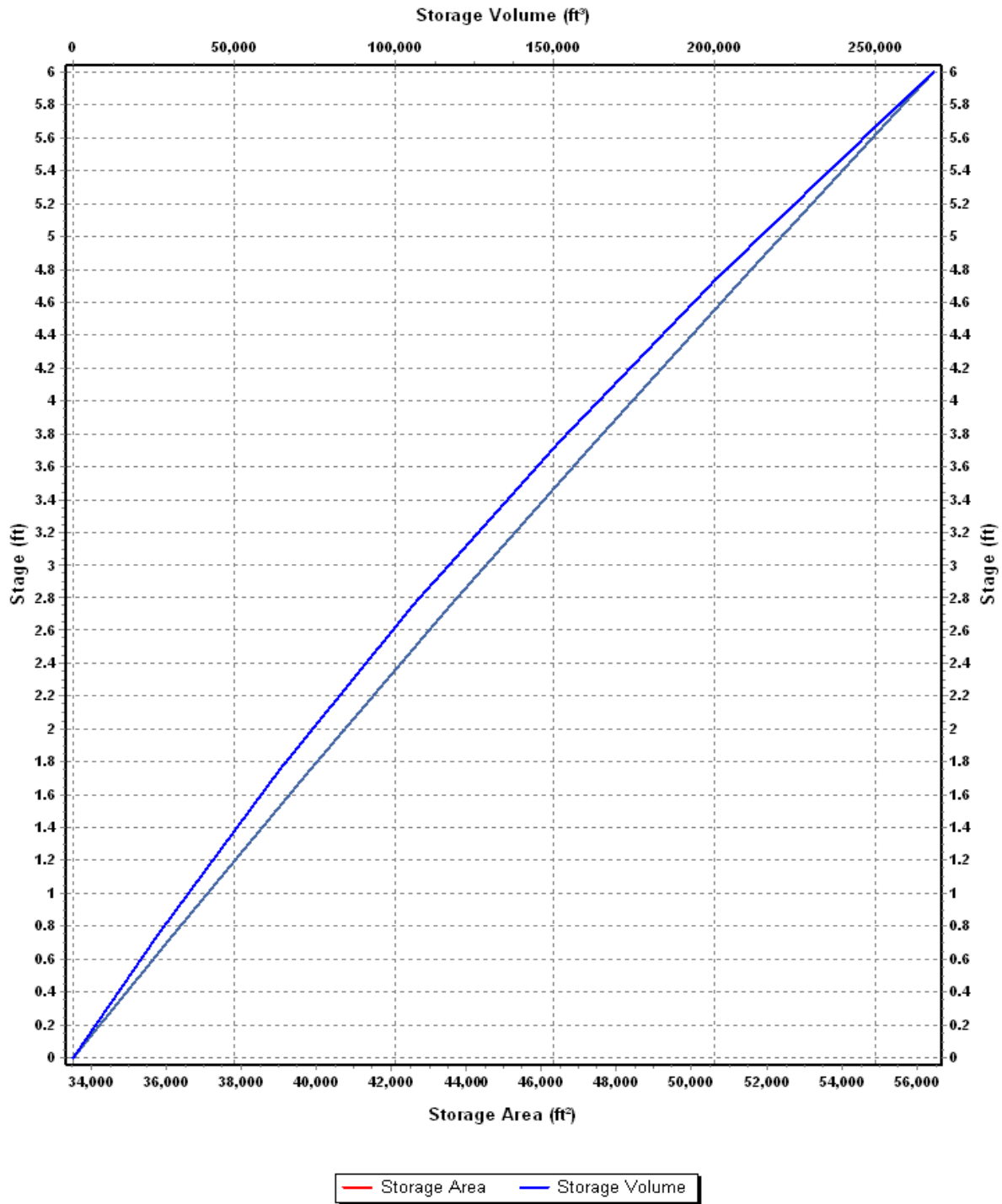
Invert Elevation (ft)	742.25
Max (Rim) Elevation (ft)	748.25
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	742.25
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	33539.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : WetPond

Stage	Storage Area	Storage Volume
(ft)	(ft²)	(ft³)
0	33538.98	0.000
0.75	36203.77	26153.53
1.75	39844.78	64177.81
2.75	43586.33	105893.37
3.75	47428.40	151400.74
4.75	51371.01	200800.45
5.75	55414.14	254193.03
6	56440.64	268174.88

Storage Area Volume Curves



Storage Node : Stor-01 (continued)

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Orifice-100yr	Side	Rectangular	No		8.00	24.00	744.35	0.63
2 Orifice-WQ	Side	CIRCULAR	No	7.50			742.25	0.61

Output Summary Results

Peak Inflow (cfs)	58.25
Peak Lateral Inflow (cfs)	58.25
Peak Outflow (cfs)	5.40
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	745.09
Max HGL Depth Attained (ft)	2.84
Average HGL Elevation Attained (ft)	743.03
Average HGL Depth Attained (ft)	0.78
Time of Max HGL Occurrence (days hh:mm)	0 12:49
Total Exfiltration Volume (1000-ft ³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00