



91 W. Colt Square Dr. Suite 3 / Fayetteville, AR 72703
PH: 479-442-9350 * FAX: 479-521-9350

DRAINAGE DESIGN COMPUTATIONS

FOR

CENTRAL ELECTRIC

BA No. 15-198

FLORENCE AVENUE
TONTITOWN, ARKANSAS

JULY 7, 2015

SUBMITTED TO:
CITY OF TONTITOWN

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REFERENCES

PROJECT OWNER AND DEVELOPER:

Central Electric Contractors
228 S. 40th Street A
Springdale, AR 72756

PROJECT TITLE:

The following information is the drainage report for Central Electric.

PROJECT LOCATION:

This project is located at 1167 Florence Ave, in Tontitown, Arkansas in Washington County. See the attached vicinity map for the exact location.

PROJECT DESCRIPTION:

This project site is a 1.27 acre tract in the existing Tontitown Plaza subdivision. Improvements to the site will consist of paving parking lot, drives and adding a 5,000 s.f. building. See the large scale development plan for details.

SITE DRAINAGE:

This project is a small part of a large drainage basin that flows into Brush Creek and eventually discharging into the Illinois River. The soil type for the drainage basin found in the Natural Resources Conservation Service Soil Survey is Captina silt loam which belongs to Hydrologic Soil Group C and Johnsburg which belongs to Hydrologic Soil Group D. The majority of the soil types in the basin are in Soil Group C.

Soil group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission.

Group D soils have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

No portion of this property is located within Flood Zone "AE" and the "Floodway" as determined by the National Flood Insurance Program's Flood Insurance Rate Map for Washington County, Arkansas (Map No. 05143C0045 F, May 16, 2008).

Currently, the runoff from this site sheet flows from the northwest to southeast. Once developed, the runoff from the site will continue in the same general pattern.

AREA DRAINAGE PROBLEMS:

To our knowledge, there are no known drainage problems in this area at this time.

DRAINAGE DESIGN:

Runoff Coefficients for each drainage basin was selected from the Tontitown Drainage Manual. The coefficient was selected based on the amount of pervious and impervious area in the basin. A composite runoff curve number was then calculated for the basin. The composite runoff coefficients are as follows:

| Cover | (50%) Type C | (50%) Type D |
|-------------------------|-----------------|-----------------|
| Open Space (good cover) | 86 | 89 |
| Gravel | 89 | |
| Impervious | 98 | 98 |

| | | |
|------------------------------------|------------|------------------|
| <u>Pre Developed Basin1</u> | | (0.28 ac) |
| 86 | Open space | 0.28 ac |

| | | |
|-------------------------------------|------------|------------------|
| <u>Pre Developed Basin 2</u> | | (0.75 ac) |
| 89 | Open space | 0.75 ac |

| | | |
|--------------------------------------|------------|------------------|
| <u>Post Developed Basin 1</u> | | (0.23 ac) |
| 86 | Open space | 0.08 ac |
| 98 | Impervious | 0.15 ac |

90 Post developed composite curve number

| | | |
|--------------------------------------|------------|------------------|
| <u>Post Developed Basin 2</u> | | (0.80 ac) |
| 89 | Open space | 0.32 ac |
| 89 | Gravel | 0.27 ac |
| 98 | Impervious | 0.21 ac |

91 Post developed composite curve number

Basin 1 Runoff Calculations

The 2-year through 100-year frequency storm events for pre- and post-development flows were calculated using the drainage program Hydraflow Hydrographs (SCS Method). The post developed peak flows decreased slightly due to decreasing the basin size.

Basin 1:

The peak runoff will slightly increase in basin 1 due to the increase in impervious area.

| Design Storm | (Peak flow in cfs) | | |
|-------------------------|---------------------------|----------|------------|
| | Pre-Dev. | Post-Dev | Difference |
| 2-yr | 0.75 | 0.69 | -0.06 |
| 5-yr | 0.89 | 0.80 | -.009 |
| 10-yr | 1.23 | 1.08 | -0.15 |
| 25-yr | 1.47 | 1.28 | -0.19 |
| 100-yr | 1.89 | 1.62 | -0.27 |

Basin 2:

The peak runoff will slightly increase in basin 2 due to the increase in impervious area. However, detention is proposed to reduce the peak runoff to pre developed conditions.

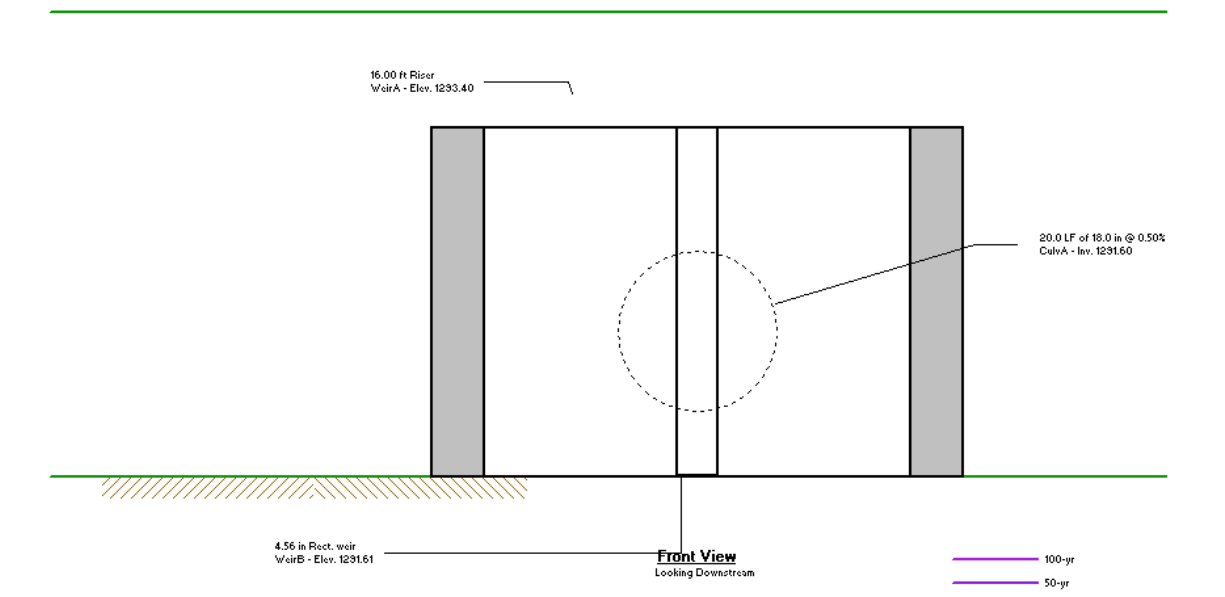
| Design Storm | (Peak flow in cfs) | | |
|--------------|--------------------|----------|------------|
| | Pre-Dev. | Post-Dev | Difference |
| 2-yr | 1.59 | 1.57 | -0.02 |
| 5-yr | 1.88 | 1.77 | -0.11 |
| 10-yr | 2.55 | 2.09 | -0.46 |
| 25-yr | 3.03 | 2.36 | -0.67 |
| 100-yr | 3.85 | 3.67 | -0.18 |

DETENTION BASIN 1:

The 100 year WSEL in the pond is 1293.5 and the berm is at elevation 1294.5. This provides 12 inches of freeboard. The release structure consists of a 4'x4' riser with a 4.5" weir and an 18" corrugated metal pipe outlet. See the grading plan for details.

| Design Storm | Storage Cu. Ft | Elevation |
|--------------|----------------|-----------|
| 2-yr | 4,895 | 1287.41 |
| 10-yr | 8,986 | 1287.84 |
| 25-yr | 11,483 | 1288.04 |
| 50-yr | 13,885 | 1288.15 |
| 100-yr | 15,743 | 1288.23 |

Top of pond
Elev. 1294.00



EROSION AND SEDIMENT CONTROL:

Erosion and sediment control will be achieved through the use of silt fences and rip rap ditch checks.

CONCLUSION:

The improvements to the site consist of adding parking, drives and a building. The peak runoff will increase due to the improvements replacing pervious area with impervious area. However, detention is proposed to lower the peak runoff to pre developed conditions.

CERTIFICATION:

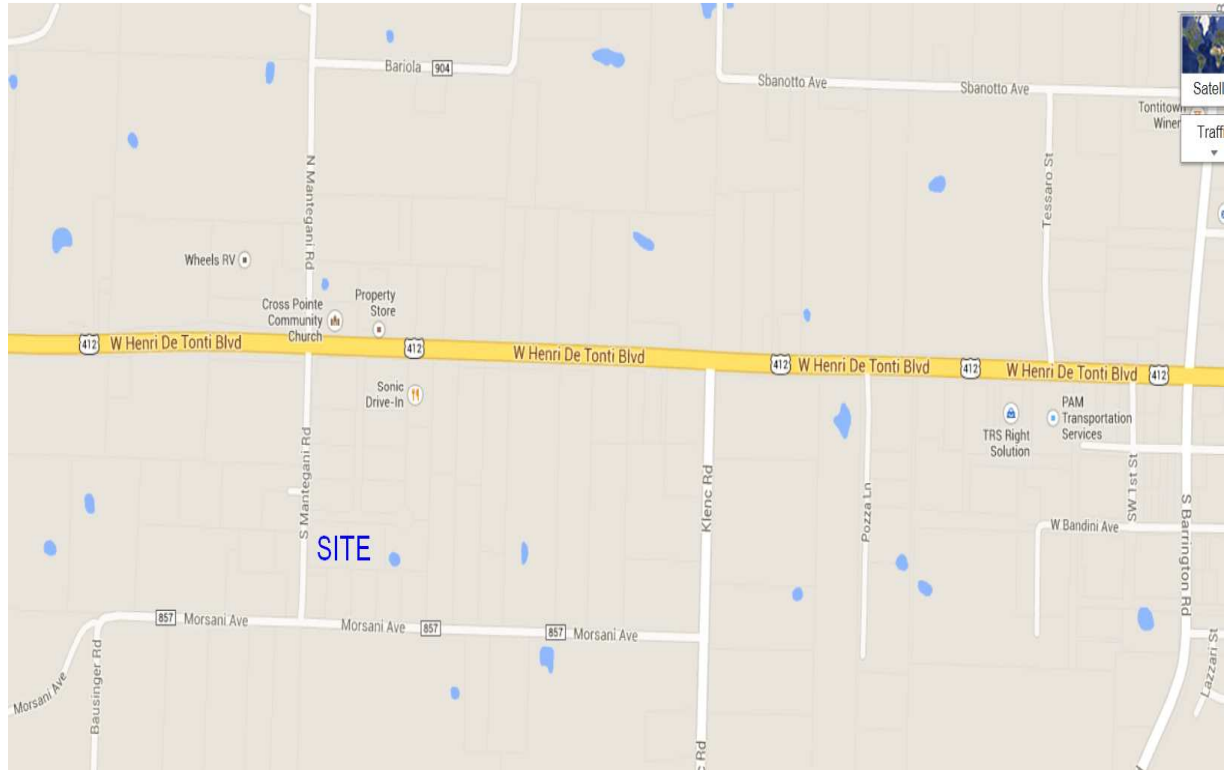
I, Geoffrey H. Bates, Registered Professional Engineer No. 9810 in the State of Arkansas, hereby certify that the drainage studies, reports, calculations, designs, and specifications contained in this report have been prepared in accordance with the requirements of the City of Tontitown. Further, I hereby acknowledge that the review of the drainage studies, reports, calculations, designs, and specifications by the City of Tontitown or its representatives cannot and does not relieve me from any professional responsibility or liability."

Sincerely,

Bates & Associates, Inc.

A handwritten signature in blue ink that reads "Geoffrey Bates". The signature is written in a cursive, flowing style.

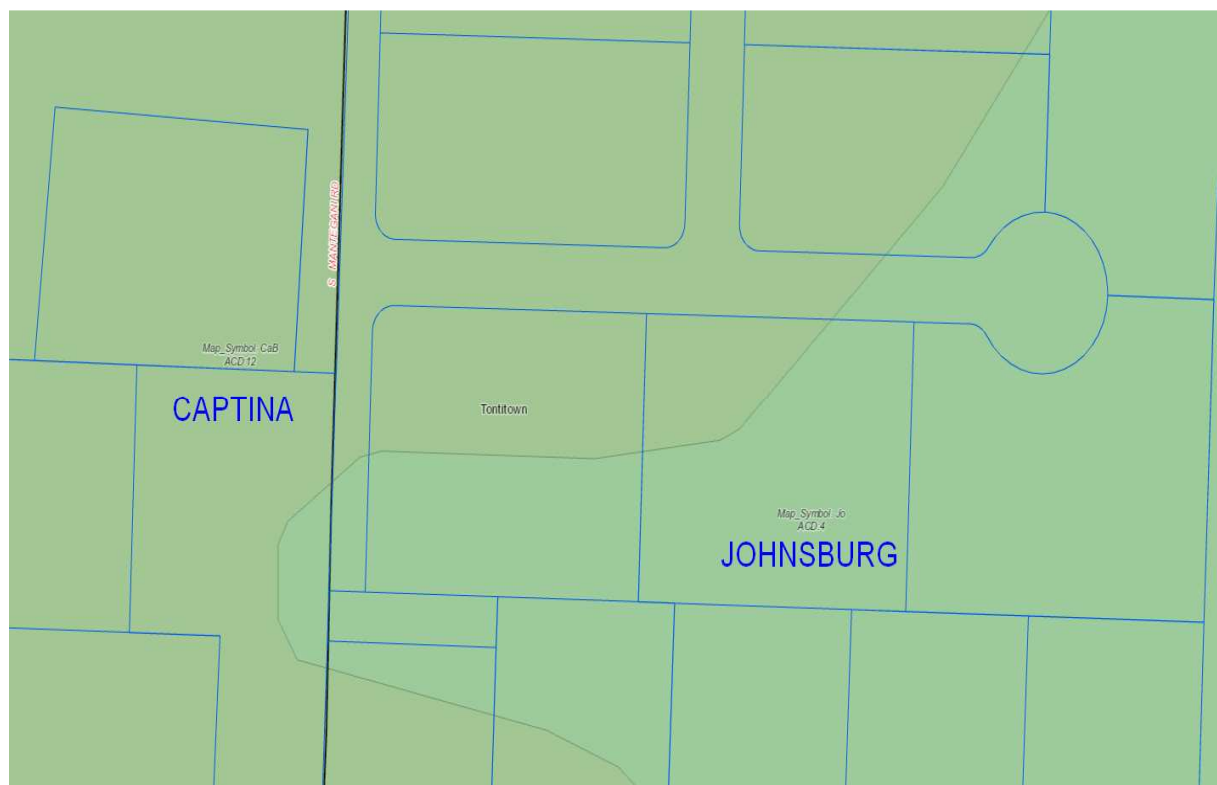
Geoffrey H. Bates, P.E.
President of Engineering



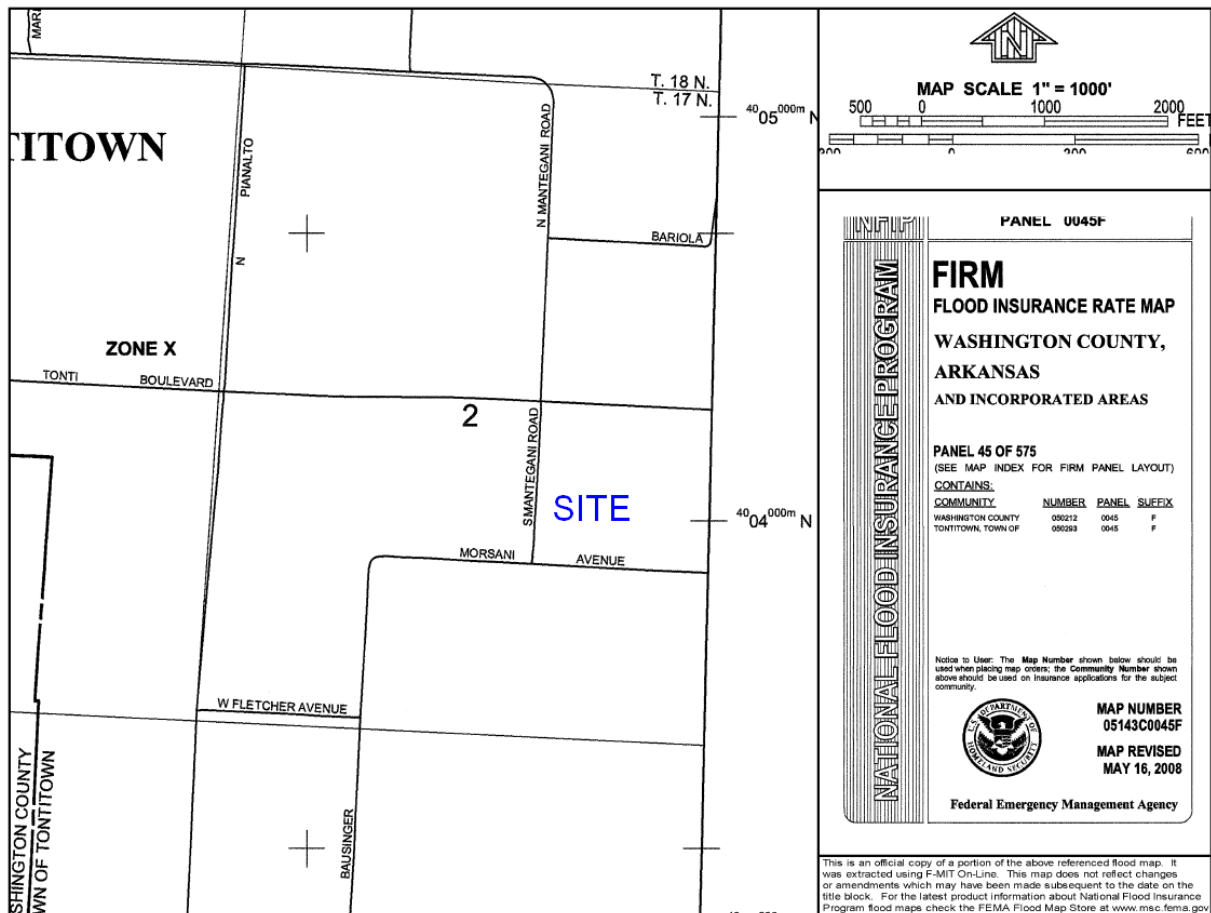
VICINITY MAP



AERIAL PHOTOGRAPH

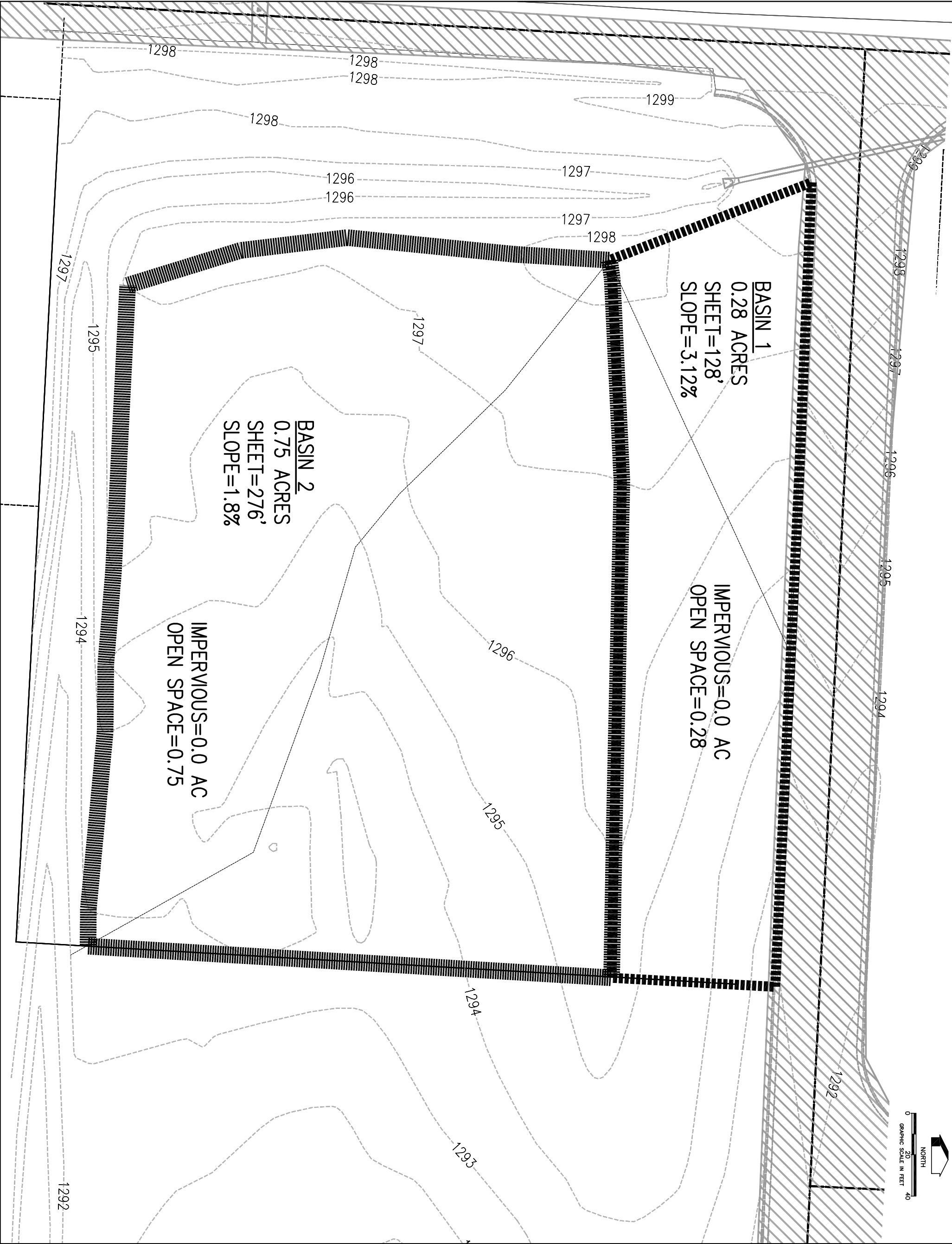


SOILS MAP




FEMA FIRM PANEL

RUNOFF CALCULATIONS



PROJECT NO
15-198

DRAWING NO
01



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CENTRAL ELECTRICAL CONTRACTORS
LARGE SCALE DEVELOPMENT PLANS

PRE DEVELOPED DRAINAGE MAP

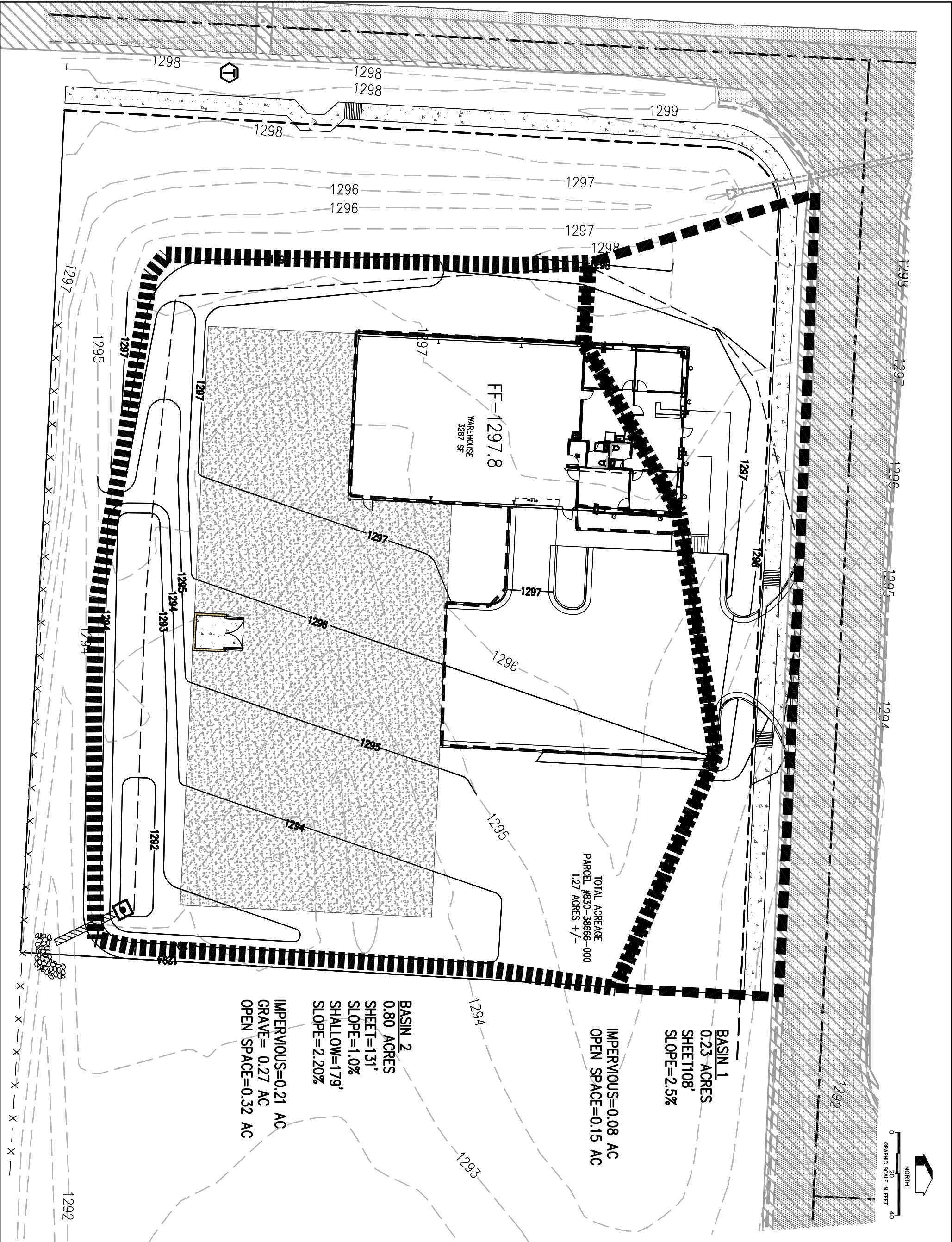
TONTITOWN, ARKANSAS

| REVISIONS | DATE |
|-----------------|----------|
| FIRST SUBMITTAL | 07/07/15 |
| | |
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| | |
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| | |

DRAWN BY: J. YoungENGINEER: G. Bates



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PROJECT NO

15-198

DRAWING NO

02



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CENTRAL ELECTRICAL CONTRACTORS
LARGE SCALE DEVELOPMENT PLANS

POST DEVELOPED DRAINAGE MAP

TONTITOWN, ARKANSAS

REVISIONS

DATE

FIRST SUBMITTAL

07/07/15

DRAWN BY: J. Young

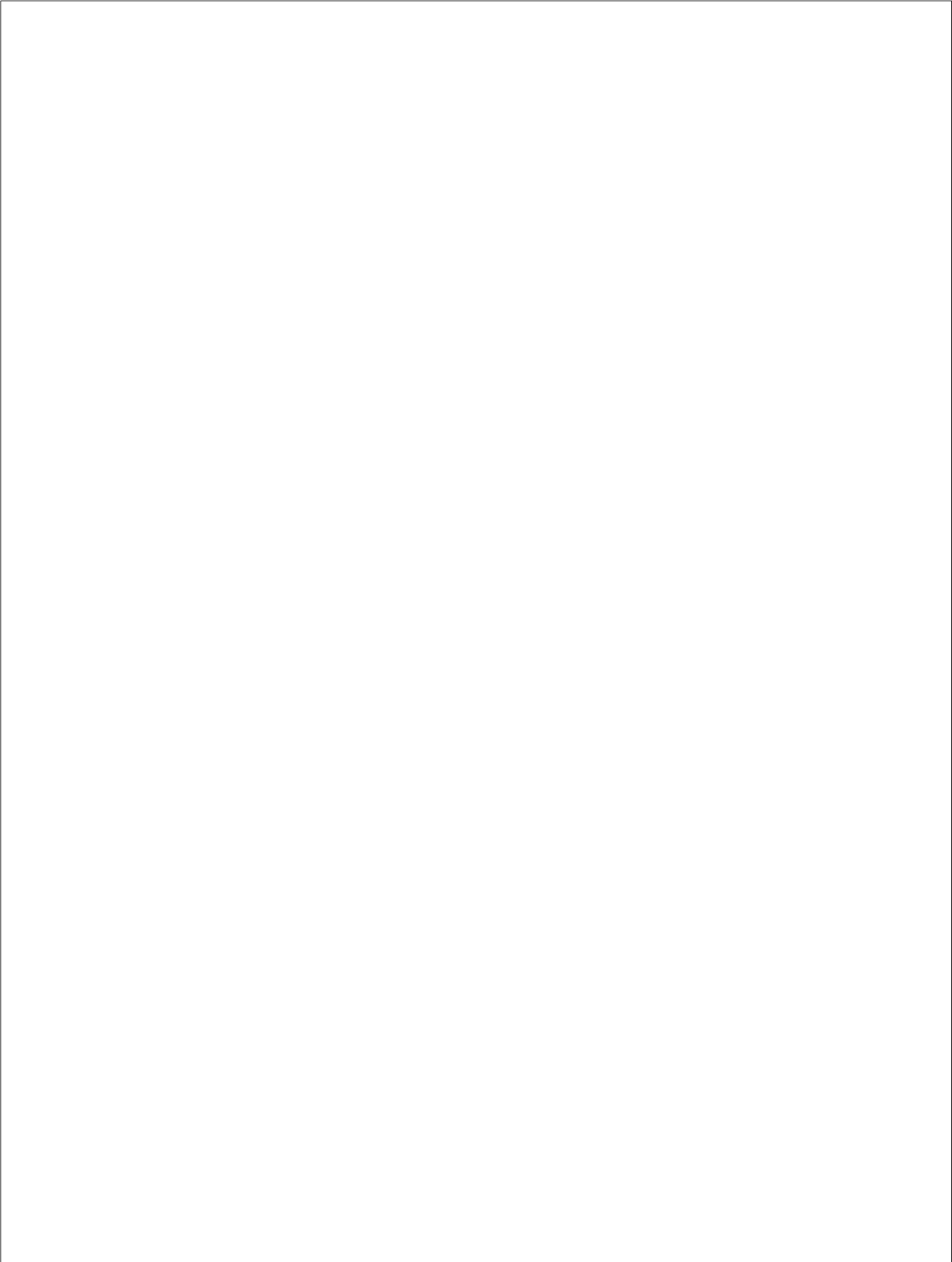
ENGINEER: G. Bates



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Watershed Model Schematic

Hydraflow Hydrographs by Intelisolve v9.2



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Inflow Hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph description |
|----------------------------------|--------------------------|---------------|--------------------|-------|-------|-------|-------|-------|-------------------------|--------|------------------------|
| | | | 1-Yr | 2-Yr | 3-Yr | 5-Yr | 10-Yr | 25-Yr | 50-Yr | 100-Yr | |
| 1 | SCS Runoff | ----- | ----- | 0.745 | ----- | 0.888 | 1.228 | 1.470 | 1.710 | 1.890 | Pre Developed Basin 1 |
| 2 | SCS Runoff | ----- | ----- | 1.593 | ----- | 1.878 | 2.551 | 3.026 | 3.499 | 3.852 | Pre Developed Basin 2 |
| 3 | SCS Runoff | ----- | ----- | 0.685 | ----- | 0.803 | 1.081 | 1.276 | 1.471 | 1.617 | Post Developed Basin 1 |
| 4 | SCS Runoff | ----- | ----- | 2.026 | ----- | 2.367 | 3.171 | 3.739 | 4.303 | 4.725 | Post Developed Basin 2 |
| 5 | Reservoir | 4 | ----- | 1.569 | ----- | 1.766 | 2.094 | 2.359 | 3.128 | 3.670 | Detention Pond |
| Proj. file: Central Electric.gpw | | | | | | | | | Wednesday, Jul 22, 2015 | | |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

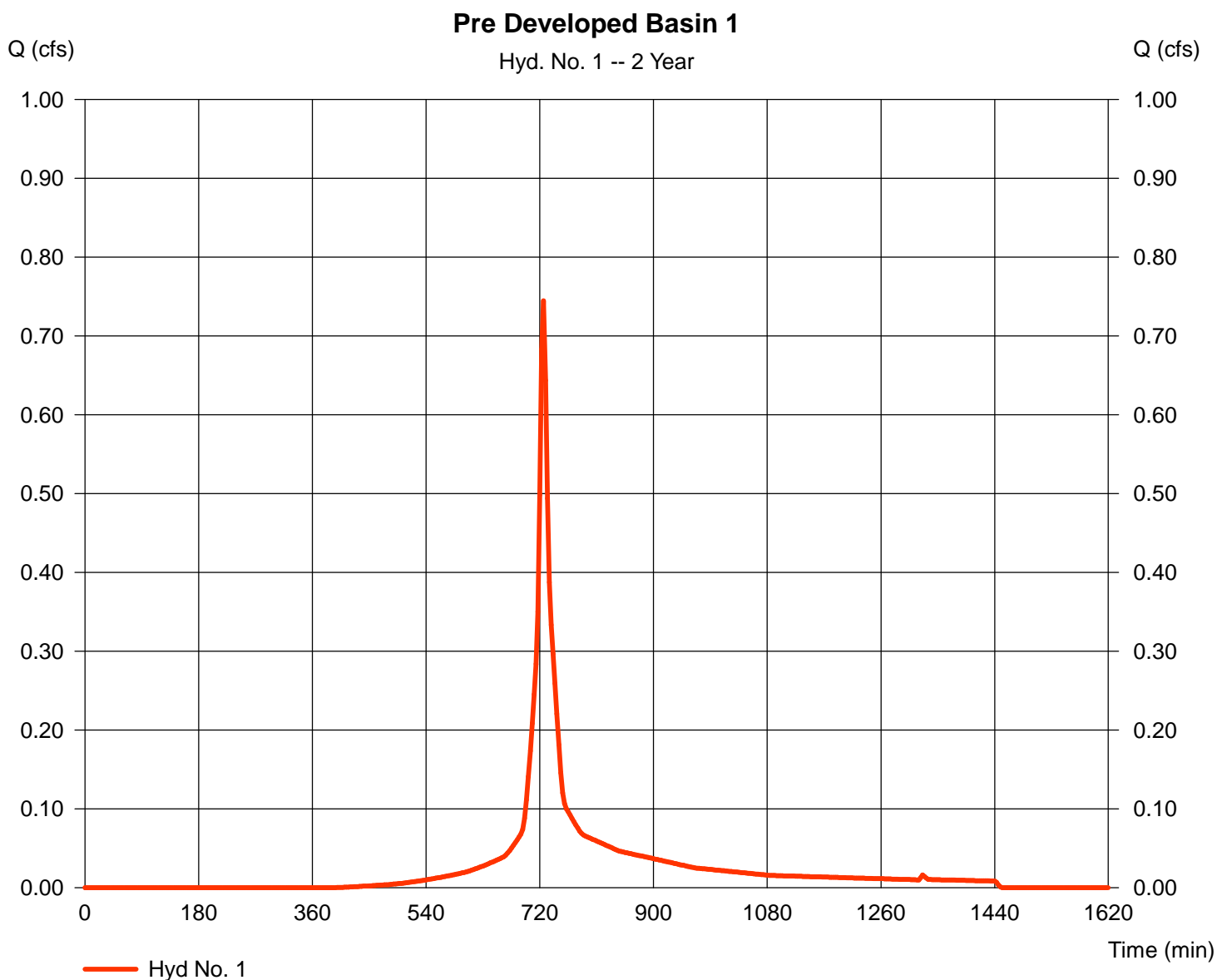
Wednesday, Jul 22, 2015

Hyd. No. 1

Pre Developed Basin 1

Hydrograph type = SCS Runoff
 Storm frequency = 2 yrs
 Time interval = 3 min
 Drainage area = 0.280 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 4.08 in
 Storm duration = 24 hrs

Peak discharge = 0.745 cfs
 Time to peak = 726 min
 Hyd. volume = 2,495 cuft
 Curve number = 86
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 8.80 min
 Distribution = Type III
 Shape factor = 484



Pre Developed Basin 1

| <u>Description</u> | <u>A</u> | <u>B</u> | <u>C</u> | <u>Totals</u> | | | |
|------------------------------------|---------------|----------|-------------|---------------|-----------------|----------|-------------|
| Sheet Flow | | | | | | | |
| Manning's n-value | = 0.150 | 0.011 | 0.011 | | | | |
| Flow length (ft) | = 128.0 | 0.0 | 0.0 | | | | |
| Two-year 24-hr precip. (in) | = 4.08 | 0.00 | 0.00 | | | | |
| Land slope (%) | = 3.12 | 0.00 | 0.00 | | | | |
| Travel Time (min) | = 8.85 | + | 0.00 | + | 0.00 | = | 8.85 |
| Shallow Concentrated Flow | | | | | | | |
| Flow length (ft) | = 0.00 | 0.00 | 0.00 | | | | |
| Watercourse slope (%) | = 0.00 | 0.00 | 0.00 | | | | |
| Surface description | = Paved | Paved | Paved | | | | |
| Average velocity (ft/s) | = 0.00 | 0.00 | 0.00 | | | | |
| Travel Time (min) | = 0.00 | + | 0.00 | + | 0.00 | = | 0.00 |
| Channel Flow | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | 0.00 | 0.00 | | | | |
| Wetted perimeter (ft) | = 0.00 | 0.00 | 0.00 | | | | |
| Channel slope (%) | = 0.00 | 0.00 | 0.00 | | | | |
| Manning's n-value | = 0.015 | 0.015 | 0.015 | | | | |
| Velocity (ft/s) | = 0.00 | 0.00 | 0.00 | | | | |
| Flow length (ft) | = 0.0 | 0.0 | 0.0 | | | | |
| Travel Time (min) | = 0.00 | + | 0.00 | + | 0.00 | = | 0.00 |
| Total Travel Time, Tc | | | | | 8.80 min | | |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

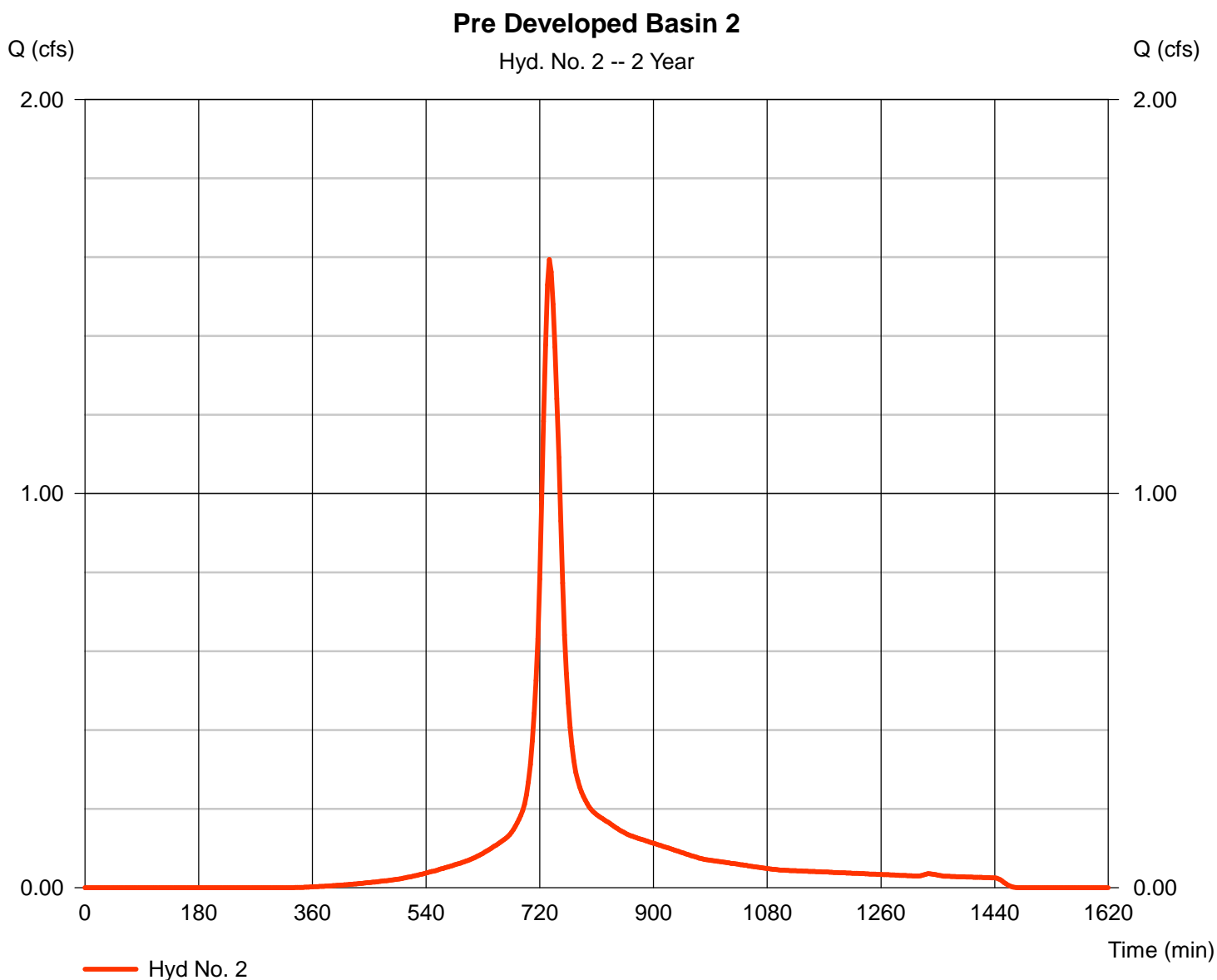
Wednesday, Jul 22, 2015

Hyd. No. 2

Pre Developed Basin 2

Hydrograph type = SCS Runoff
 Storm frequency = 2 yrs
 Time interval = 3 min
 Drainage area = 0.750 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 4.08 in
 Storm duration = 24 hrs

Peak discharge = 1.593 cfs
 Time to peak = 735 min
 Hyd. volume = 7,693 cuft
 Curve number = 89
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 20.40 min
 Distribution = Type III
 Shape factor = 484



Pre Developed Basin 2

| <u>Description</u> | <u>A</u> | <u>B</u> | <u>C</u> | <u>Totals</u> | | | |
|------------------------------------|----------------|----------|-------------|---------------|------------------|----------|--------------|
| Sheet Flow | | | | | | | |
| Manning's n-value | = 0.150 | 0.011 | 0.011 | | | | |
| Flow length (ft) | = 276.0 | 0.0 | 0.0 | | | | |
| Two-year 24-hr precip. (in) | = 4.08 | 0.00 | 0.00 | | | | |
| Land slope (%) | = 1.80 | 0.00 | 0.00 | | | | |
| Travel Time (min) | = 20.39 | + | 0.00 | + | 0.00 | = | 20.39 |
| Shallow Concentrated Flow | | | | | | | |
| Flow length (ft) | = 0.00 | 0.00 | 0.00 | | | | |
| Watercourse slope (%) | = 0.00 | 0.00 | 0.00 | | | | |
| Surface description | = Paved | Paved | Paved | | | | |
| Average velocity (ft/s) | = 0.00 | 0.00 | 0.00 | | | | |
| Travel Time (min) | = 0.00 | + | 0.00 | + | 0.00 | = | 0.00 |
| Channel Flow | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | 0.00 | 0.00 | | | | |
| Wetted perimeter (ft) | = 0.00 | 0.00 | 0.00 | | | | |
| Channel slope (%) | = 0.00 | 0.00 | 0.00 | | | | |
| Manning's n-value | = 0.015 | 0.015 | 0.015 | | | | |
| Velocity (ft/s) | = 0.00 | 0.00 | 0.00 | | | | |
| Flow length (ft) | = 0.0 | 0.0 | 0.0 | | | | |
| Travel Time (min) | = 0.00 | + | 0.00 | + | 0.00 | = | 0.00 |
| Total Travel Time, Tc | | | | | 20.40 min | | |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

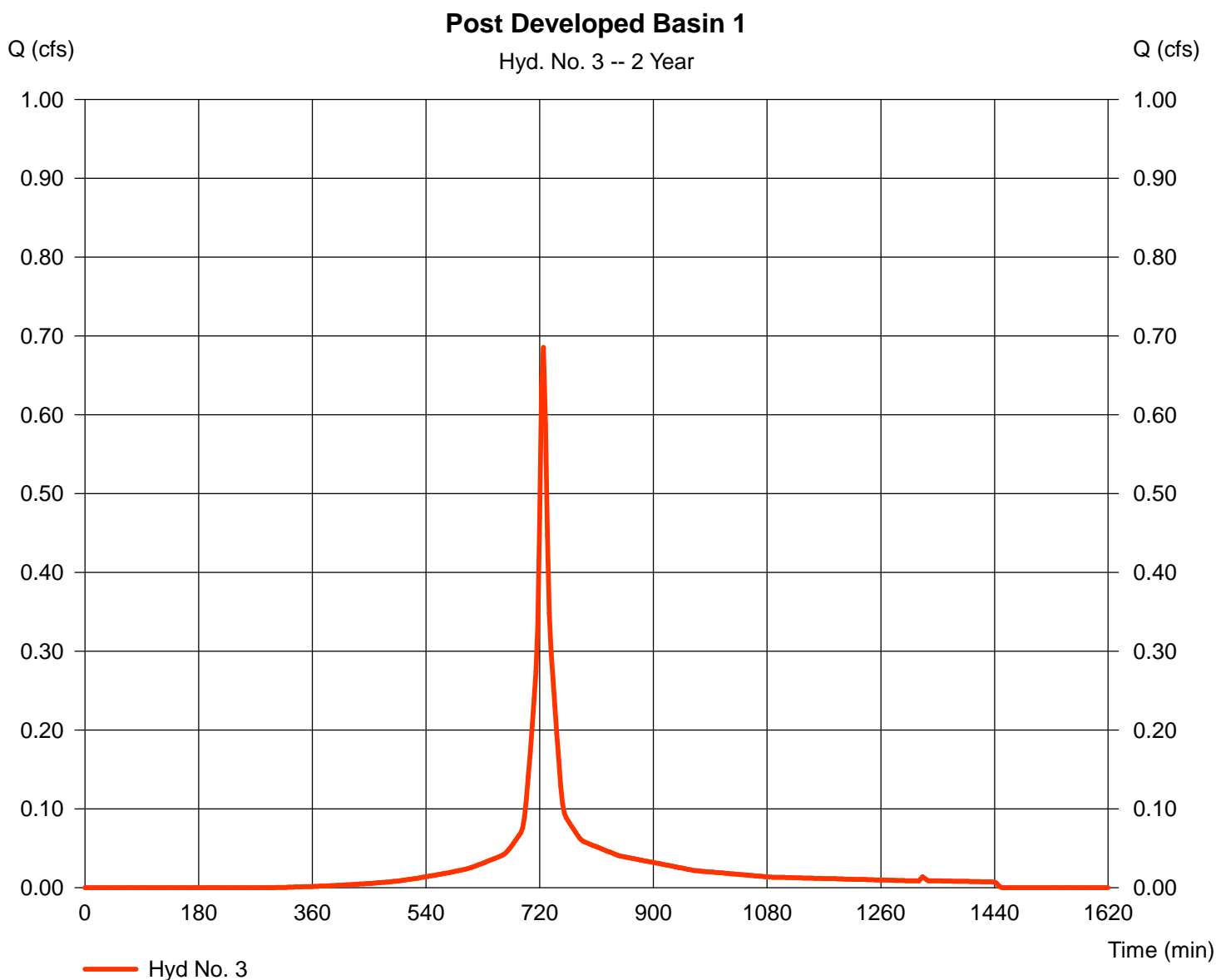
Hyd. No. 3

Post Developed Basin 1

Hydrograph type = SCS Runoff
 Storm frequency = 2 yrs
 Time interval = 3 min
 Drainage area = 0.230 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 4.08 in
 Storm duration = 24 hrs

Peak discharge = 0.685 cfs
 Time to peak = 726 min
 Hyd. volume = 2,344 cuft
 Curve number = 90*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 8.40 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.080 \times 98) + (0.150 \times 86)] / 0.230$



Post Developed Basin 1

| <u>Description</u> | <u>A</u> | <u>B</u> | <u>C</u> | <u>Totals</u> | | | |
|------------------------------------|---------------|----------|-------------|---------------|-----------------|----------|-------------|
| Sheet Flow | | | | | | | |
| Manning's n-value | = 0.150 | 0.011 | 0.011 | | | | |
| Flow length (ft) | = 108.0 | 0.0 | 0.0 | | | | |
| Two-year 24-hr precip. (in) | = 4.08 | 0.00 | 0.00 | | | | |
| Land slope (%) | = 2.50 | 0.00 | 0.00 | | | | |
| Travel Time (min) | = 8.44 | + | 0.00 | + | 0.00 | = | 8.44 |
| Shallow Concentrated Flow | | | | | | | |
| Flow length (ft) | = 0.00 | 0.00 | 0.00 | | | | |
| Watercourse slope (%) | = 0.00 | 0.00 | 0.00 | | | | |
| Surface description | = Paved | Paved | Paved | | | | |
| Average velocity (ft/s) | = 0.00 | 0.00 | 0.00 | | | | |
| Travel Time (min) | = 0.00 | + | 0.00 | + | 0.00 | = | 0.00 |
| Channel Flow | | | | | | | |
| X sectional flow area (sqft) | = 0.00 | 0.00 | 0.00 | | | | |
| Wetted perimeter (ft) | = 0.00 | 0.00 | 0.00 | | | | |
| Channel slope (%) | = 0.00 | 0.00 | 0.00 | | | | |
| Manning's n-value | = 0.015 | 0.015 | 0.015 | | | | |
| Velocity (ft/s) | = 0.00 | 0.00 | 0.00 | | | | |
| Flow length (ft) | = 0.0 | 0.0 | 0.0 | | | | |
| Travel Time (min) | = 0.00 | + | 0.00 | + | 0.00 | = | 0.00 |
| Total Travel Time, Tc | | | | | 8.40 min | | |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

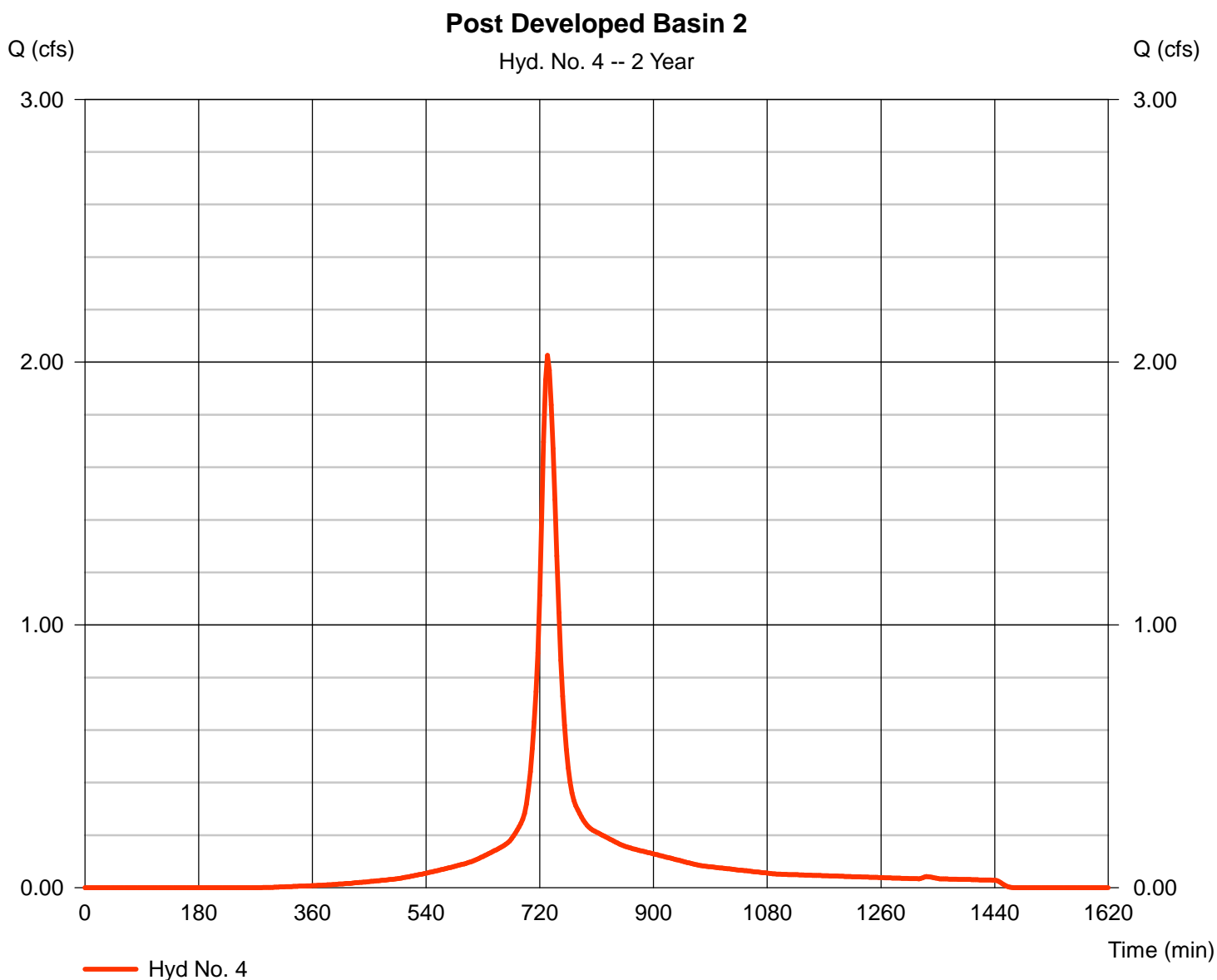
Hyd. No. 4

Post Developed Basin 2

Hydrograph type = SCS Runoff
 Storm frequency = 2 yrs
 Time interval = 3 min
 Drainage area = 0.800 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 4.08 in
 Storm duration = 24 hrs

Peak discharge = 2.026 cfs
 Time to peak = 732 min
 Hyd. volume = 9,266 cuft
 Curve number = 91*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 15.50 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.320 \times 89) + (0.270 \times 89) + (0.210 \times 98)] / 0.800$



TR55 Tc Worksheet

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No. 4

Post Developed Basin 2

| <u>Description</u> | <u>A</u> | <u>B</u> | <u>C</u> | <u>Totals</u> | | |
|------------------------------------|----------------|----------|-------------|---------------|------------------|----------------|
| Sheet Flow | | | | | | |
| Manning's n-value | = 0.150 | 0.011 | 0.011 | | | |
| Flow length (ft) | = 131.0 | 0.0 | 0.0 | | | |
| Two-year 24-hr precip. (in) | = 4.08 | 0.00 | 0.00 | | | |
| Land slope (%) | = 1.00 | 0.00 | 0.00 | | | |
| Travel Time (min) | = 14.21 | + | 0.00 | + | 0.00 | = 14.21 |
| Shallow Concentrated Flow | | | | | | |
| Flow length (ft) | = 179.00 | 0.00 | 0.00 | | | |
| Watercourse slope (%) | = 2.20 | 0.00 | 0.00 | | | |
| Surface description | = Unpaved | Paved | Paved | | | |
| Average velocity (ft/s) | = 2.39 | 0.00 | 0.00 | | | |
| Travel Time (min) | = 1.25 | + | 0.00 | + | 0.00 | = 1.25 |
| Channel Flow | | | | | | |
| X sectional flow area (sqft) | = 0.00 | 0.00 | 0.00 | | | |
| Wetted perimeter (ft) | = 0.00 | 0.00 | 0.00 | | | |
| Channel slope (%) | = 0.00 | 0.00 | 0.00 | | | |
| Manning's n-value | = 0.015 | 0.015 | 0.015 | | | |
| Velocity (ft/s) | = 0.00 | 0.00 | 0.00 | | | |
| Flow length (ft) | = 0.0 | 0.0 | 0.0 | | | |
| Travel Time (min) | = 0.00 | + | 0.00 | + | 0.00 | = 0.00 |
| Total Travel Time, Tc | | | | | 15.50 min | |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

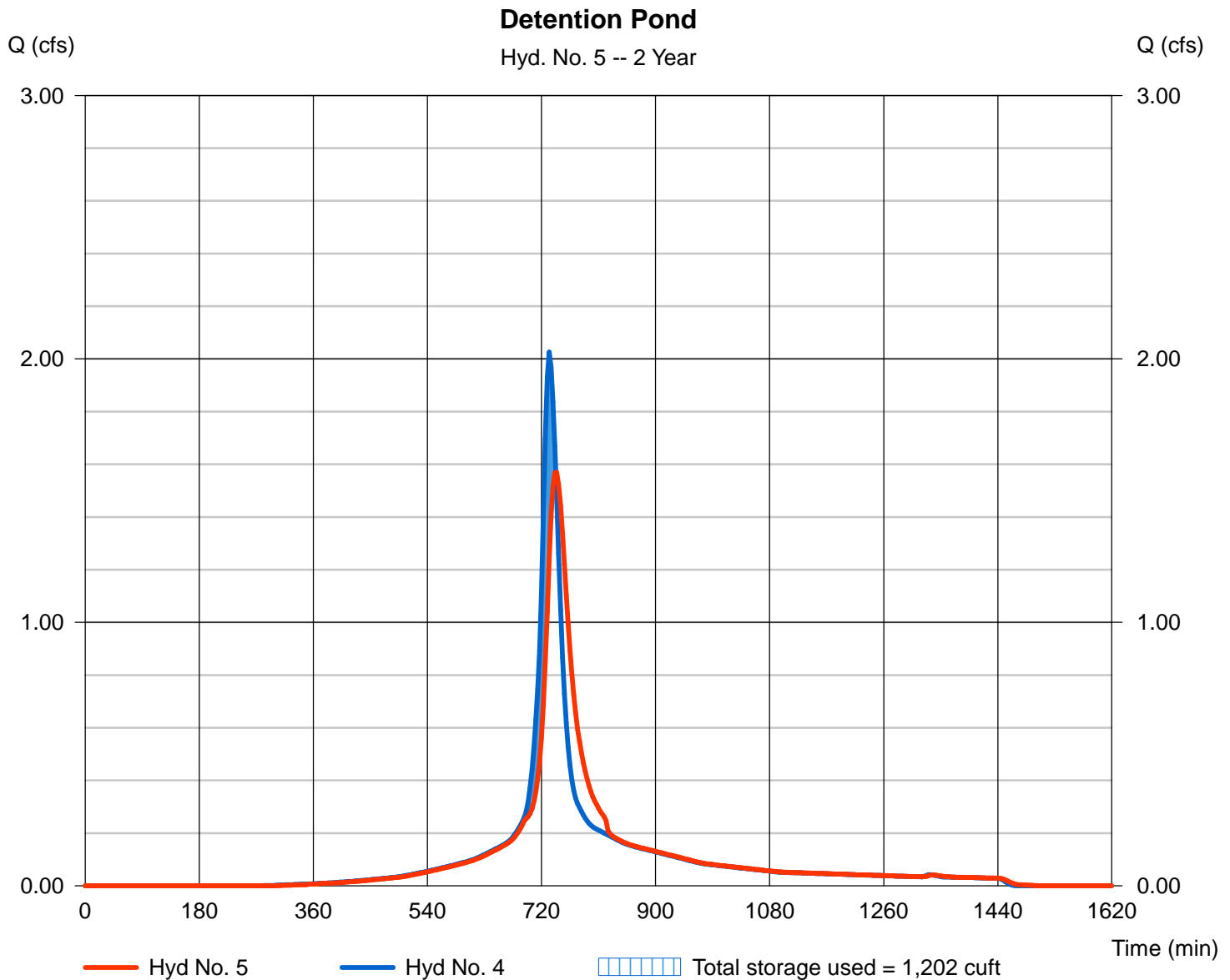
Hyd. No. 5

Detention Pond

Hydrograph type = Reservoir
 Storm frequency = 2 yrs
 Time interval = 3 min
 Inflow hyd. No. = 4 - Post Developed Basin 2
 Reservoir name = <New Pond>

Peak discharge = 1.569 cfs
 Time to peak = 744 min
 Hyd. volume = 9,264 cuft
 Max. Elevation = 1292.93 ft
 Max. Storage = 1,202 cuft

Storage Indication method used.



Pond No. 1 - <New Pond>

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1291.60 ft

Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|------------|----------------|---------------------|----------------------|----------------------|
| 0.00 | 1291.60 | 10 | 0 | 0 |
| 0.40 | 1292.00 | 412 | 65 | 65 |
| 1.40 | 1293.00 | 2,308 | 1,232 | 1,296 |
| 2.40 | 1294.00 | 6,245 | 4,116 | 5,412 |

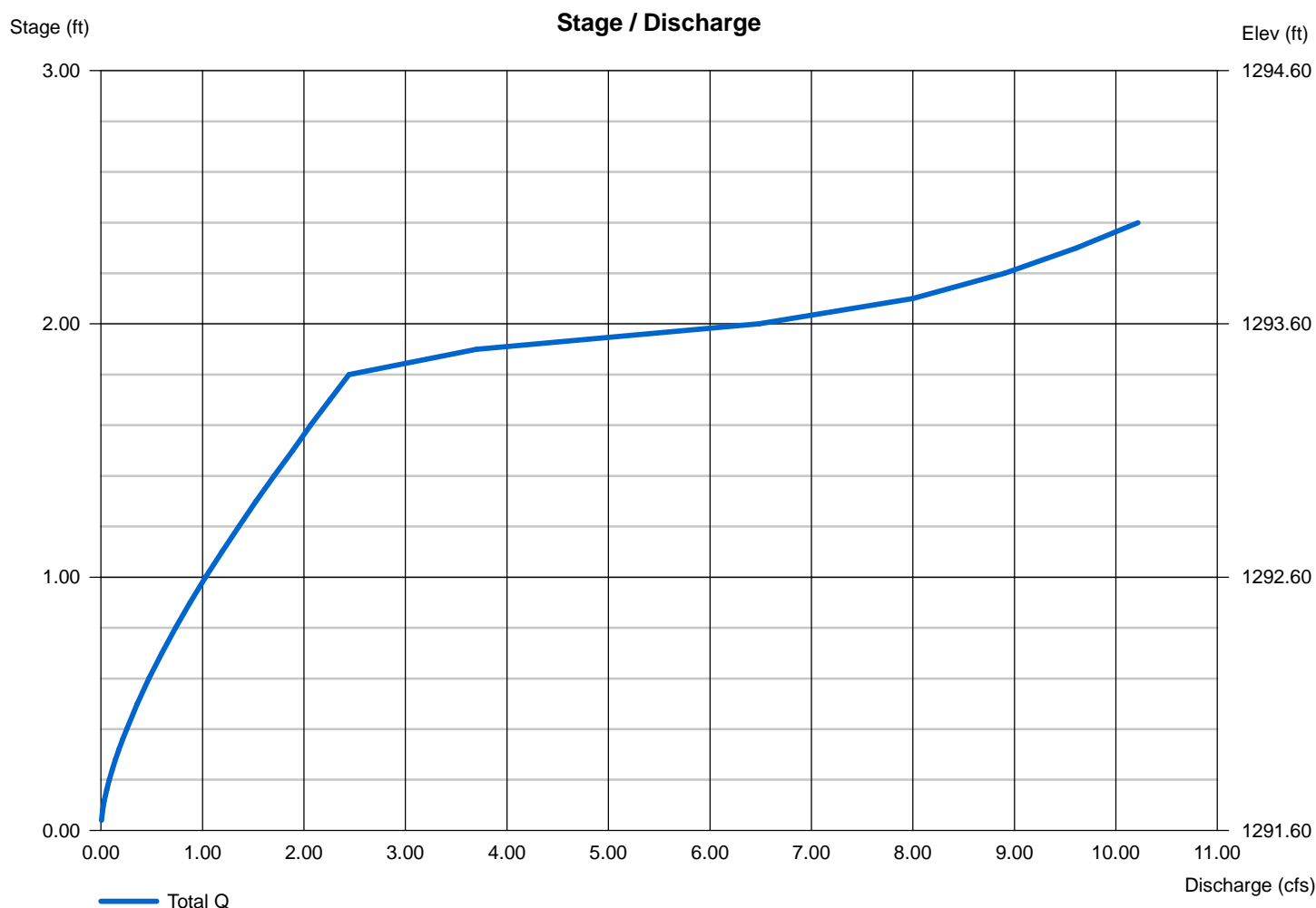
Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|-----------------|-----------|------|------|----------|
| Rise (in) | = 18.00 | 0.00 | 0.00 | 0.00 |
| Span (in) | = 18.00 | 0.00 | 0.00 | 0.00 |
| No. Barrels | = 1 | 0 | 0 | 0 |
| Invert El. (ft) | = 1291.60 | 0.00 | 0.00 | 0.00 |
| Length (ft) | = 20.00 | 0.00 | 0.00 | 0.00 |
| Slope (%) | = 0.50 | 0.00 | 0.00 | n/a |
| N-Value | = .013 | .013 | .013 | n/a |
| Orifice Coeff. | = 0.60 | 0.60 | 0.60 | 0.60 |
| Multi-Stage | = n/a | No | No | No |

Weir Structures

| | [A] | [B] | [C] | [D] |
|----------------|-----------------------|---------|------|------|
| Crest Len (ft) | = 16.00 | 0.38 | 0.00 | 0.00 |
| Crest El. (ft) | = 1293.40 | 1291.61 | 0.00 | 0.00 |
| Weir Coeff. | = 3.33 | 3.33 | 3.33 | 3.33 |
| Weir Type | = Riser | Rect | --- | --- |
| Multi-Stage | = Yes | Yes | No | No |
| Exfil.(in/hr) | = 0.000 (by Wet area) | | | |
| TW Elev. (ft) | = 0.00 | | | |

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

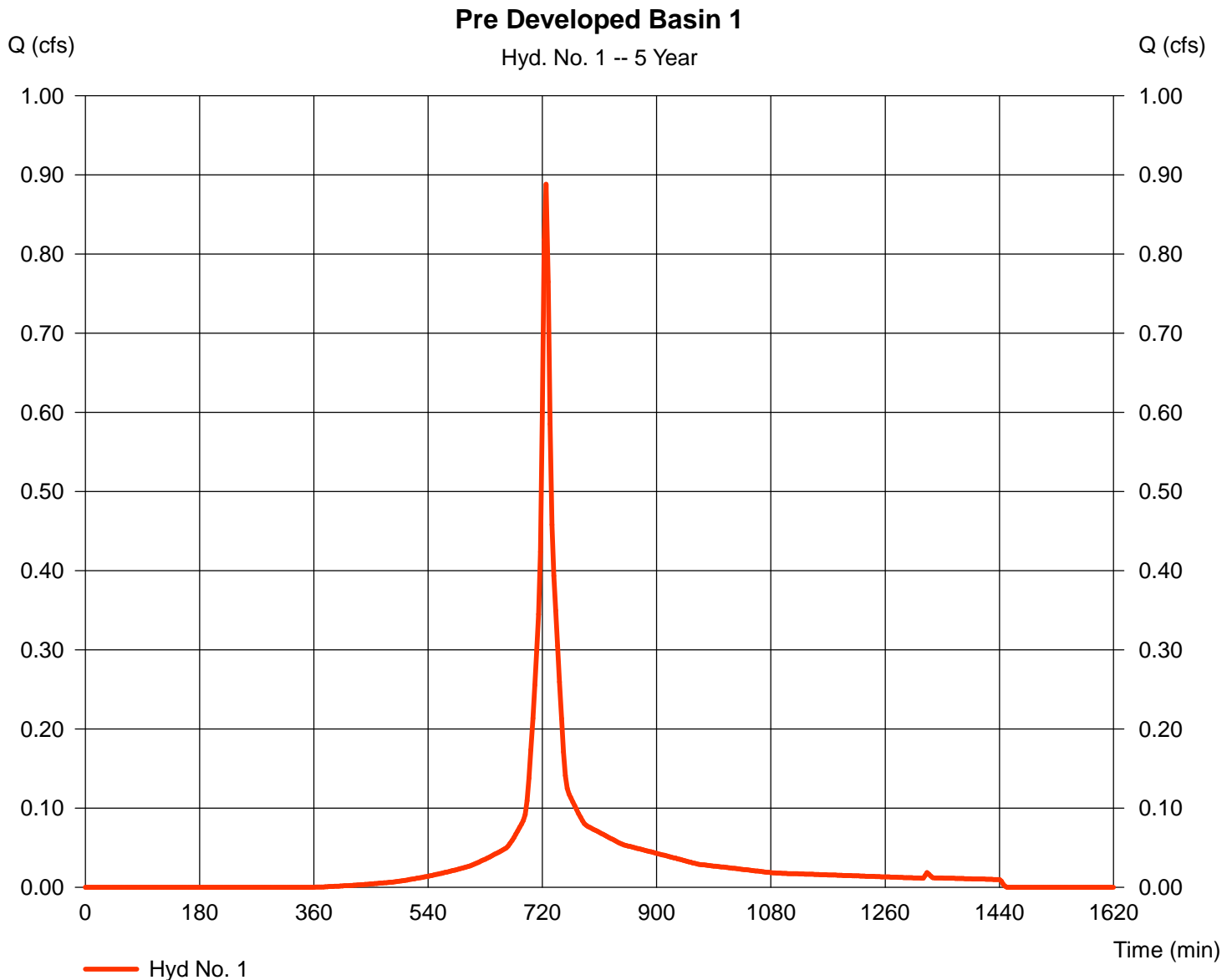
Wednesday, Jul 22, 2015

Hyd. No. 1

Pre Developed Basin 1

Hydrograph type = SCS Runoff
 Storm frequency = 5 yrs
 Time interval = 3 min
 Drainage area = 0.280 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 4.65 in
 Storm duration = 24 hrs

Peak discharge = 0.888 cfs
 Time to peak = 726 min
 Hyd. volume = 2,994 cuft
 Curve number = 86
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 8.80 min
 Distribution = Type III
 Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

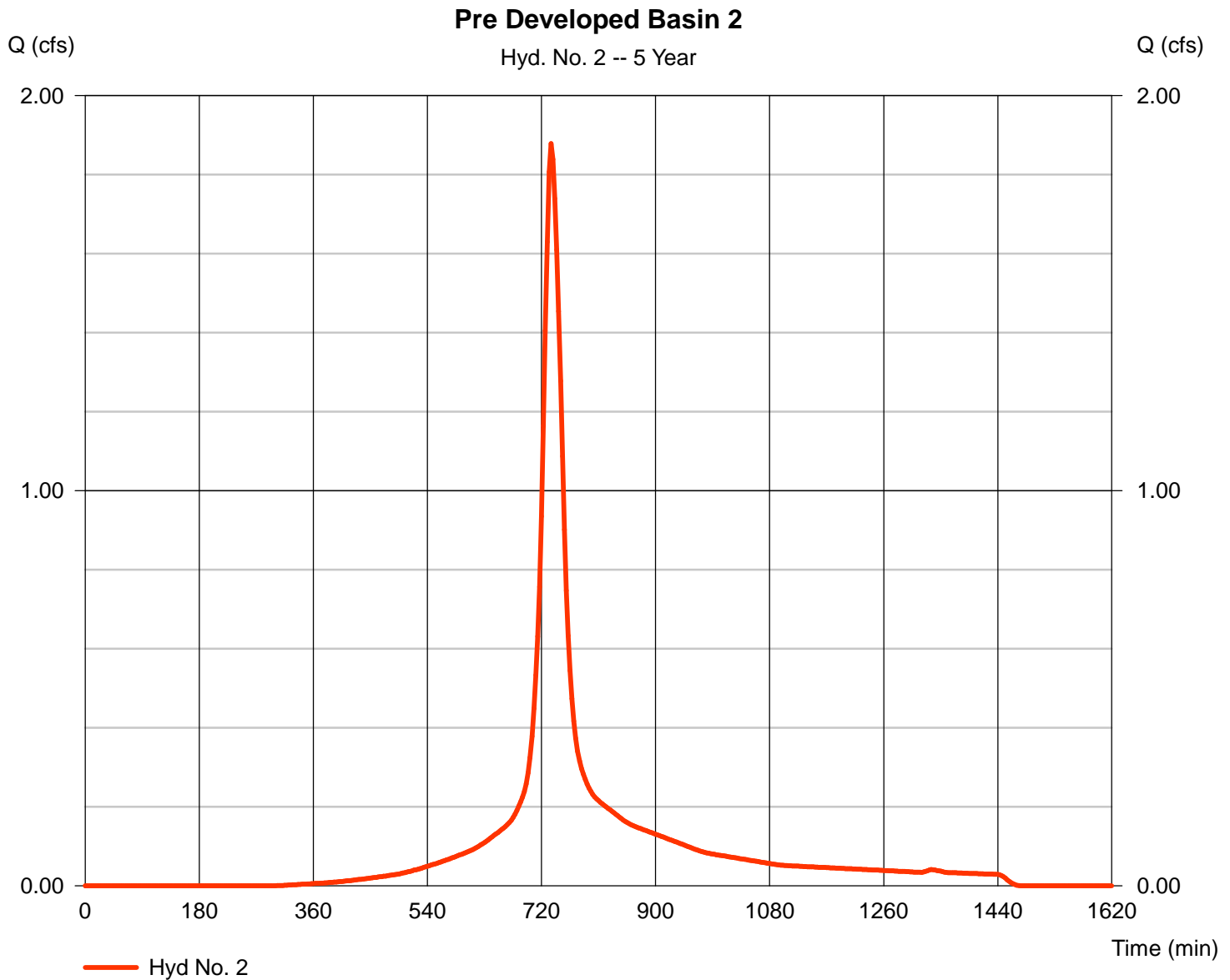
Wednesday, Jul 22, 2015

Hyd. No. 2

Pre Developed Basin 2

Hydrograph type = SCS Runoff
 Storm frequency = 5 yrs
 Time interval = 3 min
 Drainage area = 0.750 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 4.65 in
 Storm duration = 24 hrs

Peak discharge = 1.878 cfs
 Time to peak = 735 min
 Hyd. volume = 9,125 cuft
 Curve number = 89
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 20.40 min
 Distribution = Type III
 Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

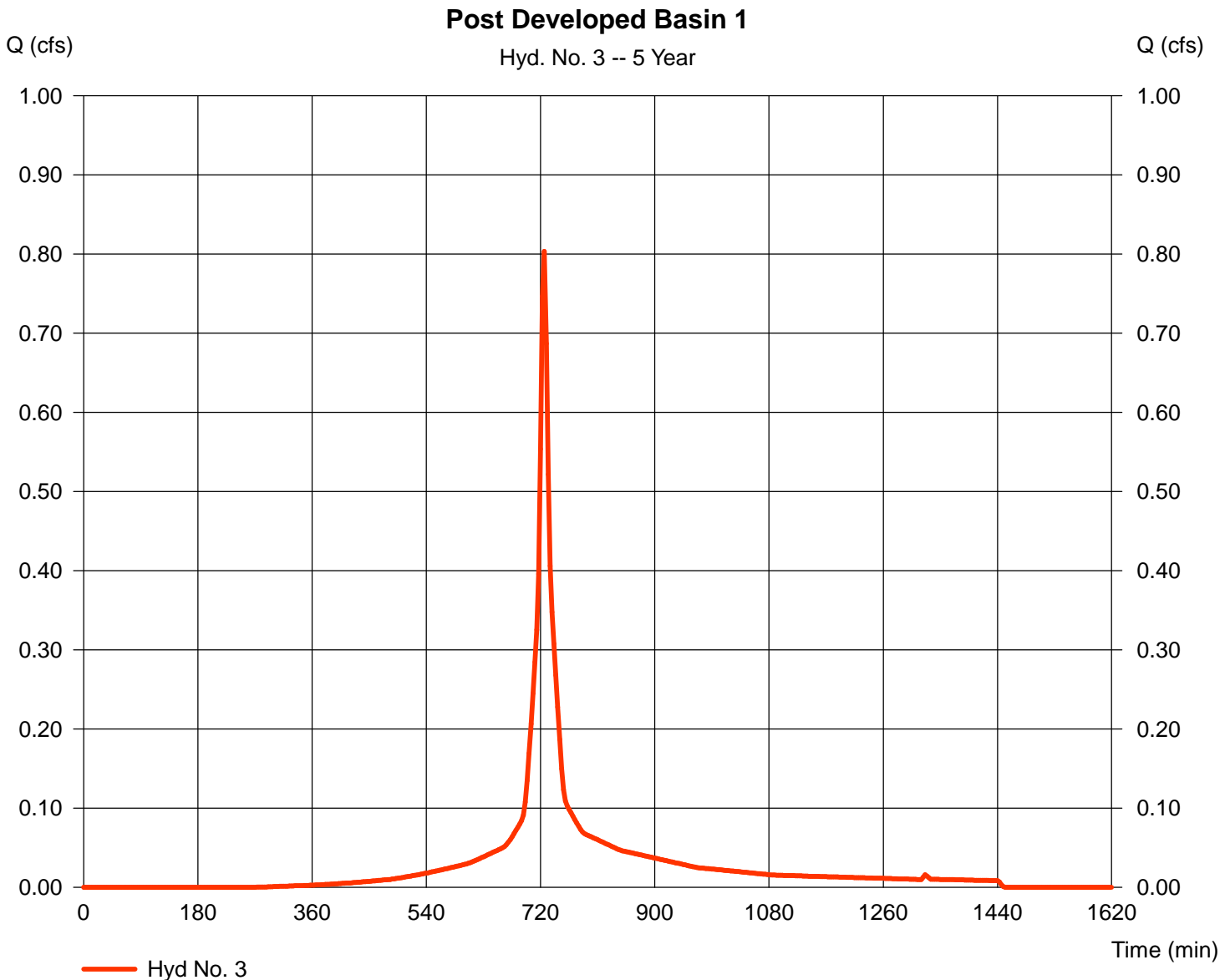
Hyd. No. 3

Post Developed Basin 1

Hydrograph type = SCS Runoff
 Storm frequency = 5 yrs
 Time interval = 3 min
 Drainage area = 0.230 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 4.65 in
 Storm duration = 24 hrs

Peak discharge = 0.803 cfs
 Time to peak = 726 min
 Hyd. volume = 2,770 cuft
 Curve number = 90*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 8.40 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.080 \times 98) + (0.150 \times 86)] / 0.230$



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

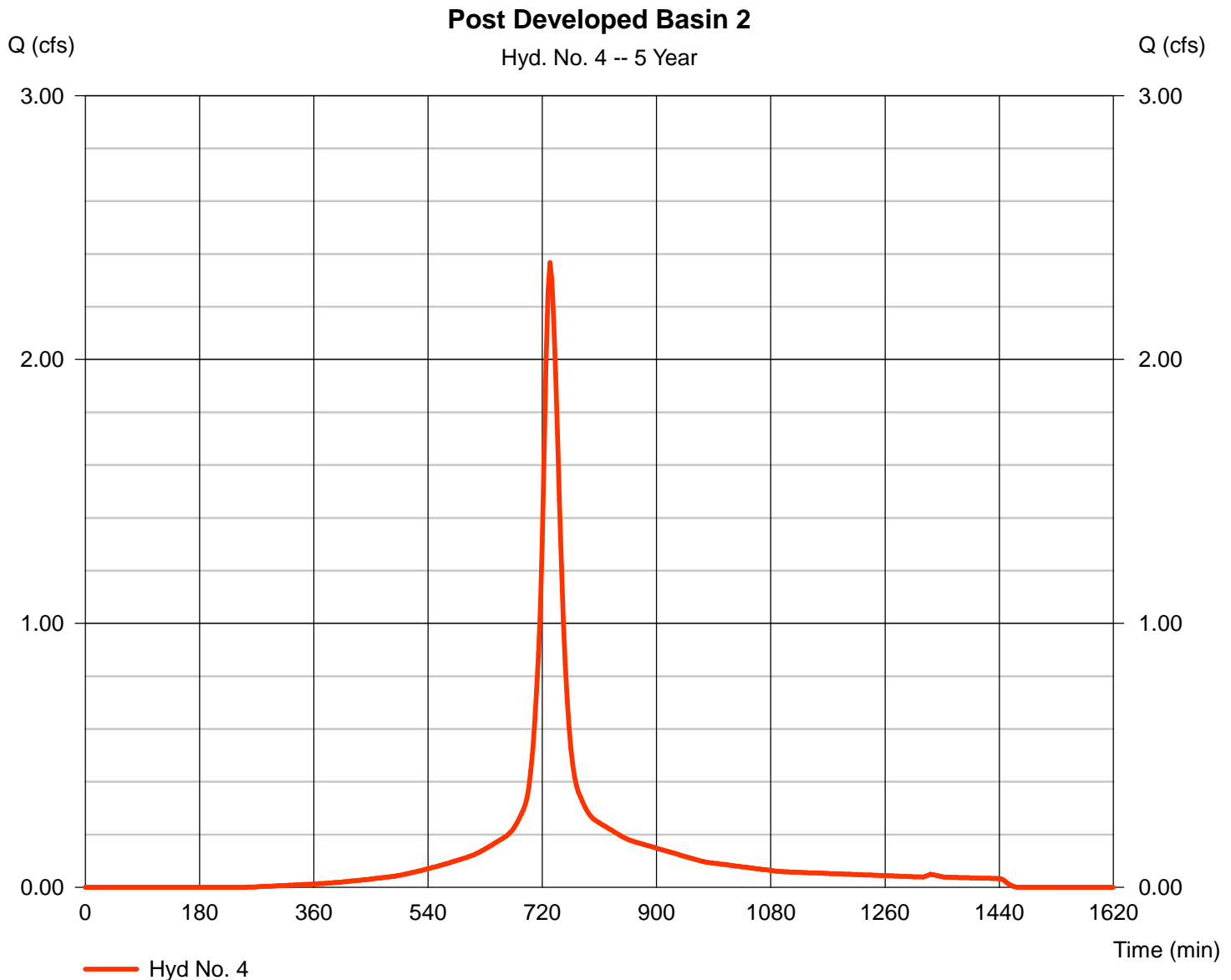
Hyd. No. 4

Post Developed Basin 2

Hydrograph type = SCS Runoff
 Storm frequency = 5 yrs
 Time interval = 3 min
 Drainage area = 0.800 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 4.65 in
 Storm duration = 24 hrs

Peak discharge = 2.367 cfs
 Time to peak = 732 min
 Hyd. volume = 10,910 cuft
 Curve number = 91*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 15.50 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.320 \times 89) + (0.270 \times 89) + (0.210 \times 98)] / 0.800$



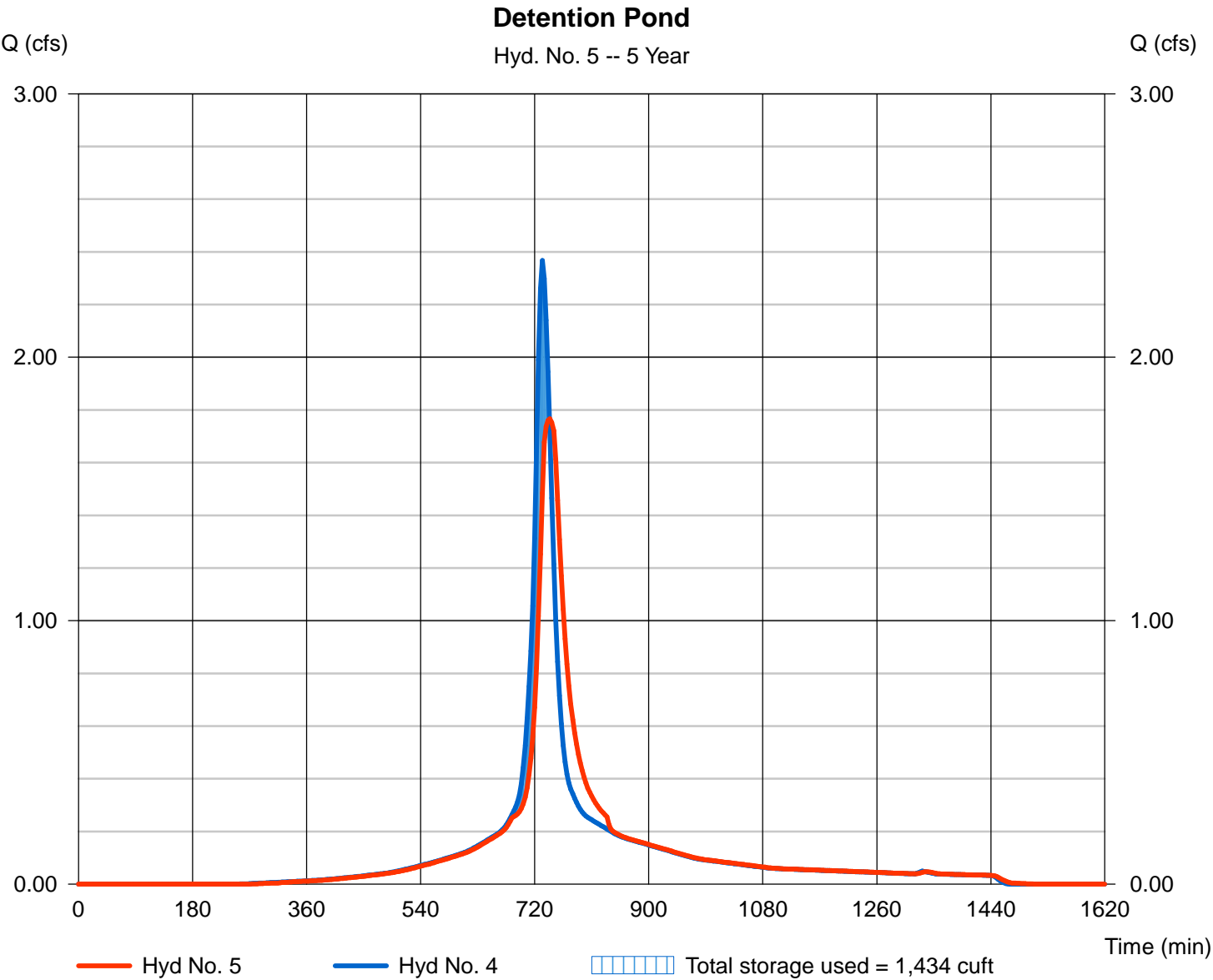
Hydrograph Report

Hyd. No. 5

Detention Pond

| | | | |
|-----------------|------------------------------|----------------|---------------|
| Hydrograph type | = Reservoir | Peak discharge | = 1.766 cfs |
| Storm frequency | = 5 yrs | Time to peak | = 744 min |
| Time interval | = 3 min | Hyd. volume | = 10,908 cuft |
| Inflow hyd. No. | = 4 - Post Developed Basin 2 | Max. Elevation | = 1293.04 ft |
| Reservoir name | = <New Pond> | Max. Storage | = 1,434 cuft |

Storage Indication method used.

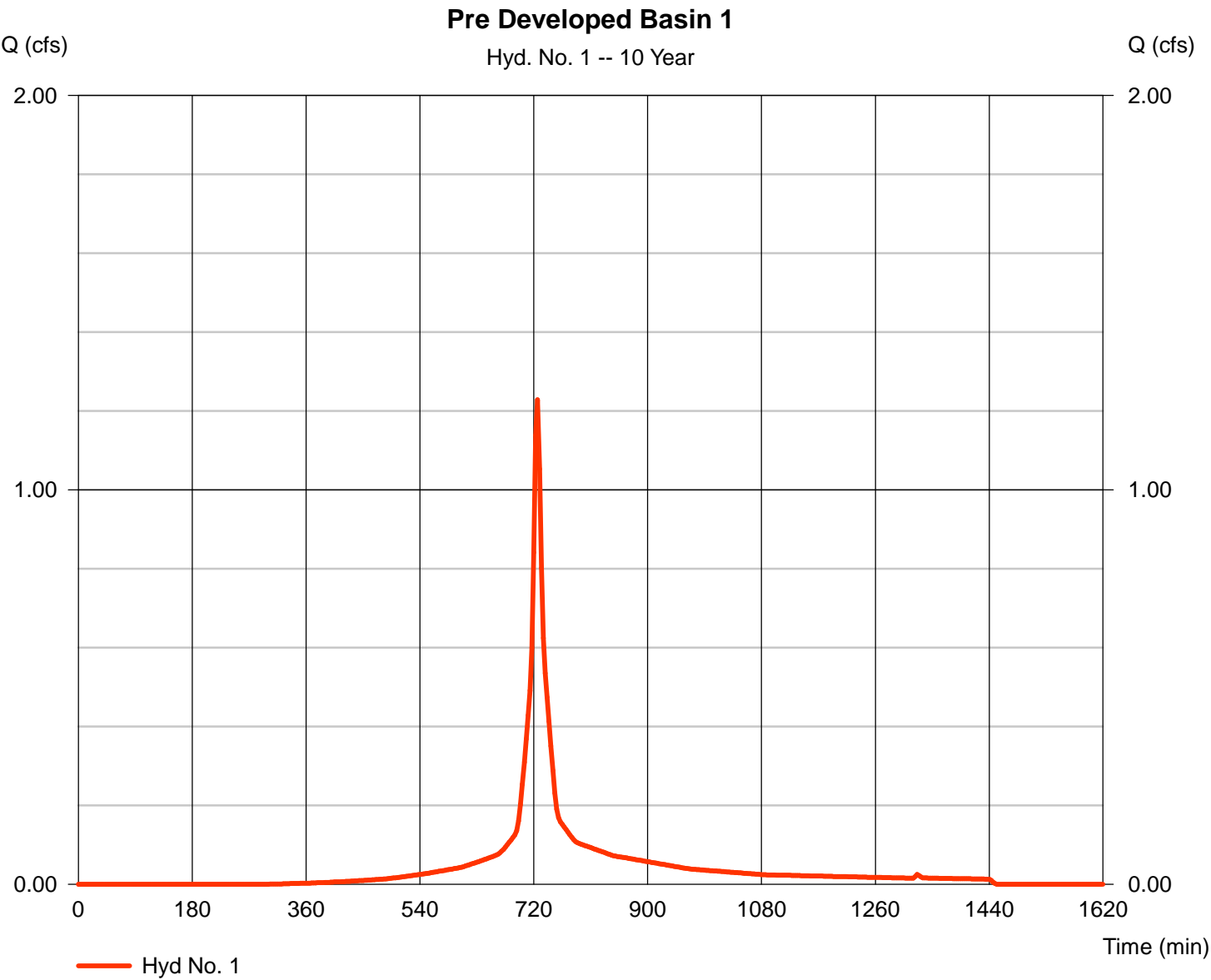


Hydrograph Report

Hyd. No. 1

Pre Developed Basin 1

| | | | | | |
|-----------------|---|------------|--------------------|---|------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.228 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 726 min |
| Time interval | = | 3 min | Hyd. volume | = | 4,202 cuft |
| Drainage area | = | 0.280 ac | Curve number | = | 86 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 8.80 min |
| Total precip. | = | 6.00 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

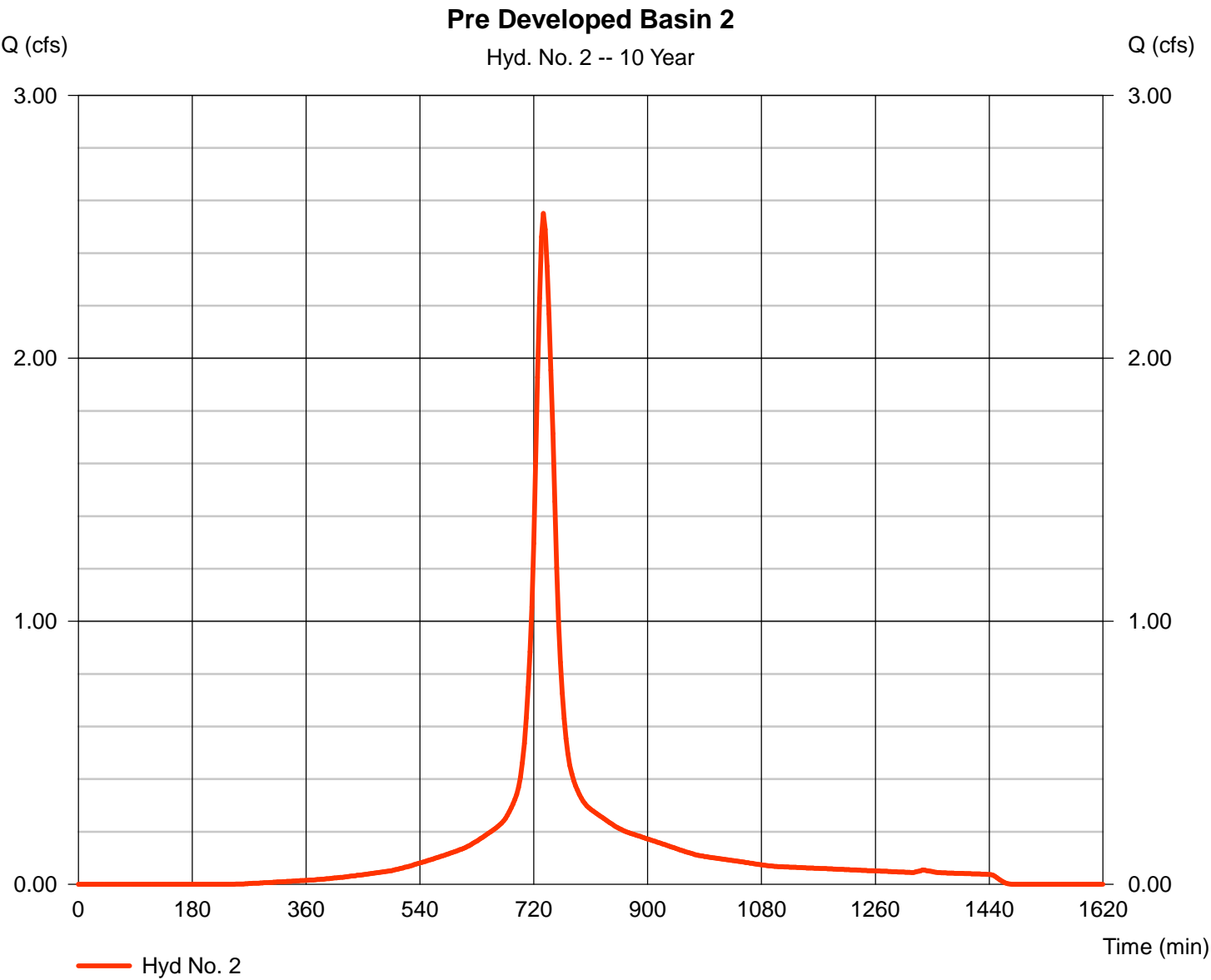


Hydrograph Report

Hyd. No. 2

Pre Developed Basin 2

| | | | | | |
|-----------------|---|------------|--------------------|---|-------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 2.551 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 735 min |
| Time interval | = | 3 min | Hyd. volume | = | 12,570 cuft |
| Drainage area | = | 0.750 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 20.40 min |
| Total precip. | = | 6.00 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

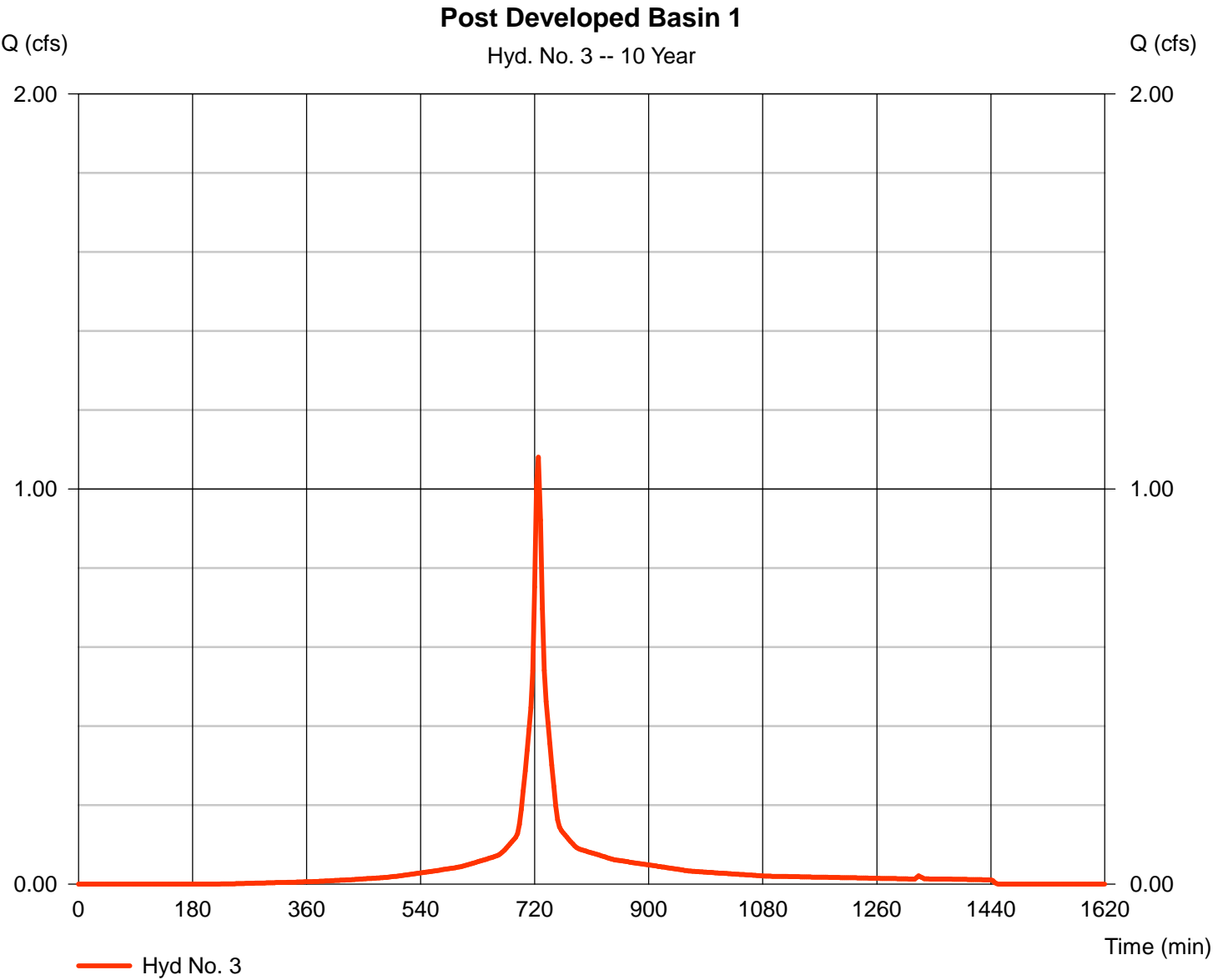
Wednesday, Jul 22, 2015

Hyd. No. 3

Post Developed Basin 1

| | | | | | |
|-----------------|---|------------|--------------------|---|------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.081 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 726 min |
| Time interval | = | 3 min | Hyd. volume | = | 3,793 cuft |
| Drainage area | = | 0.230 ac | Curve number | = | 90* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 8.40 min |
| Total precip. | = | 6.00 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.080 x 98) + (0.150 x 86)] / 0.230



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

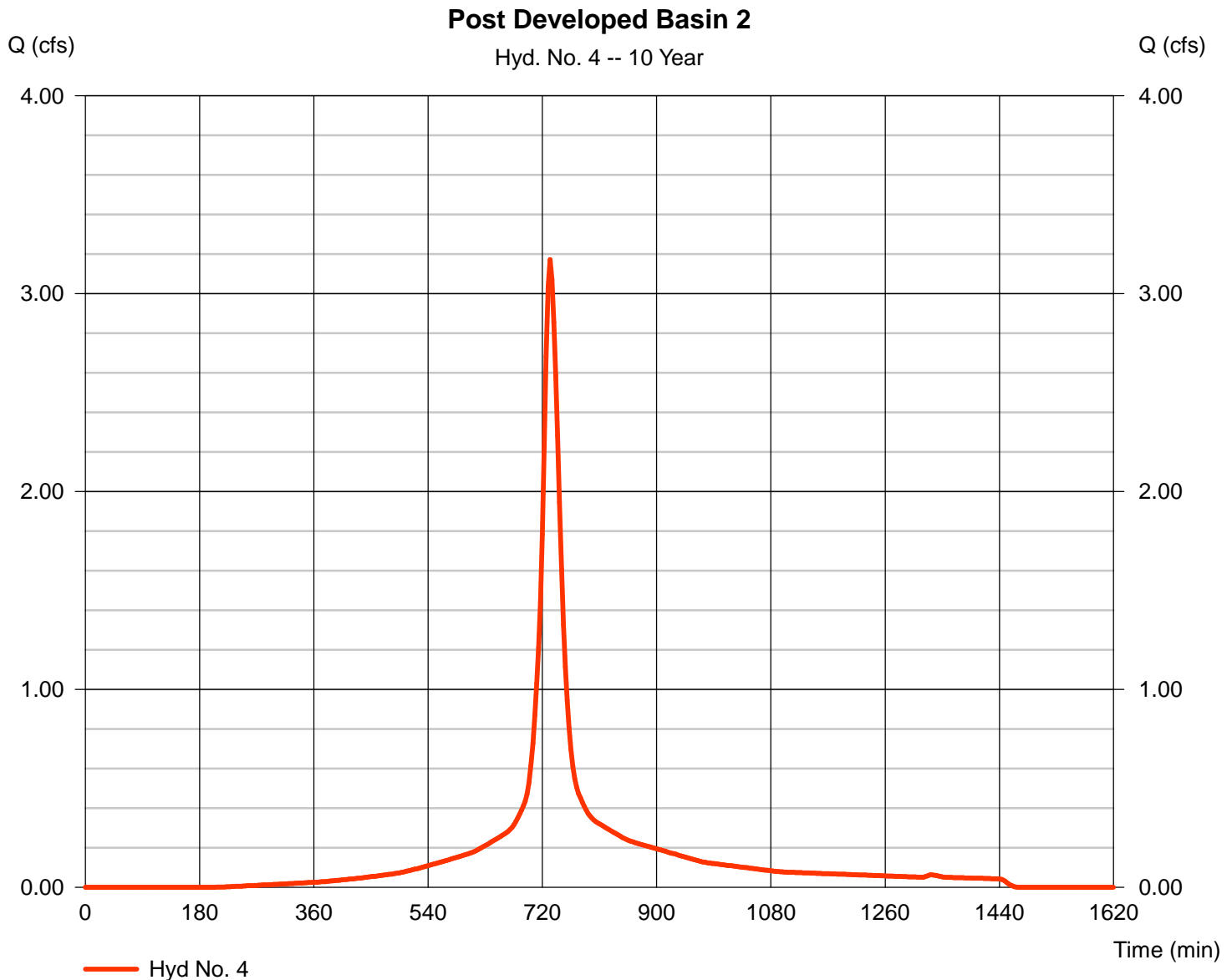
Hyd. No. 4

Post Developed Basin 2

Hydrograph type = SCS Runoff
 Storm frequency = 10 yrs
 Time interval = 3 min
 Drainage area = 0.800 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 6.00 in
 Storm duration = 24 hrs

Peak discharge = 3.171 cfs
 Time to peak = 732 min
 Hyd. volume = 14,846 cuft
 Curve number = 91*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 15.50 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.320 \times 89) + (0.270 \times 89) + (0.210 \times 98)] / 0.800$



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

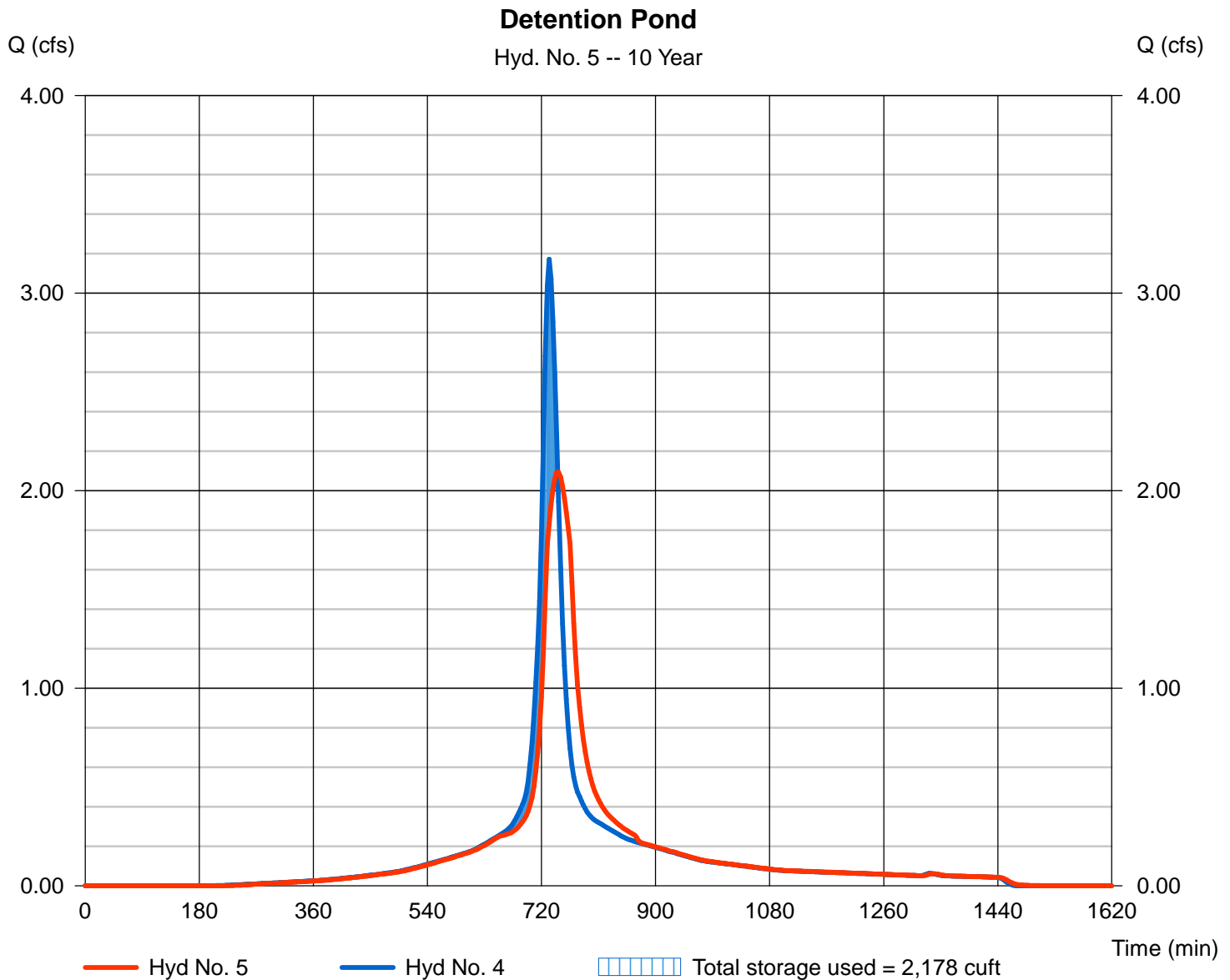
Hyd. No. 5

Detention Pond

Hydrograph type = Reservoir
 Storm frequency = 10 yrs
 Time interval = 3 min
 Inflow hyd. No. = 4 - Post Developed Basin 2
 Reservoir name = <New Pond>

Peak discharge = 2.094 cfs
 Time to peak = 747 min
 Hyd. volume = 14,844 cuft
 Max. Elevation = 1293.22 ft
 Max. Storage = 2,178 cuft

Storage Indication method used.

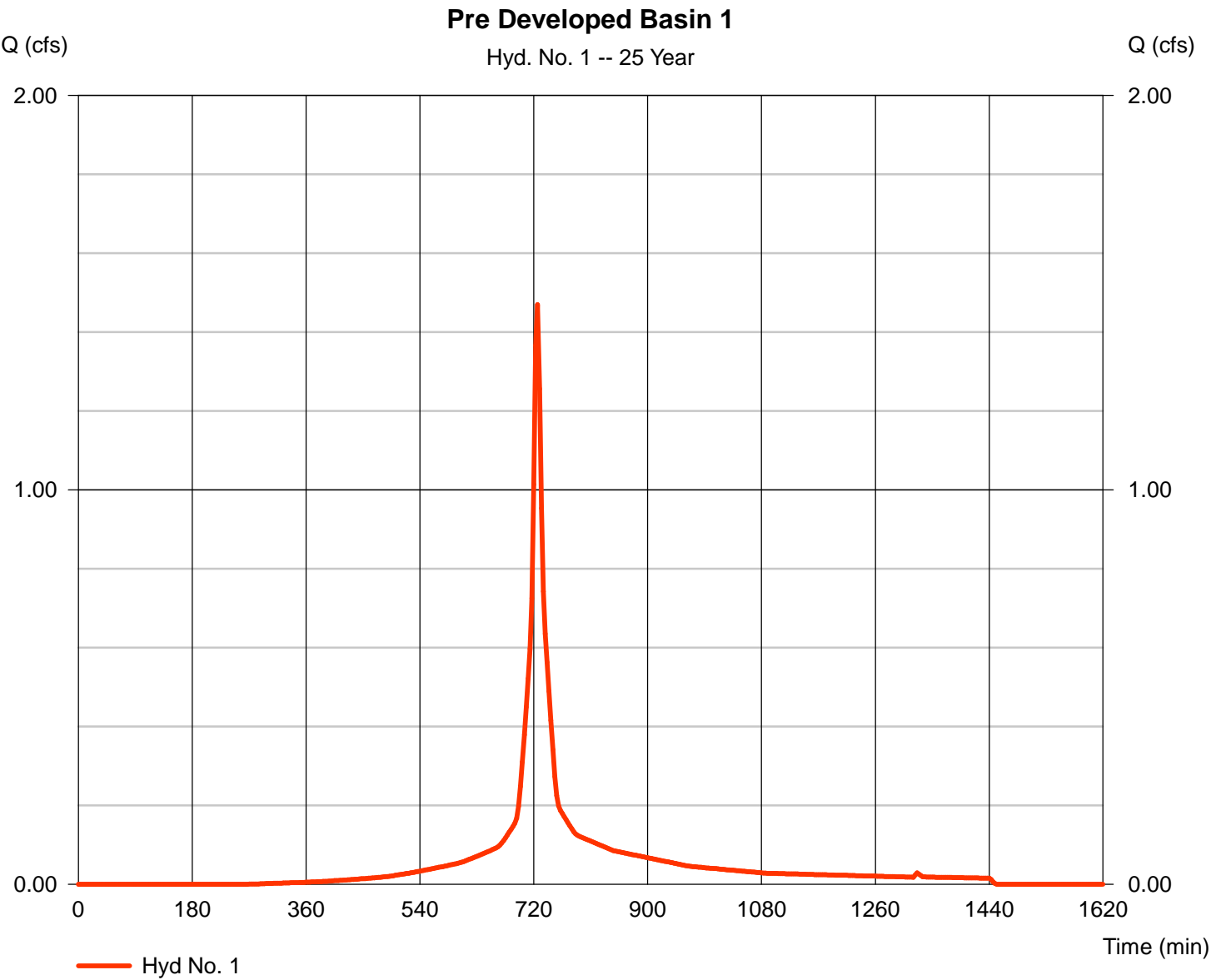


Hydrograph Report

Hyd. No. 1

Pre Developed Basin 1

| | | | | | |
|-----------------|---|------------|--------------------|---|------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.470 cfs |
| Storm frequency | = | 25 yrs | Time to peak | = | 726 min |
| Time interval | = | 3 min | Hyd. volume | = | 5,076 cuft |
| Drainage area | = | 0.280 ac | Curve number | = | 86 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 8.80 min |
| Total precip. | = | 6.96 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

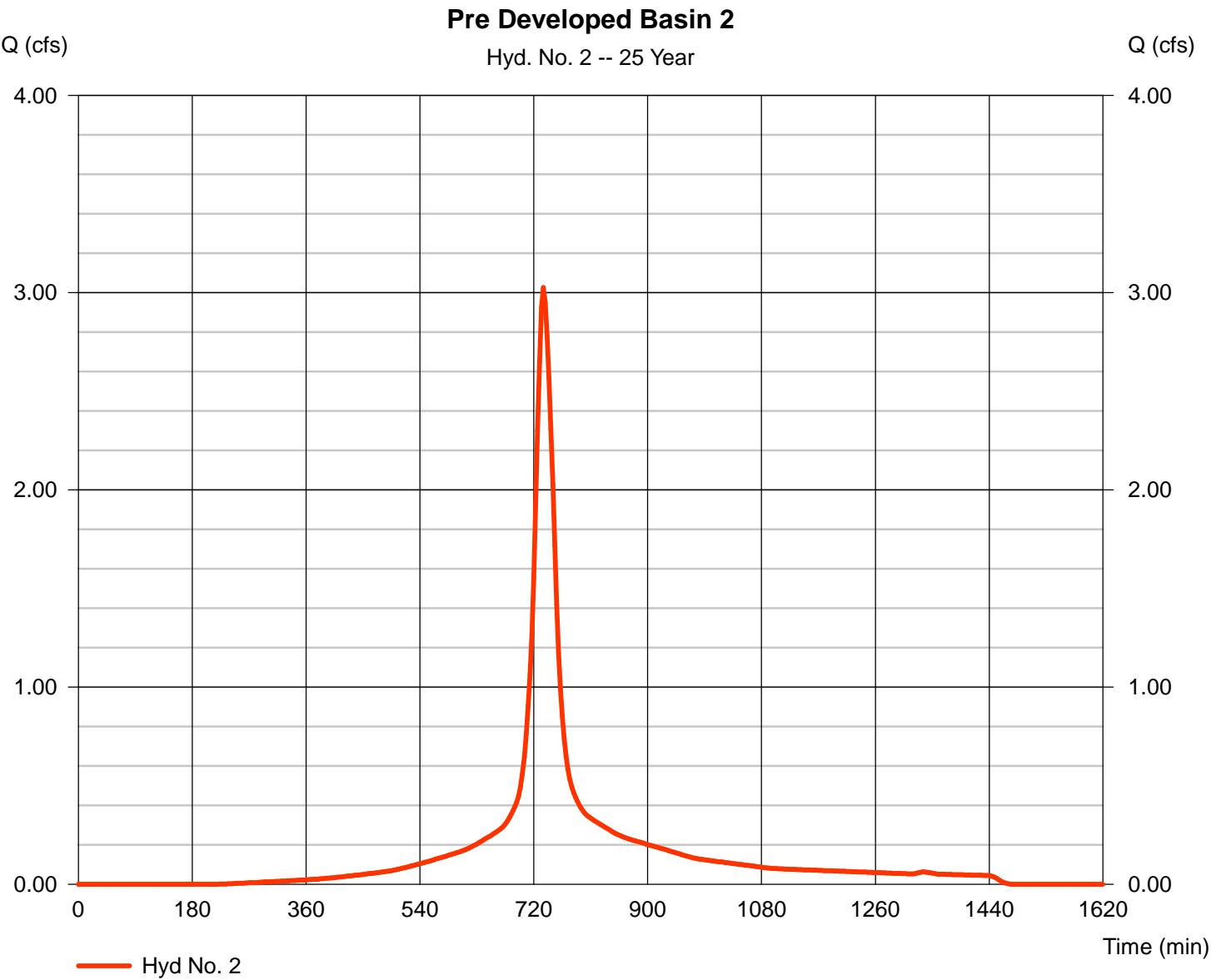


Hydrograph Report

Hyd. No. 2

Pre Developed Basin 2

| | | | | | |
|-----------------|---|------------|--------------------|---|-------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 3.026 cfs |
| Storm frequency | = | 25 yrs | Time to peak | = | 735 min |
| Time interval | = | 3 min | Hyd. volume | = | 15,048 cuft |
| Drainage area | = | 0.750 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 20.40 min |
| Total precip. | = | 6.96 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

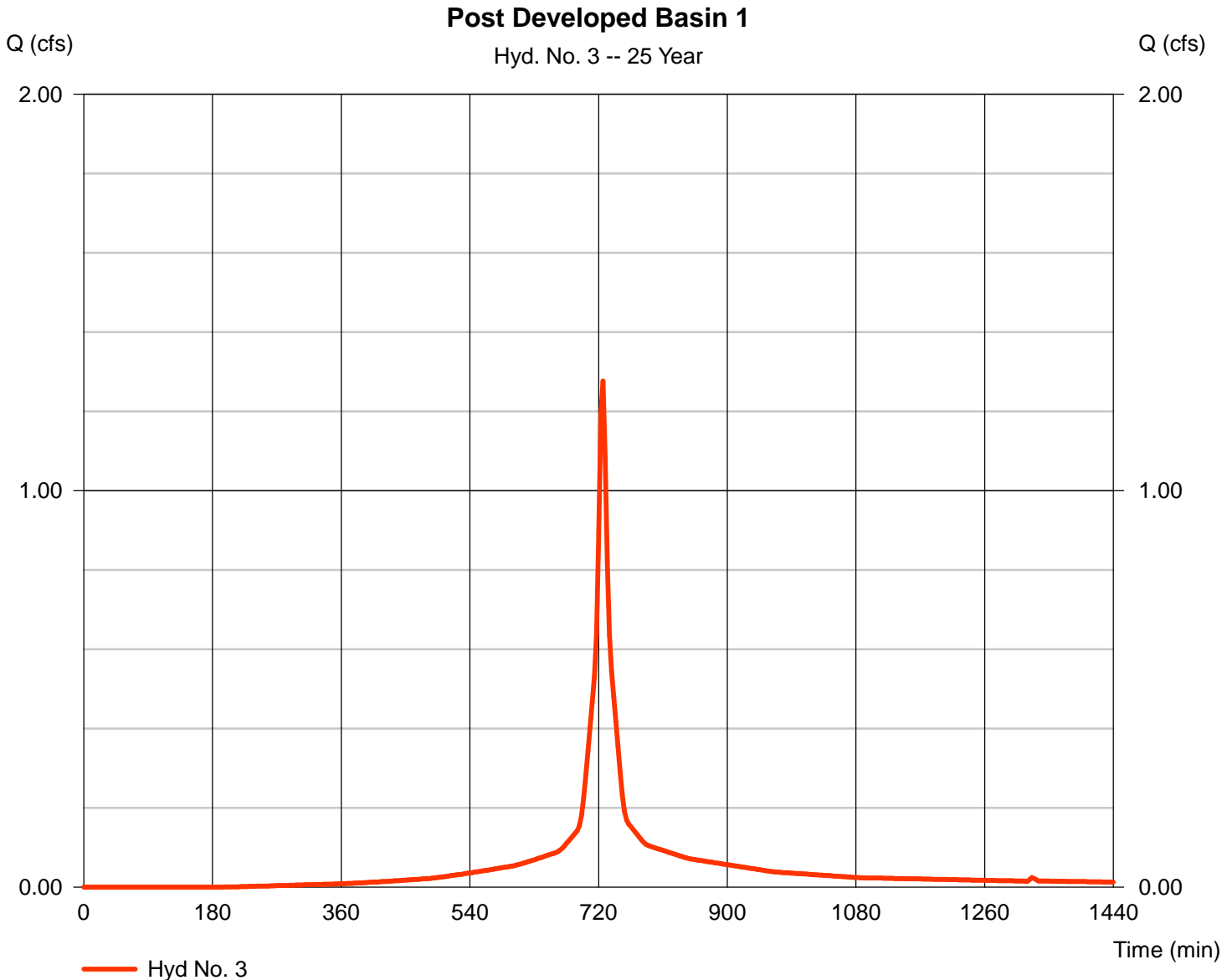
Hyd. No. 3

Post Developed Basin 1

Hydrograph type = SCS Runoff
 Storm frequency = 25 yrs
 Time interval = 3 min
 Drainage area = 0.230 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 6.96 in
 Storm duration = 24 hrs

Peak discharge = 1.276 cfs
 Time to peak = 726 min
 Hyd. volume = 4,527 cuft
 Curve number = 90*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 8.40 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.080 \times 98) + (0.150 \times 86)] / 0.230$



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

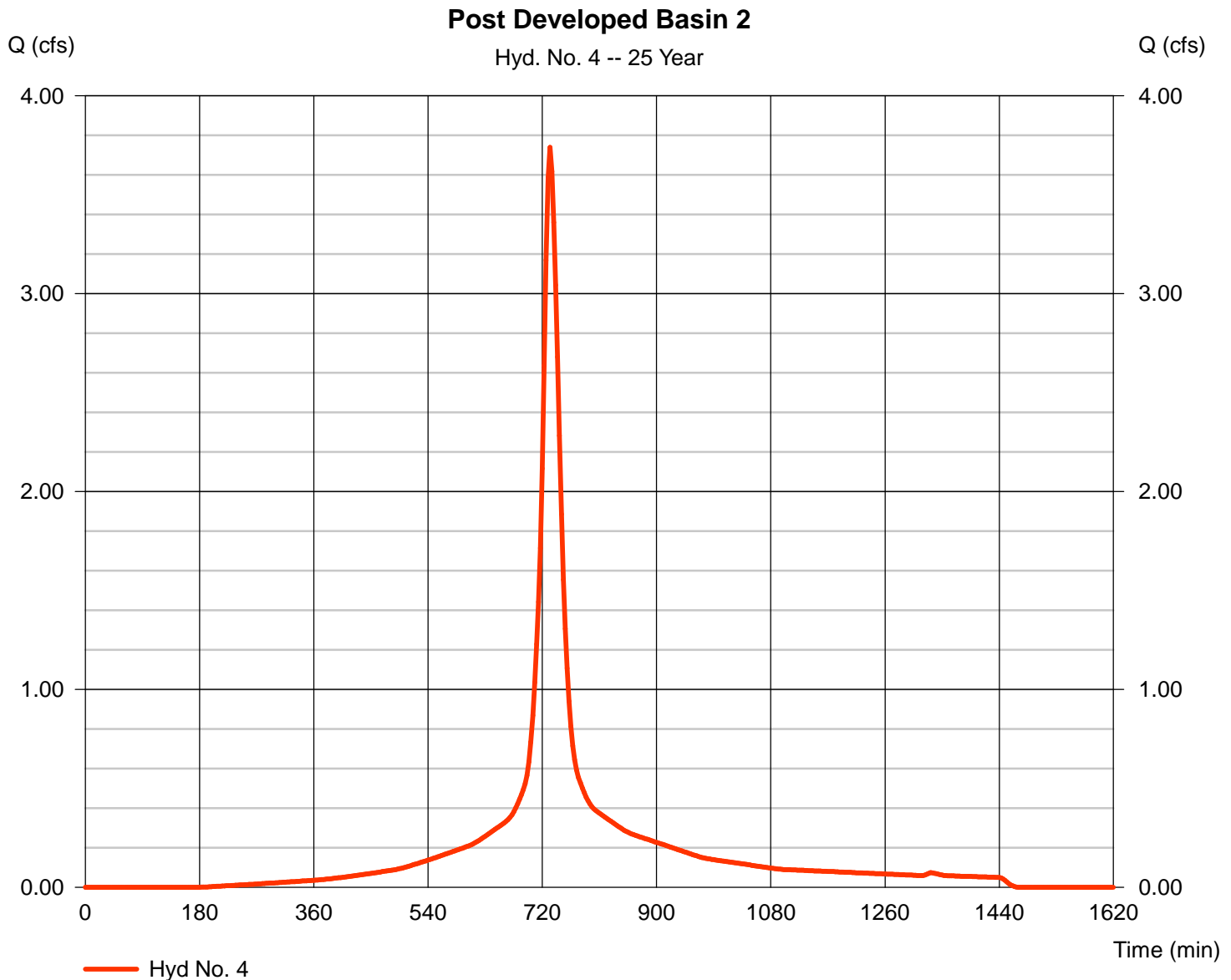
Hyd. No. 4

Post Developed Basin 2

Hydrograph type = SCS Runoff
 Storm frequency = 25 yrs
 Time interval = 3 min
 Drainage area = 0.800 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 6.96 in
 Storm duration = 24 hrs

Peak discharge = 3.739 cfs
 Time to peak = 732 min
 Hyd. volume = 17,667 cuft
 Curve number = 91*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 15.50 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.320 \times 89) + (0.270 \times 89) + (0.210 \times 98)] / 0.800$



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

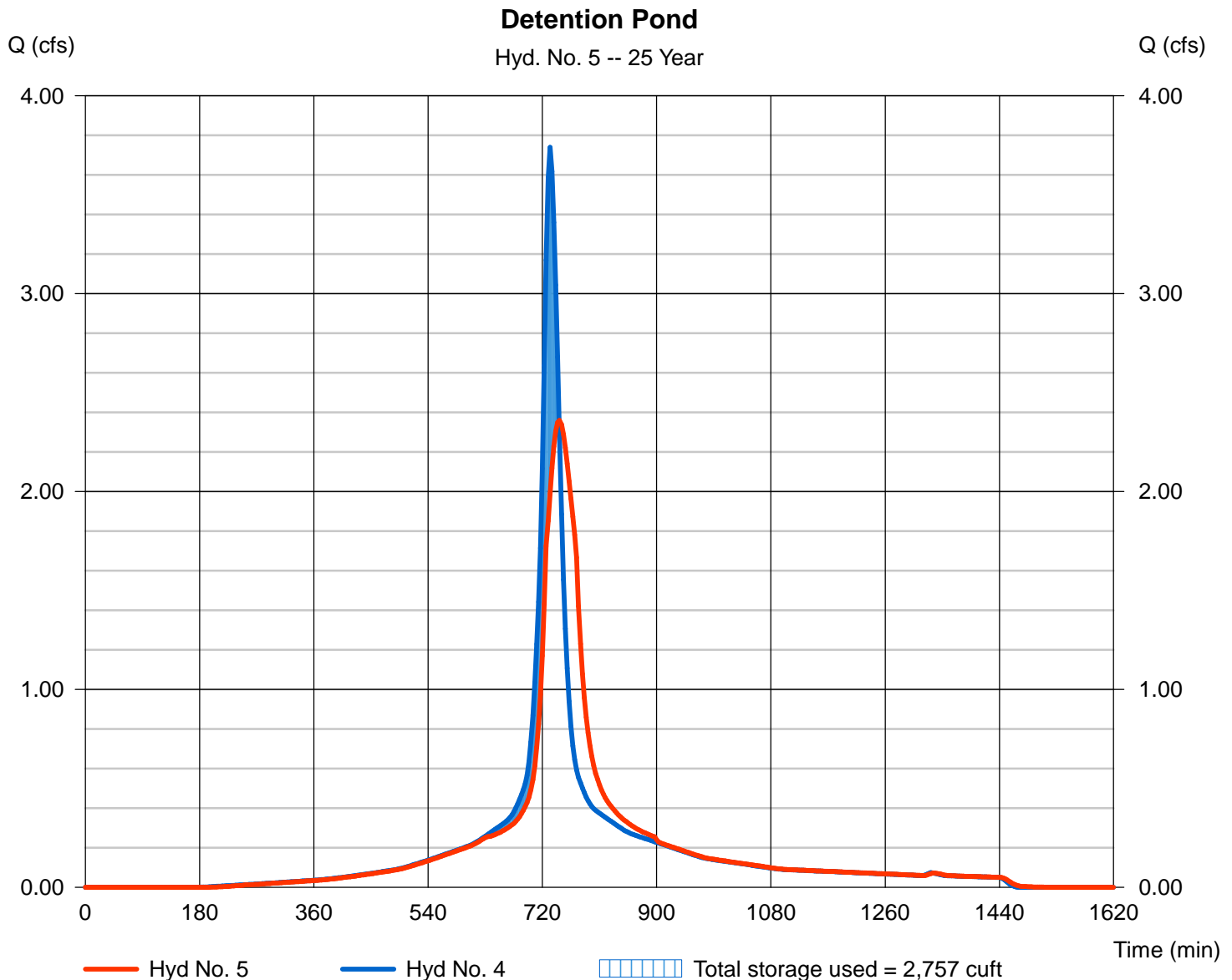
Hyd. No. 5

Detention Pond

Hydrograph type = Reservoir
 Storm frequency = 25 yrs
 Time interval = 3 min
 Inflow hyd. No. = 4 - Post Developed Basin 2
 Reservoir name = <New Pond>

Peak discharge = 2.359 cfs
 Time to peak = 747 min
 Hyd. volume = 17,666 cuft
 Max. Elevation = 1293.36 ft
 Max. Storage = 2,757 cuft

Storage Indication method used.

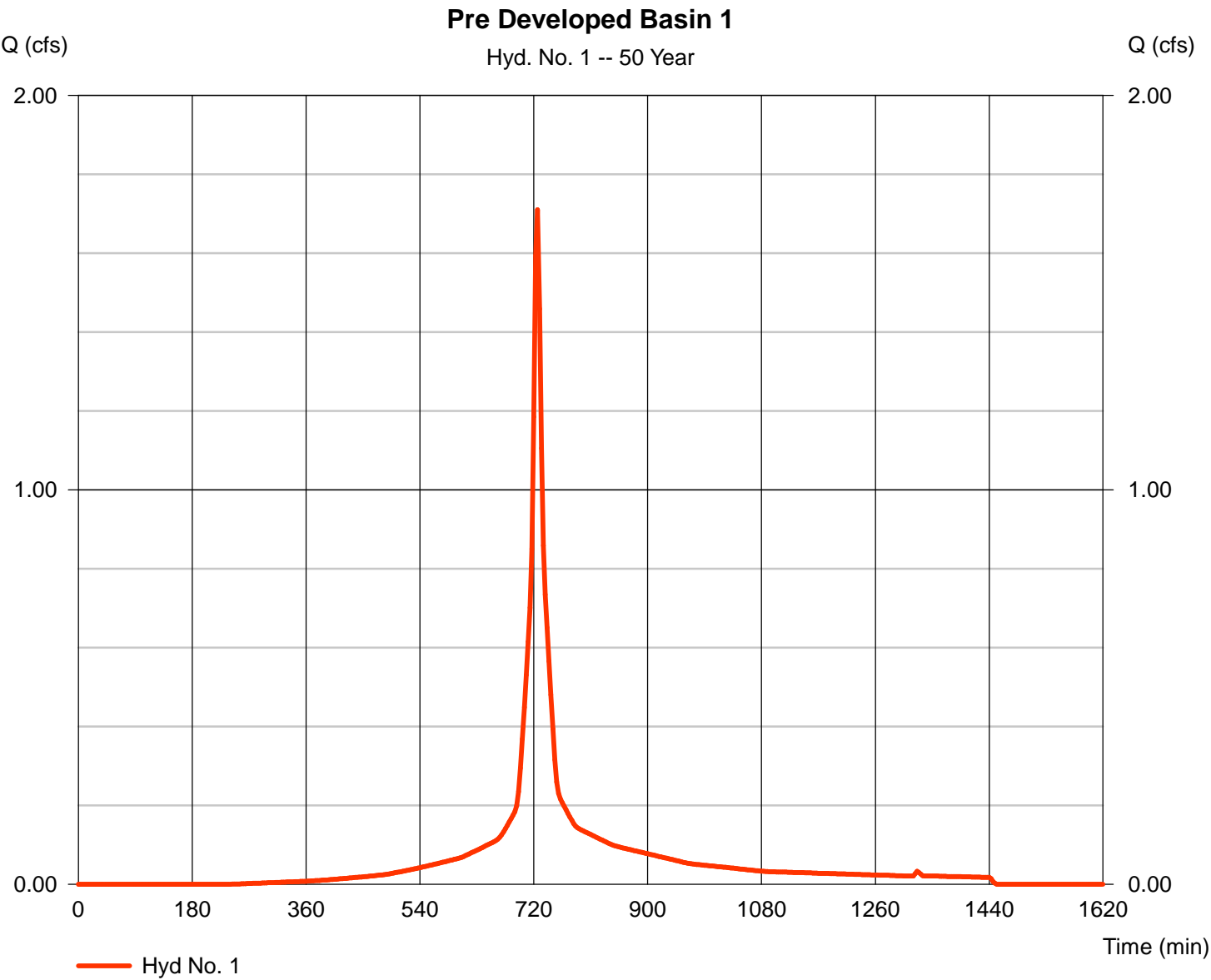


Hydrograph Report

Hyd. No. 1

Pre Developed Basin 1

| | | | | | |
|-----------------|---|------------|--------------------|---|------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.710 cfs |
| Storm frequency | = | 50 yrs | Time to peak | = | 726 min |
| Time interval | = | 3 min | Hyd. volume | = | 5,959 cuft |
| Drainage area | = | 0.280 ac | Curve number | = | 86 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 8.80 min |
| Total precip. | = | 7.92 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

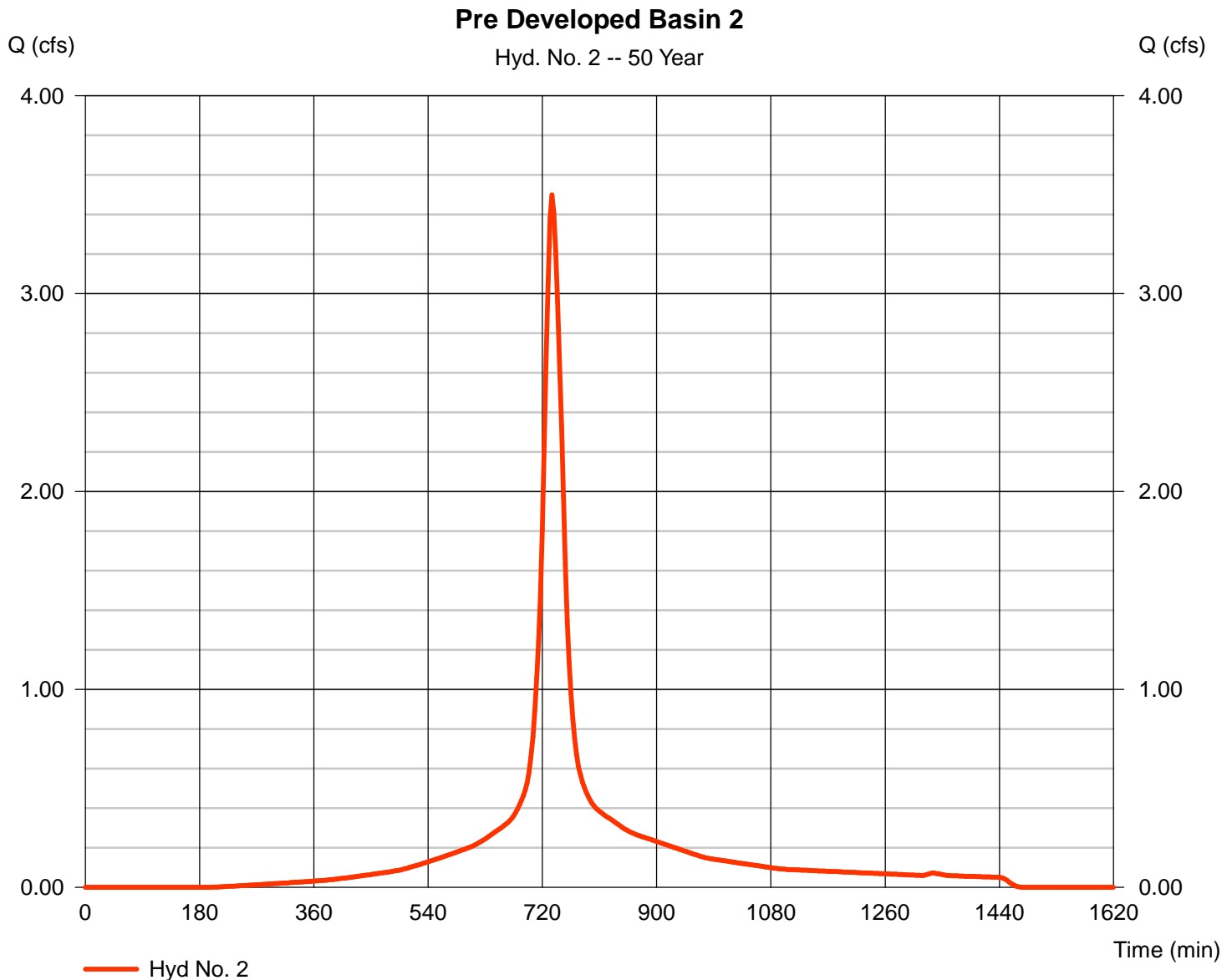
Wednesday, Jul 22, 2015

Hyd. No. 2

Pre Developed Basin 2

Hydrograph type = SCS Runoff
 Storm frequency = 50 yrs
 Time interval = 3 min
 Drainage area = 0.750 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 7.92 in
 Storm duration = 24 hrs

Peak discharge = 3.499 cfs
 Time to peak = 735 min
 Hyd. volume = 17,541 cuft
 Curve number = 89
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 20.40 min
 Distribution = Type III
 Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

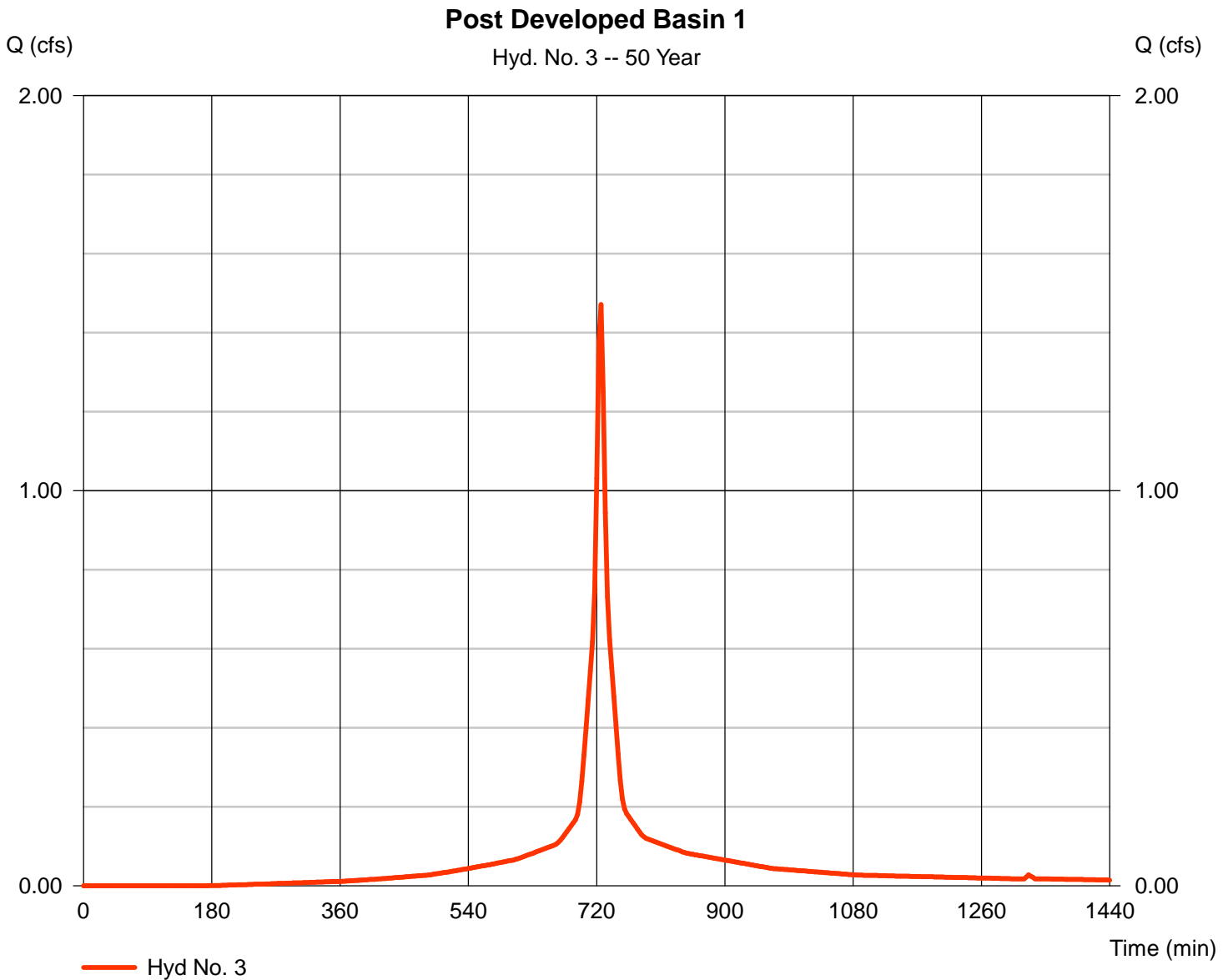
Hyd. No. 3

Post Developed Basin 1

Hydrograph type = SCS Runoff
 Storm frequency = 50 yrs
 Time interval = 3 min
 Drainage area = 0.230 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 7.92 in
 Storm duration = 24 hrs

Peak discharge = 1.471 cfs
 Time to peak = 726 min
 Hyd. volume = 5,265 cuft
 Curve number = 90*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 8.40 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.080 \times 98) + (0.150 \times 86)] / 0.230$



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

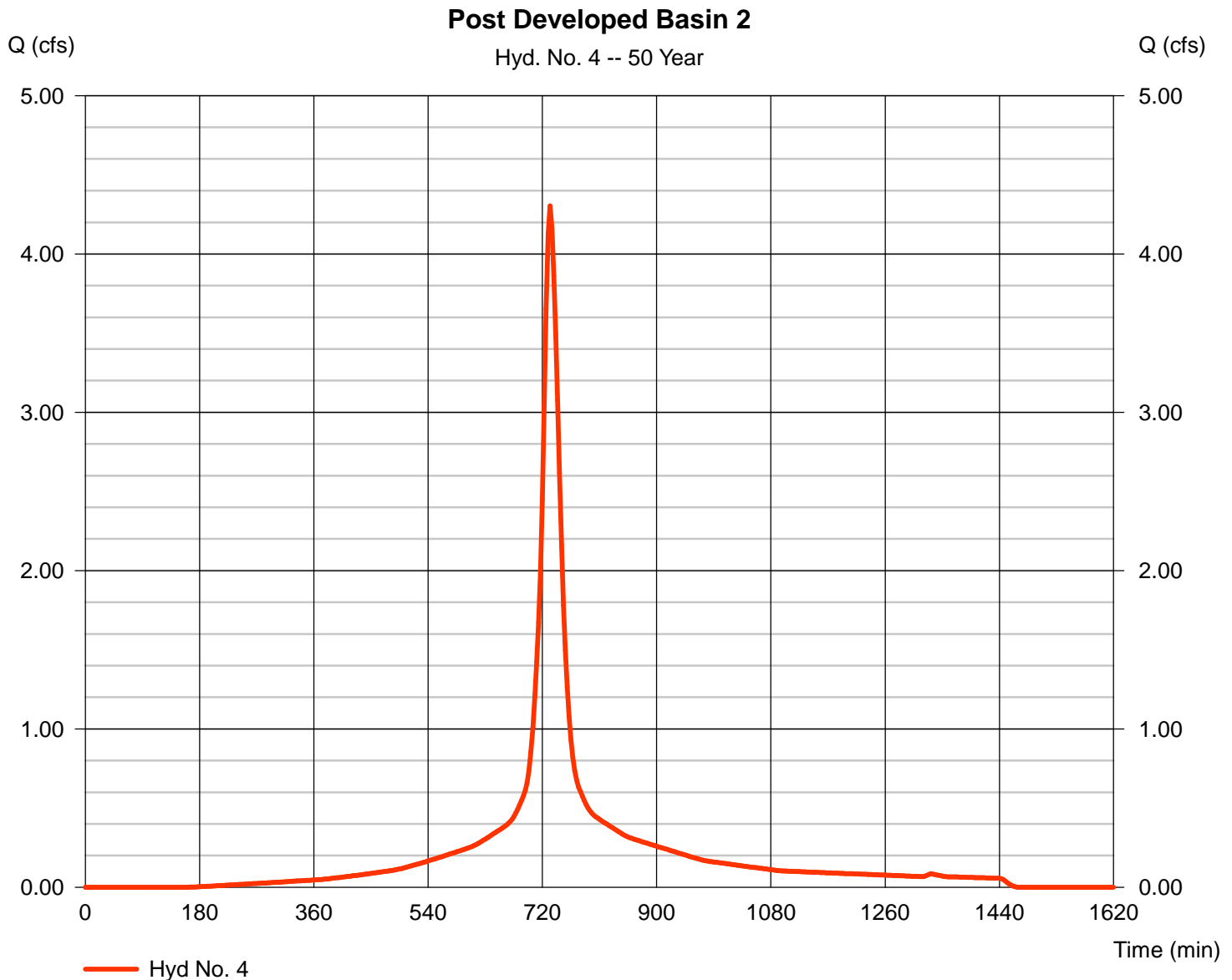
Hyd. No. 4

Post Developed Basin 2

Hydrograph type = SCS Runoff
 Storm frequency = 50 yrs
 Time interval = 3 min
 Drainage area = 0.800 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 7.92 in
 Storm duration = 24 hrs

Peak discharge = 4.303 cfs
 Time to peak = 732 min
 Hyd. volume = 20,500 cuft
 Curve number = 91*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 15.50 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.320 \times 89) + (0.270 \times 89) + (0.210 \times 98)] / 0.800$



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

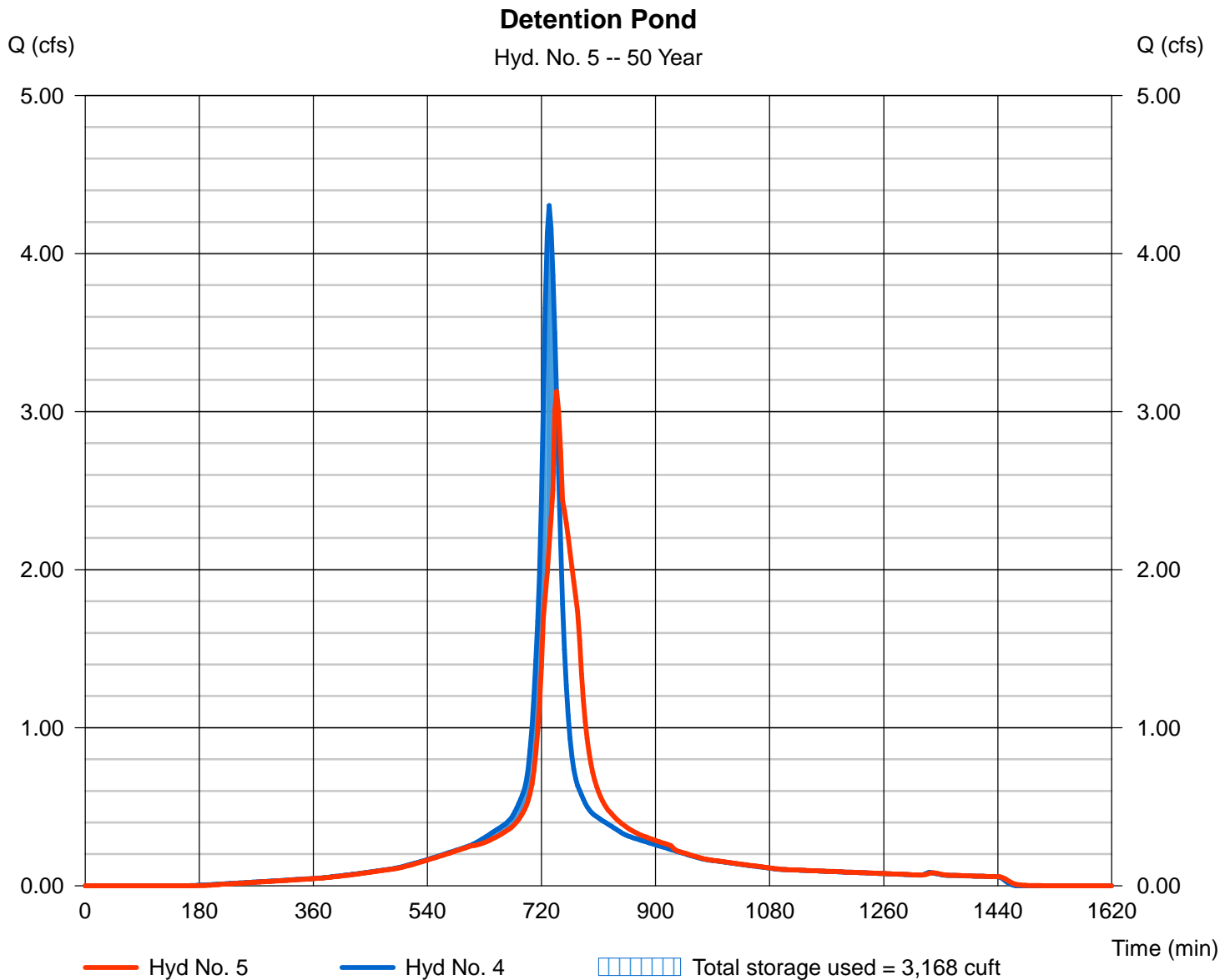
Wednesday, Jul 22, 2015

Hyd. No. 5

Detention Pond

| | | | |
|-----------------|------------------------------|----------------|---------------|
| Hydrograph type | = Reservoir | Peak discharge | = 3.128 cfs |
| Storm frequency | = 50 yrs | Time to peak | = 744 min |
| Time interval | = 3 min | Hyd. volume | = 20,499 cuft |
| Inflow hyd. No. | = 4 - Post Developed Basin 2 | Max. Elevation | = 1293.46 ft |
| Reservoir name | = <New Pond> | Max. Storage | = 3,168 cuft |

Storage Indication method used.

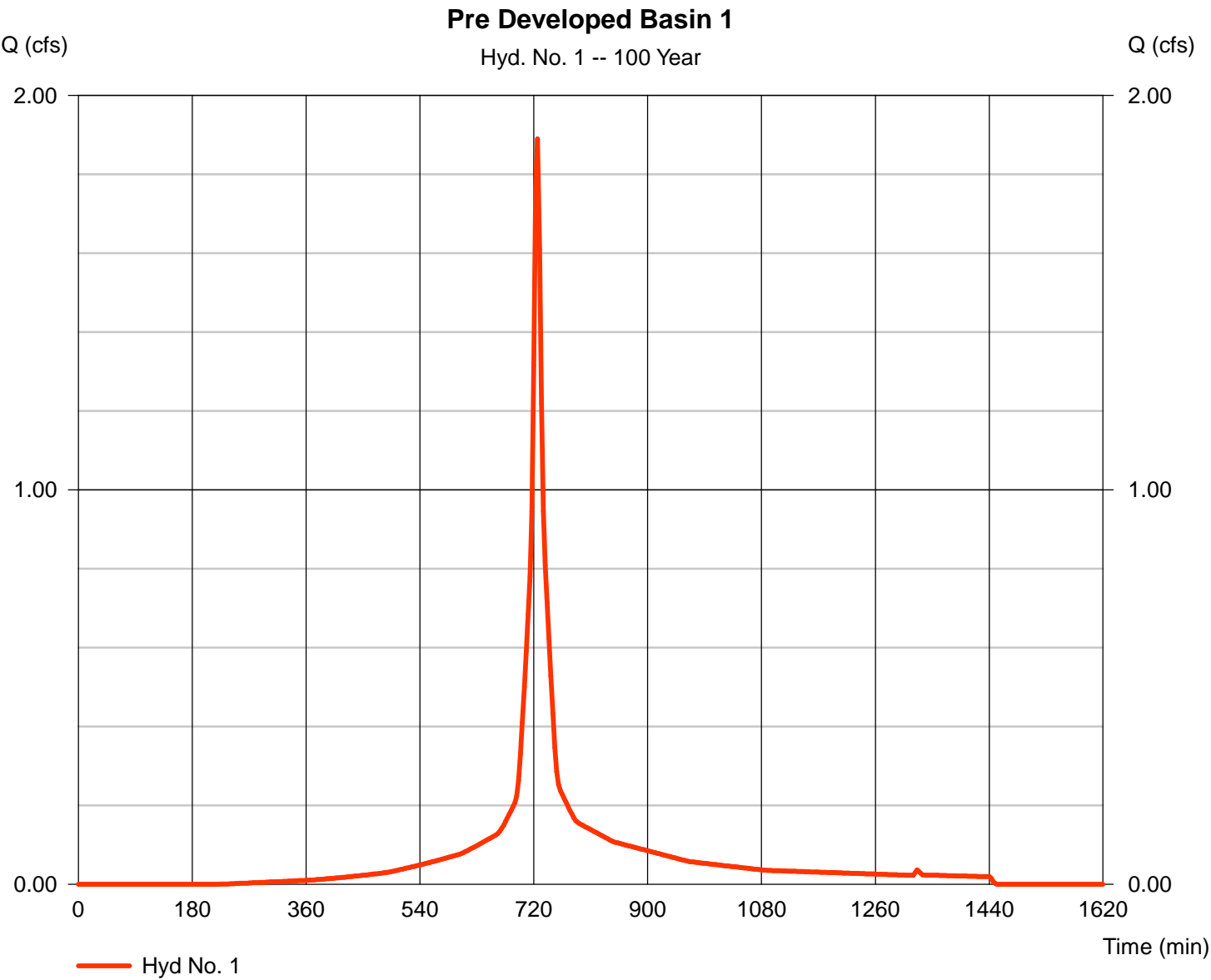


Hydrograph Report

Hyd. No. 1

Pre Developed Basin 1

| | | | | | |
|-----------------|---|------------|--------------------|---|------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.890 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 726 min |
| Time interval | = | 3 min | Hyd. volume | = | 6,625 cuft |
| Drainage area | = | 0.280 ac | Curve number | = | 86 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 8.80 min |
| Total precip. | = | 8.64 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

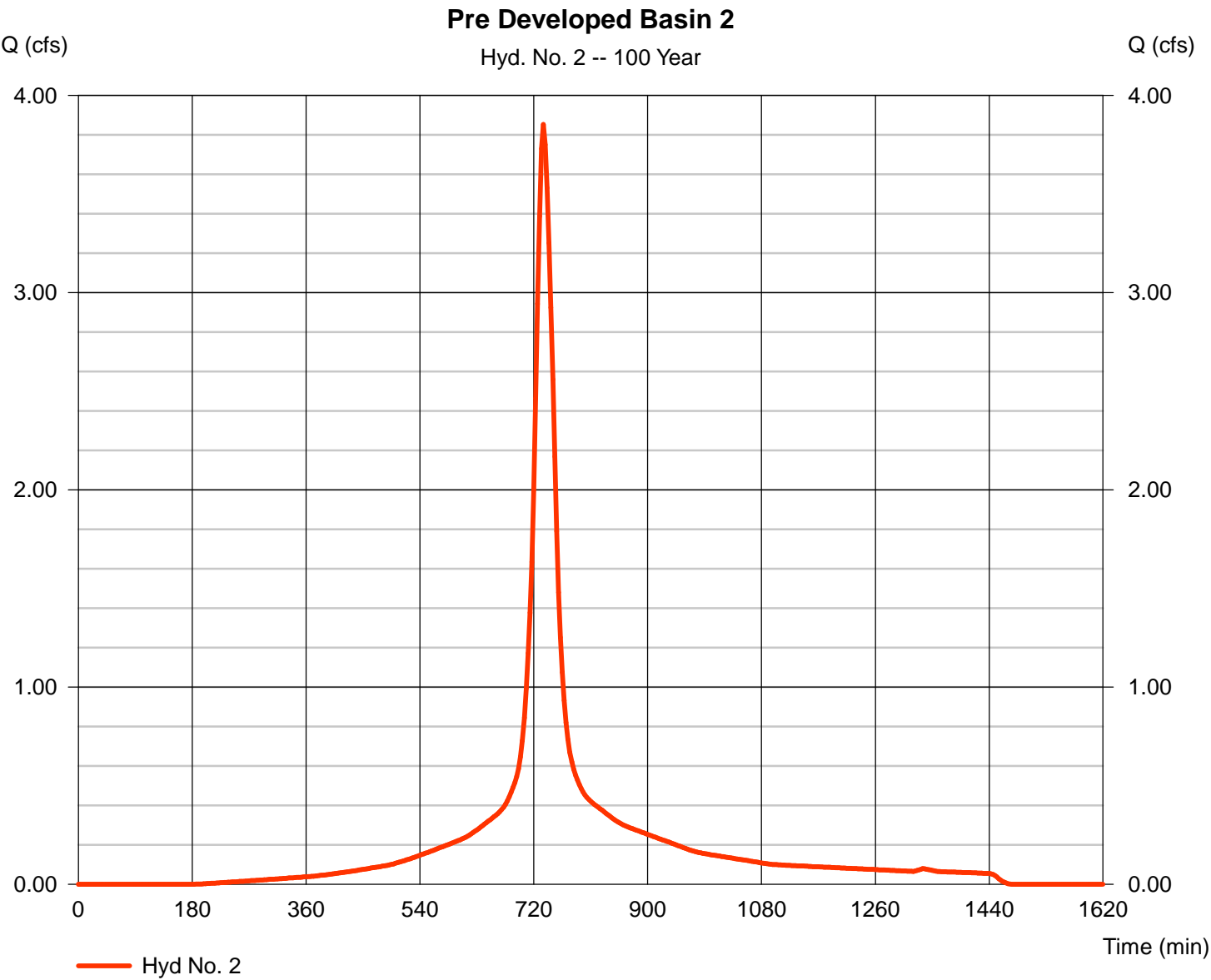


Hydrograph Report

Hyd. No. 2

Pre Developed Basin 2

| | | | | | |
|-----------------|---|------------|--------------------|---|-------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 3.852 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 735 min |
| Time interval | = | 3 min | Hyd. volume | = | 19,419 cuft |
| Drainage area | = | 0.750 ac | Curve number | = | 89 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 20.40 min |
| Total precip. | = | 8.64 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 22, 2015

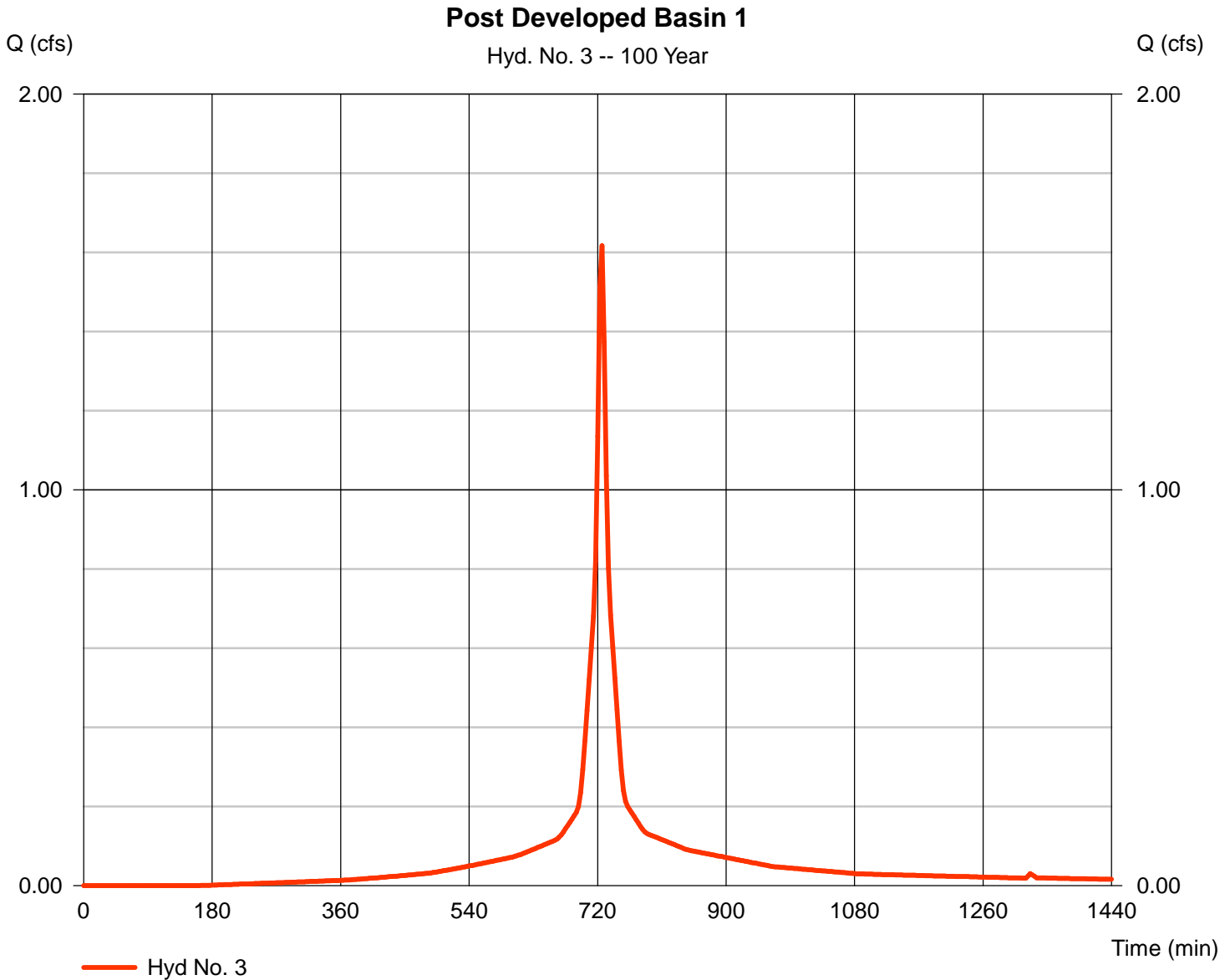
Hyd. No. 3

Post Developed Basin 1

Hydrograph type = SCS Runoff
 Storm frequency = 100 yrs
 Time interval = 3 min
 Drainage area = 0.230 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 8.64 in
 Storm duration = 24 hrs

Peak discharge = 1.617 cfs
 Time to peak = 726 min
 Hyd. volume = 5,820 cuft
 Curve number = 90*
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 8.40 min
 Distribution = Type III
 Shape factor = 484

* Composite (Area/CN) = $[(0.080 \times 98) + (0.150 \times 86)] / 0.230$



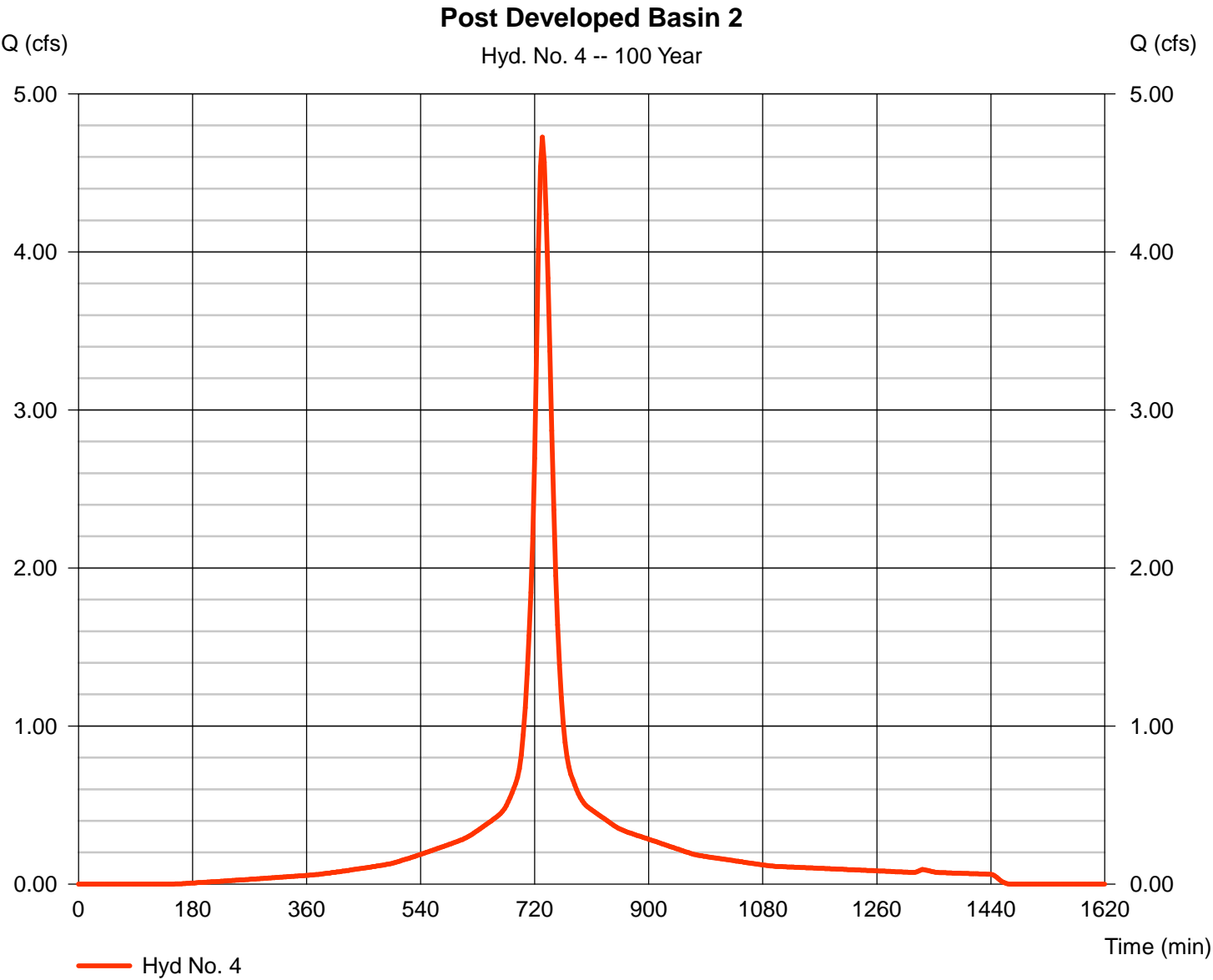
Hydrograph Report

Hyd. No. 4

Post Developed Basin 2

| | | | | | |
|-----------------|---|------------|--------------------|---|-------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 4.725 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 732 min |
| Time interval | = | 3 min | Hyd. volume | = | 22,631 cuft |
| Drainage area | = | 0.800 ac | Curve number | = | 91* |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | TR55 | Time of conc. (Tc) | = | 15.50 min |
| Total precip. | = | 8.64 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

* Composite (Area/CN) = [(0.320 x 89) + (0.270 x 89) + (0.210 x 98)] / 0.800



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

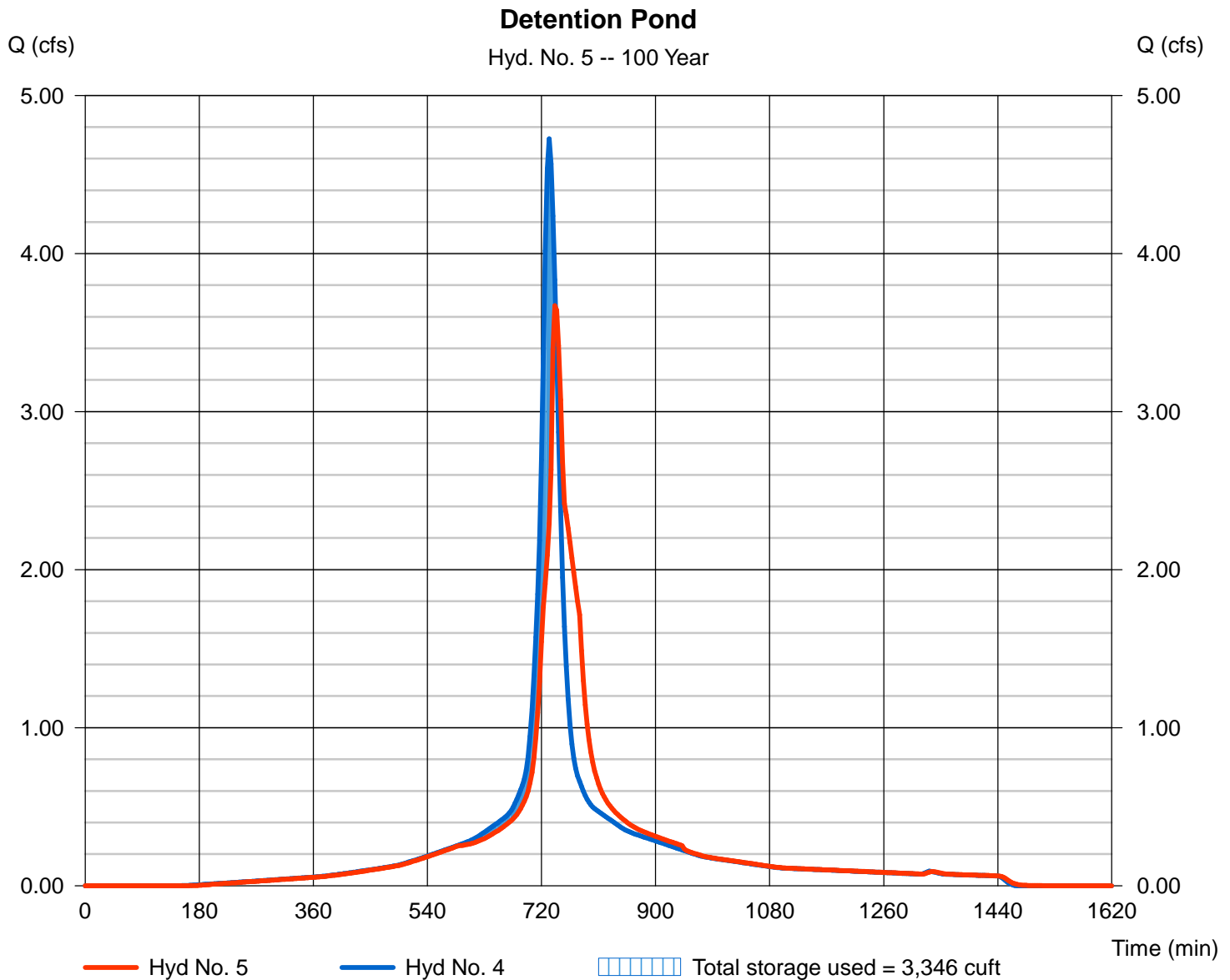
Wednesday, Jul 22, 2015

Hyd. No. 5

Detention Pond

| | | | |
|-----------------|------------------------------|----------------|---------------|
| Hydrograph type | = Reservoir | Peak discharge | = 3.670 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 741 min |
| Time interval | = 3 min | Hyd. volume | = 22,630 cuft |
| Inflow hyd. No. | = 4 - Post Developed Basin 2 | Max. Elevation | = 1293.50 ft |
| Reservoir name | = <New Pond> | Max. Storage | = 3,346 cuft |

Storage Indication method used.



| Return Period (Yrs) | Intensity-Duration-Frequency Equation Coefficients (FHA) | | | |
|------------------------|--|---------|--------|-------|
| | B | D | E | (N/A) |
| 1 | 0.0000 | 0.0000 | 0.0000 | ----- |
| 2 | 63.3915 | 13.3000 | 0.8386 | ----- |
| 3 | 0.0000 | 0.0000 | 0.0000 | ----- |
| 5 | 64.9066 | 13.0000 | 0.7920 | ----- |
| 10 | 79.4587 | 14.3000 | 0.8048 | ----- |
| 25 | 104.1785 | 15.8000 | 0.8275 | ----- |
| 50 | 102.8257 | 15.1000 | 0.7991 | ----- |
| 100 | 95.5744 | 13.9000 | 0.7608 | ----- |

File name: Tontitown.IDF

$$\text{Intensity} = B / (T_c + D)^E$$

| Return Period (Yrs) | Intensity Values (in/hr) | | | | | | | | | | | |
|----------------------------|--------------------------|------|------|------|------|------|------|------|------|------|------|------|
| | 5 min | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 5.54 | 4.52 | 3.84 | 3.35 | 2.98 | 2.69 | 2.45 | 2.26 | 2.10 | 1.96 | 1.84 | 1.73 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 6.58 | 5.42 | 4.64 | 4.07 | 3.64 | 3.30 | 3.02 | 2.80 | 2.60 | 2.44 | 2.30 | 2.17 |
| 10 | 7.34 | 6.10 | 5.24 | 4.62 | 4.14 | 3.76 | 3.45 | 3.19 | 2.97 | 2.79 | 2.62 | 2.48 |
| 25 | 8.45 | 7.07 | 6.11 | 5.39 | 4.84 | 4.40 | 4.04 | 3.74 | 3.48 | 3.26 | 3.07 | 2.90 |
| 50 | 9.35 | 7.83 | 6.77 | 5.99 | 5.38 | 4.90 | 4.51 | 4.18 | 3.90 | 3.65 | 3.44 | 3.26 |
| 100 | 10.21 | 8.54 | 7.39 | 6.55 | 5.90 | 5.38 | 4.96 | 4.60 | 4.30 | 4.04 | 3.82 | 3.62 |

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sprindale.pcp

[illegible]

| | |
|--|-----------|
| Watershed Model Schematic | 1 |
| Hydrograph Return Period Recap | 2 |
| 2 - Year | |
| Hydrograph Reports | 3 |
| Hydrograph No. 1, SCS Runoff, Pre Developed Basin 1 | 3 |
| TR-55 Tc Worksheet | 4 |
| Hydrograph No. 2, SCS Runoff, Pre Developed Basin 2 | 5 |
| TR-55 Tc Worksheet | 6 |
| Hydrograph No. 3, SCS Runoff, Post Developed Basin 1 | 7 |
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