

CEQA Drainage Study

Aliso Canyon Subdivision
County of San Diego, California

PDS2014-TM-5589

June 2014
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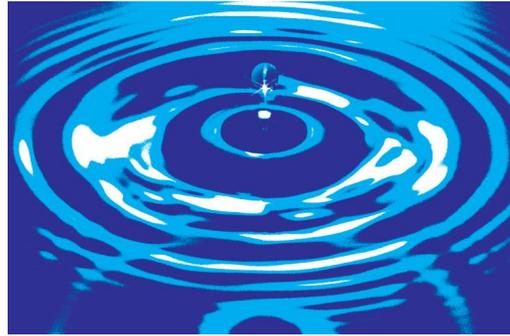
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Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the business and professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as Engineer of Work, of my responsibilities for the project design.

David A. Wiener
RCE 77285

9/17/14
Date



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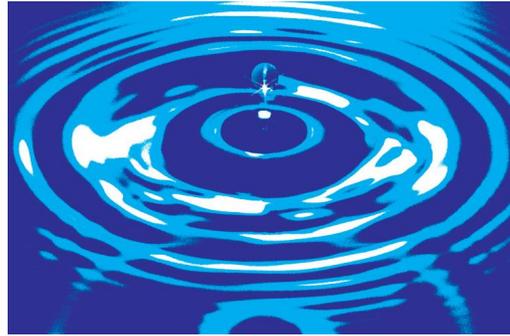
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Introduction

This drainage report presents an analysis of the effects the proposed Aliso Canyon subdivision might have on the *quantity* and *pattern* of storm water runoff in the local watershed. The purpose of this report is to help fulfill requirements of the California Environmental Quality Act (CEQA). Storm water *quality* is addressed in the Storm Water Management Plan (SWMP) for the project, under separate cover from this document.

This report examines the existing and proposed hydrology of the site and nearby watershed and presents preliminary design of drainage facilities. This report is for planning purposes and does not present final design engineering recommendations for the project.

Section 1. Project Information

This section describes the location, activities, and hydrologic setting (watershed, topography, land use, soils and vegetation, drainage patterns, and impervious cover) of the project site.

1.1 Project Description

1.1.1 Project Location

The project site is located in the community of Rancho Santa Fe within the County of San Diego, California. The project is located just south of the intersection of Aliso Canyon Road and Pacifica Ranch Road (reference Google Maps). **Exhibit A** is the Vicinity Map.

1.1.2 Project Activities Description

The project proposes to subdivide the property into eight lots. Lots 1-8 shall serve as single-family residences. Lots 1-7 will have new homes constructed, and Lot 8 will retain its existing structures. A 50' wetland buffer will protect the existing wetlands from current development.



Exhibit A- Vicinity Map (Reference Google Maps)

1.2 Hydrologic Setting

This section summarizes the project's size and location in the context of the larger watershed perspective, topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and other relevant hydrologic and environmental factors specific to the project area's watershed.

The project site is located in the 22,602-acre (35.32-square mile) Rancho Santa Fe Hydrologic Sub-Area (HSA 905.11), which is part of the San Dieguito Hydrologic Unit (HU 905.00). The 30.7-acre property accounts for approximately 0.14 percent of the local watershed area. Table 1-1 summarizes the area occupied by the site inside the watershed. **Exhibit B** is the Watershed Vicinity Map.

Table 1-1 Project Area

| Area | Area (acres) | % of Total |
|----------------------------|--------------|------------|
| Rancho Santa Fe HSA 905.11 | 22,602 | 100% |
| Subject Property | 30.7 | 0.135% |
| Impervious Area (Estimate) | 9.0 | 0.04% |

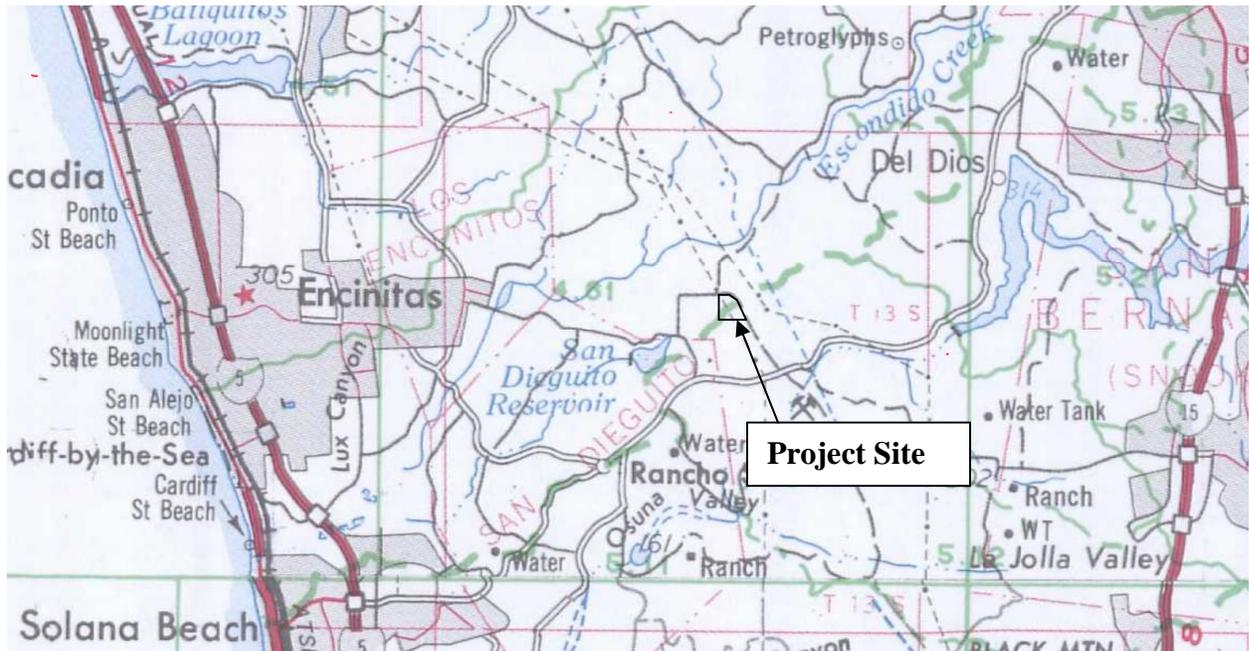


Exhibit B- Watershed Vicinity Map (Reference California Regional Water Quality Control Board, San Diego Region, HSA 905.11)

1.2.1 Topography

The topography of this site is defined by high points on the east, west, and north site borders, as well as a high point in Lot 8, a ridgeline south of Lot 1 and Pacifica Ranch Drive. The high point along the western border is located northwest of Lot 2, at an elevation of approximately 449 feet MSL. This area of the site drains either to the east or southeast. The easterly drainage travels east to Pacifica Ranch Drive, then northwest to an elevation of 375 feet MSL for an average grade of 7.2%. The southerly drainage travels south to an elevation of 422 feet MSL for an average grade of 6.5%. The ridgeline begins at a high point located at the intersection of Pacifica Ranch Drive and Aliso Canyon Road with an elevation of 437 feet MSL. This area of the site drains to the southwest to an elevation of 375 feet MSL for an average grade of 11.7%. The high point in Lot 8 has an elevation of 460 feet MSL. This area of the site drains to the east until it

reaches Pacifica Ranch Drive before turning north to an elevation of 416 feet MSL, for an average grade of 6.8%. The highest point of the site is located on the east border, northeast of Lot 8 with an elevation of 490 feet MSL. This area of the site drains either east or south away from this point. The easterly drainage continues east to an elevation of 416 feet MSL for an average grade of 10.0%. The southerly drainage continues south to an elevation of 400 feet MSL for an average grade of 7.3%. A high point occurs in Lot 3 with an elevation of 434 feet MSL. This area of the site drains to the south to an elevation of 421 for an average grade of 4.8%.

1.2.2 Current and Adjacent Land Use

The majority of the project site is currently undeveloped. Existing single family residential land is adjacent to the project site. The site is bounded on the north and east side by Aliso Canyon Road.

1.2.3 Soil and Vegetation Conditions

Per the Hydrologic Soil Group Map in the San Diego County Hydrology Manual, the project site contains hydrologic type D soil. The map is included as **Exhibit C**.

1.2.4 Existing Drainage Patterns and Facilities

In the existing condition, approximately half of the site flows to the west and half flows to the south. A ridgeline, located approximately through proposed Lots 2, 3, and 8, divides the property into two parts. The highest point of the property is located on proposed Lot 8, at an elevation of approximately 460 feet MSL. The portion of the property draining to the west flows a distance of approximately 1,000 feet to an elevation of approximately 380 feet MSL for an average grade of approximately 8%. The portion of the property draining to the south flows a distance of approximately 1,100 feet to an elevation of approximately 400 feet MSL for an average grade of approximately 5.5%. The project site consists of a natural high point at the midpoint of the easterly property line. Approximately half of the site drains to the west from this high point, and half drains to the south. Off-site flows enter the site from the east, west, and south. The only storm drain improvement on site consists of a 30" culvert that directs flow under Pacific Ranch Drive, east to west. Flow traverses the property via natural swales.

1.2.5 Floodplain Mapping

The Federal Emergency Management Agency (FEMA) has not mapped any Special Flood Hazard Areas (SFHAs) through the project site.

The FEMA FIRM Map was reviewed to identify the existing County Floodway and 100-Year Floodline (shown in **Exhibit D**).

1.2.6 Downstream Conditions

Analysis of downstream conditions has not been attempted, because the project site plan has been designed to detain storm water flows to match pre-development levels.

1.2.7 Impervious Cover

The site has little impervious cover under the existing condition. The project will add approximately 2.4 acres of impervious area to the project site. This estimate assumes that each residential unit will contribute 10,000 square feet of impervious area, that there will be approximately 1,100 linear feet of a 30-foot wide private street. In addition, approximately 4,700 square feet of pavement will be added to existing Aliso Canyon Road east of the site in order to create a 24-foot minimum roadway width.

Section 2. Methodology and Design Criteria

This section summarizes the design criteria and methodology applied during drainage analysis of the project site. The design criteria and methodology follow the County of San Diego Hydrology Manual (June 2003) and the Hydraulic Design and Procedure Manual (April 1993) as appropriate for the project site.

2.1 Rational Method

Rational Method Peak Flow for the area of interest at the southwest corner of the development footprint was calculated using methodology in the County of San Diego Hydrology manual for the rational method. These calculations were performed for both the existing and proposed conditions, so as to quantify increase in peak rate of discharge. Runoff coefficients were based upon researched soils data and Table 3-1 of the County Hydrology Manual for the existing condition. Proposed condition assumed a Type D soil, and “Low Density Residential” land use. Time of concentration was calculated per Section 3.1.4. of the County Hydrology Manual and corresponding runoff intensities for the 100-year storm were based upon a 6-hour precipitation of 3.0 inches.

Using results from rational method calculations for peak flow in both existing and proposed conditions, 6 hour hydrographs were generated using the Hydraflow Hydrographs computer program, which utilizes the methods described in Section 6 of the San Diego County Hydrology Manual. By overlaying both the pre-development and post-development hydrographs for the 100-year 6-hour event, we were able to estimate the required detention storage volume for this project (see **Appendix B** for the Preliminary Basin Sizing calculation).

Rational Method Peak Flow for the project drainage areas shall match the existing peak flows in the post-development conditions. Runoff from the lots will collect in bioretention areas, which will be used for flood control and water quality.

Section 3. Hydrologic Effects of Project

This section characterizes the quantities and location of storm water runoff from the project site. Discussion of the water quality aspects of the project can be found in the Storm Water Management Plan (SWMP), which is under separate cover from this report.

3.1 *Drainage Patterns*

The existing drainage patterns on the site will be preserved without any changes. The runoff from the proposed graded pads will collect in bioretention areas. This will attenuate the existing peak flows. See **Appendix A** for the Existing Hydrology Map and **Appendix B** for the Proposed Hydrology Map

3.2 *Impervious Cover*

The project will add approximately 2.4 acres of impervious area (7.7% percent of the project site) in the form of rooftops, streets, and access roads.

3.3 *Peak Runoff*

The project will not increase the peak 100-year storm discharge from the 45-acre watershed, because bioretention areas have been included in the site plan to capture and attenuate the flow rates of most runoff from the proposed development. The required detention volume for each drainage subarea is shown in Table 3-3.

Tables 3-1 and 3-2 summarize the hydrologic effects in terms of calculated peak runoff from the watershed under both the existing and proposed conditions, respectively. Nodes at points of drainage discharge from the project pre- and post-development (corresponding with Tables 3-1 and 3-2 below) are labeled on the hydrology maps in **Appendix A** and **Appendix B**, respectively. Table 3-3 summarizes the detention volume required per drainage node under the pre- and post-development conditions. The detention volumes are listed on the hydrology maps in **Appendix A** and **Appendix B**.

Table 3-1 Existing Hydrology Summary Table

| Node | Area (acres) | C | T _c (min) | Q ₁₀₀ (cfs) |
|------|--------------|------|----------------------|------------------------|
| 100 | 22.70 | 0.39 | 11.7 | 40.4 |
| 200 | 2.62 | 0.35 | 10.5 | 4.5 |
| 300 | 0.87 | 0.35 | 10.1 | 1.5 |
| 400 | 18.91 | 0.37 | 11.9 | 31.5 |

Table 3-2 Proposed Hydrology Summary Table

| Node | Area (acres) | C | T _c (min) | Q ₁₀₀ (cfs) | Q ₁₀₀ (cfs) with Detention |
|------|--------------|------|----------------------|------------------------|---------------------------------------|
| 100 | 23.15 | 0.41 | 11.7 | 43.0 | 39.3 |
| 200 | 2.62 | 0.40 | 11.1 | 4.9 | 3.5 |
| 300 | 1.52 | 0.43 | 7.4 | 4.0 | 1.5 |
| 400 | 17.81 | 0.40 | 11.9 | 32.3 | 27.3 |

Table 3-3 Summary of Peak Volume Detention

| Node | Existing Peak Volume (cuft) | Proposed Peak Volume (cuft) | Detention Required (cuft) | Detention Provided (cuft) |
|-------|-----------------------------|-----------------------------|---------------------------|---------------------------|
| 100 | 95,832 | 102,816 | 6,984 | 7,000 |
| 200 | 10,098 | 11,352 | 1,254 | 2,757 |
| 300 | 3,600 | 6,930 | 3,330 | 3,460 |
| 400 | 75,600 | 77,040 | 1,440 | 8,920 |
| TOTAL | | | 13,008 | 21,110 |

Table 3-4 Post-Construction BMP Summary Table

| POST-CONSTRUCTION BMP SUMMARY TABLE | | | | | | | | | | | | | |
|-------------------------------------|-----|------------------|-----------------|---------------|-----------------------------|-----------------------------|------------------------------|----------------|----------------|-----------------------------|-----------------------------|---------------------|----------------------------------|
| POC | DMA | Bioretention IMP | WQ Surface Area | | WQ Volume | | Water Quality Compliance Met | Peak Flow | | Peak Volume | | CEQA Compliance Met | HYDROMODIFICATION COMPLIANCE MET |
| | | | Required (SF) | Provided (SF) | Required (ft ³) | Provided (ft ³) | | Existing (cfs) | Proposed (cfs) | Required (ft ³) | Provided (ft ³) | | |
| 1 | 1-1 | - | - | - | - | - | - | 40.4 | 39.3 | 6,984 | 7,000 | YES | YES |
| | 1-2 | - | - | - | - | - | | | | | | | |
| | 1-3 | IMP 1-3 | 499 | 1,000 | 1,007 | 1,900 | YES | | | | | | |
| | 1-4 | IMP 1-4 | 720 | 1,000 | 1,788 | 1,900 | YES | | | | | | |
| | 1-5 | IMP 1-5 | 506 | 1,000 | 1,037 | 1,900 | YES | | | | | | |
| | 1-6 | IMP 1-6 | 859 | 1,200 | 1,998 | 3,240 | YES | | | | | | |
| | 1-7 | - | - | - | - | - | - | | | | | | |
| 2 | 2 | IMP 2 | 490 | 1,000 | 1,149 | 2,300 | YES | 4.5 | 3.5 | 1,254 | 2,757 | YES | YES |
| 3 | 3 | IMP 3 | 518 | 1,200 | 1,101 | 2,760 | YES | 1.5 | 1.5 | 3,330 | 3,460 | YES | YES |
| 4 | 4-1 | IMP 4-1 | 476 | 1,000 | 893 | 2,300 | YES | 31.5 | 27.3 | 1,440 | 8,920 | YES | YES |
| | | IMP 4-2 | 519 | 1,000 | 1,101 | 2,300 | YES | | | | | | |
| | | IMP 4-3 | 499 | 1,000 | 1,007 | 2,300 | YES | | | | | | |
| | | IMP 4-4 | 760 | 1,500 | 1,106 | 3,450 | YES | | | | | | |
| | | IMP 4-5 | 894 | 1,250 | 1,851 | 3,375 | YES | | | | | | |

3.4 Project Erosion and Siltation

Because runoff over erodible surfaces will be restricted to flows from the individual lots, and because the proposed grading will limit the flows and velocities of runoff generated, neither erosion nor siltation are anticipated.

3.5 Project Impacts to Existing Drainage Facilities

Because the project design features will control runoff to match pre-development peaks, the project will not adversely impact existing drainage facilities.

Section 4. Summary and Conclusions

This section provides a summary discussion of the potential effects of the proposed project on local water resources in terms of quantity and location.

- ❖ The project will not increase peak 100-year discharges or other points downstream. It accomplishes this by means of on-site bioretention basins.
- ❖ There are no County Master Plan drainage facilities shown in the approved Comprehensive Plan that would affect the project.
- ❖ The project will not cause flooding on- or off-site to people or property substantially by altering the existing drainage patterns (they substantially remain the same), or by increasing the peak runoff.
- ❖ The project will not affect the capacity of existing drainage facilities on- or off-site. The project site currently contains no drainage improvements and the bridge and other storm drainage pipes proposed as part of this project will be designed to convey the peak 100-year flows without causing flooding of proposed structures.

Section 5. CEQA Summary

This section summarizes the results of the hydrology, hydraulics and drainage analysis in the context of CEQA significance guidelines.

5.1 Drainage

5.1.1 Erosion and/or Sedimentation

Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on- or off-site?

No. The project will not substantially alter existing drainage patterns of the site area in a manner that would result in substantial erosion or siltation. The project does not alter the course of a stream or river.

- The project proposes to preserve the alignment and profile of existing natural drainage paths throughout the project site.
- Nine on-lot bioretention areas mitigate the potential increase in peak flow (see Table 3-1), such that no significant erosion and/or siltation are expected.
- Flows may be concentrated at certain locations, including storm drain outfalls. However, all existing and proposed storm drain outfalls will be outfitted with appropriate energy dissipation devices. These energy dissipation devices, along with other storm water Best Management Practices (BMPs), will help preclude significant erosion and/or siltation on-site and off-site.

5.1.2 Flooding

Does the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on- or off-site?

No. The project will not substantially alter existing drainage patterns of the site area in a manner that would result in flooding on- of off-site. The project does not alter the course of a stream or river.

- The drainage study demonstrates that the project will not increase the peak 100-year storm discharge from the on-site contributing watershed. While the proposed development will add impervious area, the increase in peak flows will be mitigated to pre-development level by means of on-site bioretention areas.

5.1.3 Drainage System Capacity

Does the project create or contribute runoff water that would exceed the capacity of existing or planned storm water drainage systems?

No. The project will not create or contribute to runoff water that would exceed the capacity of existing or planned storm water drainage systems.

- The project would not affect any County master-planned drainage facilities, per the Comprehensive Plan.

5.2 Flood Hazards

5.2.1 Residential Flood Hazard

Would the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps?

No. The project does not propose to locate any housing within the 100-year flood hazard area.

- ❑ The project does not propose any development within the 100-year floodplain or other Special Flood Hazard Area (SFHA) designated by FEMA or the County of San Diego.

5.2.2 Flood Flow

Does the project place within a 100-year flood hazard area structures that would impede or redirect flood flows?

No. The project does not propose to locate any structures or grading in the floodplain that would impede or redirect flood flows.

- ❑ The project does not propose any development within the 100-year floodplain or other Special Flood Hazard Area (SFHA) designated by FEMA or the County of San Diego.

5.2.3 Flood Hazard

Does the project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?

No. The project does not place any people or structures at significant risk of loss, injury, or death due to flooding.

- ❑ The project does not propose any development within the 100-year floodplain or other Special Flood Hazard Area (SFHA) designated by FEMA or the County of San Diego.
- ❑ The project will ensure emergency access during significant flood events. The project is not located behind a levee or below a dam that would present a flood hazard upon its failure.

5.2.4 Other Hazards

Is the project at significant risk of inundation by seiche, tsunami, or mudflow?

No. The project is not located within an area at risk of inundation by seiche (lake slosh) tsunami, or mud flow.

5.3 Waiver and Release Agreements

The project does not alter downstream flow characteristics significantly, either due to increase in flow or flood condition, diversion of flow, or flow concentration. Therefore, it should not be necessary to obtain waiver and release agreements from any affected property owners.

Section 6. References

- FEMA, 1997.** FEMA. (June 17, 1997). Flood Insurance Study, San Diego County.
- FEMA, 2006.** FEMA. (September 29, 2006). Flood Insurance Study, San Diego County.
- San Diego County, 2003.** San Diego County Flood Control District. (June 2003). Hydrology Manual.
- San Diego County, 1993.** San Diego County Flood Control District. (April 1993). Hydrology Manual and Design and Procedure Manual. Ref. SFC P3055.
- SCS, 1973.** Soil Conservation Service. (December, 1973). Soil Survey, San Diego Area, California.
- San Diego County, 1992.** San Diego County Department of Public Works. (February 1992). Flood and Drainage Management Report for the Fallbrook Area.
- San Diego County, 1984.** San Diego County Department of Public Works. (November 1984). Floodplain Map 430-1695, Ostrich Farms Creek, Sheet 7 of 9.
- US Department of Transportation, 2001.** Federal Highway Administration. (August 2001). Hydraulic Engineering Circular No. 22, Urban Drainage Design Manual, 2nd ed.
- Chang, Howard H., 1988.** San Diego State University. (1988). Fluvial Processes in River Engineering.

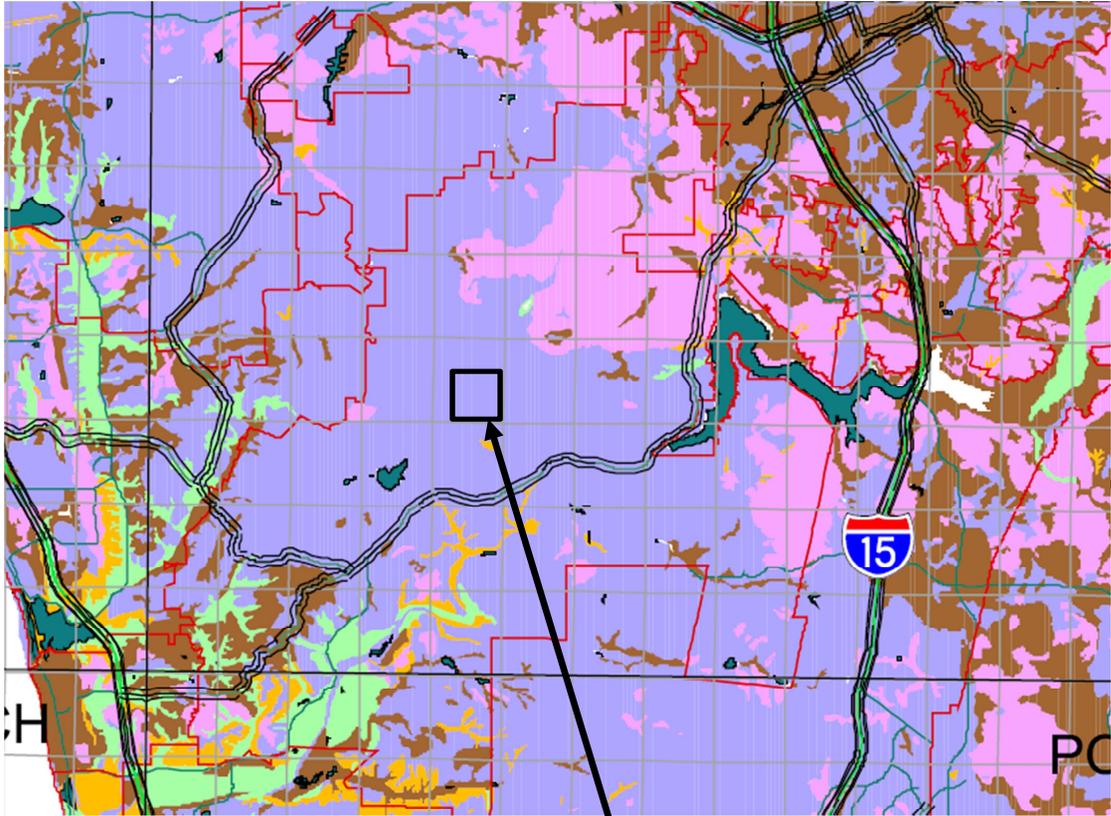
Exhibit “C”

Hydrologic Soil Group Map

County of San Diego Hydrology Manual



Soil Hydrologic Groups



PROJECT SITE: Soil Group D

Legend

| Soil Groups | |
|---|------------------|
|  | Group A |
|  | Group B |
|  | Group C |
|  | Group D |
|  | Undetermined |
|  | Data Unavailable |

HYDROLOGIC SOIL GROUP MAP

Exhibit “D”

FEMA Flood Map



ance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1070G

FIRM
FLOOD INSURANCE RATE MAP
SAN DIEGO COUNTY,
CALIFORNIA
AND INCORPORATED AREAS

PANEL 1070 OF 2375
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

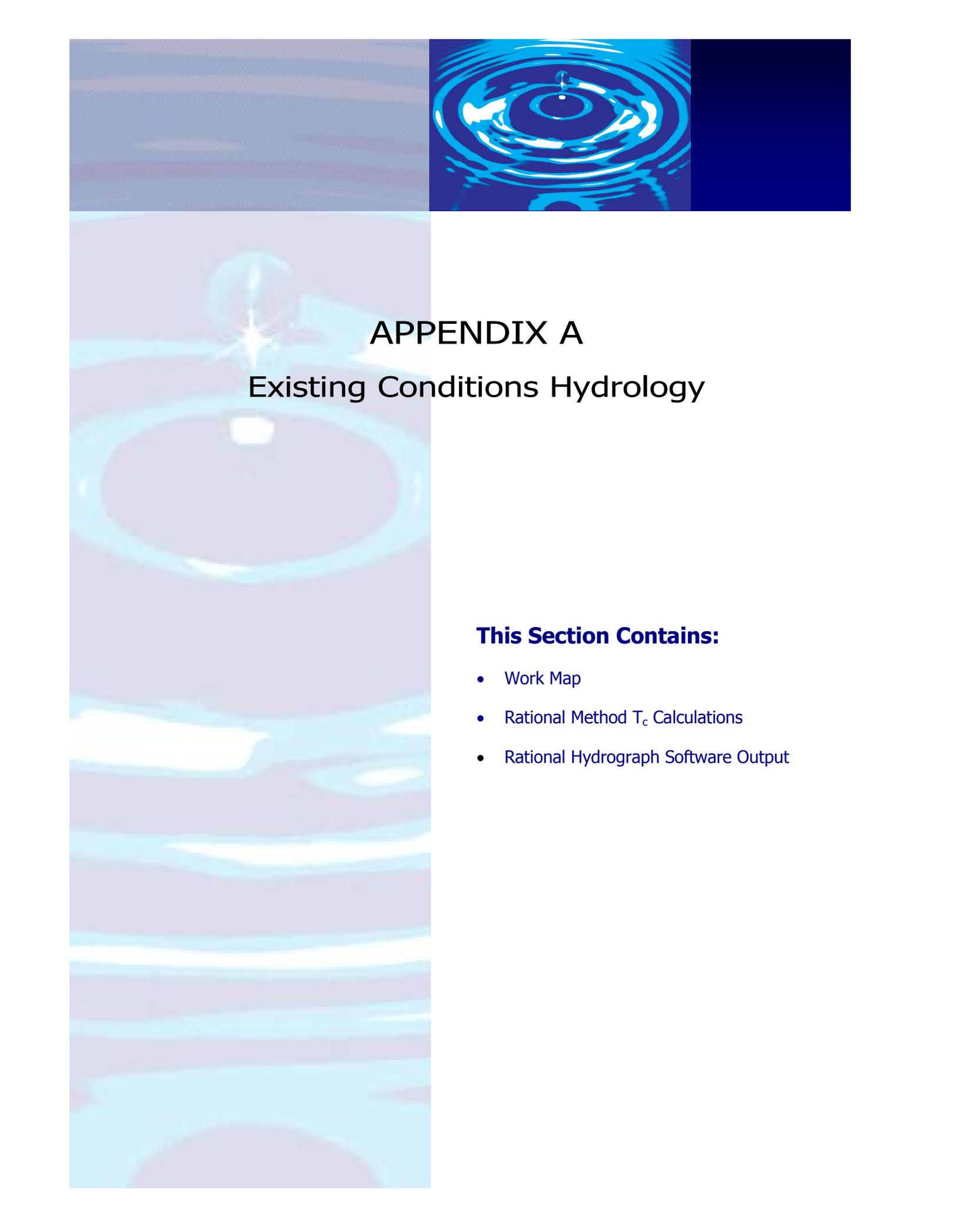
| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--------------------|--------|-------|--------|
| SAN DIEGO COUNTY | 060284 | 1070 | G |
| SAN DIEGO, CITY OF | 060295 | 1070 | G |

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
06073C1070G
MAP REVISED
MAY 16, 2012


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



APPENDIX A

Existing Conditions Hydrology

This Section Contains:

- Work Map
- Rational Method T_c Calculations
- Rational Hydrograph Software Output

JOB NAME _____

JOB NO. _____

SHEET NO. 1 OF 2

DESIGNED BY DW DATE 8/14/14

CHECKED BY _____ DATE _____

Existing Hydrology

SD County Hydrology Manual

Isoplethial Map \Rightarrow 100-year $P_6 = 3.0$ inches

Soil Type D \Rightarrow Table 3.1 $\Rightarrow C = 0.35$

Node 100 - Flow Path = 1300'

T_i : Table 3-2, 10% Slope $\Rightarrow T_i = 6.9$ $L_m = 100'$

T_t : Fig 3-4 $\Rightarrow \left(\frac{11.9L^3}{4E} \right)^{.385}$

$\Delta E = 476 - 375 = 101'$

$L = 1200' = 0.23$ miles

= 4.8 min

$\Rightarrow T_L = T_i + T_t = 6.9 + 4.8 = \underline{\underline{11.7 \text{ min}}}$

Existing Hydrology

~~Node 150 - Flow = 740'~~
 ~~$T_i = 6.9 \text{ min}, L_m = 100'$~~
 ~~$T_t = \Delta E = 475 - 420 = 55', L = 640'$~~
 ~~$\Rightarrow 2.9 \text{ min}$~~
 ~~$T_c = 6.9 + 2.9 = \underline{9.8 \text{ min}}$~~

Node 200 - Flow = 415'
 $T_i = 8.7 \text{ min}, L_m = 100'$
 $T_t = \Delta E = 443 - 421 = 22', L = 315'$
 $\Rightarrow 1.8 \text{ min}$
 $T_c = 8.7 + 1.8 = \underline{10.5 \text{ min}}$

Node 300 - Flow = 270'
 $T_i = 8.7 \text{ min}, L_m = 100'$
 $T_t = \Delta E = 428 - 421 = 7', L = 170'$
 $\Rightarrow 1.4 \text{ min}$
 $T_c = 8.7 + 1.4 = \underline{10.1 \text{ min}}$

Node 400 - Flow = 1240'
 $T_i = 6.9 \text{ min}, L_m = 100'$
 $T_t = \Delta E = 478 - 400 = 78', L = 1140'$
 $\Rightarrow 5.0 \text{ min}$
 $T_c = 6.9 + 5.0 = \underline{11.9 \text{ min}}$

County of San Diego Hydrology Manual



Rainfall Isopleths

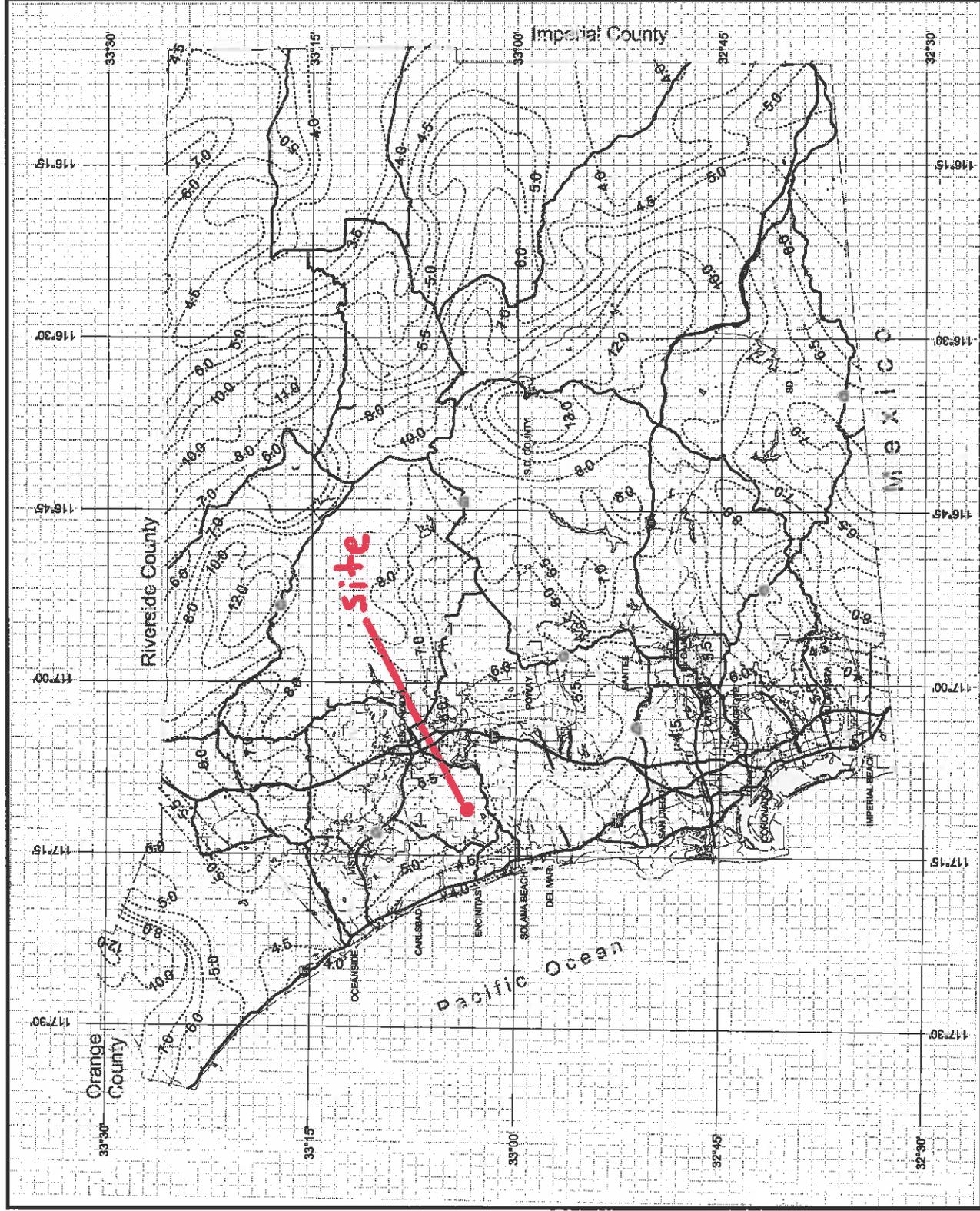
100 Year Rainfall Event - 24 Hours

..... Isopleth (inches)

$P_{(24)} 100 = 5.2$ in.



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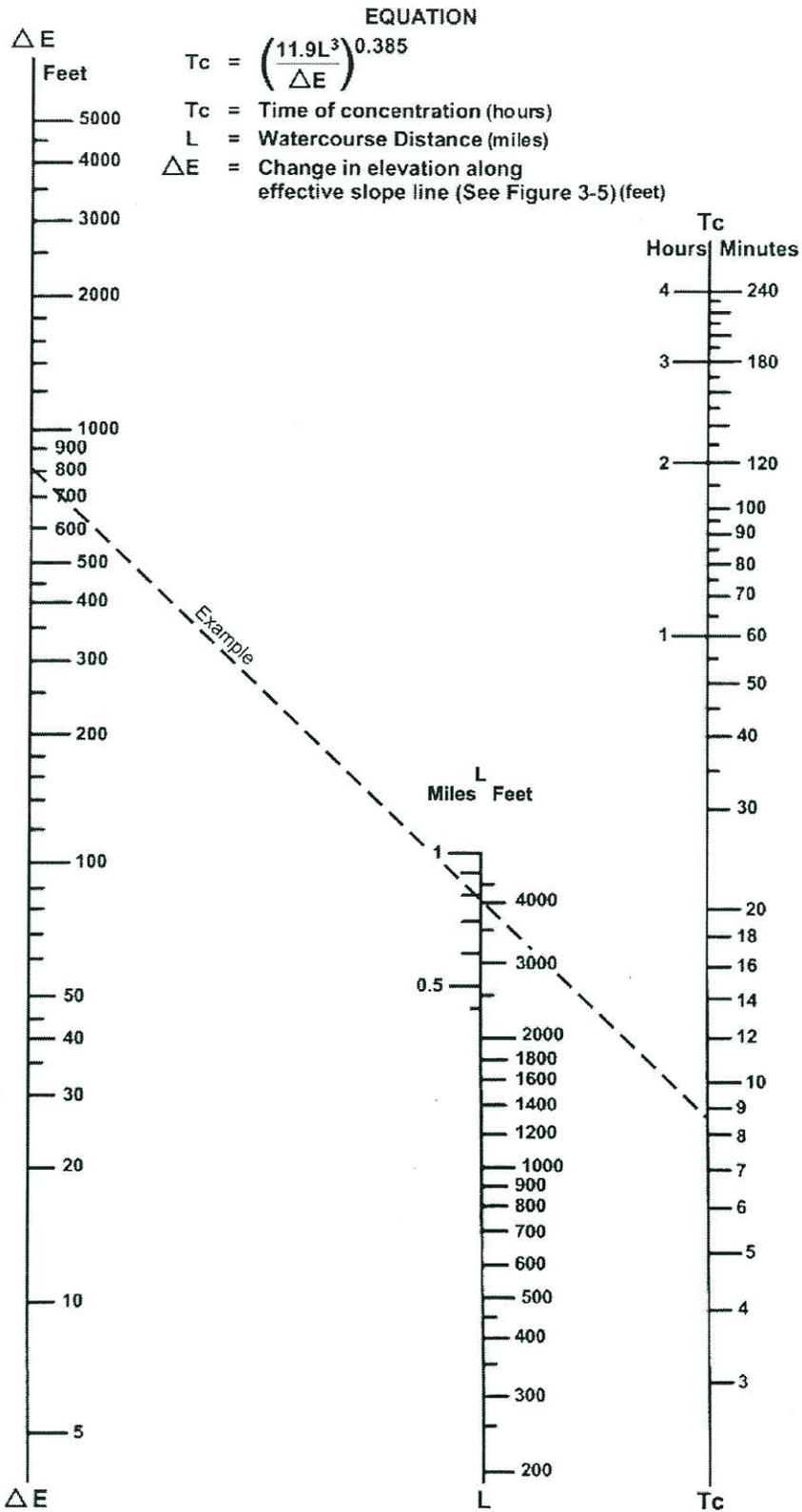
**Table 3-1
 RUNOFF COEFFICIENTS FOR URBAN AREAS**

| NRCS Elements | Land Use | County Elements | % IMPER. | Runoff Coefficient "C" | | | |
|---------------------------------------|----------|--------------------------------|----------|------------------------|------|------|------|
| | | | | A | B | C | D |
| Undisturbed Natural Terrain (Natural) | | Permanent Open Space | 0* | 0.20 | 0.25 | 0.30 | 0.35 |
| Low Density Residential (LDR) | | Residential, 1.0 DU/A or less | 10 | 0.27 | 0.32 | 0.36 | 0.41 |
| Low Density Residential (LDR) | | Residential, 2.0 DU/A or less | 20 | 0.34 | 0.38 | 0.42 | 0.46 |
| Low Density Residential (LDR) | | Residential, 2.9 DU/A or less | 25 | 0.38 | 0.41 | 0.45 | 0.49 |
| Medium Density Residential (MDR) | | Residential, 4.3 DU/A or less | 30 | 0.41 | 0.45 | 0.48 | 0.52 |
| Medium Density Residential (MDR) | | Residential, 7.3 DU/A or less | 40 | 0.48 | 0.51 | 0.54 | 0.57 |
| Medium Density Residential (MDR) | | Residential, 10.9 DU/A or less | 45 | 0.52 | 0.54 | 0.57 | 0.60 |
| Medium Density Residential (MDR) | | Residential, 14.5 DU/A or less | 50 | 0.55 | 0.58 | 0.60 | 0.63 |
| High Density Residential (HDR) | | Residential, 24.0 DU/A or less | 65 | 0.66 | 0.67 | 0.69 | 0.71 |
| High Density Residential (HDR) | | Residential, 43.0 DU/A or less | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (N. Com) | | Neighborhood Commercial | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (G. Com) | | General Commercial | 85 | 0.80 | 0.80 | 0.81 | 0.82 |
| Commercial/Industrial (O.P. Com) | | Office Professional/Commercial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (Limited I.) | | Limited Industrial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (General I.) | | General Industrial | 95 | 0.87 | 0.87 | 0.87 | 0.87 |

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

**MAXIMUM OVERLAND FLOW LENGTH (L_M)
 & INITIAL TIME OF CONCENTRATION (T_i)**

| Element* | DU/ Acre | .5% | | 1% | | 2% | | 3% | | 5% | | 10% | |
|------------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | L_M | T_i |
| Natural | | 50 | 13.2 | 70 | 12.5 | 85 | 10.9 | 100 | 10.3 | 100 | 8.7 | 100 | 6.9 |
| LDR | 1 | 50 | 12.2 | 70 | 11.5 | 85 | 10.0 | 100 | 9.5 | 100 | 8.0 | 100 | 6.4 |
| LDR | 2 | 50 | 11.3 | 70 | 10.5 | 85 | 9.2 | 100 | 8.8 | 100 | 7.4 | 100 | 5.8 |
| LDR | 2.9 | 50 | 10.7 | 70 | 10.0 | 85 | 8.8 | 95 | 8.1 | 100 | 7.0 | 100 | 5.6 |
| MDR | 4.3 | 50 | 10.2 | 70 | 9.6 | 80 | 8.1 | 95 | 7.8 | 100 | 6.7 | 100 | 5.3 |
| MDR | 7.3 | 50 | 9.2 | 65 | 8.4 | 80 | 7.4 | 95 | 7.0 | 100 | 6.0 | 100 | 4.8 |
| MDR | 10.9 | 50 | 8.7 | 65 | 7.9 | 80 | 6.9 | 90 | 6.4 | 100 | 5.7 | 100 | 4.5 |
| MDR | 14.5 | 50 | 8.2 | 65 | 7.4 | 80 | 6.5 | 90 | 6.0 | 100 | 5.4 | 100 | 4.3 |
| HDR | 24 | 50 | 6.7 | 65 | 6.1 | 75 | 5.1 | 90 | 4.9 | 95 | 4.3 | 100 | 3.5 |
| HDR | 43 | 50 | 5.3 | 65 | 4.7 | 75 | 4.0 | 85 | 3.8 | 95 | 3.4 | 100 | 2.7 |
| N. Com | | 50 | 5.3 | 60 | 4.5 | 75 | 4.0 | 85 | 3.8 | 95 | 3.4 | 100 | 2.7 |
| G. Com | | 50 | 4.7 | 60 | 4.1 | 75 | 3.6 | 85 | 3.4 | 90 | 2.9 | 100 | 2.4 |
| O.P./Com | | 50 | 4.2 | 60 | 3.7 | 70 | 3.1 | 80 | 2.9 | 90 | 2.6 | 100 | 2.2 |
| Limited I. | | 50 | 4.2 | 60 | 3.7 | 70 | 3.1 | 80 | 2.9 | 90 | 2.6 | 100 | 2.2 |
| General I. | | 50 | 3.7 | 60 | 3.2 | 70 | 2.7 | 80 | 2.6 | 90 | 2.3 | 100 | 1.9 |

*See Table 3-1 for more detailed description

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 12 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 22.7 ACRES
RUNOFF COEFFICIENT 0.39
PEAK DISCHARGE 40.4 CFS

Node 100 - Exist

| | |
|------------------|------------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 12 | DISCHARGE (CFS) = 1.6 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 1.6 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 1.7 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 1.7 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 1.8 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 1.9 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 2 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 2.1 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 2.2 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 2.3 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 2.5 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 2.6 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 2.9 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 3.1 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 3.6 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 3.9 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 4.7 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 5.4 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 7.9 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 10.5 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 40.4 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 6.3 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 4.2 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 3.3 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 2.8 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 2.4 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 2.2 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 2 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 1.8 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 1.7 |
| TIME (MIN) = 372 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 11 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 2.62 ACRES
RUNOFF COEFFICIENT 0.35
PEAK DISCHARGE 4.5 CFS

Node 200 - Exist

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 11 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 22 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 33 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 44 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 55 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 77 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 88 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 99 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 110 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 121 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 143 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 154 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 165 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 176 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 187 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 209 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 220 | DISCHARGE (CFS) = 0.6 |
| TIME (MIN) = 231 | DISCHARGE (CFS) = 0.9 |
| TIME (MIN) = 242 | DISCHARGE (CFS) = 1.1 |
| TIME (MIN) = 253 | DISCHARGE (CFS) = 4.5 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.7 |
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| TIME (MIN) = 319 | DISCHARGE (CFS) = 0.2 |
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| TIME (MIN) = 341 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 352 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 363 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 374 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 10 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.87 ACRES
RUNOFF COEFFICIENT 0.35
PEAK DISCHARGE 1.5 CFS

Node 300-Exist

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 10 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 20 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 30 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 40 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 50 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 70 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 80 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 90 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 100 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 110 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 130 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 140 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 150 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 160 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 170 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 190 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 200 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 220 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 230 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 250 | DISCHARGE (CFS) = 1.5 |
| TIME (MIN) = 260 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 270 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 280 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 290 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 310 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 320 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 330 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 340 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 350 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 370 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 12 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 18.91 ACRES
RUNOFF COEFFICIENT 0.37
PEAK DISCHARGE 31.5 CFS

Node 400 - Exist

| | |
|------------------|------------------------|
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| TIME (MIN) = 12 | DISCHARGE (CFS) = 1.3 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 1.3 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 1.3 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 1.4 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 1.5 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 1.5 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 1.6 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 1.6 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 1.8 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 1.8 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 2 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 2.1 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 2.3 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 2.5 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 2.8 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 3 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 3.7 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 4.2 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 6.2 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 8.7 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 31.5 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 5 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 3.3 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 2.6 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 2.2 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 1.9 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 1.7 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 1.5 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 1.4 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 1.3 |
| TIME (MIN) = 372 | DISCHARGE (CFS) = 0 |

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

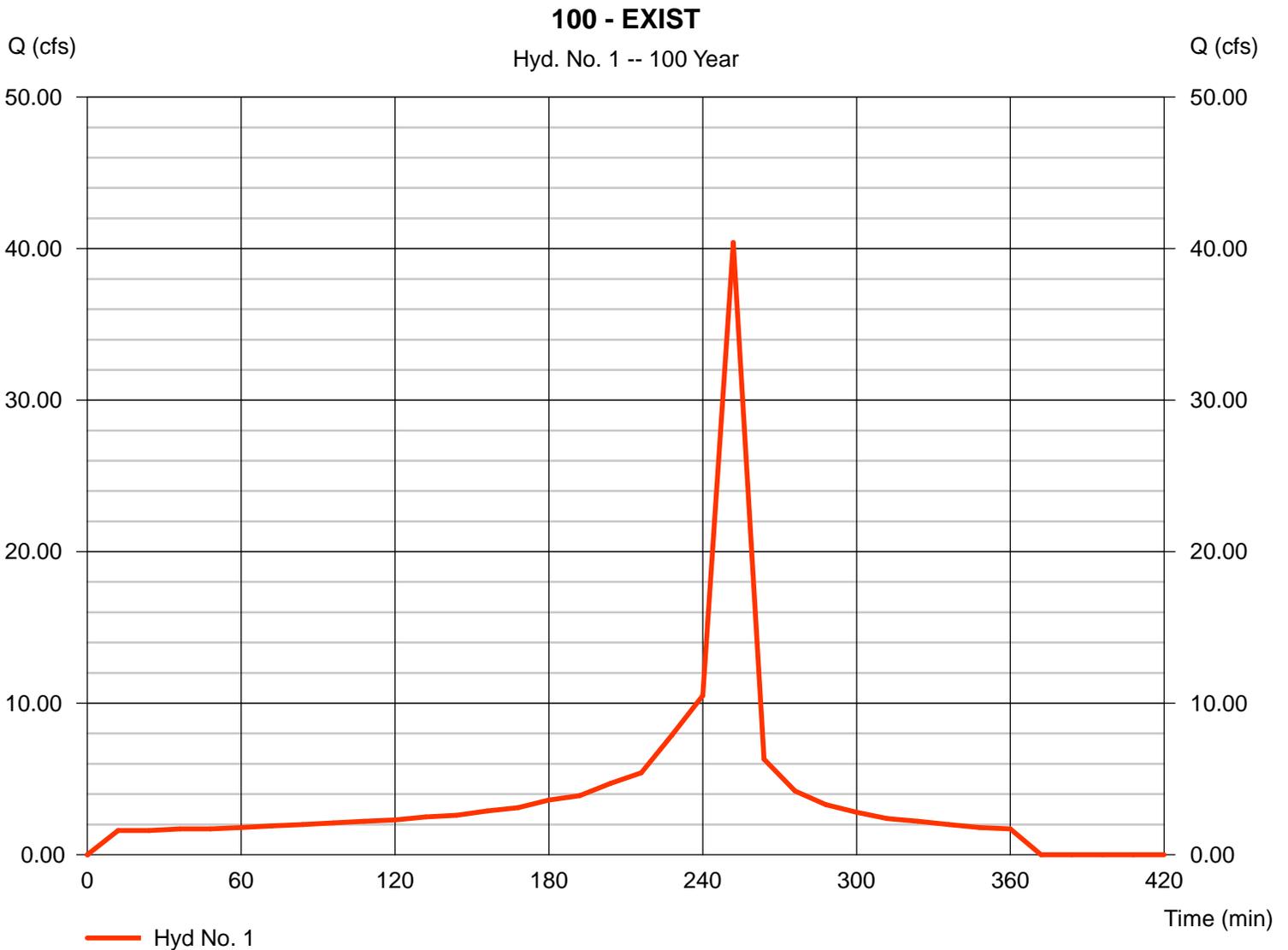
Saturday, Aug 16, 2014

Hyd. No. 1

100 - EXIST

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 12 min

Peak discharge = 40.40 cfs
Time to peak = 252 min
Hyd. volume = 95,832 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

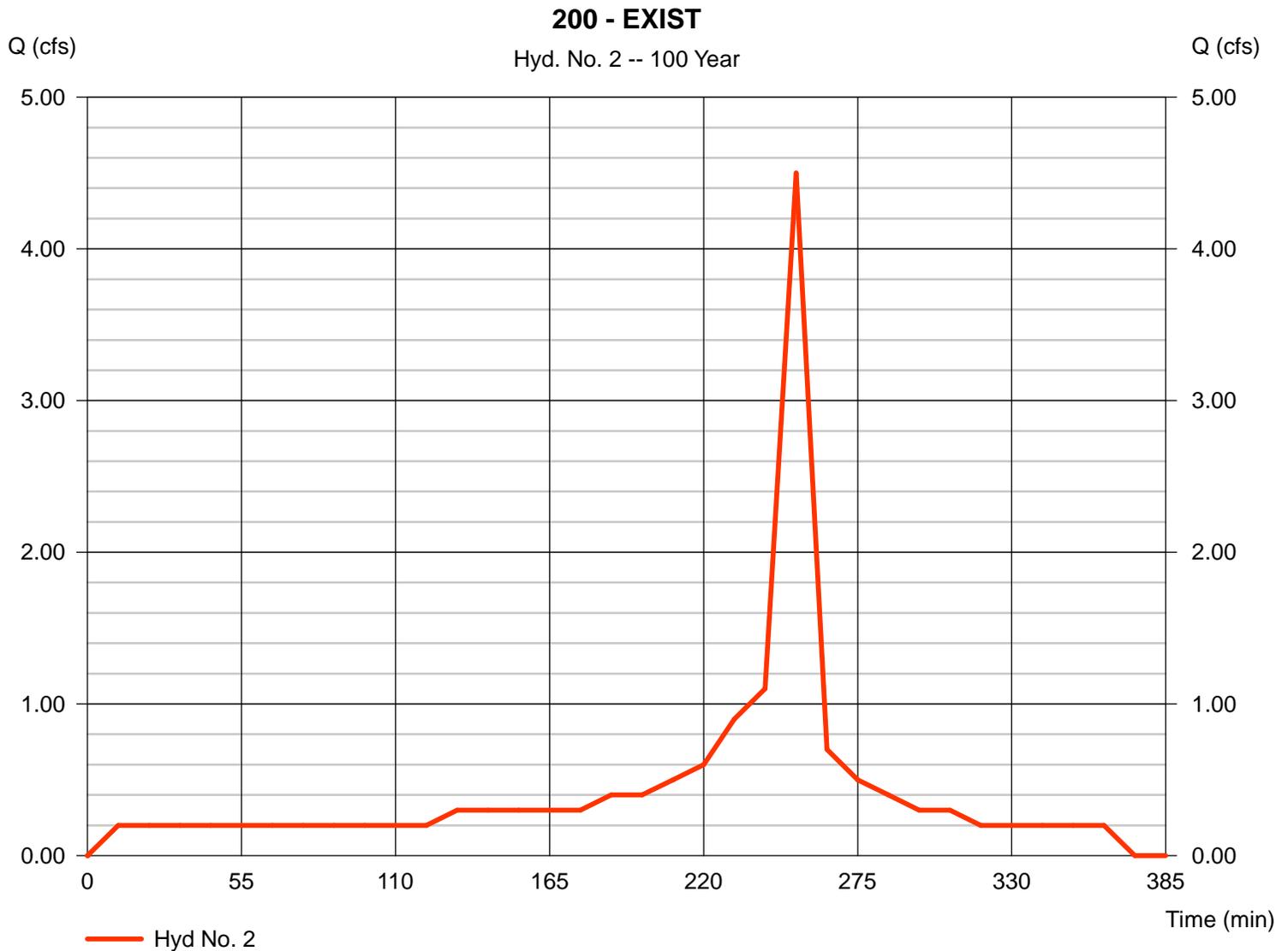
Saturday, Aug 16, 2014

Hyd. No. 2

200 - EXIST

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 11 min

Peak discharge = 4.500 cfs
Time to peak = 253 min
Hyd. volume = 10,098 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

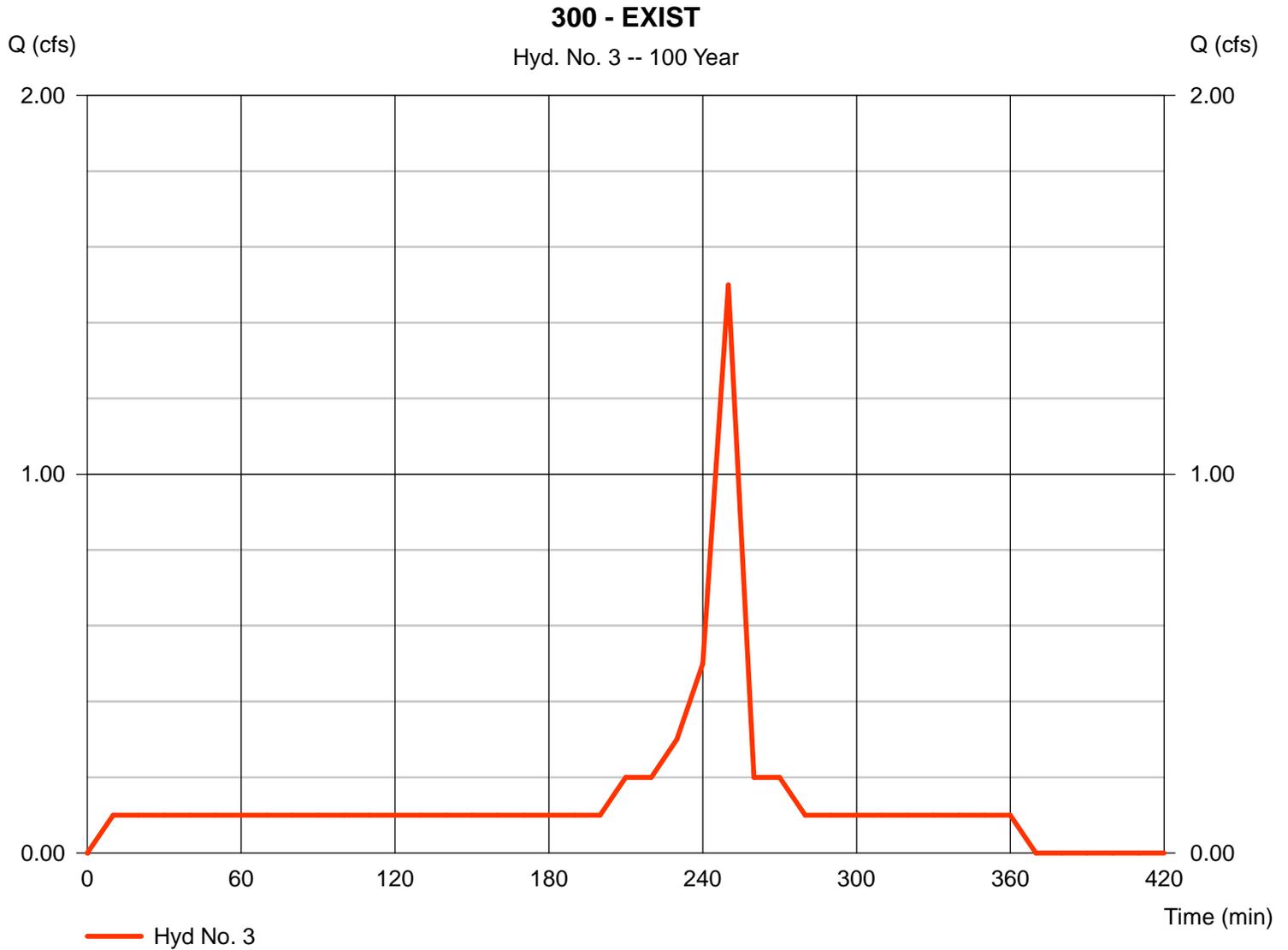
Saturday, Aug 16, 2014

Hyd. No. 3

300 - EXIST

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 10 min

Peak discharge = 1,500 cfs
Time to peak = 250 min
Hyd. volume = 3,600 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

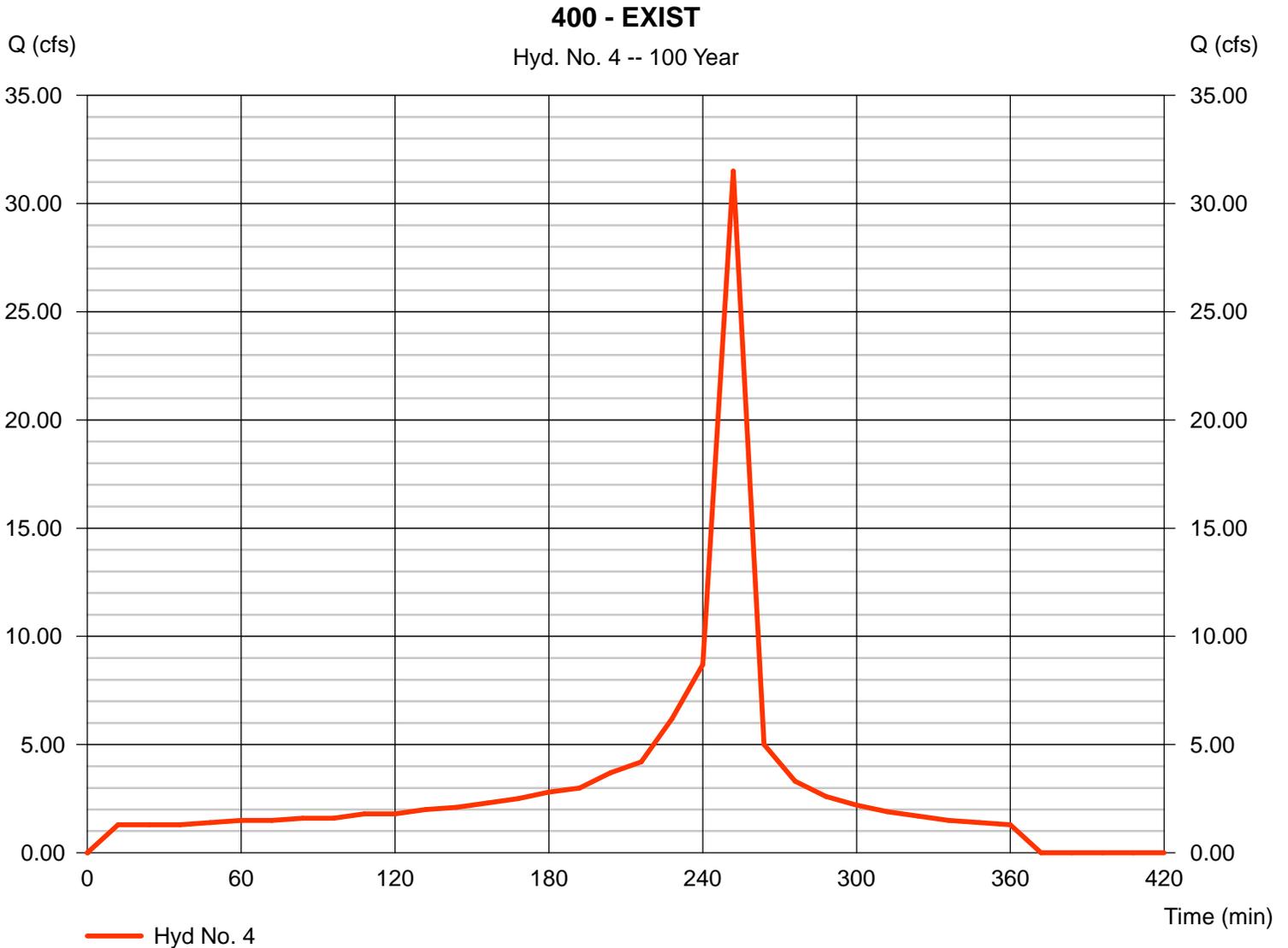
Saturday, Aug 16, 2014

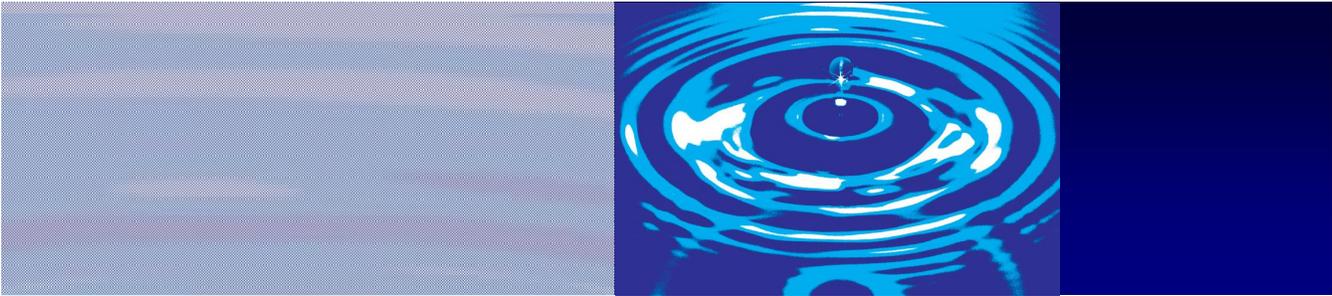
Hyd. No. 4

400 - EXIST

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 12 min

Peak discharge = 31.50 cfs
Time to peak = 252 min
Hyd. volume = 75,600 cuft



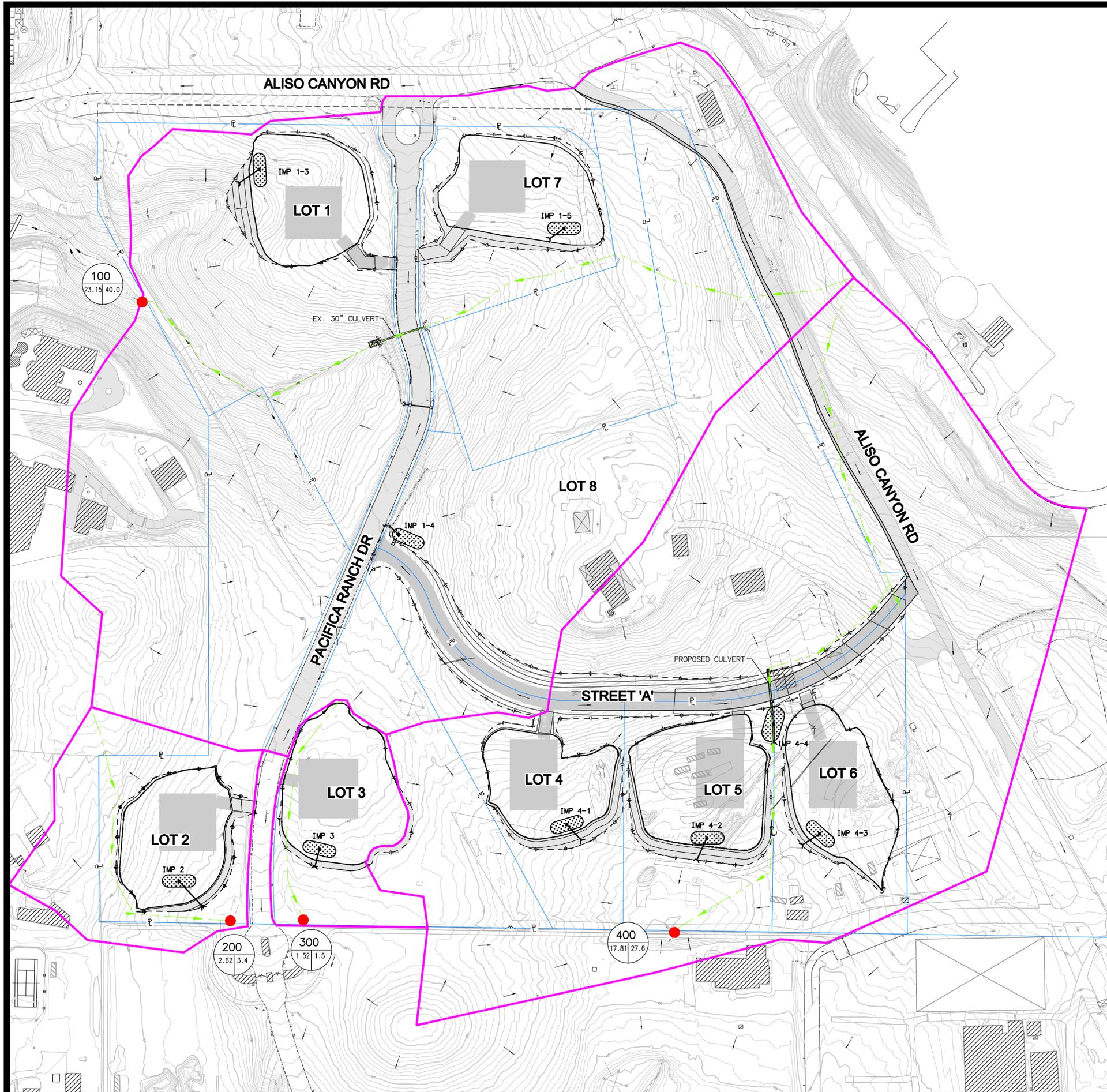


APPENDIX B

Proposed Conditions Hydrology

This Section Contains:

- Work Map
- Rational Method T_c Calculations
- Rational Hydrograph Software Output



LEGEND

- PROPERTY LINE
 - DRAINAGE AREA NODE
 - DRAINAGE AREA BOUNDARY
 - LONGEST FLOW PATH
 - BIORETENTION AREA
 - EXISTING IMPERVIOUS AREA
 - PROPOSED IMPERVIOUS AREA
- NODE NUMBER
 DRAINAGE AREA (ACRES) Q_{100} (CFS)

| PROPOSED DRAINAGE AREAS | | | | | | | | |
|-------------------------|-----------|-----------------|--------------|------|-----------------------------------|-------------------------------------|----------------------|----------------------------------|
| NODE | AREA (AC) | IMPERVIOUS (AC) | % IMPERVIOUS | C | T _c (min) ¹ | Q ₁₀₀ (cfs) ² | FLOW REDUCTION (cfs) | MITIGATED Q ₁₀₀ (cfs) |
| 100 | 23.15 | 2.37 | 10% | 0.41 | 11.7 | 43.0 | 3.7 | 39.3 |
| 200 | 2.62 | 0.23 | 9% | 0.40 | 11.1 | 4.9 | 1.4 | 3.5 |
| 300 | 1.52 | 0.23 | 15% | 0.43 | 7.4 | 4.0 | 2.5 | 1.5 |
| 400 | 17.81 | 1.67 | 9% | 0.40 | 11.9 | 32.3 | 5.0 | 27.3 |

1. REFER TO PROPOSED HYDROLOGY CALCULATIONS IN APPENDIX B FOR TIME OF CONCENTRATION.
2. RATIONAL METHOD CALCULATION PER SAN DIEGO COUNTY HYDROLOGY MANUAL.

| FLOW TO DETENTION | | | | | | | | | | |
|-------------------|--------------|-----------|-----------------|--------------|------|----------------------|------------------------|----------------------------------|----------------------|---------------------|
| NODE | BIORETENTION | AREA (AC) | IMPERVIOUS (AC) | % IMPERVIOUS | C | T _c (min) | Q ₁₀₀ (cfs) | MITIGATED Q ₁₀₀ (cfs) | FLOW REDUCTION (cfs) | STORAGE VOLUME (CF) |
| 100 | IMP 1-3 | 0.80 | 0.23 | 29% | 0.51 | 6.1 | 2.8 | 1.6 | 1.2 | 2,428 |
| 100 | IMP 1-4 | 0.28 | 0.28 | 100% | 0.90 | 6.1 | 1.8 | 0.6 | 1.2 | 2,124 |
| 100 | IMP 1-5 | 0.84 | 0.23 | 27% | 0.50 | 6.1 | 2.9 | 1.6 | 1.3 | 2,448 |
| NODE 100 TOTAL | | | | | | | 7.5 | 3.8 | 3.7 | 7,000 |
| 200 | IMP 2 | 0.97 | 0.23 | 24% | 0.48 | 6.1 | 3.2 | 1.8 | 1.4 | 2,757 |
| 300 | IMP 3 | 0.91 | 0.23 | 25% | 0.49 | 6.1 | 3.1 | 0.6 | 2.5 | 3,460 |
| 400 | IMP 4-1 | 0.67 | 0.23 | 34% | 0.54 | 6.1 | 2.5 | 1.3 | 1.2 | 2,622 |
| 400 | IMP 4-2 | 0.91 | 0.23 | 25% | 0.49 | 6.1 | 3.1 | 1.8 | 1.3 | 2,745 |
| 400 | IMP 4-3 | 0.80 | 0.23 | 29% | 0.51 | 6.1 | 2.8 | 1.6 | 1.2 | 2,700 |
| 400 | IMP 4-4 | 0.41 | 0.41 | 100% | 0.90 | 6.1 | 2.6 | 0.1 | 2.5 | 3,475 |
| NODE 400 TOTAL | | | | | | | 8.5 | 3.5 | 5.0 | 8,920 |

**ALISO CANYON SUBDIVISION
PROPOSED HYDROLOGY MAP**



H:\P\A\131718_Aliso Canyon\Drawings\Drainage\240131718-Hydro-PROP.dwg 10/27/14 1:13:58pm 0mm

Proposed Hydrology

Node 100

$T_c = \underline{11.7 \text{ min}}$
 See Ex Hydro Calc

Node 200

Flowline = 500'
 $T_i = 8.7 \text{ min}, L_M = 100'$
 $T_t = \Delta E = 443 - 421 = 22', L = 400'$
 $\Rightarrow 2.4 \text{ min}$
 $T_c = 8.7 + 2.4 = \underline{11.1 \text{ min}}$

Node 300 - Pad swale + natural flowline

$T_i = 5 \text{ min assumed}$
 $T_t: Q_{\text{assumed}} = 2A = 2(1.5) = 3 \text{ cfs}$
 Pad swale: 1% slope @ 250' $\Rightarrow v = 2.2 \text{ fps} \Rightarrow T_t = 1.7 \text{ min}$
 Nat. Swale: 7% slope @ 140' $\Rightarrow v = 4.7 \text{ fps} \Rightarrow T_t = 0.5 \text{ min}$
 $T_c = 5 + 1.9 + 0.5 = \underline{7.4 \text{ min}}$

Node 400

$T_c = \underline{11.9 \text{ min}}$
 See Ex. Hydro Calc

County of San Diego Hydrology Manual



Rainfall Isopleths

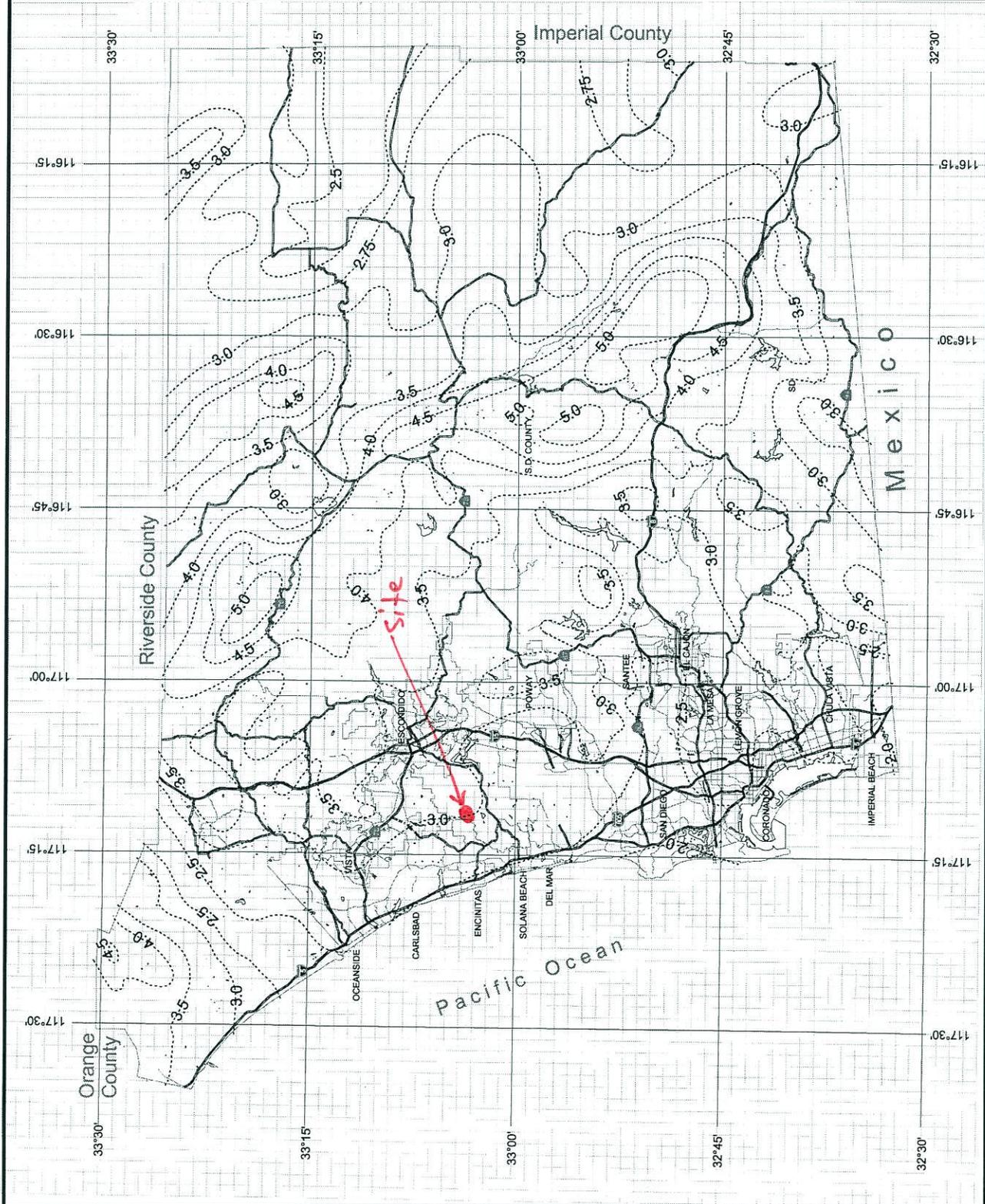
100 Year Rainfall Event - 6 Hours



$P_2(100) = 3.0$ in



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County of San Diego Hydrology Manual



Rainfall Isopleths

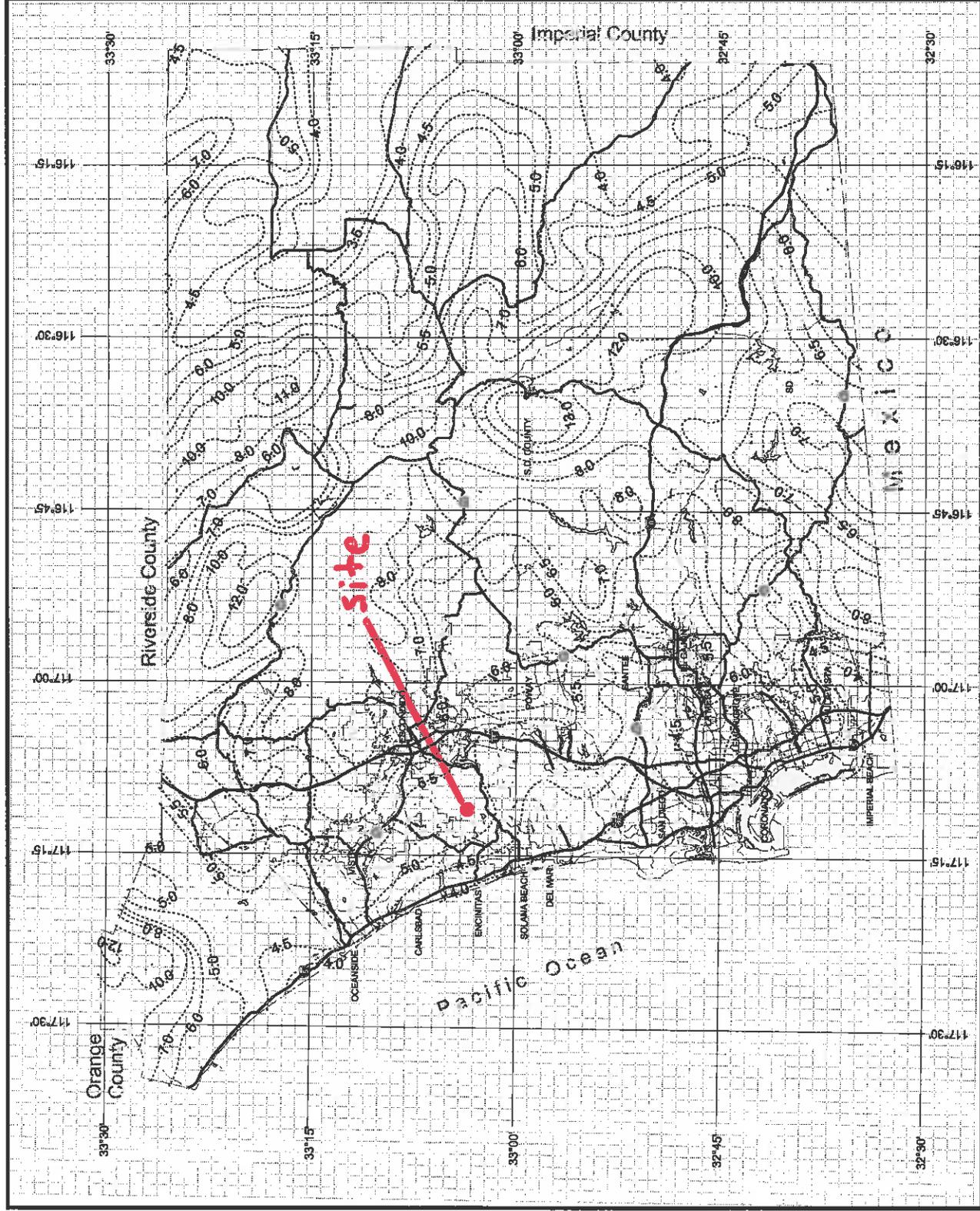
100 Year Rainfall Event - 24 Hours

..... Isopleth (inches)

$P_{(24)} 100 = 5.2 \text{ in.}$



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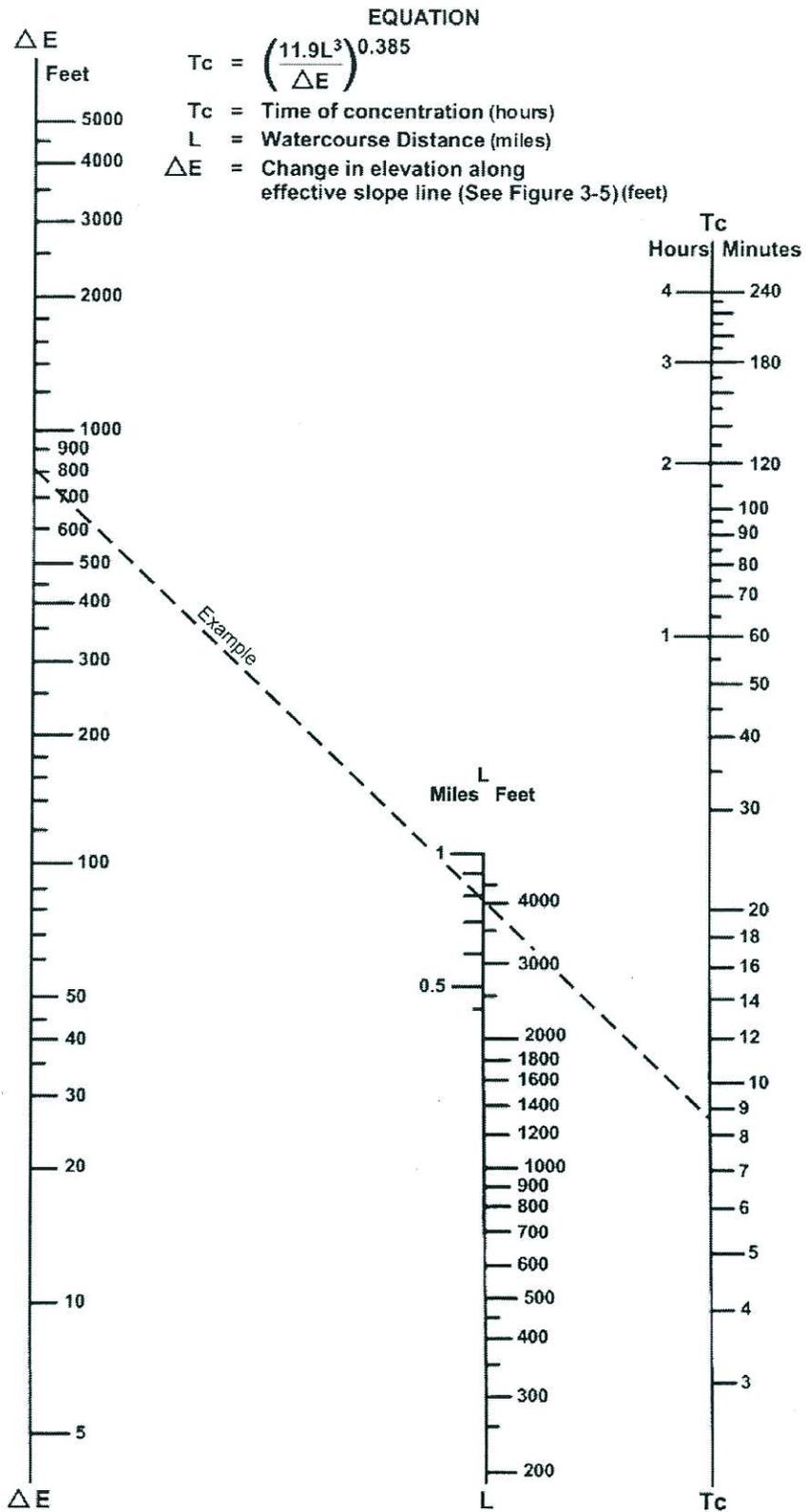
**Table 3-1
 RUNOFF COEFFICIENTS FOR URBAN AREAS**

| Land Use | | Runoff Coefficient "C" | | | | |
|---------------------------------------|--------------------------------|------------------------|-----------|------|------|------|
| NRCS Elements | County Elements | % IMPER. | Soil Type | | | |
| | | | A | B | C | D |
| Undisturbed Natural Terrain (Natural) | Permanent Open Space | 0* | 0.20 | 0.25 | 0.30 | 0.35 |
| Low Density Residential (LDR) | Residential, 1.0 DU/A or less | 10 | 0.27 | 0.32 | 0.36 | 0.41 |
| Low Density Residential (LDR) | Residential, 2.0 DU/A or less | 20 | 0.34 | 0.38 | 0.42 | 0.46 |
| Low Density Residential (LDR) | Residential, 2.9 DU/A or less | 25 | 0.38 | 0.41 | 0.45 | 0.49 |
| Medium Density Residential (MDR) | Residential, 4.3 DU/A or less | 30 | 0.41 | 0.45 | 0.48 | 0.52 |
| Medium Density Residential (MDR) | Residential, 7.3 DU/A or less | 40 | 0.48 | 0.51 | 0.54 | 0.57 |
| Medium Density Residential (MDR) | Residential, 10.9 DU/A or less | 45 | 0.52 | 0.54 | 0.57 | 0.60 |
| Medium Density Residential (MDR) | Residential, 14.5 DU/A or less | 50 | 0.55 | 0.58 | 0.60 | 0.63 |
| High Density Residential (HDR) | Residential, 24.0 DU/A or less | 65 | 0.66 | 0.67 | 0.69 | 0.71 |
| High Density Residential (HDR) | Residential, 43.0 DU/A or less | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (N. Com) | Neighborhood Commercial | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (G. Com) | General Commercial | 85 | 0.80 | 0.80 | 0.81 | 0.82 |
| Commercial/Industrial (O.P. Com) | Office Professional/Commercial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (Limited I.) | Limited Industrial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (General I.) | General Industrial | 95 | 0.87 | 0.87 | 0.87 | 0.87 |

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

**MAXIMUM OVERLAND FLOW LENGTH (L_M)
 & INITIAL TIME OF CONCENTRATION (T_i)**

| Element* | DU/ Acre | .5% | | 1% | | 2% | | 3% | | 5% | | 10% | |
|------------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | L_M | T_i |
| Natural | | 50 | 13.2 | 70 | 12.5 | 85 | 10.9 | 100 | 10.3 | 100 | 8.7 | 100 | 6.9 |
| LDR | 1 | 50 | 12.2 | 70 | 11.5 | 85 | 10.0 | 100 | 9.5 | 100 | 8.0 | 100 | 6.4 |
| LDR | 2 | 50 | 11.3 | 70 | 10.5 | 85 | 9.2 | 100 | 8.8 | 100 | 7.4 | 100 | 5.8 |
| LDR | 2.9 | 50 | 10.7 | 70 | 10.0 | 85 | 8.8 | 95 | 8.1 | 100 | 7.0 | 100 | 5.6 |
| MDR | 4.3 | 50 | 10.2 | 70 | 9.6 | 80 | 8.1 | 95 | 7.8 | 100 | 6.7 | 100 | 5.3 |
| MDR | 7.3 | 50 | 9.2 | 65 | 8.4 | 80 | 7.4 | 95 | 7.0 | 100 | 6.0 | 100 | 4.8 |
| MDR | 10.9 | 50 | 8.7 | 65 | 7.9 | 80 | 6.9 | 90 | 6.4 | 100 | 5.7 | 100 | 4.5 |
| MDR | 14.5 | 50 | 8.2 | 65 | 7.4 | 80 | 6.5 | 90 | 6.0 | 100 | 5.4 | 100 | 4.3 |
| HDR | 24 | 50 | 6.7 | 65 | 6.1 | 75 | 5.1 | 90 | 4.9 | 95 | 4.3 | 100 | 3.5 |
| HDR | 43 | 50 | 5.3 | 65 | 4.7 | 75 | 4.0 | 85 | 3.8 | 95 | 3.4 | 100 | 2.7 |
| N. Com | | 50 | 5.3 | 60 | 4.5 | 75 | 4.0 | 85 | 3.8 | 95 | 3.4 | 100 | 2.7 |
| G. Com | | 50 | 4.7 | 60 | 4.1 | 75 | 3.6 | 85 | 3.4 | 90 | 2.9 | 100 | 2.4 |
| O.P./Com | | 50 | 4.2 | 60 | 3.7 | 70 | 3.1 | 80 | 2.9 | 90 | 2.6 | 100 | 2.2 |
| Limited I. | | 50 | 4.2 | 60 | 3.7 | 70 | 3.1 | 80 | 2.9 | 90 | 2.6 | 100 | 2.2 |
| General I. | | 50 | 3.7 | 60 | 3.2 | 70 | 2.7 | 80 | 2.6 | 90 | 2.3 | 100 | 1.9 |

*See Table 3-1 for more detailed description

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 12 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 23.18 ACRES
RUNOFF COEFFICIENT 0.41
PEAK DISCHARGE 43 CFS

Node 100- Prop

| | |
|------------------|------------------------|
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| TIME (MIN) = 12 | DISCHARGE (CFS) = 1.7 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 1.7 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 1.8 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 1.9 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 2 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 2 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 2.2 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 2.2 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 2.4 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 2.5 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 2.7 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 2.8 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 3.1 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 3.3 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 3.8 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 4.1 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 5.1 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 5.8 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 8.5 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 11.6 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 43 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 6.8 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 4.5 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 3.6 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 3 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 2.6 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 2.3 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 2.1 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 1.9 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 1.8 |
| TIME (MIN) = 372 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 11 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 2.61 ACRES
RUNOFF COEFFICIENT 0.4
PEAK DISCHARGE 4.9 CFS

Node 200-Prop

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 11 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 22 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 33 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 44 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 55 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 77 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 88 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 99 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 110 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 121 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 143 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 154 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 165 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 176 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 187 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 209 | DISCHARGE (CFS) = 0.6 |
| TIME (MIN) = 220 | DISCHARGE (CFS) = 0.7 |
| TIME (MIN) = 231 | DISCHARGE (CFS) = 1 |
| TIME (MIN) = 242 | DISCHARGE (CFS) = 1.4 |
| TIME (MIN) = 253 | DISCHARGE (CFS) = 4.9 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.8 |
| TIME (MIN) = 275 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 286 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 297 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 308 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 319 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 330 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 341 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 352 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 363 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 374 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 7 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 1.52 ACRES
RUNOFF COEFFICIENT 0.43
PEAK DISCHARGE 4 CFS

Node 300 - Prop

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 7 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 14 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 21 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 28 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 35 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 42 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 49 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 56 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 63 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 70 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 77 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 91 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 98 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 105 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 112 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 119 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 126 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 133 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 140 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 147 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 154 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 161 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 175 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 182 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 189 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 196 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 203 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 217 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 224 | DISCHARGE (CFS) = 0.6 |
| TIME (MIN) = 231 | DISCHARGE (CFS) = 0.8 |
| TIME (MIN) = 238 | DISCHARGE (CFS) = 1.3 |
| TIME (MIN) = 245 | DISCHARGE (CFS) = 4 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 0.7 |
| TIME (MIN) = 259 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 266 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 273 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 280 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 287 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 294 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 301 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 308 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 315 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 322 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 329 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 343 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 350 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 357 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 364 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 12 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 17.79 ACRES
RUNOFF COEFFICIENT 0.4
PEAK DISCHARGE 32.3 CFS

Node 400 - Prop

| | |
|------------------|------------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 12 | DISCHARGE (CFS) = 1.3 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 1.3 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 1.4 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 1.4 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 1.5 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 1.5 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 1.6 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 1.7 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 1.8 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 1.9 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 2 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 2.1 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 2.4 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 2.5 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 2.9 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 3.1 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 3.8 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 4.3 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 6.3 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 8.6 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 32.3 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 5.1 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 3.4 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 2.7 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 2.2 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 1.9 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 1.7 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 1.6 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 1.4 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 1.3 |
| TIME (MIN) = 372 | DISCHARGE (CFS) = 0 |

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

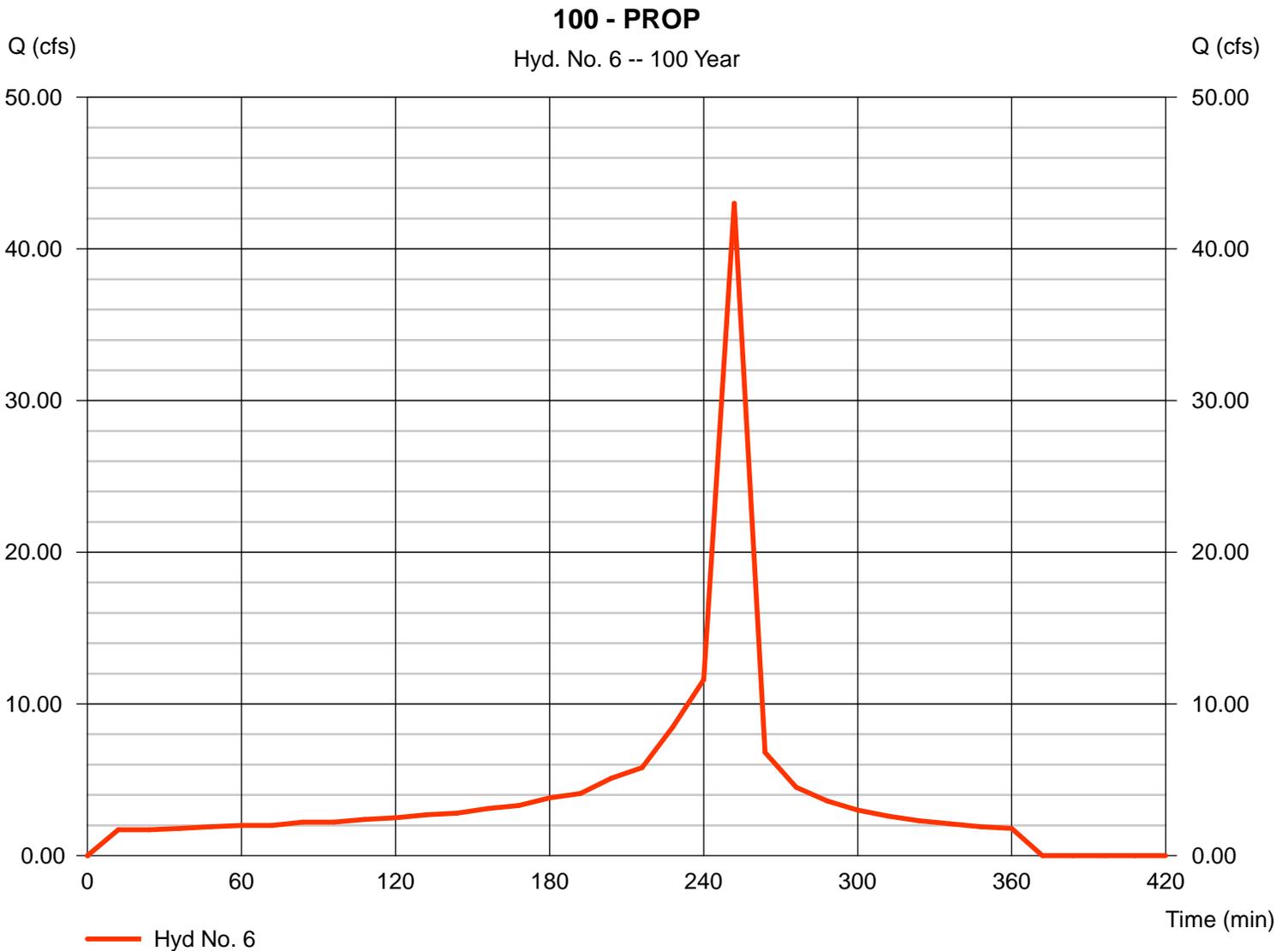
Saturday, Aug 16, 2014

Hyd. No. 6

100 - PROP

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 12 min

Peak discharge = 43.00 cfs
Time to peak = 252 min
Hyd. volume = 102,816 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

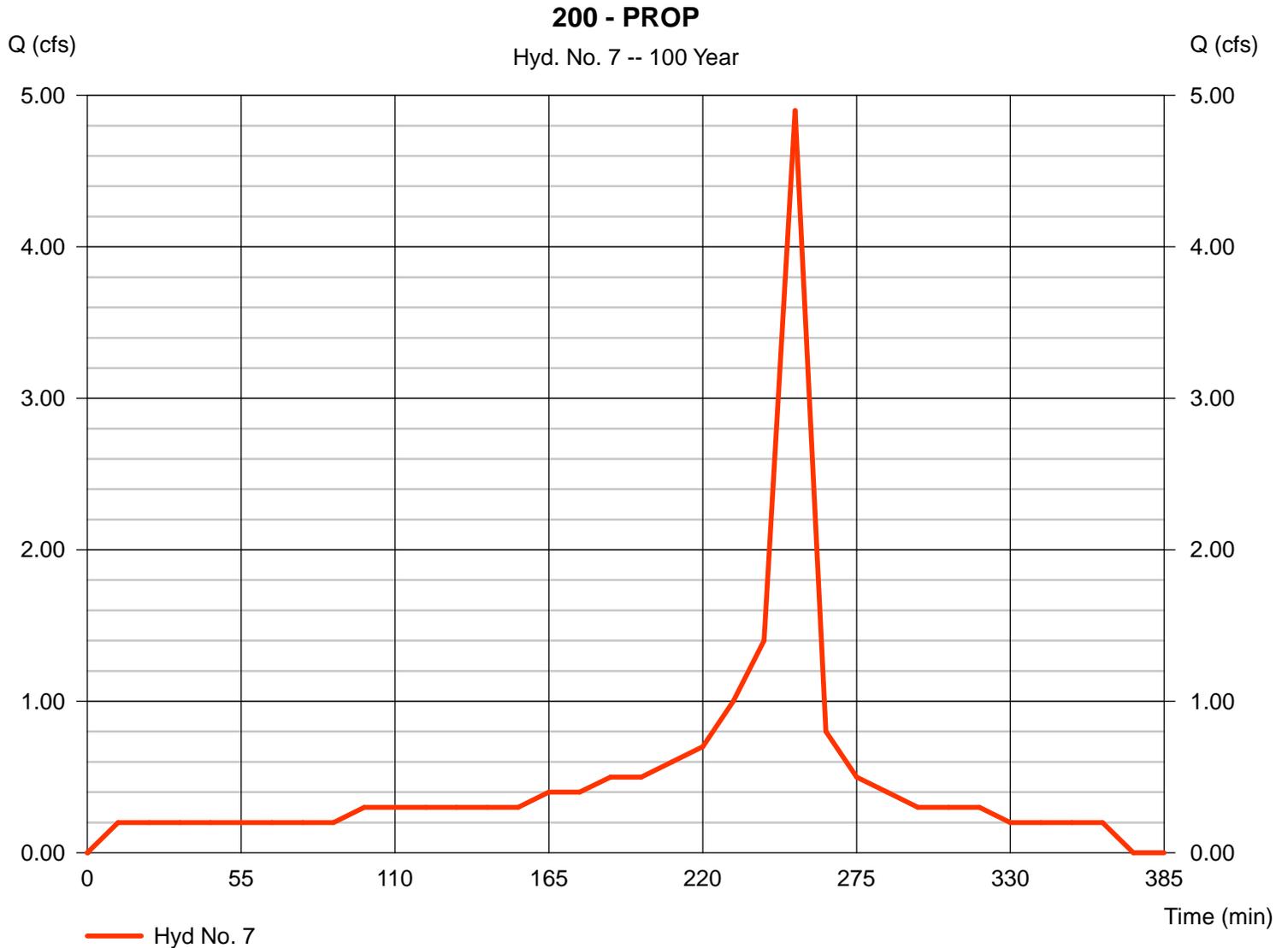
Saturday, Aug 16, 2014

Hyd. No. 7

200 - PROP

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 11 min

Peak discharge = 4.900 cfs
Time to peak = 253 min
Hyd. volume = 11,352 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

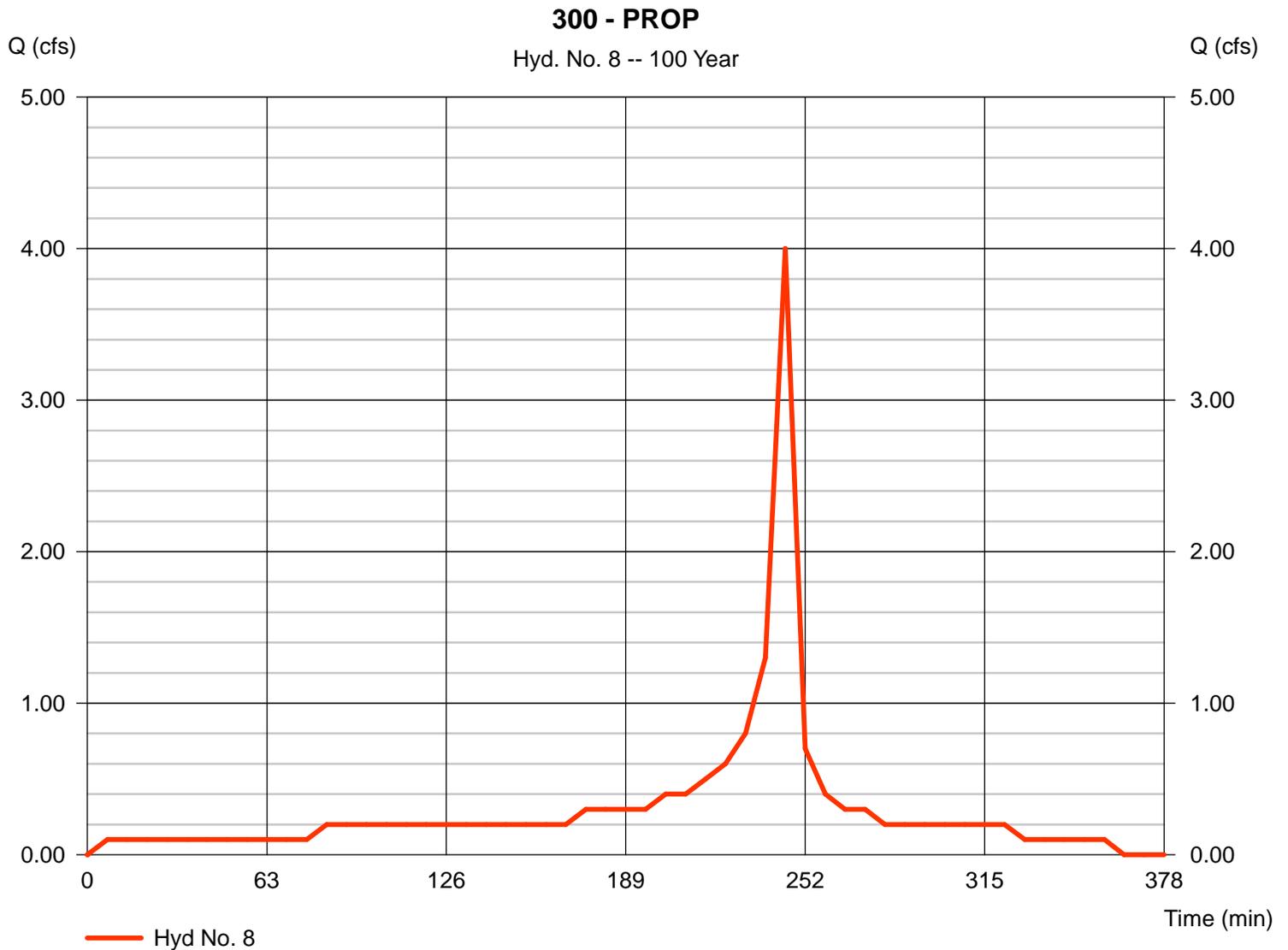
Saturday, Aug 16, 2014

Hyd. No. 8

300 - PROP

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 7 min

Peak discharge = 4.000 cfs
Time to peak = 245 min
Hyd. volume = 6,930 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

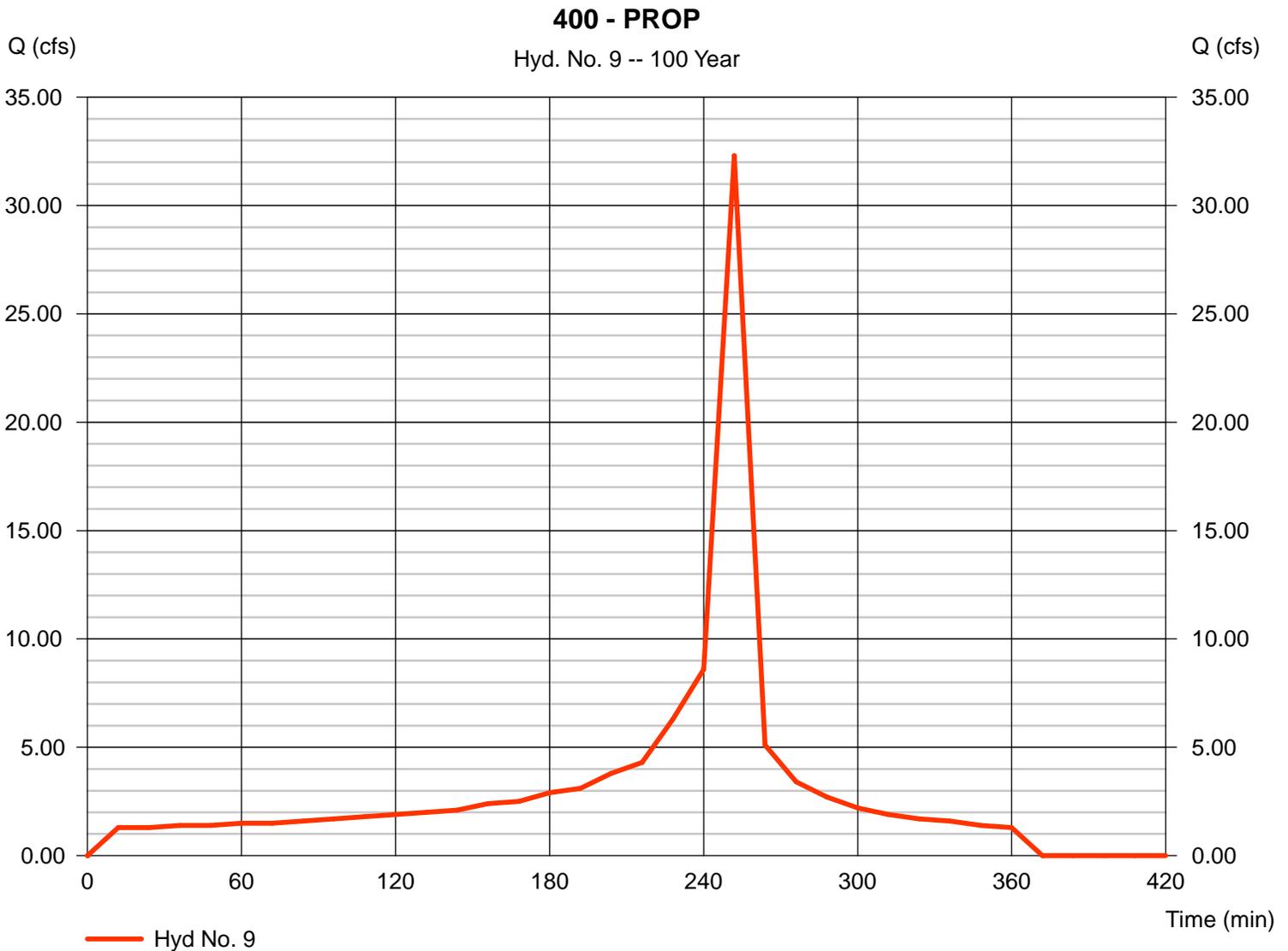
Saturday, Aug 16, 2014

Hyd. No. 9

400 - PROP

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 12 min

Peak discharge = 32.30 cfs
Time to peak = 252 min
Hyd. volume = 77,040 cuft



RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 6 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.8 ACRES
RUNOFF COEFFICIENT 0.51
PEAK DISCHARGE 2.8 CFS

Q100 to IMA 1-3

| TIME (MIN) | DISCHARGE (CFS) |
|------------|-----------------|
| 0 | 0 |
| 6 | 0.1 |
| 12 | 0.1 |
| 18 | 0.1 |
| 24 | 0.1 |
| 30 | 0.1 |
| 36 | 0.1 |
| 42 | 0.1 |
| 48 | 0.1 |
| 54 | 0.1 |
| 60 | 0.1 |
| 66 | 0.1 |
| 72 | 0.1 |
| 78 | 0.1 |
| 84 | 0.1 |
| 90 | 0.1 |
| 96 | 0.1 |
| 102 | 0.1 |
| 108 | 0.1 |
| 114 | 0.1 |
| 120 | 0.1 |
| 126 | 0.1 |
| 132 | 0.1 |
| 138 | 0.1 |
| 144 | 0.1 |
| 150 | 0.1 |
| 156 | 0.1 |
| 162 | 0.1 |
| 168 | 0.1 |
| 174 | 0.2 |
| 180 | 0.2 |
| 186 | 0.2 |
| 192 | 0.2 |
| 198 | 0.2 |
| 204 | 0.2 |
| 210 | 0.3 |
| 216 | 0.3 |
| 222 | 0.3 |
| 228 | 0.4 |
| 234 | 0.6 |
| 240 | 0.9 |
| 246 | 2.8 |
| 252 | 0.5 |
| 258 | 0.3 |
| 264 | 0.2 |
| 270 | 0.2 |
| 276 | 0.2 |
| 282 | 0.2 |
| 288 | 0.1 |
| 294 | 0.1 |
| 300 | 0.1 |
| 306 | 0.1 |
| 312 | 0.1 |
| 318 | 0.1 |
| 324 | 0.1 |
| 330 | 0.1 |
| 336 | 0.1 |
| 342 | 0.1 |
| 348 | 0.1 |
| 354 | 0.1 |
| 360 | 0.1 |
| 366 | 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 6 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.28 ACRES
RUNOFF COEFFICIENT 0.9
PEAK DISCHARGE 1.8 CFS

Q₁₀₀ to IMP 1-4

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
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| TIME (MIN) = 12 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 18 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 30 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 42 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 54 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 78 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 90 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 102 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 114 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 126 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 138 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 150 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 162 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 174 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 186 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 222 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 234 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 246 | DISCHARGE (CFS) = 1.8 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 258 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 270 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 282 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 294 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 306 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 318 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 330 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 342 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 354 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 366 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 6 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.84 ACRES
RUNOFF COEFFICIENT 0.5
PEAK DISCHARGE 2.9 CFS

Q₁₀₀ to IMA 1-5

| TIME (MIN) | DISCHARGE (CFS) |
|------------|-----------------|
| 0 | 0 |
| 6 | 0.1 |
| 12 | 0.1 |
| 18 | 0.1 |
| 24 | 0.1 |
| 30 | 0.1 |
| 36 | 0.1 |
| 42 | 0.1 |
| 48 | 0.1 |
| 54 | 0.1 |
| 60 | 0.1 |
| 66 | 0.1 |
| 72 | 0.1 |
| 78 | 0.1 |
| 84 | 0.1 |
| 90 | 0.1 |
| 96 | 0.1 |
| 102 | 0.1 |
| 108 | 0.1 |
| 114 | 0.1 |
| 120 | 0.1 |
| 126 | 0.1 |
| 132 | 0.1 |
| 138 | 0.1 |
| 144 | 0.1 |
| 150 | 0.1 |
| 156 | 0.1 |
| 162 | 0.1 |
| 168 | 0.2 |
| 174 | 0.2 |
| 180 | 0.2 |
| 186 | 0.2 |
| 192 | 0.2 |
| 198 | 0.2 |
| 204 | 0.2 |
| 210 | 0.3 |
| 216 | 0.3 |
| 222 | 0.3 |
| 228 | 0.4 |
| 234 | 0.6 |
| 240 | 0.9 |
| 246 | 2.9 |
| 252 | 0.5 |
| 258 | 0.3 |
| 264 | 0.2 |
| 270 | 0.2 |
| 276 | 0.2 |
| 282 | 0.2 |
| 288 | 0.1 |
| 294 | 0.1 |
| 300 | 0.1 |
| 306 | 0.1 |
| 312 | 0.1 |
| 318 | 0.1 |
| 324 | 0.1 |
| 330 | 0.1 |
| 336 | 0.1 |
| 342 | 0.1 |
| 348 | 0.1 |
| 354 | 0.1 |
| 360 | 0.1 |
| 366 | 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 6 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.97 ACRES
RUNOFF COEFFICIENT 0.48
PEAK DISCHARGE 3.2 CFS

Q₁₀₀ to IMP 2

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 6 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 12 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 18 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 30 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 42 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 54 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 78 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 90 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 102 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 114 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 126 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 138 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 150 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 162 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 174 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 186 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 222 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 234 | DISCHARGE (CFS) = 0.6 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 1 |
| TIME (MIN) = 246 | DISCHARGE (CFS) = 3.2 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 258 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 270 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 282 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 294 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 306 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 318 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 330 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 342 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 354 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 366 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 6 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.91 ACRES
RUNOFF COEFFICIENT 0.49
PEAK DISCHARGE 3.1 CFS

Q₁₀₀ to 1MP3

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 6 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 12 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 18 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 30 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 42 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 54 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 78 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 90 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 102 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 114 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 126 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 138 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 150 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 162 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 174 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 186 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 222 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 234 | DISCHARGE (CFS) = 0.6 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 0.9 |
| TIME (MIN) = 246 | DISCHARGE (CFS) = 3.1 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 258 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 270 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 282 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 294 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 306 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 318 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 330 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 342 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 354 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 366 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 6 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.67 ACRES
RUNOFF COEFFICIENT 0.54
PEAK DISCHARGE 2.5 CFS

Q100 to IMA 4-1

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 6 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 12 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 18 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 30 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 42 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 54 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 78 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 90 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 102 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 114 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 126 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 138 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 150 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 162 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 174 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 186 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 222 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 234 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 0.8 |
| TIME (MIN) = 246 | DISCHARGE (CFS) = 2.5 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 258 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 270 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 282 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 294 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 306 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 318 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 330 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 342 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 354 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 366 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 6 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.91 ACRES
RUNOFF COEFFICIENT 0.49
PEAK DISCHARGE 3.1 CFS

Q₁₀₀ to IMP 4-2

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 6 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 12 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 18 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 30 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 42 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 54 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 78 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 90 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 102 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 114 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 126 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 138 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 150 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 162 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 174 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 186 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 222 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 234 | DISCHARGE (CFS) = 0.6 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 0.9 |
| TIME (MIN) = 246 | DISCHARGE (CFS) = 3.1 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 258 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 270 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 282 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 294 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 306 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 318 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 330 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 342 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 354 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 366 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 6 MIN.
6 HOUR RAINFALL 3 INCHES
BASIN AREA 0.8 ACRES
RUNOFF COEFFICIENT 0.51
PEAK DISCHARGE 2.8 CFS

Q₁₀₀ to 4-3

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 6 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 12 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 18 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 30 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 42 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 54 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 78 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 90 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 102 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 114 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 126 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 138 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 150 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 162 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 174 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 186 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 222 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 234 | DISCHARGE (CFS) = 0.6 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 0.9 |
| TIME (MIN) = 246 | DISCHARGE (CFS) = 2.8 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 258 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 270 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 282 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 294 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 306 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 318 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 324 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 330 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 336 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 342 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 354 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 366 | DISCHARGE (CFS) = 0 |

RUN DATE 8/16/2014
 HYDROGRAPH FILE NAME Text1
 TIME OF CONCENTRATION 6 MIN.
 6 HOUR RAINFALL 3 INCHES
 BASIN AREA 0.41 ACRES
 RUNOFF COEFFICIENT 0.9
 PEAK DISCHARGE 2.6 CFS

Q₁₀₀ to IMP 4-4

| | |
|------------------|-----------------------|
| TIME (MIN) = 0 | DISCHARGE (CFS) = 0 |
| TIME (MIN) = 6 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 12 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 18 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 24 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 30 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 36 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 42 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 48 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 54 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 60 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 66 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 72 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 78 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 84 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 90 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 96 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 102 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 108 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 114 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 120 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 126 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 132 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 138 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 144 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 150 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 156 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 162 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 168 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 174 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 180 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 186 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 192 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 198 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 204 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 210 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 216 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 222 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 228 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 234 | DISCHARGE (CFS) = 0.5 |
| TIME (MIN) = 240 | DISCHARGE (CFS) = 0.7 |
| TIME (MIN) = 246 | DISCHARGE (CFS) = 2.6 |
| TIME (MIN) = 252 | DISCHARGE (CFS) = 0.4 |
| TIME (MIN) = 258 | DISCHARGE (CFS) = 0.3 |
| TIME (MIN) = 264 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 270 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 276 | DISCHARGE (CFS) = 0.2 |
| TIME (MIN) = 282 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 288 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 294 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 300 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 306 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 312 | DISCHARGE (CFS) = 0.1 |
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| TIME (MIN) = 336 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 342 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 348 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 354 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 360 | DISCHARGE (CFS) = 0.1 |
| TIME (MIN) = 366 | DISCHARGE (CFS) = 0 |

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

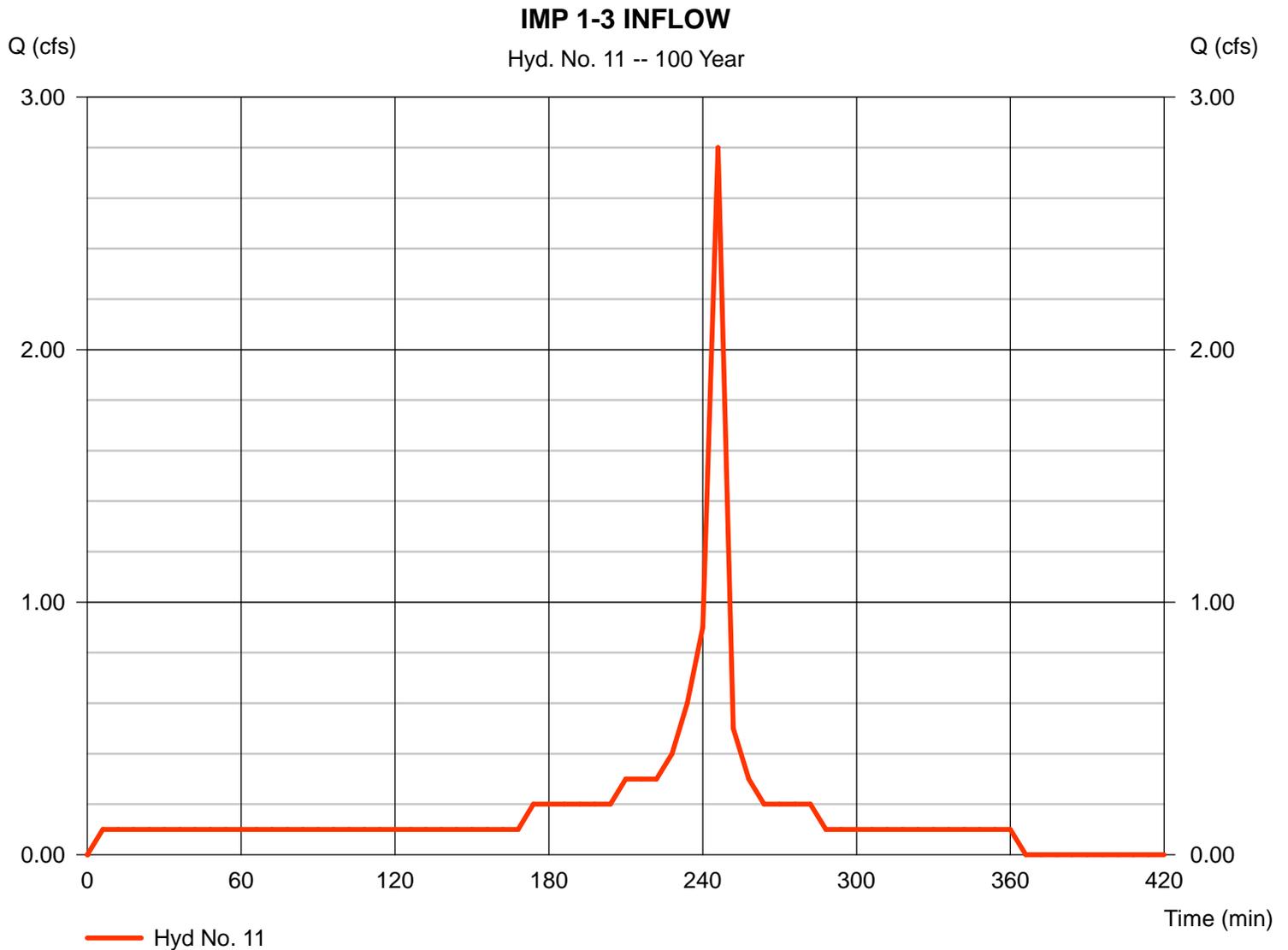
Thursday, Sep 25, 2014

Hyd. No. 11

IMP 1-3 INFLOW

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 6 min

Peak discharge = 2.800 cfs
Time to peak = 246 min
Hyd. volume = 4,500 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Thursday, Sep 25, 2014

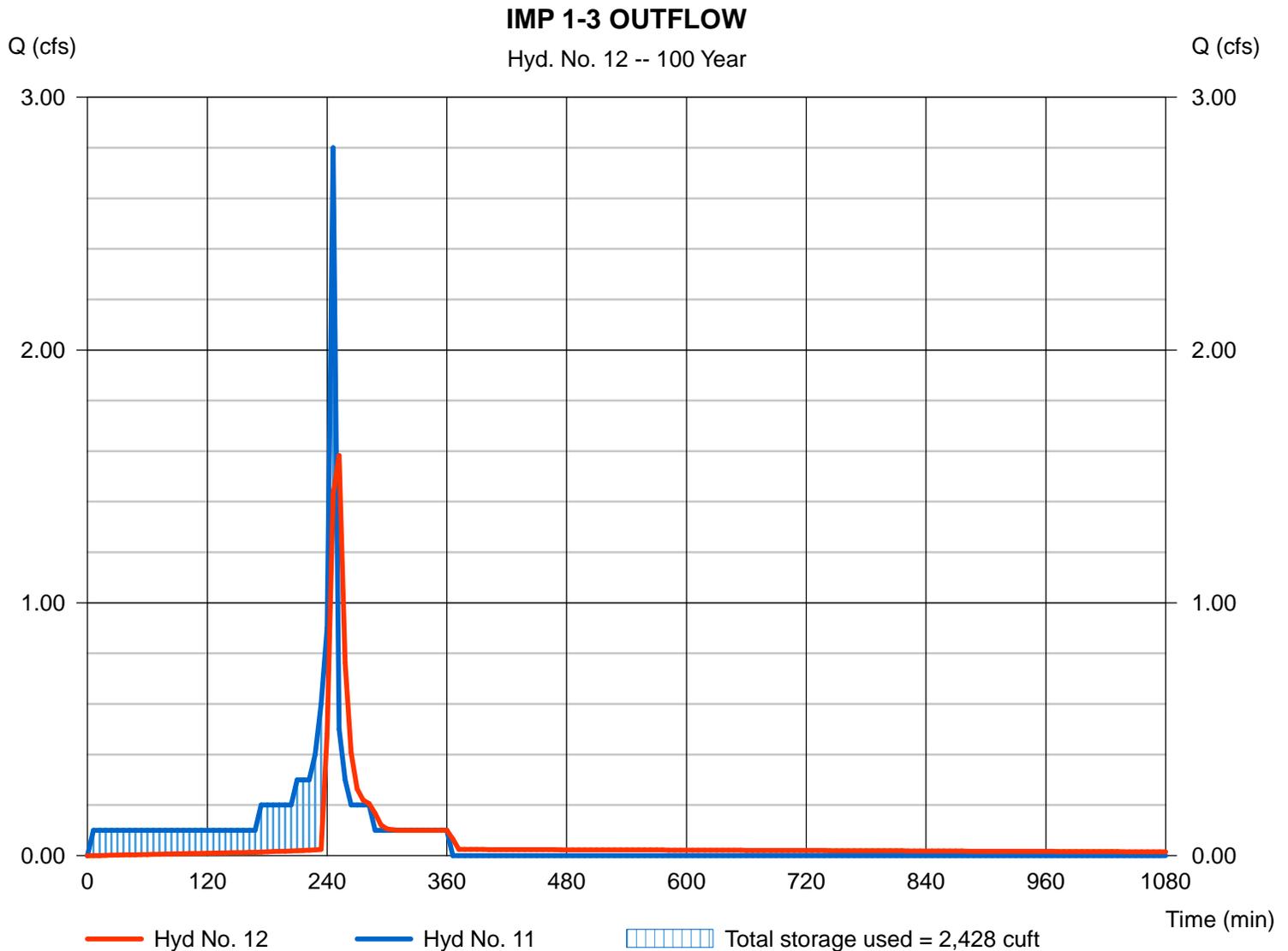
Hyd. No. 12

IMP 1-3 OUTFLOW

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyd. No. = 11 - IMP 1-3 INFLOW
Reservoir name = IMP 1-3

Peak discharge = 1.583 cfs
Time to peak = 252 min
Hyd. volume = 4,430 cuft
Max. Elevation = 104.53 ft
Max. Storage = 2,428 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

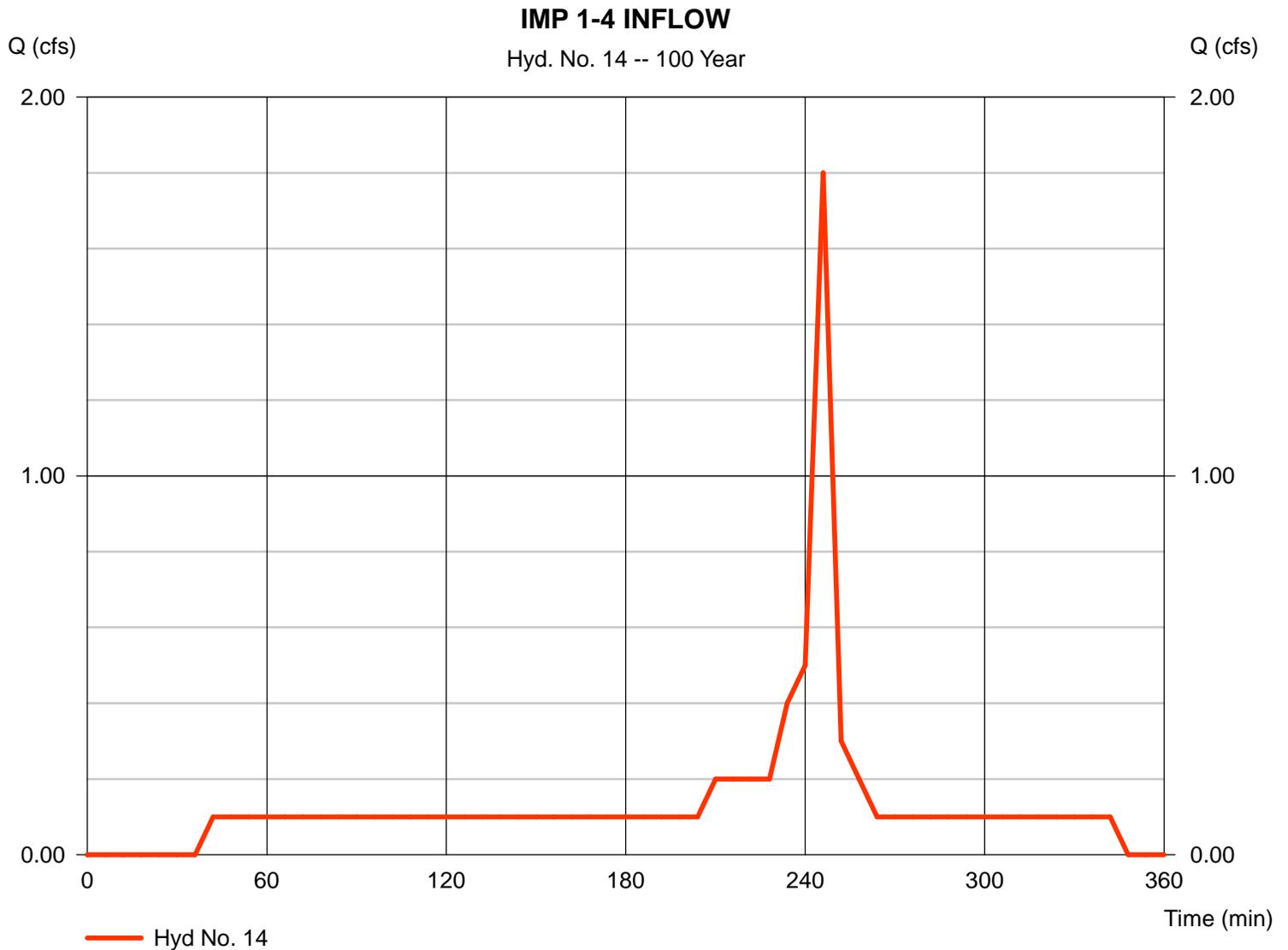
Thursday, Sep 25, 2014

Hyd. No. 14

IMP 1-4 INFLOW

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 6 min

Peak discharge = 1.800 cfs
Time to peak = 246 min
Hyd. volume = 2,952 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Thursday, Sep 25, 2014

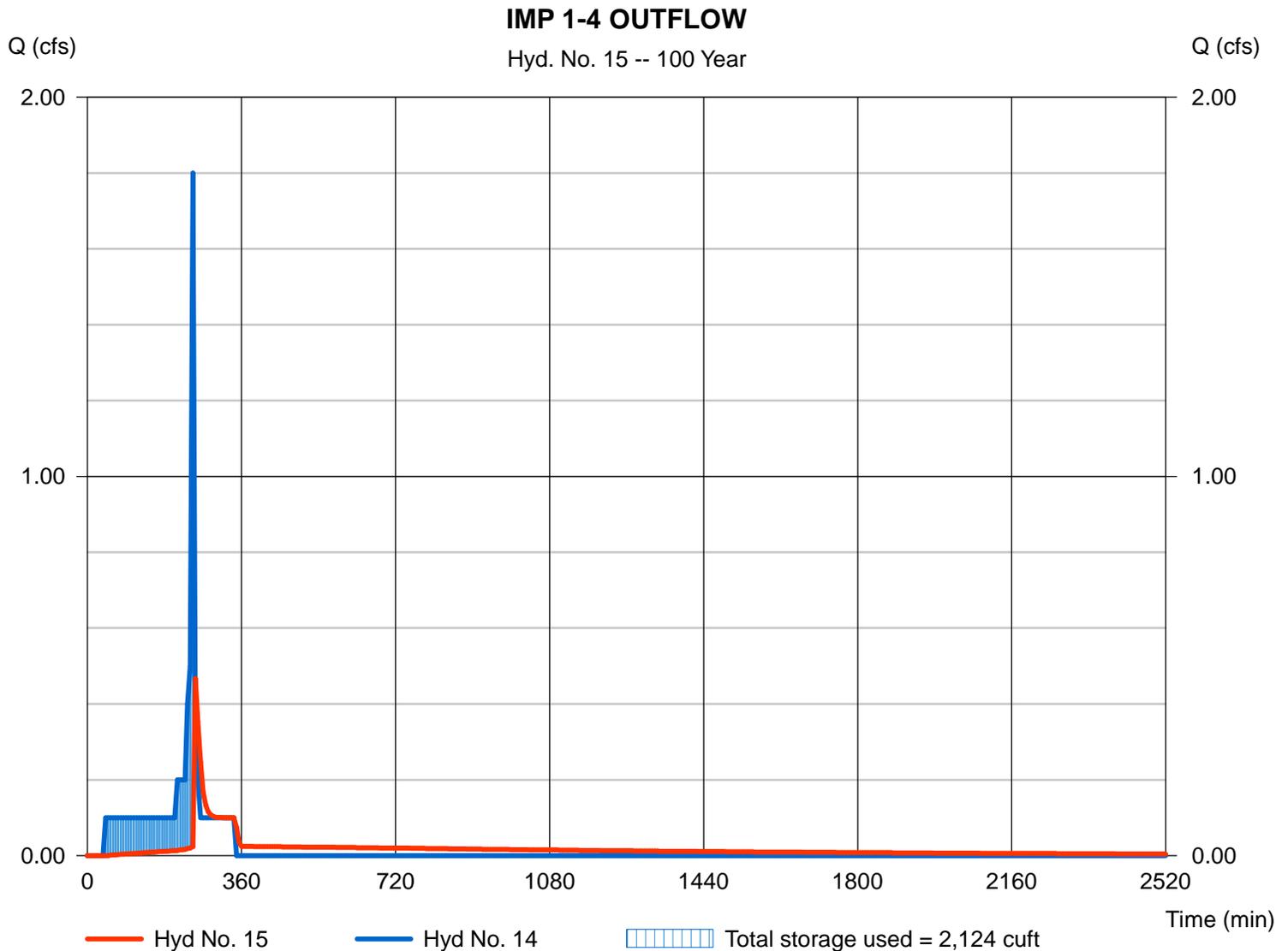
Hyd. No. 15

IMP 1-4 OUTFLOW

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyd. No. = 14 - IMP 1-4 INFLOW
Reservoir name = IMP 1-4

Peak discharge = 0.467 cfs
Time to peak = 252 min
Hyd. volume = 2,882 cuft
Max. Elevation = 104.25 ft
Max. Storage = 2,124 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

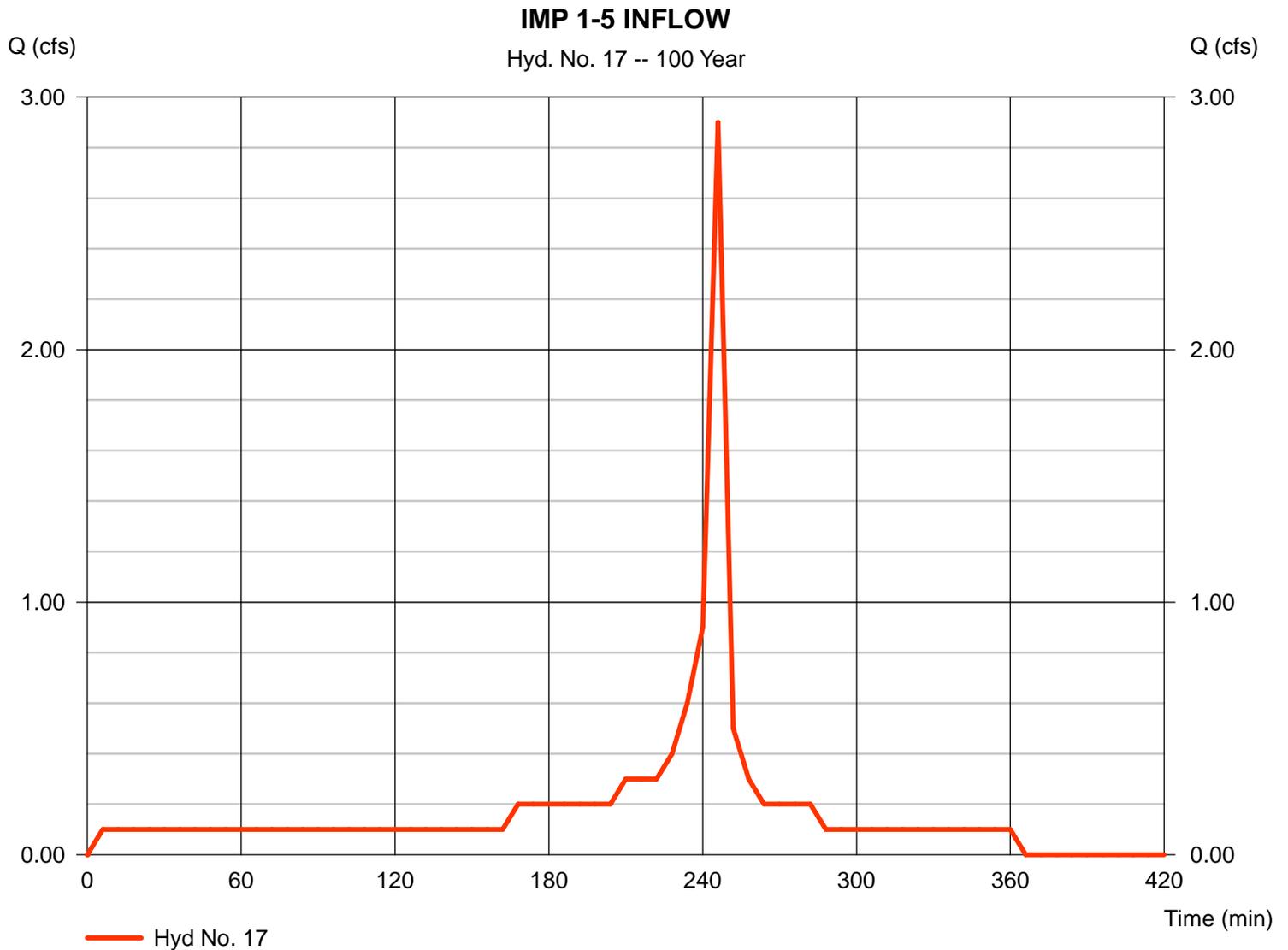
Thursday, Sep 25, 2014

Hyd. No. 17

IMP 1-5 INFLOW

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 6 min

Peak discharge = 2.900 cfs
Time to peak = 246 min
Hyd. volume = 4,572 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Thursday, Sep 25, 2014

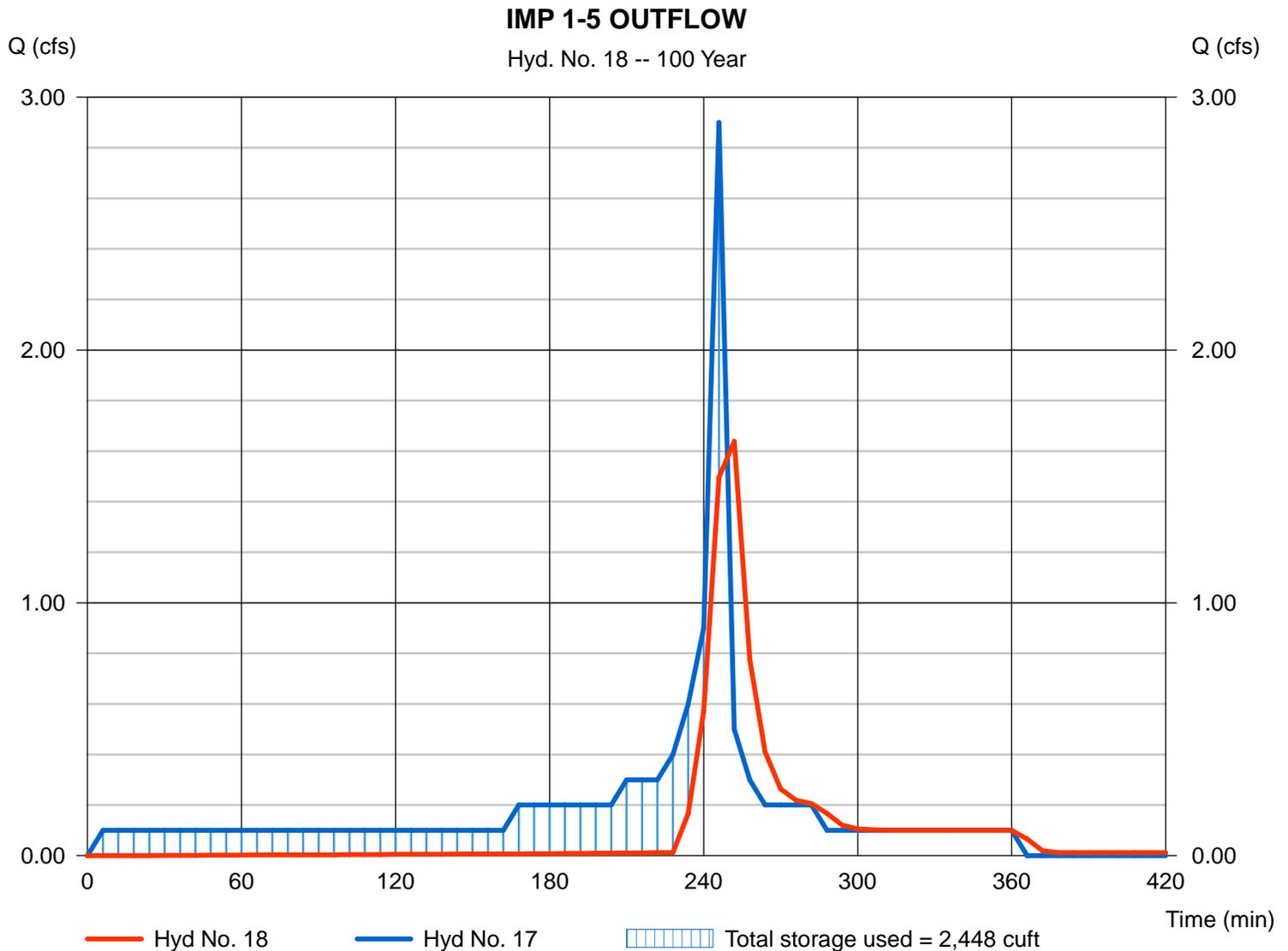
Hyd. No. 18

IMP 1-5 OUTFLOW

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyd. No. = 17 - IMP 1-5 INFLOW
Reservoir name = IMP 1-5

Peak discharge = 1.638 cfs
Time to peak = 252 min
Hyd. volume = 4,433 cuft
Max. Elevation = 104.55 ft
Max. Storage = 2,448 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

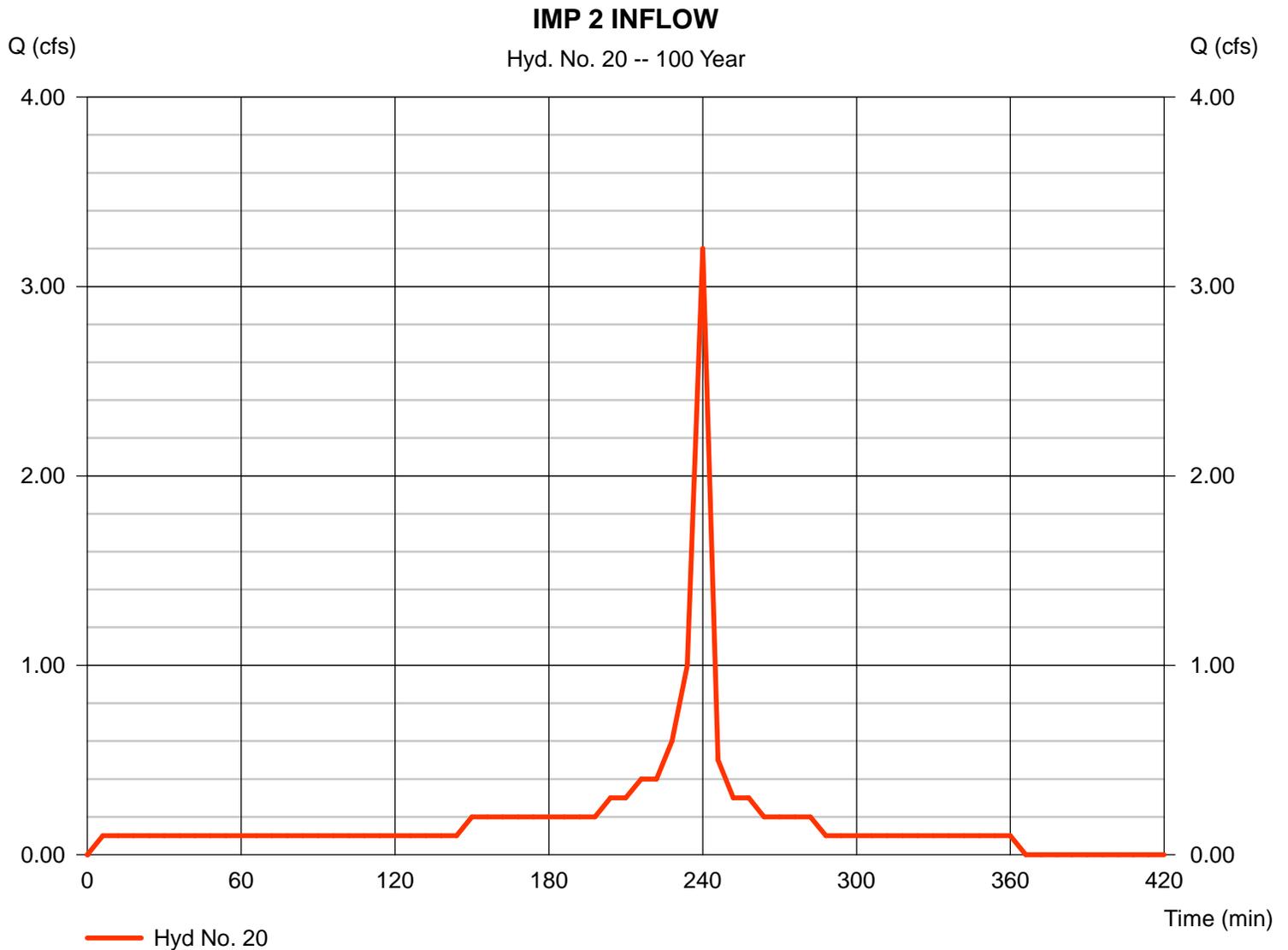
Thursday, Sep 25, 2014

Hyd. No. 20

IMP 2 INFLOW

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 6 min

Peak discharge = 3.200 cfs
Time to peak = 240 min
Hyd. volume = 4,896 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Thursday, Sep 25, 2014

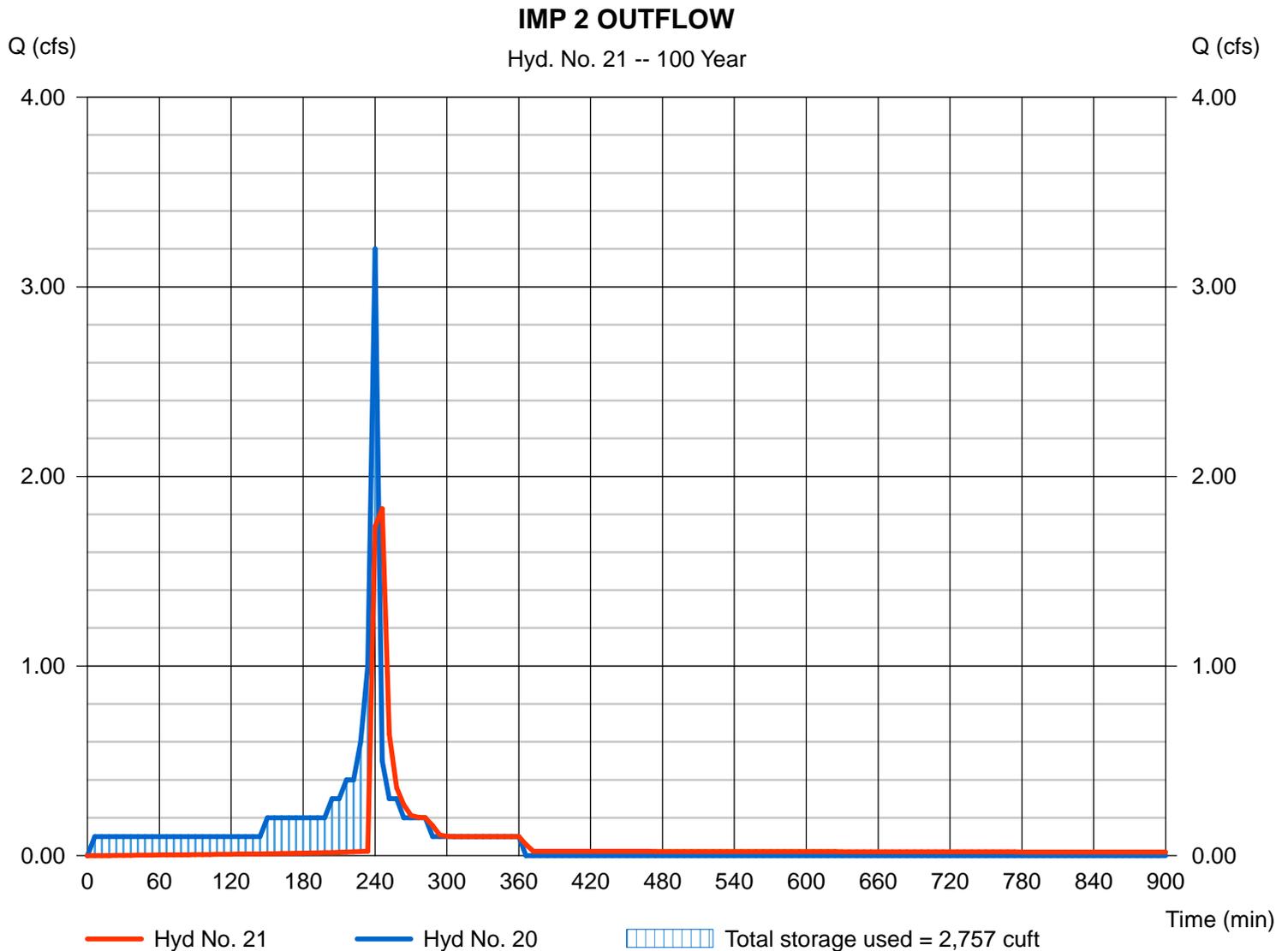
Hyd. No. 21

IMP 2 OUTFLOW

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyd. No. = 20 - IMP 2 INFLOW
Reservoir name = IMP 2

Peak discharge = 1.831 cfs
Time to peak = 246 min
Hyd. volume = 4,806 cuft
Max. Elevation = 105.46 ft
Max. Storage = 2,757 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

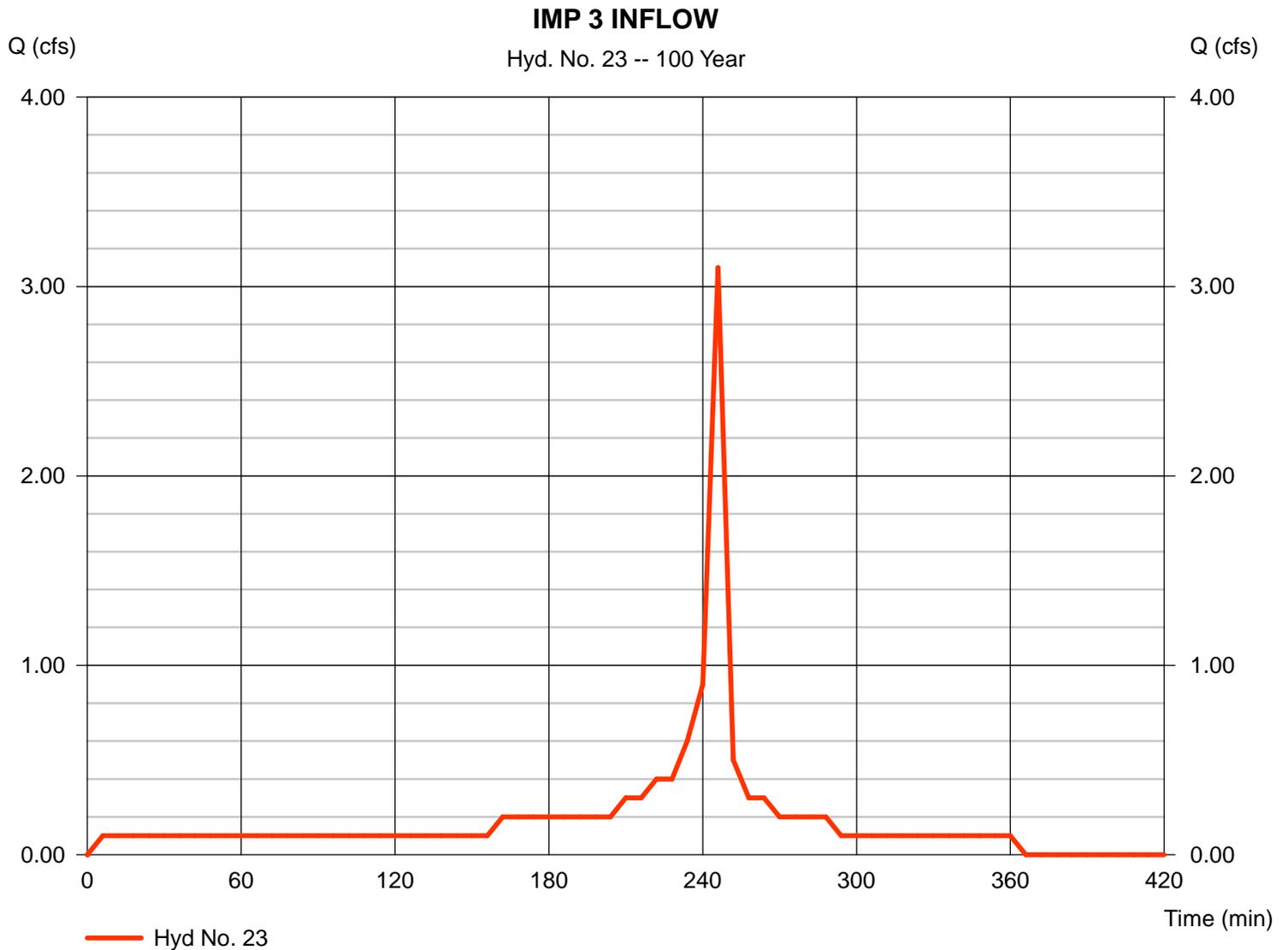
Thursday, Sep 25, 2014

Hyd. No. 23

IMP 3 INFLOW

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 6 min

Peak discharge = 3.100 cfs
Time to peak = 246 min
Hyd. volume = 4,788 cuft



Hydrograph Report

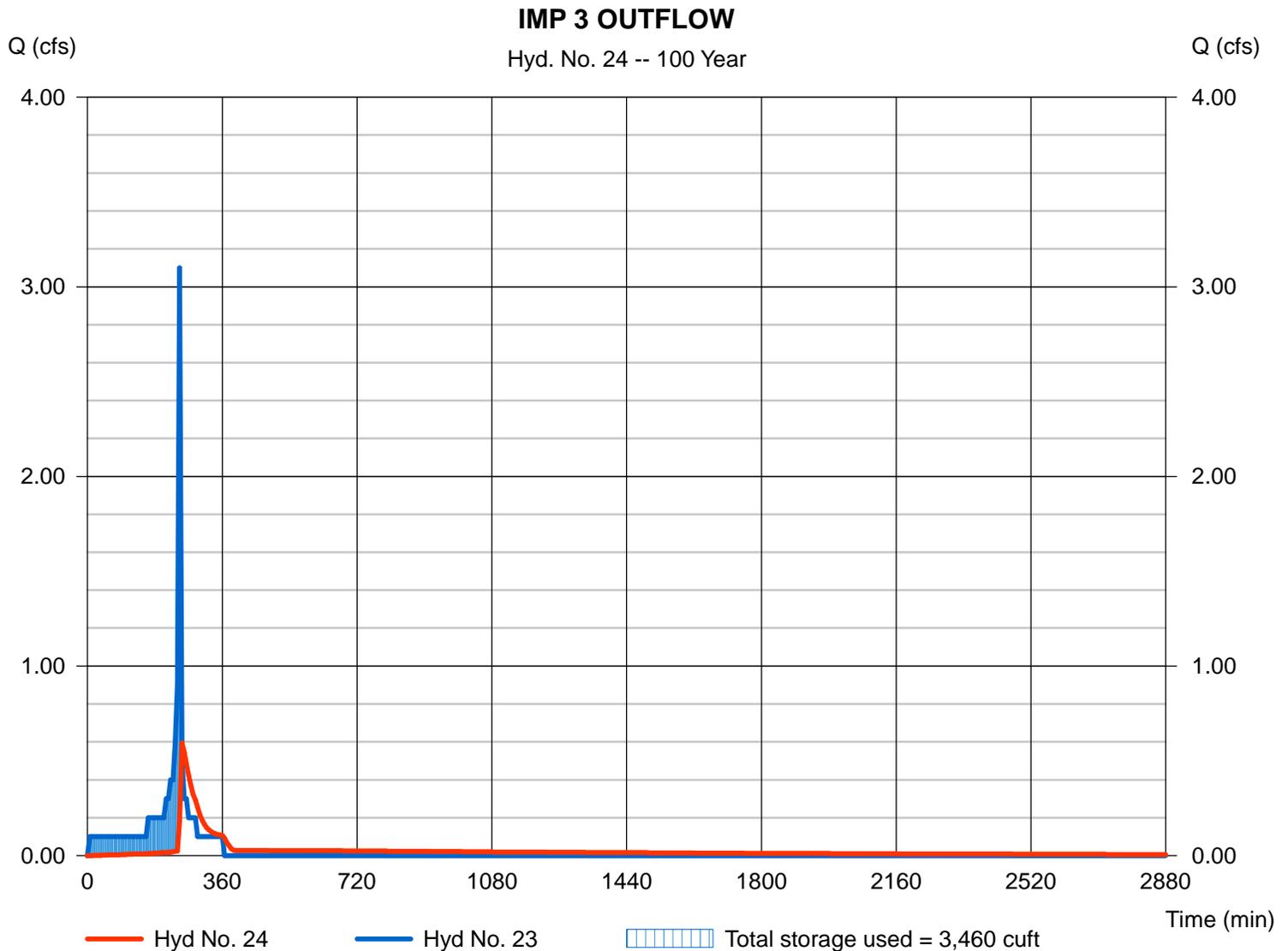
Hyd. No. 24

IMP 3 OUTFLOW

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyd. No. = 23 - IMP 3 INFLOW
Reservoir name = IMP 3

Peak discharge = 0.595 cfs
Time to peak = 252 min
Hyd. volume = 4,699 cuft
Max. Elevation = 105.60 ft
Max. Storage = 3,460 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

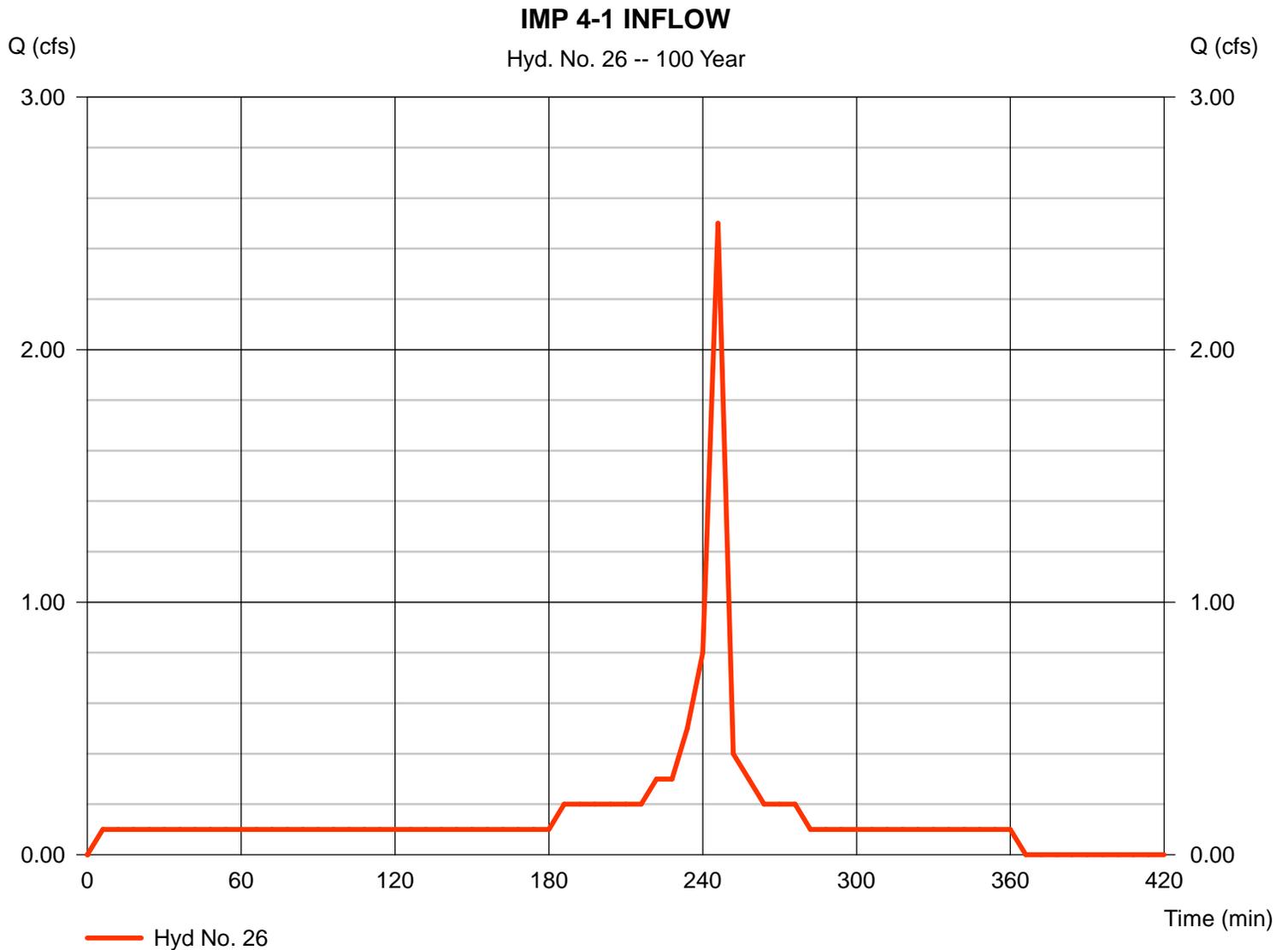
Thursday, Sep 25, 2014

Hyd. No. 26

IMP 4-1 INFLOW

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 6 min

Peak discharge = 2.500 cfs
Time to peak = 246 min
Hyd. volume = 4,068 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Thursday, Sep 25, 2014

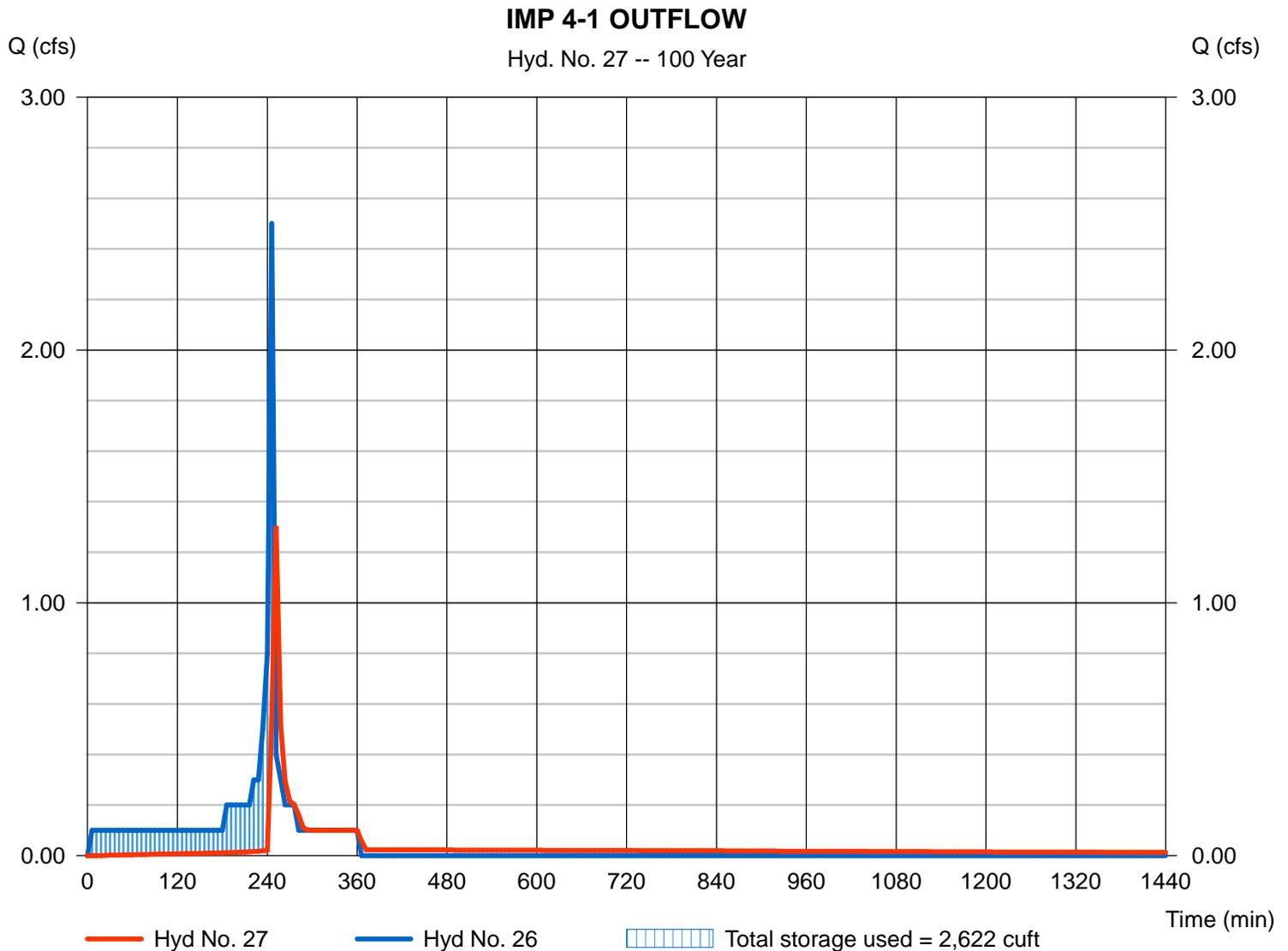
Hyd. No. 27

IMP 4-1 OUTFLOW

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyd. No. = 26 - IMP 4-1 INFLOW
Reservoir name = IMP 4-1

Peak discharge = 1.297 cfs
Time to peak = 252 min
Hyd. volume = 3,978 cuft
Max. Elevation = 105.48 ft
Max. Storage = 2,622 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

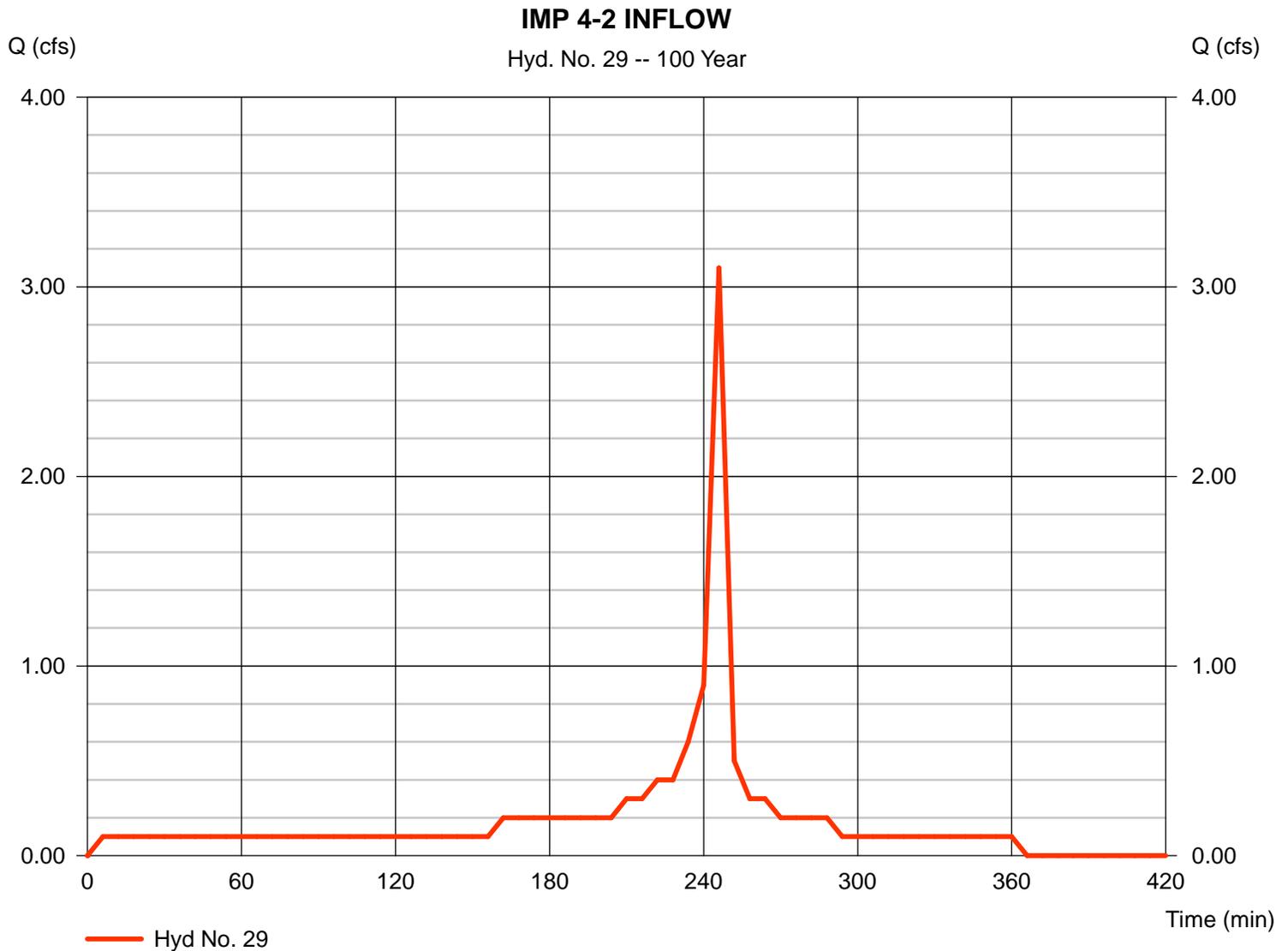
Thursday, Sep 25, 2014

Hyd. No. 29

IMP 4-2 INFLOW

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 6 min

Peak discharge = 3.100 cfs
Time to peak = 246 min
Hyd. volume = 4,788 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Thursday, Sep 25, 2014

Hyd. No. 30

IMP 4-2 OUTFLOW

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyd. No. = 29 - IMP 4-2 INFLOW
Reservoir name = IMP 4-2

Peak discharge = 1.781 cfs
Time to peak = 252 min
Hyd. volume = 4,610 cuft
Max. Elevation = 105.44 ft
Max. Storage = 2,745 cuft

Storage Indication method used.

