

STORMWATER REPORT

for

Townsend Capital, LLC

Summit Orchard
Lee's Summit, MO

April, 2016

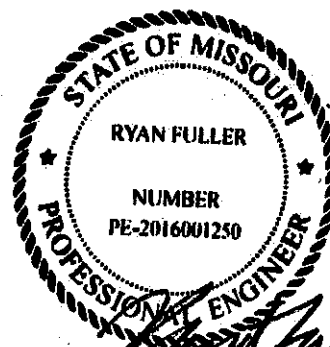
I hereby certify this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Missouri.

Date: 4/4/2016

Ryan Fuller, P.E.

License No. PE-2016001250

My renewal date is December 31, 2016



-2016-039-

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Planning & Codes Admin



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Introduction

This report details the preliminary design of the storm sewer system supporting the Summit Orchard Preliminary Development Plan (PDP), a mixed-use development, at the Summit Technology Campus (STC) located in Lee's Summit, Missouri. See Figure 1 for a site location map

Project Description

The Summit Technology Campus is located southeast of the Interstate-470/State Highway 50 interchange. The entire development covers approximately 367 acres, and is bordered to the south by Chipman Road, to the north by I-470, to the west by Blue Parkway, and to the east by the Union Pacific Railroad. The Summit Technology Campus is split by Ward Road which was opened to traffic in October 2008.

Townsend Capital, LLC proposes improvements to the existing Summit Technology Campus, including the addition of a variety of mixed business commercial and residential uses to the lot northeast of the intersection of Ward Road and Chipman Road. In this report, the site for these improvements is referred to as Lot 7A. The current proposed building and lot layout for Summit Orchard can be found in the PDP.

Existing Drainage Overview

The majority of Lot 7A has been disturbed during borrow activities for the development of the Summit Innovation Center directly North of Lot 7A. A portion of Lot 7A sheet flows stormwater to the storm sewers installed along Ward Rd. This water flows south where it discharges into a ditch along the southern portion of Lot 7A. This water channel flows east to a natural drainage way west of the Union Pacific Railroad. This water flows to the regional detention basin constructed in 2008. Additional information on the regional detention basin can be found in the stormwater master plan prepared for the Summit Technology Campus in 2007.

The remainder of the site sheet flows stormwater east across the site to the natural drainage way west of the Union Pacific Railroad. Stormwater is then routed North to the regional detention basin.

A Stormwater Master Plan and model was prepared for the entire Summit Technology Campus development in 2007 and approved by the City. The Master Plan established a regional detention facility on Tract C at the northeast corner of the development. The improvements were constructed in 2008 and the facility has been in operation since that time.

Proposed Improvements

This project develops Lot 7A from an existing pasture to a mixed use commercial and residential development called Summit Orchard. The 2007 study assumed

this portion of the site would be developed with up to 71% impervious area. The proposed development limits the impervious area to 63%. Therefore, the proposed development is within the parameters of the original study and we do not propose a revision to the hydraulic study for the regional detention basin.

While onsite detention is not necessary based on the 2007 study, we are proposing a detention basin along the Eastern property line west of the Union Pacific Railroad. This will be a shallow basin with a large footprint to minimize the ponding depth. Multiple outlets and overflows will be provided to reduce runoff rates from Summit Orchards.

Within the site we will install storm sewers to convey stormwater west towards Ward Rd and East toward the existing drainage way west of the Union Pacific Railroad. The layout and drainage areas are depicted on the stormwater masterplan drawing. The peak flows generated by this site are:

Storm Return Period	Pre-Development Q (cfs)	Post Development Q (cfs) West to Ward Rd	Post Development Q (cfs) East to Drainage way along Railroad
1 Year	40.5	13.1	92.6
10 Year	115.1	27.7	197.7
100 Year	198.2	42.5	305.5

Hydrographs for the storms listed above were generated using Hydraflow Hydrograph Extension to AutoCAD Civil 3D 2015 and are included in the appendix at the end of this report.

Results of Analysis

The preliminary layout of the system and system sizing is depicted on the Stormwater masterplan drawing included in the PDP.

Appendix

Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2015 Report

1 - Year

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Hydrograph Report

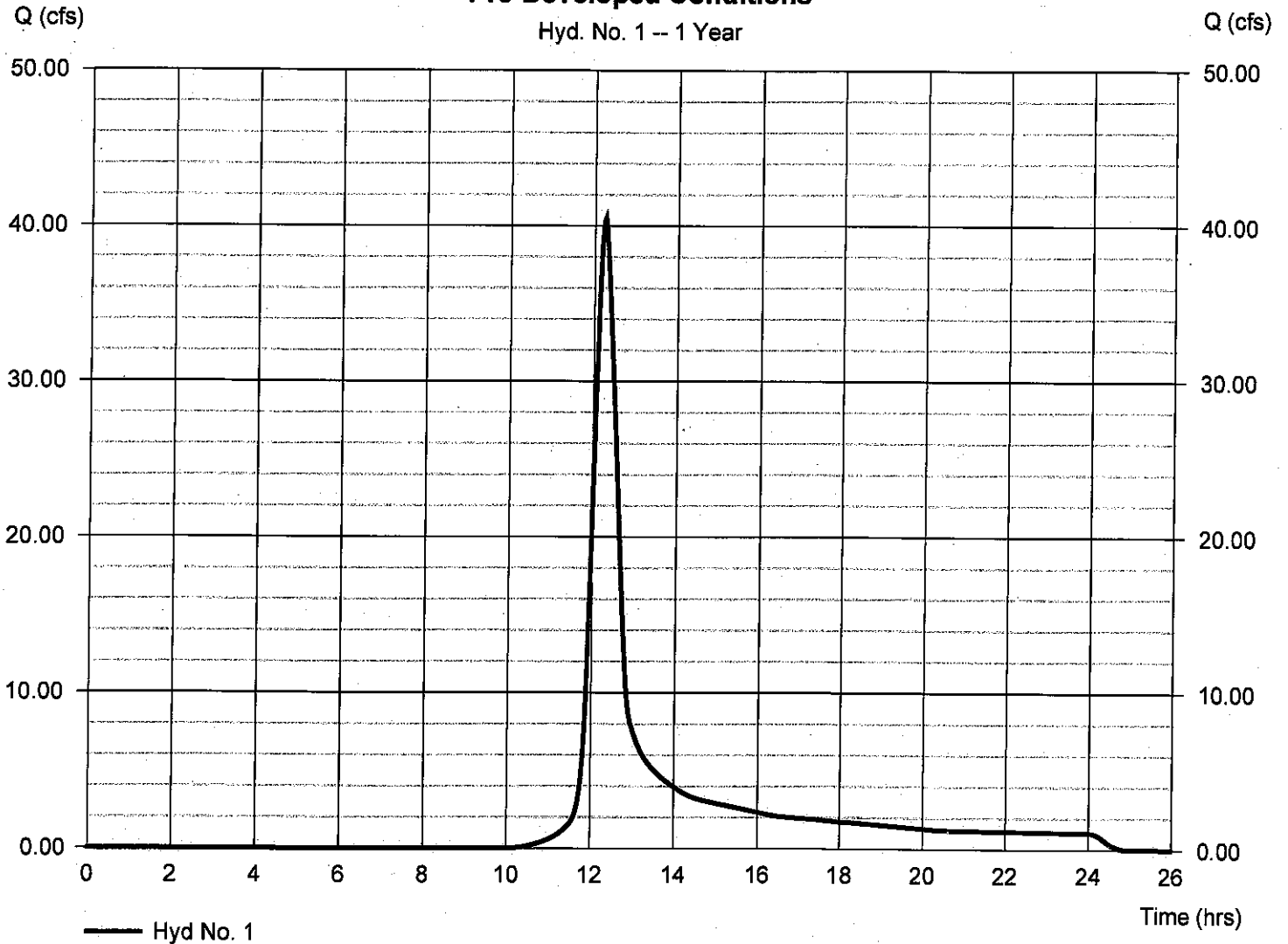
Hyd. No. 1

Pre-Developed Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 40.51 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 188,909 cuft
Drainage area	= 44.780 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.10 min
Total precip.	= 2.90 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Pre-Developed Conditions

Hyd. No. 1 -- 1 Year



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

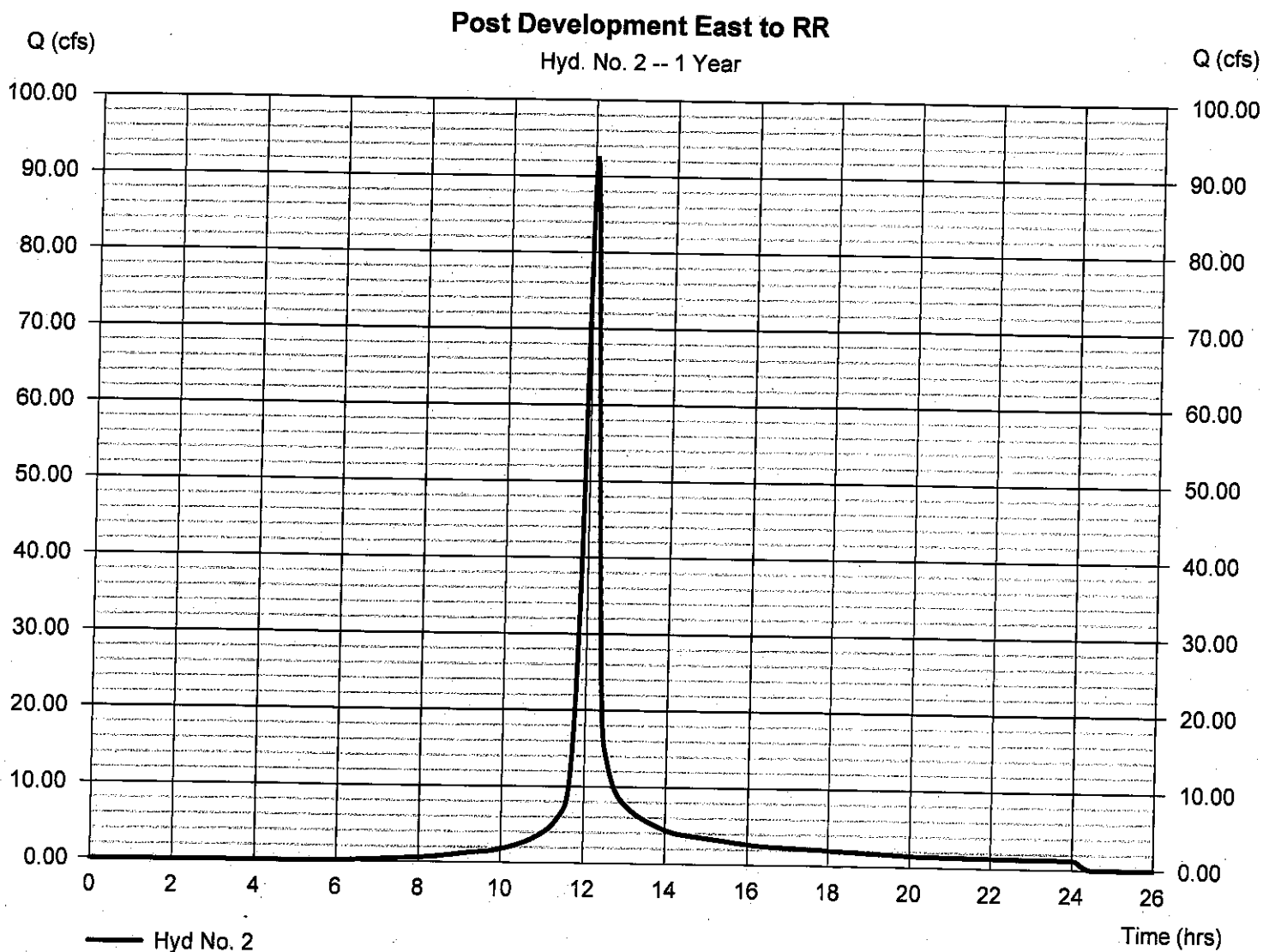
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Hyd. No. 2

Post Development East to RR

Hydrograph type	= SCS Runoff	Peak discharge	= 92.62 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 292,474 cuft
Drainage area	= 40.730 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.60 min
Total precip.	= 2.90 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(25.660 x 98) + (15.070 x 80)] / 40.730



Hydrograph Report

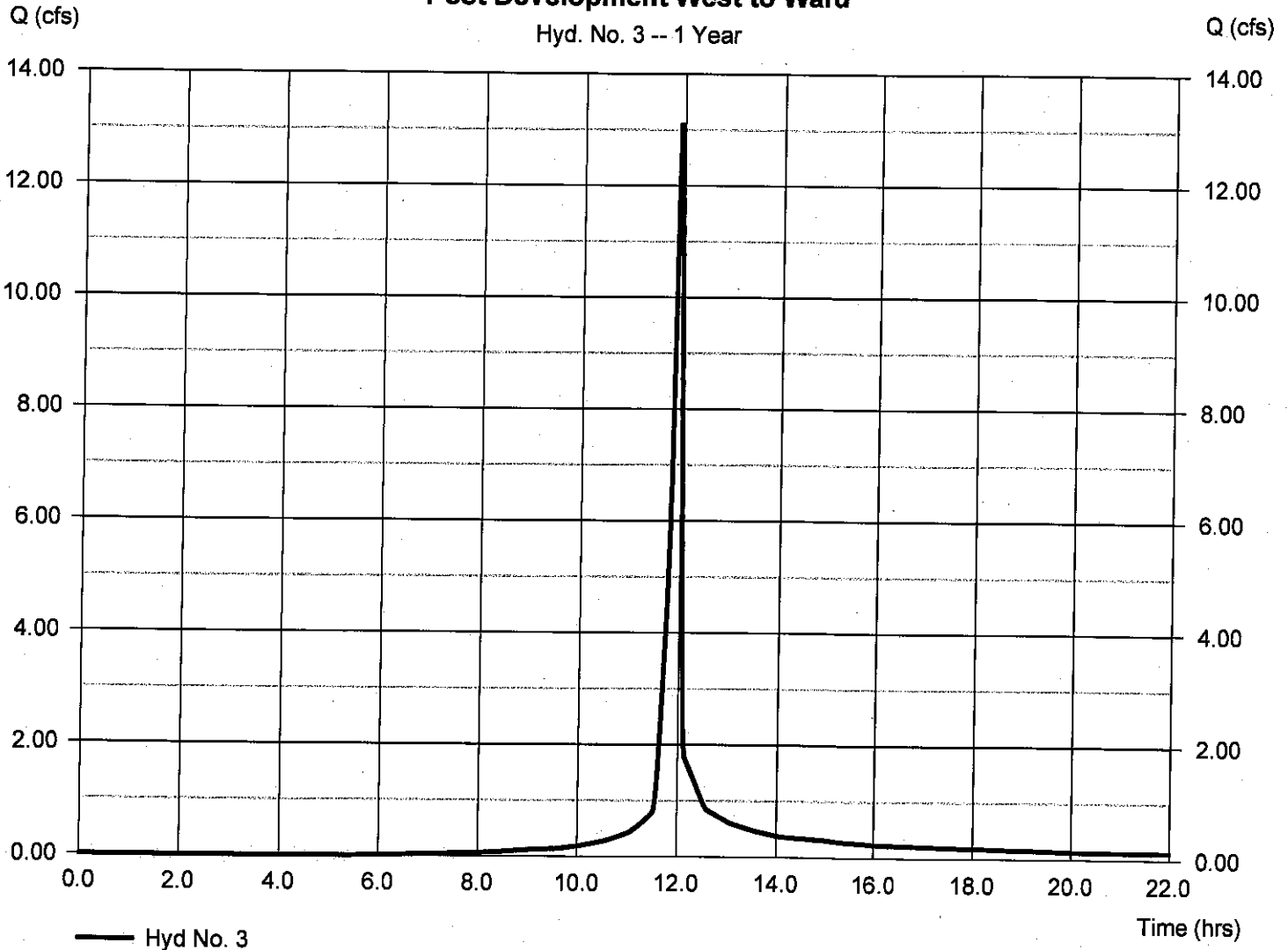
Hyd. No. 3

Post Development West to Ward

Hydrograph type	= SCS Runoff	Peak discharge	= 13.12 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 27,265 cuft
Drainage area	= 4.050 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.90 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(2.550 \times 98) + (1.500 \times 80)] / 4.050$

Post Development West to Ward
Hyd. No. 3 -- 1 Year



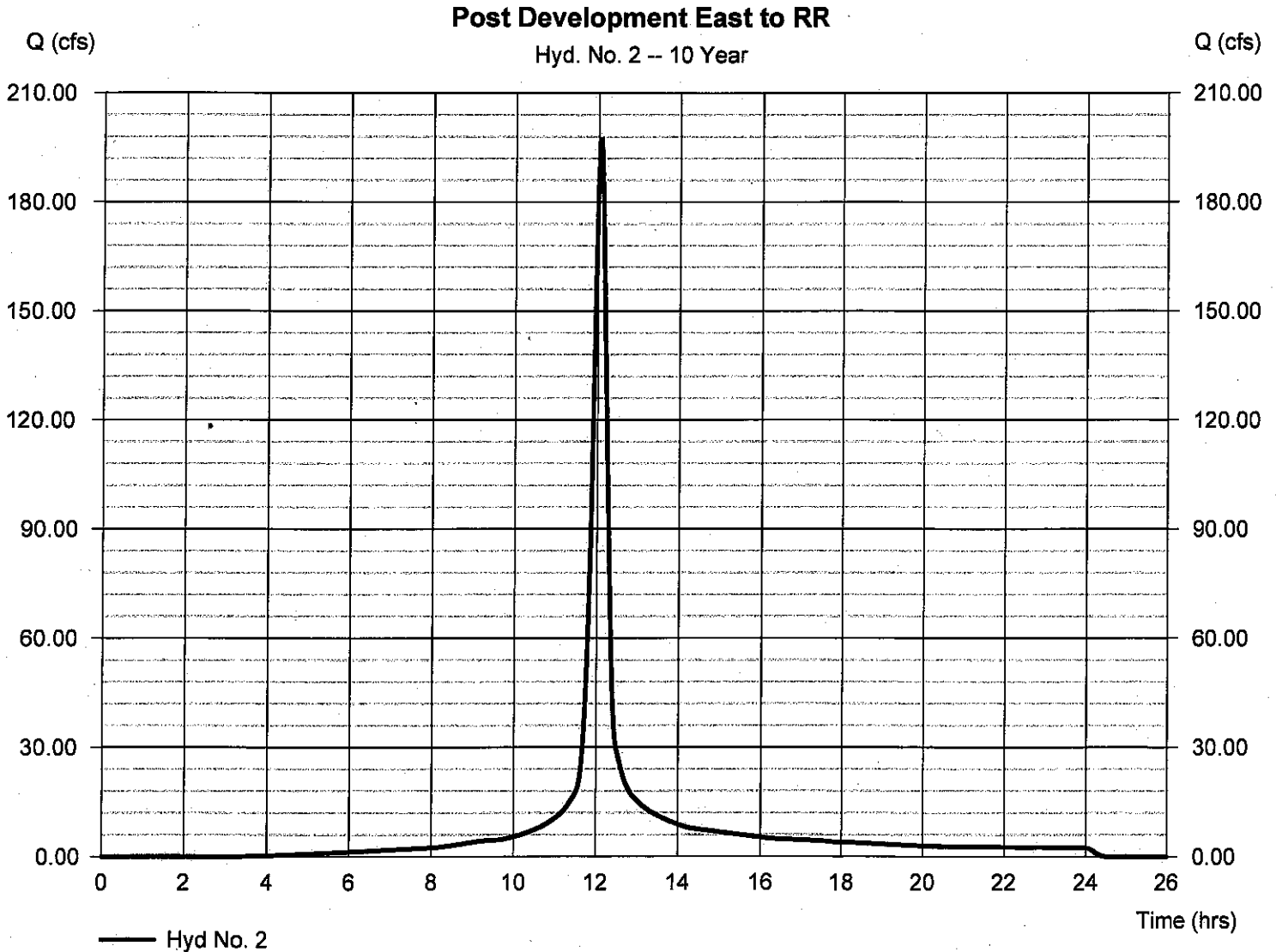
Hydrograph Report

Hyd. No. 2

Post Development East to RR

Hydrograph type	= SCS Runoff	Peak discharge	= 197.74 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 646,278 cuft
Drainage area	= 40.730 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.60 min
Total precip.	= 5.40 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(25.660 \times 98) + (15.070 \times 80)] / 40.730$



Hydrograph Report

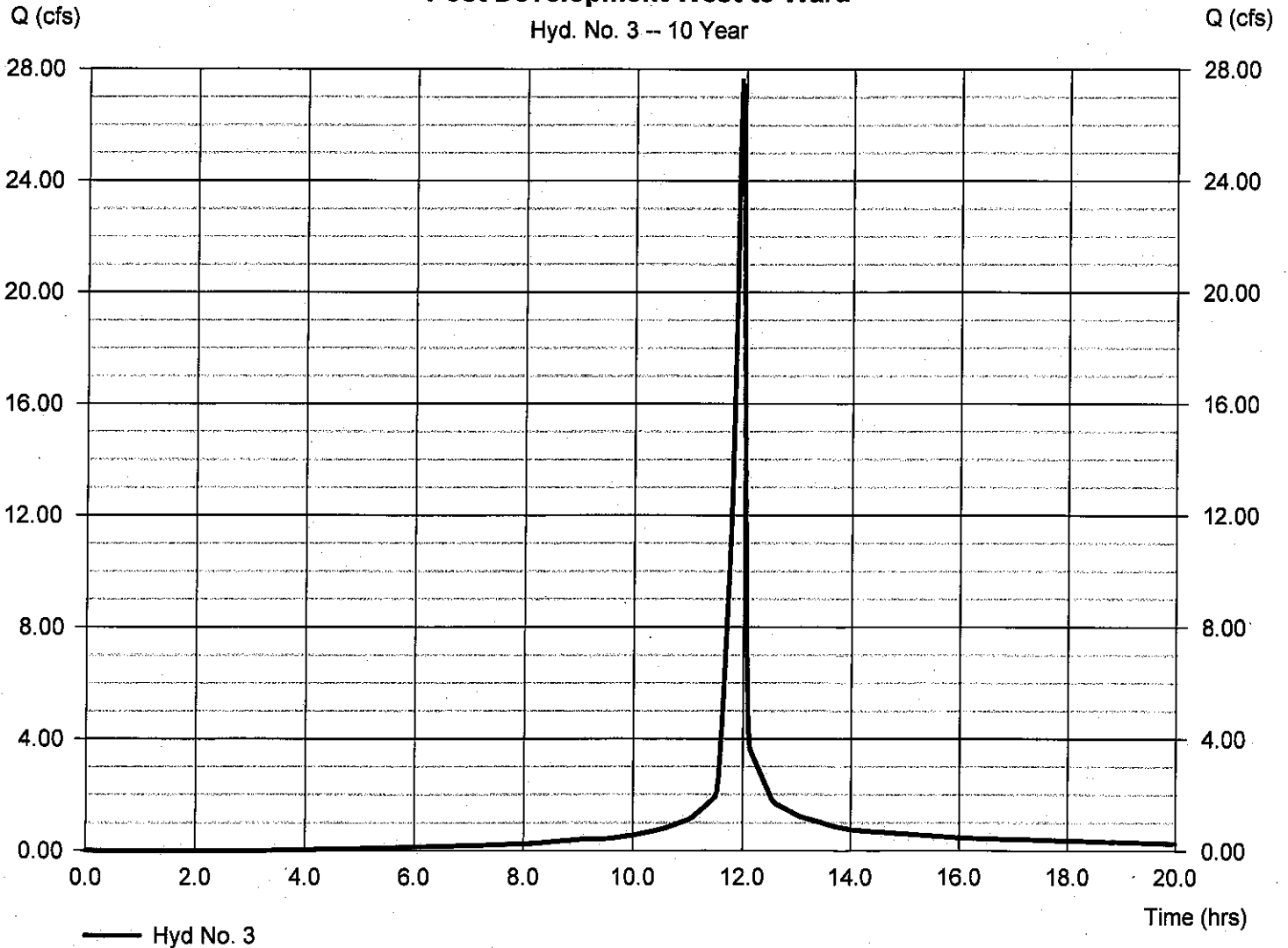
Hyd. No. 3

Post Development West to Ward

Hydrograph type	= SCS Runoff	Peak discharge	= 27.66 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 60,246 cuft
Drainage area	= 4.050 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.40 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.550 x 98) + (1.500 x 80)] / 4.050

Post Development West to Ward
Hyd. No. 3 -- 10 Year



Hydrograph Report

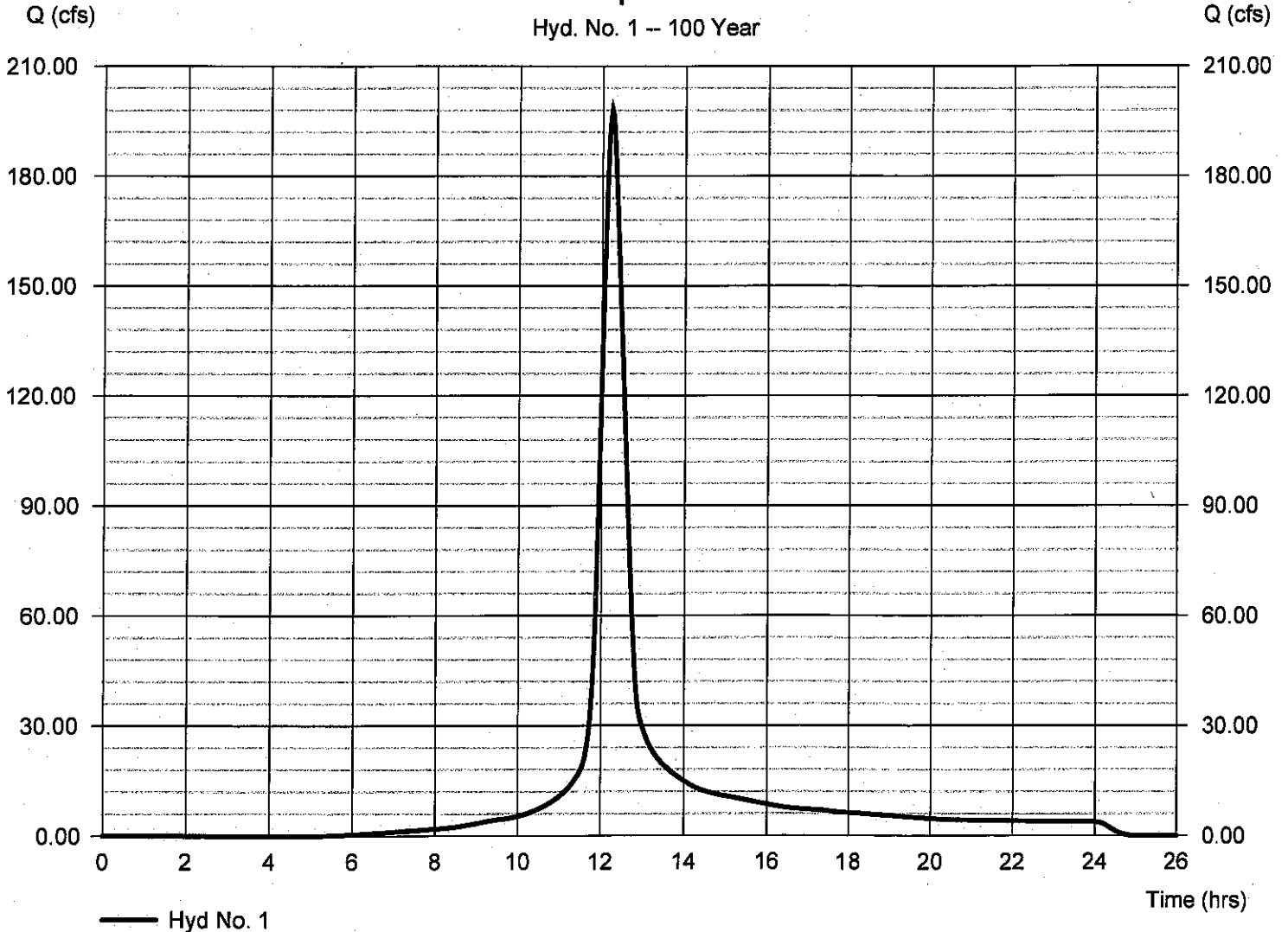
Hyd. No. 1

Pre-Developed Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 198.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 903,962 cuft
Drainage area	= 44.780 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.10 min
Total precip.	= 8.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Pre-Developed Conditions

Hyd. No. 1 -- 100 Year



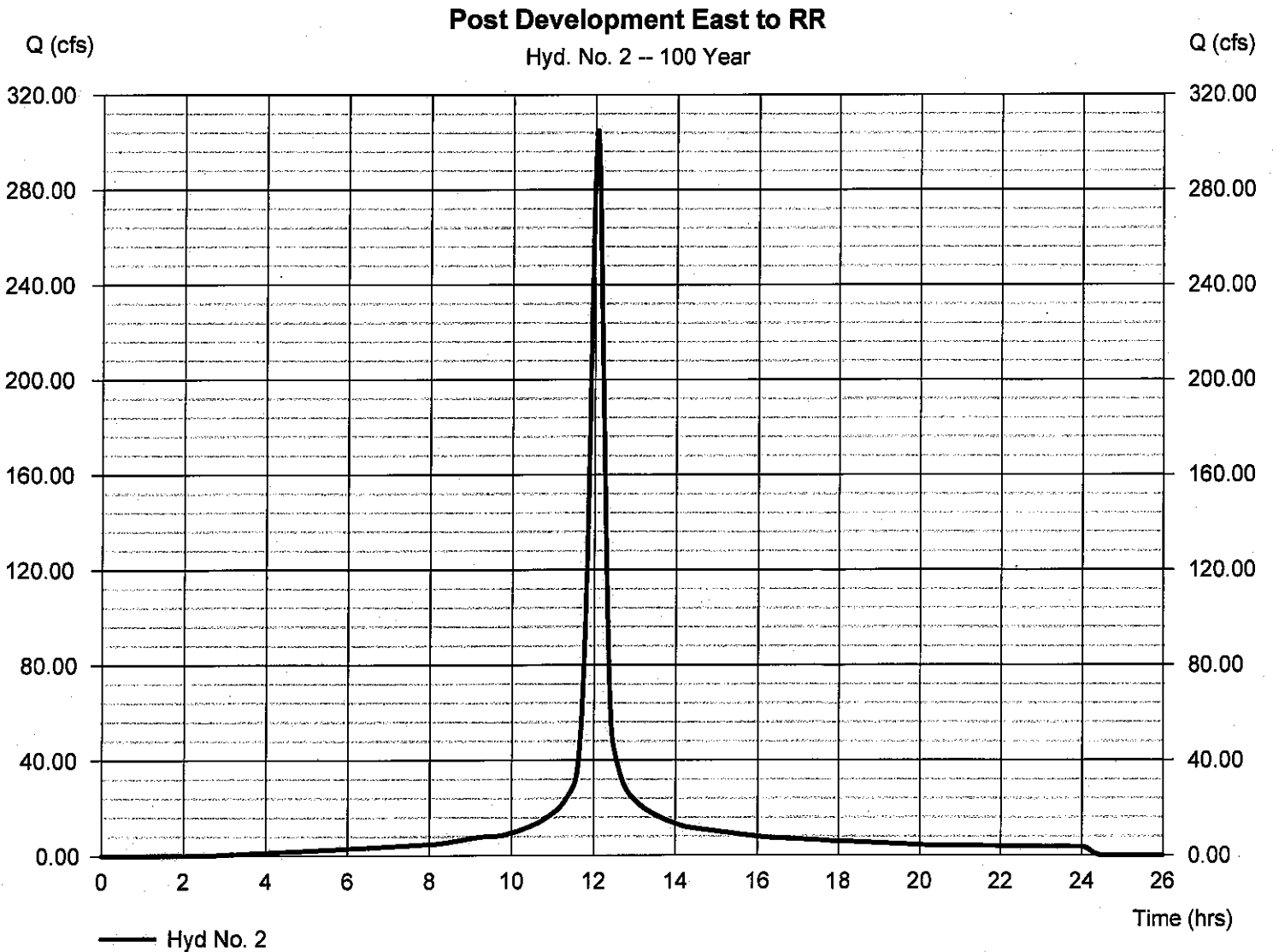
Hydrograph Report

Hyd. No. 2

Post Development East to RR

Hydrograph type	= SCS Runoff	Peak discharge	= 305.49 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 1,023,779 cuft
Drainage area	= 40.730 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.60 min
Total precip.	= 8.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(25.660 x 98) + (15.070 x 80)] / 40.730



Hydrograph Report

Hyd. No. 3

Post Development West to Ward

Hydrograph type	= SCS Runoff	Peak discharge	= 42.53 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 95,437 cuft
Drainage area	= 4.050 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 8.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.550 x 98) + (1.500 x 80)] / 4.050

Post Development West to Ward

Hyd. No. 3 -- 100 Year

