

STORM DRAINAGE ANALYSIS

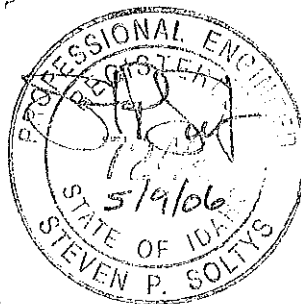
FOR

ALDER CREEK SUBDIVISION

APRIL 2006

PREPARED FOR:
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THIS REPORT HAS BEEN PREPARED BY THE UNDERSIGNED PROFESSIONAL ENGINEER WHOSE SEAL AND SIGNATURE APPEARS HEREON.



PURPOSE

The purpose of this report is to determine the extent of storm drainage facilities that will be required to dispose of stormwater runoff created by the construction of the proposed project.

ANALYSIS METHODOLOGY

The SCS TR-55 method was used to approximate the pre-developed and post-developed flows on the site. The software used was Intellisolve's Hydraflow software and the data files are available upon request.

PROJECT DESCRIPTION

The 22-acre site is currently vacant. It is bounded by commercial and industrial uses along Triangle Drive to the west, Kootenai Cutoff Road to the north, some multifamily residential uses to the east, and the UP Railroad tracks along the southeast line. The topography is relatively flat but generally sloping northwest to southeast. The vicinity is characterized by seasonally high groundwater and relatively impermeable soils. The surface water runoff in the area is trapped behind the fills used to build the railroad and Highway 200 to the east, with only two undersized culverts downstream of the site to release the runoff towards Lake Pend Oreille. According to the Soil Survey for Bonner County, Idaho, the soils on the site are predominantly Odenson Silt Loams, 0 to 2 % slopes, with some Mission Silt Loams, 0 to 2 % slopes in the southern end of the site. The soils are in SCS Hydrologic Soil Group D.

Unlike a typical stormwater design for a development where the impervious area is increased, and the main concern is controlling the runoff rate in the post-developed condition, the challenge on this site was getting the runoff to leave the site and provide enough storage to hold the stormwater while it is slowly released.

CALCULATIONS

The 50-year peak flows for pre-developed and post developed conditions for the project were calculated using the SCS TR-55 method and precipitation information for Ponderay. In the pre-developed condition, there are 3 distinct drainage basins. Basin 1 is made up of approximately the north 3rd of the site and its flows end up in the existing channel that skirts the Vet Clinic and flows under the RR tracks and Highway 200 to the east. Basin 2 is the middle 3rd of the site. Its runoff is currently trapped by the RR grade and sits in two depressions that are delineated as wetlands. Basin 3, made up of the southern 3rd flows south and east into the existing wetland area in the southernmost "point" of the site, where it overflows through an undersized culvert under

the RR tracks and Highway 200 to the east. The pre-developed peak flows and storm volumes for the 50-year event are as follows:

<i>Basin 1</i>	<i>Qp = 3.81 cfs</i>	<i>Vol. = 34,440 cf</i>
<i>Basin 2</i>	<i>Qp = 4.09 cfs</i>	<i>Vol. = 33,410 cf</i>
<i>Basin 3</i>	<i>Qp = 2.89 cfs</i>	<i>Vol. = 23,584 cf</i>

In the post-developed condition, the roadway ditches and channels intercept the majority of the runoff for the northern 2/3rds of the site to the existing channel, making the post-developed Basin 1 approximately twice the area of the pre-developed condition. In order to mitigate the increased basin area and imperviousness, detention storage has been added to the basin. The runoff curve number for Basin 1 was calculated assuming 70% impervious area coverage on Lots 1 through 10, Block 1, 60% coverage on Lots 1 through 3, Block 2, and 75% for the developable portion of Lot 20, Block 1. The actual building footprint and driveway sizes were used for the residential lots in Basin 1.

Basin 2, with the majority of its basin area intercepted, experiences a reduction of stormwater runoff rate and volume in the post developed condition.

As part of this subdivision, Basin 3 is reduced in size, and is otherwise unaffected. The effect of the eventual development of the piece as a multi-family site, with an assumed impervious area coverage of 60% was also modeled. The increase in runoff rate and volume will be handled with a treatment and detention pond which will be designed as part of the site plan for the multi-family site.

The post-developed peak flows and storm volumes for the 50-year event are as follows:

<i>Basin 1</i>	<i>Qp = 14.04 cfs</i>	<i>Vol. = 111,236 cf</i>
<i>Basin 2</i>	<i>Qp = 0.75 cfs</i>	<i>Vol. = 3,797 cf</i>
<i>Basin 3</i>	<i>Qp = 2.43 cfs</i>	<i>Vol. = 19,832 cf</i>

The roadside ditches, with a culver under each driveway, provide detention volume of 10 cubic feet per foot for a project total of approximately 90,000 cubic feet. The grassy channel in Block 2 and the wider grassy channel in Lot 20, Block 1 provide storage volumes of 20 and 40 cubic feet per foot respectively, for a project total of 21,000 cubic feet. The detention pond, located on Lot 3, Block 2, between the two channels has a full stage volume of 18,000 cubic feet. The total storage volume created by the project in Basin 1 is 129,000 cubic feet, which is enough to store the ENTIRE 50-year stormwater volume and is also 67% more than the increase in stormwater volume created by the development of the site (76,796 cf). The detention volume is all hydraulically connected and will slowly release from the site once the storm event has passed and the downstream channel has capacity.

The grass-lined channels and detention pond also provide approximately 10,000 sf of treatment area for the first ½ inch of runoff created from the asphalt pavement on the site. That is enough area to treat the 68,000 sf of pavement on the public roads, as well as an additional 52,000 sf of pavement on the commercial lots in the subdivision. The larger commercial lots at the north end of the site may need to provide additional treatment area on-site if their use creates more parking than anticipated, but the excess treatment volume should be sufficient for the other commercial lots (4-10, Block 1 and 1-3, Block 2).

SUMMARY

The Alder Creek project is being developed in an area already experiencing seasonal stormwater issues. The goal of the stormwater design was to make the situation no worse, and wherever possible, make it better. The project facilities, which are primarily within Basin 1, reduce the stormwater volume which will leave the site. The stormwater in Basin 2 is drastically reduced, and Basin 3 remains essentially unchanged until the development of that site, which will be mitigated at that time with added detention volume.

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description	
1	SCS Runoff	3.81	6	768	34,440	---	----	----	Basin1_PRE	
2	SCS Runoff	4.09	6	762	33,410	---	----	----	Basin2_PRE	
3	SCS Runoff	2.89	6	762	23,584	---	----	----	Basin3_PRE	
4	SCS Runoff	14.04	6	762	111,236	---	----	----	Basin1_Post	
5	SCS Runoff	0.75	6	738	3,797	---	----	----	Basin2_Post	
6	SCS Runoff	2.43	6	762	19,832	---	----	----	Basin3_Post	
7	SCS Runoff	4.11	6	762	32,580	---	----	----	Basin3_Future	
Ponderay.gpw					Return Period: 50 Year		Tuesday, May 9 2006, 9:27 AM			

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, May 9 2006, 9:27 AM

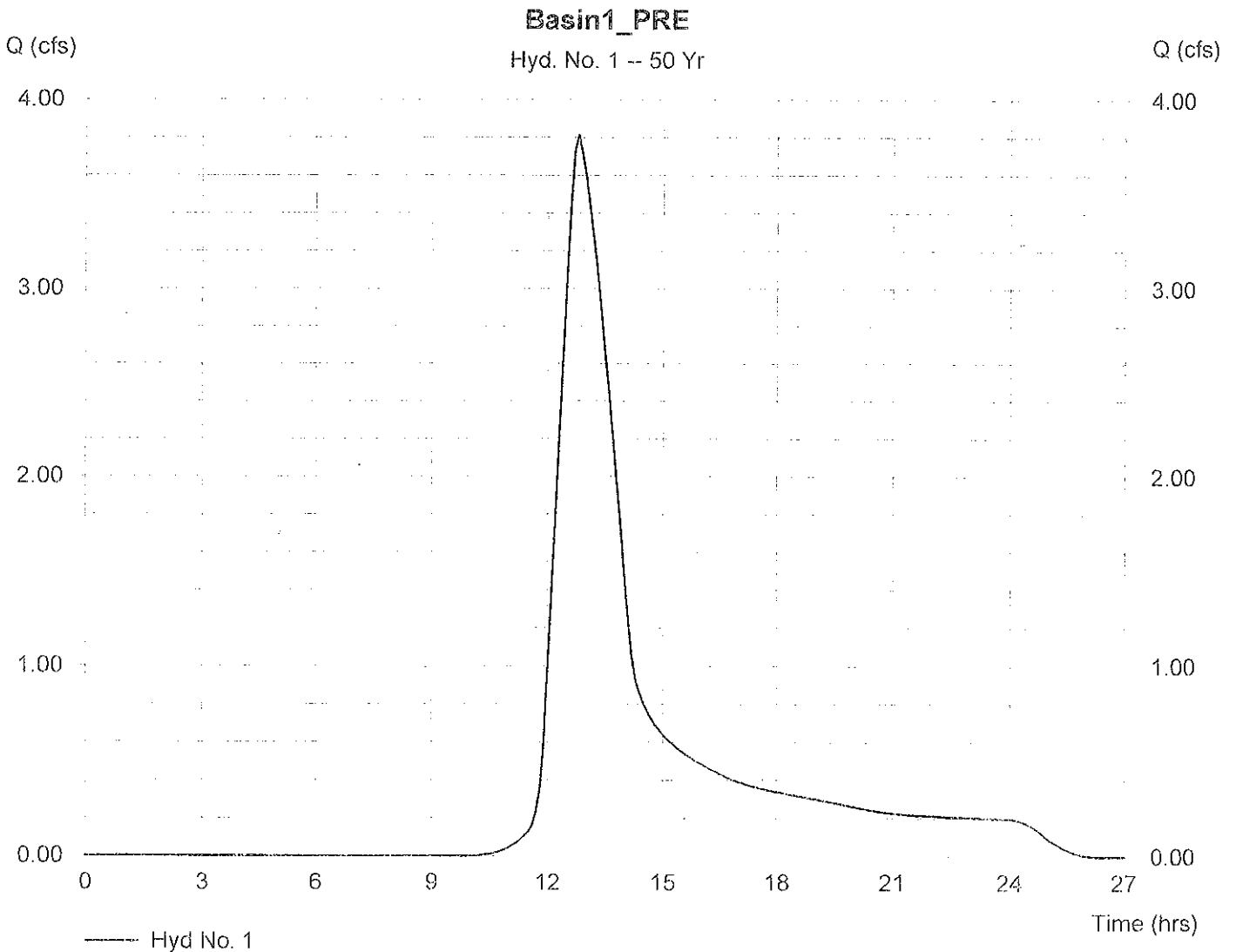
Hyd. No. 1

Basin1_PRE

Hydrograph type = SCS Runoff
 Storm frequency = 50 yrs
 Drainage area = 7.590 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 3.00 in
 Storm duration = 24 hrs

Peak discharge = 3.81 cfs
 Time interval = 6 min
 Curve number = 80
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 82.10 min
 Distribution = Type II
 Shape factor = 484

Hydrograph Volume = 34,440 cuft



TR55 Tc Worksheet

Hydraflow Hydrographs by Intelisolve

Hyd. No. 1

Basin1_PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 1.80	0.00	0.00	
Land slope (%)	= 0.20	0.00	0.00	
Travel Time (min)	= 79.03	+ 0.00	+ 0.00	= 79.03
Shallow Concentrated Flow				
Flow length (ft)	= 300.00	0.00	0.00	
Watercourse slope (%)	= 1.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 1.61	0.00	0.00	
Travel Time (min)	= 3.10	+ 0.00	+ 0.00	= 3.10
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				82.10 min

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, May 9 2006, 9:27 AM

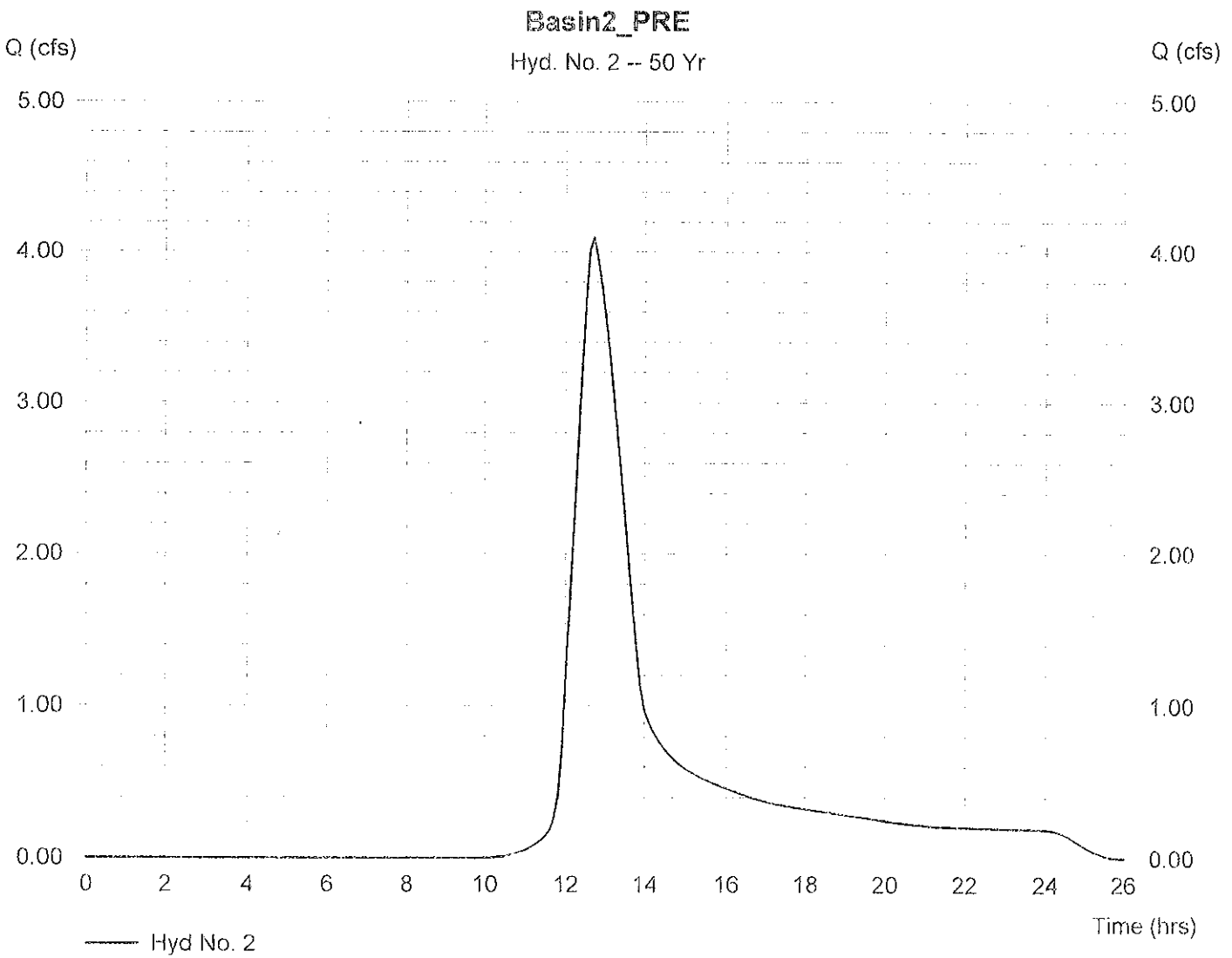
Hyd. No. 2

Basin2_PRE

Hydrograph type = SCS Runoff
Storm frequency = 50 yrs
Drainage area = 7.480 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 4.09 cfs
Time interval = 6 min
Curve number = 80
Hydraulic length = 0 ft
Time of conc. (Tc) = 79.90 min
Distribution = Type II
Shape factor = 484

Hydrograph Volume = 33,410 cuft



TR55 Tc Worksheet

Hydraflow Hydrographs by Intelisolve

Hyd. No. 2

Basin2_PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 1.80	0.00	0.00	
Land slope (%)	= 0.30	0.00	0.00	
Travel Time (min)	= 67.19	+ 0.00	+ 0.00	= 67.19
Shallow Concentrated Flow				
Flow length (ft)	= 550.00	0.00	0.00	
Watercourse slope (%)	= 0.20	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 0.72	0.00	0.00	
Travel Time (min)	= 12.70	+ 0.00	+ 0.00	= 12.70
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				79.90 min

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, May 9 2006, 9:27 AM

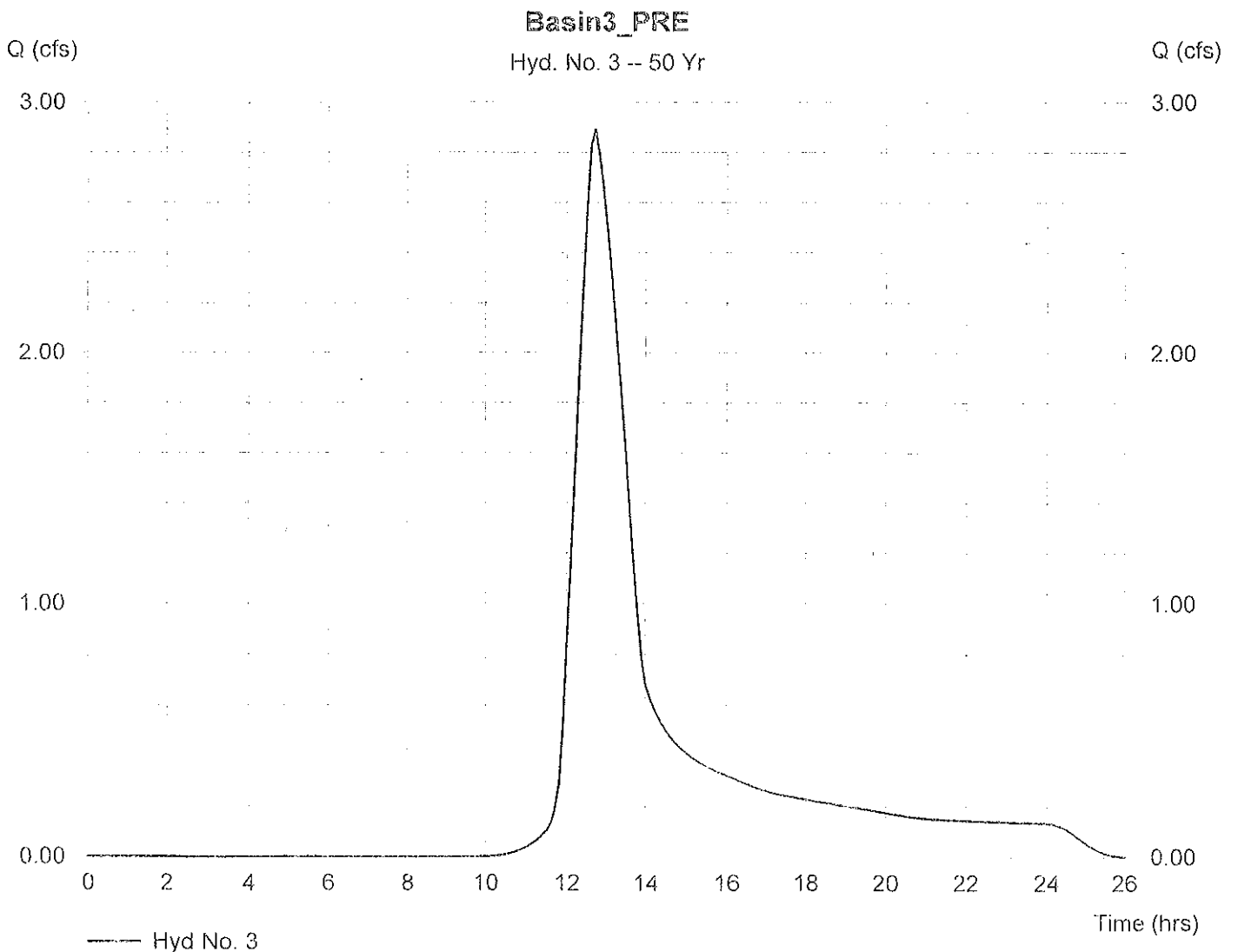
Hyd. No. 3

Basin3_PRE

Hydrograph type = SCS Runoff
 Storm frequency = 50 yrs
 Drainage area = 5.280 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 3.00 in.
 Storm duration = 24 hrs

Peak discharge = 2.89 cfs
 Time interval = 6 min
 Curve number = 80
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 80.30 min
 Distribution = Type II
 Shape factor = 484

Hydrograph Volume = 23,584 cuft



TR55 Tc Worksheet

Hydraflow Hydrographs by Intellisolve

Hyd. No. 3

Basin3_PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 1.80	0.00	0.00	
Land slope (%)	= 0.30	0.00	0.00	
Travel Time (min)	= 67.19	+ 0.00	+ 0.00	= 67.19
Shallow Concentrated Flow				
Flow length (ft)	= 800.00	0.00	0.00	
Watercourse slope (%)	= 0.25	0.00	0.00	
Surface description	= Paved	Paved	Paved	
Average velocity (ft/s)	= 1.02	0.00	0.00	
Travel Time (min)	= 13.12	+ 0.00	+ 0.00	= 13.12
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				80.30 min

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, May 9 2006, 9:27 AM

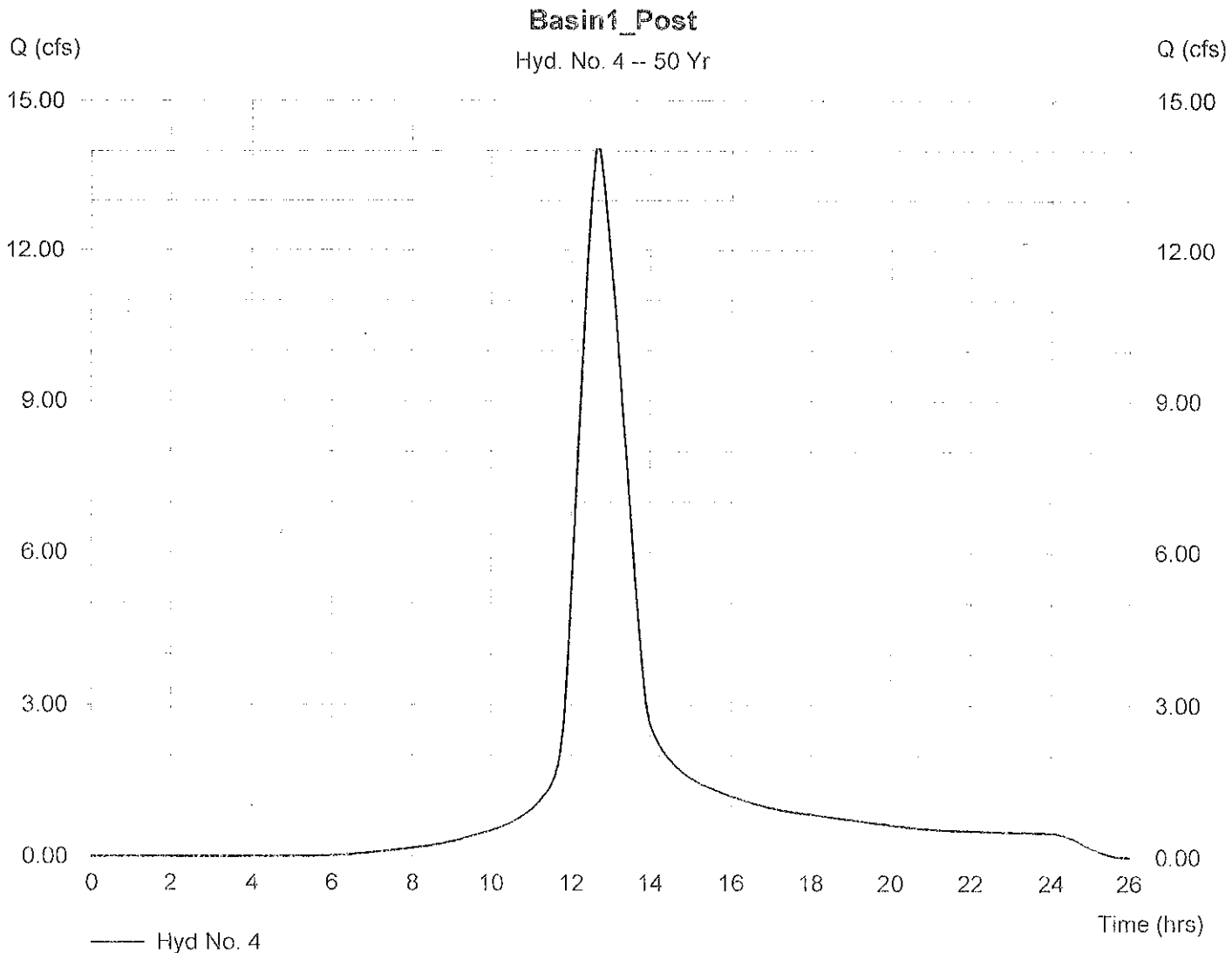
Hyd. No. 4

Basin1_Post

Hydrograph type = SCS Runoff
 Storm frequency = 50 yrs
 Drainage area = 15.030 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 3.00 in
 Storm duration = 24 hrs

Peak discharge = 14.04 cfs
 Time interval = 6 min
 Curve number = 91
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 75.20 min
 Distribution = Type II
 Shape factor = 484

Hydrograph Volume = 111,236 cuft



TR55 Tc Worksheet

Hydraflow Hydrographs by Intelisolve

Hyd. No. 4

Basin1_Post

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
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Sheet Flow

Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 200.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 1.80	0.00	0.00	
Land slope (%)	= 0.50	0.00	0.00	

Travel Time (min)	= 57.68	+ 0.00	+ 0.00	= 57.68
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Shallow Concentrated Flow

Flow length (ft)	= 1200.00	0.00	0.00	
Watercourse slope (%)	= 0.50	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 1.14	0.00	0.00	

Travel Time (min)	= 17.53	+ 0.00	+ 0.00	= 17.53
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Channel Flow

X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	

Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
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Total Travel Time, Tc 75.20 min

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, May 9 2006, 9:27 AM

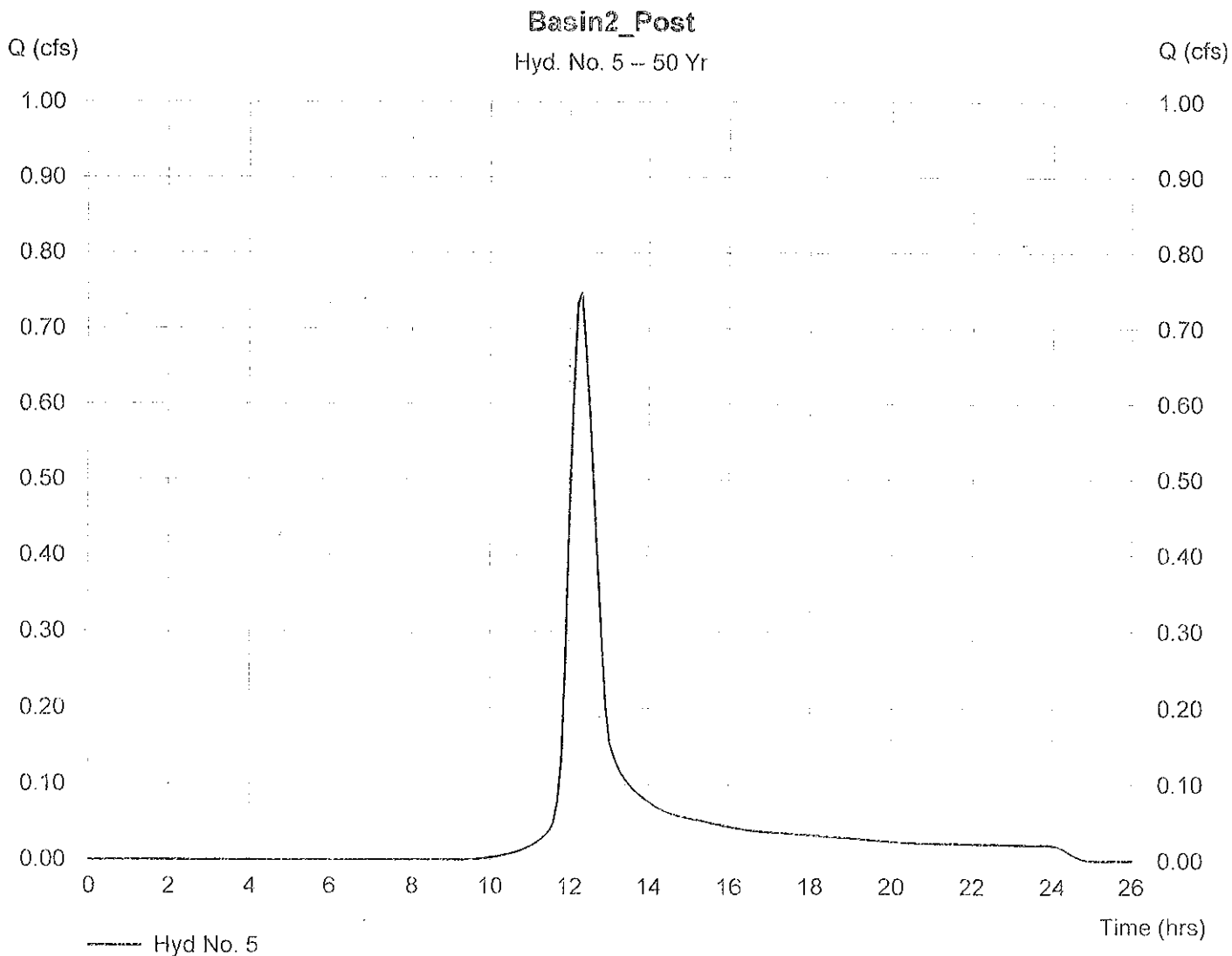
Hyd. No. 5

Basin2_Post

Hydrograph type = SCS Runoff
 Storm frequency = 50 yrs
 Drainage area = 0.750 ac
 Basin Slope = 0.5 %
 Tc method = TR55
 Total precip. = 3.00 in
 Storm duration = 24 hrs

Peak discharge = 0.75 cfs
 Time interval = 6 min
 Curve number = 81.6
 Hydraulic length = 200 ft
 Time of conc. (Tc) = 32.80 min
 Distribution = Type II
 Shape factor = 484

Hydrograph Volume = 3,797 cuft



TR55 Tc Worksheet

Hydraflow Hydrographs by Intelisolve

Hyd. No. 5

Basin2_Post

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 1.80	0.00	0.00	
Land slope (%)	= 0.20	0.00	0.00	
Travel Time (min)	= 32.82	+ 0.00	+ 0.00	= 32.82
Shallow Concentrated Flow				
Flow length (ft)	= 0.00	0.00	0.00	
Watercourse slope (%)	= 0.00	0.00	0.00	
Surface description	= Paved	Paved	Paved	
Average velocity (ft/s)	= 0.00	0.00	0.00	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc			32.80 min

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, May 9 2006, 9:27 AM

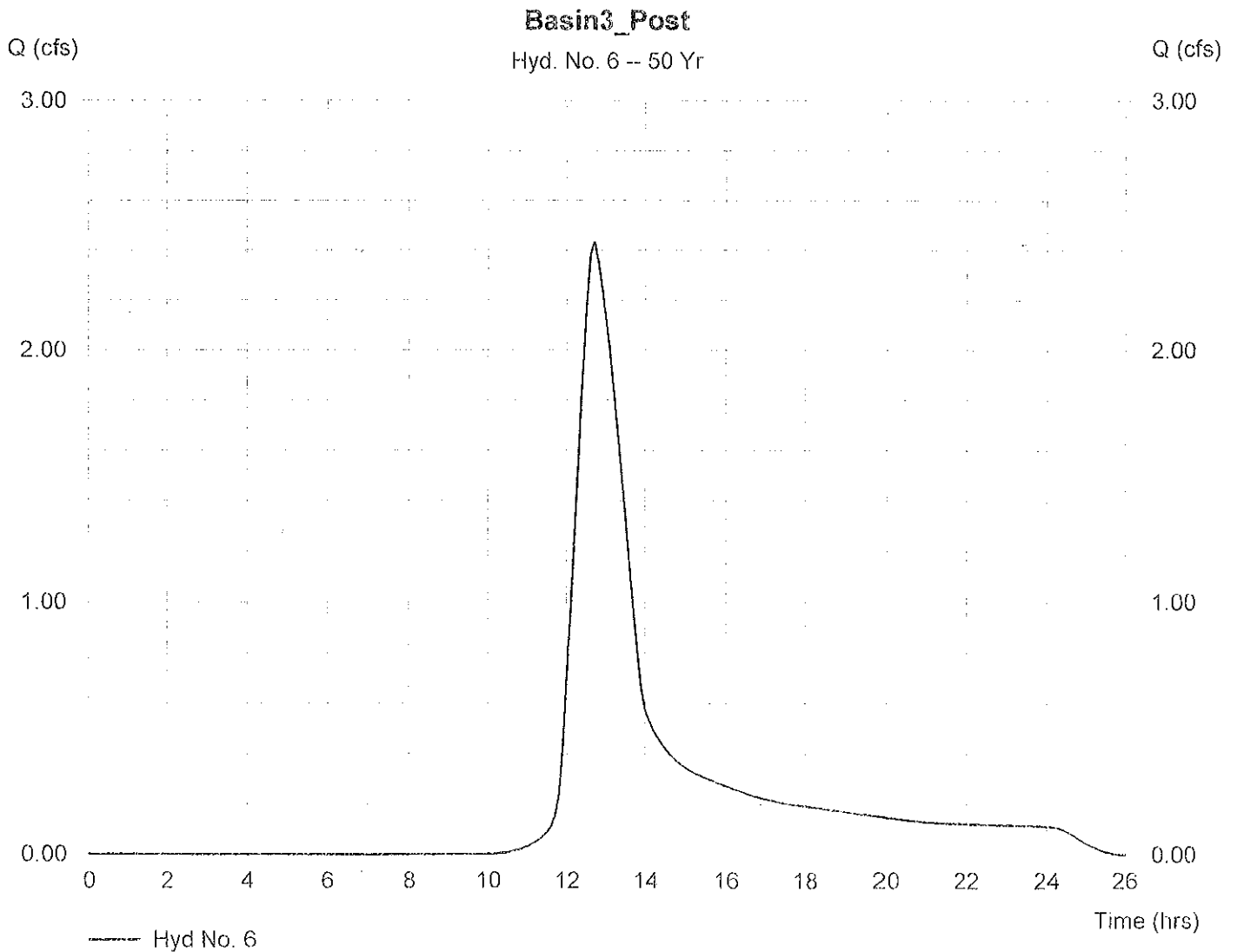
Hyd. No. 6

Basin3_Post

Hydrograph type = SCS Runoff
Storm frequency = 50 yrs
Drainage area = 4.440 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 3.00 in
Storm duration = 24 hrs

Peak discharge = 2.43 cfs
Time interval = 6 min
Curve number = 80
Hydraulic length = 0 ft
Time of conc. (Tc) = 80.30 min
Distribution = Type II
Shape factor = 484

Hydrograph Volume = 19,832 cuft



TR55 Tc Worksheet

Hydraflow Hydrographs by Intelisolve

Hyd. No. 6

Basin3_Post

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 1.80	0.00	0.00	
Land slope (%)	= 0.30	0.00	0.00	
Travel Time (min)	= 67.19	+ 0.00	+ 0.00	= 67.19
Shallow Concentrated Flow				
Flow length (ft)	= 800.00	0.00	0.00	
Watercourse slope (%)	= 0.25	0.00	0.00	
Surface description	= Paved	Paved	Paved	
Average velocity (ft/s)	= 1.02	0.00	0.00	
Travel Time (min)	= 13.12	+ 0.00	+ 0.00	= 13.12
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				80.30 min

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Tuesday, May 9 2006, 9:27 AM

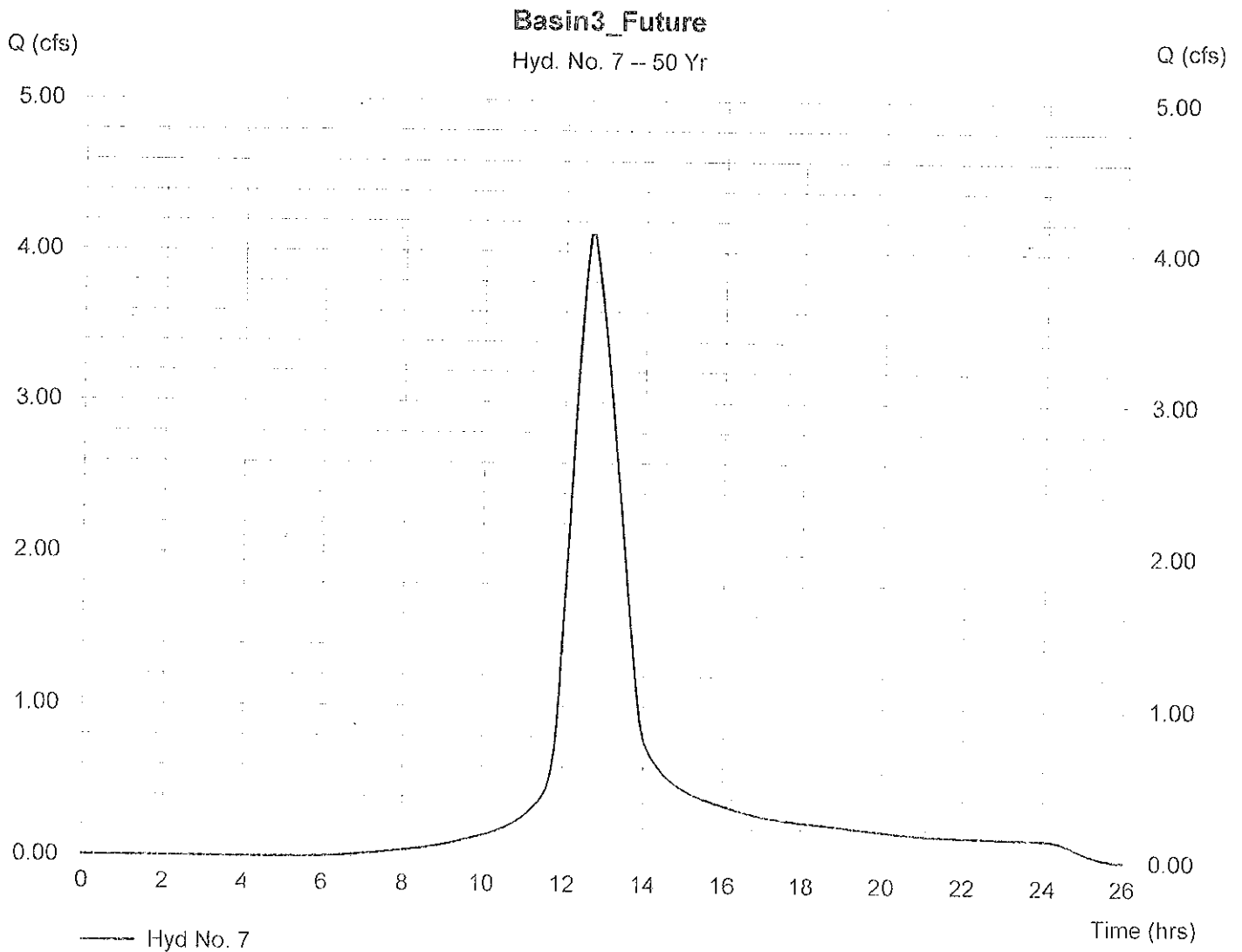
Hyd. No. 7

Basin3_Future

Hydrograph type = SCS Runoff
 Storm frequency = 50 yrs
 Drainage area = 4.440 ac
 Basin Slope = 0.0 %
 Tc method = TR55
 Total precip. = 3.00 in
 Storm duration = 24 hrs

Peak discharge = 4.11 cfs
 Time interval = 6 min
 Curve number = 90.8
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 80.30 min
 Distribution = Type II
 Shape factor = 484

Hydrograph Volume = 32,580 cuft



TR55 Tc Worksheet

Hydraflow Hydrographs by Intelisolve

Hyd. No. 7

Basin3_Future

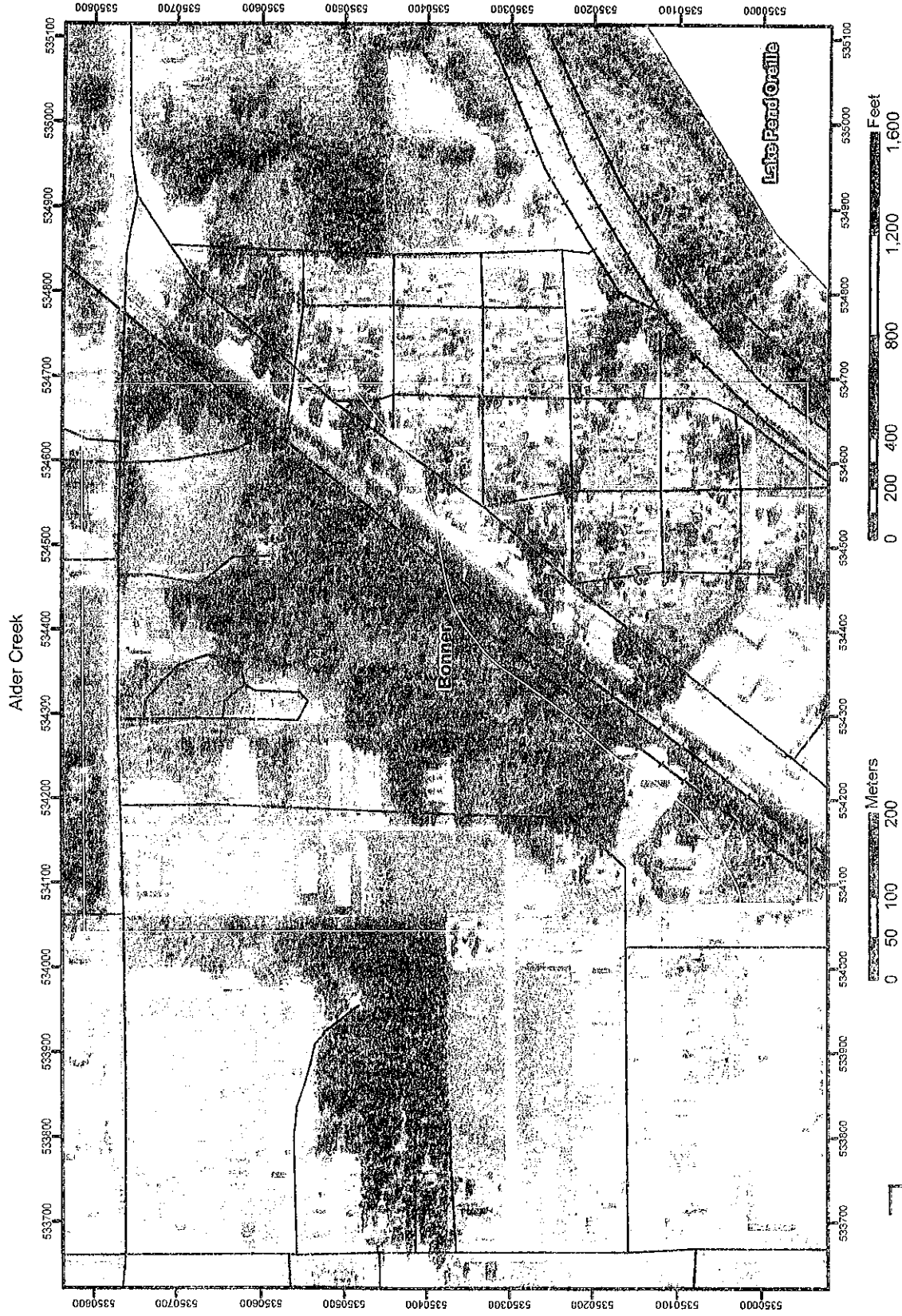
<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 1.80	0.00	0.00	
Land slope (%)	= 0.30	0.00	0.00	
Travel Time (min)	= 67.19	+ 0.00	+ 0.00	= 67.19
Shallow Concentrated Flow				
Flow length (ft)	= 800.00	0.00	0.00	
Watercourse slope (%)	= 0.25	0.00	0.00	
Surface description	= Paved	Paved	Paved	
Average velocity (ft/s)	= 1.02	0.00	0.00	
Travel Time (min)	= 13.12	+ 0.00	+ 0.00	= 13.12
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				80.30 min

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SOIL SURVEY OF BONNER COUNTY AREA, IDAHO, PARTS OF BONNER AND BOUNDARY COUNTIES

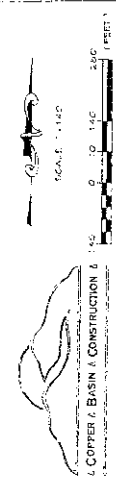
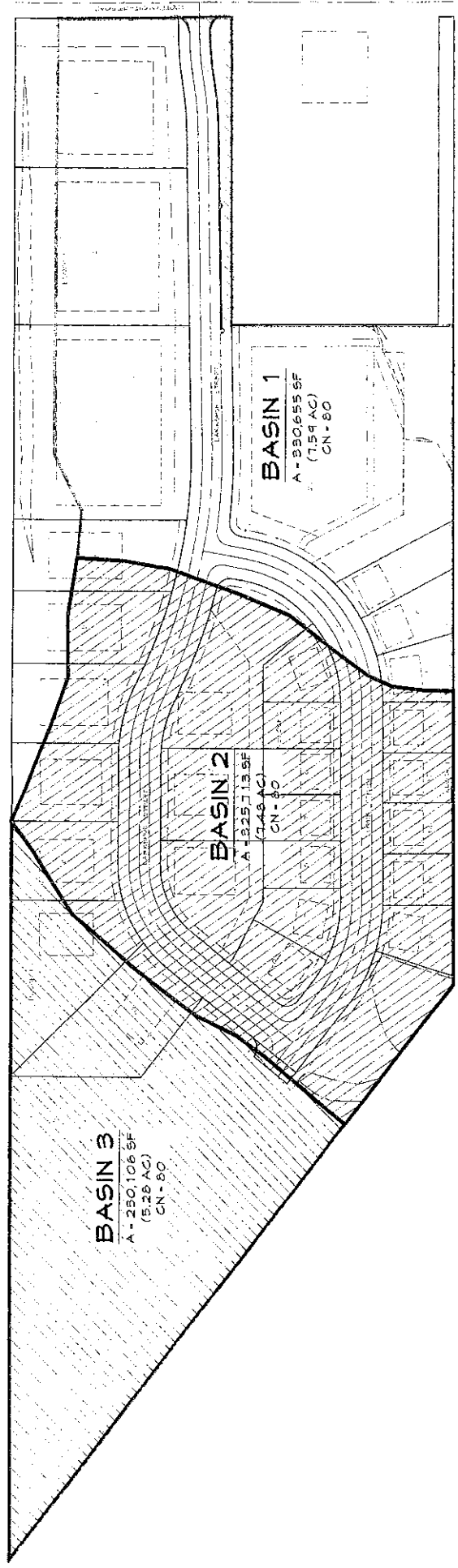


Map Unit Legend Summary

Bonner County Area, Idaho, Parts of Bonner and Boundary Counties

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
31	Mission silt loam, 0 to 2 percent slopes	52.5	37.1
34	Odenson silt loam, 0 to 2 percent slopes	88.9	62.9

PRE-DEVELOPED CONDITIONS BASIN MAP



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