APPENDIX IX

The Hydraflow Hydrographs computer output contained in this Appendix is provided to show the Residential and Commercial Design Example solutions described in this manual. Contained in the following pages are the selective hydrographs, tables and model components output used to provide a solution to the Stormwater Management Ordinance. Note: choices of orifice size, pond height, width, length and depth selected by each designer will result in different solutions of time and discharge from what is shown in this Manual, but may still meet the requirements of the ordinance.

Exhibit 9.1 Residential Design Example Output

- Basic pre-development and post-development schematic model showing the various elements of the watershed in which the proposed residential site exists. Elements of interest in the Residential Design Example model are: 17, 19, 22, 32, 38, 43 and 45
- Pre-peak flows are noted at elements 17 (at the 7’ diameter pipe), 19 (downstream junction) and 22 (location where site represents 10% of the watershed-Muddy Creek).
- Post-peak flows to compare with pre-peak flows are found at elements of interest: 32 (wet detention basin), 38 (7’ diameter pipe, 43 (downstream junction) and 45 (location where site represents 10% of the watershed-Muddy Creek)
- Hydrograph print-outs for the peak flows for specific elements of interest
- Table with stage and storage, orifice sizes and overall dimensions/areas of the wet detention pond located in Basin # 7 in the Residential Design Example.
- Hydrograph plot drawdown time for wet detention pond

Exhibit 9.2 Commercial Design Example Output

- Basic pre-development and post-development model schematic for the proposed commercial site with a legend for each element. Elements of interest in the Commercial Design Example model are: 8, 18, 15, 20 and 26
- Pre-peak flows at elements of interest: 8 (pre-junction at 15 inch pipe) and 18 (pre-junction at 10% location downstream).
- Post-peak flows to compare model elements of interest: 15 (underground detention), 20 (post junction at 15 inch pipe) and 26 (post junction at 10% of the watershed).
- Hydrograph print-outs for the peak flows for specific elements of the model
- Table with the stage and storage, orifice sizes and overall dimensions of the underground detention structure for the Commercial Design Example (see also Exhibit 3.5).
- Hydrograph plot drawdown time for underground detention
Project: ResidentialExample

Wednesday, Aug 15, 2007
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<th>3-Yr</th>
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<th>10-Yr</th>
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Proj. file: ResidentialExample_final.gpw  
Tuesday, Nov 11, 2008
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

**Hyd. No. 17**

Detention at 7' pipe

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<th>Value</th>
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<td>Storm frequency</td>
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<tr>
<td>Time interval</td>
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<td>12 - Junction # 3 at 7' Dia PIPE</td>
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<td>Reservoir name</td>
<td>7' Diameter Pipe</td>
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<td>Max. Elevation</td>
<td>766.93 ft</td>
</tr>
<tr>
<td>Max. Storage</td>
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Storage Indication method used.

**Detention at 7' pipe**

Hyd. No. 17 -- 2 Year

<table>
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<tr>
<th>Time (hrs)</th>
<th>Q (cfs)</th>
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</tr>
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<tr>
<td>8.00</td>
<td>0.00</td>
</tr>
<tr>
<td>9.00</td>
<td>0.00</td>
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</table>

Total storage used = 6,724 cuft
Hyd. No. 19

Junction #4

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyds. = 13, 14, 16, 18

Peak discharge = 14.91 cfs
Time to peak = 2.87 hrs
Hyd. volume = 152,599 cuft
Contrib. drain. area = 32.300 ac
Hyd. No. 22

Confluence with Muddy Creek

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyds. = 15, 20, 21

Peak discharge = 23.76 cfs
Time to peak = 2.60 hrs
Hyd. volume = 230,004 cuft
Contrib. drain. area = 53.630 ac

Confluence with Muddy Creek

Hyd. No. 22 -- 2 Year

Q (cfs)

Hyd No. 22
Hyd No. 15
Hyd No. 20
Hyd No. 21

Time (hrs)
Hyd. No. 32
Post runoff - Wet Det

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 3 min
Inflow hyd. No. = 31 - Post Basin # 7
Reservoir name = 25-yr Detention Pond

Peak discharge = 0.310 cfs
Time to peak = 6.15 hrs
Hyd. volume = 33,184 cuft
Max. Elevation = 777.56 ft
Max. Storage = 29,728 cuft

Total storage used = 29,728 cuft
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

Hyd. No. 38

Post detention 7’ pipe

<table>
<thead>
<tr>
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<th>Reservoir</th>
<th>Peak discharge</th>
<th>12.10 cfs</th>
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<td>Max. Storage</td>
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Storage Indication method used.
Hyd. No. 43
Post Junction # 4

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyds. = 33, 34, 39, 40

Peak discharge = 16.92 cfs
Time to peak = 2.82 hrs
Hyd. volume = 188,152 cuft
Contrib. drain. area = 32.300 ac

Hyd. No. 43
Hyd No. 33
Hyd No. 34
Hyd No. 39
Hyd No. 40
Hyd. No. 45
Post Junction # 5 - Confluence at Muddy Creek

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyds. = 41, 42, 44

Peak discharge = 24.60 cfs
Time to peak = 2.62 hrs
Hyd. volume = 265,543 cuft
Contrib. drain. area = 53.630 ac
Hyd. No. 17
Detention at 7’ pipe

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 1 min
Inflow hyd. No. = 12 - Junction # 3 at 7’ Dia PIPE
Reservoir name = 7’ Diameter Pipe

Peak discharge = 47.52 cfs
Time to peak = 2.65 hrs
Hyd. volume = 275,603 cuft
Max. Elevation = 768.09 ft
Max. Storage = 16,190 cuft

Storage Indication method used.
Hydrograph Report

Hyd. No. 19

Junction #4

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 1 min
Inflow hyds. = 13, 14, 16, 18

Peak discharge = 66.38 cfs
Time to peak = 2.60 hrs
Hyd. volume = 402,284 cuft
Contrib. drain. area = 32.300 ac

Junction #4
Hyd. No. 19 -- 10 Year
**Hydrograph Report**

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

**Hyd. No. 22**

Confluence with Muddy Creek

- **Hydrograph type**: Combine
- **Storm frequency**: 10 yrs
- **Time interval**: 1 min
- **Inflow hyds.**: 15, 20, 21

- **Peak discharge**: 96.98 cfs
- **Time to peak**: 2.62 hrs
- **Hyd. volume**: 591,630 cuft
- **Contrib. drain. area**: 53.630 ac

---

**Confluence with Muddy Creek**

Hyd. No. 22 -- 10 Year

![Graph showing hydrographs for Hyd. No. 22 with inflow hydros 15, 20, 21 and contributing area 53.630 ac]
Hyd. No. 32

Post runoff - Wet Det

Hydrograph type = Reservoir  
Storm frequency = 10 yrs  
Time interval = 3 min  
Inflow hyd. No. = 31 - Post Basin # 7  
Reservoir name = 25-yr Detention Pond

Peak discharge = 0.442 cfs  
Time to peak = 6.15 hrs  
Hyd. volume = 72,995 cuft  
Max. Elevation = 780.07 ft  
Max. Storage = 67,774 cuft

Storage Indication method used.

Post runoff - Wet Det
Hyd. No. 32 -- 10 Year

Total storage used = 67,774 cuft
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

**Hyd. No. 38**

Post detention 7' pipe

- **Hydrograph type**: Reservoir
- **Peak discharge**: 48.19 cfs
- **Storm frequency**: 10 yrs
- **Time to peak**: 2.65 hrs
- **Time interval**: 1 min
- **Hyd. volume**: 321,483 cuft
- **Inflow hyd. No.**: 37 - Post Junction # 3 at 7' pipe
- **Max. Elevation**: 768.10 ft
- **Reservoir name**: Post 7' Diameter Pipe
- **Max. Storage**: 15,199 cuft

Storage Indication method used.

---

**Post detention 7' pipe**

Hyd. No. 38 -- 10 Year

- **Q (cfs)**
  - 0.00 to 60.00
- **Time (hrs)**
  - 0.00 to 8.00

- **Hyd. No. 38**
- **Hyd. No. 37**
- **Total storage used = 15,199 cuft**
Hyd. No. 43
Post Junction # 4

Hydrograph type = Combine  
Storm frequency = 10 yrs  
Time interval = 1 min  
Inflow hyds. = 33, 34, 39, 40

Peak discharge = 68.39 cfs  
Time to peak = 2.58 hrs  
Hyd. volume = 448,155 cuft  
Contrib. drain. area = 32.300 ac
Hyd. No. 45

Post Junction # 5 - Confluence at Muddy Creek

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 1 min
Inflow hyds. = 41, 42, 44

Peak discharge = 100.40 cfs
Time to peak = 2.60 hrs
Hyd. volume = 637,446 cuft
Contrib. drain. area = 53.630 ac
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

Hyd. No. 17

Detention at 7’ pipe

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<td>Max. Elevation</td>
<td>= 768.72 ft</td>
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<td>Reservoir name</td>
<td>= 7’ Diameter Pipe</td>
<td>Max. Storage</td>
<td>= 28,787 cuft</td>
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</tbody>
</table>

Storage Indication method used.

---

### Detention at 7’ pipe

**Hyd. No. 17 -- 25 Year**

![Graph showing hydrograph Q (cfs) vs Time (hrs)]

- **Q (cfs)**
  - 90.00
  - 80.00
  - 70.00
  - 60.00
  - 50.00
  - 40.00
  - 30.00
  - 20.00
  - 10.00
  - 0.00

- **Time (hrs)**
  - 0.0
  - 1.0
  - 2.0
  - 3.0
  - 4.0
  - 5.0
  - 6.0
  - 7.0

- **Hyd No. 17**
- **Hyd No. 12**
- **Total storage used = 28,787 cuft**
Hyd. No. 19

Junction #4

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 13, 14, 16, 18

Peak discharge = 99.68 cfs
Time to peak = 2.58 hrs
Hyd. volume = 586,678 cuft
Contrib. drain. area = 32.300 ac

Junction #4
Hyd. No. 19 -- 25 Year

Q (cfs)

0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00

Time (hrs)

0.00 20.00 40.00 60.00 80.00 100.00

Q (cfs)
Hyd. No. 22

Confluence with Muddy Creek

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 15, 20, 21

Peak discharge = 150.59 cfs
Time to peak = 2.58 hrs
Hyd. volume = 855,871 cuft
Contrib. drain. area = 53.630 ac
## Hyd. No. 32

Post runoff - Wet Det

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Hydrograph type</td>
<td>Reservoir</td>
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<td>Storm frequency</td>
<td>25 yrs</td>
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<td>Time interval</td>
<td>3 min</td>
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<td>Inflow hyd. No.</td>
<td>31 - Post Basin # 7</td>
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<tr>
<td>Reservoir name</td>
<td>25-yr Detention Pond</td>
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<tr>
<td>Peak discharge</td>
<td>3.284 cfs</td>
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<tr>
<td>Time to peak</td>
<td>6.00 hrs</td>
</tr>
<tr>
<td>Hyd. volume</td>
<td>100,229 cuft</td>
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<tr>
<td>Max. Elevation</td>
<td>781.03 ft</td>
</tr>
<tr>
<td>Max. Storage</td>
<td>84,330 cuft</td>
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</table>

Storage Indication method used.

![Graph](chart.png)
Hyd. No. 38

Post detention 7' pipe

Hydrograph type = Reservoir
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyd. No. = 37 - Post Junction # 3 at 7' pipe
Reservoir name = Post 7' Diameter Pipe

Peak discharge = 71.37 cfs
Time to peak = 2.65 hrs
Hyd. volume = 464,550 cuft
Max. Elevation = 768.68 ft
Max. Storage = 26,518 cuft

Total storage used = 26,518 cuft
### Stage / Storage Table

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### Culvert / Orifice Structures

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<th>[C]</th>
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### Weir Structures

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### Stage / Storage / Discharge Table

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<th>Clv C cfs</th>
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<th>Wr A cfs</th>
<th>Wr B cfs</th>
<th>Wr C cfs</th>
<th>Wr D cfs</th>
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Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).
**Hyd. No. 32**

Post runoff - Wet Det

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrograph type</td>
<td>Reservoir</td>
</tr>
<tr>
<td>Storm frequency</td>
<td>25 yrs</td>
</tr>
<tr>
<td>Time interval</td>
<td>3 min</td>
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<tr>
<td>Inflow hyd. No.</td>
<td>31 - Post Basin # 7</td>
</tr>
<tr>
<td>Reservoir name</td>
<td>25-yr Detention Pond</td>
</tr>
<tr>
<td>Peak discharge</td>
<td>3.284 cfs</td>
</tr>
<tr>
<td>Time to peak</td>
<td>6.00 hrs</td>
</tr>
<tr>
<td>Hyd. volume</td>
<td>100,229 cuft</td>
</tr>
<tr>
<td>Max. Elevation</td>
<td>781.03 ft</td>
</tr>
<tr>
<td>Max. Storage</td>
<td>84,330 cuft</td>
</tr>
</tbody>
</table>

Storage Indication method used.
Pond No. 2 - 25-yr Detention Pond

Top of pond
Elev. 782.50

9.50 ft Riser
Weir A - Elev. 781.00

2.00 ft Rect. weir
Weir C - Elev. 780.50

2.75 in orifice
Culvert B - Inv. 775.00

Bottom of Pond Elevation 771.0

Permanent Pool Elevation 775.0

Elev. 775.00

Culvert A - 55.0 LF of 24.0 in @ 2.70%

Inflow hydrograph = 1. SCS Runoff - Basin 1 w/pond

Project: ResidentialExample_final.gpw

Tuesday, Nov 11, 2008
Pond No. 2 - 25-yr Detention Pond

Project: ResidentialExample_final.gpw

Thursday, Nov 20, 2008

0.00
2.00
4.00
6.00
8.00

Stage (ft)

55.0 LF of 24.0 in @ 2.70%
CulvA - Inv. 771.00

2.75 in orifice
CulvB - Inv. 775.00

9.50 ft Riser
WeirA - Elev. 781.50

8.00 ft Broad crested weir
WeirB - Elev. 781.50

Top of pond
Elev. 782.50

2-yr
10-yr
25-yr
100-yr

Inflow hydrograph = 31. SCS Runoff - Post Basin # 7

Front View
NTS - Looking Downstream

Permanent Pool Elevation 775.0

Bottom of Pond Elevation 771.0
Hyd. No. 43

Post Junction # 4

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 33, 34, 39, 40

Peak discharge = 99.48 cfs
Time to peak = 2.57 hrs
Hyd. volume = 642,240 cuft
Contrib. drain. area = 32.300 ac
Hyd. No.  45
Post Junction # 5 - Confluence at Muddy Creek

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 41, 42, 44

Peak discharge = 151.44 cfs
Time to peak = 2.57 hrs
Hyd. volume = 911,376 cuft
Contrib. drain. area = 53.630 ac
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

Hyd. No. 17
Detention at 7’ pipe

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyd. No. = 12 - Junction # 3 at 7' Dia PIPE
Reservoir name = 7’ Diameter Pipe

Peak discharge = 122.83 cfs
Time to peak = 2.63 hrs
Hyd. volume = 654,336 cuft
Max. Elevation = 770.04 ft
Max. Storage = 55,927 cuft

Storage Indication method used.

Detention at 7’ pipe
Hyd. No. 17 -- 100 Year

Q (cfs)

0.00 0.00
20.00 20.00
40.00 40.00
60.00 60.00
80.00 80.00
100.00 100.00
120.00 120.00
140.00 140.00
160.00 160.00

Time (hrs)

0.00 1.0 2.0 3.0 4.0 5.0 6.0 7.0

Hyd No. 17  Hyd No. 12  Total storage used = 55,927 cuft
**Hyd. No. 19**

Junction #4

Hydrograph type = Combine

Peak discharge = 166.76 cfs

Storm frequency = 100 yrs

Time to peak = 2.58 hrs

Time interval = 1 min

Hyd. volume = 922,049 cuft

Contrib. drain. area = 32.300 ac

Inflow hyds. = 13, 14, 16, 18
Hyd. No. 22

Confluence with Muddy Creek

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyds. = 15, 20, 21

Peak discharge = 247.64 cfs
Time to peak = 2.57 hrs
Hyd. volume = 1,333,475 cuft
Contrib. drain. area = 53.630 ac
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

**Hyd. No. 32**
Post runoff - Wet Det

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrograph type</td>
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<tr>
<td>Reservoir name</td>
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<tr>
<td>Peak discharge</td>
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<td>Hyd. volume</td>
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<tr>
<td>Max. Storage</td>
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Storage Indication method used.

**Post runoff - Wet Det**
Hyd. No. 32 -- 100 Year

Total storage used = 87,474 cuft
Hyd. No. 38

Post detention 7' pipe

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyd. No. = 37 - Post Junction # 3 at 7' pipe
Reservoir name = Post 7' Diameter Pipe

Peak discharge = 117.36 cfs
Time to peak = 2.63 hrs
Hyd. volume = 729,874 cuft
Max. Elevation = 769.89 ft
Max. Storage = 50,181 cuft

Storage Indication method used.

Post detention 7' pipe

Hyd. No. 38 -- 100 Year

Total storage used = 50,181 cuft
**Hyd. No. 43**

Post Junction # 4

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<td>Time interval</td>
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---

**Graph**

*Post Junction # 4*

**Hyd. No. 43 -- 100 Year**

![Graph showing Hydrographs for Hyd. No. 43]
Hyd. No. 45
Post Junction # 5 - Confluence at Muddy Creek

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyds. = 41, 42, 44

Peak discharge = 244.10 cfs
Time to peak = 2.57 hrs
Hyd. volume = 1,408,956 cuft
Contrib. drain. area = 53.630 ac
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<th>Hyd. No.</th>
<th>Hydrograph type (origin)</th>
<th>Inflow Hyd(s)</th>
<th>1-Yr</th>
<th>2-Yr</th>
<th>3-Yr</th>
<th>5-Yr</th>
<th>10-Yr</th>
<th>25-Yr</th>
<th>50-Yr</th>
<th>100-Yr</th>
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<td>------ ------</td>
<td>29.32</td>
<td>------</td>
<td>------</td>
<td>48.79</td>
<td>60.55</td>
<td>------</td>
<td>------</td>
<td>79.43</td>
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<tr>
<td>2</td>
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<td>------ ------</td>
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<td>------</td>
<td>------</td>
<td>36.09</td>
<td>47.25</td>
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<td>------</td>
<td>65.80</td>
<td>PRE-Basin 2</td>
</tr>
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<td>------ 0.787</td>
<td>-------</td>
<td>2.105</td>
<td>3.050</td>
<td>------</td>
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<td>------</td>
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<td>4.724</td>
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<td>------</td>
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<td>------</td>
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<td>------</td>
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<td>------</td>
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<tr>
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<td>0.933</td>
<td>1.148</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>1.493</td>
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<tr>
<td>7</td>
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<td>6 0.041</td>
<td>-------</td>
<td>0.269</td>
<td>0.760</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>1.348</td>
<td>Route West Pond</td>
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<tr>
<td>8</td>
<td>Combine 3, 4, 1, 13</td>
<td>------ 6.102</td>
<td>-------</td>
<td>9.742</td>
<td>11.92</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>15.40</td>
<td>Post Basins to Underground Detention</td>
</tr>
<tr>
<td>9</td>
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<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>5.593</td>
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<td>1.708</td>
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<td>------</td>
<td>2.557</td>
<td>Post Basin = All Roof drainage</td>
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<tr>
<td>11</td>
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<td>-------</td>
<td>9.742</td>
<td>11.92</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>15.40</td>
<td>Post Basins to Underground Detention</td>
</tr>
<tr>
<td>12</td>
<td>Reach 8</td>
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<td>-------</td>
<td>3.958</td>
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<td>------</td>
<td>------</td>
<td>8.896</td>
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<td>8.776</td>
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<td>87.45</td>
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<td>1.427</td>
<td>2.795</td>
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<td>------</td>
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<td>11.04</td>
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<td>16</td>
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<td>------</td>
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<td>------</td>
<td>------</td>
<td>79.43</td>
<td>Post-Basin 1</td>
</tr>
<tr>
<td>17</td>
<td>Reach 14</td>
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<td>51.15</td>
<td>64.86</td>
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<td>87.06</td>
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<td>Combine 2, 17</td>
<td>------ 47.35</td>
<td>-------</td>
<td>86.46</td>
<td>111.28</td>
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<td>------</td>
<td>------</td>
<td>151.89</td>
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<td>4.550</td>
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<td>13.10</td>
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<tr>
<td>21</td>
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<td>-------</td>
<td>2.770</td>
<td>3.652</td>
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<td>13.18</td>
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<td>3.512</td>
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<td>12.30</td>
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<tr>
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<td>50.73</td>
<td>63.34</td>
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<td>84.59</td>
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<tr>
<td>25</td>
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<td>36.09</td>
<td>47.25</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>65.80</td>
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<td>26</td>
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<td>86.26</td>
<td>110.03</td>
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<td>------</td>
<td>149.49</td>
<td>POST junction at 10 percent location</td>
</tr>
</tbody>
</table>
Hyd. No. 8
Pre-Junction at existing 15 inch pipe

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 1.482 cfs
Time to peak = 2.53 hrs
Hyd. volume = 7,507 cuft
Contrib. drain. area = 4.520 ac
Hyd. No. 15

Underground Detention

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyd. No. = 11 - Post Basins to Underground Detention
Reservoir name = Underground detention

Peak discharge = 0.266 cfs
Time to peak = 6.08 hrs
Hyd. volume = 24,560 cuft
Max. Storage = 21,436 cuft

Storage Indication method used.

Underground Detention
Hyd. No. 15 -- 2 Year
Hyd. No. 18
Pre junction at 10 percent location downstream

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyds. = 2, 17

Peak discharge = 47.35 cfs
Time to peak = 2.47 hrs
Hyd. volume = 206,640 cuft
Contrib. drain. area = 23.020 ac
Hyd. No. 20

POST junction at 15 inch pipe

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyds. = 7, 15, 19

Peak discharge = 1.548 cfs
Time to peak = 2.43 hrs
Hyd. volume = 32,663 cuft
Contrib. drain. area = 1.450 ac
Hyd. No. 26

POST junction at 10 percent location downstream

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 1 min
Inflow hyds. = 24, 25

Peak discharge = 47.98 cfs
Time to peak = 2.47 hrs
Hyd. volume = 231,711 cuft
Contrib. drain. area = 23.020 ac
Hyd. No. 8

Pre-Junction at existing 15 inch pipe

Hydrograph type = Combine  
Storm frequency = 10 yrs  
Time interval = 1 min  
Inflow hyds. = 3, 4

Peak discharge = 3.965 cfs  
Time to peak = 2.52 hrs  
Hyd. volume = 17,644 cuft  
Contrib. drain. area = 4.520 ac
Hyd. No. 15
Underground Detention

Hydrograph type = Reservoir  Peak discharge = 1.427 cfs
Storm frequency = 10 yrs  Time to peak = 4.15 hrs
Time interval = 1 min  Hyd. volume = 39,605 cuft
Inflow hyd. No. = 11 - Post Basins to Underground Detention Max. Elevation = 954.08 ft
Reservoir name = Underground detention  Max. Storage = 29,140 cuft

Storage Indication method used.
Hyd. No. 18

Hydrograph Report
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

Pre junction at 10 percent location downstream

Hydrograph type = Combine  
Storm frequency = 10 yrs  
Time interval = 1 min  
Inflow hyds. = 2, 17

Peak discharge = 86.46 cfs  
Time to peak = 2.45 hrs  
Hyd. volume = 367,192 cuft  
Contrib. drain. area = 23.020 ac

Pre junction at 10 percent location downstream

Hyd. No. 18 -- 10 Year

Q (cfs)

0.00 10.00 20.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00

0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00

Time (hrs)

Hyd No. 18  Hyd No. 2  Hyd No. 17
Hyd. No. 20

POST junction at 15 inch pipe

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 1 min
Inflow hyds. = 7, 15, 19

Peak discharge = 2.800 cfs
Time to peak = 2.42 hrs
Hyd. volume = 53,530 cuft
Contrib. drain. area = 1.450 ac
Hyd. No. 26

POST junction at 10 percent location downstream

Hydrograph type = Combine  
Storm frequency = 10 yrs  
Time interval = 1 min  
Inflow hyds. = 24, 25

Peak discharge = 86.26 cfs  
Time to peak = 2.45 hrs  
Hyd. volume = 403,035 cuft  
Contrib. drain. area = 23.020 ac
Hyd. No.  8

Pre-Junction at existing 15 inch pipe

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 5.744 cfs
Time to peak = 2.48 hrs
Hyd. volume = 24,765 cuft
Contrib. drain. area = 4.520 ac
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

Thursday, Nov 20, 2008

Hyd. No. 15

Underground Detention

Hydrograph type = Reservoir
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyd. No. = 11 - Post Basins to Underground Detention
Reservoir name = Underground detention

Peak discharge = 2.795 cfs
Time to peak = 3.05 hrs
Hyd. volume = 48,954 cuft
Max. Elevation = 954.18 ft
Max. Storage = 29,405 cuft

Storage Indication method used.

Underground Detention

Hyd. No. 15 -- 25 Year

Total storage used = 29,405 cuft
Pond Report
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

Pond No. 4 - Underground detention

Pond Data
UG Chambers - Invert elev. = 948.40 ft, Rise x Span = 6.00 x 6.00 ft, Barrel Len = 78.00 ft, No. Barrels = 11, Slope = 0.20%, Headers = Yes
Encasement - Invert elev. = 948.30 ft, Width = 6.00 ft, Height = 7.00 ft, Voids = 30.00%

Stage / Storage Table

<table>
<thead>
<tr>
<th>Stage (ft)</th>
<th>Elevation (ft)</th>
<th>Contour area (sqft)</th>
<th>Incr. Storage (cuft)</th>
<th>Total storage (cuft)</th>
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</thead>
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Culvert / Orifice Structures

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<th>Rise (in)</th>
<th>Span (in)</th>
<th>No. Barrels</th>
<th>Invert El. (ft)</th>
<th>Length (ft)</th>
<th>Slope (%)</th>
<th>N-Value</th>
<th>Orifice Coeff.</th>
<th>Multi-Stage</th>
<th>Exfil.(in/hr)</th>
<th>TW Elev. (ft)</th>
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Weir Structures

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<th>[B]</th>
<th>[C]</th>
<th>[PrfRsr]</th>
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<th>[B]</th>
<th>[C]</th>
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<td>3.33</td>
<td>3.33</td>
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</tr>
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</table>

Stage / Storage / Discharge Table

<table>
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<tr>
<th>Stage ft</th>
<th>Storage (cuft)</th>
<th>Elevation ft</th>
<th>Clv A cfs</th>
<th>Clv B cfs</th>
<th>Clv C cfs</th>
<th>PrfRsr cfs</th>
<th>Wr A cfs</th>
<th>Wr B cfs</th>
<th>Wr C cfs</th>
<th>Wr D cfs</th>
<th>Exfil. cfs</th>
<th>User cfs</th>
<th>Total cfs</th>
</tr>
</thead>
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<td>0.00</td>
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<tr>
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Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).
Underground Detention Schematic

Schematic for Proposed Underground Detention (N.T.S.)
Manages water quantity requirement for proposed site. Water quality is managed in other BMPs.

Calculated 25-Yr Quantity Volume Increase
25-Yr Quantity Volume in Underground Pipe Storage
Max Volume Used for the 25-Yr Event

32,340 CF Storage Required
32,255 CF Storage
31,312 CF Max. Storage

6.0' Diameter Storage Pipe with 6" in Between Pipes & Filled with Gravel
1/2-Foot of Gravel Above and Below 6.0' Diameter Pipes

Commercial Design Example

Exhibit 3.5
Hyd. No. 18
Pre junction at 10 percent location downstream

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 2, 17

Peak discharge = 111.28 cfs
Time to peak = 2.45 hrs
Hyd. volume = 468,868 cuft
Contrib. drain. area = 23.020 ac
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Nov 20, 2008

**Hyd. No. 20**

POST junction at 15 inch pipe

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 7, 15, 19

Peak discharge = 3.681 cfs
Time to peak = 2.53 hrs
Hyd. volume = 66,811 cuft
Contrib. drain. area = 1.450 ac

POST junction at 15 inch pipe

Hyd. No. 20 -- 25 Year

---

**Hyd No. 20**
**Hyd No. 7**
**Hyd No. 15**
**Hyd No. 19**
Hyd. No. 26
POST junction at 10 percent location downstream

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![Graph of Hydrograph](image)

**POST junction at 10 percent location downstream**

Hyd. No. 26 -- 25 Year

Q (cfs)

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