



November 10, 2010

Nancy Greifenhagen  
Village of Menomonee Falls  
W156 N8480 Pilgrim Road  
Menomonee Falls, WI 53051

Re: Willow Springs Stormwater Detention Basin Certification  
Client Name: Hamilton School District  
Bonestroo Project No.: 7167-10-001

Dear Ms. Greifenhagen:

Bonestroo has completed our certification of the Stormwater Detention Basin at Willow Springs School. We find the existing detention basin meets the stormwater runoff quantity requirements for the Village of Menomonee Falls based on the as-built information included in the inspection report and the attached hydraulic modeling. The results of the calculations are summarized as follows:

|                       | 2-Year Peak<br>Flow (cfs) | 100-Year Peak<br>Flow (cfs) |
|-----------------------|---------------------------|-----------------------------|
| Village Requirements* | 0.44                      | 1.48                        |
| Basin As-Built        | 0.29                      | 0.68                        |

\*Based on a site of 2.95 acres and maximum runoff of release rate of 0.15 and 0.50 cfs/acre for the 2- and 100-year, 24-hour events, respectively.

Should you have any further questions, please contact me at 262.241.4466 or joellen.donovan@bonestroo.com.

Sincerely,

BONESTROO

JoEllen Donovan, PE, CFM  
Staff Engineer  
262-643-9014





Village of Menomonee Falls  
 W156 N8480 Pilgrim Road  
 Menomonee Falls, WI 53051-3140  
 Telephone: (262) 532-4200

# STORMWATER MANAGEMENT FACILITIES OPERATION AND INSPECTION REPORT

Quarter Section  
 Property Tax ID Number

SW 1/4 Sec 19

Name of Business/Subdivision  
 Address of Property

Willow Springs School  
 W 220 N 16660 Town Line Rd  
 Menomonee Falls, WI 53051

|          |                                     |
|----------|-------------------------------------|
| Dry Pond | <input checked="" type="checkbox"/> |
| Wet Pond | <input type="checkbox"/>            |
| Other    | <input type="checkbox"/>            |

Location Of  
 Pond

SE corner of property

Description:

Year Pond Constructed

2005

Year of Last Certification

NA

| Compliance Verification                           | Design  | Actual | Compliant<br>Yes No | Comments<br>(Condition of Structure) |
|---------------------------------------------------|---------|--------|---------------------|--------------------------------------|
| <i>Primary Outlet Pipe</i>                        |         |        |                     |                                      |
| Opening Diameter                                  | 8"      | 8"     | ✓                   |                                      |
| Upstream Invert                                   | 860     | 859.26 | ✓                   |                                      |
| Downstream Invert                                 | unknown | 857.82 | ✓                   |                                      |
| Length                                            | unknown | 31'    | ✓                   |                                      |
| Slope                                             | unknown | 4.65%  | ✓                   |                                      |
| <i>Secondary Outlet Pipe</i><br>(If Applicable)   |         |        |                     |                                      |
| Opening Diameter                                  |         |        |                     |                                      |
| Upstream Invert                                   |         |        |                     |                                      |
| Downstream Invert                                 |         |        |                     |                                      |
| Length                                            |         |        |                     |                                      |
| Slope                                             |         |        |                     |                                      |
| <i>Riser</i><br>(If Applicable)                   |         |        |                     |                                      |
| Opening Diameter                                  |         |        |                     |                                      |
| Elevation                                         |         |        |                     |                                      |
| <i>Upper Discharge Control</i><br>(If Applicable) |         |        |                     |                                      |
| Opening Diameter                                  | 4"      | 4"     | ✓                   |                                      |
| Elevation                                         | 860     | 859.26 | ✓                   |                                      |



| Compliance Verification                                | Design          | Actual | Compliant |    | Comments        |                |
|--------------------------------------------------------|-----------------|--------|-----------|----|-----------------|----------------|
|                                                        |                 |        | Yes       | No |                 |                |
| <i>Lower Discharge Control</i>                         | (If Applicable) |        |           |    |                 |                |
| Opening Diameter                                       |                 |        |           |    |                 |                |
| Elevation                                              |                 |        |           |    |                 |                |
| <i>Other (Description)</i>                             |                 |        |           |    |                 |                |
| Opening Type                                           |                 |        |           |    |                 |                |
| Elevation                                              |                 |        |           |    |                 |                |
| <i>Emergency Spillway</i>                              |                 |        |           |    |                 |                |
| Elevation                                              | 862             | 862    | ✓         |    |                 |                |
| Length of spillway                                     | unknown         | 45'    | ✓         |    |                 |                |
| <i>Embankment</i>                                      |                 |        | Present   |    |                 |                |
|                                                        |                 |        | Yes       | No |                 |                |
| Unauthorized plantings, trees, or woody vegetation     |                 |        |           |    |                 |                |
| Animal burrows or slope erosion                        |                 |        |           |    |                 |                |
| Storage Properties                                     | Design          | Actual | Compliant |    | Points Surveyed | Equipment Used |
|                                                        | Yes             | No     |           |    |                 |                |
| Normal Water Elevation<br>(Wet Ponds)                  | NA              | NA     |           |    |                 |                |
| Design High Water Elevation                            | 861.23          | 861.63 | ✓         |    |                 |                |
| Area at Normal Water Elevation (Ac) (Wet Ponds)        | NA              | NA     |           |    |                 |                |
| Area at Design High Water Elevation (Ac)               | unknown         | 0.503  | ✓         |    |                 |                |
| Active Storage Available (Ac-Ft)*                      | 0.78            | 0.66   | ✓         |    |                 |                |
| Lowest Elevation at Top of Embankment (If Applicable)  | 863             | 862.60 | ✓         |    |                 |                |
| Average Elevation at Top of Embankment (If Applicable) | 863             | 863.52 | ✓         |    |                 |                |
| Maximum Bottom Elevation                               | 860             | 859.22 | ✓         |    |                 |                |
| Average Pond Bottom Elevation                          | 860             | 859.85 | ✓         |    |                 |                |
| Pond Bottom Area (Ac)                                  | unknown         | 0.2    | ✓         |    |                 |                |
| Maximum Pond Depth                                     | 3'              | 43'    | ✓         |    |                 |                |
| Average Pond Depth                                     | 3'              | 3.67   | ✓         |    |                 |                |

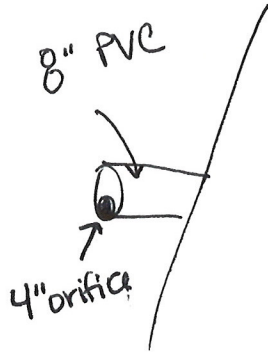
\*To Determine Active Storage  $V = H/3(A1 + A2 + (A1 \times A2)^{1/2})$

Wet Ponds Use  $H$  = Height of Section,  $A1$  = area at normal water elevation,  $A2$  = area at top section

Dry Ponds Use  $H$  = Height of Section,  $A1$  = pond bottom area,  $A2$  = area at top section



Sketch Outlet



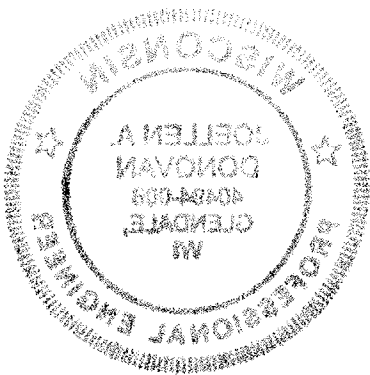
Inspection Firm: Bonestroo Inspector Name: James Erickson  
Phone Number: 262-241-4466 Inspection Date: \_\_\_\_\_  
Address: 12075 Corporate Parkway  
Suite 200  
Mequon, WI 53092

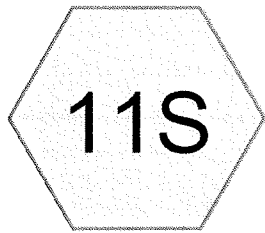
Certifying  
Professional Name: JoEllen Donovan  
Phone Number: 262-643-9014

Date: 10/22/10

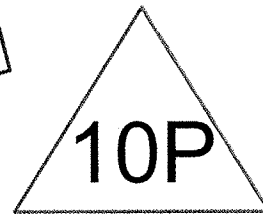
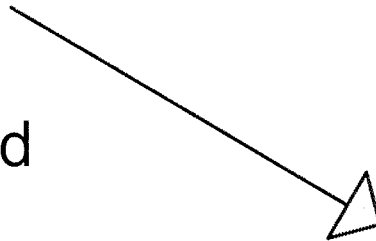
Signature: JoEllen Donovan



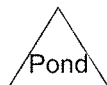
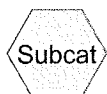




Watershed



Dry Pond



## Pond Certification

Prepared by Bonestroo

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Type II 24-hr 2 Rainfall=2.60"

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Page 2

### Summary for Subcatchment 11S: Watershed

Runoff = 5.67 cfs @ 11.98 hrs, Volume= 0.263 af, Depth> 1.07"

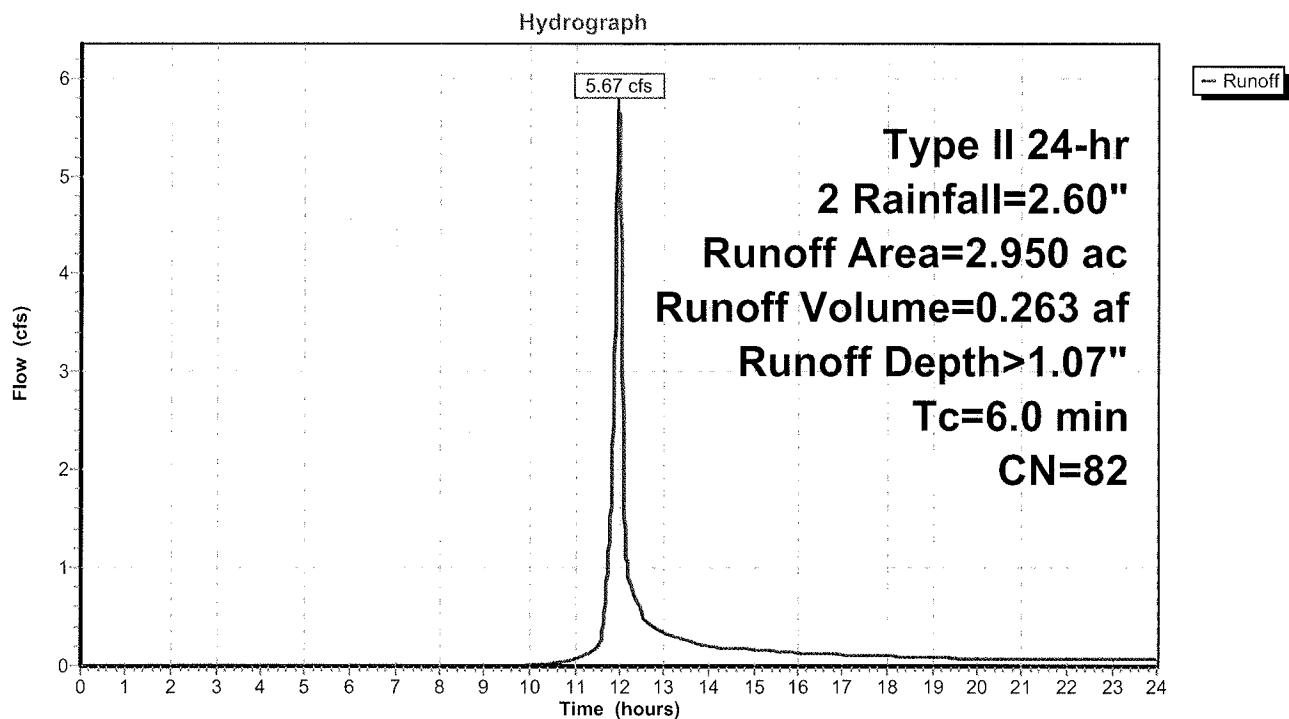
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type II 24-hr 2 Rainfall=2.60"

| Area (ac) | CN | Description           |
|-----------|----|-----------------------|
| * 2.950   | 82 |                       |
| 2.950     |    | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description   |
|----------|---------------|---------------|-------------------|----------------|---------------|
| 6.0      |               |               |                   |                | Direct Entry, |

### Subcatchment 11S: Watershed



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Type II 24-hr 2 Rainfall=2.60"

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Page 3

**Summary for Pond 10P: Dry Pond**

Inflow Area = 2.950 ac, 0.00% Impervious, Inflow Depth > 1.07" for 2 event  
 Inflow = 5.67 cfs @ 11.98 hrs, Volume= 0.263 af  
 Outflow = 0.29 cfs @ 13.25 hrs, Volume= 0.215 af, Atten= 95%, Lag= 76.3 min  
 Primary = 0.29 cfs @ 13.25 hrs, Volume= 0.215 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 859.91' @ 13.25 hrs Surf.Area= 0.214 ac Storage= 0.134 af

Plug-Flow detention time= 259.4 min calculated for 0.215 af (82% of inflow)  
 Center-of-Mass det. time= 179.5 min ( 1,022.0 - 842.5 )

| Volume | Invert  | Avail.Storage | Storage Description                                        |
|--------|---------|---------------|------------------------------------------------------------|
| #1     | 859.26' | 2.157 af      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(acres) | Inc.Store<br>(acre-feet) | Cum.Store<br>(acre-feet) |
|---------------------|----------------------|--------------------------|--------------------------|
| 859.26              | 0.200                | 0.000                    | 0.000                    |
| 860.37              | 0.224                | 0.235                    | 0.235                    |
| 861.34              | 0.446                | 0.325                    | 0.560                    |
| 862.49              | 0.671                | 0.642                    | 1.203                    |
| 863.71              | 0.894                | 0.955                    | 2.157                    |

| Device | Routing  | Invert  | Outlet Devices                                                                                                                                                                                                |
|--------|----------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary  | 859.26' | <b>8.0" Round Culvert</b><br>L= 31.0' CPP, end-section conforming to fill, Ke= 0.500<br>Inlet / Outlet Invert= 859.26' / 857.82' S= 0.0465 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf |
| #2     | Device 1 | 859.26' | <b>4.0" Vert. Orifice/Grate</b> C= 0.600                                                                                                                                                                      |

**Primary OutFlow** Max=0.29 cfs @ 13.25 hrs HW=859.91' (Free Discharge)

↑ **1=Culvert** (Passes 0.29 cfs of 0.95 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.29 cfs @ 3.33 fps)

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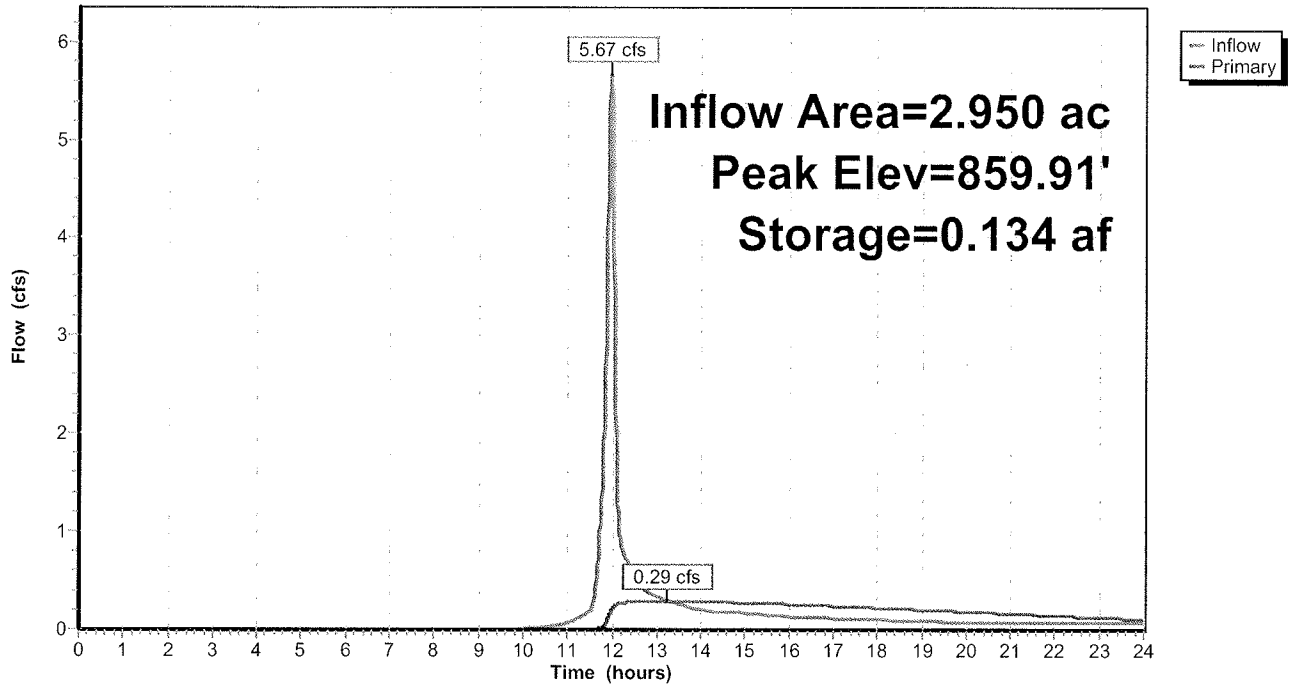
Type II 24-hr 2 Rainfall=2.60"

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Page 4

### Pond 10P: Dry Pond

Hydrograph



## Pond Certification

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Type II 24-hr 10 Rainfall=4.00"

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Page 5

### Summary for Subcatchment 11S: Watershed

Runoff = 11.54 cfs @ 11.97 hrs, Volume= 0.541 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

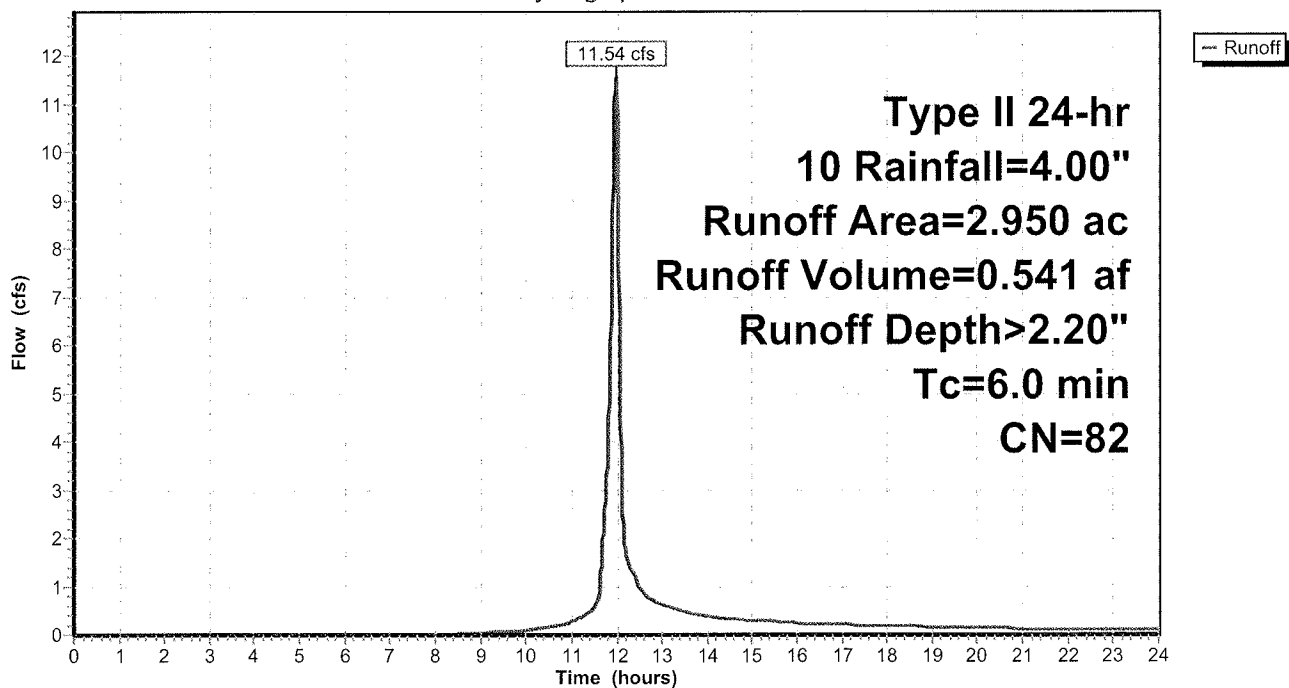
Type II 24-hr 10 Rainfall=4.00"

| Area (ac) | CN | Description           |
|-----------|----|-----------------------|
| * 2.950   | 82 |                       |
| 2.950     |    | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description   |
|----------|---------------|---------------|-------------------|----------------|---------------|
| 6.0      |               |               |                   |                | Direct Entry, |

### Subcatchment 11S: Watershed

Hydrograph



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Type II 24-hr 10 Rainfall=4.00"

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Page 6

### Summary for Pond 10P: Dry Pond

Inflow Area = 2.950 ac, 0.00% Impervious, Inflow Depth > 2.20" for 10 event  
Inflow = 11.54 cfs @ 11.97 hrs, Volume= 0.541 af  
Outflow = 0.47 cfs @ 13.53 hrs, Volume= 0.407 af, Atten= 96%, Lag= 93.5 min  
Primary = 0.47 cfs @ 13.53 hrs, Volume= 0.407 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Peak Elev= 860.65' @ 13.53 hrs Surf.Area= 0.289 ac Storage= 0.308 af

Plug-Flow detention time= 315.6 min calculated for 0.407 af (75% of inflow)  
Center-of-Mass det. time= 222.7 min ( 1,044.5 - 821.8 )

| Volume | Invert  | Avail.Storage | Storage Description                                        |
|--------|---------|---------------|------------------------------------------------------------|
| #1     | 859.26' | 2.157 af      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(acres) | Inc.Store<br>(acre-feet) | Cum.Store<br>(acre-feet) |
|---------------------|----------------------|--------------------------|--------------------------|
| 859.26              | 0.200                | 0.000                    | 0.000                    |
| 860.37              | 0.224                | 0.235                    | 0.235                    |
| 861.34              | 0.446                | 0.325                    | 0.560                    |
| 862.49              | 0.671                | 0.642                    | 1.203                    |
| 863.71              | 0.894                | 0.955                    | 2.157                    |

| Device | Routing  | Invert  | Outlet Devices                                                                                                                                                                                                |
|--------|----------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary  | 859.26' | <b>8.0" Round Culvert</b><br>L= 31.0' CPP, end-section conforming to fill, Ke= 0.500<br>Inlet / Outlet Invert= 859.26' / 857.82' S= 0.0465 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf |
| #2     | Device 1 | 859.26' | <b>4.0" Vert. Orifice/Grate</b> C= 0.600                                                                                                                                                                      |

**Primary OutFlow** Max=0.47 cfs @ 13.53 hrs HW=860.65' (Free Discharge)

↑ **1=Culvert** (Passes 0.47 cfs of 1.73 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.47 cfs @ 5.33 fps)

# Pond Certification

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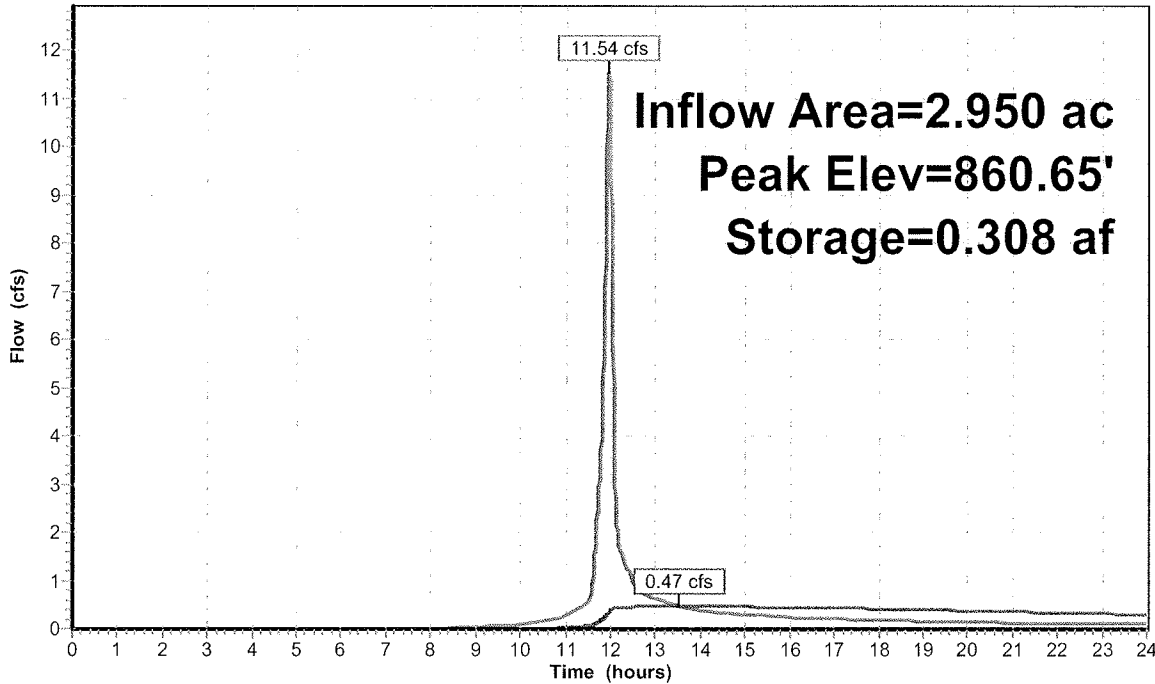
Type II 24-hr 10 Rainfall=4.00"

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Page 7

## Pond 10P: Dry Pond

Hydrograph



Inflow  
Primary

## Pond Certification

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Type II 24-hr 50 Rainfall=5.80"

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Page 8

### Summary for Subcatchment 11S: Watershed

Runoff = 19.47 cfs @ 11.97 hrs, Volume= 0.934 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

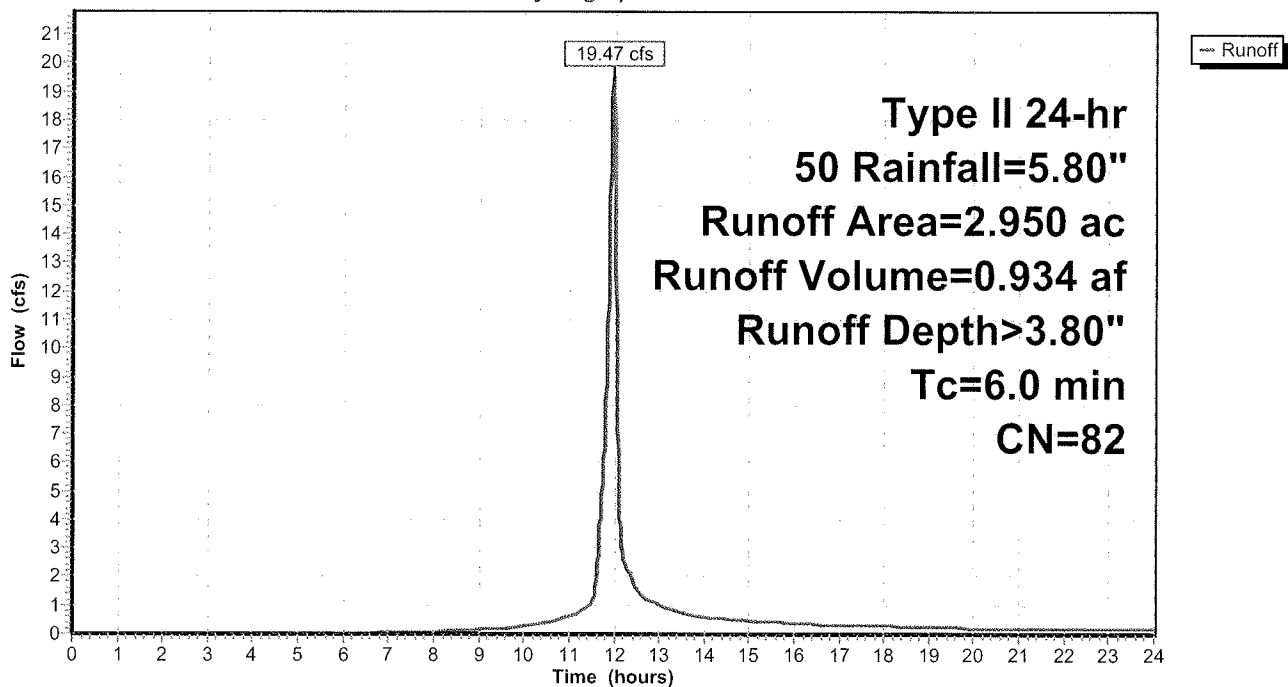
Type II 24-hr 50 Rainfall=5.80"

| Area (ac) | CN | Description           |
|-----------|----|-----------------------|
| * 2.950   | 82 |                       |
| 2.950     |    | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description   |
|----------|---------------|---------------|-------------------|----------------|---------------|
| 6.0      |               |               |                   |                | Direct Entry, |

### Subcatchment 11S: Watershed

Hydrograph



## Pond Certification

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Type II 24-hr 50 Rainfall=5.80"

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Page 9

### Summary for Pond 10P: Dry Pond

Inflow Area = 2.950 ac, 0.00% Impervious, Inflow Depth > 3.80" for 50 event  
Inflow = 19.47 cfs @ 11.97 hrs, Volume= 0.934 af  
Outflow = 0.59 cfs @ 14.03 hrs, Volume= 0.579 af, Atten= 97%, Lag= 123.3 min  
Primary = 0.59 cfs @ 14.03 hrs, Volume= 0.579 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Peak Elev= 861.37' @ 14.03 hrs Surf.Area= 0.452 ac Storage= 0.575 af

Plug-Flow detention time= 350.1 min calculated for 0.579 af (62% of inflow)  
Center-of-Mass det. time= 244.5 min ( 1,050.8 - 806.3 )

| Volume | Invert  | Avail.Storage | Storage Description                                        |
|--------|---------|---------------|------------------------------------------------------------|
| #1     | 859.26' | 2.157 af      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(acres) | Inc.Store<br>(acre-feet) | Cum.Store<br>(acre-feet) |
|---------------------|----------------------|--------------------------|--------------------------|
| 859.26              | 0.200                | 0.000                    | 0.000                    |
| 860.37              | 0.224                | 0.235                    | 0.235                    |
| 861.34              | 0.446                | 0.325                    | 0.560                    |
| 862.49              | 0.671                | 0.642                    | 1.203                    |
| 863.71              | 0.894                | 0.955                    | 2.157                    |

| Device | Routing  | Invert  | Outlet Devices                                                                                                                                                                                                |
|--------|----------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary  | 859.26' | <b>8.0" Round Culvert</b><br>L= 31.0' CPP, end-section conforming to fill, Ke= 0.500<br>Inlet / Outlet Invert= 859.26' / 857.82' S= 0.0465 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf |
| #2     | Device 1 | 859.26' | <b>4.0" Vert. Orifice/Grate</b> C= 0.600                                                                                                                                                                      |

**Primary OutFlow** Max=0.59 cfs @ 14.03 hrs HW=861.37' (Free Discharge)

↑ **1=Culvert** (Passes 0.59 cfs of 2.24 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.59 cfs @ 6.72 fps)

## Pond Certification

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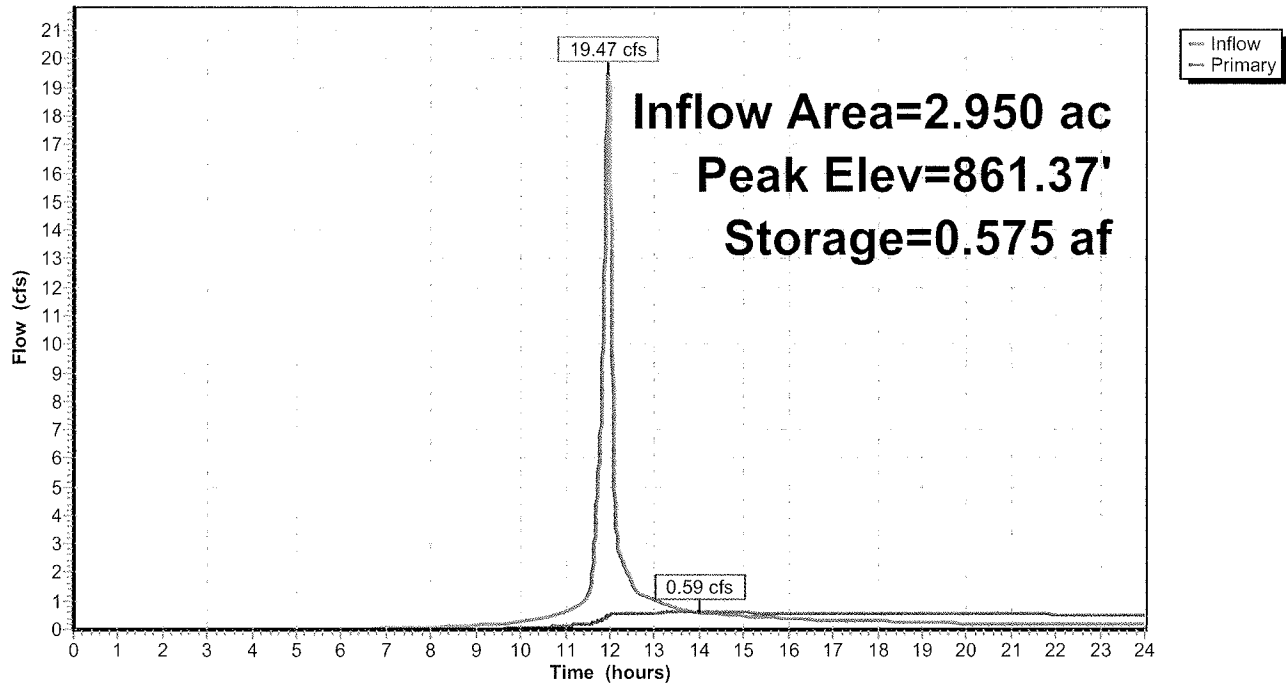
Type II 24-hr 50 Rainfall=5.80"

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Page 10

### Pond 10P: Dry Pond

Hydrograph



## Pond Certification

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Type II 24-hr 100 Rainfall=7.90"

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Page 11

### Summary for Subcatchment 11S: Watershed

Runoff = 28.83 cfs @ 11.97 hrs, Volume= 1.415 af, Depth> 5.76"

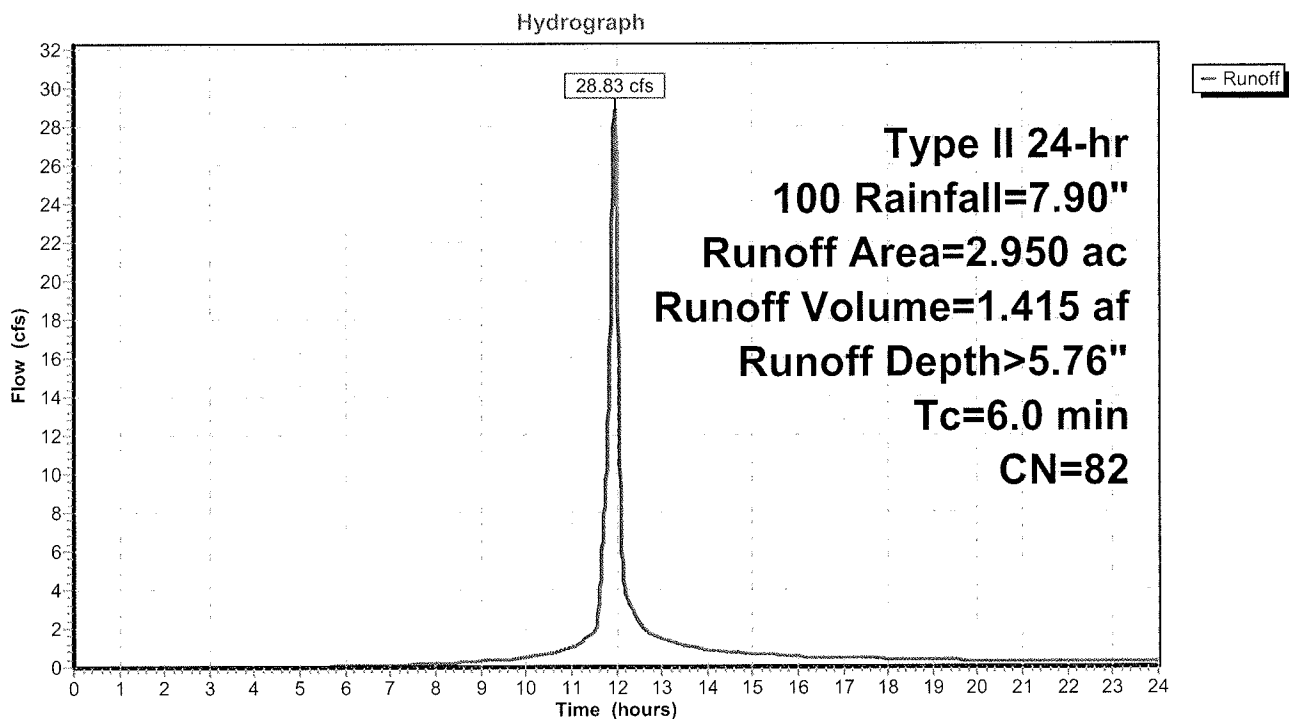
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type II 24-hr 100 Rainfall=7.90"

| Area (ac) | CN | Description           |
|-----------|----|-----------------------|
| * 2.950   | 82 |                       |
| 2.950     |    | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description   |
|----------|---------------|---------------|-------------------|----------------|---------------|
| 6.0      |               |               |                   |                | Direct Entry, |

### Subcatchment 11S: Watershed



## Pond Certification

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Type II 24-hr 100 Rainfall=7.90"

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Page 12

### Summary for Pond 10P: Dry Pond

Inflow Area = 2.950 ac, 0.00% Impervious, Inflow Depth > 5.76" for 100 event  
Inflow = 28.83 cfs @ 11.97 hrs, Volume= 1.415 af  
Outflow = 0.68 cfs @ 14.95 hrs, Volume= 0.713 af, Atten= 98%, Lag= 178.9 min  
Primary = 0.68 cfs @ 14.95 hrs, Volume= 0.713 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Peak Elev= 862.04' @ 14.95 hrs Surf.Area= 0.583 ac Storage= 0.921 af

Plug-Flow detention time= 358.3 min calculated for 0.713 af (50% of inflow)  
Center-of-Mass det. time= 246.5 min ( 1,041.1 - 794.6 )

| Volume | Invert  | Avail.Storage | Storage Description                                        |
|--------|---------|---------------|------------------------------------------------------------|
| #1     | 859.26' | 2.157 af      | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(acres) | Inc.Store<br>(acre-feet) | Cum.Store<br>(acre-feet) |
|---------------------|----------------------|--------------------------|--------------------------|
| 859.26              | 0.200                | 0.000                    | 0.000                    |
| 860.37              | 0.224                | 0.235                    | 0.235                    |
| 861.34              | 0.446                | 0.325                    | 0.560                    |
| 862.49              | 0.671                | 0.642                    | 1.203                    |
| 863.71              | 0.894                | 0.955                    | 2.157                    |

| Device | Routing  | Invert  | Outlet Devices                                                                                                                                                                                                |
|--------|----------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary  | 859.26' | <b>8.0" Round Culvert</b><br>L= 31.0' CPP, end-section conforming to fill, Ke= 0.500<br>Inlet / Outlet Invert= 859.26' / 857.82' S= 0.0465 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf |
| #2     | Device 1 | 859.26' | <b>4.0" Vert. Orifice/Grate</b> C= 0.600                                                                                                                                                                      |

**Primary OutFlow** Max=0.68 cfs @ 14.95 hrs HW=862.04' (Free Discharge)

↑ **1=Culvert** (Passes 0.68 cfs of 2.63 cfs potential flow)  
↑ **2=Orifice/Grate** (Orifice Controls 0.68 cfs @ 7.78 fps)

## Pond Certification

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Type II 24-hr 100 Rainfall=7.90"

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Page 13

### Pond 10P: Dry Pond

Hydrograph

