

STORMWATER CALCULATIONS

**FOR: STEVE McCONNELL
PROPOSED SINGLE FAMILY DWELLING
LOT 4B DONAHUE COURT
NEWBURYPORT, MA**

PREPARED BY:

MILLENNIUM ENGINEERING, INC.
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FEBRUARY 6, 2018



Christopher M. York
2-6-18

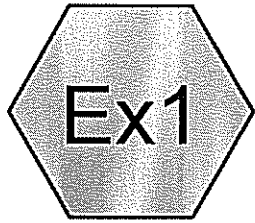
CONCLUSIONS

The results of these calculations indicate the proposed stormwater management systems for the proposed development are capable of storing and treating the runoff for the 2-year, 10-year and 100-year storm events.

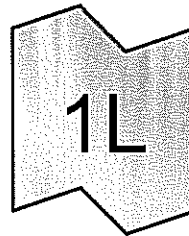
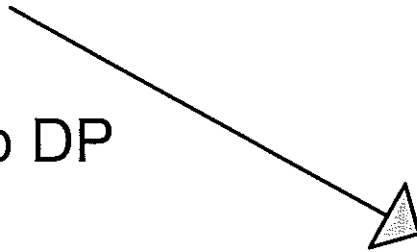
The peak flow rates in this analysis have been conservatively estimated for both the pre- and post-development conditions. Based on the results of the analyses described herein, the proposed development will not increase the runoff rate leaving the site. The proposed storm water management facilities shown on the Site Plan will produce no adverse storm water runoff impacts under the storms analyzed.

| Condition | 2-year | 10-year | 100-year |
|------------------|--------|---------|----------|
| Pre-Development | 2.2 | 5.2 | 13.0 |
| Post Development | 1.7 | 4.5 | 11.1 |

PRE-DEVELOPMENT DRAINAGE CALCULATIONS



Exist. Flow to DP



Design Point



M173263-Existing

Type III 24-hr 2-Year Rainfall=3.10"

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Subcatchment Ex1: Exist. Flow to DP

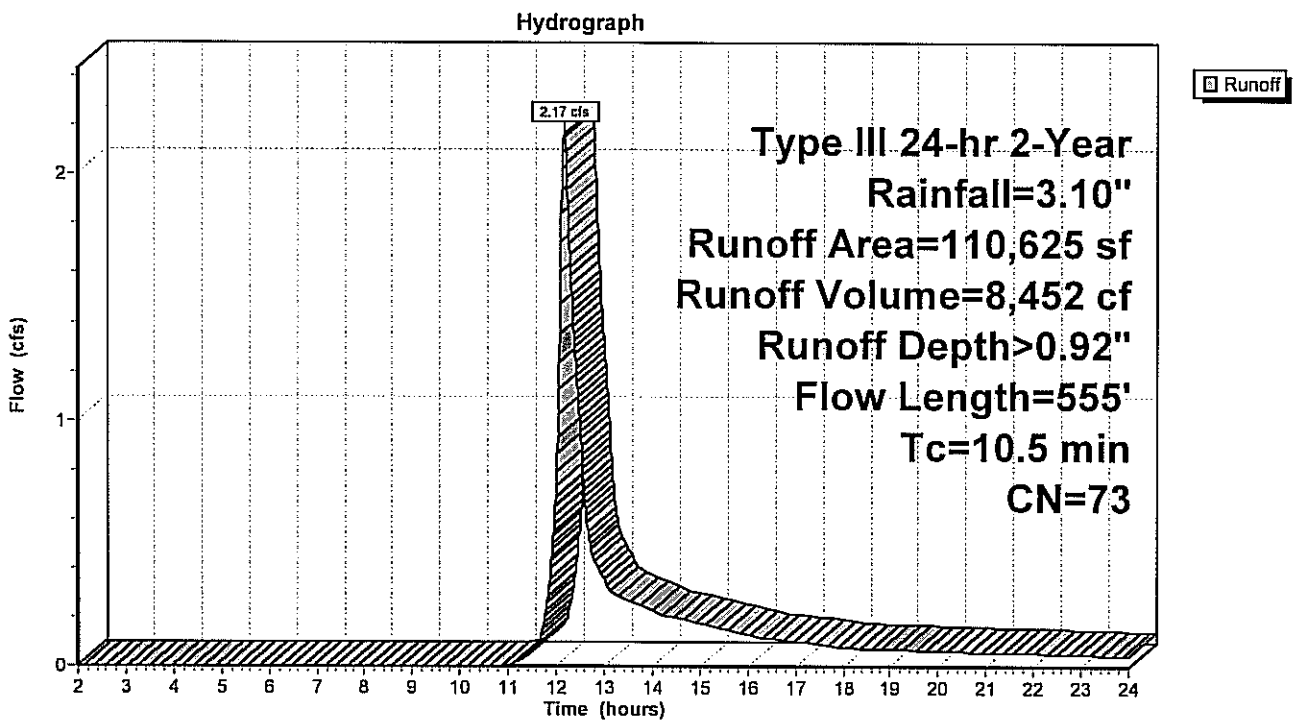
Runoff = 2.17 cfs @ 12.16 hrs, Volume= 8,452 cf, Depth> 0.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

| Area (sf) | CN | Description |
|-----------|----|---------------------------------|
| 2,964 | 98 | Buildings |
| 105 | 98 | Brick Walk |
| 2,633 | 90 | Gravel roads, HSG C/D |
| 51,836 | 76 | Woods, Fair, HSG C/D |
| 5,480 | 36 | Woods, Fair, HSG A |
| 12,187 | 49 | 50-75% Grass cover, Fair, HSG A |
| 35,420 | 79 | 50-75% Grass cover, Fair, HSG C |
| 110,625 | 73 | Weighted Average |
| 107,556 | | Pervious Area |
| 3,069 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 5.4 | 95 | 0.0830 | 0.29 | | Sheet Flow, Grass: Short n= 0.150 P2= 3.10" |
| 0.5 | 130 | 0.0830 | 4.64 | | Shallow Concentrated Flow, Unpaved Kv= 16.1 fps |
| 0.7 | 60 | 0.0830 | 1.44 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 0.5 | 40 | 0.0830 | 1.44 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 3.4 | 230 | 0.0500 | 1.12 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 10.5 | 555 | Total | | | |

Subcatchment Ex1: Exist. Flow to DP



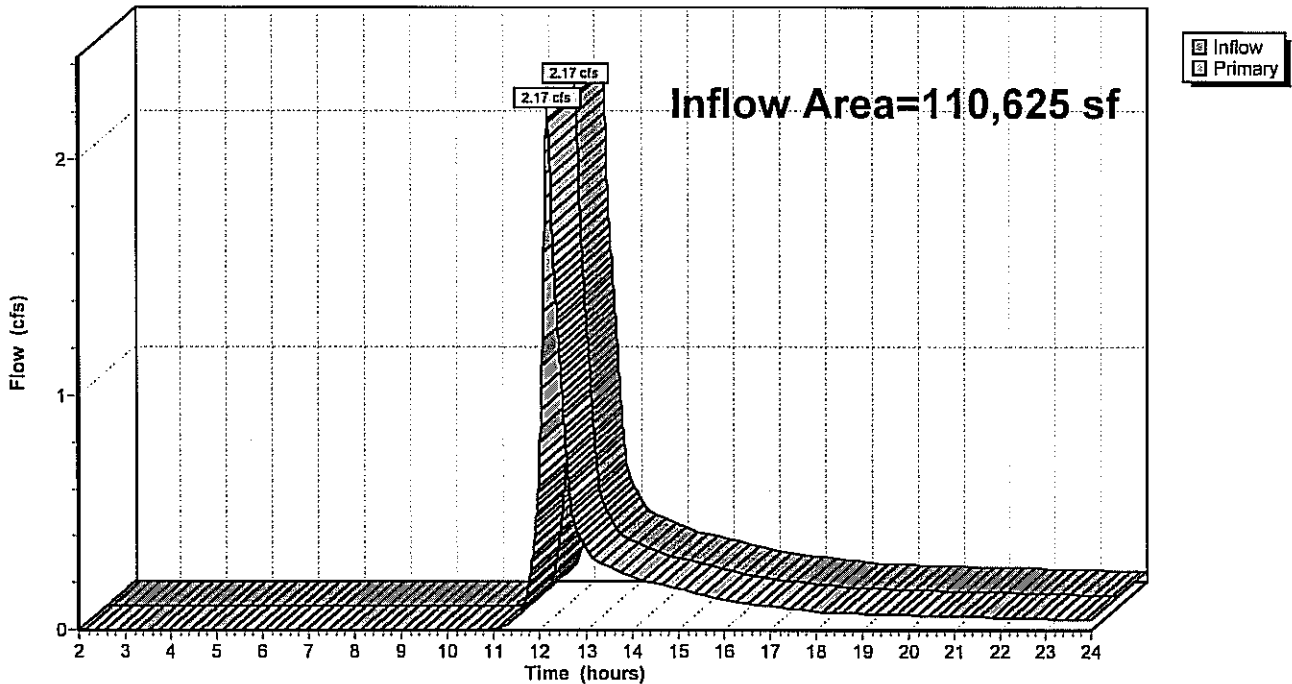
Link 1L: Design Point

Inflow Area = 110,625 sf, Inflow Depth > 0.92" for 2-Year event
Inflow = 2.17 cfs @ 12.16 hrs, Volume= 8,452 cf
Primary = 2.17 cfs @ 12.16 hrs, Volume= 8,452 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Design Point

Hydrograph



M173263-Existing

Type III 24-hr 10-Year Rainfall=4.70"

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Subcatchment Ex1: Exist. Flow to DP

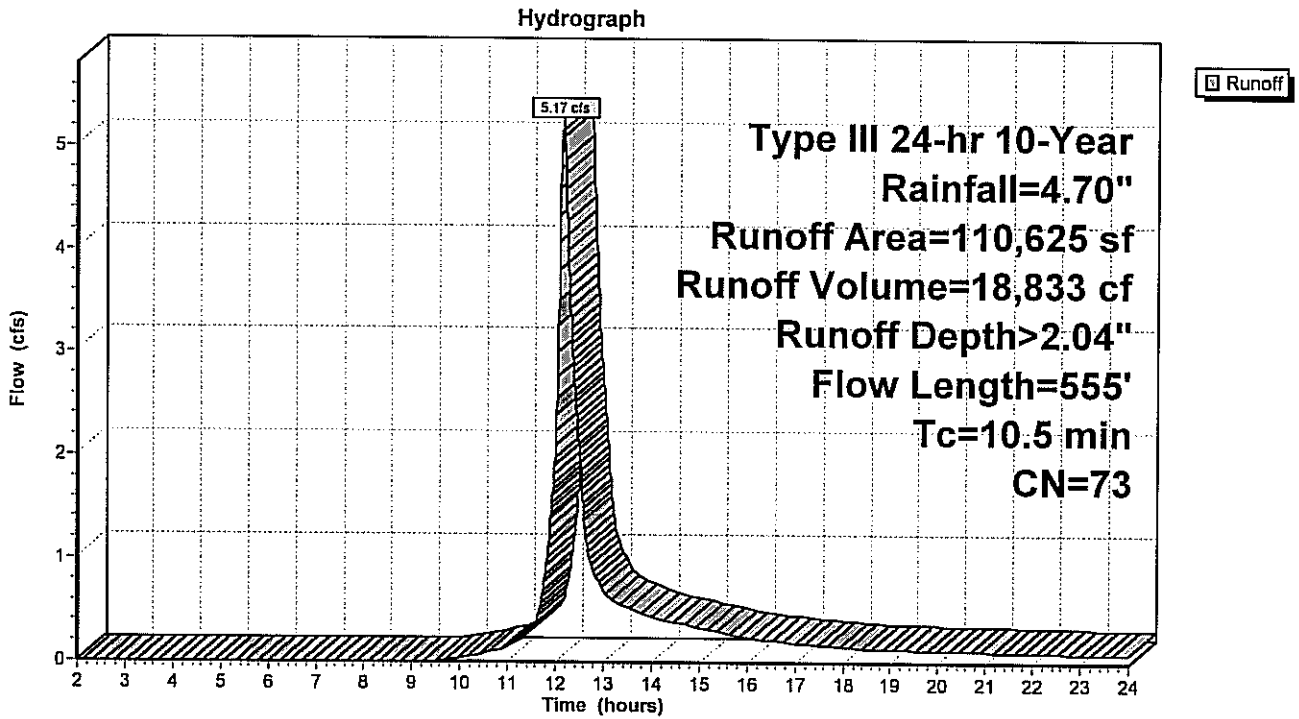
Runoff = 5.17 cfs @ 12.15 hrs, Volume= 18,833 cf, Depth> 2.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.70"

| Area (sf) | CN | Description |
|-----------|----|---------------------------------|
| 2,964 | 98 | Buildings |
| 105 | 98 | Brick Walk |
| 2,633 | 90 | Gravel roads, HSG C/D |
| 51,836 | 76 | Woods, Fair, HSG C/D |
| 5,480 | 36 | Woods, Fair, HSG A |
| 12,187 | 49 | 50-75% Grass cover, Fair, HSG A |
| 35,420 | 79 | 50-75% Grass cover, Fair, HSG C |
| 110,625 | 73 | Weighted Average |
| 107,556 | | Pervious Area |
| 3,069 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 5.4 | 95 | 0.0830 | 0.29 | | Sheet Flow, Grass: Short n= 0.150 P2= 3.10" |
| 0.5 | 130 | 0.0830 | 4.64 | | Shallow Concentrated Flow, Unpaved Kv= 16.1 fps |
| 0.7 | 60 | 0.0830 | 1.44 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 0.5 | 40 | 0.0830 | 1.44 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 3.4 | 230 | 0.0500 | 1.12 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 10.5 | 555 | Total | | | |

Subcatchment Ex1: Exist. Flow to DP



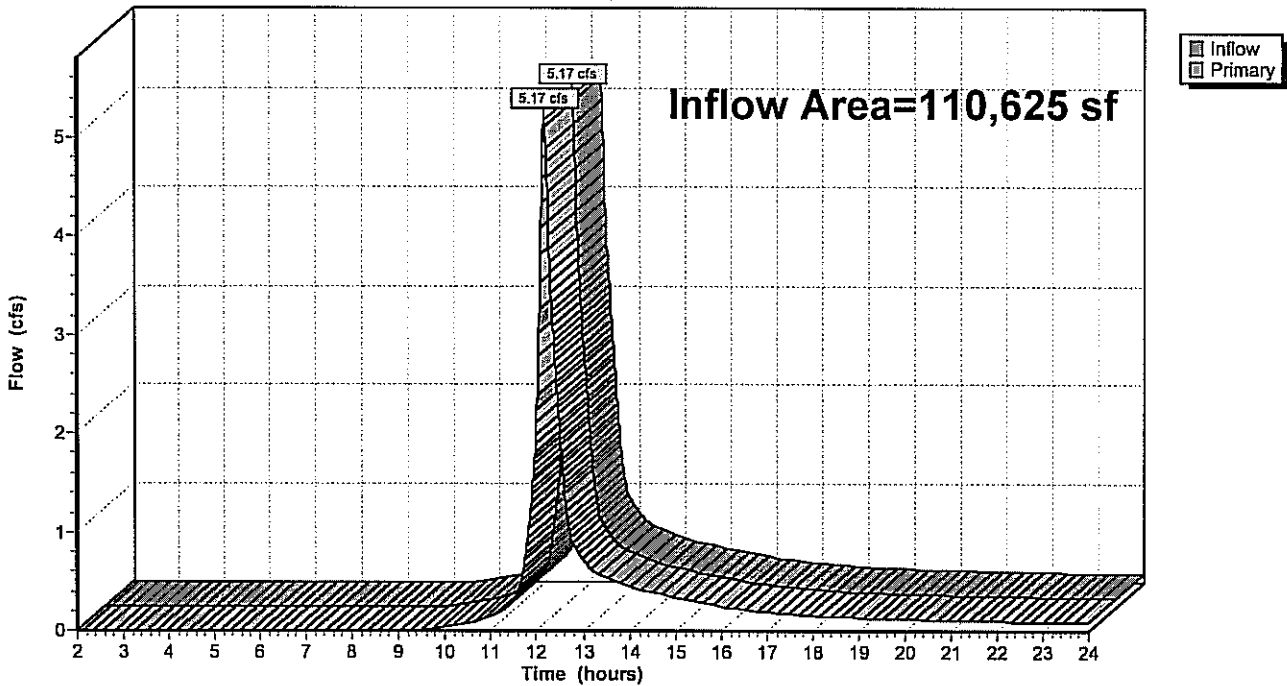
Link 1L: Design Point

Inflow Area = 110,625 sf, Inflow Depth > 2.04" for 10-Year event
Inflow = 5.17 cfs @ 12.15 hrs, Volume= 18,833 cf
Primary = 5.17 cfs @ 12.15 hrs, Volume= 18,833 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Design Point

Hydrograph



M173263-Existing

Type III 24-hr 100-Year Rainfall=8.30"

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Subcatchment Ex1: Exist. Flow to DP

Runoff = 12.98 cfs @ 12.15 hrs, Volume= 46,708 cf, Depth> 5.07"

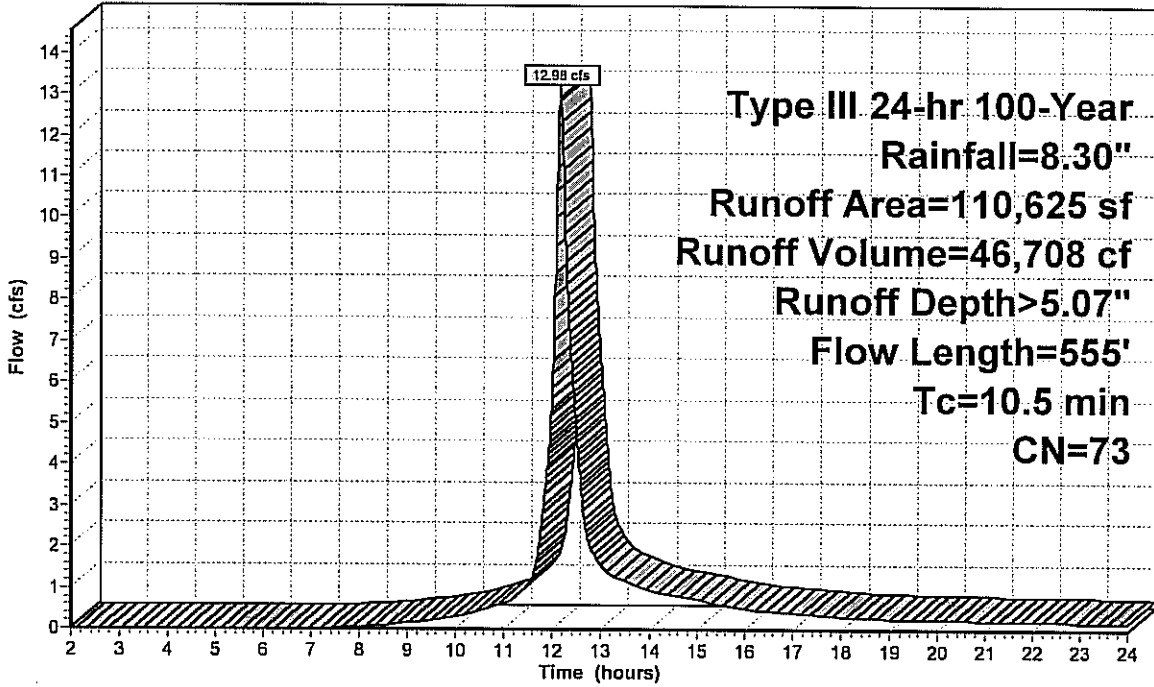
Runoff by SCS TR-20 method, UH=SCS, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.30"

| Area (sf) | CN | Description |
|-----------|----|---------------------------------|
| 2,964 | 98 | Buildings |
| 105 | 98 | Brick Walk |
| 2,633 | 90 | Gravel roads, HSG C/D |
| 51,836 | 76 | Woods, Fair, HSG C/D |
| 5,480 | 36 | Woods, Fair, HSG A |
| 12,187 | 49 | 50-75% Grass cover, Fair, HSG A |
| 35,420 | 79 | 50-75% Grass cover, Fair, HSG C |
| 110,625 | 73 | Weighted Average |
| 107,556 | | Pervious Area |
| 3,069 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 5.4 | 95 | 0.0830 | 0.29 | | Sheet Flow, Grass: Short n= 0.150 P2= 3.10" |
| 0.5 | 130 | 0.0830 | 4.64 | | Shallow Concentrated Flow, Unpaved Kv= 16.1 fps |
| 0.7 | 60 | 0.0830 | 1.44 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 0.5 | 40 | 0.0830 | 1.44 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 3.4 | 230 | 0.0500 | 1.12 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 10.5 | 555 | Total | | | |

Subcatchment Ex1: Exist. Flow to DP

Hydrograph



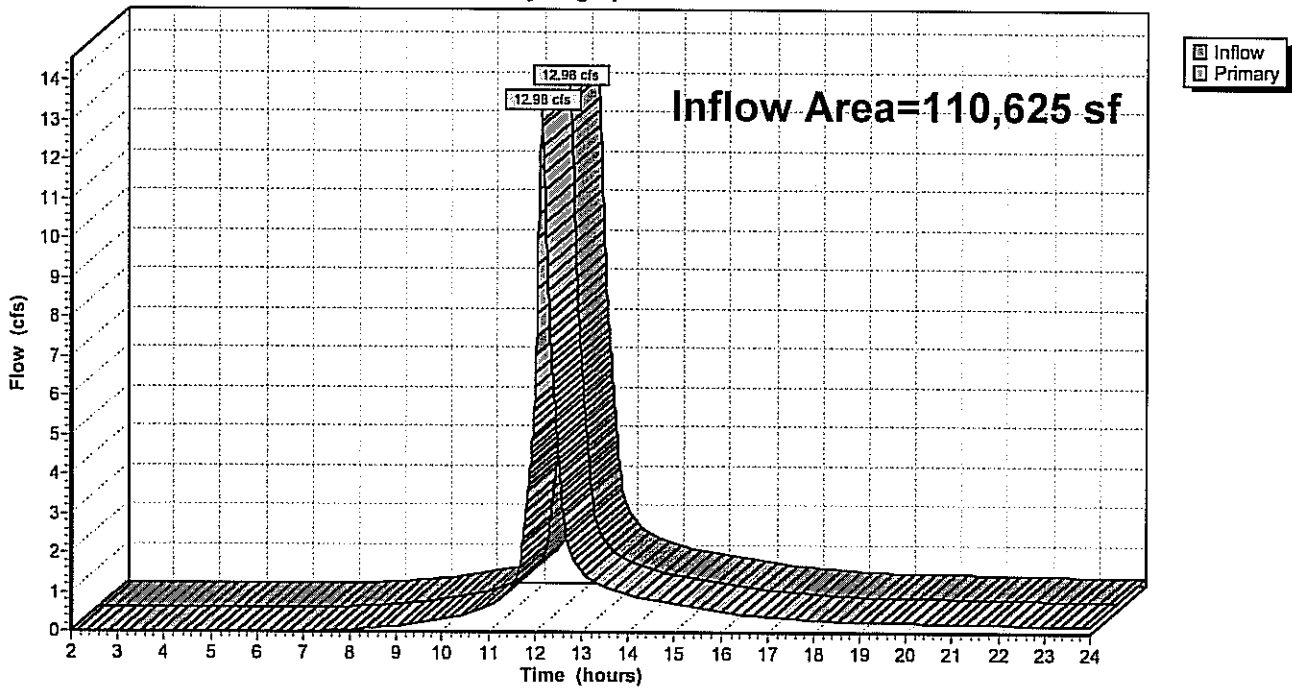
Link 1L: Design Point

Inflow Area = 110,625 sf, Inflow Depth > 5.07" for 100-Year event
Inflow = 12.98 cfs @ 12.15 hrs, Volume= 46,708 cf
Primary = 12.98 cfs @ 12.15 hrs, Volume= 46,708 cf, Atten= 0%, Lag= 0.0 min

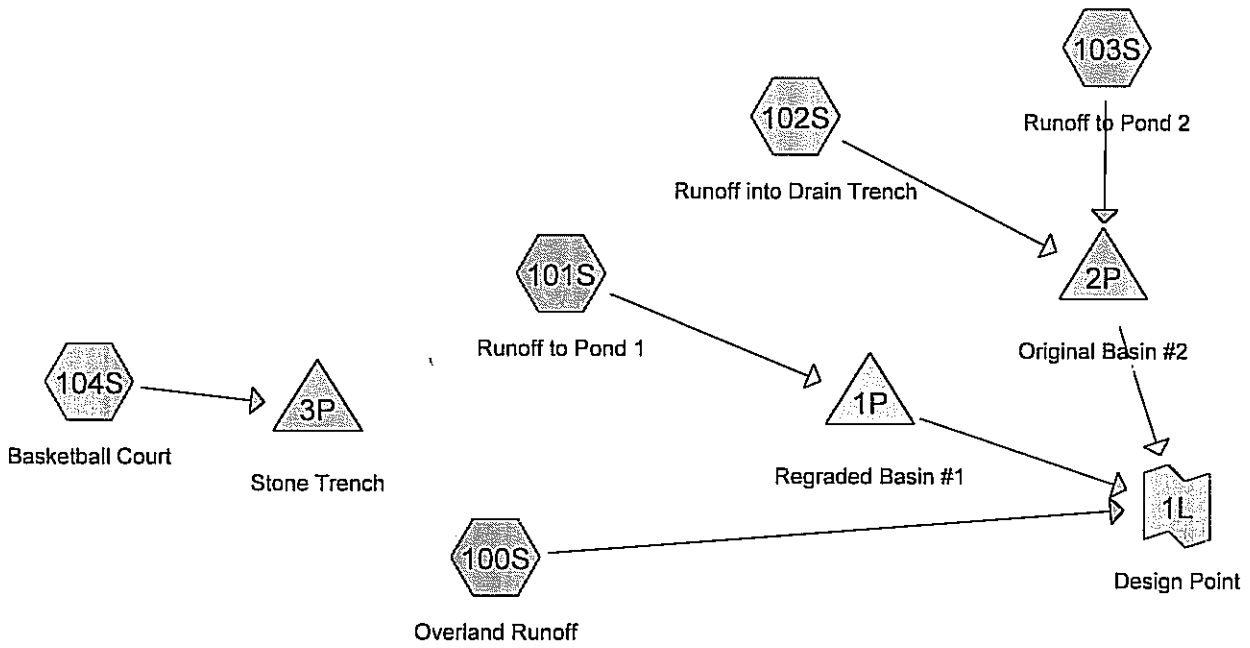
Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Design Point

Hydrograph



POST-DEVELOPMENT DRAINAGE CALCULATIONS



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Subcatchment 100S: Overland Runoff

Runoff = 0.86 cfs @ 12.10 hrs, Volume= 3,026 cf, Depth> 0.77"

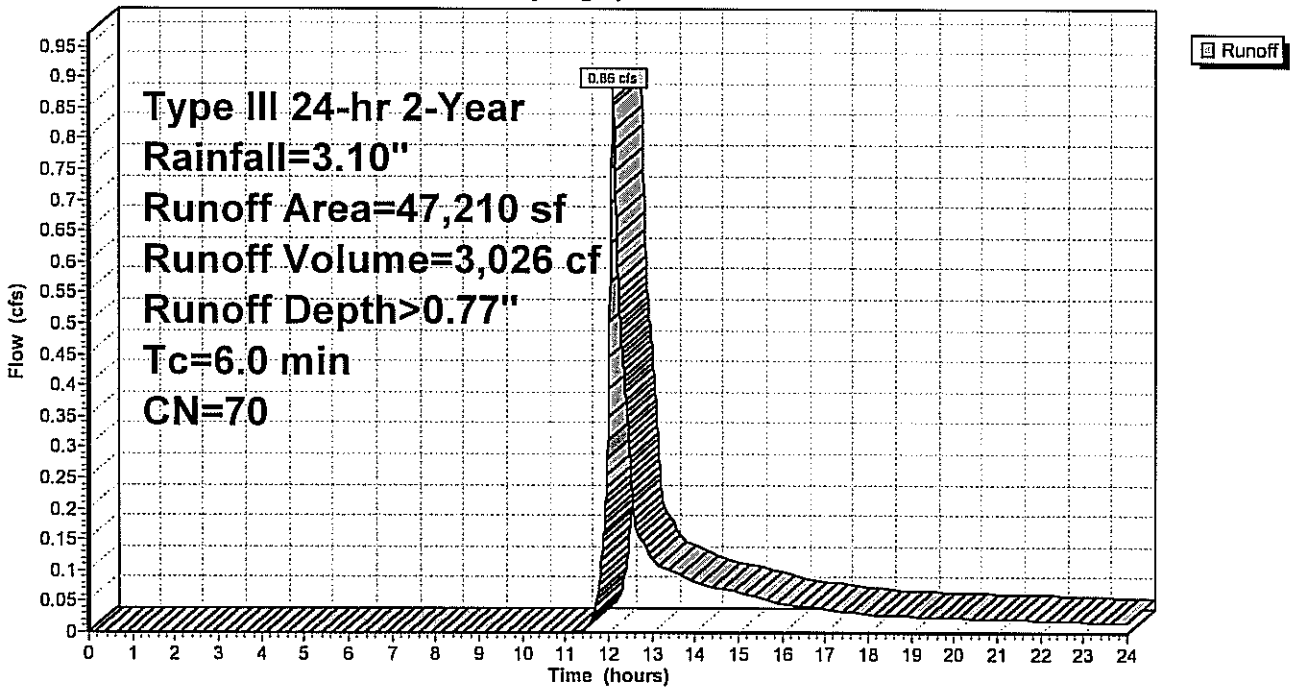
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.10"

| Area (sf) | CN | Description |
|-----------|----|---------------------------------|
| 4,982 | 49 | 50-75% Grass cover, Fair, HSG A |
| 5,379 | 36 | Woods, Fair, HSG A |
| 15,910 | 73 | Woods, Fair, HSG C |
| 14,217 | 74 | >75% Grass cover, Good, HSG C |
| 6,722 | 98 | Impervious Areas |
| 47,210 | 70 | Weighted Average |
| 40,488 | | Pervious Area |
| 6,722 | | Impervious Area |

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

Subcatchment 100S: Overland Runoff

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Subcatchment 101S: Runoff to Pond 1

Runoff = 0.52 cfs @ 12.09 hrs, Volume= 1,616 cf, Depth> 1.53"

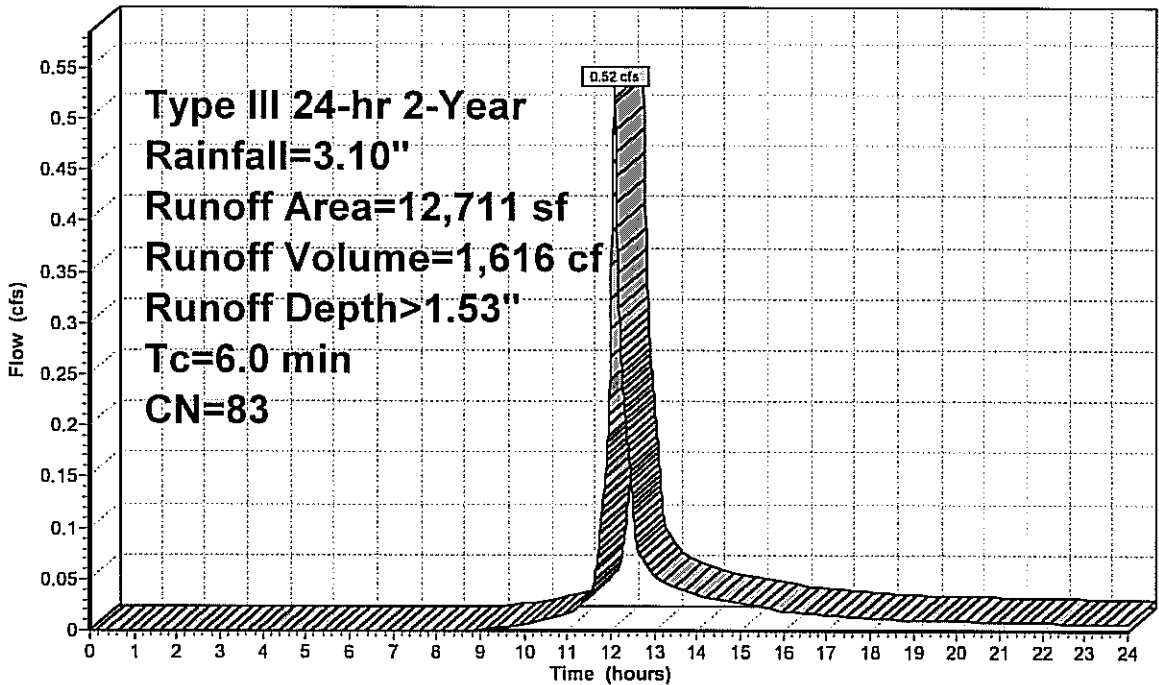
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 6,298 | 74 | >75% Grass cover, Good, HSG C |
| 1,413 | 73 | Woods, Fair, HSG C |
| 5,000 | 98 | Impervious Areas |
| 12,711 | 83 | Weighted Average |
| 7,711 | | Pervious Area |
| 5,000 | | Impervious Area |

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

Subcatchment 101S: Runoff to Pond 1

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Pond 1P: Regraded Basin #1

Inflow Area = 12,711 sf, Inflow Depth > 1.53" for 2-Year event
 Inflow = 0.52 cfs @ 12.09 hrs, Volume= 1,616 cf
 Outflow = 0.29 cfs @ 12.22 hrs, Volume= 1,615 cf, Atten= 44%, Lag= 7.9 min
 Discarded = 0.11 cfs @ 12.22 hrs, Volume= 1,339 cf
 Primary = 0.18 cfs @ 12.22 hrs, Volume= 277 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 56.50' @ 12.22 hrs Surf.Area= 569 sf Storage= 252 cf
 Flood Elev= 58.00' Surf.Area= 1,040 sf Storage= 1,444 cf

Plug-Flow detention time= 8.9 min calculated for 1,615 cf (100% of inflow)
 Center-of-Mass det. time= 8.6 min (842.3 - 833.7)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1 | 56.00' | 1,444 cf | Custom Stage Data (Conic) Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|------------------|-------------------|------------------------|------------------------|------------------|
| 56.00 | 440 | 0 | 0 | 440 |
| 57.00 | 715 | 572 | 572 | 728 |
| 58.00 | 1,040 | 872 | 1,444 | 1,069 |

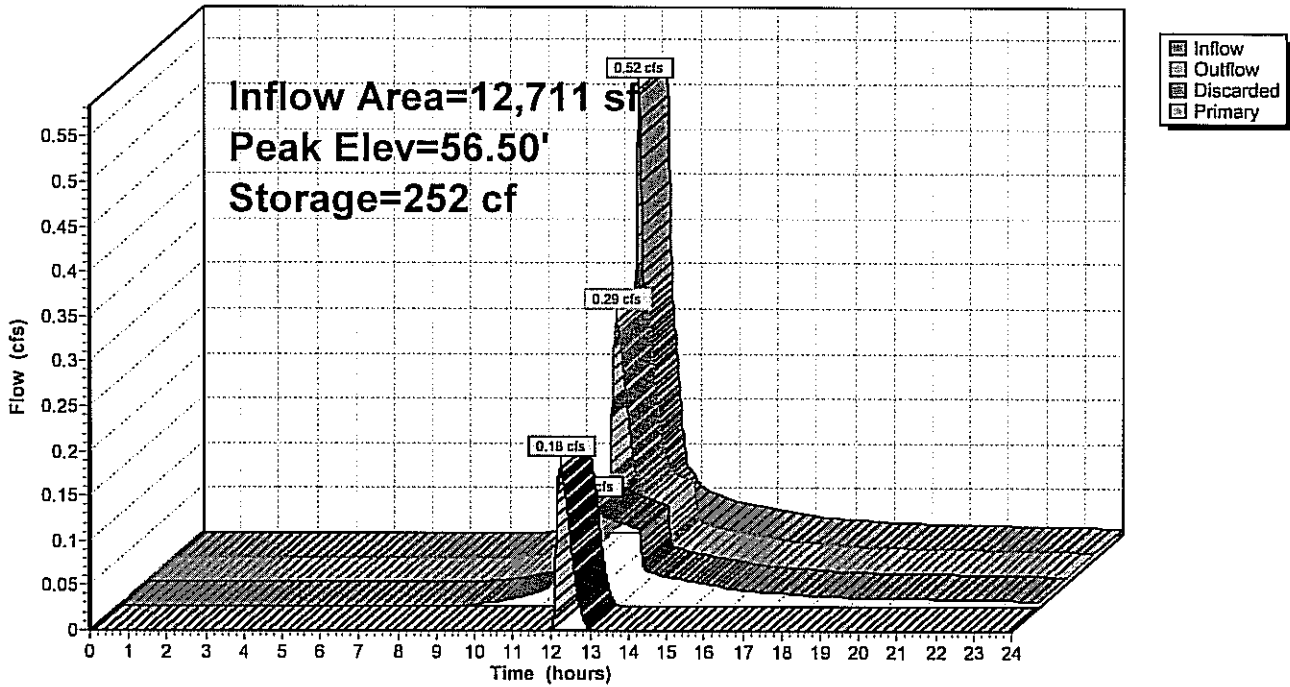
| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 0.00' | 8.270 in/hr Exfiltration over Surface area |
| #2 | Primary | 56.20' | 6.0" x 15.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 56.00' S= 0.0133 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior |

Discarded OutFlow Max=0.11 cfs @ 12.22 hrs HW=56.50' (Free Discharge)
 ↖1=Exfiltration (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.18 cfs @ 12.22 hrs HW=56.50' (Free Discharge)
 ↖2=Culvert (Inlet Controls 0.18 cfs @ 1.47 fps)

Pond 1P: Regraded Basin #1

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Subcatchment 102S: Runoff into Drain Trench

Runoff = 0.74 cfs @ 12.10 hrs, Volume= 2,462 cf, Depth> 0.92"

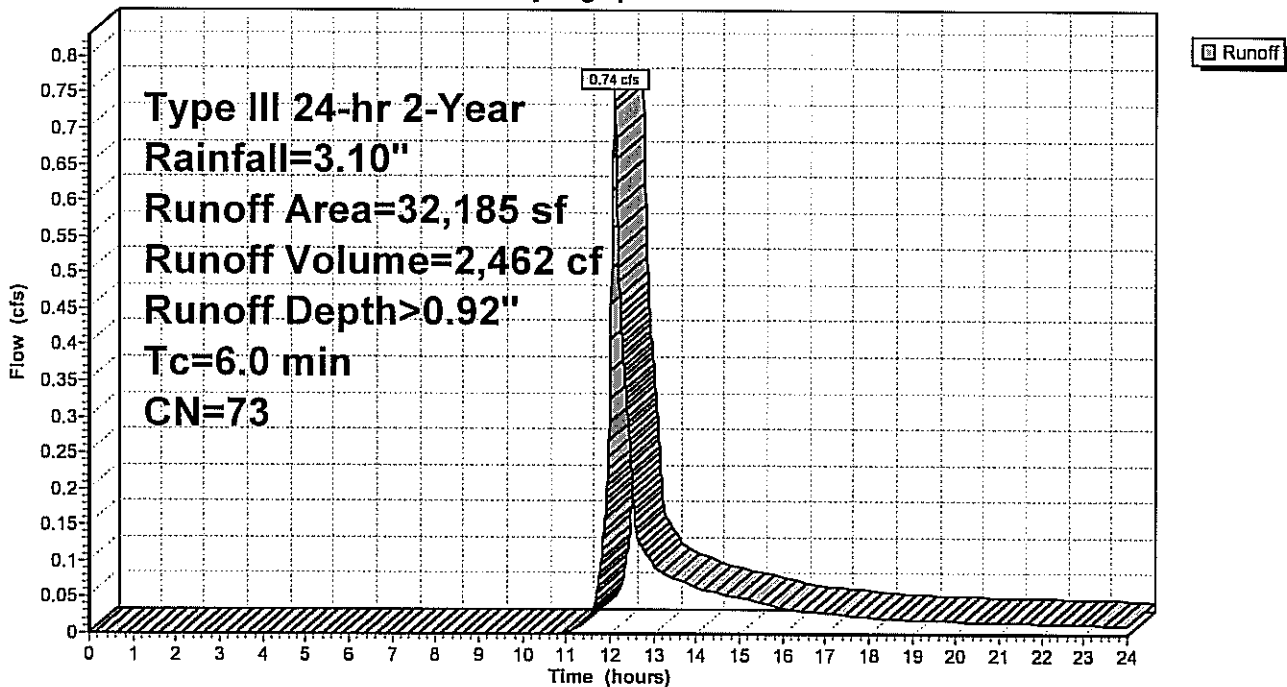
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.10"

| Area (sf) | CN | Description |
|-----------|----|---------------------------------|
| 7,276 | 49 | 50-75% Grass cover, Fair, HSG A |
| 12,022 | 79 | 50-75% Grass cover, Fair, HSG C |
| 2,220 | 74 | >75% Grass cover, Good, HSG C |
| 6,817 | 73 | Woods, Fair, HSG C |
| 3,850 | 98 | Impervious Areas |
| 32,185 | 73 | Weighted Average |
| 28,335 | | Pervious Area |
| 3,850 | | Impervious Area |

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

Subcatchment 102S: Runoff into Drain Trench

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Subcatchment 103S: Runoff to Pond 2

Runoff = 0.19 cfs @ 12.09 hrs, Volume= 587 cf, Depth> 1.20"

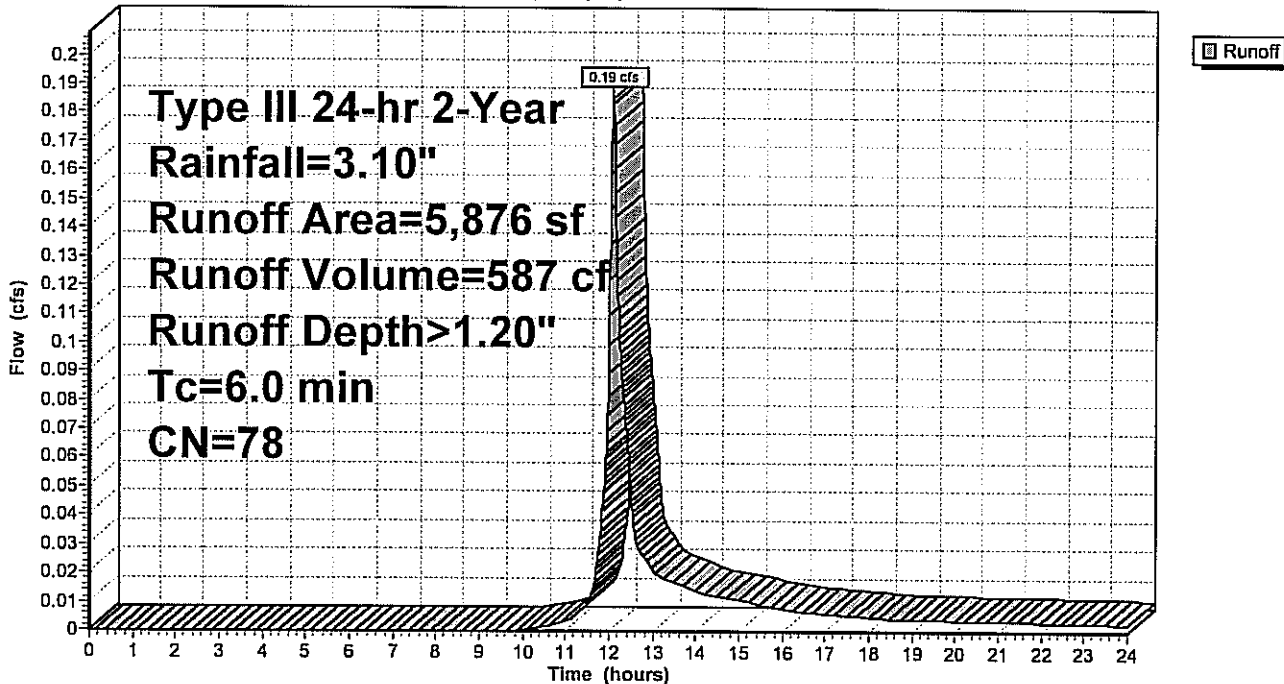
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.10"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 4,776 | 74 | >75% Grass cover, Good, HSG C |
| 1,100 | 98 | Impervious Areas |
| 5,876 | 78 | Weighted Average |
| 4,776 | | Pervious Area |
| 1,100 | | Impervious Area |

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

Subcatchment 103S: Runoff to Pond 2

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Pond 2P: Original Basin #2

Inflow Area = 38,061 sf, Inflow Depth > 0.96" for 2-Year event
 Inflow = 0.93 cfs @ 12.10 hrs, Volume= 3,049 cf
 Outflow = 0.77 cfs @ 12.15 hrs, Volume= 2,994 cf, Atten= 17%, Lag= 3.3 min
 Primary = 0.77 cfs @ 12.15 hrs, Volume= 2,994 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 50.75' @ 12.15 hrs Surf.Area= 381 sf Storage= 219 cf
 Flood Elev= 52.20' Surf.Area= 740 sf Storage= 1,029 cf

Plug-Flow detention time= 16.6 min calculated for 2,994 cf (98% of inflow)
 Center-of-Mass det. time= 6.5 min (869.9 - 863.4)

| Volume | Invert | Avail.Storage | Storage Description |
|----------------------------|-----------------------------|----------------------------------|--|
| #1 | 50.00' | 1,029 cf | Custom Stage Data (Conic) Listed below (Recalc) |
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
| 50.00 | 214 | 0 | 0 |
| 51.00 | 448 | 324 | 324 |
| 52.20 | 740 | 706 | 1,029 |
| | | | Wet.Area (sq-ft) |
| | | | 214 |
| | | | 456 |
| | | | 766 |

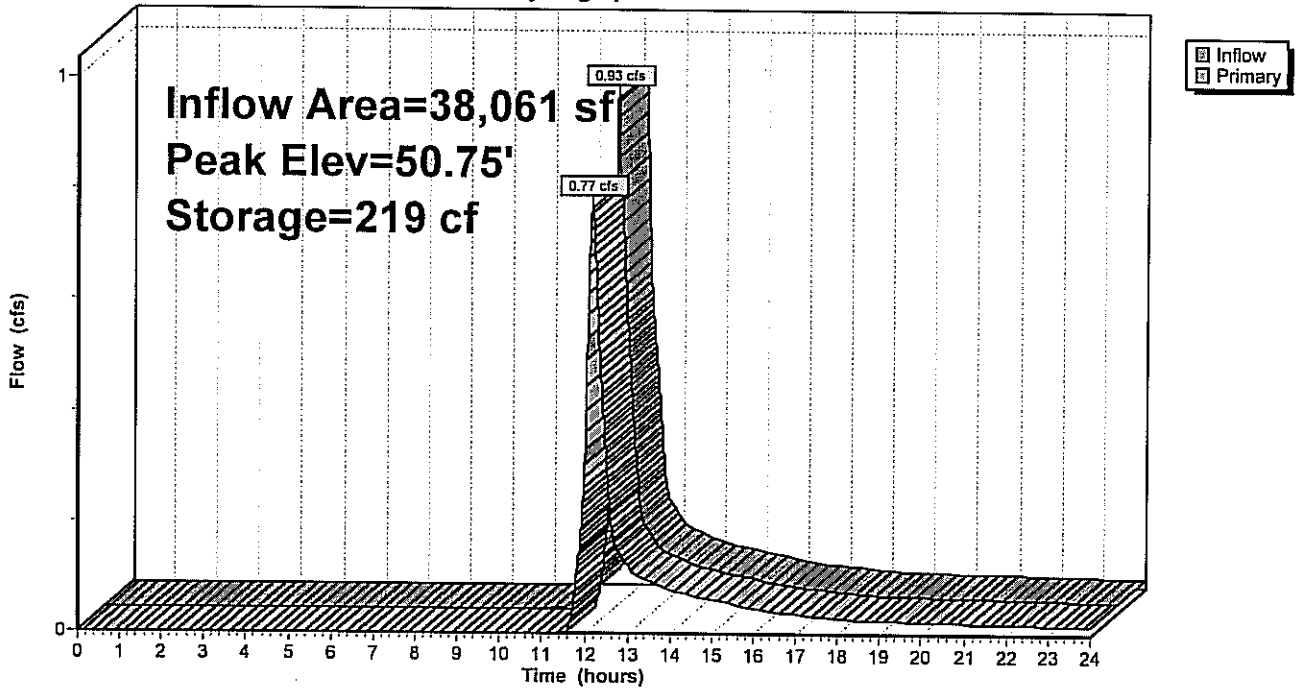
| Device | Routing | Invert | Outlet Devices |
|--------|----------|--------|---|
| #1 | Primary | 48.30' | 12.0" x 59.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 46.50' S= 0.0305 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior |
| #2 | Device 1 | 50.20' | 0.79' W x 0.33' H Vert. Orifice/Grate C= 0.600 |
| #3 | Device 1 | 51.20' | 11.0" Horiz. Orifice/Grate Limited to weir flow C= 0.600 |

Primary OutFlow Max=0.77 cfs @ 12.15 hrs HW=50.75' (Free Discharge)

- 1=Culvert (Passes 0.77 cfs of 5.28 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.77 cfs @ 2.95 fps)
- 3=Orifice/Grate (Controls 0.00 cfs)

Pond 2P: Original Basin #2

Hydrograph



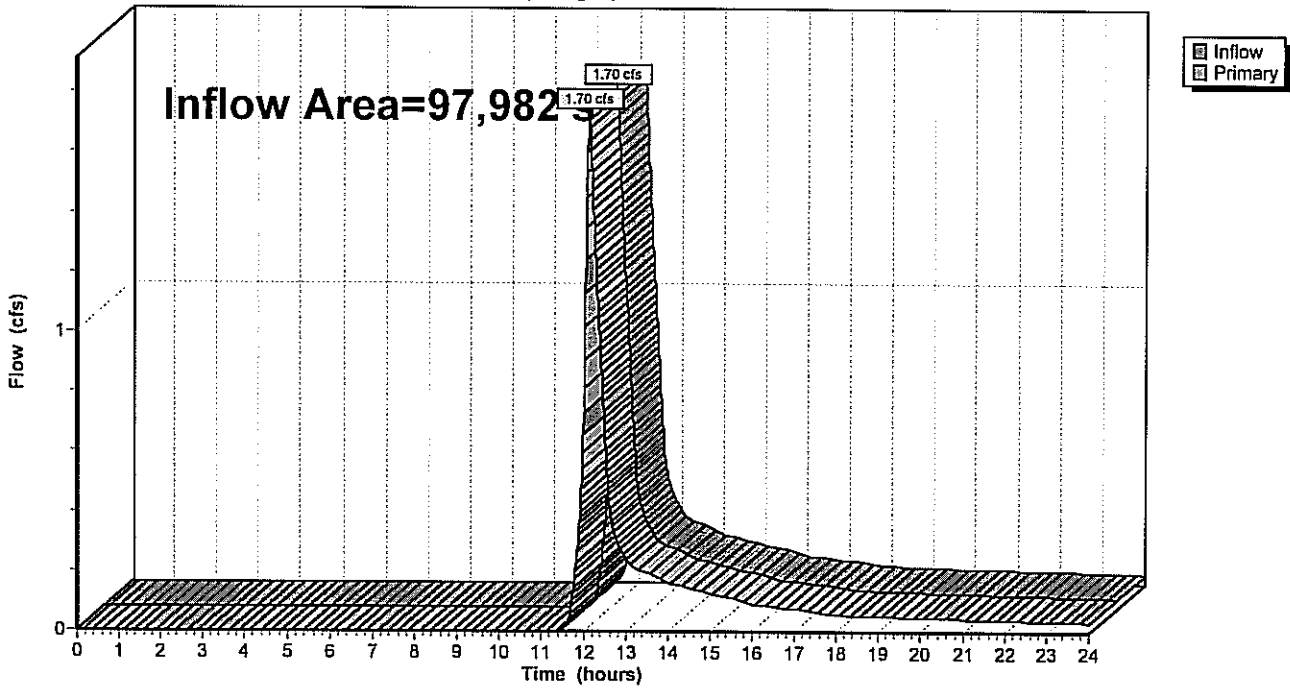
Link 1L: Design Point

Inflow Area = 97,982 sf, Inflow Depth > 0.77" for 2-Year event
Inflow = 1.70 cfs @ 12.13 hrs, Volume= 6,297 cf
Primary = 1.70 cfs @ 12.13 hrs, Volume= 6,297 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Design Point

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Subcatchment 104S: Basketball Court

Runoff = 0.47 cfs @ 12.09 hrs, Volume= 1,461 cf, Depth> 1.91"

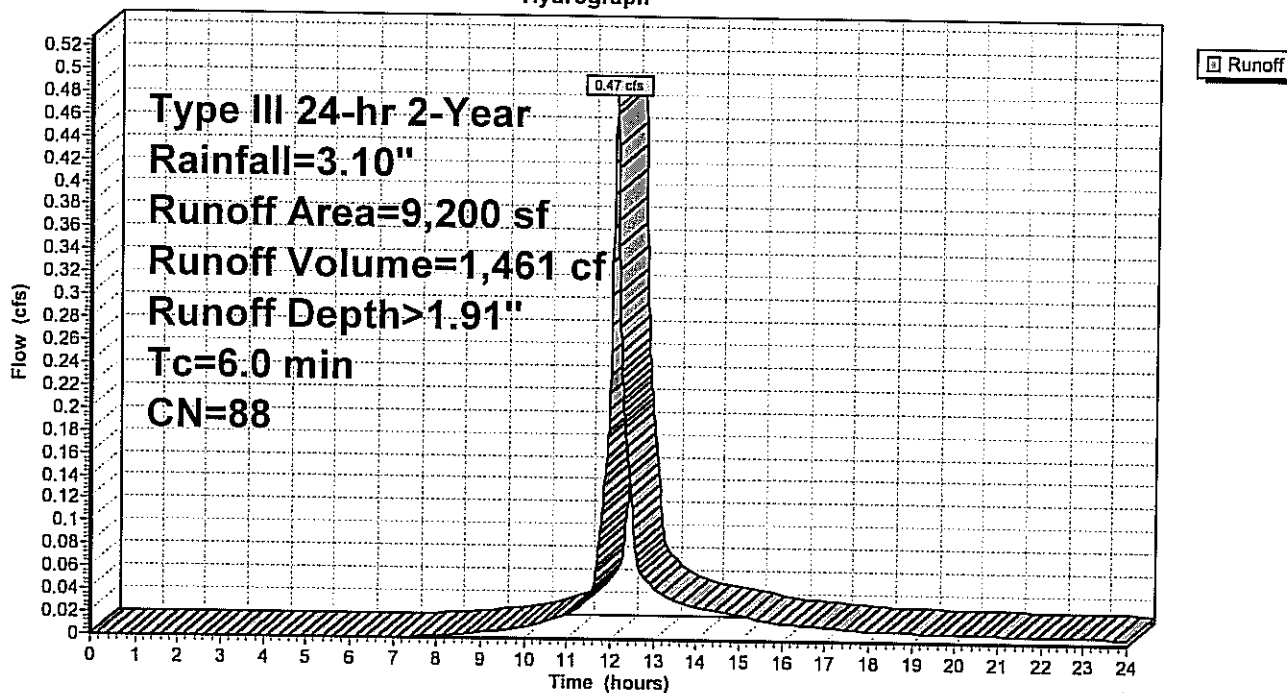
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 5,200 | 98 | Impervious Area |
| 4,000 | 74 | >75% Grass cover, Good, HSG C |
| 9,200 | 88 | Weighted Average |
| 4,000 | | Pervious Area |
| 5,200 | | Impervious Area |

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

Subcatchment 104S: Basketball Court

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

Prepared by Millennium Engineering, Inc.

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2/6/2018

Pond 3P: Stone Trench

Inflow Area = 9,200 sf, Inflow Depth > 1.91" for 2-Year event
 Inflow = 0.47 cfs @ 12.09 hrs, Volume= 1,461 cf
 Outflow = 0.25 cfs @ 12.01 hrs, Volume= 1,460 cf, Atten= 48%, Lag= 0.0 min
 Discarded = 0.25 cfs @ 12.01 hrs, Volume= 1,460 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 0.23' @ 12.23 hrs Surf.Area= 1,280 sf Storage= 119 cf
 Flood Elev= 3.00' Surf.Area= 1,280 sf Storage= 1,536 cf

Plug-Flow detention time= 2.5 min calculated for 1,460 cf (100% of inflow)
 Center-of-Mass det. time= 2.4 min (818.1 - 815.7)

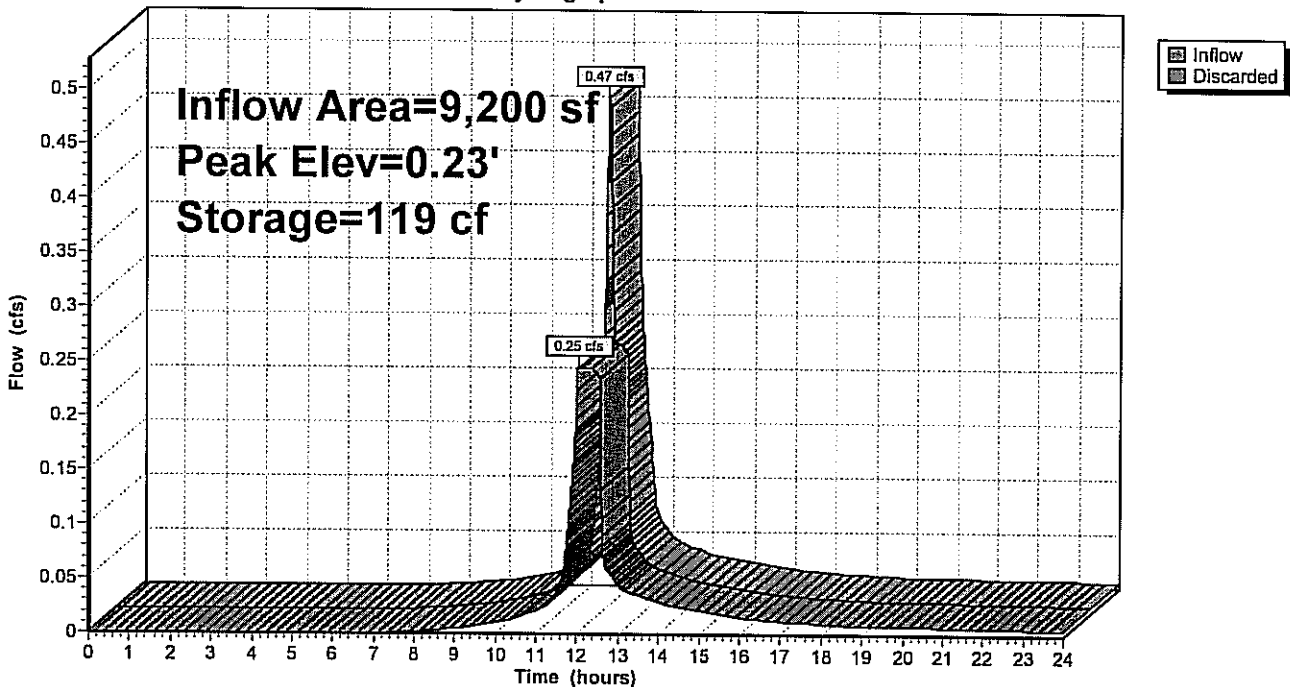
| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1 | 0.00' | 1,536 cf | 16.00'W x 80.00'L x 3.00'H Prismatoid 3,840 cf Overall x 40.0% Voids |

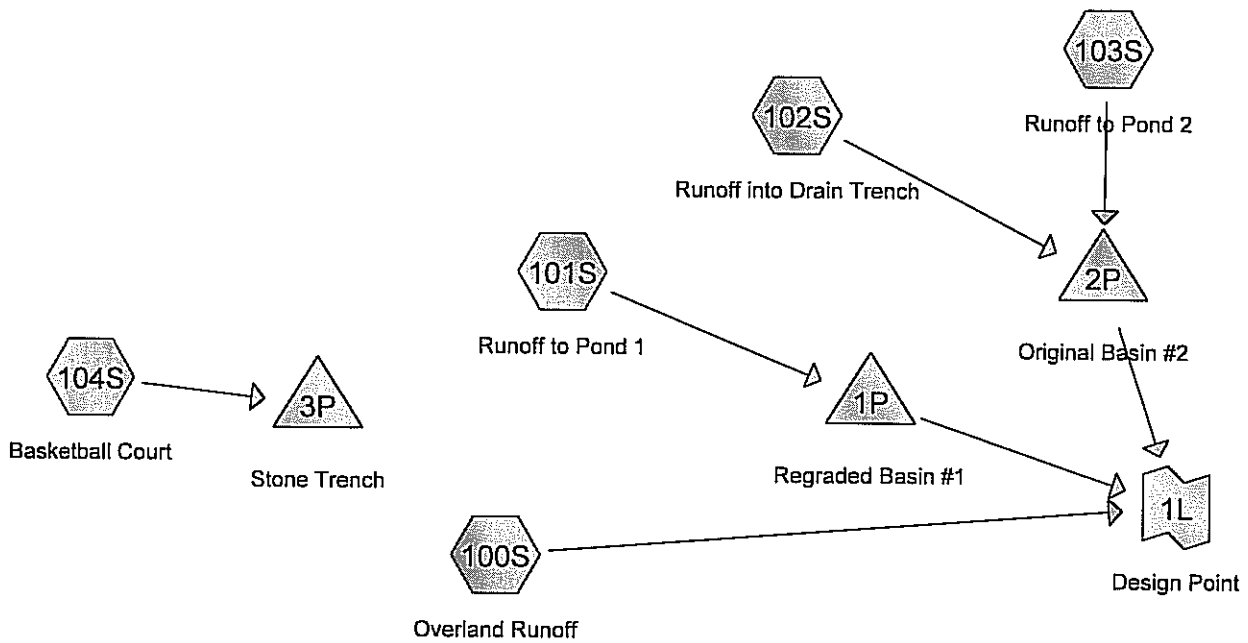
| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 0.00' | 8.270 in/hr Exfiltration over Surface area |

Discarded OutFlow Max=0.25 cfs @ 12.01 hrs HW=0.03' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.25 cfs)

Pond 3P: Stone Trench

Hydrograph





Subcatchment 100S: Overland Runoff

Runoff = 2.25 cfs @ 12.09 hrs, Volume= 7,137 cf, Depth> 1.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-Year Rainfall=4.70"

| Area (sf) | CN | Description |
|-----------|----|---------------------------------|
| 4,982 | 49 | 50-75% Grass cover, Fair, HSG A |
| 5,379 | 36 | Woods, Fair, HSG A |
| 15,910 | 73 | Woods, Fair, HSG C |
| 14,217 | 74 | >75% Grass cover, Good, HSG C |
| 6,722 | 98 | Impervious Areas |
| 47,210 | 70 | Weighted Average |
| 40,488 | | Pervious Area |
| 6,722 | | Impervious Area |

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

Subcatchment 101S: Runoff to Pond 1

Runoff = 0.99 cfs @ 12.09 hrs, Volume= 3,073 cf, Depth> 2.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-Year Rainfall=4.70"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 6,298 | 74 | >75% Grass cover, Good, HSG C |
| 1,413 | 73 | Woods, Fair, HSG C |
| 5,000 | 98 | Impervious Areas |
| 12,711 | 83 | Weighted Average |
| 7,711 | | Pervious Area |
| 5,000 | | Impervious Area |

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

Subcatchment 102S: Runoff into Drain Trench

Runoff = 1.76 cfs @ 12.09 hrs, Volume= 5,485 cf, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-Year Rainfall=4.70"

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Type III 24-hr 10-Year Rainfall=4.70"

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| Area (sf) | CN | Description |
|-----------|----|---------------------------------|
| 7,276 | 49 | 50-75% Grass cover, Fair, HSG A |
| 12,022 | 79 | 50-75% Grass cover, Fair, HSG C |
| 2,220 | 74 | >75% Grass cover, Good, HSG C |
| 6,817 | 73 | Woods, Fair, HSG C |
| 3,850 | 98 | Impervious Areas |
| 32,185 | 73 | Weighted Average |
| 28,335 | | Pervious Area |
| 3,850 | | Impervious Area |

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

Subcatchment 103S: Runoff to Pond 2

Runoff = 0.39 cfs @ 12.09 hrs, Volume= 1,203 cf, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.70"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 4,776 | 74 | >75% Grass cover, Good, HSG C |
| 1,100 | 98 | Impervious Areas |
| 5,876 | 78 | Weighted Average |
| 4,776 | | Pervious Area |
| 1,100 | | Impervious Area |

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

Subcatchment 104S: Basketball Court

Runoff = 0.82 cfs @ 12.09 hrs, Volume= 2,592 cf, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.70"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 5,200 | 98 | Impervious Area |
| 4,000 | 74 | >75% Grass cover, Good, HSG C |
| 9,200 | 88 | Weighted Average |
| 4,000 | | Pervious Area |
| 5,200 | | Impervious Area |

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

Pond 1P: Regraded Basin #1

Inflow Area = 12,711 sf, Inflow Depth > 2.90" for 10-Year event
 Inflow = 0.99 cfs @ 12.09 hrs, Volume= 3,073 cf
 Outflow = 0.60 cfs @ 12.19 hrs, Volume= 3,072 cf, Atten= 39%, Lag= 6.3 min
 Discarded = 0.13 cfs @ 12.19 hrs, Volume= 2,119 cf
 Primary = 0.47 cfs @ 12.19 hrs, Volume= 953 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 56.85' @ 12.19 hrs Surf.Area= 670 sf Storage= 469 cf
 Flood Elev= 58.00' Surf.Area= 1,040 sf Storage= 1,444 cf

Plug-Flow detention time= 9.5 min calculated for 3,072 cf (100% of inflow)
 Center-of-Mass det. time= 9.3 min (824.6 - 815.3)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1 | 56.00' | 1,444 cf | Custom Stage Data (Conic) Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|------------------|-------------------|------------------------|------------------------|------------------|
| 56.00 | 440 | 0 | 0 | 440 |
| 57.00 | 715 | 572 | 572 | 728 |
| 58.00 | 1,040 | 872 | 1,444 | 1,069 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|--|
| #1 | Discarded | 0.00' | 8.270 in/hr Exfiltration over Surface area |
| #2 | Primary | 56.20' | 6.0" x 15.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 56.00' S= 0.0133 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior |

Discarded OutFlow Max=0.13 cfs @ 12.19 hrs HW=56.85' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.47 cfs @ 12.19 hrs HW=56.85' (Free Discharge)
 ↑2=Culvert (Inlet Controls 0.47 cfs @ 2.41 fps)

Pond 2P: Original Basin #2

Inflow Area = 38,061 sf, Inflow Depth > 2.11" for 10-Year event
 Inflow = 2.14 cfs @ 12.09 hrs, Volume= 6,688 cf
 Outflow = 1.93 cfs @ 12.13 hrs, Volume= 6,628 cf, Atten= 10%, Lag= 2.4 min
 Primary = 1.93 cfs @ 12.13 hrs, Volume= 6,628 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 51.37' @ 12.13 hrs Surf.Area= 531 sf Storage= 506 cf
 Flood Elev= 52.20' Surf.Area= 740 sf Storage= 1,029 cf

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Type III 24-hr 10-Year Rainfall=4.70"

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Plug-Flow detention time= 10.7 min calculated for 6,628 cf (99% of inflow)

Center-of-Mass det. time= 5.4 min (845.4 - 840.0)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 50.00' | 1,029 cf | Custom Stage Data (Conic) Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|------------------|-------------------|------------------------|------------------------|------------------|
| 50.00 | 214 | 0 | 0 | 214 |
| 51.00 | 448 | 324 | 324 | 456 |
| 52.20 | 740 | 706 | 1,029 | 766 |

| Device | Routing | Invert | Outlet Devices |
|--------|----------|--------|---|
| #1 | Primary | 48.30' | 12.0" x 59.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 46.50' S= 0.0305 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior |
| #2 | Device 1 | 50.20' | 0.79' W x 0.33' H Vert. Orifice/Grate C= 0.600 |
| #3 | Device 1 | 51.20' | 11.0" Horiz. Orifice/Grate Limited to weir flow C= 0.600 |

Primary OutFlow Max=1.93 cfs @ 12.13 hrs HW=51.37' (Free Discharge)

- 1=Culvert (Passes 1.93 cfs of 6.06 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 1.26 cfs @ 4.83 fps)
- 3=Orifice/Grate (Weir Controls 0.67 cfs @ 1.36 fps)

Pond 3P: Stone Trench

Inflow Area = 9,200 sf, Inflow Depth > 3.38" for 10-Year event
 Inflow = 0.82 cfs @ 12.09 hrs, Volume= 2,592 cf
 Outflow = 0.25 cfs @ 11.85 hrs, Volume= 2,592 cf, Atten= 70%, Lag= 0.0 min
 Discarded = 0.25 cfs @ 11.85 hrs, Volume= 2,592 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 0.88' @ 12.42 hrs Surf.Area= 1,280 sf Storage= 449 cf
 Flood Elev= 3.00' Surf.Area= 1,280 sf Storage= 1,536 cf

Plug-Flow detention time= 9.0 min calculated for 2,592 cf (100% of inflow)
 Center-of-Mass det. time= 8.9 min (808.4 - 799.5)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---|
| #1 | 0.00' | 1,536 cf | 16.00'W x 80.00'L x 3.00'H Prismaoid 3,840 cf Overall x 40.0% Voids |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|--------|---|
| #1 | Discarded | 0.00' | 8.270 in/hr Exfiltration over Surface area |

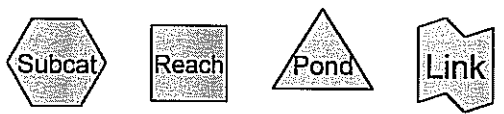
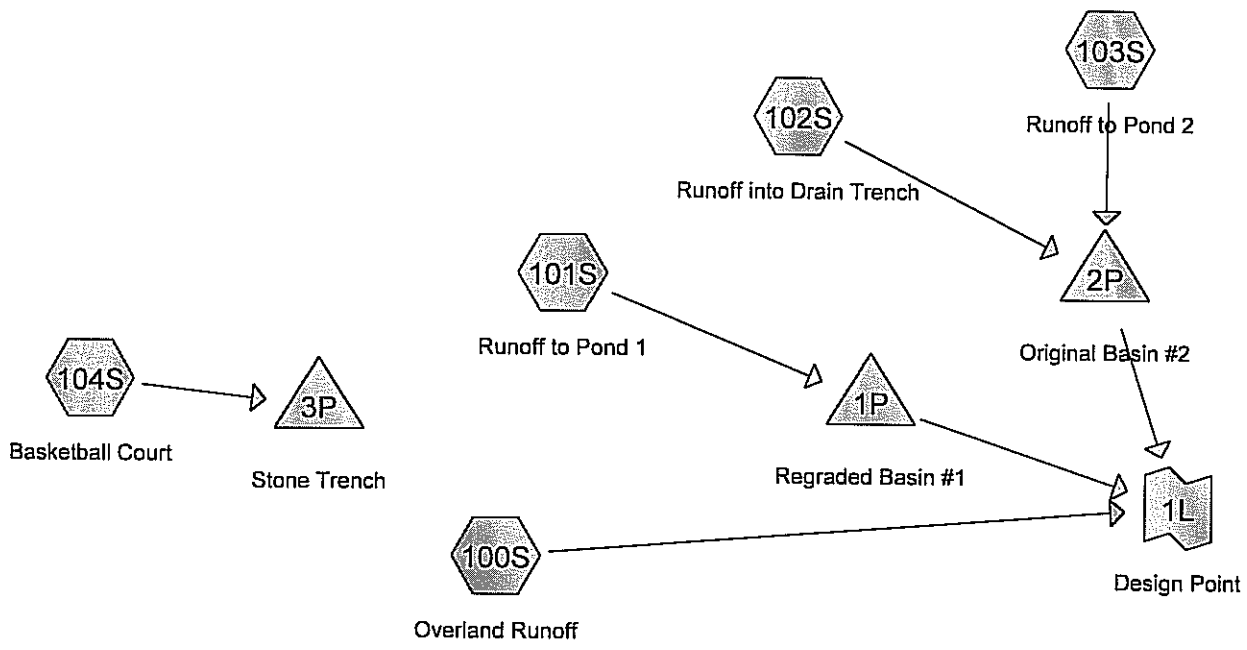
Discarded OutFlow Max=0.25 cfs @ 11.85 hrs HW=0.03' (Free Discharge)

- 1=Exfiltration (Exfiltration Controls 0.25 cfs)

Link 1L: Design Point

Inflow Area = 97,982 sf, Inflow Depth > 1.80" for 10-Year event
Inflow = 4.48 cfs @ 12.12 hrs, Volume= 14,718 cf
Primary = 4.48 cfs @ 12.12 hrs, Volume= 14,718 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Drainage Diagram for M173263-Proposed
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2/6/2018**Area Listing (selected nodes)**

| <u>Area (sq-ft)</u> | <u>CN</u> | <u>Description (subcats)</u> |
|---------------------|-----------|--|
| 5,379 | 36 | Woods, Fair, HSG A (100S) |
| 12,258 | 49 | 50-75% Grass cover, Fair, HSG A (100S,102S) |
| 24,140 | 73 | Woods, Fair, HSG C (100S,101S,102S) |
| 31,511 | 74 | >75% Grass cover, Good, HSG C (100S,101S,102S,103S,104S) |
| 12,022 | 79 | 50-75% Grass cover, Fair, HSG C (102S) |
| 5,200 | 98 | Impervious Area (104S) |
| 16,672 | 98 | Impervious Areas (100S,101S,102S,103S) |
| <hr/> | | |
| 107,182 | | |

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Type III 24-hr 100-Year Rainfall=8.30"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100S: Overland RunoffRunoff Area=47,210 sf Runoff Depth>4.72"
Tc=6.0 min CN=70 Runoff=6.00 cfs 18,561 cf**Subcatchment 101S: Runoff to Pond 1**Runoff Area=12,711 sf Runoff Depth>6.26"
Tc=6.0 min CN=83 Runoff=2.08 cfs 6,629 cf**Subcatchment 102S: Runoff into Drain Trench**Runoff Area=32,185 sf Runoff Depth>5.07"
Tc=6.0 min CN=73 Runoff=4.39 cfs 13,601 cf**Subcatchment 103S: Runoff to Pond 2**Runoff Area=5,876 sf Runoff Depth>5.66"
Tc=6.0 min CN=78 Runoff=0.89 cfs 2,773 cf**Subcatchment 104S: Basketball Court**Runoff Area=9,200 sf Runoff Depth>6.86"
Tc=6.0 min CN=88 Runoff=1.61 cfs 5,256 cf**Pond 1P: Regraded Basin #1**Peak Elev=57.68' Storage=1,134 cf Inflow=2.08 cfs 6,629 cf
Discarded=0.18 cfs 3,684 cf Primary=0.83 cfs 2,943 cf Outflow=1.01 cfs 6,627 cf**Pond 2P: Original Basin #2**Peak Elev=52.06' Storage=925 cf Inflow=5.28 cfs 16,374 cf
Outflow=4.57 cfs 16,307 cf**Pond 3P: Stone Trench**Peak Elev=2.95' Storage=1,508 cf Inflow=1.61 cfs 5,256 cf
Outflow=0.25 cfs 5,255 cf**Link 1L: Design Point**Inflow=11.08 cfs 37,810 cf
Primary=11.08 cfs 37,810 cfTotal Runoff Area = 107,182 sf Runoff Volume = 46,820 cf Average Runoff Depth = 5.24"
79.59% Pervious Area = 85,310 sf 20.41% Impervious Area = 21,872 sf

WATERSHED PLANS