

STORMWATER REPORT FOR THE BOARDWALK RESIDENCES AT MARINA BAY QUINCY, MA



Prepared by:
Howard/Stein-Hudson Associates, Inc.
38 Chauncy Street, 9th Floor
Boston, MA 02111
(T) (617) 482-7080
(F) (617) 482-7417

NOVEMBER 20, 2012
REVISED APRIL 14, 2013



Contents

APPENDIX A: PRE-CONSTRUCTION HYDROLOGY
APPENDIX B: POST-CONSTRUCTION HYDROLOGY
APPENDIX C: SITE GRADING & UTILITY PLAN (DWG. NO. C3.00)
AND SITE DETAILS SHEET (DWG. NO. C5.03)
APPENDIX D: RECHARGE CALCULATIONS
APPENDIX E: OPERATION AND MAINTENANCE PLAN

List of Figures

Figure 1. Pre Vs. Post-Development Peak Discharge Rates

Figure 1 - Pre Vs. Pos-Development Peak Discharge Rates

Design Point	Pre-Development Peak Runoff (cfs)	Post-Development Peak Runoff (cfs)
2-Year Storm		
DP #1: Dorchester Bay	2.07	0.83
DP #2: Outfall Pipe #1	6.53	4.74
DP#3: Outfall Pipe #2	2.89	1.63
DP#4: Parking Lot Drain	3.04	2.27
DP#5: Haul Road Drain	9.92	8.2
10-Year Storm		
DP #1: Dorchester Bay	3.27	1.48
DP #2: Outfall Pipe #1	10.17	6
DP#3: Outfall Pipe #2	4.29	2.36
DP#4: Parking Lot Drain	4.43	3.5
DP#5: Haul Road Drain	14.62	10.67

APPENDIX A: PRE-CONSTRUCTION HYDROLOGY

PROJECT NUMBER: 12002.00

DATE: November 20, 2012

REVISIONS:

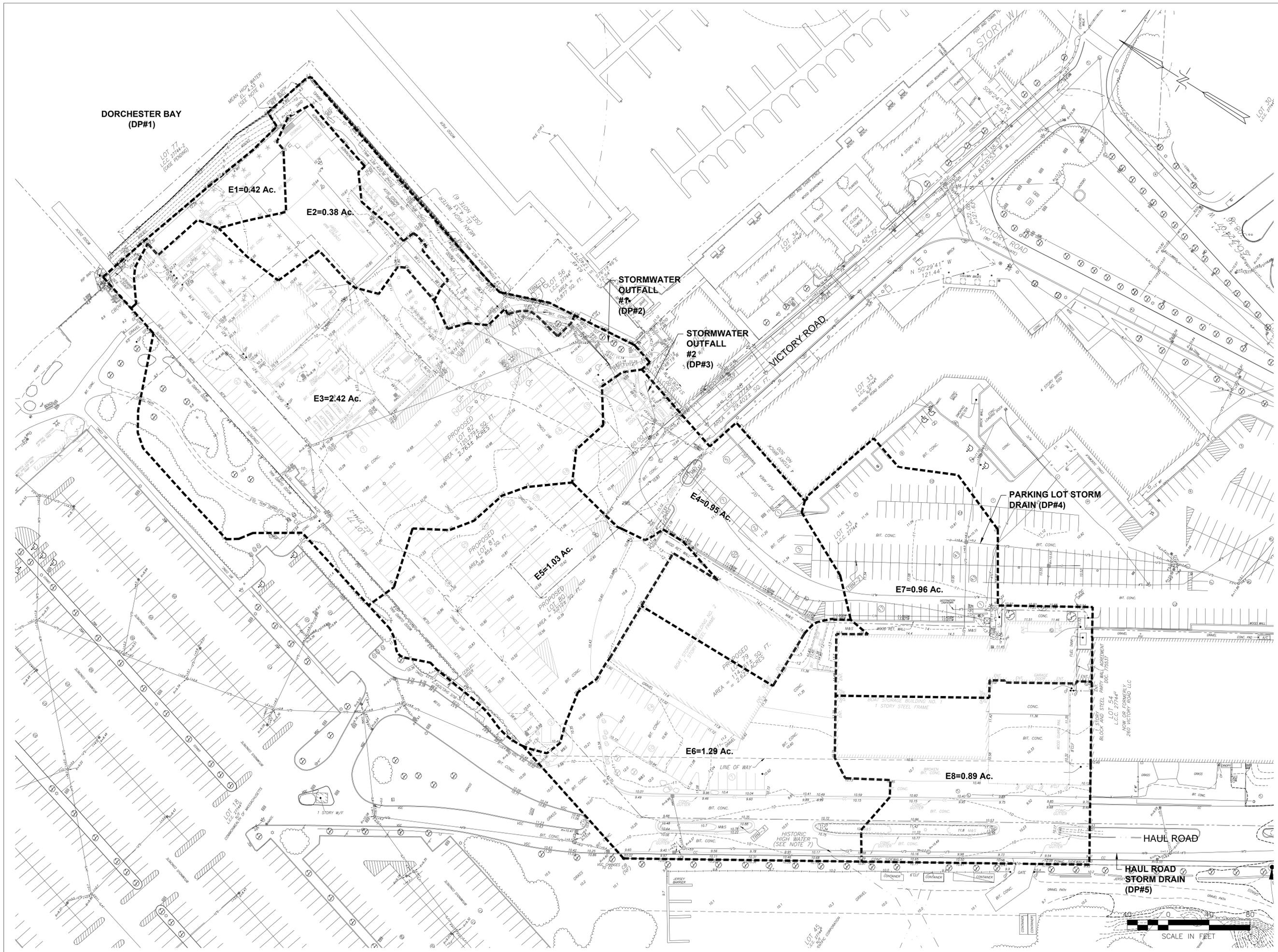
SCALE: 1"=40'

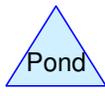
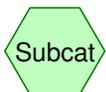
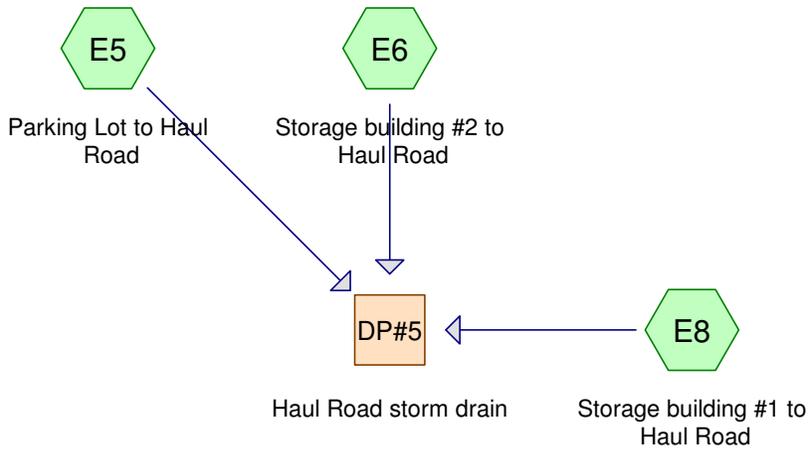
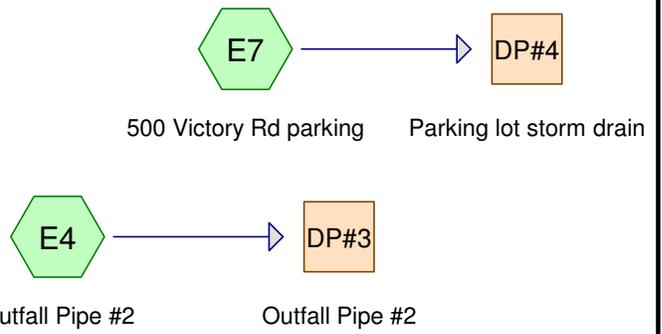
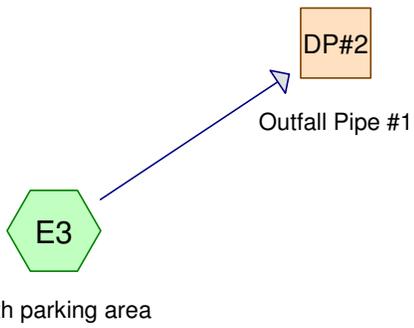
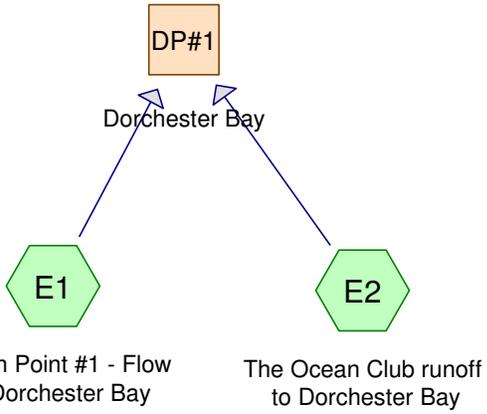
DRAWING NAME:

Figure 1
Pre-construction
Hydrology

DRAWING NUMBER:

FIG.1





Drainage Diagram for Residences at Marina Bay - Hydrology PRE

Prepared by {enter your company name here} 10/15/2012
 HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by {enter your company name here}

Page 2

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

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 E1: Design Point #1 - Flow to Dorchester Bay Runoff Area=0.420 ac Runoff Depth=1.91"
Tc=5.0 min CN=87 Runoff=0.98 cfs 0.067 af

Subcatchment E2: The Ocean Club runoff to Dorchester Bay Runoff Area=0.380 ac Runoff Depth=2.44"
Tc=5.0 min CN=93 Runoff=1.09 cfs 0.077 af

Subcatchment E3: North parking area Runoff Area=2.420 ac Runoff Depth=2.26"
Tc=5.0 min CN=91 Runoff=6.53 cfs 0.455 af

Subcatchment E4: Outfall Pipe #2 Runoff Area=0.950 ac Runoff Depth=2.64"
Tc=5.0 min CN=95 Runoff=2.89 cfs 0.209 af

Subcatchment E5: Parking Lot to Haul Road Runoff Area=1.030 ac Runoff Depth=2.54"
Tc=5.0 min CN=94 Runoff=3.05 cfs 0.218 af

Subcatchment E6: Storage building #2 to Haul Road Runoff Area=1.290 ac Runoff Depth=2.75"
Tc=5.0 min CN=96 Runoff=4.01 cfs 0.295 af

Subcatchment E7: 500 Victory Rd parking Runoff Area=0.960 ac Runoff Depth=2.85"
Tc=5.0 min CN=97 Runoff=3.04 cfs 0.228 af

Subcatchment E8: Storage building #1 to Haul Road Runoff Area=0.890 ac Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=2.86 cfs 0.220 af

Reach DP#1: Dorchester Bay Inflow=2.07 cfs 0.144 af
Outflow=2.07 cfs 0.144 af

Reach DP#2: Outfall Pipe #1 Inflow=6.53 cfs 0.455 af
Outflow=6.53 cfs 0.455 af

Reach DP#3: Outfall Pipe #2 Inflow=2.89 cfs 0.209 af
Outflow=2.89 cfs 0.209 af

Reach DP#4: Parking lot storm drain Inflow=3.04 cfs 0.228 af
Outflow=3.04 cfs 0.228 af

Reach DP#5: Haul Road storm drain Inflow=9.92 cfs 0.733 af
Outflow=9.92 cfs 0.733 af

Total Runoff Area = 8.340 ac Runoff Volume = 1.770 af Average Runoff Depth = 2.55"

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by {enter your company name here}

Page 3

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

Subcatchment E1: Design Point #1 - Flow to Dorchester Bay

Runoff = 0.98 cfs @ 12.07 hrs, Volume= 0.067 af, 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-YR Rainfall=3.20"

Area (ac)	CN	Description
0.190	98	Paved parking & roofs
0.080	65	Sand
0.150	86	<50% Grass cover, Poor, HSG C
0.420	87	Weighted Average

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

Subcatchment E2: The Ocean Club runoff to Dorchester Bay

Runoff = 1.09 cfs @ 12.07 hrs, Volume= 0.077 af, Depth= 2.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.060	65	Sand
0.320	98	Paved parking & roofs
0.380	93	Weighted Average

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

Subcatchment E3: North parking area

Runoff = 6.53 cfs @ 12.07 hrs, Volume= 0.455 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.400	70	Brush, Fair, HSG C
0.130	65	Sand
0.020	74	>75% Grass cover, Good, HSG C
0.040	86	Landscape Mulch
1.810	98	Paved parking & roofs
0.020	89	Gravel roads, HSG C
2.420	91	Weighted Average

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by {enter your company name here}

Page 4

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

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

Subcatchment E4: Outfall Pipe #2

Runoff = 2.89 cfs @ 12.07 hrs, Volume= 0.209 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.060	74	>75% Grass cover, Good, HSG C
0.040	65	Sand
0.020	86	Landscape Mulch
0.830	98	Paved parking & roofs
0.950	95	Weighted Average

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

Subcatchment E5: Parking Lot to Haul Road

Runoff = 3.05 cfs @ 12.07 hrs, Volume= 0.218 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.100	89	Gravel roads, HSG C
0.120	70	Brush, Fair, HSG C
0.810	98	Paved parking & roofs
1.030	94	Weighted Average

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

Subcatchment E6: Storage building #2 to Haul Road

Runoff = 4.01 cfs @ 12.07 hrs, Volume= 0.295 af, Depth= 2.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by {enter your company name here}

Page 5

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

Area (ac)	CN	Description
0.040	74	>75% Grass cover, Good, HSG C
0.030	89	Gravel roads, HSG C
0.020	70	Brush, Fair, HSG C
0.100	86	Landscape Mulch
1.100	98	Paved parking & roofs
1.290	96	Weighted Average

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

Subcatchment E7: 500 Victory Rd parking

Runoff = 3.04 cfs @ 12.07 hrs, Volume= 0.228 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.920	98	Paved parking & roofs
0.040	74	>75% Grass cover, Good, HSG C
0.960	97	Weighted Average

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

Subcatchment E8: Storage building #1 to Haul Road

Runoff = 2.86 cfs @ 12.07 hrs, Volume= 0.220 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.030	86	Landscape Mulch
0.860	98	Paved parking & roofs
0.890	98	Weighted Average

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

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by {enter your company name here}

Page 6

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

Reach DP#1: Dorchester Bay

Inflow Area = 0.800 ac, Inflow Depth = 2.17" for 2-YR event
Inflow = 2.07 cfs @ 12.07 hrs, Volume= 0.144 af
Outflow = 2.07 cfs @ 12.07 hrs, Volume= 0.144 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach DP#2: Outfall Pipe #1

Inflow Area = 2.420 ac, Inflow Depth = 2.26" for 2-YR event
Inflow = 6.53 cfs @ 12.07 hrs, Volume= 0.455 af
Outflow = 6.53 cfs @ 12.07 hrs, Volume= 0.455 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach DP#3: Outfall Pipe #2

Inflow Area = 0.950 ac, Inflow Depth = 2.64" for 2-YR event
Inflow = 2.89 cfs @ 12.07 hrs, Volume= 0.209 af
Outflow = 2.89 cfs @ 12.07 hrs, Volume= 0.209 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach DP#4: Parking lot storm drain

Inflow Area = 0.960 ac, Inflow Depth = 2.85" for 2-YR event
Inflow = 3.04 cfs @ 12.07 hrs, Volume= 0.228 af
Outflow = 3.04 cfs @ 12.07 hrs, Volume= 0.228 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach DP#5: Haul Road storm drain

Inflow Area = 3.210 ac, Inflow Depth = 2.74" for 2-YR event
Inflow = 9.92 cfs @ 12.07 hrs, Volume= 0.733 af
Outflow = 9.92 cfs @ 12.07 hrs, Volume= 0.733 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by {enter your company name here}

Page 7

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

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 E1: Design Point #1 - Flow to Dorchester Bay Runoff Area=0.420 ac Runoff Depth=3.19"
Tc=5.0 min CN=87 Runoff=1.61 cfs 0.112 af

Subcatchment E2: The Ocean Club runoff to Dorchester Bay Runoff Area=0.380 ac Runoff Depth=3.80"
Tc=5.0 min CN=93 Runoff=1.66 cfs 0.120 af

Subcatchment E3: North parking area Runoff Area=2.420 ac Runoff Depth=3.59"
Tc=5.0 min CN=91 Runoff=10.17 cfs 0.724 af

Subcatchment E4: Outfall Pipe #2 Runoff Area=0.950 ac Runoff Depth=4.02"
Tc=5.0 min CN=95 Runoff=4.29 cfs 0.318 af

Subcatchment E5: Parking Lot to Haul Road Runoff Area=1.030 ac Runoff Depth=3.91"
Tc=5.0 min CN=94 Runoff=4.58 cfs 0.336 af

Subcatchment E6: Storage building #2 to Haul Road Runoff Area=1.290 ac Runoff Depth=4.13"
Tc=5.0 min CN=96 Runoff=5.90 cfs 0.444 af

Subcatchment E7: 500 Victory Rd parking Runoff Area=0.960 ac Runoff Depth=4.25"
Tc=5.0 min CN=97 Runoff=4.43 cfs 0.340 af

Subcatchment E8: Storage building #1 to Haul Road Runoff Area=0.890 ac Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=4.14 cfs 0.323 af

Reach DP#1: Dorchester Bay Inflow=3.27 cfs 0.232 af
Outflow=3.27 cfs 0.232 af

Reach DP#2: Outfall Pipe #1 Inflow=10.17 cfs 0.724 af
Outflow=10.17 cfs 0.724 af

Reach DP#3: Outfall Pipe #2 Inflow=4.29 cfs 0.318 af
Outflow=4.29 cfs 0.318 af

Reach DP#4: Parking lot storm drain Inflow=4.43 cfs 0.340 af
Outflow=4.43 cfs 0.340 af

Reach DP#5: Haul Road storm drain Inflow=14.62 cfs 1.103 af
Outflow=14.62 cfs 1.103 af

Total Runoff Area = 8.340 ac Runoff Volume = 2.718 af Average Runoff Depth = 3.91"

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by {enter your company name here}

Page 8

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

Subcatchment E1: Design Point #1 - Flow to Dorchester Bay

Runoff = 1.61 cfs @ 12.07 hrs, Volume= 0.112 af, Depth= 3.19"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.190	98	Paved parking & roofs
0.080	65	Sand
0.150	86	<50% Grass cover, Poor, HSG C
0.420	87	Weighted Average

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

Subcatchment E2: The Ocean Club runoff to Dorchester Bay

Runoff = 1.66 cfs @ 12.07 hrs, Volume= 0.120 af, Depth= 3.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.060	65	Sand
0.320	98	Paved parking & roofs
0.380	93	Weighted Average

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

Subcatchment E3: North parking area

Runoff = 10.17 cfs @ 12.07 hrs, Volume= 0.724 af, Depth= 3.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.400	70	Brush, Fair, HSG C
0.130	65	Sand
0.020	74	>75% Grass cover, Good, HSG C
0.040	86	Landscape Mulch
1.810	98	Paved parking & roofs
0.020	89	Gravel roads, HSG C
2.420	91	Weighted Average

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by {enter your company name here}

Page 9

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

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

Subcatchment E4: Outfall Pipe #2

Runoff = 4.29 cfs @ 12.07 hrs, Volume= 0.318 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.060	74	>75% Grass cover, Good, HSG C
0.040	65	Sand
0.020	86	Landscape Mulch
0.830	98	Paved parking & roofs
0.950	95	Weighted Average

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

Subcatchment E5: Parking Lot to Haul Road

Runoff = 4.58 cfs @ 12.07 hrs, Volume= 0.336 af, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.100	89	Gravel roads, HSG C
0.120	70	Brush, Fair, HSG C
0.810	98	Paved parking & roofs
1.030	94	Weighted Average

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

Subcatchment E6: Storage building #2 to Haul Road

Runoff = 5.90 cfs @ 12.07 hrs, Volume= 0.444 af, Depth= 4.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by {enter your company name here}

Page 10

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

Area (ac)	CN	Description
0.040	74	>75% Grass cover, Good, HSG C
0.030	89	Gravel roads, HSG C
0.020	70	Brush, Fair, HSG C
0.100	86	Landscape Mulch
1.100	98	Paved parking & roofs
1.290	96	Weighted Average

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

Subcatchment E7: 500 Victory Rd parking

Runoff = 4.43 cfs @ 12.07 hrs, Volume= 0.340 af, Depth= 4.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.920	98	Paved parking & roofs
0.040	74	>75% Grass cover, Good, HSG C
0.960	97	Weighted Average

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

Subcatchment E8: Storage building #1 to Haul Road

Runoff = 4.14 cfs @ 12.07 hrs, Volume= 0.323 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.030	86	Landscape Mulch
0.860	98	Paved parking & roofs
0.890	98	Weighted Average

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

Residences at Marina Bay - Hydrology PRE

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by {enter your company name here}

Page 11

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

10/15/2012

Reach DP#1: Dorchester Bay

Inflow Area = 0.800 ac, Inflow Depth = 3.48" for 10-YR event
Inflow = 3.27 cfs @ 12.07 hrs, Volume= 0.232 af
Outflow = 3.27 cfs @ 12.07 hrs, Volume= 0.232 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach DP#2: Outfall Pipe #1

Inflow Area = 2.420 ac, Inflow Depth = 3.59" for 10-YR event
Inflow = 10.17 cfs @ 12.07 hrs, Volume= 0.724 af
Outflow = 10.17 cfs @ 12.07 hrs, Volume= 0.724 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach DP#3: Outfall Pipe #2

Inflow Area = 0.950 ac, Inflow Depth = 4.02" for 10-YR event
Inflow = 4.29 cfs @ 12.07 hrs, Volume= 0.318 af
Outflow = 4.29 cfs @ 12.07 hrs, Volume= 0.318 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach DP#4: Parking lot storm drain

Inflow Area = 0.960 ac, Inflow Depth = 4.25" for 10-YR event
Inflow = 4.43 cfs @ 12.07 hrs, Volume= 0.340 af
Outflow = 4.43 cfs @ 12.07 hrs, Volume= 0.340 af, Atten= 0%, Lag= 0.0 min

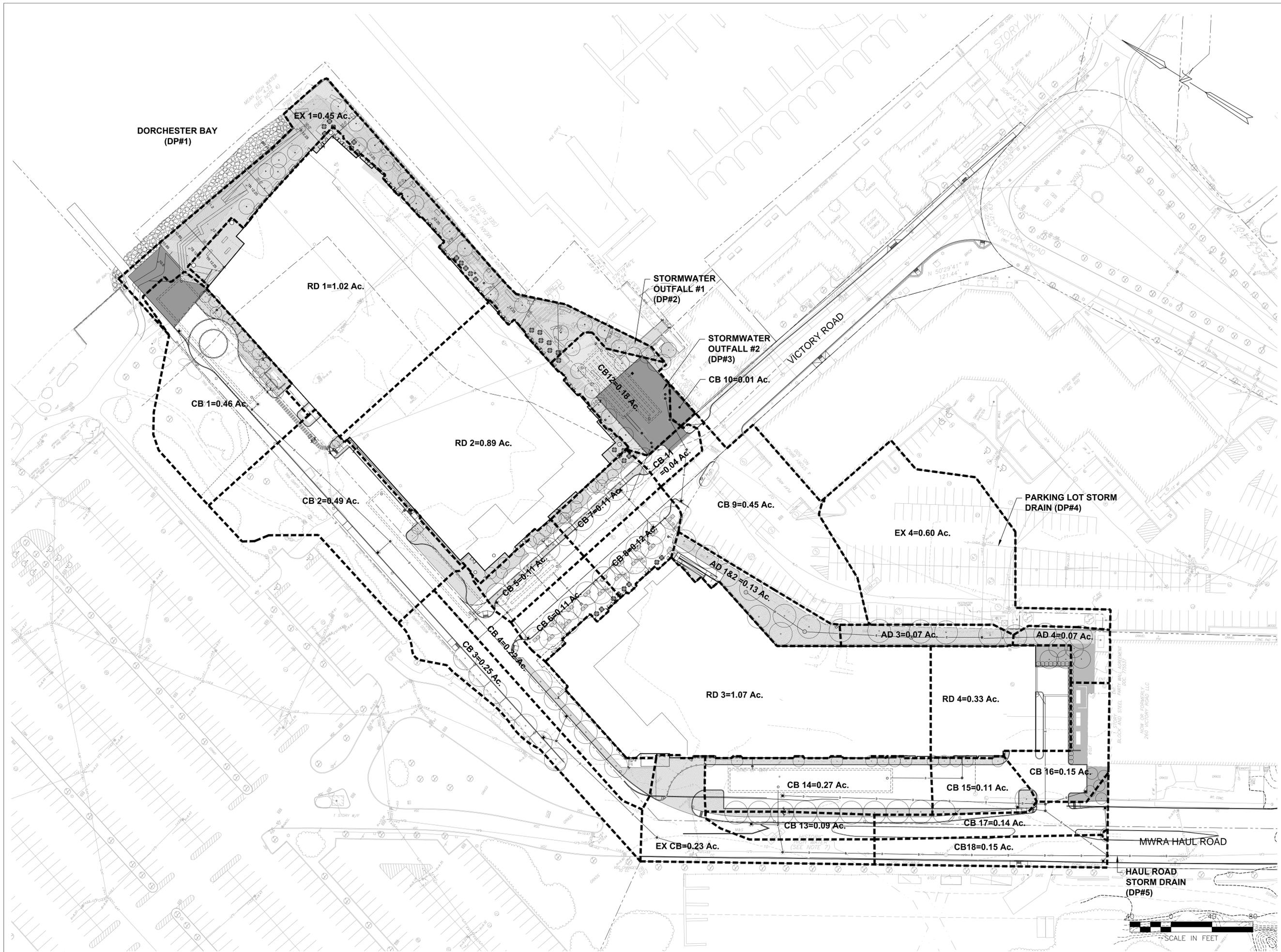
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

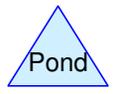
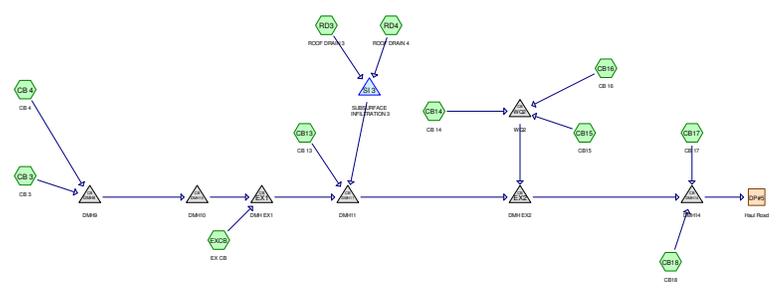
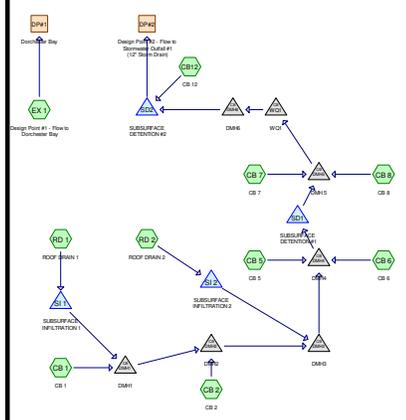
Reach DP#5: Haul Road storm drain

Inflow Area = 3.210 ac, Inflow Depth = 4.12" for 10-YR event
Inflow = 14.62 cfs @ 12.07 hrs, Volume= 1.103 af
Outflow = 14.62 cfs @ 12.07 hrs, Volume= 1.103 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

APPENDIX B: POST-CONSTRUCTION HYDROLOGY





Drainage Diagram for Residences at Marina Bay - Post-Development
 Prepared by Howard/Stein-Hudson Associates, Inc. 3/15/2013
 HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 2

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment AD12: AREA DRAIN 1 & 2	Runoff Area=0.133 ac	Runoff Depth=1.04"		
Flow Length=74'	Tc=4.6 min	CN=74	Runoff=0.16 cfs	0.011 af
Subcatchment AD3: AREA DRAIN 3	Runoff Area=0.073 ac	Runoff Depth=1.04"		
Flow Length=46'	Tc=4.0 min	CN=74	Runoff=0.09 cfs	0.006 af
Subcatchment AD4: AREA DRAIN 4	Runoff Area=0.074 ac	Runoff Depth=1.04"		
Flow Length=42'	Tc=4.9 min	CN=74	Runoff=0.09 cfs	0.006 af
Subcatchment CB 1: CB 1	Runoff Area=0.461 ac	Runoff Depth=1.83"		
Flow Length=301'	Tc=8.0 min	CN=86	Runoff=0.93 cfs	0.070 af
Subcatchment CB 11: CB 11	Runoff Area=0.044 ac	Runoff Depth=2.97"		
	Tc=5.0 min	CN=98	Runoff=0.14 cfs	0.011 af
Subcatchment CB 2: CB 2	Runoff Area=0.487 ac	Runoff Depth=2.00"		
	Tc=5.0 min	CN=88	Runoff=1.18 cfs	0.081 af
Subcatchment CB 3: CB 3	Runoff Area=0.247 ac	Runoff Depth=2.26"		
	Tc=5.0 min	CN=91	Runoff=0.67 cfs	0.046 af
Subcatchment CB 4: CB 4	Runoff Area=0.223 ac	Runoff Depth=2.64"		
	Tc=5.0 min	CN=95	Runoff=0.68 cfs	0.049 af
Subcatchment CB 5: CB 5	Runoff Area=0.111 ac	Runoff Depth=2.35"		
	Tc=5.0 min	CN=92	Runoff=0.31 cfs	0.022 af
Subcatchment CB 6: CB 6	Runoff Area=0.112 ac	Runoff Depth=2.97"		
	Tc=5.0 min	CN=98	Runoff=0.36 cfs	0.028 af
Subcatchment CB 7: CB 7	Runoff Area=0.114 ac	Runoff Depth=2.26"		
	Tc=5.0 min	CN=91	Runoff=0.31 cfs	0.021 af
Subcatchment CB 8: CB 8	Runoff Area=0.118 ac	Runoff Depth=2.97"		
	Tc=5.0 min	CN=98	Runoff=0.38 cfs	0.029 af
Subcatchment CB 9: CB 9	Runoff Area=0.450 ac	Runoff Depth=2.97"		
	Tc=5.0 min	CN=98	Runoff=1.45 cfs	0.111 af
Subcatchment CB10: CB 10	Runoff Area=0.012 ac	Runoff Depth=2.97"		
	Tc=5.0 min	CN=98	Runoff=0.04 cfs	0.003 af
Subcatchment CB12: CB 12	Runoff Area=0.176 ac	Runoff Depth=2.75"		
	Tc=5.0 min	CN=96	Runoff=0.55 cfs	0.040 af

Residences at Marina Bay - Post-Development*Type III 24-hr 2-YR Rainfall=3.20"*

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 3

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB13: CB 13	Runoff Area=0.090 ac Runoff Depth=2.64" Tc=5.0 min CN=95 Runoff=0.27 cfs 0.020 af
Subcatchment CB14: CB 14	Runoff Area=0.274 ac Runoff Depth=2.64" Tc=5.0 min CN=95 Runoff=0.83 cfs 0.060 af
Subcatchment CB15: CB15	Runoff Area=0.113 ac Runoff Depth=2.64" Tc=6.0 min CN=95 Runoff=0.33 cfs 0.025 af
Subcatchment CB16: CB 16	Runoff Area=0.148 ac Runoff Depth=2.44" Tc=5.0 min CN=93 Runoff=0.43 cfs 0.030 af
Subcatchment CB17: CB 17	Runoff Area=0.143 ac Runoff Depth=2.85" Tc=5.0 min CN=97 Runoff=0.45 cfs 0.034 af
Subcatchment CB18: CB18	Runoff Area=0.146 ac Runoff Depth=2.97" Tc=5.0 min CN=98 Runoff=0.47 cfs 0.036 af
Subcatchment EX 1: Design Point #1 - Flow to Dorchester Bay	Runoff Area=0.447 ac Runoff Depth=1.54" Tc=5.0 min CN=82 Runoff=0.83 cfs 0.057 af
Subcatchment EX4: EX 4	Runoff Area=0.600 ac Runoff Depth=2.97" Tc=5.0 min CN=98 Runoff=1.93 cfs 0.148 af
Subcatchment EXCB: EX CB	Runoff Area=0.232 ac Runoff Depth=2.85" Tc=5.0 min CN=97 Runoff=0.74 cfs 0.055 af
Subcatchment RD 1: ROOF DRAIN 1	Runoff Area=1.023 ac Runoff Depth=2.97" Tc=5.0 min CN=98 Runoff=3.29 cfs 0.253 af
Subcatchment RD 2: ROOF DRAIN 2	Runoff Area=0.886 ac Runoff Depth=2.97" Tc=5.0 min CN=98 Runoff=2.85 cfs 0.219 af
Subcatchment RD3: ROOF DRAIN 3	Runoff Area=1.071 ac Runoff Depth=2.97" Tc=5.0 min CN=98 Runoff=3.45 cfs 0.265 af
Subcatchment RD4: ROOF DRAIN 4	Runoff Area=0.329 ac Runoff Depth=2.97" Tc=5.0 min CN=98 Runoff=1.06 cfs 0.081 af
Reach DP#1: Dorchester Bay	Inflow=0.83 cfs 0.057 af Outflow=0.83 cfs 0.057 af
Reach DP#2: Design Point #2 - Flow to Stormwater Outfall #1 (12" Storm Drai	Inflow=4.74 cfs 0.589 af Outflow=4.74 cfs 0.589 af
Reach DP#3: Design Point #3 - Flow to Stormwater Outfall #2	Inflow=1.63 cfs 0.125 af Outflow=1.63 cfs 0.125 af

Residences at Marina Bay - Post-Development*Type III 24-hr 2-YR Rainfall=3.20"*

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 4

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Reach DP#4: Design Point #4 - Parking Lot Storm DrainInflow=2.27 cfs 0.172 af
Outflow=2.27 cfs 0.172 af**Reach DP#5: Haul Road**Inflow=8.20 cfs 0.603 af
Outflow=8.20 cfs 0.603 af**Pond 9: CB 9 TO DMH 6**Peak Elev=6.79' Inflow=1.45 cfs 0.111 af
12.0" x 25.0' Culvert Outflow=1.45 cfs 0.111 af**Pond 11: CB 11 TO DMH 6**Peak Elev=6.43' Inflow=0.14 cfs 0.011 af
12.0" x 46.0' Culvert Outflow=0.14 cfs 0.011 af**Pond DMH1: DMH1**Peak Elev=7.41' Inflow=2.03 cfs 0.230 af
18.0" x 182.0' Culvert Outflow=2.03 cfs 0.230 af**Pond DMH10: DMH10**Peak Elev=5.92' Inflow=1.34 cfs 0.096 af
12.0" x 40.0' Culvert Outflow=1.34 cfs 0.096 af**Pond DMH11: DMH11**Peak Elev=5.42' Inflow=5.77 cfs 0.418 af
18.0" x 155.0' Culvert Outflow=5.77 cfs 0.418 af**Pond DMH14: DMH14**Peak Elev=3.56' Inflow=8.20 cfs 0.603 af
18.0" x 75.0' Culvert Outflow=8.20 cfs 0.603 af**Pond DMH15: DMH15 TYING INTO EXIST 12" PIPE**Peak Elev=8.60' Inflow=0.34 cfs 0.024 af
Outflow=0.34 cfs 0.024 af**Pond DMH2: DMH2**Peak Elev=7.27' Inflow=3.12 cfs 0.311 af
24.0" x 124.0' Culvert Outflow=3.12 cfs 0.311 af**Pond DMH3: DMH3**Peak Elev=7.22' Inflow=5.30 cfs 0.449 af
24.0" x 35.0' Culvert Outflow=5.30 cfs 0.449 af**Pond DMH4: DMH4**Peak Elev=7.13' Inflow=5.93 cfs 0.498 af
24.0" x 3.0' Culvert Outflow=5.93 cfs 0.498 af**Pond DMH5: DMH 5**Peak Elev=6.73' Inflow=5.65 cfs 0.549 af
24.0" x 53.0' Culvert Outflow=5.65 cfs 0.549 af**Pond DMH6: DMH6**Peak Elev=6.55' Inflow=5.65 cfs 0.549 af
18.0" x 21.0' Culvert Outflow=5.65 cfs 0.549 af**Pond DMH9: DMH9**Peak Elev=6.35' Inflow=1.34 cfs 0.096 af
12.0" x 132.0' Culvert Outflow=1.34 cfs 0.096 af**Pond E4: EX CB 4**Peak Elev=6.21' Inflow=2.27 cfs 0.172 af
12.0" x 207.0' Culvert Outflow=2.27 cfs 0.172 af

Residences at Marina Bay - Post-Development*Type III 24-hr 2-YR Rainfall=3.20"*

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 5

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond EX1: DMH EX1Peak Elev=5.81' Inflow=2.08 cfs 0.151 af
12.0" x 76.0' Culvert Outflow=2.08 cfs 0.151 af**Pond EX2: DMH EX2**Peak Elev=4.70' Inflow=7.30 cfs 0.533 af
18.0" x 154.0' Culvert Outflow=7.30 cfs 0.533 af**Pond SD1: SUBSURFACE DETENTION #1**Peak Elev=7.04' Storage=0.028 af Inflow=5.93 cfs 0.498 af
18.0" x 92.0' Culvert Outflow=5.07 cfs 0.498 af**Pond SD2: SUBSURFACE DETENTION #2**Peak Elev=6.47' Storage=1,969 cf Inflow=6.14 cfs 0.589 af
12.0" x 36.0' Culvert Outflow=4.74 cfs 0.589 af**Pond SI 1: SUBSURFACE INFILTRATION 1**Peak Elev=7.53' Storage=4,118 cf Inflow=3.29 cfs 0.253 af
Discarded=0.02 cfs 0.041 af Primary=1.74 cfs 0.159 af Outflow=1.77 cfs 0.200 af**Pond SI 2: SUBSURFACE INFILTRATION 2**Peak Elev=8.36' Storage=3,120 cf Inflow=2.85 cfs 0.219 af
Discarded=0.02 cfs 0.027 af Primary=2.34 cfs 0.138 af Outflow=2.35 cfs 0.166 af**Pond SI 3: SUBSURFACE INFILTRATION 3**Peak Elev=7.73' Storage=4,135 cf Inflow=4.51 cfs 0.346 af
Discarded=0.02 cfs 0.035 af Primary=3.60 cfs 0.247 af Outflow=3.61 cfs 0.283 af**Pond WQ1: WQ1**Peak Elev=6.64' Inflow=5.65 cfs 0.549 af
24.0" x 8.0' Culvert Outflow=5.65 cfs 0.549 af**Pond WQ2: WQ2**Peak Elev=4.87' Inflow=1.59 cfs 0.115 af
12.0" x 30.0' Culvert Outflow=1.59 cfs 0.115 af**Total Runoff Area = 8.337 ac Runoff Volume = 1.820 af Average Runoff Depth = 2.62"**

Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 6

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment AD12: AREA DRAIN 1 & 2

Runoff = 0.16 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 1.04"

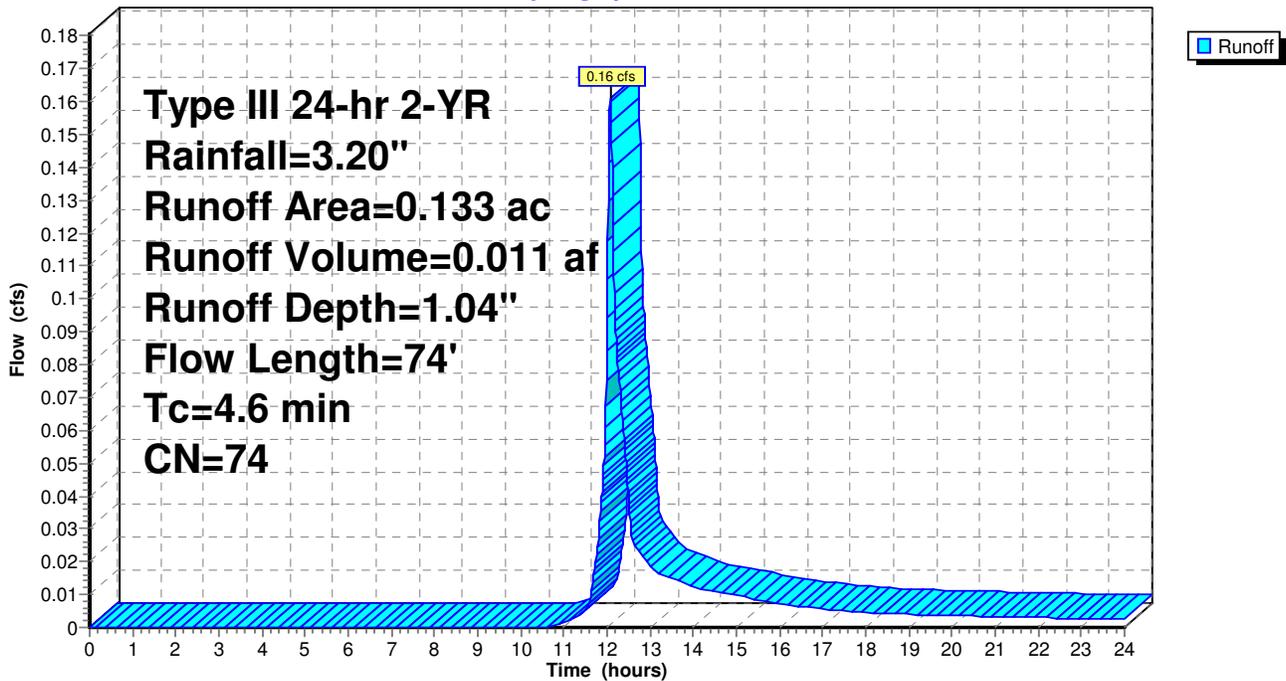
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.133	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 3.20"
0.3	24	0.0400	1.4		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
4.6	74	Total			

Subcatchment AD12: AREA DRAIN 1 & 2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 7

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment AD3: AREA DRAIN 3

Runoff = 0.09 cfs @ 12.07 hrs, Volume= 0.006 af, Depth= 1.04"

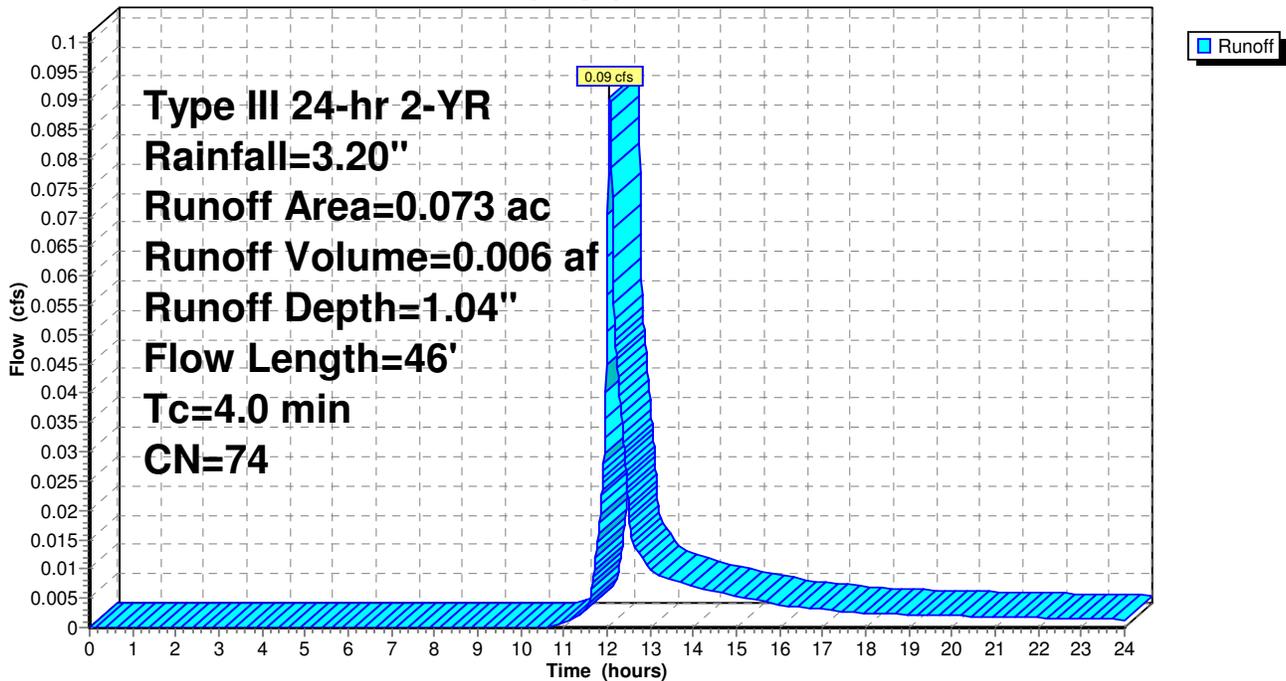
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.073	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	46	0.0400	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 3.20"

Subcatchment AD3: AREA DRAIN 3

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 8

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment AD4: AREA DRAIN 4

Runoff = 0.09 cfs @ 12.08 hrs, Volume= 0.006 af, Depth= 1.04"

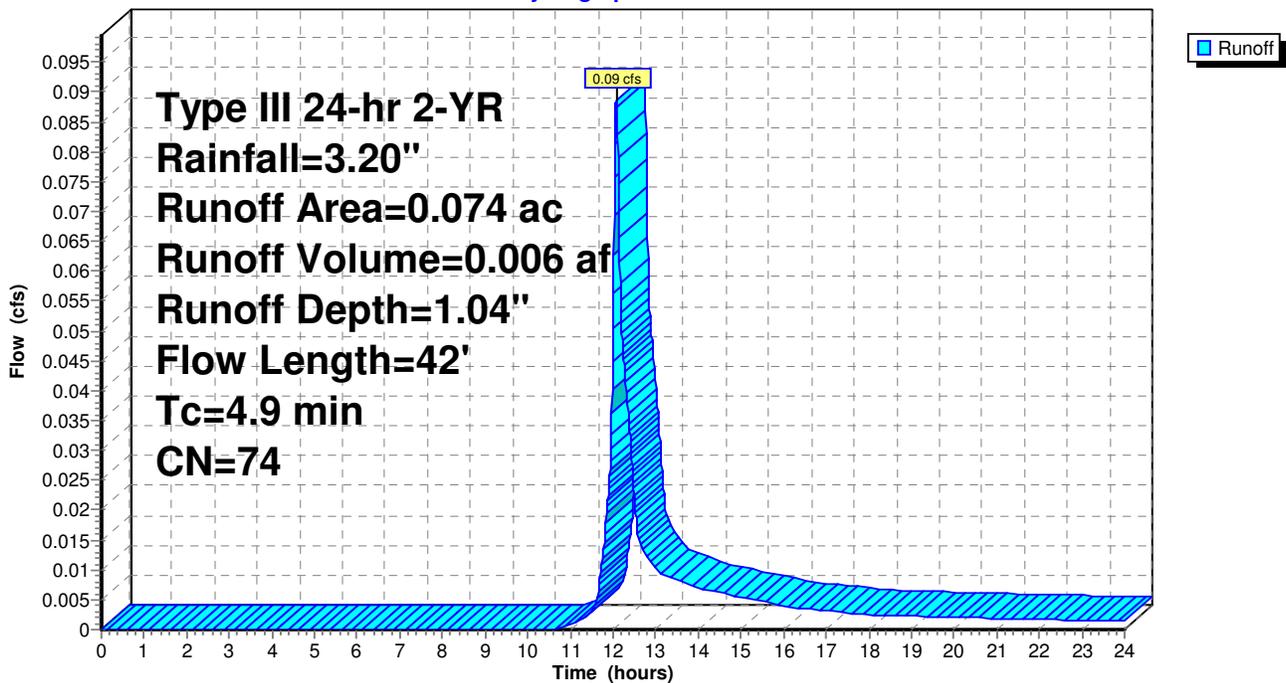
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.074	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	42	0.0200	0.1		Sheet Flow, Grass: Short n= 0.150 P2= 3.20"

Subcatchment AD4: AREA DRAIN 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 9

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 1: CB 1

Runoff = 0.93 cfs @ 12.11 hrs, Volume= 0.070 af, Depth= 1.83"

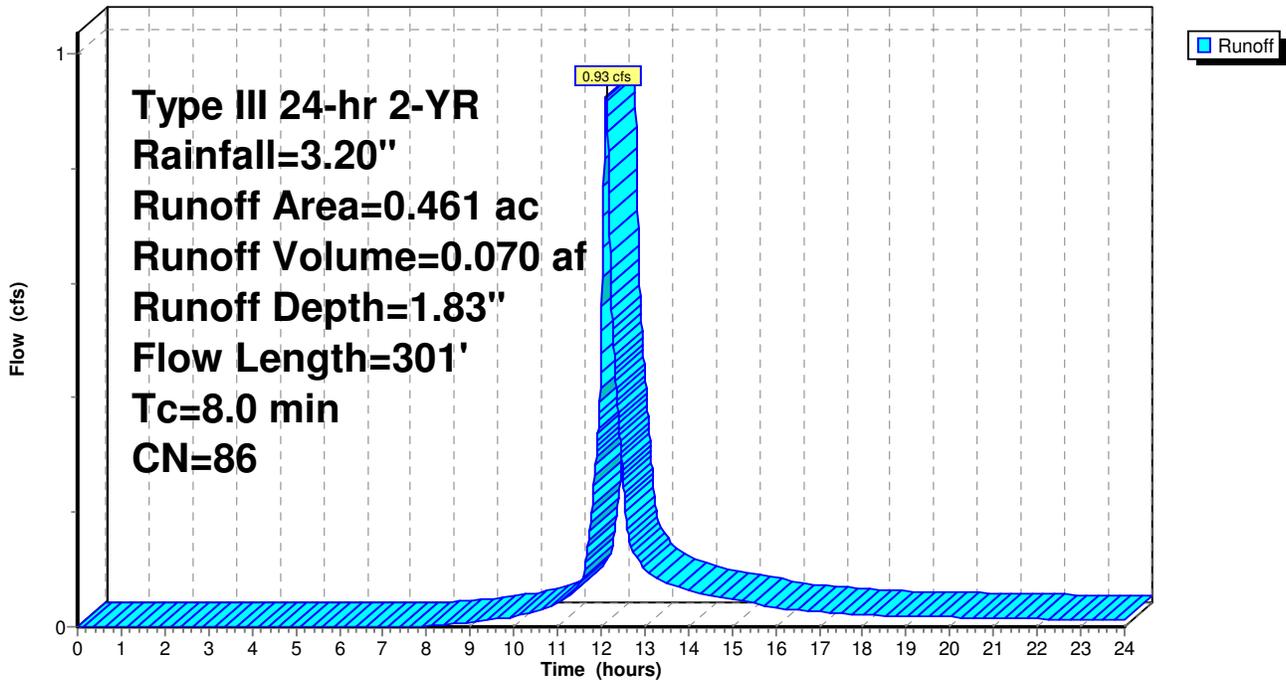
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.238	74	>75% Grass cover, Good, HSG C
0.223	98	Paved parking & roofs
0.461	86	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0600	0.2		Sheet Flow, DCR property Grass: Dense n= 0.240 P2= 3.20"
2.2	151	0.0050	1.1		Shallow Concentrated Flow, DCR prop Unpaved Kv= 16.1 fps
0.5	100	0.0050	3.2	2.52	Circular Channel (pipe), Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
8.0	301	Total			

Subcatchment CB 1: CB 1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 10

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 11: CB 11

Runoff = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af, Depth= 2.97"

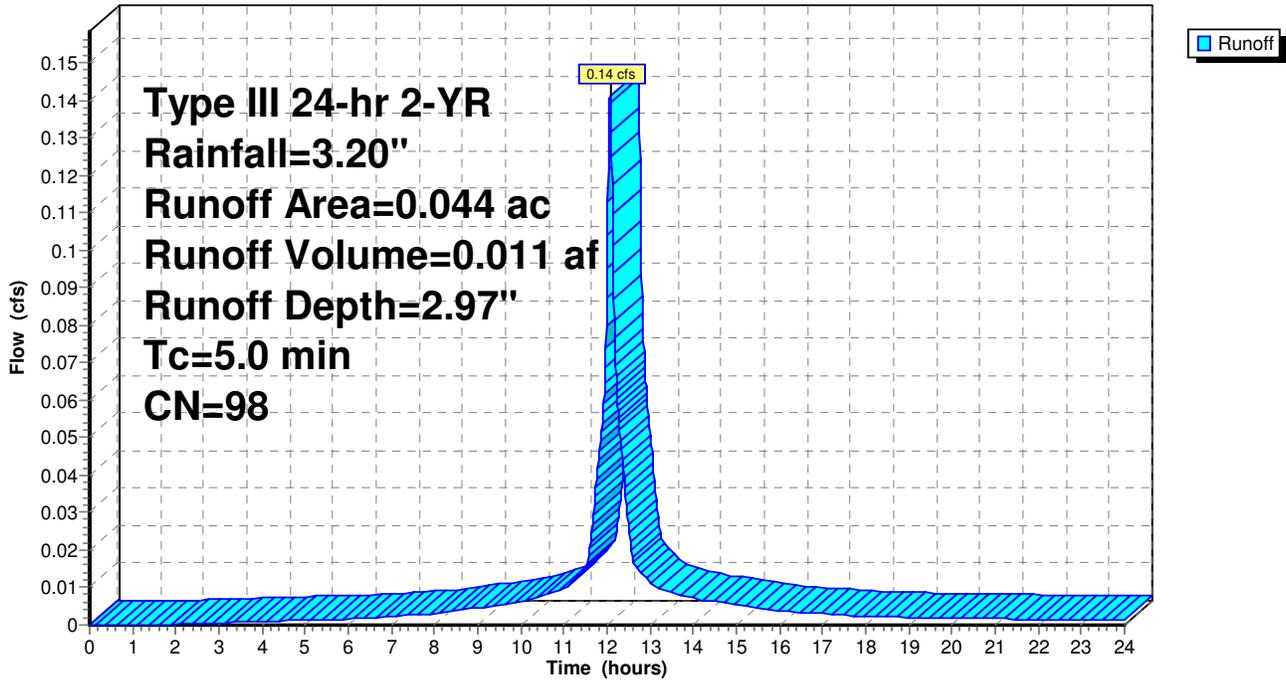
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.044	98	Paved parking & roofs

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

Subcatchment CB 11: CB 11

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 11

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 2: CB 2

Runoff = 1.18 cfs @ 12.07 hrs, Volume= 0.081 af, Depth= 2.00"

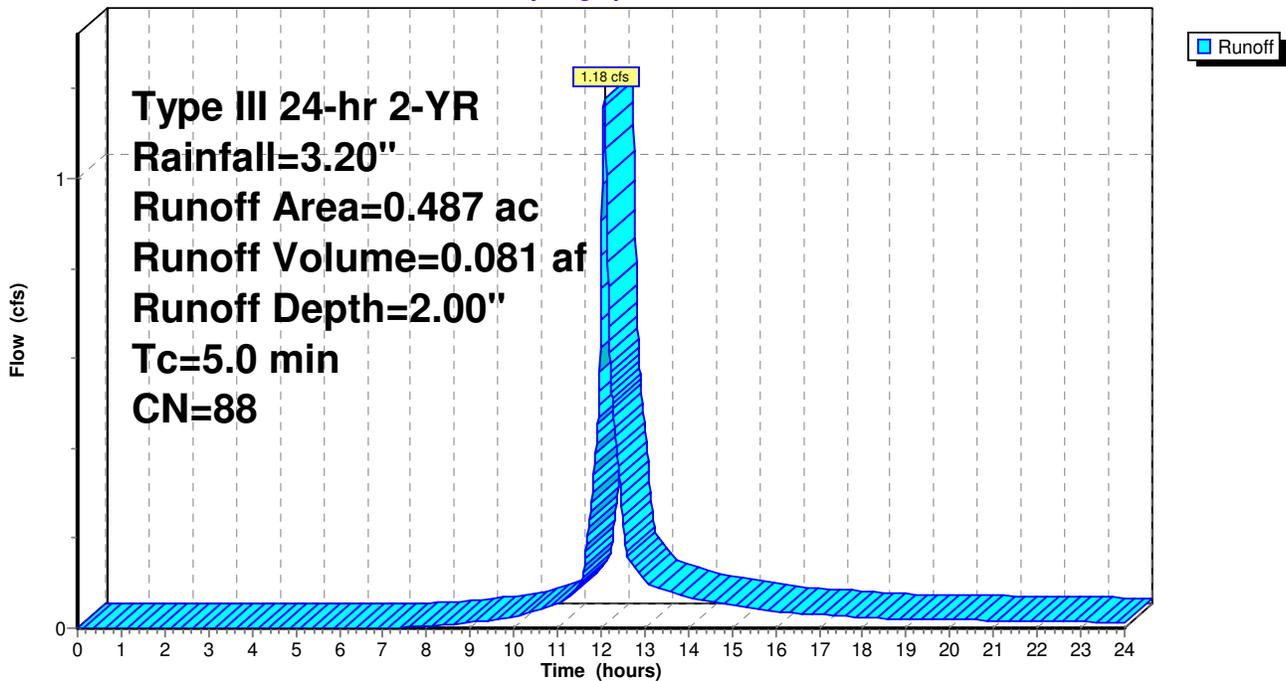
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.195	74	>75% Grass cover, Good, HSG C
0.292	98	Paved parking & roofs
0.487	88	Weighted Average

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

Subcatchment CB 2: CB 2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 12

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 3: CB 3

Runoff = 0.67 cfs @ 12.07 hrs, Volume= 0.046 af, Depth= 2.26"

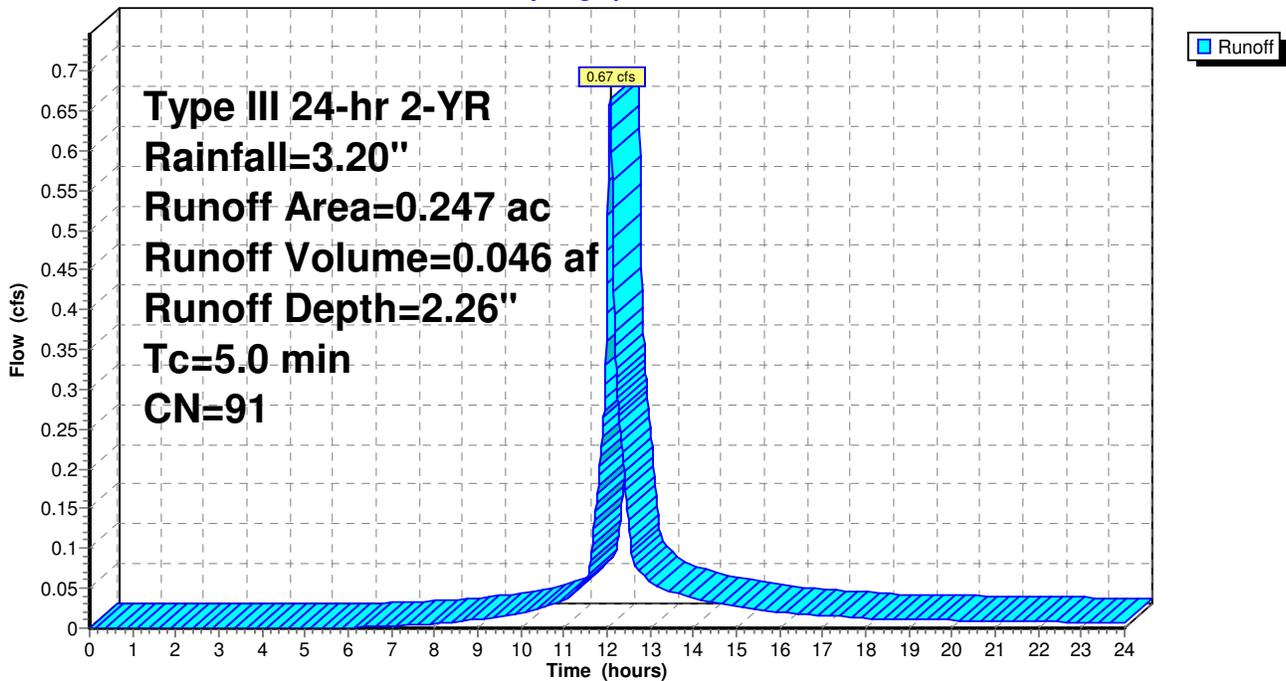
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.075	74	>75% Grass cover, Good, HSG C
0.172	98	Paved parking & roofs
0.247	91	Weighted Average

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

Subcatchment CB 3: CB 3

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 13

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 4: CB 4

Runoff = 0.68 cfs @ 12.07 hrs, Volume= 0.049 af, Depth= 2.64"

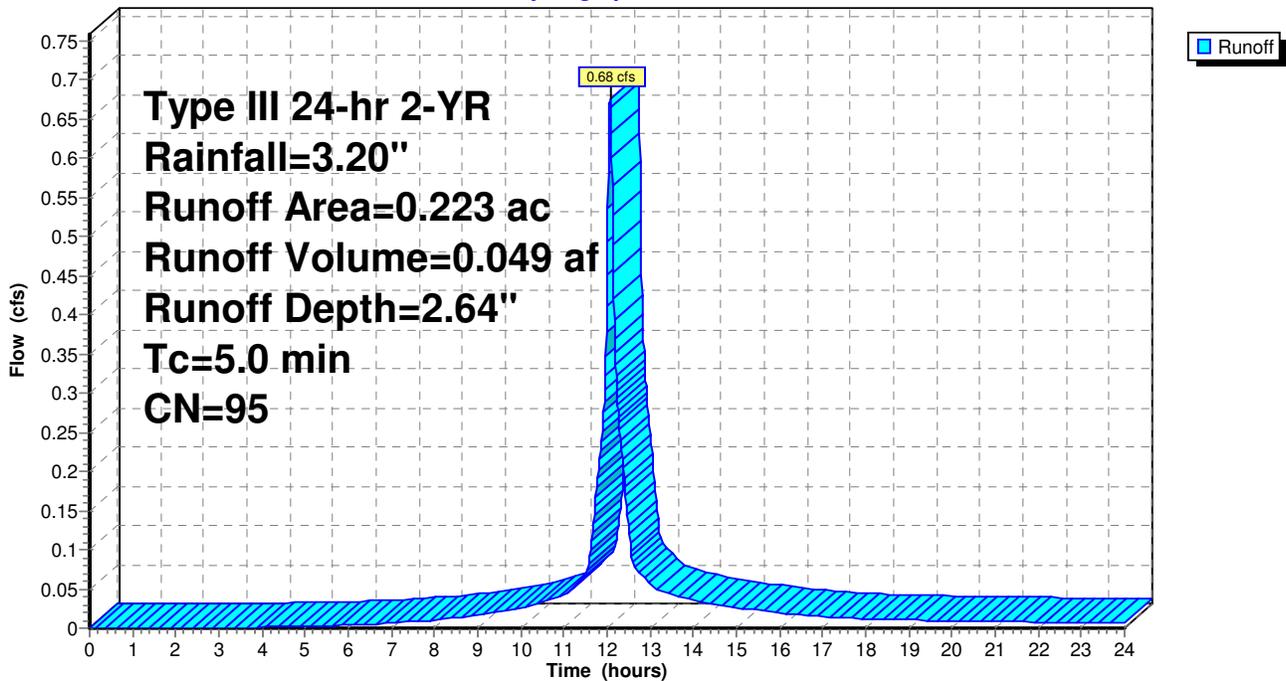
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.027	74	>75% Grass cover, Good, HSG C
0.196	98	Paved parking & roofs
0.223	95	Weighted Average

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

Subcatchment CB 4: CB 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 14

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 5: CB 5

Runoff = 0.31 cfs @ 12.07 hrs, Volume= 0.022 af, Depth= 2.35"

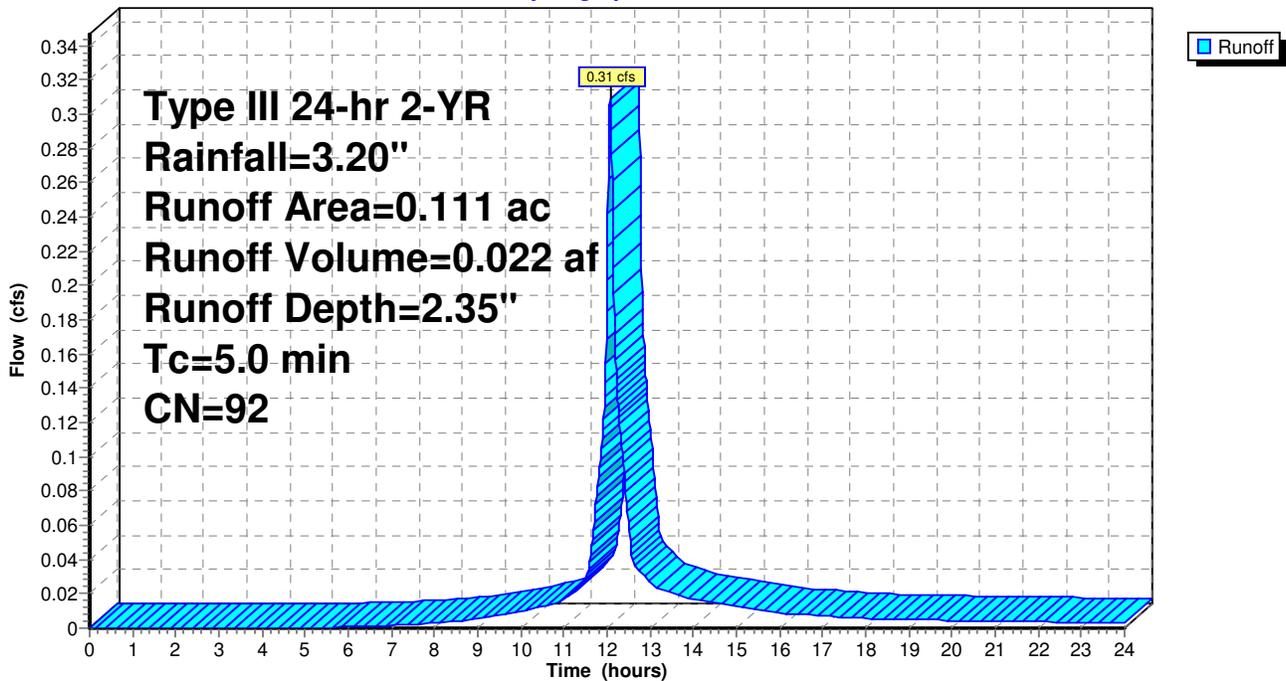
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.030	74	>75% Grass cover, Good, HSG C
0.081	98	Paved parking & roofs
0.111	92	Weighted Average

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

Subcatchment CB 5: CB 5

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 15

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 6: CB 6

Runoff = 0.36 cfs @ 12.07 hrs, Volume= 0.028 af, Depth= 2.97"

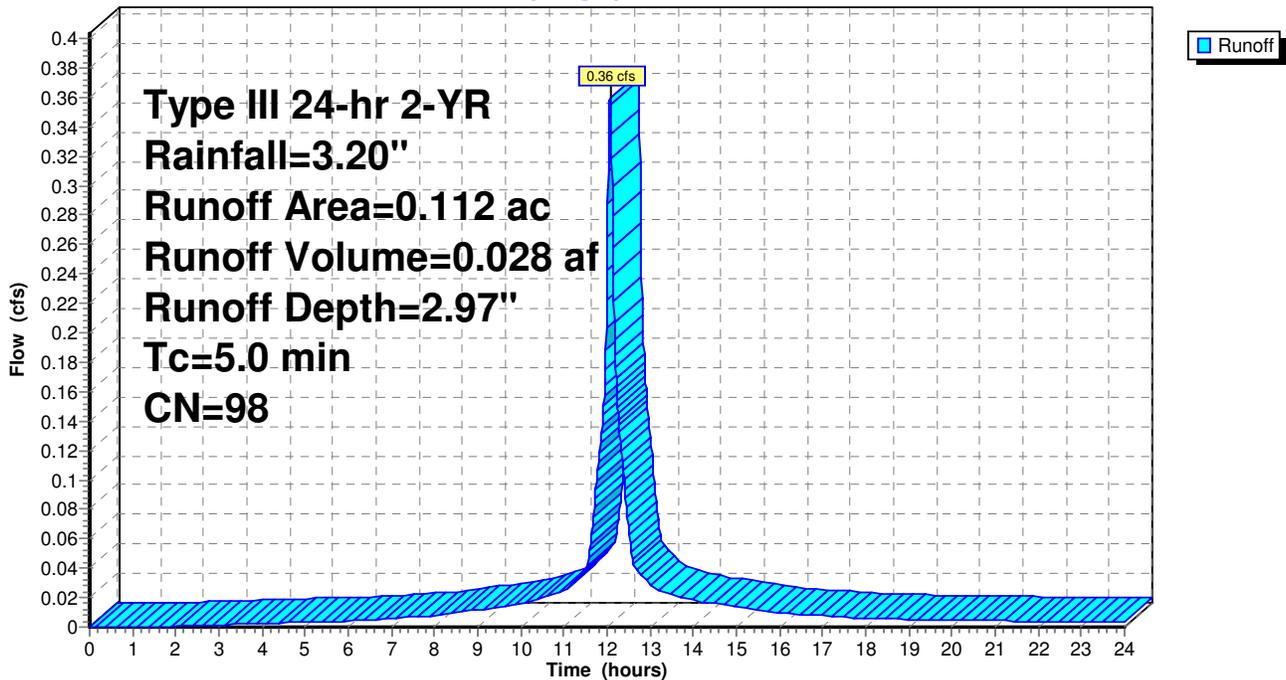
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.112	98	Paved parking & roofs

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

Subcatchment CB 6: CB 6

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 16

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 7: CB 7

Runoff = 0.31 cfs @ 12.07 hrs, Volume= 0.021 af, Depth= 2.26"

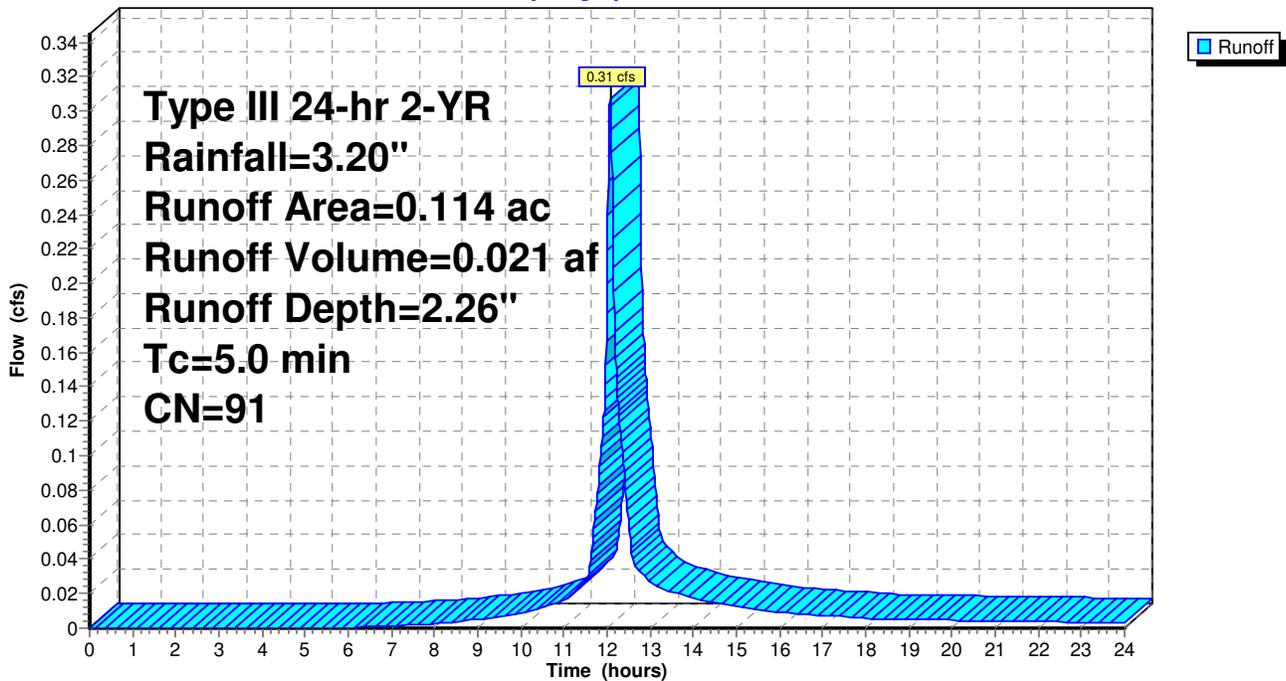
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.035	74	>75% Grass cover, Good, HSG C
0.079	98	Paved parking & roofs
0.114	91	Weighted Average

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

Subcatchment CB 7: CB 7

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 17

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 8: CB 8

Runoff = 0.38 cfs @ 12.07 hrs, Volume= 0.029 af, Depth= 2.97"

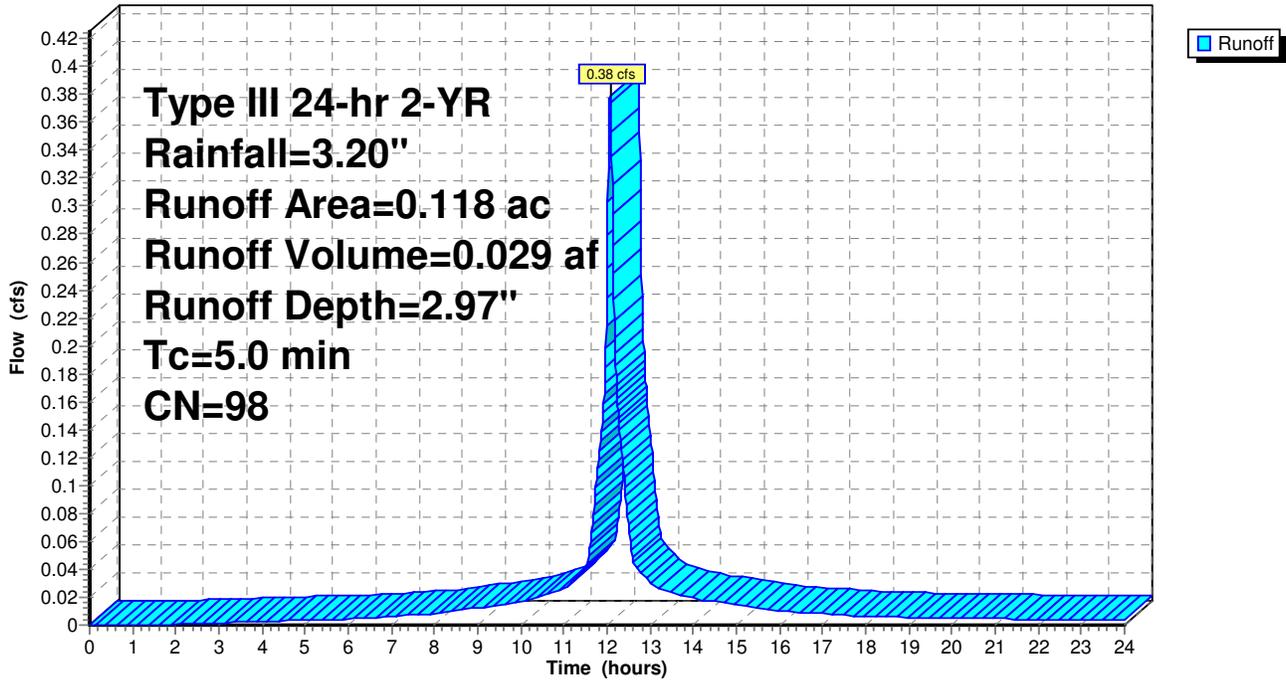
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.118	98	Paved parking & roofs

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

Subcatchment CB 8: CB 8

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 18

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 9: CB 9

Runoff = 1.45 cfs @ 12.07 hrs, Volume= 0.111 af, Depth= 2.97"

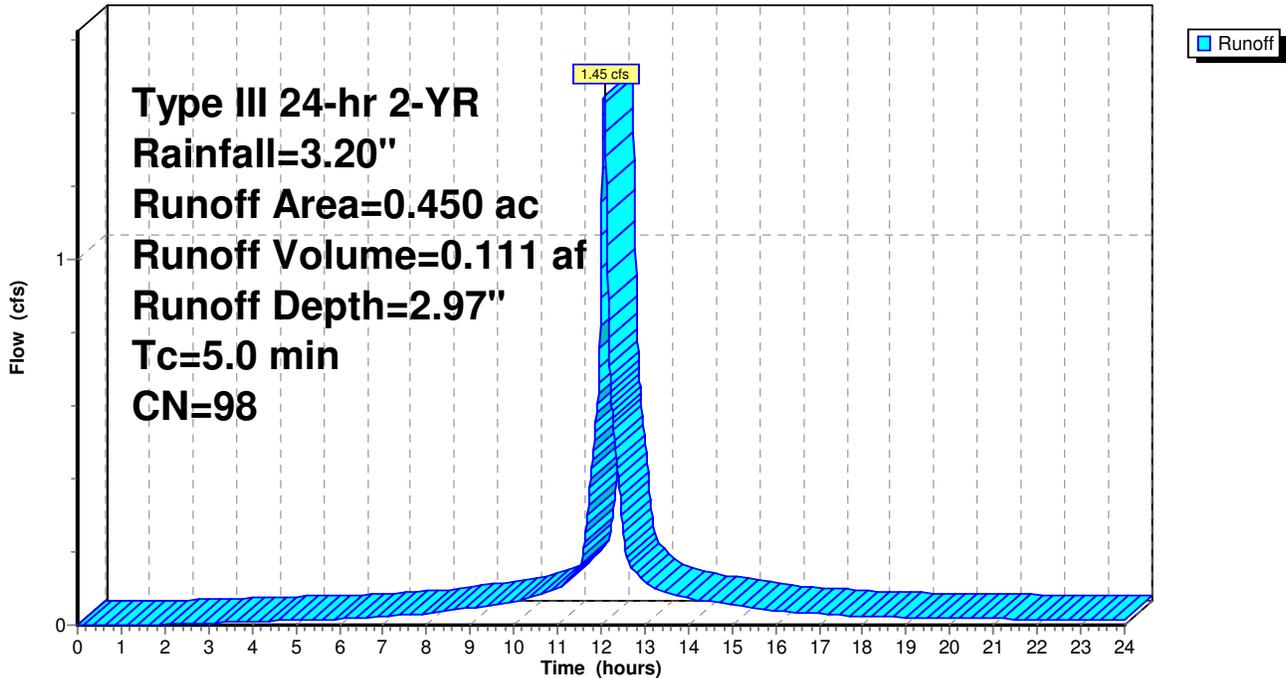
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.450	98	Paved parking & roofs

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

Subcatchment CB 9: CB 9

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 19

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB10: CB 10

Runoff = 0.04 cfs @ 12.07 hrs, Volume= 0.003 af, Depth= 2.97"

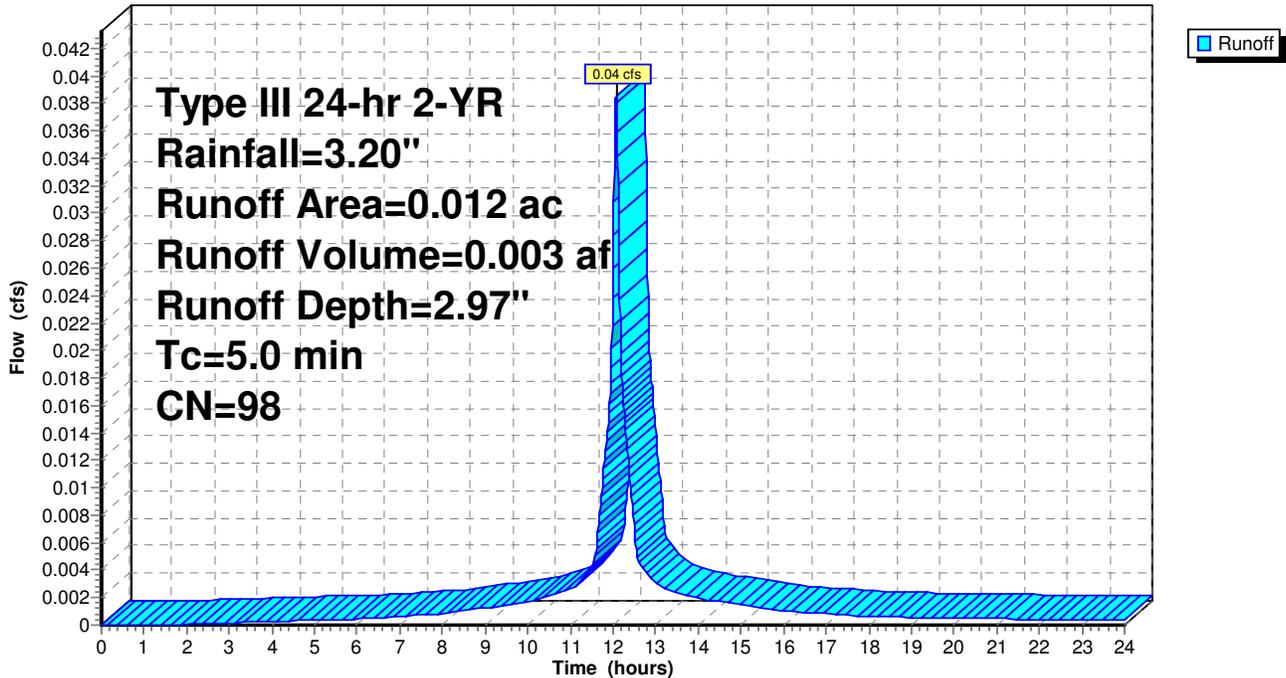
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.012	98	Paved parking & roofs

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

Subcatchment CB10: CB 10

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 20

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB12: CB 12

Runoff = 0.55 cfs @ 12.07 hrs, Volume= 0.040 af, Depth= 2.75"

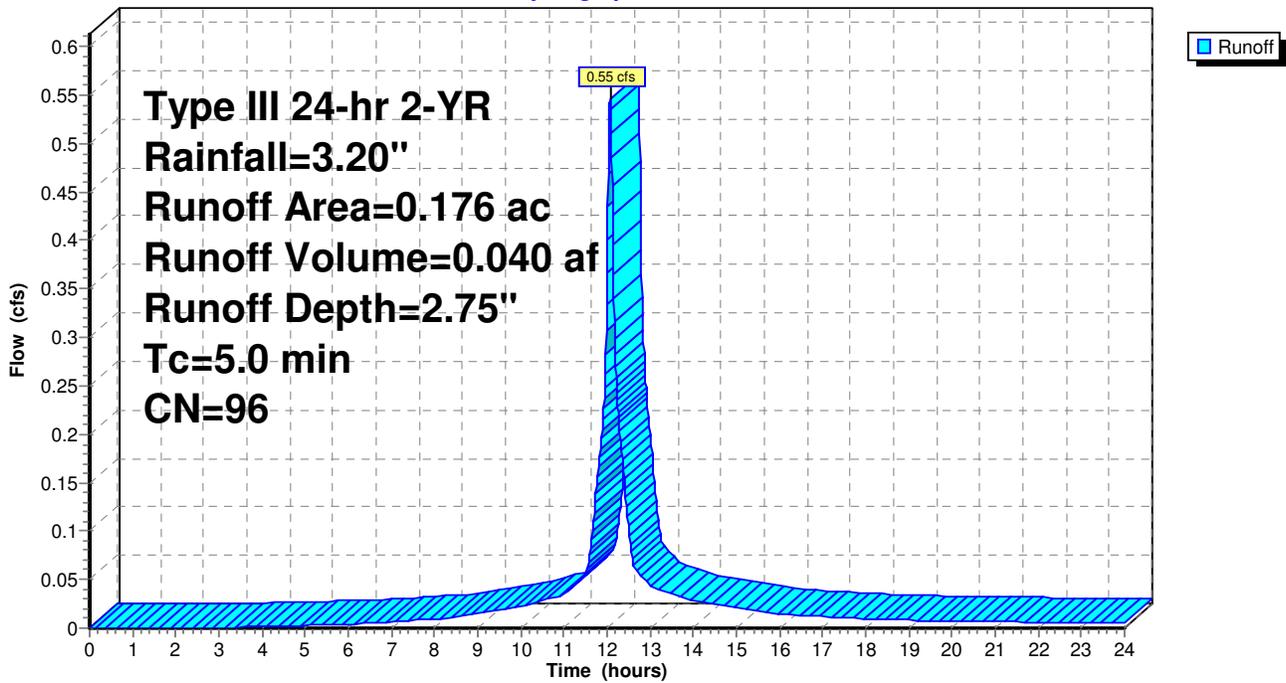
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.018	74	>75% Grass cover, Good, HSG C
0.158	98	Paved parking & roofs
0.176	96	Weighted Average

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

Subcatchment CB12: CB 12

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 21

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB13: CB 13

Runoff = 0.27 cfs @ 12.07 hrs, Volume= 0.020 af, Depth= 2.64"

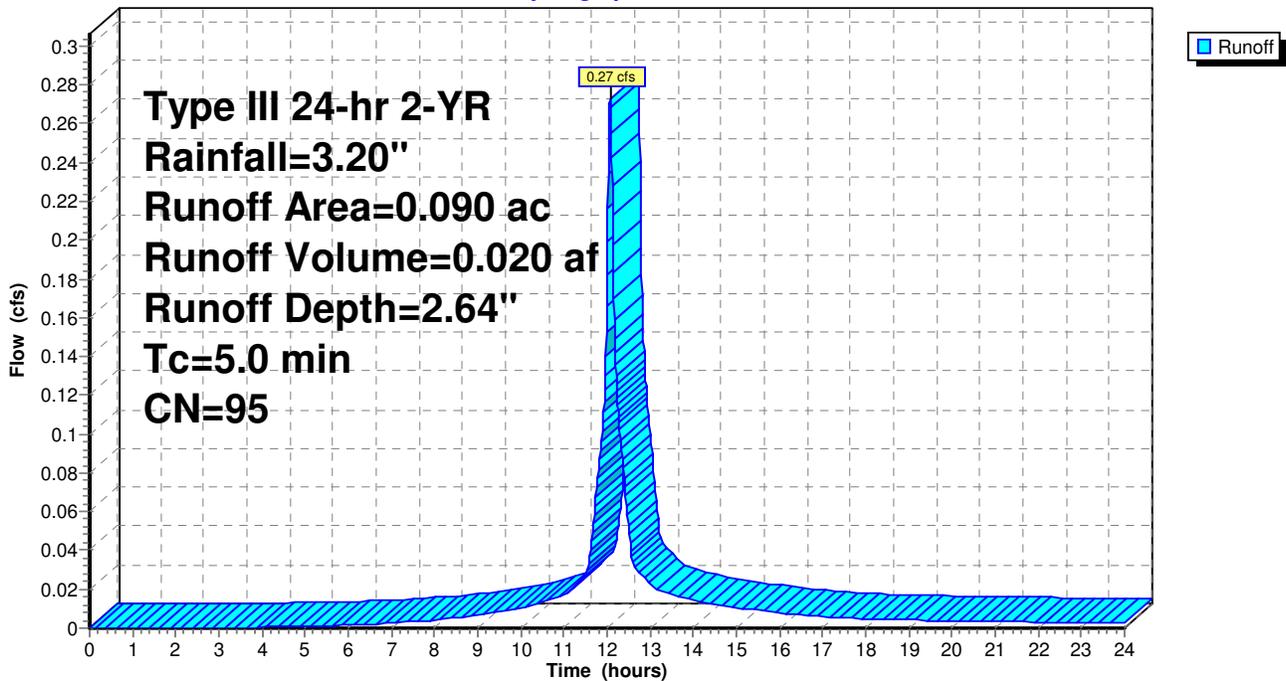
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.012	74	>75% Grass cover, Good, HSG C
0.078	98	Paved parking & roofs
0.090	95	Weighted Average

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

Subcatchment CB13: CB 13

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 22

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB14: CB 14

Runoff = 0.83 cfs @ 12.07 hrs, Volume= 0.060 af, Depth= 2.64"

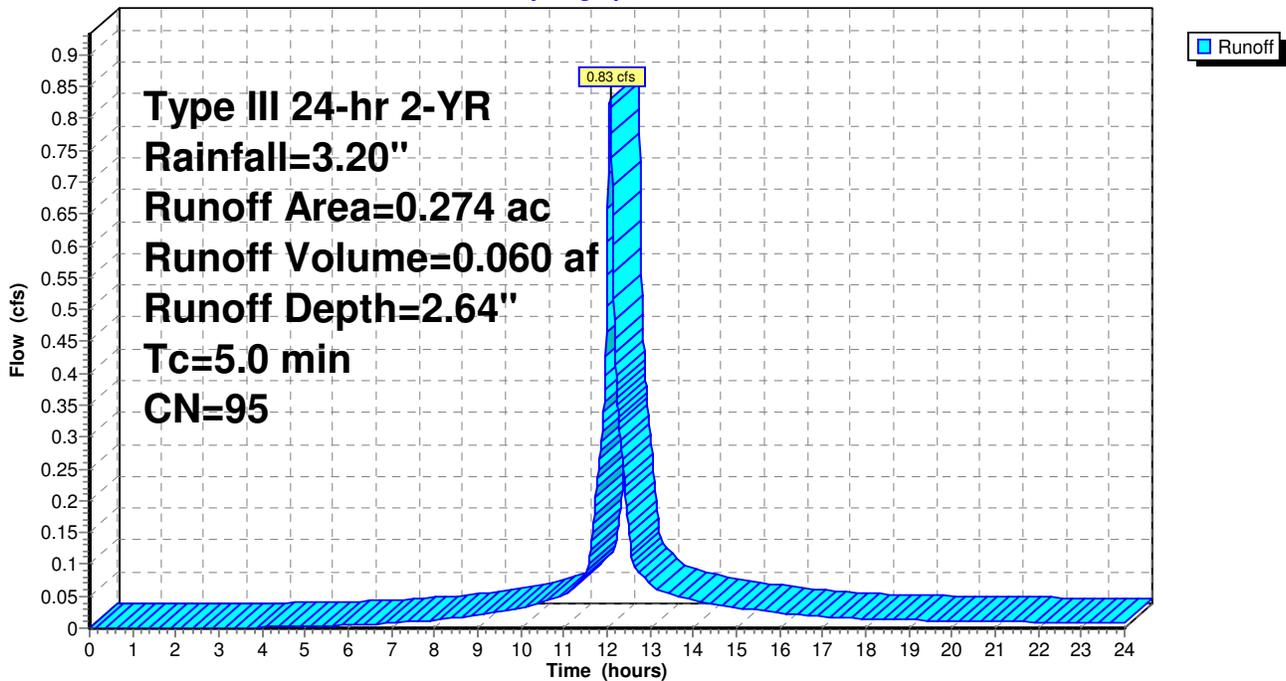
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.239	98	Paved parking & roofs
0.035	74	>75% Grass cover, Good, HSG C
0.274	95	Weighted Average

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

Subcatchment CB14: CB 14

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 23

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB15: CB15

Runoff = 0.33 cfs @ 12.08 hrs, Volume= 0.025 af, Depth= 2.64"

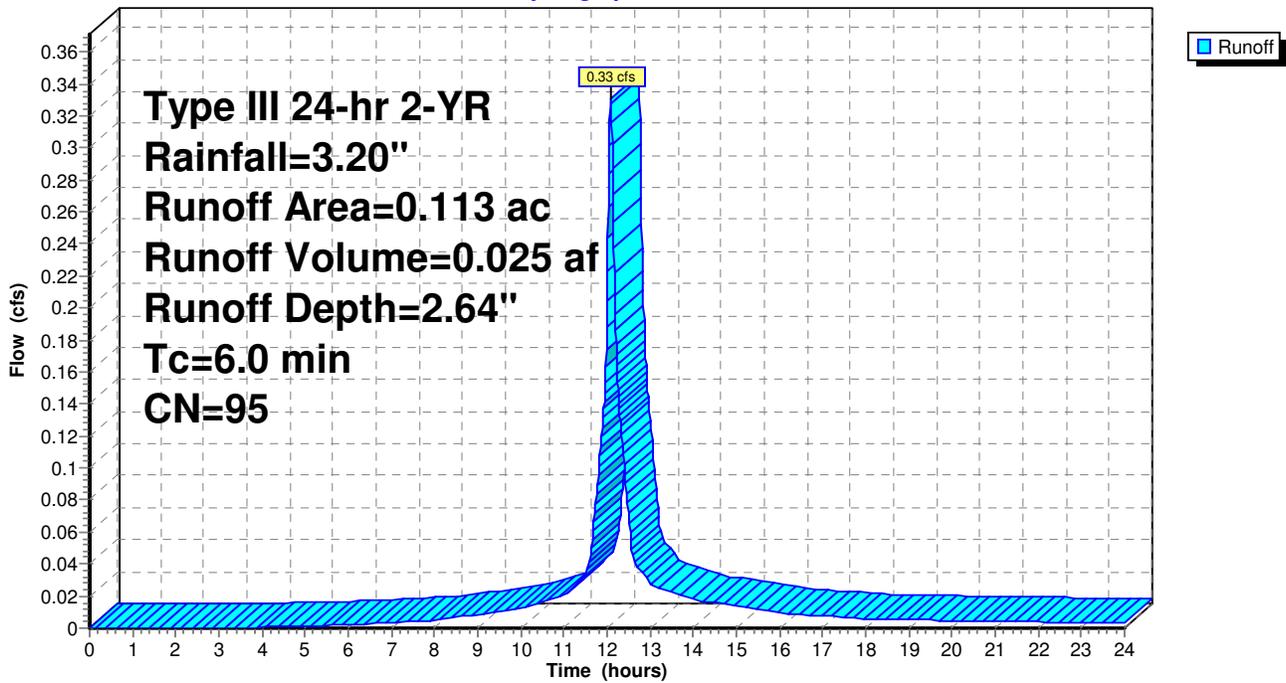
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.101	98	Paved
0.012	74	>75% Grass cover, Good, HSG C
0.113	95	Weighted Average

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

Subcatchment CB15: CB15

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 24

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB16: CB 16

Runoff = 0.43 cfs @ 12.07 hrs, Volume= 0.030 af, Depth= 2.44"

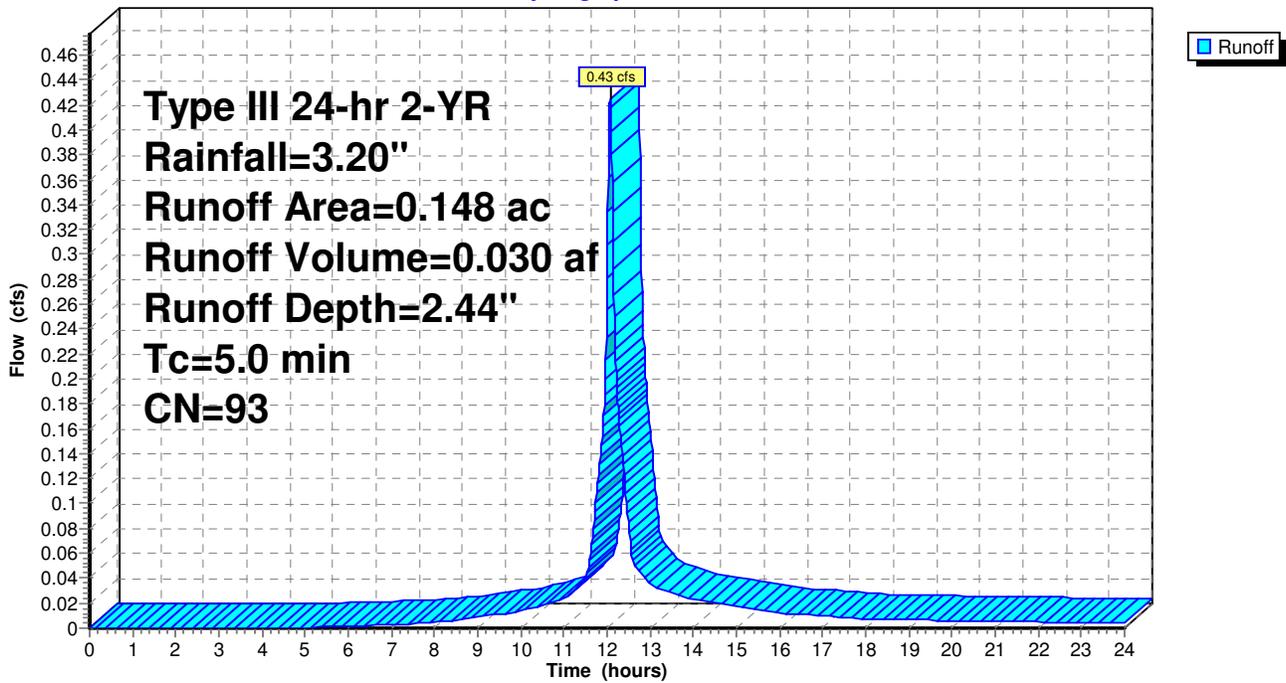
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.033	74	>75% Grass cover, Good, HSG C
0.115	98	Paved parking & roofs
0.148	93	Weighted Average

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

Subcatchment CB16: CB 16

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 25

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB17: CB 17

Runoff = 0.45 cfs @ 12.07 hrs, Volume= 0.034 af, Depth= 2.85"

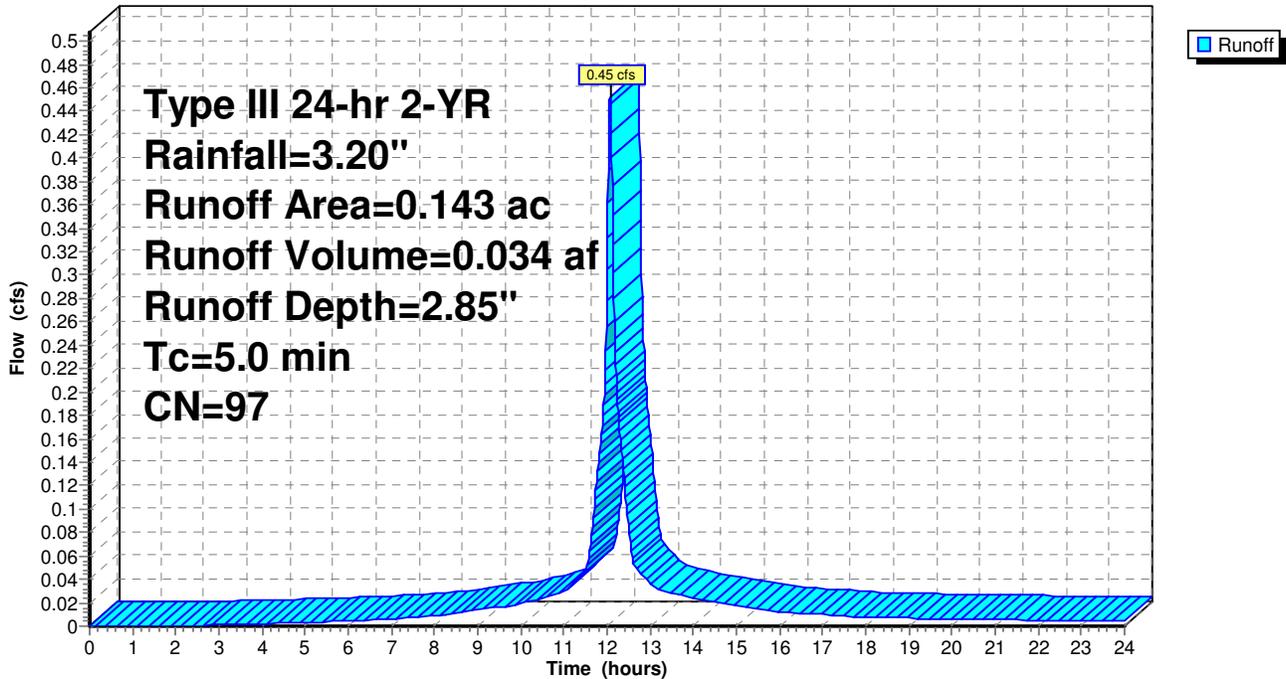
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.007	74	>75% Grass cover, Good, HSG C
0.136	98	Paved parking & roofs
0.143	97	Weighted Average

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

Subcatchment CB17: CB 17

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 26

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB18: CB18

Runoff = 0.47 cfs @ 12.07 hrs, Volume= 0.036 af, Depth= 2.97"

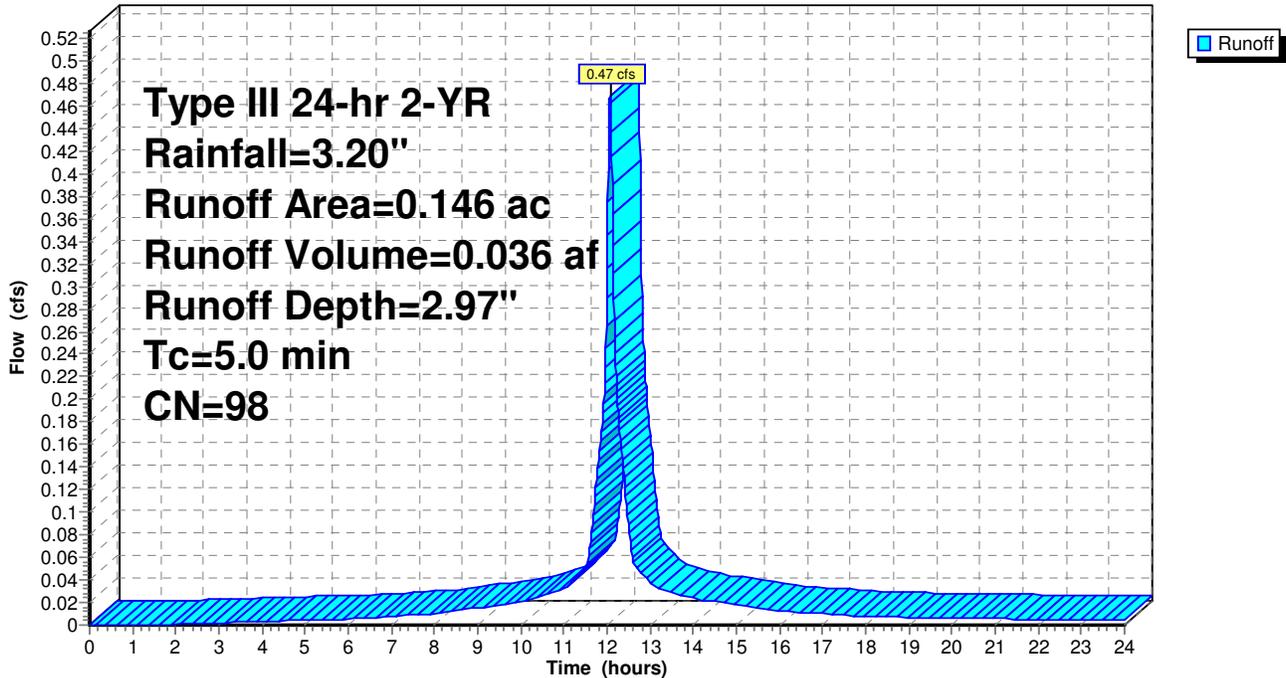
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.146	98	Paved parking & roofs

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

Subcatchment CB18: CB18

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 27

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment EX 1: Design Point #1 - Flow to Dorchester Bay

Runoff = 0.83 cfs @ 12.08 hrs, Volume= 0.057 af, Depth= 1.54"

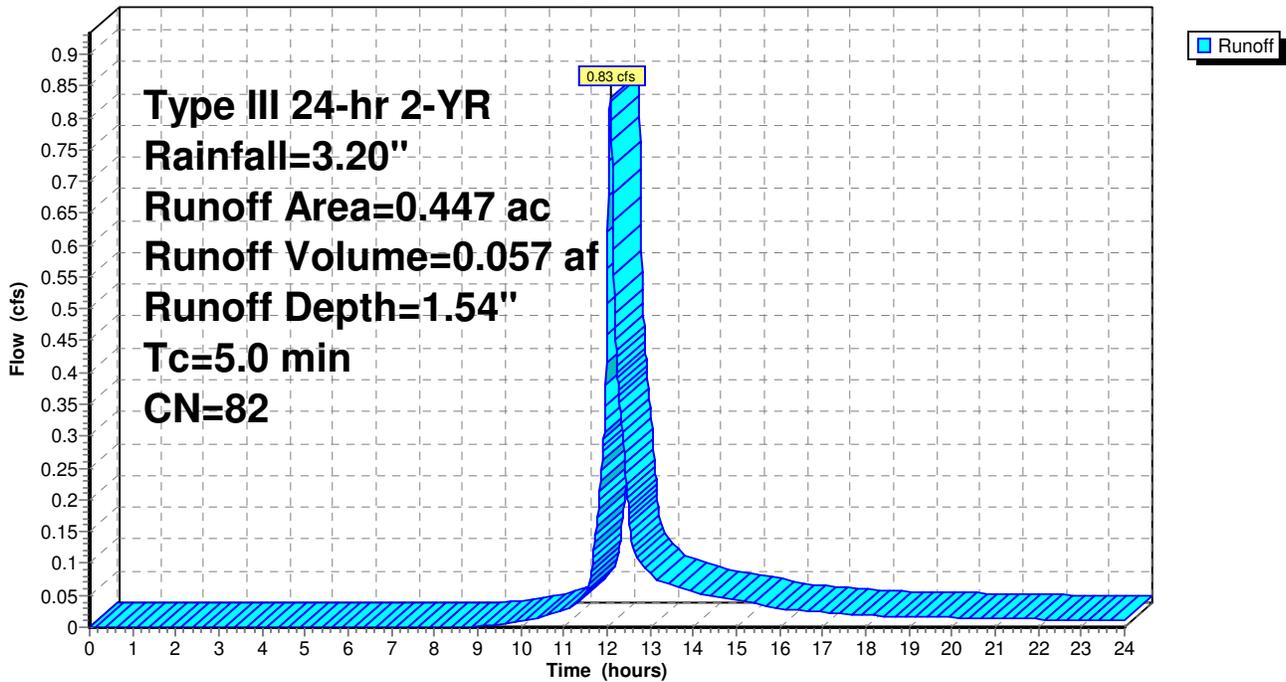
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.048	98	Paved
0.368	79	Wood Boardwalk
0.031	86	<50% Grass cover, Poor, HSG C
0.447	82	Weighted Average

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

Subcatchment EX 1: Design Point #1 - Flow to Dorchester Bay

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 28

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment EX4: EX 4

Runoff = 1.93 cfs @ 12.07 hrs, Volume= 0.148 af, Depth= 2.97"

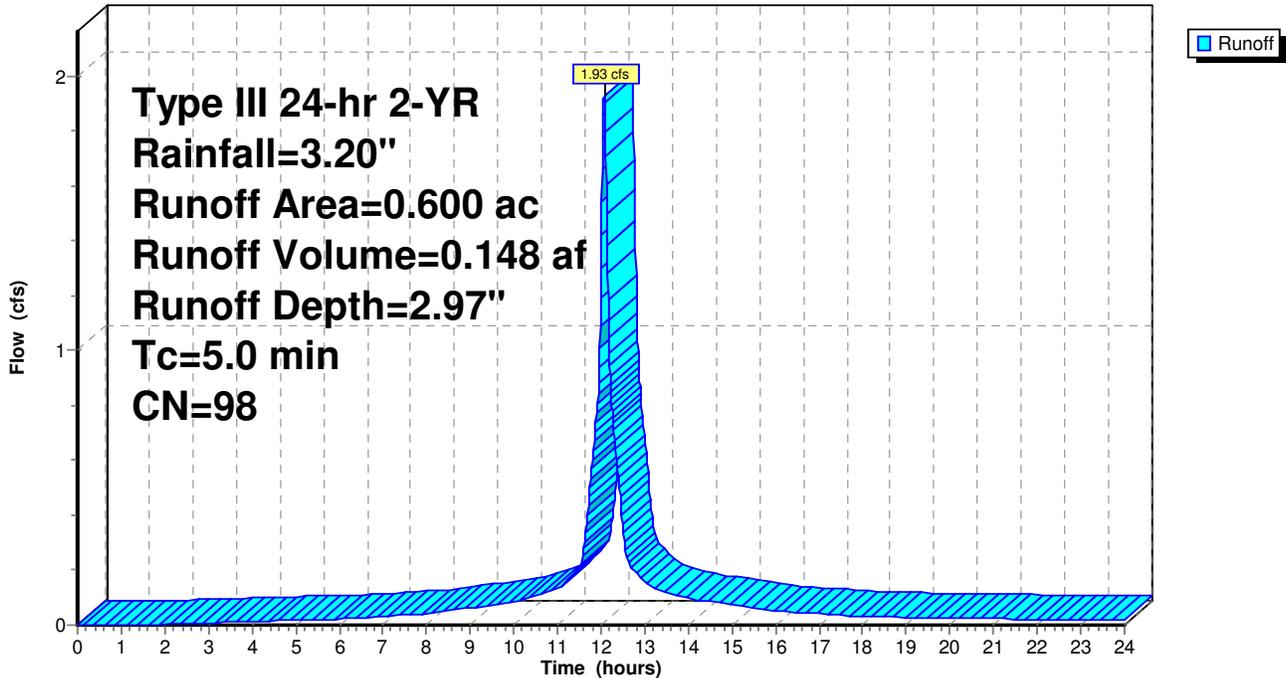
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.600	98	Paved parking & roofs

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

Subcatchment EX4: EX 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 29

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment EXCB: EX CB

Runoff = 0.74 cfs @ 12.07 hrs, Volume= 0.055 af, Depth= 2.85"

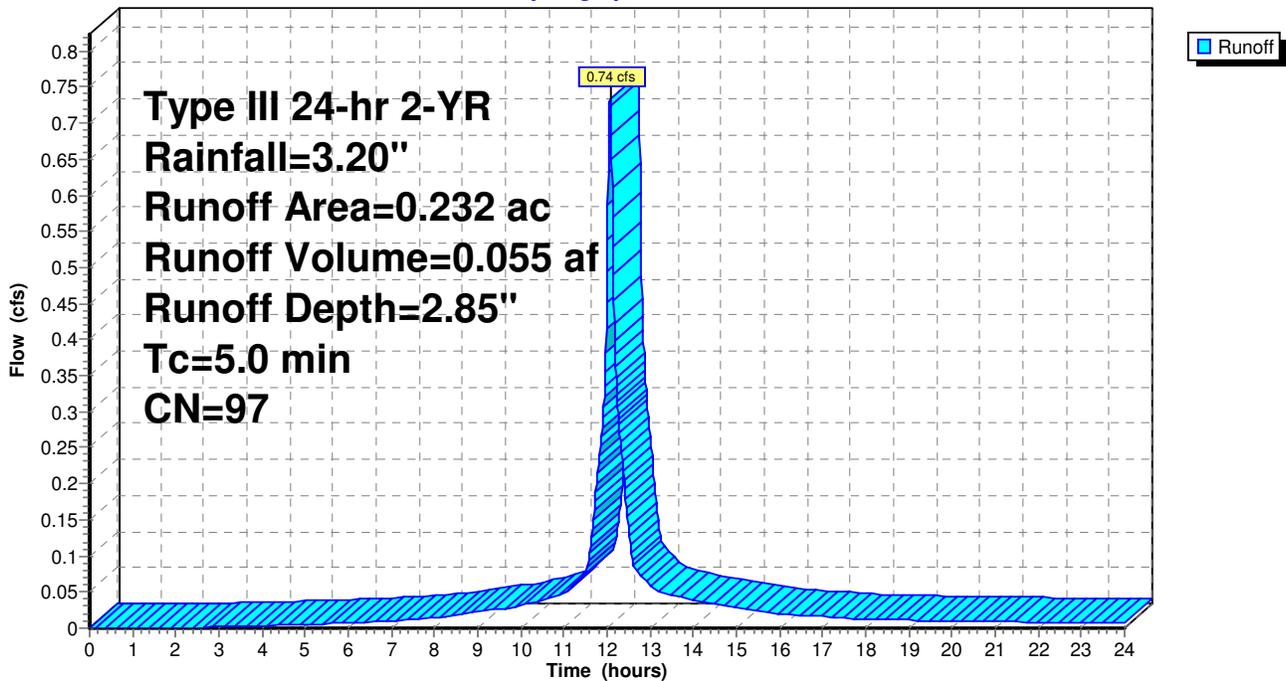
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.227	98	Paved parking & roofs
0.005	74	>75% Grass cover, Good, HSG C
0.232	97	Weighted Average

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

Subcatchment EXCB: EX CB

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 30

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment RD 1: ROOF DRAIN 1

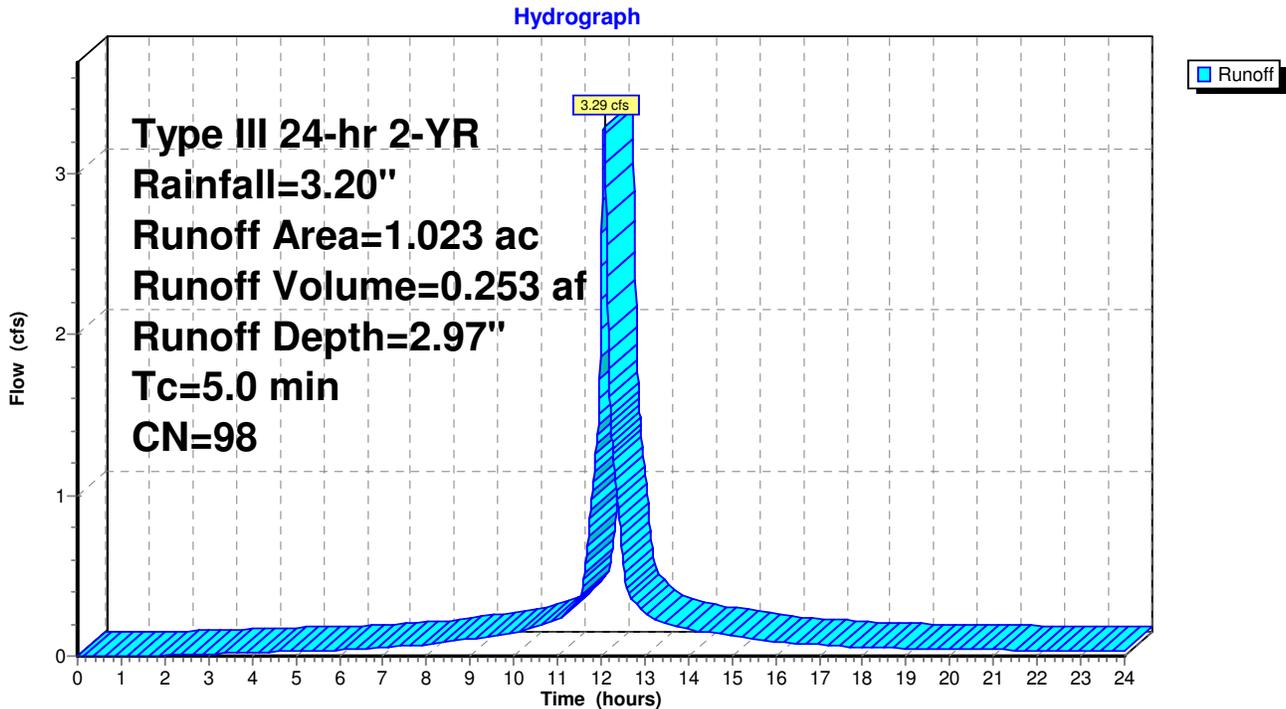
Runoff = 3.29 cfs @ 12.07 hrs, Volume= 0.253 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
1.023	98	Paved parking & roofs

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

Subcatchment RD 1: ROOF DRAIN 1



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 31

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment RD 2: ROOF DRAIN 2

Runoff = 2.85 cfs @ 12.07 hrs, Volume= 0.219 af, Depth= 2.97"

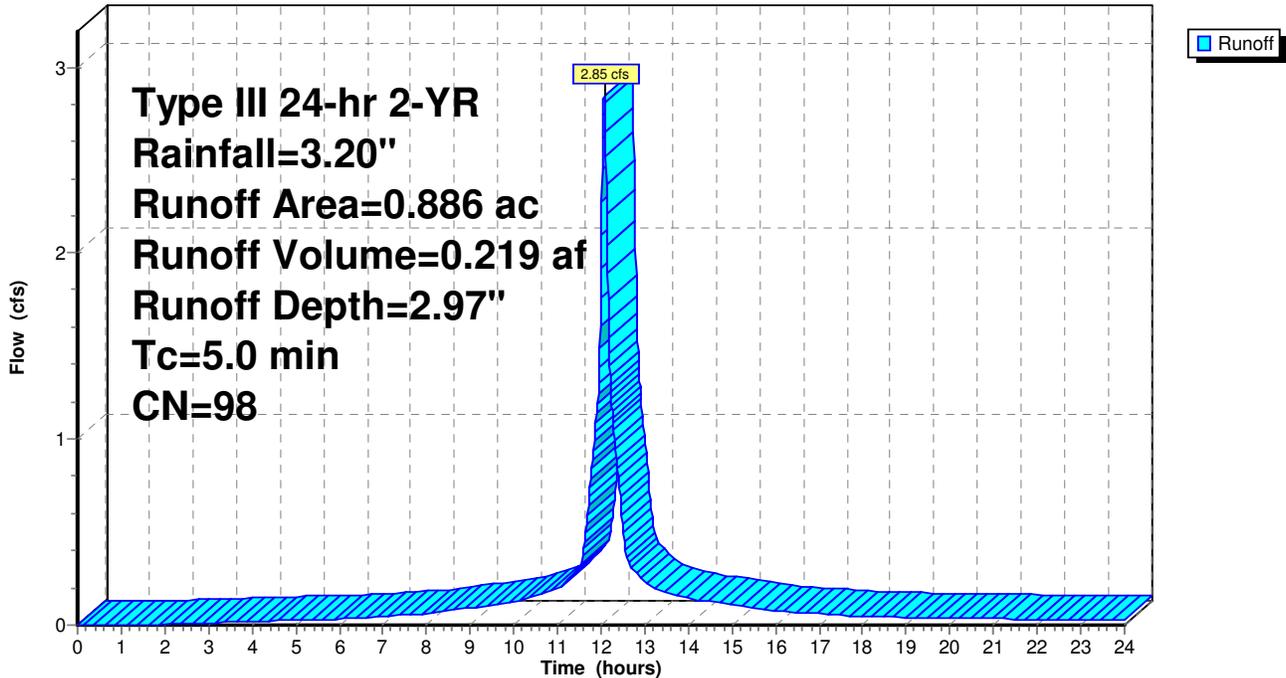
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.886	98	Paved parking & roofs

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

Subcatchment RD 2: ROOF DRAIN 2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 32

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment RD3: ROOF DRAIN 3

Runoff = 3.45 cfs @ 12.07 hrs, Volume= 0.265 af, Depth= 2.97"

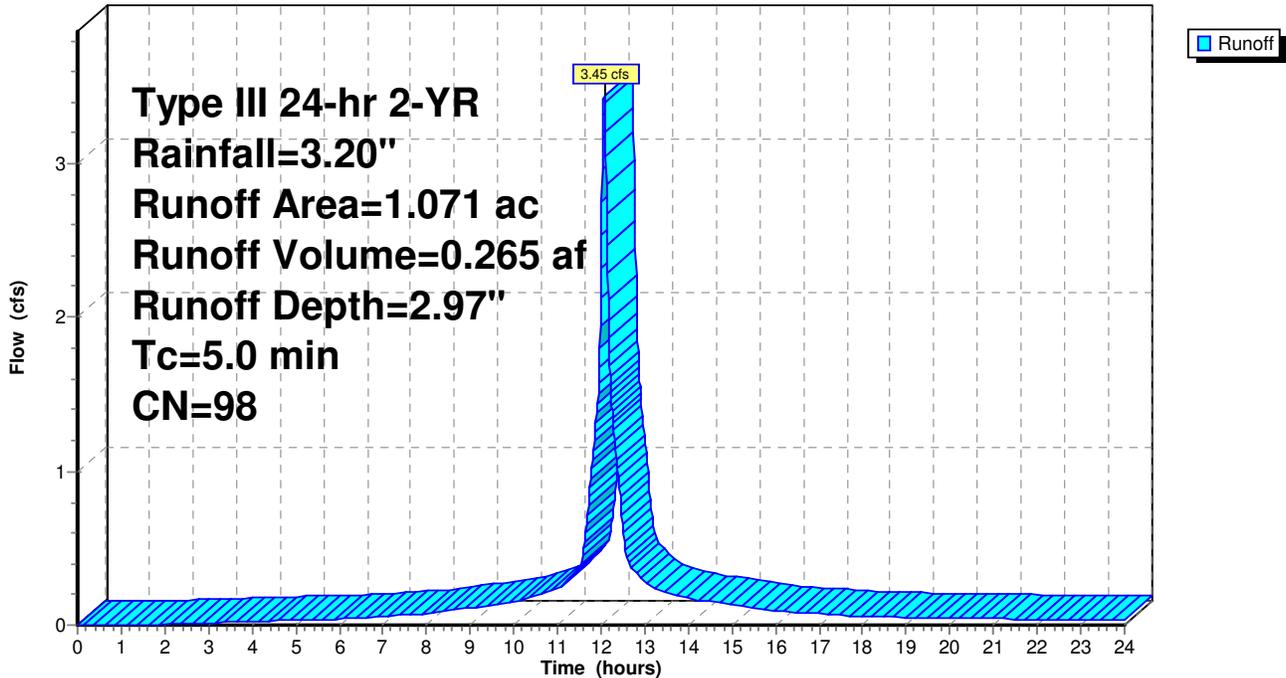
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
1.071	98	Paved parking & roofs

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

Subcatchment RD3: ROOF DRAIN 3

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 33

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment RD4: ROOF DRAIN 4

Runoff = 1.06 cfs @ 12.07 hrs, Volume= 0.081 af, Depth= 2.97"

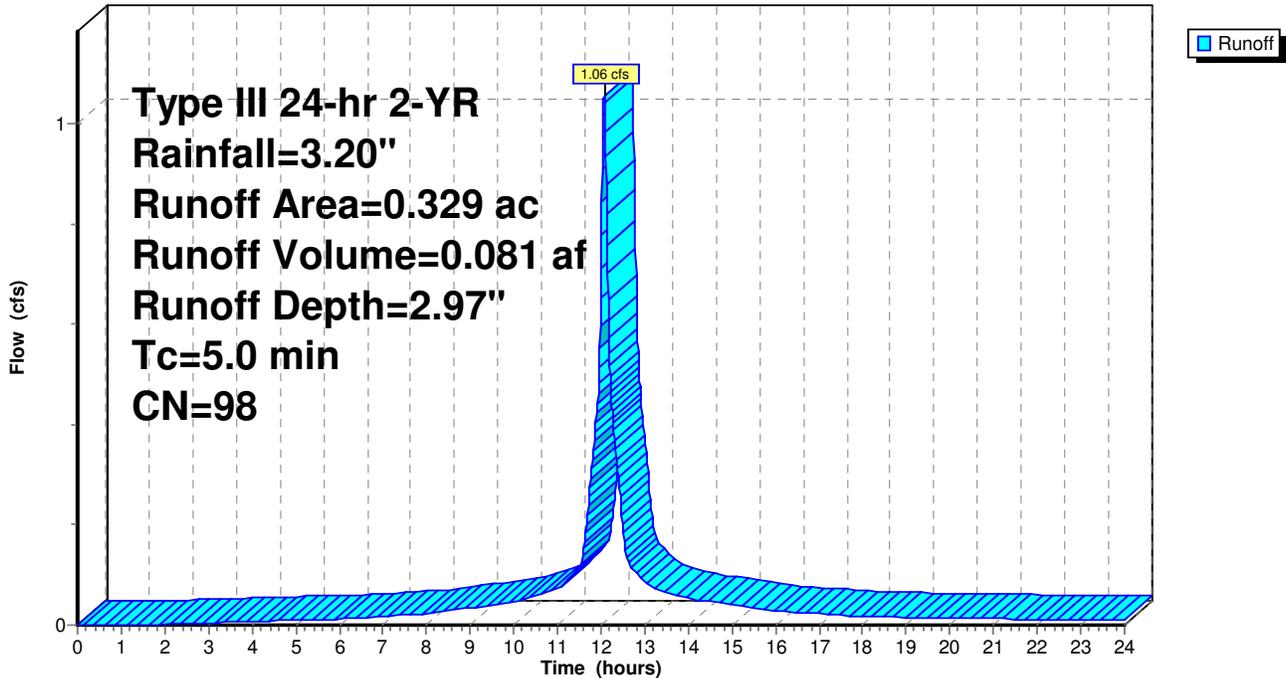
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-YR Rainfall=3.20"

Area (ac)	CN	Description
0.329	98	Paved parking & roofs

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

Subcatchment RD4: ROOF DRAIN 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 34

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

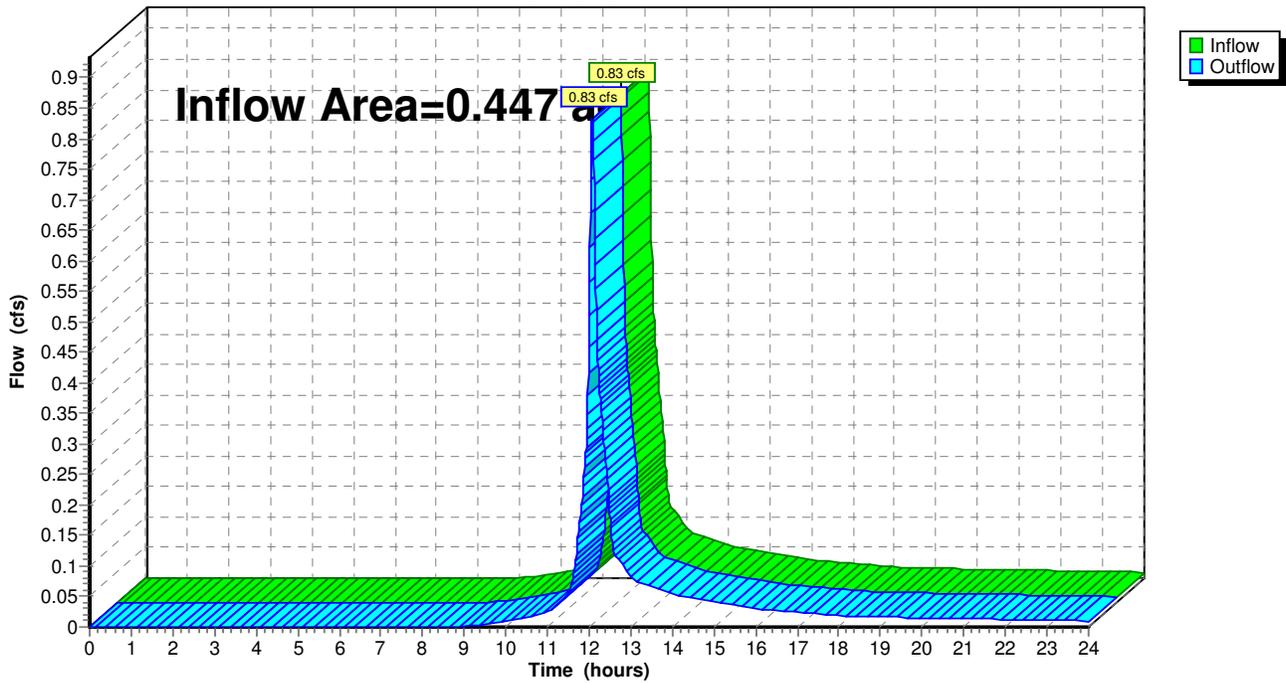
Reach DP#1: Dorchester Bay

Inflow Area = 0.447 ac, Inflow Depth = 1.54" for 2-YR event
Inflow = 0.83 cfs @ 12.08 hrs, Volume= 0.057 af
Outflow = 0.83 cfs @ 12.08 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#1: Dorchester Bay

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 35

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

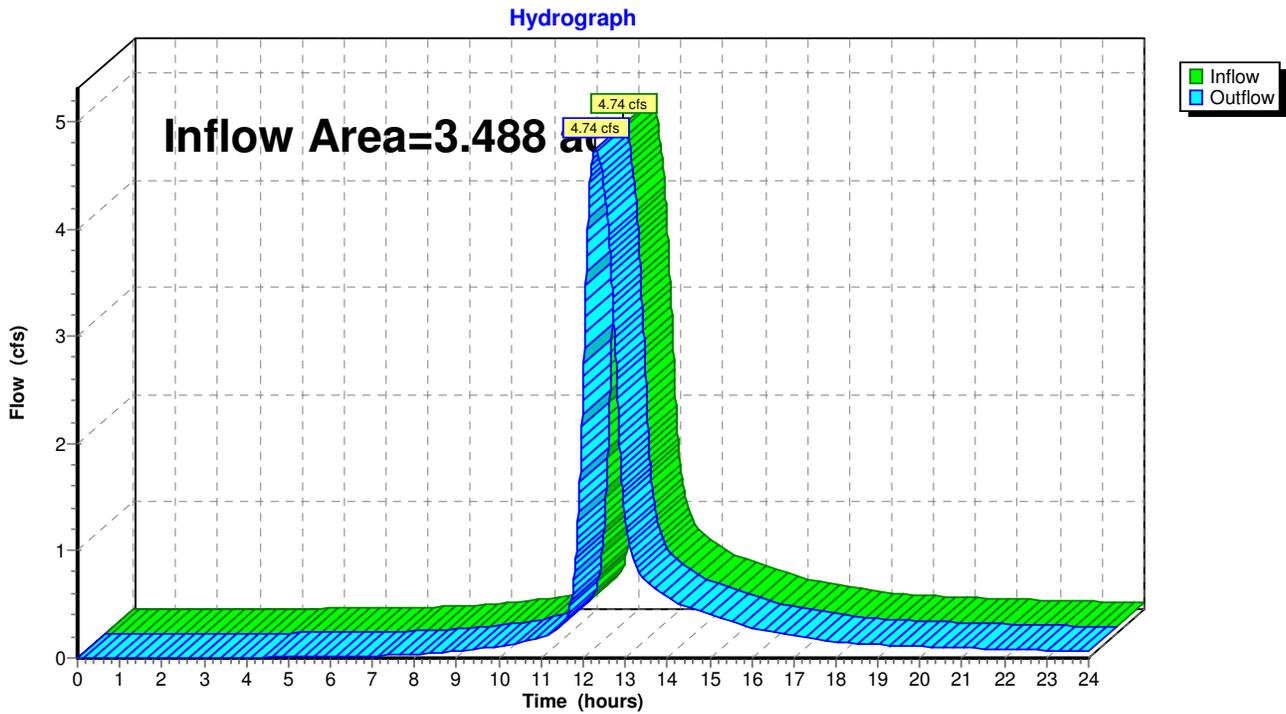
3/15/2013

Reach DP#2: Design Point #2 - Flow to Stormwater Outfall #1 (12" Storm Drain)

Inflow Area = 3.488 ac, Inflow Depth = 2.03" for 2-YR event
Inflow = 4.74 cfs @ 12.29 hrs, Volume= 0.589 af
Outflow = 4.74 cfs @ 12.29 hrs, Volume= 0.589 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#2: Design Point #2 - Flow to Stormwater Outfall #1 (12" Storm Drain)



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 36

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

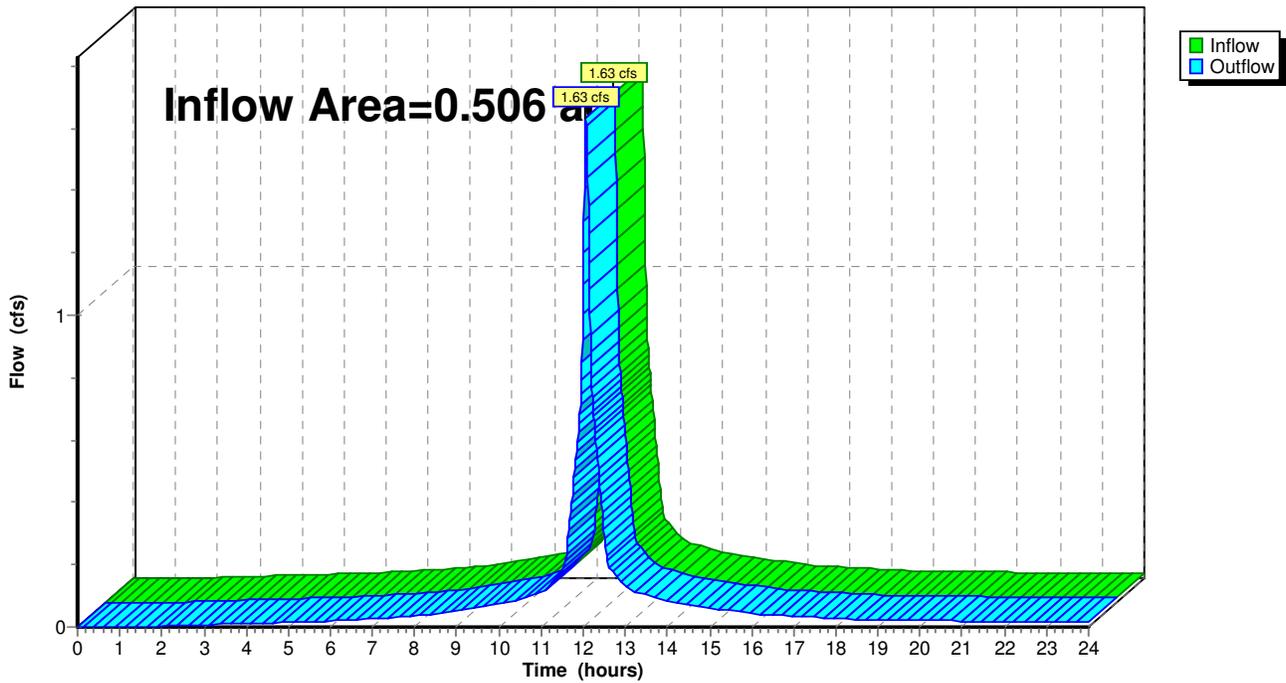
Reach DP#3: Design Point #3 - Flow to Stormwater Outfall #2

Inflow Area = 0.506 ac, Inflow Depth = 2.97" for 2-YR event
Inflow = 1.63 cfs @ 12.07 hrs, Volume= 0.125 af
Outflow = 1.63 cfs @ 12.07 hrs, Volume= 0.125 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#3: Design Point #3 - Flow to Stormwater Outfall #2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 37

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

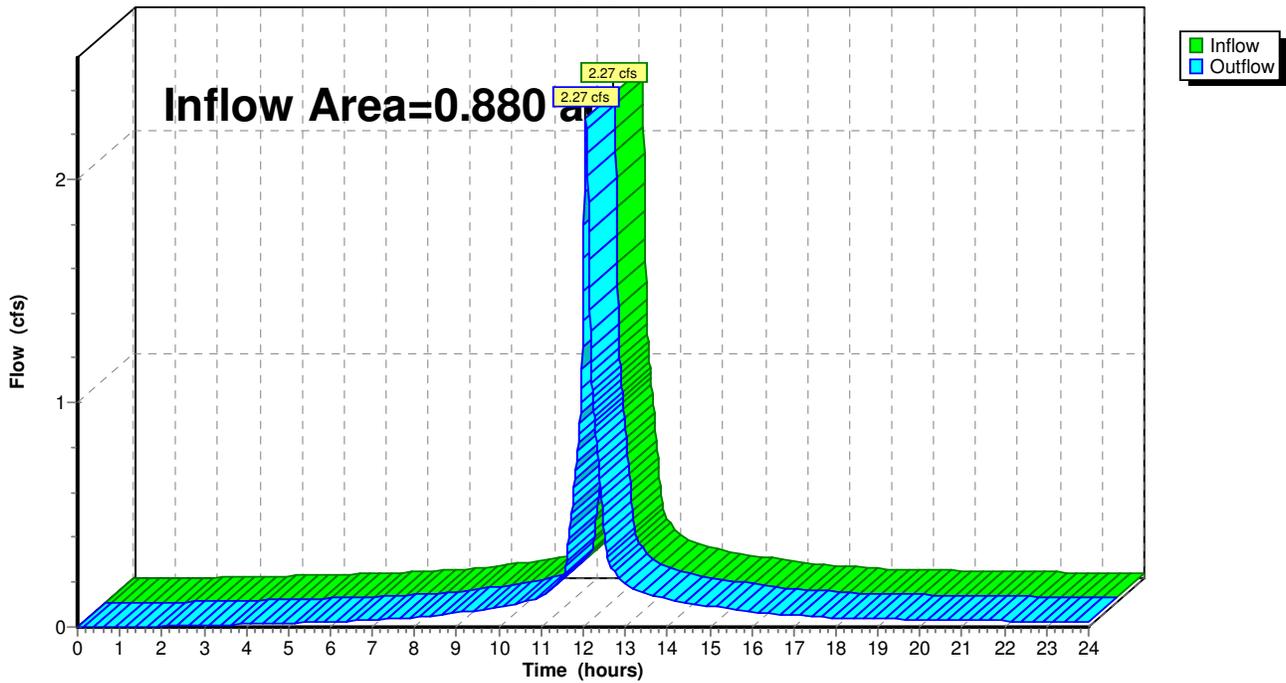
Reach DP#4: Design Point #4 - Parking Lot Storm Drain

Inflow Area = 0.880 ac, Inflow Depth = 2.35" for 2-YR event
Inflow = 2.27 cfs @ 12.07 hrs, Volume= 0.172 af
Outflow = 2.27 cfs @ 12.07 hrs, Volume= 0.172 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#4: Design Point #4 - Parking Lot Storm Drain

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 38

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

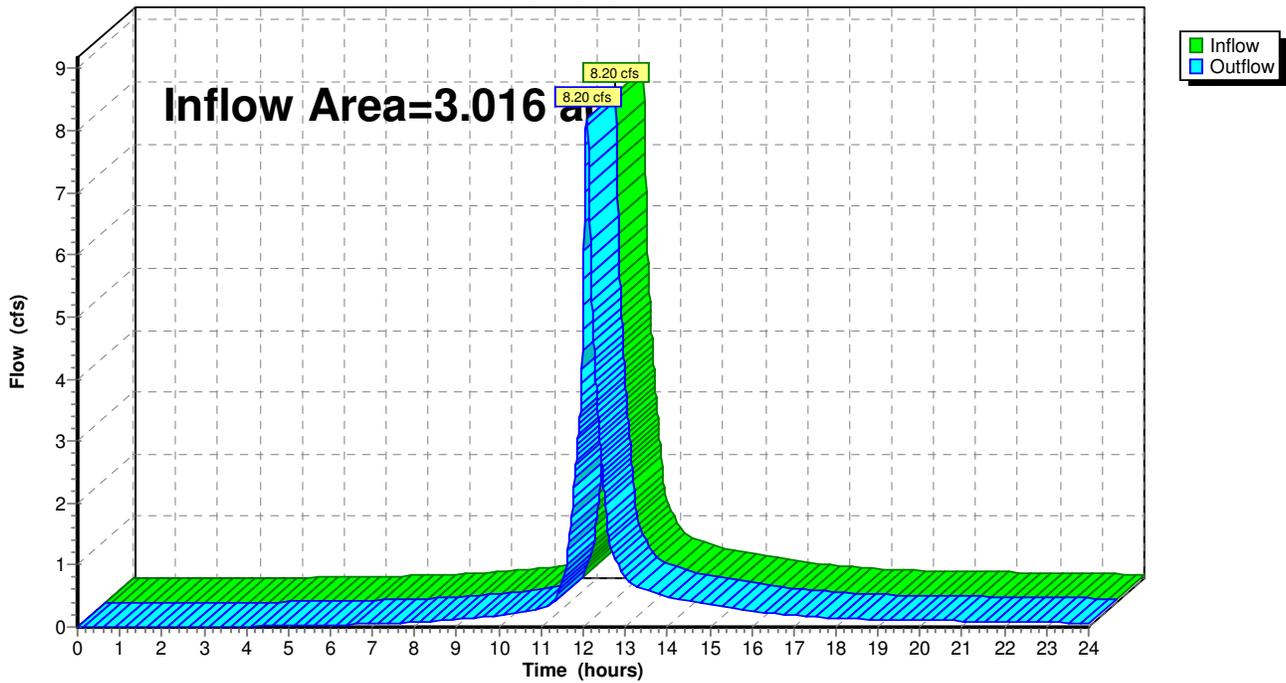
Reach DP#5: Haul Road

Inflow Area = 3.016 ac, Inflow Depth = 2.40" for 2-YR event
Inflow = 8.20 cfs @ 12.09 hrs, Volume= 0.603 af
Outflow = 8.20 cfs @ 12.09 hrs, Volume= 0.603 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#5: Haul Road

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 39

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond 9: CB 9 TO DMH 6

Inflow Area = 0.450 ac, Inflow Depth = 2.97" for 2-YR event
 Inflow = 1.45 cfs @ 12.07 hrs, Volume= 0.111 af
 Outflow = 1.45 cfs @ 12.07 hrs, Volume= 0.111 af, Atten= 0%, Lag= 0.0 min
 Primary = 1.45 cfs @ 12.07 hrs, Volume= 0.111 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.79' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

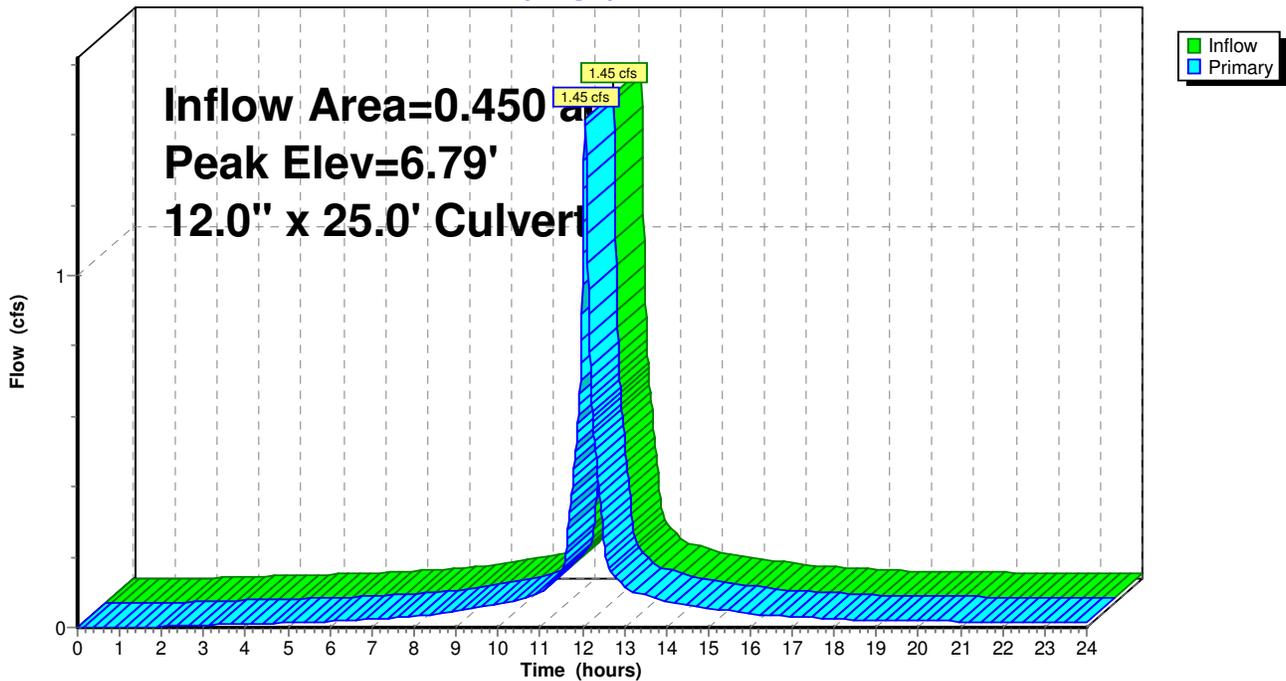
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	6.15'	12.0" x 25.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.25' S= 0.0360 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=1.45 cfs @ 12.07 hrs HW=6.79' TW=0.00' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 1.45 cfs @ 2.7 fps)

Pond 9: CB 9 TO DMH 6

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 40

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond 11: CB 11 TO DMH 6

Inflow Area = 0.044 ac, Inflow Depth = 2.97" for 2-YR event
 Inflow = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af
 Outflow = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.43' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

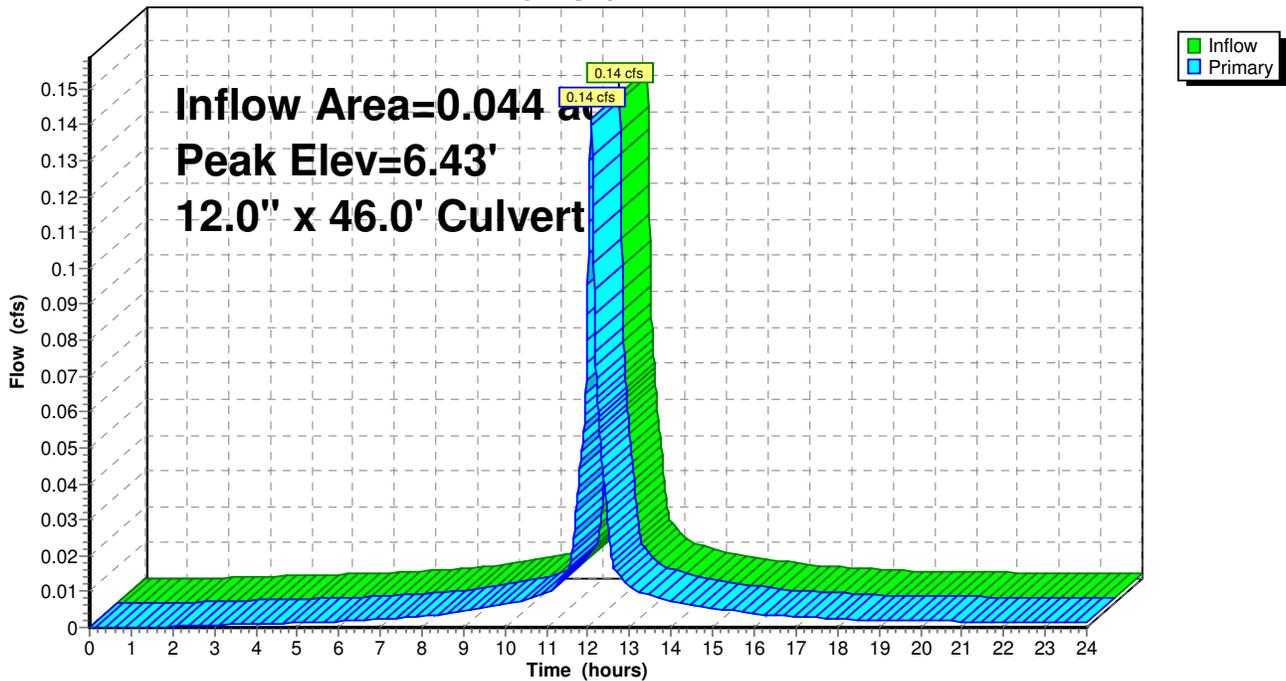
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	6.25'	12.0" x 46.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.35' S= 0.0196 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=0.14 cfs @ 12.07 hrs HW=6.43' TW=0.00' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 0.14 cfs @ 1.5 fps)

Pond 11: CB 11 TO DMH 6

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 41

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH1: DMH1

Inflow Area = 1.484 ac, Inflow Depth = 1.86" for 2-YR event
 Inflow = 2.03 cfs @ 12.41 hrs, Volume= 0.230 af
 Outflow = 2.03 cfs @ 12.41 hrs, Volume= 0.230 af, Atten= 0%, Lag= 0.0 min
 Primary = 2.03 cfs @ 12.41 hrs, Volume= 0.230 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.41' @ 12.18 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

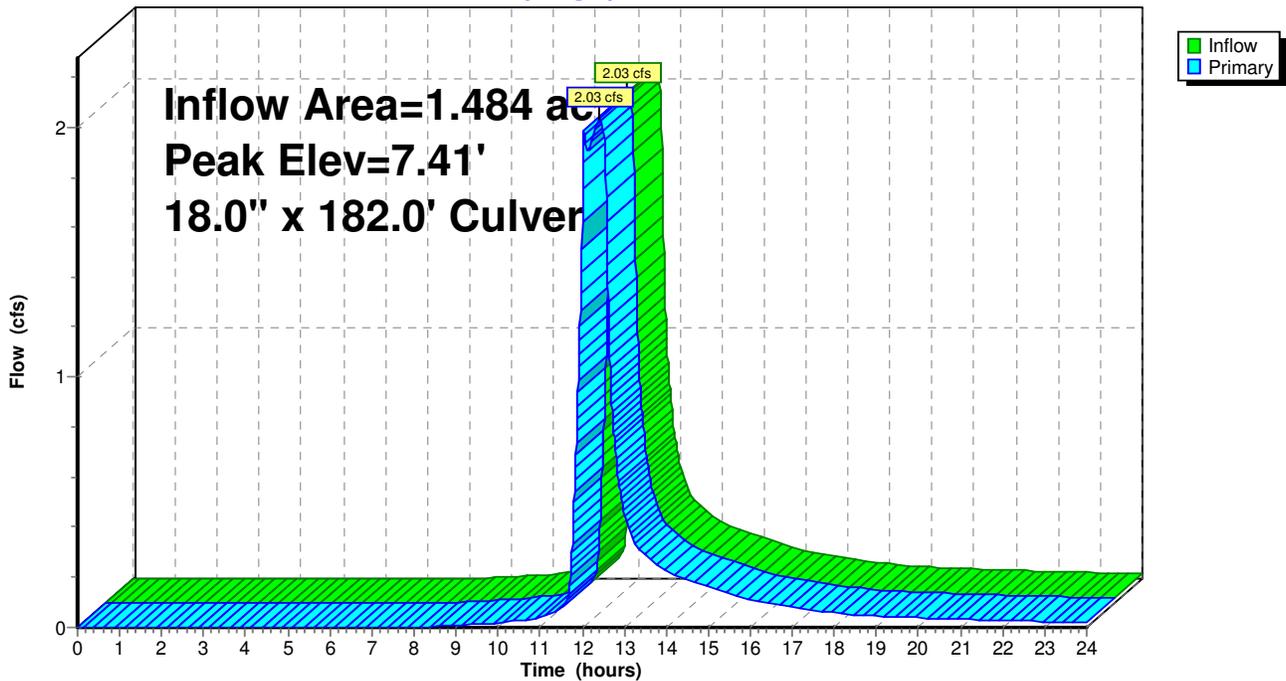
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.96'	18.0" x 182.0' long Culvert Ke= 0.600 Outlet Invert= 5.50' S= 0.0025 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=2.03 cfs @ 12.41 hrs HW=7.25' TW=7.06' (Dynamic Tailwater)
 ↳ **1=Culvert** (Barrel Controls 2.03 cfs @ 1.7 fps)

Pond DMH1: DMH1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 42

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH10: DMH10

Inflow Area = 0.470 ac, Inflow Depth = 2.44" for 2-YR event
Inflow = 1.34 cfs @ 12.07 hrs, Volume= 0.096 af
Outflow = 1.34 cfs @ 12.07 hrs, Volume= 0.096 af, Atten= 0%, Lag= 0.0 min
Primary = 1.34 cfs @ 12.07 hrs, Volume= 0.096 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 5.92' @ 12.09 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

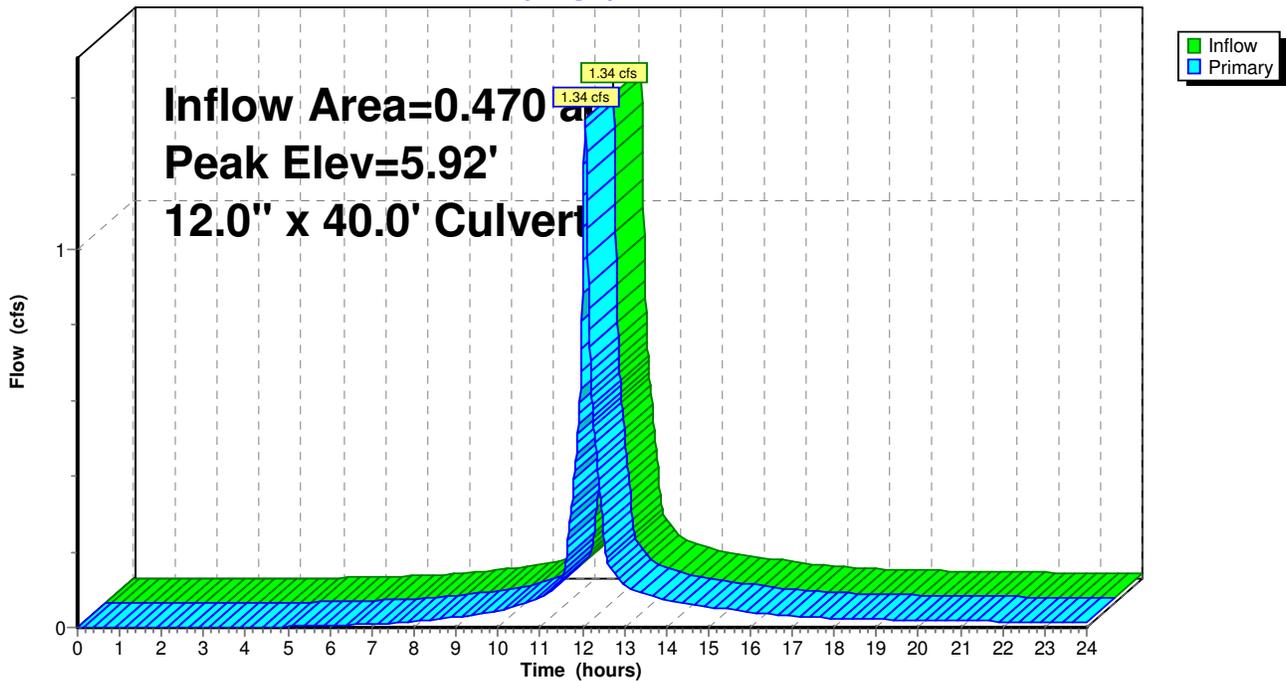
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	4.06'	12.0" x 40.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 3.55' S= 0.0127 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=0.92 cfs @ 12.07 hrs HW=5.63' TW=5.57' (Dynamic Tailwater)
↑1=Culvert (Inlet Controls 0.92 cfs @ 1.2 fps)

Pond DMH10: DMH10

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 43

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH11: DMH11

Inflow Area = 2.192 ac, Inflow Depth = 2.29" for 2-YR event
Inflow = 5.77 cfs @ 12.10 hrs, Volume= 0.418 af
Outflow = 5.77 cfs @ 12.10 hrs, Volume= 0.418 af, Atten= 0%, Lag= 0.0 min
Primary = 5.77 cfs @ 12.10 hrs, Volume= 0.418 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 5.42' @ 12.09 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

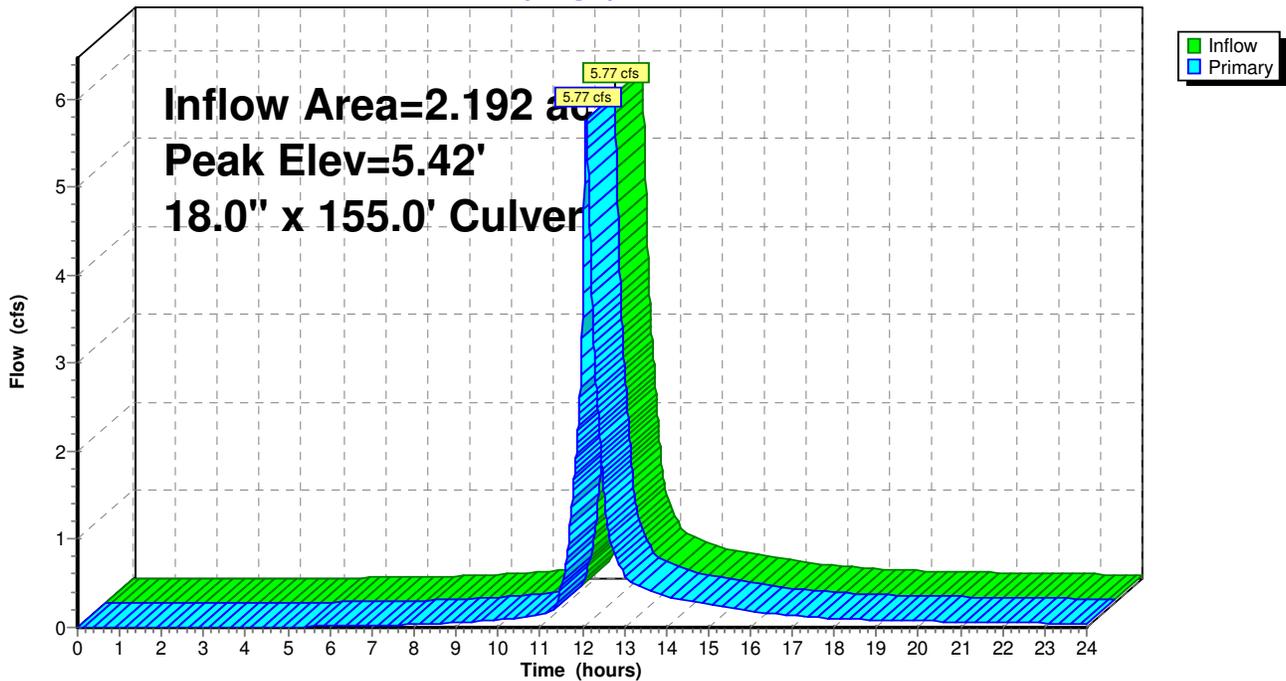
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	2.73'	18.0" x 155.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 2.20' S= 0.0034 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=5.76 cfs @ 12.10 hrs HW=5.40' TW=4.69' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 5.76 cfs @ 3.3 fps)

Pond DMH11: DMH11

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 44

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH14: DMH14

Inflow Area = 3.016 ac, Inflow Depth = 2.40" for 2-YR event
Inflow = 8.20 cfs @ 12.09 hrs, Volume= 0.603 af
Outflow = 8.20 cfs @ 12.09 hrs, Volume= 0.603 af, Atten= 0%, Lag= 0.0 min
Primary = 8.20 cfs @ 12.09 hrs, Volume= 0.603 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 3.56' @ 12.09 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

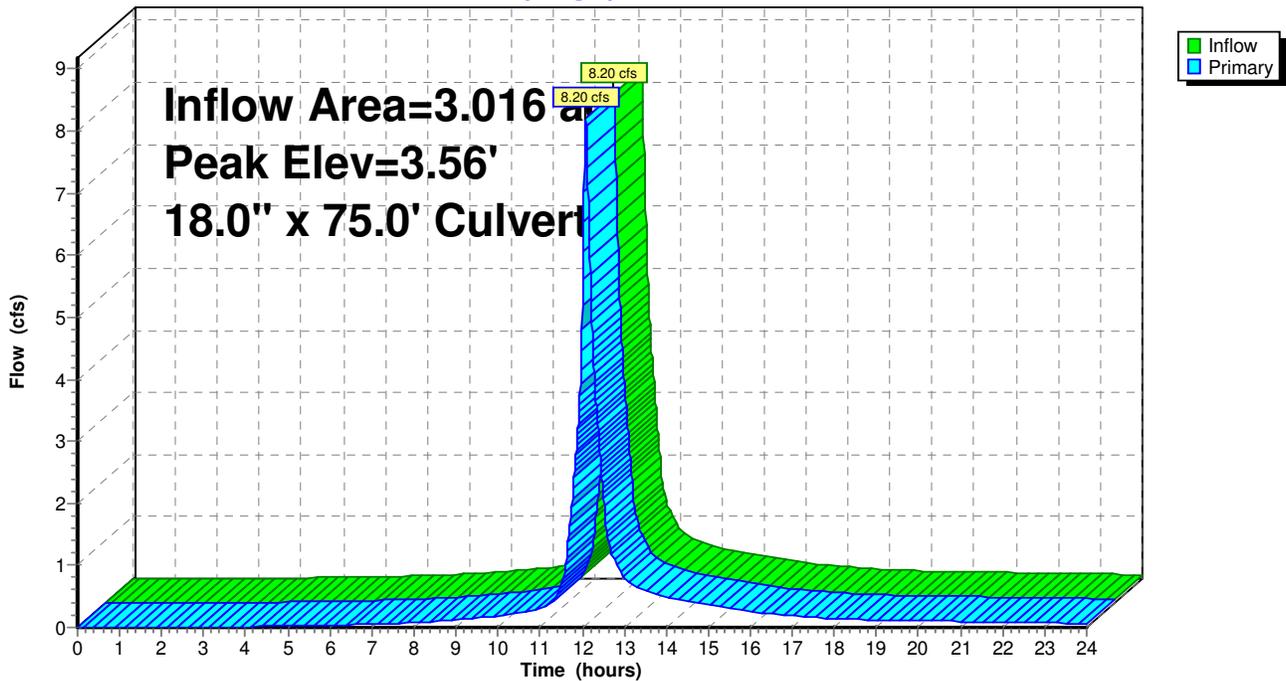
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	1.44'	18.0" x 75.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 1.10' S= 0.0045 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=8.19 cfs @ 12.09 hrs HW=3.56' TW=0.00' (Dynamic Tailwater)
↑1=Culvert (Barrel Controls 8.19 cfs @ 4.6 fps)

Pond DMH14: DMH14

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 45

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH15: DMH15 TYING INTO EXIST 12" PIPE

Inflow Area = 0.280 ac, Inflow Depth = 1.04" for 2-YR event
 Inflow = 0.34 cfs @ 12.07 hrs, Volume= 0.024 af
 Outflow = 0.34 cfs @ 12.07 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.34 cfs @ 12.07 hrs, Volume= 0.024 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.60' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= (not calculated)

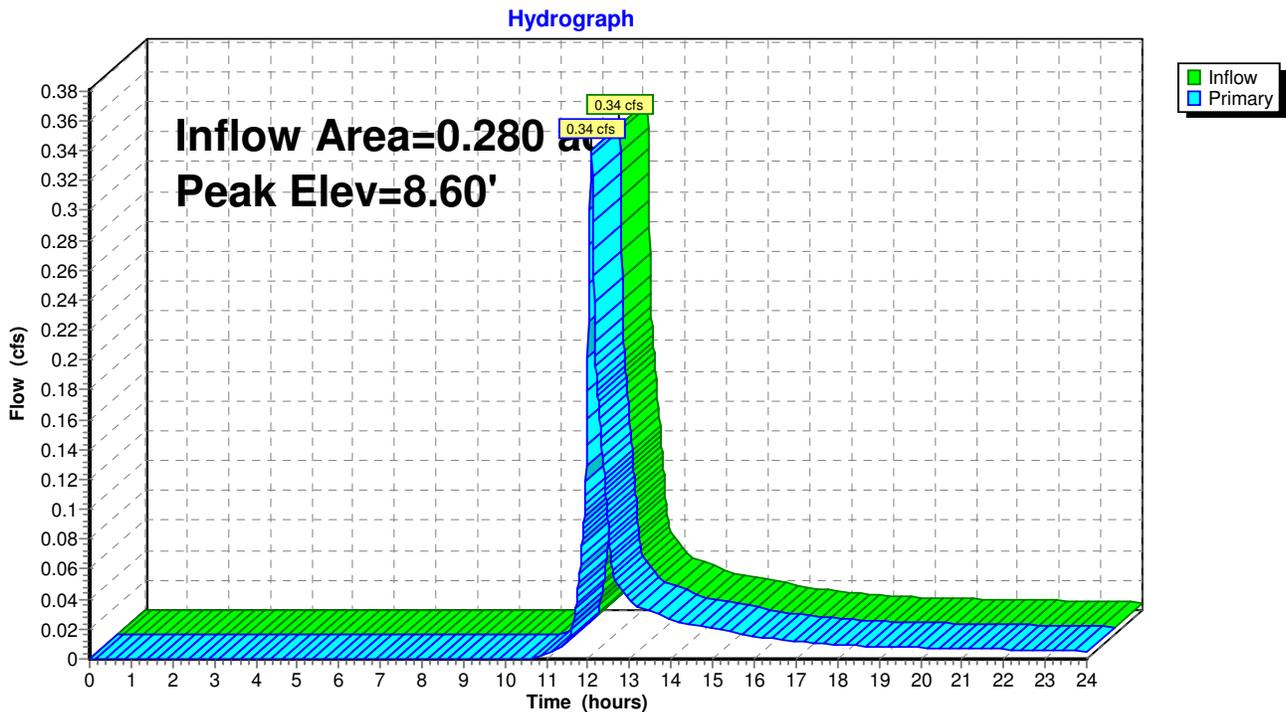
#	Routing	Invert	Outlet Devices
1	Primary	7.40'	12.0" x 86.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 6.50' S= 0.0105 '/' n= 0.013 Cc= 0.900
2	Device 1	8.50'	4.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.34 cfs @ 12.07 hrs HW=8.60' TW=6.21' (Dynamic Tailwater)

1=Culvert (Passes 0.34 cfs of 3.16 cfs potential flow)

2=Broad-Crested Rectangular Weir (Weir Controls 0.34 cfs @ 0.8 fps)

Pond DMH15: DMH15 TYING INTO EXIST 12" PIPE



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 46

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH2: DMH2

Inflow Area = 1.971 ac, Inflow Depth = 1.89" for 2-YR event
Inflow = 3.12 cfs @ 12.07 hrs, Volume= 0.311 af
Outflow = 3.12 cfs @ 12.07 hrs, Volume= 0.311 af, Atten= 0%, Lag= 0.0 min
Primary = 3.12 cfs @ 12.07 hrs, Volume= 0.311 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.27' @ 12.18 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

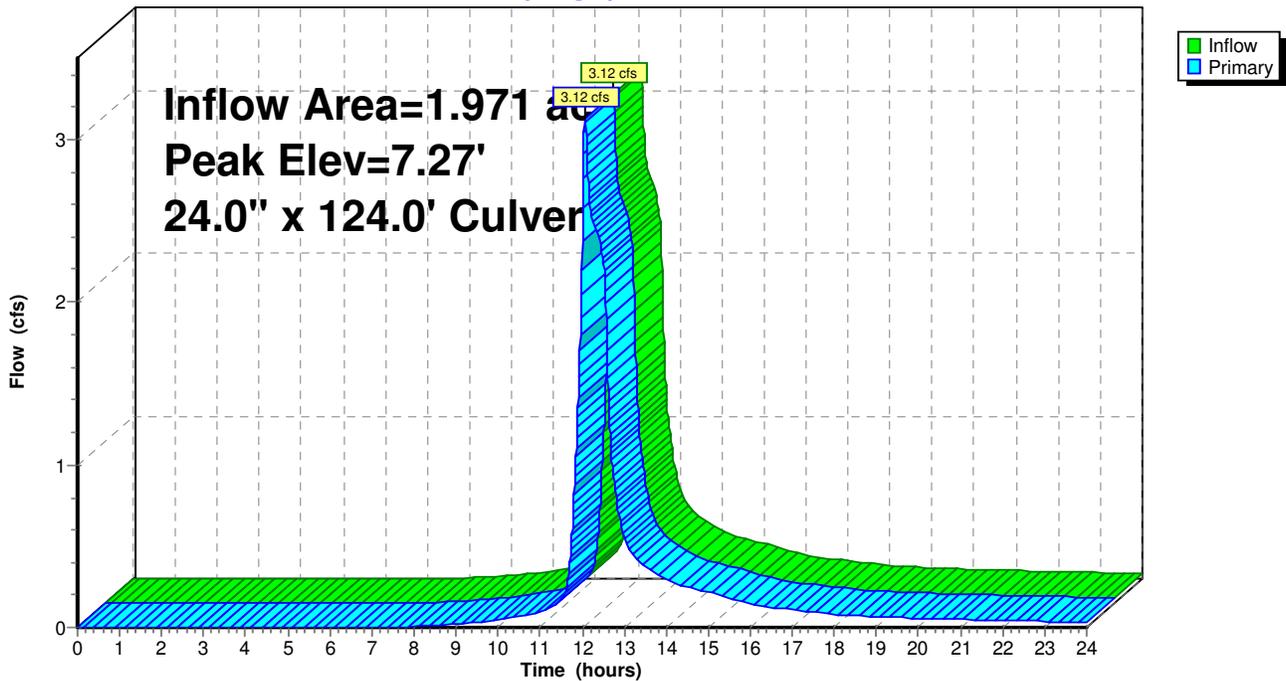
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.50'	24.0" x 124.0' long Culvert Ke= 0.600 Outlet Invert= 5.19' S= 0.0025 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=2.69 cfs @ 12.07 hrs HW=7.05' TW=6.96' (Dynamic Tailwater)
↑1=Culvert (Barrel Controls 2.69 cfs @ 1.4 fps)

Pond DMH2: DMH2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 47

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH3: DMH3

Inflow Area = 2.857 ac, Inflow Depth = 1.89" for 2-YR event
Inflow = 5.30 cfs @ 12.10 hrs, Volume= 0.449 af
Outflow = 5.30 cfs @ 12.10 hrs, Volume= 0.449 af, Atten= 0%, Lag= 0.0 min
Primary = 5.30 cfs @ 12.10 hrs, Volume= 0.449 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.22' @ 12.17 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

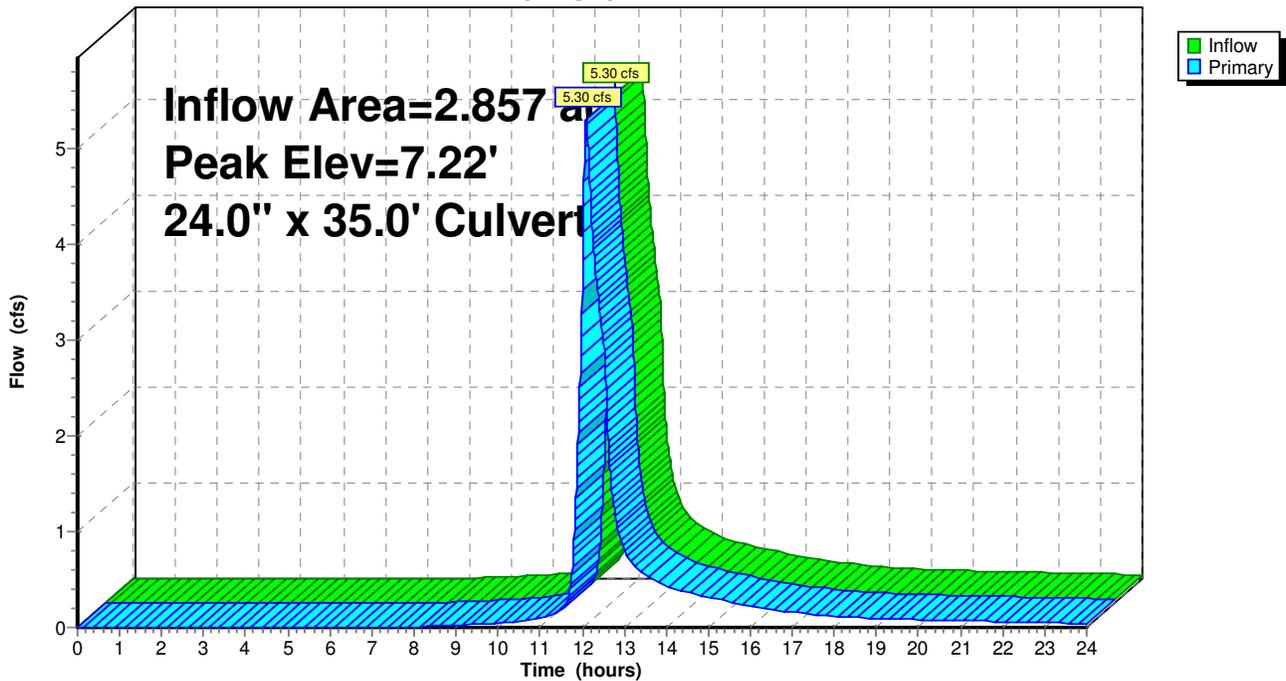
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.19'	24.0" x 35.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.09' S= 0.0029 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=5.29 cfs @ 12.10 hrs HW=7.12' TW=6.98' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 5.29 cfs @ 2.2 fps)

Pond DMH3: DMH3

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 48

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH4: DMH4

Inflow Area = 3.080 ac, Inflow Depth = 1.94" for 2-YR event
 Inflow = 5.93 cfs @ 12.09 hrs, Volume= 0.498 af
 Outflow = 5.93 cfs @ 12.09 hrs, Volume= 0.498 af, Atten= 0%, Lag= 0.0 min
 Primary = 5.93 cfs @ 12.09 hrs, Volume= 0.498 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.13' @ 12.20 hrs

Flood Elev= 10.15'

Plug-Flow detention time= (not calculated: outflow precedes inflow)

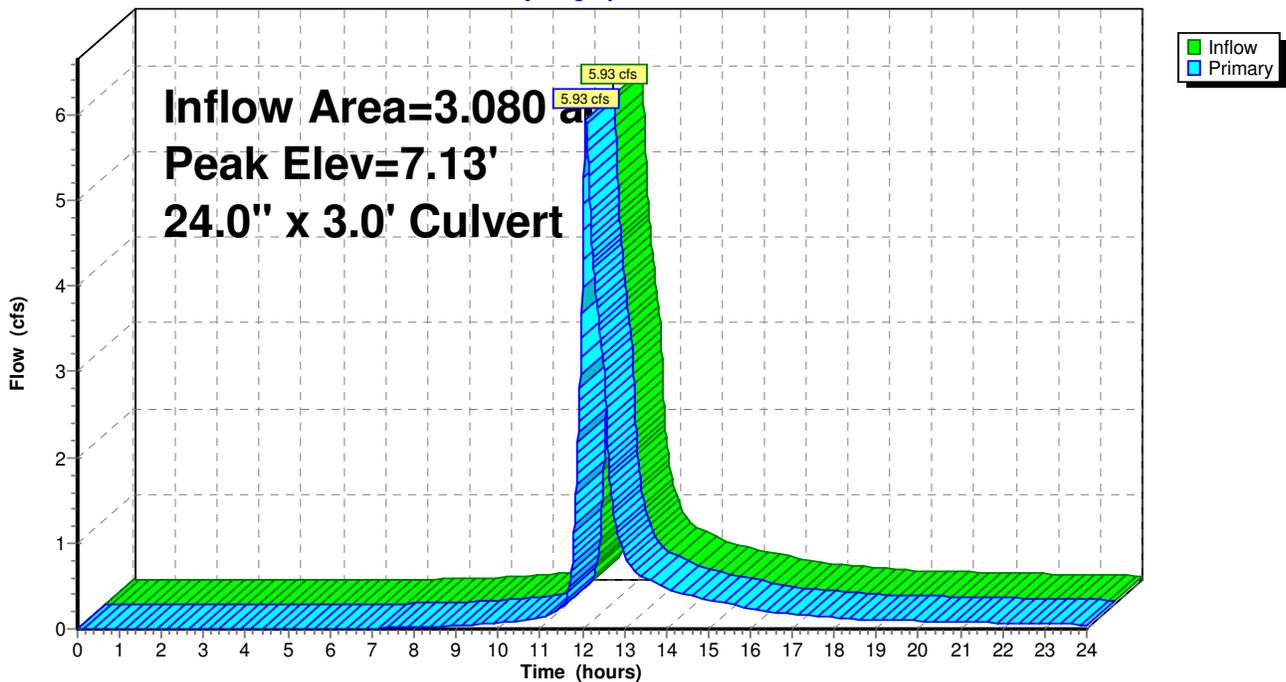
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.09'	24.0" x 3.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.05' S= 0.0133 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=5.96 cfs @ 12.09 hrs HW=6.95' TW=6.79' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 5.96 cfs @ 2.0 fps)

Pond DMH4: DMH4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 49

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH5: DMH 5

Inflow Area = 3.312 ac, Inflow Depth = 1.99" for 2-YR event
 Inflow = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af
 Outflow = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af, Atten= 0%, Lag= 0.0 min
 Primary = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.73' @ 12.27 hrs

Flood Elev= 10.40'

Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= (not calculated)

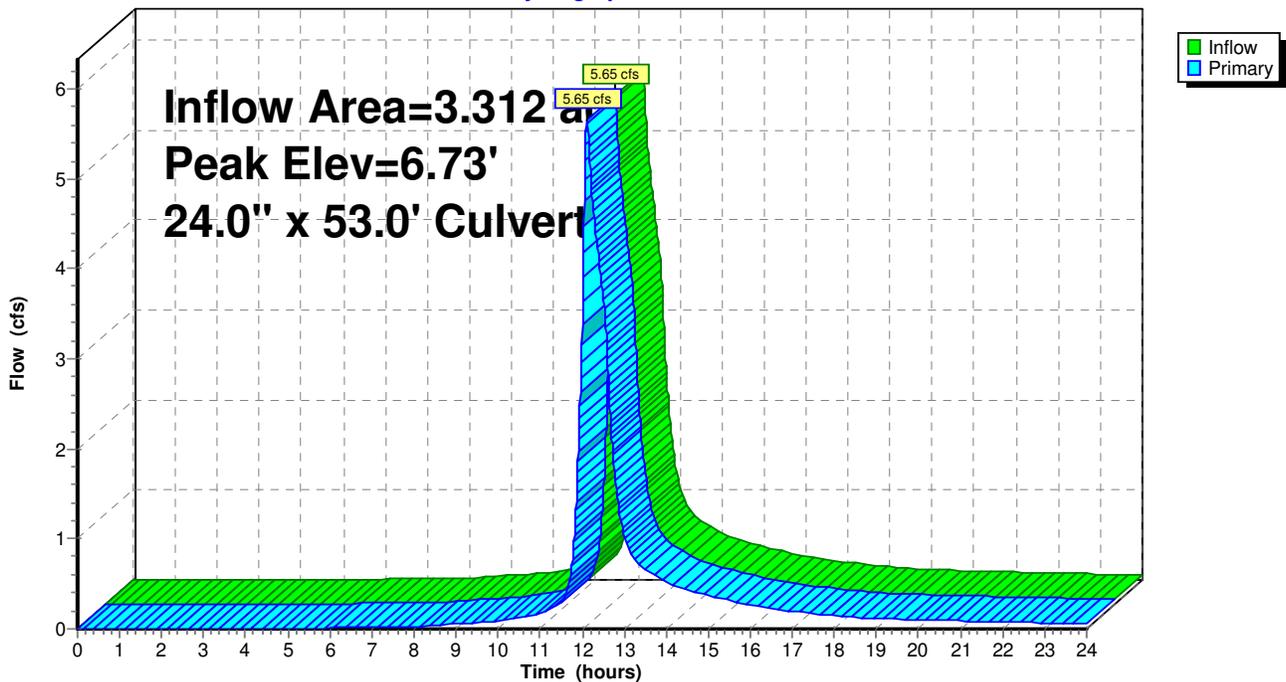
#	Routing	Invert	Outlet Devices
1	Primary	4.70'	24.0" x 53.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.57' S= 0.0025 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=4.95 cfs @ 12.11 hrs HW=6.47' TW=6.31' (Dynamic Tailwater)

↑1=Culvert (Barrel Controls 4.95 cfs @ 2.2 fps)

Pond DMH5: DMH 5

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 50

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH6: DMH6

Inflow Area = 3.312 ac, Inflow Depth = 1.99" for 2-YR event
 Inflow = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af
 Outflow = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af, Atten= 0%, Lag= 0.0 min
 Primary = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.55' @ 12.28 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

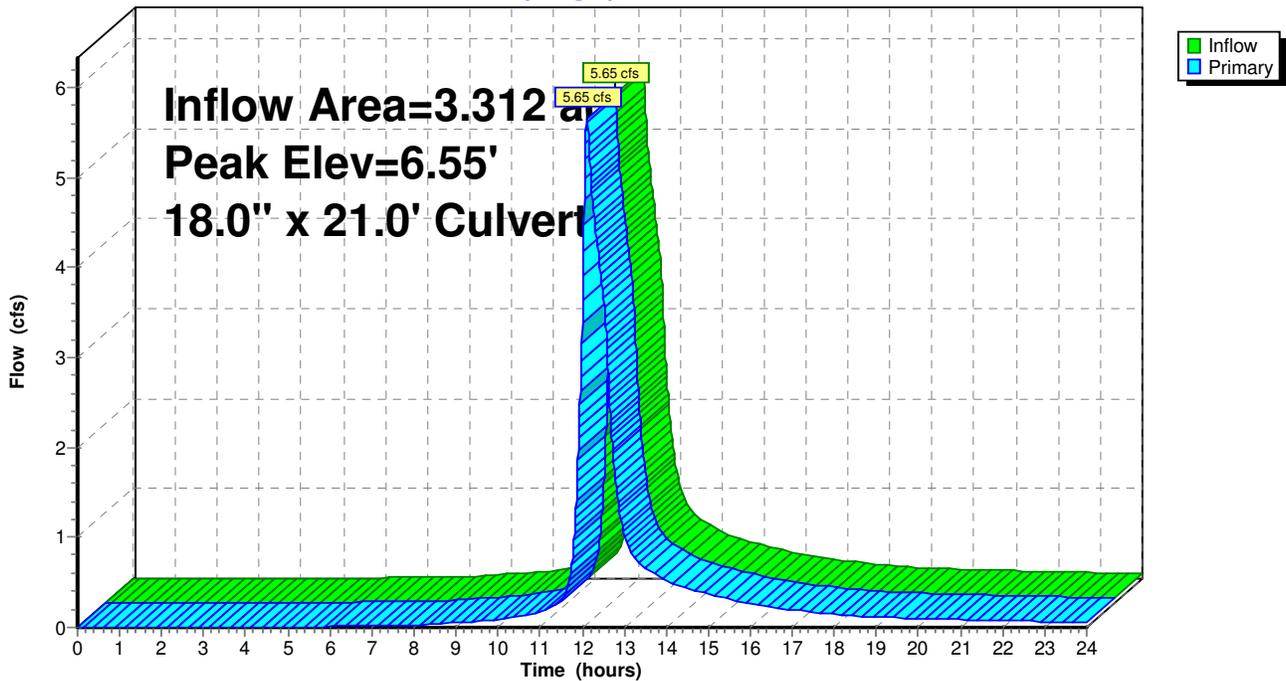
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	4.55'	18.0" x 21.0' long Culvert X 2.00 RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.50' S= 0.0024 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=5.64 cfs @ 12.11 hrs HW=6.14' TW=6.04' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 5.64 cfs @ 1.6 fps)

Pond DMH6: DMH6

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 51

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH9: DMH9

Inflow Area = 0.470 ac, Inflow Depth = 2.44" for 2-YR event
Inflow = 1.34 cfs @ 12.07 hrs, Volume= 0.096 af
Outflow = 1.34 cfs @ 12.07 hrs, Volume= 0.096 af, Atten= 0%, Lag= 0.0 min
Primary = 1.34 cfs @ 12.07 hrs, Volume= 0.096 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.35' @ 12.09 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

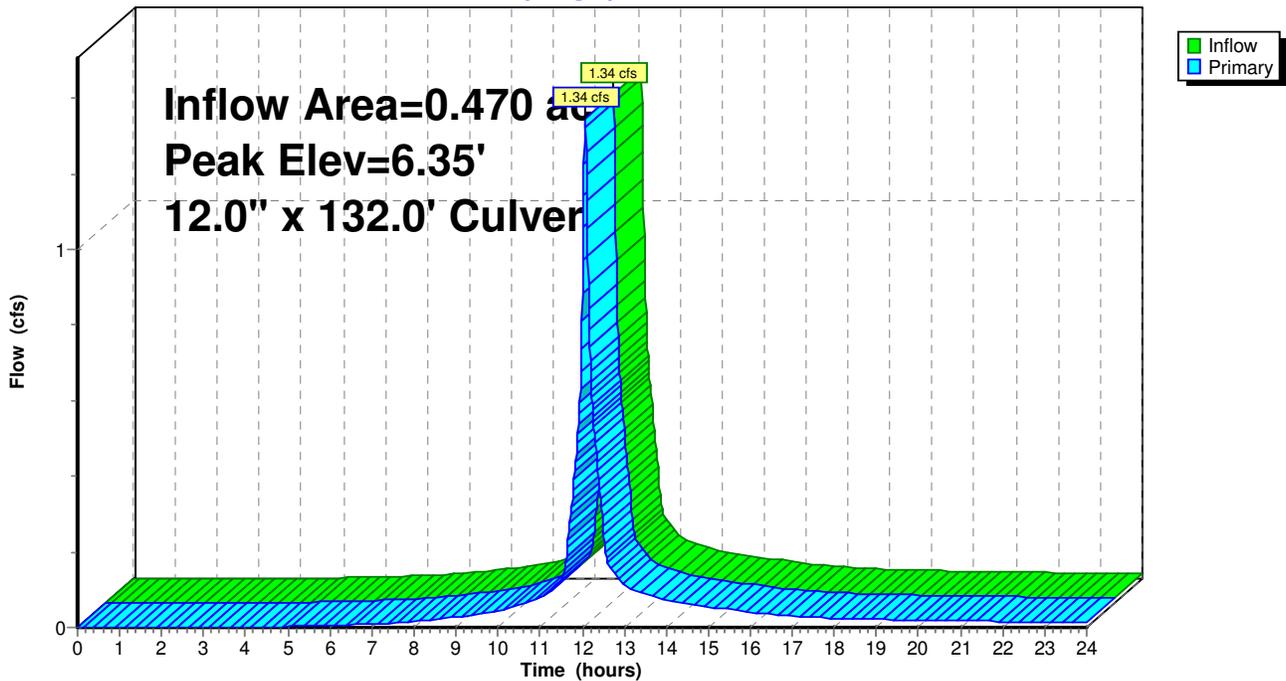
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.50'	12.0" x 132.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.06' S= 0.0109 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=1.30 cfs @ 12.07 hrs HW=6.26' TW=5.63' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 1.30 cfs @ 2.8 fps)

Pond DMH9: DMH9

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 52

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond E4: EX CB 4

Inflow Area = 0.880 ac, Inflow Depth = 2.35" for 2-YR event
Inflow = 2.27 cfs @ 12.07 hrs, Volume= 0.172 af
Outflow = 2.27 cfs @ 12.07 hrs, Volume= 0.172 af, Atten= 0%, Lag= 0.0 min
Primary = 2.27 cfs @ 12.07 hrs, Volume= 0.172 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.21' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

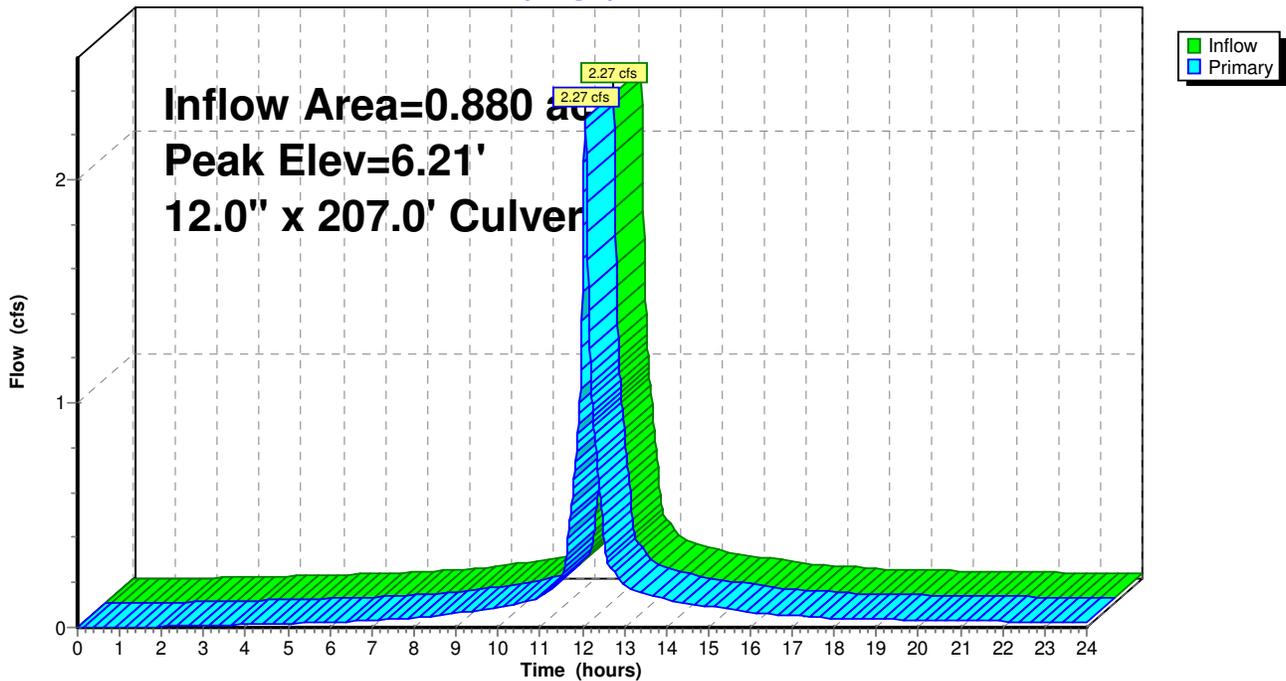
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.20'	12.0" x 207.0' long Culvert Ke= 0.500 Outlet Invert= 4.17' S= 0.0050 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=2.27 cfs @ 12.07 hrs HW=6.21' TW=0.00' (Dynamic Tailwater)
↑1=Culvert (Barrel Controls 2.27 cfs @ 3.6 fps)

Pond E4: EX CB 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 53

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond EX1: DMH EX1

Inflow Area = 0.702 ac, Inflow Depth = 2.58" for 2-YR event
Inflow = 2.08 cfs @ 12.07 hrs, Volume= 0.151 af
Outflow = 2.08 cfs @ 12.07 hrs, Volume= 0.151 af, Atten= 0%, Lag= 0.0 min
Primary = 2.08 cfs @ 12.07 hrs, Volume= 0.151 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 5.81' @ 12.09 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

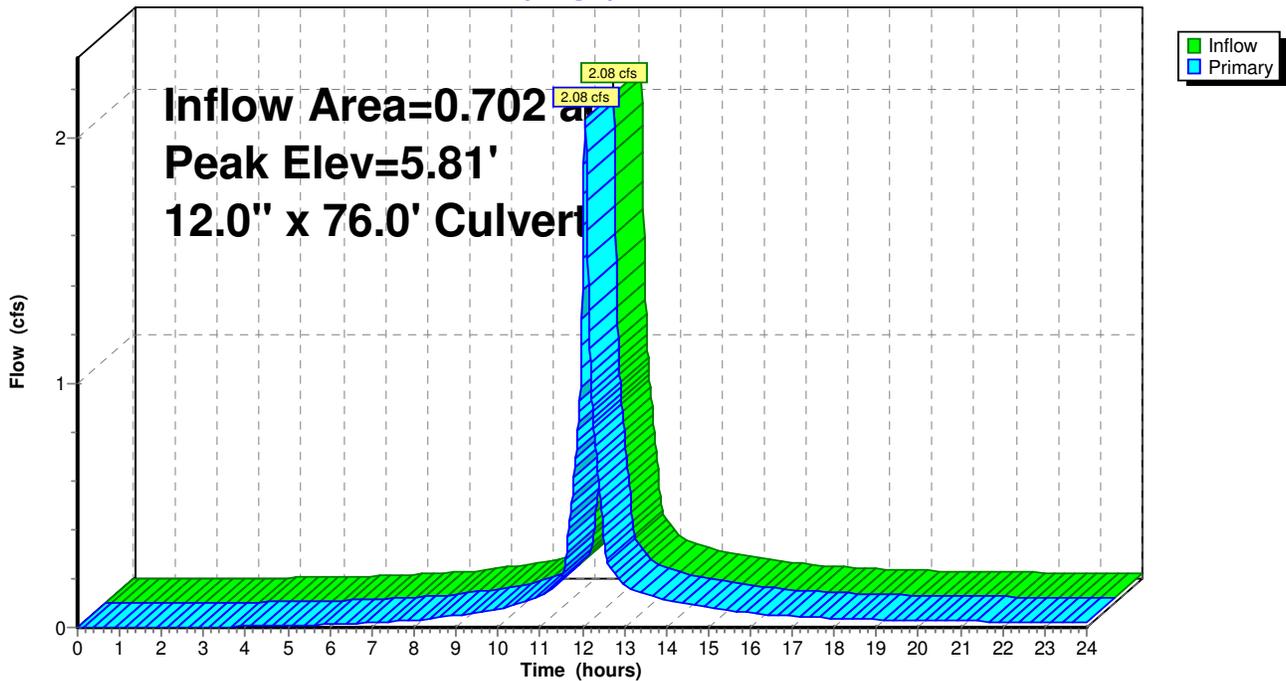
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	3.00'	12.0" x 76.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 2.73' S= 0.0036 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=1.72 cfs @ 12.07 hrs HW=5.56' TW=5.27' (Dynamic Tailwater)
↑1=Culvert (Barrel Controls 1.72 cfs @ 2.2 fps)

Pond EX1: DMH EX1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 54

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond EX2: DMH EX2

Inflow Area = 2.727 ac, Inflow Depth = 2.35" for 2-YR event
Inflow = 7.30 cfs @ 12.09 hrs, Volume= 0.533 af
Outflow = 7.30 cfs @ 12.09 hrs, Volume= 0.533 af, Atten= 0%, Lag= 0.0 min
Primary = 7.30 cfs @ 12.09 hrs, Volume= 0.533 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 4.70' @ 12.09 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

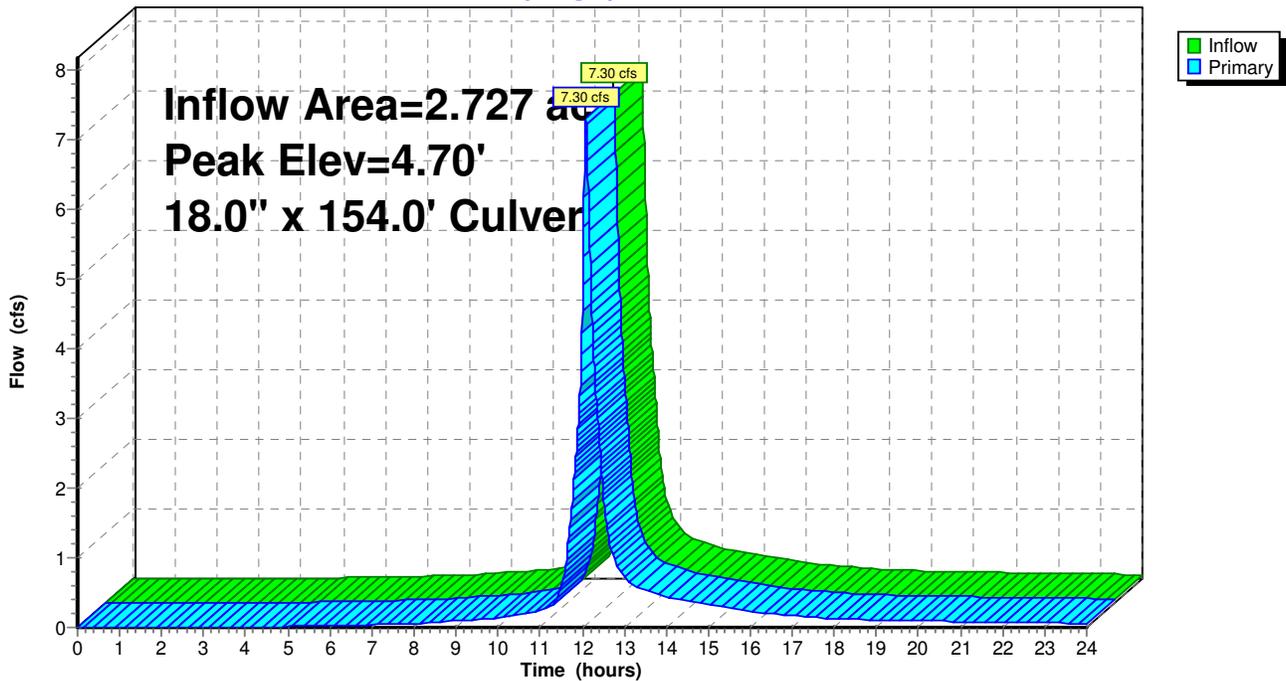
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	2.20'	18.0" x 154.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 1.44' S= 0.0049 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=7.30 cfs @ 12.09 hrs HW=4.70' TW=3.56' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 7.30 cfs @ 4.1 fps)

Pond EX2: DMH EX2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 55

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SD1: SUBSURFACE DETENTION #1

Inflow Area = 3.080 ac, Inflow Depth = 1.94" for 2-YR event
 Inflow = 5.93 cfs @ 12.09 hrs, Volume= 0.498 af
 Outflow = 5.07 cfs @ 12.13 hrs, Volume= 0.498 af, Atten= 15%, Lag= 1.9 min
 Primary = 5.07 cfs @ 12.13 hrs, Volume= 0.498 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 7.04' @ 12.23 hrs Surf.Area= 0.018 ac Storage= 0.028 af
 Plug-Flow detention time= 4.7 min calculated for 0.498 af (100% of inflow)
 Center-of-Mass det. time= 4.1 min (814.6 - 810.6)

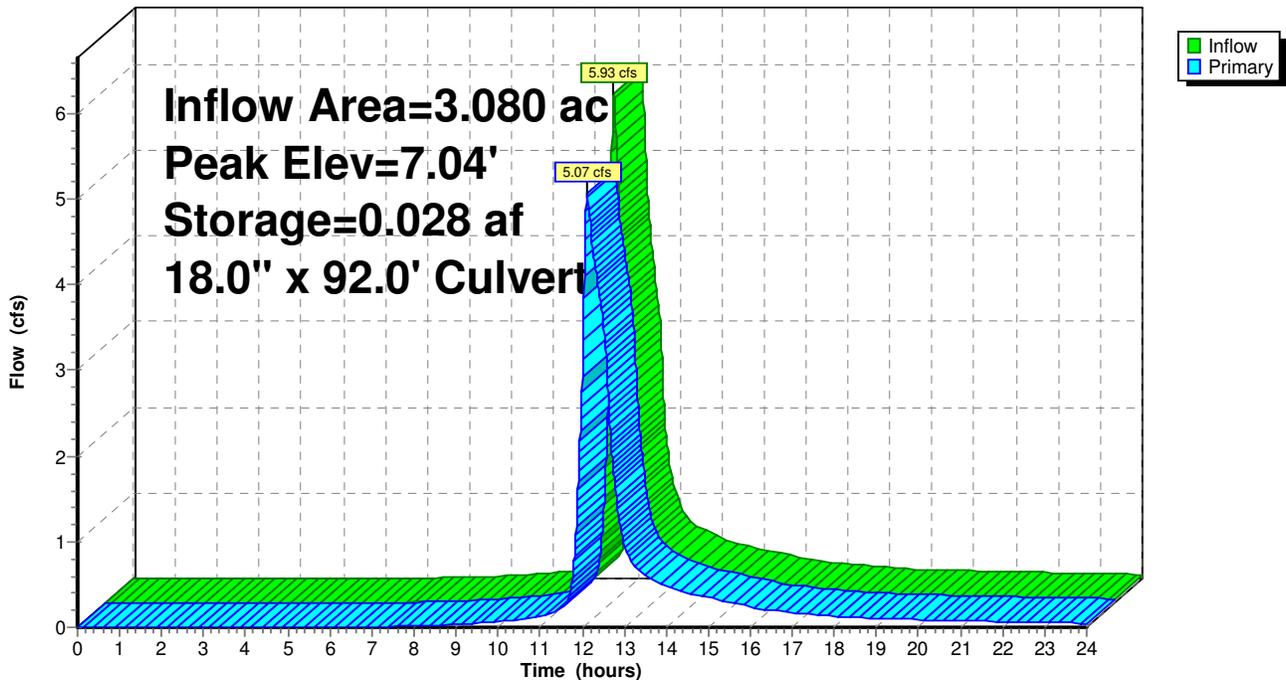
#	Invert	Avail.Storage	Storage Description
1	5.05'	0.057 af	48.0"D x 197.00'L Horizontal Cylinder

#	Routing	Invert	Outlet Devices
1	Primary	5.05'	18.0" x 92.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.70' S= 0.0038 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=5.08 cfs @ 12.13 hrs HW=6.91' TW=6.52' (Dynamic Tailwater)
 ←1=Culvert (Barrel Controls 5.08 cfs @ 3.0 fps)

Pond SD1: SUBSURFACE DETENTION #1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 56

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SD2: SUBSURFACE DETENTION #2

Inflow Area = 3.488 ac, Inflow Depth = 2.03" for 2-YR event
 Inflow = 6.14 cfs @ 12.11 hrs, Volume= 0.589 af
 Outflow = 4.74 cfs @ 12.29 hrs, Volume= 0.589 af, Atten= 23%, Lag= 10.9 min
 Primary = 4.74 cfs @ 12.29 hrs, Volume= 0.589 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 6.47' @ 12.29 hrs Surf.Area= 1,124 sf Storage= 1,969 cf
 Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= (not calculated)

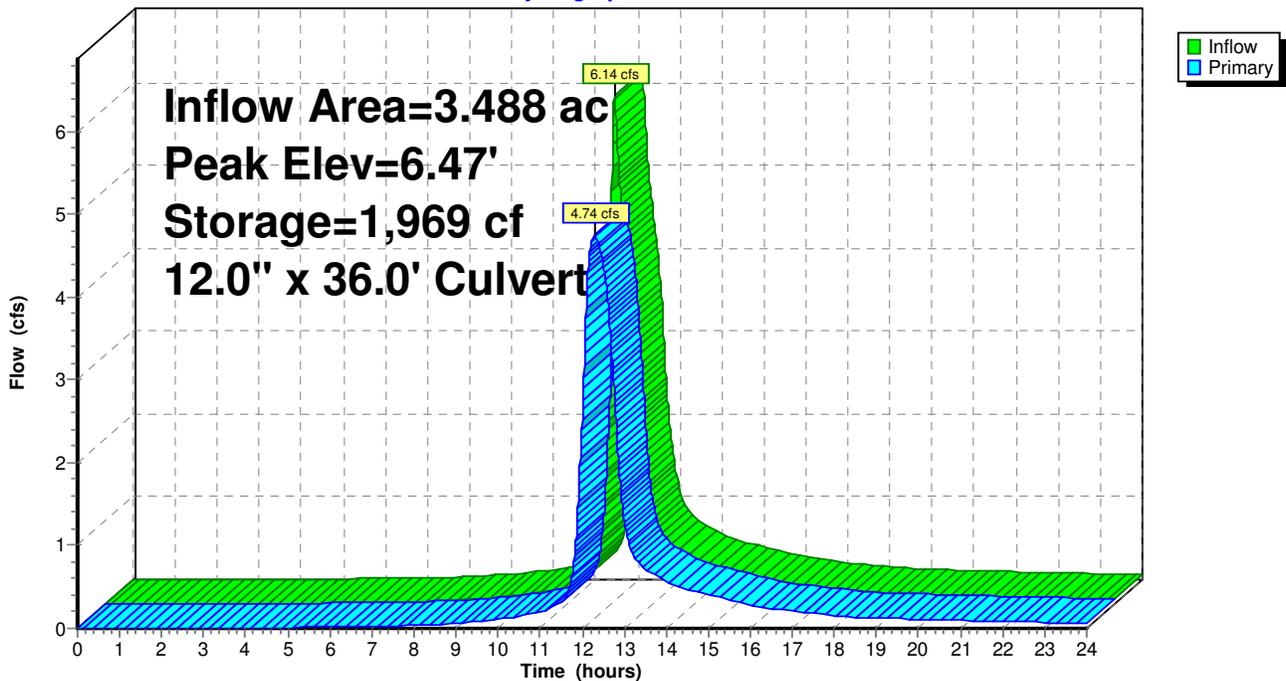
#	Invert	Avail.Storage	Storage Description
1	4.50'	2,768 cf	35.4"D x 405.00'L Horizontal Cylinder
2	4.50'	1 cf	0.50'D x 6.75'H Vertical Cone/Cylinder
		2,769 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Primary	4.40'	12.0" x 36.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 3.68' S= 0.0200 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=4.74 cfs @ 12.29 hrs HW=6.47' TW=0.00' (Dynamic Tailwater)
 ←1=Culvert (Inlet Controls 4.74 cfs @ 6.0 fps)

Pond SD2: SUBSURFACE DETENTION #2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 57

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SI 1: SUBSURFACE INFILTRATION 1

Inflow Area = 1.023 ac, Inflow Depth = 2.97" for 2-YR event
 Inflow = 3.29 cfs @ 12.07 hrs, Volume= 0.253 af
 Outflow = 1.77 cfs @ 12.53 hrs, Volume= 0.200 af, Atten= 46%, Lag= 27.6 min
 Discarded = 0.02 cfs @ 3.81 hrs, Volume= 0.041 af
 Primary = 1.74 cfs @ 12.53 hrs, Volume= 0.159 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 7.53' @ 12.24 hrs Surf.Area= 3,746 sf Storage= 4,118 cf
 Plug-Flow detention time= 131.3 min calculated for 0.200 af (79% of inflow)
 Center-of-Mass det. time= 53.9 min (808.9 - 755.0)

#	Invert	Avail.Storage	Storage Description
1	6.36'	5,755 cf	Custom Stage Data (Prismatic) Listed below 6,122 cf Overall x 94.0% Voids
2	5.96'	71 cf	4.00'D x 5.64'H Vertical Cone/Cylinder
		5,826 cf	Total Available Storage

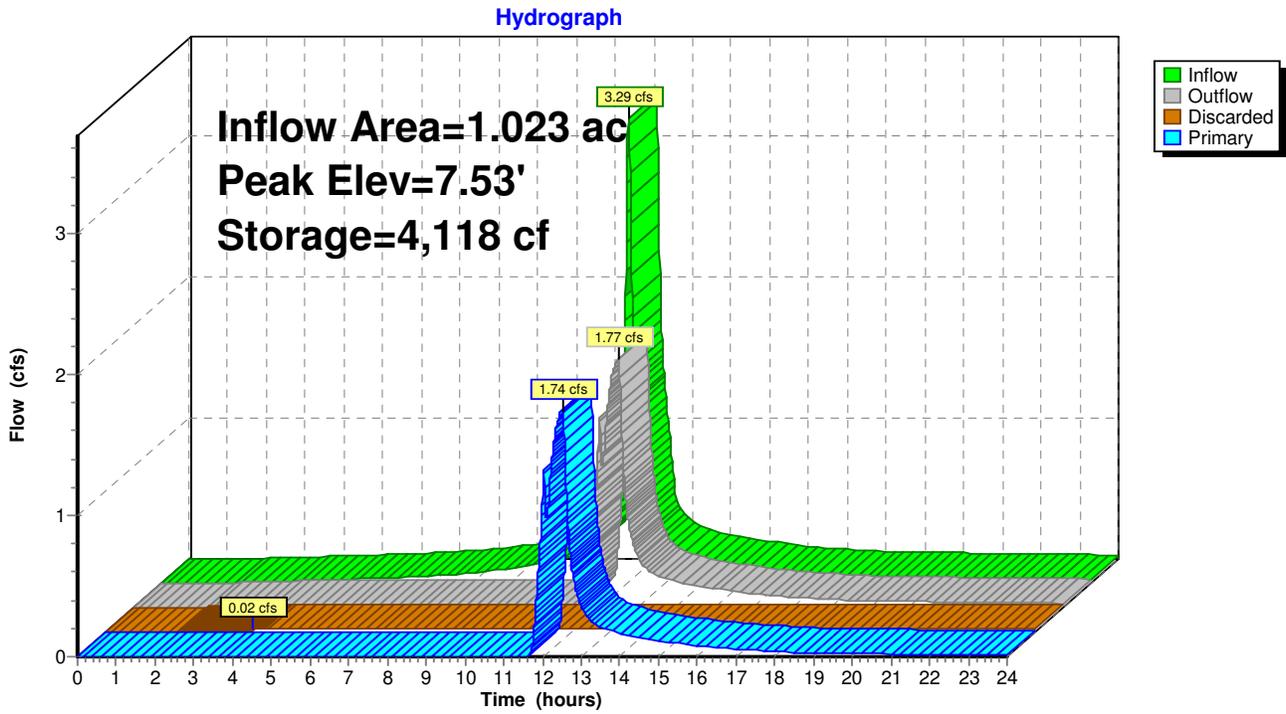
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.36	3,733	0	0
8.00	3,733	6,122	6,122

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	0.000375 fpm Exfiltration over entire Surface area
2	Primary	6.31'	12.0" x 5.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 6.21' S= 0.0200 '/' n= 0.013 Cc= 0.900
3	Device 2	7.00'	4.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 3.81 hrs HW=6.36' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.74 cfs @ 12.53 hrs HW=7.32' TW=7.11' (Dynamic Tailwater)
 ↑2=Culvert (Inlet Controls 1.74 cfs @ 2.2 fps)
 ↑3=Broad-Crested Rectangular Weir (Passes 1.74 cfs of 1.81 cfs potential flow)

Pond SI 1: SUBSURFACE INFILTRATION 1



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 59

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SI 2: SUBSURFACE INFILTRATION 2

Inflow Area = 0.886 ac, Inflow Depth = 2.97" for 2-YR event
 Inflow = 2.85 cfs @ 12.07 hrs, Volume= 0.219 af
 Outflow = 2.35 cfs @ 12.12 hrs, Volume= 0.166 af, Atten= 17%, Lag= 3.1 min
 Discarded = 0.02 cfs @ 5.13 hrs, Volume= 0.027 af
 Primary = 2.34 cfs @ 12.12 hrs, Volume= 0.138 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 8.36' @ 12.12 hrs Surf.Area= 2,442 sf Storage= 3,120 cf
 Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= (not calculated)

#	Invert	Avail.Storage	Storage Description
1	7.00'	3,765 cf	Custom Stage Data (Prismatic) Listed below 4,005 cf Overall x 94.0% Voids

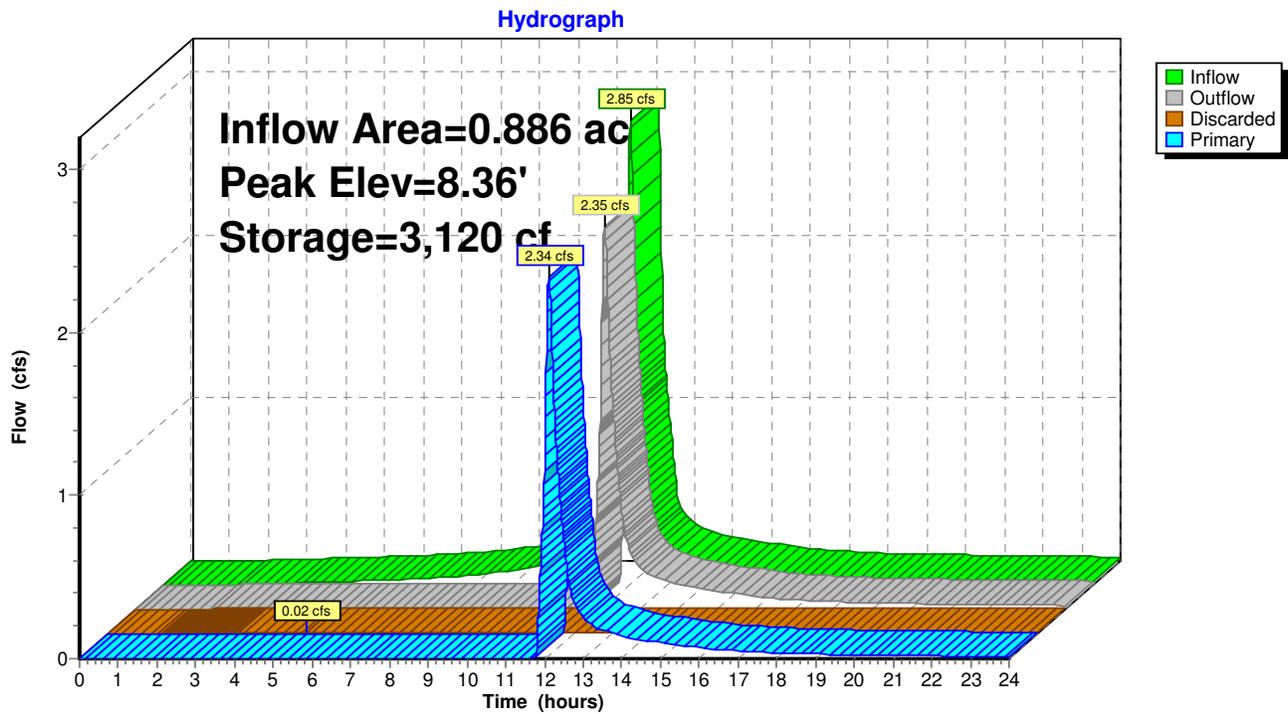
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	2,442	0	0
8.64	2,442	4,005	4,005

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	0.000375 fpm Exfiltration over entire Surface area
2	Primary	6.60'	12.0" x 10.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.72' S= 0.0880 '/' n= 0.013 Cc= 0.900
3	Device 2	8.00'	4.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 5.13 hrs HW=7.02' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=2.34 cfs @ 12.12 hrs HW=8.36' TW=7.17' (Dynamic Tailwater)
 ↑2=Culvert (Passes 2.34 cfs of 4.12 cfs potential flow)
 ↑3=Broad-Crested Rectangular Weir (Weir Controls 2.34 cfs @ 1.6 fps)

Pond SI 2: SUBSURFACE INFILTRATION 2



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 61

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SI 3: SUBSURFACE INFILTRATION 3

Inflow Area = 1.400 ac, Inflow Depth = 2.97" for 2-YR event
 Inflow = 4.51 cfs @ 12.07 hrs, Volume= 0.346 af
 Outflow = 3.61 cfs @ 12.13 hrs, Volume= 0.283 af, Atten= 20%, Lag= 3.3 min
 Discarded = 0.02 cfs @ 5.16 hrs, Volume= 0.035 af
 Primary = 3.60 cfs @ 12.13 hrs, Volume= 0.247 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 7.73' @ 12.13 hrs Surf.Area= 3,134 sf Storage= 4,135 cf
 Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= (not calculated)

#	Invert	Avail.Storage	Storage Description
1	6.33'	5,802 cf	Custom Stage Data (Prismatic) Listed below 6,172 cf Overall x 94.0% Voids
2	6.33'	2 cf	1.00'D x 3.17'H Vertical Cone/Cylinder
		5,804 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.33	3,133	0	0
8.30	3,133	6,172	6,172

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	0.000375 fpm Exfiltration over entire Surface area
2	Primary	6.33'	12.0" x 24.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.85' S= 0.0200 '/' n= 0.013 Cc= 0.900
3	Device 2	7.25'	4.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 5.16 hrs HW=6.36' (Free Discharge)

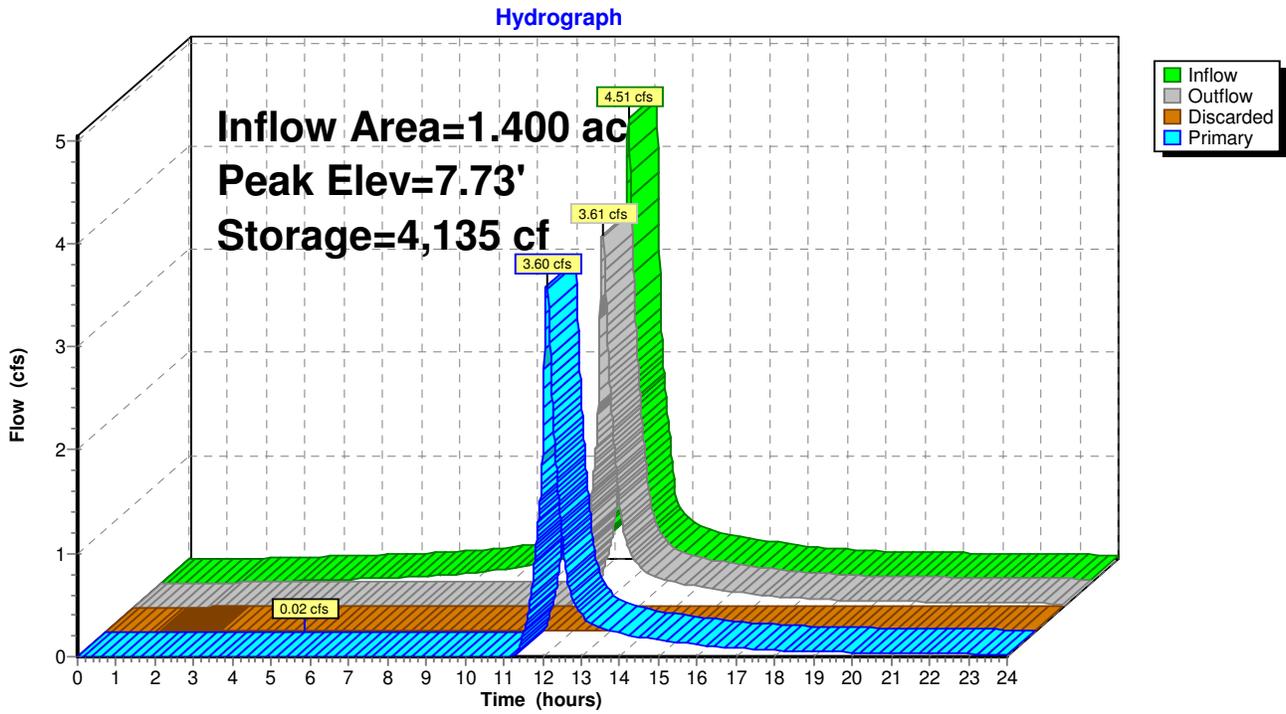
↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=3.59 cfs @ 12.13 hrs HW=7.73' TW=4.89' (Dynamic Tailwater)

↑2=Culvert (Inlet Controls 3.59 cfs @ 4.6 fps)

↑3=Broad-Crested Rectangular Weir (Passes 3.59 cfs of 3.67 cfs potential flow)

Pond SI 3: SUBSURFACE INFILTRATION 3



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 63

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond WQ1: WQ1

Inflow Area = 3.312 ac, Inflow Depth = 1.99" for 2-YR event
Inflow = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af
Outflow = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af, Atten= 0%, Lag= 0.0 min
Primary = 5.65 cfs @ 12.11 hrs, Volume= 0.549 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.64' @ 12.27 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

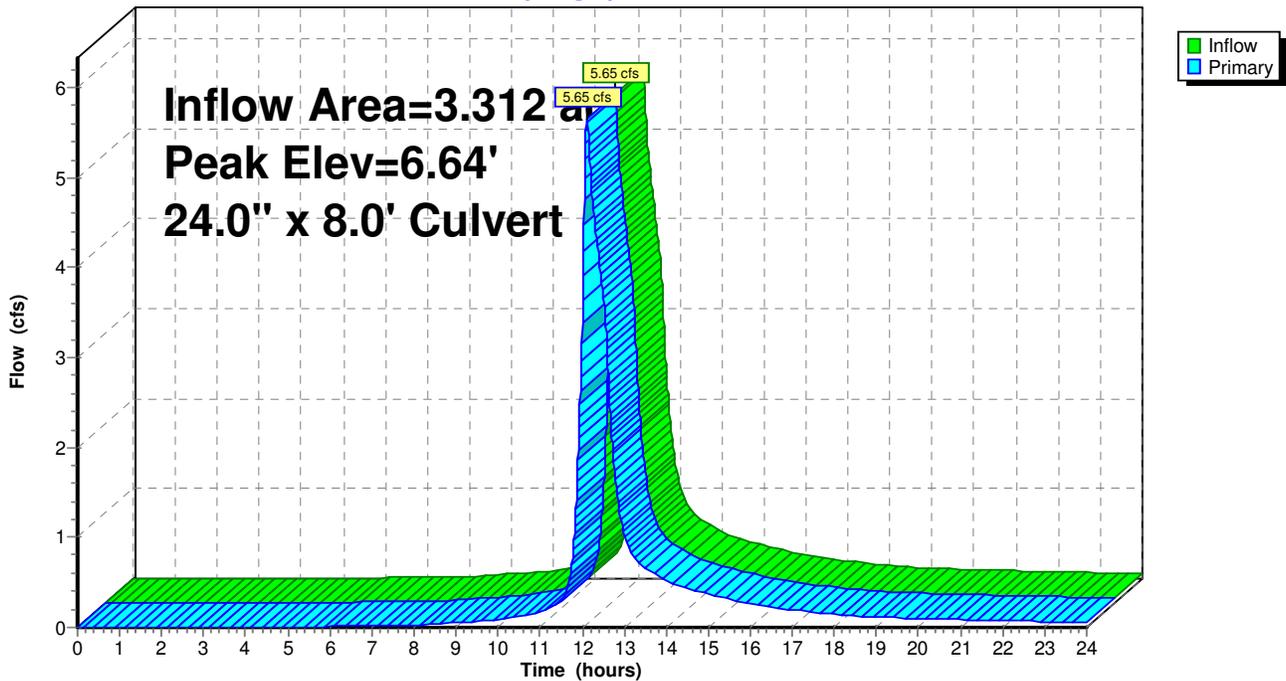
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	4.57'	24.0" x 8.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.55' S= 0.0025 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=5.70 cfs @ 12.11 hrs HW=6.31' TW=6.14' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 5.70 cfs @ 2.6 fps)

Pond WQ1: WQ1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 64

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond WQ2: WQ2

Inflow Area = 0.535 ac, Inflow Depth = 2.59" for 2-YR event
 Inflow = 1.59 cfs @ 12.07 hrs, Volume= 0.115 af
 Outflow = 1.59 cfs @ 12.07 hrs, Volume= 0.115 af, Atten= 0%, Lag= 0.0 min
 Primary = 1.59 cfs @ 12.07 hrs, Volume= 0.115 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 4.87' @ 12.09 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

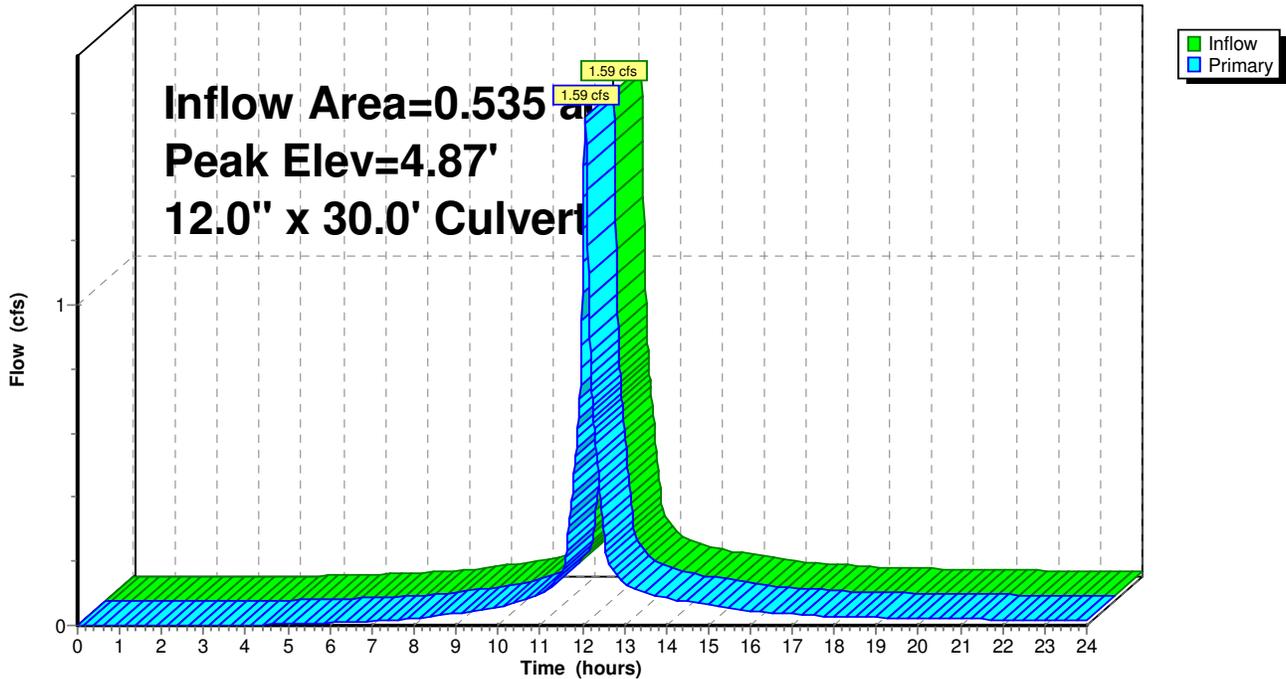
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	3.70'	12.0" x 30.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 2.50' S= 0.0400 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=1.60 cfs @ 12.07 hrs HW=4.81' TW=4.63' (Dynamic Tailwater)
 ↳ **1=Culvert** (Barrel Controls 1.60 cfs @ 2.3 fps)

Pond WQ2: WQ2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 65

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment AD12: AREA DRAIN 1 & 2 Runoff Area=0.133 ac Runoff Depth=2.05"
Flow Length=74' Tc=4.6 min CN=74 Runoff=0.33 cfs 0.023 af

Subcatchment AD3: AREA DRAIN 3 Runoff Area=0.073 ac Runoff Depth=2.05"
Flow Length=46' Tc=4.0 min CN=74 Runoff=0.19 cfs 0.012 af

Subcatchment AD4: AREA DRAIN 4 Runoff Area=0.074 ac Runoff Depth=2.05"
Flow Length=42' Tc=4.9 min CN=74 Runoff=0.18 cfs 0.013 af

Subcatchment CB 1: CB 1 Runoff Area=0.461 ac Runoff Depth=3.09"
Flow Length=301' Tc=8.0 min CN=86 Runoff=1.55 cfs 0.119 af

Subcatchment CB 11: CB 11 Runoff Area=0.044 ac Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=0.20 cfs 0.016 af

Subcatchment CB 2: CB 2 Runoff Area=0.487 ac Runoff Depth=3.29"
Tc=5.0 min CN=88 Runoff=1.91 cfs 0.133 af

Subcatchment CB 3: CB 3 Runoff Area=0.247 ac Runoff Depth=3.59"
Tc=5.0 min CN=91 Runoff=1.04 cfs 0.074 af

Subcatchment CB 4: CB 4 Runoff Area=0.223 ac Runoff Depth=4.02"
Tc=5.0 min CN=95 Runoff=1.01 cfs 0.075 af

Subcatchment CB 5: CB 5 Runoff Area=0.111 ac Runoff Depth=3.70"
Tc=5.0 min CN=92 Runoff=0.48 cfs 0.034 af

Subcatchment CB 6: CB 6 Runoff Area=0.112 ac Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=0.52 cfs 0.041 af

Subcatchment CB 7: CB 7 Runoff Area=0.114 ac Runoff Depth=3.59"
Tc=5.0 min CN=91 Runoff=0.48 cfs 0.034 af

Subcatchment CB 8: CB 8 Runoff Area=0.118 ac Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=0.55 cfs 0.043 af

Subcatchment CB 9: CB 9 Runoff Area=0.450 ac Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=2.10 cfs 0.164 af

Subcatchment CB10: CB 10 Runoff Area=0.012 ac Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=0.06 cfs 0.004 af

Subcatchment CB12: CB 12 Runoff Area=0.176 ac Runoff Depth=4.13"
Tc=5.0 min CN=96 Runoff=0.80 cfs 0.061 af

Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 66

3/15/2013

Subcatchment CB13: CB 13	Runoff Area=0.090 ac Runoff Depth=4.02" Tc=5.0 min CN=95 Runoff=0.41 cfs 0.030 af
Subcatchment CB14: CB 14	Runoff Area=0.274 ac Runoff Depth=4.02" Tc=5.0 min CN=95 Runoff=1.24 cfs 0.092 af
Subcatchment CB15: CB15	Runoff Area=0.113 ac Runoff Depth=4.02" Tc=6.0 min CN=95 Runoff=0.49 cfs 0.038 af
Subcatchment CB16: CB 16	Runoff Area=0.148 ac Runoff Depth=3.80" Tc=5.0 min CN=93 Runoff=0.65 cfs 0.047 af
Subcatchment CB17: CB 17	Runoff Area=0.143 ac Runoff Depth=4.25" Tc=5.0 min CN=97 Runoff=0.66 cfs 0.051 af
Subcatchment CB18: CB18	Runoff Area=0.146 ac Runoff Depth=4.36" Tc=5.0 min CN=98 Runoff=0.68 cfs 0.053 af
Subcatchment EX 1: Design Point #1 - Flow to Dorchester Bay	Runoff Area=0.447 ac Runoff Depth=2.72" Tc=5.0 min CN=82 Runoff=1.48 cfs 0.101 af
Subcatchment EX4: EX 4	Runoff Area=0.600 ac Runoff Depth=4.36" Tc=5.0 min CN=98 Runoff=2.79 cfs 0.218 af
Subcatchment EXCB: EX CB	Runoff Area=0.232 ac Runoff Depth=4.25" Tc=5.0 min CN=97 Runoff=1.07 cfs 0.082 af
Subcatchment RD 1: ROOF DRAIN 1	Runoff Area=1.023 ac Runoff Depth=4.36" Tc=5.0 min CN=98 Runoff=4.76 cfs 0.372 af
Subcatchment RD 2: ROOF DRAIN 2	Runoff Area=0.886 ac Runoff Depth=4.36" Tc=5.0 min CN=98 Runoff=4.13 cfs 0.322 af
Subcatchment RD3: ROOF DRAIN 3	Runoff Area=1.071 ac Runoff Depth=4.36" Tc=5.0 min CN=98 Runoff=4.99 cfs 0.389 af
Subcatchment RD4: ROOF DRAIN 4	Runoff Area=0.329 ac Runoff Depth=4.36" Tc=5.0 min CN=98 Runoff=1.53 cfs 0.120 af
Reach DP#1: Dorchester Bay	Inflow=1.48 cfs 0.101 af Outflow=1.48 cfs 0.101 af
Reach DP#2: Design Point #2 - Flow to Stormwater Outfall #1 (12" Storm Drai	Inflow=6.00 cfs 0.980 af Outflow=6.00 cfs 0.980 af
Reach DP#3: Design Point #3 - Flow to Stormwater Outfall #2	Inflow=2.36 cfs 0.184 af Outflow=2.36 cfs 0.184 af

Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 67

3/15/2013

Reach DP#4: Design Point #4 - Parking Lot Storm Drain	Inflow=3.50 cfs 0.266 af Outflow=3.50 cfs 0.266 af
Reach DP#5: Haul Road	Inflow=10.67 cfs 0.949 af Outflow=10.67 cfs 0.949 af
Pond 9: CB 9 TO DMH 6	Peak Elev=6.96' Inflow=2.10 cfs 0.164 af 12.0" x 25.0' Culvert Outflow=2.10 cfs 0.164 af
Pond 11: CB 11 TO DMH 6	Peak Elev=6.47' Inflow=0.20 cfs 0.016 af 12.0" x 46.0' Culvert Outflow=0.20 cfs 0.016 af
Pond DMH1: DMH1	Peak Elev=8.84' Inflow=4.13 cfs 0.395 af 18.0" x 182.0' Culvert Outflow=4.13 cfs 0.395 af
Pond DMH10: DMH10	Peak Elev=8.34' Inflow=2.04 cfs 0.149 af 12.0" x 40.0' Culvert Outflow=2.04 cfs 0.149 af
Pond DMH11: DMH11	Peak Elev=7.10' Inflow=7.00 cfs 0.669 af 18.0" x 155.0' Culvert Outflow=7.00 cfs 0.669 af
Pond DMH14: DMH14	Peak Elev=4.23' Inflow=10.67 cfs 0.949 af 18.0" x 75.0' Culvert Outflow=10.67 cfs 0.949 af
Pond DMH15: DMH15 TYING INTO EXIST 12" PIPE	Peak Elev=8.66' Inflow=0.70 cfs 0.048 af Outflow=0.70 cfs 0.048 af
Pond DMH2: DMH2	Peak Elev=8.54' Inflow=5.22 cfs 0.529 af 24.0" x 124.0' Culvert Outflow=5.22 cfs 0.529 af
Pond DMH3: DMH3	Peak Elev=8.48' Inflow=6.64 cfs 0.769 af 24.0" x 35.0' Culvert Outflow=6.64 cfs 0.769 af
Pond DMH4: DMH4	Peak Elev=8.37' Inflow=7.60 cfs 0.843 af 24.0" x 3.0' Culvert Outflow=7.60 cfs 0.843 af
Pond DMH5: DMH 5	Peak Elev=7.81' Inflow=6.40 cfs 0.920 af 24.0" x 53.0' Culvert Outflow=6.40 cfs 0.920 af
Pond DMH6: DMH6	Peak Elev=7.53' Inflow=6.40 cfs 0.920 af 18.0" x 21.0' Culvert Outflow=6.40 cfs 0.920 af
Pond DMH9: DMH9	Peak Elev=8.94' Inflow=2.04 cfs 0.149 af 12.0" x 132.0' Culvert Outflow=2.04 cfs 0.149 af
Pond E4: EX CB 4	Peak Elev=7.63' Inflow=3.50 cfs 0.266 af 12.0" x 207.0' Culvert Outflow=3.50 cfs 0.266 af

Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 68

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond EX1: DMH EX1

Peak Elev=8.02' Inflow=3.12 cfs 0.231 af
12.0" x 76.0' Culvert Outflow=3.12 cfs 0.231 af

Pond EX2: DMH EX2

Peak Elev=6.08' Inflow=9.33 cfs 0.846 af
18.0" x 154.0' Culvert Outflow=9.33 cfs 0.846 af

Pond SD1: SUBSURFACE DETENTION #1

Peak Elev=8.25' Storage=0.049 af Inflow=7.60 cfs 0.843 af
18.0" x 92.0' Culvert Outflow=5.66 cfs 0.843 af

Pond SD2: SUBSURFACE DETENTION #2

Peak Elev=7.42' Storage=2,763 cf Inflow=7.17 cfs 0.980 af
12.0" x 36.0' Culvert Outflow=6.00 cfs 0.980 af

Pond SI 1: SUBSURFACE INFILTRATION 1

Peak Elev=9.35' Storage=5,797 cf Inflow=4.76 cfs 0.372 af
Discarded=0.02 cfs 0.043 af Primary=2.57 cfs 0.276 af Outflow=2.60 cfs 0.319 af

Pond SI 2: SUBSURFACE INFILTRATION 2

Peak Elev=8.62' Storage=3,713 cf Inflow=4.13 cfs 0.322 af
Discarded=0.02 cfs 0.028 af Primary=3.15 cfs 0.240 af Outflow=3.17 cfs 0.268 af

Pond SI 3: SUBSURFACE INFILTRATION 3

Peak Elev=8.04' Storage=5,038 cf Inflow=6.52 cfs 0.509 af
Discarded=0.02 cfs 0.037 af Primary=4.16 cfs 0.408 af Outflow=4.18 cfs 0.445 af

Pond WQ1: WQ1

Peak Elev=7.67' Inflow=6.40 cfs 0.920 af
24.0" x 8.0' Culvert Outflow=6.40 cfs 0.920 af

Pond WQ2: WQ2

Peak Elev=6.46' Inflow=2.37 cfs 0.177 af
12.0" x 30.0' Culvert Outflow=2.37 cfs 0.177 af

Total Runoff Area = 8.337 ac Runoff Volume = 2.759 af Average Runoff Depth = 3.97"

Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 69

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment AD12: AREA DRAIN 1 & 2

Runoff = 0.33 cfs @ 12.07 hrs, Volume= 0.023 af, Depth= 2.05"

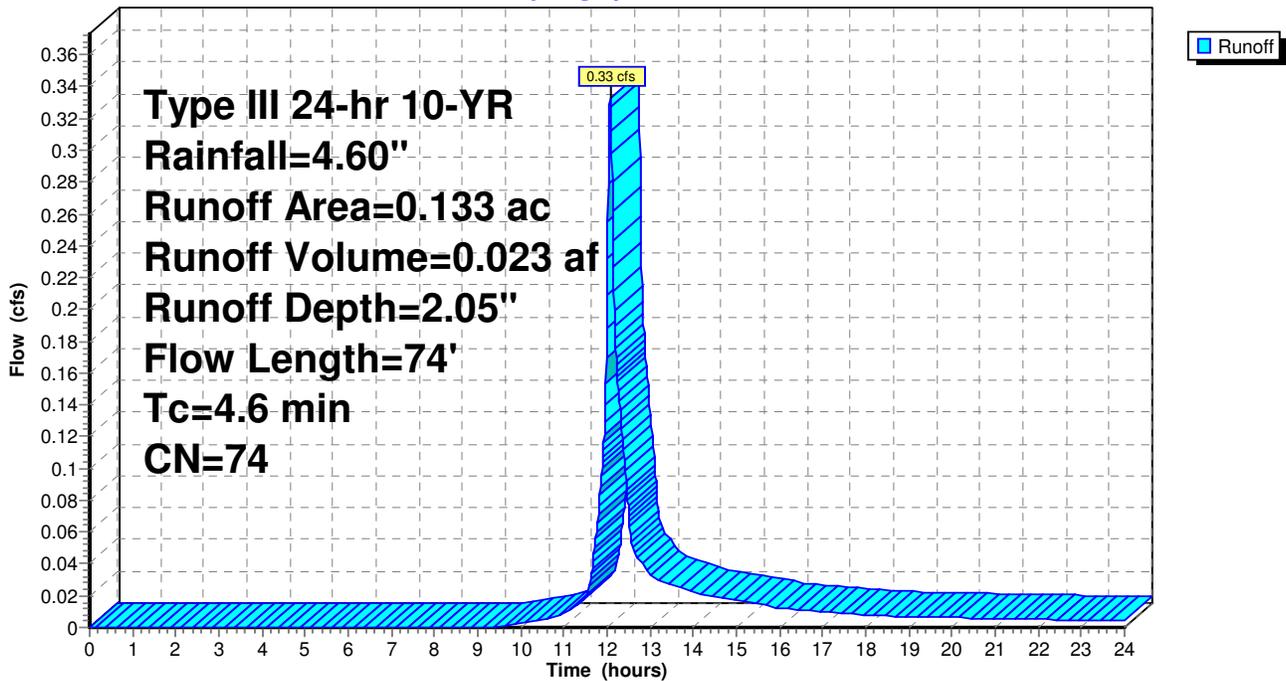
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.133	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 3.20"
0.3	24	0.0400	1.4		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
4.6	74	Total			

Subcatchment AD12: AREA DRAIN 1 & 2

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 70

3/15/2013

Subcatchment AD3: AREA DRAIN 3

Runoff = 0.19 cfs @ 12.06 hrs, Volume= 0.012 af, Depth= 2.05"

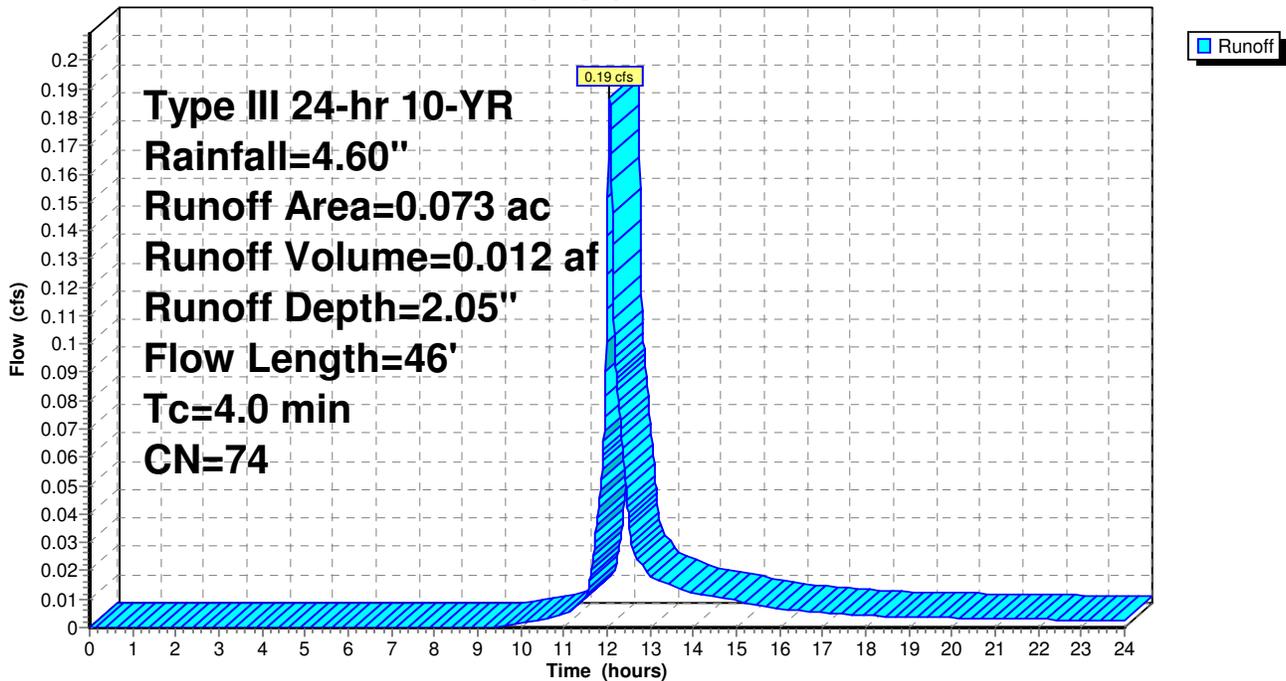
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.073	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	46	0.0400	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 3.20"

Subcatchment AD3: AREA DRAIN 3

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 71

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment AD4: AREA DRAIN 4

Runoff = 0.18 cfs @ 12.08 hrs, Volume= 0.013 af, Depth= 2.05"

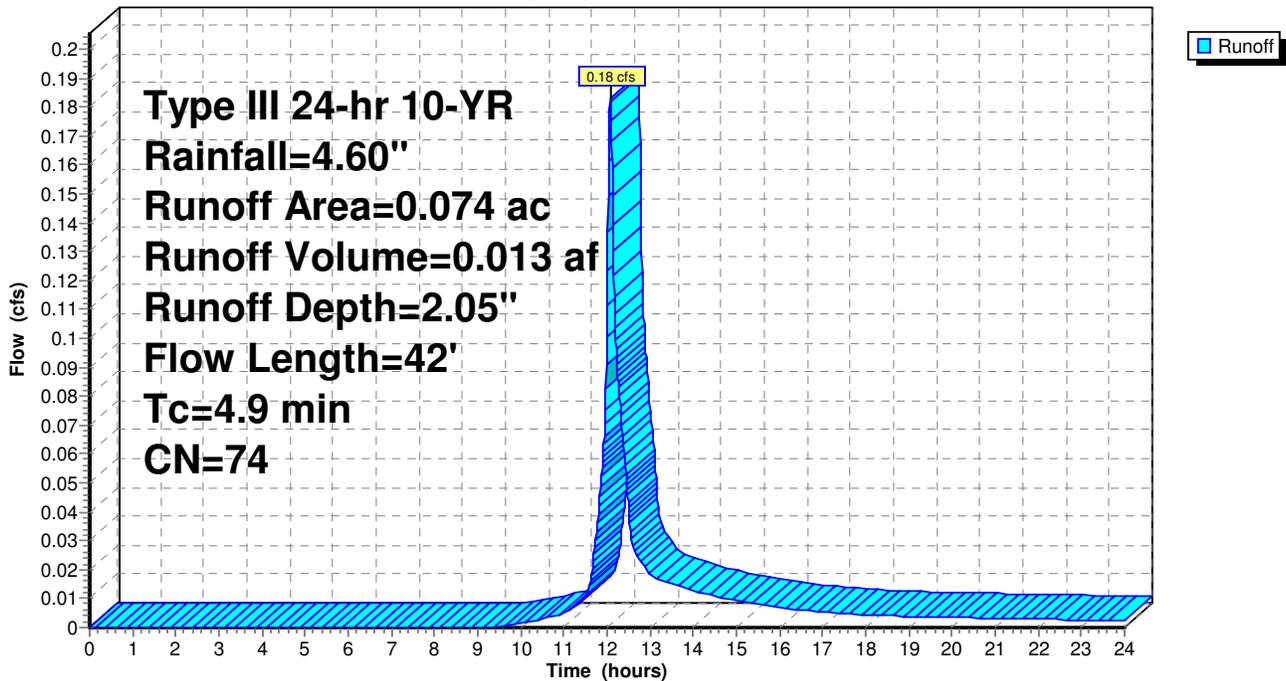
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.074	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	42	0.0200	0.1		Sheet Flow, Grass: Short n= 0.150 P2= 3.20"

Subcatchment AD4: AREA DRAIN 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 72

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 1: CB 1

Runoff = 1.55 cfs @ 12.11 hrs, Volume= 0.119 af, Depth= 3.09"

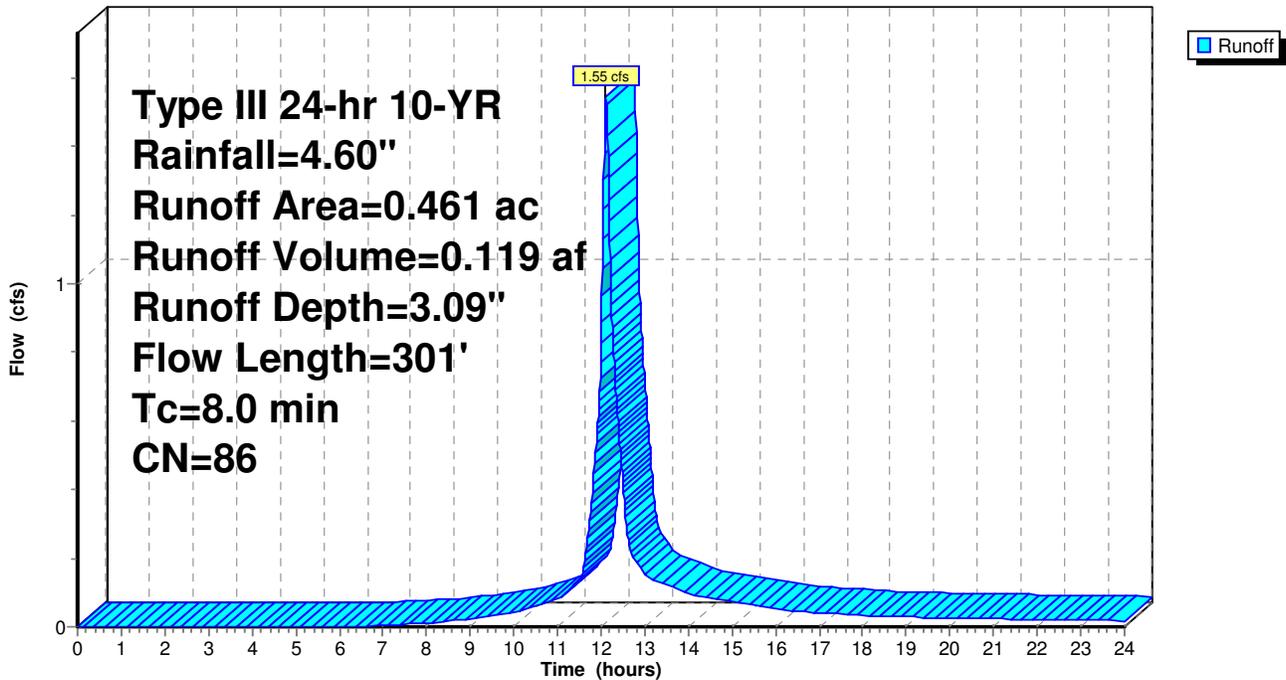
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.238	74	>75% Grass cover, Good, HSG C
0.223	98	Paved parking & roofs
0.461	86	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	50	0.0600	0.2		Sheet Flow, DCR property Grass: Dense n= 0.240 P2= 3.20"
2.2	151	0.0050	1.1		Shallow Concentrated Flow, DCR prop Unpaved Kv= 16.1 fps
0.5	100	0.0050	3.2	2.52	Circular Channel (pipe), Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
8.0	301	Total			

Subcatchment CB 1: CB 1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 73

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 11: CB 11

Runoff = 0.20 cfs @ 12.07 hrs, Volume= 0.016 af, Depth= 4.36"

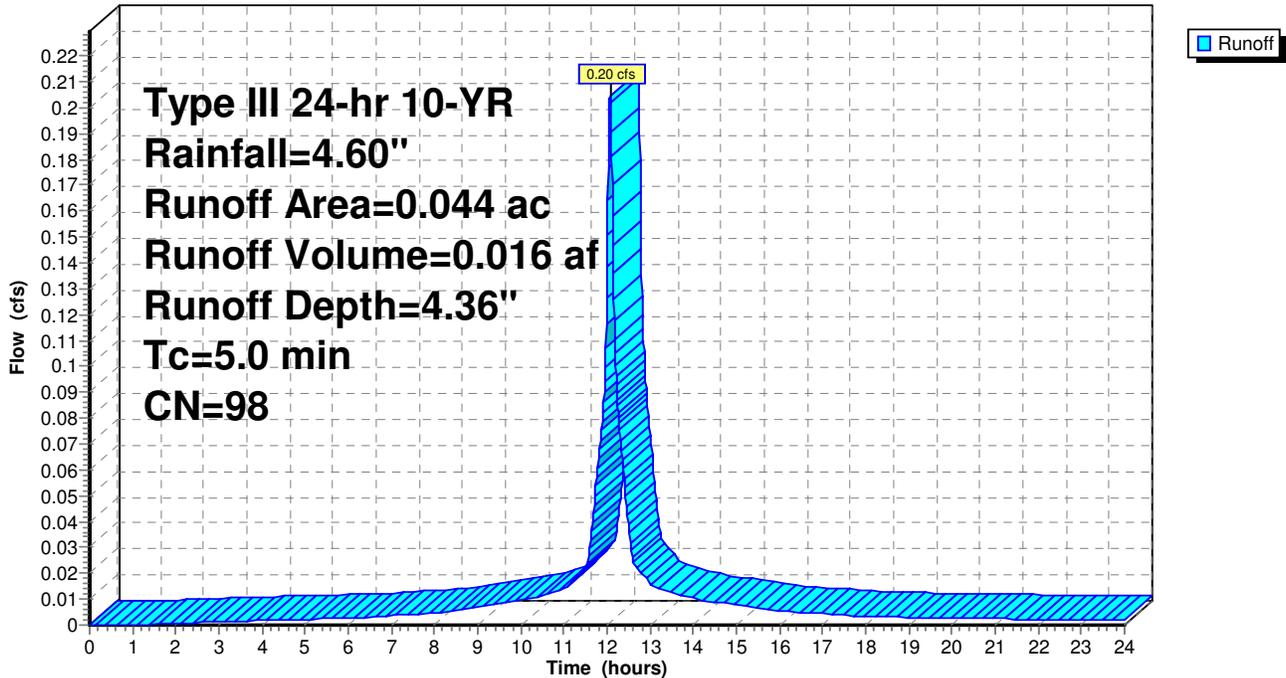
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.044	98	Paved parking & roofs

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

Subcatchment CB 11: CB 11

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 74

3/15/2013

Subcatchment CB 2: CB 2

Runoff = 1.91 cfs @ 12.07 hrs, Volume= 0.133 af, Depth= 3.29"

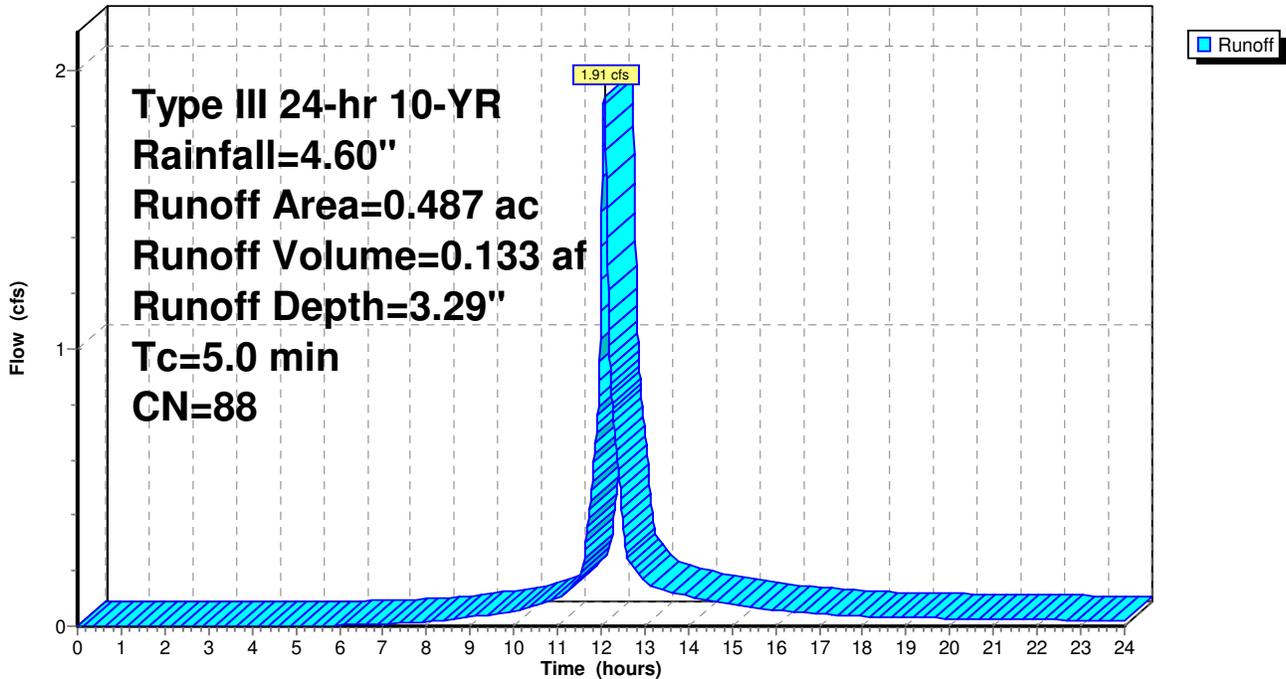
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.195	74	>75% Grass cover, Good, HSG C
0.292	98	Paved parking & roofs
0.487	88	Weighted Average

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

Subcatchment CB 2: CB 2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 75

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 3: CB 3

Runoff = 1.04 cfs @ 12.07 hrs, Volume= 0.074 af, Depth= 3.59"

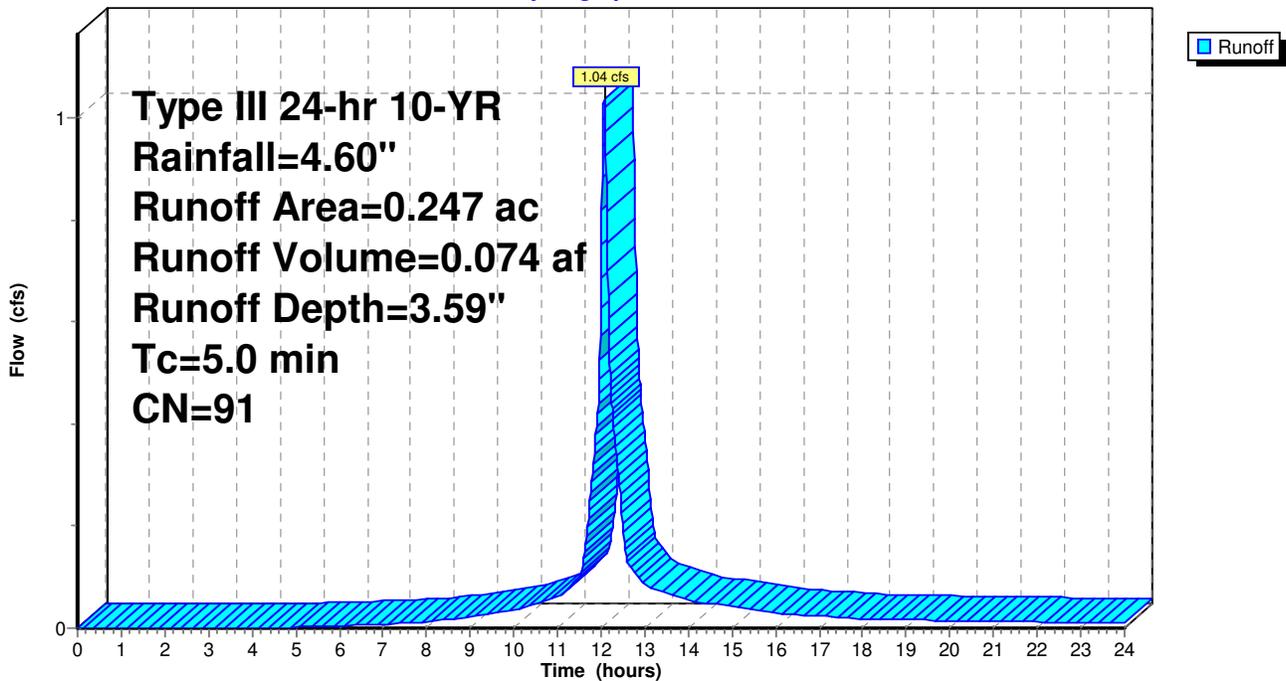
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.075	74	>75% Grass cover, Good, HSG C
0.172	98	Paved parking & roofs
0.247	91	Weighted Average

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

Subcatchment CB 3: CB 3

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 76

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 4: CB 4

Runoff = 1.01 cfs @ 12.07 hrs, Volume= 0.075 af, Depth= 4.02"

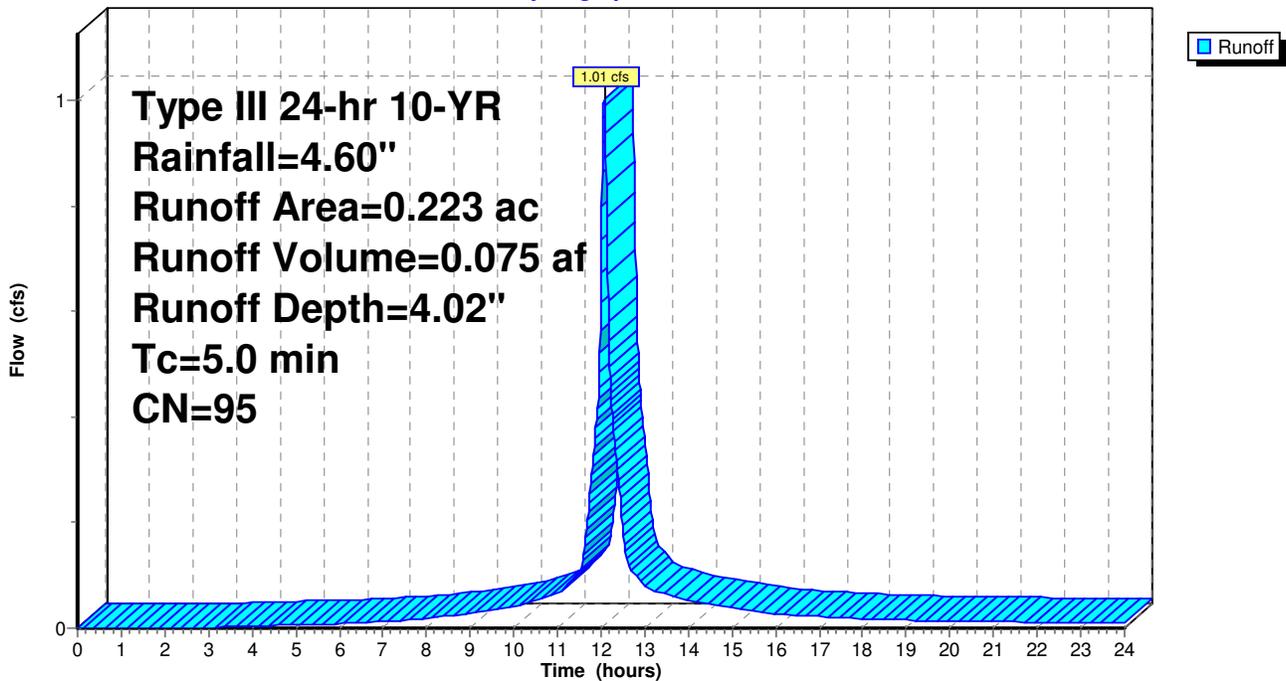
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.027	74	>75% Grass cover, Good, HSG C
0.196	98	Paved parking & roofs
0.223	95	Weighted Average

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

Subcatchment CB 4: CB 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 77

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 5: CB 5

Runoff = 0.48 cfs @ 12.07 hrs, Volume= 0.034 af, Depth= 3.70"

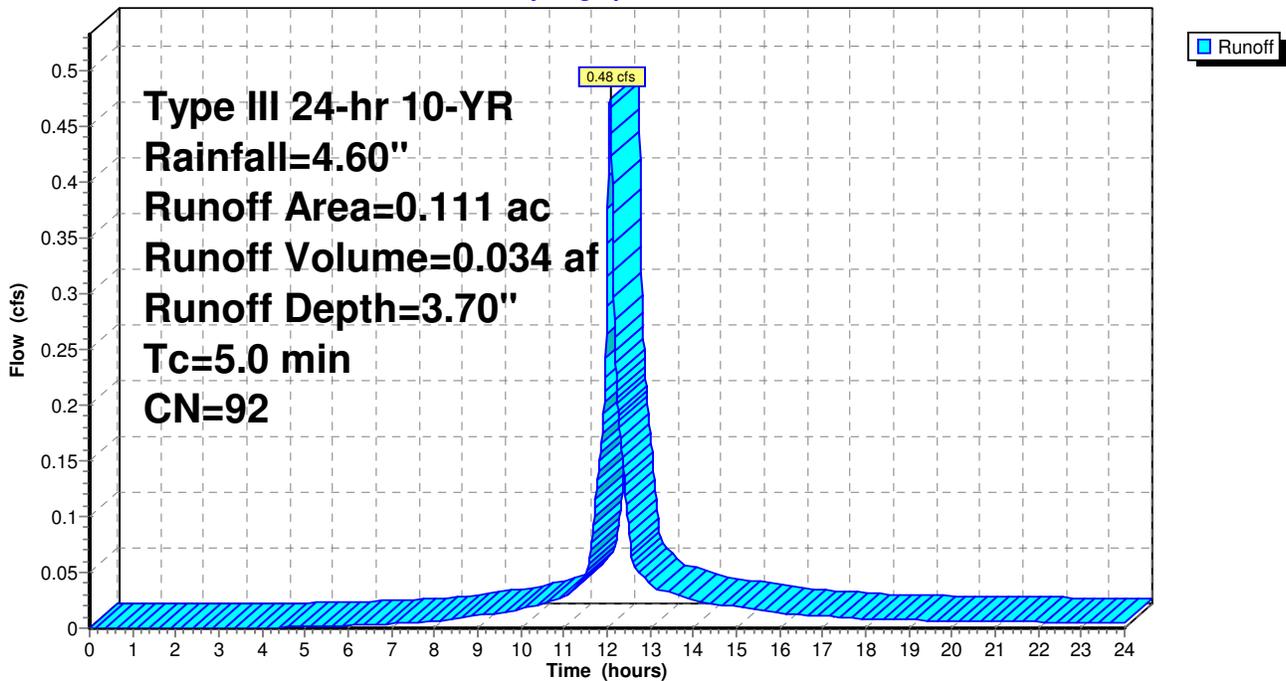
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.030	74	>75% Grass cover, Good, HSG C
0.081	98	Paved parking & roofs
0.111	92	Weighted Average

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

Subcatchment CB 5: CB 5

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 78

3/15/2013

Subcatchment CB 6: CB 6

Runoff = 0.52 cfs @ 12.07 hrs, Volume= 0.041 af, Depth= 4.36"

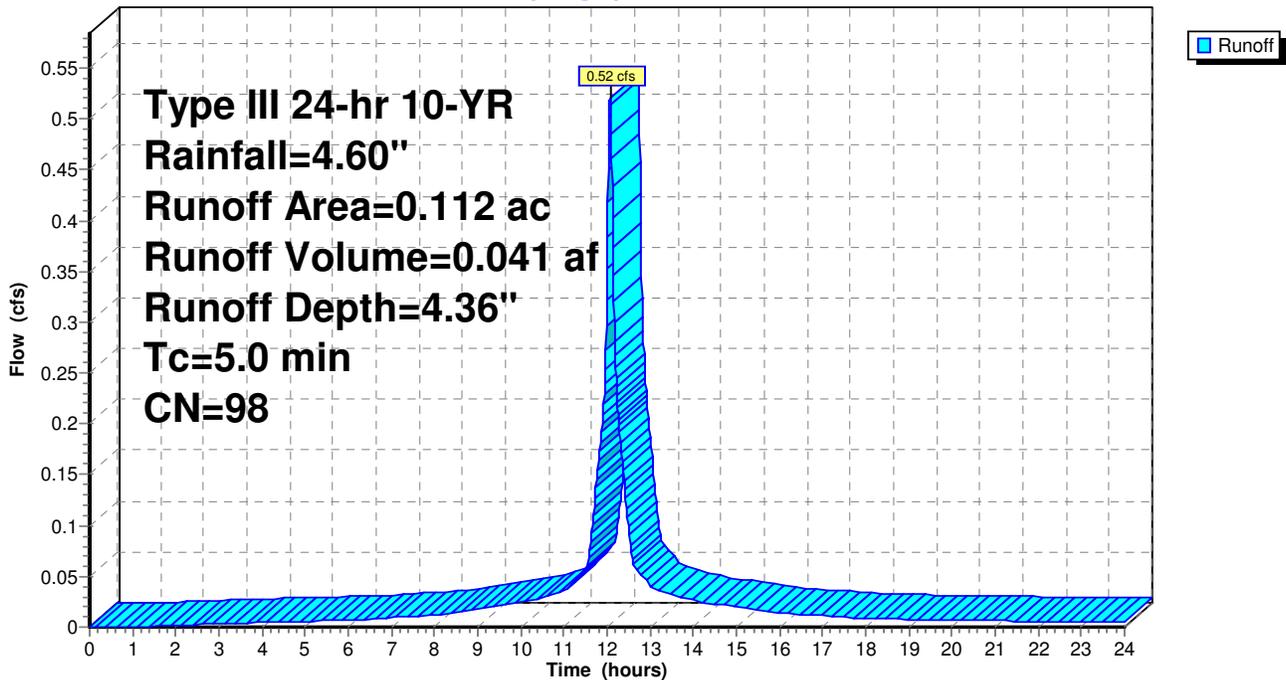
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.112	98	Paved parking & roofs

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

Subcatchment CB 6: CB 6

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 79

3/15/2013

Subcatchment CB 7: CB 7

Runoff = 0.48 cfs @ 12.07 hrs, Volume= 0.034 af, Depth= 3.59"

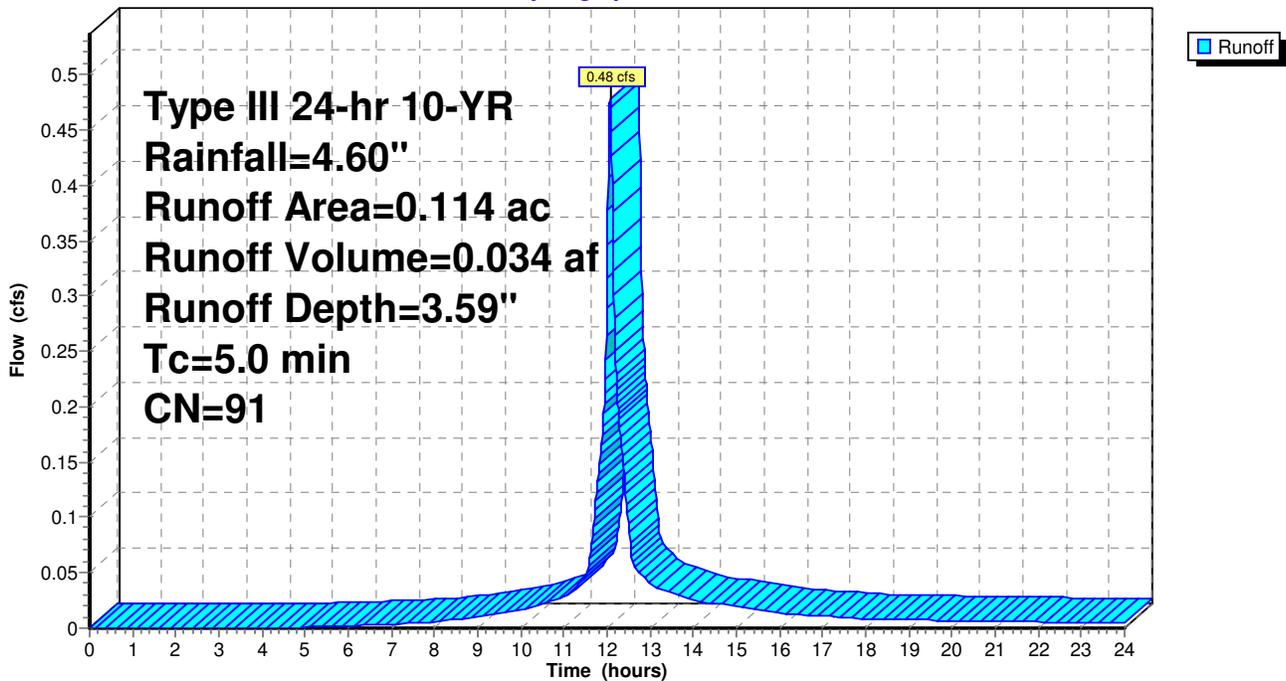
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.035	74	>75% Grass cover, Good, HSG C
0.079	98	Paved parking & roofs
0.114	91	Weighted Average

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

Subcatchment CB 7: CB 7

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 80

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB 8: CB 8

Runoff = 0.55 cfs @ 12.07 hrs, Volume= 0.043 af, Depth= 4.36"

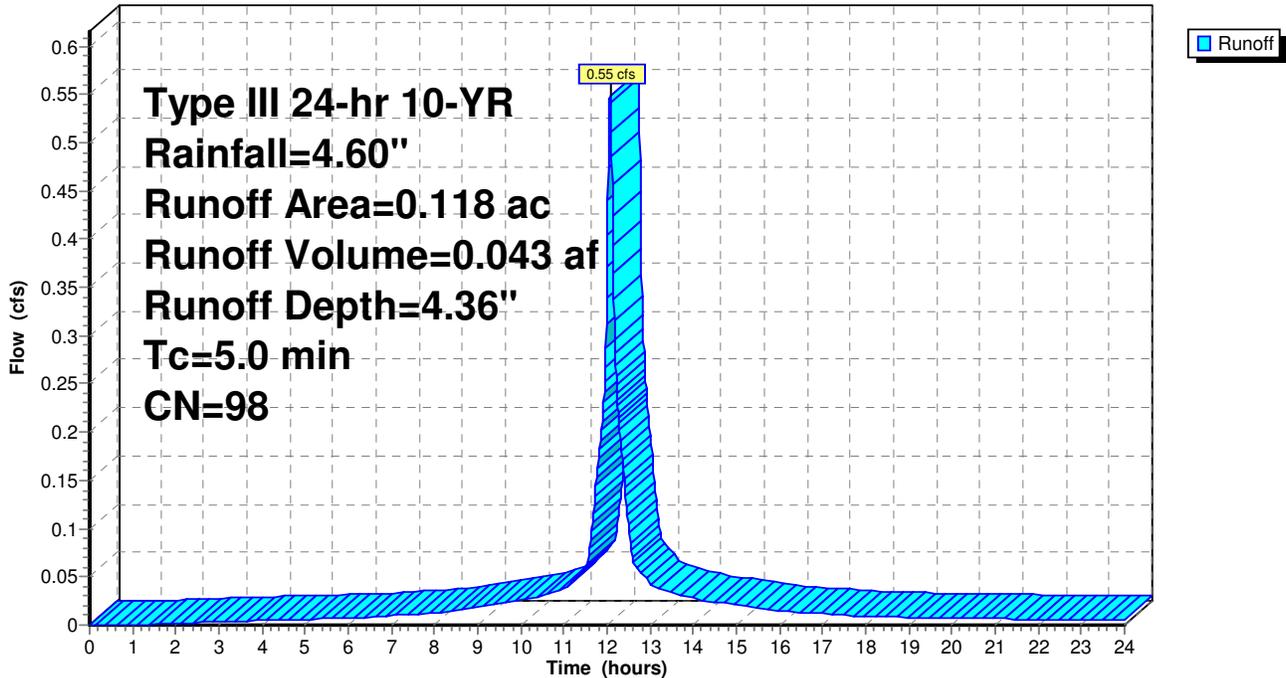
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.118	98	Paved parking & roofs

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

Subcatchment CB 8: CB 8

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 81

3/15/2013

Subcatchment CB 9: CB 9

Runoff = 2.10 cfs @ 12.07 hrs, Volume= 0.164 af, Depth= 4.36"

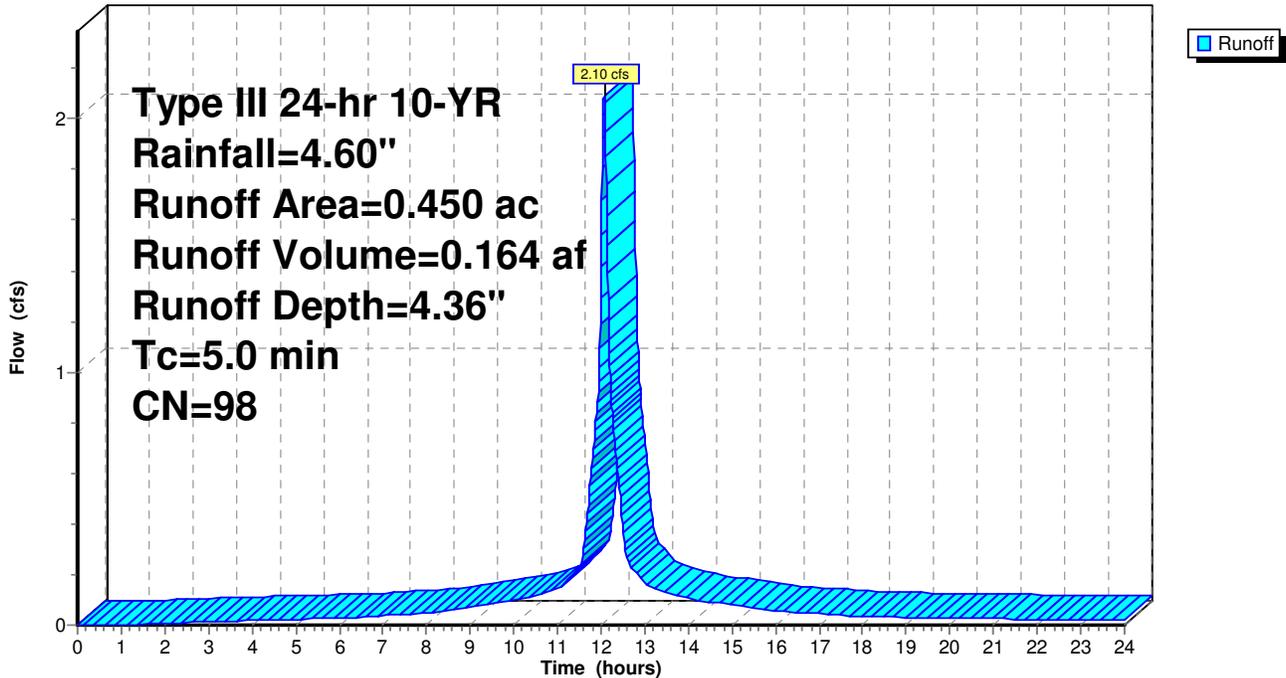
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.450	98	Paved parking & roofs

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

Subcatchment CB 9: CB 9

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 82

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB10: CB 10

Runoff = 0.06 cfs @ 12.07 hrs, Volume= 0.004 af, Depth= 4.36"

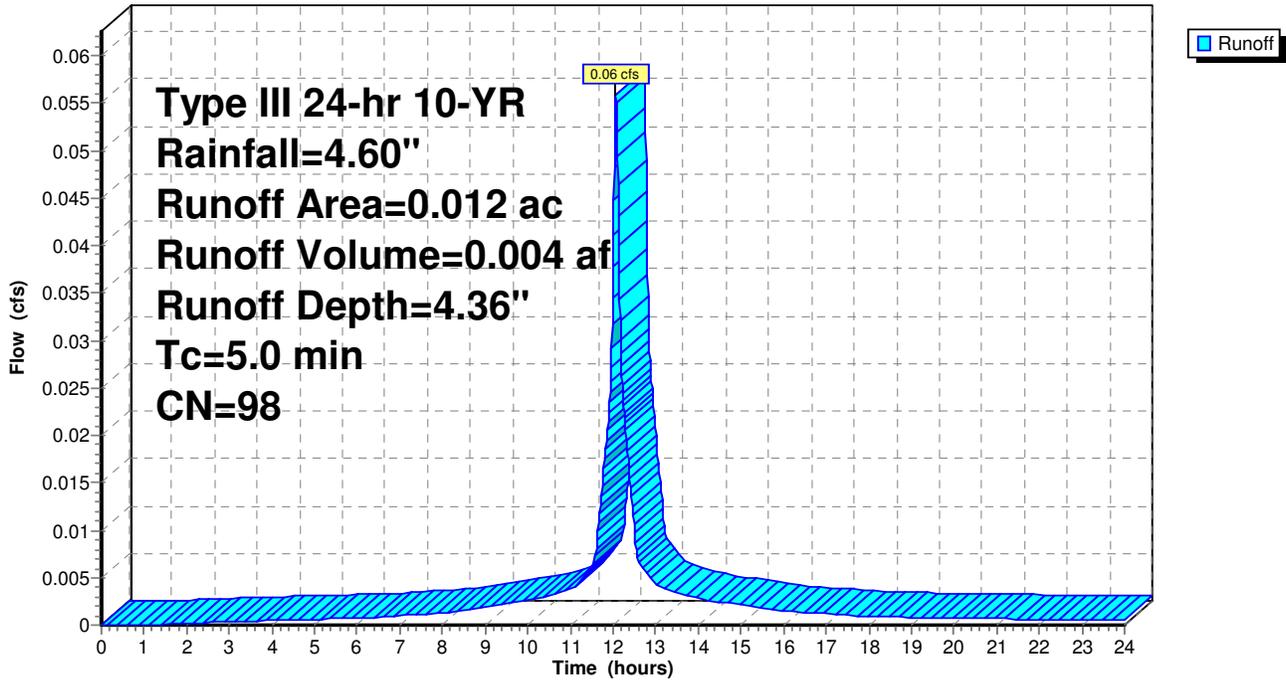
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.012	98	Paved parking & roofs

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

Subcatchment CB10: CB 10

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 83

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB12: CB 12

Runoff = 0.80 cfs @ 12.07 hrs, Volume= 0.061 af, Depth= 4.13"

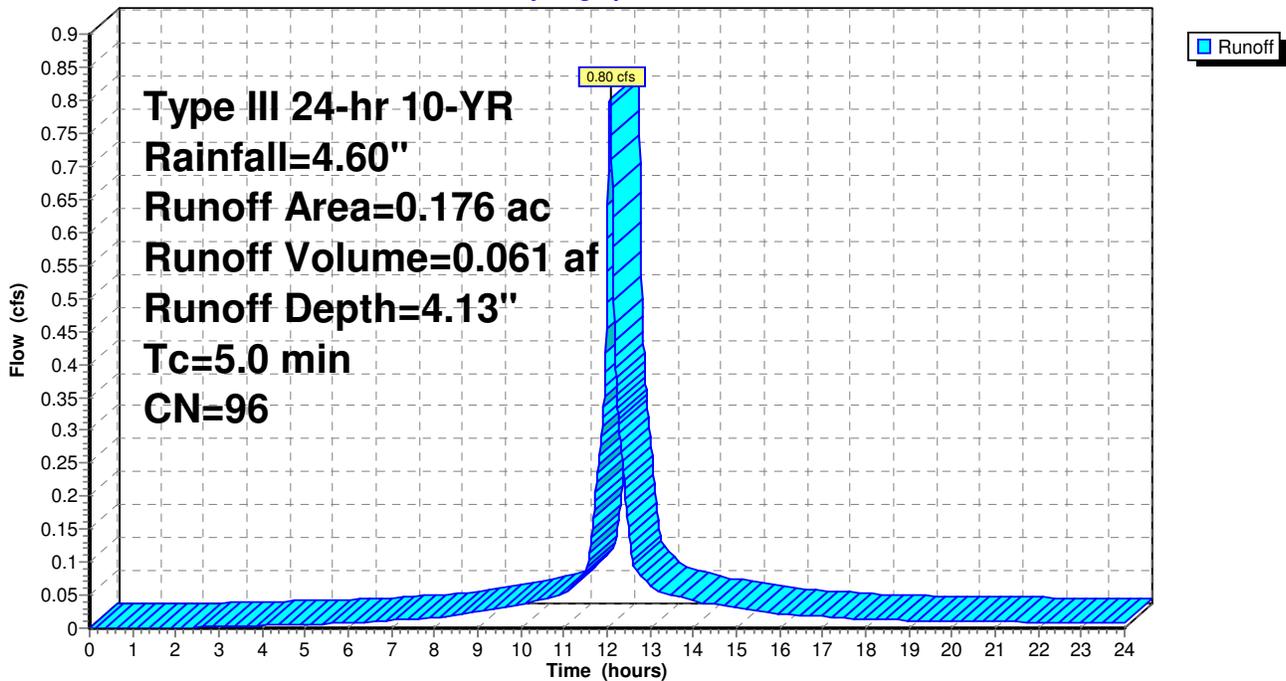
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.018	74	>75% Grass cover, Good, HSG C
0.158	98	Paved parking & roofs
0.176	96	Weighted Average

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

Subcatchment CB12: CB 12

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 84

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB13: CB 13

Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.030 af, Depth= 4.02"

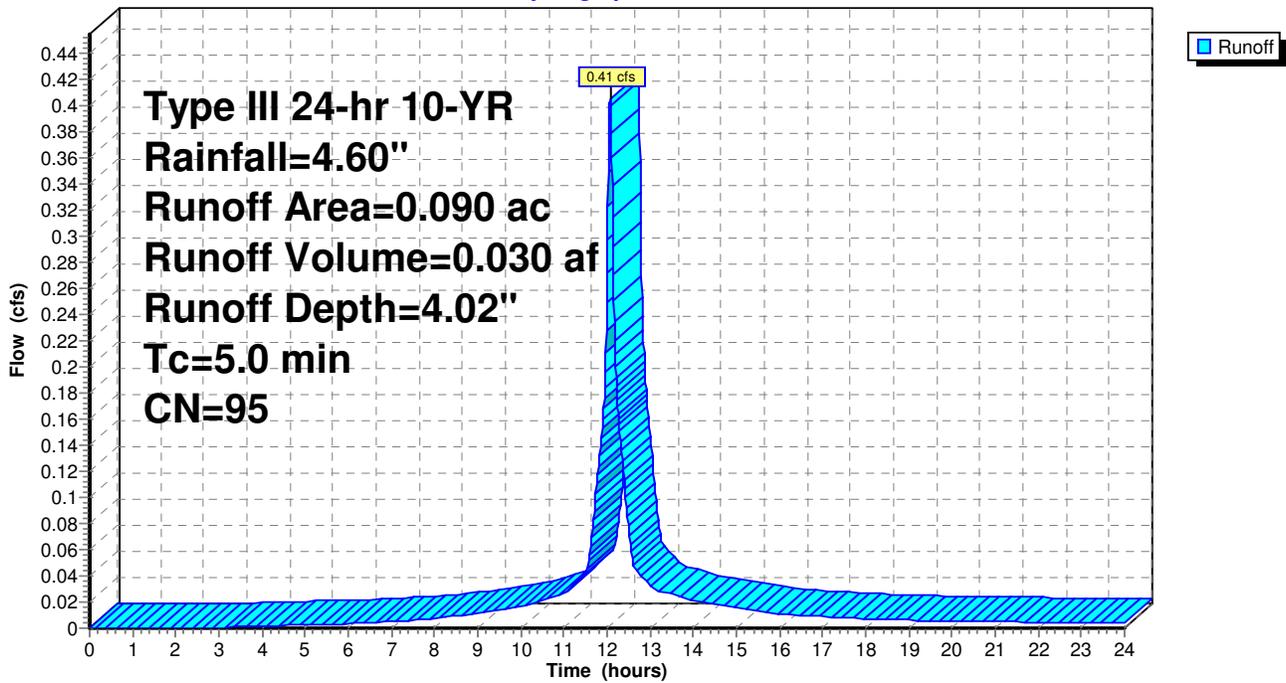
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.012	74	>75% Grass cover, Good, HSG C
0.078	98	Paved parking & roofs
0.090	95	Weighted Average

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

Subcatchment CB13: CB 13

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 85

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB14: CB 14

Runoff = 1.24 cfs @ 12.07 hrs, Volume= 0.092 af, Depth= 4.02"

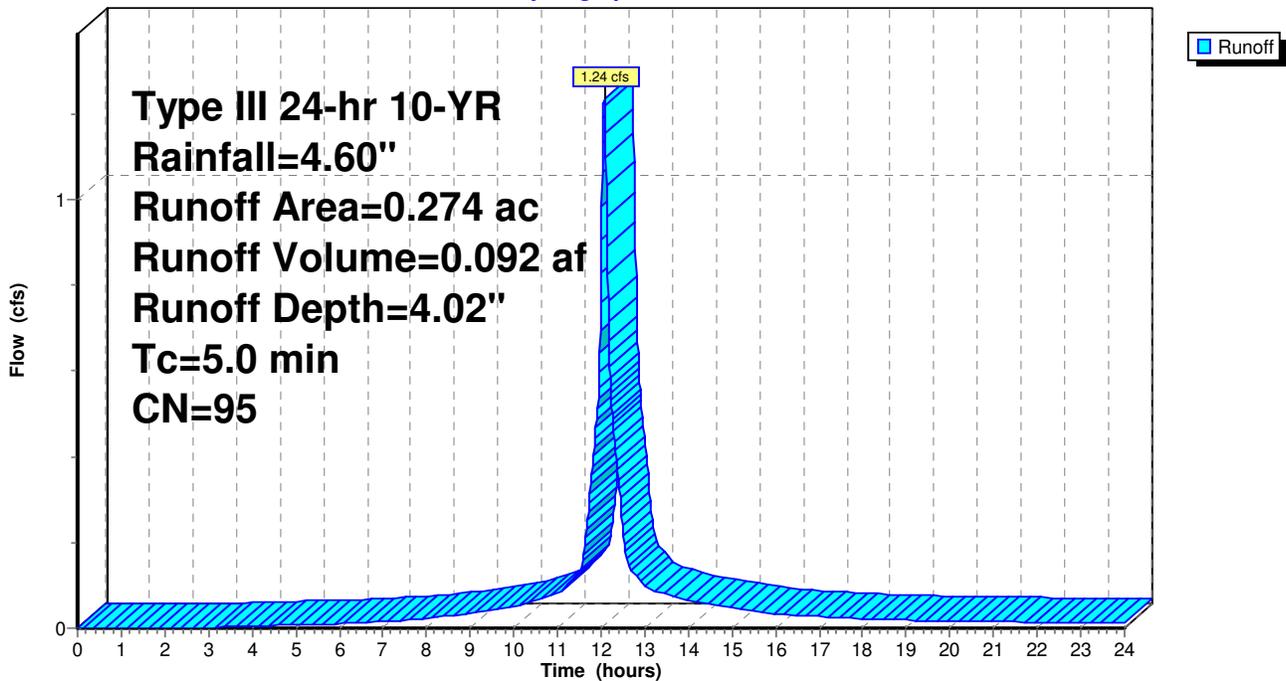
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.239	98	Paved parking & roofs
0.035	74	>75% Grass cover, Good, HSG C
0.274	95	Weighted Average

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

Subcatchment CB14: CB 14

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 86

3/15/2013

Subcatchment CB15: CB15

Runoff = 0.49 cfs @ 12.08 hrs, Volume= 0.038 af, Depth= 4.02"

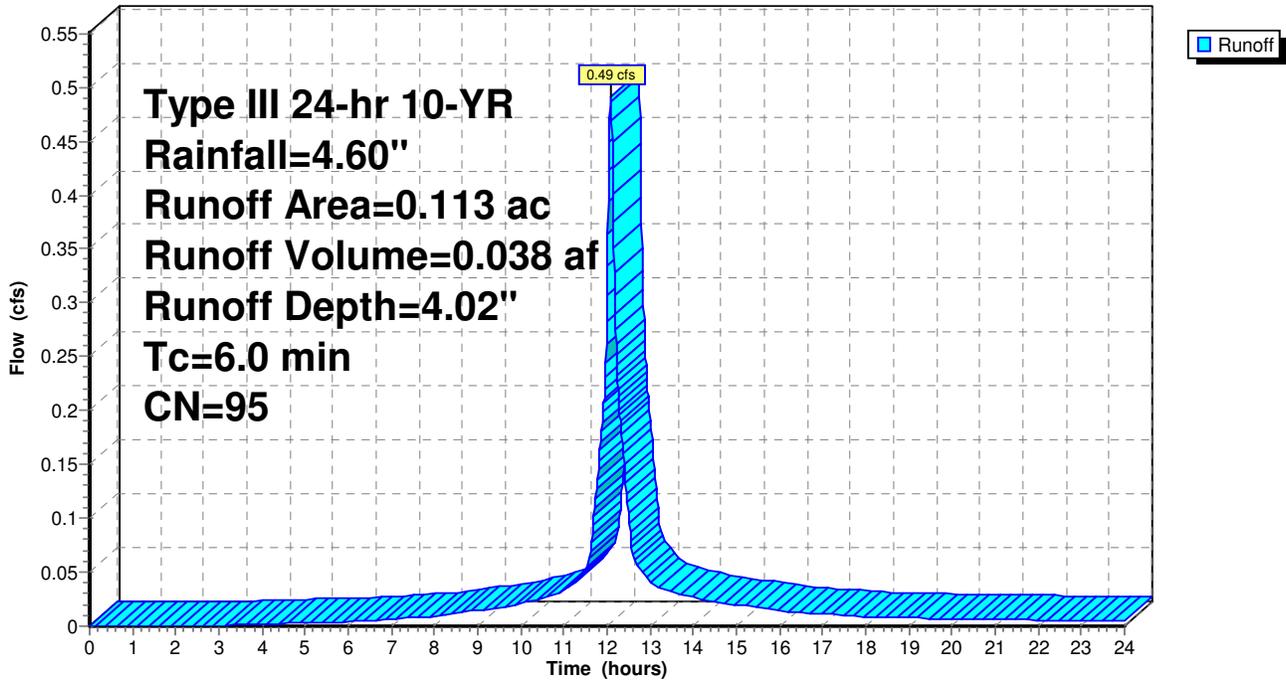
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.101	98	Paved
0.012	74	>75% Grass cover, Good, HSG C
0.113	95	Weighted Average

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

Subcatchment CB15: CB15

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 87

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB16: CB 16

Runoff = 0.65 cfs @ 12.07 hrs, Volume= 0.047 af, Depth= 3.80"

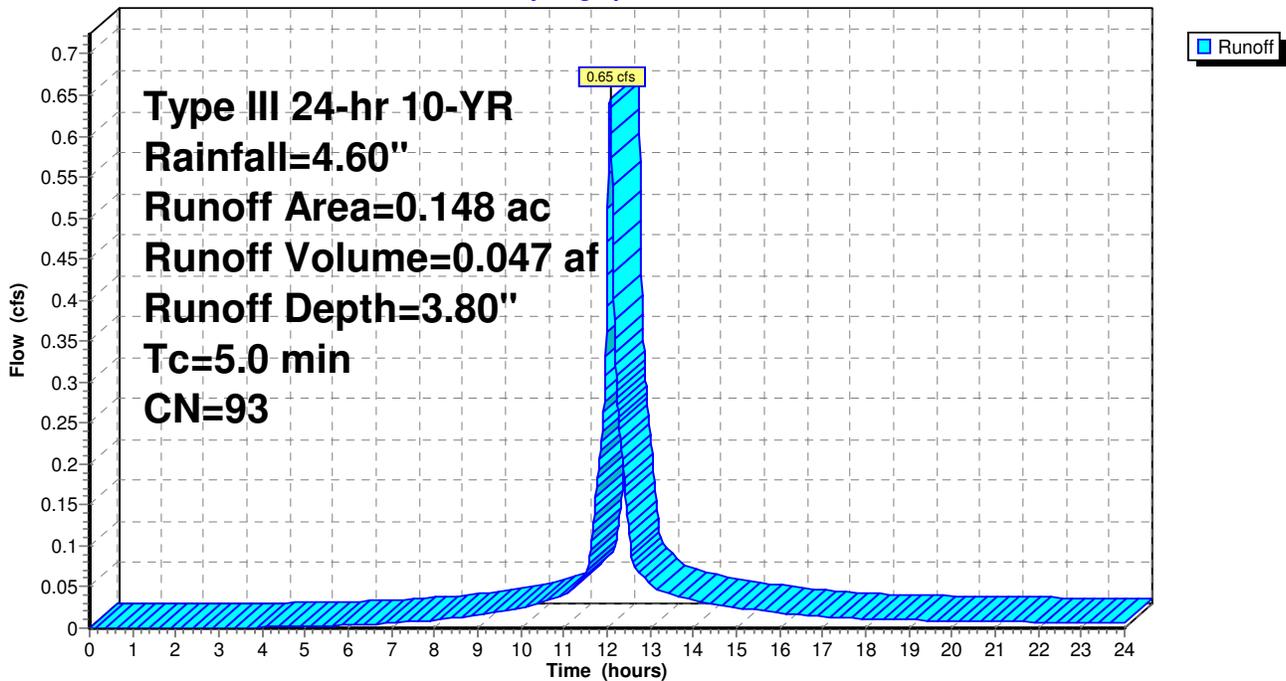
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.033	74	>75% Grass cover, Good, HSG C
0.115	98	Paved parking & roofs
0.148	93	Weighted Average

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

Subcatchment CB16: CB 16

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 88

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment CB17: CB 17

Runoff = 0.66 cfs @ 12.07 hrs, Volume= 0.051 af, Depth= 4.25"

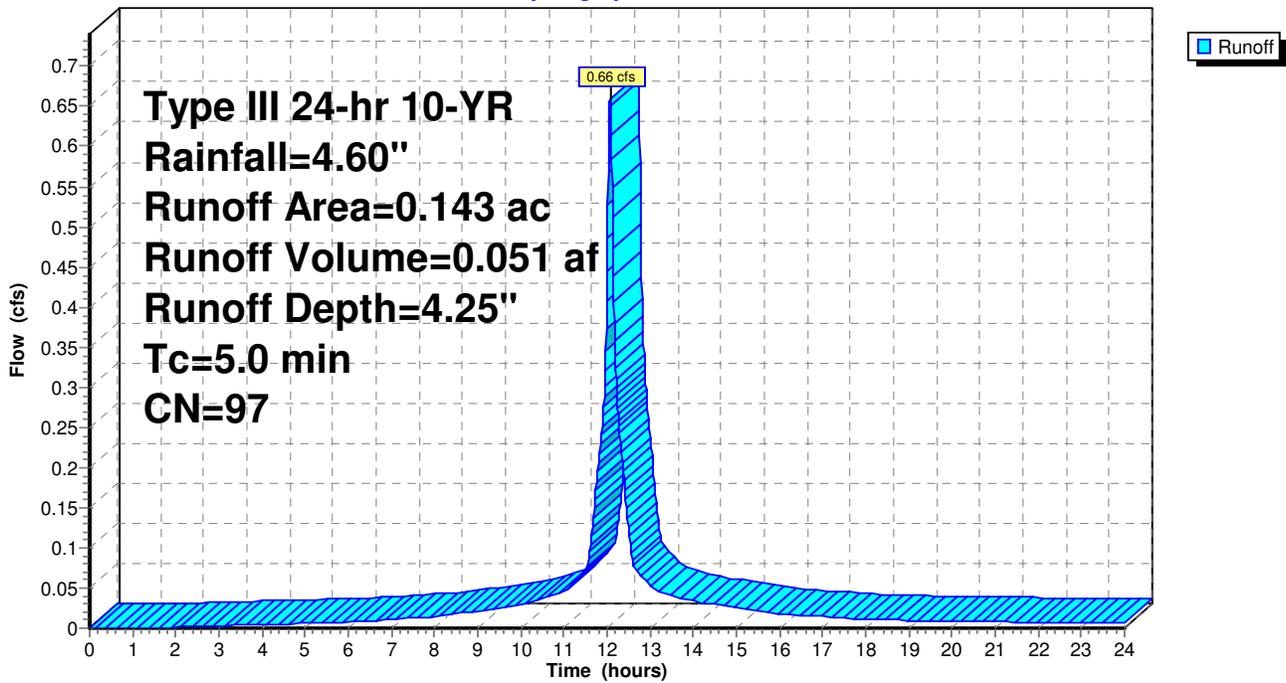
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.007	74	>75% Grass cover, Good, HSG C
0.136	98	Paved parking & roofs
0.143	97	Weighted Average

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

Subcatchment CB17: CB 17

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 89

3/15/2013

Subcatchment CB18: CB18

Runoff = 0.68 cfs @ 12.07 hrs, Volume= 0.053 af, Depth= 4.36"

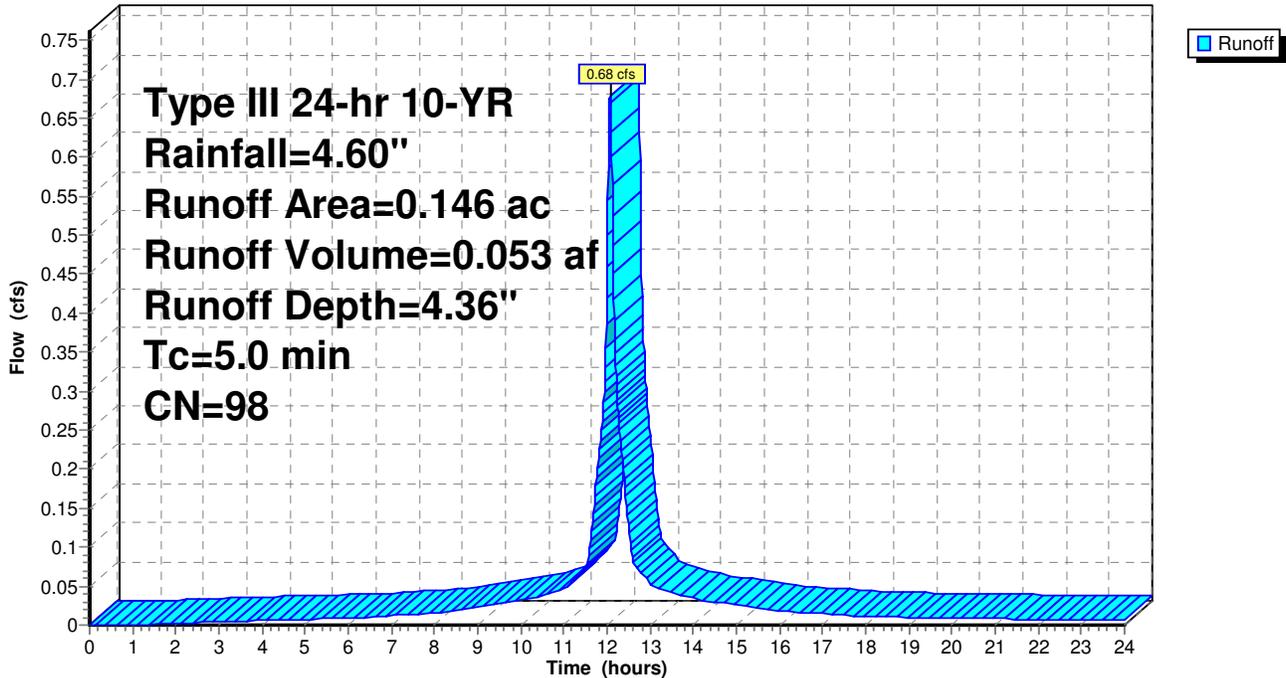
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.146	98	Paved parking & roofs

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

Subcatchment CB18: CB18

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 90

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment EX 1: Design Point #1 - Flow to Dorchester Bay

Runoff = 1.48 cfs @ 12.07 hrs, Volume= 0.101 af, Depth= 2.72"

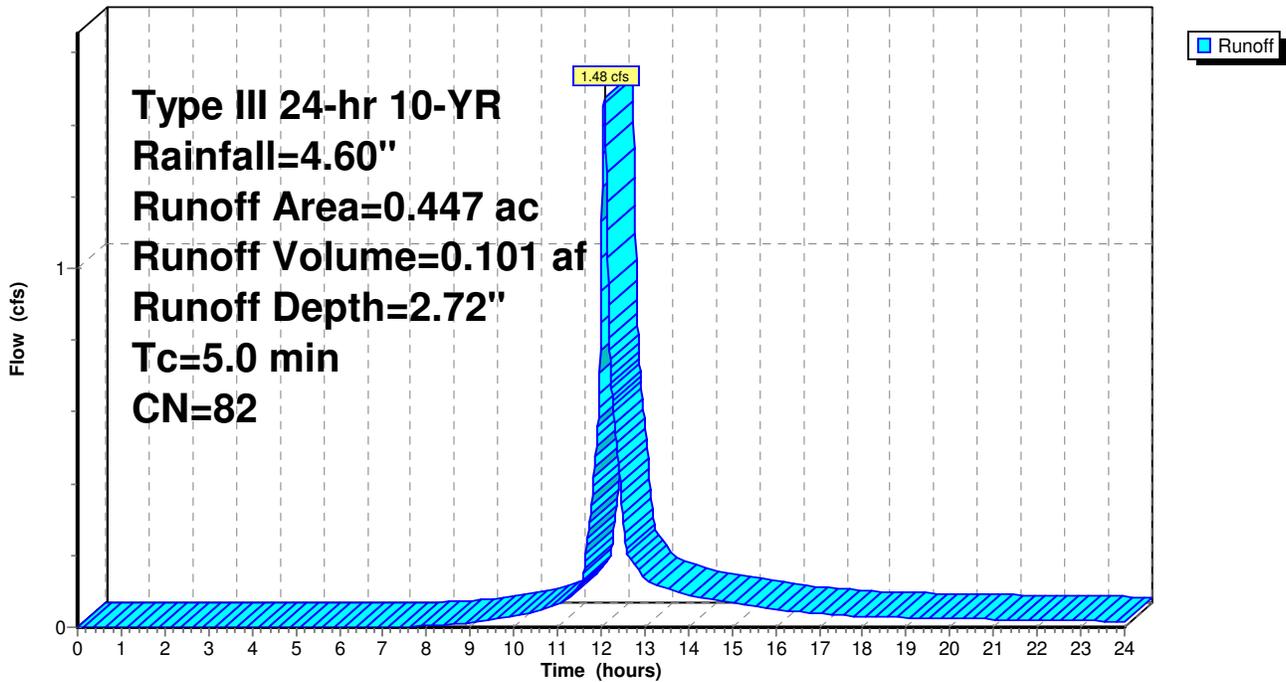
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.048	98	Paved
0.368	79	Wood Boardwalk
0.031	86	<50% Grass cover, Poor, HSG C
0.447	82	Weighted Average

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

Subcatchment EX 1: Design Point #1 - Flow to Dorchester Bay

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 91

3/15/2013

Subcatchment EX4: EX 4

Runoff = 2.79 cfs @ 12.07 hrs, Volume= 0.218 af, Depth= 4.36"

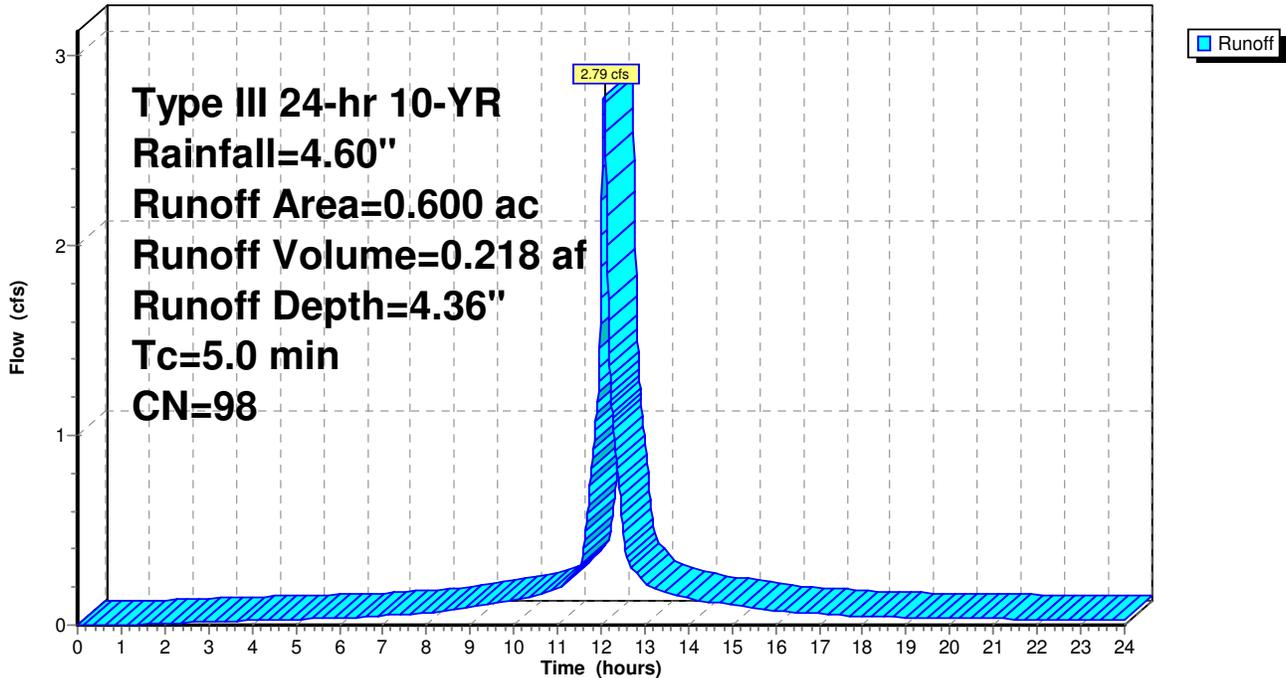
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.600	98	Paved parking & roofs

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

Subcatchment EX4: EX 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 92

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment EXCB: EX CB

Runoff = 1.07 cfs @ 12.07 hrs, Volume= 0.082 af, Depth= 4.25"

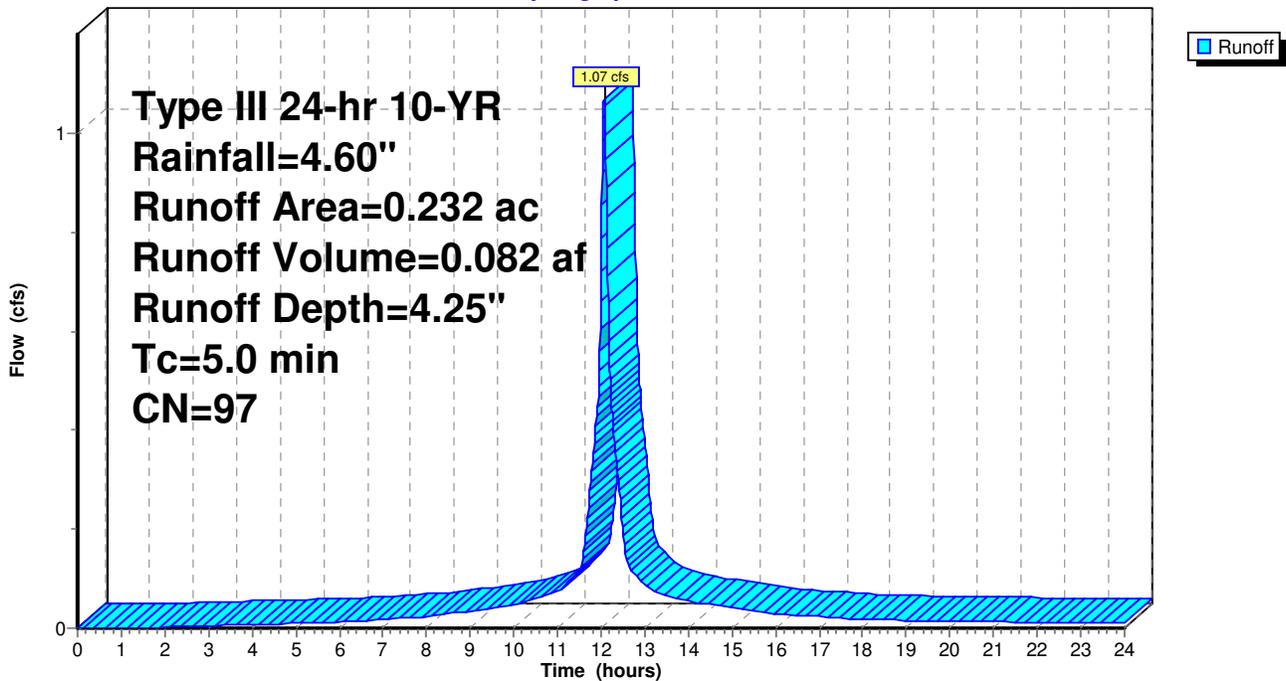
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.227	98	Paved parking & roofs
0.005	74	>75% Grass cover, Good, HSG C
0.232	97	Weighted Average

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

Subcatchment EXCB: EX CB

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 93

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment RD 1: ROOF DRAIN 1

Runoff = 4.76 cfs @ 12.07 hrs, Volume= 0.372 af, Depth= 4.36"

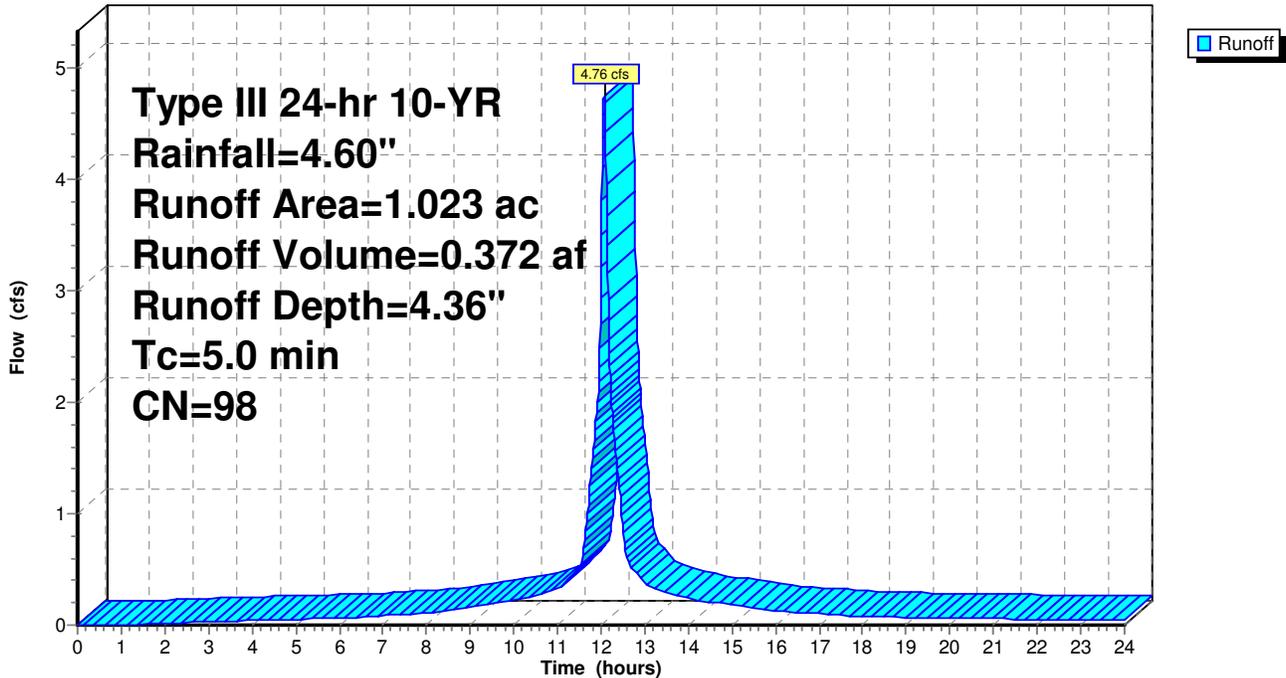
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
1.023	98	Paved parking & roofs

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

Subcatchment RD 1: ROOF DRAIN 1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 94

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment RD 2: ROOF DRAIN 2

Runoff = 4.13 cfs @ 12.07 hrs, Volume= 0.322 af, Depth= 4.36"

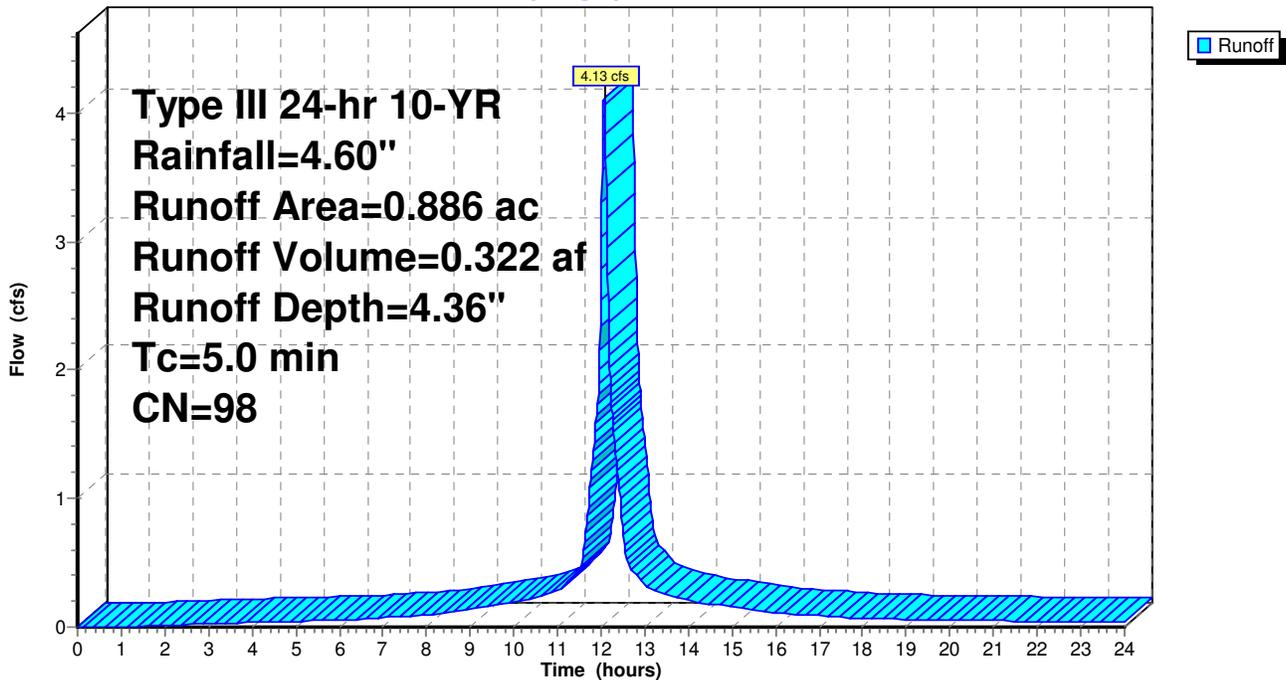
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.886	98	Paved parking & roofs

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

Subcatchment RD 2: ROOF DRAIN 2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 95

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment RD3: ROOF DRAIN 3

Runoff = 4.99 cfs @ 12.07 hrs, Volume= 0.389 af, Depth= 4.36"

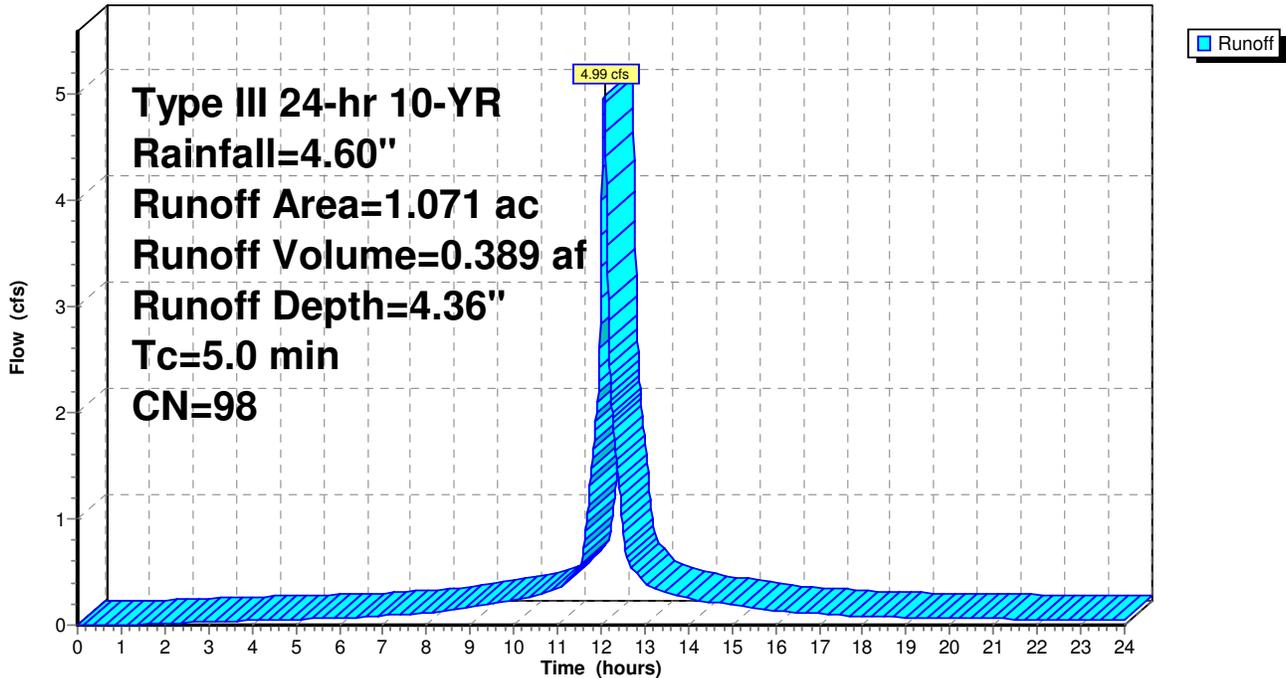
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
1.071	98	Paved parking & roofs

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

Subcatchment RD3: ROOF DRAIN 3

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 96

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Subcatchment RD4: ROOF DRAIN 4

Runoff = 1.53 cfs @ 12.07 hrs, Volume= 0.120 af, Depth= 4.36"

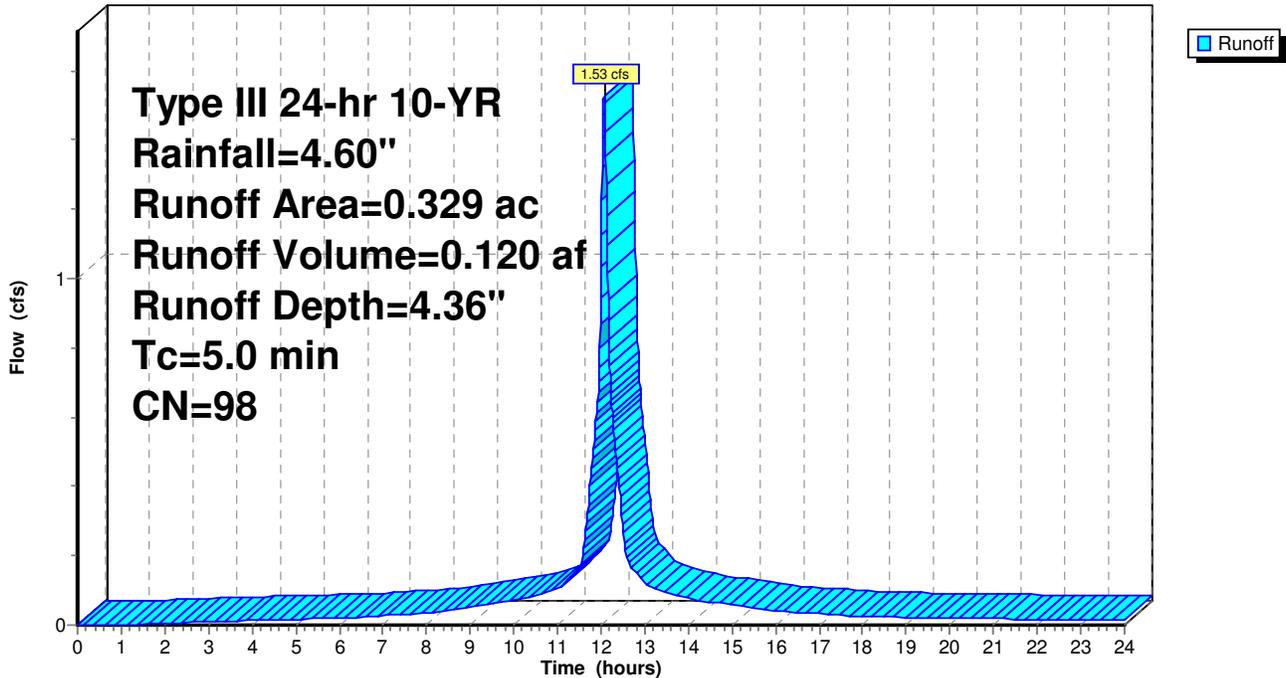
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.60"

Area (ac)	CN	Description
0.329	98	Paved parking & roofs

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

Subcatchment RD4: ROOF DRAIN 4

Hydrograph



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 97

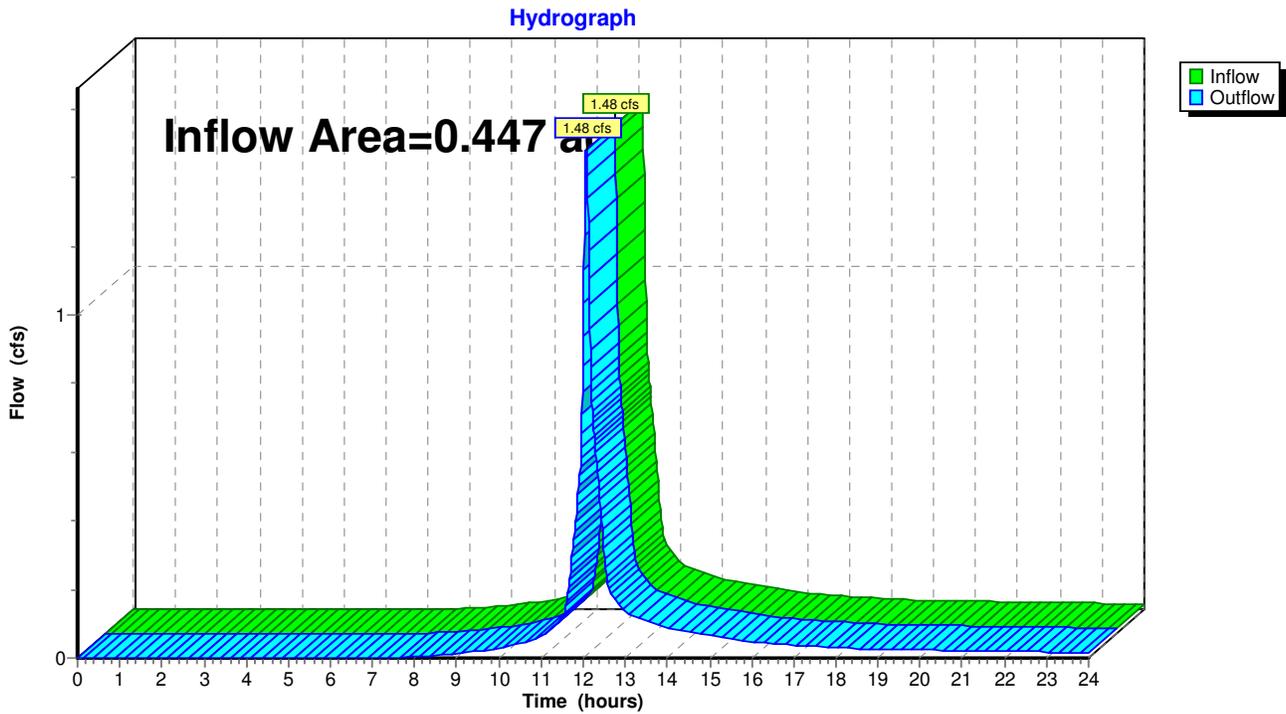
3/15/2013

Reach DP#1: Dorchester Bay

Inflow Area = 0.447 ac, Inflow Depth = 2.72" for 10-YR event
Inflow = 1.48 cfs @ 12.07 hrs, Volume= 0.101 af
Outflow = 1.48 cfs @ 12.07 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#1: Dorchester Bay



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 98

3/15/2013

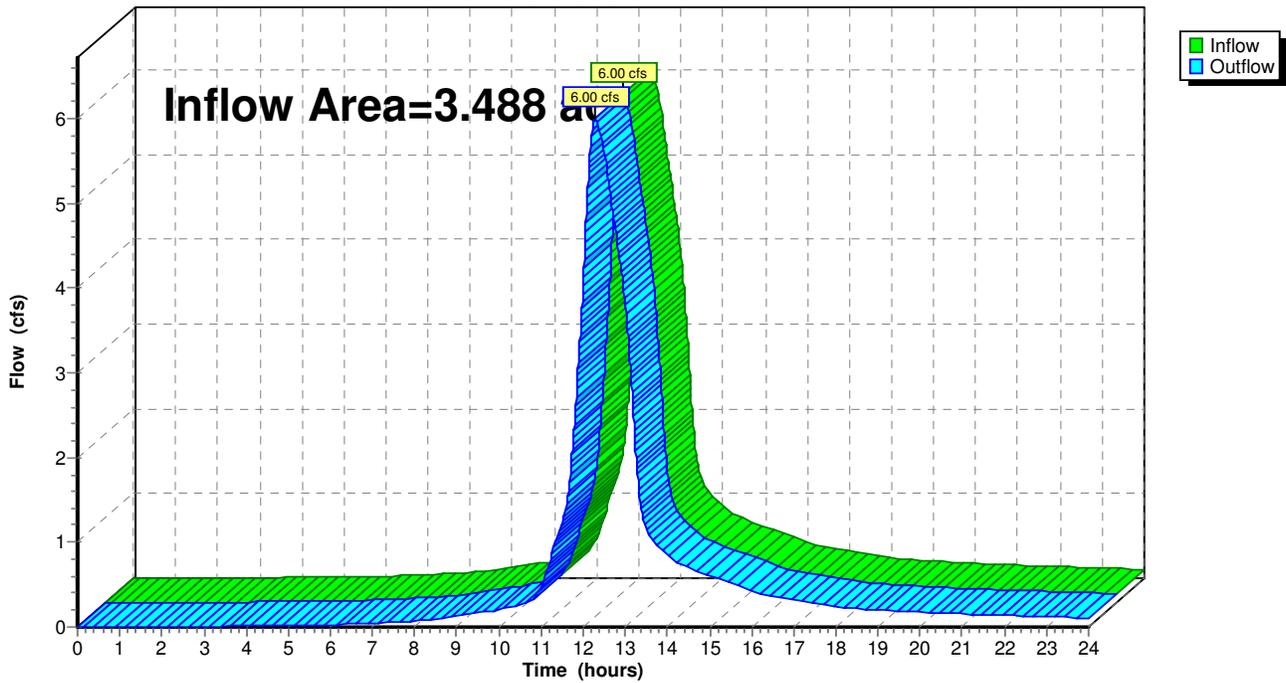
Reach DP#2: Design Point #2 - Flow to Stormwater Outfall #1 (12" Storm Drain)

Inflow Area = 3.488 ac, Inflow Depth = 3.37" for 10-YR event
Inflow = 6.00 cfs @ 12.28 hrs, Volume= 0.980 af
Outflow = 6.00 cfs @ 12.28 hrs, Volume= 0.980 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#2: Design Point #2 - Flow to Stormwater Outfall #1 (12" Storm Drain)

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 99

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

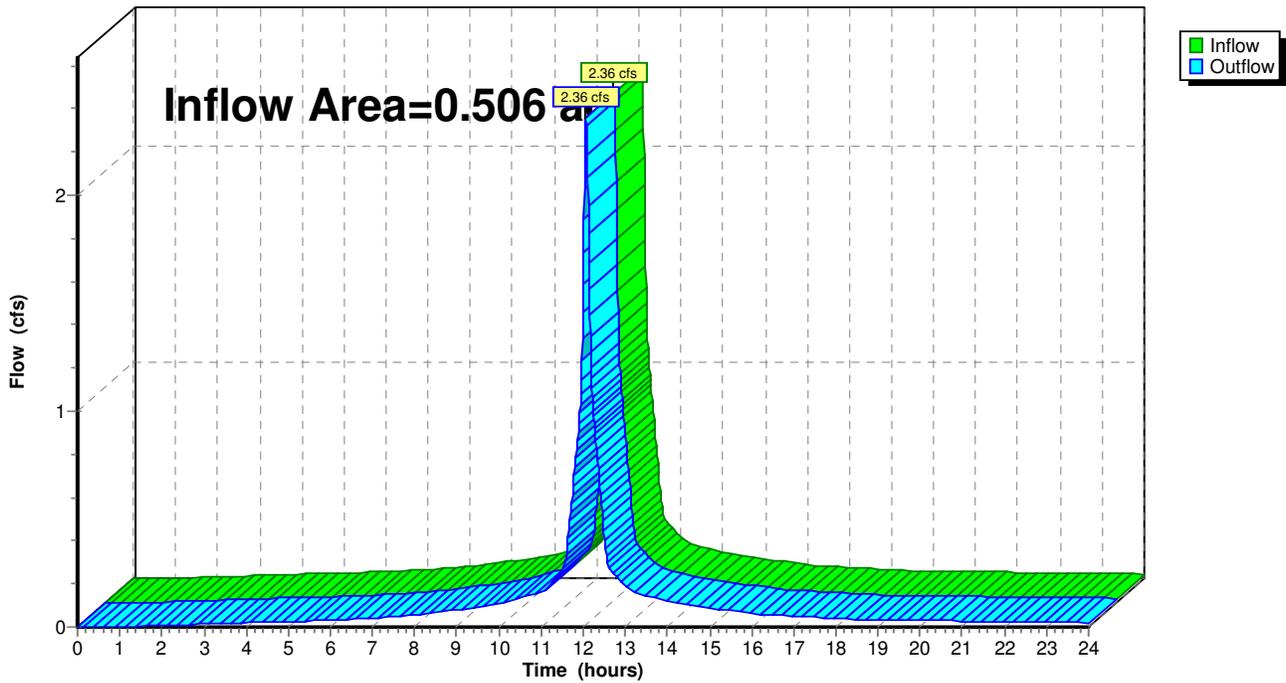
Reach DP#3: Design Point #3 - Flow to Stormwater Outfall #2

Inflow Area = 0.506 ac, Inflow Depth = 4.36" for 10-YR event
Inflow = 2.36 cfs @ 12.07 hrs, Volume= 0.184 af
Outflow = 2.36 cfs @ 12.07 hrs, Volume= 0.184 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#3: Design Point #3 - Flow to Stormwater Outfall #2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 100

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

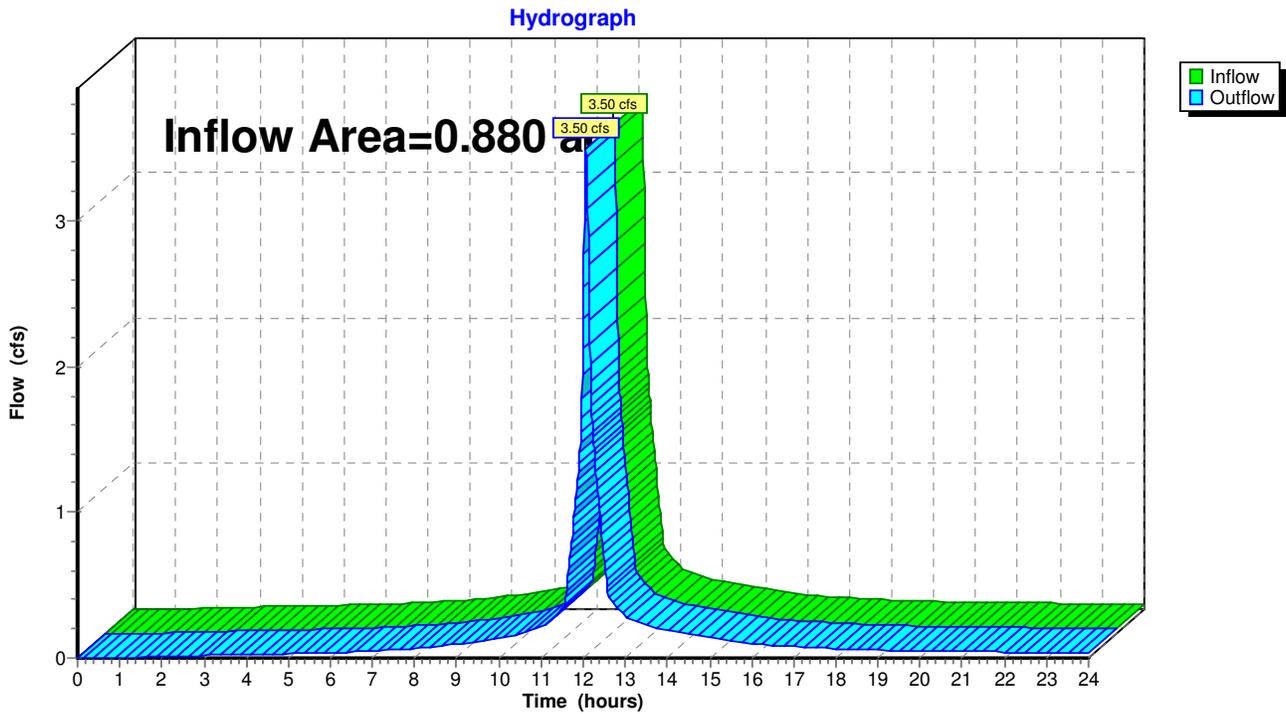
3/15/2013

Reach DP#4: Design Point #4 - Parking Lot Storm Drain

Inflow Area = 0.880 ac, Inflow Depth = 3.62" for 10-YR event
Inflow = 3.50 cfs @ 12.07 hrs, Volume= 0.266 af
Outflow = 3.50 cfs @ 12.07 hrs, Volume= 0.266 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#4: Design Point #4 - Parking Lot Storm Drain



Residences at Marina Bay - Post-Development

Prepared by Howard/Stein-Hudson Associates, Inc.

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

Type III 24-hr 10-YR Rainfall=4.60"

Page 101

3/15/2013

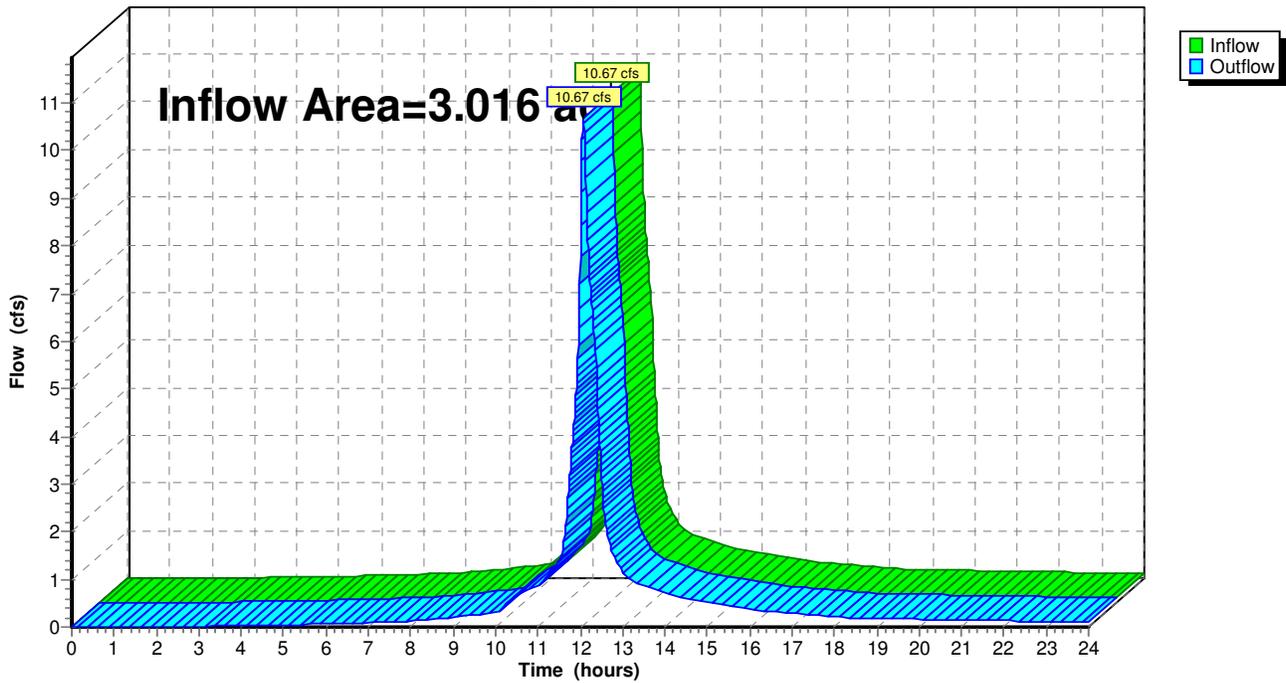
Reach DP#5: Haul Road

Inflow Area = 3.016 ac, Inflow Depth = 3.78" for 10-YR event
Inflow = 10.67 cfs @ 12.07 hrs, Volume= 0.949 af
Outflow = 10.67 cfs @ 12.07 hrs, Volume= 0.949 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach DP#5: Haul Road

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 102

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond 9: CB 9 TO DMH 6

Inflow Area = 0.450 ac, Inflow Depth = 4.36" for 10-YR event
Inflow = 2.10 cfs @ 12.07 hrs, Volume= 0.164 af
Outflow = 2.10 cfs @ 12.07 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.0 min
Primary = 2.10 cfs @ 12.07 hrs, Volume= 0.164 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.96' @ 12.07 hrs

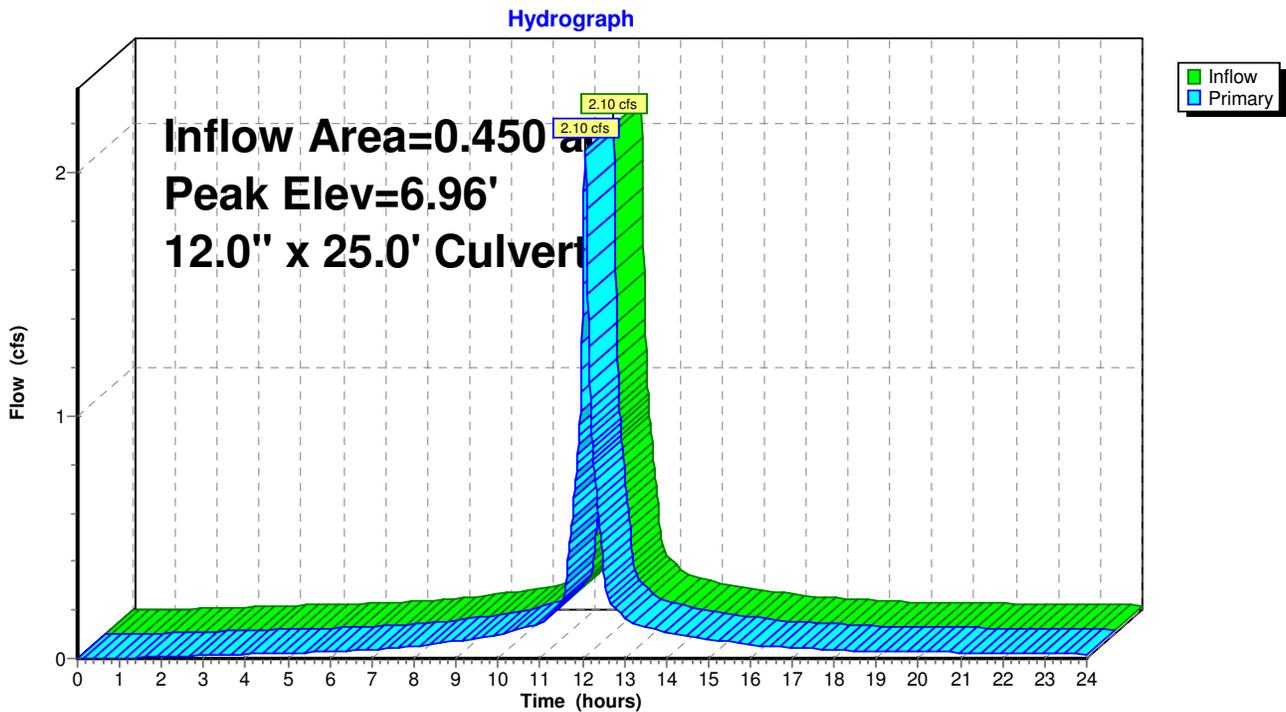
Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	6.15'	12.0" x 25.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.25' S= 0.0360 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=2.10 cfs @ 12.07 hrs HW=6.96' TW=0.00' (Dynamic Tailwater)
↑1=Culvert (Inlet Controls 2.10 cfs @ 3.1 fps)

Pond 9: CB 9 TO DMH 6



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 103

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond 11: CB 11 TO DMH 6

Inflow Area = 0.044 ac, Inflow Depth = 4.36" for 10-YR event
 Inflow = 0.20 cfs @ 12.07 hrs, Volume= 0.016 af
 Outflow = 0.20 cfs @ 12.07 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.20 cfs @ 12.07 hrs, Volume= 0.016 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.47' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

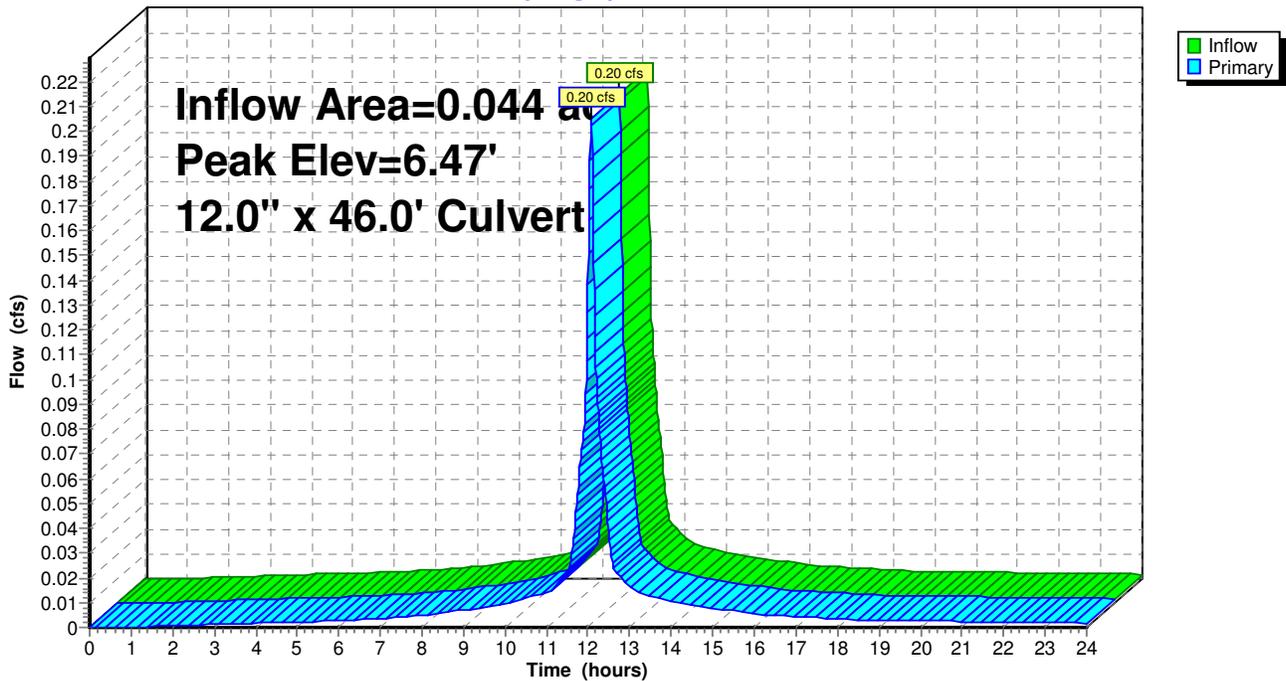
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	6.25'	12.0" x 46.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.35' S= 0.0196 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=0.20 cfs @ 12.07 hrs HW=6.47' TW=0.00' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 0.20 cfs @ 1.6 fps)

Pond 11: CB 11 TO DMH 6

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 104

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH1: DMH1

Inflow Area = 1.484 ac, Inflow Depth = 3.19" for 10-YR event
Inflow = 4.13 cfs @ 12.17 hrs, Volume= 0.395 af
Outflow = 4.13 cfs @ 12.17 hrs, Volume= 0.395 af, Atten= 0%, Lag= 0.0 min
Primary = 4.13 cfs @ 12.17 hrs, Volume= 0.395 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.84' @ 12.19 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

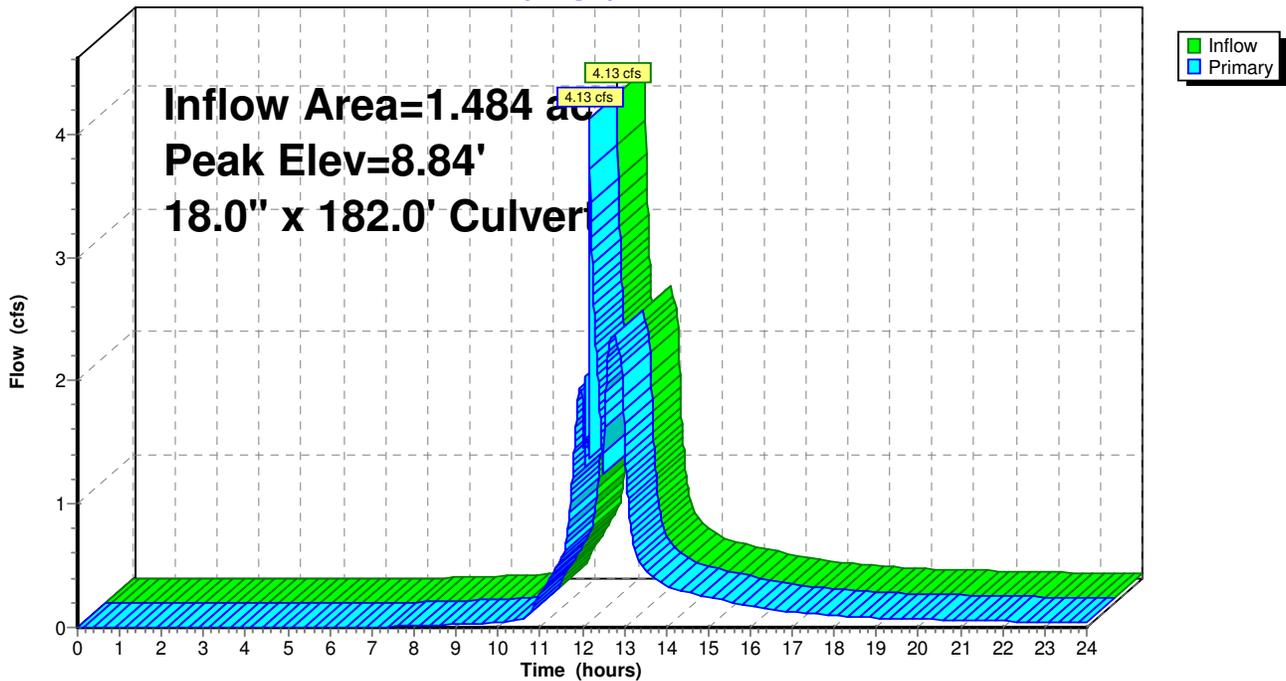
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.96'	18.0" x 182.0' long Culvert Ke= 0.600 Outlet Invert= 5.50' S= 0.0025 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=3.53 cfs @ 12.17 hrs HW=8.80' TW=8.49' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 3.53 cfs @ 2.0 fps)

Pond DMH1: DMH1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 105

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH10: DMH10

Inflow Area = 0.470 ac, Inflow Depth = 3.80" for 10-YR event
Inflow = 2.04 cfs @ 12.07 hrs, Volume= 0.149 af
Outflow = 2.04 cfs @ 12.07 hrs, Volume= 0.149 af, Atten= 0%, Lag= 0.0 min
Primary = 2.04 cfs @ 12.07 hrs, Volume= 0.149 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.34' @ 12.08 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

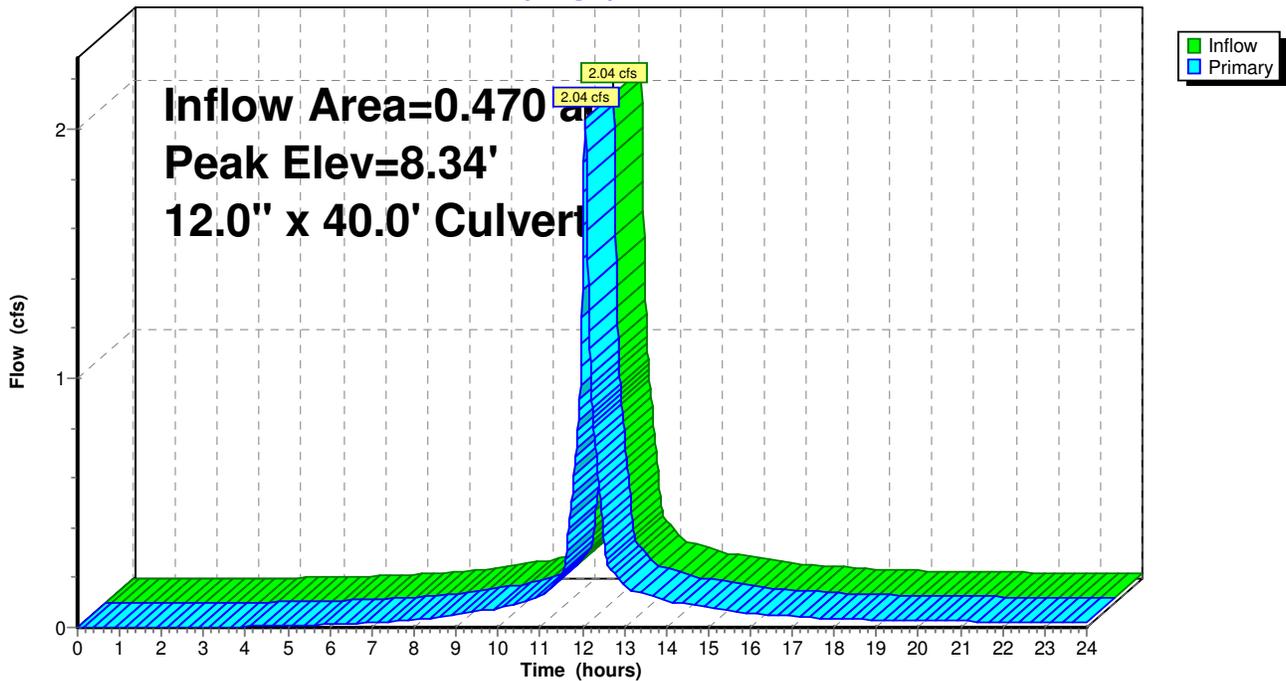
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	4.06'	12.0" x 40.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 3.55' S= 0.0127 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=2.11 cfs @ 12.07 hrs HW=8.30' TW=7.99' (Dynamic Tailwater)
↑1=Culvert (Inlet Controls 2.11 cfs @ 2.7 fps)

Pond DMH10: DMH10

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 106

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH11: DMH11

Inflow Area = 2.192 ac, Inflow Depth = 3.66" for 10-YR event
Inflow = 7.00 cfs @ 12.11 hrs, Volume= 0.669 af
Outflow = 7.00 cfs @ 12.11 hrs, Volume= 0.669 af, Atten= 0%, Lag= 0.0 min
Primary = 7.00 cfs @ 12.11 hrs, Volume= 0.669 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.10' @ 12.06 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

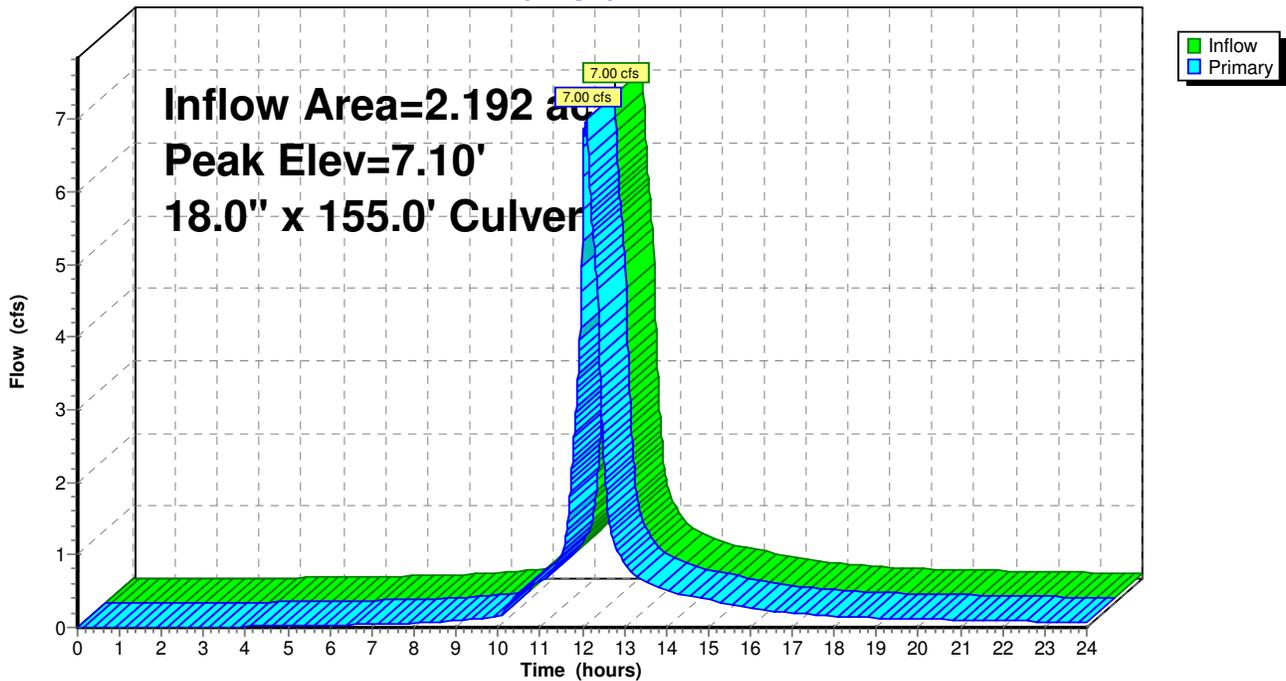
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	2.73'	18.0" x 155.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 2.20' S= 0.0034 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=6.86 cfs @ 12.11 hrs HW=6.90' TW=5.88' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 6.86 cfs @ 3.9 fps)

Pond DMH11: DMH11

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 107

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH14: DMH14

Inflow Area = 3.016 ac, Inflow Depth = 3.78" for 10-YR event
Inflow = 10.67 cfs @ 12.07 hrs, Volume= 0.949 af
Outflow = 10.67 cfs @ 12.07 hrs, Volume= 0.949 af, Atten= 0%, Lag= 0.0 min
Primary = 10.67 cfs @ 12.07 hrs, Volume= 0.949 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 4.23' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

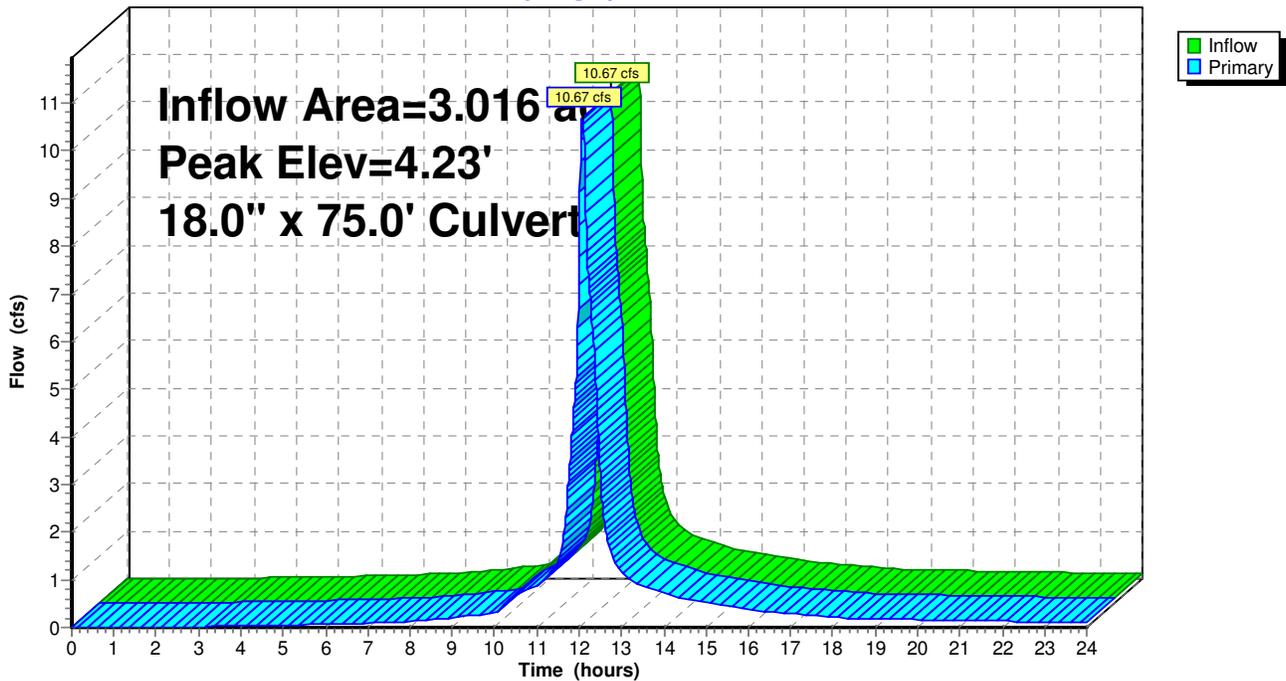
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	1.44'	18.0" x 75.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 1.10' S= 0.0045 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=10.66 cfs @ 12.07 hrs HW=4.22' TW=0.00' (Dynamic Tailwater)
↑1=Culvert (Barrel Controls 10.66 cfs @ 6.0 fps)

Pond DMH14: DMH14

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 108

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH15: DMH15 TYING INTO EXIST 12" PIPE

Inflow Area = 0.280 ac, Inflow Depth = 2.05" for 10-YR event
 Inflow = 0.70 cfs @ 12.07 hrs, Volume= 0.048 af
 Outflow = 0.70 cfs @ 12.07 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.70 cfs @ 12.07 hrs, Volume= 0.048 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.66' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= (not calculated)

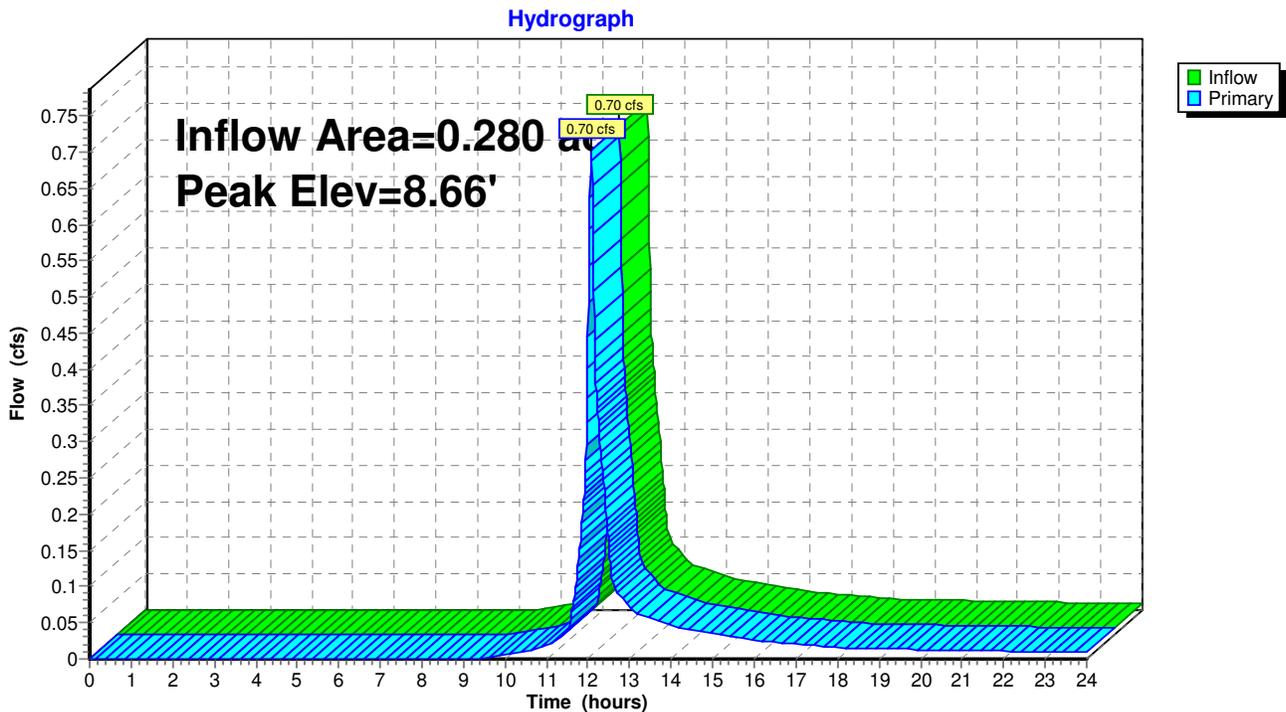
#	Routing	Invert	Outlet Devices
1	Primary	7.40'	12.0" x 86.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 6.50' S= 0.0105 '/' n= 0.013 Cc= 0.900
2	Device 1	8.50'	4.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.70 cfs @ 12.07 hrs HW=8.66' TW=7.63' (Dynamic Tailwater)

1=Culvert (Passes 0.70 cfs of 3.24 cfs potential flow)

2=Broad-Crested Rectangular Weir (Weir Controls 0.70 cfs @ 1.1 fps)

Pond DMH15: DMH15 TYING INTO EXIST 12" PIPE



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 109

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH2: DMH2

Inflow Area = 1.971 ac, Inflow Depth = 3.22" for 10-YR event
 Inflow = 5.22 cfs @ 12.17 hrs, Volume= 0.529 af
 Outflow = 5.22 cfs @ 12.17 hrs, Volume= 0.529 af, Atten= 0%, Lag= 0.0 min
 Primary = 5.22 cfs @ 12.17 hrs, Volume= 0.529 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.54' @ 12.23 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

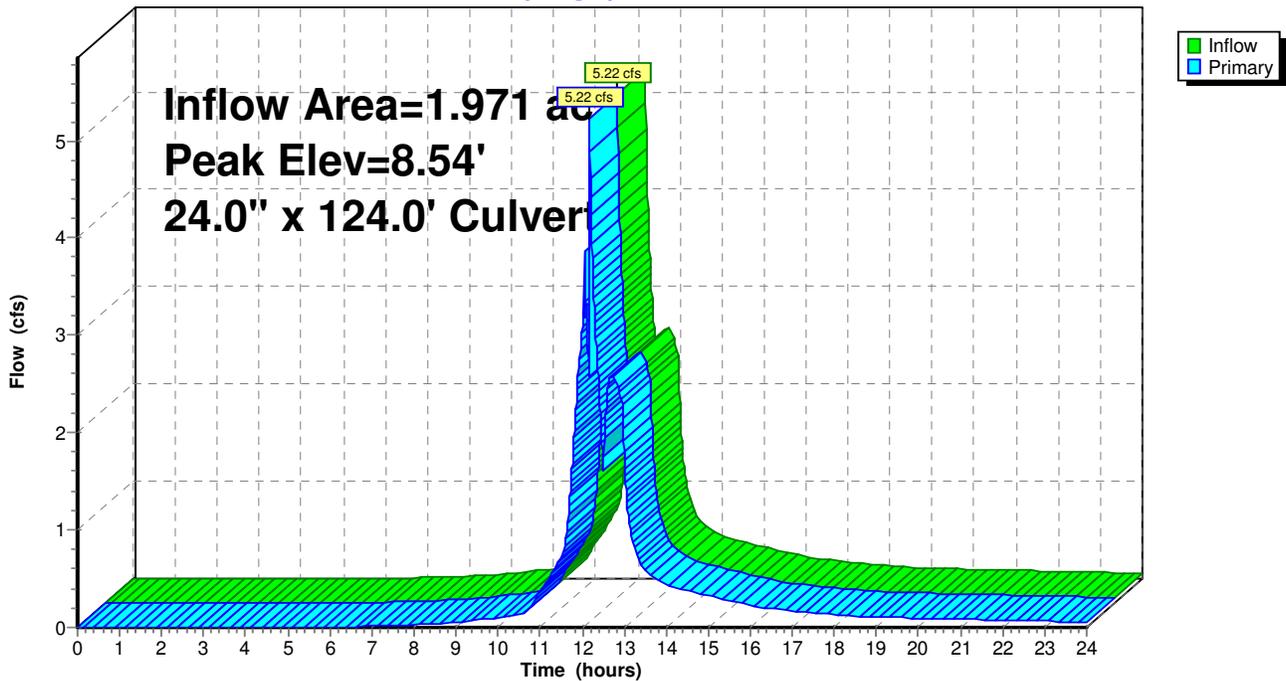
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.50'	24.0" x 124.0' long Culvert Ke= 0.600 Outlet Invert= 5.19' S= 0.0025 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=4.10 cfs @ 12.17 hrs HW=8.50' TW=8.41' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 4.10 cfs @ 1.3 fps)

Pond DMH2: DMH2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 110

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH3: DMH3

Inflow Area = 2.857 ac, Inflow Depth = 3.23" for 10-YR event
Inflow = 6.64 cfs @ 12.05 hrs, Volume= 0.769 af
Outflow = 6.64 cfs @ 12.05 hrs, Volume= 0.769 af, Atten= 0%, Lag= 0.0 min
Primary = 6.64 cfs @ 12.05 hrs, Volume= 0.769 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.48' @ 12.24 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

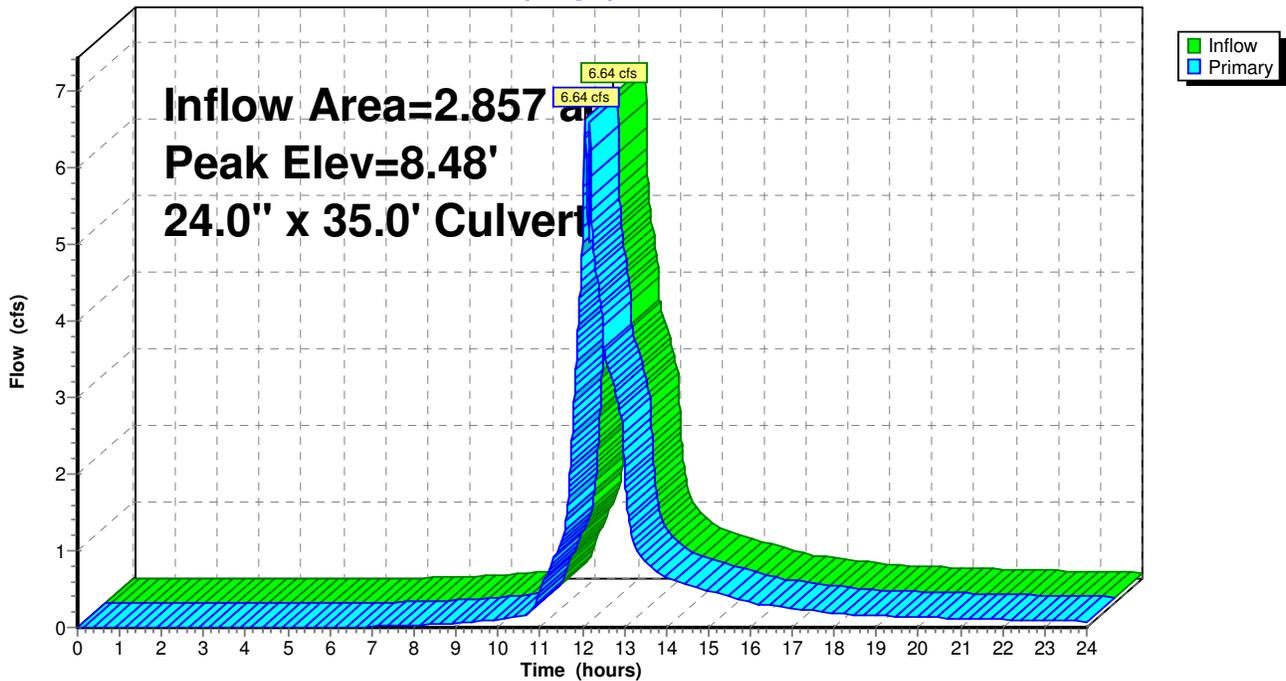
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.19'	24.0" x 35.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.09' S= 0.0029 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=6.40 cfs @ 12.05 hrs HW=7.58' TW=7.40' (Dynamic Tailwater)
↑1=Culvert (Inlet Controls 6.40 cfs @ 2.0 fps)

Pond DMH3: DMH3

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 111

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH4: DMH4

Inflow Area = 3.080 ac, Inflow Depth = 3.29" for 10-YR event
Inflow = 7.60 cfs @ 12.05 hrs, Volume= 0.843 af
Outflow = 7.60 cfs @ 12.05 hrs, Volume= 0.843 af, Atten= 0%, Lag= 0.0 min
Primary = 7.60 cfs @ 12.05 hrs, Volume= 0.843 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.37' @ 12.26 hrs

Flood Elev= 10.15'

Plug-Flow detention time= (not calculated: outflow precedes inflow)

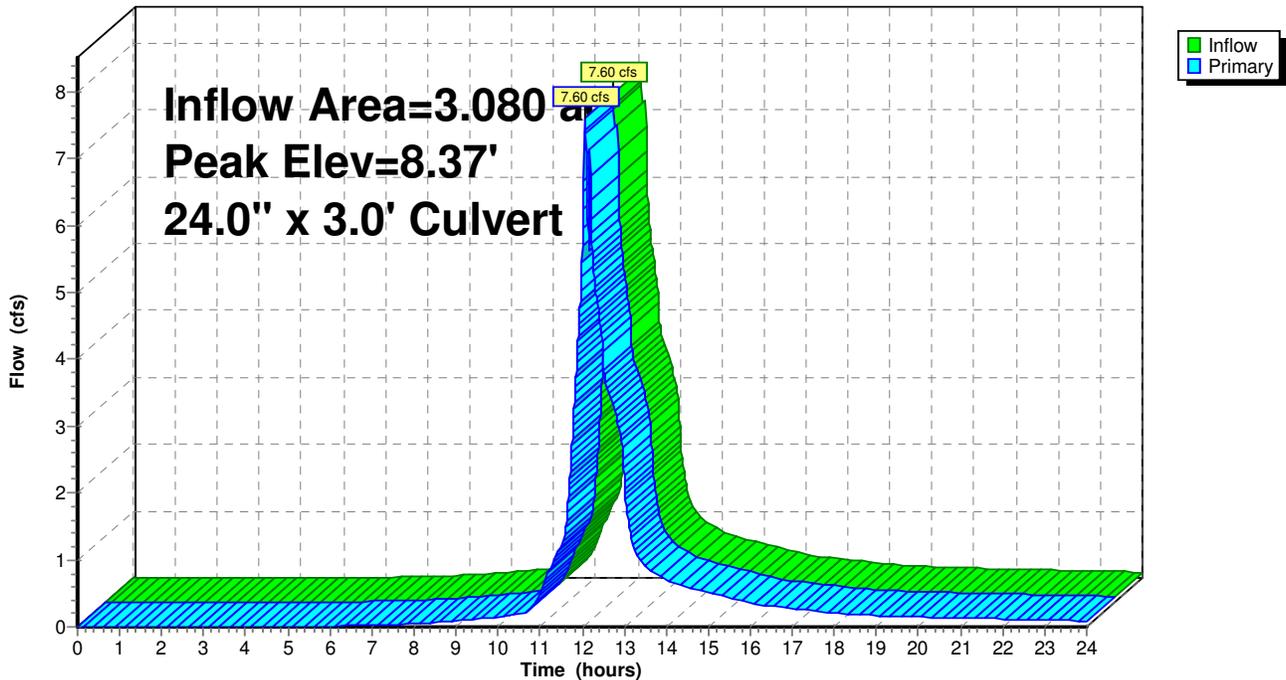
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.09'	24.0" x 3.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.05' S= 0.0133 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=7.50 cfs @ 12.05 hrs HW=7.41' TW=7.16' (Dynamic Tailwater)
↑1=Culvert (Inlet Controls 7.50 cfs @ 2.4 fps)

Pond DMH4: DMH4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 112

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH5: DMH 5

Inflow Area = 3.312 ac, Inflow Depth = 3.33" for 10-YR event
Inflow = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af
Outflow = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af, Atten= 0%, Lag= 0.0 min
Primary = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.81' @ 12.28 hrs

Flood Elev= 10.40'

Plug-Flow detention time= (not calculated: outflow precedes inflow)

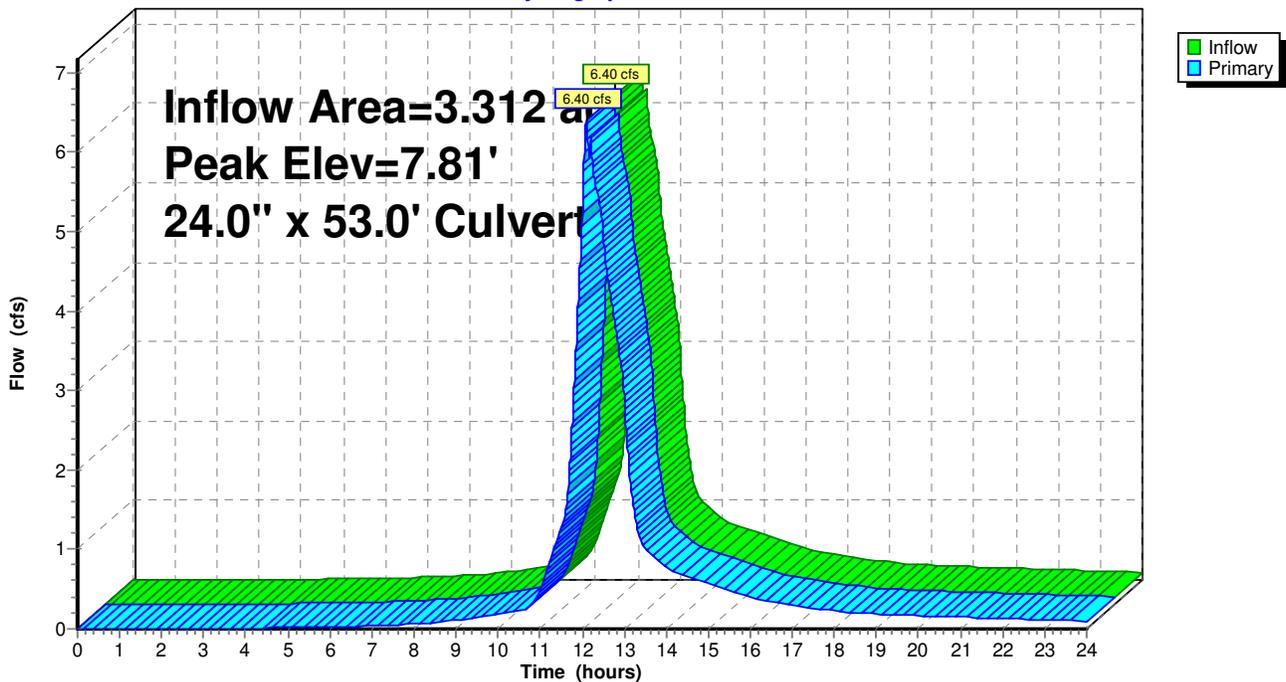
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	4.70'	24.0" x 53.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.57' S= 0.0025 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=5.17 cfs @ 12.10 hrs HW=7.14' TW=7.03' (Dynamic Tailwater)
↑1=Culvert (Inlet Controls 5.17 cfs @ 1.6 fps)

Pond DMH5: DMH 5

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 113

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH6: DMH6

Inflow Area = 3.312 ac, Inflow Depth = 3.33" for 10-YR event
Inflow = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af
Outflow = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af, Atten= 0%, Lag= 0.0 min
Primary = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.53' @ 12.28 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

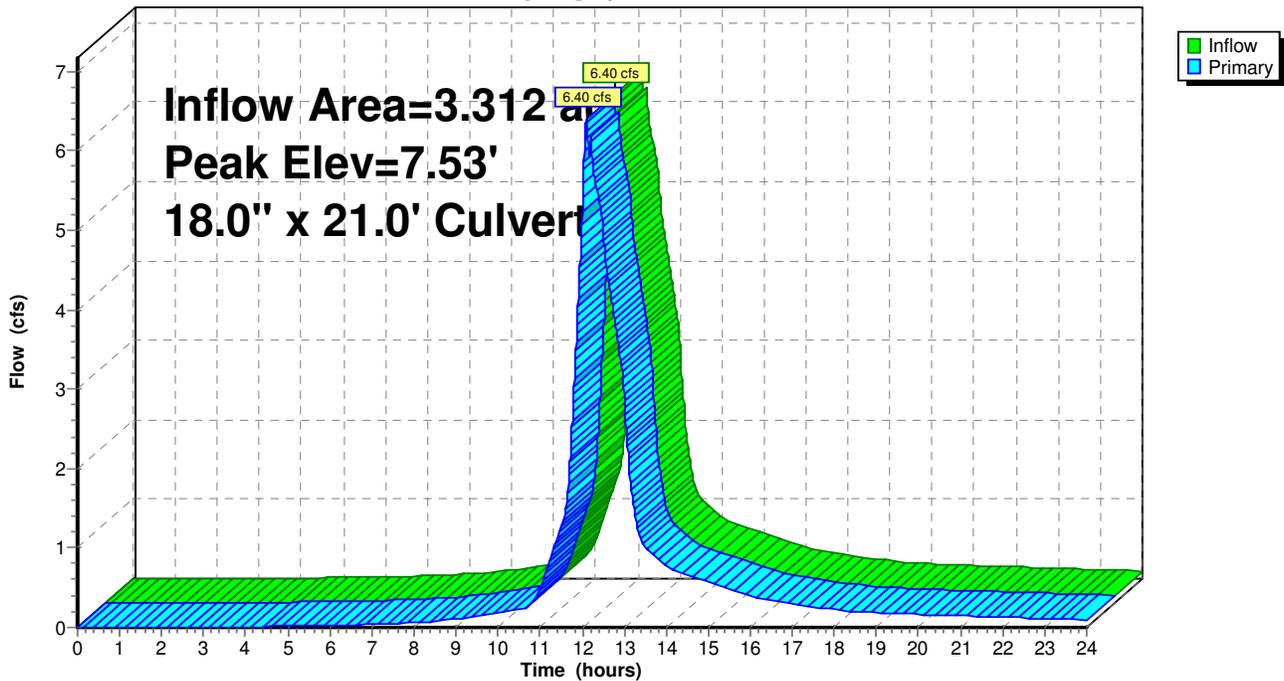
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	4.55'	18.0" x 21.0' long Culvert X 2.00 RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.50' S= 0.0024 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=6.38 cfs @ 12.10 hrs HW=6.84' TW=6.70' (Dynamic Tailwater)
↑1=Culvert (Inlet Controls 6.38 cfs @ 1.8 fps)

Pond DMH6: DMH6

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 114

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond DMH9: DMH9

Inflow Area = 0.470 ac, Inflow Depth = 3.80" for 10-YR event
Inflow = 2.04 cfs @ 12.07 hrs, Volume= 0.149 af
Outflow = 2.04 cfs @ 12.07 hrs, Volume= 0.149 af, Atten= 0%, Lag= 0.0 min
Primary = 2.04 cfs @ 12.07 hrs, Volume= 0.149 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.94' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

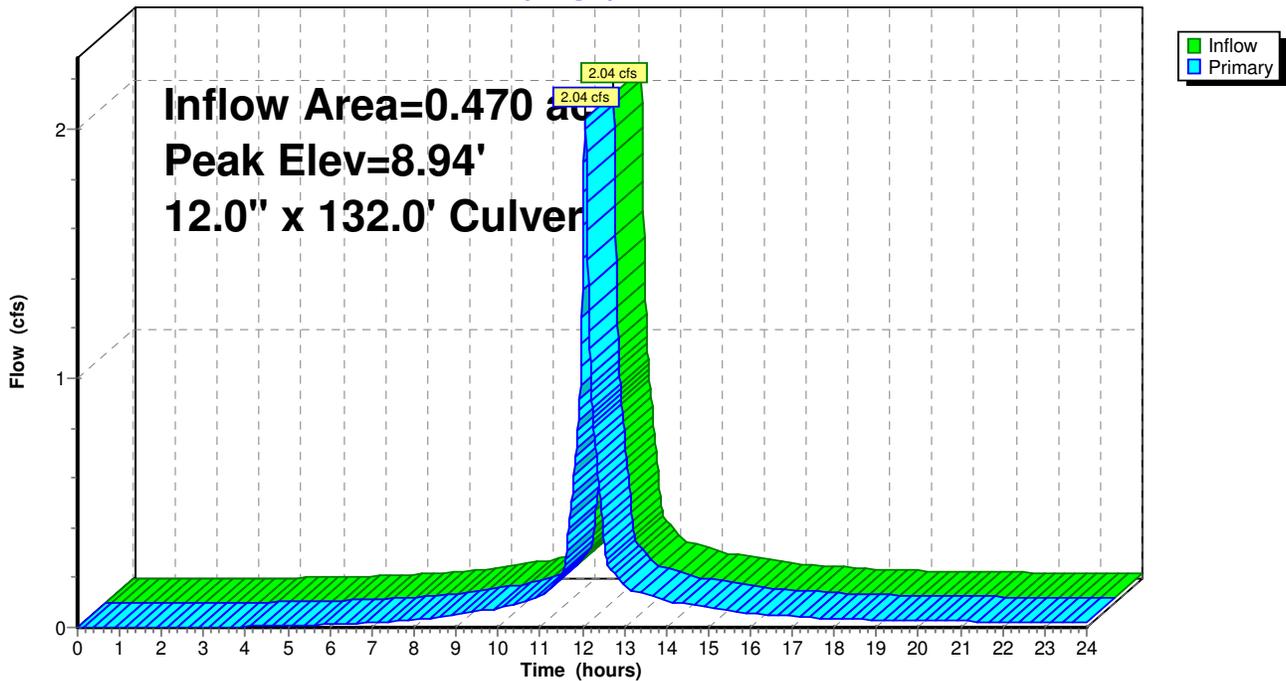
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.50'	12.0" x 132.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.06' S= 0.0109 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=2.10 cfs @ 12.07 hrs HW=8.93' TW=8.30' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 2.10 cfs @ 2.7 fps)

Pond DMH9: DMH9

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 115

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond E4: EX CB 4

Inflow Area = 0.880 ac, Inflow Depth = 3.62" for 10-YR event
Inflow = 3.50 cfs @ 12.07 hrs, Volume= 0.266 af
Outflow = 3.50 cfs @ 12.07 hrs, Volume= 0.266 af, Atten= 0%, Lag= 0.0 min
Primary = 3.50 cfs @ 12.07 hrs, Volume= 0.266 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.63' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

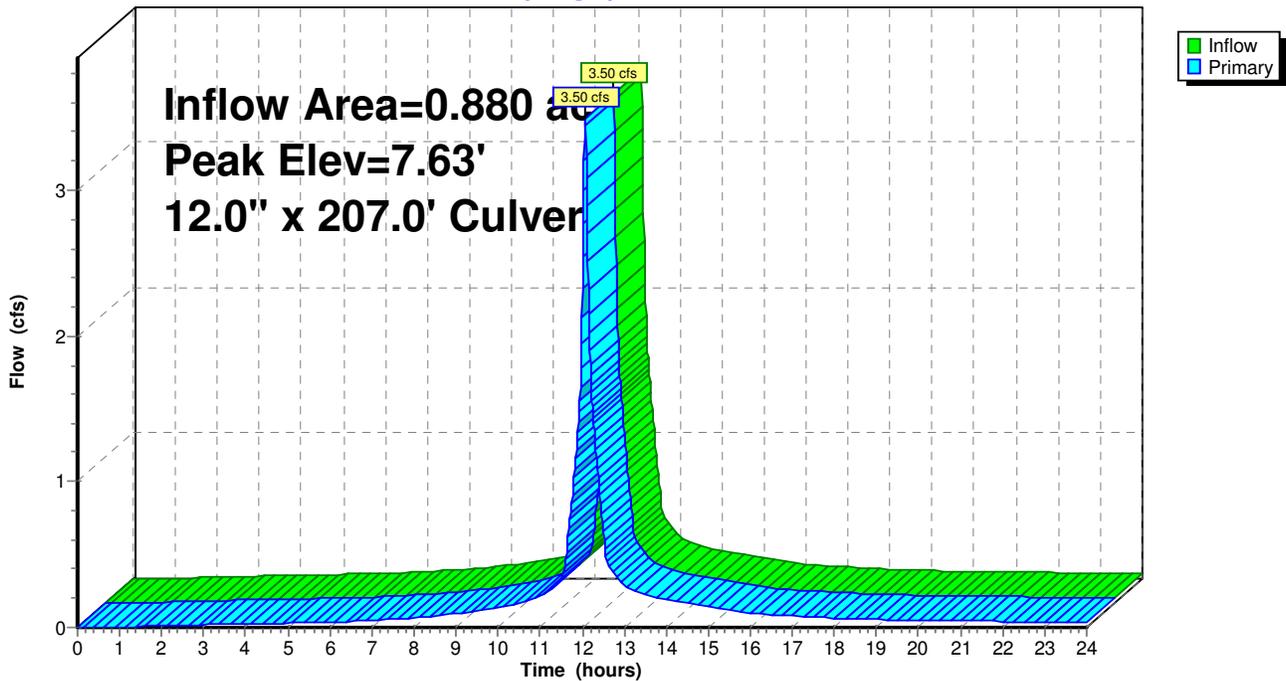
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	5.20'	12.0" x 207.0' long Culvert Ke= 0.500 Outlet Invert= 4.17' S= 0.0050 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=3.50 cfs @ 12.07 hrs HW=7.63' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 3.50 cfs @ 4.5 fps)

Pond E4: EX CB 4

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 116

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond EX1: DMH EX1

Inflow Area = 0.702 ac, Inflow Depth = 3.94" for 10-YR event
 Inflow = 3.12 cfs @ 12.07 hrs, Volume= 0.231 af
 Outflow = 3.12 cfs @ 12.07 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min
 Primary = 3.12 cfs @ 12.07 hrs, Volume= 0.231 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 8.02' @ 12.08 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

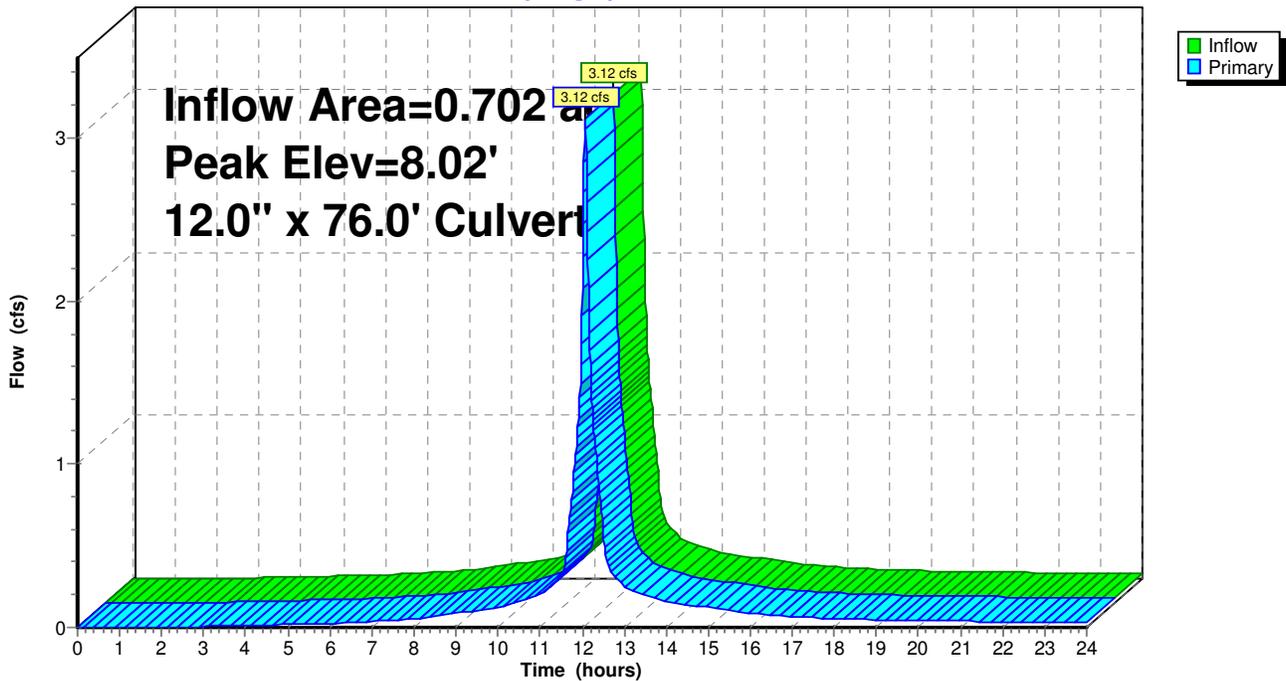
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	3.00'	12.0" x 76.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 2.73' S= 0.0036 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=3.04 cfs @ 12.07 hrs HW=7.99' TW=7.08' (Dynamic Tailwater)
 ↳ **1=Culvert** (Barrel Controls 3.04 cfs @ 3.9 fps)

Pond EX1: DMH EX1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 117

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond EX2: DMH EX2

Inflow Area = 2.727 ac, Inflow Depth = 3.72" for 10-YR event
Inflow = 9.33 cfs @ 12.07 hrs, Volume= 0.846 af
Outflow = 9.33 cfs @ 12.07 hrs, Volume= 0.846 af, Atten= 0%, Lag= 0.0 min
Primary = 9.33 cfs @ 12.07 hrs, Volume= 0.846 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.08' @ 12.07 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

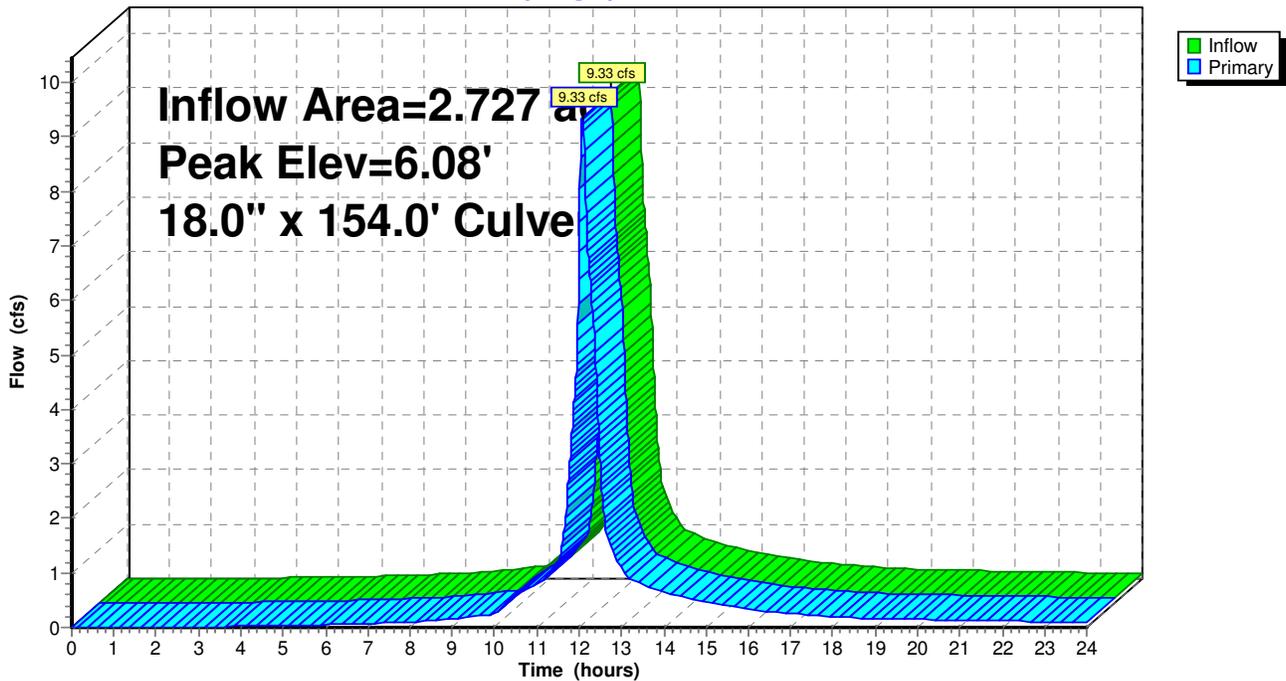
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	2.20'	18.0" x 154.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 1.44' S= 0.0049 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=9.29 cfs @ 12.07 hrs HW=6.07' TW=4.22' (Dynamic Tailwater)
↑1=Culvert (Barrel Controls 9.29 cfs @ 5.3 fps)

Pond EX2: DMH EX2

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 118

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SD1: SUBSURFACE DETENTION #1

Inflow Area = 3.080 ac, Inflow Depth = 3.29" for 10-YR event
 Inflow = 7.60 cfs @ 12.05 hrs, Volume= 0.843 af
 Outflow = 5.66 cfs @ 12.20 hrs, Volume= 0.843 af, Atten= 26%, Lag= 8.9 min
 Primary = 5.66 cfs @ 12.20 hrs, Volume= 0.843 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 8.25' @ 12.27 hrs Surf.Area= 0.014 ac Storage= 0.049 af
 Plug-Flow detention time= 5.1 min calculated for 0.843 af (100% of inflow)
 Center-of-Mass det. time= 4.4 min (807.5 - 803.0)

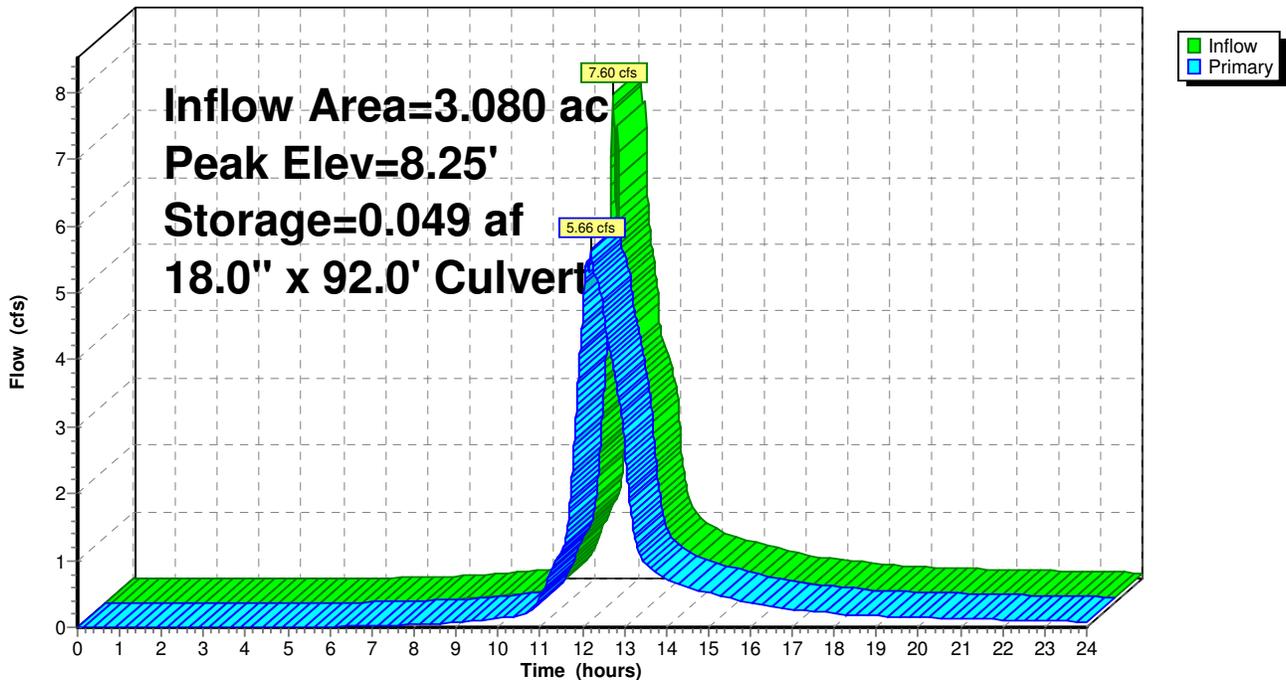
#	Invert	Avail.Storage	Storage Description
1	5.05'	0.057 af	48.0"D x 197.00'L Horizontal Cylinder

#	Routing	Invert	Outlet Devices
1	Primary	5.05'	18.0" x 92.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.70' S= 0.0038 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=5.67 cfs @ 12.20 hrs HW=8.15' TW=7.64' (Dynamic Tailwater)
 ←1=Culvert (Barrel Controls 5.67 cfs @ 3.2 fps)

Pond SD1: SUBSURFACE DETENTION #1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 119

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SD2: SUBSURFACE DETENTION #2

Inflow Area = 3.488 ac, Inflow Depth = 3.37" for 10-YR event
 Inflow = 7.17 cfs @ 12.09 hrs, Volume= 0.980 af
 Outflow = 6.00 cfs @ 12.28 hrs, Volume= 0.980 af, Atten= 16%, Lag= 11.1 min
 Primary = 6.00 cfs @ 12.28 hrs, Volume= 0.980 af

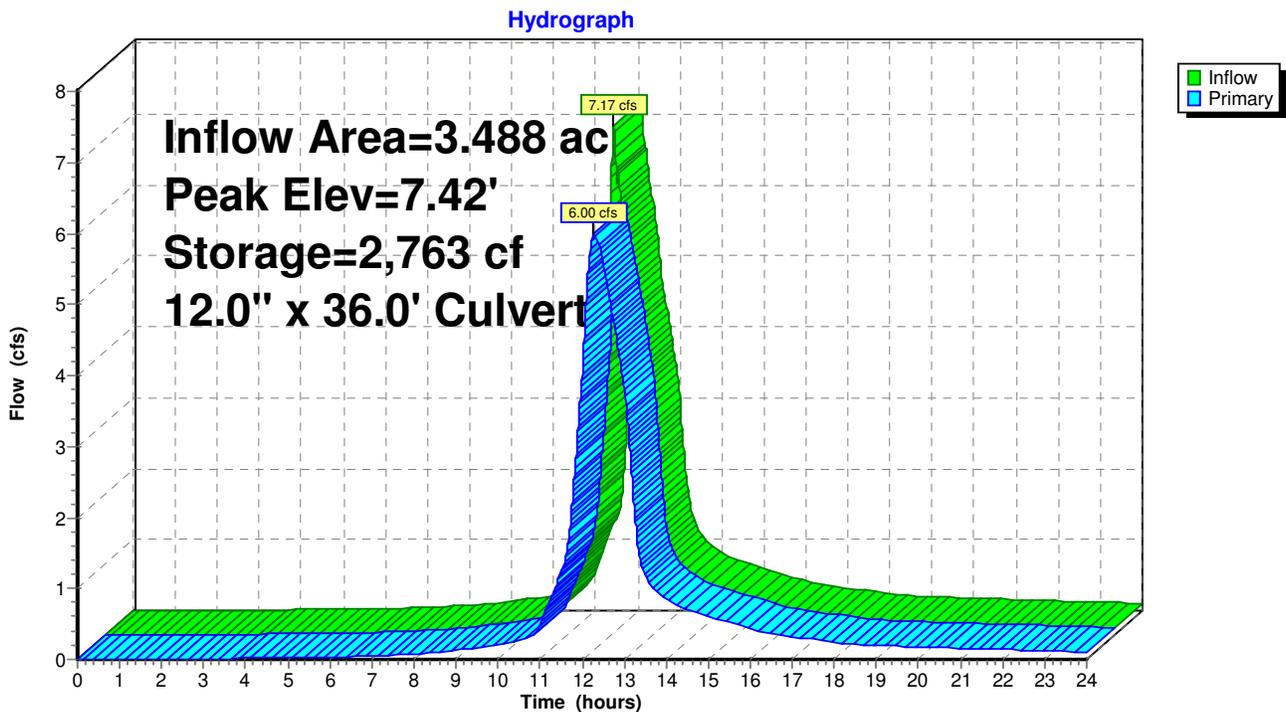
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 7.42' @ 12.28 hrs Surf.Area= 250 sf Storage= 2,763 cf
 Plug-Flow detention time= 5.3 min calculated for 0.980 af (100% of inflow)
 Center-of-Mass det. time= 5.1 min (806.6 - 801.5)

#	Invert	Avail.Storage	Storage Description
1	4.50'	2,768 cf	35.4"D x 405.00'L Horizontal Cylinder
2	4.50'	1 cf	0.50'D x 6.75'H Vertical Cone/Cylinder
		2,769 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Primary	4.40'	12.0" x 36.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 3.68' S= 0.0200 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=6.00 cfs @ 12.28 hrs HW=7.42' TW=0.00' (Dynamic Tailwater)
 ←1=Culvert (Inlet Controls 6.00 cfs @ 7.6 fps)

Pond SD2: SUBSURFACE DETENTION #2



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 120

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SI 1: SUBSURFACE INFILTRATION 1

Inflow Area = 1.023 ac, Inflow Depth = 4.36" for 10-YR event
 Inflow = 4.76 cfs @ 12.07 hrs, Volume= 0.372 af
 Outflow = 2.60 cfs @ 12.18 hrs, Volume= 0.319 af, Atten= 45%, Lag= 6.5 min
 Discarded = 0.02 cfs @ 2.43 hrs, Volume= 0.043 af
 Primary = 2.57 cfs @ 12.18 hrs, Volume= 0.276 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 9.35' @ 12.18 hrs Surf.Area= 3,746 sf Storage= 5,797 cf
 Plug-Flow detention time= 119.7 min calculated for 0.319 af (86% of inflow)
 Center-of-Mass det. time= 57.1 min (805.1 - 748.1)

#	Invert	Avail.Storage	Storage Description
1	6.36'	5,755 cf	Custom Stage Data (Prismatic) Listed below 6,122 cf Overall x 94.0% Voids
2	5.96'	71 cf	4.00'D x 5.64'H Vertical Cone/Cylinder
		5,826 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.36	3,733	0	0
8.00	3,733	6,122	6,122

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	0.000375 fpm Exfiltration over entire Surface area
2	Primary	6.31'	12.0" x 5.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 6.21' S= 0.0200 '/' n= 0.013 Cc= 0.900
3	Device 2	7.00'	4.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 2.43 hrs HW=6.36' (Free Discharge)

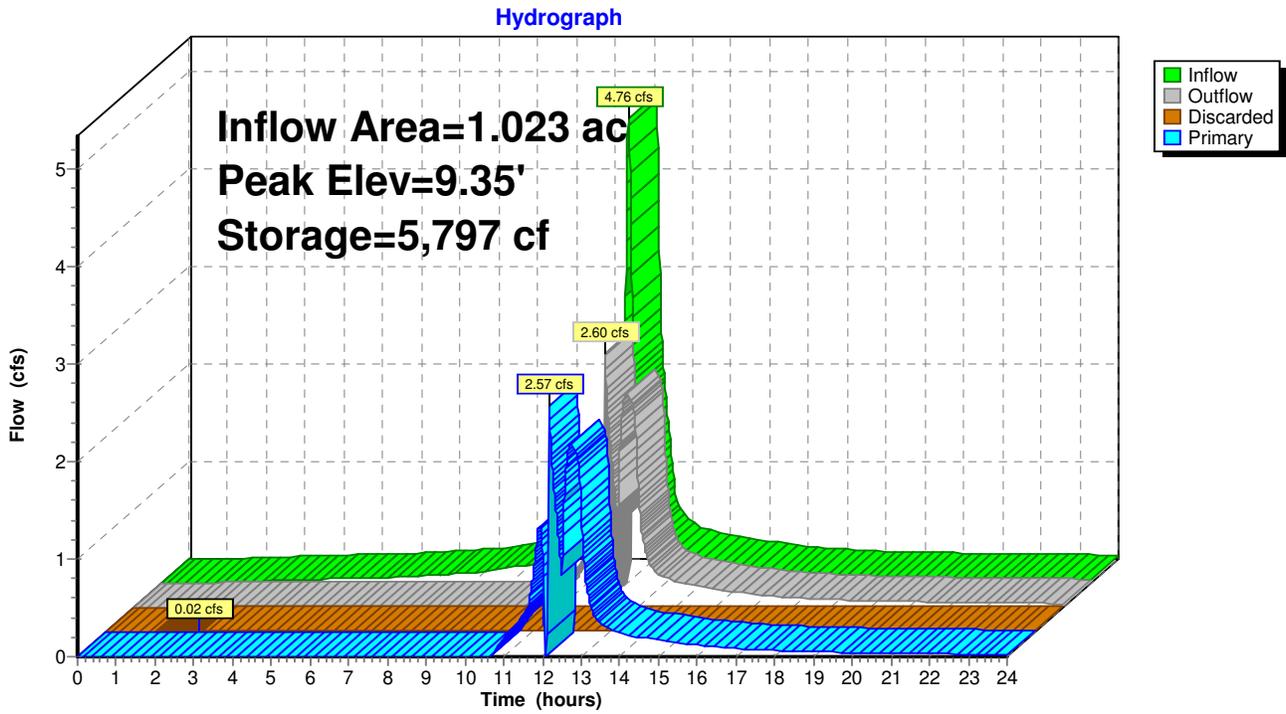
↑ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=2.56 cfs @ 12.18 hrs HW=9.27' TW=8.82' (Dynamic Tailwater)

↑ **2=Culvert** (Inlet Controls 2.56 cfs @ 3.3 fps)

↑ **3=Broad-Crested Rectangular Weir** (Passes 2.56 cfs of 27.99 cfs potential flow)

Pond SI 1: SUBSURFACE INFILTRATION 1



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 122

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SI 2: SUBSURFACE INFILTRATION 2

Inflow Area = 0.886 ac, Inflow Depth = 4.36" for 10-YR event
 Inflow = 4.13 cfs @ 12.07 hrs, Volume= 0.322 af
 Outflow = 3.17 cfs @ 12.07 hrs, Volume= 0.268 af, Atten= 23%, Lag= 0.2 min
 Discarded = 0.02 cfs @ 3.48 hrs, Volume= 0.028 af
 Primary = 3.15 cfs @ 12.07 hrs, Volume= 0.240 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 8.62' @ 12.29 hrs Surf.Area= 2,442 sf Storage= 3,713 cf
 Plug-Flow detention time= 122.7 min calculated for 0.268 af (83% of inflow)
 Center-of-Mass det. time= 53.8 min (801.9 - 748.1)

#	Invert	Avail.Storage	Storage Description
1	7.00'	3,765 cf	Custom Stage Data (Prismatic) Listed below 4,005 cf Overall x 94.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	2,442	0	0
8.64	2,442	4,005	4,005

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	0.000375 fpm Exfiltration over entire Surface area
2	Primary	6.60'	12.0" x 10.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.72' S= 0.0880 '/' n= 0.013 Cc= 0.900
3	Device 2	8.00'	4.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 3.48 hrs HW=7.02' (Free Discharge)

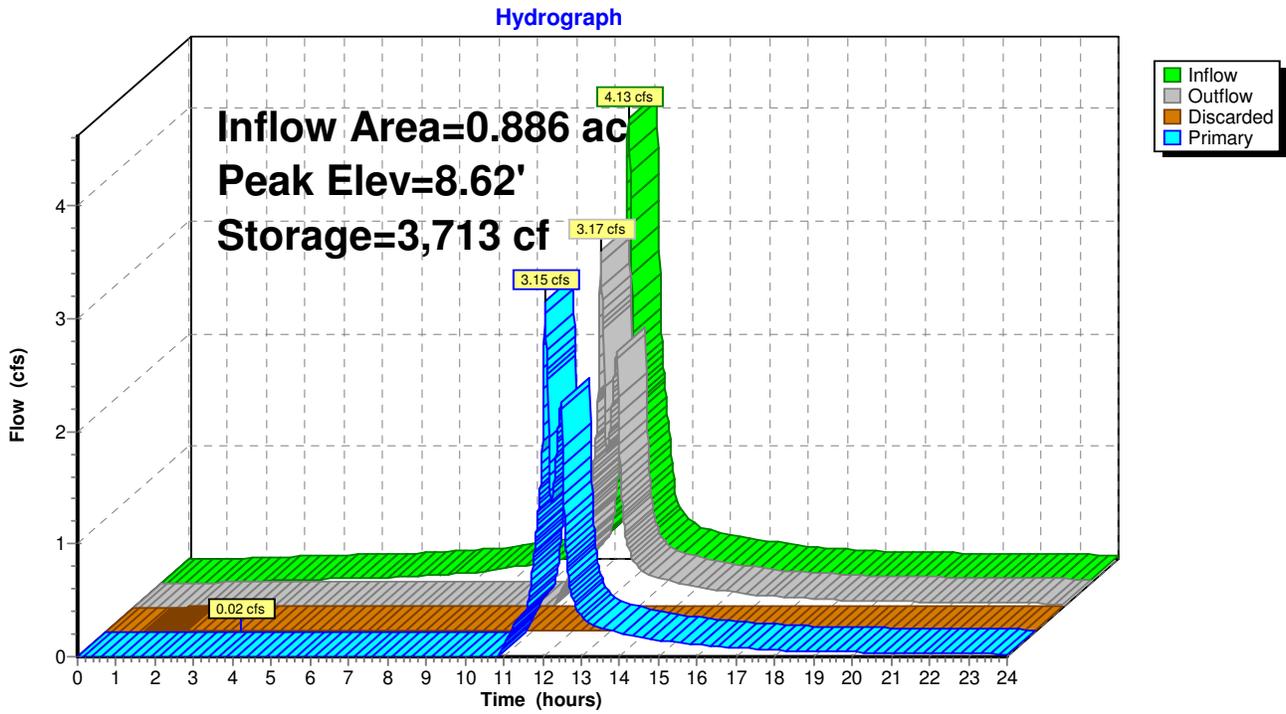
↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=3.04 cfs @ 12.07 hrs HW=8.44' TW=7.80' (Dynamic Tailwater)

↑2=Culvert (Inlet Controls 3.04 cfs @ 3.9 fps)

↑3=Broad-Crested Rectangular Weir (Passes 3.04 cfs of 3.20 cfs potential flow)

Pond SI 2: SUBSURFACE INFILTRATION 2



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 124

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond SI 3: SUBSURFACE INFILTRATION 3

Inflow Area = 1.400 ac, Inflow Depth = 4.36" for 10-YR event
 Inflow = 6.52 cfs @ 12.07 hrs, Volume= 0.509 af
 Outflow = 4.18 cfs @ 12.15 hrs, Volume= 0.445 af, Atten= 36%, Lag= 5.1 min
 Discarded = 0.02 cfs @ 3.57 hrs, Volume= 0.037 af
 Primary = 4.16 cfs @ 12.15 hrs, Volume= 0.408 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 8.04' @ 12.15 hrs Surf.Area= 3,134 sf Storage= 5,038 cf
 Plug-Flow detention time= 106.0 min calculated for 0.445 af (87% of inflow)
 Center-of-Mass det. time= 48.3 min (796.3 - 748.1)

#	Invert	Avail.Storage	Storage Description
1	6.33'	5,802 cf	Custom Stage Data (Prismatic) Listed below 6,172 cf Overall x 94.0% Voids
2	6.33'	2 cf	1.00'D x 3.17'H Vertical Cone/Cylinder
		5,804 cf	Total Available Storage

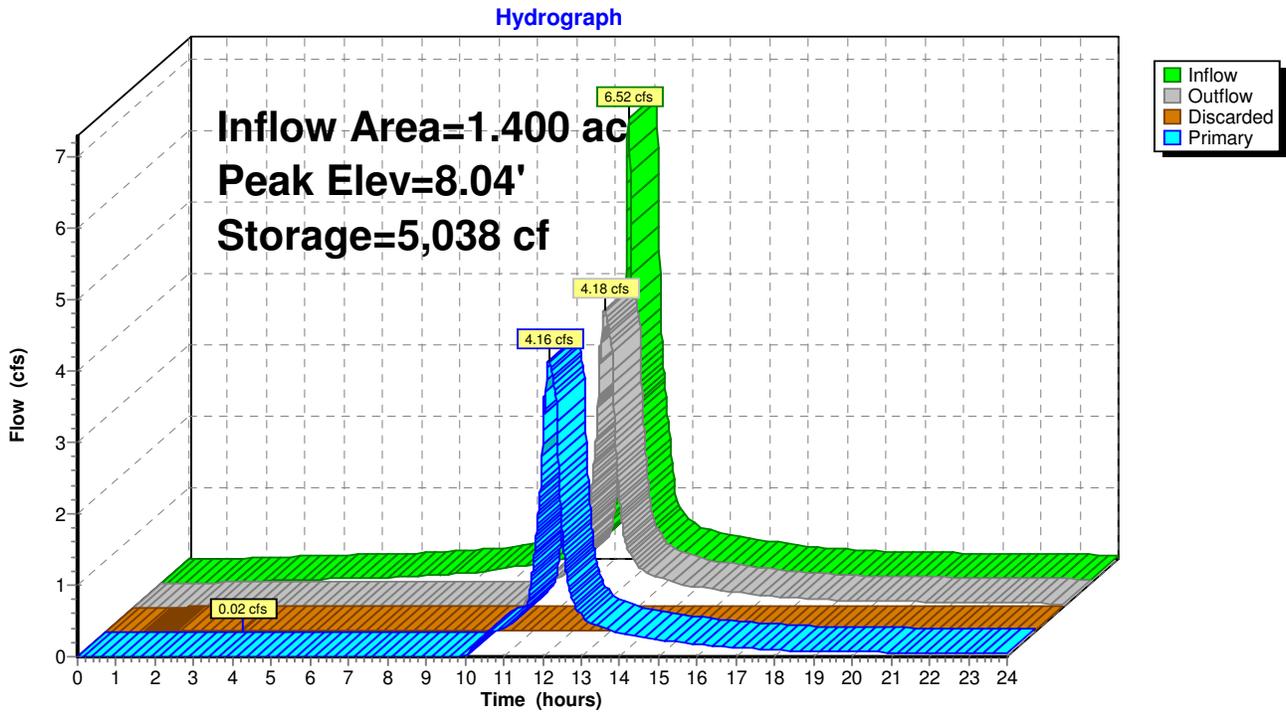
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.33	3,133	0	0
8.30	3,133	6,172	6,172

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	0.000375 fpm Exfiltration over entire Surface area
2	Primary	6.33'	12.0" x 24.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 5.85' S= 0.0200 '/' n= 0.013 Cc= 0.900
3	Device 2	7.25'	4.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.02 cfs @ 3.57 hrs HW=6.36' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=4.16 cfs @ 12.15 hrs HW=8.04' TW=6.00' (Dynamic Tailwater)
 ↑2=Culvert (Inlet Controls 4.16 cfs @ 5.3 fps)
 ↑3=Broad-Crested Rectangular Weir (Passes 4.16 cfs of 7.99 cfs potential flow)

Pond SI 3: SUBSURFACE INFILTRATION 3



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 126

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond WQ1: WQ1

Inflow Area = 3.312 ac, Inflow Depth = 3.33" for 10-YR event
Inflow = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af
Outflow = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af, Atten= 0%, Lag= 0.0 min
Primary = 6.40 cfs @ 12.10 hrs, Volume= 0.920 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 7.67' @ 12.27 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

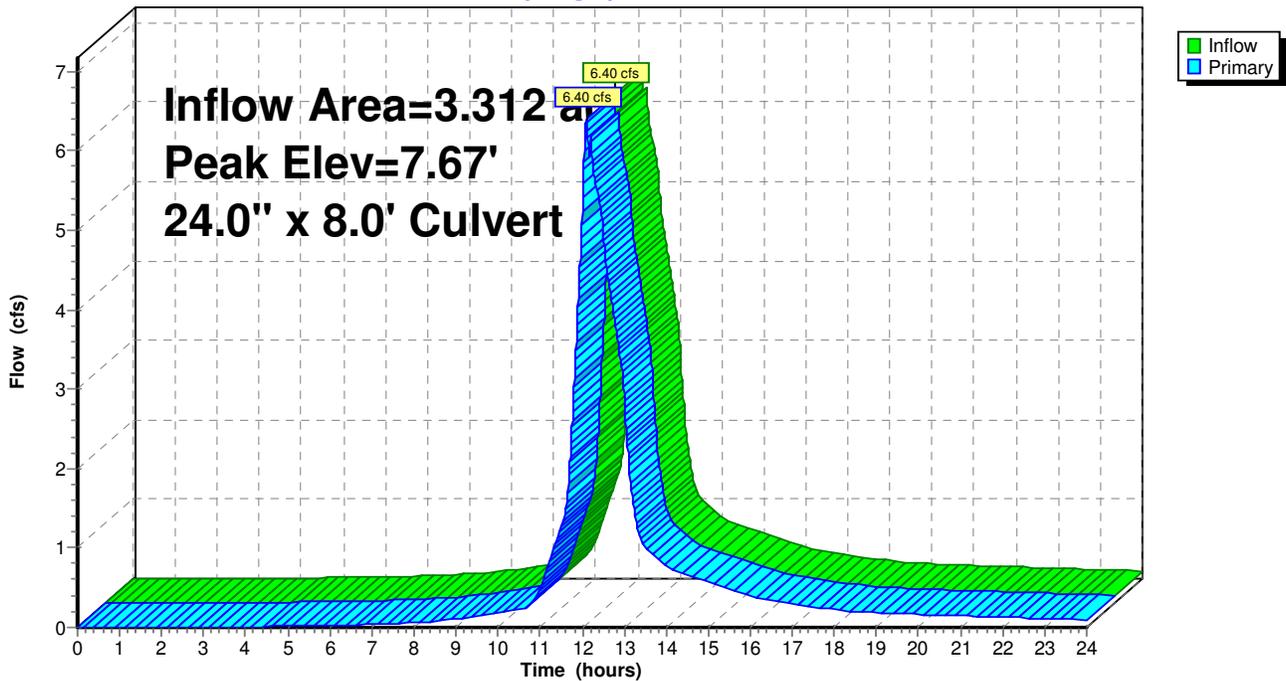
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	4.57'	24.0" x 8.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 4.55' S= 0.0025 '/ n= 0.013 Cc= 0.900

Primary OutFlow Max=6.50 cfs @ 12.10 hrs HW=7.03' TW=6.84' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 6.50 cfs @ 2.1 fps)

Pond WQ1: WQ1

Hydrograph



Residences at Marina Bay - Post-Development

Type III 24-hr 10-YR Rainfall=4.60"

Prepared by Howard/Stein-Hudson Associates, Inc.

Page 127

HydroCAD® 7.00 s/n 002930 © 1986-2003 Applied Microcomputer Systems

3/15/2013

Pond WQ2: WQ2

Inflow Area = 0.535 ac, Inflow Depth = 3.96" for 10-YR event
Inflow = 2.37 cfs @ 12.07 hrs, Volume= 0.177 af
Outflow = 2.37 cfs @ 12.07 hrs, Volume= 0.177 af, Atten= 0%, Lag= 0.0 min
Primary = 2.37 cfs @ 12.07 hrs, Volume= 0.177 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 6.46' @ 12.06 hrs

Plug-Flow detention time= (not calculated: outflow precedes inflow)

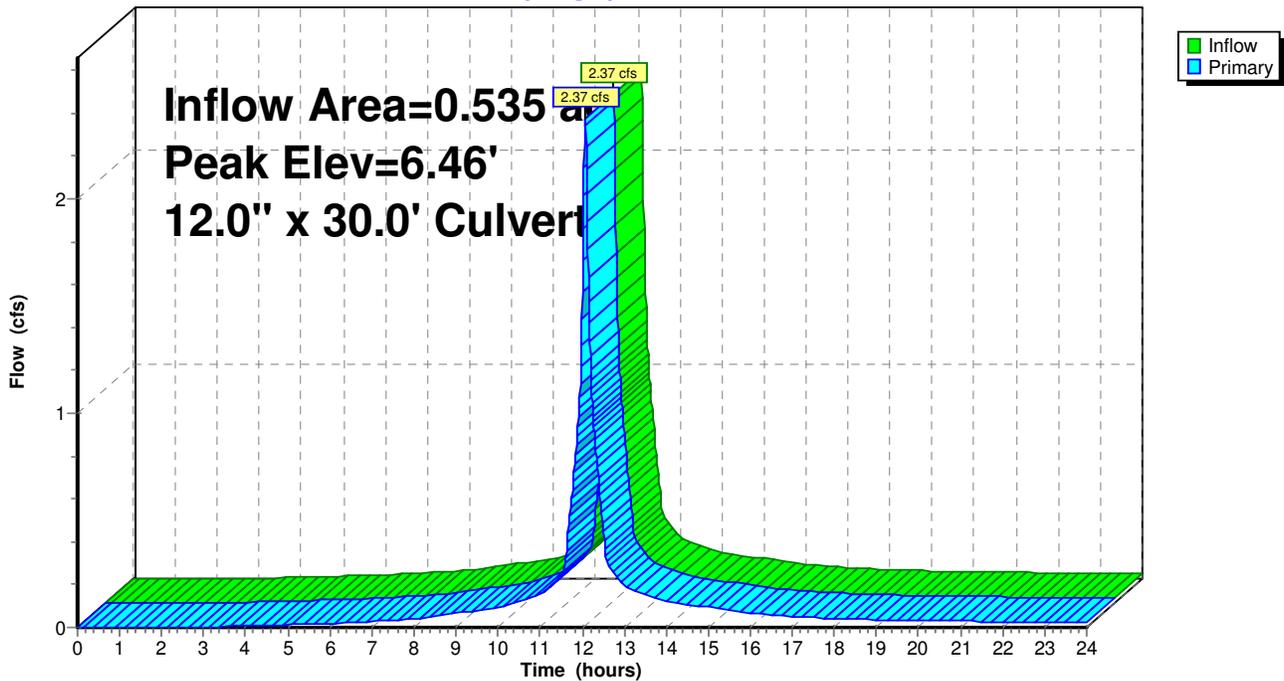
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	3.70'	12.0" x 30.0' long Culvert RCP, sq.cut end projecting, Ke= 0.500 Outlet Invert= 2.50' S= 0.0400 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=2.27 cfs @ 12.07 hrs HW=6.43' TW=6.07' (Dynamic Tailwater)
↑1=Culvert (Inlet Controls 2.27 cfs @ 2.9 fps)

Pond WQ2: WQ2

Hydrograph



**APPENDIX C: SITE GRADING & UTILITY PLAN (DWG. NO. C3.00)
AND SITE DETAILS SHEET (DWG. NO. C5.03)**

BOARDWALK RESIDENCES
AT MARINA BAY
Quincy, MA

REDGATE
Real Estate Advisors
100 Franklin Street
Boston, MA 02110

Landworks > Studio
Landscape Architect
112 Shawmut Ave, Suite 6B
Boston, MA 02118

Howard/Stein-Hudson Associates, Inc.
Civil and Transportation Engineer
38 Chauncy St., Floor 9
Boston, MA 02111

Harry R. Feldman, Inc.
Land Surveyor
112 Shawmut Ave, Floor 9
Boston, MA 02118



NOT FOR
CONSTRUCTION

PROJECT NUMBER: 12002.00

DATE: February 13, 2013

Special Permit Documents

REVISIONS:

1		01/29/2013
2	Add Basin #1 and TD Details	05/08/2013

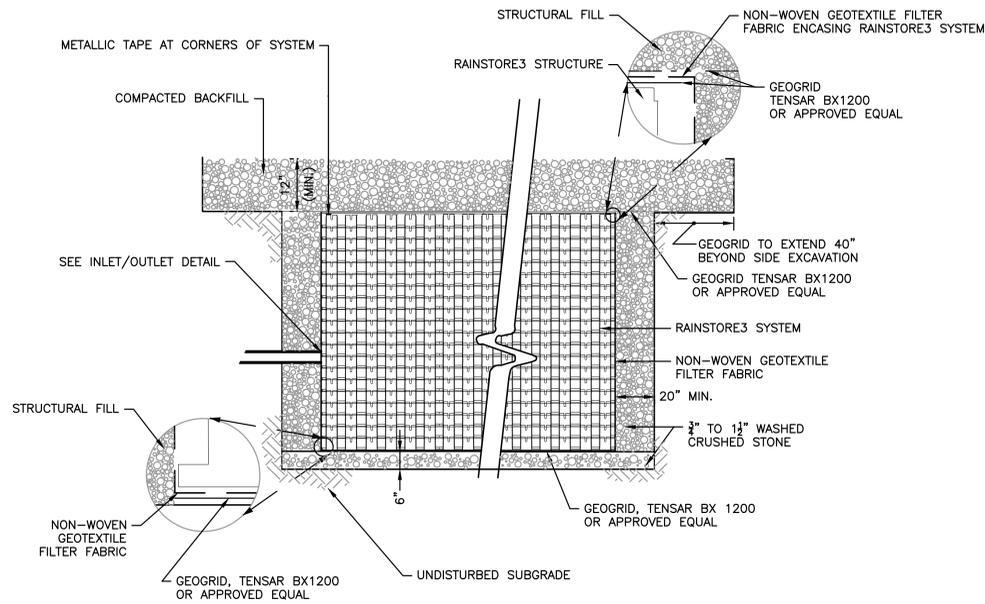
SCALE: NOT TO SCALE

DRAWING NAME:

Site Details

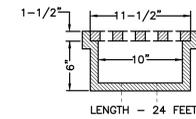
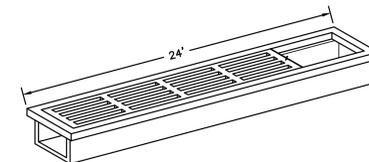
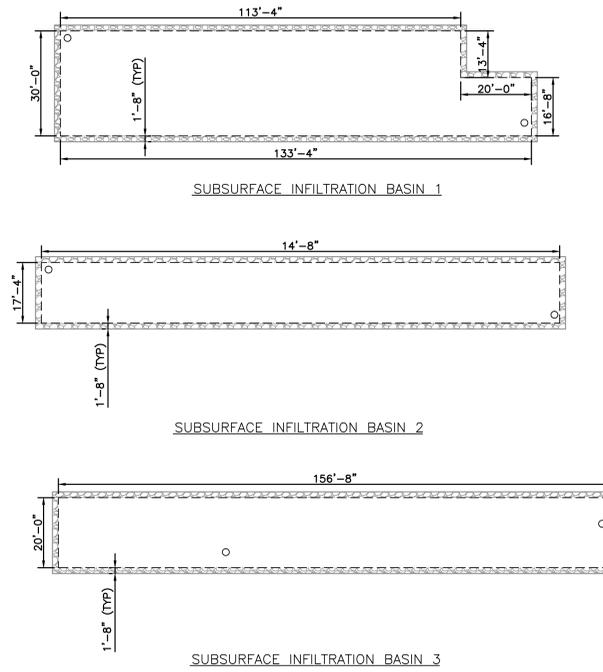
DRAWING NUMBER:

C5.03

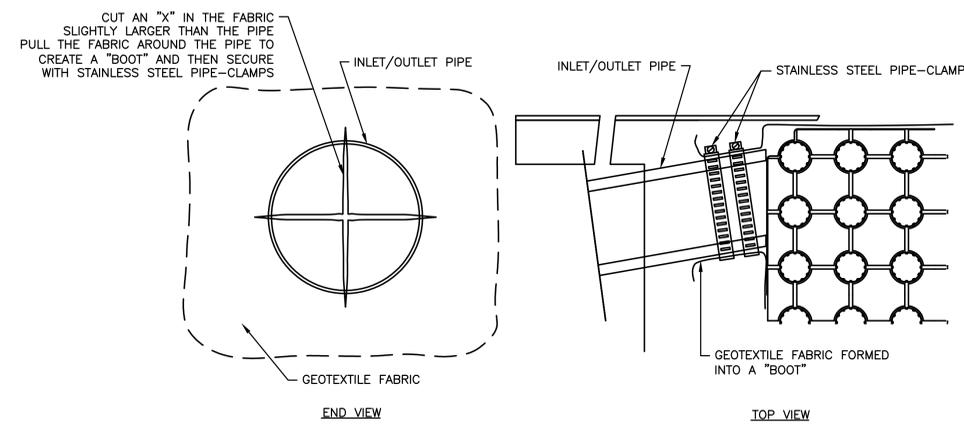
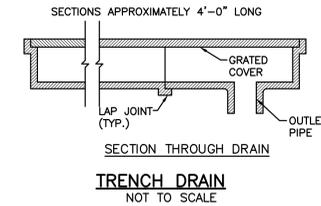


NOTES:

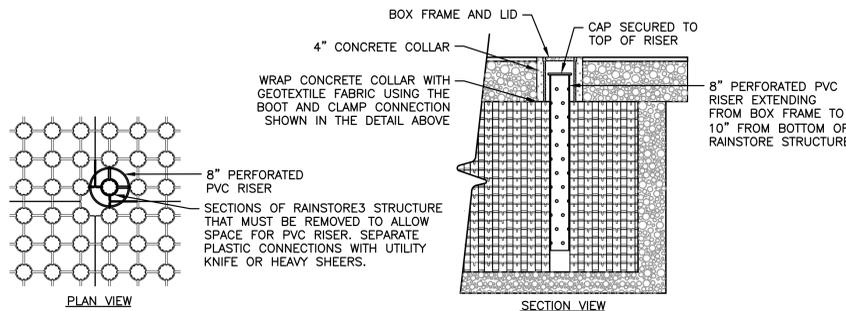
- SUBSURFACE INFILTRATION SYSTEM 1
 - CONSISTS OF 1,680 RAINSTORE3 UNITS
5 UNITS DEEP (1.64').
 - THE BOTTOM ELEVATION RAINSTORE3 UNITS IS 6.36'.
- SUBSURFACE INFILTRATION SYSTEM 2
 - CONSISTS OF 1,100 RAINSTORE3 UNITS
5 UNITS DEEP (1.64').
 - THE BOTTOM ELEVATION RAINSTORE3 UNITS IS 7.00'.
- SUBSURFACE INFILTRATION SYSTEM 3
 - CONSISTS OF 1,692 RAINSTORE3 UNITS
6 UNITS DEEP (1.97').
 - THE BOTTOM ELEVATION RAINSTORE3 UNITS IS 6.33'.



- NOTES:
- USE HEAVY DUTY NEENAH FOUNDRY COMPANY R-4996-A1 SERIES TYPE M TRENCH WITH GRATED COVER OR APPROVED EQUAL
 - DRAIN TO BE SET ON 18\"/>

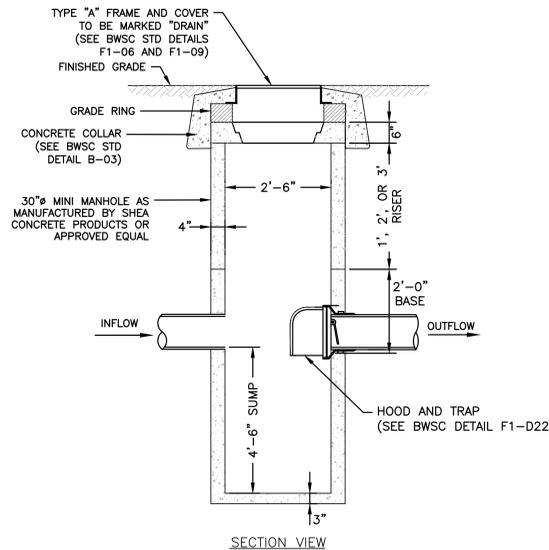


INLET/OUTLET/CLEANOUT CONNECTION DETAIL



CLEANOUT DETAIL

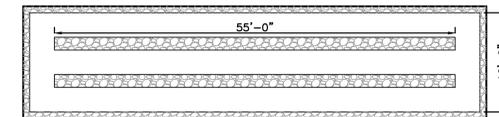
SUB-SURFACE INFILTRATION BASIN
NOT TO SCALE



NOTES:

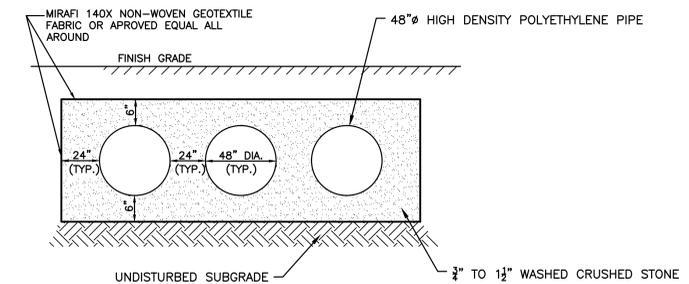
- CONCRETE: 5000 PSI MINIMUM AFTER 28 DAYS.
- DESIGNED FOR H-20 LOADING.

MINI MANHOLE
NOT TO SCALE



NOTE: 197 LF-48\"/>

PLAN VIEW



CROSS SECTION

SUBSURFACE DETENTION BASIN #1
NOT TO SCALE

APPENDIX D: RECHARGE CALCULATIONS



38 Chauncy Street
Boston, MA 02111
(617) 482-7080 ■ Fax (617) 482-7417

JOB Boardwalk Residues at Marsh Bay

SHEET NO. 1 OF 2

CALCULATED BY RL DATE 5/29/13

CHECKED BY _____ DATE _____

SCALE _____

STANDARD 3: STORMWATER RECHARGE

1) Required Recharge Volume, R_v

Impervious Area = 6.94 Ac.

$F = 0.25$ inch (target depth for hydrologic soil type C)

$$R_v = 6.94 \text{ Ac} \times \frac{43,560 \text{ SF}}{1 \text{ Ac}} \times 0.25 \text{ inch} \times \frac{1 \text{ ft}}{12 \text{ inches}}$$

► $R_v = 6,298 \text{ CF}$

2) Recharge Provided, R_{VP} (see hydrology calculations)

a.) Subsurface Infiltration 1

$$R_{VP1} = 4,118 \text{ CF}$$

b.) Subsurface Infiltration 2

$$R_{VP2} = 3,120 \text{ CF}$$

c.) Subsurface Infiltration 3

$$R_{VP3} = 4,135 \text{ CF}$$

$$R_{VP} = 4,118 + 3,120 + 4,135$$

► $R_{VP} = 11,373 \text{ CF} > 6,298 \text{ CF} \checkmark$



38 Chauncy Street
Boston, MA 02111
(617) 482-7080 ■ Fax (617) 482-7417

JOB Boardwalk Residences at Nanna Bay
SHEET NO. 2 OF 2
CALCULATED BY RL DATE 5/29/13
CHECKED BY _____ DATE _____
SCALE _____

3) Check drawdown time

a.) Subsurface Infiltration 1

$$R_{up} = 4,118 \text{ CF}$$

$$\text{Infiltration Rate} = 0.27 \text{ in/hour}$$

$$\text{Bottom Area of System} = 3,733 \text{ SF}$$

$$t_1 = \frac{4,118 \text{ CF}}{0.27 (3,733) \times \frac{1 \text{ ft}}{12 \text{ inch}}}$$

$$t_2 = 49 \text{ hours} < 72 \text{ hours} \checkmark$$

b.) Subsurface Infiltration 2

$$3,120 \text{ CF}$$

$$t_2 = \frac{3,120 \text{ CF}}{0.27 \frac{\text{meters}}{\text{hr}} \times \frac{1 \text{ ft}}{12 \text{ inch}} \times 2,442 \text{ SF}}$$

$$t_2 = 57 \text{ hours} < 72 \text{ hours} \checkmark$$

c.) Subsurface Infiltration 3

$$4,135 \text{ CF}$$

$$t_3 = \frac{4,135 \text{ CF}}{0.27 \frac{\text{in}}{\text{hr}} \times \frac{1 \text{ ft}}{12 \text{ inch}} \times 3,133 \text{ SF}}$$

$$t_3 = 59 \text{ hours} < 72 \text{ hours} \checkmark$$

APPENDIX E: OPERATION AND MAINTENANCE PLAN

**STORMWATER MANAGEMENT SYSTEM
OPERATION AND MAINTENANCE PLAN
BOARDWALK RESIDENCES AT MARINA BAY
QUINCY, MASSACHUSETTS**

Stormwater Management System Owner:

Flagship Marina Bay, LLC
333 Victory Road
Quincy, MA 02171
Tel.: (617) 847 1800

The upgraded and expanded storm drainage/stormwater management system will be maintained properly to assure its continued performance, as follows.

1. Catch basins and area drains
 - a. Inspect quarterly (January, April, July, October)
 - b. Clean 4 times per year or when deposits reach $\frac{1}{2}$ the depth of the sump
2. Subsurface Infiltration and Detention Systems
 - a. Inspect every 6 months and after every major storm event, remove debris
 - b. Remove any debris that may clog system.
 - c. Remove sediment if depth reaches 3 inches.
3. Water Quality Units

Follow manufacturer's recommendations including:

 - a. Inspect twice a year (spring and fall) minimum
 - b. System should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when appreciable level of hydrocarbons and trash has accumulated.
4. 18-inch and 24-inch storm drain lines around Phase One (north) building
 - a. Inspect every 6 months and after every major storm event, remove debris
 - b. Remove sediment if depth reaches 4 inches.
5. Stormwater Outfalls
 - a. The outfall pipes located to the east of Phase One will be inspected monthly for the first three months after construction to ensure proper functioning and correct any areas that have settled or are not functioning correctly.
 - b. Rip-rap will be maintained, as necessary.
 - c. Trash and debris shall be removed at the outfall and properly disposed. Weeds and invasive plant species will be removed by hand. Leaf litter and other detritus shall be removed twice per year.
6. Semi-annually (generally May and November)
 - a. Street sweeping