APPENDIX C -

SENSITIVITY ANALYSIS # 2

SWMM Only –

For 2 Basin Hydrographs –

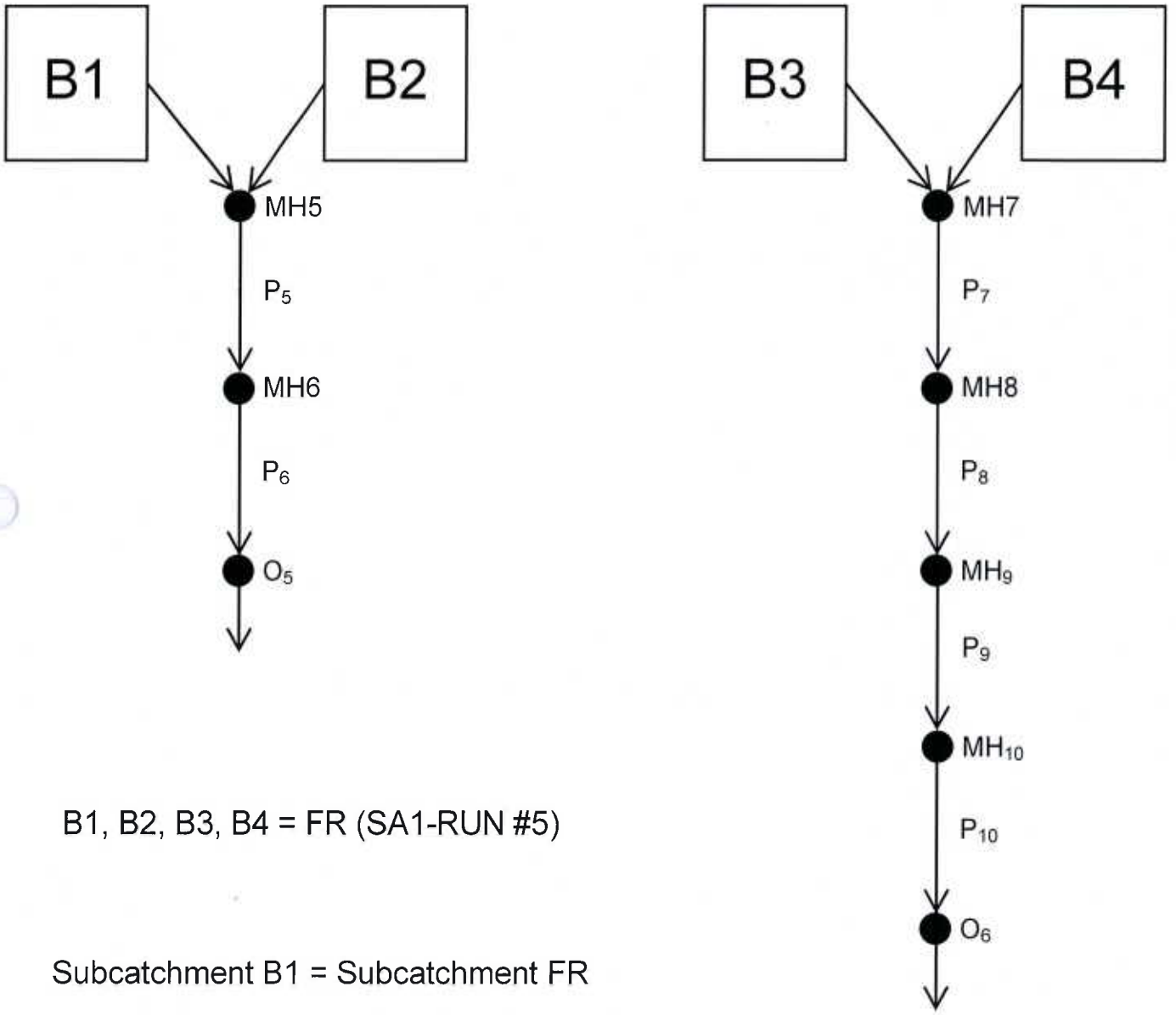
What Storm Will Exceed Capacities of 24-in. and 36-in. Storm Drains ?

Table - Sensitivity Analysis # 2

SWMM SUMMARY TABLES -

APPENDIX C -

SWMM SCHEMATIC



B1, B2, B3, B4 = FR (SA1-RUN #5)

Subcatchment B1 = Subcatchment FR

Subcatchment B2 = Subcatchment FIC

Subcatchment B3 = Subcatchment SR

Subcatchment B4 = Subcatchment SIC

							NO MANHOLES BETWEEN INTERSECTIONS							MANHOLES BETWEEN INTERSECTION							
INPUT PARAMETERS					EPA SWMM RESULTS Subcatchments		EPA SWMM RESULTS Nodes							EPA SWMM RESULTS Nodes							
Rain	Pipe Diameter	Pipe Slope	Total Storm Drain Length	Ponded Area	(B5+B6) and (B7+B8)		MH5	MH6	O5	Total Flood Volume (MH5)	Max. Ponded Depth (MH5)	Ponded Depth Above MH5 Rim		MH7	MH8	MH9	MH10	O6	Total Flood Volume (MH7)	Max. Ponded Depth (MH7)	Ponded Depth Above MH7 Rim	
	(in)	(ft/ft)	(ft)	(ft^2)	Total Runoff (ac-ft)	Total Peak Runoff (cfs)	Max. HGL (ft)	Max. HGL (ft)	Max. HGL (ft)	(ac-ft)	(ft)	(ft)	(in)	Max. HGL (ft)	Max. HGL (ft)	Max. HGL (ft)	Max. HGL (ft)	Max. HGL (ft)	(ac-ft)	(ft)	(ft)	(in)
				(g)	(a)	(b)	(c)	(d)	(e)		(h)			(c)	(f)	(f)	(d)	(e)		(h)		
2yr-24hr	24	0.001	400	791040	12.02	35.08	5006.10	5003.81	5001.20	1.75	6.1	0.10	1.20	5006.10	5005.18	5003.75	5002.83	5001.40	1.75	6.1	0.10	1.20
	36	0.001	400	791040	12.02	35.08	5005.18	5003.69	5002.20	0	-	0.00	0.00	5005.57	5004.91	5003.98	5003.33	5002.40	0	-	0.00	0.00
10yr-24hr	24	0.001	400	791040	17.72	64.72	5006.30	5005.60	5001.20	5.43	6.3	0.30	3.60	5006.30	5005.34	5003.85	5002.89	5001.40	5.43	6.3	0.30	3.60
	36	0.001	400	791040	17.72	64.72	5006.09	5004.19	5002.20	1.57	6.09	0.09	1.08	5006.10	5005.34	5004.25	5003.76	5002.40	1.81	6.1	0.10	1.20
50yr-24hr	24	0.001	400	791040	24.22	101.84	5006.55	5004.27	5001.20	9.98	6.55	0.55	6.60	5006.55	5005.54	5003.97	5002.97	5001.40	9.97	6.55	0.55	6.60
	36	0.001	400	791040	24.22	101.84	5006.27	5004.24	5002.20	4.92	6.27	0.27	3.24	5006.29	5005.49	5004.34	5003.67	5002.40	5.26	6.29	0.29	3.48
100yr-24hr	24	0.001	400	791040	27.23	120.76	5006.67	5003.94	5001.20	12.19	6.67	0.67	8.04	5006.67	5005.64	5004.04	5003.00	5001.40	12.19	6.67	0.67	8.04
	36	0.001	400	791040	27.23	120.76	5006.37	5004.52	5002.20	6.71	6.37	0.37	4.44	5006.39	5005.57	5004.84	5004.83	5002.40	7.09	6.39	0.39	4.68

General Definitions and Assumptions:
(a) Total runoff equals the summation of basins B5 and B6 for the tests with "No Manholes Between Intersections". Total runoff equals the summation of basins B7 and B8 for the tests with "Manholes Between Intersections"
(b) Total peak runoff equals the summation of basins B5 and B6 for the tests with "No Manholes Between Intersections". Total peak runoff equals the summation of basins B7 and B8 for the tests with " Manholes Between Intersections"
(c) Storm drain upstream manhole.
(d) Storm drain downstream manhole.
(e) Storm drain outfall manhole.
(f) Storm drain internal manholes or manholes between the upstream and downstream manholes.
(g) Ponded area was obtained by multiplying the number of streets inside the study basin(s) 12 x typical street width 32 ft x average length of a 6 block x 6 block study basin 2060 ft. 12 x32 'x 2060' = 791,040 ft^2.
(h) Max. Ponded depth for MH5 and MH7 includes the manhole depth. Total manhole depth for all manholes is 6 ft.

Other Assumptions:
** Please refer to the "Sensitivity Analysis 1 - (SA#1)" Table FR for additional information regarding the basin(s) or subcatchment(s) properties. This sensitivity analysis was run using the same properties for all basin(s) than the one use on SA#1 Table FR "ADJUSTED Data Element Value Assumed - Run #5".

Conclusion:
1- Ponded depth above manholes is higher in the 24 in. pipes tests than the 36 in. pipe tests.
2- A 2yr. - 24hr. storm (and above) produces flooding when using 24 in. pipe system with or without manholes between intersections.
3- A 10yr. - 24hr. storm (and above) produces flooding when using 36 in. pipe system with or without manholes between intersections.
4- There is not a significant difference in ponded depth above manholes among the tests (with or without manholes between intersections).

Final Conclusion:
1- Manholes between intersections can be omitted in the final EPA SWMM Model without producing any significant change in the results.

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 2yr. 24hr. St

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 2yr. 24hr. Storm.
All Subcatchments (Basins) have the same properties than FR (B1) from Run #5 (Sensitivity Analysis #1).
24" RCP - Printed on 2-8-2011

*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ..................... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ DEC-24-2010 00:00:00
Ending Date .............. DEC-28-2010 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Wet Time Step ............ 00:03:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 30.00 sec

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 4
Number of nodes ........... 8
Number of links ........... 6
Number of pollutants ...... 0
Number of land uses ....... 0

****************
Raingage Summary
****************

                                          Data         Recording
Name                 Data Source          Type         Interval
-----------------------------------------------------------------
R1                   Rain                 CUMULATIVE    3 min.
```

24" = RCP

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
B5	102.70	750.00	56.00	0.0958	R1	MH5
B6	102.70	750.00	56.00	0.0958	R1	MH5
B7	102.70	750.00	56.00	0.0958	R1	MH7
B8	102.70	750.00	56.00	0.0958	R1	MH7

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
MH5	JUNCTION	5000.00	6.00	791040.0	
MH6	JUNCTION	4999.60	6.00	0.0	
MH7	JUNCTION	5000.00	6.00	791040.0	
MH8	JUNCTION	4999.90	6.00	0.0	
MH9	JUNCTION	4999.70	6.00	0.0	
MH10	JUNCTION	4999.60	6.00	0.0	
O5	OUTFALL	4999.20	2.00	0.0	
O6	OUTFALL	4999.40	2.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
P5	MH5	MH6	CONDUIT	400.0	0.1000	0.0130
P6	MH6	O5	CONDUIT	400.0	0.1000	0.0130
P7	MH7	MH8	CONDUIT	100.0	0.1000	0.0130
P8	MH8	MH9	CONDUIT	200.0	0.1000	0.0130
P9	MH9	MH10	CONDUIT	100.0	0.1000	0.0130
P10	MH10	O6	CONDUIT	200.0	0.1000	0.0130

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
P5	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P6	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P7	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P8	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P9	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P10	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15

****
Control Actions Taken
****

Runoff Quantity Continuity	Volume acre-feet	Depth inches
Total Precipitation	41.765	1.220
Evaporation Loss	0.000	0.000
Infiltration Loss	17.178	0.502
Surface Runoff	24.052	0.703
Final Surface Storage	0.538	0.016
Continuity Error (%)	-0.007	

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	24.052	7.838
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	27.383	8.923
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
Continuity Error (%)	-13.853	

****
Time-Step Critical Elements
****
Link P9 (28.06%)
Link P7 (20.30%)

****
Highest Flow Instability Indexes
****
Link P10 (21)
Link P6 (16)
Link P9 (10)
Link P5 (6)

****
Routing Time Step Summary
****

Minimum Time Step	:	0.50 sec
Average Time Step	:	19.57 sec
Maximum Time Step	:	30.00 sec

Percent in Steady State : 0.00
Average Iterations per Step : 2.05

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
B5	1.22	0.00	0.00	0.50	0.70	1.96	17.54	0.576
B6	1.22	0.00	0.00	0.50	0.70	1.96	17.54	0.576
B7	1.22	0.00	0.00	0.50	0.70	1.96	17.54	0.576
B8	1.22	0.00	0.00	0.50	0.70	1.96	17.54	0.576

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
MH5	JUNCTION	0.91	6.10	5006.10	0 03:34
MH6	JUNCTION	0.83	4.21	5003.81	0 01:23
MH7	JUNCTION	0.93	6.10	5006.10	0 03:34
MH8	JUNCTION	0.88	5.28	5005.18	0 03:35
MH9	JUNCTION	0.83	4.05	5003.75	0 03:35
MH10	JUNCTION	0.78	3.23	5002.83	0 03:36
O5	OUTFALL	0.71	2.00	5001.20	0 01:23
O6	OUTFALL	0.72	2.00	5001.40	0 01:23

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
MH5	JUNCTION	35.08	35.08	0 02:00	3.918	3.919
MH6	JUNCTION	0.00	16.15	0 03:34	0.000	4.452
MH7	JUNCTION	35.08	35.08	0 02:00	3.918	3.919
MH8	JUNCTION	0.00	16.19	0 01:26	0.000	4.471
MH9	JUNCTION	0.00	16.14	0 03:34	0.000	4.472
MH10	JUNCTION	0.00	16.14	0 03:35	0.000	4.473
O5	OUTFALL	0.00	16.15	0 03:35	0.000	4.450

O6	OUTFALL	0.00	16.14	0	03:36	0.000	4.473

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH5	JUNCTION	5.78	4.096	0.000
MH6	JUNCTION	9.06	2.208	1.792
MH7	JUNCTION	6.01	4.096	0.000
MH8	JUNCTION	8.93	3.277	0.723
MH9	JUNCTION	7.32	2.048	1.952
MH10	JUNCTION	6.43	1.229	2.771

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH5	5.46	19.03	0 02:00	0.570	6.10
MH7	5.45	19.03	0 02:00	0.570	6.10

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
O5	99.88	2.63	16.15	4.450
O6	99.84	2.67	16.14	4.473
System	99.86	5.30	32.29	8.922

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
P5	CONDUIT	16.15	0	03:34	5.14	2.26	1.00
P6	CONDUIT	16.15	0	03:35	5.14	2.26	1.00
P7	CONDUIT	16.19	0	01:26	5.15	2.26	1.00
P8	CONDUIT	16.14	0	03:34	5.14	2.26	1.00
P9	CONDUIT	16.14	0	03:35	5.14	2.26	1.00
P10	CONDUIT	16.14	0	03:36	5.14	2.26	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.31	0.0003
P6	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.34	0.0055
P7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.30	0.0003
P8	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.32	0.0003
P9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.34	0.0005
P10	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.36	0.0131

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
P5	9.05	9.05	9.06	9.27	9.02
P6	8.10	8.10	8.95	8.91	8.10
P7	8.93	8.93	8.93	8.17	8.93
P8	7.32	7.32	7.32	8.21	7.32
P9	6.38	6.38	6.45	8.25	6.38
P10	6.30	6.30	6.35	8.96	6.30

Analysis begun on: Tue Feb 08 08:16:59 2011
Analysis ended on: Tue Feb 08 08:17:00 2011
Total elapsed time: 00:00:01

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 2yr. 24hr. St

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 2yr. 24hr. Storm.
All Subcatchments (Basins) have the same properties than FR (B1) from Run #5 (Sensitivity Analysis #1).
36" RCP - Printed on 2-8-2011

************************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
************************************************************

****************
Analysis Options
****************
Flow Units ..................... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ DEC-24-2010 00:00:00
Ending Date .............. DEC-28-2010 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Wet Time Step ............ 00:03:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 30.00 sec

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 4
Number of nodes ........... 8
Number of links ........... 6
Number of pollutants ...... 0
Number of land uses ....... 0

****************
Raingage Summary
****************
                                                  Data         Recording
Name                 Data Source                  Type         Interval
--------------------------------------------------------------------------
R1                   Rain                         CUMULATIVE    3 min.
```

36" = RCP

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
B5	102.70	750.00	56.00	0.0958	R1	MH5
B6	102.70	750.00	56.00	0.0958	R1	MH5
B7	102.70	750.00	56.00	0.0958	R1	MH7
B8	102.70	750.00	56.00	0.0958	R1	MH7

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
MH5	JUNCTION	5000.00	6.00	791040.0	
MH6	JUNCTION	4999.60	6.00	0.0	
MH7	JUNCTION	5000.00	6.00	791040.0	
MH8	JUNCTION	4999.90	6.00	0.0	
MH9	JUNCTION	4999.70	6.00	0.0	
MH10	JUNCTION	4999.60	6.00	0.0	
O5	OUTFALL	4999.20	3.00	0.0	
O6	OUTFALL	4999.40	3.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
P5	MH5	MH6	CONDUIT	400.0	0.1000	0.0130
P6	MH6	O5	CONDUIT	400.0	0.1000	0.0130
P7	MH7	MH8	CONDUIT	100.0	0.1000	0.0130
P8	MH8	MH9	CONDUIT	200.0	0.1000	0.0130
P9	MH9	MH10	CONDUIT	100.0	0.1000	0.0130
P10	MH10	O6	CONDUIT	200.0	0.1000	0.0130

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
P5	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P6	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P7	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P8	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P9	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P10	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09

****
Control Actions Taken
****

Runoff Quantity Continuity	Volume acre-feet	Depth inches
Total Precipitation	41.765	1.220
Evaporation Loss	0.000	0.000
Infiltration Loss	17.178	0.502
Surface Runoff	24.052	0.703
Final Surface Storage	0.538	0.016
Continuity Error (%)	-0.007	

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	24.052	7.838
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	24.084	7.848
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
Continuity Error (%)	-0.138	

****
Time-Step Critical Elements
****
Link P9 (28.90%)
Link P7 (9.90%)

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****

Minimum Time Step	:	0.50 sec
Average Time Step	:	22.82 sec
Maximum Time Step	:	30.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.02

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
B5	1.22	0.00	0.00	0.50	0.70	1.96	17.54	0.576
B6	1.22	0.00	0.00	0.50	0.70	1.96	17.54	0.576
B7	1.22	0.00	0.00	0.50	0.70	1.96	17.54	0.576
B8	1.22	0.00	0.00	0.50	0.70	1.96	17.54	0.576

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
MH5	JUNCTION	0.51	5.18	5005.18	0 02:01
MH6	JUNCTION	0.50	4.09	5003.69	0 02:01
MH7	JUNCTION	0.55	5.57	5005.57	0 02:02
MH8	JUNCTION	0.53	5.01	5004.91	0 02:03
MH9	JUNCTION	0.53	4.28	5003.98	0 02:03
MH10	JUNCTION	0.51	3.73	5003.33	0 02:03
O5	OUTFALL	0.47	3.00	5002.20	0 01:30
O6	OUTFALL	0.47	3.00	5002.40	0 01:30

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
MH5	JUNCTION	35.08	35.08	0 02:00	3.918	3.919
MH6	JUNCTION	0.00	35.08	0 02:01	0.000	3.920
MH7	JUNCTION	35.08	35.08	0 02:00	3.918	3.919
MH8	JUNCTION	0.00	35.01	0 02:02	0.000	3.922
MH9	JUNCTION	0.00	34.97	0 02:03	0.000	3.925
MH10	JUNCTION	0.00	34.94	0 02:03	0.000	3.927
O5	OUTFALL	0.00	35.08	0 02:02	0.000	3.921
O6	OUTFALL	0.00	34.94	0 02:03	0.000	3.927

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH5	JUNCTION	1.51	2.178	0.822
MH6	JUNCTION	1.50	1.089	1.911
MH7	JUNCTION	1.62	2.566	0.434
MH8	JUNCTION	1.57	2.011	0.989
MH9	JUNCTION	1.53	1.283	1.717
MH10	JUNCTION	1.52	0.729	2.271

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
O5	99.87	2.32	35.08	3.921
O6	99.82	2.32	34.94	3.927
System	99.85	4.63	69.98	7.848

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
P5	CONDUIT	35.08	0 02:01	4.96	1.66	1.00
P6	CONDUIT	35.08	0 02:02	4.96	1.66	1.00
P7	CONDUIT	35.01	0 02:02	4.95	1.66	1.00
P8	CONDUIT	34.97	0 02:03	4.95	1.66	1.00
P9	CONDUIT	34.94	0 02:03	4.94	1.66	1.00
P10	CONDUIT	34.94	0 02:03	4.94	1.66	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.42	0.0002
P6	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.42	0.0005
P7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.39	0.0002
P8	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.40	0.0002
P9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.40	0.0002
P10	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.42	0.0005

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
P5	1.49	1.49	1.50	1.52	1.49
P6	1.48	1.48	1.49	1.55	1.48
P7	1.57	1.57	1.57	1.54	1.57
P8	1.53	1.53	1.53	1.54	1.53
P9	1.51	1.51	1.52	1.53	1.51
P10	1.51	1.51	1.51	1.56	1.51

Analysis begun on: Tue Feb 08 08:24:10 2011
Analysis ended on: Tue Feb 08 08:24:10 2011
Total elapsed time: < 1 sec

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 10yr. 24hr. Storm.

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 10yr. 24hr. Storm.
All Subcatchments (Basins) have the same properties than FR (B1) from Run #5 (Sensitivity Analysis #1).
24" RCP - Printed on 2-8-2011

*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

****************
Analysis Options
****************
Flow Units ..................... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ DEC-24-2010 00:00:00
Ending Date .............. DEC-28-2010 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Wet Time Step ............ 00:03:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 30.00 sec

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 4
Number of nodes ........... 8
Number of links ........... 6
Number of pollutants ...... 0
Number of land uses ....... 0

****************
Raingage Summary
****************

                                          Data         Recording
Name                 Data Source          Type         Interval
-----------------------------------------------------------------
R1                   Rain                 CUMULATIVE    3 min.
```

24-HR. RCP

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
B5	102.70	750.00	56.00	0.0958	R1	MH5
B6	102.70	750.00	56.00	0.0958	R1	MH5
B7	102.70	750.00	56.00	0.0958	R1	MH7
B8	102.70	750.00	56.00	0.0958	R1	MH7

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
MH5	JUNCTION	5000.00	6.00	791040.0	
MH6	JUNCTION	4999.60	6.00	0.0	
MH7	JUNCTION	5000.00	6.00	791040.0	
MH8	JUNCTION	4999.90	6.00	0.0	
MH9	JUNCTION	4999.70	6.00	0.0	
MH10	JUNCTION	4999.60	6.00	0.0	
O5	OUTFALL	4999.20	2.00	0.0	
O6	OUTFALL	4999.40	2.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
P5	MH5	MH6	CONDUIT	400.0	0.1000	0.0130
P6	MH6	O5	CONDUIT	400.0	0.1000	0.0130
P7	MH7	MH8	CONDUIT	100.0	0.1000	0.0130
P8	MH8	MH9	CONDUIT	200.0	0.1000	0.0130
P9	MH9	MH10	CONDUIT	100.0	0.1000	0.0130
P10	MH10	O6	CONDUIT	200.0	0.1000	0.0130

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
P5	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P6	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P7	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P8	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P9	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P10	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15

****
Control Actions Taken
****

Runoff Quantity Continuity	Volume acre-feet	Depth inches
Total Precipitation	60.251	1.760
Evaporation Loss	0.000	0.000
Infiltration Loss	24.257	0.709
Surface Runoff	35.441	1.035
Final Surface Storage	0.559	0.016
Continuity Error (%)	-0.011	

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	35.441	11.549
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	38.867	12.665
Internal Outflow	0.001	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
Continuity Error (%)	-9.671	

****
Time-Step Critical Elements
****
Link P7 (22.71%)
Link P9 (22.05%)

****
Highest Flow Instability Indexes
****
Link P10 (19)
Link P6 (15)
Link P9 (10)
Link P5 (6)

****
Routing Time Step Summary
****
Minimum Time Step : 0.50 sec
Average Time Step : 20.37 sec
Maximum Time Step : 30.00 sec

Percent in Steady State : 0.00
Average Iterations per Step : 2.03

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
B5	1.76	0.00	0.00	0.71	1.04	2.89	32.36	0.588
B6	1.76	0.00	0.00	0.71	1.04	2.89	32.36	0.588
B7	1.76	0.00	0.00	0.71	1.04	2.89	32.36	0.588
B8	1.76	0.00	0.00	0.71	1.04	2.89	32.36	0.588

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
MH5	JUNCTION	1.03	6.30	5006.30	0 04:29
MH6	JUNCTION	0.89	6.00	5005.60	0 01:20
MH7	JUNCTION	1.05	6.30	5006.30	0 04:29
MH8	JUNCTION	0.98	5.44	5005.34	0 04:29
MH9	JUNCTION	0.89	4.15	5003.85	0 04:30
MH10	JUNCTION	0.82	3.29	5002.89	0 04:30
O5	OUTFALL	0.72	2.00	5001.20	0 01:19
O6	OUTFALL	0.72	2.00	5001.40	0 01:19

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
MH5	JUNCTION	64.72	64.72	0 01:56	5.773	5.774
MH6	JUNCTION	0.00	16.48	0 04:29	0.000	6.321
MH7	JUNCTION	64.72	64.72	0 01:56	5.773	5.774
MH8	JUNCTION	0.00	16.68	0 01:22	0.000	6.344
MH9	JUNCTION	0.00	16.49	0 04:29	0.000	6.345
MH10	JUNCTION	0.00	16.49	0 04:30	0.000	6.345
O5	OUTFALL	0.00	16.48	0 04:29	0.000	6.319

O6	OUTFALL	0.00	16.49	0	04:31	0.000	6.346

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH5	JUNCTION	4.73	4.299	0.000
MH6	JUNCTION	13.01	4.000	0.000
MH7	JUNCTION	4.98	4.299	0.000
MH8	JUNCTION	12.92	3.440	0.560
MH9	JUNCTION	11.55	2.150	1.850
MH10	JUNCTION	10.84	1.290	2.710

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH5	10.31	48.57	0 01:56	1.771	6.30
MH6	0.01	2.28	0 01:20	0.000	6.00
MH7	10.29	48.55	0 01:56	1.770	6.30

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
O5	99.88	2.91	16.48	6.319
O6	99.84	2.95	16.49	6.346
System	99.86	5.86	32.97	12.664

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
P5	CONDUIT	16.48	0	04:29	5.25	2.30	1.00
P6	CONDUIT	16.48	0	04:29	5.25	2.30	1.00
P7	CONDUIT	16.68	0	01:22	5.31	2.33	1.00
P8	CONDUIT	16.49	0	04:29	5.25	2.31	1.00
P9	CONDUIT	16.49	0	04:30	5.25	2.31	1.00
P10	CONDUIT	16.49	0	04:31	5.25	2.31	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.31	0.0004
P6	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.0051
P7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.30	0.0003
P8	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.32	0.0003
P9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.0005
P10	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.35	0.0121

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
P5	13.00	13.00	13.00	13.29	12.98
P6	12.19	12.19	12.90	13.00	12.19
P7	12.92	12.92	12.92	12.27	12.91
P8	11.55	11.55	11.56	12.35	11.55
P9	10.83	10.83	10.86	12.35	10.83
P10	10.77	10.77	10.81	13.07	10.77

Analysis begun on: Tue Feb 08 08:31:01 2011
Analysis ended on: Tue Feb 08 08:31:01 2011
Total elapsed time: < 1 sec

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 10yr. 24hr. St

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 10yr. 24hr. Storm.
All Subcatchments (Basins) have the same properties than FR (B1) from Run #5 (Sensitivity Analysis #1).
36" RCP - Printed on 2-8-2011

*************************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*************************************************************

****************
Analysis Options
****************
Flow Units ..................... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ DEC-24-2010 00:00:00
Ending Date .............. DEC-28-2010 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Wet Time Step ............ 00:03:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 30.00 sec

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 4
Number of nodes ........... 8
Number of links ........... 6
Number of pollutants ...... 0
Number of land uses ....... 0

****************
Raingage Summary
****************

Name                 Data Source          Data Type    Recording Interval
---------------------------------------------------------------------------
R1                   Rain                 CUMULATIVE     3 min.
```

36-Hr. RCP

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
B5	102.70	750.00	56.00	0.0958	R1	MH5
B6	102.70	750.00	56.00	0.0958	R1	MH5
B7	102.70	750.00	56.00	0.0958	R1	MH7
B8	102.70	750.00	56.00	0.0958	R1	MH7

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
MH5	JUNCTION	5000.00	6.00	791040.0	
MH6	JUNCTION	4999.60	6.00	0.0	
MH7	JUNCTION	5000.00	6.00	791040.0	
MH8	JUNCTION	4999.90	6.00	0.0	
MH9	JUNCTION	4999.70	6.00	0.0	
MH10	JUNCTION	4999.60	6.00	0.0	
O5	OUTFALL	4999.20	3.00	0.0	
O6	OUTFALL	4999.40	3.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
P5	MH5	MH6	CONDUIT	400.0	0.1000	0.0130
P6	MH6	O5	CONDUIT	400.0	0.1000	0.0130
P7	MH7	MH8	CONDUIT	100.0	0.1000	0.0130
P8	MH8	MH9	CONDUIT	200.0	0.1000	0.0130
P9	MH9	MH10	CONDUIT	100.0	0.1000	0.0130
P10	MH10	O6	CONDUIT	200.0	0.1000	0.0130

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
P5	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P6	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P7	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P8	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P9	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P10	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09

****
Control Actions Taken
****

Runoff Quantity Continuity	Volume acre-feet	Depth inches
Total Precipitation	60.251	1.760
Evaporation Loss	0.000	0.000
Infiltration Loss	24.257	0.709
Surface Runoff	35.441	1.035
Final Surface Storage	0.559	0.016
Continuity Error (%)	-0.011	

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	35.441	11.549
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	39.825	12.978
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
Continuity Error (%)	-12.375	

****
Time-Step Critical Elements
****
Link P9 (30.43%)
Link P7 (12.84%)

****
Highest Flow Instability Indexes
****
Link P10 (11)
Link P6 (8)
Link P9 (8)
Link P5 (3)
Link P8 (2)

****
Routing Time Step Summary
****
Minimum Time Step : 0.50 sec
Average Time Step : 20.65 sec

```
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.08
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
B5	1.76	0.00	0.00	0.71	1.04	2.89	32.36	0.588
B6	1.76	0.00	0.00	0.71	1.04	2.89	32.36	0.588
B7	1.76	0.00	0.00	0.71	1.04	2.89	32.36	0.588
B8	1.76	0.00	0.00	0.71	1.04	2.89	32.36	0.588

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
MH5	JUNCTION	0.87	6.09	5006.09	0 02:42
MH6	JUNCTION	0.83	4.59	5004.19	0 01:26
MH7	JUNCTION	0.92	6.10	5006.10	0 02:48
MH8	JUNCTION	0.88	5.44	5005.34	0 02:48
MH9	JUNCTION	0.85	4.55	5004.25	0 02:49
MH10	JUNCTION	0.81	4.16	5003.76	0 01:25
O5	OUTFALL	0.76	3.00	5002.20	0 01:26
O6	OUTFALL	0.75	3.00	5002.40	0 01:25

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
MH5	JUNCTION	64.72	64.72	0 01:56	5.773	5.774
MH6	JUNCTION	0.00	40.07	0 02:42	0.000	6.478
MH7	JUNCTION	64.72	64.72	0 01:56	5.773	5.774
MH8	JUNCTION	0.00	37.79	0 01:27	0.000	6.496
MH9	JUNCTION	0.00	37.78	0 02:48	0.000	6.498
MH10	JUNCTION	0.00	37.78	0 02:49	0.000	6.502

O5	OUTFALL	0.00	40.07	0	02:43	0.000	6.476
O6	OUTFALL	0.00	37.78	0	02:50	0.000	6.501

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH5	JUNCTION	2.79	3.086	0.000
MH6	JUNCTION	3.96	1.592	1.408
MH7	JUNCTION	2.78	3.100	0.000
MH8	JUNCTION	4.30	2.435	0.565
MH9	JUNCTION	3.68	1.550	1.450
MH10	JUNCTION	3.42	1.159	1.841

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH5	2.73	24.87	0 01:56	0.511	6.09
MH7	3.03	27.18	0 01:56	0.590	6.10

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
O5	99.89	4.80	40.07	6.476
O6	99.85	4.90	37.78	6.501
System	99.87	9.70	77.85	12.977

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
P5	CONDUIT	40.07	0 02:42	5.67	1.90	1.00
P6	CONDUIT	40.07	0 02:43	5.67	1.90	1.00
P7	CONDUIT	37.79	0 01:27	5.35	1.79	1.00
P8	CONDUIT	37.78	0 02:48	5.35	1.79	1.00
P9	CONDUIT	37.78	0 02:49	5.34	1.79	1.00
P10	CONDUIT	37.78	0 02:50	5.34	1.79	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0004
P6	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.39	0.0040
P7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.34	0.0003
P8	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.36	0.0003
P9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0005
P10	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.40	0.0082

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
P5	3.95	3.95	3.98	4.57	3.87
P6	3.69	3.69	3.86	4.62	3.69
P7	4.30	4.30	4.31	3.58	4.30
P8	3.68	3.68	3.69	3.60	3.68
P9	3.36	3.36	3.41	3.63	3.36
P10	3.33	3.33	3.36	4.31	3.33

Analysis begun on: Tue Feb 08 08:27:25 2011
Analysis ended on: Tue Feb 08 08:27:25 2011
Total elapsed time: < 1 sec

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 50yr. 24hr. St

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 50yr. 24hr. Storm.
All Subcatchments (Basins) have the same properties than FR (B1) from Run #5 (Sensitivity Analysis #1).
24" RCP - Printed on 2-8-2011

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ..................... CFS
Process Models:
  Rainfall/Runoff ........... YES
  Snowmelt ..................  NO
  Groundwater ...............  NO
  Flow Routing ..............  YES
  Ponding Allowed ...........  YES
  Water Quality .............  NO
Infiltration Method ........ CURVE_NUMBER
Flow Routing Method ........ DYNWAVE
Starting Date .............. DEC-24-2010 00:00:00
Ending Date ................ DEC-28-2010 23:00:00
Antecedent Dry Days ........ 0.0
Report Time Step ........... 00:05:00
Wet Time Step .............. 00:03:00
Dry Time Step .............. 01:00:00
Routing Time Step .......... 30.00 sec

*************
Element Count
*************
Number of rain gages ....... 1
Number of subcatchments ... 4
Number of nodes ............ 8
Number of links ............ 6
Number of pollutants ....... 0
Number of land uses ........ 0

****************
Raingage Summary
****************

Name                 Data Source          Data Type       Recording Interval
---------------------------------------------------------------------------
R1                   Rain                 CUMULATIVE      3 min.
```

24-Hr. RCP

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 50yr. 24hr. Storm.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
B5	102.70	750.00	56.00	0.0958	R1	MH5
B6	102.70	750.00	56.00	0.0958	R1	MH5
B7	102.70	750.00	56.00	0.0958	R1	MH7
B8	102.70	750.00	56.00	0.0958	R1	MH7

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
MH5	JUNCTION	5000.00	6.00	791040.0	
MH6	JUNCTION	4999.60	6.00	0.0	
MH7	JUNCTION	5000.00	6.00	791040.0	
MH8	JUNCTION	4999.90	6.00	0.0	
MH9	JUNCTION	4999.70	6.00	0.0	
MH10	JUNCTION	4999.60	6.00	0.0	
O5	OUTFALL	4999.20	2.00	0.0	
O6	OUTFALL	4999.40	2.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
P5	MH5	MH6	CONDUIT	400.0	0.1000	0.0130
P6	MH6	O5	CONDUIT	400.0	0.1000	0.0130
P7	MH7	MH8	CONDUIT	100.0	0.1000	0.0130
P8	MH8	MH9	CONDUIT	200.0	0.1000	0.0130
P9	MH9	MH10	CONDUIT	100.0	0.1000	0.0130
P10	MH10	O6	CONDUIT	200.0	0.1000	0.0130

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
P5	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P6	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P7	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P8	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P9	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P10	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15

****
Control Actions Taken
****

********** Runoff Quantity Continuity **********	Volume acre-feet	Depth inches
Total Precipitation	80.106	2.340
Evaporation Loss	0.000	0.000
Infiltration Loss	31.108	0.909
Surface Runoff	48.434	1.415
Final Surface Storage	0.576	0.017
Continuity Error (%)	-0.014	

********** Flow Routing Continuity **********	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	48.433	15.783
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	51.373	16.741
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
Continuity Error (%)	-6.073	

****
Time-Step Critical Elements
****
Link P9 (21.76%)
Link P7 (20.15%)

****
Highest Flow Instability Indexes
****
Link P10 (17)
Link P6 (13)
Link P9 (9)
Link P5 (5)

****
Routing Time Step Summary
****
Minimum Time Step : 0.50 sec
Average Time Step : 21.12 sec
Maximum Time Step : 30.00 sec

Percent in Steady State : 0.00
Average Iterations per Step : 2.06

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
B5	2.34	0.00	0.00	0.91	1.41	3.95	50.92	0.605
B6	2.34	0.00	0.00	0.91	1.41	3.95	50.92	0.605
B7	2.34	0.00	0.00	0.91	1.41	3.95	50.92	0.605
B8	2.34	0.00	0.00	0.91	1.41	3.95	50.92	0.605

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
MH5	JUNCTION	1.17	6.55	5006.55	0 05:06
MH6	JUNCTION	0.96	4.67	5004.27	0 17:10
MH7	JUNCTION	1.21	6.55	5006.55	0 05:05
MH8	JUNCTION	1.11	5.64	5005.54	0 05:06
MH9	JUNCTION	0.98	4.27	5003.97	0 05:07
MH10	JUNCTION	0.88	3.37	5002.97	0 05:07
O5	OUTFALL	0.71	2.00	5001.20	0 01:17
O6	OUTFALL	0.74	2.00	5001.40	0 01:17

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
MH5	JUNCTION	101.83	101.83	0 01:51	7.890	7.891
MH6	JUNCTION	0.00	16.88	0 05:06	0.000	8.329
MH7	JUNCTION	101.83	101.83	0 01:51	7.890	7.891
MH8	JUNCTION	0.00	16.91	0 05:02	0.000	8.411
MH9	JUNCTION	0.00	16.91	0 05:06	0.000	8.412
MH10	JUNCTION	0.00	16.91	0 05:07	0.000	8.412
O5	OUTFALL	0.00	16.88	0 05:06	0.000	8.327

O6	OUTFALL	0.00	16.91	0	05:07	0.000	8.412

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH5	JUNCTION	3.76	4.550	0.000
MH6	JUNCTION	17.32	2.665	1.335
MH7	JUNCTION	4.37	4.549	0.000
MH8	JUNCTION	17.31	3.641	0.359
MH9	JUNCTION	16.12	2.275	1.725
MH10	JUNCTION	15.75	1.367	2.633

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH5	15.30	85.58	0 01:51	3.254	6.55
MH7	15.28	85.55	0 01:51	3.251	6.55

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
O5	99.88	3.20	16.88	8.327
O6	99.84	3.32	16.91	8.412
System	99.86	6.53	33.78	16.740

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
P5	CONDUIT	16.88	0	05:06	5.37	2.36	1.00
P6	CONDUIT	16.88	0	05:06	5.37	2.36	1.00
P7	CONDUIT	16.91	0	05:02	5.38	2.36	1.00
P8	CONDUIT	16.91	0	05:06	5.38	2.36	1.00
P9	CONDUIT	16.91	0	05:07	5.38	2.36	1.00
P10	CONDUIT	16.91	0	05:07	5.38	2.36	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.31	0.0004
P6	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.0053
P7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.29	0.0004
P8	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.31	0.0003
P9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.32	0.0005
P10	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.34	0.0113

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
P5	17.32	17.32	17.32	17.11	17.24
P6	16.57	16.57	17.26	16.99	16.57
P7	17.31	17.31	17.31	16.85	17.29
P8	16.11	16.11	16.12	16.87	16.11
P9	15.73	15.73	15.77	16.92	15.73
P10	15.67	15.67	15.70	17.67	15.67

Analysis begun on: Tue Feb 08 08:33:54 2011
Analysis ended on: Tue Feb 08 08:33:54 2011
Total elapsed time: < 1 sec

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 50yr. 24hr. St

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 50yr. 24hr. Storm.
All Subcatchments (Basins) have the same properties than FR (B1) from Run #5 (Sensitivity Analysis #1).
36" RCP - Printed on 2-8-2011

*************************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*************************************************************

****************
Analysis Options
****************
Flow Units ..................... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ DEC-24-2010 00:00:00
Ending Date .............. DEC-28-2010 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Wet Time Step ............ 00:03:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 30.00 sec

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 4
Number of nodes ........... 8
Number of links ........... 6
Number of pollutants ...... 0
Number of land uses ....... 0

****************
Raingage Summary
****************

                                                 Data         Recording
Name                 Data Source                 Type         Interval
-------------------------------------------------------------------------
R1                   Rain                        CUMULATIVE    3 min.
```

36-in. RCP

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
B5	102.70	750.00	56.00	0.0958	R1	MH5
B6	102.70	750.00	56.00	0.0958	R1	MH5
B7	102.70	750.00	56.00	0.0958	R1	MH7
B8	102.70	750.00	56.00	0.0958	R1	MH7

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
MH5	JUNCTION	5000.00	6.00	791040.0	
MH6	JUNCTION	4999.60	6.00	0.0	
MH7	JUNCTION	5000.00	6.00	791040.0	
MH8	JUNCTION	4999.90	6.00	0.0	
MH9	JUNCTION	4999.70	6.00	0.0	
MH10	JUNCTION	4999.60	6.00	0.0	
O5	OUTFALL	4999.20	3.00	0.0	
O6	OUTFALL	4999.40	3.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
P5	MH5	MH6	CONDUIT	400.0	0.1000	0.0130
P6	MH6	O5	CONDUIT	400.0	0.1000	0.0130
P7	MH7	MH8	CONDUIT	100.0	0.1000	0.0130
P8	MH8	MH9	CONDUIT	200.0	0.1000	0.0130
P9	MH9	MH10	CONDUIT	100.0	0.1000	0.0130
P10	MH10	O6	CONDUIT	200.0	0.1000	0.0130

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
P5	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P6	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P7	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P8	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P9	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P10	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09

****
Control Actions Taken
****

Runoff Quantity Continuity	Volume acre-feet	Depth inches
Total Precipitation	80.106	2.340
Evaporation Loss	0.000	0.000
Infiltration Loss	31.108	0.909
Surface Runoff	48.434	1.415
Final Surface Storage	0.576	0.017
Continuity Error (%)	-0.014	

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	48.433	15.783
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	51.117	16.657
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
Continuity Error (%)	-5.543	

****
Time-Step Critical Elements
****
Link P9 (32.10%)
Link P7 (10.35%)
Link P8 (1.04%)

****
Highest Flow Instability Indexes
****
Link P10 (12)
Link P9 (7)
Link P8 (1)

****
Routing Time Step Summary
****
Minimum Time Step : 0.50 sec
Average Time Step : 20.94 sec
Maximum Time Step : 30.00 sec

Percent in Steady State : 0.00
Average Iterations per Step : 2.01

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
B5	2.34	0.00	0.00	0.91	1.41	3.95	50.92	0.605
B6	2.34	0.00	0.00	0.91	1.41	3.95	50.92	0.605
B7	2.34	0.00	0.00	0.91	1.41	3.95	50.92	0.605
B8	2.34	0.00	0.00	0.91	1.41	3.95	50.92	0.605

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
MH5	JUNCTION	0.68	6.27	5006.27	0 03:11
MH6	JUNCTION	0.63	4.64	5004.24	0 03:11
MH7	JUNCTION	0.97	6.29	5006.29	0 03:17
MH8	JUNCTION	0.92	5.59	5005.49	0 03:17
MH9	JUNCTION	0.88	4.64	5004.34	0 03:18
MH10	JUNCTION	0.83	4.07	5003.67	0 01:23
O5	OUTFALL	0.56	3.00	5002.20	0 01:23
O6	OUTFALL	0.76	3.00	5002.40	0 01:23

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
MH5	JUNCTION	101.82	101.82	0 01:51	7.889	7.891
MH6	JUNCTION	0.00	41.02	0 03:11	0.000	7.889
MH7	JUNCTION	101.82	101.82	0 01:51	7.889	7.891
MH8	JUNCTION	0.00	38.74	0 03:14	0.000	8.761
MH9	JUNCTION	0.00	38.74	0 03:17	0.000	8.763
MH10	JUNCTION	0.00	38.74	0 03:18	0.000	8.763
O5	OUTFALL	0.00	41.02	0 03:12	0.000	7.892

O6	OUTFALL	0.00	38.74	0	03:18	0.000	8.764

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH5	JUNCTION	0.04	3.271	0.000
MH6	JUNCTION	4.93	1.636	1.364
MH7	JUNCTION	2.52	3.290	0.000
MH8	JUNCTION	6.56	2.586	0.414
MH9	JUNCTION	5.79	1.645	1.355
MH10	JUNCTION	5.45	1.065	1.935

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH5	4.89	61.69	0 01:51	1.606	6.27
MH7	5.30	63.97	0 01:51	1.717	6.29

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
O5	99.89	3.24	41.02	7.892
O6	99.85	5.15	38.74	8.764
System	99.87	8.39	79.76	16.656

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
P5	CONDUIT	41.02	0	03:11	5.80	1.94	1.00
P6	CONDUIT	41.02	0	03:12	5.80	1.94	1.00
P7	CONDUIT	38.74	0	03:14	5.48	1.84	1.00
P8	CONDUIT	38.74	0	03:17	5.48	1.84	1.00
P9	CONDUIT	38.74	0	03:18	5.48	1.84	1.00
P10	CONDUIT	38.74	0	03:18	5.48	1.84	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.41	0.0002
P6	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.42	0.0002
P7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.34	0.0003
P8	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.36	0.0002
P9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0004
P10	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.39	0.0077

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
P5	4.91	4.91	4.92	4.95	4.91
P6	4.92	4.92	4.93	4.94	4.92
P7	6.56	6.56	6.56	5.71	6.55
P8	5.79	5.79	5.79	5.75	5.79
P9	5.43	5.43	5.45	5.72	5.43
P10	5.41	5.41	5.43	6.39	5.41

Analysis begun on: Tue Feb 08 08:48:01 2011
Analysis ended on: Tue Feb 08 08:48:01 2011
Total elapsed time: < 1 sec

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 100yr. 24hr. Storm.

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 100yr. 24hr. Storm.
All Subcatchments (Basins) have the same properties than FR (B1) from Run #5 (Sensitivity Analysis #1).
24" RCP - Printed on 2-8-2011

*************************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*************************************************************

****************
Analysis Options
****************
Flow Units ..................... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ DEC-24-2010 00:00:00
Ending Date .............. DEC-28-2010 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Wet Time Step ............ 00:03:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 30.00 sec

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 4
Number of nodes ........... 8
Number of links ........... 6
Number of pollutants ...... 0
Number of land uses ....... 0

****************
Raingage Summary
****************

                                                 Data         Recording
Name                 Data Source                 Type         Interval
--------------------------------------------------------------------
R1                   Rain                        CUMULATIVE    3 min.
```

24-in. RCP

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
B5	102.70	750.00	56.00	0.0958	R1	MH5
B6	102.70	750.00	56.00	0.0958	R1	MH5
B7	102.70	750.00	56.00	0.0958	R1	MH7
B8	102.70	750.00	56.00	0.0958	R1	MH7

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
MH5	JUNCTION	5000.00	6.00	791040.0	
MH6	JUNCTION	4999.60	6.00	0.0	
MH7	JUNCTION	5000.00	6.00	791040.0	
MH8	JUNCTION	4999.90	6.00	0.0	
MH9	JUNCTION	4999.70	6.00	0.0	
MH10	JUNCTION	4999.60	6.00	0.0	
O5	OUTFALL	4999.20	2.00	0.0	
O6	OUTFALL	4999.40	2.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
P5	MH5	MH6	CONDUIT	400.0	0.1000	0.0130
P6	MH6	O5	CONDUIT	400.0	0.1000	0.0130
P7	MH7	MH8	CONDUIT	100.0	0.1000	0.0130
P8	MH8	MH9	CONDUIT	200.0	0.1000	0.0130
P9	MH9	MH10	CONDUIT	100.0	0.1000	0.0130
P10	MH10	O6	CONDUIT	200.0	0.1000	0.0130

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
P5	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P6	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P7	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P8	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P9	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15
P10	CIRCULAR	2.00	3.14	0.50	2.00	1	7.15

****
Control Actions Taken
****

********** Runoff Quantity Continuity **********	Volume acre-feet	Depth inches
Total Precipitation	89.007	2.600
Evaporation Loss	0.000	0.000
Infiltration Loss	33.873	0.989
Surface Runoff	54.561	1.594
Final Surface Storage	0.586	0.017
Continuity Error (%)	-0.016	

********** Flow Routing Continuity **********	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	54.561	17.779
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	57.474	18.729
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
Continuity Error (%)	-5.342	

****
Time-Step Critical Elements
****
Link P9 (24.14%)
Link P7 (17.20%)

****
Highest Flow Instability Indexes
****
Link P10 (17)
Link P6 (13)
Link P9 (9)
Link P5 (4)

****
Routing Time Step Summary
****

Minimum Time Step	:	0.50 sec
Average Time Step	:	21.17 sec
Maximum Time Step	:	30.00 sec

Percent in Steady State : 0.00
Average Iterations per Step : 2.06

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
B5	2.60	0.00	0.00	0.99	1.59	4.44	60.38	0.613
B6	2.60	0.00	0.00	0.99	1.59	4.44	60.38	0.613
B7	2.60	0.00	0.00	0.99	1.59	4.44	60.38	0.613
B8	2.60	0.00	0.00	0.99	1.59	4.44	60.38	0.613

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
MH5	JUNCTION	1.26	6.67	5006.67	0 05:19
MH6	JUNCTION	1.02	4.34	5003.94	0 05:19
MH7	JUNCTION	1.30	6.67	5006.67	0 05:18
MH8	JUNCTION	1.19	5.74	5005.64	0 05:19
MH9	JUNCTION	1.04	4.34	5004.04	0 05:20
MH10	JUNCTION	0.93	3.40	5003.00	0 05:20
O5	OUTFALL	0.74	2.00	5001.20	0 01:16
O6	OUTFALL	0.77	2.00	5001.40	0 01:16

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
MH5	JUNCTION	120.74	120.74	0 01:50	8.888	8.889
MH6	JUNCTION	0.00	17.07	0 05:18	0.000	9.318
MH7	JUNCTION	120.74	120.74	0 01:50	8.888	8.889
MH8	JUNCTION	0.00	17.11	0 05:15	0.000	9.411
MH9	JUNCTION	0.00	17.11	0 05:18	0.000	9.412
MH10	JUNCTION	0.00	17.11	0 05:19	0.000	9.411
O5	OUTFALL	0.00	17.07	0 05:19	0.000	9.316

O6	OUTFALL	0.00	17.11	0	05:20	0.000	9.411

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH5	JUNCTION	3.69	4.672	0.000
MH6	JUNCTION	19.50	2.336	1.664
MH7	JUNCTION	4.38	4.672	0.000
MH8	JUNCTION	19.62	3.740	0.260
MH9	JUNCTION	18.41	2.336	1.664
MH10	JUNCTION	18.01	1.404	2.596

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH5	17.60	104.44	0 01:50	3.977	6.67
MH7	17.58	104.40	0 01:50	3.974	6.67

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
O5	99.88	3.44	17.07	9.316
O6	99.84	3.57	17.11	9.411
System	99.86	7.01	34.18	18.727

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
P5	CONDUIT	17.07	0	05:18	5.43	2.39	1.00
P6	CONDUIT	17.07	0	05:19	5.43	2.39	1.00
P7	CONDUIT	17.11	0	05:15	5.44	2.39	1.00
P8	CONDUIT	17.11	0	05:18	5.44	2.39	1.00
P9	CONDUIT	17.11	0	05:19	5.44	2.39	1.00
P10	CONDUIT	17.11	0	05:20	5.44	2.39	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.31	0.0004
P6	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.32	0.0052
P7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.29	0.0004
P8	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.30	0.0003
P9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.32	0.0005
P10	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.33	0.0116

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
P5	19.50	19.50	19.51	19.32	19.42
P6	18.79	18.79	19.44	19.31	18.78
P7	19.62	19.62	19.63	19.05	19.60
P8	18.41	18.41	18.41	19.11	18.41
P9	18.00	18.00	18.04	19.11	18.00
P10	17.94	17.94	17.97	19.95	17.94

Analysis begun on: Tue Feb 08 08:54:56 2011
Analysis ended on: Tue Feb 08 08:54:56 2011
Total elapsed time: < 1 sec

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 100yr. 24hr. Storm.

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.021)
--------------------------------------------------------------

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 100yr. 24hr. Storm.
All Subcatchments (Basins) have the same properties than FR (B1) from Run #5 (Sensitivity Analysis #1).
36" RCP - Printed on 2-8-2011

*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

****************
Analysis Options
****************
Flow Units ..................... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ DEC-24-2010 00:00:00
Ending Date .............. DEC-28-2010 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Wet Time Step ............ 00:03:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 30.00 sec

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 4
Number of nodes ........... 8
Number of links ........... 6
Number of pollutants ...... 0
Number of land uses ....... 0

****************
Raingage Summary
****************

                                                 Data         Recording
Name                 Data Source                 Type         Interval
--------------------------------------------------------------------
R1                   Rain                        CUMULATIVE    3 min.
```

36-in. RCP

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
B5	102.70	750.00	56.00	0.0958	R1	MH5
B6	102.70	750.00	56.00	0.0958	R1	MH5
B7	102.70	750.00	56.00	0.0958	R1	MH7
B8	102.70	750.00	56.00	0.0958	R1	MH7

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
MH5	JUNCTION	5000.00	6.00	791040.0	
MH6	JUNCTION	4999.60	6.00	0.0	
MH7	JUNCTION	5000.00	6.00	791040.0	
MH8	JUNCTION	4999.90	6.00	0.0	
MH9	JUNCTION	4999.70	6.00	0.0	
MH10	JUNCTION	4999.60	6.00	0.0	
O5	OUTFALL	4999.20	3.00	0.0	
O6	OUTFALL	4999.40	3.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
P5	MH5	MH6	CONDUIT	400.0	0.1000	0.0130
P6	MH6	O5	CONDUIT	400.0	0.1000	0.0130
P7	MH7	MH8	CONDUIT	100.0	0.1000	0.0130
P8	MH8	MH9	CONDUIT	200.0	0.1000	0.0130
P9	MH9	MH10	CONDUIT	100.0	0.1000	0.0130
P10	MH10	O6	CONDUIT	200.0	0.1000	0.0130

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
P5	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P6	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P7	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P8	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P9	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09
P10	CIRCULAR	3.00	7.07	0.75	3.00	1	21.09

****
Control Actions Taken
****

Runoff Quantity Continuity	Volume acre-feet	Depth inches
Total Precipitation	89.007	2.600
Evaporation Loss	0.000	0.000
Infiltration Loss	33.873	0.989
Surface Runoff	54.561	1.594
Final Surface Storage	0.586	0.017
Continuity Error (%)	-0.016	

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	54.561	17.780
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	57.239	18.652
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.000
Continuity Error (%)	-4.911	

****
Time-Step Critical Elements
****
Link P9 (32.15%)
Link P7 (10.24%)

****
Highest Flow Instability Indexes
****
Link P10 (11)
Link P9 (7)
Link P8 (1)

****
Routing Time Step Summary
****

Minimum Time Step	:	0.50 sec
Average Time Step	:	20.99 sec
Maximum Time Step	:	30.00 sec
Percent in Steady State	:	0.00

Average Iterations per Step : 2.01

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
B5	2.60	0.00	0.00	0.99	1.59	4.44	60.38	0.613
B6	2.60	0.00	0.00	0.99	1.59	4.44	60.38	0.613
B7	2.60	0.00	0.00	0.99	1.59	4.44	60.38	0.613
B8	2.60	0.00	0.00	0.99	1.59	4.44	60.38	0.613

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
MH5	JUNCTION	0.70	6.37	5006.37	0 03:21
MH6	JUNCTION	0.65	4.92	5004.52	0 01:23
MH7	JUNCTION	1.00	6.39	5006.39	0 03:26
MH8	JUNCTION	0.95	5.67	5005.57	0 03:27
MH9	JUNCTION	0.90	5.14	5004.84	0 01:22
MH10	JUNCTION	0.85	5.23	5004.83	0 01:22
O5	OUTFALL	0.57	3.00	5002.20	0 01:22
O6	OUTFALL	0.77	3.00	5002.40	0 01:22

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
MH5	JUNCTION	120.75	120.75	0 01:51	8.887	8.889
MH6	JUNCTION	0.00	41.51	0 03:21	0.000	8.891
MH7	JUNCTION	120.75	120.75	0 01:51	8.887	8.889
MH8	JUNCTION	0.00	39.24	0 03:24	0.000	9.753
MH9	JUNCTION	0.00	39.24	0 03:26	0.000	9.755
MH10	JUNCTION	0.00	39.24	0 03:27	0.000	9.756
O5	OUTFALL	0.00	41.51	0 03:21	0.000	8.895
O6	OUTFALL	0.00	39.24	0 03:28	0.000	9.756

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
MH5	JUNCTION	0.02	3.370	0.000
MH6	JUNCTION	5.85	1.921	1.079
MH7	JUNCTION	2.35	3.391	0.000
MH8	JUNCTION	7.40	2.666	0.334
MH9	JUNCTION	6.67	2.141	0.859
MH10	JUNCTION	6.37	2.226	0.774

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
MH5	5.83	80.44	0 01:51	2.189	6.37
MH7	6.27	82.70	0 01:51	2.311	6.39

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
O5	99.89	3.36	41.51	8.895
O6	99.85	5.30	39.24	9.756
System	99.87	8.65	80.75	18.651

****
Link Flow Summary
****

Sensitivity Analysis #2 - Manholes vs. No Manholes Between intersections - 100yr. 24hr. Storm.

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
P5	CONDUIT	41.51	0	03:21	5.87	1.97	1.00
P6	CONDUIT	41.51	0	03:21	5.87	1.97	1.00
P7	CONDUIT	39.24	0	03:24	5.55	1.86	1.00
P8	CONDUIT	39.24	0	03:26	5.55	1.86	1.00
P9	CONDUIT	39.24	0	03:27	5.55	1.86	1.00
P10	CONDUIT	39.24	0	03:28	5.55	1.86	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.41	0.0002
P6	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.42	0.0002
P7	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.34	0.0003
P8	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.36	0.0002
P9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0004
P10	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.39	0.0073

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
P5	5.83	5.83	5.84	5.86	5.83
P6	5.84	5.84	5.85	5.85	5.84
P7	7.40	7.40	7.40	6.60	7.39
P8	6.67	6.67	6.67	6.62	6.67
P9	6.37	6.37	6.38	6.63	6.37
P10	6.35	6.35	6.36	7.24	6.35

Analysis begun on: Tue Feb 08 08:51:36 2011
Analysis ended on: Tue Feb 08 08:51:37 2011
Total elapsed time: 00:00:01