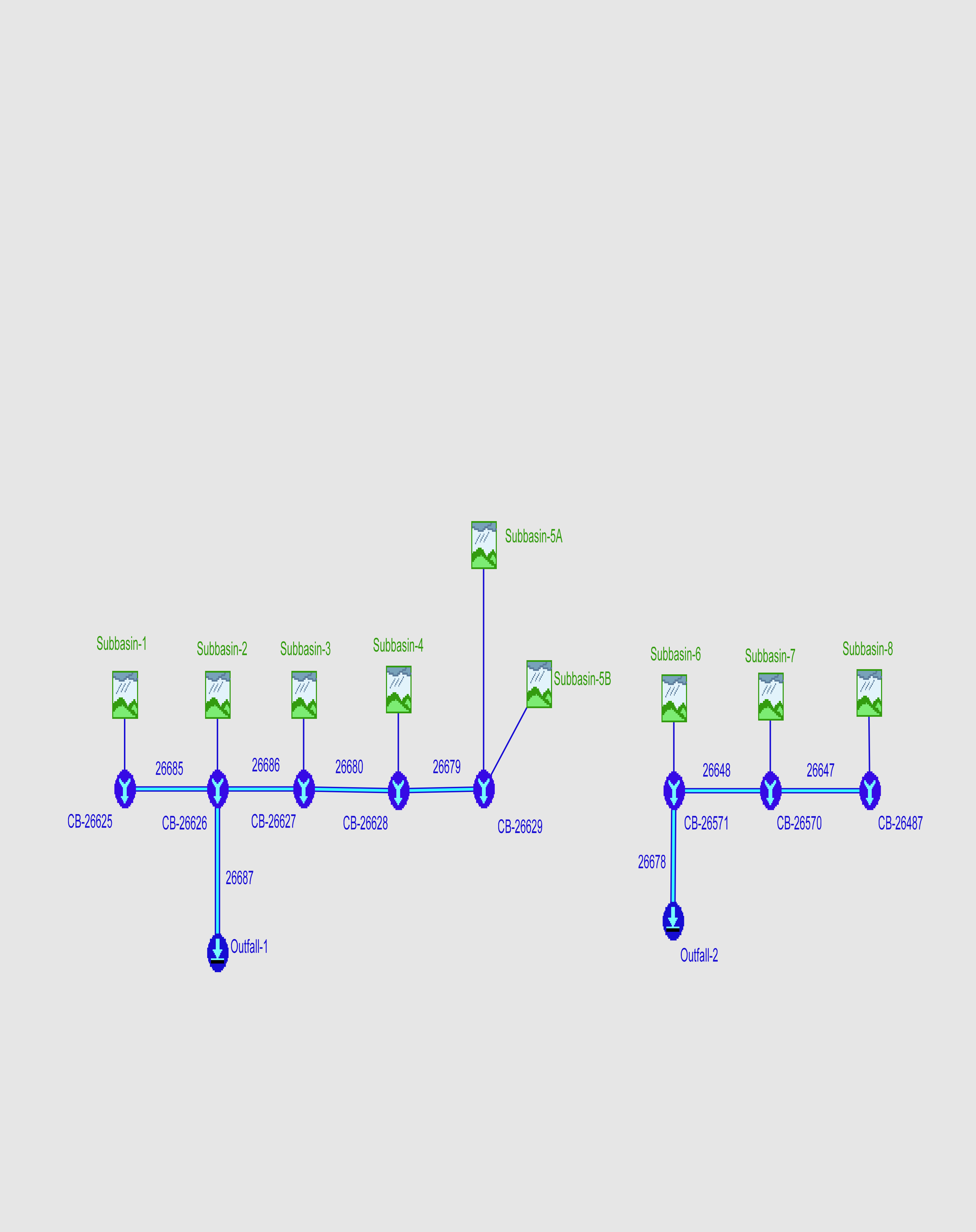
HEC-HMS **Project: Pemberwick Road** **Basin Model:**



HMS * Summary of Results

Project : Pemberwick Road   Run Name : PR-PEM-ALT-1

Start of Run : 30Mar09 0000   Basin Model : PR-PEM-ALT-1

End of Run : 31Mar09 0000   Met. Model : 10-yr

Execution Time : 29May09 1230   Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
Subbasin-1	2.9822	30 Mar 09 1211	0.27700	0.002
CB-26625	2.9822	30 Mar 09 1211	0.27700	0.002
26685	2.9822	30 Mar 09 1211	0.27700	0.002
Subbasin-5A	2.6437	30 Mar 09 1211	0.24552	0.002
Subbasin-5B	3.3541	30 Mar 09 1211	0.31228	0.002
CB-26629	5.9977	30 Mar 09 1211	0.55780	0.004
26679	5.9977	30 Mar 09 1211	0.55780	0.004
Subbasin-4	0.89899	30 Mar 09 1208	0.075578	0.001
CB-26628	6.8312	30 Mar 09 1211	0.63338	0.005
26680	6.8312	30 Mar 09 1211	0.63338	0.005
Subbasin-3	0.74916	30 Mar 09 1208	0.062981	0.001
CB-26627	7.5534	30 Mar 09 1210	0.69636	0.005
26686	7.5534	30 Mar 09 1210	0.69636	0.005
Subbasin-2	1.7980	30 Mar 09 1208	0.15116	0.001
CB-26626	12.263	30 Mar 09 1210	1.1245	0.008
26687	12.263	30 Mar 09 1210	1.1245	0.008
Outfall-1	12.263	30 Mar 09 1210	1.1245	0.008
Subbasin-8	1.2459	30 Mar 09 1208	0.10446	0.001
CB-26487	1.2459	30 Mar 09 1208	0.10446	0.001
26647	1.2459	30 Mar 09 1208	0.10446	0.001
Subbasin-7	1.1987	30 Mar 09 1208	0.10077	0.001
CB-26570	2.4445	30 Mar 09 1208	0.20523	0.002
26648	2.4445	30 Mar 09 1208	0.20523	0.002
Subbasin-6	2.2925	30 Mar 09 1211	0.21394	0.002
CB-26571	4.6446	30 Mar 09 1209	0.41917	0.003
26678	4.6446	30 Mar 09 1209	0.41917	0.003
Outfall-2	4.6446	30 Mar 09 1209	0.41917	0.003

Greenwich, CT

Alternative 1-A - Byram River Watershed - Pemberwick Road - 10-Year

MDP - 5/27/09

Pipe I.D.	Design Notes	Pipe Length (ft)	Approx. Slope (ft/ft) (min= 0.005)	10-Yr Storm Peak Rate of Runoff (cfs)	Pipe Diam (in) Existing	*n* (exist 0.015 new 0.013)	Manning's Pipe Velocity (fps)	Manning's Pipe Capacity (cfs)	Sufficient Capacity (Manning's)	Orifice's Pipe Velocity (fps)	Orifice's Pipe Capacity (cfs)	Sufficient Capacity (Orifice)	Watershed Areas contributing to the flow in the pipe	DS Cover	US Cover	DS Invert	US Invert	DS Ground Elev	US Ground Elev
	Notation	L	S		D	*n*	V_m	Q_m		V_o	Q_o					ID	IU		
	Equation Used		(1)				(2)**	(3)**		(4)*	(5)*								
new	U/S end connect to outfall	15	0.4167	2.6	15	0.013	34.0	41.7	yes	0.0	0.0	no	5-A	2.00	0.00	138.75	145.00	142.00	146.25
new	new strucutres - either end	85	0.6576	2.6	15	0.013	42.7	52.4	yes	0.0	0.0	no	5-A	2.00	2.10	82.75	138.65	86.00	142.00
new	connect to	15	0.0133	2.6	15	0.013	6.1	7.5	yes	0.0	0.0	no	5-A	2.11	8.00	76.55	76.75	79.91	86.00
26679	Q from split	123	0.0037	3.4	15	0.013	3.2	3.9	yes	0.0	0.0	no	5	2.11	1.60	76.55	77.00	79.91	79.85
26680		95	0.0053	6.8	18	0.013	4.3	7.6	yes	0.0	0.0	no	4 & 5	2.18	1.96	75.95	76.45	79.63	79.91
26686		87	0.0080	7.6	18	0.013	5.3	9.4	yes	0.0	0.0	no	3->5	1.25	2.28	75.15	75.85	77.90	79.63
26685		126	0.0140	3.0	12	0.015	4.7	3.7	yes	0.0	0.0	no	1	0.92	1.25	75.98	77.75	77.90	80.00
26687	**OUTFALL**	45	0.0144	12.3	18	0.013	7.1	12.6	yes	0.0	0.0	no	1->5	0.00	1.25	74.50	75.15	76.00	77.90
26647		126	0.0945	1.2	12	0.015	12.1	9.5	yes	0.0	0.0	no	5	0.75	0.75	81.51	93.42	83.26	95.17
26648		132	0.0268	2.4	12	0.015	6.4	5.1	yes	0.0	0.0	no	3->5	1.00	0.92	77.80	81.34	79.80	83.26
26678	**OUTFALL**	39	0.0333	4.6	12	0.013	8.3	6.5	yes	0.0	0.0	no	1->5	0.00	3.00	74.50	75.80	75.50	79.80

* Portion of Split at CB-26629

User Input=	
HMS Results=	
Calculated=	
Proposed Change=	

Equations Used:

(1) S = (IU-ID)/L

(2) $V_m = (1.486/n)*((D/48)^{(2/3)})*(S^{0.5})$

(3) $Q_m = V_m*A$

(4) $V_o = Q_o/A$

(5) $Q_o = c_d*A*((2*g*h)^{0.5})$

*When V_m > 10 fps then Q_o will be checked for capacity under orifice equation.

**When Vm < 10 fps then only Q_m and V_m should be used.

Greenwich, CT | **Alternative 1-B - Byram River Watershed - Pemberwick Road - 10-Year** | MDP - 5/27/09

Pipe I.D.	Design Notes	Pipe Length (ft)	Approx. Slope (ft/ft) (min= 0.005)	10-Yr Storm Peak Rate of Runoff (cfs)	Pipe Diam (in) Existing	*n* (exist 0.015 new 0.013)	Manning's Pipe Velocity (fps)	Manning's Pipe Capacity (cfs)	Sufficient Capacity (Manning's)	Orifice's Pipe Velocity (fps)	Orifice's Pipe Capacity (cfs)	Sufficient Capacity (Orifice)	Watershed Areas contributing to the flow in the pipe	DS Cover	US Cover	DS Invert	US Invert	DS Ground Elev	US Ground Elev
	Notation	L	S		D	*n*	V_m	Q_m		V_o	Q_o					ID	IU		
	Equation Used		(1)				(2)**	(3)**		(4)*	(5)*								
26679	Q from split	123	0.0037	3.4	15	0.013	3.2	3.9	yes	9.8	12.0	yes	5*	2.11	1.60	76.55	77.00	79.91	79.85
26680		95	0.0053	6.8	18	0.013	4.3	7.6	yes	10.8	19.1	yes	4 & 5*	2.18	1.96	75.95	76.45	79.63	79.91
26686		87	0.0080	7.6	18	0.013	5.3	9.4	yes	9.3	16.4	yes	3-5*	1.25	2.28	75.15	75.85	77.90	79.63
26685		126	0.0140	3.0	12	0.015	4.7	3.7	yes	7.8	6.2	yes	1	0.92	1.25	75.98	77.75	77.90	80.00
26687	**OUTFALL**	45	0.0144	12.3	18	0.013	7.1	12.6	yes	5.7	10.1	no	1-5*	0.00	1.25	74.50	75.15	76.00	77.90
26647		126	0.0945	1.2	12	0.015	12.1	9.5	x	7.4	5.8	yes	5*	0.75	0.75	81.51	93.42	83.26	95.17
26648		132	0.0268	2.4	12	0.015	6.4	5.1	yes	7.8	6.2	yes	3-5*	1.00	0.92	77.80	81.34	79.80	83.26
26678	**OUTFALL**	39	0.0333	4.6	12	0.013	8.3	6.5	yes	4.7	3.7	no	1-5*	0.00	3.00	74.50	75.80	75.50	79.80

* Portion of Split at CB-26629

User Input=	
HMS Results=	
Calculated=	
Proposed Change=	

Equations Used:

(1) S = (IU-ID)/L

(2) $V_m = (1.486/n)*((D/48)^{(2/3)})*(S^{0.5})$

(3) $Q_m = V_m*A$

(4) $V_o = Q_o/A$

(5) $Q_o = c_d*A*((2*g*h)^{0.5})$

*When $V_m > 10$ fps then Q_o will be checked for capacity under orifice equation.

**When $V_m < 10$ fps then only Q_m and V_m should be used.

Pemberwick Road, Greenwich, CT - Alternative 1-B - Channel Sizing

Bottom Width	1	*ft*
Side Slope	3	*run/rise*
Freeboard (FB)	1	*ft*

Manning's n Values	
Grass	0.032

						USE SOLVER					
Demand Q	**Length**	**$Elev_{beg}$**	**$Elev_{end}$**	**Slope**	**$A*R^{2/3}$**	**Flow Depth (FD)**	**set = $A*R^{2/3}$**	**Req. Depth = FD + FB**	**CHECK**	**Top Width**	**Velocity**
cfs	*ft*			*ft/ft*		*ft*	*change Flow Depth*	*ft*	*solver complete*	*ft*	*ft/sec*
2.64	25.00	148.00	146.00	0.080	0.201	0.31	0.201	1.31	OKAY	8.8	5.39

Hydraulic Gradeline Calculations

Pemberwick Road - Greenwich, CT

Alternative 1 - 10-Year Storm

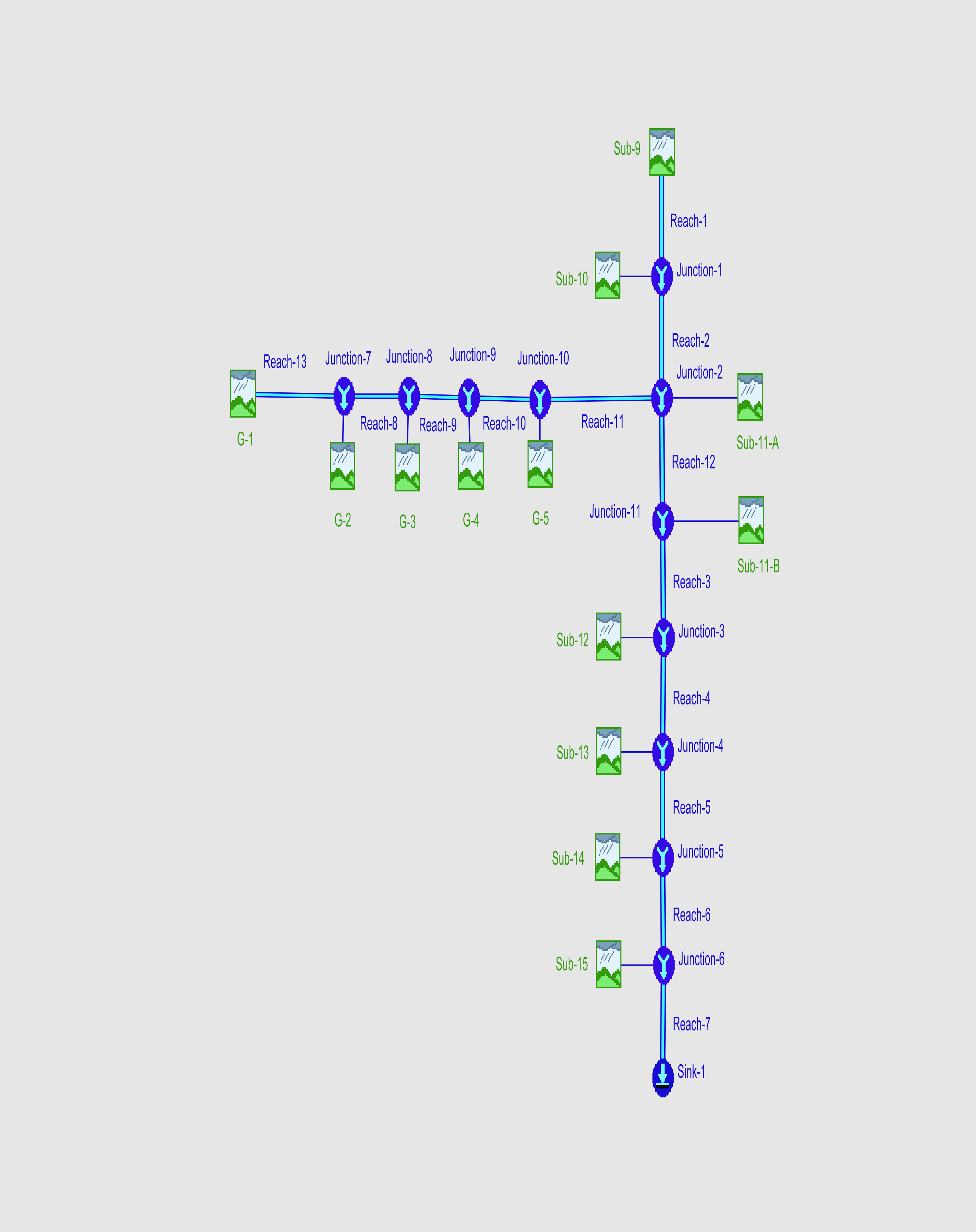
	Water Surface Elevation	10-Yr Storm Peak Rate of Runoff (cfs)	Surface Elev. @ Inlet	Surface Elev. @ Outlet	Pipe Segment	Pipe Length (ft)	Pipe Diam (in)	Area (sf)	HGL Slope	Freeboard (ft)
ALT 1-A only	77.95	2.6	146.25	142.00	new	15	15	1.23	0.0017	68.3
	77.92	2.6	142.00	86.00	new	85	15	1.23	0.0017	64.1
	77.78	2.6	86.00	79.91	new	15	15	1.23	0.0017	8.2

Water Surface Elevation	10-Yr Storm Peak Rate of Runoff (cfs)	Surface Elev. @ Inlet	Surface Elev. @ Outlet	Pipe Segment	Pipe Length (ft)	Pipe Diam (in)	Area (sf)	HGL Slope	Freeboard (ft)
77.76	6.0	79.85	79.91	26679	123	18	1.77	0.0032	2.1
77.36	6.8	79.91	79.63	26680	95	18	1.77	0.0042	2.6
76.96	7.6	79.63	77.90	26686	87	18	1.77	0.0051	2.7
77.39	3.0	80.00	77.90	26685	126	12	0.79	0.0070	2.6
76.51	12.3	77.90	76.00	26687	45	18	1.77	0.0136	1.4
75.90	*Starting Water Surface Elevation								

Water Surface Elevation	10-Yr Storm Peak Rate of Runoff (cfs)	Surface Elev. @ Inlet	Surface Elev. @ Outlet	Pipe Segment	Pipe Length (ft)	Pipe Diam (in)	Area (sf)	HGL Slope	Freeboard (ft)
77.33	1.2	95.17	83.26	26647	126	12	0.79	0.0012	17.8
77.18	2.4	83.26	79.80	26648	132	12	0.79	0.0047	6.1
76.56	4.6	79.80	75.50	26678	39	12	0.79	0.0169	3.2
75.90	*Starting Water Surface Elevation								

*Starting water surface elevations are taken from models created by CDM as part of a study on the Byram River.

HEC-HMS **Project: Pemberwick Road** **Basin Model: PR-BV**

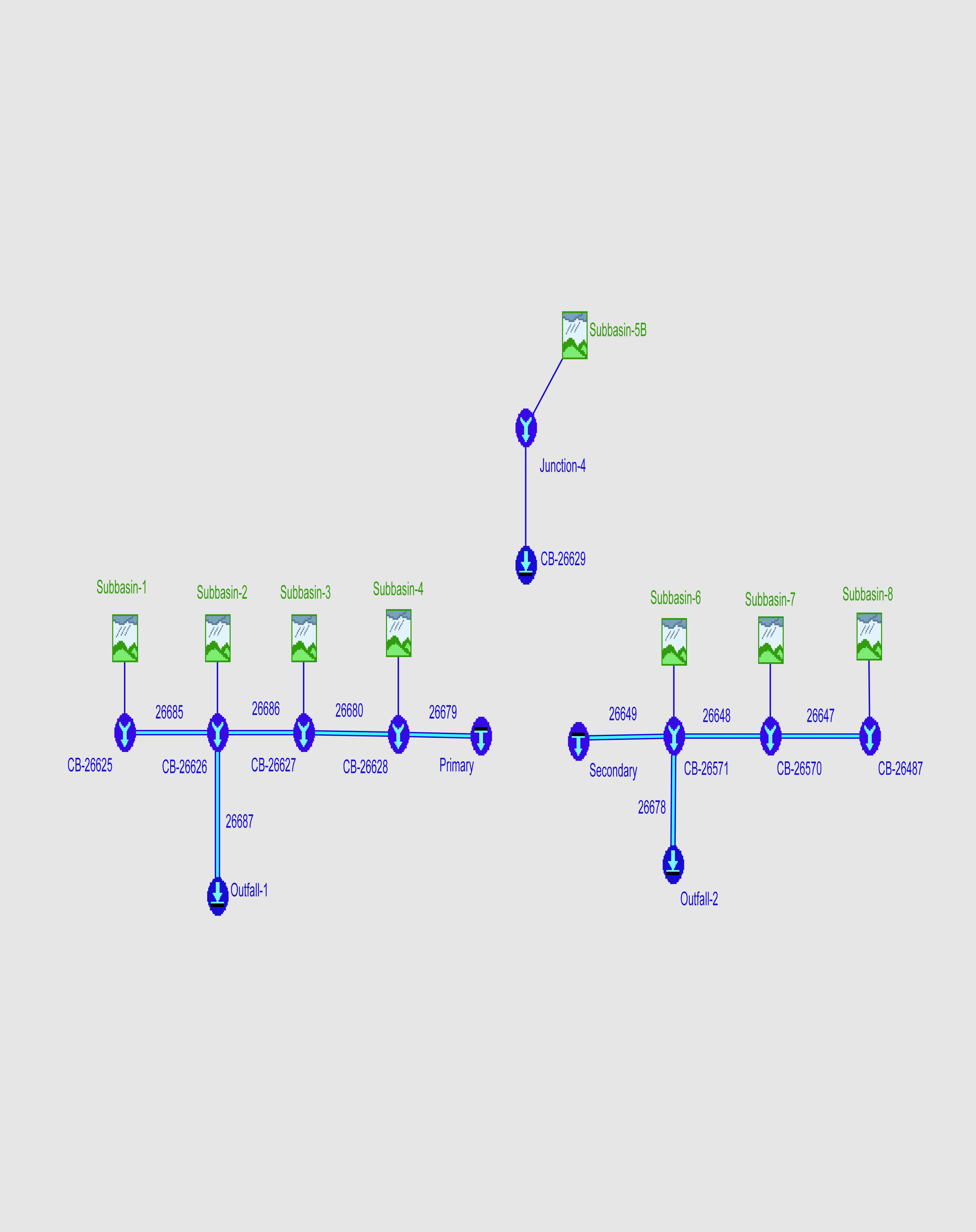


HMS * Summary of Results

Project : Pemberwick Road　　Run Name : PR-BV

Start of Run : 30Mar09 0000　　Basin Model : PR-BV
End of Run : 31Mar09 0000　　Met. Model : 10-yr
Execution Time : 29May09 0915　　Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
G-1	2.3327	30 Mar 09 1211	0.21664	0.002
Reach-13	2.3327	30 Mar 09 1211	0.21664	0.002
G-2	0.86219	30 Mar 09 1208	0.072274	0.001
Junction-7	3.1493	30 Mar 09 1210	0.28891	0.002
Reach-8	3.1493	30 Mar 09 1210	0.28891	0.002
G-3	1.0346	30 Mar 09 1208	0.086729	0.001
Junction-8	4.1531	30 Mar 09 1209	0.37564	0.003
Reach-9	4.1531	30 Mar 09 1209	0.37564	0.003
G-4	0.34488	30 Mar 09 1208	0.028910	0.000
Junction-9	4.4941	30 Mar 09 1209	0.40455	0.003
Reach-10	4.4941	30 Mar 09 1209	0.40455	0.003
G-5	0.86219	30 Mar 09 1208	0.072274	0.001
Junction-10	5.3467	30 Mar 09 1209	0.47682	0.003
Reach-11	5.3467	30 Mar 09 1209	0.47682	0.003
Sub-9	10.108	30 Mar 09 1211	0.93876	0.006
Reach-1	10.108	30 Mar 09 1211	0.93876	0.006
Sub-10	23.638	30 Mar 09 1211	2.1952	0.015
Junction-1	33.746	30 Mar 09 1211	3.1340	0.022
Reach-2	33.746	30 Mar 09 1211	3.1340	0.022
Sub-11-A	7.4645	30 Mar 09 1211	0.69323	0.005
Junction-2	46.395	30 Mar 09 1211	4.3041	0.030
Reach-12	46.395	30 Mar 09 1211	4.3041	0.030
Sub-11-B	3.5767	30 Mar 09 1211	0.33217	0.002
Junction-11	49.972	30 Mar 09 1211	4.6362	0.032
Reach-3	49.972	30 Mar 09 1211	4.6362	0.032
Sub-12	4.6653	30 Mar 09 1211	0.43327	0.003
Junction-3	54.637	30 Mar 09 1211	5.0695	0.035
Reach-4	54.637	30 Mar 09 1211	5.0695	0.035
Sub-13	5.4429	30 Mar 09 1211	0.50548	0.004
Junction-4	60.080	30 Mar 09 1211	5.5750	0.039
Reach-5	60.080	30 Mar 09 1211	5.5750	0.039
Sub-14	3.5767	30 Mar 09 1211	0.33217	0.002
Junction-5	63.656	30 Mar 09 1211	5.9072	0.041
Reach-6	63.656	30 Mar 09 1211	5.9072	0.041
Sub-15	5.4429	30 Mar 09 1211	0.50548	0.004
Junction-6	69.099	30 Mar 09 1211	6.4126	0.044
Reach-7	69.099	30 Mar 09 1211	6.4126	0.044
Sink-1	69.099	30 Mar 09 1211	6.4126	0.044

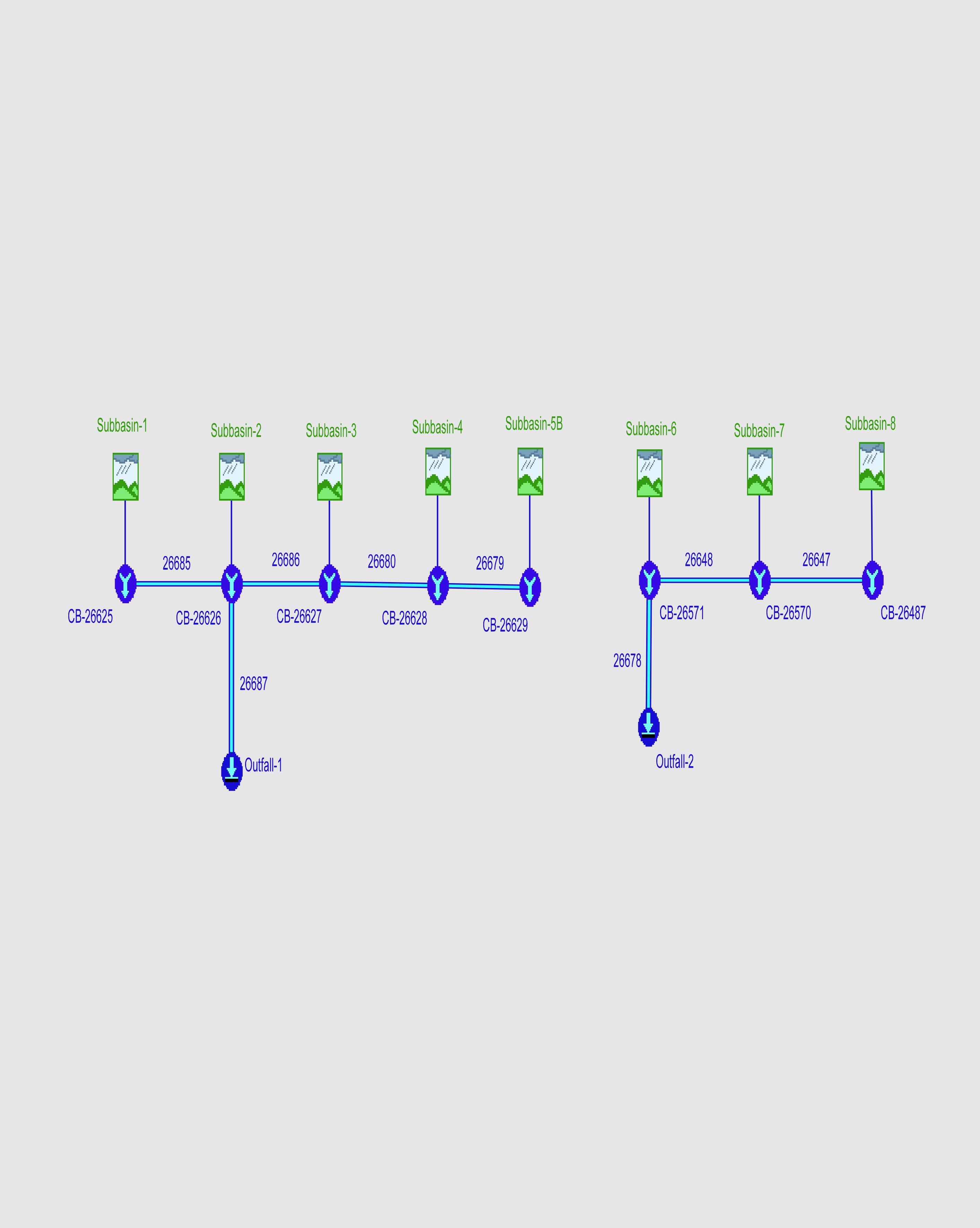

Subbasin-5B
Junction-4
CB-26629
Subbasin-1
Subbasin-2
Subbasin-3
Subbasin-4
26685
26686
26680
26679
CB-26625
CB-26626
CB-26627
CB-26628
Primary
26687
Outfall-1
Subbasin-6
Subbasin-7
Subbasin-8
26649
26648
26647
Secondary
CB-26571
CB-26570
CB-26487
26678
Outfall-2

HMS * Summary of Results

Project : Pemberwick Road   Run Name : EX-PEM-ALT-2

Start of Run : 30Mar09 0000   Basin Model : EX-PEM-ALT-2
End of Run : 31Mar09 0000   Met. Model : 10-yr
Execution Time : 29May09 0921   Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
Subbasin-1	2.9822	30 Mar 09 1211	0.27700	0.002
CB-26625	2.9822	30 Mar 09 1211	0.27700	0.002
26685	2.9822	30 Mar 09 1211	0.27700	0.002
Primary	2.0354	29 Mar 09 2400	4.0372	
26679	2.0354	29 Mar 09 2400	4.0372	0.000
Subbasin-4	0.89899	30 Mar 09 1208	0.075578	0.001
CB-26628	2.9344	30 Mar 09 1208	4.1127	0.001
26680	2.9344	30 Mar 09 1208	4.1127	0.000
Subbasin-3	0.74916	30 Mar 09 1208	0.062981	0.001
CB-26627	3.6836	30 Mar 09 1208	4.1757	0.001
26686	3.6836	30 Mar 09 1208	4.1757	0.000
Subbasin-2	1.7980	30 Mar 09 1208	0.15116	0.001
CB-26626	8.3739	30 Mar 09 1209	4.6039	0.003
26687	8.3739	30 Mar 09 1209	4.6039	0.000
Outfall-1	8.3739	30 Mar 09 1209	4.6039	0.000
Subbasin-5B	3.3541	30 Mar 09 1211	0.31228	0.002
Junction-4	3.3541	30 Mar 09 1211	0.31228	0.002
CB-26629	3.3541	30 Mar 09 1211	0.31228	0.002
Secondary	1.3187	29 Mar 09 2400	2.6156	
26649	1.3187	29 Mar 09 2400	2.6156	0.000
Subbasin-8	1.2459	30 Mar 09 1208	0.10446	0.001
CB-26487	1.2459	30 Mar 09 1208	0.10446	0.001
26647	1.2459	30 Mar 09 1208	0.10446	0.001
Subbasin-7	1.1987	30 Mar 09 1208	0.10077	0.001
CB-26570	2.4445	30 Mar 09 1208	0.20523	0.002
26648	2.4445	30 Mar 09 1208	0.20523	0.002
Subbasin-6	2.2925	30 Mar 09 1211	0.21394	0.002
CB-26571	5.9633	30 Mar 09 1209	3.0348	0.002
26678	5.9633	30 Mar 09 1209	3.0348	0.000
Outfall-2	5.9633	30 Mar 09 1209	3.0348	0.000


Subbasin-1
Subbasin-2
Subbasin-3
Subbasin-4
Subbasin-5B
Subbasin-6
Subbasin-7
Subbasin-8
26685
26686
26680
26679
26648
26647
CB-26625
CB-26626
CB-26627
CB-26628
CB-26629
CB-26571
CB-26570
CB-26487
26687
26678
Outfall-1
Outfall-2

HMS * Summary of Results

Project : Pemberwick Road   Run Name : PR-PEM-ALT-2

Start of Run : 30Mar09 0000   Basin Model : PR-PEM-ALT-2
End of Run : 31Mar09 0000   Met. Model : 10-yr
Execution Time : 29May09 1231   Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
Subbasin-1	2.9822	30 Mar 09 1211	0.27700	0.002
CB-26625	2.9822	30 Mar 09 1211	0.27700	0.002
26685	2.9822	30 Mar 09 1211	0.27700	0.002
Subbasin-5B	3.3541	30 Mar 09 1211	0.31228	0.002
CB-26629	3.3541	30 Mar 09 1211	0.31228	0.002
26679	3.3541	30 Mar 09 1211	0.31228	0.002
Subbasin-4	0.89899	30 Mar 09 1208	0.075578	0.001
CB-26628	4.1987	30 Mar 09 1210	0.38785	0.003
26680	4.1987	30 Mar 09 1210	0.38785	0.003
Subbasin-3	0.74916	30 Mar 09 1208	0.062981	0.001
CB-26627	4.9231	30 Mar 09 1210	0.45084	0.003
26686	4.9231	30 Mar 09 1210	0.45084	0.003
Subbasin-2	1.7980	30 Mar 09 1208	0.15116	0.001
CB-26626	9.6327	30 Mar 09 1210	0.87899	0.006
26687	9.6327	30 Mar 09 1210	0.87899	0.006
Outfall-1	9.6327	30 Mar 09 1210	0.87899	0.006
Subbasin-8	1.2459	30 Mar 09 1208	0.10446	0.001
CB-26487	1.2459	30 Mar 09 1208	0.10446	0.001
26647	1.2459	30 Mar 09 1208	0.10446	0.001
Subbasin-7	1.1987	30 Mar 09 1208	0.10077	0.001
CB-26570	2.4445	30 Mar 09 1208	0.20523	0.002
26648	2.4445	30 Mar 09 1208	0.20523	0.002
Subbasin-6	2.2925	30 Mar 09 1211	0.21394	0.002
CB-26571	4.6446	30 Mar 09 1209	0.41917	0.003
26678	4.6446	30 Mar 09 1209	0.41917	0.003
Outfall-2	4.6446	30 Mar 09 1209	0.41917	0.003

HYDROLOGIC ANALYSIS - PEMBERWICK ROAD - GREENWICH, CT

Pemberwick Road - Subwatershed Areas

MDP - 5-27-09

		Area			T_c used	CN	Initial Loss	Lag Time	Peak Rate of Runoff
	SUB-WATERSHED	*sf*	*acres*	*mi²*	*min*		*in*	*hr*	*10-Yr*
EXISTING PEMBERWICK ROAD	1	49,707	1.14	0.0018	15	80	0.50	0.15	3.0
	2	33,914	0.78	0.0012	10	74	0.70	0.10	1.8
	3	12,882	0.30	0.0005	10	74	0.70	0.10	0.7
	4	16,349	0.38	0.0006	10	74	0.70	0.10	0.9
	5-B	67,436	1.55	0.0024	15	75	0.67	0.15	3.4
	6	48,684	1.12	0.0017	15	74	0.70	0.15	2.3
	7	22,609	0.52	0.0008	10	74	0.70	0.10	1.2
	8	19,863	0.46	0.0007	10	79	0.53	0.10	1.2
BUENA VISTA (ALT-2)	G-1	46,186	1.06	0.0017	15	78	0.56	0.15	2.3
	G-2	15,180	0.35	0.0005	10	78	0.56	0.10	0.1
	G-3	17,452	0.40	0.0006	10	78	0.56	0.10	1.0
	G-4	6,183	0.14	0.0002	10	78	0.56	0.10	0.3
	G-5	13,784	0.32	0.0005	10	78	0.56	0.10	0.9
	9	182,543	4.19	0.0065	15	78	0.56	0.15	10.1
	10	422,560	9.70	0.0152	15	78	0.56	0.15	26.3
	11-A	133,953	3.08	0.0048	15	78	0.56	0.15	7.5
	11-B	62,903	1.44	0.0023	15	78	0.56	0.15	3.6
	12	82,400	1.89	0.0030	15	78	0.56	0.15	4.7
	13	98,247	2.26	0.0035	15	78	0.56	0.15	5.9
	14	63,908	1.47	0.0023	15	78	0.56	0.15	3.6
	15	96,775	2.22	0.0035	15	78	0.56	0.15	5.4

HYDRAULIC ANALYSIS - PEMBERWICK ROAD - GREENWICH, CT

PEMBERWICK ROAD - ALT 2 - REDUCED DEMAND MDP - 5/27/09
SPLIT FLOW ANALYSIS (ORIFICE): 10-YEAR STORM

Q_{total} [cfs] = 3.3541

PRIMARY

D_1 [in] =	12
C_1 =	0.82
I_1 =	77.93

SECONDARY

D_2 [in] =	12
C_2 =	0.82
I_2 =	78.02

$Q_{total} = [C_1*A_1*(2g(\Delta H+(I_2-I_1)))^{1/2}]+[C_2*A_2*(2g(\Delta H))^{1/2}]$

USE MS EXCEL SOLVER TO GET ΔH

Q_{total} [cfs] =	3.3541
ΔH [ft] =	0.0651

$Q_{primary}$ [cfs] =	2.0354	
$Q_{secondary}$ [cfs] =	1.3187	
Q_{total} [cfs] =	3.3541	OKAY

Greenwich, CT — **Alternative 2 - Existing Pipes After Diversion- Byram River Watershed - Pemberwick Road - 10-Year** — MDP - 5/27/09

Pipe I.D.	Design Notes	Pipe Length (ft)	Approx. Slope (ft/ft) (min= 0.005)	10-Yr Storm Peak Rate of Runoff (cfs)	Pipe Diam (in) Existing	*n* (exist 0.015 new 0.013)	Manning's Pipe Velocity (fps)	Manning's Pipe Capacity (cfs)	Sufficient Capacity (Manning's)	Orifice's Pipe Velocity (fps)	Orifice's Pipe Capacity (cfs)	Sufficient Capacity (Orifice)	Watershed Areas contributing to the flow in the pipe	DS Cover	US Cover	DS Invert	US Invert	DS Ground Elev	US Ground Elev
	Notation	L	S		D	*n*	V_m	Q_m		V_o	Q_o					ID	IU		
	Equation Used		(1)				(2)**	(3)**		(4)*	(5)*								
26679	Q from split	123	0.0042	2.0	12	0.015	2.6	2.0	no	7.8	6.2	yes	5	1.50	0.92	77.41	77.93	79.91	79.85
26680	neg. slope, use actual head	95	0.0000	2.9	12	0.015	0.1	0.1	no	8.1	6.3	yes	4 & 5	1.00	1.58	77.63	77.63	79.63	79.91
26686		87	0.0190	3.7	12	0.015	5.4	4.3	yes	8.1	6.3	yes	3->5	1.00	1.08	75.90	77.55	77.90	79.63
26685		126	0.0140	3.0	12	0.015	4.7	3.7	yes	7.8	6.2	yes	1	0.92	1.25	75.98	77.75	77.90	80.00
26687	**OUTFALL**	45	0.0238	8.4	12	0.015	6.1	4.8	no	4.7	3.7	no	1->5	0.00	1.33	74.50	75.57	75.50	77.90
26647		126	0.0945	1.2	12	0.015	12.1	9.5	x	7.4	5.8	yes	5	0.75	0.75	81.51	93.42	83.26	95.17
26648		132	0.0268	2.4	12	0.015	6.4	5.1	yes	7.8	6.2	yes	3->5	1.00	0.92	77.80	81.34	79.80	83.26
26649	Q from split	129	0.0017	1.3	12	0.015	1.6	1.3	no	7.6	6.0	yes	1	1.00	0.83	77.80	78.02	79.80	79.85
26678	**OUTFALL** - velocity	39	0.0803	6.0	12	0.015	11.1	8.7	x	4.7	3.7	no	1->5	0.00	1.17	74.50	77.63	75.50	79.80

* Portion of Split at CB-26629

User Input =	
HMS Results =	
Calculated =	
Velocity > 10 fps; OR <3 fps =	

Equations Used:

(1) S = (IU-ID)/L

(2) $V_m = (1.486/n)*((D/48)^{(2/3)})*(S^{0.5})$

(3) $Q_m = V_m*A$

(4) $V_o = Q_o/A$

(5) $Q_o = c_d*A*((2*g*h)^{0.5})$

*When V_m > 10 fps then Q_o will be checked for capacity under orifice equation.

**When Vm < 10 fps then only Q_m and V_m should be used.

Greenwich, CT

Alternative 2 - Divert Flows from Greenway Drive - Byram River Watershed - Pemberwick Road - 10-Year

MDP - 5/27/09

Pipe I.D.	Design Notes	Pipe Length (ft)	Approx. Slope (ft/ft) (min= 0.005)	10-Yr Storm Peak Rate of Runoff (cfs)	Pipe Diam (in) Existing	*n* (exist 0.015 new 0.013)	Manning's Pipe Velocity (fps)	Manning's Pipe Capacity (cfs)	Sufficient Capacity (Manning's)	Orifice's Pipe Velocity (fps)	Orifice's Pipe Capacity (cfs)	Sufficient Capacity (Orifice)	Watershed Areas contributing to the flow in the pipe	DS Cover	US Cover	DS Invert	US Invert	DS Ground Elev	US Ground Elev
	Notation	L	S		D	*n*	V_m	Q_m		V_o	Q_o					ID	IU		
	Equation Used		(1)				(2)**	(3)**		(4)*	(5)*								
26679	Q from split	123	0.0061	3.4	15	0.013	4.1	5.0	yes	9.0	11.1	yes	5	2.06	1.25	76.60	77.35	79.91	79.85
26680		95	0.0084	4.2	15	0.013	4.8	5.9	yes	11.0	13.5	yes	4 & 5	2.68	2.16	75.70	76.50	79.63	79.91
26686		87	0.0069	4.9	15	0.013	4.4	5.4	yes	9.9	12.2	yes	3->5	1.65	2.78	75.00	75.60	77.90	79.63
26685		126	0.0140	3.0	12	0.015	4.7	3.7	yes	7.8	6.2	yes	1	0.92	1.25	75.98	77.75	77.90	80.00
26687	**OUTFALL**	45	0.0089	9.6	18	0.013	5.6	9.9	yes	5.7	10.1	yes	1->5	0.00	1.50	74.50	74.90	76.00	77.90

26647		126	0.0945	1.2	12	0.015	12.1	9.5	yes	7.4	5.8	yes	5	0.75	0.75	81.51	93.42	83.26	95.17
26648		132	0.0268	2.4	12	0.015	6.4	5.1	yes	7.8	6.2	yes	3->5	1.00	0.92	77.80	81.34	79.80	83.26
26678	**OUTFALL**	39	0.0333	4.6	12	0.013	8.3	6.5	yes	4.7	3.7	no	1->5	0.00	3.00	74.50	75.80	75.50	79.80

* Portion of Split at CB-26629

User Input=	(light grey)
HMS Results=	(dark grey)
Calculated=	(white)
Proposed Change=	(green)

Equations Used:

(1) S = (IU-ID)/L

(2) $V_m = (1.486/n)*((D/48)^{(2/3)})*(S^{0.5})$

(3) $Q_m = V_m*A$

(4) $V_o = Q_o/A$

(5) $Q_o = c_d*A*((2*g*h)^{0.5})$

*When $V_m > 10$ fps then Q_o will be checked for capacity under orifice equation.

**When $V_m < 10$ fps then only Q_m and V_m should be used.

Hydraulic Gradeline Calculations

Pemberwick Road - Greenwich, CT

Alternative 2 - 10-Year Storm

Water Surface Elevation	10-Yr Storm Peak Rate of Runoff (cfs)	Surface Elev. @ Inlet	Surface Elev. @ Outlet	Pipe Segment	Pipe Length (ft)	Pipe Diam (in)	Area (sf)	HGL Slope	Freeboard (ft)
77.51	3.4	79.85	79.91	26679	123	15	1.23	0.0027	2.3
77.18	4.2	79.91	79.63	26680	95	15	1.23	0.0042	2.7
76.78	4.9	79.63	77.90	26686	87	15	1.23	0.0058	2.9
77.15	3.0	80.00	77.90	26685	126	12	0.79	0.0070	2.8
76.28	9.6	77.90	76.00	26687	45	18	1.77	0.0084	1.6
75.90	*Starting Water Surface Elevation								

77.33	1.2	95.17	83.26	26647	126	12	0.79	0.0012	17.8
77.18	2.4	83.26	79.80	26648	132	12	0.79	0.0047	6.1
76.56	4.6	79.80	75.50	26678	39	12	0.79	0.0169	3.2
75.90	*Starting Water Surface Elevation								

*Starting water surface elevations are taken from models created by CDM as part of a study on the Byram River.

Greenwich, CT **Alternative 2 - Proposed Pipes - Byram River Watershed - Buena Vista Drive - 10-Year** MDP - 5/27/09

Pipe I.D.	Design Notes	Pipe Length (ft)	Approx. Slope (ft/ft) (min= 0.005)	10-Yr Storm Peak Rate of Runoff (cfs)	Pipe Diam (in) Existing	*n* (exist 0.015 new 0.013)	Manning's Pipe Velocity (fps)	Manning's Pipe Capacity (cfs)	Sufficient Capacity (Manning's)	Orifice's Pipe Velocity (fps)	Orifice's Pipe Capacity (cfs)	Sufficient Capacity (Orifice)	Watershed Areas contributing to the flow in the pipe	DS Cover	US Cover	DS Invert	US Invert	DS Ground Elev	US Ground Elev
	Notation	L	S		D	*n*	V_m	Q_m		V_o	Q_o					ID	IU		
	Equation Used		(1)				(2)**	(3)**		(4)*	(5)*								
new		172	0.0058	2.3	12	0.013	3.5	2.7	yes	11.4	8.9	yes	G-1	7.00	4.00	164.00	165.00	172.00	170.00
new		171	0.0468	3.1	12	0.013	9.8	7.7	yes	11.4	8.9	yes	G-1 - G-2	3.00	10.50	152.50	160.50	156.50	172.00
new	topo. contraints - high vel.	118	0.0593	4.2	12	0.013	11.0	8.7	yes	11.4	8.9	yes	G-1 - G-3	3.00	9.50	139.00	146.00	143.00	156.50
new		184	0.1033	4.5	12	0.013	14.6	11.4	yes	11.4	8.9	yes	G-1 - G-4	3.00	7.00	116.00	135.00	120.00	143.00
new		27	0.0333	5.3	12	0.013	8.3	6.5	yes	11.4	8.9	yes	G-1 - G-5	4.00	3.10	115.00	115.90	120.00	120.00
26133-N	add manhole, CB's	239	0.0069	46.4	36	0.013	7.8	55.4	yes	11.4	80.5	yes	G, 9-11-A	4.90	3.00	112.35	114.00	120.25	120.00
26133-S		125	0.0100	50.0	36	0.013	9.4	66.7	yes	11.4	80.5	yes	G, 9-11-B	4.79	5.00	111.00	112.25	118.79	120.25
26134		157	0.0102	54.6	36	0.013	9.5	67.3	yes	11.4	80.5	yes	G, 9-12	3.70	4.89	109.30	110.90	116.00	118.79
25574		65	0.0100	60.8	36	0.013	9.4	66.7	yes	11.4	80.5	yes	G, 9-13	3.55	3.80	108.55	109.20	115.10	116.00
25575		96	0.0099	60.8	36	0.013	9.4	66.4	yes	11.4	80.5	yes	G, 9-13	3.00	3.65	107.50	108.45	113.50	115.10
new	new drains in Buena Vista	128	0.0102	63.7	36	0.013	9.5	67.2	yes	11.4	80.5	yes	G, 9-14	6.15	3.10	106.10	107.40	115.25	113.50
new	abandon drains on private	102	0.0098	63.7	36	0.013	9.3	66.0	yes	11.4	80.5	yes	G, 9-14	11.75	6.25	105.00	106.00	119.75	115.25
new	property, eliminate outfall over	43	0.0105	63.7	36	0.013	9.7	68.2	yes	11.4	80.5	yes	G, 9-15	5.55	11.85	104.45	104.90	113.00	119.75
new	catch basin	60	0.0108	63.7	36	0.013	9.8	69.4	yes	11.4	80.5	yes	G, 9-14	3.00	8.05	101.30	101.95	107.30	113.00
25581	new drop manhole	55	0.0111	69.0	36	0.013	9.9	70.2	yes	11.2	79.2	yes	G, 9-15	1.40	8.96	94.73	95.34	99.13	107.30
2300	primary - maintain flow (weir)	11	0.0391	6.1	12	0.015	7.8	6.1	yes	4.7	3.7	no	G, 9-15	0.00	2.20	95.50	95.93	96.50	99.13
no name	secondary - weir control	35	0.0100	62.9	36	0.013	9.4	66.7	yes	8.1	56.9	no	G, 9-15	0.00	0.28	95.50	95.85	98.50	99.13

User Input=	
HMS Results=	
Calculated=	
Proposed Change=	

Equations Used:

(1) $S = (IU-ID)/L$

(2) $V_m = (1.486/n)*((D/48)^(2/3))*(S^0.5)$

(3) $Q_m = V_m*A$

(4) $V_o = Q_o/A$

(5) $Q_o = c_d*A*((2*g*h)^0.5)$

*When V_m > 10 fps then Q_o will be checked for capacity under orifice equation.

**When Vm < 10 fps then only Q_m and V_m should be used.

Hydraulic Gradeline Calculations

Buena Vista Drive - Greenwich, CT

Alternative 2 - 10-Year Storm

Water Surface Elevation	10-Yr Storm Peak Rate of Runoff (cfs)	Surface Elev. @ Inlet	Surface Elev. @ Outlet	Pipe Segment	Pipe Length (ft)	Pipe Diam (in)	Area (sf)	HGL Slope	Freeboard (ft)
111.82	2.3	170.00	172.00	new	172	12	0.79	0.0043	58.2
111.09	3.1	172.00	156.50	new	171	12	0.79	0.0078	60.9
109.76	4.2	156.50	143.00	new	118	12	0.79	0.0135	46.7
108.17	4.5	143.00	120.00	new	184	12	0.79	0.0158	34.8
105.26	5.3	120.00	120.00	new	27	12	0.79	0.0224	14.7
104.65	46.4	120.00	120.25	26133-N	239	36	7.07	0.0048	15.3
103.50	50.0	120.25	118.79	26133-S	125	36	7.07	0.0056	16.7
102.80	54.6	118.79	116.00	26134	157	36	7.07	0.0067	16.0
101.75	60.8	116.00	115.10	25574	65	36	7.07	0.0083	14.2
101.22	60.8	115.10	113.50	25575	96	36	7.07	0.0083	13.9
100.42	63.7	113.50	115.25	new	128	36	7.07	0.0091	13.1
99.26	63.7	115.25	119.75	new	102	36	7.07	0.0091	16.0
98.34	63.7	119.75	113.00	new	43	36	7.07	0.0091	21.4
97.95	63.7	113.00	107.30	new	60	36	7.07	0.0091	15.0
97.41	69.0	107.30	99.13	25581	55	36	7.07	0.0106	9.9
96.82	6.1	99.13	96.50	2300	11	12	0.79	0.0292	2.3
96.50	*Starting Water Surface Elevation								

*Starting water surface elevation is assumed to be equal to crown of primary outfall.