BANGOR HYDRO-ELECTRIC
NORTHEAST RELIABILITY INTERCONNECT

SECTION 12 - STORMWATER MANAGEMENT

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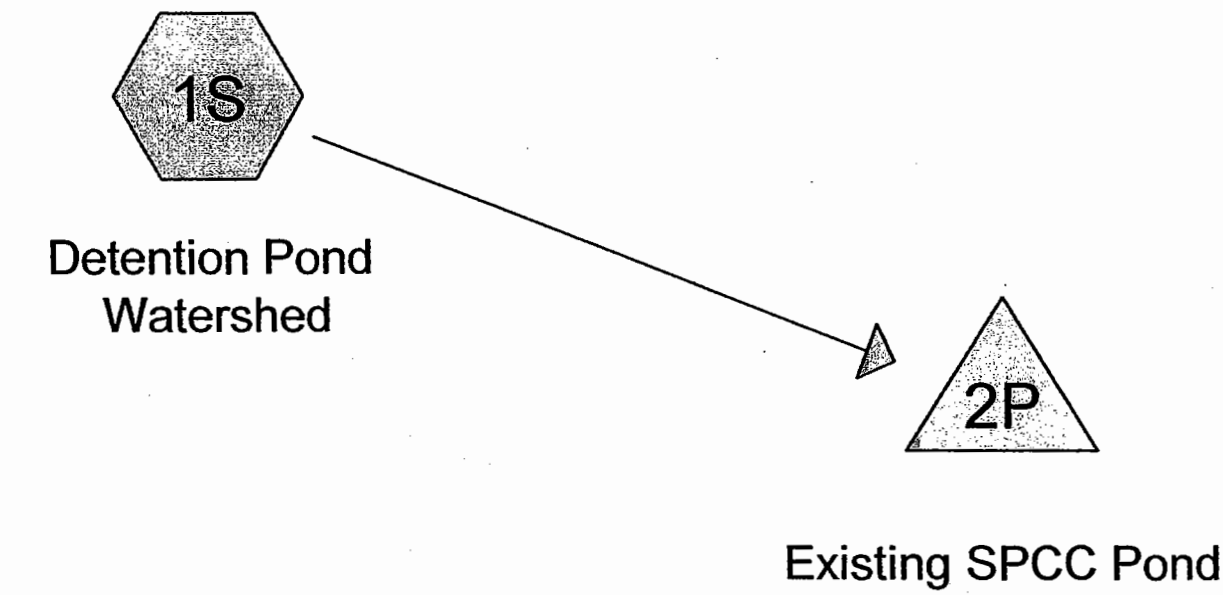

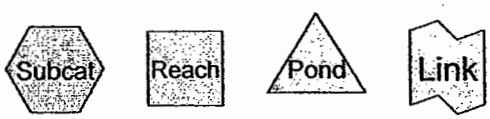

Drainage Diagram for Existing Condition
Prepared by E/PRO Consulting, LLC--DTB 1/21/2005
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Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Detention Pond Watershed Runoff Area=206,760 sf Runoff Depth=0.77"
Tc=25.3 min CN=75 Runoff=2.40 cfs 0.305 af

Pond 2P: Existing SPCC Pond Peak Elev=141.73' Storage=5,375 cf Inflow=2.40 cfs 0.305 af
Outflow=2.92 cfs 0.260 af

Total Runoff Area = 4.747 ac Runoff Volume = 0.305 af Average Runoff Depth = 0.77"

Subcatchment 1S: Detention Pond Watershed

Runoff = 2.40 cfs @ 12.40 hrs, Volume= 0.305 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=2.70"

Area (sf)	CN	Description
67,880	89	S/S, HSG C (Udorthents)
4,220	98	Paved parking & roofs
10,100	89	Gravel roads, HSG C
124,560	65	Brush, Good, HSG C
206,760	75	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.3					**Direct Entry, See Spreadsheet**

Pond 2P: Existing SPCC Pond

Inflow Area = 4.747 ac, Inflow Depth = 0.77" for 2-yr event
Inflow = 2.40 cfs @ 12.40 hrs, Volume= 0.305 af
Outflow = 2.92 cfs @ 12.48 hrs, Volume= 0.260 af, Atten= 0%, Lag= 5.1 min
Primary = 2.92 cfs @ 12.48 hrs, Volume= 0.260 af

OUTFLOW > INFLOW

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.19' Surf.Area= 0 sf Storage= 4,521 cf
Peak Elev= 141.73' @ 12.48 hrs Surf.Area= 0 sf Storage= 5,375 cf (854 cf above start)
Flood Elev= 133.00' Surf.Area= 0 sf Storage= 5,375 cf (854 cf above start)
Plug-Flow detention time= 202.0 min calculated for 0.201 af (66% of inflow)
Center-of-Mass det. time= 38.3 min (926.1 - 887.7)

#	Invert	Avail.Storage	Storage Description
1	130.28'	5,375 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
130.28	0
131.00	3,410
132.00	4,321
133.00	5,375

#	Routing	Invert	Outlet Devices
1	Device 2	132.19'	**6.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
2	Primary	130.30'	**6.0" x 32.0' long Culvert** Ke= 0.500 Outlet Invert= 129.83' S= 0.0147 '/' n= 0.010 Cc= 0.900

Primary OutFlow Max=2.92 cfs @ 12.48 hrs HW=141.73' (Free Discharge)
└─**2=Culvert** (Passes 2.92 cfs of 3.07 cfs potential flow)
└─**1=Orifice/Grate** (Orifice Controls 2.92 cfs @ 14.9 fps)

* HYDROCAD ERROR DUE TO POND HAVING INSIGNIFICANT STORAGE. TYPICAL FOR ALL STORM EVENTS EVALUATED.

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Detention Pond Watershed Runoff Area=206,760 sf Runoff Depth=1.74"
Tc=25.3 min CN=75 Runoff=5.81 cfs 0.689 af

Pond 2P: Existing SPCC Pond Peak Elev=203.87' Storage=5,375 cf Inflow=5.81 cfs 0.689 af
Outflow=7.80 cfs 0.606 af

Total Runoff Area = 4.747 ac Runoff Volume = 0.689 af Average Runoff Depth = 1.74"

Subcatchment 1S: Detention Pond Watershed

Runoff = 5.81 cfs @ 12.37 hrs, Volume= 0.689 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
67,880	89	S/S, HSG C (Udorthents)
4,220	98	Paved parking & roofs
10,100	89	Gravel roads, HSG C
124,560	65	Brush, Good, HSG C
206,760	75	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.3					**Direct Entry, See Spreadsheet**

Pond 2P: Existing SPCC Pond

Inflow Area = 4.747 ac, Inflow Depth = 1.74" for 10-yr event
Inflow = 5.81 cfs @ 12.37 hrs, Volume= 0.689 af
Outflow = 7.80 cfs @ 12.37 hrs, Volume= 0.606 af, Atten= 0%, Lag= 0.2 min
Primary = 7.80 cfs @ 12.37 hrs, Volume= 0.606 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.19' Surf.Area= 0 sf Storage= 4,521 cf
Peak Elev= 203.87' @ 12.37 hrs Surf.Area= 0 sf Storage= 5,375 cf (854 cf above start)
Flood Elev= 133.00' Surf.Area= 0 sf Storage= 5,375 cf (854 cf above start)
Plug-Flow detention time= 101.6 min calculated for 0.585 af (85% of inflow)
Center-of-Mass det. time= 29.8 min (892.6 - 862.7)

#	Invert	Avail.Storage	Storage Description
1	130.28'	5,375 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
130.28	0
131.00	3,410
132.00	4,321
133.00	5,375

#	Routing	Invert	Outlet Devices
1	Device 2	132.19'	**6.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
2	Primary	130.30'	**6.0" x 32.0' long Culvert** Ke= 0.500 Outlet Invert= 129.83' S= 0.0147 '/' n= 0.010 Cc= 0.900

Primary OutFlow Max=7.80 cfs @ 12.37 hrs HW=203.85' (Free Discharge)
└─**2=Culvert** (Barrel Controls 7.80 cfs @ 39.7 fps)
└─**1=Orifice/Grate** (Passes 7.80 cfs of 8.00 cfs potential flow)

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Detention Pond Watershed Runoff Area=206,760 sf Runoff Depth=2.29"
Tc=25.3 min CN=75 Runoff=7.72 cfs 0.905 af

Pond 2P: Existing SPCC Pond Peak Elev=216.69' Storage=5,375 cf Inflow=7.72 cfs 0.905 af
Outflow=8.46 cfs 0.822 af

Total Runoff Area = 4.747 ac Runoff Volume = 0.905 af Average Runoff Depth = 2.29"

Subcatchment 1S: Detention Pond Watershed

Runoff = 7.72 cfs @ 12.35 hrs, Volume= 0.905 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=4.80"

Area (sf)	CN	Description
67,880	89	S/S, HSG C (Udorthents)
4,220	98	Paved parking & roofs
10,100	89	Gravel roads, HSG C
124,560	65	Brush, Good, HSG C
206,760	75	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.3					**Direct Entry, See Spreadsheet**

Pond 2P: Existing SPCC Pond

Inflow Area = 4.747 ac, Inflow Depth = 2.29" for 25-yr event
Inflow = 7.72 cfs @ 12.35 hrs, Volume= 0.905 af
Outflow = 8.46 cfs @ 12.35 hrs, Volume= 0.822 af, Atten= 0%, Lag= 0.0 min
Primary = 8.46 cfs @ 12.35 hrs, Volume= 0.822 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.19' Surf.Area= 0 sf Storage= 4,521 cf
Peak Elev= 216.69' @ 12.35 hrs Surf.Area= 0 sf Storage= 5,375 cf (854 cf above start)
Flood Elev= 133.00' Surf.Area= 0 sf Storage= 5,375 cf (854 cf above start)
Plug-Flow detention time= 82.8 min calculated for 0.801 af (89% of inflow)
Center-of-Mass det. time= 24.6 min (879.3 - 854.8)

#	Invert	Avail.Storage	Storage Description
1	130.28'	5,375 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
130.28	0
131.00	3,410
132.00	4,321
133.00	5,375

#	Routing	Invert	Outlet Devices
1	Device 2	132.19'	**6.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
2	Primary	130.30'	**6.0" x 32.0' long Culvert** Ke= 0.500 Outlet Invert= 129.83' S= 0.0147 '/' n= 0.010 Cc= 0.900

Primary OutFlow Max=8.46 cfs @ 12.35 hrs HW=216.67' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 8.46 cfs @ 43.1 fps)
↑—**1=Orifice/Grate** (Passes 8.46 cfs of 8.69 cfs potential flow)

EXISTING COND.

PROJECT:	**TRC Bangor Hydro**	**CALC'D BY: DTB**	
E/PRO Proj:	**10545**	**CHKD BY:**	
Watershed:	**A**		

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5		
SHEET FLOW							
Manning's No.	0.41						
Length, ft	136						
P2 , in	2.7						
Slope, ft/ft	0.0368						
T_t^1, hr	0.398						0.3982
SHALLOW CONCENTRATED FLOW							
Paved							
Length, ft							
Slope, ft/ft							
Velocity[2], ft/sec							
T_t^3, hr							0.0000
Unpaved							
Length, ft		16					
Slope, ft/ft		0.156					
Velocity[4], ft/sec		6.372617					
T_t, hr		0.001					0.0007
CHANNEL FLOW							
Waterways & Swamps, No Channels							
Length, ft							
Slope, ft/ft							
Velocity[5], ft/sec							
T_t, hr							0.0000
Grassed Waterways/Roadside Ditches							
Length, ft			136		68		
Slope, ft/ft			0.0419		0.0989		
Velocity[6], ft/sec			3.070		4.717		
T_t, hr			0.012		0.004		0.0163
Small Tributary & Swamp w/Channels							
Length, ft							
Slope, ft/ft							
Velocity[7], ft/sec							
T_t, hr							0.0000
Large Tributary							
Length, ft							
Slope, ft/ft							
Velocity[8], ft/sec							
T_t, hr							0.0000
Main River							
Length, ft							
Slope, ft/ft							
Velocity[9], ft/sec							
T_t, hr							0.0000
Culvert							
Diameter, ft				1.25		1	
Area, ft^2				1.226563		0.785	
Wetted Perimeter, ft				3.925		3.14	
Hydraulic Radius, R, ft				0.3125		0.25	
Slope, ft/ft				0.0322		0.0282	
Manning's No.				0.024		0.024	
Velocity[10], ft/sec				5.128235		4.13547659	
Length, L, ft				50		50	
T_t, hr				0.00271		0.00336	0.0061
							0.421 HR
							25.28 Min

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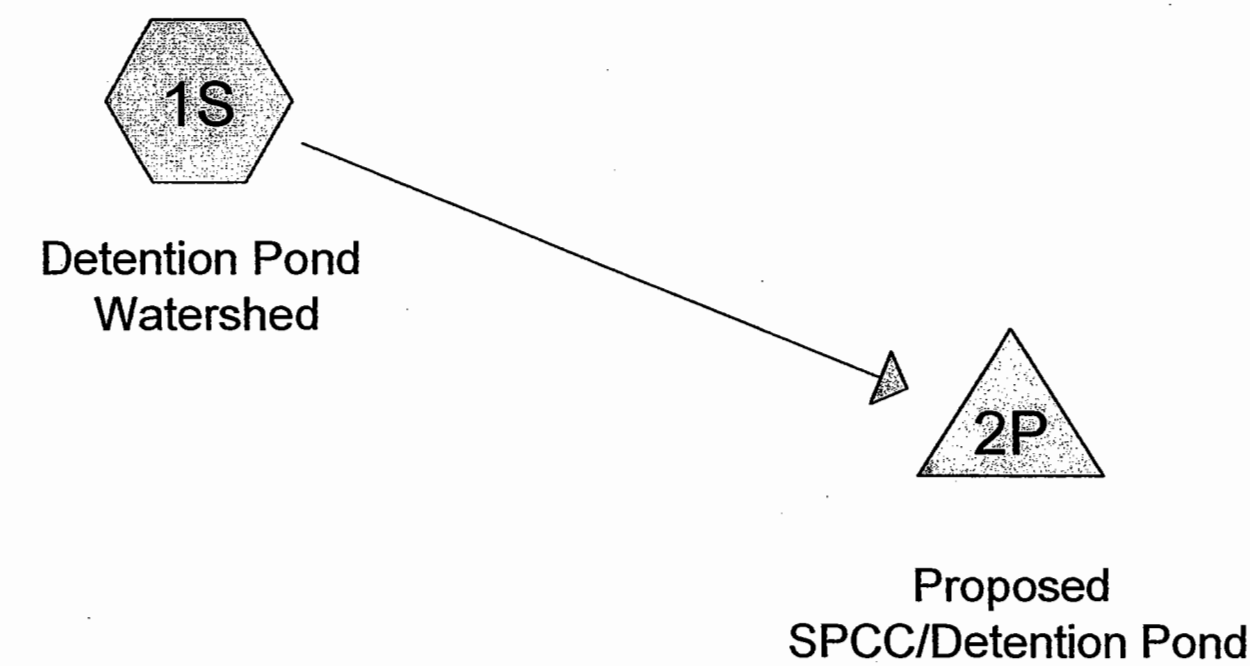
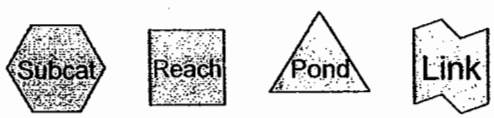




Drainage Diagram for Proposed Condition
Prepared by E/PRO Consulting, LLC--DTB 1/21/2005
HydroCAD® 7.00 s/n 001824 © 1986-2003 Applied Microcomputer Systems

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Detention Pond Watershed Runoff Area=207,690 sf Runoff Depth=0.97"
Tc=26.1 min CN=79 Runoff=3.15 cfs 0.387 af

Pond 2P: Proposed SPCC/Detention Pond Peak Elev=132.89' Storage=9,619 cf Inflow=3.15 cfs 0.387 af
Primary=2.86 cfs 0.387 af Secondary=0.00 cfs 0.000 af Outflow=2.86 cfs 0.387 af

Total Runoff Area = 4.768 ac Runoff Volume = 0.387 af Average Runoff Depth = 0.97"

Subcatchment 1S: Detention Pond Watershed

Runoff = 3.15 cfs @ 12.38 hrs, Volume= 0.387 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=2.70"

Area (sf)	CN	Description
103,130	89	S/S, HSG C (Udorthents)
10,000	98	Paved parking, roofs, and liner
4,300	89	Gravel roads, HSG C (EsB Soils)
90,260	65	Brush, Good, HSG C (EsB Soils)
207,690	79	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1					**Direct Entry, See Spreadsheet**

Pond 2P: Proposed SPCC/Detention Pond

Inflow Area = 4.768 ac, Inflow Depth = 0.97" for 2-yr event
Inflow = 3.15 cfs @ 12.38 hrs, Volume= 0.387 af
Outflow = 2.86 cfs @ 12.51 hrs, Volume= 0.387 af, Atten= 9%, Lag= 7.3 min
Primary = 2.86 cfs @ 12.51 hrs, Volume= 0.387 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.50' Surf.Area= 3,617 sf Storage= 8,219 cf
Peak Elev= 132.89' @ 12.51 hrs Surf.Area= 3,877 sf Storage= 9,619 cf (1,400 cf above start)
Flood Elev= 135.00' Surf.Area= 5,801 sf Storage= 19,586 cf (11,366 cf above start)
Plug-Flow detention time= 267.7 min calculated for 0.198 af (51% of inflow)
Center-of-Mass det. time= 13.4 min (887.5 - 874.1)

#	Invert	Avail.Storage	Storage Description
1	129.00'	19,586 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
129.00	0	0	0
130.00	2,106	1,053	1,053
131.00	2,665	2,386	3,439
132.00	3,280	2,973	6,411
133.00	3,953	3,617	10,028
134.00	4,681	4,317	14,345
135.00	5,801	5,241	19,586

#	Routing	Invert	Outlet Devices
1	Device 2	129.75'	**15.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 129.50' S= 0.0125 '/' n= 0.010 Cc= 0.900
2	Device 3	132.50'	**15.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Primary	129.50'	**15.0" x 25.0' long Culvert** Ke= 0.500

Outlet Invert= 129.00' S= 0.0200 '/' n= 0.010 Cc= 0.900

4 Secondary 134.00' **10.0' long x 12.0' breadth Broad-Crested Rectangular Weir**
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=2.90 cfs @ 12.51 hrs HW=132.89' (Free Discharge)
└─**3=Culvert** (Passes 2.90 cfs of 9.82 cfs potential flow)
└─**2=Orifice/Grate** (Passes 2.90 cfs of 3.09 cfs potential flow)
└─**1=Culvert** (Inlet Controls 2.90 cfs @ 2.4 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=132.50' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Detention Pond Watershed Runoff Area=207,690 sf Runoff Depth=2.04"
Tc=26.1 min CN=79 Runoff=6.85 cfs 0.813 af

Pond 2P: Proposed SPCC/Detention Pond Peak Elev=133.60' Storage=12,620 cf Inflow=6.85 cfs 0.813 af
Primary=4.89 cfs 0.813 af Secondary=0.00 cfs 0.000 af Outflow=4.89 cfs 0.813 af

Total Runoff Area = 4.768 ac Runoff Volume = 0.813 af Average Runoff Depth = 2.04"

Subcatchment 1S: Detention Pond Watershed

Runoff = 6.85 cfs @ 12.38 hrs, Volume= 0.813 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
103,130	89	S/S, HSG C (Udorthents)
10,000	98	Paved parking, roofs, and liner
4,300	89	Gravel roads, HSG C (EsB Soils)
90,260	65	Brush, Good, HSG C (EsB Soils)
207,690	79	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1					**Direct Entry, See Spreadsheet**

Pond 2P: Proposed SPCC/Detention Pond

Inflow Area = 4.768 ac, Inflow Depth = 2.04" for 10-yr event
Inflow = 6.85 cfs @ 12.38 hrs, Volume= 0.813 af
Outflow = 4.89 cfs @ 12.62 hrs, Volume= 0.813 af, Atten= 29%, Lag= 14.3 min
Primary = 4.89 cfs @ 12.62 hrs, Volume= 0.813 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.50' Surf.Area= 3,617 sf Storage= 8,219 cf
Peak Elev= 133.60' @ 12.62 hrs Surf.Area= 4,390 sf Storage= 12,620 cf (4,400 cf above start)
Flood Elev= 135.00' Surf.Area= 5,801 sf Storage= 19,586 cf (11,366 cf above start)
Plug-Flow detention time= 142.9 min calculated for 0.624 af (77% of inflow)
Center-of-Mass det. time= 13.2 min (865.4 - 852.2)

#	Invert	Avail.Storage	Storage Description
1	129.00'	19,586 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
129.00	0	0	0
130.00	2,106	1,053	1,053
131.00	2,665	2,386	3,439
132.00	3,280	2,973	6,411
133.00	3,953	3,617	10,028
134.00	4,681	4,317	14,345
135.00	5,801	5,241	19,586

#	Routing	Invert	Outlet Devices
1	Device 2	129.75'	**15.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 129.50' S= 0.0125 '/' n= 0.010 Cc= 0.900
2	Device 3	132.50'	**15.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Primary	129.50'	**15.0" x 25.0' long Culvert** Ke= 0.500

Outlet Invert= 129.00' S= 0.0200 '/' n= 0.010 Cc= 0.900

4 Secondary 134.00' **10.0' long x 12.0' breadth Broad-Crested Rectangular Weir**
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=4.89 cfs @ 12.62 hrs HW=133.60' (Free Discharge)
↑└**3=Culvert** (Passes 4.89 cfs of 11.02 cfs potential flow)
↑└**2=Orifice/Grate** (Passes 4.89 cfs of 6.20 cfs potential flow)
↑└**1=Culvert** (Inlet Controls 4.89 cfs @ 4.0 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=132.50' (Free Discharge)
↑└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Detention Pond Watershed Runoff Area=207,690 sf Runoff Depth=2.63"
Tc=26.1 min CN=79 Runoff=8.83 cfs 1.045 af

Pond 2P: Proposed SPCC/Detention Pond Peak Elev=134.06' Storage=14,634 cf Inflow=8.83 cfs 1.045 af
Primary=5.82 cfs 1.041 af Secondary=0.36 cfs 0.004 af Outflow=6.18 cfs 1.045 af

Total Runoff Area = 4.768 ac Runoff Volume = 1.045 af Average Runoff Depth = 2.63"

Subcatchment 1S: Detention Pond Watershed

Runoff = 8.83 cfs @ 12.37 hrs, Volume= 1.045 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=4.80"

Area (sf)	CN	Description
103,130	89	S/S, HSG C (Udorthents)
10,000	98	Paved parking, roofs, and liner
4,300	89	Gravel roads, HSG C (EsB Soils)
90,260	65	Brush, Good, HSG C (EsB Soils)
207,690	79	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1					**Direct Entry, See Spreadsheet**

Pond 2P: Proposed SPCC/Detention Pond

Inflow Area = 4.768 ac, Inflow Depth = 2.63" for 25-yr event
Inflow = 8.83 cfs @ 12.37 hrs, Volume= 1.045 af
Outflow = 6.18 cfs @ 12.62 hrs, Volume= 1.045 af, Atten= 30%, Lag= 14.7 min
Primary = 5.82 cfs @ 12.62 hrs, Volume= 1.041 af
Secondary = 0.36 cfs @ 12.62 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.50' Surf.Area= 3,617 sf Storage= 8,219 cf
Peak Elev= 134.06' @ 12.62 hrs Surf.Area= 4,743 sf Storage= 14,634 cf (6,414 cf above start)
Flood Elev= 135.00' Surf.Area= 5,801 sf Storage= 19,586 cf (11,366 cf above start)
Plug-Flow detention time= 121.6 min calculated for 0.856 af (82% of inflow)
Center-of-Mass det. time= 14.0 min (858.9 - 844.9)

#	Invert	Avail.Storage	Storage Description
1	129.00'	19,586 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
129.00	0	0	0
130.00	2,106	1,053	1,053
131.00	2,665	2,386	3,439
132.00	3,280	2,973	6,411
133.00	3,953	3,617	10,028
134.00	4,681	4,317	14,345
135.00	5,801	5,241	19,586

#	Routing	Invert	Outlet Devices
1	Device 2	129.75'	**15.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 129.50' S= 0.0125 '/' n= 0.010 Cc= 0.900
2	Device 3	132.50'	**15.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Primary	129.50'	**15.0" x 25.0' long Culvert** Ke= 0.500

Outlet Invert= 129.00' S= 0.0200 '/' n= 0.010 Cc= 0.900

4 Secondary 134.00' **10.0' long x 12.0' breadth Broad-Crested Rectangular Weir**
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=5.82 cfs @ 12.62 hrs HW=134.06' (Free Discharge)
└─**3=Culvert** (Passes 5.82 cfs of 11.71 cfs potential flow)
└─**2=Orifice/Grate** (Passes 5.82 cfs of 7.37 cfs potential flow)
└─**1=Culvert** (Inlet Controls 5.82 cfs @ 4.7 fps)

Secondary OutFlow Max=0.33 cfs @ 12.62 hrs HW=134.06' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 0.33 cfs @ 0.6 fps)

DEVELOPED COND.

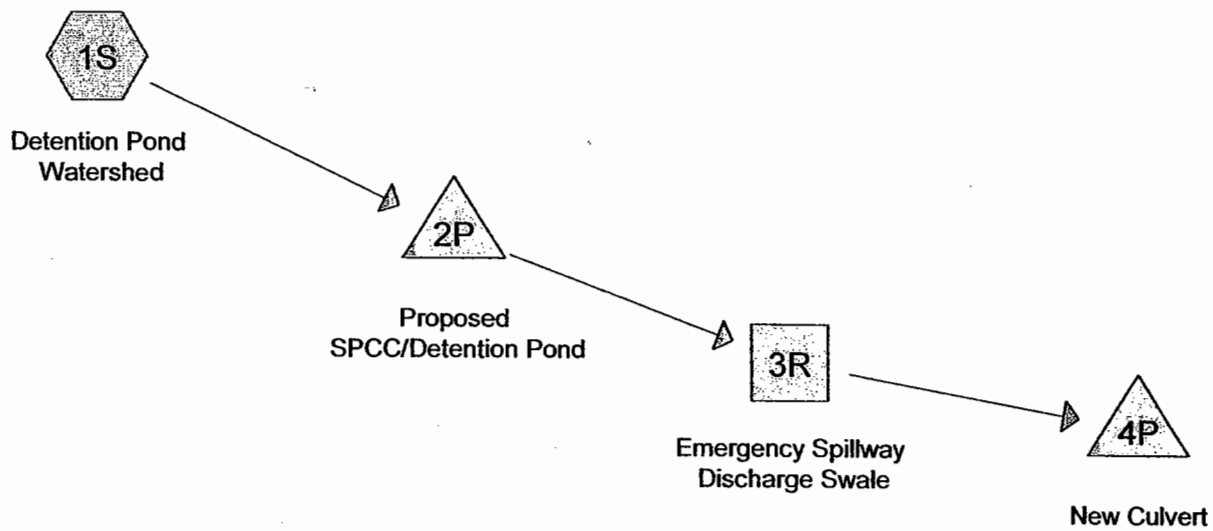
PROJECT:	**TRC Bangor Hydro**	**CALC'D BY: DTB**	
E/PRO Proj:	**10545**	**CHKD BY:**	
Watershed:	**A**		

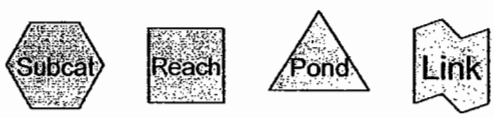
Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5		
SHEET FLOW							
Manning's No.	0.41						
Length, ft	136						
P2 , in	2.7						
Slope, ft/ft	0.0368						
T_t[1] hr	0.398						0.3982
SHALLOW CONCENTRATED FLOW							
Paved							
Length, ft							
Slope, ft/ft							
Velocity[2], ft/sec							
T_t[3], hr							0.0000
Unpaved							
Length, ft		16					
Slope, ft/ft		0.156					
Velocity[4], ft/sec		6.372617					
T_t, hr		0.001					0.0007
CHANNEL FLOW							
Waterways & Swamps, No Channels							
Length, ft							
Slope, ft/ft							
Velocity[5], ft/sec							
T_t, hr							0.0000
Grassed Waterways/Roadside Ditches							
Length, ft			116	140			
Slope, ft/ft			0.047	0.04			
Velocity[6], ft/sec			3.252	3.000			
T_t, hr			0.010	0.013			0.0229
Small Tributary & Swamp w/Channels							
Length, ft							
Slope, ft/ft							
Velocity[7], ft/sec							
T_t, hr							0.0000
Large Tributary							
Length, ft							
Slope, ft/ft							
Velocity[8], ft/sec							
T_t, hr							0.0000
Main River							
Length, ft							
Slope, ft/ft							
Velocity[9], ft/sec							
T_t, hr							0.0000
Culvert							
Diameter, ft					1.25		
Area, ft^2					1.226563		
Wetted Perimeter, ft					3.925		
Hydraulic Radius, R, ft					0.3125		
Slope, ft/ft					0.01		
Manning's No.					0.01		
Velocity[10], ft/sec					6.858849		
Length, L, ft					310		
T_t, hr					0.01255		0.0126
							0.434 HR
							26.06 Min

12:19 PM

1/20/2005





Drainage Diagram for Spillway Design
Prepared by E/PRO Consulting, LLC--DTB 1/28/2005
HydroCAD® 7.00 s/n 001824 © 1986-2003 Applied Microcomputer Systems

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Detention Pond Watershed Runoff Area=207,690 sf Runoff Depth=2.63"
Tc=26.1 min CN=79 Runoff=8.83 cfs 1.045 af

Pond 2P: Proposed SPCC/Detention Pond Peak Elev=134.47' Storage=16,817 cf Inflow=8.83 cfs 1.045 af
Outflow=8.59 cfs 0.904 af

Reach 3R: Emergency Spillway Discharge S Peak Depth=0.22' Max Vel=3.7 fps Inflow=8.59 cfs 0.904 af
n=0.050 L=16.0' S=0.1250 '/' Capacity=117.36 cfs Outflow=8.59 cfs 0.904 af

Pond 4P: New Culvert Peak Elev=133.88' Storage=1,391 cf Inflow=8.59 cfs 0.904 af
15.0" x 32.0' Culvert Outflow=7.75 cfs 0.904 af

Total Runoff Area = 4.768 ac Runoff Volume = 1.045 af Average Runoff Depth = 2.63"

Subcatchment 1S: Detention Pond Watershed

Runoff = 8.83 cfs @ 12.37 hrs, Volume= 1.045 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=4.80"

Area (sf)	CN	Description
103,130	89	S/S, HSG C (Udorthents)
10,000	98	Paved parking, roofs, & liner
4,300	89	Gravel roads, HSG C
90,260	65	Brush, Good, HSG C
207,690	79	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1					**Direct Entry, See Spreadsheet**

Pond 2P: Proposed SPCC/Detention Pond

Inflow Area = 4.768 ac, Inflow Depth = 2.63" for 25-yr event
Inflow = 8.83 cfs @ 12.37 hrs, Volume= 1.045 af
Outflow = 8.59 cfs @ 12.42 hrs, Volume= 0.904 af, Atten= 3%, Lag= 3.0 min
Primary = 8.59 cfs @ 12.42 hrs, Volume= 0.904 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.50' Surf.Area= 3,617 sf Storage= 8,219 cf
* Peak Elev= 134.47' @ 12.42 hrs Surf.Area= 5,209 sf Storage= 16,817 cf (8,598 cf above start)
Flood Elev= 135.00' Surf.Area= 5,801 sf Storage= 19,586 cf (11,366 cf above start)
Plug-Flow detention time= 169.5 min calculated for 0.716 af (68% of inflow)
Center-of-Mass det. time= 34.2 min (879.1 - 844.9)

#	Invert	Avail.Storage	Storage Description
1	129.00'	19,586 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
129.00	0	0	0
130.00	2,106	1,053	1,053
131.00	2,665	2,386	3,439
132.00	3,280	2,973	6,411
133.00	3,953	3,617	10,028
134.00	4,681	4,317	14,345
135.00	5,801	5,241	19,586

#	Routing	Invert	Outlet Devices
1	Primary	134.00'	**10.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

* TOP OF EMBANKMENT TO BE 135.50 → 1.03' HIGHER THAN PEAK EL. OF DISCHARGE.

Primary OutFlow Max=8.58 cfs @ 12.42 hrs HW=134.47' (Free Discharge)
└1=**Broad-Crested Rectangular Weir** (Weir Controls 8.58 cfs @ 1.8 fps)

Reach 3R: Emergency Spillway Discharge Swale

Inflow Area = 4.768 ac, Inflow Depth = 2.28" for 25-yr event
Inflow = 8.59 cfs @ 12.42 hrs, Volume= 0.904 af
Outflow = 8.59 cfs @ 12.43 hrs, Volume= 0.904 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
* Max. Velocity= 3.7 fps, Min. Travel Time= 0.1 min ← * USED TO SIZE RIPRAP FOR SWALE.
Avg. Velocity = 1.2 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.22' @ 12.42 hrs, Defined Flood Depth= 1.50'
Capacity at bank full= 117.36 cfs, at defined flood depth= 245.91 cfs
Inlet Invert= 134.00', Outlet Invert= 132.00'
10.00' x 1.00' deep channel, n= 0.050 Length= 16.0' Slope= 0.1250 '/'
Side Slope Z-value= 3.0 '/'

Pond 4P: New Culvert

Inflow Area = 4.768 ac, Inflow Depth = 2.28" for 25-yr event
Inflow = 8.59 cfs @ 12.43 hrs, Volume= 0.904 af
Outflow = 7.75 cfs @ 12.55 hrs, Volume= 0.904 af, Atten= 10%, Lag= 7.4 min
Primary = 7.75 cfs @ 12.55 hrs, Volume= 0.904 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 133.88' @ 12.55 hrs Surf.Area= 1,174 sf Storage= 1,391 cf
Flood Elev= 134.00' Surf.Area= 1,250 sf Storage= 1,497 cf
Plug-Flow detention time= 1.0 min calculated for 0.904 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (880.4 - 879.3)

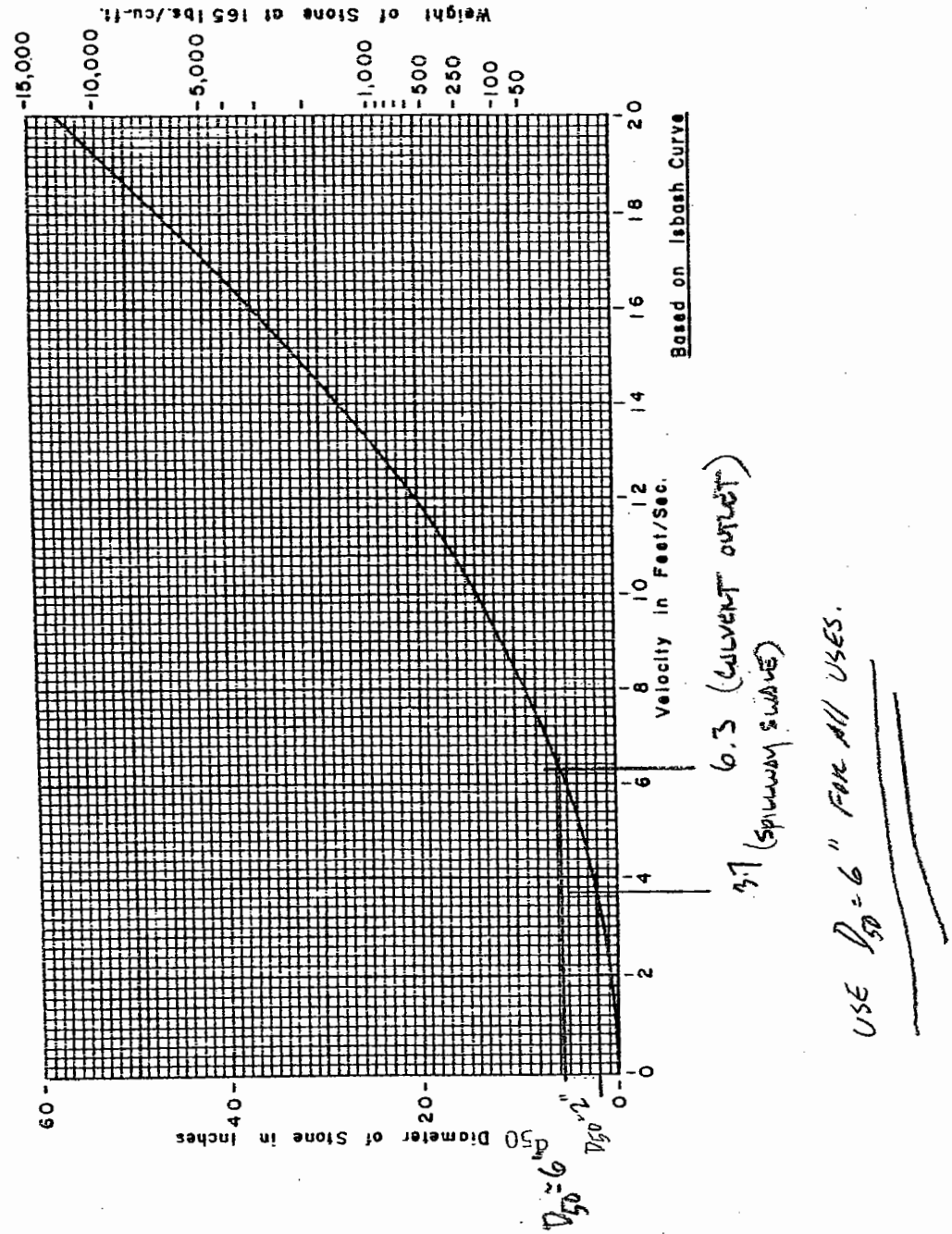
#	Invert	Avail.Storage	Storage Description
1	130.50'	1,497 cf	**Custom Stage Data (Prismatic)** Listed below

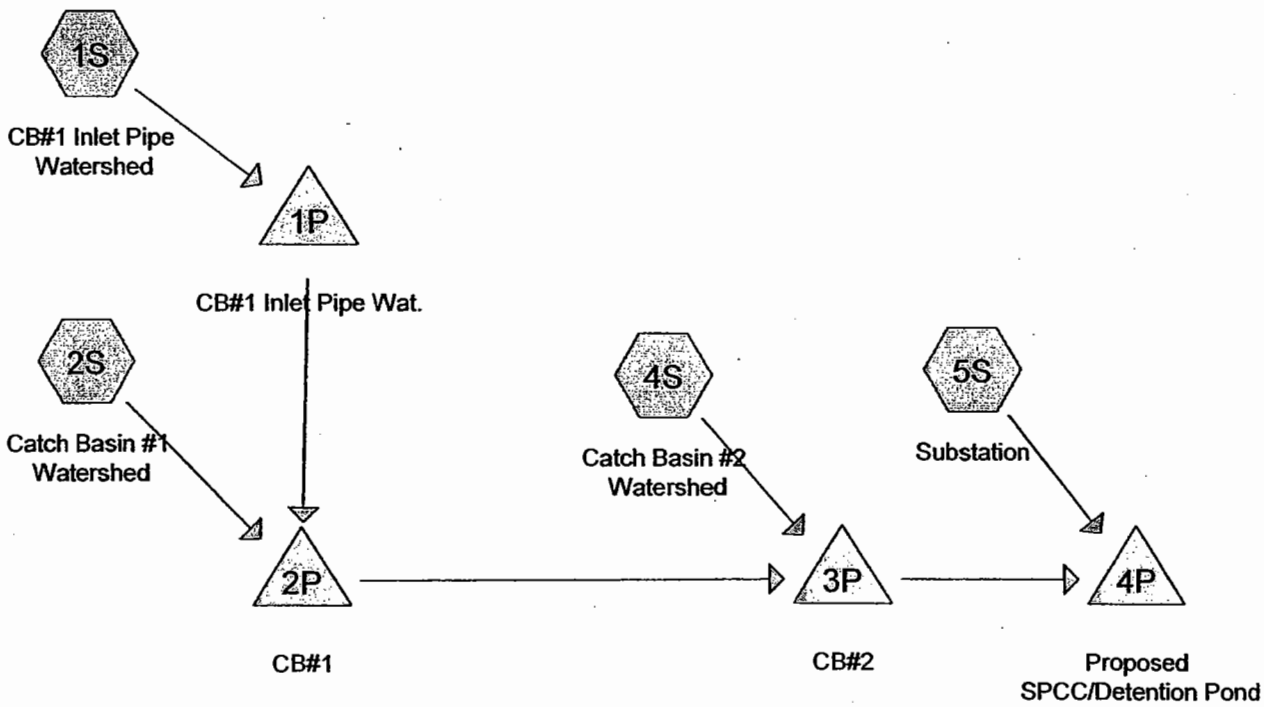
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
130.50	0	0	0
131.00	36	9	9
132.00	253	145	154
133.00	592	423	576
134.00	1,250	921	1,497

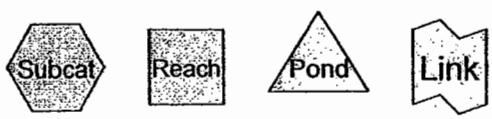
#	Routing	Invert	Outlet Devices
1	Primary	130.50'	**15.0" x 32.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 130.00' S= 0.0156 '/' n= 0.012 Cc= 0.900

Primary OutFlow Max=7.75 cfs @ 12.55 hrs HW=133.88' (Free Discharge)
└1=**Culvert** (Inlet Controls 7.75 cfs @ 6.3 fps) ← USED TO SIZE RIPRAP @ OUTLET

Figure 70.1 STONE SIZE FOR RIPRAP (USDA Soil Conservation Service)







Drainage Diagram for Catch Basin & Culvert Design
Prepared by E/PRO Consulting, LLC--DTB 1/28/2005
HydroCAD® 7.00 s/n 001824 © 1986-2003 Applied Microcomputer Systems

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CB#1 Inlet Pipe Watershed Runoff Area=50,884 sf Runoff Depth=2.55"
Tc=6.2 min CN=85 Runoff=3.46 cfs 0.248 af

Subcatchment 2S: Catch Basin #1 Watershed Runoff Area=75,530 sf Runoff Depth=1.27"
Tc=25.3 min CN=68 Runoff=1.47 cfs 0.183 af

Subcatchment 4S: Catch Basin #2 Watershed Runoff Area=16,380 sf Runoff Depth=1.60"
Tc=16.6 min CN=73 Runoff=0.50 cfs 0.050 af

Subcatchment 5S: Substation Runoff Area=64,896 sf Runoff Depth=2.73"
Tc=6.0 min CN=87 Runoff=4.72 cfs 0.339 af

Total Runoff Area = 4.768 ac Runoff Volume = 0.820 af Average Runoff Depth = 2.06"

Subcatchment 1S: CB#1 Inlet Pipe Watershed

Runoff = 3.46 cfs @ 12.09 hrs, Volume= 0.248 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
9,860	65	Brush, Good, HSG C
1,200	98	Paved parking & roofs
39,824	89	S/S & Gravel roads, HSG C
50,884	85	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2					**Direct Entry, See Spreadsheet**

Subcatchment 2S: Catch Basin #1 Watershed

USED TO SIZE DITCH.

Runoff = 1.47 cfs @ 12.39 hrs, Volume= 0.183 af, Depth= 1.27" USED TO SIZE DITCH

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
8,150	89	Gravel roads & S/S, HSG C
500	98	Paved parking & roofs
66,880	65	Brush, Good, HSG C
75,530	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.3					**Direct Entry, See Spreadsheet**

Subcatchment 4S: Catch Basin #2 Watershed

Runoff = 0.50 cfs @ 12.23 hrs, Volume= 0.050 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
2,400	98	Paved parking & roofs
2,100	89	Gravel roads & S/S, HSG C
11,880	65	Brush, Good, HSG C
16,380	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.6					**Direct Entry, See Spreadsheet**

Subcatchment 5S: Substation

Runoff = 4.72 cfs @ 12.09 hrs, Volume= 0.339 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
6,640	65	Brush, Good, HSG C
5,900	98	Paved parking & roofs
52,356	89	Gravel roads & S/S, HSG C
64,896	87	Weighted Average

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

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Pond 1P: CB#1 Inlet Pipe Wat. Peak Elev=141.97' Storage=857 cf Inflow=3.46 cfs 0.248 af
12.0" x 260.0' Culvert Outflow=2.86 cfs 0.248 af

Pond 2P: CB#1 Peak Elev=137.76' Storage=10 cf Inflow=3.66 cfs 0.431 af
12.0" x 170.0' Culvert Outflow=3.66 cfs 0.431 af

Pond 3P: CB#2 Peak Elev=136.19' Storage=23 cf Inflow=4.13 cfs 0.481 af
12.0" x 140.0' Culvert Outflow=4.13 cfs 0.481 af

Pond 4P: Proposed SPCC/Detention Pond Peak Elev=133.63' Storage=12,752 cf Inflow=8.18 cfs 0.820 af
Primary=4.96 cfs 0.820 af Secondary=0.00 cfs 0.000 af Outflow=4.96 cfs 0.820 af

Pond 1P: CB#1 Inlet Pipe Wat.

Inflow Area =	1.168 ac,	Inflow Depth =	2.55"	for	10-yr event
Inflow =	3.46 cfs @	12.09 hrs,	Volume=	0.248 af	
Outflow =	2.86 cfs @	12.14 hrs,	Volume=	0.248 af,	Atten= 17%, Lag= 3.3 min
Primary =	2.86 cfs @	12.14 hrs,	Volume=	0.248 af	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 141.97' @ 12.14 hrs Surf.Area= 1,202 sf Storage= 857 cf
Flood Elev= 143.00' Surf.Area= 2,366 sf Storage= 2,674 cf
Plug-Flow detention time= 8.2 min calculated for 0.248 af (100% of inflow)
Center-of-Mass det. time= 8.2 min (823.8 - 815.7)

#	Invert	Avail.Storage	Storage Description
1	140.90'	2,674 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
140.90	0	0	0
141.00	489	24	24
142.00	1,222	856	880
143.00	2,366	1,794	2,674

#	Routing	Invert	Outlet Devices
1	Primary	140.90'	**12.0" x 260.0' long Culvert** Ke= 0.500 Outlet Invert= 138.30' S= 0.0100 '/' n= 0.010 Cc= 0.900

Primary OutFlow Max=2.86 cfs @ 12.14 hrs HW=141.97' TW=137.76' (Fixed TW Elev= 137.76')
└**1=Culvert** (Inlet Controls 2.86 cfs @ 3.6 fps)

Pond 2P: CB#1

Inflow Area =	2.902 ac,	Inflow Depth =	1.78"	for	10-yr event
Inflow =	3.66 cfs @	12.18 hrs,	Volume=	0.431 af	
Outflow =	3.66 cfs @	12.18 hrs,	Volume=	0.431 af,	Atten= 0%, Lag= 0.1 min
Primary =	3.66 cfs @	12.18 hrs,	Volume=	0.431 af	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 137.76' @ 12.18 hrs Surf.Area= 5 sf Storage= 10 cf
Flood Elev= 140.50' Surf.Area= 13 sf Storage= 28 cf
Plug-Flow detention time= 0.1 min calculated for 0.431 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (849.0 - 848.9)

#	Invert	Avail.Storage	Storage Description
1	136.25'	2,145 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
136.25	0	0	0
140.50	13	28	28
141.00	331	86	114
142.00	944	638	751
143.00	1,843	1,394	2,145

#	Routing	Invert	Outlet Devices
1	Primary	136.25'	**12.0" x 170.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 135.00' S= 0.0074 '/' n= 0.010 Cc= 0.900

Primary OutFlow Max=3.66 cfs @ 12.18 hrs HW=137.76' TW=136.19' (Fixed TW Elev= 136.19')
└─**1=Culvert** (Barrel Controls 3.66 cfs @ 4.7 fps)

Pond 3P: CB#2

Inflow Area = 3.278 ac, Inflow Depth = 1.76" for 10-yr event
Inflow = 4.13 cfs @ 12.20 hrs, Volume= 0.481 af
Outflow = 4.13 cfs @ 12.20 hrs, Volume= 0.481 af, Atten= 0%, Lag= 0.1 min
Primary = 4.13 cfs @ 12.20 hrs, Volume= 0.481 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 136.19' @ 12.20 hrs Surf.Area= 13 sf Storage= 23 cf
Flood Elev= 137.50' Surf.Area= 13 sf Storage= 40 cf
Plug-Flow detention time= 0.3 min calculated for 0.481 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (850.4 - 850.2)

#	Invert	Avail.Storage	Storage Description
1	134.40'	721 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.40	13	0	0
137.50	13	40	40
138.00	436	112	153
139.00	701	569	721

#	Routing	Invert	Outlet Devices
1	Primary	134.50'	**12.0" x 140.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 133.00' S= 0.0107 '/' n= 0.010 Cc= 0.900

Primary OutFlow Max=4.13 cfs @ 12.20 hrs HW=136.19' TW=133.63' (Fixed TW Elev= 133.63')
└─**1=Culvert** (Inlet Controls 4.13 cfs @ 5.3 fps)

Pond 4P: Proposed SPCC/Detention Pond

Inflow Area =	4.768 ac,	Inflow Depth =	2.06"	for 10-yr event	
Inflow =	8.18 cfs @	12.11 hrs,	Volume=	0.820 af	
Outflow =	4.96 cfs @	12.38 hrs,	Volume=	0.820 af,	Atten= 39%, Lag= 16.5 min
Primary =	4.96 cfs @	12.38 hrs,	Volume=	0.820 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.50' Surf.Area= 3,617 sf Storage= 8,219 cf
Peak Elev= 133.63' @ 12.38 hrs Surf.Area= 4,412 sf Storage= 12,752 cf (4,533 cf above start)
Flood Elev= 135.00' Surf.Area= 5,801 sf Storage= 19,586 cf (11,366 cf above start)
Plug-Flow detention time= 145.4 min calculated for 0.631 af (77% of inflow)
Center-of-Mass det. time= 13.5 min (846.6 - 833.2)

#	Invert	Avail.Storage	Storage Description
1	129.00'	19,586 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
129.00	0	0	0
130.00	2,106	1,053	1,053
131.00	2,665	2,386	3,439
132.00	3,280	2,973	6,411
133.00	3,953	3,617	10,028
134.00	4,681	4,317	14,345
135.00	5,801	5,241	19,586

#	Routing	Invert	Outlet Devices
1	Device 2	129.75'	**15.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900
			Outlet Invert= 129.50' S= 0.0125 '/' n= 0.010 Cc= 0.900
2	Device 3	132.50'	**15.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Primary	129.50'	**15.0" x 25.0' long Culvert** Ke= 0.500
			Outlet Invert= 129.00' S= 0.0200 '/' n= 0.010 Cc= 0.900
4	Secondary	134.00'	**10.0' long x 12.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=4.96 cfs @ 12.38 hrs HW=133.63' (Free Discharge)
↑—**3=Culvert** (Passes 4.96 cfs of 11.06 cfs potential flow)
↑—**2=Orifice/Grate** (Passes 4.96 cfs of 6.28 cfs potential flow)
↑—**1=Culvert** (Inlet Controls 4.96 cfs @ 4.0 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=132.50' (Free Discharge)
↑—**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

PROJECT:	**TRC Bangor Hydro**	**CALC'D BY: DTB**	
E/PRO Proj:	**10545**	**CHKD BY:**	
Watershed:	**CB #1 Inlet pipe**		

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5		
SHEET FLOW							
Manning's No.	0.41						
Length, ft	12						
P2 , in	2.7						
Slope, ft/ft	0.125						
T_t[1], hr	0.035						0.0350
SHALLOW CONCENTRATED FLOW							
Paved							
Length, ft							
Slope, ft/ft							
Velocity[2], ft/sec							
T_t[3], hr							0.0000
Unpaved							
Length, ft		20					
Slope, ft/ft		0.45					
Velocity[4], ft/sec		10.82335					
T_t, hr		0.001					0.0005
CHANNEL FLOW							
Waterways & Swamps, No Channels							
Length, ft							
Slope, ft/ft							
Velocity[5], ft/sec							
T_t, hr							0.0000
Grassed Waterways/Roadside Ditches							
Length, ft			96				
Slope, ft/ft			0.001				
Velocity[6], ft/sec			0.474				
T_t, hr			0.056				0.0562
Small Tributary & Swamp w/Channels							
Length, ft							
Slope, ft/ft							
Velocity[7], ft/sec							
T_t, hr							0.0000
Large Tributary							
Length, ft							
Slope, ft/ft							
Velocity[8], ft/sec							
T_t, hr							0.0000
Main River							
Length, ft							
Slope, ft/ft							
Velocity[9], ft/sec							
T_t, hr							0.0000
Culvert							
Diameter, ft				1			
Area, ft^2				0.785			
Wetted Perimeter, ft				3.14			
Hydraulic Radius, R, ft				0.25			
Slope, ft/ft				0.01			
Manning's No.				0.01			
Velocity[10], ft/sec				5.910337			
Length, L, ft				260			
T_t, hr				0.01222			0.0122
						0.104	HR
						6.24	Min ← Use 6.2 Min

3:21 PM

1/28/2005

PROJECT:	**TRC Bangor Hydro**	**CALC'D BY: DTB**	
E/PRO Proj:	**10545**	**CHKD BY:**	
Watershed:	**CB #1**		

Time of Concentration Determination Worksheet, SCS Methods

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5		
SHEET FLOW							
Manning's No.	0.41						
Length, ft	136						
P2 , in	2.7						
Slope, ft/ft	0.0368						
T_t[1], hr	0.398						0.3982
SHALLOW CONCENTRATED FLOW							
Paved							
Length, ft							
Slope, ft/ft							
Velocity[2], ft/sec							
T_t[3], hr							0.0000
Unpaved							
Length, ft		16					
Slope, ft/ft		0.156					
Velocity[4], ft/sec		6.372617					
T_t, hr		0.001					0.0007
CHANNEL FLOW							
Waterways & Swamps, No Channels							
Length, ft							
Slope, ft/ft							
Velocity[5], ft/sec							
T_t, hr							0.0000
Grassed Waterways/Roadside Ditches							
Length, ft			116	140			
Slope, ft/ft			0.047	0.04			
Velocity[6], ft/sec			3.252	3.000			
T_t, hr			0.010	0.013			0.0229
Small Tributary & Swamp w/Channels							
Length, ft							
Slope, ft/ft							
Velocity[7], ft/sec							
T_t, hr							0.0000
Large Tributary							
Length, ft							
Slope, ft/ft							
Velocity[8], ft/sec							
T_t, hr							0.0000
Main River							
Length, ft							
Slope, ft/ft							
Velocity[9], ft/sec							
T_t, hr							0.0000
Culvert							
Diameter, ft							
Area, ft^2							
Wetted Perimeter, ft							
Hydraulic Radius, R, ft							
Slope, ft/ft							
Manning's No.							
Velocity[10], ft/sec							
Length, L, ft							
T_t, hr							0.0000
							0.422 HR
							25.31 Min ← USE 25.3

5:03 PM

1/20/2005

PROJECT:	**TRC Bangor Hydro**	**CALC'D BY: DTB**	
E/PRO Proj:	**10545**	**CHKD BY:**	
Watershed:	**CB #2**		

Time of Concentration Determination Worksheet, SCS Methods

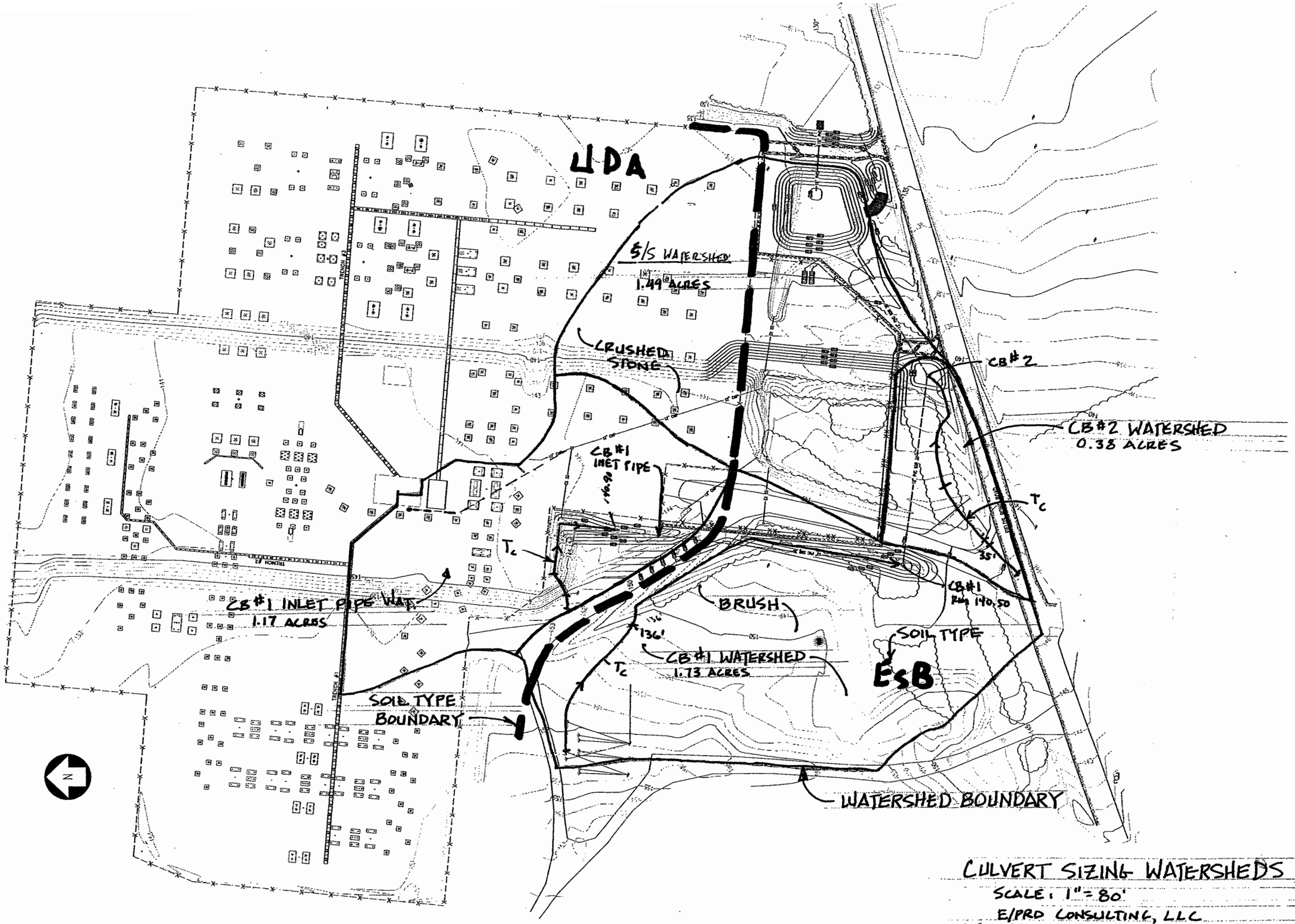
	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5		
SHEET FLOW							
Manning's No.	0.011	0.41	0.41				
Length, ft	35	5	60				
P2 , in	2.7	2.7	2.7				
Slope, ft/ft	0.038	0.038	0.0278				
T_t[1], hr	0.007	0.03	0.23				0.2668
SHALLOW CONCENTRATED FLOW							
Paved							
Length, ft							
Slope, ft/ft							
Velocity[2], ft/sec							
T_t[3], hr							0.0000
Unpaved							
Length, ft				10	106		
Slope, ft/ft				0.0278	0.051		
Velocity[4], ft/sec				2.690159	3.643683		
T_t, hr				0.001	0.008		0.0091
CHANNEL FLOW							
Waterways & Swamps, No Channels							
Length, ft							
Slope, ft/ft							
Velocity[5], ft/sec							
T_t, hr							0.0000
Grassed Waterways/Roadside Ditches							
Length, ft							
Slope, ft/ft							
Velocity[6], ft/sec							
T_t, hr							0.0000
Small Tributary & Swamp w/Channels							
Length, ft							
Slope, ft/ft							
Velocity[7], ft/sec							
T_t, hr							0.0000
Large Tributary							
Length, ft							
Slope, ft/ft							
Velocity[8], ft/sec							
T_t, hr							0.0000
Main River							
Length, ft							
Slope, ft/ft							
Velocity[9], ft/sec							
T_t, hr							0.0000
Culvert							
Diameter, ft							
Area, ft^2							
Wetted Perimeter, ft							
Hydraulic Radius, R, ft							
Slope, ft/ft							
Manning's No.							
Velocity[10], ft/sec							
Length, L, ft							
T_t, hr							0.0000

0.276 HR

16.56 Min ← use 16.6

3:13 PM

1/28/2005



CULVERT SIZING WATERSHEDS

SCALE: 1" = 80'

E/PRD CONSULTING, LLC

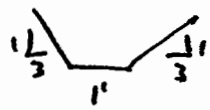
PLEASE REFER TO CONSTRUCTION DRAWINGS FOR MORE DETAIL.

BHE-Permissible Velocities
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\academic\fmw\wells.fm2
Worksheet	Permissible Velocities
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.020000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	1.00	ft
Discharge	4.00	cfs

WE HAVE 1.47 CFS < 4.00 CFS
CURRENT CONFIG OF



@ 2%
IS ADEQUATE.

Results		
Depth	0.50	ft
Flow Area	1.27	ft²
Wetted Perimeter	4.19	ft
Top Width	4.03	ft
Critical Depth	0.50	ft
Critical Slope	0.020353	ft/ft
Velocity	3.16	ft/s
Velocity Head	0.15	ft
Specific Energy	0.66	ft
Froude Number	0.99	
Flow is subcritical.		

Table 36.1 (Continued)

2

Hydrologic Group C

Soil Name	K factor (10" - 20")	Permissible Velocity Feet per second		Inflow Rate cfs/1000 ft. (Where water table exists)
		Bare	Vegetated	
Becket	.28	1.5	3.0	.10
Boothbay	.49	1.5	3.0	.05
Brayton (Ridgebury)	.32	1.5	3.0	.10
Buxton (Suffield)	.49	1.5	3.5	.05
Canaan	.17	2.0	3.5	----
Charles (Limerick)	.49	1.5	3.0	.10
Chesuncook	.32	1.5	3.0	.10
Colonel	.24	2.0	3.5	.10
Conant	.24	2.0	3.5	.15
Cornish	.49	1.5	3.0	.10
Crary	.64	1.0	2.5	.10
Daigle	.24	1.5	3.0	.10
Dixfield	.24	2.0	3.5	.10
Dixmont	.28	1.5	3.0	.15
Eldridge	.24	1.5	3.0	.05
Elmwood	.32	1.5	3.0	.05
Finch (Saugatuck)	.15	2.0	3.5	.15
Fredon	.24	2.0	3.5	.15
Howland	.24	2.0	3.5	.10
Kinsman	.17	2.0	4.0	.15
Mapleton	.20	2.0	3.5	----
Marlow (Paxton)	.32	2.0	4.0	.10
Melrose	.32	2.0	4.0	.10
Moosilauke (Walpole)	.24	2.0	4.0	.15
Naskeag	.10	2.5	4.5	.15
Naumburg	.17	2.0	4.0	.15
Nicholville (Belgrade, Scio)	.64	1.0	2.5	.10
Peru	.32	2.0	3.5	.10
Plaisted	.24	2.0	3.5	.10
Potsdam	.64	1.0	2.5	.10
Red Hook	.24	2.5	4.5	.15
Roundabout (Raynham)	.64	1.0	2.5	.05
Rumney	.37	1.5	3.0	.15
Skerry	.28	1.5	3.0	.10
Swanville(Canandaigua)	.49	1.5	3.0	.05
Telos	.32	1.5	3.0	.10
Tunbridge	.20	2.0	3.5	----
Westbury	.24	1.5	3.0	.10
Winnecook	.28	1.5	3.0	1.00

Table 36.1 (Continued)

3

Hydrologic Group D

Soil Name	K factor (10" - 20")	Permissible Velocity Feet per second		Inflow Rate cfs/1000 ft. (Where water table exists)
		Bare	Vegetated	
Abram	-----	2.0	3.5	----
Aurelie	.17	2.0	3.5	.10
Beaches	.05	2.5	4.5	1.00
Benson	.17	2.0	3.5	----
Biddeford	.32	1.5	3.0	.05
Burnham	.28	1.5	3.0	.10
Easton	.37	1.5	3.0	.10
Gouldsboro	.37	1.5	3.0	.05
Lamoine	.49	1.5	3.0	.05
Lyme(Leicester)	.32	1.5	3.0	.10
Medomak (Saco)	.49	1.5	3.0	.05
Monarda	.28	2.0	3.5	.10
Peacham (Whitman)	.28	2.0	3.5	.10
Scantic	.49	1.5	3.5	.05
Schoodic	.17	2.0	3.5	----
Searsport (Scarboro)	.17	2.5	4.5	.15
Washburn	.24	2.0	3.5	.10
Whately	.28	2.0	3.5	.05

Hydrologic Group B/D

(Atherton)	.28	2.0	3.5	.15

Hydrologic Group C/D

Creasy	.28	1.5	3.0	----
Halsey	.24	2.0	3.5	.15
Lyman (Hollis)	.32	2.0	3.5	----
Mapleton, Stony	.20	2.0	3.5	1.00
Monson	.24	2.0	3.5	----
Swanton	.32	1.5	3.0	.05
Thorndike	.20	2.0	3.5	1.00

Mesic soil names appear in parenthesis

Miscellaneous land types are not assigned to a hydrologic group because of the variability of the soil material.

Organic soils and those soils mapped above an elevation of 2300 feet (cryic soils) do not appear on this list as they will require special considerations.

E·PRO

Engineering & Environmental Consulting, LLC

BOOK NO. PAGE NO.
FILE NO.
SUBJECT Uplift Resistance SHEET 1 OF 1 SHEETS
COMPUTED BY DTB DATE 2/2/05 CHECKED BY

OUTLET STRUCTURE – ANTI-FLOTATION DESIGN

UPLIFT FORCE: ASSUME GROUNDWATER @ FINISH GRADE

T/ STRUCTURE: EL. 135.50
FINISH GRADE: EL. 135.50
B/STRUCTURE: EL. 127.00

HEAD GENERATED: 135.50 – 127.00 = 8.50'

UPLIFT FORCE: 8.50 · 62.4 #/FT³ = 530.4 #/FT²

TOTAL FORCE: $\pi \frac{(5.83)^2}{4} \cdot 530.4$ #/FT² = 14,159 #

← BOTTOM OF STRUCTURE W/6" LIP

RESISTING FORCE:

STRUCTURE COVER: $\pi \frac{(4.83)^2}{4} \cdot 0.67 \cdot 150$ #/FT³ = 1,841.4 #

STRUCTURE BOTTOM: $\pi \frac{(5.83)^2}{4} \cdot 0.67 \cdot 150$ #/FT³ = 2,682.8 #

STRUCTURE WALLS: T/STRUCT = 135.50 – 0.67 = 134.83'
T/BASE = 127.50 — 127.50
7.33'

$7.33' \times \pi \frac{(4.83^2 - 4^2)}{4} \times 150$ #/FT³ = 6,328.8 #

SOIL ABOVE LIP: $\pi \frac{(5.83^2 - 4.83^2)}{4} \times (135.5 - 127.50)$
= 66.98 × 120 #/FT³ = 8,037.5 #
↑ WT OF SOIL

TOTAL RESISTING = 18,890.5 #

FACTOR OF SAFETY AGAINST UPLIFT:

$FS = \frac{\text{RESIST}}{\text{UPLIFT}} = \frac{18,890.5}{14,159} = 1.334 > 1.15$ ✓ GOOD

E·PRO
Engineering & Environmental Consulting, LLC

BOOK NO. PAGE NO.
FILE NO.
SUBJECT _____ SHEET OF SHEETS
COMPUTED BY _____ DATE _____ CHECKED BY _____

DETERMINE OIL STORAGE

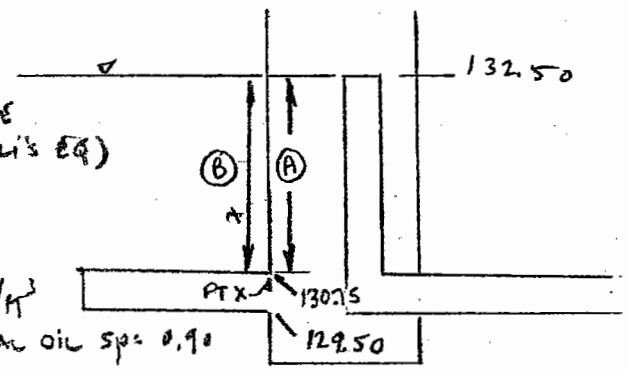
- REQUIRED VOLUME : TRANSFORMERS CONTAIN 33,400 GALLONS (SOURCE · SPCC PLAN)

$$33{,}400 \text{ GALLONS} \cdot \frac{0.1337}{1 \text{ GALLON}} = \underline{\underline{4465 \text{ FT}^3}}$$

SPILL POND HAS TO CONTAIN 4465 FT^3 OF OIL

- POND CAPACITY

BASED ON THE PROPOSED CONFIGURATION, THE POND HAS THE FOLLOWING CAPACITY:



PRESSURES AT PT X MUST BE THE SAME ON BOTH SIDES (BERNOULLI'S EQ)

(B) SIDE = (A) SIDE

$$x \cdot SP \cdot 62.4\#/ft^3 = (132.5 - 130.75) \cdot 62.4\#/ft^3$$

SP = SPECIFIC GRAVITY = MINERAL OIL SP = 0.90

$$x \cdot 0.90 = 1.75'$$
$$x = 1.94'$$

SUMMARY: 1.94' OF OIL WILL EQUAL 1.75' WATER

TOTAL VOLUME OF CONTAINMENT IN POND FROM ELEVATION 132.69 (130.75 + 1.94) TO 130.75 IS

EL 132.69 ⇒ 3906 FT^3
EL 130.75 ⇒ 2842 FT^3

6064 FT^3 TOTAL STORAGE > 4465 ✓ GOOD

Proposed Condition *Type III 24-hr 25-yr Rainfall=4.80"*
Prepared by E/PRO Consulting, LLC--DTB
HydroCAD® 7.00 s/n 001824 © 1986-2003 Applied Microcomputer Systems 1/20/2005

Pond 2P: Proposed SPCC/Detention Pond

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 130.75' Surf.Area= 2,525 sf Storage= 2,842 cf
Peak Elev= 130.75' @ 0.00 hrs Surf.Area= 2,525 sf Storage= 2,842 cf ← TOTAL STORAGE @ 130.75
Flood Elev= 135.00' Surf.Area= 5,801 sf Storage= 19,586 cf (16,743 cf above start)
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

#	Invert	Avail.Storage	Storage Description
1	129.00'	19,586 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
129.00	0	0	0
130.00	2,106	1,053	1,053
131.00	2,665	2,386	3,439
132.00	3,280	2,973	6,411
133.00	3,953	3,617	10,028
134.00	4,681	4,317	14,345
135.00	5,801	5,241	19,586

#	Routing	Invert	Outlet Devices
1	Device 2	129.75'	**15.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 129.50' S= 0.0125 '/' n= 0.010 Cc= 0.900
2	Device 3	132.50'	**15.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Primary	129.50'	**15.0" x 25.0' long Culvert** Ke= 0.500 Outlet Invert= 129.00' S= 0.0200 '/' n= 0.010 Cc= 0.900
4	Secondary	134.00'	**10.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=130.75' (Free Discharge)
└─**3=Culvert** (Passes 0.00 cfs of 4.67 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.00 cfs)
    └─**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=130.75' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Proposed Condition *Type III 24-hr 25-yr Rainfall=4.80"*
Prepared by E/PRO Consulting, LLC--DTB
HydroCAD® 7.00 s/n 001824 © 1986-2003 Applied Microcomputer Systems 1/20/2005

Pond 2P: Proposed SPCC/Detention Pond

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	1.06 cfs @	0.00 hrs,	Volume=	0.016 af, Atten= 0%, Lag= 0.0 min
Primary	=	1.06 cfs @	0.00 hrs,	Volume=	0.016 af
Secondary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 132.69' Surf.Area= 3,744 sf Storage= 8,906 cf ← TOTAL STORAGE @ 132.69'
Peak Elev= 132.69' @ 0.00 hrs Surf.Area= 3,744 sf Storage= 8,906 cf
Flood Elev= 135.00' Surf.Area= 5,801 sf Storage= 19,586 cf (10,679 cf above start)
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

#	Invert	Avail.Storage	Storage Description
1	129.00'	19,586 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
129.00	0	0	0
130.00	2,106	1,053	1,053
131.00	2,665	2,386	3,439
132.00	3,280	2,973	6,411
133.00	3,953	3,617	10,028
134.00	4,681	4,317	14,345
135.00	5,801	5,241	19,586

#	Routing	Invert	Outlet Devices
1	Device 2	129.75'	**15.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 129.50' S= 0.0125 '/' n= 0.010 Cc= 0.900
2	Device 3	132.50'	**15.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Primary	129.50'	**15.0" x 25.0' long Culvert** Ke= 0.500 Outlet Invert= 129.00' S= 0.0200 '/' n= 0.010 Cc= 0.900
4	Secondary	134.00'	**10.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=1.06 cfs @ 0.00 hrs HW=132.69' (Free Discharge)
└─**3=Culvert** (Passes 1.06 cfs of 9.46 cfs potential flow)
└─**2=Orifice/Grate** (Weir Controls 1.06 cfs @ 1.4 fps)
└─**1=Culvert** (Passes 1.06 cfs of 2.03 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=132.69' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Compatibility of XR-5 1/2

SECTION B — CHEMICAL/ENVIRONMENTAL RESISTANCE

PART B-1: XR-5® FLUID RESISTANCE GUIDELINES

The data below is the result of laboratory tests and is intended to serve only as a guide. No performance warranty is intended or implied. The degree of chemical attack on any material is governed by the conditions under which it is exposed. Exposure time, temperature, and size of the area of exposure usually varies considerably in application, therefore, this table is given and accepted at the user's risk. Confirmation of the validity and suitability in specific cases should be obtained.

When considering XR-5 for specific applications, it is suggested that a sample be tested in actual service before specification. Where impractical, tests should be devised which simulate actual service conditions as closely as possible.

EXPOSURE	RATING
Acetic Acid (5%)	B
Acetic Acid (50%)	C
Ammonium Phosphate	T
Ammonium Sulfate	T
Antifreeze (ethylene glycol)	A
Animal Oil	A
Aqua Regia	X
ASTM Fuel A (100% Iso-octane)	A
ASTM Oil #2 (Flash pt. 240°C)	A
ASTM Oil #3	A
Benzene	X
Calcium Chloride Solutions	T
Calcium Hydroxide	T
20% Chlorine Solution	A
Clorox	A
Conc. Ammonium Hydroxide	A
Corn Oil	A
Crude Oil	A
Diesel Fuel	A
Ethanol	A
Ethyl Acetate	C
Ethyl Alcohol	A
Fertilizer Solution	A
#2 Fuel Oil	A
#6 Fuel Oil	A
Furfural	X
Gasoline	B
Glycerin	A
Hydraulic Fluid	A
Hydrocarbon Type II (40% Aromatic)	C
Hydrochloric Acid (50%)	A
Hydrofluoric Acid (5%)	A
Hydrofluoric Acid (50%)	A
Hydrofluosilicic Acid (30%)	A
Isopropyl Alcohol	T
Ivory Soap	A
Jet A	A
JP-4 Jet Fuel	A

EXPOSURE	RATING
JP-5 Jet Fuel	A
JP-8 Jet Fuel	A
Kerosene	A
Magnesium Chloride	T
Magnesium Hydroxide	T
Methanol	A
Methyl Alcohol	A
Methyl Ethyl Ketone	X
Mineral Spirits	A
Naptha	A
Nitric Acid (5%)	B
Nitric Acid (50%)	C
Perchloroethylene	C
Phenol	X
Phenol Formaldehyde	B
Phosphoric Acid (50%)	A
Phosphoric Acid (100%)	C
Phthalate Plasticizer	C
Potassium Chloride	T
Potassium Sulphate	T
Raw Linseed Oil	A
SAE-30 Oil	A
Salt Water (25%)	B
Sea Water	A
Sodium Acetate Solutions	T
Sodium Bisulfite Solution	T
Sodium Hydroxide (60%)	A
Sodium Phosphate	T
Sulphuric Acid (50%)	A
50% Tanic Acid	A
Toluene	C
Transformer Oil	A
Turpentine	A
Urea Formaldehyde	A
UAN	A
Vegetable Oil	A
Water (200°F.)	A
Xylene	X
Zinc Chloride	T

Ratings are based on visual and physical examination of samples after removal from the test chemical after the samples of Black XR-5 were immersed for 28 days at room temperature. Results represent ability of material to retain its performance properties when in contact with the indicated chemical.

RATING KEY:
A—Fluid has little or no effect
B—Fluid has minor to moderate effect
C—Fuild has severe effect
T—No data-likely to be acceptable
X—No data-not likely to be acceptable

Table II-B.

Chemical	PVC[1] 72°F	PVC[1] 140°F	CPVC[2] 72°F	CPVC[2] 185°F	PP[3] 73°F	PP[3] 120°F	PP[3] 150°F	PP[3] 180°F‡	PVDF[4] 70°F	PVDF[4] 150°F	PVDF[4] 250°F	LDPE[5] 70°F	LDPE[5] 140°F	HDPE[6] 70°F	HDPE[6] 140°F	VITON* 73°F	VITON* 140°F	VITON* 185°F	EPT[7] 73°F	EPT[7] 140°F	EPT[7] 210°F	B[illegible] 2[illegible]
Lead Acetate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	NR	R	R	R	R
Lemon Oil	—	—	—	—	F	—	—	—	R	R	R	—	—	—	—	—	—	—	—	—	—	—
Ligroine	—	—	—	—	R	R	—	—	—	—	—	—	—	—	—	R	R	R	NR	NR	NR	—
Lime Sulfur	R	—	R	—	R	—	—	—	—	—	—	—	—	—	—	R	R	R	R	R	R	—
Linoleic Acid	R	R	R	R	R	R	R	R	R	R	R	—	—	—	—	R	R	NR	NR	NR	NR	F
Linseed Oil	R	R	R	—	R	R	F	—	R	R	R	F★	NR	F★	NR	R	R	R	NR	NR	NR	F
Linseed Oil, Blue	—	—	—	—	R	NR	NR	NR	—	—	—	—	—	—	—	R	R	R	—	—	—	—
Liqueurs	R	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lubricating Oil	R	R	R	R	F	F	NR	NR	R	R	R	NR	NR	F★	NR	R	R	R	NR	NR	NR	NR
Lye Solutions	R	R	—	R	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Machine Oil	R	R	R	R	R	R	NR	NR	R	R	—	—	—	—	—	R	R	NR	NR	NR	NR	R
Magnesium Carbonate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Magnesium Chloride	R	R	R	R	R	R	R	F	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Magnesium Hydroxide	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Magnesium Nitrate	R	R	R	R	—	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Magnesium Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Maleic Acid	R	R	R	R	—	—	—	—	R	R	R	—	—	—	F	R	R	R	R	NR	NR	F
Malic Acid	R	R	R	R	F	F	F	—	R	R	R	R	F	R	F	R	R	R	R	NR	NR	F
Manganese Salts	R	—	R	—	R	R	R	R	—	—	—	—	—	—	—	R	R	R	R	R	R	R
Mercuric Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	F
Mercuric Cyanide	R	R	R	R	R	R	—	—	R	R	R	R	R	R	R	R	NR	NR	R	R	R	F
Mercurous Nitrate	R	R	R	R	R	R	—	—	R	R	R	R	R	R	R	R	—	—	R	—	—	F
Mercury	R	R	R	R	R	R	R	—	R	R	R	R	R	R	R	R	R	R	R	R	R	F
Methane	R	R	R	—	R	F	F	—	R	R	R	—	—	—	—	R	R	R	NR	NR	NR	F
Methyl Alcohol	R	R	R	R	R	R	R	R	R	R	R	R★	R★	R★	R★	R	R	F	R	R	—	F
Methyl Bromide	NR	NR	NR	NR	—	—	—	—	R	R	R	F★	NR	F★	NR	R	R	R	NR	NR	NR	NR
Methyl Cellosolve	—	—	—	—	R	—	—	—	R	R	R	—	—	—	—	NR	NR	NR	R	NR	NR	—
Methyl Chloride	NR	NR	NR	NR	NR	—	—	—	R	R	R	F★	NR	F★	NR	R	R	R	NR	NR	NR	NR
Methyl Chloroform	NR	NR	NR	NR	—	—	—	—	R	R	—	—	—	—	—	—	—	—	NR	NR	NR	NR
Methyl Ethyl Ketone	NR	NR	NR	NR	R	R	F	—	NR	NR	NR	F★†	NR	NR	NR	NR	NR	NR	R	NR	NR	NR
Methyl Isobutyl Ketone	NR	NR	NR	NR	R	NR	NR	NR	R	NR	NR	—	—	—	—	NR	NR	NR	NR	NR	NR	NR
Methyl Salicylate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Methyl Sulfate	R	F	R	—	—	—	—	—	R	R	R	—	—	—	—	—	—	—	—	—	—	—
Methyl Sulfuric Acid	R	R	R	R	R	R	F	—	NR	NR	NR	R	R	R	R	—	—	—	NR	NR	NR	—
Methylene Chloride	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	F	NR	F	NR	R	NR	NR	NR	NR	NR	F
Methylisobutyl Carbinol	—	—	—	—	R	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Milk	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Mineral Oil	R	R	R	R	F	F	NR	—	R	R	R	F★	NR	F★	NR	R	R	R	NR	NR	NR	R
Molasses	R	R	R	R	R	R	—	—	—	—	—	R	R	R	R	R	R	R	R	R	R	R
Monoethanolamine	—	—	—	—	—	—	—	—	NR	NR	NR	—	—	—	—	R	R	R	R	NR	NR	R
Motor Oil	R	R	R	R	F	F	NR	NR	R	R	R	—	—	—	—	R	R	R	NR	NR	NR	R
Naptha	R	R	R	—	R	F	F	—	R	R	R	F★	NR	F★	NR	R	R	R	NR	NR	NR	NR
Naphthalene	NR	NR	NR	NR	R	F	F	F	R	R	NR	F★	NR	F★	NR	R	R	R	NR	NR	NR	NR
n-Heptane	—	—	—	—	R	F	NR	NR	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Natural Gas	R	—	R	—	R	—	—	—	—	—	—	—	—	—	—	R	R	R	NR	NR	NR	—
Nickel Chloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Nickel Nitrate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Nickel Salt	R	R	R	R	R	R	R	R	—	—	—	—	—	—	—	R	R	R	R	R	R	R
Nickel Sulfate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Nicotine	R	R	R	R	—	—	—	—	R	NR	NR	R★	R★	R★	R★	—	—	—	—	—	—	—
Nicotinic Acid	R	R	R	R	—	—	—	—	R	R	R	R★	R★	R★	R★	—	—	—	—	—	—	—
Nitric Acid, 10%	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	NR	NR	NR
Nitric Acid, 30%	R	R	R	R	R	R	R	R	R	R	F	R	R	R	R	R	R	R	R	NR	NR	NR
Nitric Acid, 40%	R	—	R	NR	R	R	F	NR	R	R	NR	R	F	F	NR	R	R	R	NR	NR	NR	NR
Nitric Acid, 50%	R	—	R	NR	R	NR	NR	NR	R	R	NR	R	F	F	NR	R	R	R	NR	NR	NR	NR

[1]Polyvinyl Chloride TIGI [2]Chlorinated Polyvinyl Chloride [3]Polypropylene [4]Polyvinylidene Fluoride [5]Low Density Polyethylene

[6]High Density Polyethylene [7]Ethylene Propylene Terpolymer *Buna-N (Nitrile Rubber)

‡For drainage application only

★These chemicals can cause stress-cracking under certain conditions. Use polypropylene or cross-linked polyethylene tanks.

†Permeation by this solvent may cause swelling

*In the event these elastomers are not recommended consult factory or alternater

TAKEN FROM THE PLASTIC PIPING SYSTEMS HANDOUT

COMPATIBILITY OF PVC PIPING

Selection of Materials

2/2