APPENDIX 6

Determining Required Stream Protection Volumes and Release Rates for Detention Basins

Background

Recently Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) developed subdivision drainage rules and storm water design criteria for Van Buren, Newaygo, and Montcalm Counties and the City of Portage, Kalamazoo County (counties). These rules include, among other things, provisions for protecting streambanks from erosive velocities during 1 to 2 year rainfall events. The intent was to find a simple set of rules based on easily determined site parameters that, when followed, would provide this streambank protection. The result is that detention basins that are to be designed for streambank protection must have at least 5,000 ft3 of storage per impervious acre of development and that the peak release rate from the basin shall be less than or equal to 0.05 cfs per impervious acre during a 1.5-year rainfall event. Note that additional criteria exist for flood protection, spill protection, etc.

The basis for these rules comes from the Uniform Storm Water Sizing Criteria established for the State of Maryland (Maryland). Their criteria for channel protection are given in the document "Method for Computing the Channel Protection Storage Volume (CPV)" (Appendix D.11 of the Unified Storm Water Sizing Criteria). The Maryland sizing criteria is based on obtaining a 24-hour extended detention time for the 1-year rainfall event. The detention time is defined as the lag time between the centroids of the inflow and outflow detention pond hydrographs. The implementation procedures in Maryland are more involved than the rules developed by FTC&H. The following analysis provides a direct comparison with the Maryland approach.

Basis

Streambank erosion occurs when velocities associated with channel-forming flows are given time to cause damage. Storm water detention policies that are based on maintaining predevelopment flow rates for a 2-year (channel-forming) event can often lead to increased erosion since erosive velocities are present for a longer period of time because of the increased volume associated with development. The Maryland stream protection sizing criteria is based on over-managing the more frequent (1-year) events by extended detention. By doing this, the peak discharges from the 2-year event are reduced to approximately predevelopment levels but, more importantly, these discharges occur over the same amount of time as would under pre-development conditions since they pass through the extended detention controls.

The county stream protection rules developed by FTC&H require extended detention for the 1.5-year event. This means that, on average, any drop of water entering the basin will be held for a 24-hour period. The specific criterion is that the centroid of the outflow hydrograph is delayed from the centroid of the inflow hydrograph by 24 hours.

Methodology

The major problem that has to be solved is that of finding a simple rule based on easily identified site specific parameters that, when followed, has a high likelihood of meeting the 24 hour detention time goal. The approach that was followed involves extensive sampling. Many runs were made using hydrologic modeling software (HydroCad) each with a different set of parameters. The results of these runs were used to establish a set of relationships which could then be used to establish the appropriate rules. The major challenge with this approach is to reduce the number of parameters that need to be varied to keep the task manageable and to make the derived relationships presentable. The hydrologic model (in HydroCad) is simple - a single subbasin providing flow into a single detention pond. The possible parameters that could be varied are the following:

- Drainage area, A
- Curve Number, CN
- Time of concentration, tc
- Rainfall depth, P
- Type of unit hydrograph
- Type and duration of storm
- Shape of the detention pond
- Size of the detention pond
- Side slopes of the detention pond
- Peak depth of the detention pond
- Outlet diameter of the detention pond

There are two ways to reduce the number of parameters that need to be sampled. First, a set of reasonable assumptions can be made about several of the parameters. Second, some of the parameters can be combined into groups allowing variation of a smaller number of parameters.

The following assumptions have been made to reduce the number of parameters:

- Use a 24-hour soil conservation service (SCS) type II rainfall distribution.

- Use a unit hydrograph that corresponds to observed stream behavior in Michigan. A SCS triangular unit hydrograph with 28.5% of the volume under the rising limb was used for this purpose. This is the same unit hydrograph used to generate the results published in the document “Computing Flood Discharges For Small Ungaged Watersheds”.

- Use a rectangular detention basin with 4:1 side slopes and peak depth (for the 1.5-year storm) of approximately 5 feet.

The parameterization follows the approach in Appendix D.11 of Maryland’s Unified Storm Water Sizing Criteria. In this approach a relationship is first developed between the Unit peak discharge, qU (in cfs per mi2 per inch of runoff), and 2 parameters - the time of concentration and the ratio of initial abstraction, Ia to the precipitation depth, P. This unit peak discharge is the same as QP given in equation 9.1 in “Computing Flood Discharges For Small Ungaged Watersheds”. (Equation 9.1 does not include the second parameter (Ia/P) because it is based on a fixed CN value of 75). To show that the unit peak discharge can be expressed as a function of only Ia/P and tC consider the 2 cases given in the table below:

Parameter	Case I	Case II
A [acre]	100	25
CN	80	66.7
P [in]	2	4
tc [hr]	1	1
Ia [in] = .2(1000/CN-10)	0.5	1.0
Ia/P	0.25	0.25
Peak discharge [cfs]	20.14	10.31
Runoff depth [in]	0.56	1.14
Unit Peak discharge, qU [cfs/mi2/in]	230	231

In this example A, CN, and P are different for both cases but they produce the same Ia/P value and the same resulting unit peak discharge. No new information was therefore derived from the running of the second sample. If the unit peak discharge can be used as a key parameter in the detention basin model, then the selected sample values of A, CN, and P need only generate a complete range of Ia/P values. This greatly reduces the number of sample cases to be run.

The second relationship that is developed is that between the unit peak discharge and the ratio of peak outflow to peak inflow, qo/qi, for a 24-hour detention time. This simple relationship is possible since the shape of the inflow hydrograph is influenced more by the SCS rainfall distribution than the time of concentration of the drainage area. All of the inflow hydrographs will have a shape, which is quite independent of the drainage area parameters. The table below shows the results of running 3 examples to show that this relationship is valid. All cases use the same detention basin side slope (4:1). In each case, the detention basin base area and outlet diameter are manually adjusted to get a 24-hour detention time with a maximum depth of about 5 feet. All 3 runs use the same precipitation depth of 2.0 inches.

Parameter	Case A	Case B	Case C
A [acre]	640	1,280	640
CN	84	84	71
tC [min]	30	30	15
Runoff depth [in]	0.74	0.74	0.27
Peak drainage area discharge or peak detention basin inflow, qi [cfs]	312.5	624.9	115.1
Unit Peak Discharge, qu [cfs/mi2/in]	422	422	426
Detention pond base area [ac]	4	8	1.4
Outlet diameter [in]	14.5	21	8.4
Peak Detention basin outflow, qo [cfs]	11.27	22.84	3.99
Detention outflow/inflow ratio, qo/qi	.036	.036	.035

In this example each case has the same unit peak discharge and results in the same detention outflow/inflow ratio.

The results of detailed sampling are shown in the data table provided as Table 1 at the end of this appendix. The detailed sampling procedure used was as follows:

- The rainfall depth was fixed at 2.06 inches. This is arbitrary as long as a range of Ia/P values are used.
- Basin side slopes were set to 4:1.
- CN values were selected to give Ia/P range from 0.05 to 0.40 (columns 2 and 3).
- tC values were selected in the range from 15 to 480 minutes (column 4).
- The runoff depth, peak discharge, and unit peak discharge were computed from the HydroCad computer model (columns 5, 6, and 7).
- With the detention basin base area set to 1 acre the drainage area (column 1) and outlet diameter (column 8) were adjusted to provide a 24-hour detention time (column 9) with a 5-foot peak pond elevation (column 10). This was easier than setting a particular, arbitrary drainage area and then adjusting the basin base area and outlet diameter.

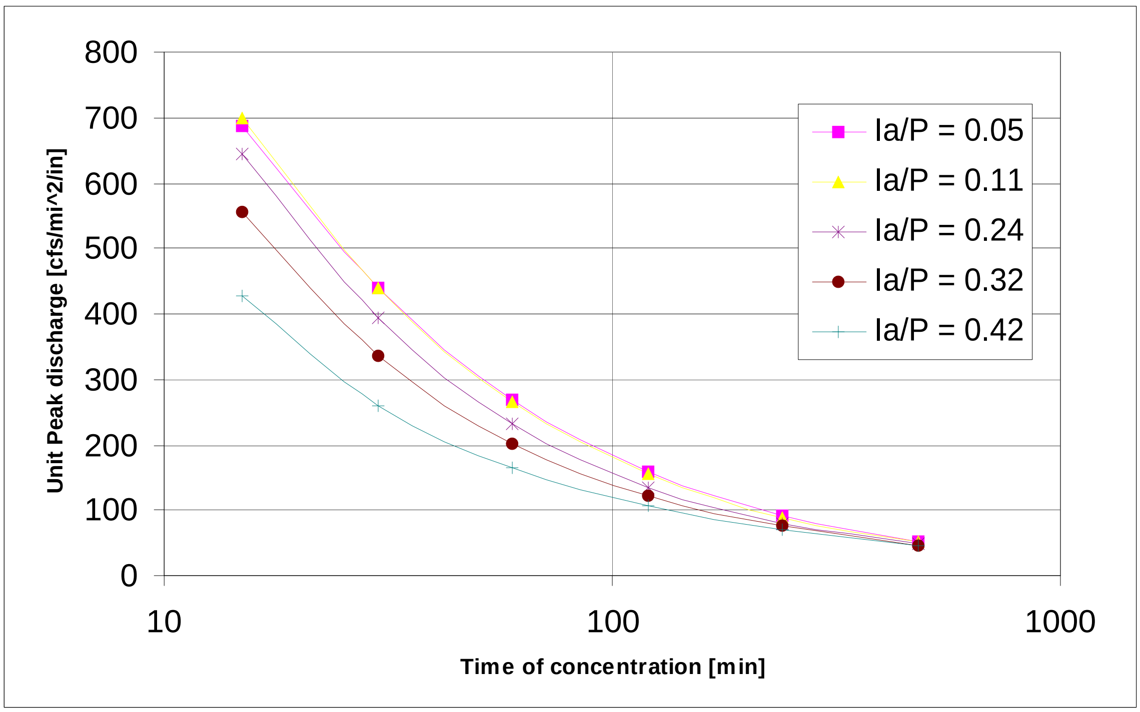
- From these results the peak release rate (column 11) and outflow/inflow ratio (column 13) can be computed.

- The detention storage volume (column 12) and the ratio of storage volume to inflow volume (column 13) are also computed.

Results

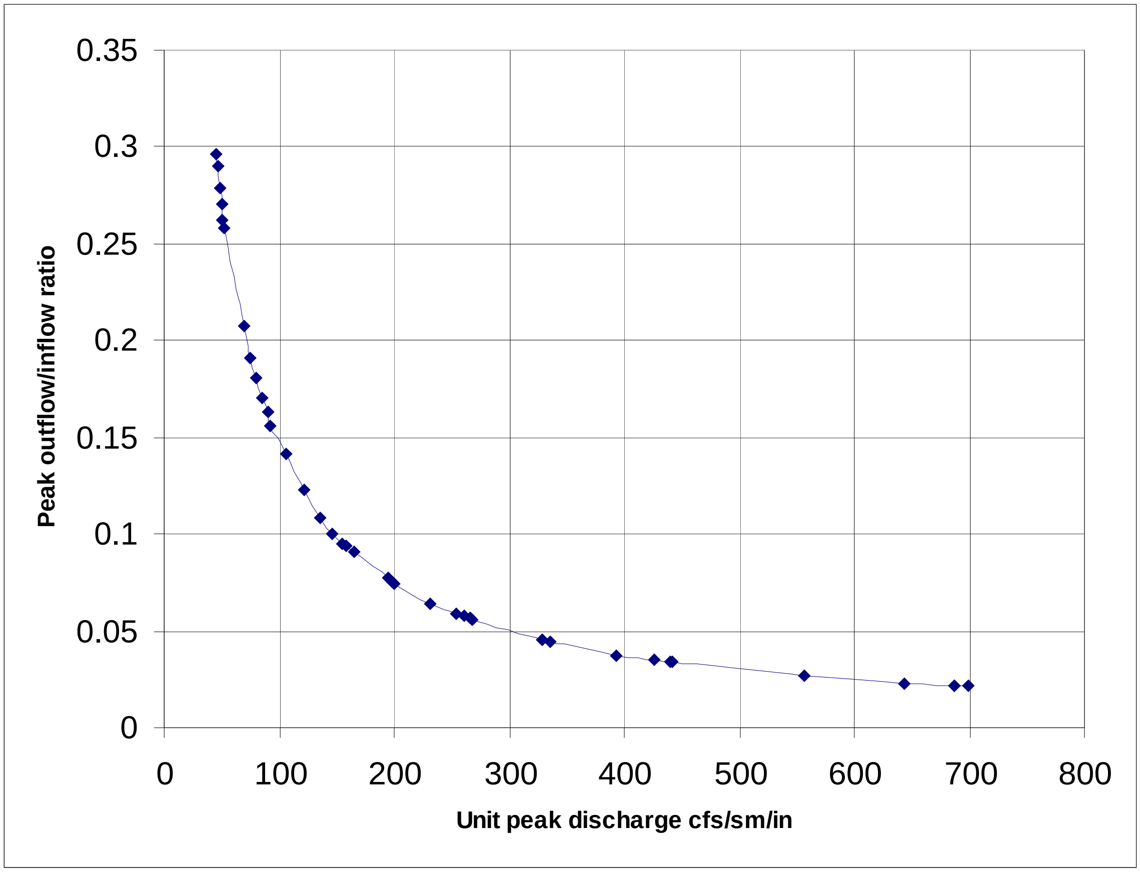
The two relationships described above are the primary results of this analysis. The first is the unit peak discharge (column 7) given as a function of time of concentration (column 4) and Ia/P (column 3). This is shown graphically in Figure 1.

Figure 1 - Unit Peak Discharge Related to Ia/P and Time of Concentration



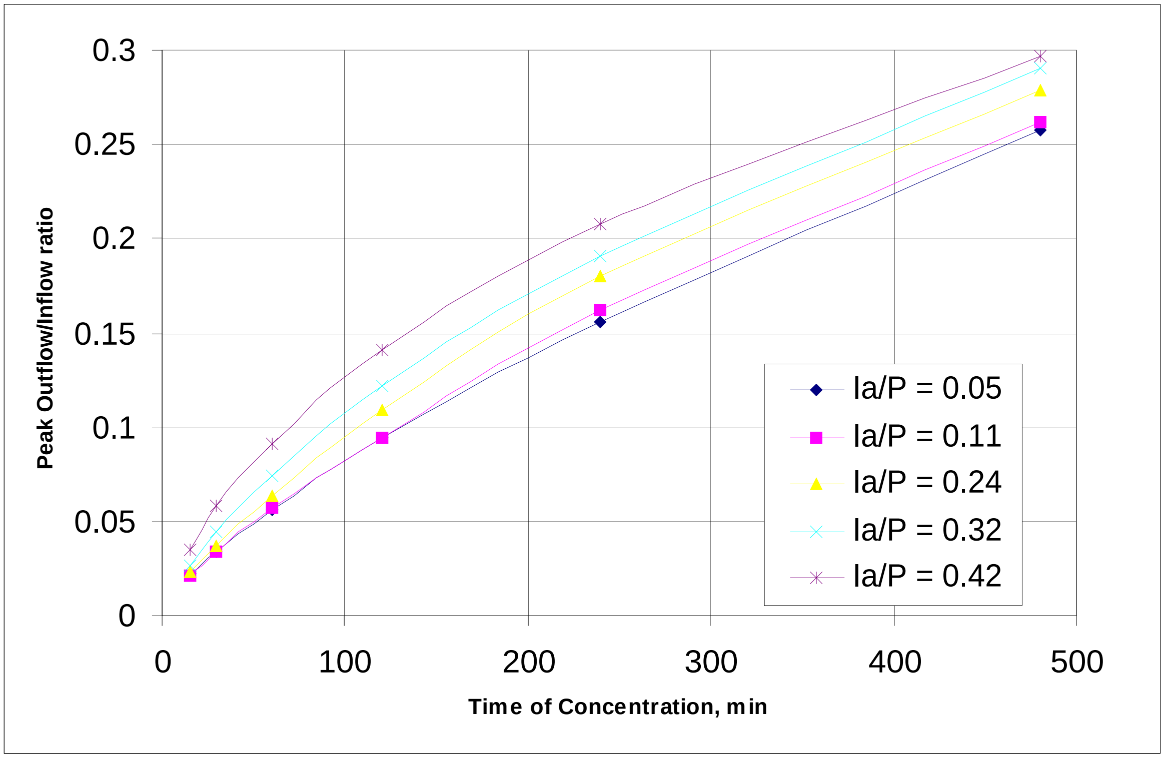
The second relationship is that between Unit Peak Discharge (column 7) and the detention basin outflow/inflow ratio needed to obtain a 24-hour detention time (column 13). This is shown in figure 2.

Figure 2 - Peak Outflow/Inflow as a Function of Unit Peak Discharge



These two relationships can also be combined as shown in Figure 3.

Figure 3 - Peak Inflow/Outflow as a Function of Ia/P and Time of Concentration



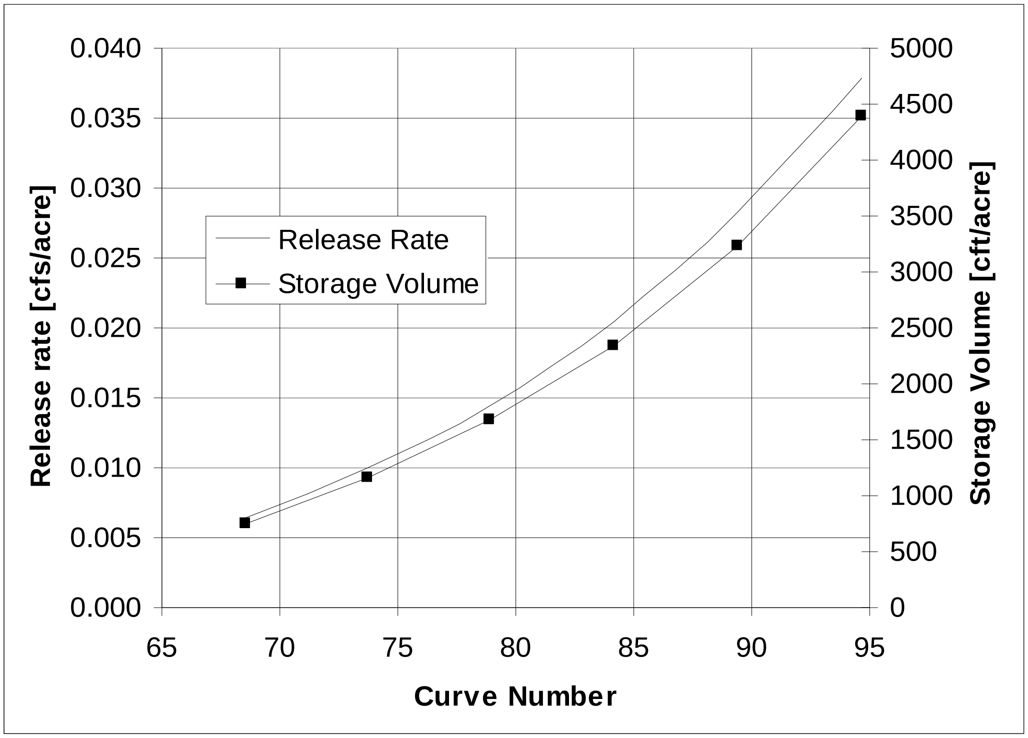
Results applied to Allegan County

Figures 1 and 2 could easily be used together to size a detention basin outlet for streambank protection. The procedures that would be followed are outlined in Appendix D.11 of the Maryland Uniform Storm Water Sizing Criteria. A simpler method was desired for the county storm water design criteria that used a simple discharge release rate restriction.

Table 2 shows the results of the release rate analysis applied to Allegan County. Columns 1 through 5 are the results of the sampling described above. They are the tabular version of Figures 1 and 2. This data can be considered generic for Michigan since they are based on a typical Michigan unit hydrograph. Column 6 (column 1 times 2.2 inches) is the initial abstraction associated with the 1.5-year rainfall event in Allegan County. Column 7 is the CN associated with that initial abstraction value (Ia=0.2*[1000/CN-10]). Column 8 is the runoff depth associated with the CN in column 7 and the 2.2 inches of rainfall. Column 9 is the peak discharge (per acre) from the drainage area. This is also the peak inflow rate into the detention basin. It is computed by multiplying the Unit Peak Discharge (column 3) by the runoff depth (column 8) times 1/640 (1 acre in mi2). Column 10 is the release rate in cfs/acre. It is column 9 times column 4. Column 11 gives the required detention storage in ft3/acre. It is computed as the runoff depth in feet (column 8 divided by 12) times 43560 ft2 times the storage volume to runoff volume ratio (column 5).

It can be seen that using a 24-hour detention of the 1.5-year event as the basis for stream protection results in a very wide range of values in columns 10 and 11. For the range of Ia/P and tC values used in this analysis this release rate varies over 6.5 orders of magnitude from 0.006 to 0.039 cfs per acre. Selecting a single value would be difficult to do. To be able to select a release criterion that has less variability requires incorporating more parameters. One approach would be to simply use the developed curve number as an additional parameter. The values in column 10 and 11 vary only a small amount for any particular CN value. Averaging the release rates and storage volumes for each curve number value results in the relationships shown in Figure 4.

Figure 4 - Release Rate as a Function of Curve Number



Another, somewhat simpler, approach does not require the developer to compute the curve number. It is based on the hydrologic soil group and the imperviousness of the drainage area. Additional columns are now needed in Table 2. Columns 12 through 15 are the impervious fraction for development for the 4 different hydrologic soil groups. This assumes that the curve number in column 7 is a weighted average of 98 for the impervious part and the value associated with open space in good condition. So, if the soil is in hydrologic soil group B the impervious fraction needs 0.91 to get an average curve number of 95 (row 1). By dividing column 10 by the impervious fractions in columns 12 through 15 the release rate is recomputed in terms of cfs per impervious acres (columns 16 through 19). The values in each of these columns vary less than those in column 10. This same process was done for the detention storage volume, resulting in the values in columns 20 through 23 which are now in ft3/impervious acre for each soil type.

A recommended value can now be determined for each hydrologic soil group using an average from each column. The results are as follows:

- HSG A: Release 0.026 cfs/impervious acre, Volume 3,000 ft3/impervious acre
- HSG B: Release 0.034 cfs/impervious acre, Volume 4,000 ft3/impervious acre
- HSG C: Release 0.051 cfs/impervious acre, Volume 5,800 ft3/impervious acre
- HSG D: Release 0.059 cfs/impervious acre, Volume 5,800 ft3/impervious acre

If it is assumed that infiltration will be used for type A and B soils then a reasonable value for C and D soils is 0.05 cfs per impervious acre and 5800 ft3/impervious acre.

Table 1 - Sampling Data and Calculations

Drainage Area Inputs				Drainage Area Output			Reservoir Input	Reservoir Output				Calculations	
Area [acre] (1)	CN (2)	Ia/P (3)	Time of Concentration tc [min] (4)	Runoff Depth [in] (5)	Peak Discharge qi [cfs] (6)	Unit peak Discharge, qu [cfs/mi2/in] (7)	Orifice Diameter [in] (8)	Detention Time [min] (9)	Maximum Depth [ft] (10)	Peak Release, qo [cfs] (11)	Storage Volume, Vs [ac-ft] (12)	Peak Outflow to Inflow Ratio qo/qi (13)	Storage Volume to Runoff Volume Ratio, Vs/Vr (14)
80	95	0.051	15	1.54	132.18	687	7.1	1,455	5.05	2.89	7.65	0.022	0.745
80	95	0.051	30	1.54	84.55	439	7.1	1,454	5.05	2.89	7.65	0.034	0.745
80	95	0.051	45	1.54	63.42	329	7.1	1,453	5.04	2.88	7.64	0.045	0.744
80	95	0.051	60	1.54	51.53	268	7.1	1,451	5.04	2.88	7.63	0.056	0.743
80	95	0.051	90	1.54	38.17	198	7.1	1,447	5.03	2.88	7.62	0.075	0.742
80	95	0.051	120	1.54	30.57	159	7.1	1,443	5.01	2.88	7.59	0.094	0.739
80	95	0.051	240	1.54	17.83	93	7	1,462	4.97	2.78	7.52	0.156	0.732
80	95	0.051	480	1.54	10.19	53	6.9	1,454	4.71	2.63	7.14	0.258	0.695
110	90	0.108	15	1.15	138.11	699	7.2	1,435	5.11	2.99	7.74	0.022	0.734
110	90	0.108	30	1.15	87.16	441	7.2	1,433	5.11	2.98	7.74	0.034	0.734
110	90	0.108	45	1.15	65.08	329	7.2	1,431	5.1	2.98	7.73	0.046	0.733
110	90	0.108	60	1.15	52.51	266	7.2	1,429	5.09	2.98	7.72	0.057	0.732
110	90	0.108	90	1.15	38.48	195	7.2	1,425	5.08	2.98	7.69	0.077	0.729
110	90	0.108	120	1.15	30.68	155	7.1	1,457	5.09	2.9	7.71	0.095	0.731
110	90	0.108	240	1.15	17.71	90	7.1	1,436	5.02	2.88	7.6	0.163	0.721
110	90	0.108	480	1.15	10.14	51	6.9	1,467	4.83	2.66	7.31	0.262	0.693
150	85	0.171	15	0.84	135.08	686	7.2	1,431	5.06	2.97	7.74	0.022	0.737
150	85	0.171	60	0.84	50.15	255	7.2	1,425	5.04	2.96	7.64	0.059	0.728
150	85	0.171	120	0.84	28.93	147	7.1	1,453	5.05	2.89	7.65	0.100	0.729
150	85	0.171	240	0.84	16.86	86	7.1	1,432	4.99	2.87	7.56	0.170	0.720
150	85	0.171	480	0.84	9.84	50	6.9	1,464	4.81	2.66	7.28	0.270	0.693
210	80	0.243	15	0.6	126.75	644	7.1	1,462	5.1	2.9	7.72	0.023	0.735
210	80	0.243	30	0.6	77.43	393	7.1	1,461		2.9	7.71	0.037	0.734
210	80	0.243	60	0.6	45.66	232	7.1	1,457		2.9	7.7	0.064	0.733
210	80	0.243	120	0.6	26.58	135	7.1	1,448		2.89	7.65	0.109	0.729
210	80	0.243	240	0.6	15.85	81	7.1	1,428	4.97	2.86	7.54	0.180	0.718
210	80	0.243	480	0.6	9.5	48	6.9	1,462	4.78	2.65	7.25	0.279	0.690

Drainage Area Inputs				Drainage Area Output			Reservoir Input	Reservoir Output				Calculations	
Area [acre] (1)	CN (2)	Ia/P (3)	Time of Concentration tc [min] (4)	Runoff Depth [in] (5)	Peak Discharge qi [cfs] (6)	Unit peak Discharge, qu [cfs/mi2/in] (7)	Orifice Diameter [in] (8)	Detention Time [min] (9)	Maximum Depth [ft] (10)	Peak Release, qo [cfs] (11)	Storage Volume, Vs [ac-ft] (12)	Peak Outflow to Inflow Ratio qo/qi (13)	Storage Volume to Runoff Volume Ratio, Vs/Vr (14)
300	75	0.324	15	0.41	107.09	557	7.1	1,442	5.02	2.88	7.6	0.027	0.741
300	75	0.324	30	0.41	64.6	336	7.1	1,440	5.01	2.87	7.59	0.044	0.740
300	75	0.324	60	0.41	38.58	201	7.1	1,437	4.99	2.87	7.59	0.074	0.740
300	75	0.324	120	0.41	23.28	121	7.1	1,429	4.95	2.85	7.49	0.122	0.731
300	75	0.324	240	0.41	14.44	75	7	1,449	4.89	2.76	7.41	0.191	0.723
300	75	0.324	480	0.41	9	47	6.9	1,445		2.61	7.04	0.290	0.687
450	70	0.416	15	0.26	77.99	427	7	1,448	4.9	2.76	7.42	0.035	0.761
450	70	0.416	30	0.26	47.66	261	7	1,447	4.89	2.76	7.4	0.058	0.759
450	70	0.416	60	0.26	30.29	166	7	1,444	4.86	2.75	7.37	0.091	0.756
450	70	0.416	120	0.26	19.35	106	7	1,437	4.81	2.73	7.28	0.141	0.747
450	70	0.416	240	0.26	12.72	70	6.9	1,459	4.73	2.64	7.17	0.208	0.735
450	70	0.416	480	0.26	8.37	46	6.8	1,457	4.47	2.48	6.77	0.296	0.694

Table 2 - Allegan County Data

Results from Sampling (see Table 1)					Values Based on Allegan County 1.5-Year Rainfall: P=2.2 in						Impervious Fraction				Release Rate [cfs/imp acre]				Storage Volume [ft3/imp acre]			
Ia/P (1)	Time of Concentration tc [min] (2)	Unit Peak Discharge, qu [cfs/mi2/in] (3)	Peak Outflow to Inflow Ratio qo/qi (4)	Storage Volume to Runoff Volume Ratio, Vs/Vr (5)	Initial Abstraction, Ia [in] (6)	CN (7)	Runoff Depth, [in] (8)	Peak Detention Basin Inflow, qi [cfs/acre] (9)	Peak Detention Basin Outflow, qo [cfs/acre] (10)	Detention Storage [ft3/acre (11)	HSG A Open CN=39 (12)	HSG B Open CN=61 (13)	HSG C Open CN=74 (14)	HSG D Open, CN=80 (15)	HSG A (16)	HSG B (17)	HSG C (18)	HSG D (19)	HSG A (20)	HSG B (21)	HSG C (22)	HSG D (23)
0.051	15	686.6	0.022	0.745	0.112	95	1.64	1.76	0.039	4,449	0.94	0.91	0.86	0.82	0.041	0.042	0.045	0.047	4,714	4,887	5,163	5,455
0.051	30	439.2	0.034	0.745	0.112	95	1.64	1.13	0.039	4,449	0.94	0.91	0.86	0.82	0.041	0.042	0.045	0.047	4,714	4,887	5,163	5,455
0.051	45	329.5	0.045	0.744	0.112	95	1.64	0.85	0.038	4,443	0.94	0.91	0.86	0.82	0.041	0.042	0.045	0.047	4,708	4,881	5,157	5,448
0.051	60	267.7	0.056	0.743	0.112	95	1.64	0.69	0.038	4,437	0.94	0.91	0.86	0.82	0.041	0.042	0.045	0.047	4,702	4,875	5,150	5,441
0.051	90	198.3	0.075	0.742	0.112	95	1.64	0.51	0.038	4,431	0.94	0.91	0.86	0.82	0.041	0.042	0.045	0.047	4,696	4,868	5,143	5,434
0.051	120	158.8	0.094	0.739	0.112	95	1.64	0.41	0.038	4,414	0.94	0.91	0.86	0.82	0.041	0.042	0.045	0.047	4,677	4,849	5,123	5,413
0.051	240	92.6	0.156	0.732	0.112	95	1.64	0.24	0.037	4,373	0.94	0.91	0.86	0.82	0.039	0.041	0.043	0.046	4,634	4,804	5,076	5,363
0.051	480	52.9	0.258	0.695	0.112	95	1.64	0.14	0.035	4,152	0.94	0.91	0.86	0.82	0.037	0.039	0.041	0.043	4,400	4,562	4,819	5,092
0.108	15	698.7	0.022	0.734	0.237	89	1.22	1.34	0.029	3,260	0.85	0.77	0.64	0.52	0.034	0.038	0.045	0.055	3,817	4,248	5,083	6,248
0.108	30	441.0	0.034	0.734	0.237	89	1.22	0.84	0.029	3,260	0.85	0.77	0.64	0.52	0.034	0.038	0.045	0.055	3,817	4,248	5,083	6,248
0.108	45	329.3	0.046	0.733	0.237	89	1.22	0.63	0.029	3,256	0.85	0.77	0.64	0.52	0.034	0.038	0.045	0.055	3,812	4,243	5,076	6,240
0.108	60	265.7	0.057	0.732	0.237	89	1.22	0.51	0.029	3,252	0.85	0.77	0.64	0.52	0.034	0.038	0.045	0.055	3,807	4,237	5,070	6,231
0.108	90	194.7	0.077	0.729	0.237	89	1.22	0.37	0.029	3,239	0.85	0.77	0.64	0.52	0.034	0.038	0.045	0.055	3,792	4,221	5,050	6,207
0.108	120	155.2	0.095	0.731	0.237	89	1.22	0.30	0.028	3,247	0.85	0.77	0.64	0.52	0.033	0.037	0.044	0.054	3,802	4,232	5,063	6,223
0.108	240	89.6	0.163	0.721	0.237	89	1.22	0.17	0.028	3,201	0.85	0.77	0.64	0.52	0.033	0.036	0.043	0.053	3,748	4,172	4,991	6,135
0.108	480	51.3	0.262	0.693	0.237	89	1.22	0.10	0.026	3,079	0.85	0.77	0.64	0.52	0.030	0.034	0.040	0.049	3,605	4,012	4,801	5,901
0.171	15	686.1	0.022	0.737	0.377	84	0.90	0.96	0.021	2,399	0.77	0.63	0.42	0.23	0.028	0.034	0.050	0.092	3,135	3,835	5,676	
0.171	60	254.7	0.059	0.728	0.377	84	0.90	0.36	0.021	2,368	0.77	0.63	0.42	0.23	0.028	0.034	0.050	0.092	3,094	3,785	5,603	
0.171	120	146.9	0.100	0.729	0.377	84	0.90	0.21	0.021	2,371	0.77	0.63	0.42	0.23	0.027	0.033	0.049	0.089	3,098	3,790	5,610	
0.171	240	85.6	0.170	0.720	0.377	84	0.90	0.12	0.020	2,343	0.77	0.63	0.42	0.23	0.027	0.033	0.048	0.089	3,062	3,746	5,544	
0.171	480	50.0	0.270	0.693	0.377	84	0.90	0.07	0.019	2,256	0.77	0.63	0.42	0.23	0.025	0.030	0.045	0.082	2,949	3,607	5,339	
0.243	15	643.8	0.023	0.735	0.534	79	0.64	0.64	0.015	1,708	0.68	0.48	0.21		0.022	0.030	0.072		2,525	3,526	8,322	
0.243	30	393.3	0.037	0.734	0.534	79	0.64	0.39	0.015	1,706	0.68	0.48	0.21		0.022	0.030	0.072		2,521	3,522	8,311	
0.243	60	231.9	0.064	0.733	0.534	79	0.64	0.23	0.015	1,704	0.68	0.48	0.21		0.022	0.030	0.072		2,518	3,517	8,300	
0.243	120	135.0	0.109	0.729	0.534	79	0.64	0.14	0.015	1,693	0.68	0.48	0.21		0.022	0.030	0.072		2,502	3,494	8,246	
0.243	240	80.5	0.180	0.718	0.534	79	0.64	0.08	0.015	1,669	0.68	0.48	0.21		0.021	0.030	0.071		2,466	3,444	8,128	
0.243	480	48.3	0.279	0.690	0.534	79	0.64	0.05	0.013	1,604	0.68	0.48	0.21		0.020	0.028	0.066		2,371	3,311	7,815	
0.324	15	557.2	0.027	0.741	0.712	74	0.44	0.38	0.010	1,181	0.59	0.34			0.017	0.030			2,005	3,427		
0.324	30	336.1	0.044	0.740	0.712	74	0.44	0.23	0.010	1,179	0.59	0.34			0.017	0.030			2,002	3,422		
0.324	60	200.7	0.074	0.740	0.712	74	0.44	0.14	0.010	1,179	0.59	0.34			0.017	0.030			2,002	3,422		
0.324	120	121.1	0.122	0.731	0.712	74	0.44	0.08	0.010	1,164	0.59	0.34			0.017	0.030			1,976	3,377		
0.324	240	75.1	0.191	0.723	0.712	74	0.44	0.05	0.010	1,151	0.59	0.34			0.017	0.029			1,955	3,341		
0.324	480	46.8	0.290	0.687	0.712	74	0.44	0.03	0.009	1,094	0.59	0.34			0.016	0.027			1,857	3,174		
0.416	15	426.6	0.035	0.761	0.915	69	0.28	0.19	0.007	778	0.50	0.21			0.013	0.032			1,550	3,786		
0.416	30	260.7	0.058	0.759	0.915	69	0.28	0.11	0.007	776	0.50	0.21			0.013	0.032			1,546	3,775		
0.416	60	165.7	0.091	0.756	0.915	69	0.28	0.07	0.007	772	0.50	0.21			0.013	0.032			1,540	3,760		
0.416	120	105.8	0.141	0.747	0.915	69	0.28	0.05	0.007	763	0.50	0.21			0.013	0.032			1,521	3,714		
0.416	240	69.6	0.208	0.735	0.915	69	0.28	0.03	0.006	752	0.50	0.21			0.013	0.031			1,498	3,658		
0.416	480	45.8	0.296	0.694	0.915	69	0.28	0.02	0.006	710	0.50	0.21			0.012	0.029			1,414	3,454		