

Combined Watershed Flooding and Water Quality Prioritization Greenville County, South Carolina August 2010

1. Introduction

Greenville County's two primary watershed management objectives are flood protection and water quality improvement. There is a regulatory-driven connection between the two objectives that is defined in the County's National Pollutant Discharge Elimination System (NPDES) Multiple Separate Storm Sewer System (MS4) permit that requires the County to include an assessment of water quality impacts when master plans are created or revised, or when stormwater conveyance upgrades and other capital improvements to the storm sewer system are defined. In addition, the County's permit requires a continuing prioritization of Watershed Management Units (WMUs) that identify water quality problems, areas of concern and Pollutants of Concern (POCs). Prioritization of County watersheds has been accomplished, separately, for each of these goals in the past. The County now wishes to develop an overall watershed prioritization map that combines these two goals in order to focus attention to water quality activities that can be included in the County's stormwater, flood plain and road improvement programs.

The previous and new prioritization processes that have been developed and applied to Greenville County watersheds are detailed in this report.

2. Previous Watershed Water Quality Prioritization Process and Parameters

Greenville County previously developed and implemented a ranking process for prioritizing watersheds for the stormwater management program based on water quality problems and areas of concern. This prioritization process was developed and implemented as part of the overall Stormwater Management Plan (SWMP) for Greenville County per the County's NPDES MS4 permit.

Greenville County was previously divided into 150 sub-watershed units, referred to as WMUs, each approximately 5 square miles in size, for the water quality prioritization process. This process was applied to Greenville County watersheds over the past several years as progress was made implementing the SWMP. Updates to the WMU prioritization rankings were made each year as additional watershed areas were phased into the SWMP and as updates to parameter values occurred.

Table 1 provides a list of the parameters used and their corresponding weighting factors and ranking scores for the previous water quality prioritization of the WMUs. A detailed description of the process used for water quality prioritization is provided in the Greenville County MS4 Third Year Annual Report, dated February 2004. The most recent WMU prioritization ranking using this process was performed for and is documented in the Greenville County 2007 Permit, Year 1 Annual Report, NPDES MS4 Permit, dated February 2009.

3. Previous Watershed Flooding Prioritization Process and Parameters

Prioritization of Greenville County watersheds based on flood hazard and flood risk potential was also performed as documented in Watershed Flooding Prioritization and Action Plan, Greenville County, August 2007. The County was divided into 42 named watersheds for the watershed flooding prioritization process. Table 2 provides a list of the parameters used, their weightings and the ranking scores used. The most current flooding prioritization ranking results for the 42 watersheds was provided in the referenced 2007 Flooding Prioritization document.

4. Updated Water Quality Prioritization Process and Parameters

It was decided that the majority of the parameters used in the previous WMU water quality prioritization process would also be used in the updated process, with the following revisions:

1. The water quality prioritization included 9 pollutants in the land use pollutant loadings category. The proposed combined prioritization method will only take into account 4 pollutants included in the previous water quality prioritization: Total Suspended Solids (TSS), Total Zinc (TZN), Total Copper (TCU) and Total Phosphorus (TP). An additional pollutant, fecal coliform, has also been included in the combined prioritization. These 5 pollutants were selected because they are responsible for the impaired status of several reaches of Greenville County streams. The others, while pollutants of concern in urban runoff, have not contributed to current water quality impairment in Greenville County.
2. An additional parameter that accounts for the number of Commercial Animal Feeding Operations (CAFO) within each WMU was added to the water quality goal.
3. The weights assigned to each water quality parameter were revised slightly from what has been used in the previous rankings. However, the weights assigned to the parameters selected still add up to 1.0. In addition, the ranking scores for some of the parameters were also revised slightly. Table 3 provides a list of the revised WMU water quality parameters, weights and ranking scores to be used in the updated water quality prioritization.

First, updated data for the water quality parameters for each WMU were obtained and a prioritization ranking was performed using the updated data with the revised prioritization process. The results of this updated WMU water quality prioritization is provided in Table 4 and shown in the Prioritization Map.

In general, the WMUs with the highest rankings based on the water quality parameters are those that have both Total Maximum Daily Loads (TMDLs) and are highly urbanized. Several of these WMUs also have 303(d) impaired points and are not fully supporting their designated uses. Many of these WMUs are concentrated in and around the City of Greenville as can be seen in the Prioritization Map. One exception to this is Laurel Creek, which has a low water quality priority compared to the urbanized areas immediately surrounding it. The reason for this is that Laurel Creek is only about 50% urbanized and has no TMDLs.

The Upper Middle Reedy River has the next highest water quality priority even though it has no TMDLs. This is because it is highly urbanized, has several 303(d) segments, and does not support its designated use for recreation.

The next highest priority WMUs in terms of water quality are those that have TMDLs but are not highly urbanized. These are in the outlying areas of the County. These are high priority specifically because of the TMDLs. Finally, in general, those areas with high urbanization but no TMDLs ranked lower in priority.

5. 2010 Watershed Flooding Prioritization Process and Parameters

It was decided that the parameters, their weights, as well as the ranking process performed for watershed flooding prioritization in 2007 would be used “as is” in the current prioritization, as shown in Table 2. The 2007 flooding prioritization ranking results are provided in Table 4 and shown in the Prioritization Map at the end of this Summary Report.

As shown in the Prioritization Map , the areas with the greatest flooding problems (those with the highest priority) are located within the central portion of the County, in the more highly urbanized areas. One exception to this is the relatively higher rank of the Middle Saluda River in northern Greenville County which has a higher level of urbanization than the surrounding areas. It also has repetitive loss structures, several buildings within 100 feet of floodplain Zones A and AE, has a high hazard dam , and has a substantial amount of land currently under construction.

6. Combined Watershed Flooding and Water Quality Prioritization Rankings

Table 4 shows the results of the combined prioritization rankings. The results of the combined ranking prioritizations of the 42 watersheds for flood prioritization and the top 15 ranked WMUs in the water quality prioritization are also shown graphically in the Prioritization Map.

In the Prioritization Map, the results are basically as would be expected from combining the water quality and flooding rankings. Both rankings are directly affected by urbanization and development, and the evaluation on both the watershed and WMU levels supports this conclusion. The only exceptions that stand out are the resulting WMU priority rank for the WMUs in the eastern portion of the County and in the town of Greer. While the affected watersheds have a very low flood priority ranking, the associated water quality prioritizations are very high (four out of the fifteen top ranked WMUs). The explanation for this disconnect is the highly urbanized/developed nature of the WMUs, streams not supporting their designated uses, and the development of TMDLs for streams in these WMUs.

7. Summary

Greenville County’s NPDES Permit No. SCS230001 requires the County to evaluate and prioritize the WMUs to identify water quality problems, areas of concern and POCs. In addition, the County’s permit requires an assessment of water quality impacts of all flood management projects and coordination of flood control improvement projects with water quality improvement activities. The

County will continue to use the WMU water quality prioritization ranking to identify opportunities for targeted water quality improvement activities. The combined ranking information in Table 4 and the Prioritization Map will provide another tool for the County to utilize that identifies specific water quality issues that will be evaluated in both the master planning and flood control improvement project development process.

Table 1. Previous WMU Water Quality Prioritization¹ Parameters, Weighting Factors and Ranking Scores				
Parameter	Unit	Weighting Factor	Ranking Scores	Source
TMDL	No. in WMU	21.00	0 or 7	SCDHEC
EPA listed waters (303(d), 304, 305(b), 314(a), 319(a), etc.)	No. in WMU	18.53	0 for 0 pts, 3 for 1 pt, 6 for 2 pts, 9 for 3 pts, etc.	SCDHEC
Impaired waters (supporting designated use?)	No. in WMU	16.06	0 for FS, 3 for PS, 6 for NS	SCDHEC
Waters draining urbanized areas	Acres	13.58	0 - 10 based on max.	SCDHEC
Landuse Parameters:	lbs/acre/year	11.11	0 -10 based on max.	Calculated
TSS	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
TDS	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
BOD5	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
COD	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
TP	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
DP	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
TN	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
TKN	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
TCD	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
TCU	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
TPB	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
TZN	lbs/year/acre	11.11	0 - 10 based on max.	Calculated
Drinking water sources	No. in WMU	8.64	0 for 0 pts, 3 for 1 pt, 6 for 2 pts, 9 for 3 pts, etc.	SCDHEC
Highly sensitive waters	Ft. in WMU	6.17	0 - 10 based on max.	SCDHEC
RCRA sites	No. in WMU	3.69	0 for 0 pts, 3 for 1 pt, 6 for 2 pts, etc.	SCDHEC
NPDES sites	No. in WMU	1.22	0 for 0 pts, 3 for 1 pt, 6 for	SCDHEC

			2 pts, etc.	
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¹ January 26, 2009 Prioritization

Table 2. Watershed Flooding Prioritization (2007)¹ Parameters, Weighting Factors and Ranking Scores				
Parameter	Unit	Weighting Factor	Ranking Scores	Source
Flood Hazard Potential:				
USGS streams per watershed area	Miles/ sq. mi of watershed	0.10	1 – 42	Measured
Proportion of Approximate Zone A areas to detailed study areas (Flood Hazard Areas)	%	0.10	1 – 42	FEMA
High hazard dams	No. in watershed	0.10	1- 5 based on max.	SCDHEC
Current Flood Risk:				
Number of buildings in watershed	No. buildings/ sq. mi. of watershed	0.20	1 – 42	Measured
Number of buildings within 100 ft. of SFHA (Zones A and AE)	No. buildings in watershed	0.20	1- 42	FEMA
Repetitive loss structures	No. in watershed	0.20	1 – 5 based on max.	Greenville County
Future Flood Risk:				
Quantity of land currently under permit (current grading permits)	Acres in watershed	0.10	1 – 42	Greenville County

¹ **2007 Study**

Table 3. Revised WMU Water Quality Prioritization Parameters, Weighting Factors and Ranking Scores				
No.	Parameter	Unit	Weighting Factor	Ranking Scores
1	TMDL, number of TMDLs	No. in WMU	0.20	0 for no TMDL, 10 for TMDL
2	EPA listed waters [303(d)], number of impairment points	No. in WMU	0.18	0 for 0 pts, 3 for 1 pt, 6 for 2 pts, 9 for 3 pts, etc.
3	Supporting designated uses [305(b)]	Designation: NS = non-supporting; PS = partially supporting; FS = fully supporting	0.16	Score for both Recreational and Aquatic Uses: 0 for FS, 3 for PS, 5 for NS (max 10)
4	Measure of urbanization	No. of urbanized acres in WMU	0.14	0 – 10 (based on max)
5	Annual pollutant loadings from watershed land uses for: TSS, TP, TCU, TZN, Fecal (equal weight for each parameter)	lbs/year/acre per WMU	0.10	5 – 25 (1 – 5 based on max, for each pollutant)
6	Highly sensitive waters	Ft. in WMU	0.06	0 – 10 (based on max)
7	NPDES sites	No. in WMU	0.02	0 – 5
8	Drinking water sources	No. in WMU	0.08	0 – 3
9	RCRA sites	No. in WMU	0.04	0 – 1
10	CAFO sites	No. in WMU	0.02	0 – 1

Table 4. Results of Combined Watershed Flooding and Water Quality Prioritizations			
Watershed Name	WMU	2007 Watershed Flooding Rank	2010 WMU Water Quality Rank
Horsepen Creek	HPC4	1	25
	HPC5		77
	HPC6		79
	HPC1		92
	HPC3		119
	HPC2		125
Middle Saluda River	MSR4	2	1
	MSR3		84
	MSR1		102
	MSR2		104
Lower Middle Reedy River	LMRR6	3	7
	LMRR5		13
	LMRR3		14
	LMRR4		24
	LMRR1		44
	LMRR2		86
Brushy Creek North	BCN1	4	2
	BCN2		3
	BCN3		4
Upper Middle Reedy River	UMRR1	5	6
	UMRR2		27
Langston Creek	LAC1	6	32
Upper Enoree River	UER9	7	12
	UER1		34
	UER2		36
	UER3		78
	UER6		82
	UER8		83
	UER5		91
	UER7		94
	UER4		109
Rocky Creek North	RCN1	8	49
Upper Reedy River	URR2	9	28
	URR4		42
	URR1		75
	URR3		81
Middle Enoree River	MER3	10	51
	MER1		100

Table 4. Results of Combined Watershed Flooding and Water Quality Prioritizations			
Watershed Name	WMU	2007 Watershed Flooding Rank	2010 WMU Water Quality Rank
	MER2		107
Mountain Creek North	MCN1	11	26
	MCN2		76
Rocky Creek South	RCS1	12	10
	RCS2		29
Brushy Creek South	BCS3	13	39
	BCS1		40
	BCS2		41
North Saluda Headwaters	NSH1	14	30
	NSH4		31
	NSH2		54
	NSH5		58
	NSH3		66
	NSH6		68
Richland Creek	RICH	15	33
Huff Creek	HFC3	16	74
	HFC6		80
	HFC4		93
	HFC1		97
	HFC2		99
	HFC7		105
	HFC5		106
Upper Middle Saluda River	UMSR1	17	85
	UMSR2		127
	UMSR4		135
	UMSR3		141
Upper South Tyger River	USTR6	18	16
	USTR5		22
	USTR7		23
	USTR8		53
	USTR2		56
	USTR3		60
	USTR9		64
	USTR4		65
	USTR1		69
	Grove Creek		GC6
GC3		98	
GC4		101	
GC5		103	

Table 4. Results of Combined Watershed Flooding and Water Quality Prioritizations			
Watershed Name	WMU	2007 Watershed Flooding Rank	2010 WMU Water Quality Rank
	GC2		113
	GC1		114
Laurel Creek	LC1	20	43
	LC2		95
Lower South Tyger River	LSTR2	21	8
	LSTR1		11
	LSTR3		48
	LSTR4		52
Rabon Creek	RC3	22	9
	RC1		20
	RC2		21
North Enoree Branch	NEB1	23	15
Durbin Creek	DC3	24	87
	DC1		90
	DC2		133
Lower Middle Saluda River	LMSR2	25	132
	LMSR1		140
Upper Saluda River	USR1	26	143
Lower Reedy River	LRR3	27	45
	LRR4		46
	LRR2		88
	LRR1		89
Frohawk Creek	FC1	28	5
Beaverdam Creek	BC2	29	120
	BC1		124
	BC3		128
Mountain Creek South	MCS3	30	50
	MCS2		121
	MCS1		130
	MCS4		131
Maple Creek	MC1	31	96
Middle Tyger River	MTR4	32	17
	MTR3		18
	MTR5		19
	MTR6		55
	MTR1		147
	MTR2		149
South Saluda	SSH1	33	59

Table 4. Results of Combined Watershed Flooding and Water Quality Prioritizations			
Watershed Name	WMU	2007 Watershed Flooding Rank	2010 WMU Water Quality Rank
Headwaters	SSH4		61
	SSH3		63
	SSH5		67
	SSH2		70
	SSH8		139
	SSH7		144
	SSH6		150
Lower Saluda River	LSR3	34	122
	LSR2		136
	LSR1		137
Lower Enoree River	LER1	35	123
Horse Creek	HC4	36	138
	HC3		142
	HC2		146
	HC1		148
North Rabon Creek	NRC1	37	35
Wolfe Creek	WC1	38	112
Big Falls Creek	BFC1	39	37
	BFC2		38
	BFC3		111
	BFC4		134
Middle Saluda Headwaters	MSH8	40	47
	MSH1		57
	MSH4		62
	MSH2		71
	MSH3		72
	MSH6		126
	MSH7	129	
	MSH5	145	
North Pacolet River	NPR1	41	108
South Pacolet River	SPR1	42	110
	SPR3		115
	SPR2		116
	SPR4		117
	SPR5		118