Appendix A

Methods for Estimating Pollutant Load Reductions and Ranking Projects

1.0 Estimating Pollutant Loads

The Watershed Treatment Model (WTM) was developed by the Center for Watershed Protection as a planning-level spreadsheet model used to estimate pollutant loading (nutrients, sediment, and bacteria) under current watershed conditions, and to evaluate the effects of proposed structural and non-structural management practices identified during field assessments on current pollutant loads. The model can also account for the influence of existing management practices and evaluate the effects of future development on pollutant loads. Unless otherwise noted, this analysis uses default land use coefficients, pollutant event mean concentrations (EMCs) and loading rates for primary and secondary sources, as well as reduction efficiencies for structural and non-structural BMPs. It should be noted that a number of these values should be adapted to the USVI if absolute numerical loads are desired, but for comparative purposes, the default values are deemed appropriate when consistently applied across watersheds.

1.1 Existing Load Assumptions

The following important assumptions and input variables were used for establishing existing loads:

1. The primary input into the WTM is land use and the 2003 UVI/DPNR GIS land use layer was used to generate acres per land use category for this analysis. The USVI land use layer for the East End is incomplete and should be updated to better reflect on the ground conditions. No modifications to the existing land use maps were made for this analysis, except for the addition of paved and unpaved roads that were added to the model as separate land use categories. Table 1 summarizes watershed acres per land use category used in the WTM. Where USVI and WTM land use categories differed, procedures used in the 2007 North Shore TMDL were followed, including:
    - Hotels (USVI) are represented by Multifamily land use (WTM)
    - Parks & Open Space lands use (USVI) are represented by Rural lands (WTM)
    - Public Facilities and Waterfront/Marina areas (USVI) are represented by Commercial/Retail lands (WTM)
    - Undeveloped areas (USVI) are represented by Forest lands (WTM)

Table 1. Watershed Land Use Acres Used in Model Run

WTM Land Use	Erosion Potential	Watershed (acres)					
		GP	MC	SB	SG	TB	TH
Forested[1]	High	457.8	547.6	432.0	263.9	252.2	316.4
	Low	688.9	476.4	315.3	376.3	154.4	113.8
Rural[2]	High	11.7		124.6	19.3	241.9	62.5
	Low	582.5		165.0	323.7	162.2	6.8
Residential (High)	High			6.9	17.8	7.1	
	Low			1.4	91.0	3.0	
Residential (Low)	High	13.2	3.2	230.9		84.2	64.3
	Low	172.1	1.9	234.9	210.3	41.2	48.2
Residential (Medium)	High					6.4	14.5
	Low			16.0		3.0	7.4
Multifamily[3]	High			3.3			12.2
	Low	7.4		23.2	10.0		12.0
Commercial[4]	High					8.8	
	Low					7.9	
Paved	High	9.4	1.7	22.1	16.9	18.8	13.1
	Low	32.9	9.0	27.8	36.6	15.3	36.5
Unpaved	High	0.7	1.2	16.8	1.9	8.5	3.0
	Low	9.6	2.3	20.7	8.2	6.2	3.2
Water		13.5			22.7		
Total		**1999.7**	**1043.2**	**1640.9**	**1398.4**	**1021.1**	**713.9**

[1] Forested (WTM) land use includes Undeveloped Land (USVI); roads and any missing land use acres were subtracted from undeveloped lands totals to reach equivalent total watershed acres
[2] Rural (WTM) land use includes Agricultural (USVI) and Open Space/Parks (USVI)
[3] Mutifamily (WTM) includes Hotels/Resorts (USVI)
[4] Commercial (WTM) includes Public Facilities (USVI) and Marinas (USVI)

2. Impervious cover estimates for each land use category were based on WTM default values, and adjusted based on information presented in Finney, et al (2008). The total watershed impervious area in the model was compared to the existing DPNR impervious cover data for each watershed and assumed acceptable if they fell within 10% of DPNR value. Table 2 summarizes the impervious coefficients used.

3. An average annual rainfall of 37 inches was used to estimate runoff volumes. Soils are based on 2008 USDA SSURGO data for the USVI (Table 3).

Table 2. Impervious Cover Coefficients Used in Model Run

Category Imperviousness	IC Coefficient Ranges*	Used in WTM
major paved roads	50-100%	100% paved, 90% unpaved
commercial/industrial land	35-85%	72%**
high density residential	35-65%	40% HDR; 44% resorts (multifamily)
medium density residential	20-38%	25%
low density residential	5-20%	12%**
agricultural land/golf course	2-7%	0% rural
urban open land	3%	0% rural
forested land	0-7%	0% undeveloped
* Presented in Finney et al. (2008) ** WTM default		

Table 3. Percentage of HSG Soil Group in each Watershed

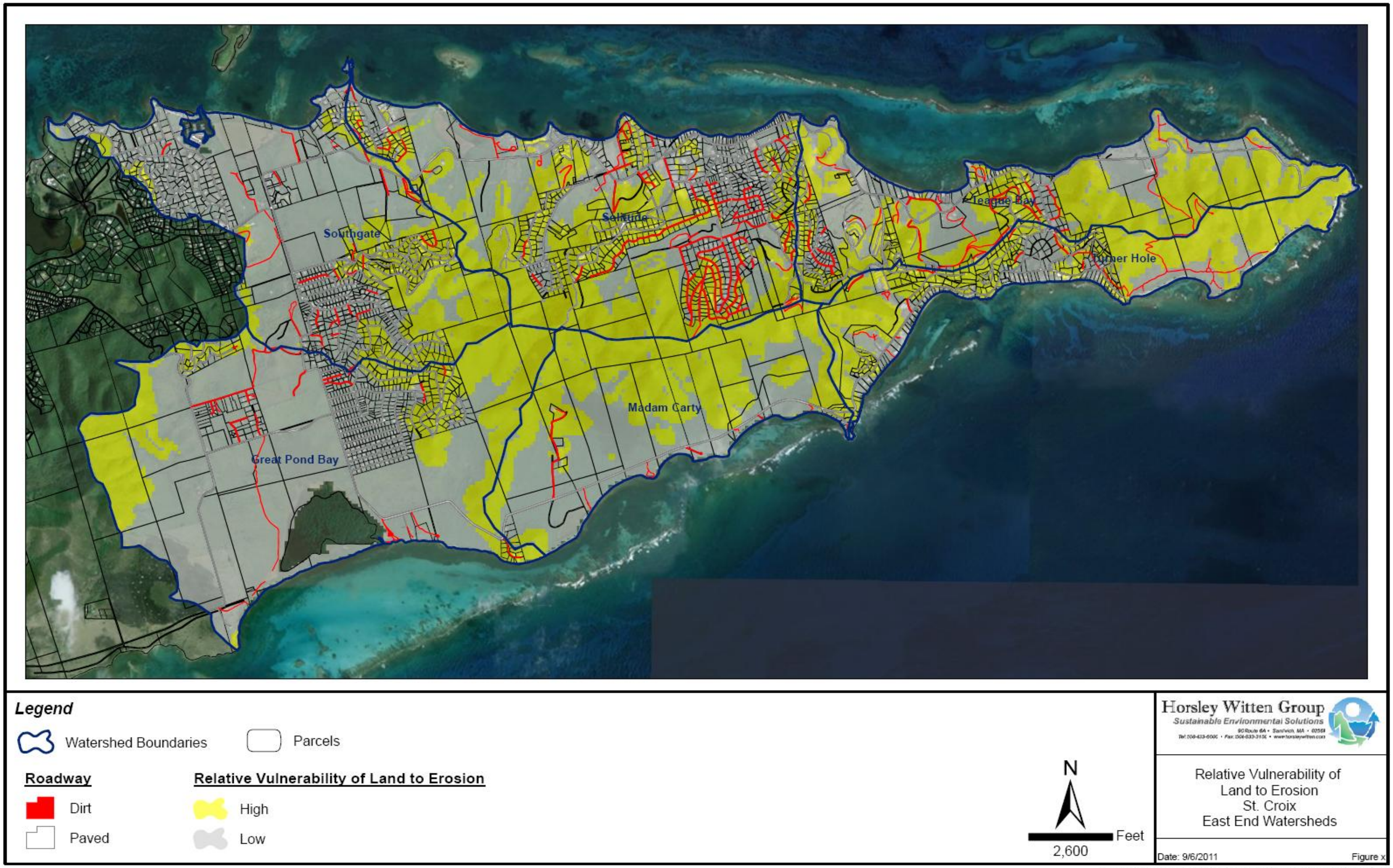
Watershed	Hydrologic Soil Group			
	A	B	C	D
Great Pond Bay	0%	25%	63%	12%
Madam Carty	1%	58%	38%	3%
Solitude Bay	1%	59%	36%	4%
Southgate	1%	31%	60%	7%
Teague Bay	0%	68%	27%	4%
Turner Hole	0%	70%	24%	5%

4. Default pollutant event mean concentrations (EMCs) in runoff from various land uses were derived from values from the National Stormwater Quality Database (NSQD), which is a summary of national stormwater data from over 200 jurisdictions nationwide (Pitt et. al., 2003). Tables 4 and 5 show the values used in this analysis, some of which were adjusted as follows:

    - High and low TSS and TP EMC values were assigned for each land use category based on designated "High" or "Low" Erosion Potential areas. WRI/NOAA (2005) applied the N-SPECT model in 2005 in USVI and Puerto Rico watersheds by using slope, rainfall, soil, and an erodibility factor to determine areas of relative erosion potential (see Figure 1). The re-interpretation of this data specifically for this analysis sets the threshold for "High" Erosion Potential based on the relative value of 1000 for the East End watersheds using WRI's "Vulnerability to Erosion" dataset.

    - Loading rates for undeveloped and rural lands were based on rates used in the 2007 North Shore TMDL (adjusted to account for annual rainfall variation by a factor of 1.1).

Figure 1. Using Erosion Potential Analysis to Assign High and Low EMCs and Loading Rates for Primary Sources in the WTM



Path: H:\Projects\2010\10070 NOAA-St. Croix\GIS\Maps\Erosion_Potential.mxd

- High and low TSS loads from unpaved roads were derived from work done by Carlos Ramos-Scharron (2007) in Puerto Rico (see Figure 2 below). These values are lower than loads estimated in Fish Bay, USVI, and should be considered on the low end. More data would need to be collected and more thorough analysis conducted to accurately estimate sediment loads from roads in the East End (per com. Ramos-Scharron, 2011).

Figure 2. High and Low values selected from points along the sediment production curve for unpaved roads as slope increases based on data from La Parguera (Ramos- Scharrón, 2007). These estimates should be considered conservative for application in the East End given the high vehicular usage of the unpaved network.

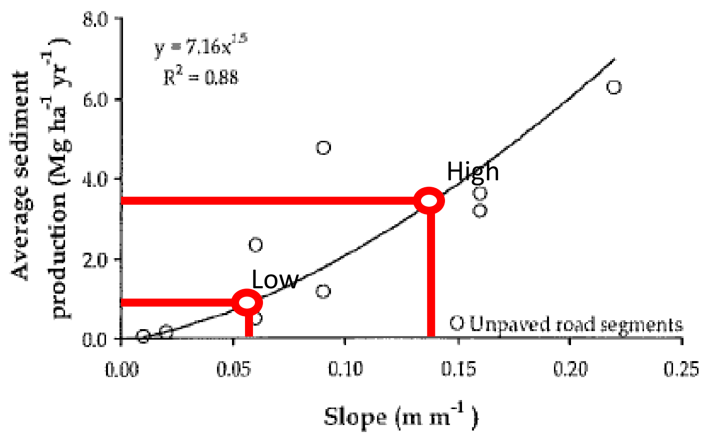


Table 4. Pollutant Event Mean Concentrations (EMC) in Stormwater Runoff Used in Model Run

WTM Land Use	Erosion Potential	EMC			
		(mg/L)			(MPN/100ml)
		TN	TP	TSS	Fecal Coliform
Residential+	High	2.1	0.31	59	7,000
	Low		0.27+	49	
Commercial+	High	2.1	0.27+	59	4,200
	Low		0.22	43	
Paved+	High	2.3	0.27+	99	1,700
	Low			59+	
Unpaved	High	2.3	0.25	588++	1,700
	Low			167++	

EMCs are based on median concentrations for each specific land use type as reported in the NSQD (2004) unless otherwise noted.
+ Median value across all land types in NSQD (2004)
++ Conservative TSS EMCs back calculated from Ramos-Scharron (2007) average sediment production in La Parguera for roads, where Low value is equivalent to a median annual loading rate at 30 inches of rainfall a year of896 lbs/acre/yr (1 Mg/ha), and high is of 3136 lbs/acre/yr at 3.5Mg/ha/yr (15% slope). These rates are an order of magnitude lower than production rates measured on St. John.

Table 5. Annual Loading Rates Used in the WTM

WTM Land Use	Erosion Potential	Assumed Loading Rate			
		(lbs/acre/yr)			(#billion/acre/yr)
		TN	TP	TSS	FC
Forested	High	2.5	0.2	78[+++]	12
	Low			50[++]	
Rural	High	4.6	0.7	127[+]	39
	Low			100	
Water	n/a	12.8	0.5	155	--

Rates are based on default loading rates in the WTM, unless otherwise noted.
[+] Loading rate for rural lands used in 2007 North Shore TMDL (adjusted from 40 inches/yr rainfall)
[++] Uses half of rural TSS loading rate for forested area.
[+++] High value uses same rate adjustment factor of 1.27 as rural load.

5. Secondary sources of pollutants were limited to gut erosion, marina berths, septic discharges, livestock, and waste water discharges from package plants. Tables 6A and 6B summarize the data assumptions used for these secondary sources. Septics were estimated based on the number of single family dwelling units determined by an aerial mapping count. DPNR and local package plant manager provided estimates of daily flow and average effluent concentrations for wastewater point discharges. Estimates of marina berths were based on direct conversation with Green Cay Marina operators and a count of vessels moored at the St. Croix Yacht Club using 2007 aerial images. Since goats and horses are not default values in the WTM, estimates for livestock were applied uniformly across the three watersheds and modeled as 30 cattle.

   The WTM has limited capacity to model stream erosion in non-urban settings. Most of the guts in the East End are not typical perennial, urban streams; therefore the model requires the user to assign a broad level of erosion, effectively assigning an allocation of total estimated load to stream erosion (e.g., we assume 1/3 of the TSS load is from stream erosion), which the model then backs into based on the loads estimated from other primary and secondary sources. We assigned an erosion level to each watershed based on a combination of factors including: miles of guts, field observations, and number of candidate gut restoration projects identified in each watershed.

6. Existing treatment options were limited to marina pumpouts and existing stormwater facilities. No non-structural practices such as buffer enhancement, erosion control, pet waste programs, street sweeping, reduced lawn fertilization, etc were incorporated into the model at this time.

Table 6A. Secondary Sources and Existing Management Assumptions

Watershed	Secondary Sources				Existing Management	
	% of total watershed storm load allocated to gut erosion*	Estimated # dwellings	Estimated # of boats	Live-stock	Marina Pumpouts	BMPs**
Great Pond Bay	10%	196	-	No	-	0
Madam Carty	5%	7	-	No	-	0
Solitude Bay	25%	372	-	Yes	-	0
Southgate	25%	333	154	Yes	1	0
Teague Bay	15%	91	30	Yes	0	0
Turner Hole	15%	94	-	No	-	3 dry detention basin
* Due to lack of available data, this value is assigned based on best professional judgment from field observations and serves as a placeholder. ** BMPs are located at the Divi Casino, Divi Hotel, and Villa Madeline						

Table 6B. Point Source Discharge from Waste Water Package Plants

Treatment plant	Type	Average Flow (GPD)	Effluent TSS (mg/L)	Effluent TP (mg/L)	Effluent TN (mg/L)
Chenay Bay Resort	Extended Aeration W/disinfection	2,883	8.3	5.0	5
Cheeseburgers/Southgate Condos	Activated Sludge W/ disinfection	2,051	17.9	5.0	3.48
Divi Hotel and Condominiums	Secondary Treatment	57,000	30	5.0	40
Reef Golf/Condos (Reef Assoc. II)	Secondary Treatment	32,000	30	5.0	40
Coakley Bay Condos	Secondary Treatment	15,000	30	5.0	40
Green Cay Marina (St. Croix Financial Center)	Secondary Treatment	6,000	30	5.0	40
Estimates provided by Mirko Restivic and Benjamin Keularts (DPNR)					

1.2 Future Load Assumptions

Future development in the WTM often uses Zoning information. The zoning information available in the USVI is outdated and not ideal for WTM application. Modeling for future development in this analysis was based on best professional judgment and is based on the following assumptions:

1. Two new resorts/hotels that result in the conversion of 25 existing agricultural land use acres and 50 undeveloped acres to resort/hotel ("multifamily" in the WTM) acres.

2. Assume that both new developments have wastewater systems that meet the assumptions used for the existing Divi site (see Table 6B)
3. Existing stormwater management practices at the Great Pond site is considered either non-effective and not accounted for since proposed plans were not available at this time. Stormwater management at the Robin Bay site in Madam Carty includes wet ponds, constructed wetlands, and bioretention facilities.
4. The future development tab in the WTM spreadsheet was not used, rather a new model was run reflecting changes in land use.

1.3 Load Reduction Assumptions

Potential load reductions are modeled based on the implementation of only three restoration activities: road stabilization, gut repair, and stormwater retrofitting. No programmatic or non-structural improvements are considered at this time. Modeling assumptions include:

1. Stabilization of unpaved roads was modeled as a change in the EMC for existing unpaved roads to the lower EMC associated with paved roads. Where necessary, individual road projects were evaluated separately and total surface area (generated in GIS or by assuming average road width of 20 ft) divided between high and low erosion potential areas.
2. Gut restoration projects were modeled only for Southgate and were assigned a reduction consistent with shifting from 25% to 15% of TSS contribution to the total watershed storm load.
3. Stormwater retrofits were modeled as management practices applied to existing conditions (rather than using the revised retrofit spreadsheet provided in the model). Total drainage area and impervious estimates for each retrofit practice were used (see Table 9) and adjusted to reflect a 75% capture efficiency. Removal efficient discount values for maintenance and design criteria were set at the highest level available. Default pollutant removal efficiencies provided in the WTM were used for this analysis (Table 7). Only TSS reductions were evaluated.

Table 7. WTM default BMP Pollutant Removal Efficiencies

BMP	Efficiency (%)			
	TN	TP	TSS	Bacteria
Dry Water Quantity Pond	5%	10%	10%	0%
Dry Extended Detention Pond	10%	15%	55%	0%
Wet Pond	30%	50%	80%	70%
Wetland	25%	50%	75%	80%
Filters	30%	60%	80%	80%
Green Roof	45%	45%	80%	0%
Rooftop Disconnection	25%	25%	85%	0%
Permeable Pavement	60%	60%	75%	0%
Grass (open) Channel	30%	25%	60%	0%
Dry Swale (bioswale, WQ swale)	55%	50%	85%	0%

BMP	Efficiency (%)			
	TN	**TP**	**TSS**	**Bacteria**
Wet Swale	25%	20%	70%	0%
Raintanks and Cisterns	40%	40%	40%	0%
Soil Amendments	50%	50%	75%	0%
Sheetflow to Open Space (excluding riparian buffers)	50%	50%	85%	0%
Grassed Filter Strips	50%	50%	85%	0%
Bioretention	65%	55%	85%	90%
Infiltration Practices	55%	65%	95%	85%

2.0 Project Ranking and Prioritization

Table 8 provides the ranking criteria used to help prioritize candidate projects. Scoring criteria and weights are assigned to 11 different metrics. Specific feedback from local residents and agency staff was used to establish project ranking criteria and weights. The following discussion points from July 2011 meetings in particular were used to revise the ranking methodology:

- While important, priorities should not be driven by impaired water status given the limitations of the water quality monitoring program;
- Private vs. publicly-owned lands, while typically an important implementation factor are not as important in STX given the existence of funding opportunities for private/rural properties and DPW's willingness to support road and drainage projects on private networks;
- Cost is not as big of a factor as improvement in water quality;
- The most important factor is pollutant load reduction; and
- Improved safety (of the road network) is important to local residents.

A brief description of the ranking metrics is provided below:

- Impaired waters are based on the DPNR 2010 Integrated Waters Report and are shown in Figure 2.15 of the Existing Conditions Report.

- Drainage areas to each candidate project were delineated using GIS and based on field notations. Impervious cover within each drainage area was estimated using the impervious cover layer provided by DPNR. Minor modifications were made to this estimate as observed in the field.

- To determine pollutant removal potential, we used a combination of the WTM default removal efficiencies provided in Table 7 and a conservative estimate of how much area actually could be captured and managed given practice space limitation. In addition gut stabilization practices assume a pollutant removal 70% reduction in TSS and nutrients based on recent studies in the Chesapeake Bay (Medina and Curtis, 2011). Road stabilization projects are assumed to reduce pollutant loads by 80%.

- To determine relative cost estimates, generally accepted cost estimates derived by the Center for Watershed Protection were used were feasible (CWP ranking spreadsheet, 2010). Table 8 shows the assumed cost/cubic foot treated for various practices and provides the sources of this information. Using this table, plus best professional judgement practices were loosely considered low cost if unit costs were less than or equal to $10/cf; medium if between $11 and $25/cf, and high if $25/cf. This estimate was supplemented with site-specific knowledge related to site constraints and complexity of design. For planning level cost estimates for more detailed concepts, these unit costs will actually be increased by at least 30% given the additional costs for material and labor in the USVI.

- Projects scored highly if they were determined to provide a public benefit such as reduced road flooding. High scoring projects also include those located on public lands or on private property that was in a highly visible location or open to volunteer participation by residents or others.

- Where the identification of an implementation partner or management entity has occurred or is considered easy to determine (e.g., Homeowners association, business owner, designated agency, or site facilities manager) , then the management feasibility was considered high. If there are no easily identifiable partners, then the project ranked low.

- Site constraint factors may include soils, utilities, access issues, ownership issues, limitations on space, and impacts to existing natural areas.

Similar factors were used to rank gut and road restoration projects with the exception of the following additional metrics:

Guts

- Length of gut restoration—on a scale of 1-5

Roads

- Traffic volume—on a scale of 1-5 with 1 being low
- Load reduction from road stabilization—on a scale of 2-5 based on number of acres stabilized and severity of existing condition
- DPW priority—on a scale of 1-5 based on whether there is a current or potential threat to public roads/culverts
- Relative cost—on a scale of 1-5 based on the # of structures and extent of effort

Tables 10A-10C are the ranking spreadsheets and show which projects were grouped into High, Medium, and Low implementation priorities.

Table 8. Project Ranking Factors

Factor	Description	Scoring Criteria and Numerical Range		Weight
Water Quality Benefits	Areas drains to designated impaired waters	yes	5	5
		no	0	
	Total drainage area to project	≥ 10 ac	5	5
		≥ 5 ac	3	
		< 5 acre	2	
	Total impervious cover to be managed (retrofit only)	> 5 acre	5	5
		≥ 1 acre	3	
		< 1 acre	2	
	Pollutant removal potential (TSS) based on pre-determined BMP removal efficiencies and volume managed	> 85% or most of WQ volume managed	10	10
		≥ 75% or some of WQ volume managed	6	
		<75% or not much of WQ volume managed	3	
Other Public Benefit	Flood prevention, drainage improvement; or transportation safety	High	5	5
		Med	3	
		Low	2	
	Public Awareness: Visibility and potential for public education and involvement	High	5	5
		Medium	3	
		Low	0	
Cost	Relative Construction Cost Based on the Type of Practice	Low cost	2	2
		Med cost	1	
		High cost	0	
	Potential funding source for early implementation	High	3	3
		Low	0	
Management Feasibility	Identified party for implementation and long-term management	Yes	5	5
		Maybe	2	
		Not really	0	
Site Constraints	Includes conflicts with existing natural areas; soils; utilities; limited space; and construction and maintenance access	None	5	5
		Minor or Unknown	2	
		Major	0	
			Retrofit Total	50

Table 9. Unit Costs for Various Practices (from Center for Watershed Protection)

Unit Costs

Derived From: Urban Subwatershed Restoration Manual (USRM) 3, Appendix E, Table E.4, Median Cost (except where noted)

Practice	Qualifier	Unit Cost ($/cf treated)	Notes	Ranking Factor
Green Roof	Extensive green roof	$170.00	Appendix E -- assumes "Extensive" green roof system	High
Rooftop Disconnection	100-900 ft^2 of rooftop, 1" of rainfall, $50 per disconnection	$1.00	Derived from programs evaluated in Portland, OR	Low
Rain Tank/Cistern	Cistern or larger storage device	$15.00	Appendix E	Medium
Soil Amendments		$7.50	Appendix E	Low
Filter Strip	Width = 25 to 75 ft	$6.00	Appendix E	Low
Permeable Pavement		$30.00	Derived from $10 per sq ft from Hathaway & Hunt (2006)	High
Grass Channel	3 - 5% of CDA	$6.25	Half of water quality swale, needs updating. Can also use $15/lf (WDNR, 2003)	Low
Bioretention	> 0.5 acre treated	$20.00	Derived from actual bids in Virginia from consulting firm (in 2010)	Medium
Rain Garden	< 0.5 acre treated	$10.00	Assumed as half of cost of bioretention due to lack of underdrain, gravel, etc.	Medium
Stormwater Planters		$26.00	Appendix E	High
Infiltration	3 -- 5% of CDA	$15.00	Appendix E, Table E.4. Can also use $10 per sf (WDNR, 2003)	Medium
Dry Wells/French Drain		$11.50	Appendix E	Medium
Dry Swale	3 -- 5% of CDA	$12.50	Appendix E, Table E.4	Medium
Wet Swale	3 -- 5% of CDA	$12.50	Assumed to be same as Dry Swale	Medium
Extended Detention Pond	2 -- 4% of CDA	$3.00	Appendix E, Table E.4. Can also use $3800 per impervious acre.	Low
Filtering Practice	3 -- 5% of CDA	$20.00	Appendix E, Table E.4. Assumes structural filter.	Medium
Constructed Wetland	3 -- 6% of CDA	$7.00	Appendix E. Can also use $2900 per impervious acre.	Low
Wet Pond	3 -- 5% of CDA	$5.00	Appendix E. Can also use $8350 per impervious acre.	Low
Regenerative Design				
Other Practices (not included in remainder of spreadsheet)				
Catch Basin Insert		$4.00	From EPA Website: *http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=77*	Low
Downspout Disconnection to Rain Barrel	1 or several 55-gallon barrels	$25.00		Medium
Impervious Cover Removal		$20.00		Medium
Reforestation/Tree Planting/Native Landscaping		$5.00	Based on guidance in the Chesapeake Bay Riparian Handbook and City of Portland Stormwater Management Manual	Low

References

City of Portland Stormwater Management Manual is available on line at: http://www.portlandonline.com/BES/index.cfm?c=47952

Chesapeake Bay Riparian Handbook is available online at: http://www.chesapeakebay.net/pubs/subcommittee/nsc/forest/sect06.pdf

Runoff Reduction Method Technical Memo is available online at: http://www.cwp.org/Resource_Library/Center_Docs/SW/RRTechMemo.pdf

Urban Subwatershed Restoration Manaul No. 3: Urban Stormwater Retrofit Practices is available online at: http://www.cwp.org/formmaker/Download-Form_RedirectFormPage.html

Wisconsin Department of Natural Resources (WDNR). 2003. *Rain gardens: A how-to manual for homeowners* . Madison, WI.

Hathaway, J. and W. Hunt. 2006. “Stormwater BMP Costs.” North Carolina State University. Department of Biological and Agricultural Engineering. Raleigh, NC.

List of Acronymns

CDA	Contributing Drainage Area
cf	cubic foot/feet
sf	square foot/feet

Table 10A. Retrofit Project Ranking

	RETROFIT					Water Quality					Public Benefit		Cost				
Rank	Site ID	Location	Description	Drainage Area (acres)	Impervious Area (acres)	Impaired water	Drainage Area to Site	Impervious Area to Site	TSS Removal and volume managed	Length	Other	Public Awareness	Construction Cost	potential funding	Mngmt Feas.	Site Constraints	Total
	SG-R-3A	Green Cay Marina	oil/grit separator	0.8	0.6	5	2	2	3		0	0	1	0	5	2	20
	SG-R-3C	Green Cay Marina	oil/grit separator	0.4	0.3	5	2	2	3		0	0	1	0	5	2	20
	SB-R-8	Candle Reef II	cul-de-sac island bioretention	0.5	0.3	0	2	2	6		1	1	1	0	5	4	22
	SB-R-5A	Coakley Bay Condo	bioretention	0.7	0.4	0	2	2	8		1	1	2	0	5	2	23
	SB-R-5B	Coakley Bay Condo	bioretention	0.4	0.2	0	2	2	8		1	1	2	0	5	2	23
	SB-R-2A	Blue Water Terrace	bioretention	1.0	0.60	0	2	2	6		0	2	2	0	5	4	23
	SB-R-2B	Blue Water Terrace	bioretention	1.0	0.60	0	2	2	6		0	2	2	0	5	4	23
Low	SB-R-7A	Carden Beach	cul-de-sac island bioretention, forebay maintenance, and outlet stabilization	1.7	0.2	0	2	2	8		3	3	2	0	3	2	25
	SB-R-4	Ziggy's	swale	5.8	1.5	0	3	3	6		2	5	1	0	5	0	25
	SG-R-2B	Southgate Condos	bioretention in rear	0.4	0.3	5	2	2	6		0	0	2	0	5	3	25
	SB-R-7	Carden Beach	shallow constructed wetland	3.1	0.5	0	2	2	10		3	2	2	0	5	0	26
	SG-R-1	Cheeseburgers	bioswale	0.9	0.6	3	2	2	5		1	5	1	3	3	2	27
	SB-R-6	Coakley Bay Condo	roadside swale in front of Coakley Bay Condos (includes fixing trail and culvert)	19.4	4.0	0	5	2	6		5	3	1	3	2	1	28
	TH-R-3C	Divi Hotel/Resort	permeable pavement in parking lot	0.4	0.3	5	2	2	10		2	2	0	0	2	3	28
	TH-R-4	Hotel Renovation	bioretention in parking lot	0.4	0.3	5	2	2	8		2	3	1	0	5	2	30
	TH-R-2C	Divi Casino	landscape island rain garden in Divi parking lot	0.6	0.6	5	2	2	5		2	3	2	1	5	3	30
	TH-R-2B	Divi Casino	landscape island rain garden in Divi parking lot	0.3	0.3	5	2	2	5		0	3	2	1	5	5	30
	SG-R-20B	Chenay Bay	linear bioretention in parking lot	0.4	0.4	5	2	2	6		5	2	1	0	5	2	30
	SG-R-3B	Green Cay Marina	bioretention	0.4	0.2	5	2	2	8		2	3	1	0	5	2	30
Med		Villa Madeline	maintenance and expansion of existing detention practice	6.7	3.7	5	3	3	8		4	1	2	0	3	2	31
	SG-R-2A	Southgate Condos	rain garden at Entrance	0.3	0.2	5	2	2	8		0	2	2	1	5	4	31
	SG-R-4	Green Cay Marina	swales in roadside median	9.9	2.6	5	5	3	6		3	3	1	2	3	0	31
	TH-R-3B	Divi Hotel/Resort	rain garden in parking lot	0.6	0.5	5	2	2	6		3	3	2	1	5	3	32
	TH-R-3D	Divi Hotel/Resort	rain garden in parking lot	0.4	0.3	5	2	2	6		3	3	2	1	5	3	32
	TB-R-2A	STX Yacht Club	constructed wetland forebay and formalized swale	0.8	0.5	5	2	2	8		3	4	1	2	3	2	32
	SG-R-5	Tamarind Reef	shallow bioretention near tennis courts	0.3	0.1	5	2	2	10		2	3	1	0	5	2	32
	SB-R-3	Seven Flags	stepped detention behind homes on Seven Flags Rd.	54.1	7.4	0	5	5	10		5	2	0	3	2	3	35
	TB-R-2B	STX Yacht Club	rain garden	86.5	9.8	5	5	5	5		2	4	2	2	3	2	35
	SB-R-1A	Fire Station	rain garden in front	9.7	1.9	0	5	3	6		3	5	2	3	5	3	35
	TH-R-3A	Divi Hotel/Resort	retrofit existing dry detention basin	11.6	3.7	5	5	3	6		5	2	2	0	5	2	35
High	TH-R-1	East End Bay Trail	bioretention at East End Bay Trailhead parking lot	1.4	0.3	0	2	2	10		5	5	2	3	5	2	36
	SG-R-20A	Chenay Bay	rain garden at resturant	0.2	0.1	5	2	2	10		2	3	2	3	5	3	37
	SB-R-1B	Fire Station	dry swale, cistern, and dumpster area on side	2.5	2.3	0	2	5	8		5	5	1	3	5	3	37
	TB-R-3A	Reef Golf Course	ED wet pond	27.9	3.1	5	5	3	6		5	2	2	0	5	5	38
	TB-R-3B	Reef Golf Course	constructed wetland/forebay	205.1	29.9	5	5	5	10		2	5	1	3	3	0	39
	TH-R-2A	Divi Casino	retrofit existing dry detention basin	66.5	13.7	5	5	5	6		4	3	2	0	5	5	40

Table 10B. Gut Restoration Project Ranking

		Water Quality					Public Benefit		Cost					
Location	Description	Impaired water	Drainage Area to Site	Impervious Area to Site	TSS Removal and volume managed	Length	Other	Public Awareness	Construction Cost	potential funding	Mngmt Feas.	Site Constraints	Total	Priority
West Gut behind Cheeseburgers	isolated bank stabilization	5	5	1	3	0	0	0	2	0	0	5	21	Low
West Gut on Schusters property	NCSU restoration plan	5	5	2	5	0	1	0	0	3	2	0	23	Low
Sally's Fancy	Riprap stabilization at head cut, install curb and paved flume	0	5	1	5	0	3	5	2	5	2	3	31	Medium
East Gut Adams Farm headcut	Stabilize headcut and overland flow path	5	5	5	10	3	5	0	0	5	2	5	45	High
Gut at Reef Golf Course	Divert small storms, stabilize eroding banks, check dams to slow erosive velocities	5	5	5	5	3	2	3	0	3	4	5	40	High
	Total points possible	5	5	5	10	5	5	5	5	5	5	5	60	

Table 10C. Unpaved Road Improvement Project Ranking

	Unpaved Road Improvements										
		Distance	Acres	Impaired Waters	Traffic volume	Potential load reduction	DPW priority	Cost	Funding Potential		Priority
SB-RC-1	Sierra Verde/Bajamar Rd	350 ft	0.2	0	2	2	0	4	0	8	Low
GP-RC-33	Unnamed Road off SouthShore	300 ft	0.1	0	2	2	4	3	2	13	Medium
SB-RC-8	Hope and Carton Neighborhood	3.6 miles	8.7	0	4	5	1	1	5	16	High
TB-RC-4	Goat Hill Rd.	1200 ft	0.6	5	1	3	0	3	4	16	
SB-RC-9	Seven Flags Rd.	1000 ft	0.5	0	3	5	5	1	3	17	
TB-RC-3	Ridge Rd. at Rt. 82	250 ft	0.1	5	3	2	2	4	1	17	
	Total points possible			5.0	5.0	5	5	5	5	30	