

APPENDIX F

TETRA TECH CONSTRUCTION COST ESTIMATING MEMO 10-30-07



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MEMORANUM

Date: October 30, 2007
From: Tham Saravanapavan
To: Jennifer Callahan, Vermont Department of Environmental Conservation
Re: BMP Cost Function in Vermont's BMPDSS

Defining Cost Function and Variables

When refer to the cost of stormwater best management practices (BMP), generally it includes construction cost, maintenance and inspection cost, and land opportunity cost (Wossink and Hunt, 2003). In BMPDSS (Cheng et al., 2006), a generic cost function is employed as described below.

Total Cost = Installation Cost [I] + Land Cost [L] + Fixed Cost [F]

Installation Cost [I] represents the material and labor expenses related to the construction of the BMP. Land Cost [L] represents the land value. It is important to note that L is negligible if the BMP were installed in small areas, such as bioretention or infiltration, and underground storages. Fixed Cost [F] represents the cost associated with design and permitting activities. Due to the unavailability of the cost information on maintenance and inspection, these costs were not included in the equation.

In Vermont BMPDSS, a detention BMP (assumed a wet pond) represents to control the flood flow and a bio-infiltration BMP represents to control the low flow. The following equations represent the selected BMPs.

Detention BMP:

Cost = I * Detention Volume (ft³) + Detention Surface Area (acre)*L + F

I = \$5 per ft³ and L = \$ 217,800 per acre, were based on USEPA (1999a) similar to the Prince George's County model.

F = [\$ 2,000 x number of eligible parcels within a sub-watershed] (Assuming each parcel will install a separate BMP and it will cost \$ 2,000 for permitting and design of these BMPs)

Infiltraion BMP:

Cost = I * BMP volume (ft³) + F

I = \$6 per ft³, was based on USEPA (1999b) similar to the Prince George's County model.

F = [\$ 2,000 x number of eligible parcels within a sub-watershed] (Assuming each parcel will install a separate BMP and it will cost \$ 2,000 for permitting and design of these BMPs)

Discussion on Selection of Cost Function and Variables

One of the challenges to apply BMPDSS in Vermont is to identify appropriate cost variables to be input into BMPDSS that represent Vermont's site specific environment. Tetra Tech, along with Vermont Department of Environmental Conservation, has conducted a limited research on BMP cost information available for Vermont environment, including data and reports from University of Vermont (UVM) and the City of South Burlington.

The cost information available at the City of South Burlington excludes the resources that were directly provided by the City (For example, the staff time of City employees, the use of City owned equipments, etc.). Therefore, the data is not complete enough to be represented in BMPDSS. A review further revealed that the cost information available at UVM Redesigning American Neighborhood (RAN) program are based on USEPA (1999 a & b) that is the same information of the Prince George's County BMPDSS.

Due to the unavailability of the site-specific cost data for Vermont and USEPA (1999 a & b) data are presently used in UVM RAN program, Tetra Tech has employed the cost information of existing BMPDSS model. As and when more site specific information available, the variables can be easily updated in BMPDSS. Although the changes in these variables will result in changes in the total cost for implementing BMP, the optimization and other BMPDSS results, such as sizing and locations, have no impact due the changes.

Reference:

Cheng, M.S., C.A. Akinbobola, J. Zhen, J. Riverson, K. Alvi, and L. Shoemaker. 2006. BMP decision support system for evaluating watershed-based stormwater management alternatives. In *Proc. 2006 World Environmental and Water Resources Congress*, May 21-25, 2006, Omaha, Nebraska.

United States Environmental Protection Agency, 1999a. Stormwater Technology Fact Sheet: Wet Detention Pond, EPA 832-F-99-048.

United States Environmental Protection Agency, 1999b. Stormwater Technology Fact Sheet: Bioretention, EPA 832-F-99-012.

University of Vermont, Redesigning the American Neighborhood (RAN) Toolbox. <http://www.uvm.edu/~ran/ran/toolbox/bmp/index.php>, (accessed May 2007).

Wossink, A. and B. Hunt, 2003. An evaluation of cost and benefits of structural stormwater BMPs in North Carolina, NC State Corporative Extension.