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MEMORANDUM

Date: February 16, 2004

To: Upper Neuse Site Evaluation Tool (SET) Task Group

From: Kimberly Brewer and Scott Job, Tetra Tech, Inc.

Subject: Hydrologic measures and methods for Upper Neuse SET

This memo discusses the next step in the dialogue between the Upper Neuse Site Evaluation Tool (SET) Task Group and Tetra Tech – deciding upon what hydrologic measures and methods should be incorporated in the Upper Neuse SET. At our previous meeting we asked the Task Group what hydrologic they would like to see tracked. The short answer is that the Group ideally would like to compare runoff volume and peak flow from a variety of design storms to targets specified by various regulations. Tetra Tech agreed to outline what options are available both within the scope of this project, and also looking down the road. The Task Group will then discuss the options at our next meeting.

Evaluation of Multiple Storm Events

The SET is currently configured to evaluate two design storms. In the Mecklenburg County/City of Huntersville application, there are two development zones, one that uses a 1-yr 24-hour storm for a runoff target, and another that uses a 2-yr 24-hour storm for a runoff target. The user selects the design storm based on the site location (Figure 1), and the model output is tailored to represent conditions for the selected design storm.

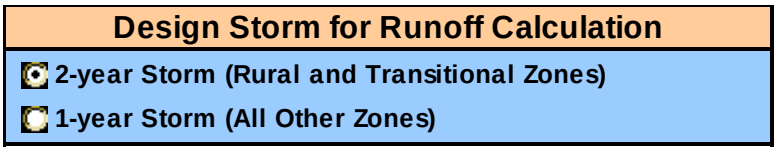

Figure 1: User input for selecting design storm

The Upper Neuse SET can be modified to evaluate and show output for multiple storm events. There could be an additional entry for location, and the SET could be programmed to filter the choice and display of design storms based on the selected location.

Methods For Estimating Site Runoff Volume

Option A) Curve Number Method.

This is the current SET method for estimating pre- and post-development storm event runoff. Design storm depths and curve numbers for each land use are used to calculate the aggregated storm event runoff. The user enters the percentage of the site in each soil hydrologic group. The SET makes a simplifying assumption that site land uses are equally distributed among soil hydrologic groups – a more detailed approach would require a much more complicated entry for site land use. Tetra Tech recommends using the curve number approach in the Upper Neuse SET.

Methods For Estimating Peak Flow

Option A) Estimate peak flow only using Rational method ($Q = C \cdot I \cdot A$).

The Rational Method is a widely accepted un-calibrated method to estimate peak flow from a site. An important task would be developing representative land use runoff coefficients (the C factor) and rainfall intensity factors (the I factor). The value of the runoff coefficient is a function of land cover, cover condition, soil parameters, and watershed slope, and many tables of common values area available. The rainfall intensity is typically obtained from a intensity-duration-frequency (IDF) curve for the region of interest using both the return period (e.g., 2-yr, 5-yr) and a duration equal to the time of concentration as input. Some consideration of how and whether to address variation in time of concentration for pre- and post-development scenarios will be required. We would calculate pre- and post-development peak flow rates for relative comparisons. Tetra Tech proposes to estimate peak flow treating the entire study area as a "single watershed".

Option B) Use unit hydrographs developed from HEC-HMS for site land uses and combine into a composite hydrograph.

With this method we would calculate existing and design peak flow using unit hydrographs for rural pervious, forested, urban pervious, and impervious lands. Unit hydrographs would be calculated using HEC-HMS for each land use. The hydrographs would be combined into a single composite hydrograph and scaled to the area considered. This could be done for a unit area of 1 acre, or for a range of areas, providing a more accurate composite. Design storm depths and types can be specified so we can create hydrographs specific to this region. Tetra Tech proposes to estimate peak flow treating the entire study area as a "single watershed".

Tetra Tech recommends configuring the SET to present both the Rational Method peak flow and the composite hydrograph peak flow so the user may compare the results.

Methods For Determining BMP Influence on Capture Volume, Peak Flow, and post BMP hydrograph

Option A) User enters BMP storm event runoff capture volume calculated outside of the model

This is how the SET is presently configured, and the approach used by Mecklenburg County/Huntersville for the four case studies.

Option B) User enters post-BMP peak flow calculated outside of the model

This method is just like Option A, but applied to peak flow. We would have text boxes for entry of the post BMP peak flows for the design storms, and these could be compared to an appropriate target, calculated using one of the peak flow methods above. The user may already know the peak flows, having calculated the detention capture volume.

Option C) Use rule-of-thumb BMP capture volume and release rates to calculate the influence of BMPs on the post BMP hydrograph.

The SET would calculate rule-of-thumb capture volumes and release rates for selected BMPs – for instance, the volume generated by a 1-inch storm released over a 48 hour period. The user could accept the default numbers, or could specify capture volumes and/or release rates. This method would then be paired with the composite hydrograph method; the BMP would capture the initial runoff up to the capture volume, pass the remaining peak, and show the gradual release of the capture volume. An example is shown in Figure 2. Other simple methods could be developed for non-detention BMPs (such as greenroofs).

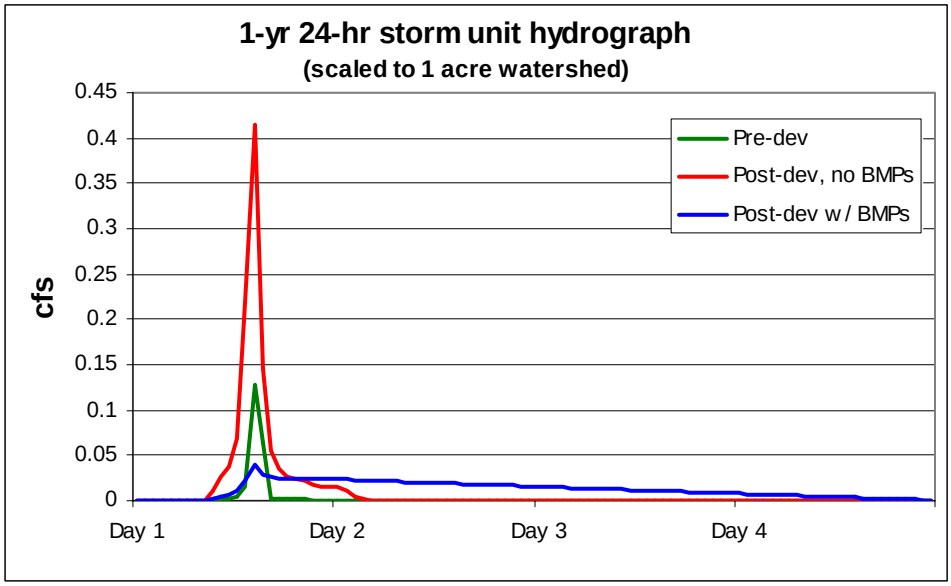

Figure 2: Example output pre- and post-development hydrographs

This method would not be used for any regulatory purpose; the post BMP hydrograph would simply be for educational purposes. However, it does provide useful information about the scale of influence BMPs have on a hydrograph. The rule-of-thumb approach could provide useful information during the early evaluation and screening of site designs and BMP effectiveness, and could provide feedback about the post BMP hydrograph and to users without immediate access to engineering staff.

Recommendations

1. Treat the site as a single “drainage area” and produce composite volume and hydrograph reports. These composite results are still useful on a screening level – it is the entire site that is being evaluated, in the end.

2. For estimating storm event runoff volume, continue using Option A (Curve Number Method). This method has wide acceptance in the engineering community and is already implemented in the SET.

3. For peak flow, use Option A (Rational Method) and Option B (composite hydrographs from HEC-HMS). The Rational Method has wide acceptance in the engineering community and is the best option for estimating a single number for peak flow. It can be implemented in the SET fairly easily. However, it does not provide a hydrograph. The composite hydrograph approach is advantageous since it does not require additional user input.

4. For BMP influence calculations, provide all three options. Continue providing Option A (user enters BMP extended detention storage) and Option B (user enters post BMP peak flow). BMP detention storage would still be compared to runoff volume using the Curve Number approach. In the same vein, the post BMP peak flow entered by the user could be compared to the peak flow from the Rational method and the composite hydrograph method. Both inputs would be optional. In addition, provide Option C (effect of capture volume and release rates) for estimating BMP influence on hydrograph. Implementing this feature provides a valuable educational tool – the ability to see quickly how various BMPs influence a hydrograph.

Tetra Tech recommends that the Upper Neuse River Basin Association incorporate these hydrology functions into the Site Evaluation Tool developed this year (2004). In coming years, the tool may need to be revised and updated due to revised regulations, new information, and enhances in technology.