TECH NOTE - INCOMING TIRANGULAR HYDROGRAPH FROM FIELD LONG-TERM PRZM/VFSMOD ASSESSMENTS

R.Muñoz-Carpena, University of Florida, carpena@ufl.edu
April 23, 2013

A simple rectangular hydrograph could used in PRZM/VFSMOD long-term assessments to represent the inflow from the field with the dimensions depicted in Fig. 1 (blue line).

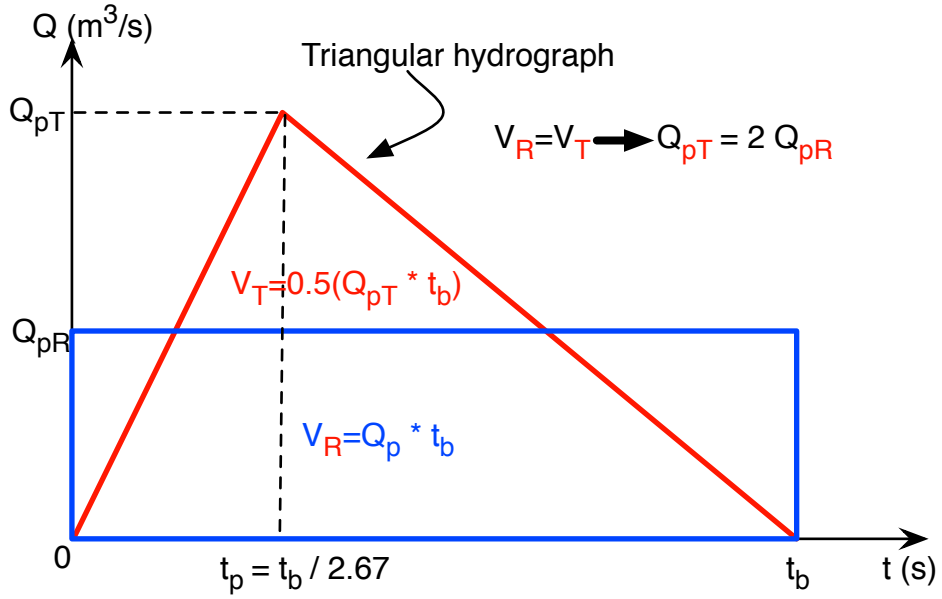

Fig. 1. Types of field hydrograph into the VFS.

The use of a rectangular hydrograph implies a large hydraulic shock over the filter form the beginning of the event, especially for large events (i.e. a lot of water enters the filter instantaneously). This is not realistic and field runoff is typically described with a smoother (slower) initial flow up to a peak flow (Q_p) and a lowering flow until the end of the event. One of the simplest descriptions of a hydrograph is the synthetic triangular hydrograph (proposed by US-SCS, now NRCS) shown in Fig. 1 as a red line. Both rectangular and triangular hydrographs are equivalent in that both have the same duration (t_b) and the same total volume (V, area under the curve in m^3). For this the peak flow of the triangular hydrograph is double of that of the rectangular hydrograph, with a time to peak $t_p = t_b/2.67$. The representation of the inflow hydrograph as a triangular hydrograph, compared to the rectangular hydrograph) is not only more realistic, but will also result in more robust and faster VFSMOD numerical solutions. This is because the hydraulic shock (kinematic shock) of the rectangular hydrograph at the beginning of the event can lead to numerical errors and instability in the overland flow calculations (kinematic shock is a well-know phenomena in the literature). The triangular hydrograph avoids this and improves the reliability and speed of the long-term simulations.

To implement this, SWAN 3.0 (or similar EPA schemes) should create an IRO hydrograph file for VFSMOD with 3 points, as opposed to 2 needed for a rectangular hydrograph. For example, using the FOCUS event on 780522, the IRO for the rectangular hydrograph is,

```
100 100       Swidth(m), Slength(m)
     2 5.5694E-03       nbcroff, bcropeak(m3/s)
     0 5.5694E-03
 86400 5.5694E-03       (24 * 3600s)
-----------------------------------------------------------------
```

Where for the rectangular hydrograph t_b= 86400 s, Q_{pR} = 5.5694e-3 m^3/s and V= t_b*Q_{pR} =86400*5.5694e-3=481.2 m^3. The triangular hydrograph time to peak would be $t_p = t_b$ / 2.67 = 32360 s, the new peak flow Q_{pT} = 2 Q_{pR} = 1.1139e-2 m^3/s and again V= 0.5*(t_b*Q_{pR})=0.5(86400*1.1139e-2)=481.2 m^3. The IRO file for the triangular hydrograph becomes,

```
100 100       Swidth(m), Slength(m)
     3 1.1139E-02       nbcroff, bcropeak(m3/s)
     0 0
 32360 1.1139E-02
 86400 0        (24 * 3600s)
-----------------------------------------------------------------
```

The effect of the use of the triangular vs. rectangular hydrographs on the pesticide reduction results is relatively small (see Table 1), while the triangular form increases the reliability, physical description and speed of the VFSMOD simulations.

Table 1. Comparison of results using rectangular (current) and triangular (proposed) inflow hydrographs for event FOCUS 780522 with VFS sizes (VL=5, 10 m)

	VL=5 m		VL=10 m	
	Rectangular	Triangular	Rectangular	Triangular
V in (m3)	479	481	476	481
Sed. In (Kg)	642	642	639	642
dQ (%)	4.3	11.9	24.9	20.8
dE (%)	99.7	99.6	99.9	99.9
dP (%)	57.4	61.4	68.6	66.4
Δ (dP) (%)	--	+7%	--	-3.2%

Note: simulations with VFSMOD v4.2.0 using N (number of nodes)= 57 (the default).