CE 5362 Surface Water Modeling
Lesson 11

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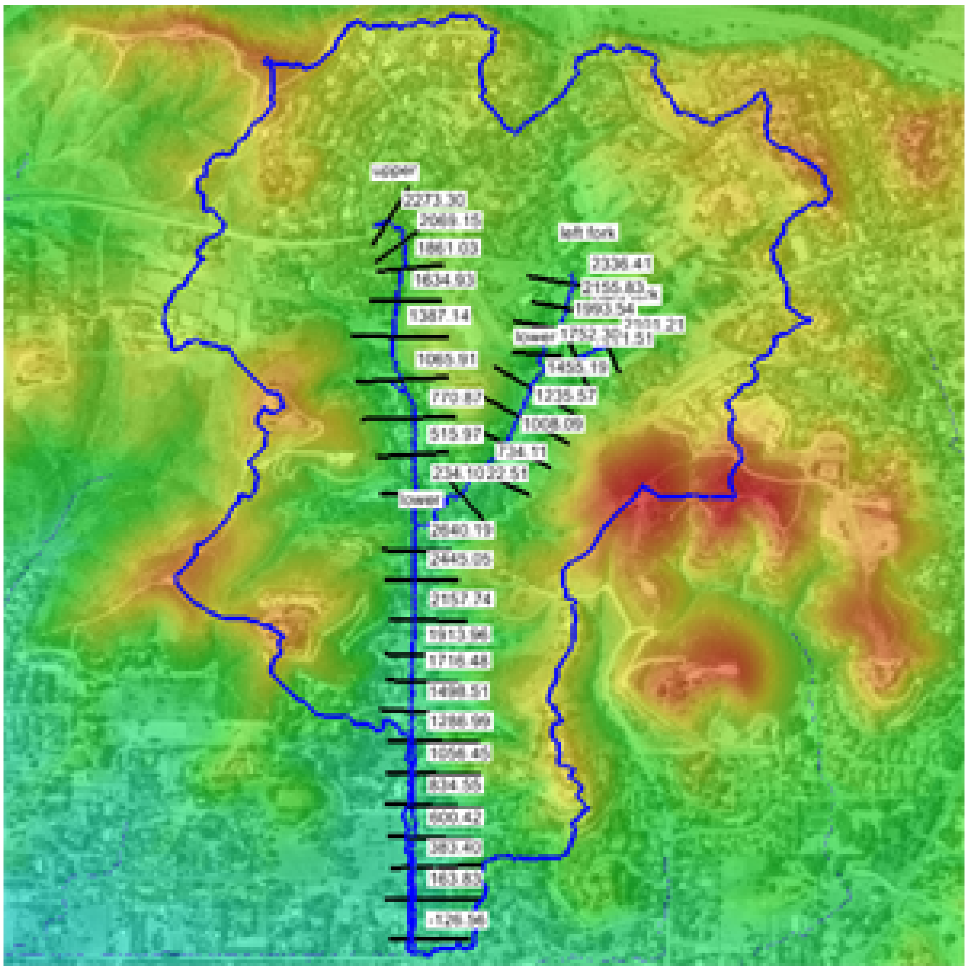

Contents

1 HEC-RAS Unsteady

what is HEC-RAS? what is unsteady?

1.1 Examples

1.1.1 Example 3 – Sudden Gate Closing in an Aqueduct Channel

Flow in a 1000-m long trapezoidal channel with a bottom width of 20-m, side slope of 2H:1V, longitudinal slope S_0=0.0001, and Manning's resistance n=0.013. Initial discharge in the channel is 110 m3/s and initial flow depth is 3.069 m. Simulate the flow and depth at every 100-m station when a downstream gate is closed at t=0. Produce a graph of depth and velocity versus location for t=0, 60, 360 seconds.[1]

1.1.2 Example 4 – Flood Hydrograph in Horizontal Channel

The initial depth in a 5 meter wide horizontal channel of rectangular cross section is 1 meter. The channel is 29 kilometers long and ends with a non-reflection boundary condition.

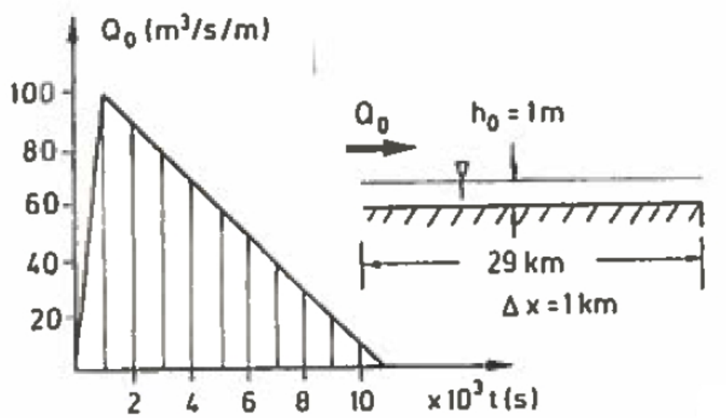

Figure 1. Upstream hydrograph for example.

The initial discharge in the channel is 0 cubic meters per second. The upstream input hydrograph is shown in Figure 1. The manning friction factor is $n = 1/40$. Simulate the water surface elevation over time in the channel.[2]

[1]Example 12-1, Page 623. Roberson, J A., Cassidy, J.J., and Chaudhry, M. H. (1988). Hydraulic Engineering. Houghton Mifflin Co., Boston, 662p.

[2]Modified from Example 4.1, Page 70. Koutitas, C.G. (1983). Elements of Computational Hydraulics. Pentech Press, London 138p. ISBN 0-7273-0503-4

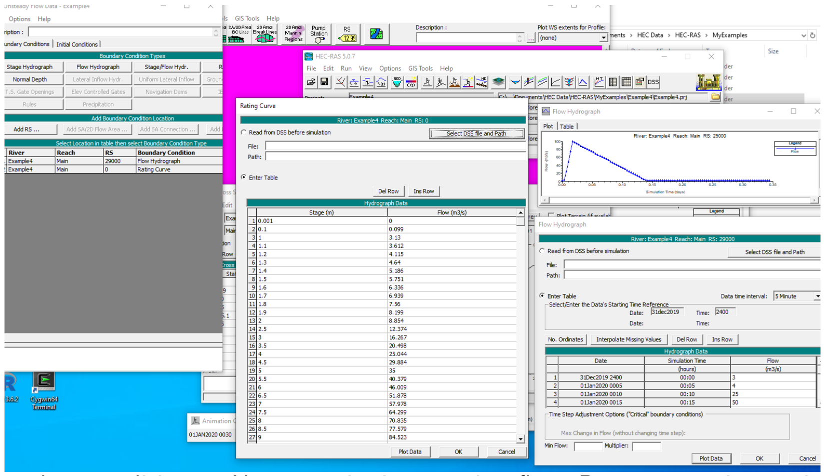

Figure 2. Boundary conditions – Upstream is time-varying flow; Downstream is a rating curve (depth vs flow) if depth is critical, then simulating a free outfall.

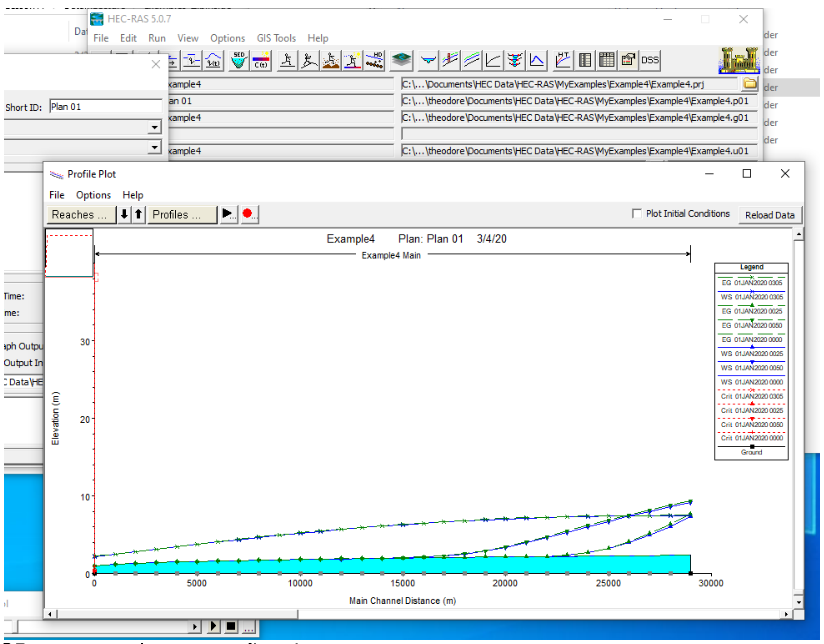

Figure 3. WSP at several times – flood wave is apparent..

1.1.3 Example 5 – Long waves in a Tidal-Influenced Channel

Simulate the propogation of a long wave of period T=600sec (10 minutes) along an estuary of rectangular cross section bottom slope 0.4% and friction coefficient $n = \frac{1}{30}$. The amplitude of the tide at the open sea boundary is 3 meters.[3]

What is the depth and water velocity at 15 km from the open boundary?

[3]Example 4.2, Page 77. Koutitas, C.G. (1983). Elements of Computational Hydraulics. Pentech Press, London 138p. ISBN 0-7273-0503-4

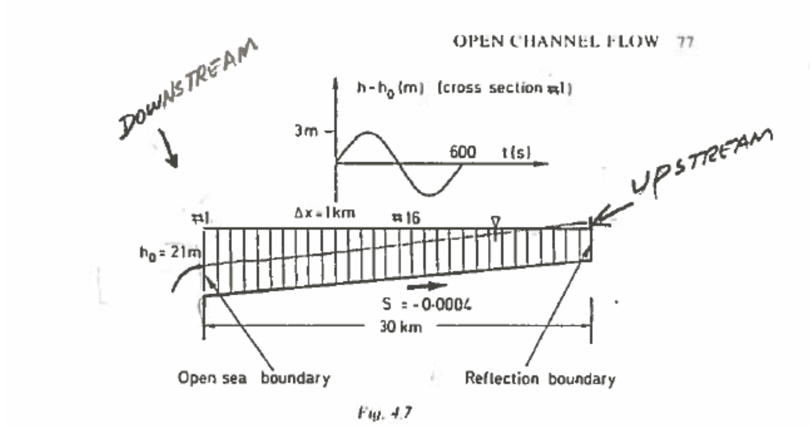

Figure 4. Schematic — Long Waves in Open Channel.

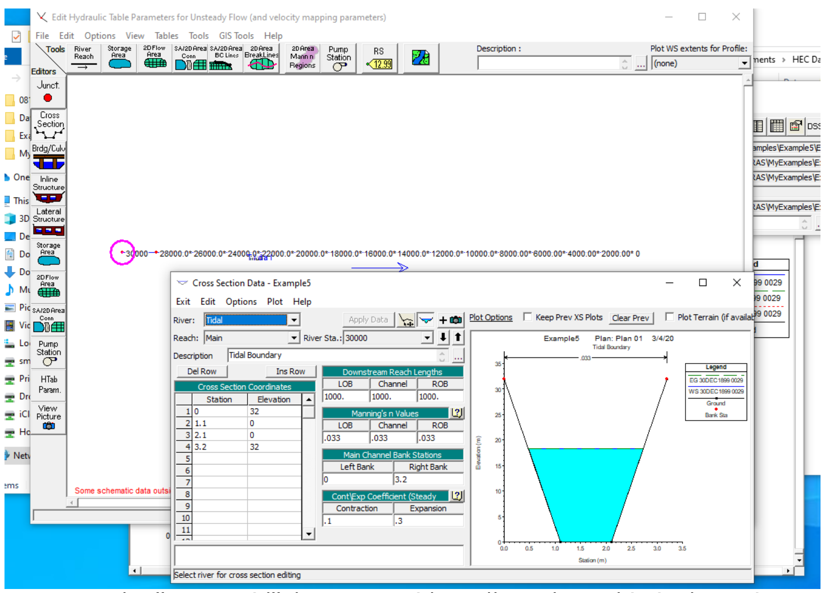

Figure 5. Geometry – the "trapezoid" has steep side walls and graphic is deceptive.

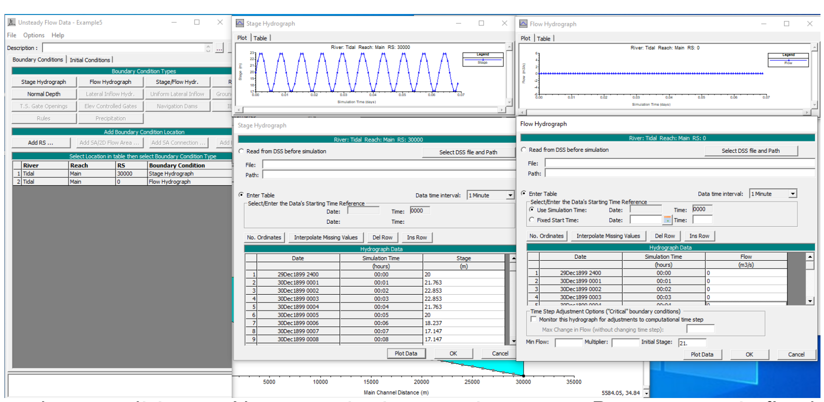

Figure 6. Boundary conditions – Upstream is time-varying stage; Downstream is fixed zero discharge (should reflect incoming waves).

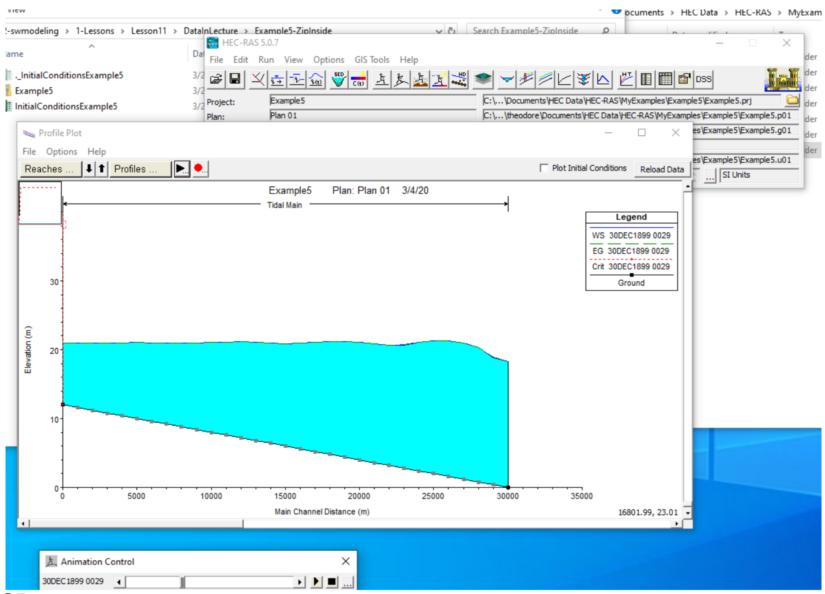

Figure 7. WSP at some time slice.

1.2 Appendix

References

Koutitas, C.G. (1983). *Elements of Computational Hydraulics*. Pentech Press, London 138p. ISBN 0-7273-0503-4

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