Test 8B – Surface flow from a surcharging sewer in urban areas

1. Modelling performance tested

This tests the package's capability to simulate shallow inundation originating from a surcharging underground pipe, at relatively high resolution. The pipe is modelled in 1D and connected to the 2D grid through a manhole.

2. Description

The modelled area is approximately 0.4 km by 0.96 km and covers entirely the DEM provided and shown in Figure (a). Ground elevations span a range of ~21m to ~37m.

A culverted watercourse of circular section, 1400mm in diameter, ~1070m in length, and with invert level uniformly 2m below ground is assumed to run through the modelled area. An inflow boundary condition is applied at the upstream end of the pipe, illustrated in Figure (b). A surcharge is expected to occur at a vertical manhole of $1m^2$ cross-section located 467m from the top end of the culvert, and at the location shown in Figure (a).

The flow from the above surcharge spreads across the surface of the DEM.

The DEM is a 0.5m resolution Digital Terrain Model (no vegetation or buildings) created from LiDAR data collected on 13th August 2009 and provided by the Environment Agency (http://www.geomatics-group.co.uk).

Participants are expected to take into account the presence of a large number of buildings in the modelled area. Building outlines are provided with the dataset. Roof elevations are not provided (arbitrary elevations to be set by modellers if needed, at least 1m above ground).

A land-cover dependent roughness value is applied, with 2 categories: 1) Roads and pavements; 2) Any other land cover type.

The model is run until time T = **5** hours to allow the flood to settle in the lower parts of the modelled area (or until this has happened according to the model)

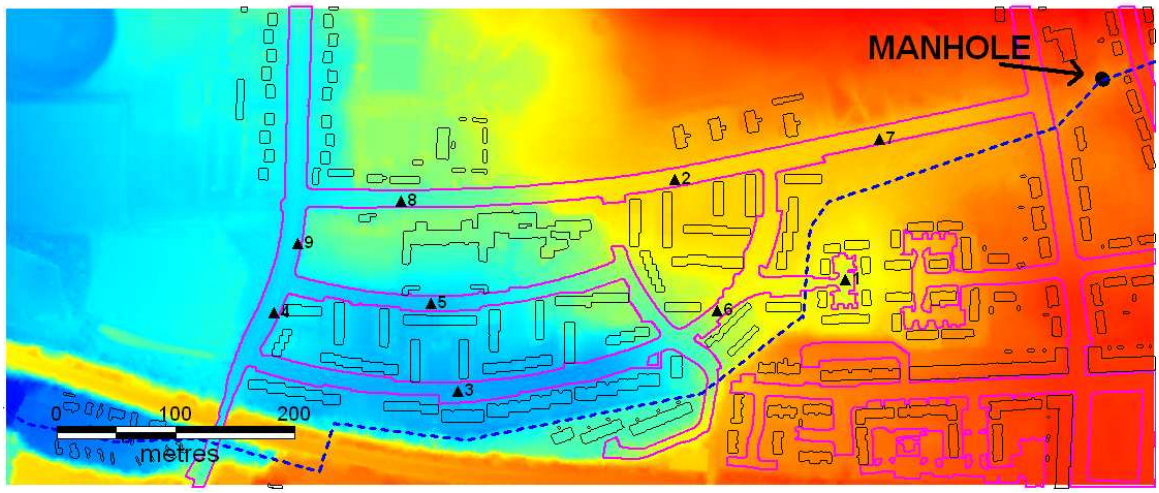

Figure (a): DEM used, with the location of the manhole. The course of the underground pipe is indicated, although irrelevant to the modelling. Purple lines: outline of roads and pavements. Black lines: building outlines. Triangles: output point locations.

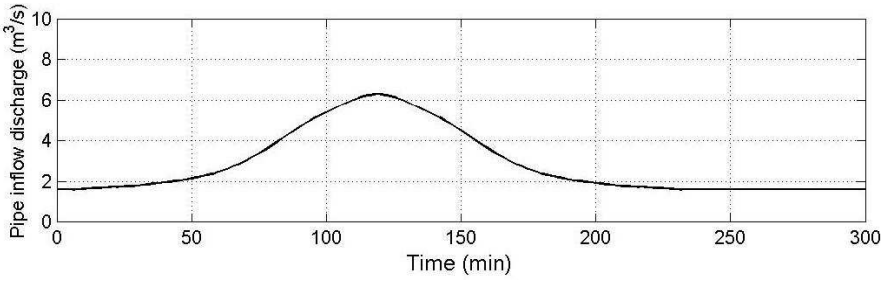

Figure (b): Inflow hydrograph applied in Test 8B at upstream end of culvert.

3. Boundary and initial conditions

Underground pipe

- Upstream boundary condition: discharge versus time provided as part of dataset
- Downstream boundary condition: free outfall (critical flow)
- Baseflow (uniform initial condition): 1.6 m^3/s

2D domain

Manhole connected to 2D grid in one point.

All boundaries of the modelled area are closed (no flow).

Initial condition: Dry bed.

Conditions at manhole/2D surface link

The surface flow is assumed not to affect the manhole outflow.

4. Misc. parameter values

Manning's n: **0.02** for roads and pavements

0.05 everywhere else

Model grid resolution: **2m**

(or ~97000 nodes in the 0.388 km^2 area modelled)

Time of end: the model is to be run until time t = 5 hours (if an alternative end time is used run times must be reported for t=5 hours)

5. Required output

Software package used: version and numerical scheme.

Specification of hardware used to undertake the simulation: processor type and speed, RAM.

Minimum recommended hardware specification for a simulation of this type.

Time increment used, grid resolution (or number of nodes in area modelled) and total simulation time to specified time of end.

Raster grids (or TIN) at the model resolution consisting of:

a. Peak **water level elevations** reached during the simulation
b. Peak water **depths** reached during the simulation

Water level elevation and **Velocity** versus time (output frequency 30s), at locations shown in Figure (a) and provided as part of the dataset.

Discharge versus time through the manhole (output frequency 30s).

6. Dataset content

Description	File Name
Georeferenced Raster ASCII DEM at resolution 0.5m	Test8DEM.asc
Culvert upstream boundary condition table (discharge vs. time)	Test8B-pipe-inflow.csv
Geometry of pipe	Test8BPipeGeometry.xls
Location of output points	Test8Output.csv
Outline of roads and pavements (shapefile polygons)	Test8Road_Pavement_polyg_region
Outline of roads and pavements (ASCII raster file)	Test8RoadPavement.asc
Outline of buildings (shapefile polygons)	Test8Buildings_polyg_region
Outline of buildings (ASCII raster file)	Test8Buildings.asc

7. Additional comments

The location modelled is in the City of Glasgow, UK (Cockenzie Street and surrounding streets). The above representation of the culverted watercourse is a gross simplification of reality and is for the purpose of the present test only.

Linear interpolation should be used to interpolate inflow values.

Participants are asked to provide model results **at least** for the grid resolution specified above.

Model results for 1 alternative resolution or mesh may also be provided.

Participants are asked to justify their reasons for not carrying out the test, or for carrying out the test using an alternative resolution.