Flood Diversion Problem

River modelling

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Model schematisation

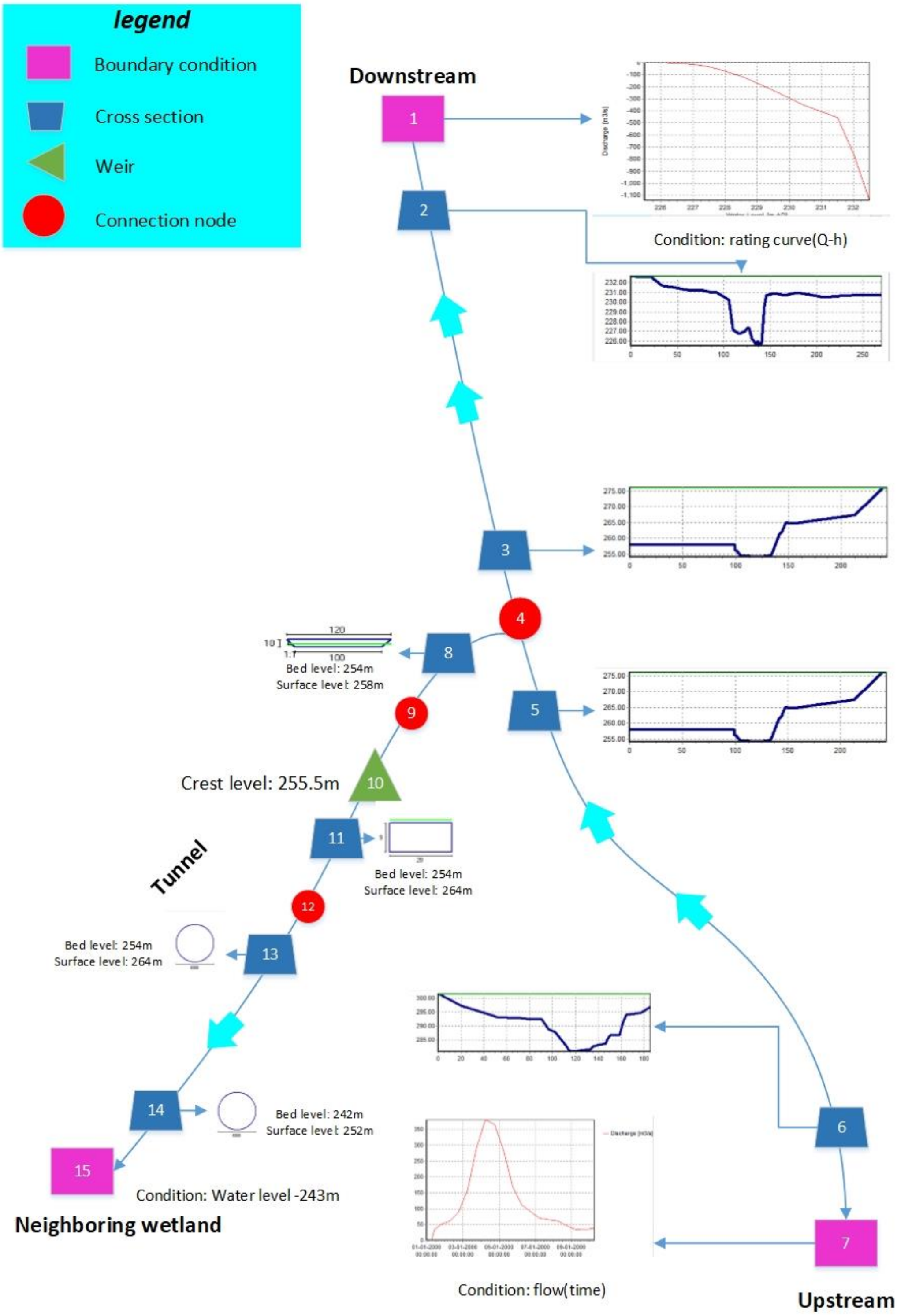

Figure 1. The model schematisation

Boundary conditions

Upstream boundary

The location is 7 unit in the south part of the Ciliwung River. The boundary condition is discharge over time graph. The following figure is the specific data. This is reasonable because during the flood, observers can measure the discharge data.

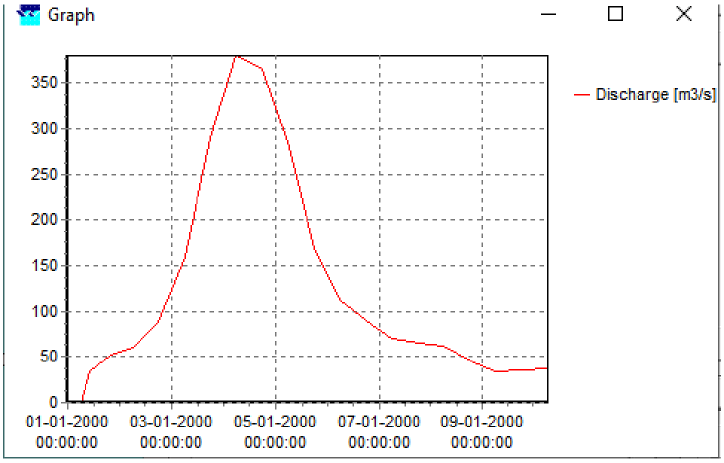

Figure 2. Discharge over time graph

Downstream boundary

- The location is 1 unit in the north part of the Ciliwung River. The boundary condition is rating curve (Q-h). The setting condition is reasonable since the downstream water level of the flood is related to the upstream water level, so it is difficult to obtain real-time data on the downstream water level. However, we can infer the change of the two variables through the relationship curve of discharge with water level.

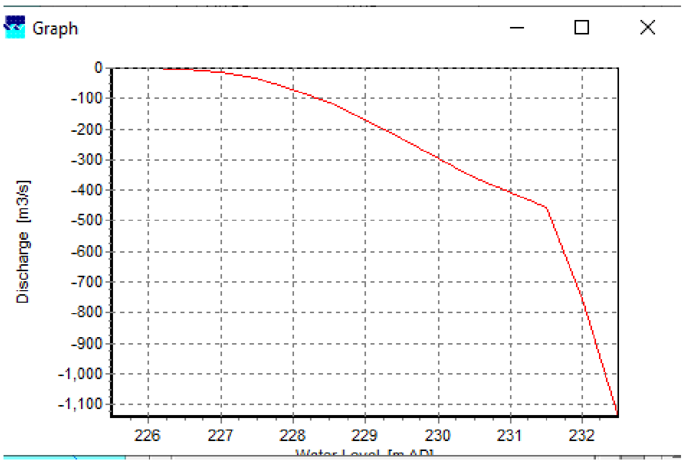

Figure 3. Rating curve

- The location is 15 unit in the entrance of wetland. The boundary condition is water level equal to 243m. Because the volume of water in wetland is very large, and the inflow of the tunnel does not change the water level. We assume that the boundary level is a fixed value.

Sensitivity of the numerical parameters

Time step (dt)

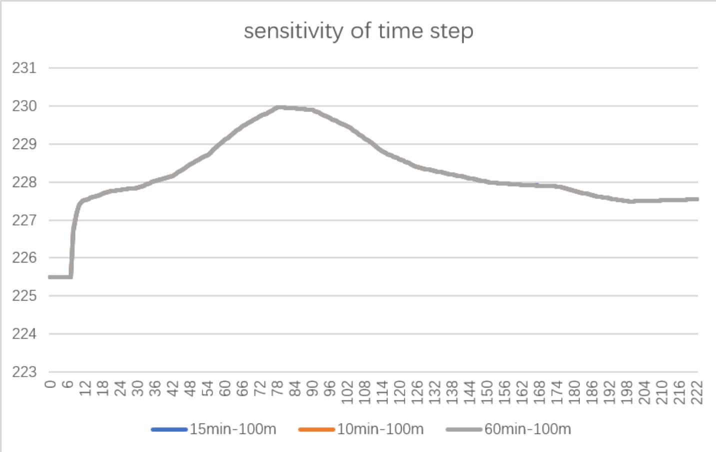

Figure 4. The sensitivity of time step

In the model, I set three groups of time step, 10 min, 15 min and 60 min separately. Observed the outcomes, the figure of the downstream water level are almost the same. Thus, the time step is not sensitive.

Distance step (dx)

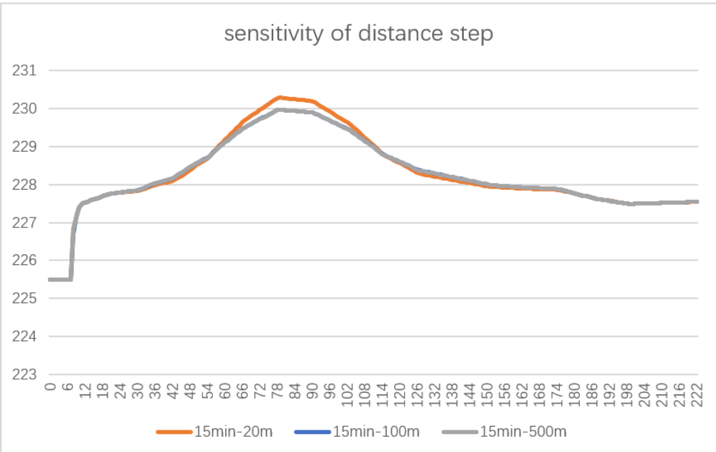

Figure 5. The sensitivity of distance step

In the model, I set three groups of distance step, 20m, 100m and 200m separately. Observed the outcomes, when the distance is small, the water level is higher than the other two. There is no difference between the curves with 100 m and 500 m distance steps separately. Therefore, the distance step is a little sensitive as distance step is small. In contrast, it is not sensitive as the distance step is relatively large.

Sensitivity of hydraulic parameters

Dimension of the intake structure

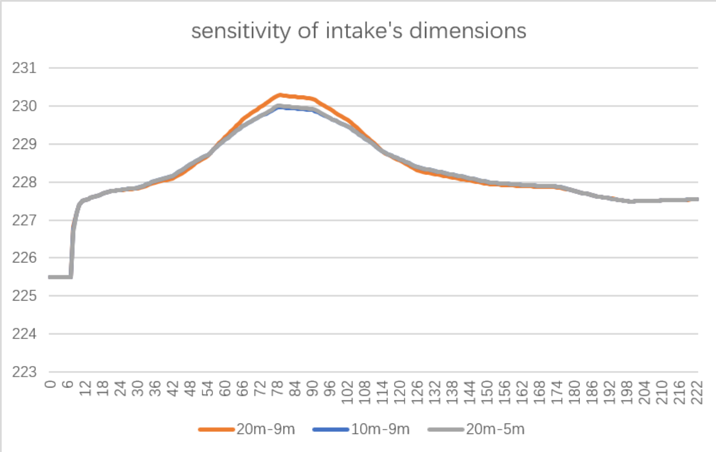

Figure 6. The sensitivity of intake's dimensions

The length and width of the intake structure are changed separately. The three schemes are (20m, 9m), (10m, 9m) and (20m, 5m). The results show that only the base case has a higher water level, and the other two are basically the same. Thus, the dimension of the intake structure is a little sensitive.

Shape of intake structure

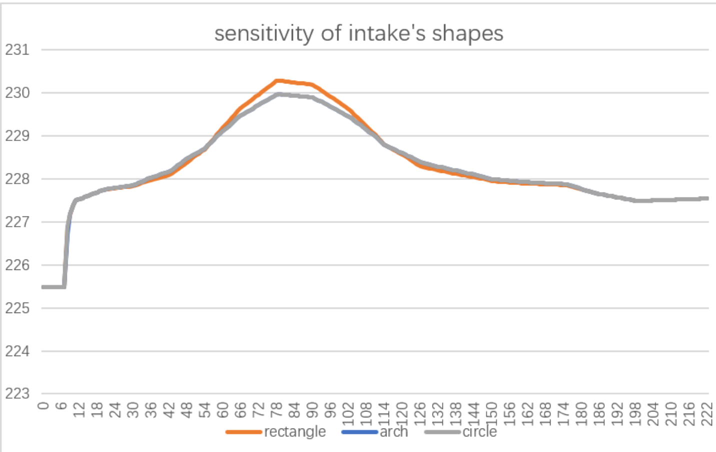

Figure 7. The sensitivity of intake's shapes

I have adopted two schemes, arch and circle, to compare with rectangle. The result shows that the rectangle's overcurrent capability is weak, but there is not much difference between the three schemes. The remaining two curves basically coincide. Thus, the shape of intake structure is a little sensitive.

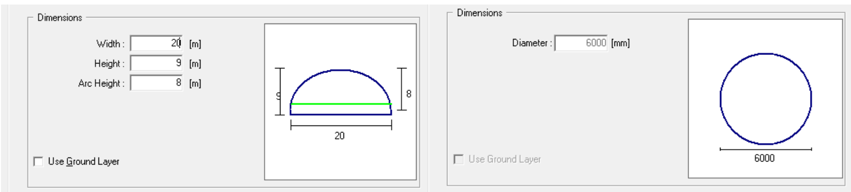

Figure 8. Different shape

Design

Save construction

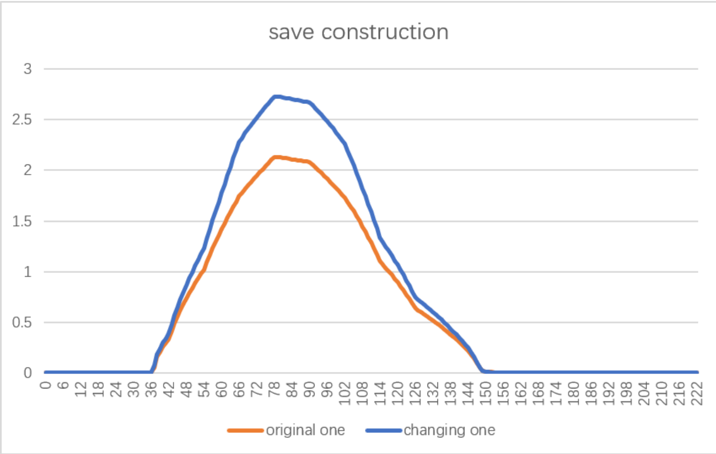

Figure 9. Tunnel's depth along the flood procession

The phenomenon that the size of weir is fixed leads to the discharge of diversion is determined. Observing the cross section, the highest water depth of the tunnel is only about 2.5m. So it is advised to reduce the diameter to 3.5m, while changing the rectangular size to (10m, 9m).

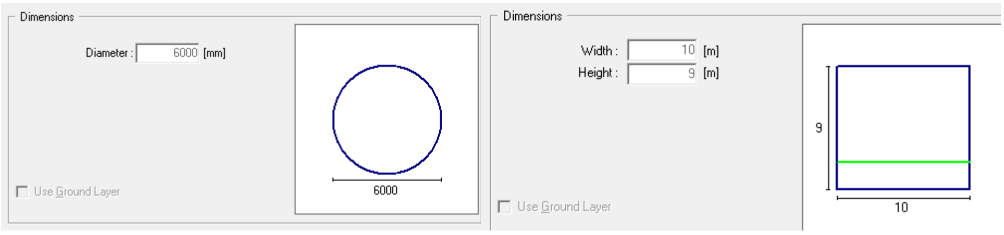

Figure 10. The intake's structure

Reduce the downstream level peak

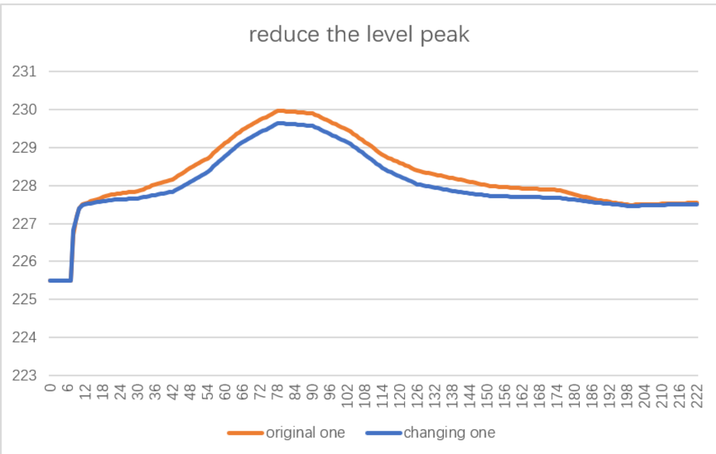

Figure 11. The downstream water level peak

The diversion flow capacity is mainly determined by the weir's dimensions. According to the formula,

$$Q = CLH^{n}$$

Where:

L is the width of the crest

H is the height of head of water over the crest

I increase width to 80m and decrease crest level to 255m. This method improve the diversion ability so that the peak value can be reduced.

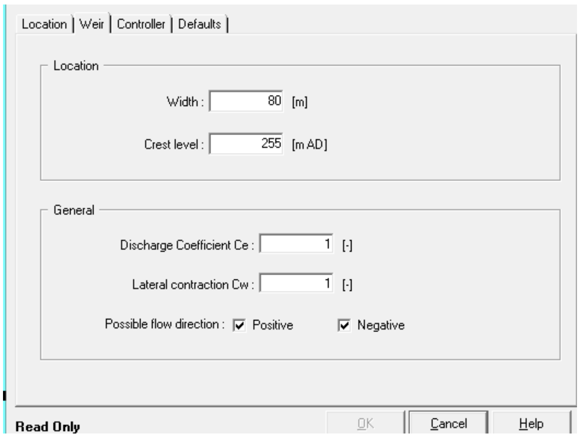

Figure 12. The alternative structure design