

(m)								
Port height (m)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Vertical angle	0°	0°	0°	0°	0°	0°	0°	0°
Horizontal angle	0°	45°	90°	135°	180°	225°	270°	315°
Salinity (ppt)	10	10	10	10	10	10	10	10


General Notes:

1. The given outfall configuration is close to that of the operating outfall near the Stonecutters Island being used in the HATS. For a more realistic simulation, you may wish to create *a scenario in Stonecutters Island*. The way of creating a scenario in Stonecutters Island are the same as instructed in the tutorial 1 except that the location is changed to Stonecutters Island.
2. *Input ambient parameters*: Input the ambient parameters, including the current velocity given, as instructed in other tutorials.
3. At this stage it is assumed that readers have gained familiarity with various functions of the VISJET 3 system, certain detailed steps will be omitted, instead we will outline a sensible sequence of an outfall construction in the system which users can take it as reference. The sequence by no means need to be strictly followed but it is considered to be an efficient way for constructing a realistic outfall scenario based on our own experiences.
4. The construction sequence can be thought to be a “Top-down approach”, in which the outfall parameters are considered first, then to the riser, and finally to the jet parameters.
5. For example, in this scenario the outfall parameters can first be entered (after clicking “**Create Outfall with Risers**”), including the length, depth, and flow, etc.. We do not need to care about the riser or jet parameters yet. Choose a suitable location by entering directly the outfall coordinates or by using the “**Pick**” function.
6. Next, click the “**New Riser**” button, and enter various given riser parameters. Note that at this moment we need to care about ONE riser only as you will see later one (distance can be ignored at present).
7. Next, click the “**New Jet**” button, enter various given jet parameters, such as diameter, port height, and vertical angle (horizontal angle can be ignored as it will be calculated automatically in this case). Repeat clicking the “**New Jet**” button until Jet #08 appears. Highlight Riser #01 and click “**Evenly Distribute Jets**”. Jets are then distributed evenly on the riser circumference from angle 0° of Jet #01 to 315° of Jet #08.
8. You may have noticed that there are totally 24 risers installed on the outfall. To create all of these risers, simply highlight Riser #01 and

click “**New Riser**” for an extra of 23 times until Riser #24 appears, then 24 identical risers will be created.

9. The last step would be entering the suitable riser distance; for evenly distributed risers simply highlight Outfall #01 and click “**Evenly Distribute Risers**”. The 24 risers will then automatically be distributed evenly along the riser with a riser distance of 52.2.

Effect of buoyancy

10. Click “**Start Near-Field VISJET simulation**”  . Observe the evolution of the jet groups. Jets can be seen to be discharged at different angles merging and interacting with each other within the same riser. Not much bending by the current is observed. After reaching the trapping layer the computation continues and stops after several oscillations.
11. Open the suspend file and obtain different jet mixing characteristics. The buoyancy length scale $l_b = 143.6$ m, the water depth of the port is 22.5 m. Since $l_b/z \gg 1$, the strong buoyancy effect dominates the jet mixing characteristics in this case, thus jet groups are only slightly advected by the ambient crossflow.

Effect of ambient crossflow

12. Now change the ambient current to 0.2 m/s, and re-run the simulation.
13. Observe the jet evolution again, notice the difference between this case and the previous case. Jet groups can be seen to be strongly bent by the ambient current within a short distance from the discharge point. The jet groups are trapped under the water surface. Computations stop after several oscillations of the jets in the trapping layer.
14. Open the suspend file and obtain different jet mixing characteristics. The buoyancy length scale $l_b = 2.24$ m, the water depth of the port is 22.5 m. Since $l_b/z \ll 1$, ambient current dominates the flow, and the jets are observed to be strongly bent by the ambient.

Jet interactions

15. For the case with ambient current = 0.2 m/s, change the angle of view until the cross-section of the jet group can be seen. Re-run the simulation and observe the interaction (overlapping) among jets. Do the jets between adjacent risers merge? At a riser separation of 52 m (which is quite large), only jet interaction within the same riser can be observed, there is no interaction between jets of neighbouring risers.
16. As can be seen in the simulation, jets from risers which are separate far apart do not merge with each other even after reaching the trapping layer. The *line plume approximation* then, strictly speaking, is not valid in this case.
17. Try reduce the riser spacing by halving the outfall length, and distribute evenly the risers on outfall. Re-run the simulation again. This time do jets from neighbouring risers interact?

18. When risers are placed close enough, interaction between jets from neighbouring risers can be observed. When risers are close enough such that jets merge and form a uniform two-dimensional plume layer, the *line plume approximation* may then be a reasonable approximation