**RD 1049 –**
**Hydrologic Measurement, Mangrove Monitoring and Sedimentation Survey at Estuaries of Kam Tin River, Shan Pui River, Tin Shui Wai Western Drainage Channel and Shenzhen River**
**Part 2 - Sedimentation Analysis**

## EXECUTIVE SUMMARY

### (I) Introduction

The hydraulic performance of drainage networks in Yuen Long and North Districts is to be affected by the sedimentation at estuaries of Kam Tin River, Shan Pui River, Tin Shui Wai Western Drainage Channel and Shenzhen River discharging into Deep Bay.

The process of sedimentation in Deep Bay and its estuaries is very complex as it is affected by (a) the sediment loads from rivers upstream and Pearl Estuary under tidal flow moving in and out through the mouth of Deep Bay; (b) the complex hydrodynamic processes in Deep Bay. On one hand the tide causes a circulation in the horizontal plane. This circulation, coupled with mixing processes, leads to a net transport of sediment towards the estuaries. On the other hand, due to a salinity gradient, there is a vertical plane circulation which causes a net flow into Deep Bay near the bed and a return flow out of Deep Bay near the water surface. As sediment concentrations are higher near the bed, the net effect is a flux of sediment towards the estuaries.

The sedimentation processes for Kam Tin River, Shan Pui River and Tin Shui Wai Western Drainage Channel were included in the previous Territorial Land Drainage & Flood Control Strategy Study – Phase III Sedimentation Study (TEL III) completed in 1997 using 1D modelling while the sedimentation process for Shenzhen River Stage I & II were investigated under the Study on Hydraulics and Sedimentation of Shenzhen River and the Estuary (Shenzhen River Sedimentation Study) completed in 2009 using 2D modelling.

### (II) Sedimentation Study under Review of Drainage Master Plans (DMP) in Yuen Long and North Districts

In order to have a better understanding of and insight into the sediment transport and morphological development of the Deep Bay-estuaries-rivers system, and to quantify the sedimentation amount in the bay and in the estuaries/tidal sections of the river channels, a sedimentation study was conducted under the DMP Review Study using Delft3D modelling (a 3D modelling system for the development of coastal models) to simulate the flow, waves, salinity, sediment transport and morphodynamic changes for Shenzhen River (Stage 1, II & III), Kam Tin River, Shan Pui River and Tin Shui Wai Western Drainage Channel discharging to Deep Bay.

The Delft3D Model consists of 4 components including the 3D hydrodynamic model, salinity model, wave model and sediment transport model. The extent of Delft3D model covers part of Pearl River Estuary, Deep Bay, Shenzhen River and tidal rivers of Yuen Long District.

The total number of computational points, in the horizontal direction, amounts approximately 25,000. The grid size of the model varies from about 30 m x 30 m in the fine grid to about 1000 m x 250 m in the coarse grid. Since the model should be able to represent the gravitational circulation. Hence, the 3-dimensional functionality of the Delft3D has been adopted. In the vertical direction 10 sigma-layers, each having a thickness of 10% of the local water depth, have been used.

Field data were required for calibrating and verifying the Delft3D model. Part of the data was based on the data obtained from the previous studies including TEL III, the Shenzhen River Sedimentation Study, and joint surveys conducting by DSD and the Shenzhen River Regulation Office of Shenzhen Water Bureau and the Shenzhen Municipal Government (SRRO). In addition to the desk data, additional field data including bed sediment properties, wave data and sediment concentration were surveyed for the dry season of 2009/2010.

**(III) Conclusion**

Shenzhen River Stage I & II Section was found reaching "dynamic equilibrium" in 2004-2005 by Delft3D modelling. The estimated sediment under equilibrium bed level for Shenzhen River Stage I & II was about 3 million $m^3$. The "dynamic equilibrium" and trigger level of Shenzhen River Stage I & II section recommended in the Shenzhen River Sedimentation Study was verified and supported by 3D modelling. It was concluded that dredging would be required if the surveyed sediment volume for Shenzhen River Stage I & II reached a value of about 3.3 million $m^3$.

Shenzhen River Stage III Section would need sometimes (within 2 years to few years from 2010) to achieve the "dynamic equilibrium" based on theoretical considerations and results of the Delft3D modelling. The amount of sediment needed to achieve equilibrium was about 112,500 $m^3$. To minimize flood risk along this section of Shenzhen River, it was suggested dredging should be carried out whenever the trigger level in Stage I & II was achieved, or a trigger level of about 100,000 $m^3$ (approximately 500mm above the predicted dynamic equilibrium bed level).

Tin Shui Wai Main Channel, Shan Pui and Kam Tin Rivers were found reaching "dynamic equilibrium" based on field observations and modelling. The trigger levels for Tin Shui Wai Main Channel, Shan Pui River and Kam Tin River recommended in the previous TEL III Study were supported except at an upstream end of Shan Pui River (i.e. the trained Yuen Long Main Nullah section). At that portion of appropriate 1 km in length, the equilibrium level was found to be almost 1m below the trigger level, the trigger level suggested in TEL III Study was therefore recommend to be lowered to 0.8mPD (about 500mm above the design bed level).

As the sedimentation process at estuaries of Kam Tin River, Shan Pui River, Tin Shui Wai Western Drainage Channel and Shenzhen River discharging into Deep Bay is very complex and be affected by numerous factors, further research studies on this subject from time to time is supported when resources are available.