The Environmental Education and Conservation Project in Bang Sue, Bangkok (MIKE URBAN Modelling and Analyses)

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As a part of feasibility study for the Environmental Education and Conservation Project in Bang Sue, Bangkok – Panya Consultants and DHI have developed a hydrological, hydrodynamic and water quality model for the wastewater and storm water drainage system in the Bang Sue project area.

The models were developed inside the framework of MIKE URBAN modelling platform for urban water systems. MIKE URBAN is a GIS-based software tool, compatible with major GIS software (ArcGIS).

Based on the system configuration data available for the present configuration and the design data for the future, the models were developed in three different alternatives:

1. Present configuration (2005)
2. Future configuration (2009 -> 2034) with interceptor along the Ratchadaphisek Road, WWTP plant in the Chatuchak park and effluent disposal pipeline into the Khlong Premprachakorn. Alternative 1.
3. Future configuration (2009 -> 2034) with interceptor along the Khlong Bangkhen, WWTP plant in the Chatuchak park and effluent disposal pipeline into the Khlong Premprachakorn. Alternative 2.

The models have been used for the simulations of the system behaviour in all three alternative configurations, under different loading and operational scenarios. The dynamic simulations included dry weather operations and wet weather operations under historical rainfalls and wet weather operations under extreme synthetic rainfalls, featuring both the hydrodynamic and water quality processes.

On the basis of the simulations carried out, the following conclusions are drawn:

1. **Operation of the sewer network in dry weather:** The drainage network has been analysed with a hydrodynamic model taking into the account the dynamic routing of the waster water flow together with the routing of the daily dry weather flow peaks. Both under the present DWF load (year 2005) and under increased DWF in the period up to 2034, the drainage network is and will be capable of collecting and transporting the wastewater generated in the area. This conclusion is valid for the main drains included in the model, i.e. not including local drainage conditions on micro-scale.

2. **Operation of the sewer network and the Khlong system in wet weather under extreme loading conditions:** The hydrodynamic simulations have shown, in accordance with historical records, that the system is subject to risk of local flooding as a consequence of intensive rainstorms. With data available for the model developed it was not possible accurately to

localise and quantify the flooding risk exactly according to the historical records. However, it is clear that the processes like continued impermeabilisation, deterioration of the pipe network, land settlement etc. will contribute to a further increase of the flooding risk, unless counteracted by substantial and continuous rehabilitation of the pipe network. When data becomes available then the model can be verified to a higher extent and it can be applied for simulation of rainfall and flood events with different return periods.

3. **Operation of the designed interceptor during dry weather:** For both alternatives, the designed interceptor is capable of intercepting approx. 96-98% of the dry weather loads. The hydraulic conditions under the minimum load according to the Thailand design criteria (velocity at 1.5 * DWF at the first year – 2009 - after commissioning) remain almost inside the design criteria, where the minimum velocity for the combined sewer is based on pipe diameter: less than 600mm = 0.8 m/s; 600mm-1200mm = 0.7m/s and greater than 1200mm = 0.6m/s.

4. **Operations of the designed interceptor in wet weather:** The simulations in both alternatives have demonstrated that even under the extreme storm load, maximum pressure grade line would not rise to the level which would cause surcharge of water from the interceptor on the surface. This is because the pressure grade line is in normal operation controlled and held relatively low by the WWTP pumping station. With the pumping station at WWTP shut down, the pressure grade line would be controlled by the water levels in the CSO structures.

5. **Operation of the pumping station at WWTP:** This pumping station will under normal conditions operate under varying pumping heads – high heads during DWF, and low head during wet weather. This means two distinct pumping regimes, requiring adequately adaptable pumping machinery.

6. **Impact of the interceptor on drainage capacity of the system:** The simulations have confirmed that the construction of the interceptor does not have any important effect on the drainage capacity in the system. I.e. neither will interceptor worsen the drainage situation, not it will improve it significantly. The reason for this is that the small upstream pipes with a limited flow capacity control the flow passed forward to the interceptor. I.e. the amount of water passed forward to the interceptor is limited by the small upstream pipes, and as they remain unchanged then the flood conditions in the area will remain unchanged. Possible alternatives to reduce flooding could be applications of the model developed under the present project to identify the most important pipes to be upgraded to pass water forward to the interceptor or to be discharged to the khlongs or to add routing of flow in the street to the model and in this way be able to design road, gutter etc for fast evacuation of the flood water to the khlongs.

7. **Water quality in the khlongs:** The water quality (WQ) simulations reproduced the WQ measurement in the past very well. The model simulations have confirmed that the water quality in the khlongs will worsen significantly in future under increased pollution loads, unless something is done. After the construction of the interceptor, WQ in khlongs will improve notably in dry weather, but it will still not be satisfactory compared to Thai national standards, due to the remaining pollution loads and stagnant waters. A way to further improve the WQ in the khlongs is to let water from the Chayo Praya river flow into the khlongs on a regular basis – when ever feasible. The developed model can be applied for such analyses of how to improve the WQ further by use of flushing. **T**he effect of the wastewater treatment plant (WWTP) effluent will be dominantly felt in the Premprachakorn khlong. Storm water runoff will cause intermittent spills of wastewater and polluted runoff into the khlongs. However, storm runoff will, due to supply of large amount of relatively less polluted, well aerated water, actually contribute to improve the WQ situation in the khlongs.

The developed models remain as powerful tools for studying the system performance in future, more detailed phases of design process, where various alternatives and loading scenarios can be quickly tested end evaluated against selected benchmark.