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Integration of the Floodway and Urban Drainage System in the Eastern Part of Semarang Lowland Area

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Master of Science Thesis

by

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Summary

The East Floodway (EFW) and Tenggang Urban Drainage System is a part of East Semarang Urban Drainage System. Topographically, the system is located in a lowland region where the ground surface level is relatively flat and close to a coastline. Consequently, some areas will be inundated partly due to high tide. Moreover, a severe situation will be faced when high rain fall at upstream and high tide occur at the same time.

In the past the East Floodway as part of an irrigation system, equipped by Pucanggading flood control gates, had been designed to divert over capacity of the upstream river and to prevent flooding towards the downstream part dominated by farmlands and settlements. Accordingly, the farmlands had independently drainage systems. Therefore, two main streams were settled in the area, the East Floodway and the main drain of the farmlands.

At present, most of the area are developed, hence housings and business lots cover dominantly in the catchment area. In other word, the land utilization has been altered. The East Floodway not only diverts upstream flood but also receives excess water coming from the city centre and the developing area nearby.

Regarding flooding, previous projects were undertaken particularly for Tenggang Urban Drainage, such as pumping station installation. However, flooding still emerges almost every year. Recently, the river improvement project was planned to widen and separate the downstream end of Tenggang Main Drain from the East Floodway, but it has not been realized yet. Besides, there are no evaluation study dealing with the performance of the existing scheme and structures.

On the other hand, there are some spaces available in both Tenggang urban area and in the left and right banks of the East Floodway for flood water management improvement. Therefore, the study subjects to assess proposed measures including integration between two systems, river improvement and retarding ponds in regard with flooding reduction. Of course, the current situation will also be reviewed beforehand.

This study describes the steps followed to propose structural solutions to recurring flooding problems in the area of Tenggang urban area. First, the evaluation is done towards the existing systems not only the East Floodway but also main and secondary drains. Basically, this evaluation will assess the discharge capacity and pumping performance of the existing system. Second, the integrated assessment is undertaken towards proposed improvements including constructing dikes, sediment clearance, constructing storage, spillway, diversion and ring-dikes. The assessment is supported by hydrodynamic model simulation with DUFLOW Modelling Studio (DMS). In order to carry out these simulations, both hydrology data and cross-sections from secondary data surveys are integrated into the model. Further, the flooding problem was analyzed with a time-dependent and space-dependent approach consisting of simulating floods following extreme rainfall events for 50 % and 2 % chance of occurrence.

The hydrological aspects were studied starting from catchment delineation to rainfall intensity and design flood discharge. Catchment delineation is obtained in a spatially way using GIS analyst tools of Arc Map. The available data on the study location such as the digital elevation model, contour data and flow direction were exploited to identify

the basic spatial modelling parameters. In addition, the rainfall - runoff contribution were computed by using the empirical formula of Nakayasu and Van Breen.

Two main scenarios were included in the model simulation. First, existing flood control and drainage system were simulated with design runoff for 50 % and 2 % of occurrence and second, improved systems affected by land subsidence and sea level rise in 2025 were simulated with design runoff for 2 % of occurrence. In addition, alternatives of hydraulic structures also evaluated in term of reducing flood discharge and reducing flood water level such as spillway, long storage, and pumping station.

Various solutions were reviewed. Regarding flooding mitigation of the existing situation, structural measures proposed are widening sectional areas and heightening dikes of the EFW. Improving pumping capacity and storage construction, sediment clearance and rising dike are proposed measures towards Tenggang Main Drain and secondary drains. These improvements reduce approximately 55% of flood water level at the EFW and 26 % at Tenggang Main Drain. Conversely, they increase the discharge with about 20 % at downstream points.

Particularly, at the EFW is proposed an alternative of spillway-long storage construction which reduces flood discharge with 48 % and water level with 62 % at the downstream point. Similar situation towards Tenggang Main Drain, by spillway construction decreased about 44 % of the discharge checked at the outflow of the spillway. Furthermore, in qualitative terms, the rainwater stored in the upstream of the spillway is expected to infiltrate and recharge the groundwater.

Finally, heightening dikes and Tenggang diversion are solutions proposed to mitigate flooding affected by land subsidence and sea level rise in the future. The heightened dikes covered flood overflowing the canals, while the diversion has two advantages, to discharge flood water from urban area to the EFW and the diversion dikes required to protect partly of lowering area against inundation due to high tide or even low tide. Additionally, the ring-dike construction is also proposed regarding flooding in right side of Tenggang main drain to protect the area against high tide.

Keywords: *Urban drainage, flood control, DUFLOW Modelling Studio, GIS analyst tools*