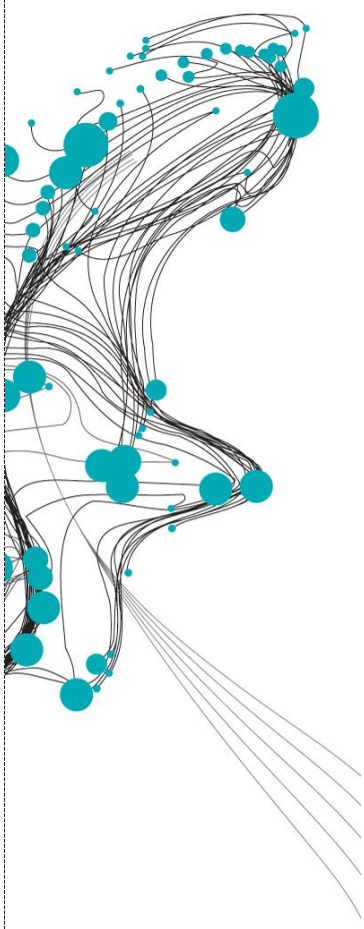
Application of SWMM to analyse the effect of sewage water treatment on water quality in Guwahati, India



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Drastic population growth in India in the last decades has resulted in uncontrolled development and urbanisation in many cities. In 2015, the Government of India launched the Smart Cities Mission in which adequate water supply, sanitation and solid waste management are part of the core infrastructural elements of a smart city. Guwahati, the largest city in the state of Assam and situated at the banks of the Brahmaputra River, has been selected for this programme as it has also observed this rapid growth of population. The absence of a sewage treatment plant (STP) in the entire state of Assam results in direct discharge of untreated sewage waste into the open surface waters of Guwahati. Hence, the need for sewage water treatment is high, but due to the complexity of the water system and lack of data in Guwahati, there is a limited overview of how to act to improve the water quality in the most efficient way. This study had two major purposes: (1) to obtain an in-depth understanding of the water quality in the Guwahati water system in relation to how it functions and (2) to identify effective sewage water treatment management scenarios to improve the water quality in Guwahati. Water quality aspects were added to an existing schematization of Guwahati for quantitative water management in the Storm Water Management Model (SWMM). It was then used for system analysis and to assess the effect of each scenario on improving the water quality in the area.

Considering the population in 2050 can increase by as much as 50% from the reference 2025 population, it will consequently also increase the amount of sewage water being generated, eventually ending up in the water system. Investigated scenarios ranged from projecting the future with both centralised and decentralised STPs to diverting flows and addition of extra capacity to treat part of the storm water runoff, which were compared to a worst-case scenario in which no measures were taken. Results from SWMM revealed that all selected scenarios managed to lower both pollutant load and concentration in the focused water bodies. However, the scenarios were not able to completely fulfil the goals of adequate sanitation and solid waste management, hence not improving the water quality to desirable concentrations. Especially during dry winter season the water quality showed to be poorest, but all scenarios were most effective in improving the water quality in this period. Furthermore, the addition of extra treatment capacity to treat most incoming flow during monsoon season had little effect, neither was a correlation found between total combined treatment capacity of all STPs and reduction in pollutant load. The location and number of STPs throughout the area, on the other hand, were found to have a measurable impact on pollutant concentrations in the lake as well as the reduction in total pollutant load from the study area. A more decentralised approach would lead to a greater reduction in pollutant load, but not necessarily a large improvement in lake water quality.

Table 1: Score table with scores for different aspects of each scenario (++ means it scores good and -- means it scores low on that aspect)

	Scenario 1 Centralised	**Scenario 2** Decentralised	**Scenario 3** Diverting flow	**Scenario 4** Extra capacity
Water quality in lakes				
Deepor Beel (dry)	+	-	-	-
Deepor Beel (wet)	--	-	--	-
Borsola Beel (dry)	++	+	+	+
Borsola Beel (wet)	+	-	-	+
Eutrophication	-	-	-	-
Overall water quality				
Overall (dry)	-	+	++	-
Overall (wet)	-	-	+	-
Other aspects				
Costs	++	-	+	-
Feasibility	++	-	+	+

To conclude, this study showed that the scenario and STP selection greatly depends on the final goal, whether the local authority prioritises plans to improve water quality in the city or primarily in the selected water bodies. Based on a limited available budget and prioritising improvement in the lakes only, scenario 1, having two centralised STPs, would be the best, but for maximum impact in both lakes as well as the city, scenario 3, with four smaller decentralised STPs in combination with diverting flow to Deepor Beel, shows more potential.

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