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Effective Water, Sanitation, and Hygiene Services (E-WASH) Program

USAID E-WASH Hydraulic Modelling of Pipe Network - Abia State

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EXECUTIVE SUMMARY

The U.S. Agency for International Development (USAID) Effective Water, Sanitation, and Hygiene Services (E-WASH) program seeks to improve urban water and sanitation service delivery by strengthening the governance, financial and technical viability in Abia State Water Board (AbSWB). In achieving these objectives, the determination of the hydraulic state of the existing network in Abia State metropolis cannot be overemphasized. Also, the need to ensure the sustainable maintenance of the hydraulic models mutually reinforced the need for the training of the AbSWB staff on hydraulic modelling. The existing pipe network was appraised in terms of the impact of additional users on the system with and without upgrades, considering the projected water demand. The water network in Umuahia consists of a combination of branch and looped configuration. The network consists of various pipe types and sizes. The existing pipe network is comprised of steel and asbestos cement (AC) pipes, with sizes ranging from ND100 mm to ND 600 mm. The water transmission system is made up of steel, while the water distribution system is made of Asbestos Cement pipes. Water is abstracted from the Imo River and supplied to the Umuopara WTP (Water Treatment Plant) with the aid of a pump. The scheme has however been moribund for some years. In the zeal to making water available to the citizenry, a quick fix water supply approach was adopted. In the quick fix approach, the water source is groundwater. The urban scheme is fed by groundwater. Groundwater is abstracted from three boreholes within the vicinity of the Ugbanankata reservoir and supplied to the said Reservoir. The water from the reservoir is then distributed by gravity. Similarly, groundwater is abstracted from four boreholes

within the vicinity of the AbSWB premises. The water from the borehole is pumped into the aeration basin, and then pumped into the network via a pumping station located within the SWB compound. The current operational arrangement serves some residents within the locality due to the inability of the pump and reservoirs to meet the current water demands. In considering how the network responds to several real-time conditions of water demand loading for the original design (surface water fed scheme from Umuopara WTP) and the current operations (quick fix – ground water fed scheme), four scenarios were studied. The nodal water demand loading conditions under review included daily average water demand, maximum daily demand, maximum hourly demand and firefighting scenario. The analysis of the system in delivering the requisite demand and pressures for the 2020 projected water demands for the scenarios under review revealed that the network failed in delivering the water demand at required pressures. This occurred due to the obvious reasons of the inability of the pipe network, tanks and pumps to deliver the projected water demands. Modifications were done to the existing network to ensure that it satisfied the Laws of Conservation of energy and continuity. Minimal modifications were carried out to minimize the cost of upgrade and get the system started and not necessarily to meet all the design criteria. This option was considered with the view that the networks could quickly be upgraded at least cost, funds generated from the customers for future upgrade of the entire network. The modifications entailed increasing some of the pipe diameters to increase the pressure energy, hence the hydraulic gradient. Also, pump upgrade was carried out to enhance the delivery of the required demand and the introduction of a new tank. In doing this, the Laws of conservation of energy and continuity were satisfied. However, the set design criteria were not met in totality. Therefore, it was imperative to carry out proper optimization in line with the objectives of the assignment. Therefore, the Umuahia metropolis pipe network was optimized considering a design horizon of 15 years with respect to the base year. The proposed model constitutes an optimally sized water-supply pumping systems considering steady states and Extended Period Simulation. The results revealed that the pressures for the various scenarios were satisfactory, considering the fact that the least pressure was 15.02 m (21.32 psi) obtained for the EPS for the maximum hourly water demand scenario. The head loss gradients along the pipelines for each of the four water demand loading conditions fall within acceptable values recommended by American Water Works Association (AWWA) for the different pipe sizes. The maximum head loss gradients corresponding to the average, maximum daily, maximum hourly and fire loading demands are 7.86 m/km, 10.91 m/km, 23.21 m/km and 36.32 m/km, respectively. The flow velocities (V) within the

network for all loading scenarios were less than 3.0 m/s and therefore satisfactory. It is worthy of note to state that there are no water treatment units for the treatment of the water at the Ugbanankata and the Abia State Water Board premises. Therefore, the current operations of the scheme would at best meet the short-term water needs of the metropolis. The surface water source scheme would serve as a more sustainable source compared to the groundwater fed scheme, considering the increasing water needs of the metropolis residents. Factors such as the proximity to the river, the infinite water availability from the river, the existing water treatment plant at Umuopara etc render this alternative as a better and sustainable means of water supply in Umuahia urban. The model was developed based on the assumption that the underground reservoir at Umuopara WTP can satisfactorily meet the demand of Umuahia metropolis.

In accordance with the Terms of Reference and in ensuring the sustainability of the operations of AbSWB, the USAID E-WASH incorporated capacity building of the State Water Utility staff to the assignment. The essence being to enhance the effective and efficient maintenance of the model after the STTA Hydraulic modelling Consultant's task was completed. The training of the staff of the Utility was carried out with a high sense of responsibility and accorded the seriousness it deserved. Trainees were nominated by the Utility and Ministry of Public Utilities for the training. The Consultant interacted with them prior to the training to ascertain their knowledge gaps. Various software packages were installed in their computers. The training was held on the 26th and 27th of August 2020 at Glajosh Hotel, Umuahia. The Trainees were drawn from different fields of endeavors, comprising of technicians, engineers and allied professionals in the WASH sector. The Trainees were taught the basics of hydraulic modelling and then how to use EPANET and WaterGEMS for hydraulic modelling of pipe network. The training approach was participatory. Softcopies of the presentations, and the manuals (EPANET and WaterGEMS) were made available to the participants. In general, the training was impactful. Barring issues of lack of computers, the Trainees would be able to effectively and efficiently maintain the network systems after the STTA Hydraulic modelling Consultant's task was completed.