Clean Water – Clean Environment for the City of Lahore, Pakistan!!!

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My alma mater and the beautiful city of Lahore is the capital of Punjab province in Pakistan. As per Population Census of 2017, Lahore is the second-most populous city and financial hub of Pakistan after Karachi. It is densely populated with a population of 11 million and an area of about 1200 square kilometers and still growing very fast due to migration from all rural areas of Pakistan. It is undergoing a rapid modernizing process, requiring substantial infrastructure to improve the living conditions of its residents. Among others, water supply, sewerage and drainage are some of the most important utilities for sustaining public life.

One of the major issues Lahore is facing is that the whole sewage effluent generated by the city is being pumped into the network of storm water channels, which were meant for draining out the rain water. This has created a huge set of problems related to health and environment. It is therefore imminent that this practice is stopped forthwith. For combating this problem, the Water and Sanitation Authority (WASA) of Lahore, under its leadership with a vision and foresight, has undertaken a major project in Central Zone of Lahore, that is heart of the town, construction of large size underground trunk sewers by using trenchless technology, that is, microtunneling using a tunnel boring process. The trunk sewers will carry the sewage effluent straight to the river Ravi, where a sewage treatment plant is proposed to be built in future. This will alleviate the contamination of the storm runoff in the storm water channels to the extent of the sewage effluent generated from the Central Zone of the city. The need for pumping of the sewage effluent will also be eliminated in this way, resulting in a huge saving on operation and maintenance of the lift/disposal stations.

This was no less challenge to conceive, study, plan, design and build such a system without having good data to start with. Based on dry and wet weather flows this system will convey about 580 cubic feet per second (cfs). To convey this massive flow through a 20+ kilometer (12.5+ miles) long pipe system, the hydraulic modeling resulted in sizes ranging from 60-, 72-, 96- and 120-inch inner diameter sewer pipes. Microtunneling will be done by jacking concrete pipes 10+ meters (30+ feet) below the ground level to clear all shallow utilities and foundations. A major challenge was to finalize the alignment to clear all known crossing utilities, structures, streams, pile foundations for transportation infrastructure like the existing Orange Line train route and the proposed elevated expressway.

While recently visiting Lahore, I was continuously asked what is “Microtunneling” and what is the difference between the Microtunnel Boring Machine (MTBM) and Tunnel Boring Machine (TBM). Full disclaimer that, I am no expert by any means and only have basic 101 knowledge. The two systems of construction for underground tunnels are quite different but are used to develop an underground pipe/tunnel system for various needs, whether it is a trunk sewer or a subway tunnel to carry trains. In MTBM, a pipe is pushed into the ground using a jacking system where as in TBM, the pipe is created behind the tunnel boring machine using segmental precast concrete panels. Usually, the MTBM is limited to a 120-inch (10 foot) diameter. For tunnel sizes larger than 120-inch we generally use TBM system. It is worth noting that the selection of an appropriate system (MTBM or TBM) depends on several factors including soil conditions, depth of the system, length of the tunnel, access shaft and several other factors rather than just the diameter of the pipe.

Jacking and receiving pits will be constructed every 300 to 500 meters (1000 to 1600 feet) to facilitate lowering the pipes and jacking system and to withdraw the jacking machine. Once the water is conveyed on the downstream end, a 580 cfs disposal pumping station will be used to discharge flow into open conveyance channel and later to the wastewater treatment plants before discharging into river Ravi that flows west of the city of Lahore.

A million-dollar question is why are we doing this? The countless benefits of this project to the citizens of Lahore and to their environment overweigh all counter arguments and justifies the cost to build this mega project. Let us investigate some of the benefits this project will bring home:

Separate sewer from storm flow – this should have been done a long time back, but we can say that even Washington, DC in US still has combined system so why can’t we have the same. Firstly, DC WASA is spending over

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$2.5 Billion (yes, it is not typo, it is costing that much!) to build an underground storage tunnel under its Clean Rivers Project – a 24 feet diameter, 17 mile long and about 100 feet below grade using the TBM system to create a segmental panel tunnel. So, Lahore must do something to keep its sewage from flowing into storm drain channels, ditches, streams, and rivers.

- ***Eliminate flooding*** – We all know that the recent floods in Pakistan are unprecedented and have caused havoc across the country. The metropolitan cities survived to some extent but still everyone witnessed boats being used for rescue operation in several metropolitan cities. Construction of this trunk sewer will significantly reduce the chances of flooding in the most critical central business districts and residential areas.
- ***Help maintain drinking water quality*** – if sewage is not piped, it is a major source of contamination for our precious drinking water aquifers through seepage and infiltration. This alone is such a big reason to build this trunk sewer and help contamination of underground water system that we use for drinking purposes.
- ***Proactive versus reactive*** – Diverting sewage in a pipeline is a proactive and planned approach to manage unanticipated consequences of sewage overflows and floods needing millions of dollars for cleanup and rehabilitation efforts rather than significantly low capital investment to upgrade existing systems – in other terms we can call it an asset management practice that in the long run would save significant amount of money that can be used for other priorities.
- ***Reduced impact to the traffic and citizens*** – microtunneling being the trenchless technology, allows life to go on as-usual above the ground while the tunnel is being built underground. The disturbance or impact at the ground level is limited to the access shaft locations only, thus a huge benefit to the businesses and homes.
- ***Pollution and odor control*** – currently most of the sewage is caried through the existing open channels, streams and major water bodies resulting in septic conditions and consequently a big source of pollution and odor in the neighborhoods – that is not only unhygienic but causes bacterial infections, various diseases and health issues among the residents specifically the children and the elderly.
- ***Last but not least positive impact on the environment*** – living in the 21st century and not thinking about the environment is just not possible. The toll of flooding on the citizens has direct and indirect impacts; when water hits their homes and businesses as well as when it ruins public spaces like parks, schools, grocery stores and other facilities – creating negative impact on the environment.

To accomplish these goals and being proactive, WASA Lahore awarded a contract for the Project Management Consultants (PMC) / Owner's Representative to a joint venture of four firms, EBA-ECSP-EEC-TEAM, led by EBA Engineering, Inc. of USA. EBA is a 40-year-old reputable civil and environmental engineering firm with its headquarters in Maryland, USA, and 4 other offices in Mid-Atlantic area with specialized experience in tunneling and trenchless technologies for water and sewer systems. The proposed trunk sewers will convey the sewage to the proposed disposal station at the Bund Road near the existing Gulshan-e-Ravi sewage disposal station.

The Project will accomplish optimal wastewater management while minimizing the issues of urban flooding by freeing the drainage system of sewage discharge within the Central Zone of Lahore. The services are to be provided in two phases; Phase-1 services to prepare design guidelines and tender documents for selecting a contractor for Engineering, Procurement and Construction (EPC) of the project, followed by Phase-2 services to oversee design and construction for a proposed 3-year period. Needless to say, such mega projects are only successful when there is a partnership and close working relationship between the owner, the engineer and the contractor. WASA Lahore leadership should be commended to provide the vision for such an important public service project and then working very closely with the engineer (the PMC team) but also with other stakeholders, more importantly the public – kudos to MD WASA Lahore and his dedicated team. This project is going to be a win-win situation for the citizens of Lahore and the environment!