

## Chapter 3: Management of Water Quality in Dhaka

### I. Dhaka: a Mega-City under Stress

81. Dhaka is the eighth largest city in the world, with a population of about 12 million people in the Dhaka Statistical Metropolitan Area<sup>61</sup> (DSMA), accounting for about one third of Bangladesh's urban population. By 2015, assuming current population growth trends, the DSMA will have a population of about 21 million, and may be the fourth largest city in the world.<sup>62</sup> In Dhaka City (the metropolitan area administered by Dhaka City Corporation, DCC), the population density is one of the highest in the world, at more than 20,000 people per square kilometer.<sup>63</sup> About 4.2 million people live in slum areas, and it is estimated that up to 55% of Dhaka residents live below the poverty line. Most of the poor lack access to clean water and adequate sanitation facilities, and many live in squalid conditions next to extremely polluted water bodies.

82. Given the size and growth rate of the city's population, and the significance of the DSMA to the national economy (contributing some 20% of GDP), the host of environmental challenges facing Dhaka constitute a problem of national concern, meriting particular attention in the broader effort to strengthen environmental management within the country.

### II. A Triple Threat: Contamination of the Air, Land and Water

83. Chief among Dhaka's environmental challenges are risks to human health and natural resource productivity from the poor quality of air, inadequate management of solid waste, and contamination of surface and groundwater in and around the city. While initiatives are underway to better manage air quality and solid waste, little has yet been done to improve water quality, although the economic costs associated with water pollution are estimated to exceed those attributable to poor air quality and solid waste.

84. Despite important steps in reducing air pollution, particularly through the phasing out of leaded gasoline and two-stroke three-wheelers, concentrations of respirable particulate matter in Dhaka exceed standards for more than 100 days of the year, contributing to an estimated 3,500 premature deaths annually as a result of poor air quality in the city. The economic costs associated with death and disease caused by poor air quality in Dhaka are estimated to be in the order of US\$500 million per year. Efforts to address this threat continue under the Department of Environment's (DoE's) Air Quality Management Project, focusing on reducing emissions from gross polluters (particularly trucks and buses), improving fuel specifications (particularly reducing sulphur in diesel), and increasing public support for air quality improvement initiatives through monitoring and dissemination of air quality information.

85. The management of solid waste in Dhaka remains a major challenge. The population of more than five million people living within the area covered by DCC produces about 3,500 tonnes of solid waste daily, of which only 42% is collected and disposed of at an open,

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<sup>61</sup> Comprising the areas administered by Dhaka City Corporation (DCC), Dhaka District, Gazipur District, and Narayanganj District

<sup>62</sup> Lizin, 2002

<sup>63</sup> BCAS, 2004

unlined landfill site<sup>64</sup>. The unsanitary conditions created by the poor management of solid waste impose economic costs in the form of health impacts, blocked drainage and aesthetic insults. A promising new direction has been taken, however, with the agreement between DCC and an NGO for private management of the landfill, with carbon financing in support of composting and methane recovery being used to augment the revenue stream. In addition, DCC with support from the JICA is preparing a master plan for solid waste management in Dhaka city.

86. Dhaka is surrounded by rivers and inter-connected with canals which have always formed a life-line for city residents. In the last twenty years, a convergence of unregulated industrial expansion, rural-to-city migration, encroachment of the rivers, overloaded infrastructure, confusion about institutional responsibility for the quality of Dhaka's water bodies, and very ineffective enforcement of environmental regulations have all taken their toll on surface water quality. There is only one sewage treatment plant at Pagla which is currently operating below capacity because of sewerage system failures, and few industries operate effluent treatment systems. Almost all the waste from humans, industry, and millions of farm animals, along with tonnes of pesticides and fertilizers, make their way into Dhaka's surface water untreated, and a percentage of these wastes infiltrate to the groundwater. As a result, pollutant levels in the groundwater are increasing, and many sections of the rivers and canals in the city and surrounding areas, especially the Buriganga and Sitalakhya, are biologically dead during the dry season, spurring widespread public concern and prompting reaction at the highest political levels.

### **III. The Economic and Social Costs of Water Degradation**

87. Dhaka surface water is in very poor condition, especially in the dry season. For some six months of the year, the flow rate of the rivers is negligible, often with only a tidal pulse, but the volume of effluent entering the canal and river system remains about the same as during the wet season. Consequently, dilution of contaminants is drastically reduced in the dry season. As Figure 3.1 shows, the most polluted areas are the Buriganga and Sitalakhya Rivers, Tongi Khal, and the canal system in Dhaka East, where very low oxygen levels reflect the breakdown of organic waste, principally domestic sewage and chemical residues from industry. The high levels of oxygen demand in the Buriganga and Sitalakhya Rivers, in particular, reflect the high density of industries discharging untreated waste into the rivers. Some tidal backflow of relatively clean water from the Meghna and Dhaleswari Rivers results in dilution of contaminants in the southern reaches of both the Buriganga and Sitalakhya Rivers, as may be seen in Figure 3.1, but the extent of this positive effect is limited.

88. The very high ammonia levels shown in Table 3.1, particularly in the canal system in Dhaka East, in the Balu River, and in the southern reaches of the Buriganga River, reflect the discharge of sewage into these waterways. Most of this water is unfit for any human use, and is likely to be dangerous to livestock. Of particular concern in the dry season are the high ammonia levels in the raw water used by the Saidabad Water Treatment Plant, which now threaten the plant's ability to treat the water to drinking quality standards. The intake for the Saidabad plant is located at Sarulia, near the confluence of the Balu and Sitalakhya Rivers, one of the Dhaka water pollution "hotspots" (see Figure 3.1). Ammonia in this area increases

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<sup>64</sup> Waste Concern, 2005

from about 0.3 mg/l in October to greater than 10 mg/l in March-April, which is twenty times higher than the national environmental quality standard for ammonia in surface water. Ammonia binds to the chlorine in the treatment plant, forming mono, di-, and tri-chloroamines, which significantly reduce the bactericidal effect of chlorine. As a consequence, the chlorine inputs to the process have to be increased (sometimes from 0.2 ppm to 5 ppm). This increases the risk to human health, as well as increasing the cost of plant inputs and raising questions about the overall effectiveness of chlorine treatment.

89. The water quality problem is further reflected by high levels of e-coli bacteria, which are indicators of the potential for more harmful bacteria and viruses in the waterways, including hepatitis viruses, typhoid, dysentery, and various other infectious bacteria. Levels of e-coli bacteria higher than 10,000/ml of water have been recorded in Norai Khal in the last six years. All Dhaka residents are impacted to some extent by deteriorating water quality, but the most vulnerable are the poor, who have few options for accessing clean water and little ability to move away from offensive locations next to polluted ponds, canals, and rivers. In addition to the lost productivity and health care costs associated with waterborne disease, a recent survey of household willingness to pay for improved river water quality in the Dhaka area suggests that the loss of amenity associated with contaminated surface water amounts to about 0.5% of the region's GDP.<sup>65</sup>

90. Groundwater resources are becoming increasingly polluted. Recent data<sup>66</sup> on groundwater quality show elevated and increasing levels of dissolved solids, both in the upper (5 to 200 meters below surface) and the lower (below 200 meters) aquifer. The total groundwater abstraction from licensed production wells operated by the Dhaka Water and Sewerage Authority (DWASA) and private (mainly industrial) operators is around 700 MCM per year, or 80% of the total monitored water supply to Dhaka city. The quantity of water abstracted from unlicensed wells is not known, but is estimated to be significant, since groundwater serves as the main water supply for areas that are not connected to the water supply network. Consequently, the infiltration of industrial effluents to groundwater has severe adverse impacts on quality of potable water supplies and potentially poses a serious risk to public health. This risk has only recently been recognized by the responsible agencies, and in response a program to monitor groundwater contamination is being implemented. As more data from this program becomes available, the extent of groundwater pollution, the impact of this pollution on public health, and possible remediation measures can be identified.

91. More than 80% of the DSMA is still used for agriculture and fisheries, but these activities have declined as pollution has increased. In polluted areas, some 45% of households report persistent losses in the production of rice, and more than 20% are experiencing production losses in vegetable crops. Reflecting experience with the death of livestock after drinking river water, less than 15% of households in highly polluted areas allow livestock to drink river water, compared with more than half in the past. It is estimated that agricultural and fisheries production in the DSMA may be reduced by about one third as a result of poor water quality.<sup>67</sup>

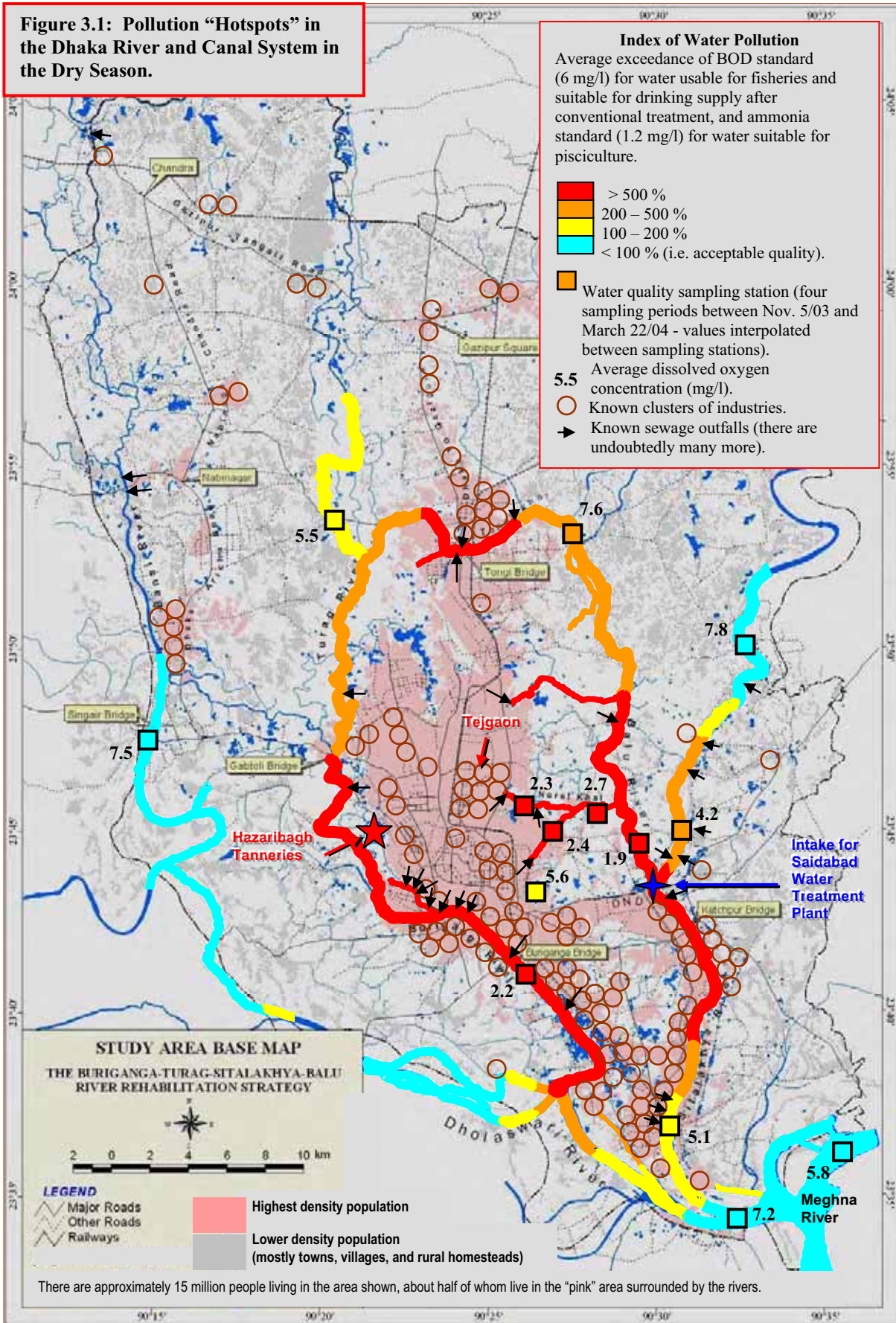
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<sup>65</sup> Alam et al, 2002

<sup>66</sup> DWASA and IWM, 2005 unpublished

<sup>67</sup> BEMP, 2004a

**Figure 3.1: Pollution “Hotspots” in the Dhaka River and Canal System in the Dry Season.**



**Table 3.1: Water Quality in the River and Canal System around Dhaka, 2003 - 2004**

Location	Season	Water Layer	Parameter (all mg/l)				
			Total Dissolved Solids	Dissolved Oxygen	Biological Oxygen Demand	Chemical Oxygen Demand	Ammonia
Postogola (Buriganga River)	Dry	surface	319	2.3	29.9	82.7	7.4
		bottom	319	2.0	35.4	113.3	7.3
	Wet	surface	69	8.3	0.9	67.3	0.4
		bottom	66	8.5	0.9	76.0	0.4
Convergence of Sitalakhya and Dhaleswari Rivers	Dry	surface	127	7.2	2.0	58.0	0.6
		bottom	129	7.1	1.4	75.3	0.5
	Wet	surface	63	8.9	1.3	70.7	0.7
		bottom	63	9.1	1.3	67.3	0.5
Narayanganj Ghat (Sitalakhya River)	Dry	surface	189	5.1	9.0	88.0	2.3
		bottom	194	5.0	9.2	97.7	2.3
	Wet	surface	63	8.6	1.0	73.3	0.4
		bottom	63	8.5	0.9	66.0	0.5
Kanchon	Dry	surface	193	7.2	2.0	72.3	0.6
		bottom	208	7.3	2.0	56.3	0.6
	Wet	surface	56	8.7	1.0	53.3	0.6
		bottom	56	8.6	1.7	50.0	0.7
Demra (Sitalakhya River)	Dry	surface	234	4.3	14.3	130.7	2.6
		bottom	236	4.1	15.4	114.7	3.0
	Wet	surface	56	8.8	1.4	74.7	0.6
		bottom	56	8.4	1.5	57.3	0.6
Balu River	Dry	surface	257	2.1	28.0	151.7	6.7
		bottom	258	1.6	30.5	215.3	6.7
	Wet	surface	76	6.4	1.4	81.3	0.7
		bottom	71	6.4	1.1	62.7	0.7
Singair	Dry	surface	220	7.6	1.6	16.7	0.6
		bottom	262	7.3	1.5	21.3	0.6
	Wet	surface	66	8.5	0.7	31.3	0.4
		bottom	65	8.3	0.8	33.3	0.4
Ashulia (Turag River)	Dry	surface	326	6.4	5.1	98.7	2.2
		bottom	344	6.6	4.5	85.3	1.6
	Wet	surface	62	8.2	0.9	58.0	0.4
		bottom	59	8.0	0.7	60.7	0.3
Uttar Khan	Dry	surface	356	7.3	12.1	41.7	4.5
		bottom	376	7.9	12.0	54.0	4.2
	Wet	surface	53	8.0	0.8	52.7	0.4
		bottom	62	8.1	0.7	44.0	0.3
Dholai Khal (Dhaka East)	Dry	surface	396	2.4	77.7	167.8	20.8
		bottom	388	2.3	94.9	199.0	19.5
	Wet	surface	-	-	-	-	-
		bottom	-	-	-	-	-
Begunbari Khal (Dhaka East)	Dry	surface	386	2.1	75.9	187.5	22.4
		bottom	385	2.4	71.2	163.3	21.8
	Wet	surface	-	-	-	-	-
		bottom	-	-	-	-	-
Norai Khal (Dhaka East)	Dry	surface	343	2.6	54.8	137.9	21.5
		bottom	316	2.9	53.9	135.1	22.0
	Wet	surface	-	-	-	-	-
		bottom	-	-	-	-	-
Saidabad Beel (Dhaka East)	Dry	surface	179	5.3	11.0	64.8	2.2
		bottom	181	5.8	10.2	65.8	2.3
	Wet	surface	-	-	-	-	-
		bottom	-	-	-	-	-
Hot spots (contaminated water) indicated as follows:			> 100	< 5	> 5	> 60	> 1

92. A benefit-cost assessment conducted for Bangladesh Environmental Management Project (BEMP)<sup>68</sup> examined the economic costs associated with poor water resource management in the DSMA. Setting aside the costs associated with inadequate water supply and flood control, the assessment identified annual costs amounting to some US\$400 million linked to poor surface water quality, including lost agricultural and fisheries production (17%), costs to industry (22%), lost amenity (21%), and health costs (40%).

#### **IV. Policy and Institutional Factors Affecting Water Quality**

93. The institutional framework for management of the city and its environment is chaotic. There is a serious problem of overlapping jurisdiction between many Government agencies, which often leads to inaction. The legislated roles and responsibilities of Government institutions that have some involvement with Dhaka waterways are summarized in Box 3.1. Currently there is no mechanism for coordinating the planning and implementation of the activities and interventions of all these stakeholders.

##### *Strategic Management of the Sub-Basin*

94. Regardless of the choice of technical interventions to improve the quality of surface water in Dhaka, they need to fit within a coherent long-term strategy, which adopts an integrated perspective to the management of water resources in the Dhaka region drainage sub-basin. Currently there is no such strategy. The RAJUK Structure Plan (1995-2015), which includes protection of waterways and floodplains, has largely been ignored in practice, and is already out of date. In the absence of a single authority having comprehensive responsibility and decision-making power for all water quality and urban habitat issues in the DSMA, reliance must be placed on a coordinating mechanism between the many GoB agencies with roles to play.

95. Building on the Flood Action Plan's integrated land use study for Dhaka, a strategic approach to the management of the sub-basin's water resources would address water quality, water supply, sanitation, and flood management in an integrated fashion. All interventions that deal with water quality will fall under the over-arching policies and directions of the recently approved National Water Management Plan (2004) and therefore need to be consistent with the guiding principles in the plan. The NWMP is a progressive strategy that embraces an increased role for stakeholders in managing water, and the use of economic instruments to encourage wise allocation and use of water, while assigning a more realistic value to access, treatment, and delivery of water, and the use of waterbodies.

##### *Compliance Promotion through Prioritization, Institutional Incentives and Waste Minimization*

96. Although there are sufficient regulations in place to control most activities that may have harmful effects on the urban environment, in practice these are largely ignored and enforcement is very weak. In particular, the current impunity with which industry discharges effluent into rivers and canals must be checked if surface water quality is to be improved, requiring stricter enforcement of environmental clearance conditions and effluent standards. Recognizing DoE's limited manpower and technical capability in monitoring and enforcing

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<sup>68</sup> BEMP, 2004c

environmental regulations, any program of enhanced regulatory activities must be focused on priority sources of contamination. The institutional incentives for DoE staff to strengthen enforcement must be re-examined, based on a consideration of performance indicators, transparency and accountability.

### **Box 3.1: Responsibilities of Government Institutions Regarding Dhaka Water Quality**

**Department of Environment:** Under Ministry of Environment and Forests: enforcement of environmental rules (environmental impact assessment; environmental clearances; effluent standards); setting environmental quality standards for water uses; routine monitoring of water quality; technical input to various GoB committees; administration of the Open Space and Wetland Conservation Act, 2000 and Urban Water Body Protection Law, 2001.

**Dhaka City Corporation:** Under Local Government Division (Ministry of Local Government, Rural Development and Cooperatives): responsible for handling and disposal of solid waste; issuance of business licenses; management of public green spaces; mosquito control; provision of public toilets; maintenance of public bathing and washing locations; surface drainage from roads; maintenance of some lakes (such as Dhanmondi); control of markets; operation of health facilities; flood control measures; regulation of private sources of water supply; city planning; now participating in Dhaka Good Governance Committee, under Principal Secretary, PMO.

**Adjacent Districts:** Deputy Commissioners, acting under the Ministry of Land, for Dhaka District; Gazipur District; Narayanganj District: local administration of infrastructure and services in these districts, many of which have a direct bearing on water flow and water quality; any project, such as waste treatment, that has land requirements will go through the DCs; municipalities and union parishads in these districts covered by the Pourashava and Union Parishad Ordinances (under Ministry of Local Government, Rural Development and Cooperatives), giving them jurisdiction for waste disposal and pollution management within their boundaries.

**Rajdhani Unnayan Kartipakha (RAJUK):** Autonomous body under Ministry of Housing and Public Works: planning for development and land regulation in urban areas; jurisdiction for Dhaka City and surrounding areas in Greater Dhaka, including preparation, implementation, and monitoring of a master plan; creation of planned townships, with related infrastructure; development control, including approval of plans for land use; jurisdiction over Gulshan Lake; presently completing Detailed Area Plans for Dhaka.

**Dhaka Water and Sewerage Authority:** Under Ministry of Local Government, Rural Development and Cooperatives: provision of pure, safe, and dependable water to Dhaka citizens (including Narayanganj); regular, safe, continuous disposal of sewage; operation and maintenance of drains for stormwater disposal; collection of fees for these services.

**Water Development Board:** Under Ministry of Water Resources and Flood Control: planning and implementation of water-related projects at the national level that involve infrastructure (direction and flow of water; mostly embankments and flood control); coordination of implementation of the National Water Management Plan (with WARPO).

**Ministry of Land:** Register of government title for land (through Department of Survey and Land Records), including river beds and contiguous land; through the Deputy Commissioners, leasing of these lands, and eviction, as necessary; administration of land compensation process for private lands.

**Department of Public Health Engineering:** Under Ministry of Local Government, Rural Development and Cooperatives: outside the DCC area, responsible for rural water supply; monitoring of water quality.

**Bangladesh Inland Water Transport Authority:** Under Ministry of Shipping: development, maintenance, and control of inland water transport and maintaining navigable waterways; involved in riverbank protection on the Buriganga and demolition of structures in river buffer zone; dredging, shipping terminal maintenance, and waste disposal at these facilities.

**Department of Shipping:** Under Ministry of Shipping: responsible for survey and certification of ships and boats in the river system (including seaworthiness and waste management).

**Ministry of Industry:** Overall policy direction for industrial development; a role in development of industry in specified zones and compliance with pollution control regulations in factory design.

97. In addition to DoE, there is a clear incentive for DWASA to be involved to a greater extent in the enforcement of environmental compliance, since DWASA bears the increasing costs of wastewater and drinking water treatment as a result of indiscriminate effluent disposal. Stricter enforcement of effluent standards would also help stimulate demand for alternative approaches to waste treatment that may reduce industry's operational costs and increase production efficiency, as well as bringing environmental benefits. In response to this demand, technical assistance for waste minimization initiatives could be provided as part of a broader program of compliance promotion.

#### *Building Support through Consultation, Transparency and Participation*

Even without additional enforcement activities, international experience has demonstrated the power of enhanced monitoring when the results are disclosed, and the environmental performance of individual facilities is publicly recognized. There is significant scope for DoE to adopt such an approach, focusing on priority sources of contamination, and applying “e-government” techniques to make the results of environmental monitoring and decision-making as transparent as possible. Increased transparency would also strengthen the role of community groups and NGOs in the organization of Dhaka environmental management initiatives. NGOs are already making valuable contributions to the improvement of the Dhaka environment, for example through trials with composting and slum improvement projects, and their participation must be welcomed and recognized to build the community support required for stronger regulatory action.

#### *Attracting the Resources Required*

98. The resources required to address Dhaka's environmental challenges will be significant, with estimates ranging up to US\$ 8 billion over 20 years.<sup>69</sup> Maintenance and expansion of the urban infrastructure has been neglected, and major overhauls are now required. Mobilizing resources of this scale will require private sector participation, in addition to the support of development partners. Attracting private investment, even more so than development assistance, will require institutional reform that provides strategic direction and clarity of roles, and supports the recovery of costs for urban services as well as the transparent enforcement of regulations.

### **V. Responses to Water Quality Issues in the Dhaka Area**

99. The deteriorating condition of the Buriganga River in the mid-1990s stimulated the “Save the Buriganga” movement, a collaboration of various Government agencies and NGOs. Most of the effort focused on public awareness, processions, monitoring of the Dhaka canal and river system, and destruction of buildings that encroached on the Buriganga River. More recently, the Prime Minister reactivated the River Committee, which reported in January, 2004, listing a series of proposals that deal with water supply, flow, and water quality (see Table 3.2).

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<sup>69</sup> BEMP, 2005a

**Table 3.2: River Committee Proposals for Water Resource Management in Dhaka**<sup>70</sup>

Proposal or Initiative	Status
Flood Retention Ponds in RAJUK Dhaka Structure Plan	Concept more or less defunct; many of the proposed flood retention ponds have been filled in; this concept is not being actively pursued by any GoB agency; RAJUK recently started work on Detailed Area Plans for Dhaka.
Eastern Embankment cum By-Pass Road (WDB and DWASA)	Included in the Prime Minister's River Committee Report (January, 2004), this was recently passed over by the Planning Commission; concerns about high cost, technical complications, and potential negative environment effects; has recently been re-activated because of the 2004 flood; undergoing technical feasibility analysis and environmental screening.
Augmentation of Flow in the Buriganga River, Circular Waterway Project (WDB and BIWTA)	These various initiatives included in the Prime Minister's River Committee Report; augmentation of flow still requires more analysis (potential problems with upstream water abstraction and negative environmental effects); circular waterways project partially completed (not fully funded, but a recent announcement of additional US\$ 10 million GoB funds for walkways and barriers); prevention of river encroachment has involved occasional demolition of structures on the Buriganga River.
Saidabad Water Treatment Plant (DWASA)	Funding for Phase 2 being sought (now being considered by DANIDA and SIDA); ongoing issue with ammonia contamination and excessive algae in water supply; DWASA favours moving the Sarulia intake up the Sitalakhya River (this is controversial); other options include an ammonia scrubber at Saidabad or an intake on the Meghna River ( a long-term solution).
North Dhaka Sewage Treatment Plants (DWASA)	Included in the Prime Minister's River Committee Report; DWASA has had difficulty securing financing; small "footprint" multi-storey sewage treatment plants (Bangkok model) promoted during recent consultations in Dhaka.
Upgrading the Pagla Sewage Treatment Plant; Extending the DWASA Sewage Network	Some of this work has been undertaken by DWASA, with JICA funding; however, stalled due to lack of full funding; infrastructure division at World Bank is actively considering this initiative.
Moving the Hazaribagh Tanneries to Savar (BSCIC)	Included in the Prime Minister's River Committee Report; BSCIC has purchased some land in Savar and 200 plots are being prepared, but the tannery industry is still lobbying GoB for financial subsidies to support the move, and proper environmental management facilities are not clearly documented; very high priority initiative.
Common Effluent Treatment Plants (CETP) for Industry (DoE)	Still only a concept; LGRD has asked for more technical details and cost analysis from the Bangladesh University of Engineering and Technology; could also be supported by a proposed constructed wetland near Norai Khal, for Tejgaon industries, and common reed beds for textile industry clusters; ongoing experimentation with waste minimization, settling ponds, and reed beds for the textile industry in Narsingdi, a collaboration of BEMP, DoE, and textile industry associations – this has produced positive results showing technical effectiveness and cost efficiencies; recent interest in combining CETPs with constructed wetlands in a "hybrid" system.
Dhaka Solid Waste Management (DCC)	Included in the Prime Minister's River Committee Report; JICA has been undertaking design work over the last year; Waste Concern has been experimenting with small composting facilities and is proposing larger-scale composting and methane recovery at Matuail; full funding still being sought.

100. Subsequently, the consultative process for the Dhaka Environment Programme (an initiative of MoEF) resulted in a portfolio of potential solutions to address water quality issues in Dhaka. The solutions were clustered according to key issues, summarized below, in order of priority (highest to lowest - see Appendix I for details):

<sup>70</sup> As of January, 2005, updated from BEMP, 2003

- improvement of water supply;
- treatment and disposal of sewage;
- treatment and disposal of industrial effluent;
- handling and disposal of solid waste;
- flood management, dredging, and improving river navigability;
- management of household liquid waste;
- management of ship oily waste;
- improving aesthetics and opportunities for recreation;
- controlling agricultural runoff.

*Investment and Institutional Strengthening for improved Water Supply and Sanitation Services*

101. The supply of safe water and treatment of sewage are the clear responsibility of DWASA and require major overhauls of infrastructure, as well as significant investment in new distribution and collection networks and treatment plants. DWASA is presently involved in discussions with a number of Development Partners, including the World Bank, to address these issues. In particular, GoB has requested assistance from the Bank to prepare a project to improve water supply, sewerage, sanitation and storm water drainage services in Dhaka. The sewerage and sanitation project plans, among other improvements, to rehabilitate the existing sewer systems, storm water drains and natural retention reservoirs, and build new storm water pumping stations in Dhaka. The main objective of the “Dhaka Sewerage” sub-component would be to rehabilitate existing trunk sewers and extend secondary and tertiary sewers to reach new customers so that the full capacity of the Pagla sewage treatment plant can be used.

102. DWASA is currently in discussions with development partners to finance an expansion to the Saidabad Water Treatment Plant, rehabilitation and improvement of services of the water supply distribution network, as well as urgently needed improvements to the sewerage network and the Pagla Sewerage Treatment Plant. DWASA and development partners are coordinating closely to ensure that overlaps are minimized and that no gaps occur in the needed investment to Dhaka's water supply, sewerage and drainage system. DWASA has already begun to implement a performance improvement program for the utility, which focuses on key operating and financial indicators to monitor improvement in DWASA's service in water supply, sewerage and drainage operations.

*Targeted Enforcement and Low-Cost Treatment Options to Control Industrial Effluent*

103. The remaining priority water quality challenge is treatment of industrial waste. Of the challenges noted above, this is the one that is most in the control of the private sector, and currently the least effectively handled by regulatory agencies. To date there has been little to no enforcement of environmental regulations, and as a result, industry pollutes the surface waters of Dhaka with impunity. To reduce the pollution of surface water bodies, both on-site and centralized treatment of industrial effluents are required. To reduce the pollution of groundwater bodies, a reduction of pollutants leached to the aquifer can be achieved by on-

site treatment in combination with improved conveyance of effluents to a centralized treatment facility.

104. The Government has requested assistance from the Bank to reduce the pollution of water bodies by industrial effluent. The proposed integrated environment and water management project will invest in treatment options for industrial effluent, and will also build appropriate capacity for improved monitoring of pollution and the more efficient enforcement of environmental compliance. As the main agency responsible for water quality and water treatment in Dhaka, DWASA is likely to be the principal implementing agency for this project, while DoE will be involved in all components, especially those related to environmental monitoring and compliance.

105. The main industry clusters and effluent “hotspots” include the tanneries at Hazaribagh which pollute the Buriganga River, the Tejgaon Industrial Area which drains to the Balu River, the Tongi Industrial Area which pollutes Tongi Khal, the Sayampur and Fatullah industrial clusters in Dhaka South and Narayanganj which discharge to the Buriganga River, and the developing heavy industry strip along the Sitalakhya River. A comprehensive strategy to bring industrial effluent under control at the industrial sites would include at least the following four elements:

- Tighter control on new industrial development in the center of the city, through more effective application of the EIA system. Credible use of the EIA approval process to require investment in adequate on-site or shared effluent treatment facilities would reduce the attraction of land-scarce city center locations for new developments, and would have the effect of encouraging the development of industrial zones outside the city that can properly service all industrial waste.
- In addition to controlling new development, the EIA system could also be used much more effectively to manage effluent from existing facilities. Under the Environmental Conservation Rules (1997), industries in the Orange and Red Categories are required to renew their Environmental Clearance Certificates annually. Although little used at present, this requirement offers a clear opportunity for the DoE to agree on compliance plans with priority polluting facilities, which if combined with an enhanced program of environmental monitoring and regulatory action, would gradually increase pressure to reduce contamination.
- The development of compliance plans linked to annual renewals of Environmental Clearance Certificates would also stimulate demand for technical assistance for waste minimization. Such assistance, potentially drawing on the ISO 14001 model of environmental management systems, could be offered by the DoE as a component of the compliance planning process. The added advantage of the introduction of environmental management systems is that it provides businesses with a tool to optimize production processes whilst reducing waste and improving the efficiency of energy use.
- Development of shared waste treatment facilities. In planning such investments, two key principles should be adhered to: (i) maximize the involvement, both financial and technical, of the industries whose effluent the facilities are intended to handle; and (ii) minimize the capital and recurrent costs involved. In particular, it should be clear

that the operating and maintenance costs of waste treatment will be borne by those generating effluent, based on a per unit volume charge.

106. A reduction in the discharge of effluents to vulnerable surface water bodies can be achieved through appropriate treatment trains of primary, secondary and tertiary treatment technologies, including wastewater stabilization and retention ponds, as well as constructed wetlands. Due to the high pollutant load of the effluents, a single treatment option will not achieve the desired effluent quality; consequently, a successful treatment strategy is likely to consist of a combination of appropriate treatment technologies.

107. Constructed wetlands in combination with primary and secondary treatment, such as waste stabilization ponds, offer one possible approach to minimize the capital and recurrent costs of treating industrial effluent. International experience has demonstrated the effectiveness of using reed beds to strip contaminants from a variety of waste streams, and recent positive data from reed bed experiments in Narsingdi<sup>71</sup> have stimulated interest in pilot implementation of constructed wetlands in the Dhaka area. Results from the Narsingdi pilot indicate that constructing and operating a settling tank and reed bed wastewater treatment system, excluding the cost of land, increases the annual operating costs of small and medium-sized textile factories by only 0.5%. Amortized over ten years, the purchase of land required for a reed bed could increase annual operating costs of textile factories by a further 2%. In comparison, the costs of mechanical and chemical waste effluent treatment systems are up to 5% of the annual operating costs of larger textile factories.

108. Assessment of the feasibility of a constructed wetland initiative in Dhaka will require consideration of the land cost, the practicality of acquiring sufficient land and protecting it from future encroachment, the construction and operational costs, and determination of the potential decrease in pollution load and the associated benefits. These results could then be compared to more conventional wastewater management methods involving mechanical and chemical treatment, which require less land, but have higher construction and operational costs. A potentially important consideration will be whether the wetland area required can serve a dual purpose, for example as a pump pond or storm water buffer. One possible approach is the construction of “hybrid” systems that combine the positive elements of the wetland and mechanical options. These might handle the wide variability of contaminants in the surface drainage in specific Dhaka sub-drainage basins, such as Tejgaon, by combining a common effluent treatment plant for settling of solids and associated contaminants, and a constructed wetland for stripping dissolved contaminants from surface drainage.

109. An initial assessment of opportunities for application of the constructed wetlands approach to managing industrial effluent suggests that it would be worth conducting feasibility studies for the following four locations:

- isolation of wastewater from Tejgaon, and use of a series of linked settling ponds and constructed wetlands (total area of about 20-30 hectares) running between Rampura and the Balu River to strip contaminants (especially ammonia) from water (land availability still to be determined);

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<sup>71</sup> BEMP, 2005b

- application of a small (2-4 hectare) constructed wetland for treatment of waste from a textile industry cluster (5-8 factories) in the Fatullah area (suitable land appears to be available);
- experimentation with settling ponds and constructed wetlands to clean polluted surface drainage in the Goran Chatbari pump ponds on the Turag River (276 hectares of land/pond owned by BWDB are available); and
- development of in-plant waste minimization and common reed beds for small clusters of industries along the Dhaka-Tangail Road (Dhaka District); this area has been surveyed by Waste Concern, providing a good baseline for design and implementation of innovative wastewater management schemes; apparently land acquisition would not be a significant problem.

## **V. Water Quality in Dhaka: Recommendations and Areas for World Bank Support**

### *Strategic Framework for Management of Dhaka's Water Resources*

110. Interventions to improve the quality of surface and groundwater in Dhaka need to fit within a integrated long-term strategy addressing water quality, water supply, sanitation, and flood management. To achieve this goal, a single statutory body should be formed to promote cross-sectoral coordination and minimize jurisdictional conflicts. An important element of the strategic framework will be adequate monitoring of environmental pollution, in combination with public information, aimed at raising awareness of the causes and impacts of environmental degradation, and at disseminating information about related interventions. Such initiatives are essential to build civil society and private sector support, both for the necessary investments, and for strengthened enforcement of environmental regulations.

### *Compliance Promotion*

111. Industrial discharges into rivers, canals and groundwater must be reduced if water quality is to be improved. This will require stricter enforcement of environmental clearance conditions and effluent standards, focusing on priority sources of contamination. Compliance plans for existing priority facilities should be agreed through application of the requirement that they renew their Environmental Clearance Certificates annually. Tighter control on new industrial development in the center of the city must be applied through more effective use of the EIA system. To achieve tighter regulatory control it will be necessary to re-examine the institutional incentives for DoE staff, based on a consideration of performance indicators, transparency and accountability, and to better define the linkages between the regulatory roles of DoE and DWASA, as the principle agency responsible for water quality in the Dhaka watershed.

112. In addition to direct regulatory control, international experience underlines the value of providing the public with specific information on sources of pollution, including the identities and performance of the principal actors involved. There is significant scope for DoE to adopt such an approach, focusing on priority sources of contamination, and making the results of environmental monitoring and decision-making as transparent as possible. Heightened public pressure, combined with stricter enforcement of effluent standards, will help stimulate demand for alternative approaches to waste treatment and reduction. In response, technical assistance for waste minimization initiatives, including the development

of environmental management systems based on the ISO 14000 model, could be provided through DoE as part of a broader program of compliance promotion.

113. A number of mechanisms exist or are proposed through which the World Bank could support compliance promotion initiatives in Dhaka. In addition to budget support for the DoE through the ongoing program of development policy lending, proposed projects for private sector development and water resource management in Dhaka could include components to provide the DoE and DWASA with technical assistance for the initiatives described above.

#### *Investing in Waste Treatment*

114. The World Bank's Country Water Resources Assistance Strategy for Bangladesh<sup>72</sup> establishes that improving the quality of surface and groundwater in and around Dhaka will require significant investment in effluent collection and treatment. In response to the Government's request, the Bank is helping prepare a project to improve water supply, sewerage, sanitation and storm water drainage services in Dhaka. Bank assistance for a separate project was requested by the Government, to strengthen the management of environmental quality and water resources through investments in appropriate treatment technologies, including non-conventional solutions, such as septic tank effluent systems and constructed wetlands.

115. In addition to Government investment and the support of development partners, mobilizing sufficient resources to effectively address Dhaka's environmental challenges will require private sector participation. Improved compliance with environmental legislation, combined with application of the Polluter Pays Principle, will stimulate demand for private investment, for example in shared waste treatment facilities. Establishing and maintaining the conditions necessary to attract private resources will require the continued transparent enforcement of regulations, combined with institutional reforms that provide strategic direction and clarity of roles, and that support the recovery of costs for urban services.

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<sup>72</sup> World Bank, 2005b