SUMMARY PROJECT CLIMATE AND DISASTER RISK ASSESSMENT AND MANAGEMENT REPORT

I. Basic Project Information

Project Title: West Bengal Drinking Water Sector Improvement Project
Project Budget: Regular loan of $240 million from ADB's ordinary capital resources. Grant of $3 million from Japan Fund Poverty Reduction. Government of West Bengal contribution is $106 million. In addition, a transaction technical assistance grant of $2 million from the Urban Climate Change Resilience Trust Fund, administered by ADB.
Location: West Bengal, India. Selected arsenic, fluoride, and salinity-affected areas in the districts of Bankura, North 24 Parganas (including a neighboring block in South 24 Parganas) and Purba Medinipur.
Sector: Water supply infrastructure and services.
Theme: Environmentally sustainable growth

Brief Description: The proposed West Bengal Drinking Water Sector Improvement Project aims to provide continuous potable water as per the Government of India's standards to about 1.65 million people in the arsenic, fluoride, and salinity-affected areas of Bankura, North 24 Parganas (including a neighboring block in South 24 Parganas), and Purba Medinipur districts of West Bengal. The impact of the project will be drinking water security ensured in West Bengal.[a] The outcome will be safe, sustainable, and inclusive drinking water service delivered in project districts. The project outputs are:

Output 1: Climate resilient drinking water infrastructure constructed. The project will provide a minimum of 70 liters per capita per day (lpcd), continuous potable water through metered connections to the households in the project areas. The distribution systems will be designed on a district metering area basis. Both the bulk and the distribution systems will be integrated with modern smart water management and monitoring tools, including supervisory control and data acquisition and geographic information system. Bulk water supply systems, consisting of intakes, water treatment plants, and transmission mains, will be interconnected into a grid where feasible to improve the redundancy and resilience of the system.[b]

Output 2: Institutions and capacity of stakeholders for drinking water service delivery strengthened. The project will strengthen the institutional capacity of Public Health Engineering Department (PHED) and the project *gram panchayats* for efficient and sustainable drinking water service delivery. It will support and enable them to operate the smart water management, including geographic information system and web-based water quantity and quality monitoring, electronic billing and collections, meter reading, and accounting.[c] The project will improve skills, build the capacities of the stakeholders, and generate employment for about 350 people at the local level, of whom a minimum of 33% will be females. It will strengthen the sector through introducing and implementing, institutionalizing water and sanitation safety planning, developing a regulatory framework for and piloting fecal sludge and septage management, and supporting public awareness on water, sanitation, and hygiene.[d]

II. Summary of Climate Risk Screening and Assessment

A. Sensitivity of project component(s) to climate/weather conditions and sea level – HIGH

Higher temperatures, shifting rainfall patterns, and rising sea levels are affecting the hydrological balance. These intensify water shortages and cause flooding and erosion, which, in turn, threaten drinking water supplies, harvests, and production. Water infrastructure and services are likely to be affected if not properly sited, designed, and managed.

1. Raw water intake systems; 2. Raw water transmission mains and pumps; 3. Water treatment plants; 4. Potable water transmission mains and pumps; 5. Potable water reservoirs and	**1) Temperature rise** may lead to (i) reduced efficiency of raw water intake structures and water availability through the year due to enhanced evaporation losses affecting the level of rivers and reservoirs; (ii) deteriorated water quality due to increasing biological activity in reservoirs affecting water treatment plant (WTP) capacity, efficiency, and cost; (iii) reduced efficiency of mechanical and electrical equipment due to the upper limit of the temperature range being exceeded; and (iv) reduced capacity utilization of existing infrastructure (e.g., pumps, pipes, storage, and treatment facilities) due to lower water availability. **2) Decreased annual average rainfall and erratic distribution in time and space** may result in (i) reduced raw water availability through the year and capacity utilization of existing infrastructure; (ii) unavailable raw water during

<table>
<tr><td>overhead tanks (groundwater level reservoir);
6. Potable water distribution network;
7. Household connections; and
8. Frequency of maintenance.</td><td>droughts; and (iii) raw water quality deterioration in reservoirs (reduced dilution) leading to increased treatment requirement costs.

3) Higher frequency and intensity of cyclones and other heavy rainfall events may lead to (i) higher and more frequent damage to infrastructure (intakes, WTPs, reservoirs, tanks) and equipment (pumps, electronic system) requiring higher maintenance cost; and (ii) more frequent disruptions of water supply services due to flooding caused by intense rainfall and storm surges.

4) Sea level rise could (i) deteriorate raw water quality due to saline intrusion, affecting freshwater availability and WTP efficiency; and (ii) inundate infrastructure close to coastal areas (such as intakes or WTPs).</td></tr>
<tr><td colspan="2">B. Climate Risk Screening:</td></tr>
<tr><td>Risk topic
1. Earthquakes and induced landslides
2. Floods and/or extreme rainfall events
3. Drought
4. Wind and cyclone, including storm surges
5. Projected temperature change
6. Projected precipitation changes (seasonal)
7. Projected cyclonic storms and storm surges
8. Sea level rise</td><td>Description of the risk
1. North 24 (including one block in South 24 Parganas) are under zone IV – Medium to High;
Bankura and Purba Medinipur are under zone III – Low to Medium
2. North 24 (including one block in South 24 Parganas) – Low to Medium;
Bankura and Purba Medinipur – High
3. North 24 (including one block in South 24 Parganas) – High;
Bankura and Purba Medinipur – Low
4. All project districts – High
5. All project districts – High
6. High. Variability in the projected rainfall changes in West Bengal. Monsoon rains — June to September—generally decrease or remain unchanged for the most part, but increases are projected over the southern part that includes South 24 Parganas in the winter months (Jan–Feb), generally decreasing in all areas. In the summer months (Mar–May), decreasing northwards, including Bankura and North 24 Parganas, but increasing in the south, including South 24 Parganas
7. Low. From modeling results, there is a decreasing trend of exposure to cyclonic storms due to decreasing frequency for most of the year, including storm surges.
8. Low to medium</td></tr>
<tr><td colspan="2">Climate Risk Classification MEDIUM TO HIGH</td></tr>
<tr><td colspan="2">C. Climate risk assessment

A detailed climate risk and vulnerability assessment (CRVA) was carried out for the project. The detailed CRVA for the project is available on request and is publicly disclosed on PHED‘s project website at http://wbphed.gov.in/information/wb-drinking-water-sector/.

Climate Change Scenarios. The study reviewed climate change prediction methodologies used for other similar projects in West Bengal and considered their application to the project. As specified in the West Bengal State Action Plan for Climate Change, projections for 2050 and 2100 have been derived from PRECIS (Providing Regional Climate for Impact Studies), which is a portable version of the HadRM3 model, developed to run on a PC with a grid resolution of 0.44° x 0.44°. PRECIS simulation dataset is provided by the Indian Institute of Tropical Meteorology, Pune. Climate change scenarios are driven by the Green House Gas emission scenarios, A1B in this case, prescribed by the climate modelling tools of Intergovernmental Panel on Climate Change (see http://www.ipcc.ch/ipccreports/sres/emission/index.php?idp=3). This scenario assumes a future world of rapid economic growth, global population peaking mid-century and declining after that, and rapid introduction of new and efficient technologies. Change in mid-century (2021–2050) and end of the century (2071–2098) have been derived with reference to the baseline (recorded average from 1961 to 1990).

Projections
Temperature. Average daily maximum and minimum temperatures by the 2050s are projected to rise by 2.2°C. By 2100, temperatures are likely to rise by 3.6°C to greater than 5°C with reference to baseline levels (recorded average from 1960 to 1990).</td></tr>
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Rainfall. Projections for the 2050s indicate no change in monsoon rainfall (June–September) for the entire state, except for an increase in southern Sundarbans region of the South 24 Parganas and the eastern part of Purulia. However, in winter (October–December), rainfall decreases in most parts of southern Bengal within no change in eastern parts of Cooch Behar, Jalpaiguri (hill zone) and Purulia. A marginal increase in rainfall is projected for the northern tip of Darjeeling during the same period. Projections for January and February show an overall decrease in rainfall in the entire state with no change in the Sundarbans. In summer, rainfall is likely to decrease northwards starting from Bankura, Burdwan, and Purulia with no change in Howrah, Hooghly, North 24 Parganas and Paschim Medinipur, and an increase in summer rainfall in South 24 Parganas and Uttar Medinipur. Projections for the end of the century (2100) indicate that rainfall will increase over the entire state, except in January–February when rainfall is likely to decrease in the entire alluvial region from Dakshin Dinajpur in the north to Bankura, Howrah, Kolkata, and the northern parts of Paschim Dinajpur and North 24 Parganas in the south.

Sea Level Rise. Model-based projections of global average sea level rise at the end of the 21st century (2090–2099) made for a number of climate scenarios indicate that the sea globally may rise from a minimum of 0.21 meter (m) to a maximum of 0.48 m by the end of the century at the rate of 0.4 millimeters per year (mm/yr) in the A1B scenario.[e] In the absence of availability of regional projections, global projections can be used as a first approximation of sea-level rise along the Indian coast in the next few decades as well as towards the end of the century. As noted in the West Bengal Climate Change State Action Plan, the average sea level rise has been 1.3 mm per year along the Indian coast.[f] However, tide gauge observations at the Diamond Harbor port in South 24 Parganas district of West Bengal indicate a sea level rise of 5.7 mm, which can be attributed to subsidence in the region at the rate of 4mm per year. While the sea level rise numbers may not directly impact inland subproject areas, the effect of average sea level rise coupled with subsidence and storm surge conditions can result in adverse effects inland along tidally influenced waterways during extreme weather events.

Cyclones. Cyclonic storm tracks seem to shift more southwards over the Indian Subcontinent with very few hits along the West Bengal coast. Overall, the frequency of cyclones hitting the Indian coast appears to decrease in the future. However, projections for the end of the century scenario indicate that the number of cyclonic events during the post-monsoon period may increase by around 10 to 15 cyclonic events per year compared with the 1970s (footnote f).

Storm surges. For the two stations considered in the head bay, namely, Sagar Island and Kolkata, increase in 100-year return levels of storm surges for the future scenario were found to be less than 5 % (footnote e).

Water availability. Based on the projected changes expected in rainfall (marginal increase or no change) and temperature (relatively significant increase) over West Bengal (specifically southern districts) during the 21st century under the A1B scenario, the results point to a high sensitivity in the availability of adequate water sources, specifically during the non-monsoon period. Research has indicated that 1 degree increase in temperature can increase the moisture absorption capacity of the atmosphere by about 7%, which could proportionately increase by evaporation from water bodies (i.e., reservoirs, lakes, and rivers) and transpiration from land.[g] Increased evapotranspiration has also been attributed to impact the natural water cycle affecting rainfall patterns.

Climate risk assessment. A climate risk assessment was carried out for subprojects and the climate change risk was identified as **medium to high** based on (i) a high risk of temperature increase, precipitation variability, droughts (in North 24 and South 24 Parganas), cyclonic storms and storm surges (in North 24 and South 24 Parganas), and floods and extreme rainfalls (in Bankura and Purba Medinipur); (ii) a low risk of cyclonic storms and storm surges, drought (in Purba Medinipur), flood (North 24 and South 24 Parganas), and sea level rise.

Key impacts on project performance

1. **Raw water availability.** Decreasing annual rainfall and rainfall patterns coupled with increasing temperatures, which lead to higher evapotranspiration and water demand (e.g., from agriculture), are likely to decrease raw water availability in groundwater and rivers. Project performance will be very poor if raw intake and extraction is from unsustainable sources. Project design needs to integrate water conservation and grid-based redundancy measures.
2. **Water quality**. Higher temperature, lower precipitation, and saline instruction due to sea level rise may lead to deterioration of water quality in certain water bodies, making them less suitable or unsustainable

for raw water supply. This may lead to increased operational cost and lower WTP treatment capacity if improper sources are utilized.

3. **Water supply infrastructure and equipment design.** Potential increases in flood intensity and duration have implications for water supply infrastructure standards and specifications and increases in maintenance frequency and costs.

III. Climate Risk Management Response within the Project

Redesigning preliminary design of the project to make it climate resilient. The initial project proposal from PHED incorporated small groundwater-based schemes without household connections and no nonrevenue water controls.

The project was redesigned through extensive discussions over more than a year with support from the project preparatory team and consultation with ADB and senior government officers, to make the proposed subprojects climate resilient by taking the following critical steps:

(i) exclusively tapping sustainable surface and subsurface-based sources;
(ii) designing the systems based on a comprehensive district water quality action plans for the entire district;
(iii) adopting a grid-based system where feasible to increase system redundancy and resilience to water shortages;
(iv) designing the distribution systems on a district metering area basis to reduce non-revenue water;
(v) providing household connections with smart water management devices, for smart response to changing water availability; and
(vi) raising awareness and promoting demand management and water conservation among project beneficiaries.

The CRVA then assessed any associated potential risks of climate change impacts and vulnerability of the revised preliminary design of the project to ensure that the project components incorporated necessary climate resilience and mitigation measures in the preliminary, detailed design, and implementation stages of the project. These measures and details of additional mitigation and adaptation measures proposed for consideration by the design–build contractor or design consultants during the detailed design phase are identified, described, and costed in the CRVA (available on the project website, and to be included in all bid documents contracts of civil works under the project).

‘Climate financing’ includes the amount pertaining to a resilient system formulated under the project that is over and above the initially proposed and conventional piped water supply system (the business as usual case). The objective of the resilient system is to ensure migration of the target beneficiaries from a baseline or presently sub-optimal system of water supply, which relies on groundwater-based localized sources. A cost comparison of current baseline (sub-optimal) scenario of water supply based on localized groundwater sources is made with the proposed resilient system of water supply as described above. This comparison is to estimate the increment climate resilient financing that is required to achieve the desired climate resilient outcome and outputs. The representative cost of the resilient system comprises the following components of each subproject package: (i) cost of civil works; (ii) cost of equipment, vehicles, and furniture; and (iii) cost of land acquisition for locating WTP, clear water reservoirs and/or booster stations.

[a] Government of West Bengal. Public Health Engineering Department. 2011. Vision Plan 2020, Kolkata; Government of India. Ministry of Drinking Water and Sanitation. 2016, *National Sub-Mission for Arsenic and Fluoride Removal*. Delhi.
[b] The bulk systems are sized to provide water supply to the urban or rural habitations to neighboring areas in future.
[c] Project Smart Water Management is detailed in a supplementary linked document in Appendix 2.
[d] ADB has partnered with the World Health Organization (WHO) to jointly support the government in preparing the water safety plan and sanitation safety plan guidelines for the state, and capacity building for their implementation.
[e] Government of West Bengal. 2012. West Bengal State Action Plan on Climate Change. India.
[f] Government of India, Ministry of Environment & Forests, Indian Network for Climate Change Assessment. 2010. *Climate Change and India – A 4x4 Assessment: A Sectoral and Regional Analysis for 2030s.* India.
[g] Kevin E Trenberth. 2007. The Impact of Climate Change and Variability on Heavy Precipitation, Floods and Droughts. In United States National Centre for Atmospheric Research, National Science Foundation, Boulder, Colorado, USA: *Encyclopedia of Hydrological Sciences.*

Source: Asian Development Bank.