# PROJECT CLIMATE RISK ASSESSMENT AND MANAGEMENT

## I. Basic Project Information

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| **Project Title:** Phuentsholing Township Development Project |
| **Project Budget:** $63 million |
| **Location:** Phuentsholing, Bhutan |
| **Sector:** Agriculture, natural resources and rural development; and Water and Other Urban Infrastructure and Services |
| **Theme:** Disaster risk reduction and urban development |
| **Brief Description:**<br>The Amochhu Land Development and Township Project (ALDTP) will ultimately develop 460 hectares of riparian land near the city of Phuentsholing, which is located adjacent to the Amochhu River on Bhutan's southwestern border with India. It will (i) provide protection for the new town from floods and erosion, and construct smart urban infrastructure to allow phased urban expansion; and (ii) protect the existing town from floods and riverbank erosion which currently threatens lives and livelihoods and disrupts connectivity with nearby communities. ALDTP is divided into five development Zones A to E that the government will implement in a phased approach.<br><br>The Phuentsholing Township Development Project (PTDP) will finance the development of only Zone A as the first phase, which comprises developing about 66 ha of land immediately adjacent to existing Phuentsholing along the left-bank of the Amochhu River. The project will construct about 4 kilometers of robust river walls to provide protection from floods and erosion to the existing municipality and new urban areas. Behind the new river walls, it will raise ground levels to above the 100-year flood levels, and install common urban infrastructure comprising water supply, sewerage and roads to the new plots of land. The new urban area will accommodate up to 15,000 residents. |

## II. Summary of Climate Risk Screening and Assessment

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

The river training and embankment protection works to be constructed along the banks of the Amochhu will be exposed to floods up to, and exceeding, the design flood of 7,100 $m^3/s$ (1 in 100 AEP, excluding climate change). The Amochhu has a large catchment area with no natural or man-made storage in the catchment to attenuate flooding. Changes in precipitation with higher intensity storm events may result in higher run-off and more severe flood discharge for a given frequency, as well as the associated velocity attack leading to erosion/scour which could ultimately lead to structural failure of the diaphragm wall and protection works, exposing the land reclamation to erosion and flooding. The cross drainage works will be sensitive to the predicted increase in frequency and intensity of precipitation, which will result in more severe floods. They are also sensitive to sediment and debris flows resulting from landslides. Sea-level rise will not be a major issue as the project is not located in a low-lying coastal area.

| *Project component* | *Sensitivity to climate/weather conditions and sea level* |
|---|---|
| 1. River training, embankment protection, land filling, cross drainage and slope stabilization<br>2. Bulk water supply and distribution<br>3. Wastewater collection and treatment<br>4. Storm water drainage<br>5. Road network<br>6. Solid waste management | 1. Frequency and intensity of heavy rainfall events<br>2. Not very sensitive as the demand is small<br>3. Not very sensitive<br>4. Flooding and damage from heavy rainfall events<br>5. Frequency and intensity of heavy rainfall events<br>6. Not very sensitive |

**B. Climate Risk Screening**[1]

| Risk topic | Description of the risk |
|---|---|
| 1. Precipitation increase<br>2. Flood<br>3. Landslide | 1. Precipitation increase may result in an increase in flood frequency and intensity, and therefore impact on river and drainage infrastructure.<br>2. Increased frequency and intensity of flood events may increase erosion and siltation of water courses, landslide events, surface flooding (pluvial) and damage to drainage systems.<br>3. An increase in landslide activity may increase sediment generation and debris flows, leading to conveyance issues for the cross drainage facilities. |

[1] Screening is based on AWARE assessment.

Climate Risk Classification: High.

**C. Climate risk assessment**

The SASEC Rd climate change study[2] identified trends in mean annual and seasonal (monsoon/wet and winter/dry) temperature of ~ $3.5^0$C and ~ $3^0$C respectively over the period 1980 to 2069, and an increase of up to 30% (600 mm/year) in annual precipitation over the same period. It also identified seasonal differences with an increase in monsoonal mean total precipitation up to 34% (~450 mm/year) over the same period. Key climate change risks include (i) increased frequency and intensity of flood events, and (ii) increased frequency and intensity of precipitation events leading to frequent landslides.

## III. Climate Risk Management Response within the Project

The investment will help better cope with climate variability and change through:

1. *Material specifications.* High strength/durable concrete mix and increased reinforcement cover will be specified on areas of the river training structures which are exposed to abrasion and erosive forces (e.g. the cast in-situ wall on the outside of the bend in Zone A). Specify riprap size and grading appropriate for the anticipated hydraulic conditions.
2. *Material specifications*. Specify riprap size and grading appropriate for the anticipated hydraulic conditions.
3. *Dimension and capacity standards.* Designs of planned infrastructure (river training works, cross drainage and storm water system) will allow for climate change, including effects of potential increase in flood event magnitudes. A climate change allowance has been estimated for both the Amochhu river and tributaries.
4. *Dimension and capacity standards* – Specify an appropriate freeboard between the estimated flood level for the design event and the top of the embankments / finished levels in land reclamation areas.
5. *Protective engineering structures.* Adequately sized debris dams will be specified on the tributary catchments that feed the cross drainage facilities.
6. *Protective engineering structures*. Provide scour counter measures for cross drainage facilities and for river training works to protect foundations.
7. *Flood management*. Improve catchment and river basin management to achieve better capacity, planning and monitoring to reduce flood risk. Improve meteorological and hydrological data collection in the catchment to improve the database used for making decisions.
8. *Infrastructure operation and maintenance planning.* Implement regular and detailed monitoring of channels and structures, particularly prior to and during the monsoon season when flood risk is highest. Vigilant management of sediment deposition is vital to maintain conveyance capacity of the natural and engineered channels.
9. *Master planning and land use management.* Development within the project area will avoid geologically unstable areas and flood prone areas.
10. *Training/capacity building.* Provide training for implementing agency maintenance personnel related to climate change impacts, use of climate information, weather forecasting and early warning systems.
11. *Information systems.* Installation of a flood early warning system and operate it in accordance with a flood management plan that will be prepared under the project. Phuentsholing does not have an existing operational flood management plan.

[2] ADB. 2016. *Initial Environmental Examination, BHU: SASEC Transport, Trade Facilitation and Logistics Project*. Manila. This document was prepared by the Department of Roads for ADB, Project Number: 47284-002, May 2016. The SASEC climate change study is predominantly based on the findings of Singh B. 2011. *Vulnerability and Adaptation Assessment, Volume 1: Technical Paper*. Thimphu, which was prepared for the National Environment Commission, Government of Bhutan, Second National Communication from Bhutan to the United Nations Framework Convention on Climate Change, September 2011.