

Supplementary Appendix Climate Change: Project Adaptation Action (PAA) Report

Part 1: Climate Change Adaptation

BASIC PROJECT INFORMATION	
Project Title: 46417-001 IND: Jaipur Metro Rail Line 1- Phase B Project	Sector: Transport and ICT
Location: Walled City of Jaipur, Rajasthan, India	Estimated ADB Financing: \$176 million
Brief Description:	Implementation Period: Jan 2014-Mar 2018
<p>The project is to build an underground rail infrastructure of 2.3 kilometers and 2 stations, including alignment and formation of tunnel, standard gauge permanent way, traction system, signal and train control, telecommunication, automatic fare collection, ventilation and air conditioning, lifts, ramps, and escalators, public announcement system, and security infrastructure. The rail level at midsection in tunneling portion shall be kept at least 12.0 m below the ground to maintain a cover of at least 6m available over the tunnel. At stations, the desirable depth of rail below ground level is 12.5m.</p>	
Climate Change Classification: Adaptation – medium; Mitigation - high	
SUMMARY of CLIMATE RISK SCREENING	
<i>A. Projected changes under A2 scenario</i>	
Precipitation (mm)	
From: Jaipur City receives about 650 mm of rainfall annually, and more than 50% fall within August and September (Monsoon).	
To: Annual precipitation is projected to increase by 200mm (2050s -A2A -Ensemble). Projected scenario does not seem to indicate any significant change in seasonality, although precipitation during the monsoon season is projected to increase by about 2%.	
<i>B. Climate Risks</i>	
<ol style="list-style-type: none"> 1. Flood 2. Landslides due to precipitation 3. Drought 4. others 	<p>Description of the risk:</p> <p>The project was classified as Category B (low to medium) in terms of climate risk and found no risk for earthquake, landslide triggered by earthquake, and fire, and low to medium risk for flooding, and landslide triggered by precipitation. The screening noted that precipitation is low at 650 mm/year on an average. This coupled with flat terrain results in low risk of landslide. However, the projected increase in precipitation by 2050s may magnify the risk of flooding, and hence should be addressed.</p>
<i>C. Recommendations</i>	
<p>Activities:</p> <ol style="list-style-type: none"> 1. Both current and future risks of urban flash floods as well as the adequacy of the existing drainage and stormwater collection systems within the area of the underground portion need to be assessed. 2. The Environmental Impact Assessment (EIA) should contain a chapter that is specifically devoted to climate risk assessment. 	<p>Requirements for TOR:</p> <ol style="list-style-type: none"> 1. Review and propose improvements to the tunnels flood water handling and management capabilities 2. Draft EIA containing a chapter on climate risk assessment
Risk Classification: Low	

DUE DILIGENCE

Activities:

1. Review of tunnel design focusing on drainage and impermeability to water seepage and found adequate.
2. Review of hydro-geologic study to compare tunnel and groundwater depths and established an average separation of about 5 meters below the tunnel floor.
3. EIA includes a chapter on Climate risk screening and mitigation

PROJECT DESIGN CHANGE OR ADAPTATION RESPONSE

The following engineering designs have been incorporated in the project to address the risk of flooding:

- Seepage pump and pump rooms for each underground cut-and-cover stations including waterproofing with concrete admixtures for base slabs to station boxes, watertight diaphragm walls, waterproofing membranes for roof slabs, water stops at construction joints, and fillers at expansion joints
- Waterproofing of bored tunnels including gaskets for segmental lining in order to minimize any groundwater leakage
- Drainage pipes along the tunnel and sump pumps located at every low point within each running tunnel