4.4 Water Management

Indicator 1: Water Resources Management

Rationale: Climate change is expected to impact the water resources and subsequently the water availability. It is, therefore, important to take stock of the water availability and demand equation and in the context of climate change so that adequate action can be taken if required.

Description: This indicator is to assess whether the city is on course to meet the future water demand. The indicator requires an assessment of both current and future water availability; and corresponding current and future water demand. Given that many cities depend significantly on ground water resources to augment piped water supply, it is expected that both surface and groundwater assessments would have been conducted.

Methodology: The water resource assessment should look at both surface and groundwater, wherever required, and quantify both availability and demand using scientific techniques. Various sectors for water allocation are domestic, Industrial and agriculture. The city preparing a new water resource management plan shall include the climate change factors.

Formula: NA

Unit: NA

Maximum Score: Total score for the indicator is 100. Cities will be marked in 5 levels with scores ranging from 0 to 100. In this indicator the level 4 and 5 have been merged taking into consideration the actions initiated, actions implemented and WRM plan revised based on climate change factors. Cities will be marked based on the evidence provided for actions initiated and implemented from 1 – 15 marks each, and up to 20 marks for providing evidence for revised WRM plan considering climate change factors. Any city scoring above 50 and 75 marks in total will be in level 4 and 5 respectively.

Performance Evaluation Levels:
Table 4.17: Water Resource Management

	1	2	3	4/5
Progression Levels	No water resource assessment has been carried out	Assessment of current water resources along with future demand and water availability for at least five years	Water Resource Management (WRM) Plan is prepared with Short, Medium- and Long-Term Actions	Actions for Water Resource Management
Evidence/ Data sources		• A Report/study that indicates stock of existing water resources with projections, its uses for various sectors; projected future water demand water availability and water quality for at least five years. The Report/study shall include: • Main water resources of the city including ground water / surface water • Quantum of water available at source • Details of water allocation for domestic, industry and agriculture purposes • Water quality test report at source and after treatment. • Map of major (catering to 5% of more of the city's water needs) ground & surface water sources as .kml file (additional evidence) * Report/study older than 5 years will not be considered	• A Report/ study/ plan that estimates future water availability. The Report/study/plan shall include: • Demand management Plan for best utilization of available water resources • Augmentation of existing water resource through recharge, rejuvenation and storage (includes rain-water harvesting) * Report / study older than 5 years will not be considered	• Actions initiated for execution of works specified in the water resource management plan • The city has reviewed and revised the Water resource Management Plan to include climate change factors.
Responsible Department/ Agency	ULB/ Water Utility/Water Boards/Flood and Irrigation Department / Ground Water Department / Industries Department/ Industrial Corporations / Any SPV and or any other relevant implementation agency, IMD.			
Reference	Technical Material for Water Resources Assessment, World Meteorological Organization (2012) http://www.wmo.int/pages/prog/hwrp/publications/Technical_report_series/1095_en_4_Web.pdf Strengthening Water Security in Asia and the Pacific, Asian Water Development Outlook, ADB (2016) https://www.adb.org/sites/default/files/publication/189411/awdo-2016.pdf			
Score	0	25	50	100

Indicator 2: Extent of Non-Revenue Water

Rationale: Reducing Non-Revenue Water (NRW) is a powerful demand management instrument, which decreases the stress on existing water resources. Given that climate change is expected to create an additional pressure on the existing water resources, reducing NRW is considered as a robust climate smart solution. Reduction in NRW will enhance resilience by reducing both the water losses as well as demand for electricity required for pumping, thereby mitigating GHG emissions.

Description: This indicator highlights the extent of water produced which does not earn the utility any revenue. Non-revenue water is the difference between the volume of water put into a water distribution system and the volume that is billed to customers. NRW comprises - a) Consumption which is authorized but not billed, such as public stand posts; b) Apparent losses such as illegal water connections, water theft and metering inaccuracies; c) Real losses which are leakages in the transmission and distribution networks. Benefits of NRW reduction, in particular of leakage reduction, include:

- financial gains from increased water sales or reduced water production, including possibly the delay of costly capacity expansion;
- increased knowledge about the distribution system;
- increased firefighting capability due to increased pressure;
- reduced risk of contamination.
- More stabilized water pressure throughout the system

Methodology: NRW is computed as - Difference between total water produced and put into transmission and distribution system, and total water sold expressed as a percentage of total water produced. The city also conducts NRW study considering each distribution network and followed by adopting measures to reduce the extent of NRW.

Formula:

$$\frac{\text{(Total water produced and put into the transmission and distribution system - Total water sold)}}{\text{Total water produced and put into the transmission and distribution system}} \times 100$$

Unit: %

Maximum Score: Total score for the indicator is 100. Cities will be marked in 5 levels with scores ranging from 0 to 100.

Performance Evaluation Levels:
Table 4.18: Extent of Non-Revenue Water

	1	2	3	4	5
Progression Levels	NRW study is not conducted by city	NRW study is conducted by the city and the most recent NRW of the city during 2016-20 is >40%	Most recent NRW of the city during 2016-20 is >30% to 40%	Most recent NRW of the city during 2016-20 is ≥20% to 30%	Most recent NRW of the city during 2016-20 is <20%
Evidence/ Data sources		• Non-Revenue Water (NRW) report (2016-20) • Map of ward wise NRW as a .kml file (polygon geometry with attribute: percentage of NRW) (additional evidence)			
Responsible Department/ Agency	ULB/ Water Utility/ Water Boards/ Flood and Irrigation Department/ Any SPV and or any other relevant implementation agency.				
Reference	Designing an Effective Leakage Reduction and Management Program (WSP; 2008) http://documents1.worldbank.org/curated/en/479201468316169165/pdf/441260WSP0BOX31e0reduction01PUBLIC1.pdf The Issues and Challenges of Reducing Non-Revenue Water (ADB; 2010) https://www.adb.org/sites/default/files/publication/27473/reducing-nonrevenue-water.pdf				
Score	0	25	50	75	100

Indicator 3: Wastewater Recycle and Reuse

Rationale: Recycling and reuse of wastewater reduces the stress on the existing water resources, which are expected to be impacted by climate change.

Description: The percentage of wastewater received at the treatment plant that is recycled or reused after appropriate treatment for various purposes. This should only consider water that is directly conveyed for recycling or reuse, such as use in gardens and parks, use for irrigation, etc. Water that is discharged into water bodies, which is subsequently used for a variety of purposes, should not be included in this quantum. Reuse may be in diverse avenues such as non-potable domestic use; horticulture, agricultural, power plants, industries among others. The indicator emphasises to reduce the consumption/ utilization of clear water.

Methodology: This indicator highlights what percentage of the wastewater generated is being recycled and reused. It is important that the wastewater treatment meets the approved CPCB standards.

Formula:

$$\frac{\text{Treated wastewater recycled and reused in Million litres per day (or) month}}{\text{0.80 X water supplied to the city in Million litres per day (or) month}} \times 100$$

Unit: %

Maximum Score: Total score for the indicator is 100. Cities will be marked in 5 levels with scores ranging from 0 to 100.

Performance Evaluation Levels:
Table 4.19: Wastewater Recycle and Reuse

	1	2	3	4	5
Progression levels	No reuse	< 5% treated wastewater recycled and reused	5 to <10%Treated Wastewater recycled and reused	10 to <20%Treated Wastewater recycled and reused	≥20% Treated Wastewater recycled and reused
Evidence/ Data sources	• Water supply records for last twelve months • Records for treated water reuse for last twelve months				
Responsible Department/ Agency	ULB/ Water Utility/ Water Boards/ Flood and Irrigation Department/ Any SPV and or any other relevant implementation agency, CPHEEO.				
Reference	Handbook of Service Level Benchmarking(CPHEEO; 2008) http://cpheeo.gov.in/upload/uploadfiles/files/Handbook.pdf Chapter 7: Part A: Engineering, Recycling and Reuse of Sewage, Manual on Sewerage and Sewage Treatment Systems (CPHEEO; 2013) http://cpheeo.gov.in/upload/uploadfiles/files/engineering_chapter7.pdf				
Score	0	25	50	75	100

Indicator 4: Flood/ water stagnation risk management

Rationale: With increased urbanization and high densities, cities are inherently vulnerable to flooding and water stagnation events. Climate change will only intensify the problem and increase the frequency of such risks. A flood risk assessment is the first step in developing robust flood management strategies and plans.

Description: Urban flood is defined as 'the submergence of usually dry area by a large amount of water that comes from sudden excessive rainfall, an overflowing river or lake, melting snow or an exceptionally high tide'. This indicator assesses the preparedness of the city to address the risk of flooding and water stagnation. Here, water stagnant for more than four hours of a depth more than six inches is considered as water stagnation.

Methodology: There are generally two types of flood risk assessment. First is a rapid flood risk assessment that uses simple techniques to determine the likely impacts of a flooding event. Second is comprehensive flood risk assessment that is expressed as a function of vulnerability and hazard.

Formula: NA

Unit: NA

Maximum Score: Total score for the indicator is 100. Cities will be marked in 5 levels with scores ranging from 0 to 100. In this indicator, levels 4 and 5 have been merged taking into consideration the various stages on implementation. Cities will be marked based on the evidence provided for the implementation of measures recommended in the flood management plan and urban flood management SOP form 1 – 20 marks each, and 1-10 marks for establishing flood alert and early warning system. Any city scoring above 50 and 75 marks in total will be in level 4 and 5 respectively.

Performance Evaluation Levels:
Table 4.20: Flood/ water stagnation risk management

	1	2	3	4/5
Progression levels	Flood/water stagnation risk assessment not conducted	Rapid flood/ water stagnation risk assessment	Detailed flood risk assessment and preparation of management plan	Implementation of actions for flood/ water stagnation management
Evidence/ Data sources		Rapid flood risk assessment report prepared which shall include: Reasons of flooding/ water stagnation Flooding/ water stagnation Hotspots in city (including the number of incidences) Flood/ water stagnation Levels and frequency Map of flooding/ stagnation hotspots in the city as a .kml file (additional evidence) * Report/study older than 5 years will not be considered	Detailed flood risk assessment for various return period (5 years, 10 years and 50 years) Flood management plans including structural and non -structural strategies (as per NDMA guidelines for urban flood management, 2010) Mechanisms for implementing SOPs (as per MoHUA/ state guidelines) in place. Map of detailed flood risk assessment (scale 1:5000) as a .kml file (additional evidence)	Implementation of measures recommended in the flood management plan (20 points) Implementation of urban flood management SOP (as per MoHUA/state guidelines) (20 points) Urban flood alert and early warning systems established (10 points) Map of drainage and storm water networks in the city as a .kml file (additional evidence)
Responsible Department/ Agency	ULB/ Water Utility/ Water Boards/ Flood and Irrigation Department/ Any SPV and or any other relevant implementation agency			
Reference	Management of Floods, National Disaster Management Guidelines (NDMA; 2008) https://ndma.gov.in/images/guidelines/flood.pdf Flood Risk Management, A Strategic Approach (Asian Development Bank, GIWP, UNESCO, and WWF-UK; 2013) https://www.adb.org/sites/default/files/publication/30246/flood-risk-management.pdf NDMA guideline for urban flood management - https://ndma.gov.in/images/guidelines/management_urban_flooding.pdf SOP for urban flood management as per MoHUA guideline - http://mohua.gov.in/upload/uploadfiles/files/SOP%20Urban%20flooding_5%20May%202017.pdf			
Score	0	25	50	100

Indicator 5: Energy-efficient water supply system

Rationale: Energy efficient equipment for water supply in the city leads to reduction in GHG emissions (CO_2 emissions) per KwH of electricity consumed, thereby contributing to climate change mitigation.

Description: Water Supply System is defined as the water collected from the source, treated, stored and supplied to the end user i.e. entire chain from source to the user with a number of equipment that use energy in a water supply system. Hence, the use of different methods, type of pumps/ equipment and solutions can reduce the use of energy in entire system. The main objective is to explore various possibilities for energy conservation. An energy audit is an assessment and analysis of energy flows in a process or system, aimed at reducing the amount of energy input into the system without negatively affecting the output(s). An energy audit requires a thorough and detailed study of every aspect of the system, through the performance of various tests and measurement. Steps in energy audit report are:

- Collect and analyse historical energy usage.
- Study pumping systems and their operational characteristics.
- Identify potential modification that will reduce the energy usage and or cost
- Perform an engineering and economic analysis of potential modifications.
- Prepare a rank-ordered list of appropriate modifications

These are considered here to be a representative of energy efficient water supply system.

Methodology: This indicator aims to quantify the use and reduction of energy (per MLD of water supplied to the city) by using different options and solution used/ implemented by the city.

Formula:
Trend of reduction in energy consumption per MLD

Unit: %

Maximum Score: Total score for the indicator is 100. Cities will be marked in 5 levels with scores ranging from 0 to 100.

Performance Evaluation Levels:
Table 4.21: Energy-efficient Water Supply System

	1	2	3	4	5
Progression Levels	City has not conducted the Energy Audit including for pumping stations and treatment plants	City has conducted the Energy Audit and the most recent energy reduction reported per MLD by the city during 2016-20 is <10% of baseline data	Most recent energy reduction reported per MLD by the city during 2016-20 is >10% to 15% of baseline data	Most recent energy reduction reported per MLD by the city during 2016-20 is >15% to 20% of baseline data	≥Most recent energy reduction reported per MLD by the city during 2016-20 is >20% of baseline data
Evidence/ Data sources		Energy Audit Report (2016-20)			
Responsible Department/ Agency	ULB/ Water Utility/ Water Boards/ Flood and Irrigation Department/ Any SPV and or any other relevant implementation agency				
Reference	Manual for the Development of Municipal Energy Efficiency Projects. BEE (2008) https://tinyurl.com/w6omgtt A Primer on Energy Efficiency for Municipal Water and Wastewater Utilities (ESMAP; 2012) https://tinyurl.com/sw6qja5				
Score	0	25	50	75	100

Indicator 6: Energy-efficient wastewater management system

Rationale: Energy efficient equipment for wastewater pumping in the city leads to reduction in GHG emissions (CO_2 emissions) per KwH of electricity consumed, thereby contributing to climate change mitigation.

Description: Wastewater Management System is defined here as the collection of wastewaters from the stakeholders of the city and its treatment. Reuse system is not be considered in this analysis and or assessment. There are number of equipment that use energy in a wastewater management system. However, wastewater pumps account for the maximum usage of energy. There are different methods, type of pumps/ equipment and solutions that can reduce the use of energy in entire wastewater management system. Energy Audit is an assessment and analysis of energy flows in a process or system, aimed at reducing the amount of energy input into the system without negatively affecting the output(s). The main objective is to explore various possibilities for energy conservation. An energy audit requires a thorough and detailed study of every aspect of the system, through the performance of various tests and measurement. Steps in energy audit report are:

- Collect and analyse historical energy usage.
- Study pumping systems and their operational characteristics.
- Identify potential modification that will reduce the energy usage and or cost
- Perform an engineering and economic analysis of potential modifications.
- Prepare a rank-ordered list of appropriate modifications

These are considered here to be a representative of energy efficient Wastewater Management system.

Methodology: This indicator aims to quantify the use and reduction of energy (per MLD of wastewater generation and treatment) by using different options and solution used/implemented by the city.

Formula:
Trend of reduction in energy consumption per MLD

Unit: %

Maximum Score: Total score for the indicator is 100. Cities will be marked in 5 levels with scores ranging from 0 to 100.

Performance Evaluation Levels:
Table 4.24: Energy-efficient wastewater management system

	1	2	3	4	5
Progression levels	Energy audit for wastewater pumping stations and treatment plants not conducted	City has conducted energy audit for wastewater pumping stations and treatment plants. Most recent energy reduction reported per MLD by the city during 2016-20 is <10% of baseline dat	Most recent energy reduction reported per MLD by the city during 2016-20 is >10% to 15% of baseline data	Most recent energy reduction reported per MLD by the city during 2016-20 is >15% to 20% of baseline data	Most recent energy reduction reported per MLD by the city during 2016-20 is >20% of baseline data
Evidence/ Data sources		Energy Audit Report (2016-20)			
Responsible Department/ Agency	ULB/ Water Utility/ Water Boards/ Flood and Irrigation Department/ Any SPV and or any other relevant implementation agency				
Reference	Manual for the Development of Municipal Energy Efficiency Projects. BEE (2008) https://tinyurl.com/w6omgtt A Primer on Energy Efficiency for Municipal Water and Wastewater Utilities (ESMAP; 2012) https://tinyurl.com/sw6qja5				
Score	0	25	50	75	100