MANUAL ON

URBAN WATER BODY DIAGNOSTIC TOOL

For effective management of urban water bodies

APRIL 2022

National Institute of Urban Affairs

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Manual on Urban Water Body Diagnostic Tool

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PREFACE

The purpose of the Manual is to introduce the '**Urban Water Body Diagnostic Tool'** as a decision support system for city administrators to manage the water bodies within their jurisdiction. The tool is jointly developed by NIUA and UNESCO, New Delhi Office to help identify and prioritize actions for the rehabilitation and rejuvenation of water bodies within any city.

The target audience for the manual includes city administrators, municipal officers, researchers, and practitioners associated with the management of urban water bodies.

CONTENTS

BACKGROUND AND CONTEXT

The importance of water bodies in an urban context cannot be over emphasized. Healthy water bodies provide a range of benefits to the city that include: serving as an avenue for flood regulation, water supply, socio-cultural connect, recreation, and augmenting groundwater recharge, while at the same time enhancing nutrient balance, micro-climate and air quality, livelihood generation, and biodiversity conservation.

Despite these manifold benefits, the condition of water bodies in many Indian cities has generally been deteriorating. Some are shrinking, some are getting polluted, yet others are entirely encroached upon. It is quite evident that cities are rapidly losing their water bodies.

Some recent newspaper headlines confirm this status. The Times of India in 2020 reported, *"70 percent of water bodies vanished in three decades in Bihar"*. Likewise, News 18 in 2019 also highlighted that *"Lucknow lost nearly 50% of its Water Bodies to encroachment by builders"*.

Owing to these concerns, the protection of water bodies has been recognized in the agenda of the recently launched AMRUT 2.0 Mission, calling on cities to revive and rejuvenate water bodies to enhance the overall water security of the city.

In June 2021, the National Institute of Urban Affairs (NIUA) and UNESCO, New Delhi initiated a project aimed to create a decision support system for cities to manage the water bodies within their jurisdiction. The main output of the project was an **Urban Water Body Diagnostic Tool** that is meant to help city officials in identifying and prioritising actions for rejuvenation of water bodies within any city.

The diagnostic tool is based on assessing the status-quo of urban water bodies in terms of four dimensions - Physical, Chemical, Biological, and Management. The Tool uses an indicator-driven approach, comprising both outcome- and process-based indicators to evaluate the four dimensions.

All indicators are quantitative, conforming to the SMART (Specific, Measurable, Achievable, Responsive and Time-bound) criteria.

While there is an abundance of scientific literature on various individual indicators that can be used to measure the health of water bodies, there are very few studies that propose a holistic system that captures diverse perspectives.

The Urban Water Body Diagnostic Tool seeks to plug this knowledge gap. Furthermore, the Tool has been designed to make a rapid assessment of a water body. Because most cities have a large number of water bodies, the 'rapid' assessment aspect is vital to ensure the scalability and sustainability of monitoring efforts.

SCOPE OF THE TOOL

The tool aims to create a decision support system for cities to manage the water bodies within their jurisdiction. It is meant to help city officials in identifying and prioritising actions for rejuvenation of water bodies within the city.

This Tool can be used for all urban water bodies of **area greater or equal to one Acre (4047 square meters).** This is based on an observation that several Master Plans across the country specify that all water bodies above one Acre should be taken up for protection.

Likewise, Master Plans generally advocate a buffer of at least 9 m for all water bodies upto 10 Ha, and at least 30 m for water bodies above 10 Ha. Therefore, the Urban Water Body Diagnostic Tool also uses the same norms for buffers.

DESIGN PHILOSOPHY

Various water bodies assessment frameworks across the globe may have the same objective but differ in their design principles. These design principles are typically based on the scope and intended use of the framework.

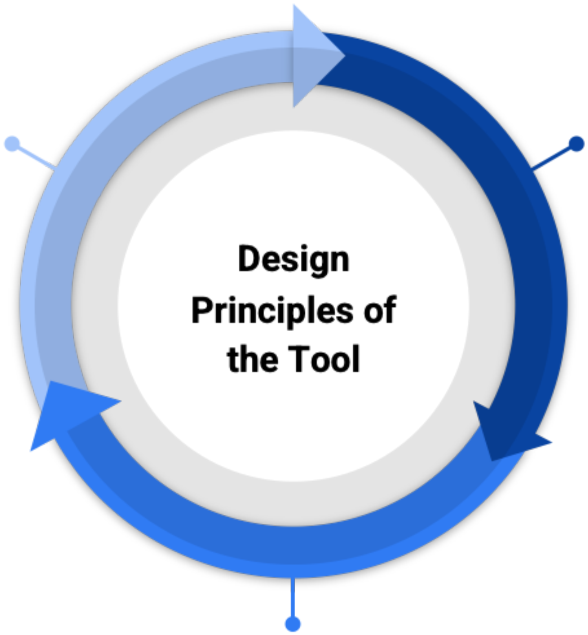
The Water Body Diagnostic Tool has three design principles.

1. The Tool is holistic, encompassing diverse aspects required to diagnose a water body.
2. The Tool helps in the rapid assessment of water bodies using an indicator based approach.
3. The Tool informs tangible actions for improving/maintaining the state of water bodies.

The Urban Water Body Diagnostic Tool is generic in nature and can be used for the assessment of water bodies in any city. However, cities with unique water body functions and characteristics may consider additional indicators, specific to the local features. For example, this tool may find limited application for coastal wetlands, which have very specific unique features.

·A complete assessment of water bodies requires an understanding of a mix of rapid indicators as well as detailed measures. This tool is only for a rapid diagnosis of the status of urban water bodies. Detailed analysis and surveys of the water bodies may be conducted separately, wherever required.

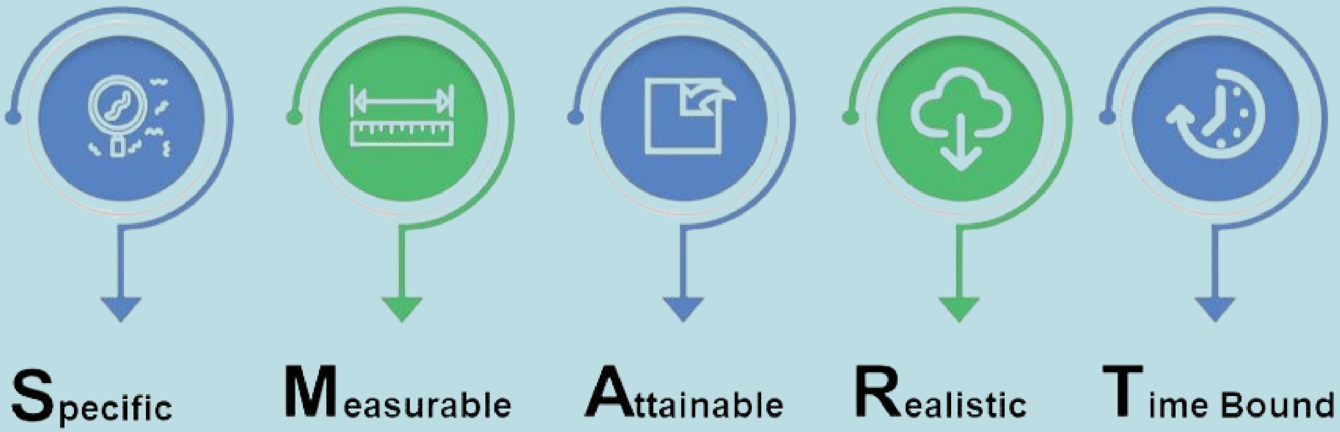
Holistic Assessment: Indicators address diverse aspects related to urban water bodies



Rapid Assessment: Indicators can be easily and quickly ascertained with minimal equipment

Action-Oriented Assessment: Indicators inform actions for water body management

Indicators for the Urban Water Body Diagnostic Tool



STRUCTURE OF THE TOOL

The tool has been designed to evaluate the parameters that are relevant for the diagnosis of urban water bodies. The various components of the tool are described below:

1) Dimensions: Dimensions are the broad categories of evaluation. Each dimension is unique and looks at a different aspect of diagnosis. The Tool has four dimensions - Physical, Water Quality, Water Quantity and Management.

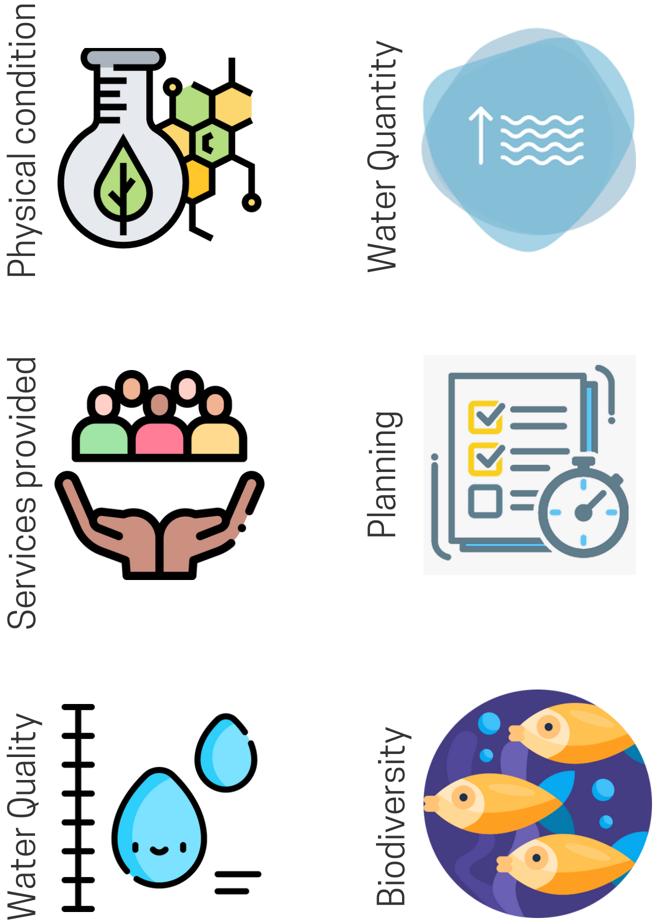
2) Indicators: Indicators make an evaluation of the aspects within the various dimensions. Therefore, indicators are meant to quantify the dimensions using numerical values. The Tool uses ten indicators for the evaluation.

Each indicator is assigned a certain weight that has been determined by experts using the Analytical Hierarchy Process methodology, based on its relative significance to the overall diagnosis of the water body.

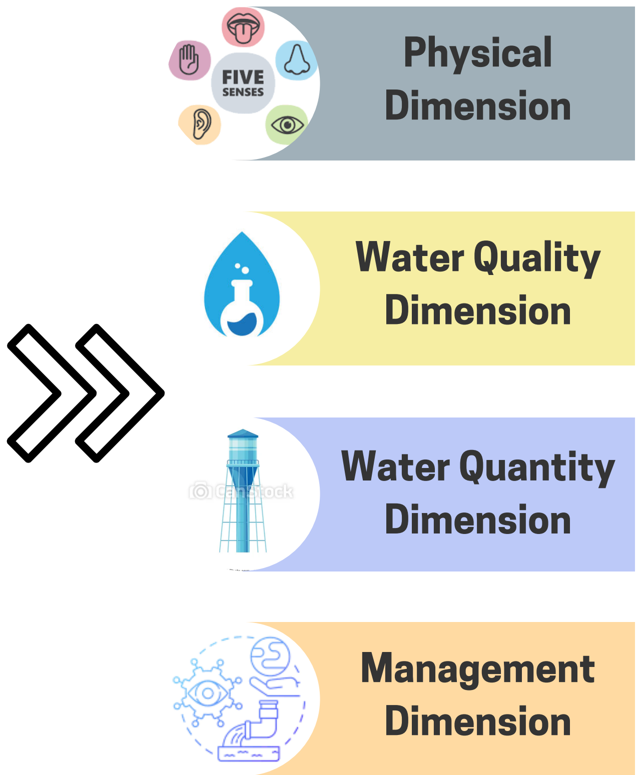
The indicators are given a value from 0 to 5, based on set of reference values identified from the literature. For reference values that are not available, expert judgment of the tool developers has been used.

3) Urban Water Body Diagnostic Value (UWD value)

The UWD value paints a picture of the overall status of a water body. It is calculated as the mathematical average of all indicators. It is measured on a scale from 0 to 5. Higher values indicate a better condition of the water body and vice versa. Details of the interpretation of the UWD value are provided further in this manual.



Parameters relevant for the
diagnosis of urban water bodies



Dimensions for
water body diagnosis

Urban Water Body Diagnostic Value (UWDvalue)

= D1 + D2 + D3 + D4

D1 — Physical Dimension

To evaluate characteristics that can be determined by senses of touch, sight, smell, and taste.

- **Indicator 1**
  Visible surface algal bloom
- **Indicator 2**
  Odour
- **Indicator 3**
  Solid waste in the water body
- **Indicator 4**
  Solid waste in the buffer

D2 — Water Quality Dimension

To evaluate chemical and biological properties that have a bearing on the health of water bodies

- **Indicator 5**
  Dissolved oxygen
- **Indicator 6:**
  pH value

D3 — Water Quantity Dimension

To evaluate the change in water availability within the body

- **Indicator 7:**
  Change in surface area of the water body

D4 — Management Dimension

To evaluate the practices followed for management of water bodies

- **Indicator 8:**
  Extent of built-up in the buffer
- **Indicator 9:**
  Vegetation in the buffer
- **Indicator 10:**
  Management protocols

INDICATORS

INDICATOR 1
Visible surface algal bloom

Why is it important?

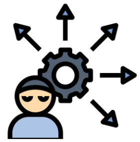
This indicator captures the effect of eutrophication, which occurs when the environment becomes enriched with excessive nutrients primarily because of the discharge of untreated sewage and fertilizers into the water body.

Algal blooms can signify eutrophication, which reduces oxygen/ sunlight in the water body and threatens the survival of aquatic species.

How should it be evaluated?

A visual inspection of the water body is needed to evaluate this indicator. The purpose of the investigation would be to make a visual estimate of the proportion of the surface of the water body that is covered by algal bloom.

Indicator Type



Outcome based

Mode of investigation

Primary survey

$$I1 \quad \frac{\text{Surface area covered with algae}}{\text{Total surface area of water body}} \times 100$$

I1	IS1
100	0
75 to 99	1
50 to 74	2
25 to 49	3
1 to 24	4
<1	5

Important considerations

1. An algal bloom is more prevalent in warm temperatures. Hence, it is crucial to evaluate this indicator in summer.
2. Boats may be needed to inspect larger water bodies.

INDICATOR 2
Odour

Why is it important?

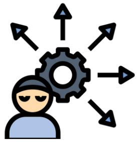
The foul smell in water bodies is because of chemical pollution, presence of toxins, dead fish/ organic decay, presence of a particular group of algae, etc. Foul smell directly impacts the functionality, use, and accessibility of the water body.

How should it be evaluated?

A physical examination of the water body is required to evaluate this indicator.

The objective of the examination would be to detect whether or not there is a foul smell.

Indicator Type



Outcome based

Mode of investigation

Primary survey

I2 **(Presence of odour) OR (Absence of odour)**

I2	IS2
Yes	**0**
No	**5**

Important considerations

1. Sometimes, it is difficult to detect smell directly in the water body. In such cases, it is useful to take the water in a beaker or container and perform the odour test.

INDICATOR 3
Solid Waste in the water body

Why is it important?

Solid waste in the water body includes visible floating waste such as plastics, paper, trash, wood, food, etc.

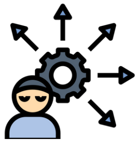
The presence of any solid waste in the waterbody not only degrades the overall health of the water body; it also impacts the aesthetics and reduces the overall appeal of the feature.

How should it be evaluated?

A physical examination of the water body is required to evaluate this indicator.

The objective of the examination would be to estimate the approximate percentage of the waterbody covered with solid waste.

Indicator Type



Outcome based

Mode of investigation

Primary survey

$$I3 = \frac{\text{Area of waterbody covered with solid waste}}{\text{Total surface area of the water body}} \times 100$$

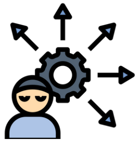
I3	IS3
100	0
76 to 99	1
10 to 75	2
1 to 9	3
<1	4
0	5

Important considerations

1. Boats may be needed to inspect larger water bodies.
2. Sometimes solid waste settles down in the water body. This is called legacy waste, which is difficult to estimate by a physical inspection. It is recommended that a special survey is additionally carried out wherever such problems exist.

INDICATOR 4
Solid Waste in the buffer

Indicator Type



Outcome based

Mode of investigation

Primary survey

Why is it important?

The presence of solid waste in the buffer area of the water bodies may pollute the water body during monsoon. It also contaminates the underlying groundwater, some of which enters the water body as baseflow.

Solid waste in the buffer includes construction and demolition waste, in addition to domestic waste.

How should it be evaluated?

A buffer of 9m should be considered for water bodies smaller than 10 Ha and 30 m for water bodies larger than 10 Ha.

A physical examination of the buffer is required to evaluate this indicator. The buffer may be visually marked approximately.

The objective of the examination would be to detect the presence of solid waste in the buffer.

I4 **(Presence of solid waste in the buffer)**
OR
(Absence of solid waste in the buffer)

I4	IS4
Yes	**0**
No	**5**

Important considerations

1. Some buffer areas around large water bodies may be inaccessible due to thick vegetation, steep slope, or the presence of solid waste. In such cases, it would be helpful to carry out the inspection from a tall building nearby.


400
300

INDICATOR 5
Dissolved Oxygen

Why is it important?

Dissolved Oxygen (DO) refers to the amount of oxygen present in water. This is vital for the sustenance of aquatic life (fish, invertebrates, bacteria, and plants) in the water body.

Very low or high DO levels harm aquatic life and affect water quality.

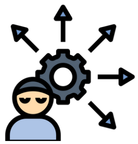
How should it be evaluated?

A DO meter is needed to evaluate this indicator.

The DO meter can be immersed in a beaker containing a water sample from the water body or can be immersed directly in the water body.

It is measured either in milligrams per liter (mg/L) parts per million (ppm), or percent saturation.

Indicator Type



Outcome based

Mode of investigation

Primary survey

I5 **DO Meter Value (in mg/l)**

I5	IS5
0	0
Less than 1	1
1 to2	2
2 to 3	3
3 to 4; greater than 12	4
4 to 12	5

Important considerations

1. The DO meter must be calibrated properly before using it in the field.
2. If the DO meter starts showing inconsistent readings, it needs to be calibrated again.
3. DO should be measured in at least 3-4 locations (more for larger water bodies). An average value can then be used to represent the water body.

INDICATOR 6
pH Value

Why is it important?

pH is a measure of the acidity or alkalinity of water. A pH value of 6.5 to 8.5 in water bodies is considered normal. Values higher than 8.5 or lower than 6.5 indicate contamination (mostly from industries), which are harmful for some aquatic species in the water bodies.

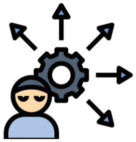
How should it be evaluated?

A pH meter is needed to evaluate this indicator.

The pH meter can be immersed in a beaker containing a water sample from the water body or can be immersed directly in the water body.

It is measured on a logarithmic scale of 0–14, where 7 is neutral, below 7 is acidic, and above 7 is alkaline.

Indicator Type



Outcome based

Mode of investigation

Primary survey

I6 pH Value

I6	IS6
0 and 14	0
0.1 - 1.9 and 13.1 - 13.9	1
2.0 - 3.9 and 11.1 - 13.0	2
4.0 - 5.9 and 9.1 - 11.0	3
6.0 - 6.4 and 8.6 - 9.0	4
6.5 - 8.5	5

Important considerations

1. The pH meter must be calibrated properly before using it in the field.
2. If the pH meter starts showing inconsistent readings, it needs to be calibrated again.
3. pH should be measured in at least 3-4 locations (more for larger water bodies). An average value can then be used to represent the water body.

INDICATOR 7
Change in surface area of the water body

Why is it important?

This indicator is a measure of the amount of water within the water body. Fluctuation in this parameter directly impacts the ecosystem, both within and around the water body.

The surface area of the water body may change because of unsustainable extraction of water for various purposes or increased evaporation as a result of climatic changes.

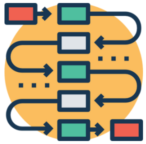
How should it be evaluated?

Satellite images of the water body should be used to evaluate this indicator.

First, a baseline needs to be developed. This is the average historical surface area of the water body based on data for the last five years available on Google Earth or any other portal.

Next, the existing surface area of the water body can be estimated using the current year's data.

Indicator Type



Process based

Mode of investigation

Secondary source

$$I7 = \frac{\text{Baseline surface area - Area of water body in the present year}}{\text{Baseline surface area}} \times 100$$

I7	IS7
71 - 100	0
51 - 70	1
21 - 50	2
6 - 20	3
1 - 5	4
0 or less	5

Important considerations

1. This indicator is affected by seasonal variations. Hence, it is important to measure this indicator in the dry season (April to May), when the surface area of the water body is expected to be minimum.
2. Historical satellite data may not be available for the same month for five previous years. If so, data for adjacent months may be used to establish the baseline.
3. Some edges of the water body may not be visible in the satellite images; in such cases, an approximate boundary can be marked.

INDICATOR 8
Extent of built-up in the buffer

Why is it important?

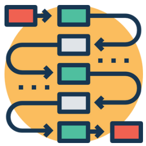
Any built-up area within the water body buffer (permanent, semi-permanent, or temporary) has a number of negative impacts on the water body. These include a decline in water quality, loss of aquatic and terrestrial habitat, increased siltation, and change in ecological processes.

How should it be evaluated?

Satellite images of the water body buffer are to be used to evaluate this indicator.

The boundary of the water body and its buffer zone (9m for water bodies smaller than 10 Ha and 30m for water bodies larger than 10 Ha) should be marked on Google Earth or any other similar portal. Then, the approximate percentage of buffer zone covered with built structures should be estimated.

Indicator Type



Process based

Mode of investigation

Secondary source

$$I8 = \frac{\text{Built-up area in the buffer zone}}{\text{Total area of the buffer zone}} \times 100$$

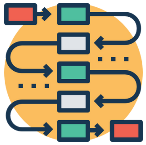
I8	IS8
71 - 100	0
51 - 70	1
21 - 50	2
6 - 20	3
1 - 5	4
0	5

Important considerations

1. Some sections of the buffer zone may not be clearly visible in the satellite images. In such cases, an approximate built-up area can be marked.
2. With satellite image, only the extent of built up can be estimated. If needed, a detailed site survey can be conducted in order to ascertain the impacts of different kinds and uses of built spaces.

INDICATOR 9
Vegetation in the buffer

Indicator Type



Process based

Mode of investigation

Secondary source

Why is it important?

Vegetation in the buffer provides multiple benefits like improved water quality with filtered discharge, carbon storage, air quality improvement, flood and erosion control, increase in property values, habitat for wildlife, avenues for recreation, etc. It also helps in preventing encroachment or dumping of waste in vacant areas around the water bodies.

More vegetation cover within the buffer zone, generally reflects a healthier water body.

How should it be evaluated?

Satellite images of the water body buffer should be used to evaluate this indicator.

The boundary of the water body and its buffer zone (9m for water bodies smaller than 10 Ha and 30m for water bodies larger than 10 Ha) should be marked on Google Earth or any similar portal. Then, the approximate percentage of buffer zone covered with vegetation should be estimated.

$$I9 = \frac{\text{Vegetated area in the buffer zone}}{\text{Total area of the buffer zone}} \times 100$$

I9	IS9
0	0
1-25	1
26 - 50	2
51 - 60	3
61 - 70	4
71 - 100	5

Important considerations

1. The vegetation cover varies with different climatic zones. For example, water bodies in arid regions may have less vegetation cover compared to other regions. In such cases, the evaluation scores need to be adjusted accordingly
   0 %, Score = 0
   1-33 %, Score = 1
   33-50 %, Score = 3
   51-100 %, Score = 5

INDICATOR 10
Management protocols

Why is it important?

Adequate monitoring and management of water bodies is essential for maintaining a healthy water body ecosystem.

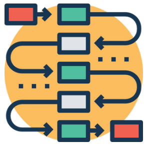
The management protocols include diverse aspects encompassing planning, monitoring and maintenance instruments.

How should it be evaluated?

A list of desired basic management protocols for water bodies has been prepared, which includes:
1. Dedicated land use assigned for the water bodies. in the Master Plan
2. Dedicated allocation of buffer for water bodies in the Master Plan
3. Dedicated agency assigned for maintaining the water body
4. Water body is monitored at least twice a year
5. Presence of a database that has details of the water body (location, area, ownership).

Each water body should be examined to ascertain how many of these desirable protocols are present.

Indicator Type



Process based

Mode of investigation

Secondary source

I10 — Number of desired basic management protocols present

I10	IS10
No basic protocol present	0
1 basic protocol present	1
2 basic protocols present	2
3 basic protocols present	3
4 basic protocols present	4
All basic protocol present	5

Important considerations

1. For a city that does not have a Master Plan, other similar plans such as City Development Plan may be used for the evaluation.
2. It is unlikely that all information on the basic management protocols would be available with a single agency. Hence the assessment will need engagement with multiple agencies.

CALCULATING UWD VALUE

	INDICATOR SCORE	INDICATOR WEIGHTAGE*	INDICATOR VALUE	DIMENSION VALUE
Indicator 1 Visible surface algal bloom	IS1	0.08	IV1 = IS1 X 0.08	D1 = IV1 + IV2 + IV3 + IV4
Indicator 2 Odour	IS2	0.08	IV2 = IS2 X 0.08	
Indicator 3 Solid waste in the water body	IS3	0.15	IV3 = IS3 X 0.15	
Indicator 4 Solid waste in the buffer	IS4	0.09	IV4 = IS4 X 0.09	
Indicator 5 Dissolved oxygen	IS5	0.16	IV5 = IS5 X 0.16	D2 = IV5 + IV6
Indicator 6 pH value	IS6	0.09	IV6 = IS6 X 0.09	
Indicator 7 Change in surface area of water body	IS7	0.10	IV7 = IS7 X 0.10	D3 = IV7
Indicator 8 Extent of built-up in the buffer	IS8	0.08	IV8 = IS8 X 0.08	D4 = IV8 + IV9 + IV10
Indicator 9 Vegetation in the buffer	IS9	0.04	IV9 = IS9 X 0.04	
Indicator 10 Monitoring mechanisms	IS10	0.12	IV10 = IS10 X 0.12	

*Established based on Analytical Hierarchy Process (AHP) with sector experts

UWD value

Sum of all Dimension Values = D1 + D2 + D3 + D4

UWD Value	Interpretation	What it means?
0 to 1.59	Very poor	The waterbody is in an extremely neglected and dilapidated condition. It performs poorly against most of the indicators. There is an urgent need to revive and rehabilitate the water body.
1.60 to 2.59	Poor	The water body is in a poor condition. There is ample room for improvement against all indicators. It will take a significant effort to revive the water body.
2.60 to 3.59	Average	The overall condition of the water body is fair. While it performs well against some indicators, it performs poorly against the others.
3.60 to 4.59	Good	The overall condition of the water is good. It performs well against most of the indicators. The shortcomings are not very serious and can be addressed with relative ease.
4.60 to 5.0	Very good	The water body is in an ideal condition. It performs well against all indicators. There are hardly any shortcomings, and if there are, they can be fixed easily and quickly.

PROCESS for conducting a Water Body Diagnosis

01

Set up a team of preferably 5-8 members who have a basic understanding of water bodies

02

Carry out the secondary data collection and analysis (maps, listing, khasra records, satellite images, Master Plans, etc.)

03

Prepare for primary data collection by procuring and calibrating the required survey equipment (GPS tracker, DO Meter, pH meter, beakers, gloves, distilled water and gum boots)

04

Prepare a schedule for primary data collection for all water bodies **greater than one acre**

05

Carry out the primary data collection at each location as per the schedule

06

Collate secondary and primary data to estimate the indicator values using the relevant formulae and weights, and subsequently the UWD value

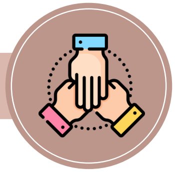
07

Devise dedicated strategies for rejuvenation of each water body, based on the UWD values and individual indicator values

PILOT TESTING

This tool was tested to evaluate the water bodies of Visakhapatnam.

01



Establish a team

The Greater Visakhapatnam Municipal Corporation (GVMC) was identified as the nodal agency to undertake this task.

02

Process existing water body information

For the purpose of pilot testing, five distinct water bodies were selected and some basic information was collected about each. This ensured identification of each water body in the departmental records, through satellite imagery, and at the site.

For example, the basic information compiled for one of the water bodies at Kambalakonda is shown below:

Existing information	**Water Body 1**
Name of the water body (if assigned)	Kambalakonda water body
Location coordinates	17°46'27.80"N 83°20'24.59"E
Total surface area of the water body	2.07 Ha
Total area of the water body buffer (9m width)	1.19 Ha
Satellite image of water body and its buffer	
Ownership	Forest Department

03

Procure and calibrate survey equipment

The following equipment were used.

1. **GPS Tracker:** Costing around INR 10,000/-, this hand-held device is used to mark the geo-spatial locations of the sample collection points and position the on-site boundary of the water body. The instrument needs to be manually geo-referenced before use. The information stored on the device can be transferred onto Google maps.
2. **DO Meter:** Costing around INR 15,000/-, this hand-held device is a scientific testing equipment for checking the Dissolved Oxygen level in a water sample. The instrument needs to be manually calibrated before use. It displays the results within seconds of immersing the sensor in the water sample. The sensor can either be immersed in the water sample collected in a beaker or directly in the water body.
3. **pH Meter:** Costing around INR 1,000/-, this hand-held device is a scientific testing equipment for checking the pH of a water sample. The instrument needs to be manually calibrated before use. It displays the results within seconds of immersing the sensor in the water sample. The sensor can either be immersed in the water sample collected in a beaker or directly in the water body.

Other equipment required for water body testing include -

1. **Beakers:** Costing around INR 550/-, these are required to collect and measure samples of water.
2. **Distilled Water:** Costing around INR 400/-, this is required to wash the equipment after each testing.
3. **Sample Collection Bottles:** Costing around INR 500/-, or recycled small bottles (200 ml-400ml) of mineral water costing around INR 10 per bottle, can be used to store water samples. Bottles need to be appropriately labelled, to indicate the sampling location.
4. **Disposable Gloves and Gum Boots:** Costing around INR 1000/-, these are required for safety and hygiene.

04

Collect water sample

Water samples were collected from different locations spread across the water body. Samples from the water body edge were avoided because these can give misleading results. For larger water bodies, boats were used to reach different locations within the water body.

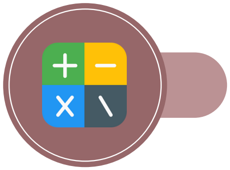
05

Conduct the survey

For each water body, data was collected based on water tests, google images, and information received from secondary sources. This data was subsequently fed into an excel file.

The data required for evaluation against each indicator is listed below.

Indicator	Data Required	Source
Visible surface algal bloom	Surface area covered with algae	Primary survey
Odour	Presence of odour in water	Primary survey
Solid waste in the water body	Surface area covered with solid waste	Primary survey
Solid waste in the buffer	Presence of solid waste in the buffer	Primary survey
Dissolved oxygen	Dissolved Oxygen in water	Primary survey
pH value	pH of the water	Primary survey
Change in surface area of water body	Surface area of the water body in the last 5 years	Satellite image
Extent of built-up in the buffer	Area covered with built-up in the buffer	Satellite image
Vegetation in the buffer	Area covered with trees (vegetated) in the buffer	Satellite image
Monitoring mechanisms	Master Plan, Development Regulations and Land use plan Nodal agency for maintenance Monitoring and maintenance records/ status Water bodies database (with details of location, area, ownership, etc)	Secondary survey (agencies)



06

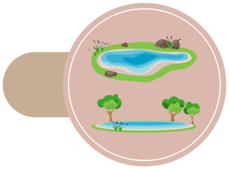
Calculate UWD value

The UWD value for each water body was calculated as per the procedure mentioned in the manual.

For example, the calculation of the UWD value for one of the water bodies at Kambalakonda is explained below:

Indicator	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
Indicator Data (I)	0.5%	No	2%	No	6.26	8.26	2%	0%	80%	5
Indicator Score (IS)	5	5	3	5	5	5	4	5	5	5
Indicator Weightage	0.08	0.08	0.15	0.09	0.16	0.09	0.10	0.08	0.04	0.12
Indicator Value (IV)	0.40	0.40	0.45	0.45	0.80	0.45	0.40	0.40	0.20	0.60
Dimension Value (D)	1.70				1.25		0.40	1.20		
UWD value	**4.55**									

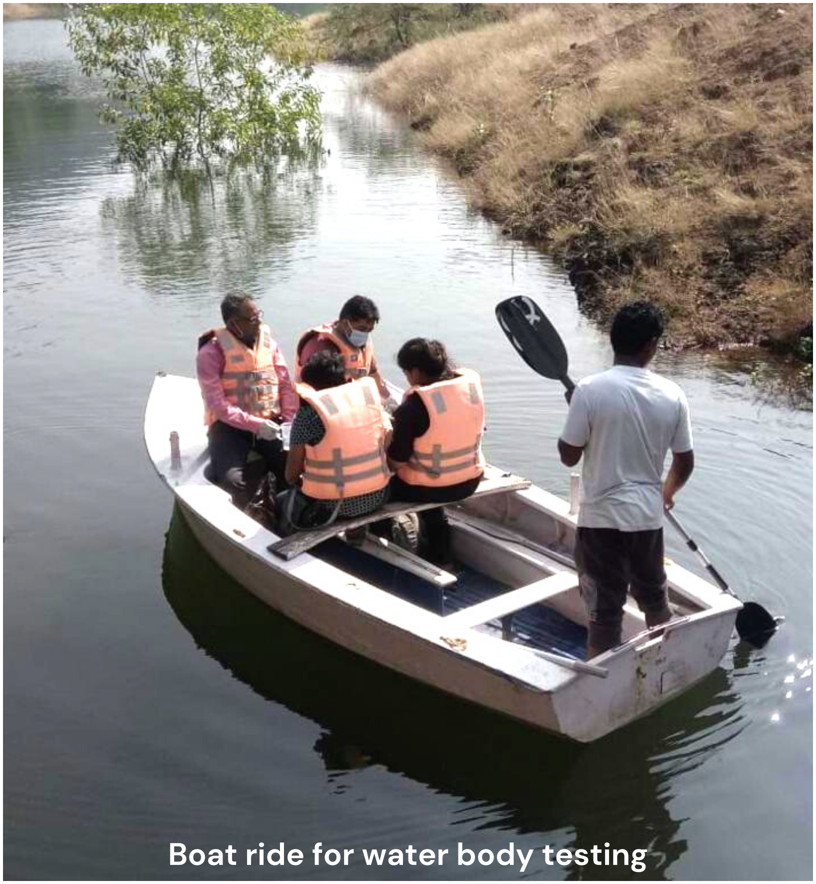
07



Devise rejuvenation sarategies

The Kambalakonda water body performs marginally lower only against the Indicator I3, which is related to solid waste in the water. Approximately 2% of the water body is covered in solid waste.

The rejuvenation strategy for this water body, therefore, is centered around
a. identifying the source of solid waste,
b. making arrangements for solid waste from these sources to be disposed off safely through the right channels, and
c. clearing the existing solid waste in the waterbody.



Boat ride for water body testing

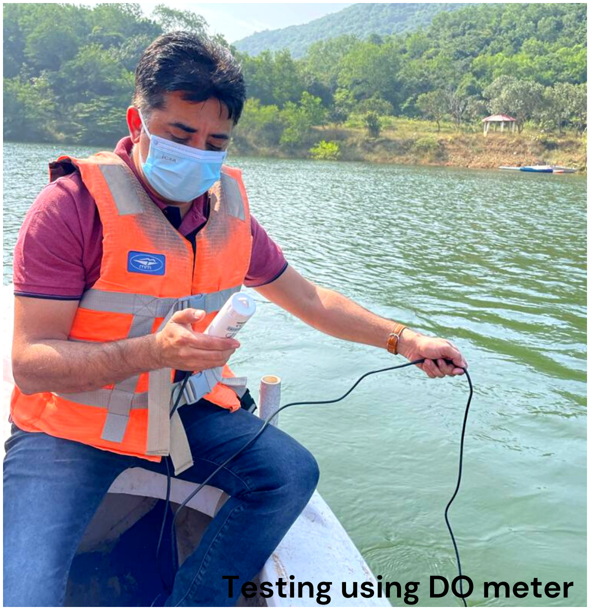
Testing using pH meter

Sample Collection using a beaker

DO testing in process using DO meter

Testing using pH meter

Testing using DO meter



Testing using DO meter

Water testing equipments- pH meter, GPS tracker, DO meter

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