Global Water & Sanitation Center

Geo-spatial Approach of CWIS Planning

Rationale , Introduction and Experience Sharing

Structure of Presentation

1. Introduction to CWIS Planning
2. 7 different Stages for CWIS Planning across Sanitation Value Chain
3. Enabling Environment – Regulatory Reforms
4. Experience with Integrated Sewer and Non-sewer planning
5. CWIS Alignment

Introduction - Geo-spatial Approach of CWIS Planning

Global Sanitation Challenge

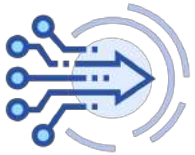
Achieving SDG 6.2 targets will be impossible without actively promoting access to and inclusivity in sanitation facilities for all

Devising Approaches

CWIS is one such approach which ensures inclusivity and access to safe and sustainable sanitation for all.

Challenges with CWIS

The framework/efforts have been predominantly qualitative in nature



What it is ?

Geo-spatial approach to CWIS planning has a core objective of designing a climate responsible, pro-poor and smart geo-spatial sanitation plan for urban areas.

What it does ?

Ascertaining questions such as who is to be served, where is such service needed, and how are they to be served.

Past Experience ?

This is a relatively new approach and has been introduced in several projects (around 25 cities of South Asia) supported by the BMGF, through the platform of CWIS TA Hub.

Uncovering the marginalized

Inclusive and Accessible Sanitation

Inclusive

Economic vulnerable settlements – urban poor, slum dwellers, landless family

Climate risk settlements – Flood affected, water-logged, land-slide etc.

Environmental risk settlement – Water proximity, eco-sensitive

Disadvantaged group - family headed by specially-abled, transgender, single women

- *Where are the located ?*
- *Need to be prioritized for intervention – containment improvement, service provisioning, ?*
- *Degree of vulnerability may add to the associated risks ?*

Accessible

Hard to reach settlements – accessible only be small volume trucks, need electric pump for longer hauling distance, need small volume manual cart

Remote settlements from treatment plant – settlements beyond 30 minutes of travel distance from treatment plant

- *Designing robust sludge collection system ?*
- *Ensure safe collection and transportation to all*
- *Appropriate treatment plant coverage to all settlement area and provisioning of outliers*

7 different Stages for CWIS Planning across Sanitation Value Chain

Equity	• *Urban Poor* • *Climate and environment risk*
Safety	• *Safety across sanitation value chain* • *Safe containment – one solution will not fit for all ?*
Sustainability	• *Environmentally* • *Financially*
Responsibility	• *Managed through sound regulatory system* • *Mechanisms for enforcement*
Accountability	• *Service level benchmark* • *Performance monitoring indicator*
Resource Planning	• *Smart management* • *Evidence based planning and management*

1. Organizing Geo-Spatial Database
2. Develop a Composite Risk-Map
3. Safe Containment Plan for All
4. Adequate Public Toilet Coverage to Users
5. Safe Collection & Transportation Plan for All
6. Settlement Proximity from FSTP
7. Ground Truthing and Validations

Stage 2 Composite Risk Map

5 Identified Challenges for Safe Containment Solutions

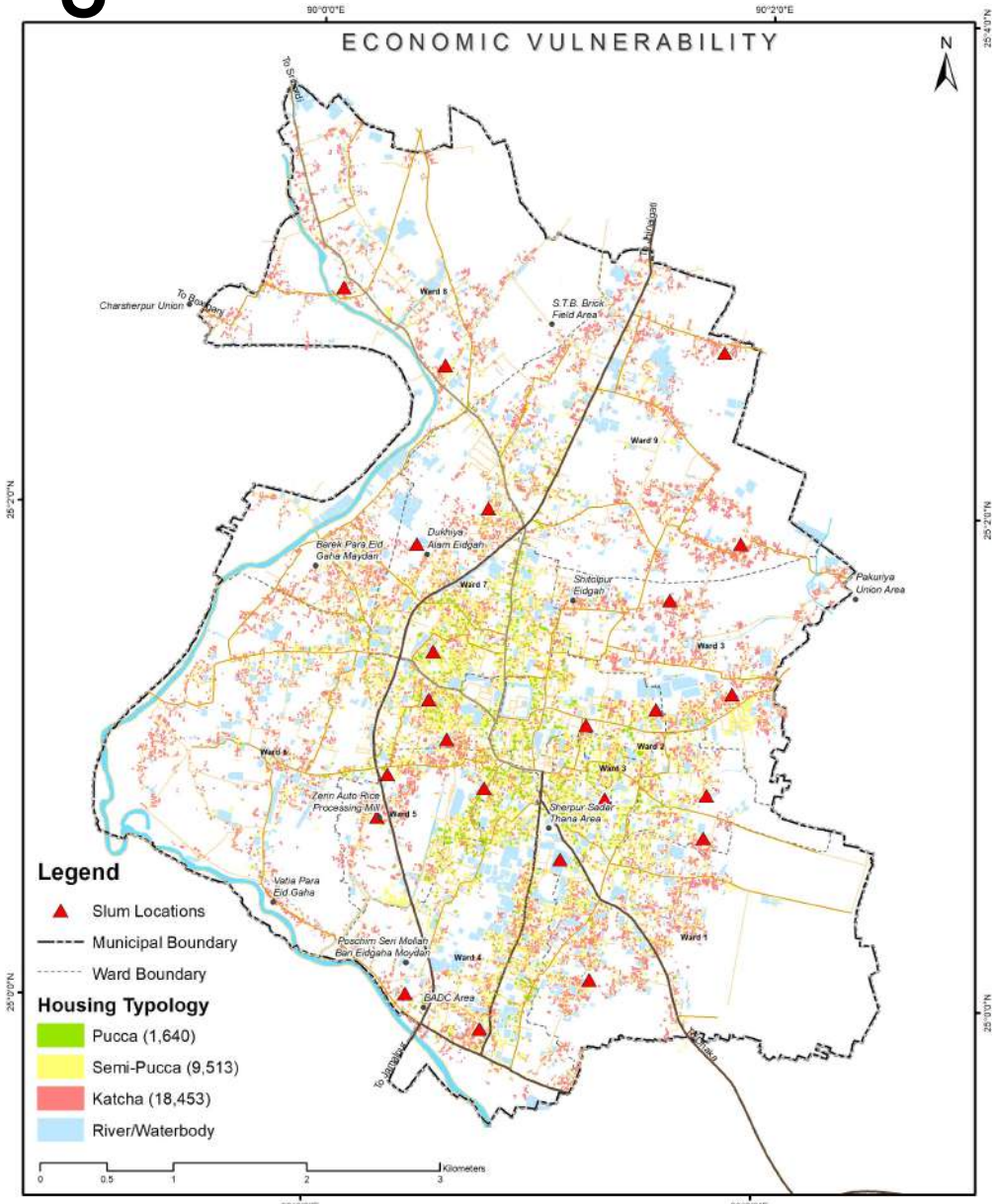
Inputs *– Housing structure typology.*

Process *– Mapping of housing typology with an assumption that Katcha housing belongs to the economically vulnerable population.*

Output *–18,453 (62%) of family as economic vulnerable*

Applications *-*

Economically vulnerable settlements - priority in designing sanitation interventions and implementation



1. Economic Vulnerability HHs
2. Flood/Waterlogged Risk Area, HHs
3. Settlement Close to Water Bodies
4. Hard to Reach Areas
5. Bulk Volume of Wastewater Generator

Stage 2 Composite Risk Map

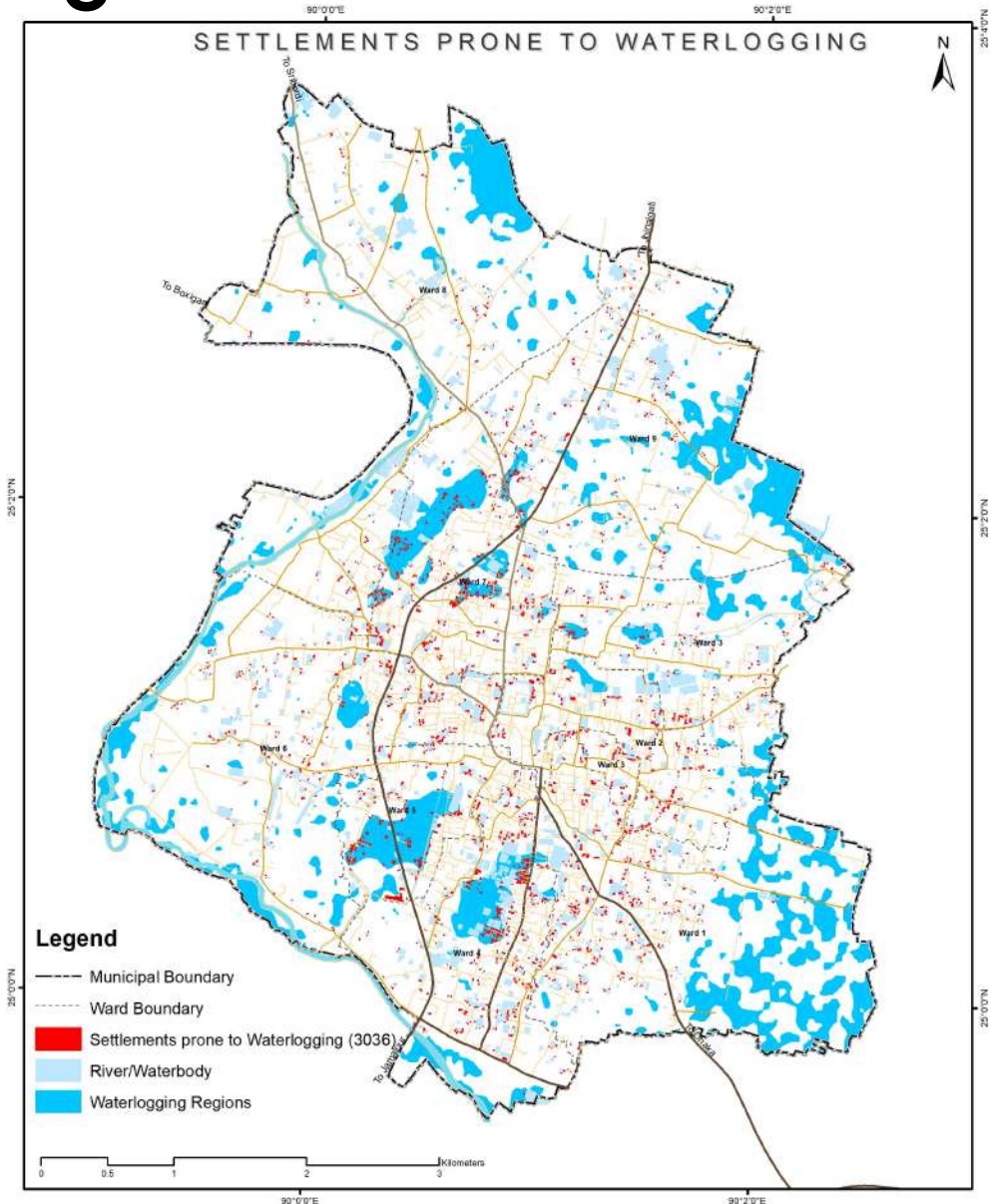
5 Identified Challenges for Safe Containment Solutions

Inputs *– natural drainage density and municipal drainage network*

Process *– From watershed analysis, identify the density of natural drainage in low lying areas and overlay existing drainage network.*

Output *–3,036 (10%) of housing as water-logged*

Application *- Area with waterlogging risks also have operational challenges like toilet back-flow and non-functional soak-pits.*



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Stage 2 Composite Risk Map

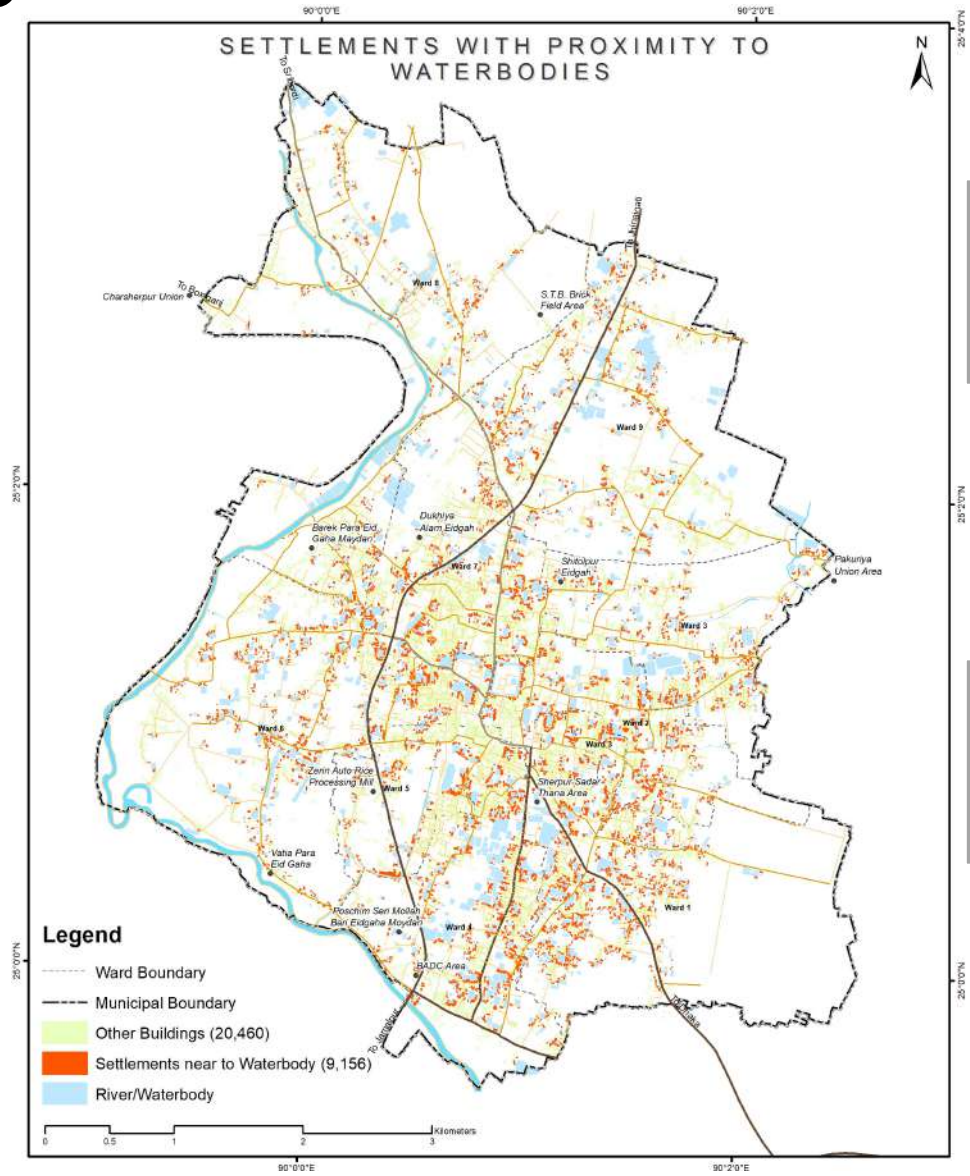
5 Identified Challenges for Safe Containment Solutions

Inputs *– 100-meter buffer from the river and 30 meters from other waterbodies to settlement areas*

Process *–Using buffer analysis, identifying settlements which are in proximity of water-body*

Output *– 9,156 (31%) of housing as water-proximity settlements*

Application *- Areas with water proximity tend to have more risk of untreated waste-water encroachment into nearby water bodies including toilet outlets opening directly into water bodies of adjoining settlement areas.*



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Stage 2 Composite Risk Map

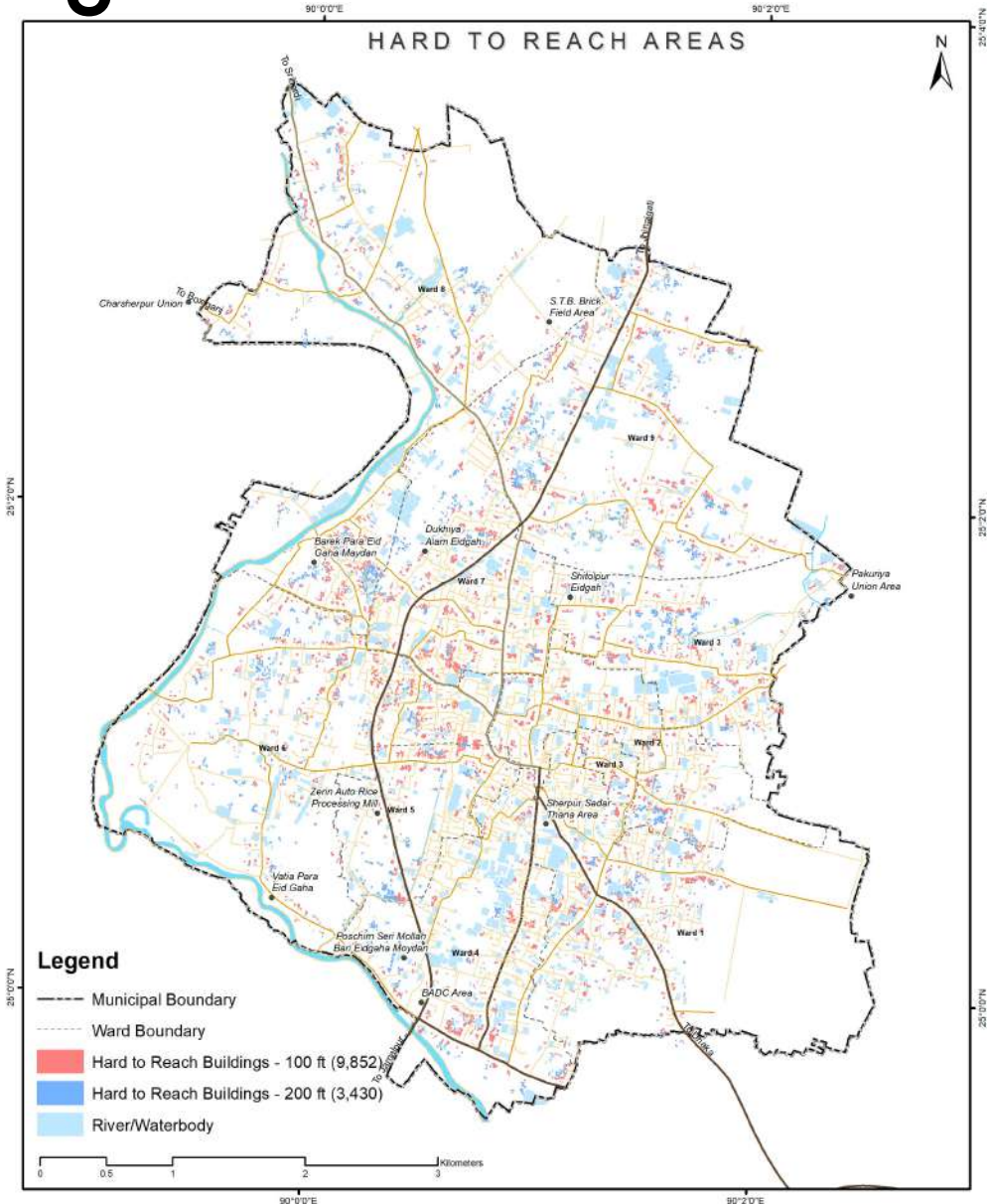
5 Identified Challenges for Safe Containment Solutions

Inputs *– Road network maps with width details and settlement areas.*

Process *– Settlements with less than 3.5-meter adjoining road width and beyond 100 feet from accessible point for emptying truck.*

Output *– 3,430 (12%) of settlements - hard to reach*

Applications *- Completely relying on manual emptying process and tend to have higher frequency of toilet outlets directly emptying into a nearby storm water drainage.*



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Stage 2 Composite Risk Map

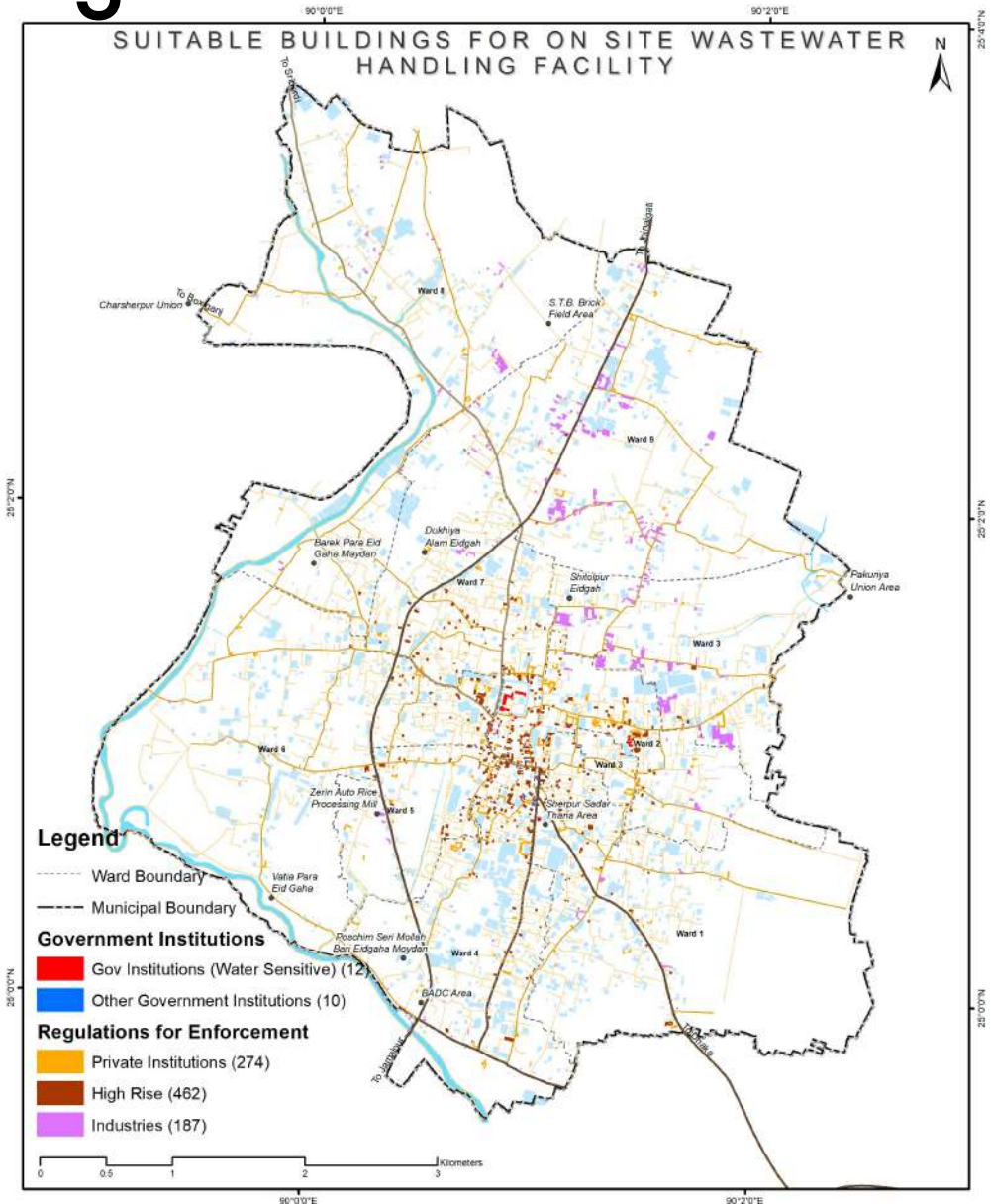
5 Identified Challenges for Safe Containment Solutions

Inputs *– Location of institutional, high-rise buildings, industries etc.*

Process *– Geo locating all bulk wastewater generators,*

Output *– Gov. institution 22 (11 in risk zone and 10 in safe), Private institutions 274*

Applications *- Adds significant pollutant load and needs to be prioritized for on-site treatment solutions. In-case they are close to water sensitive areas, the environmental and public health risk gets more acute.*



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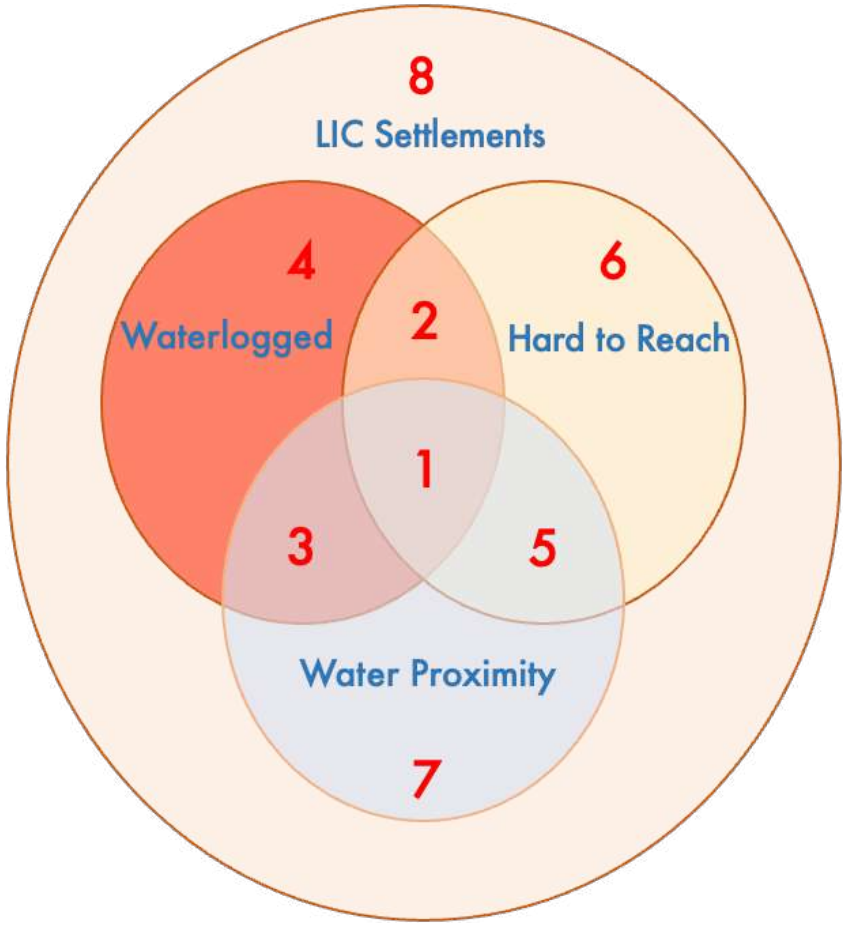
Stage 3 Safe Containment for all Technology, Target Beneficiaries, Risk Ranking and Prioritization



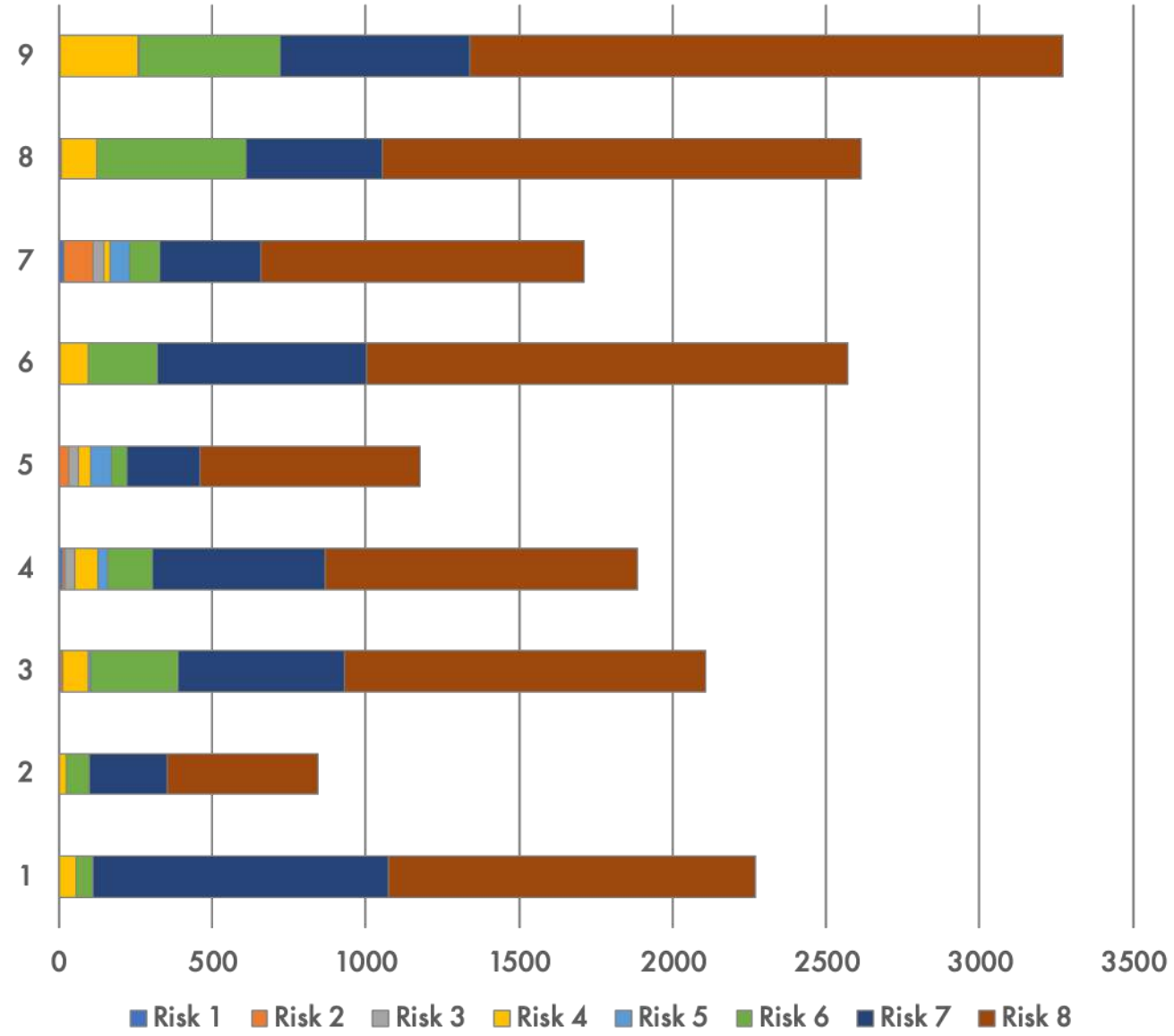
Risk Ranking	Risk Typology within LIC Settlements	Suggested Interventions (Community/Individual scale)
1	*Waterlogged + Hard to reach + Water Proximity*	*Community – DEWATs, MURT* *Individual - Raised/Bermed Twin Pits , SURT*
2	*Waterlogged + Hard to reach*	*Community - DEWATs* *Individual - Raised/Bermed Twin Pits*
3	*Waterlogged + Water proximity*	*Community - DEWATs* *Individual - Raised - Septic Tank & Soak Pits*
4	*Remaining waterlogged settlements*	*Community - DEWATs* *Individual - Raised - Septic Tank & Soak Pits*
5	*Hard to reach + Water proximity*	*Individual - Raised/Bermed Twin Pits*
6	*Remaining hard to reach settlements*	*Individual - Twin Pits*
7	*Remaining water proximity settlements*	*Individual - Plastic septic tank and soak-pit*
8	*Remaining LIC settlements*	*Individual - Twin Pits / Plastic septic tank and soak-pit*

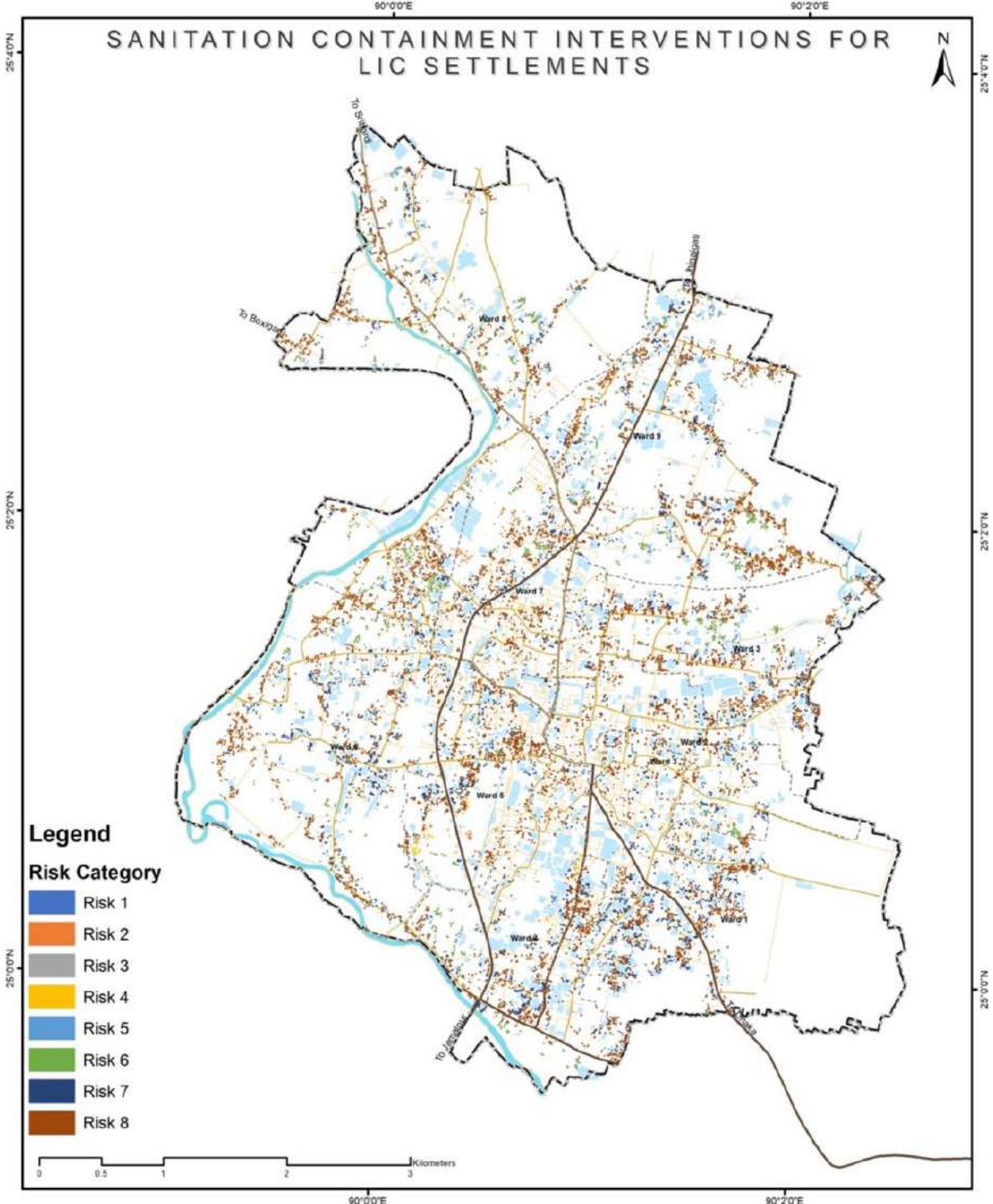
Stage 3 Safe Containment for all Beneficiaries Prioritization and Estimated Investments

Risk Ranking/ Category	Risk Typology within LIC Settlements	Suggested Interventions (Community/Individual scale)	Interventions	Estimated Investments
1	*Waterlogged + Hard to reach + Water Proximity*	*Community – DEWATs Individual - Raised/Bermed Twin Pits*	*Total – 36 HHs, DEWATS – 2 units (19 HHs), Individual Containment – 17*	*= 16000 + 3825 = 19825*
2	*Waterlogged + Hard to reach*	*Community - DEWATs Individual - Raised/Bermed Twin Pits*	*Total – 148 HHs, DEWATS – 5 units (102 HHs), Individual Containment – 46 HHs*	*= 50000 + 10350 = 60350*
3	*Waterlogged + Water proximity*	*Community - DEWATs Individual - Raised - Septic Tank & Soak Pits*	*Total – 102 HHs, DEWATS – 4 units (53 HHs), Individual Containment – 49 HHs*	*= 32000 + 19600 = 51600*
4	*Remaining waterlogged settlements*	*Community - DEWATs Individual - Raised - Septic Tank & Soak Pits*	*Total – 175 HHs , DEWATS – 2 units (63 HHs), Individual – 112 HHs containment*	*= 20000 +44800 = 64800*
5	*Hard to reach + Water proximity*	*Individual - Raised/Bermed Twin Pits*	*Total – 2187 HHs*	*= 492075*
6	*Remaining hard to reach settlements*	*Individual - Twin Pits*		
7	*Remaining water proximity settlements*	*Individual - Plastic septic tank and s*		
8	*Remaining LIC settlements*	*Individual - Twin Pits / Plastic septic soak-pit*		

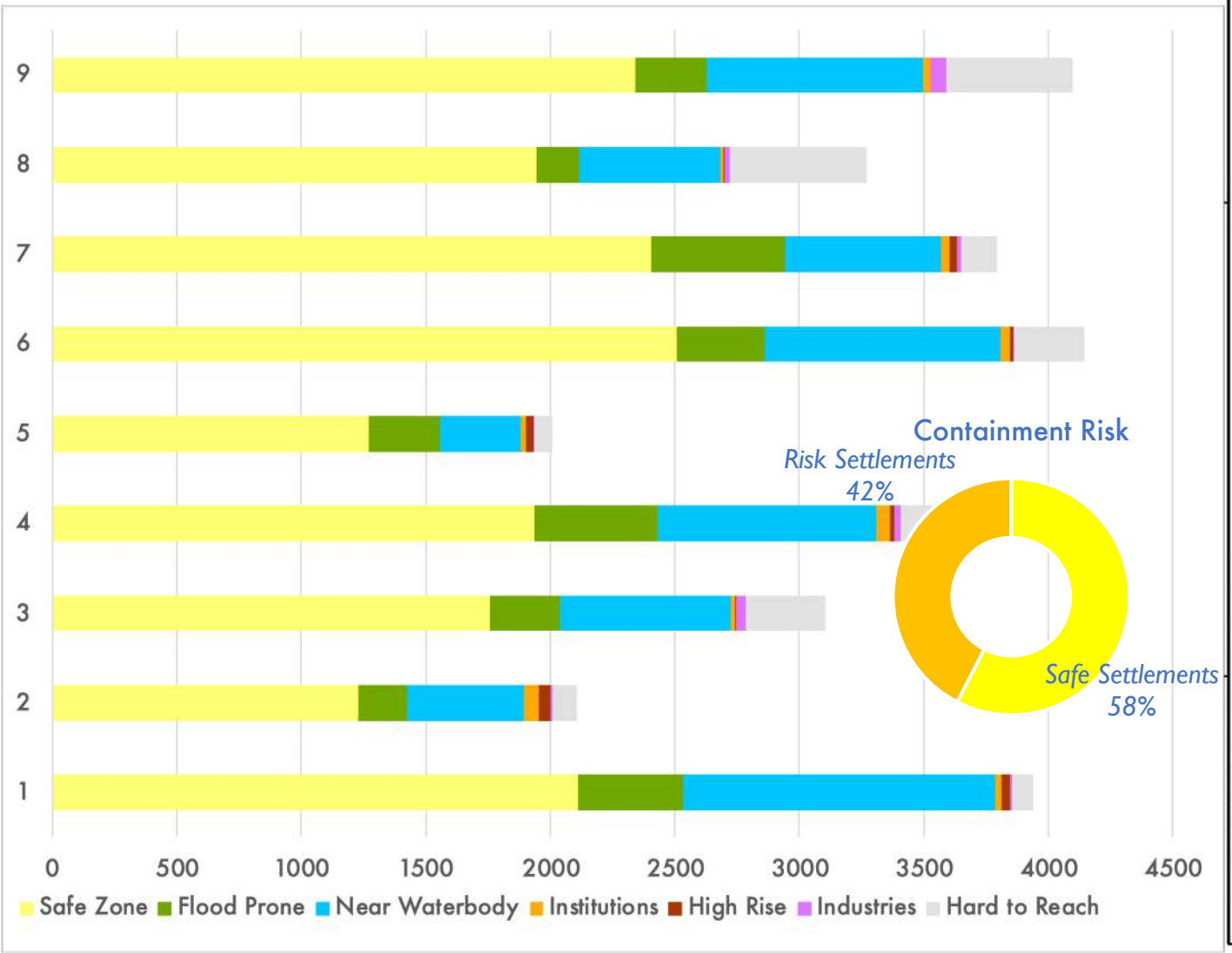
Estimated Costy for Sanitation Interventions in priority households (USD) =	196575 461 Family
CAPEX/Capita	426
CAPEX for Indivisual Containment	78575
CAPEX for DEWATs	118000

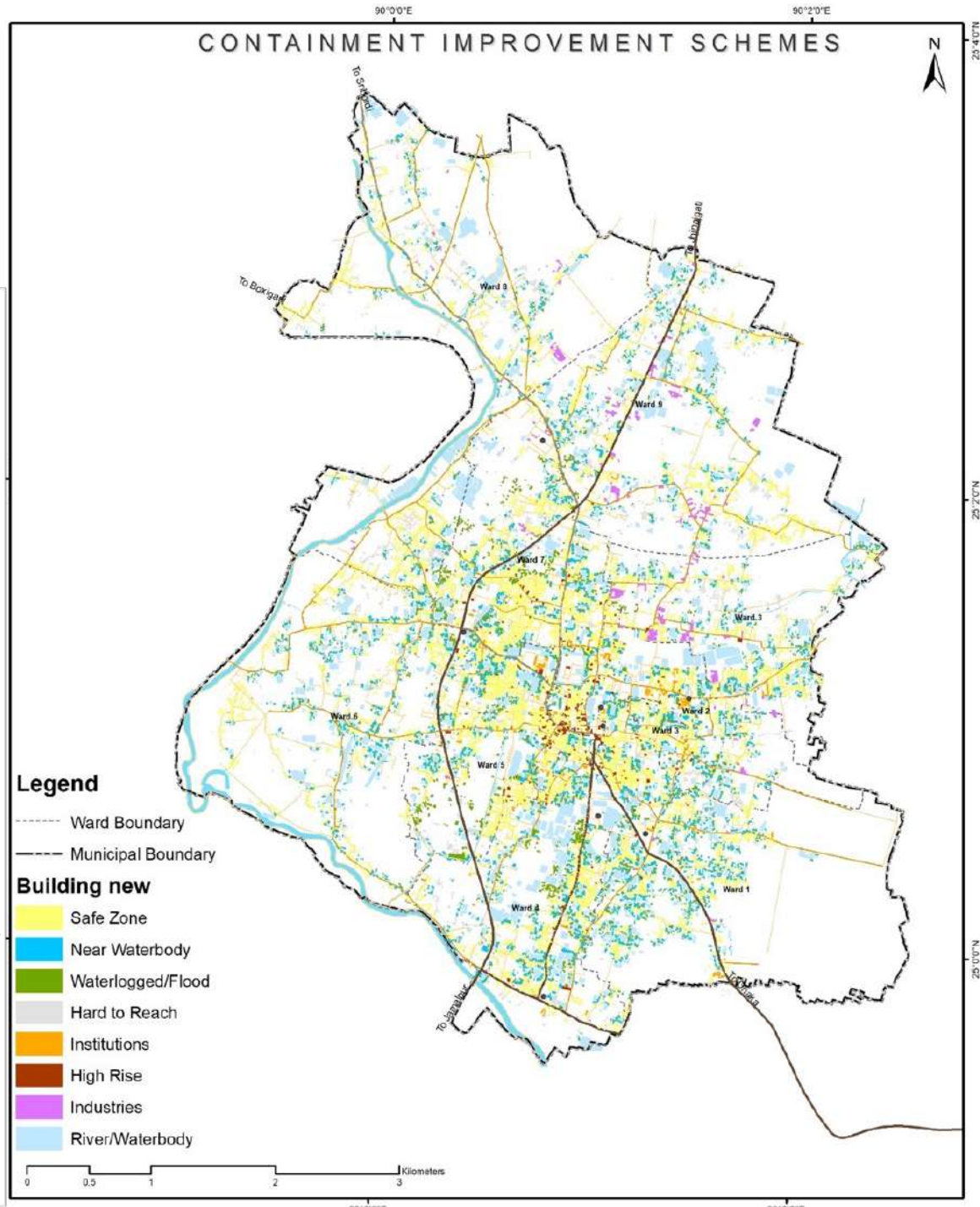
Stage 3 Safe Containment for all - Output Map and Settlement Performance





Stage 3 Safe **Containment** for all
- Containment's **Risk Nature** and Settlement





Stage 4 Adequate Public Toilet

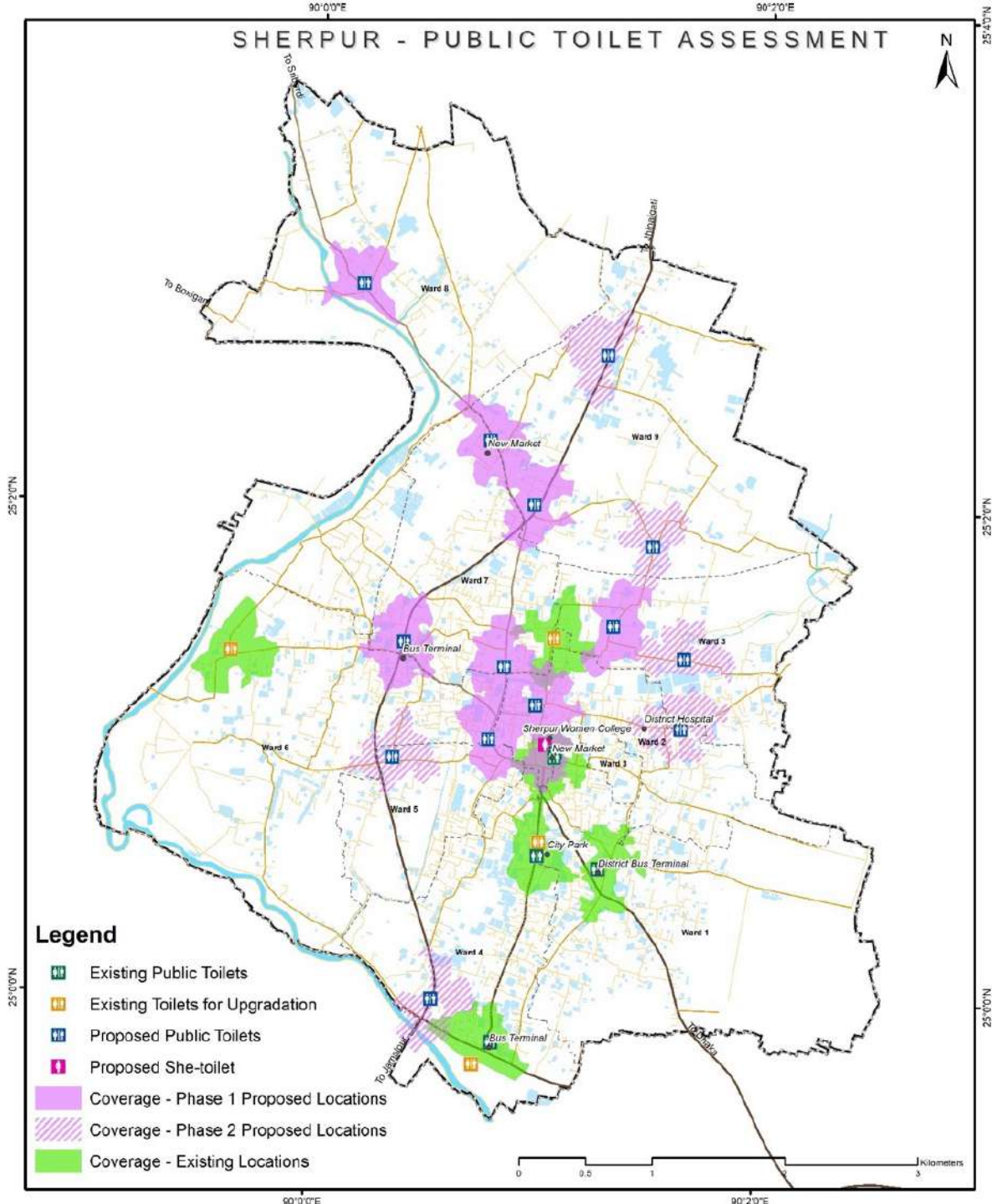
Upgradation, New Block Construction and She Toilet

Inputs *– Commercial unit's location and area, non-residential land use, location and WC details of existing toilets, floating population*

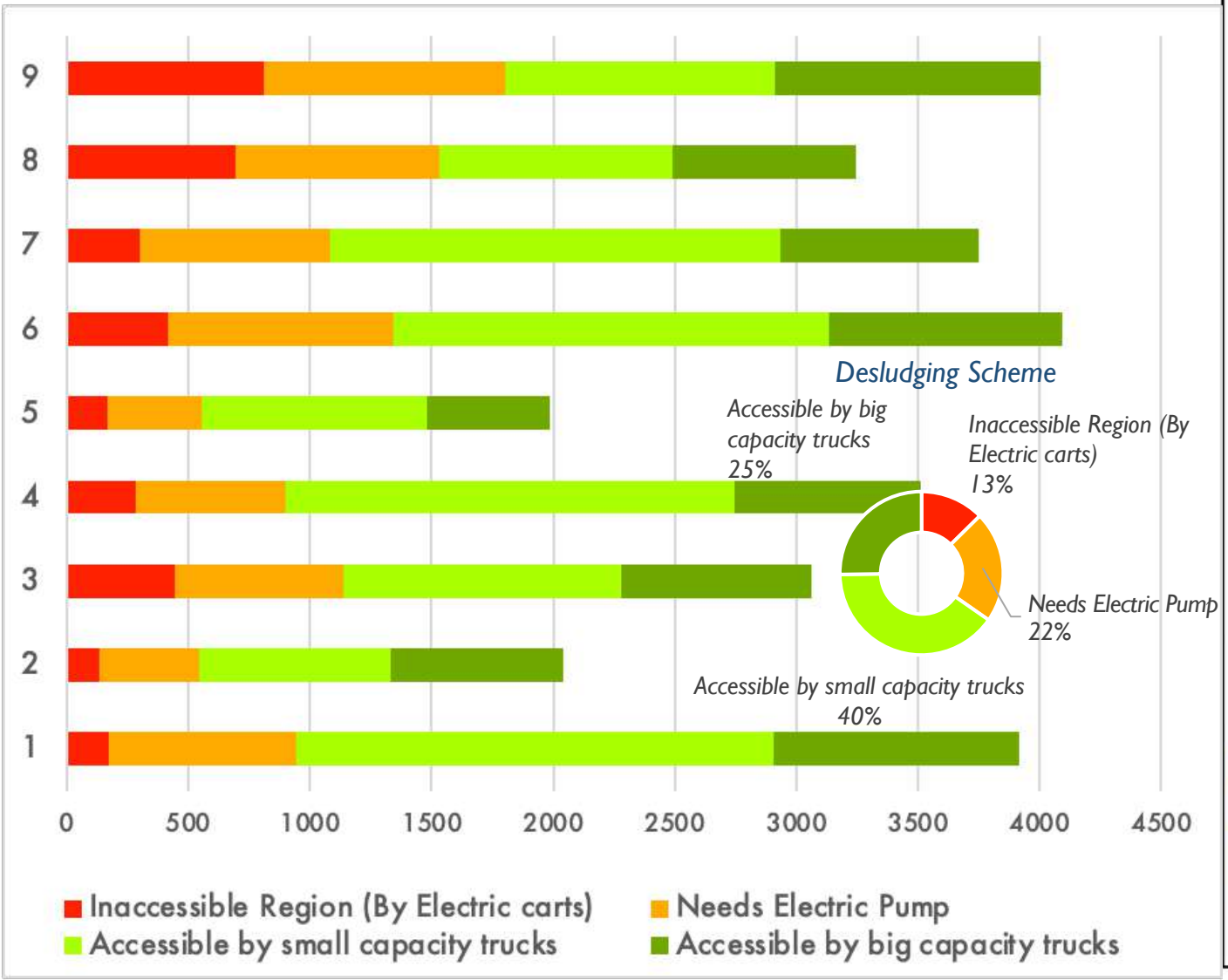
Process *–. Ward wise demand is calculated and compared with standards (both WC and units) to understand gaps. Gaps are reviewed spatially, and recommendation are made .*

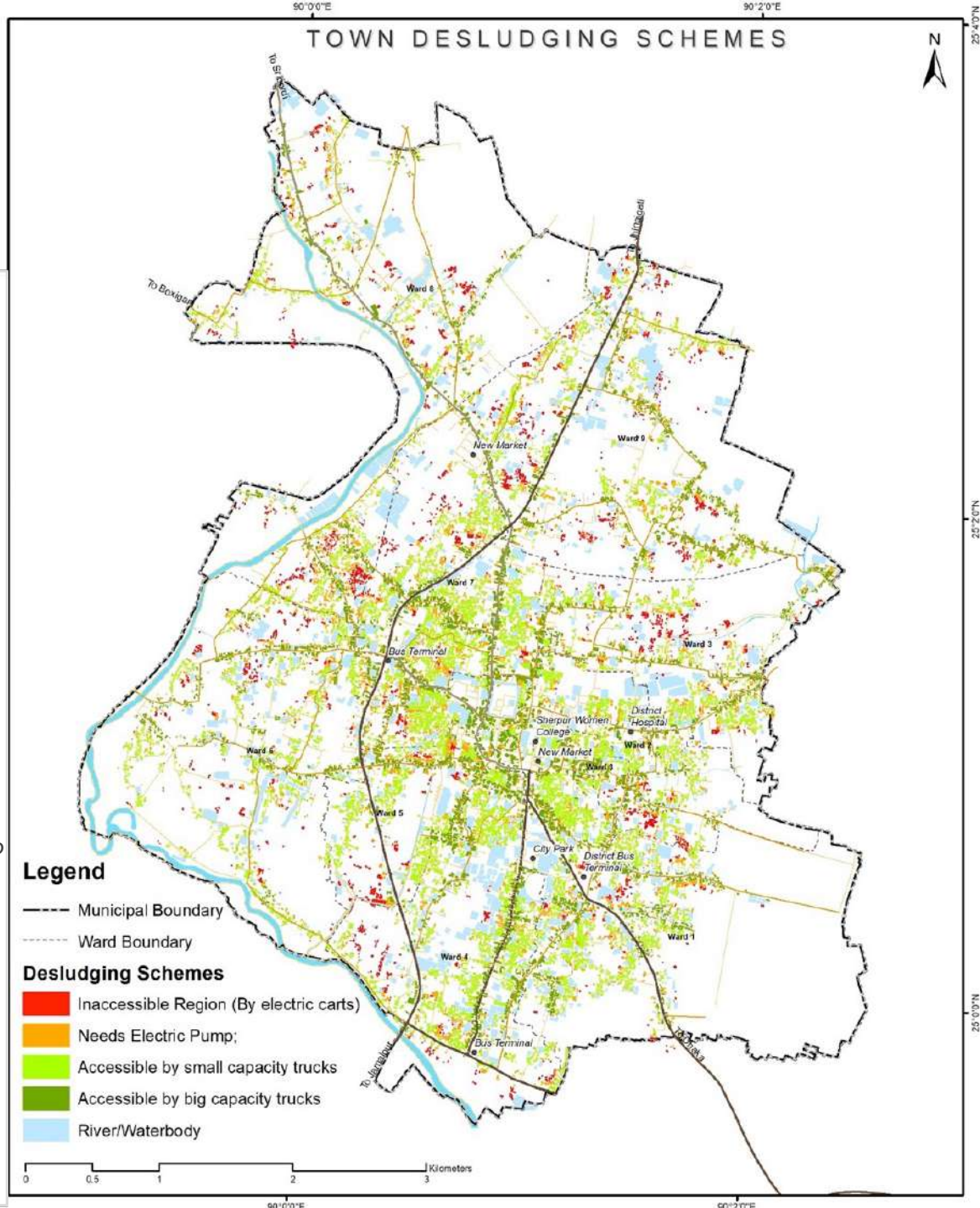
Output *– 9 new toilet blocks (including a She toilet) and upgradation of 4 units.*

Application *– Applying and adopting the recommendations would help to have adequate distribution and coverage of public toilet services.*



Stage 5 Safe Collection to All Emptying Trucks, Capacity and Hardware





Stage 5 Safe Collection to All : Computation Framework of emptying system

Sl.	Category of Sludge Collection	Description	Eligible (HHs)	%	Sludge Volume/d (wrt. to proposed FSTP of 18 KL)	Existing truck volume	Expected volume coverage	Existing volume gaps	tru t de
1	Containments that are accessible by big vacuum trucks	Settlements along the wider road (more than 3.5 meters) within 100 feet distance from a large vacuum truck	7388	25%	7KLD	3 KL (1 Nos)	9 KLD	0	
2	Containments that are not accessible by big vacuum trucks but are accessible by pickup trucks (small capacity trucks)	Settlements along narrow roads (between 2 to 3.5 meters) within 100 feet distance from a small vacuum truck	12364	42%	12KLD	2 KL (1 Nos)	6 KLD	6 KLD	
3	Containments that are remotely located for motorized vehicle access and that require extended pipe length with additional electric pump	In-accessible settlements (less than 2 meters) and between distances of 100 to 200 feet from a vacuum truck	6434	22%	6KLD	1.5 KL (1Nos)	4.5 KLD	1.5 KLD	
4	Containments that are not accessible by motorized vehicle and	In-accessible settlements (less than 2 meters) and beyond the distance of	3430	11%	3KLD	None	None	3 KLD	0

Stage 6 Settlement Proximity from existing/proposed FSTP at pan-town level

Inputs *– Road network and width, building footprints and FSTP location.*

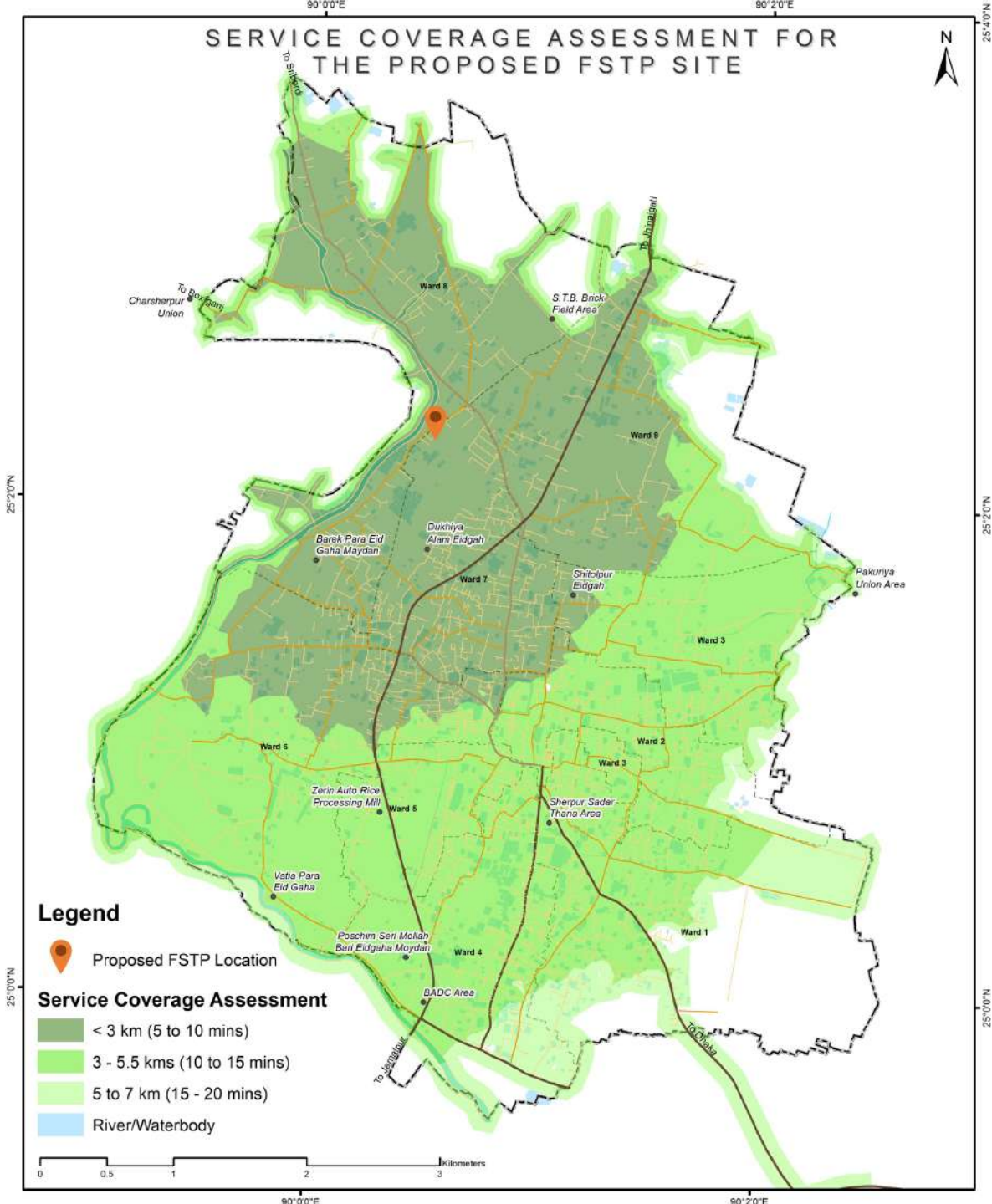
Process *– Proximity analysis from FSTP location, helps in understanding both distance and travel time to all settlement areas*

Output *–*

94% of settlements area of Sherpur are located within 15 mins of travel distance from FSTP and rest 6% within 30 mins.

Application *–*

Helps to validate the locational suitability of both existing and proposed location of FSTP. Based on this analysis, area outside smooth travel distance may also explore options of transfer stations or additional treatment plants.



Stage 7 Ground Truthing and validation of the Proposed Interventions

Illustrations of Sherpur Town

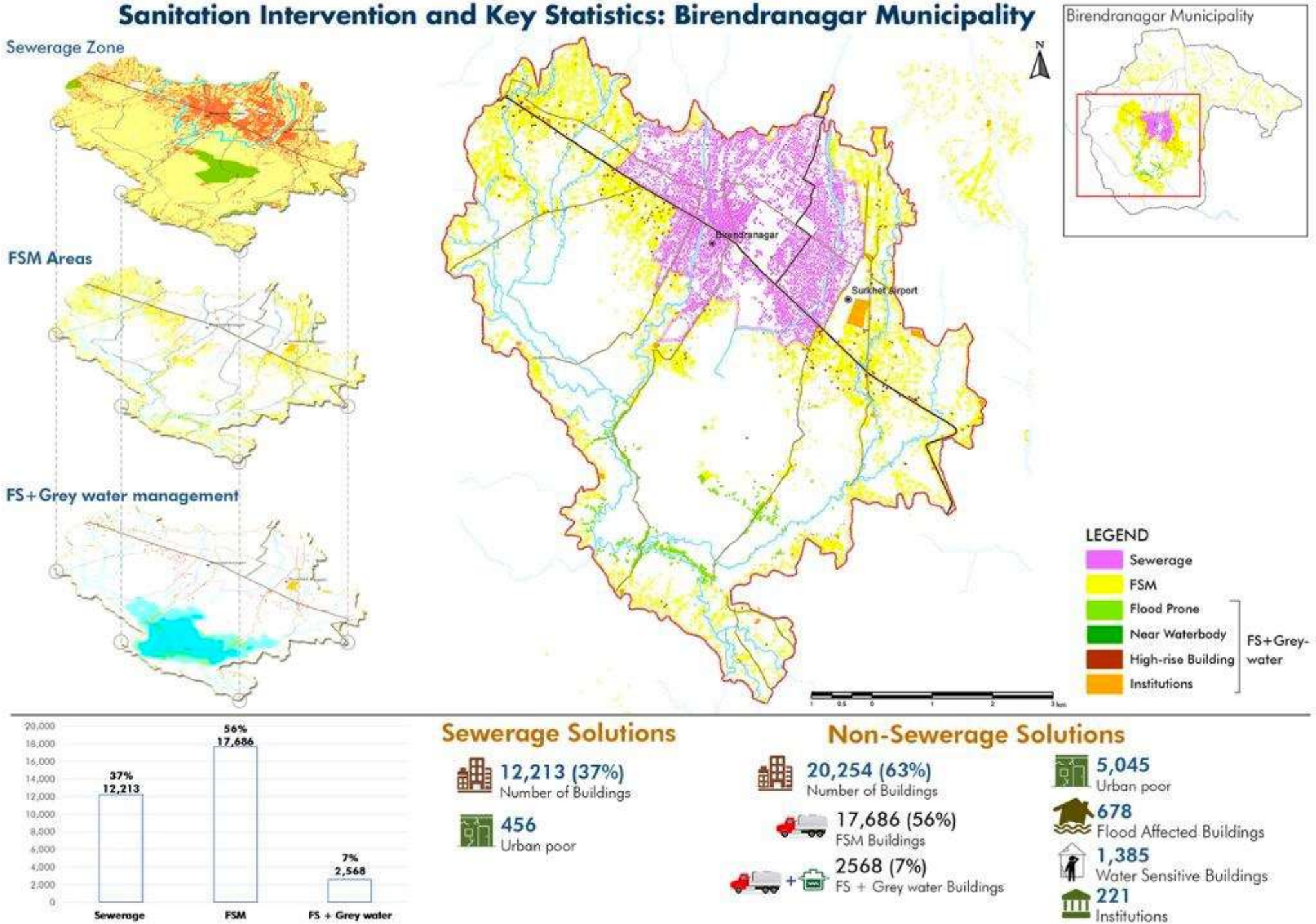
1 – open discharge to stormwater from pits, 2- dilapidated toilet containment, 3,4 – newly purchased emptying trucks, 5- Planted drying bed FSTP, 6,7,8 – Consultations and meetings

Enabling Environment – Regulatory Reforms

Sl.	Suggested Regulations Outline	Timeline
1.0	*Safe Containment for All*	
1.1	*Private Institutions, Hotels and Industries install on-site waste-water management facility like DEWATS/packaged treatment facility within premises (existing premises adhere to this within 5 year's timeline and immediately effective for new premises) - submit plans and a construction schedule for fixing the problem within 1 year*	*Up-to 5 years (case to case)*
1.2	*All houses (non LIC) directly connected to storm water drainage (without any containment), need to construct safe containment within 24 months' timeline.*	*24 months*
1.3	*All buildings (non LIC) falling under risk zones are encouraged to upgrade their toilet's containment within a 24 months' timeline (complete technical handholding and masonry support can be provided by Pourashava).*	*36 months*
1.4	*All buildings (non LIC) falling under safe zone would have a series of options to choose (from any of standard containment system) while constructing/upgrading their toilet's tank. All faulty toilets of this zone would also need improvement for safe functioning.*	*Continues process*
1.5	*All new buildings, irrespective of land uses adhere to the respective zone by-laws for new containment construction (parked under building plan approval).*	*Immediately Effective*
1.6	*Launch subsidy scheme provision for all new LIC community members which shall help in toilet construction.*	*Immediately Effective*
2.0	*Safe Collection, Transportation and Treatment*	
2.1	*Mandatory disposal of all containment emptying operations at FSTP*	*Post upgradation/ construction of the FSTP*
2.2	*Shifting from manual emptying to mechanical operations (banning manual emptying)*	*12 months*
2.3	*Combined operations of plant and truck for attaining operational sustainability*	*Post upgradation/ construction of the FSTP*
2.4	*Health Insurance scheme for all sanitary workers*	*12 months*
2.5	*Encourage sanitary workers to form groups and to lead /manage the entire operation of the built infrastructure*	*Continues Process*
2.6	*Scheduled desludging @every 3 years (up-to)*	*Post upgradation/ construction of the FSTP*

Experience Illustration :

CWIS Assessment and Planning,



Experience Illustration –

CWIS Assessment and Planning, Raghogarh, MP (India)

Parameters

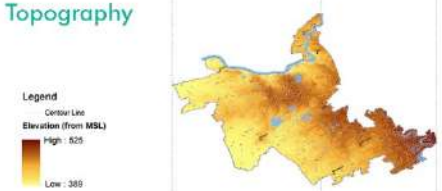
Settlement Typology

Economic Vulnerability

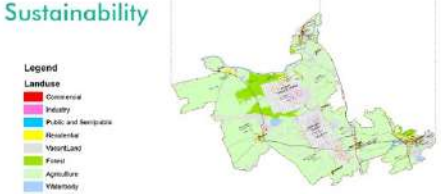
Accessibility

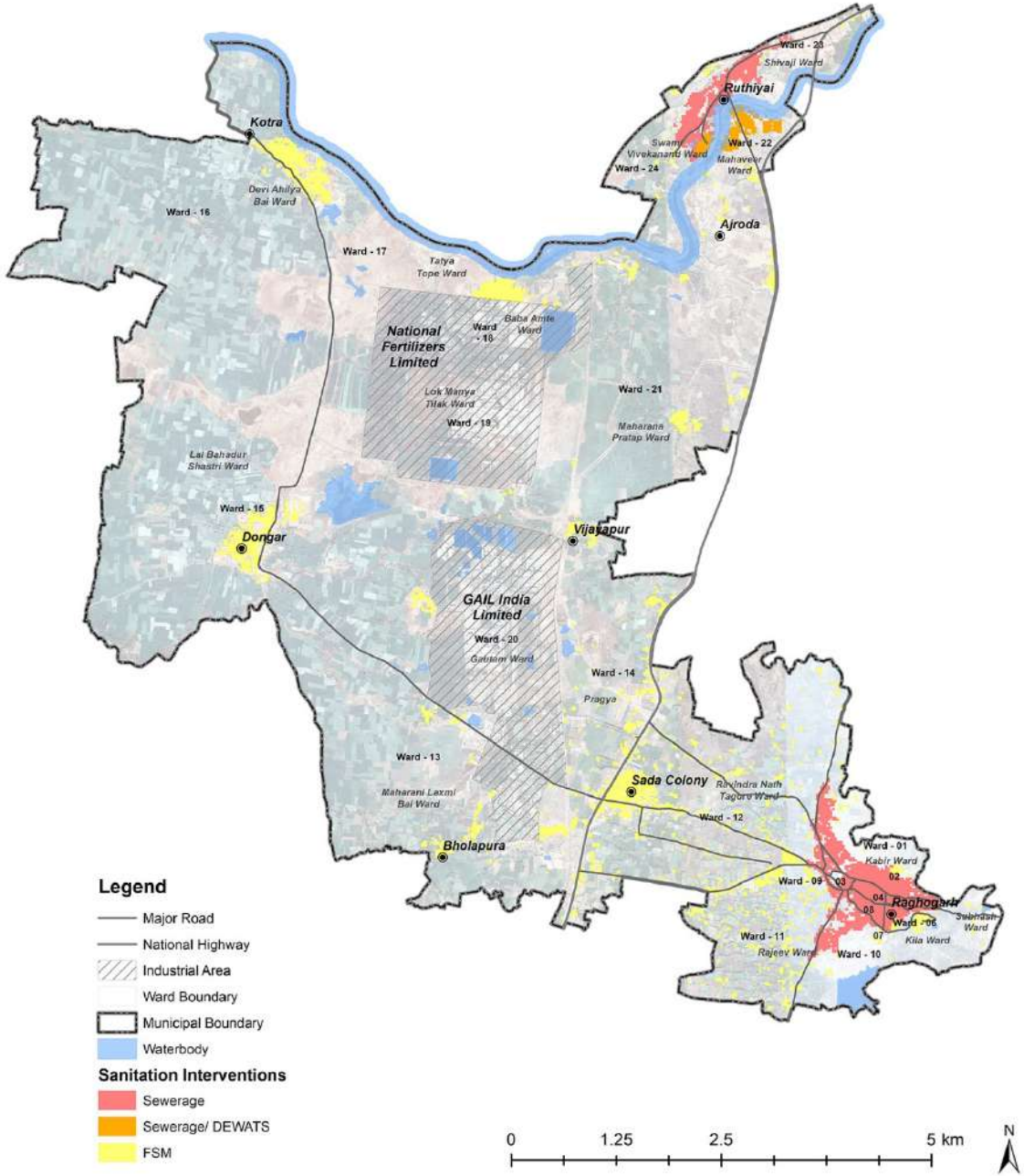
Water Sensitive Area

Topography



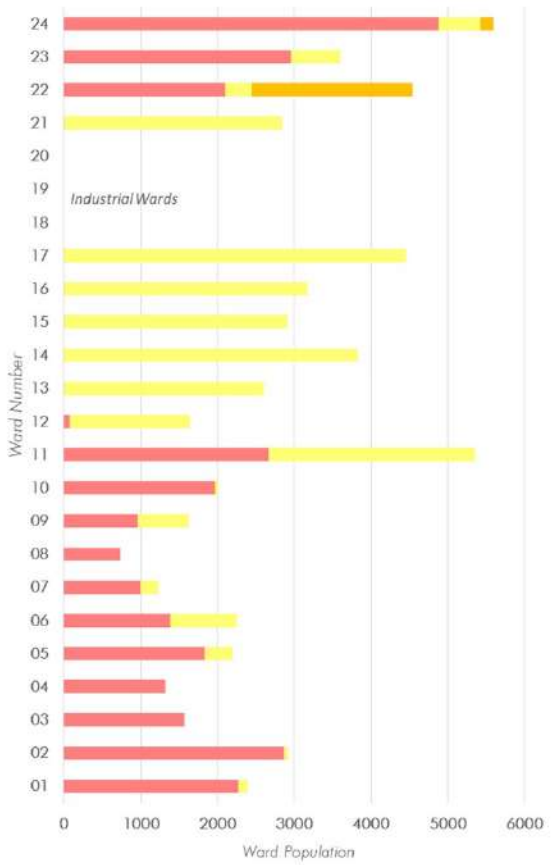
Sustainability



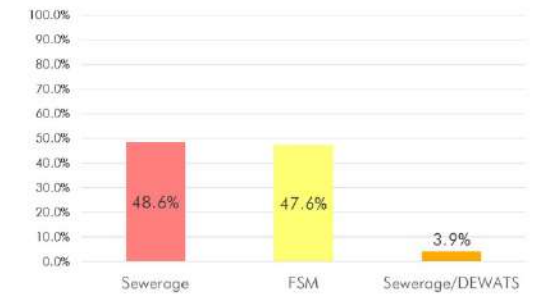


Key Inferences

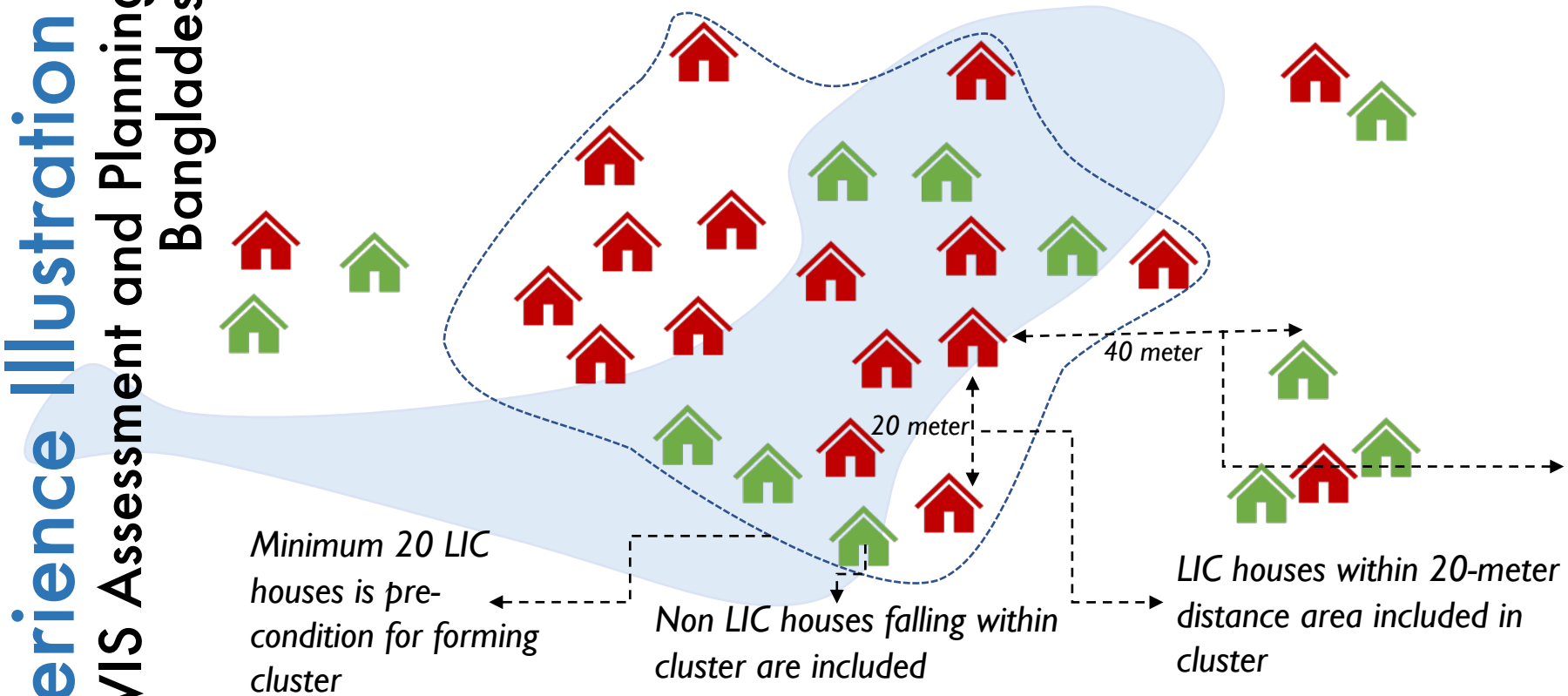
Ward Level Settlement Coverage



Town Level Coverage



Experience Illustration : CWIS Assessment and Planning, Bangladesh



Legend

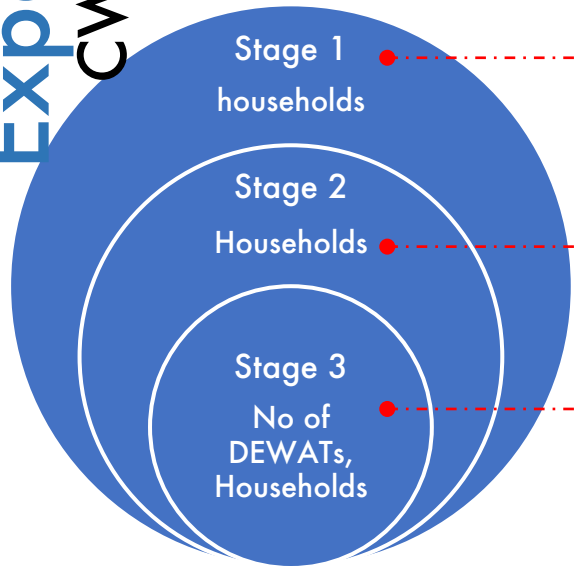
- DEWATs Cluster
- LIC Household
- Other Household
- Risk region identified

Houses more than 20-meter distance intervals are excluded from cluster.

Minimum 20 LIC houses is pre-condition for forming cluster

Non LIC houses falling within cluster are included

LIC houses within 20-meter distance area included in cluster



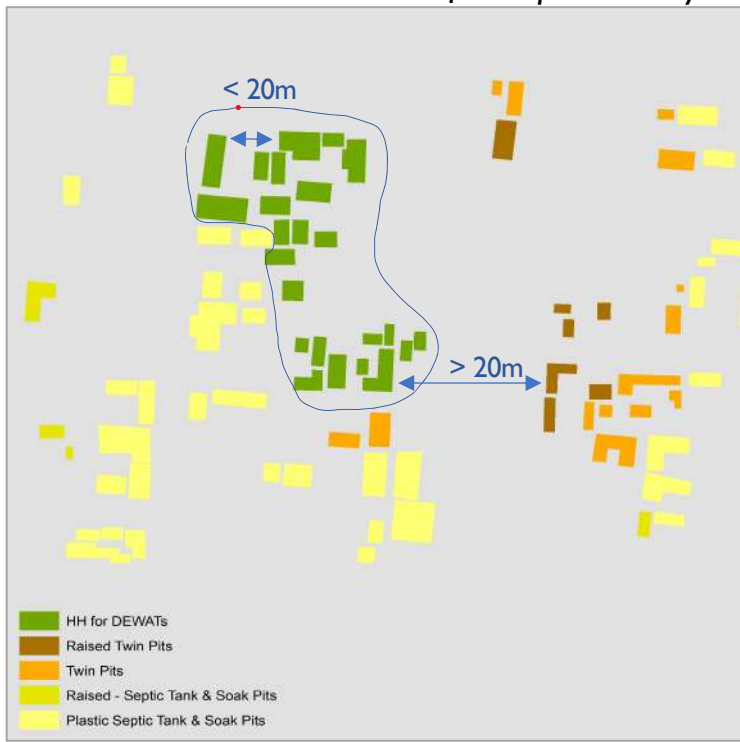
Identify and demarcate climate risk settlements

Identify LIC settlements within stage 1 demarcation

Delineate potential DEWATs cluster (based on density and proximity based)

Methodology – Identification and Delineations of DEWATs Cluster

Illustration from spatial analysis



CWIS Alignment

- ✓ *Inclusion of vulnerable settlements (economic and environmentally)*
- ✓ *Unlocking to Hard-to-reach areas*

- ✓ *Safe containment scheme for pan town*
- ✓ *Safe collection framework to all*

- ✓ *Climate resilient sanitation solutions*
- ✓ *Well located FSTP*
- ✓ *Sustaining ODF+ status in true sense*

- ✓ *Broad areas of regulatory reforms with responsibility and timeline*

- ✓ *Key performance indicator (KPI) for progress monitoring*
- ✓ *Road-map and implementation phasing of reforms*

- ✓ *Strong foundation and enabling atmosphere for smart management system – IMIS*

Advanced Tools for Data Generation

Output Maps	Data Layer	Data Generation Techniques
1. Base map	Administrative boundary	Secondary Sources
	Water bodies	Remote Sensing
	Road/Rail network	Open Street Maps/ High Resolution Imageries/ LiDAR
	Land-use	Remote Sensing
	Building footprints	High Resolution Imageries/ LiDAR
	Building uses	Secondary Sources
	Ward-wise population	Secondary Sources
2. Waterlogged Risk mapping	Elevation profile	DEM/ LiDAR
	Natural drainage density	DEM/ LiDAR
	Storm water drainage network	High Resolution Imageries/ LiDAR
3. Flood risk mapping	Highest flood level (HFL) of nearby river	Secondary Sources
	Elevation profile	DEM/ LiDAR
4. Water proximity settlements mapping	Buffer of water bodies	GIS Analysis
5. Hard to reach settlement mapping	Applying buffers on different road width	GIS Analysis
	In-accessible settlements	GIS Analysis
	Building footprints	High Resolution Imageries/ LiDAR
6. LIC Settlements	Building structure types (Katcha and Pucca)	High Resolution Imageries/ LiDAR
7. Public Toilet – upgradation and new units	Location of all existing toilets	Secondary Sources
	No. of seats (male and female) with each toilet block	Secondary Sources
8. FSTP Proximity Assessment Mapping	Building footprints	High Resolution Imageries/ LiDAR
	Road width and network	High Resolution Imageries/ LiDAR
	Location of FSTP	Secondary Sources

Data to be collected from secondary sources

Data which can be generated

Happy to Answer Your Questions ☺