Evaluation The Role of Blue-Green Infrastructure

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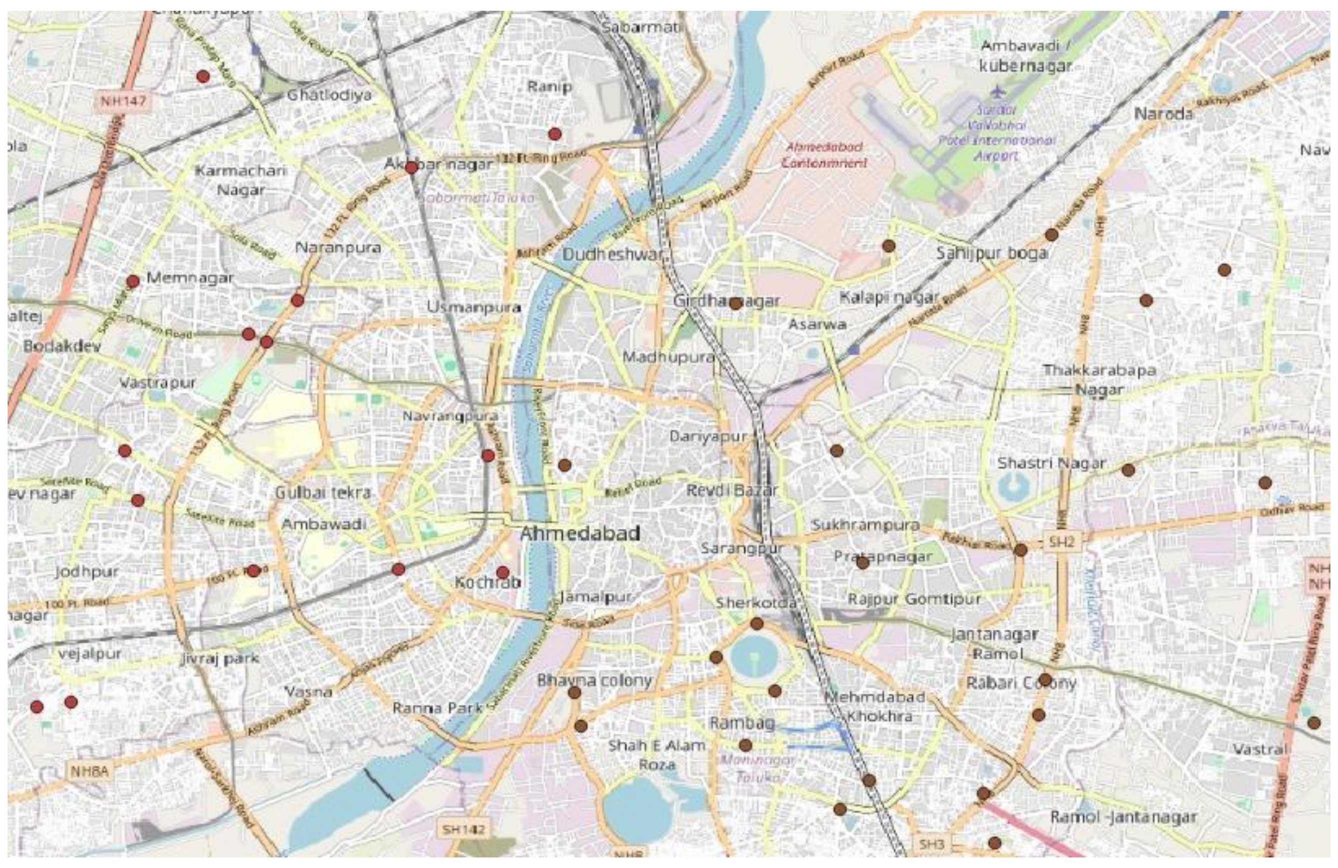
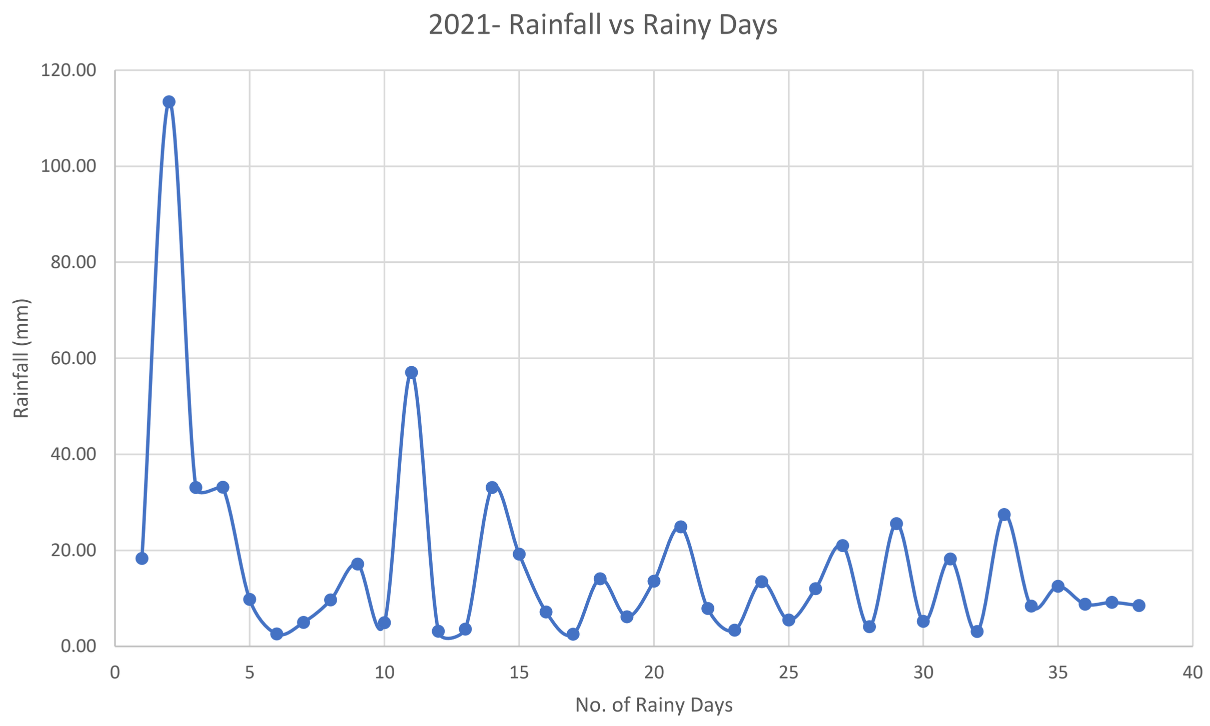
Background: Flooding & Waterlogging

Waterlogging areas in Ahmedabad:



Waterlogging points in Ahmedabad
Referred from SUKALP Documentation

Rainfall Characteristics of Ahmedabad:
Ahmedabad faces recurring and severe urban flooding and waterlogging during monsoon seasons. Rainfall data for Ahmedabad were obtained from local monitoring records and **IMD station** datasets (2018-2021).



Graph of rainfall values at rainy days in 2021

Average rainfall data in mm for 2018 to 2021 years

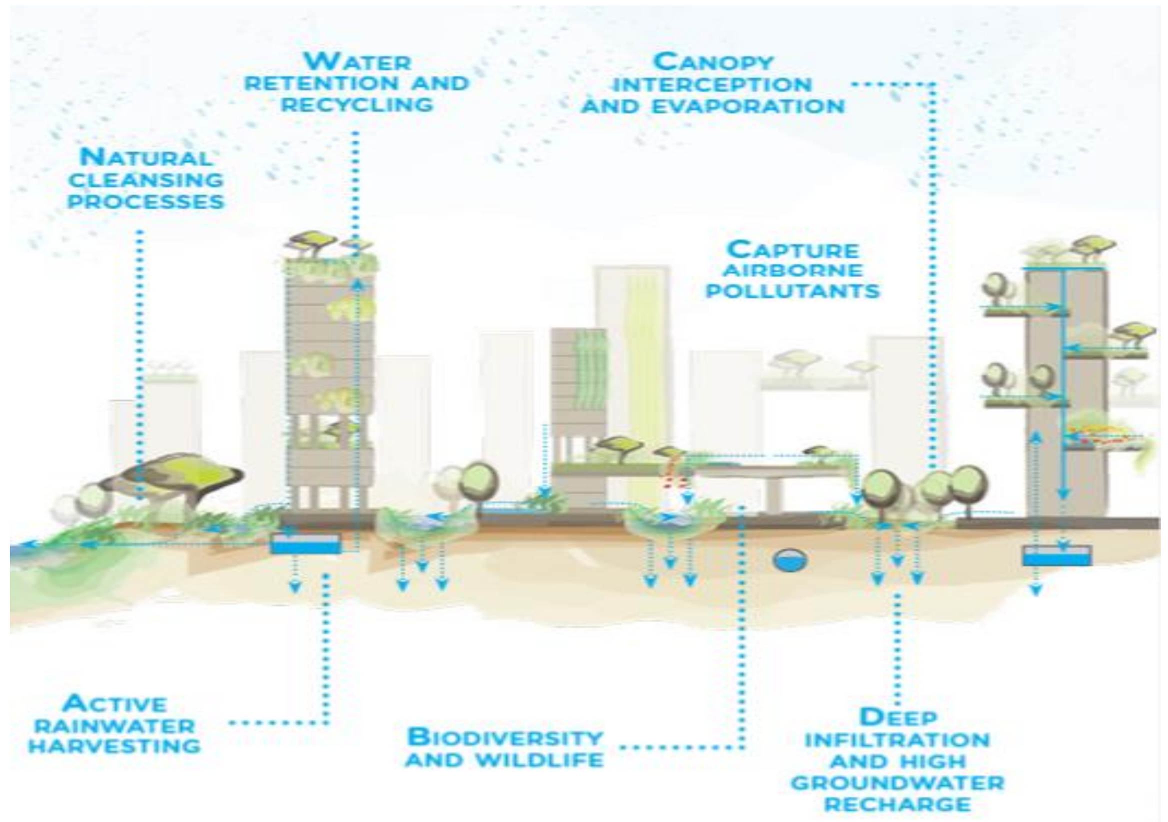
Year	Annual (TOTAL)	Daily(AVG)	MAX	Date of MAX	Rainy Days
2018	371.75	4.24	108.25	17/8/2018	24
2019	763.38	6.21	124.38	9/8/2019	36
2020	918.13	8.01	72.00	17/8/2020	46
2021	625.29	4.50	113.43	18/5/2021	38
AVG	669.63	5.74	-	-	36

The results indicate that Ahmedabad receives an average annual rainfall of about 670 mm, with the maximum daily rainfall of ~124 mm. Although the number of rainy days remains modest (around 36 days per year), the short-duration rainfall intensity is often high, occasionally exceeding 35-50 mm/hr during peak events.

Methodology

- Step 1 – Literature Review & Conceptual Framework
- Step 2 – Classification of BGI Strategies
- Step 3 – Flooding & Waterlogging Analysis in Ahmedabad
- Step 4 – Field Documentation of Percolation Wells
- Step 5 – Infiltration Calculation using 2 methods
- Step 6 – Analysis of Groundwater level recharge
- Step 7 – Public interviews & Feedbacks for Percolation Wells
- Step 8 – Impact Assessment
- Step 9 - Conclusion

Blue-Green Infrastructure BGI



https://www.drishtiias.com/images/uploads/1659960438_Integrated_BGI_Approach_Drishti_IAS_English.png

BGI combines
- Blue systems (rivers, lakes, canals, ponds stormwater drains, wells)
- Green systems (vegetation, forests, trees, parks)

to create integrated and sustainable solutions for urban water and land management

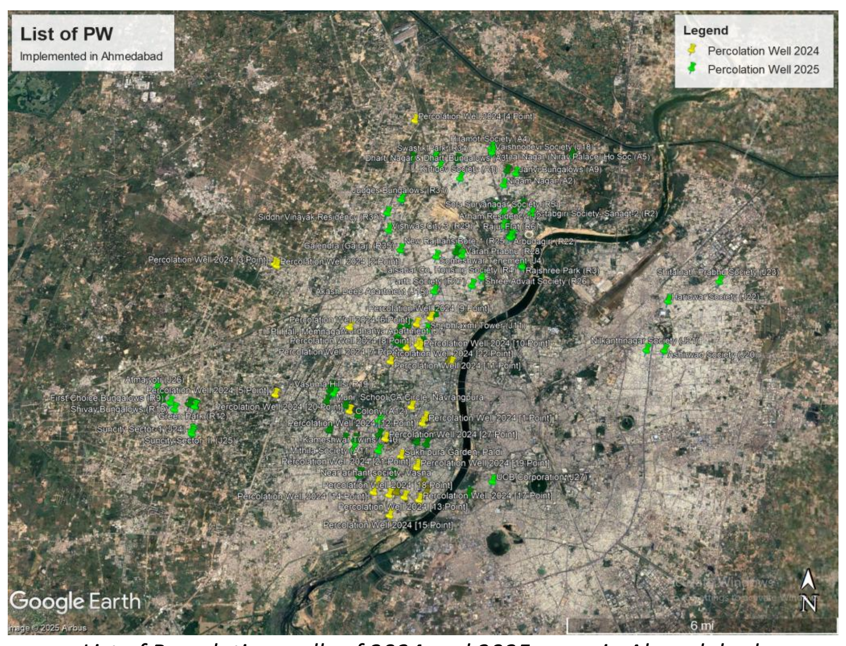
BGI Strategies Classified into **4 categories** by Hydrological Function:

1. **Storage-Based Strategies:** Hold stormwater temporarily or permanently to prevent flooding and release it slowly. (Constructed Wetland, Storage basins for the detention and retention, Rainwater Harvesting Tanks, Blue roof, Urban lake, etc.)
2. **Infiltration-Based Strategies:** Allow stormwater to percolate into the soil (ground) and Increase groundwater recharge and reduce surface runoff. (Rain garden, Infiltration trench/bed/shaft/basin, Dry well, Soak pit, Permeable pavements, Percolation well, etc.)
3. **Vegetation-Based Strategies:** Use plants to slow down flow, enhance infiltration, improve evapotranspiration & biodiversity while providing ecological and cooling benefits. (Urban Forests, Symphony Park, Rooftop gardens, Green Walls / Vertical Gardens, etc.)
4. **Increase in Time of Concentration Strategies:** Slow down and spread-out stormwater to reduce peak flow by increasing surface permeability. (Bioswales, Check dams, Stepped-Pools, Terracing on slopes, etc.)

BGI aims to mimic natural hydrological processes
- Capturing
- Storing
- Filtering
- Reusing
- Rainwater where it falls

BGI represents a paradigm shift
- from traditional grey infrastructure (pipes, drains, tanks)
- toward nature-based solutions that are:
- Cost effective
- Multi-functional
- Environmentally sustainable

Analysis Of Percolation Wells (PW)



List of Percolation wells of 2024 and 2025 years in Ahmedabad.

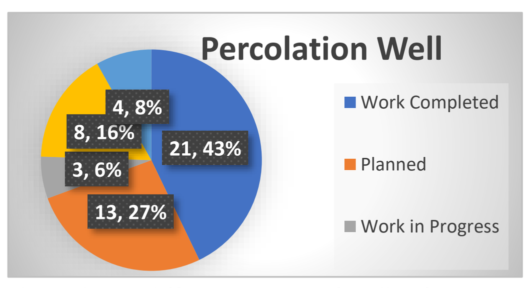


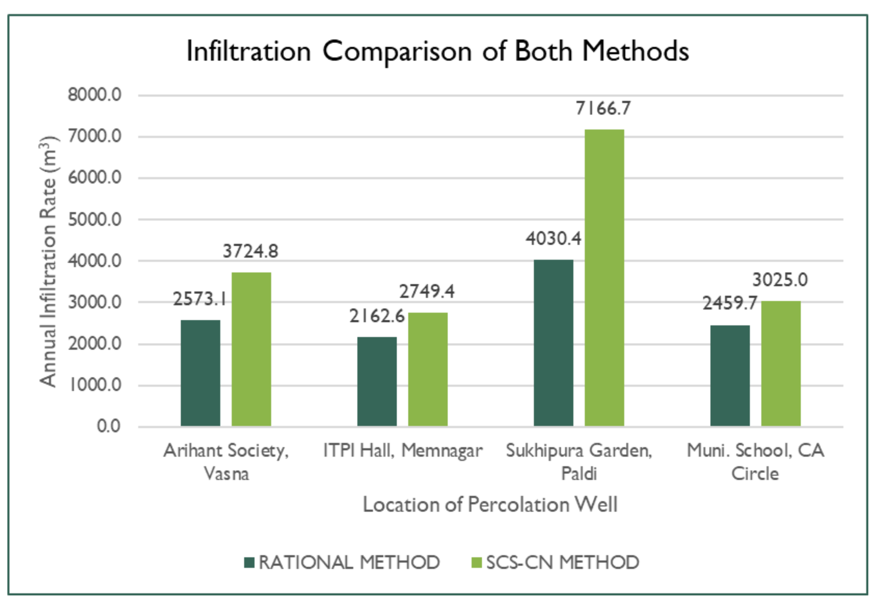
Chart shows different stages of wells of 2024 year

Percolation Well, Vasna

Infiltration Rate Calculations OF PW

Catchment area (4,357 m²) of ITPI Hall, Memnagar (Institutional)

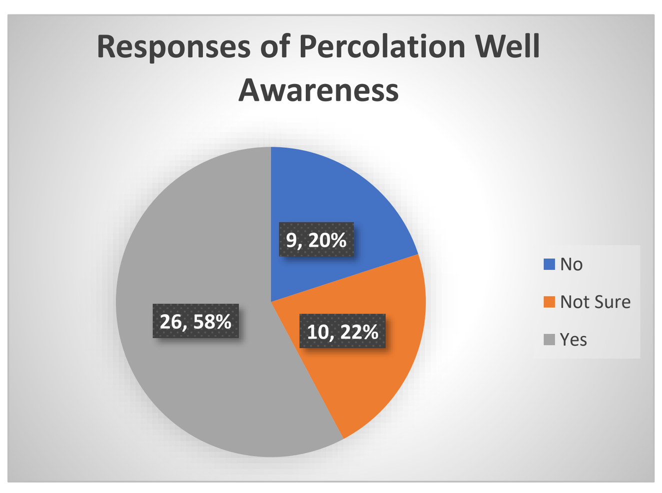
Infiltration comparison of both methods for 4 selected wells



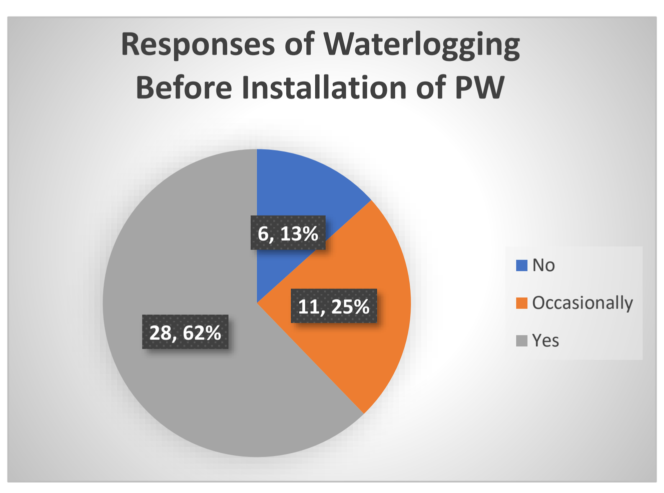
- Overall, the comparison demonstrates that Percolation Wells have substantial recharge potential, especially when analyzed through hydrologically sensitive methods like SCS-CN.
- However, conservative estimates (Rational Method) remain useful for drainage design and stress-testing the system under high-runoff scenarios.

Public Feedback & Interviews For Pw

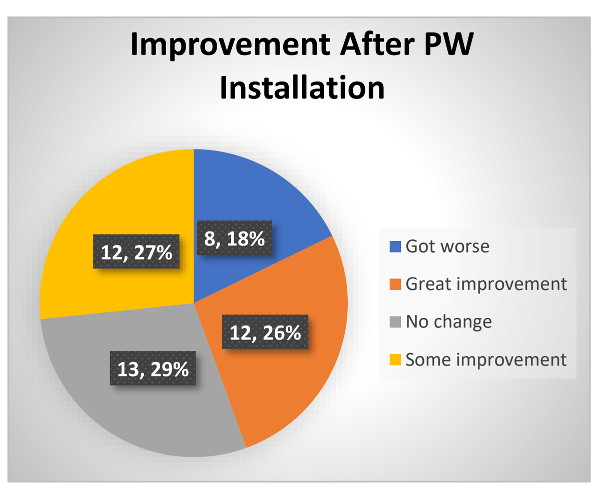
To understand real on-ground perception of Percolation wells about 45 interviews are taken across four-six selected sites.



Responses of PW awareness in numbers and percentages



Responses of waterlogging problems before installation of PWs



Improvement in waterlogging after the installation of PWs

Public Interviews

Impact Assessment & Conclusion

Hydrological Performance
- Both Rational and SCS–CN methods confirm that all four catchments generate high annual runoff, especially those with high imperviousness.
- PWs successfully infiltrate a significant portion of runoff, but larger catchments require multiple wells for effective reduction.

Groundwater Recharge Impact
- Groundwater data (2020–2025, WRIS/CGWB) show seasonal post-monsoon rise in multiple wards.
- Areas with multiple PWs, open grounds, and gardens show better recharge stability than dense built-up zones.
- Telemetric and manual readings confirm that localized recharge improves where infiltration structures are concentrated.

Public Perception & Field Observations
- Most respondents reported "Some improvement" in drainage and reduced waterlogging duration.
- Reported issues include blocked inlets, silt deposits, lack of signage, and poor public awareness.
- Sites with weak catchment connectivity showed limited impact, proving that design alone is insufficient without proper maintenance.

Overall Assessment
- PWs are hydrologically effective, environmentally beneficial, and socially valuable when maintained properly.
- Their performance varies by location due to differences in inlet design, slopes, soil type, catchment connectivity, and maintenance frequency.
- When regularly cleaned and properly linked to runoff paths, PWs significantly reduce localized flooding and strengthen groundwater recharge.