



## GHMC DISASTER RESPONSE FORCE

### *An aging megacity of over 11 million people threatened by flash flooding*

GHMC, Greater Hyderabad Municipal Corporation, in Telangana state in southern India, covers an area of 650 km<sup>2</sup> and is challenged by imbalances in water availability. Urban flooding is caused by intense upstream rainfall that overwhelms aging and insufficient drainage systems, while water scarcity is caused by overexploitation of aquifers and growing populations that strain water resources.

Typically, GHMC received the heaviest rainfalls in September, but in recent years heavy rainfall and flooding has occurred at any time around the southwest monsoon season from June to September. Flood impacts include damage to homes, roads, and infrastructure, contamination of water posing health risks, and disruptions to transport and daily life. Flood risk reduction in GHMC is challenged by a complex interplay of rapid urbanisation, reducing lake capacities, and increasingly frequent and intense episodes of extreme rainfall associated with climate change. Additional challenges include aging infrastructure, financial debts and funding constraints, waste management, and sustainable urban planning [1].

GHMC lies 456 m to 635 m above sea level (a.s.l.), sloping from the outskirts of GHMC through the city and towards the River Musi, along which the city is built. There are 185 lakes within the GHMC boundaries. However, over the last 40 years **unchecked urbanisation has isolated more than two-thirds of these interconnected lakes preventing them from naturally redistributing storm water** [2] (Figure 1).

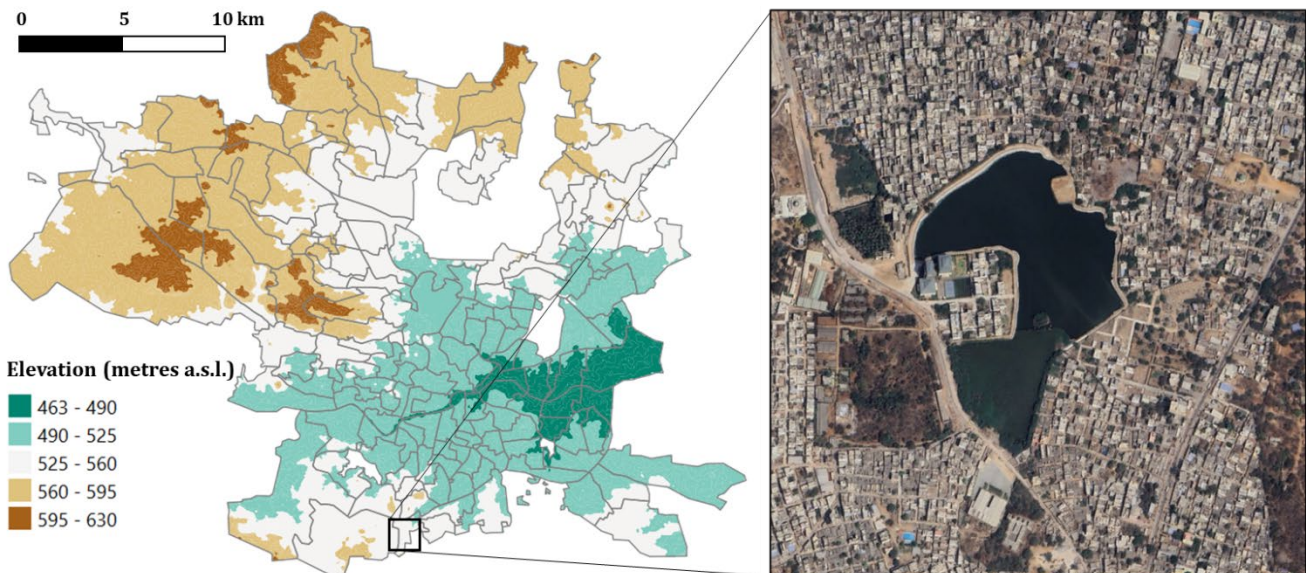


Figure 1: Elevation of GHMC (30 m SRTM DEM) across its 150 wards, with inset of an orphaned lake in the south of GHMC (image from Google Earth).

### **THE INTERVENTION: A Disaster Response Force, the first for an Indian city**

During September 2016 and October 2017, GHMC experienced incessant high intensity spells of rain, with 10 cm in two hours (September) and 13 cm in five hours (October), far exceeding the 2 cm/hour capacity

of the drainage system. The city administration was overwhelmed and forced to approach the National Disaster Response Force to save human lives and support recovery, which delayed the return of normalcy to the city. GHMC realised that a local technology-driven disaster response force was needed, which could carry out preventive flood reduction measures, develop early warning systems, and rapidly respond to threats so that losses in GHMC could be minimised, and disasters averted.

**The GHMC Disaster Response Force (DRF) was formed in 2018, the first ever city-specific rescue force in the history of Urban Local Bodies in India.**

DRF teams are equipped with customised vehicles, precision machinery and a workforce trained to tackle multiple hazard types. They are stationed in strategic disaster-prone locations in GHMC so that any location in the city is reachable within 15 minutes. There is also a centralised training centre, multiple storerooms, and a dedicated 24-hour DRF control room and ambulance service. The DRF has responded to approximately 11,000 requests in the first five years of operation.

**COUNTERFACTUAL: October 2020 floods**

On 11 October 2020, the India Meteorological Department issued an early warning for very heavy rainfall in Northern Telangana, including GHMC, on 12, 13 and 14 October. On 14 October 2020, 300 mm - equivalent of 40 % of annual rainfall - fell in 6 hours, the heaviest daily rainfall ever observed for the municipality. There was widespread panic among citizens residing in low-lying areas, and heavy runoff caused surge breaching of five lakes. **At least 81 lives were lost, >20,500 homes damaged, and 180,000 people affected** [3]; major roads and highways were severely damaged, and several communities were isolated from the rest of the city. Continued heavy rains through to 19 October hampered response efforts such that many communities were under water for a week or more [4].

With this counterfactual, we are considering the impact of these floods had they occurred in the absence of a Disaster Response Force in GHMC.

At the time of the flood in October 2020, the GHMC DRF consisted of 19 teams, 30 supervising officers and a trained workforce of 450 people. DRF carried out activities to mitigate the impact of the 2020 floods across four timeframes that align with the phases of the disaster risk management cycle (Figure 2).

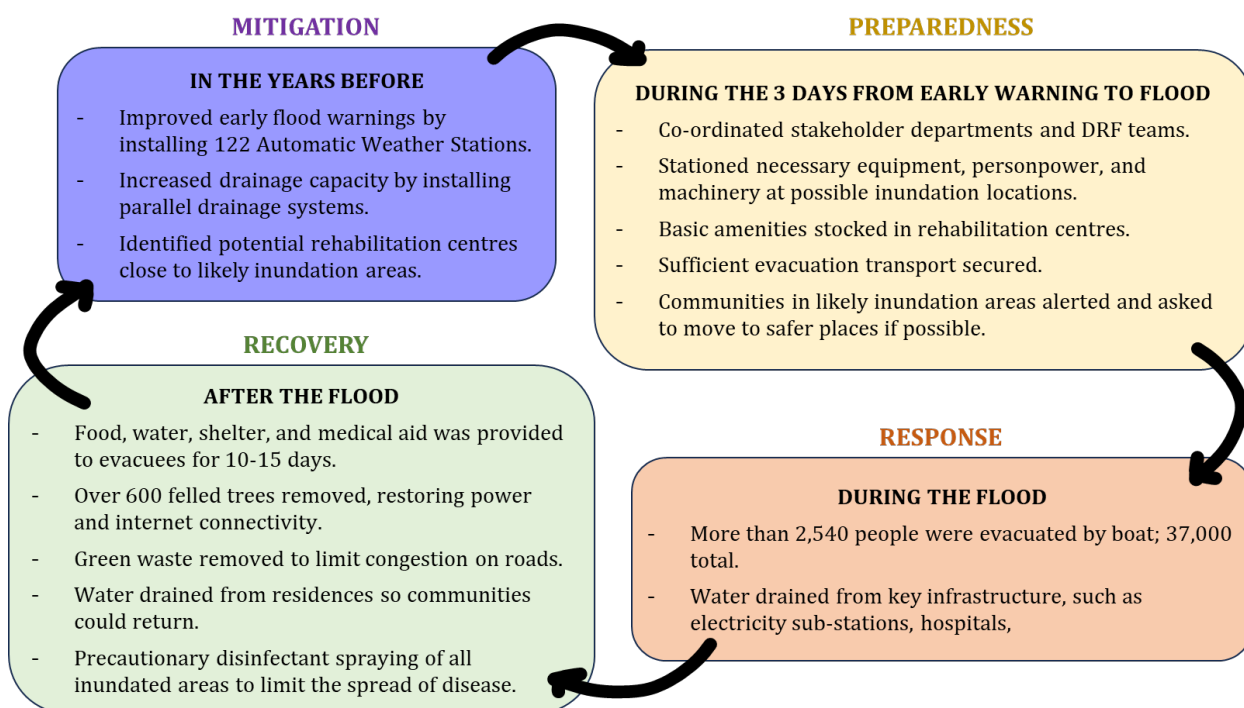


Figure 2: DRF activities around the October 2020 floods, at the four stages of the disaster risk management cycle.

The DRF evacuated a total of 37,000 people before and during the October 2020 floods. Over 34.05 km<sup>2</sup> of GHMC was inundated to a maximum of 2 to 3 m depth [3]. An openly available, realistic mapped flood extent is not available, but given the 1,360,872 mapped buildings in GHMC [6], and assuming an averaged residential building and population density across the inundation area, an estimated 71,300 buildings, the homes of 524,000 people, were inundated (given the 10 million living in GHMC in 2020 [5]).

It is difficult to calculate the effects of early warning messages, pre-emptive awareness raising, and efficient recovery practices (e.g. draining hospitals, restoring electricity) on unrealised impacts. However, considering averaged flood-induced mortality rates of 1.79% in Asia, we estimate that **between c.580 and 9,300 lives may have been saved**, based on the evacuation of 37,000 people and the potential inundation of 524,000. This does not include potential lives saved by measures to improve drainage systems (reducing flooding) or to prevent post-flood disease spread, which were carried out under pandemic conditions.

## WHAT NEXT?

The population of GHMC continues to expand, by more than 2% each year, with a forecast population of more than 14 million by 2035 [5]. Expansion of the DRF, flood management planning, and improvements in early warning systems are therefore paramount.

Prevention strategies have increased since the 2020 floods, including expansion of the drainage systems, developing communication tools and awareness training for potentially affected communities, and training volunteers to respond and support their communities during future floods. An additional 11 DRF teams have been added following their effectiveness during the October 2020 floods, bringing the total number of teams to 30. Planned urban flood management measures include pre-monsoon and post-monsoon drainage cleaning and installation of pumps, the construction and expansion of drains, high-resolution flood modelling, and the creation of more permeable and vegetated city components. Flood early warning systems have been proposed, to include the further collection of high-resolution elevation models, near real-time modelling of inundation areas, CCTV of vulnerable areas, and increasing lake capacities. This will hopefully be implemented within the year and use lessons learned and knowledge transferred from flood mitigation activities in other countries.

Many ULBs in India are studying the GHMC DRF as a blueprint for averting disasters; in recent years, Lucknow has formed its own DRF, inspired by and under the guidance of GHMC DRF.

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