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MAPPING WATER IN A SMALL TOWN

Data and Insights on Water Management in Chintamani, Karnataka

WELL LABS — WATER · ENVIRONMENT · LAND · LIVELIHOODS
BORDA SOUTH ASIA
TIDE FOR PEOPLE AND PLANET
Federal Ministry for Economic Cooperation and Development
DCB BANK

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About WELL Labs

Water, Environment, Land and Livelihoods (WELL) Labs co-creates research and innovation for social impact in the areas of land and water sustainability. It is based at the Institute for Financial Management and Research (IFMR) Society. WELL Labs designs and curates systemic, science-based solutions using a collaborative approach to enable a high quality of human life while simultaneously nurturing the environment.

About the Urban Water programme

The impacts of flooding and urban drought are expected to worsen as more people live in cities, more and more land is built up, and extreme climate events grow more intense and frequent. The Urban Water programme at WELL Labs designs pathways towards water-resilient cities. We do this by addressing knowledge gaps to enable effective decision making and building coalitions between governments, market players and civil society groups.

We focus on:

- Aggregating data and drawing actionable insights
- Building an ecosystem for water resilience
- Co-creating evidence-based and user-centric solutions
- Designing market instruments and policies

About TIDE

TIDE is a 30-year-old not-for-profit science and technology organisation which was conceived as a link between research organisations and communities, in adapting technologies for a greener future and building resilient communities. Over the span of our 30-year journey, TIDE believes technology, if tailored to align with the local conditions, has the potential to address various societal challenges.

TIDE has executed more than 250+ projects on energy, livelihood, climate education and WASH benefitting a million Indians spread across 15 states of India. In the last 3 years, TIDE has extensively engaged with and supported Chikkaballapura and Chintamani CMCs by demonstrating innovative and decentralised WASH interventions thus providing improved access to the underserved communities.

About BORDA

Bremen Overseas Research and Development Association (BORDA) e.V. is a specialist organisation active in the fields of sanitation, poverty alleviation, sustainable protection of natural resources and the strengthening of social structures. BORDA was established as a German non-governmental, not-for-profit organisation in 1977, by concerned citizens from Bremen, with assistance from the Bremen Overseas Museum (Überseemuseum), various institutes of Bremen Universities, and trade and industry enterprises as well as with support from Bremen's Senate.

BORDA's mission is to improve the living conditions of disadvantaged communities and to keep the environment intact through the expansion of Basic Needs Services in the areas of decentralised sanitation, water, and energy supply as well as wastewater and solid waste disposal. Since 2001, BORDA has concentrated on development-oriented cooperation projects and services in the field of improving Basic Needs Services (BNS) for the water and sanitation sector.

As a part of our recent projects, BORDA is supporting small and medium sized towns in South Asia (India, Nepal and Bangladesh) to tackle the challenges arising due to unplanned urbanisation in water and sanitation sector, by improving the infrastructure and service delivery of local government, municipalities, and other public utilities.

BORDA works under the following mandates:

- Develop decentralised basic needs services on local government/municipal level
- Protect natural resources: Value renewable energy sources and recycling
- Develop capacity, know-how and facilitate technology transfer
- Advising sector policies – local to global level
- Provide technical expertise, global insights, and access to decision makers, to make a meaningful contribution in the form of knowledge, technology, and empowerment

Go to https://bit.ly/46P0GO6 or scan to read the online version of this report:

bitly

Figure 3.7: Nekkundi lake catchment - UGD network

Source: Base sewerage map by the KUWSDB. Annotations based on analysis by WELL Labs.

Considering the Nekkundi catchment area, there are two main sewer pipelines – one that traverses the periphery of the lake (along the bottom) joining the second line that merges at the outlet of the lake before continuing towards Bhukkanahalli[5] (not in image as this lake is outside Chintamani).

During field visits in late 2022, it appeared that these two lines were not fully operational and were broken in parts resulting in wastewater entering the lake as shown in Figure 4.5. We also noted that these lines were not connected to any Sewage Treatment Plant (STP), which means these pipelines were ferrying raw sewage away from the town to the water body. This is a public health hazard and squanders the potential of either of these lakes – Nekkundi or Bhukkanahalli – from serving as a safe water source.

[5] We did not carry out water quality tests in Bhukkanahalli because it's one of the smallest lakes and is located outside Chintamani town limits.

Figure 3.8 : Broken underground drainage pipes near Nekkundi lake

Credit: Rajesh R, WELL Labs

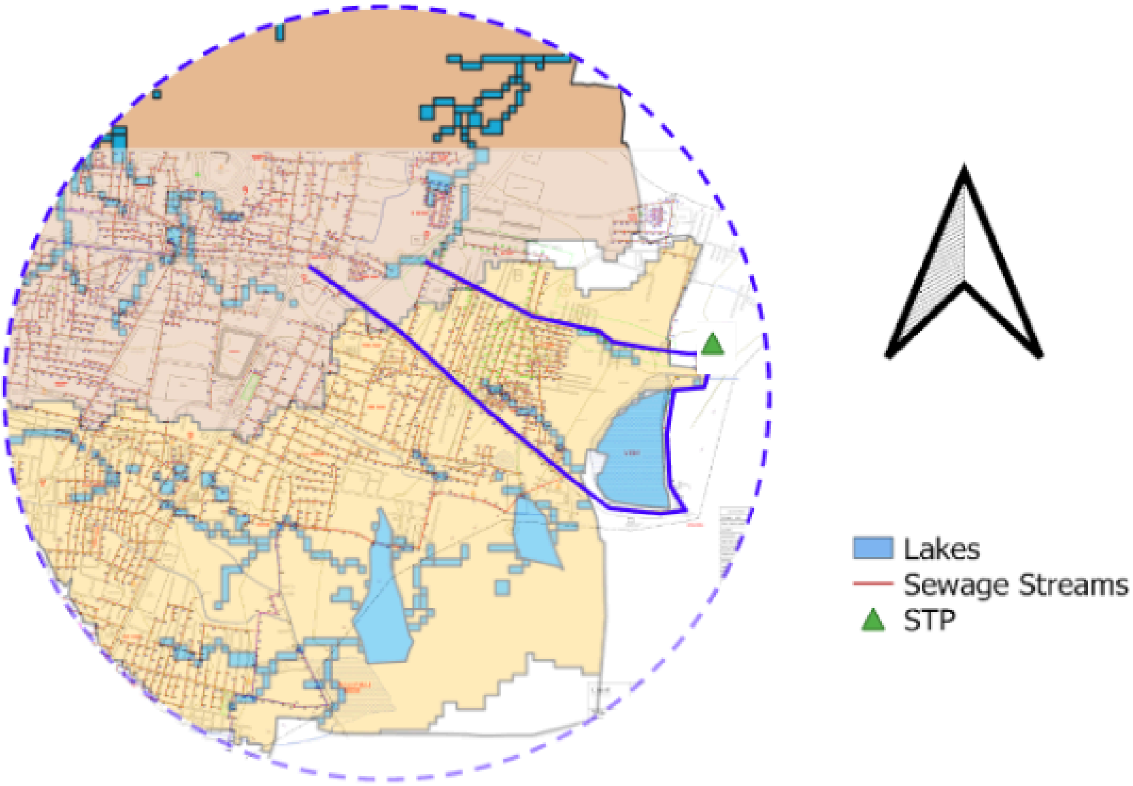
The Gopasandra catchment area has a similar story to tell except that the town's sole operational STP is located downstream of the Gopasandra lake. There are two main sewer lines here, one heads towards the north and the other loops around the length of the lake. Through our interviews with CMC officials, we understood that there were maintenance issues with the sewer pipelines in this catchment as well, although we could not verify this when we visited the lake.

The location of the STP being downstream of the Gopasandra lake makes the water body vulnerable. Typically, STPs are located upstream to allow treated wastewater to be released into the lake, and not raw sewage.

Sewage treatment infrastructure is inadequate, only 35% of the total wastewater generated is treated.

In Section 1.3 (page 16 on wastewater management), we estimated that Chintamani generates 5.72 MLD of wastewater. Chintamani's operational STP, which is based on oxidation ponds to treat wastewater, has a capacity of 2 MLD. This means that a vast majority of the wastewater goes untreated; this is particularly apparent from the flow of run-off and wastewater in the Nekkundi catchment.

Figure: 3.9 Gopasandra lake catchment - UGD network



Source: Base sewerage map by the KUWSDB. Annotations based on analysis by WELL Labs.

Records of the STP's pump operations showed that the facility has been receiving sewage well beyond its capacity. We interviewed the STP operator, who reported that the ponds have not been desludged for a long period of time. Typically, anaerobic ponds need to be desludged once sludge reaches one-third of pond depth along with periodic removal of scum on the surface for facultative ponds (Mara, D. 2008). Proper maintenance of the STP, if not done frequently, impacts treatment efficiency.

We observed that treated water from the STP was tinged green, indicating that some amount of algae was getting past the treatment process. The Chintamani municipality did not have monthly STP effluent testing results.

Treated water from this STP flows downstream and is used for pisciculture and irrigation outside the town's limits, but there appears to be no formal arrangement with users.

New STPs have been proposed, which could address water pollution in the region

As Chintamani's population grows, it becomes more critical that the town's wastewater treatment capacity is enhanced. To meet future treatment requirements, the KUWSDB has proposed a 6.4 MLD STP near Bhukkanahalli lake. Additionally, to address the flow of pollutants into Nekkundi lake, the Chintamani CMC had considered a 75 KLD interceptor-type STP near the lake boundary, where one of the major storm water drain channels enters into the lake.

Expediting the construction of another treatment facility near Nekkundi lake coupled with improvement of existing systems could significantly cut down on water pollution. This means ensuring all households are connected to the sewerage network as well as repair and maintenance of the sewerage network pipelines. These measures alone could ensure that at least 4 MLD[6] treated water would be available for reuse purposes both within the town and in the farmlands outside Chintamani town for irrigation.

Figure 3.10: Treated water from the STP

Credit: Rajesh R, WELL Labs

Lakes in Chintamani town could meet up to 50% of current demand, if rejuvenated and managed properly.

The current extent of pollution and state of the lakes in Chintamani paints a dire picture. But it is also clear that the lakes scattered across the town's semi-arid landscape are a big part of the answer to Chintamani's water woes.

We examined to what extent cleaning up the town's lakes and inlet channels could address the drinking water requirements of the town. Assuming an average year's rainfall, our preliminary analysis showed that rejuvenating Nekkundi and the two smaller lakes – Malapalli & Chikka Kannampalli – along with its feeder channels, could provide

[6] 5.73 MLD is the total wastewater generated. Post transport and treatment (losses during the process) will mean at least 4 MLD is available for reuse.

between **2.25 to 3 MLD** of water, adding to the meagre 1 MLD currently sourced from the Kannampalli lake[7].

Accounting for *imported* water as well could further increase the potential contribution of surface water sources. There is a proposed scheme being implemented to supply water from Bhaktharahalli Arsikere lake located 15 kms away from Chintamani, which will yield about 3 MLD. Along with 1 MLD currently being drawn from Kannampalli lake, we could meet over 90% of the current demand of ~7 MLD completely through surface water, greatly reducing pressure on depleting groundwater.

Figure 3.11: Bhaktharahalli Arsikere lake

Credit: TIDE

Enhancing surface water storage would create multiple benefits such as improving groundwater recharge, lowering the cost of pumping and increasing biodiversity. But rejuvenation of lakes needs to be done in a systematic and scientific manner. To accurately assess storage and recharge potential, we need to conduct a detailed assessment of the water bodies such as siltation levels and bathymetry.

It is also important to understand the local communities' aspirations – how are they vulnerable to water and sanitation-related hazards, how do they perceive these water bodies and the services it could provide, and how can it be monitored and managed in the long run? These are some of the questions that must be considered for surface water rejuvenation in the region.

[7] Please check Annexure 1 for a breakdown of these estimates and how we calculated them.

4. GOVERNANCE AND FINANCE

Planning and financing water supply and sewerage infrastructure.

Credit: TIDE

Strong local governance is pivotal for ensuring water supply and sewerage infrastructure is planned, funded, implemented and managed effectively. We have mentioned the Chintamani City Municipal Council (CMC) in other chapters of the report specifically in terms of how they manage groundwater and wastewater treatment. In this chapter, we take a closer look at their role and the extent of influence of state and district actors with respect to water and sanitation service provisioning and delivery.

One of the main parts of this analysis is the municipality's budget allocations. Though beyond the scope of this report to conduct an in-depth study on finances, we still aimed to understand their overall fiscal performance, their spending on water supply and sewerage infrastructure and whether the Chintamani CMC are able to meet the expenditure incurred.

4.1 Institutional framework for water supply and sanitation

Municipal governments often lack autonomy with certain functional domains limited and controlled by state governments (Jain & Joshi, 2015). Karnataka is one of the states where water and sewerage functions are managed by boards appointed by the state government in a bid to better manage urban agglomerations that may extend beyond the jurisdiction of a single municipality. District-level authorities and parastatal agencies thus play a key role in planning and implementing water supply and sewerage infrastructure in Chintamani

The institutional framework governing a small town urban local body is complex.

There are different administrative levels across state, district, and town levels – Directorate of Municipal Administrator (DMA) and Karnataka Urban and Water Supply Development Board (KUWSDB) at the state, Deputy Commissioner along with Project Director - District Urban Development Cell (DUDC) at the district level, and Municipal Commissioner and President of CMC at the town level.

Within the ULB, the engineering section oversees functions such as water supply supported by field-level staff such as valve men. Similarly, an environment engineer works alongside senior and junior health inspectors to oversee sanitation infrastructure and operations including solid waste. The ULB has an elected body of councillors representing each ward who in turn elect a President for a fixed term who presides over council meetings.

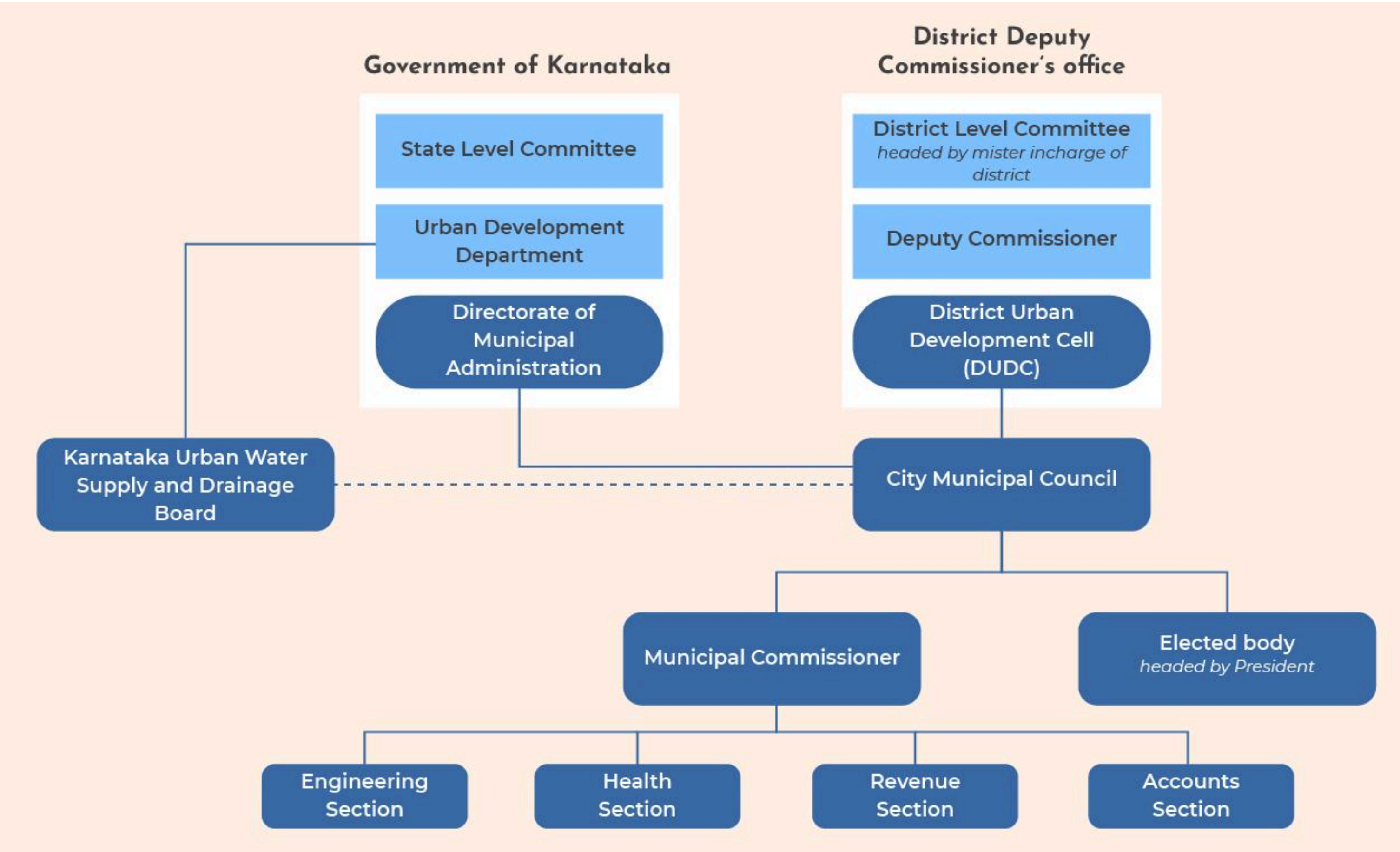
In order to access funds for major central or state government schemes such as AMRUT or Nagarothana[8], the KUWSDB prepares an action plan based on existing guidelines in consultation with the Chintamani CMC.-The KUWSDB, a parastatal body responsible for planning and execution of water supply and sewerage projects, oversees operations and maintenance for a period before it is transitioned to the Chintamani CMC. For example, it prepares Detailed Project Reports (DPR), obtains necessary approvals and oversees implementation of the proposed STP. The CMC sets tariff, collects connection fees and

[8] The Atal Mission for Rejuvenation and Urban Transformation was launched in 2015 by the central government to improve water supply and sewerage infrastructure in urban areas in India. The Nagarothana scheme was launched to improve infrastructure in the urban local bodies across Karnataka.

user charges, and manages last mile infrastructure such as digging supplementary borewells. Depending on the financing arrangements, the funds may be directed to KUWSDB from the state or channelled through the Chintamani CMC for implementation.

Ramesh & Basu (2021) developed 'activity maps' showcasing implementation of water supply schemes in two small and medium town ULBs in Karnataka; Figure 4.1 shows an adapted version of the map. The study highlighted that the process of planning for urban infrastructure remains centralised with minimal participation from ULBs despite the fact that they have to share the financial burden. Further, ULBs lack the capacity to monitor implementation of projects that are executed by private consultants engaged by parastatal agencies.

Figure 4.1: Implementation framework for water supply projects at Chintamani CMC



Source: Adapted from Ramesh & Basu (2021)

In terms of funds, small and medium town ULBs in India are funded through various sources such as the Finance Commission – union and state, central or state government missions or schemes, loans from international funding agencies, banks and other financial institutions. This is apart from the ULB's own revenue generation through property tax, fees and user charges as well as rentals.

Despite this web of institutions and sources of finance, staff shortage hinders municipal service delivery. As per information from the Chintamani CMC in June 2023, we found that 59% of sanctioned posts remain vacant out of an overall strength of 175[9]. This is particularly acute among workers such as *pourakarmikas* and water supply staff. The inadequate number of health inspectors and the absence of a full-time Assistant Executive Engineer also impact, not just provisioning, but also day-to-day operations of essential water supply and sanitation services.

Overview of Chintamani's budget

A town's dependence on external sources of funds is taken as one of the key indicators of financial health of a municipality. In the case of Chintamani, the CMC's own revenue's share stood at 44.83% in the 2021-22 financial year, which is higher compared to previous years. This shows an improvement but a continued reliance on state transfers or grants to meet its requirements.

Table 4.1 : Income and expenditure summary

Financial Year	2021-22	2020-21	2019-20
Tax Income (Rs. lakhs)	339.12	322.7	306.98
Non-Tax Income (Rs. lakhs)	858.88	790.55	823.41
Own Source Income (Rs. lakhs)	1198	1113.26	1130.39
% of Own Source Income out of Total Income	44.83%	35.43%	37.15%
State Transfers or Grants (Rs. lakhs)	1468.99	2028.61	1912.24
Total Income (Rs. lakhs)	2672.31	3141.87	3042.63
Total Revenue Expenditure (Rs. lakhs)	4620.32	3332.80	3091.99
% of Own Source Income out of Total Revenue Expenditure	25.93%	33.40%	36.55%

Source: Chintamani CMC budget documents for FY 2020-21, 2021-22, 2022-23

Ideally, a majority of the municipality's revenue expenditure should be covered by its own revenue. However, in the case of Chintamani, this has ranged between 25 and 36% over the three financial years from 2019 to 2022. Municipal corporations in Karnataka, such as Hubli-Dharwad, Tumakuru, Belagavi and Shivamogga, had averages in the range of 34%-44% for their own revenue/total revenue and between 31%-55% for own revenue/revenue expenditure for financial years 2015-16 to 2019-20 (Subalakshmi &

[9] While there are uncertainties associated with these figures, we nonetheless feel that this serves as a valuable initial estimate.

Raghunathan, 2023). This shows that the trend in Chintamani is not different from other larger towns in Karnataka.

A World Bank report on funding urban infrastructure across ULBs in India showed that own source revenue as a share of total municipal revenue nationwide declined from three-quarters to two-thirds in the FY 2011-2018 period. Concurrently, un-tied[10] fiscal transfers from central and state governments increased substantially in this period, along with increasing tied/conditional fiscal transfers for investments becoming the source of financing for urban infrastructure (Athar et. al 2022).

4.2 Capital and revenue expenditure for water supply is high

Expenditure for ensuring water supply in the town is a sizable portion of Chintamani's budget. In fact, one of the most striking learnings from this analysis was that electricity charges and fuel expenses account for more than 50% of the municipality's total operating expenses. In terms of capital expenditure, water supply and sewerage infrastructure has ranged from 28.9% to 55.84% of the total capital expenditure between the financial period of 2019 - 2021.

Table 4.2 Capital expenditure for water supply & sewerage

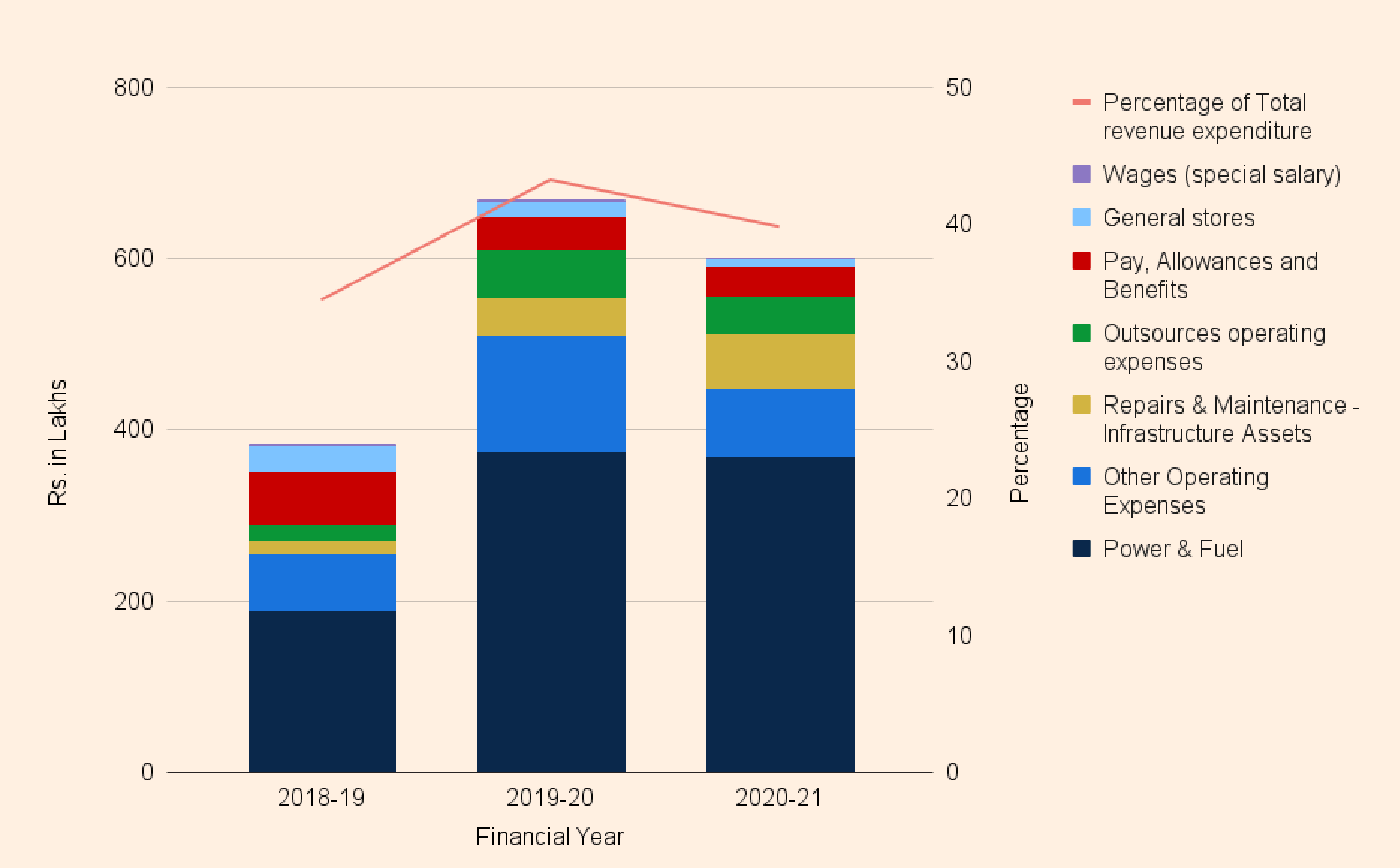
Financial Year	Total CAPEX (Rs. Lakhs)	Water supply CAPEX (Rs. Lakhs)	Sewerage CAPEX (Rs. Lakhs)	Water supply + Sewerage CAPEX / Total CAPEX
2018-19	446.45	206.78	42.52	55.84
2019-20	861.47	186.7	62.27	28.9
2020-21	847.32	233.37	99.4	39.27

Source: Chintamani CMC budget documents for FY 2020-21, 2021-22, 2022-23

Electricity charges[11] account for more than half of the operating expenses for water supply. As a proportion of overall revenue expenditures, water supply is thus a significant component coming up to between 34% and 43%. High electricity charges could be attributed to continuous running of borewells apart from other water distribution infrastructure.

[10] Un-tied implies flexibility to use funds for different functions or services of the ULB vs tied where it is specified as only to be spent for, say, drinking water
[11] Tariff category HT-1 is applicable for water supply and sewerage infrastructure based on demand charges (fixed based on sanctioned load) and energy charges (based on consumption)

Figure 4.2 Water supply revenue expenditure



Source: Chintamani CMC budget documents for FY 2020-21, 2021-22, 2022-23

The municipality faces challenges with meeting operational expenses

In the broader context of municipal budgeting challenges, a 2020 World Bank report underlines the substantial financial requirements for India's urban infrastructure. Projections suggest that cities and towns necessitate an estimated capital investment of 840 billion USD (Rs. 67,200 billion) over the next 15 years until 2036, with over half of the portion dedicated to essential infrastructure like water, sanitation, and roads. The report emphasises that current investment levels are notably lower than these needs, with the fiscal transfers from state and national governments being the primary financing mechanism that has increased over time. ULB revenue surpluses make up about 15%, with loans from Housing and Urban Development Corporation Ltd (HUDCO) accounting for 8% of total capital expenditure and only 5% is sourced through debt financing by ULBs and Public Private Partnerships.

The financial challenges faced by small and medium ULBs are pervasive, with their revenue streams failing to keep pace with the escalating demand for essential services. Our analysis of Chintamani's budget revealed three key reasons behind the town's ongoing struggle to meet its operational expenditure; these points could also apply to other small towns in the region and thus hold wider implications:

- **Unauthorised connections**: While the CMC claims that piped water supply network reaches most households in town, the municipality's records in 2021-22 showed only 8,308 water supply and 4,381 sewerage connections. The glaring disparity, considering the town's 20,000-plus households, indicates a high number of unauthorised/illegal connections.

- **Flat tariff structure**: The Chintamani CMC employs a flat tariff structure of Rs. 820 for residential and Rs. 1,640 for commercial establishments per annum. The last revision of water charges took place in the year 2016 , reflecting a lack of responsiveness to changing economic dynamics.

- **Gap between receivables and receipts**: As per the audited accounts for financial years 2020-21 and 2021-22, there appears to be a significant gap between the accrued income (receivables) from water and underground drainage charges, amounting to Rs. 540 lakhs, and the actual receipts recorded under the Water Supply Fund, which is only Rs. 18.9 lakhs for FY 2020-21 and Rs. 23.5 lakhs for FY 2021-22, respectively (Chintamani CMC, 2022b). The stark difference raises concerns about the municipality's ability to verify whether the receivables can be accounted against the municipality's dues as the Demand Collection Balance register is not updated. As a result, the verification of the legitimacy of receivables becomes challenging, impeding effective financial management.

As we conclude this section, we are left with an important question: how does a ULB manage to cover its operational costs? In the case of Chintamani municipality, a large sum comes from the Karnataka state government, which releases electricity grant matching the power bills incurred by the municipality. Another vital contributor is the State Finance Commission which covers salaries and thus reduces the deficit to a range of 20-30%, demonstrating a reliance on strategic financial support mechanisms to navigate fiscal challenges. Data for 14 cities, including some state-level averages, show that they recovered less than half (45%) of O&M costs pertaining to water supply, on average, let alone capital costs. Low O&M cost recovery rates indicate that service charges are well below the required levels for financial sustainability, and thus undermine the viability of infrastructure without substantial fiscal support (Athar et. al 2022).

This report focuses mainly on the hydrology aspect of the region and therefore, we are unable to provide more concrete steps in terms of governance and finance. This is a hefty part of the puzzle that needs separate analyses. The key takeaway is that water supply infrastructure is a huge drain on the municipality's finances particularly because of the energy required to run borewells in such a groundwater-dependent region. The larger institutional framework in place also limits the municipality from breaking out of current unsustainable models they are locked into. They remain beholden to external grants to provide basic services.

5. CONCLUSION

From water budgeting to water security planning.

Credit: Shashank Palur, WELL Labs

This study involved primary data collection – interviews and field visits – as well as an extensive review of secondary resources to map how water flows through a small town in semi-arid peninsular India. We quantified sources, storage and wastewater, a comprehensive picture that is necessary to enable better water management through strategic interventions.

We divided this report into three key sections. The first contains the meat of our quantitative analysis as we detail the data we gathered and calculated on Chintamani's water balance. We explained our methods and its limitations. Groundwater and surface water sources are interlinked but we split out analysis based on this categorisation because it allowed us to go into each resource's unique characteristics and challenges. We concluded with a primer on the state of governance and finance in Chintamani to illustrate that water management needs to be made more efficient to enable cash-strapped municipalities to save money.

Understanding the aquifer is key towards sustainable groundwater management

One of the most important insights is that nearly 80% of Chintamani's drinking water requirements are being met through municipal borewells as well as privately-owned borewells and tankers. This places a significant burden on the aquifer underlying Chintamani, which is characterised by weathered-fractured hard rock that has relatively limited storage potential and is being overexploited. With borewell failure rates in the past being 40%, developing a conceptual understanding of the aquifer characteristics, its storage/recharge potential and the consumption patterns across domestic, commercial and institutional segments remain key to developing an aquifer management plan.

An important step in putting together this plan is to delineate and characterise the aquifer through methods such as geophysical techniques, borehole lithology etc,. There is also a push from the level of the central government through flagship schemes such as the AMRUT mission, which mandates cities to prepare an urban aquifer management plan. The Central Ground Water Board leads the National Project on Aquifer Management (NAQUIM), which aims to map aquifers with a thrust on participatory groundwater management.

This brings us to another critical point, which is that Chintamani, being a small town and not a sprawling metropolis, is largely unbuilt. This means that fallow land, green spaces and water bodies have not yet been encroached upon by concrete structure and impermeable surfaces. There is a brief window of opportunity to develop and implement a blue-green infrastructure plan that could capture and store water, and also recharge the aquifer.

Rejuvenation of water bodies and improving sewage treatment remain key to meeting town demand in turn lowering groundwater dependence.

The state of underground water sources are closely linked to above ground water bodies like lakes. Our analysis showed that rejuvenating Chintamani's largest water body – Nekkundi lake and smaller lakes in the city, such as Malapalli, could supplement the current solitary surface water source of Kannampalli lake to provide up to 4 MLD. This accounts for ~50% of the town's current freshwater requirements.

But for this to take place, addressing the sewage infrastructure gap of 65% (3.72 MLD[12]) is key to ensuring that water bodies remain pollution free. Right from our first conversations with municipality members and other stakeholders in the region, it was apparent that the flow of raw sewage into lakes is a major concern in terms of public health. Moreover, it rendered the lakes in the region unusable.

There is currently only one sewage treatment plant but its low capacity is further undermined by the fact that operations and maintenance, including periodic desludging of ponds, is not carried out properly. Moreover, during our fieldwork, we found that parts of the pipeline network were broken, including those in close proximity to lakes like Nekkundi and Gopasandra, resulting in raw sewage flowing into water bodies.

With improved and more resilient sewerage infrastructure, not only would it become possible to utilise the local surface water sources, it also becomes possible to pump in or *import* water. The recently-commissioned Bhaktharahalli Arasikere project, which is slated to supply 3 MLD of water, could mean that the town potentially shifts from being groundwater dependent to being surface water reliant. This would also allow for the aquifer to recharge and be used to meet deficit or future demand.

High operational expenditure along with low O&M cost recovery makes it challenging to operate water supply infrastructure

Analysis of the town's revenue expenditure showed that 40% is spent on running water supply infrastructure. Electricity and fuel charges account for a majority share, incurred as a result of running borewells as well as pumping infrastructure. On the other hand, unauthorised connections to the network form a large component of non-revenue water. Out of 20,000 households, CMC records in 2021-22 showed only 8,308 water supply and 4,381 sewerage connections while network coverage claimed to cover most parts of the town.

Apart from employing a flat tariff structure that was last revised in 2016, there appears to be a huge disparity between the accrued income (receivables) from water and underground drainage charges as opposed to actual receipts. Further, there are staff shortages at the level of essential workers such as *pourakarmikas* and water supply staff that hinder service delivery of water supply and sanitation infrastructure.

Chintamani is representative of other towns in Karnataka

The case study of Chintamani offers valuable insights into the complexities of governance and finance surrounding water supply and sewerage infrastructure in towns. There is a high reliance on external sources – central and state government schemes and finance commission grants to fund capital expenditure – coupled with challenges in terms of navigating a complex institutional framework of district-level authorities and parastatal

[12] We estimated that the total amount of wastewater generated in the town is 5.72 MLD. With the STP here having a capacity of 2 MLD, an estimate of the amount of untreated sewage amounts to 3.72, indicating an infrastructure deficit that fails to treat 65% of wastewater produced.

agencies in planning and implementing water supply and sewerage infrastructure at the town level.

Chintamani also serves as a valuable reference point to illustrate the interconnectedness of surface and groundwater sources, and how improved water management practices in small Indian towns can make a significant difference in the quality of life for local communities. In this regard, employing analytical tools such as a water balance could play a significant role in reshaping water management and thus the landscape.

How can water balances help planning for towns in India

The water balance charts a journey from data to decision, and is guided by participatory approaches and institutional integration. It offers a blueprint for achieving sustainable water security. As Indian cities, especially small towns, grapple with the escalating challenges of water management, initiatives such as the Jal Jeevan Mission - Urban (JJM(U))[13] have mandated water balance plans for all cities, encompassing 4378 statutory towns. Aligned with the framework set by these flagship schemes, city water balance tools have become integral, providing municipal officials and stakeholders with a robust foundation for water resource assessment and management.

In the context of small towns, where short-term planning, insufficient budgets and a dearth of data-driven management practices prevail, the introduction of water balance tools becomes transformative. Applying a water balance helps quantitatively assess whether an urban region's water resources are at risk and identifies gaps that must be targeted. Integrating findings from the water balance into the region's water security plans is essential to formulating a dynamic and adaptive strategy for resilient water resource management.

Preparation of a water security plan has to be a collaborative and inclusive process, actively involving stakeholders at every level, from state/district/town decision-makers to local communities. An enhanced understanding of local water dynamics can facilitate the development of targeted interventions to address town specific water challenges, such as narrowing down areas for new borewells or rejuvenating lakes. Planning should provide for short-term adjustments for immediate challenges, encourage medium-term objectives by identifying trends and emerging issues, and support the development of a long-term vision for sustainable water resource management.

As we conclude, it is important to acknowledge that development of a water balance and water security planning necessitates specialised knowledge and skills, which may not be readily available, particularly in small towns with limited resources. This may pose a hurdle to scaling up such an initiative across municipalities in India. Institutionalising the water balance creation process would mean embedding the practice within the administrative framework of each municipality, complete with access to relevant datasets as well as trainers who can build capacity. However, this is not a straightforward task and demands a considerable investment in terms of time, resources, and soft infrastructure.

[13] The Jal Jeevan Mission was first launched with a focus on rural water supply infrastructure. JJM-Urban is the new chapter of the Atal Mission for Rejuvenation and Urban Transformation (AMRUT).

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Annexure 1: Chintamani's lake volume estimation and water availability analysis

Lake volume estimation

Lake Name	Area(m2)	Depth(m)	Volume (Million Litres)
Nekkundi	4,70,427	0.98	461.02
Malapalli	88,791	1.2	106.55
Chikka Kannampalli	31,305	1.2	37.57

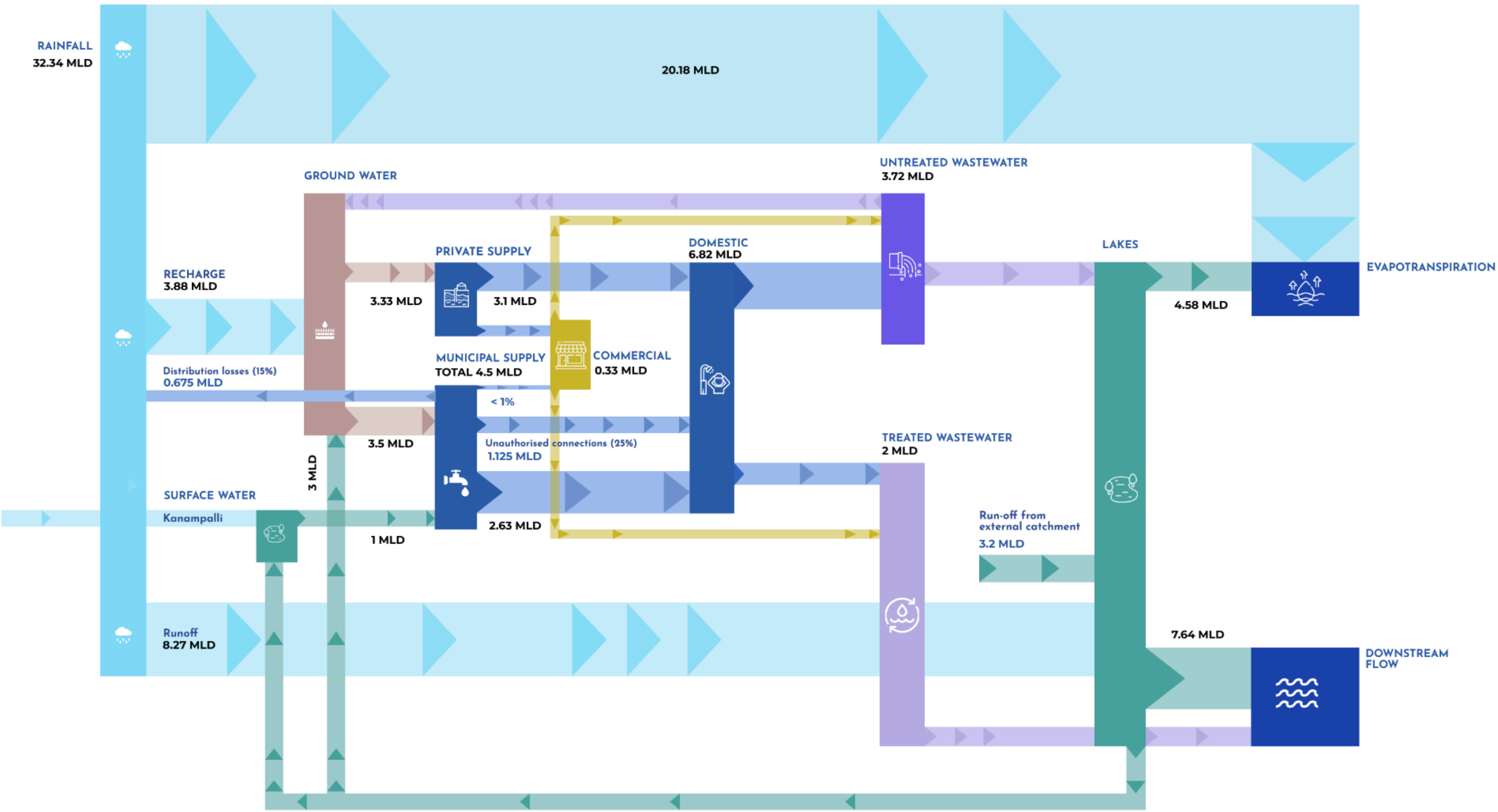
Source: GIS analysis carried out by WELL Labs

Lake water availability estimation

Description	Unit	Nekkundi	Malapalli	Chikka Kannampalli
Storage capacity	Million Litres	461.02	106.55	37.57
Siltation	20% of total storage capacity	92.2	21.31	7.51
Getting filled	70% of total storage capacity	322.71	74.58	26.30
Evaporation & Percolation	30% of Water Getting Filled	96.81	22.38	7.89
Effective capacity	Million Litres	272.00	62.86	22.16
Number of days	Days	150	100	100
Total Water Available	Million Litres	1.81	0.63	0.22

Source: *Analysis carried out by WELL Labs*

Annexure 2: Water Balance Chart Source: Analysis carried out by WELL L



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