

Paper 02

Identification of Associated Risks in the Drinking Water Distribution Systems Due to Low Water Demand Using Hydraulic Models at the Initial Years after Commissioning Considering the Panahaduwa Zone of the Udawalawa WSS

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INTRODUCTION

When commissioning a new water distribution system during the initial years water demand is lower than the design demand. Hence, the behaviour of water in the distribution system due to low water demand was studied considering the new Panahaduwa zone of Udawalawa Water Supply Scheme (WSS). The Udawalawa WSS is one of the major water supply schemes in Ratnapura district and has a production capacity of 9000 m³/day. At present its average daily production is 3000 m³/day and it is planned to commission a new distribution zone named Panahaduwa during the year 2013. Hence, it is planned to identify any risk which can be foreseen after commissioning the distribution system as a part of a water safety plan (WSP) for the Udawalawa WSS. Based on low water demand which may be anticipated in the early stage of commissioning, resulting water age and behaviour of residual chlorine decay was also analysed to identify the associated risks using hydraulic model formulated using EPANET2 software. Analysis was done for five years starting from the year 2013 and up to the year 2017 considering the most probable new connection obtaining rates in each year. The results show that high water age has been recorded at the end of distribution system. In addition it was found that low residual Chlorine had been recorded at those points. To reduce the high water age possible looping arrangement was checked and failed. In addition limiting operational height of the Panahaduwa tank and intermittent water supply to the area were other options checked. Out of those, first option has failed and second option shows remarkable improvement with respect to water age. Further, a new model was formulated for the zone by reducing transmission main diameter and increasing the rider main diameter, which indicated significant improvement with respect to high water age. Hence, it is recommended to provide intermittent water supply during initial year of commissioning in this Panahaduwa zone and recommended to select pipe diameters in comparatively equal size in both distribution main and rider main in these type of distribution systems in future designs.

HIGHLIGHTS

- Six hydraulic models were formulated using EpaNet soft ware.
- Age of water in the distribution system and behaviour of residual Chlorine in the distribution system was studied.
- High water age and the less residual Chlorine had been recorded at the dead ends and far ends of the distribution system
- Intermittent water supply to the distribution system will decrease the age of water and will increase the residual chlorine in the distribution system.
- If both main distribution pipe line and the rider main pipe line use comparatively equal size pipes, it will increase the water quality of the system.

METHODOLOGY

Six hydraulic models were developed using physical data and water demand data. Those were hydraulic model for design demand for the year 2013 and hydraulic models for the year 2013 to the year 2017 with most probable actual demand. The used software was EPANET 2. Using those models, age of water in the distribution system was analysed. together with the extended period analysis for 24 hour period and recorded average value after steady state was considered. In addition to age of water behaviour of residual chlorine was studied using same hydraulic models.

RESULTS

Based on the analysis, it was found that neither water age nor residual chlorine problems were recorded if the system has achieved the design water demand and the resulted water age as shown in figure 1. The resulted residual chlorine values are shown in the figure 2. In the case of actual water demand due to new connections in year 2013, high water age (more than 72 hour) has been recorded in some by roads and in the extreme end of the distribution system. This situation is reduced gradually with the increment of the water connections annually. Resulted average water age for the year 2013 with the actual water demand due to most probable new connections in the zone is shown in figure 3 and resulted average residual Chlorine values is shown in the figure 4.

Out of considered options, only successful option was providing intermittent supply to the zone to reduce high water age and resulted average water age is shown in figure 5. In addition, rearranging pipe diameters also indicated a remarkable improvement regarding high water age and resulted average water age for the year 2013 is shown in the figure 6.

CONCLUSION

As the water demand is less in the system at the initial years, high water age and low residual chlorine value has been recorded. Intermittent water supply to the system during initial years will decrease the risk of water quality problems. Using approximately equal size diameters for both distribution main and rider main will increase the quality of water.

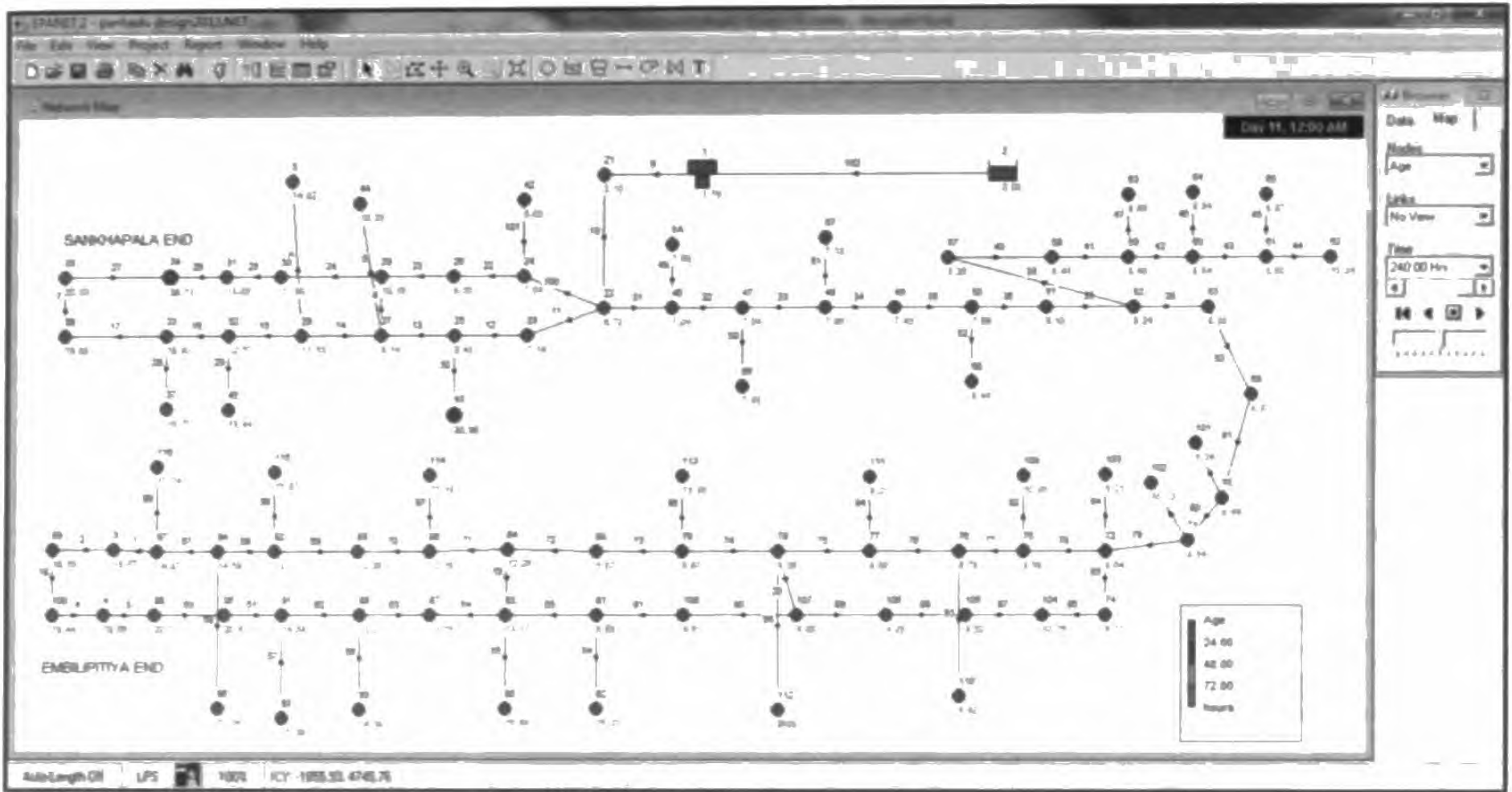


Figure 1: Resulted Average Water Age for design demand for the year 2013

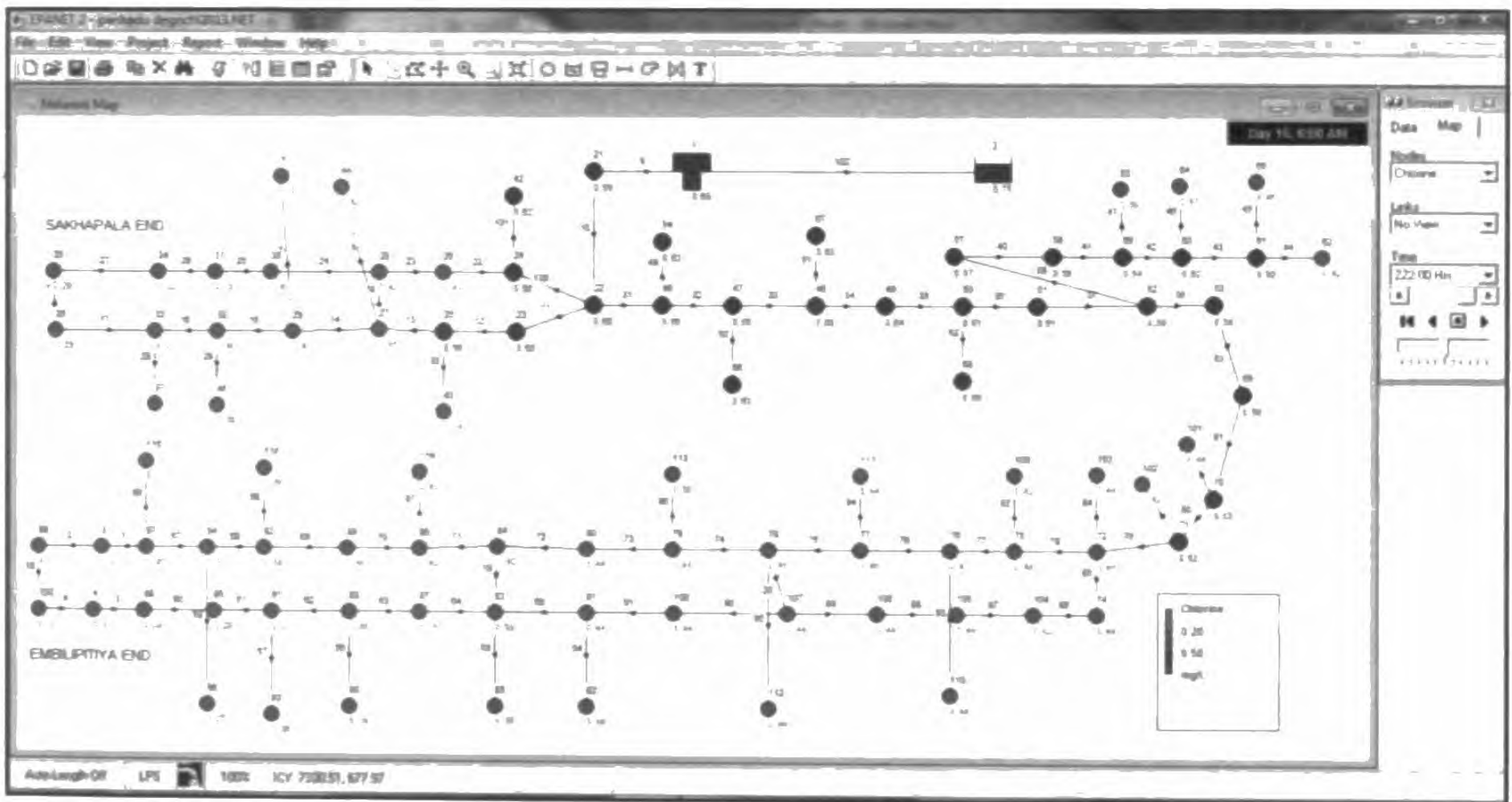


Figure 2: Resulted Average Residual Chlorine Value for design demand for the year 2013

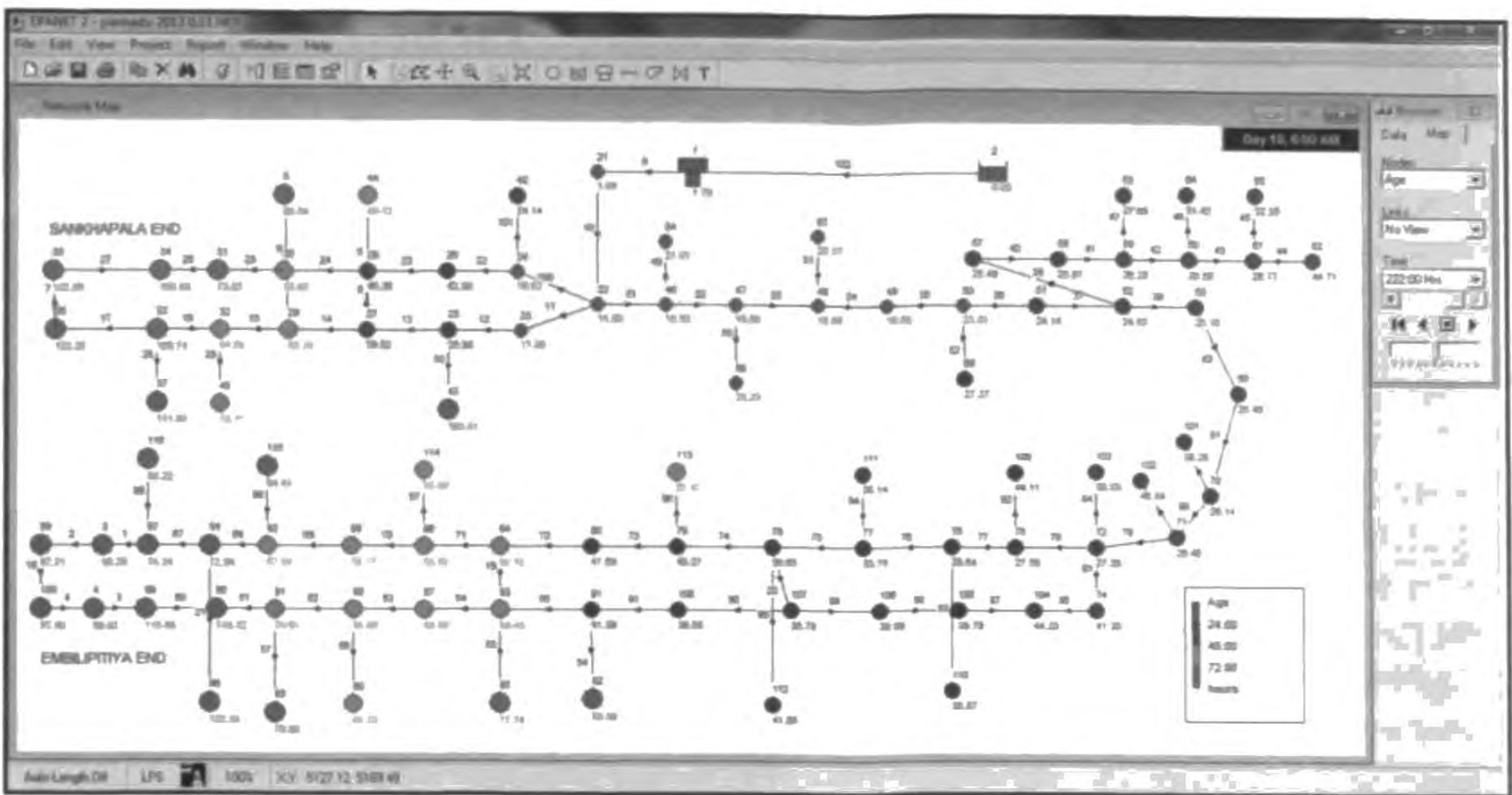


Figure 3: Resulted Average Water Age with Actual Demand for the year 2013

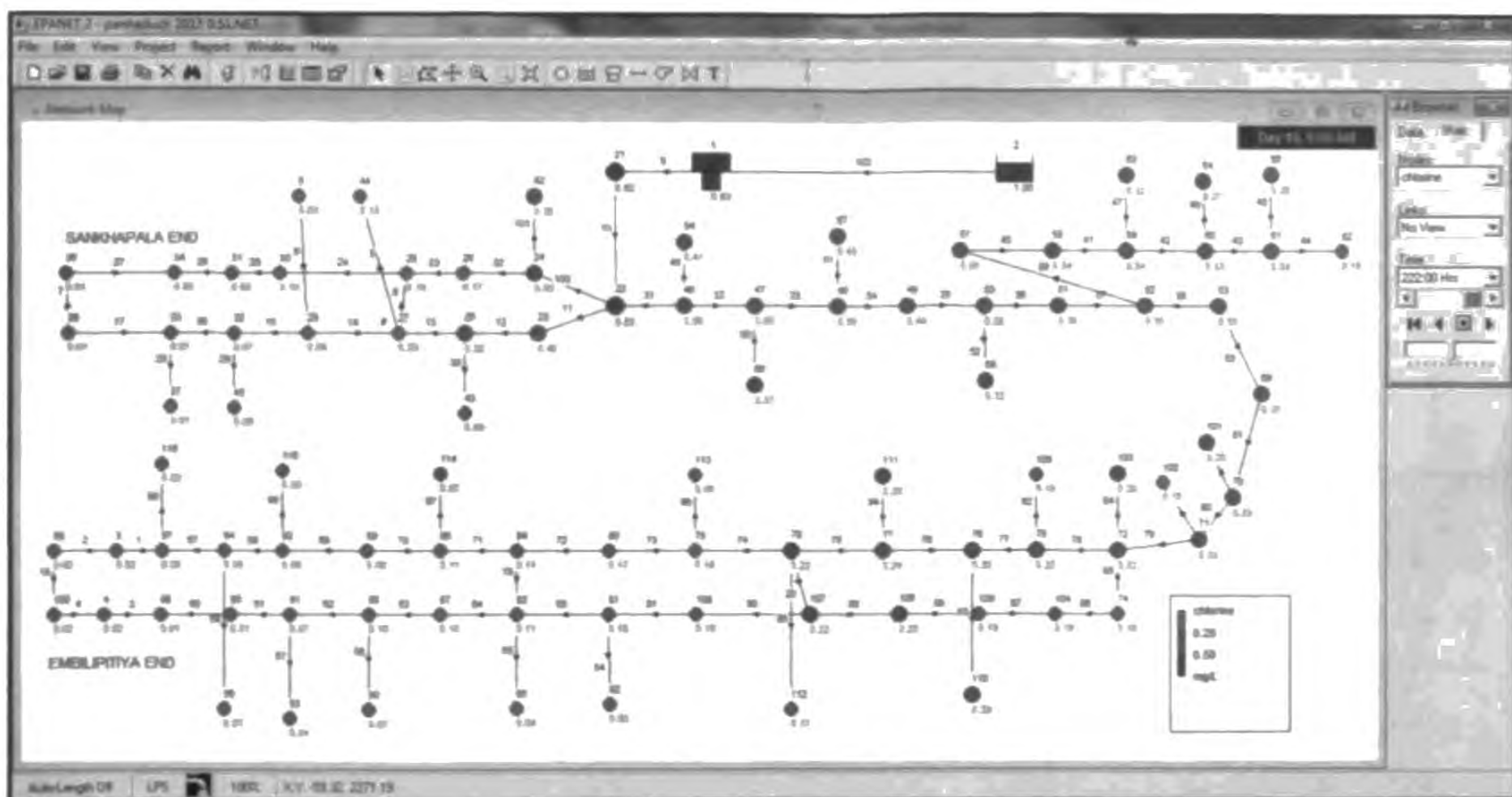


Figure 4: Resulted Average Residual Chlorine Values with Actual Demand for the year 2013

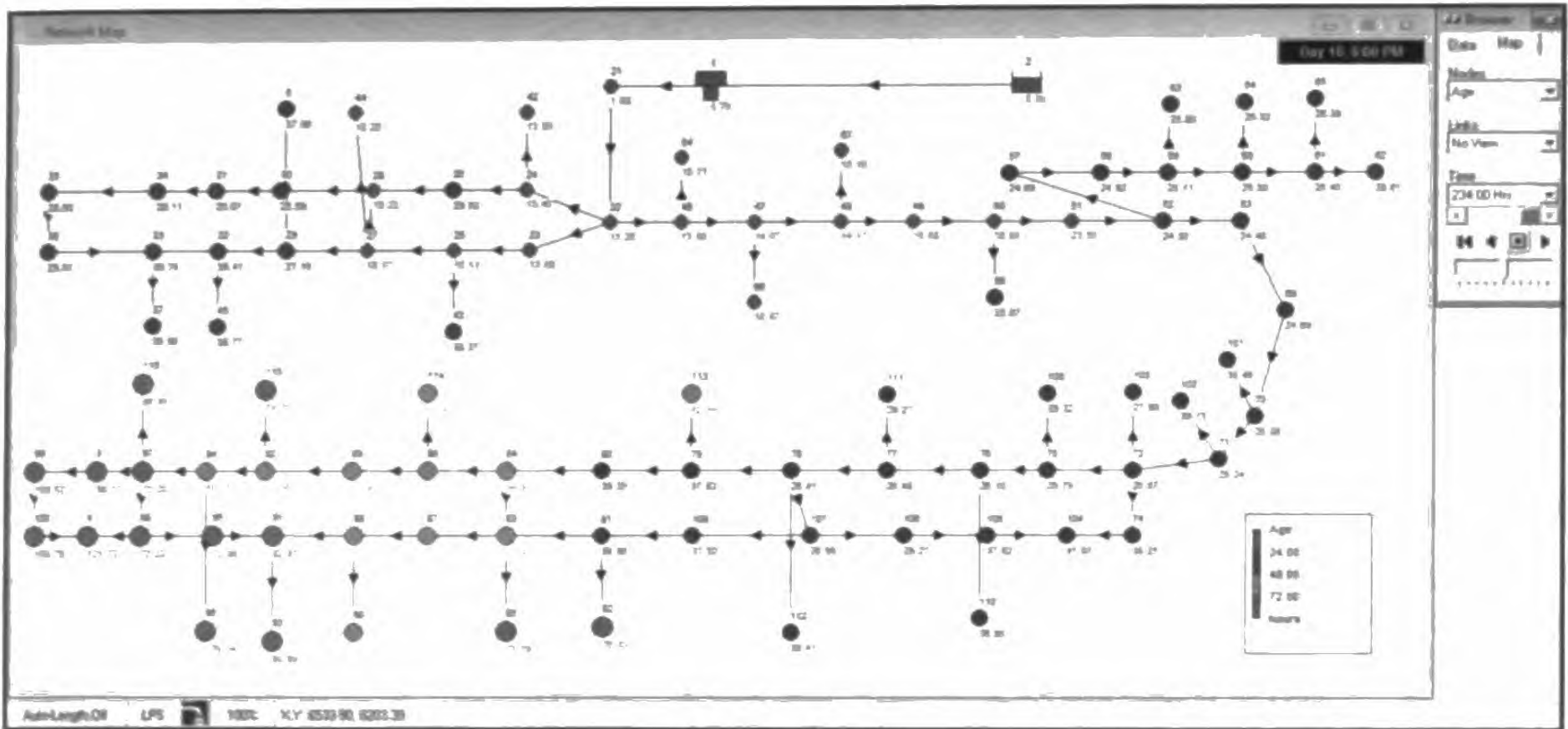


Figure 5: Resulted Average Water Age with Intermittent Supply for the year 2013 with actual demand

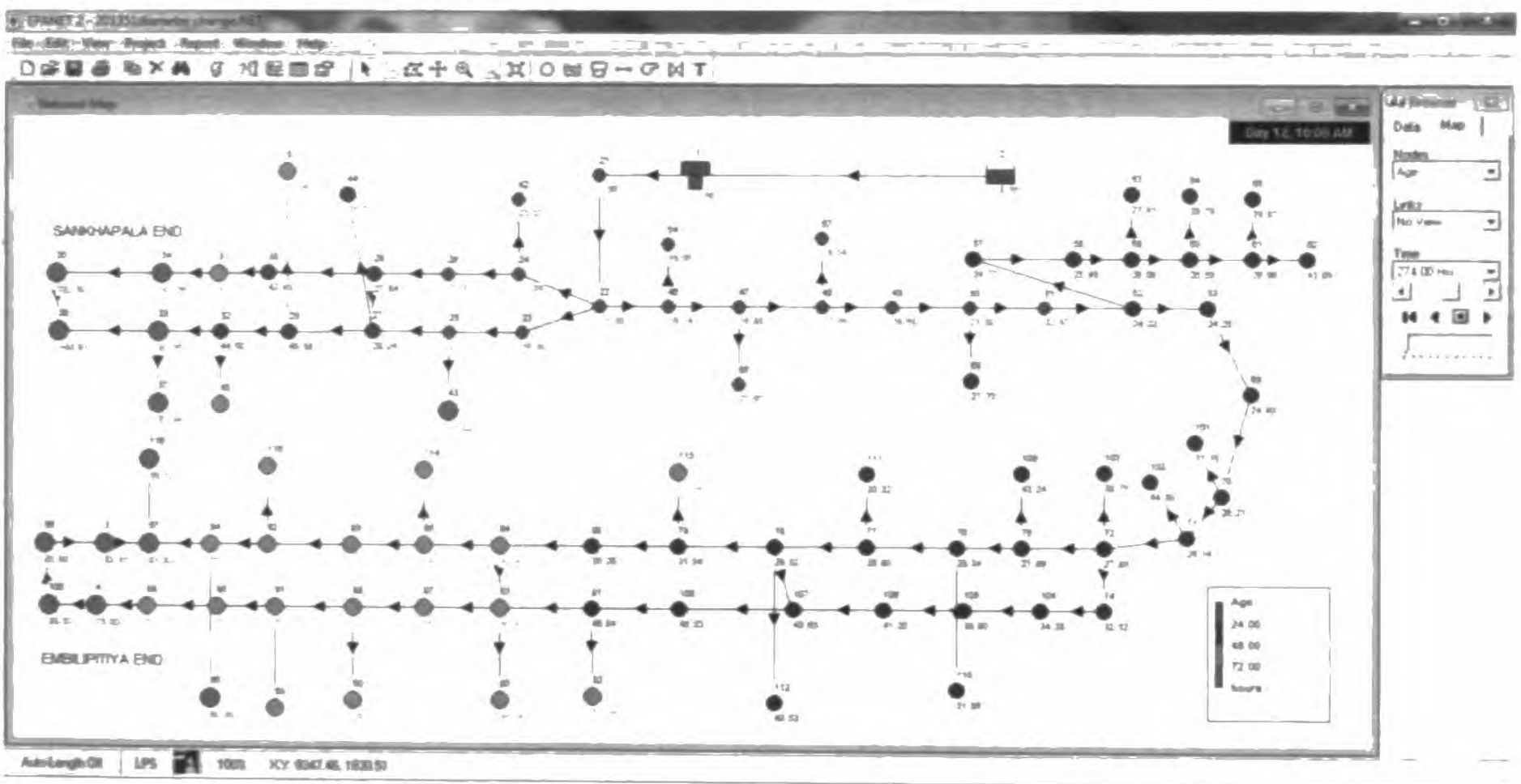


Figure 6: Resulted Average Water Age after Rearranging the Diameters for the year 2013 with actual demand