

**THIRST IN THE MIDST OF THE TWIN LAKES:
A QUEST FOR UNDERSTANDING NORTON'S IRONICAL WATER WOES**

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ABSTRACT

Located between two of the largest inland lakes in Zimbabwe, the town of Norton experiences clearly ironical water woes. The study's aim was to find out why Norton, with conducive conditions for having one of the best water supply services in the country, is experiencing water supply challenges. The study revealed a serious water scarcity in Norton reflected through water shortages and their effects in the industrial, residential, and institutional sectors of the town. The major cause of water shortages in Norton is due to the fact that the town does not have its own water treatment facility but relies on outsourcing water from the capital, Harare, which however is also facing serious water shortages. The study recommends that Norton should establish its own water treatment facility and end its precarious dependency on outsourcing water from Harare. Norton should also take imminent measures to reduce the high levels of non-revenue water loss.

Keywords: Water crisis; Water Outsourcing; Water Demand; Water Pollution

INTRODUCTION

More than 1.1 billion people lack access to safe drinking water while 2.6 billion people live without access to basic sanitation and hygiene necessary for reducing exposure to water-related diseases. This lack of access to safe drinking water and sanitation has been identified as a fundamental component of poverty. The costs of inadequate water supply and sanitation are high. Every day, some 6,000 children die from diseases associated with inadequate sanitation, poor hygiene, and unsafe water. Diarrhoea alone kills nearly 2 million children every year or one child every 20 seconds, mainly as a result of inadequate sanitation, water supply and hygiene (World Bank website).

The majority of the people lacking access to safe and adequate drinking water as well as basic sanitation are found in the poor developing countries of the world, and increasingly in the urban areas. By 2020, half of the developing world's population will live in urban areas, including the mushrooming informal settlements that now account for 40-70 percent of the population in many cities in developing countries. Informal settlements have poor housing structures and also poor facilities and services such as water and sanitation. The above means that target 10 of Millennium Development Goal 7, to halve by 2015 the proportion of people without sustainable access to safe drinking water and improved sanitation is a huge task (World Bank website)

Water is increasingly becoming a scarce resource in Zimbabwe. Demand for water is growing for domestic, industrial, agricultural, mining, and institutional needs, the five major consumptive uses of water in Zimbabwe. The country's fresh water resources are threatened not only by overexploitation as demand increases rapidly, but also by poor management and ecological degradation, and with it increasing costs of water treatment (Chenje, Sola & Paleczny, 1998).

Most of the water supply challenges in Zimbabwe are being experienced in the urban centers due to rapidly increasing demand as the urban populations are expanding at rates beyond their capacity for service provision. Currently, over 42 percent of the country's population lives in urban areas and by 2030 more than 55 percent of Zimbabwe's population, projected to be 20.57 million people, will be urban dwellers (Chenje et al., 1998). Harare alone, the capital, now houses approximately 20 percent of the national population (Central Statistical Office, 2002) and its annual average water consumption grew at a rate of 8.5 percent between 1986 and 1991 (Chenje et al., 1998). The cost of treating water has gone up radically over the years in Harare due to high pollution loads. This is because Harare sits in the catchment area of its main water supply, Lake Chivero, and this has worsened the water pollution problems (Magadza, 1997; Marshal, 1997). The situation of water availability in Bulawayo, the second city, is even more critical because, in addition to rapidly growing water demand, Bulawayo is located in a dry region. During drought periods, some households go for long periods without water and some businesses are forced to scale down their operations. To alleviate the perennial problem of inadequate water supply in Bulawayo, a multi-billion dollar water pipeline to draw water from the Zambezi River, an international water course, has been planned.

The city of Mutare experiences major water problems. Mutare's water source almost ran dry during the 1991-92 drought, hence the need to draw water from the Pungwe River. The source of water for Masvingo City, Lake Mutirikwi, Zimbabwe's largest inland water body, was also almost empty during the 1991-92 drought. Water demand for irrigation is also high for Lake Mutirikwi and pollution levels are increasing. Slums have also developed in areas such as Dzivarasekwa, Mbare, and Highfield in Harare; Mbizo in Kwekwe; Mambo in Gweru; and Sakubva in Mutare. The suburb of Mutapa in Gweru was designed for 10,000 residents but now has about 30,000 residents. Houses in Mbare, Harare, were designed for an average of six residents but now the average is 30 (Chenje et al., 1998). Such overcrowding and squalor have added to the water supply challenges being faced by the urban settlements in Zimbabwe.

The situation in Norton is quite ironic. The town, often referred to as the twin-lakes town, is sandwiched between two of the largest inland lakes in Zimbabwe, Lake Manyame and Lake Chivero- Zimbabwe's great lakes region. It is also in Natural Region II receiving over 1000mm of rainfall annually. Norton's population, which stood at 44,000 in the 2002 national census (Central Statistical Office, 2002), and is now estimated to be around 65,000, does not translate into overwhelming water demand compared to the larger and more populous urban centers in the country. In addition, Norton does not suffer from the problem of mushrooming informal settlements as is the case with most urban centers in Zimbabwe. Yet Norton experiences the same, if not worse, water supply challenges as the other urban centers in the country. The study therefore seeks to find out why Norton, which has conducive conditions to have one of the best water supply services in the country, is experiencing severe water supply problems just as those urban settlements more naturally inclined to experience water supply

challenges than it. The objectives of the paper were threefold: first, to establish the extent or magnitude of the water supply crisis in Norton; second, to ascertain the reasons for the water supply crisis in the town; and ultimately to suggest recommendations so that Norton has one of the best water supply services among the urban settlements in Zimbabwe.

DESCRIPTION OF THE STUDY AREA

Norton is located 40km to the west of Harare, the capital, along the Harare-Bulawayo highway in Mashonaland West Province. Norton's population at the 1982 census was 12,438 and by the 1992 census the town's population had increased to 29,000. The 2002 population census, the latest population count for the country, recorded the population of Norton as 44,054, with 22,184 females and 21,870 males. Currently the town's population is estimated at around 65,000. It is estimated that there will be 85,000 people in Norton by the year 2015 (Norton Town Council, 2003).

The town of Norton, together with Harare, Chitungwiza, Ruwa, and Epworth, are all situated within the Manyame catchment, the most urbanized, populous and industrialized of all the six catchment divisions of the country. This has created a huge water demand in this area, in addition to experiencing the most severe water pollution problems.

Being located close to Harare, Norton's links with the capital are so strong to the extent that a substantial number of people commute to Harare than to the Mashonaland West provincial capital, Chinhoyi. The ties between Norton and Harare are so strong that the former outsources all its water from Harare's Morton Jaffray Water Treatment Plant. The major consumptive uses of water in Norton are domestic, industrial, and institutional needs.

RESEARCH METHODOLOGY

The study was conducted between December 2009 and May 2010. The Department of Engineering for Norton, which is in charge of water supply in the town, provided most of the information for the study through personal interviews with representatives in various capacities and also through the provision of varied documents containing information addressing the research objectives. Personal interviews were also held with other key informants who included representatives from selected wet industries and also representatives from various institutions which included Norton Hospital, Katanga Utano Clinic and selected educational institutions within the town.

A questionnaire targeting the residents of the old and new suburbs of Norton was also personally administered with the help of some trained research assistants. The questionnaire was separately administered to these two categories of residents as the researcher had a working assumption that water supply challenges in Norton were more acute in the newer suburbs compared to the older ones. One hundred and fifty households were selected for questionnaire interviews from each category of residents using simple random sampling. Tap water was also tested for residual chlorine as well as for the presence of coliforms, which were an indicator for the presence of pathogens in treated drinking water.

RESULTS AND DISCUSSION

The magnitude of the water crisis in Norton

The study sought to establish the extent of the water crisis in Norton and the findings are presented and discussed in this section of the paper. The magnitude of the water crisis in Norton can be summarized in the statement that Norton, with a current population of approximately 65 000 residents, requires about 10 megalitres of water a day but receives only between 6 and 7 megalitres daily from Harare's Morton Jaffray Water Treatment Plant. This, in other words, means that Norton is only managing to get between 60 and 70 percent of its water requirements as there is no other water source for the town.

The extent of the water crisis in the study area can fully be appreciated when one assesses the water supply situation for individual sectors within the town. The study revealed that out of the 11 Suburbs in Norton, only 4, namely the high-density suburbs of Ngoni and Katanga, and the low density suburbs of Twinlakes and Nharira, have a relatively regular water supply from the town's reticulation network. These four suburbs house approximately 45 percent of the resident population of Norton while the other seven suburbs house the remaining 55 percent of the residents. This effectively means only about 45 percent of Norton residents are having a relatively regular water supply. It is interesting to note that the four suburbs with better water supply are also the oldest while the other seven suburbs were more recently established which clearly indicates that Norton's water supply infrastructure has been stretched well beyond capacity and can no longer accommodate new demand. However, asked to rate the water supply service in their area between excellent, good, moderate, poor and very poor, 68 percent of the questionnaire respondents in the four older suburbs rated the water supply service as moderate, 22 percent rated it as poor while the remaining 10 percent rated it as very poor. With 32 percent of the respondents rating the water supply service as either poor or very poor, while none rated it as excellent or good, it can be logical to conclude that even in these suburbs, where the water supply service is better; residents are still not getting adequate water. Frequent water cuts and low pressure flows were cited by the residents in support of their rating of the water service as being either moderate, poor or very poor.

In addition to frequent water cuts and low pressure flows, all the interviewed residents said that the quality of the tap water was very poor. They said that the water has some odors, sometimes contains visible organic or inorganic substances and is usually dark in color. It was against this background that the researcher sends a sample of tap water to a private laboratory to be tested for residual chlorine. According to World Health Organization (WHO) drinking water quality guidelines, treated drinking water should contain 150mg of chlorine per 100ml (World Health Organisation, 1993). However, the tap water contained 78 mg of chlorine per 100 ml which was far below the stipulated residual chlorine content for treated water. Such low residual chlorine levels prompted the need for further testing for coliforms which are a traditional indicator for the presence of pathogens in water. While there were no fecal coliforms in the tap water, the water had a total coliform count of 26 per 100 ml yet WHO guidelines stipulate that treated drinking water should not contain a single coliform. This points to serious shortcomings in the water purification process at Harare's Morton Jaffray Water Treatment Plant from where Norton buys its water, including the possibility for the contamination of the water in Norton's reticulation network probably due to leaking pipes under low pressure flow conditions.

On the other hand, all the questionnaire respondents in the 7 newer suburbs rated the water supply service as very poor, the reason being that the water service is almost non-existent as taps are dry most of the time throughout the year. Sometimes it

takes up to three or four months before the water flows again and when it eventually does, it will be under very low pressure and usually dirty. Therefore, according to the residents, it was as good to say that there is no water service in these new suburbs. The residents in the new suburbs have now resorted to well water as a coping strategy to the water crisis. Sixty nine percent of the respondents in the seven suburbs had dug out some wells while the remaining 31 percent had not and rely on borrowing well water from neighbors. The survey also asked respondents whether well water, which has now become the major water source, is meeting demand. All the respondents in the seven suburbs said that their water needs were not being satisfied by the well water. Poor well water quality, in addition to inadequate supply; as not all residents have dug out some wells, were cited as the major reasons why well water was failing to satisfy demand. Most of the well water was reported to be milky white and therefore unsuitable for such domestic uses as drinking, bathing, or laundry.

The conclusion which can be drawn concerning water supply in the residential sector is that water supply challenges are being felt most by the residents of the new suburbs thereby indicating that the water supply service can no longer cope with increasing demand. For those residents still managing to receive water relatively more regularly from Norton's reticulation network, the quality of the water is well below standard. While most residents in the new suburbs have resorted to well water as a coping strategy, such wells still do not cope with demand partly because of poor water quality and limited supply.

The magnitude of the water supply challenges in Norton was also reflected in the industrial sector. Structured interviews held with representatives from six of the wettest industries in Norton, that is, industries whose operations require large volumes of water, revealed that inadequate water supply has acted as one of the major hindrances to the capacity utilization of their industrial establishments or to the expansion of production. Some of the industries are frequently forced to scale down their operations due to water shortages, resulting in failure to meet market demand for their products. All this represents lost business and if the situation continues it will eventually lead to viability challenges for some of these industries. Some of the industries also complained about the poor quality of the water that they are receiving from Norton's reticulation network. The bad odor usually imparted by the water, suspended materials in it and its dark color were reported to make the water unsuitable for some industrial processes, especially those involving the production of foodstuffs and chemicals. Sometimes, when the water is too dirty, some of the industries are occasionally forced to do some further purification of the water so that it meets set industrial quality specifications thereby adding on to production costs. Such additional costs are counter-productive to industrial investment in Norton as they threaten viability.

Various institutions have also been affected by the water crisis in Norton. For example, representatives from Norton Hospital and Katanga Utano Clinic, the two main health institutions in the town, indicated that water scarcity sometimes affects the smooth running of their institutions. During the cholera outbreak which rocked the country between August 2008 and March 2009, Katanga Utano Clinic, which acted as the centre for cholera treatment and control for Norton, had to outsource water using water containers. Health institutions are so important that they should be able to meet all their water needs even in times of emergency disease outbreaks when their water demand sharply increases. This is because if such institutions do not have adequate water, they will endanger the same patients they are supposed to treat due to, among other reasons, compromised hygiene.

Schools have also been affected by the water supply situation in Norton, including some day care centers. With the latter hygiene, it is critical as they involve little children. This has forced some of them to frequently send children back home due to water shortages or parents transferring their children to those day care centers with better water supply. Some primary and secondary schools have also been affected in the same way by the water shortages thereby disrupting learning. While some of the educational institutions have sunk some boreholes, others, particularly those in the new suburbs, have resorted to the construction of latrines as a means of coping with the shortage of water for toilet flushing. Some churches have also resorted to latrines. However, considering the fact that many residents in these new suburbs have dug out wells, the possibility for the contamination of such wells with human excreta is extremely real.

The above domestic, industrial and institutional water needs in Norton, as it has been shown above, have in various ways been disrupted by water shortages, show the magnitude or extent of the water crisis in the town. The next section of the article shall now attempt to identify the causes of the water supply challenges in Norton.

The causes of the water crisis in Norton

The sole reason at the root of Norton's water supply challenges lies in the fact that the town has no water treatment facility of its own but relies on buying treated water for all its needs from Harare's Morton Jaffray Water Treatment Plant. Such a precarious dependency on Harare's water has created Norton's water supply challenges in two main ways. Firstly, Harare, which is the sole source of water for Norton, also provides water services to Chitungwiza, Ruwa, and Epworth, the other satellite towns within the capital's metropolitan area. According to the 2002 national census Harare's population, which includes Chitungwiza and Epworth, had a total resident population of 1,896,134 which constituted about 20 percent of the national population, with a density of 2,174 people per square kilometer and a high rate at natural increase of two. Harare's population also constituted 46 percent of the total population of all the urban areas in the country (Central Statistical Office, 2002). The approximate current population of around 2 million inhabitants for Harare and its satellite towns, in addition to it being the industrial hub of the country, translates this area into the single largest water consuming region in the county. For example, in 1994, Harare, Chitungwiza, Norton, Ruwa, and Epworth consumed about 40 percent of all water consumption for the urban centers in the country (Chenje et al, 1998). If water supply for Harare and its surrounding satellite towns matched demand, then Norton would probably find it to their advantage to continue buying water from Harare due to associated economies of scale in water treatment and supply. However, the situation on the ground is such that demand for water in this area far outstrips supply. Owing to the ageing treatment and pumping infrastructure, Morton Jaffray and Prince Edward water treatment plants, the two main water purification plants for Harare and its satellite towns, currently have a combined pumping capacity of 60 percent per day. Even if these two plants were to be renovated to maximum pumping capacity, they would still not match demand (The Sunday Mail, 2010).

Harare and its surrounding towns of Chitungwiza, Norton, Ruwa, and Epworth have a combined water demand of approximately 800 megalitres per day but current treatment and pumping infrastructure only has the capacity to produce an average of between 500 and 600 megalitres of treated water per day with a deficit of about 300 megalitres (The Sunday Mail,

2010). This explains why Norton, with an estimated water demand of 10 megalitres per day, is only managing to get between 6 and 7 megalitres of treated water. If Norton had a stand-alone water treatment facility it would be able to meet its water demand with far greater ease. As it stands, it is only at the goodwill of Harare that Norton and the other surrounding towns are still managing to get some water from the capital as Harare can not even meet its own demand.

The second way in which Norton's dependency on Harare's water has engulfed the town into persistent water woes is due to the fact that Lake Chivero, the main source of raw water for Harare and its satellites, is the most polluted lake in the country. As the city of Harare and its satellite towns progressively grew, their water requirements needed bigger catchments to supply bigger dams. Consequently, the city's dams progressively moved further downstream along the Manyame catchment, beginning with Cleveland Dam, Seke Dam, Lake Chivero, and eventually Lake Manyame. What eventually happened is Harare, Chitungwiza, Ruwa, and Epworth all now sit in the catchment area of their main water supply, Lake Chivero, and this has worsened the water pollution problems (Magadza, 1997). Cleveland and Seke Dams are situated further up within the Manyame catchment and are therefore less affected by pollution from these urban centres. Lake Manyame, located further down in the Manyame catchment, does not directly receive pollutants from the urban settlements within its catchment except those pollutants that spill over from Lake Chivero and therefore is less polluted. It only directly receives pollutants from the town of Norton and the smaller size of this town means that Lake Manyame is currently able to assimilate and dissipate its pollution load. On the other hand, Lake Chivero receives all the pollutants from the urban settlements within the Manyame catchment except those from Norton. The major source of pollution for Lake Chivero are the sewage treatment works in Harare, Chitungwiza, Ruwa and Epworth that discharge sub-standard sewage effluent into the rivers that feed into the lake namely Manyame, Mukuvisi, Marimba and Nyatsime. The sewage effluent has turned Lake Chivero into a highly eutrophic lake. Industrial discharges have also increased the levels of various heavy metals in the lake (Marshal, 1997).

The pollution of Lake Chivero with phosphates and nitrates has encouraged the establishment of some dense blooms of blue-green algae and water hyacinth. These have made water purification difficult, impart unpleasant odors to the water and may be responsible for seasonal outbreaks of gastroenteritis to consumers (Marshal, 1997). This explains why interviewed residents in Norton rated the quality of tap water as very poor. To make matters worse, Harare City Council has no money with which to import water treatment chemicals. The current treatment and pumping capacity of Harare's water infrastructure requires about US \$450,000 worth of water treatment chemicals per month which the city can not afford and has many times appealed for and received funds from the World Health Organization and the African Development Bank (The Sunday Mail, 2010). Failure to procure water treatment chemicals has left Harare with two options which are seminal in understanding the poor state of water supply for the city and its metropolitan area, including Norton. The first option is that of stopping the pumping of water to residents until water purification chemicals are available, which explains why some suburbs sometimes go for weeks or even months without water; the second option being that of pumping under purified water, which also explains the poor quality of tap water and also accounts for the frequent outbreaks of gastroenteritis among consumers. Treated drinking water in Harare, for example, was estimated to be responsible for 35 percent of gastroenteritis infections in 1991 (Chenje et al, 1998). If Norton had its own water treatment plant it would be able to procure enough water treatment chemicals to treat the meager 10 megalitres of water it requires for its daily needs and would thus be better able to provide

adequate and clean potable water to its customers. Better still, if that water treatment facility were located at Lake Manyame, which would be a cleaner source of raw water, water treatment costs would greatly be lowered.

Another reason which has worsened water supply scarcity in Norton is the high percentage of non-revenue water loss in the town. Non-revenue water is the difference between the amount of treated water produced or, in the case of Norton, treated water purchased from Harare, and the amount of water sold or billed to customers. While the acceptable percentage of non-revenue water is between 15 and 25 percent (World Bank, 2006), Norton's average non-revenue water loss percentage between 2005 and 2009 was as high as 40 percent. The major sources of non-revenue water loss, estimated to contribute about 95 percent of all non-revenue water in the town, were pipe bursts and valve leakages. This means that a lot of the water in the reticulation network for Norton is not reaching intended consumers but is being lost to the ground or as surface runoff due to pipe bursts and leaking valves. In other words, only 60 percent of the 6 to 7 megalitres of treated water being purchased by Norton daily from Harare, which is only about 4 to 5 megalitres of water, are reaching consumers while the rest is being lost. Such a huge percentage of non-revenue water loss is both unacceptable and unaffordable for Norton.

CONCLUSION AND RECOMMENDATIONS

The study has attempted to establish the extent or magnitude of the water crisis in Norton as reflected through water shortages and their effects in the domestic, industrial and institutional sectors of the town representing the three major consumptive uses of water in Norton. The study has also identified the causes of the water supply crisis in Norton, which all seem to emanate from a precarious dependency on outsourcing water from Harare, as Norton has no water treatment facility of its own. The other towns surrounding Harare also depend on it for their water needs and therefore water demand has outstripped supply for Harare and its metropolitan area including Norton. Unacceptably high non-revenue water losses have also worsened the water crisis in Norton.

The study ends by suggesting some recommendations which might see Norton radically improve its water supply situation. First and foremost, Norton must establish its own water treatment facility as a matter of urgency and priority. This will wean the town from a precarious dependency on water from Harare which has plunged it into its current water supply challenges. With a population of approximately 65,000 residents, and requiring only about 10 megalitres of treated water per day, Norton will be better able to meet its water needs. Norton will also be able to procure the necessary water purification chemicals for a smaller water demand. Moreover, if the water treatment plant were to be located at Lake Manyame, which is relatively less polluted compared to Lake Chivero, the current major raw water source for Harare and its metropolitan area, water treatment costs would greatly be reduced. Norton Town Council should therefore begin immediately to create a separate account for the construction of a stand-alone water purification plant for the town. Partnerships, if necessary, could be created with donors, non-governmental organizations, the private sector or multilateral institutions. The same applies to all the other satellite towns around Harare which depend on the capital for their water needs just like Norton. However, Norton is best placed to achieve a turnaround to its water woes by virtue of it being situated between two of the largest inland lakes in the country.

Secondly, there is a serious need to curb the various sources of pollution into the rivers and eventually lakes of the Manyame catchment if sustainability in water supply is going to be achieved by the settlements within this catchment, the most urbanized and industrialized catchment in the country. Upgrading of the sewage treatment works in Harare, Chitungwiza, Norton, Ruwa, and Epworth, which currently discharge substandard sewage effluent in the rivers that drain into the lakes within the catchment, will go a long way towards the reduction of pollution loads. Industries should closely be monitored so that they come up with effective pollution prevention measures, with heavy punitive deterrents put in place against polluters. The Environmental Management Act, the Water Act, and other environmental legislation should be put in full force so to protect water resources, not only in the Manyame catchment, but throughout the country. However, a multi-stakeholder approach would be more effective in dealing with water pollution problems in the country.

While the above recommendations require a time lag before full implementation, Norton Town Council needs to take imminent measures so as to address the water crisis in the town. One such pragmatic imperative is the need to reduce the unacceptable 40 percent non-revenue water loss mainly due to pipe bursts and valve leakages being experienced in the town's reticulation network. A lot of water which could have helped alleviate the water crisis in Norton is unnecessarily being lost through this way. Norton Town Council also needs to promote pre-use treatment of water, especially drinking water, among residents probably through boiling and use of chlorine tablets. This should apply to both tap and well water as the study has revealed that both water sources are not directly potable.

REFERENCES

- Central Statistical Office. (2002). *Zimbabwe National Census 2002*. Harare: Government Printers.
- Chenje, M., Sola, L. & Paleczny, D. (1998). *The State of Zimbabwe's Environment*. Harare: Government Printers.
- Magadza, C.H.D. (1997). Water Pollution and Catchment Management in Lake Chivero. in *Lake Chivero: A Polluted Lake*. Harare: University of Zimbabwe Publications.
- Marshall, B.E. (1997). Lake Chivero After Forty Years: The Impacts of Eutrophication. In *Lake Chivero: A Polluted Lake*. Harare: University of Zimbabwe Publications.
- Norton Town Council. (2003). *Norton Town Council Strategic Plan for Period 2003 to 2010*. Norton: Norton Town Council.
- The Sunday Mail. (2010). *Water Ministry Turns to Treasury*. Harare: ZimPapers Publishing.
- World Bank. (2006). *The Challenge of Reducing Non-Revenue Water in Developing Countries*. Washington: World Bank.
- World Bank website. (n.d.). *Water supply and Sanitation*. Retrieved from <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTWAT/0,,contentMDK:21706928~menuPK:4602430~pagePK:148956~piPK:216618~theSitePK:4602123,00.html> on May 18, 2010.
- World Health Organization. (1993). *Drinking Water Quality Guidelines*. Geneva: World Health Organization

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