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THE WORLD BANK

REPUBLIC OF ZIMBABWE

GREATER HARARE WATER AND SANITATION STRATEGIC PLAN

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

INVESTMENT PLAN REPORT

(FINAL)

VOLUME II: APPENDIX

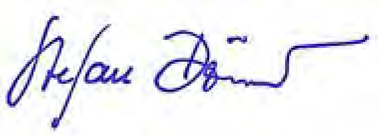
June 2014

JBG Gauff Ingenieure

Acknowledgements

The preparation and writing of this report could not have been possible without the invaluable support of theWorld Bank, the Zimbabwe Multi-donor Trust Fund, City of Harare (Harare Water), Chitungwiza Municipality, Norton Town Council, Ruwa Town Council, Epworth Local Board, GIZ, Dorsch International Consultants GmbH, Lahmeyer GKW Consult GmbH, BCHOD and ZimSTAT. We are grateful for the level of cooperation and assistance provided by the dedicated professionals from these institutions.

June 2014



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Preface

This report is the outcome of a combined financing and supervisory effort by the Zimbabwe Multi-Donor Trust Fund (Zim-Fund) and the Multi-Donor Analytical Trust Fund (MDTF) under the World Bank as well the operational contributions of the beneficiary local authorities. The Zim-Fund financed the study that generated the Harare and Chitungwiza input data, while the MDTF financed the additional investigations in Ruwa, Epworth and Norton and the development of the integrated water and sanitation investment plan for Greater Harare.

The Consultant signed two separate contracts with the two financiers with different contractual obligations regarding submission of reports. Under the Zim-Fund project, the Consultant is obliged to issue individual reports for Harare, Chitungwiza, Kwekwe, Chegutu, Masvingo and Mutare. Under the World Bank project (which includes Harare and Chitungwiza), the consultant is required to issue a single report covering all the project towns.

Considering the inter-linkages and dependencies of the technical and institutional aspects of water and sanitation service provision in the Harare area, the financiers resolved that it would be in the best interest of the Clients to receive a single combined report for the Zim-Fund and the World Bank projects instead of issuing two separate reports for Harare and Chitungwiza as per the Zim-Fund contract. This arrangement will allow the Consultant to provide the necessary information on the integrated Greater Harare water and sanitation systems in one consolidated document.

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

INVESTMENT PLAN REPORT

VOLUME II: APPENDIX

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APPENDIX 1

APPENDIX 1.1: TERMS OF REFERENCE

Greater Harare Water and Sanitation Investment Plan

Terms of Reference

June 4, 2013

1 Background

Zimbabwe Multi-Donor Trust Fund

1. The deterioration of Zimbabwe's economic and social situation culminated in the severe humanitarian crisis of 2008 that included widespread food shortages and a cholera epidemic. Following the signing of the Global Political Agreement in September 2008 and the forming of the Government of National Utility in February 2009 there has been on-going dialogue between the Government of Zimbabwe and donors. The African Development Bank (AfDB), being a significant and committed contributor to development in Africa, having been established for the purpose of contributing to the sustainable economic development and social progress of its African Member States, has been requested by a group of donors, who are willing to assist Zimbabwe, to establish and administer the Zimbabwe Multi-Donor Trust Fund (the "Zim-Fund").

2. The purpose for the Zim-Fund is to contribute to early recovery and development efforts in Zimbabwe by mobilising donor resources and promoting donor coordination so as to channel financial assistance to such efforts. One aim of the interventions to be supported by the Zim-Fund is to save lives and protect assets. Critical to the achievement of these goals are: financial and technical support to activities that are consistent with the recovery priorities of the Government and mobilisation of pooled donor resources. These are based on a common understanding of the country's recovery needs and linked to effective coordination, and complementary, with other related activities that are supported outside the Zim-Fund and efficient monitoring and evaluation of outputs and impacts.

3. As part of the Zim-Fund interventions, the Ministry of Finance, Government of the Republic of Zimbabwe has received a grant and intends to apply the proceeds towards the Urgent Water Supply and Sanitation Rehabilitation Project (UWSSRP). This covers rehabilitation to the water supply and sanitation systems in 6 urban centres, namely: Harare, Chitungwiza, Mutare, Masvingo, Kwekwe and Chegutu.

4. In December 2011, the Ministry of Finance through the Zim-Fund engaged the services of an Implementing Entity (IE) for the UWSSRP (Lahmeyer GKW Consult GmbH formerly Pöyry Environment GmbH) to, among other services, design and supervise implementation of immediate measures works in the 6 municipalities and provide coordination services for water and sanitation interventions financed by UWSSRP. Besides the physical works implementation, the Zim-Fund intends to finance 'consultancy services for the development of Medium to Long Term Water Supply and Sanitation Investment Plans'. The Investment Plans are intended to provide useful guides to the Municipalities and the Zim-Fund on the financing requirements and the phasing of future investments.

5. A summary of the terms of reference for developing investment plans for the towns of Harare, Chitungwiza, Mutare, Masvingo, Kwekwe and Chegutu is given in Annexure 1.

6. The key objectives of the terms of reference are to develop detailed water supply and sanitation investment plans that meet medium term (until 2020) and long term (until 2030) infrastructure requirements for the six municipalities. Apart from Mutare, the other cities/towns have no specific investment planning document in place for water supply and sanitation infrastructure development. Hence, the outcome of this project will be bankable Investment Plans that the municipalities can use as guide for future infrastructure and institutional development.

Multi-donor Analytical Trust Fund

7. The World Bank was requested by the City of Harare to provide advisory services in support of the development of a strategic plan for Water Supply and Sanitation for Greater Harare which, for the purposes of this document, is taken to include the local authorities for the City of Harare, Chitungwiza Municipality, Norton Town Council, Ruwa Local Board and Epworth Local Board.

8. The key objective of the support for the development of a Greater Harare Water and Sanitation Strategic Plan is to restore water services in the short-term and expand and improve services in the long-term. The work includes the assessment of institutional arrangements for restoring service delivery, improving operational efficiency and ensuring sustainable long-term water services in the Greater Harare area, reviewing investment plans, arranging an investors' conference and attracting funds to achieve the objectives.

9. The expected outcomes include improved water supply and sanitation services; better planning and management; improved customer involvement and confidence and willingness to pay; improved efficiency, cost recovery, improved equity in provision and sustainability; improve accountability to council, government, customers and key stakeholders; improved and optimized resource management (financial and human); and attracting funding through a proper funding strategy which will ensure expansion and augmentation of the water supply and sanitation systems.

10. The key scope of works related to investment are as follows:

- outline a clear investment plan, which articulates immediate, short term and long term financial needs, and captures strategies to restore customer confidence. The plan should also prioritize needs and wherever possible be based on economic assessments that determine best options.
- Develop pathways to return Greater Harare to the long term desired situation where Greater Harare can raise its own capital on financial markets.
- Once institutional and financial reforms are in place, hold an investor conference to raise capital.

11. The key objective and output of the Zimfund-AfDB project (bankable investment plans) complements the work in developing the Greater Harare Water and Sanitation Strategy.

2 Objectives

12. The goal of the water supply and sanitation sector in Zimbabwe is to improve the health and social wellbeing of the population, and to enhance the performance of the national economy, through equitable provision of adequate water supply and sanitation services.

13. The objective of this project component is to develop *an integrated* water supply and sanitation investment plan that meet medium term (until 2020) and long term (until 2030) infrastructure requirements for *Greater Harare.* The outcome of this project will be bankable Investment Plans for the Greater Harare area that the municipalities can use as guide for future infrastructure and institutional development.

14. This will entail developing an integrated investment plan for Greater Harare, incorporating the investment plans developed under the Scope of Works developed for the Zim-fund Investment Plans for city of Harare and Chitungwisa and include the investment needs of Epworth, Ruwa and Norton. When undertaking this work, to consider the Greater Harare area as a single economic and water management system.

15. This work will not duplicate the work undertaken in the Zimfund Investment Planning contract referred to in Paragraph 5 above, but complement it by developing a single integrated output for Greater Harare, incorporating investment needs for Epworth, Ruwa and Norton.

16. In undertaking the work, the consultant shall bear in mind the relative sizes and economic significant of the towns comprising Greater Harare and allocate effort appropriately to achieve the overall objective.

3 Scope of services

Task A: Data Collection and Establishment of Planning Framework

17. The Consultant shall collect available data, reports, existing drawings, plans and maps related to the project for *Epworth, Ruwa and Norton*.

18. The consultant shall take into account all relevant work undertaken and underway in each town.

Available documentation includes:

- Rapid assessment reports prepared for UNICEF and GIZ
- The Report on Technical Assistance for Water and Wastewater Treatment Works in the City of Harare prepared by Arup for the World Bank
- Documentation prepared for the Greater Harare Water Supply and Sanitation Strategy “Five town workshop” held at Troutbeck, Nyanga from 8 to 10 April 2013

Work undertaken or under way includes:

- Rehabilitation at Prince Edward Water Treatment Works by the French Red Cross
- Rehabilitation of parts of Morton Jaffray Water Treatment Works by the International Committee of the Red Cross and by UNICEF.
- Rehabilitation in Harare and Chitungwiza under the ZImfund administered by the African Development Bank
- The Japanese aid organization JICA has engaged a consultant to prepare a water and sanitation master plan for Chitungwiza
- The World Bank has engaged a consultant to prepare a national water and sanitation investment analysis (rapid assessment) which includes consideration of investments needed within Greater Harare.
- The German aid organization GIZ is providing institutional support to Norton and will carry out works to improve water supply to vulnerable communities and prevent discharge of raw sewage to Lake Manyame.
- The City of Harare is about to sign a contract with China National Machinery and Equipment Import and Export Corporation (CMEC) under a loan agreement with China Export and Import Bank (Eximbank) to do rehabilitation mainly in the water and sewage treatment plants. It is understood that the scope of work is under discussion as Harare would like to focus more on the water demand management measures in the network.
- The City of Harare has begun a program to achieve 24/7 supply to its customers. It is using site inspections with GPS to create a data base of consumers, discover unmetered consumers and identify leaks. So far a high density housing area, a low density housing area and an industrial area have been inspected.
- Ruwa Town Council is implementing a pipeline from Nora Dam to augment its supply.

Task B: Use of Planning Criteria

19. The consultant shall use the same planning criteria development in the consulting project referred to in Paragraph 5 above.

Task C: Water Demand Forecasts until year 2030

20. Assess economic base of <u>Greater Harare area</u> and develop scenarios for future economic development. Three scenarios for the economic recovery and future economic growth of Greater Harare will be developed. *This will not involve collection of empirical data*, but be undertaken through consultation with the World Bank country economist taking into account any relevant and available studies on the city economic and its growth prospects. The three scenarios should encompass the following: “low growth” (no full economic recovery), “moderate growth” (recovery of city economy, but over a long period of time) and “high growth” (rapid recovery of city economy and ongoing growth of economy).

21. Develop medium and long term water requirements and wastewater flows for <u>Greater Harare (all five towns)</u> taking into account:

a. Census 2012 population data and any other *relevant*, *recent and reliable* data on population and existing status of property and housing development and service provision.

b. The work done under Zimfund for Harare and Chitungwiza.

c. Incorporating water demand estimates for Ruwa, Epworth and Norton (bearing in mind the level of effort remand in paragraph 16 above).

d. Realistic estimates of per capita and/or household (per property) consumption, and non-domestic consumption, taking into account the economic scenarios referred to in the previous paragraph.

e. The strategic inputs available from the Greater Harare Strategic plan process, in particular, the rapid assessment of existing status of infrastructure and investments and the strategic sanitation investment report. In particular, the lack of affordability of a universal sewer network and wastewater treatment system, and the need for a 'sewer boundary', needs to be factored into the demand assessment

Task D: Assessment of Existing Water and Sewerage Infrastructure

22. The Consultant shall assess the capacity of the existing infrastructure in Ruwa, Epworth and Norton and assume the condition of this infrastructure based on the work undertaken under separate contract for Zimfund for Harare and Chitungwiza, adjusted on the basis of engagement with relevant officials. The purpose of this activity is to estimate the capacity deficits with regard to the medium and long term water requirements determined under Task C. It is important to note that some of the deficiencies may be mitigated by simply rehabilitating or replacing the existing facilities. Hence *rehabilitation of facilities is an important component of the investment costs*.

23. *For the water distribution network condition assessment*, no additional work is to be undertaken in this component of the study, but reliance will be made on the work undertaken in the Zimfund project as described above.

24. Similar to the water distribution network, the capacity and condition of the sewer network shall be assessed for Ruwa, Epworth and Norton.

Task E: Develop Medium and Long Term Investment Proposals

25. The Consultant shall propose medium and long term investment measures based on the projected water and wastewater service requirements and the assessed capacities of the existing facilities for Greater Harare, taking also as an input the work on Harare and Chitungwiza undertaken for the Zimfund project.

26. Where new water sources and treatment facilities are to be considered, the Consultant shall develop and evaluate alternative solutions before selecting the most technically and financially feasible option. It is important that each project component is selected on the basis a rational prioritization, with reference to its financial and economic costs, measured against its benefits or effectiveness (economic, financial, social and equity).

27. *This assessment will consider the infrastructure requirements and demand for the Greater Harare area as a whole and proposals shall be developed for the most cost effective development and management of a single water and wastewater infrastructure system for the greater Harare Area, taking into account the work undertaken for City of Harare and Chitungwiza in the Zimfund project.*

28. The Consultant shall prepare a single consolidated investment plan for Greater Harare, ensuring complementarity, alignment, non-redundancy and efficient resource use and taking into account an affordable investment envelop informed by the financial model (see Financial Analysis below).

Task F: Cost Estimates

29. The Consultant shall prepare cost estimates of the proposed investment measures. The Consultant shall develop realistic unit costs that take into account the current country/regional market conditions and inflationary expectations.

Task G: Financial Analysis

30. The aim of the financial analysis is to ensure that there will be sufficient funds to cover the expenditure requirements during the life of the facilities and to ensure that the project benefits are greater than the project costs over the life of the investment taking into account the time value of money. The Consultant shall, therefore, carry out a comprehensive financial analysis of the project using an appropriate financial model that captures the expected investment and recurrent expenditure over the project life (until 2030). Revenue expectations (tariffs) should be estimated, taking into account the ability and willingness to pay of the target population.

31. The consultant will develop a financial model for the Greater Harare area for water and sanitation. The financial model will be for the provision of financially sustainable water and sanitation services for Greater Harare, taking into account investment needs, affordability, realistic tariffs, efficient operating costs and a realistic performance improvement trajectory. The model will project a realistic revenue envelope and costs for provision of water and sanitation services over a period of 10 years, based on realistic performance benchmarks.

Task H: Institutional Assessment

32. The consultant will provide a brief overview of existing capacity for provision of water supply and sanitation in the three towns – Ruwa, Epworth and Norton, describing staff numbers and skill levels and any other relevant measures of capacity and competence to undertake the necessary tasks effectively. An overall institutional assessment for Greater Harare is not required.

Task I: Environmental and Social

33. The Consultant is required to work with the Councils (especially the Town Engineer) of the three towns (Ruwa, Epworth and Norton) in collecting data for the investment needs analysis.

34. The draft Investment Plan for Greater Harare shall be presented by the consultant to the relevant stakeholders for review and endorsement, as part of the Greater Harare Strategic Plan process.

Task K: Preparation of materials for Investors conference

35. The consultant shall prepare materials for an investor conference, including:

a. *Integrated investment plan for the Greater Harare area.*

b. *Summaries of the bankable investment projects which form a part of this plan.*

c. *Presentation of financial model results showing affordable revenue and investment envelop.*

4 Key Staff

Same as AfDB/Zimfund Investment planning project.

5 Minimum experience

Same as AfDB/Zimfund Investment planning project.

6 Assignment period

An additional month over and above the time period for the parallel AfDB project.

7 Estimated level of effort

Sixteen person months over 6 calendar months.

8 Data, Local Services, Personnel, and Facilities to be provided

Same as AfDB/Zimfund Investment planning project

9 Deliverables

Deliverable 1: Inception report

An inception report within one month of commencement.

Deliverable 2: Monthly progress reports

36. The Consultant shall prepare brief monthly progress reports describing the current status of works, the main activities performed and any special events and problems encountered. These reports shall preferably be in tabular format and limited to one or two pages. The reports shall be transmitted by e-mail to the World Bank. Feedback from the World Bank shall also be communicated by email. Matters arising from the progress report may also be solved by way of meetings whenever necessary.

Deliverable 3: Investment Plan Report

37. A single Investment Plan shall be prepared for Greater Harare. The Investment Plan shall provide all the relevant information needed to understand the process and methodology used to arrive at the proposed investments. (The plan will capture the main features of, and may refer to, the individual investment plans for Harare and Chitungwiza prepared separately for Zimfund project.) The findings of the facility assessments and the recommendations for addressing the capacity deficits shall be clearly elaborated in these reports. The Investment Plan shall comply with international state of the art standards. They shall comprise but not be limited to:

(i) Scope and objectives;

(ii) Characteristics of the project area;

(iii) Demographic profile and macroeconomic outlook;

(iv) Institutional and organisational structure of the Municipalities;

(v) Existing water supply and sewerage situation including O&M procedures;

(vi) Water demand and wastewater flow projections;

(vii) Strategic plan for future water supply and sewerage systems;

(viii) Conceptual design of proposed water supply and sewerage measures;

(ix) Future management and operating requirements;

(x) Investment and operating cost estimates and dynamic unit cost assessment for alternatives (if any);

(xi) Elaboration of a prioritized, staged implementation concept;

(xii) Financial analysis comprising base, best and worst case sensitivity analyses, cash flow projections taking into account willingness and affordability to pay;

(xiii) Environmental Management framework; and

(xiv) Risk assessment.

38. These reports shall be issued first in draft form Six (6) months after official commencement of services. The client and other stakeholders will be allowed Eight (8) weeks to review the documents and issue comments. During the 8 weeks allocated

for review, the Consultant shall organise a stakeholder workshops to present the investment plan. The stakeholder workshops shall be completed within 4 weeks of submission of the draft Investment Plan Reports. The final versions shall then be issued two (2) weeks after receipt of the consolidated comments.

General

39. The draft version of all reports shall be submitted in 6 hard copies, including electronic pdf, MS word or MS excel (MS Office 2007 compatible). The final version of all reports shall be submitted in 6 hard copies, including electronic pdf, MS word or MS excel (MS Office 2007 compatible), all in the English language.

10 Assignment management and administration

The Task Team Leader (TTL) for the assignment is Michael Webster, Sr. Water and Sanitation Specialist, based in Harare, Zimbabwe (mwebster@worldbank.org). All reporting and other contractual obligations must be routed through the TTL.

Day-to-day oversight of the assignment will be done by Rolfe Eberhard, Consultant to the World Bank.

The Project will be guided by a Steering Committee set-up for the Greater Harare Water and Sanitation Strategic Plan that will meet at least twice, once at Inception Stage and once at draft report stage.

Annexure 1: Summary scope of services Zimfund investment plans for City of Harare and Chitungwisa

1. The Consultant shall **collect all available data, reports, existing drawings, plans and maps related to the project**. The recent UNICEF projects and the rapid assessment projects generated some useful reports that can be used for the feasibility study. Hard copy network layouts are also available in some towns.
2. The consultant shall **set up GIS/CAD based planning system consisting relevant spatial planning data layers such as land use, topographical features, water and wastewater facilities, population distribution etc**. This GIS/CAD system shall be setup on the Consultants' own platform. The GIS/CAD data shall be properly geo-referenced and in appropriate formats so that it is easily transferable to a Utility GIS system that will be set up by the service providers later.
3. The Consultant shall prepare, in consultation with the relevant Line Ministries, **Planning Criteria for developing the investment plans.**
4. **Medium and long term water requirements and wastewater flows shall be determined on the basis of the municipality developed land use Master Plans,** which outline the development trends and population projections of the towns. Most of the project towns have land use master plans in place. Where these documents are not available, the Consultant shall make reasonable assumptions in consultation with the town/city authorities. Census data from the government statistics office may also be used.
5. The Consultant shall **assess the condition and capacity of the existing infrastructure**.
6. The water distribution network condition assessment will be done using **sampling methods** aimed at establishing parameter relationships that can be used to extrapolate network rehabilitation investment requirements.
7. Similar to the water distribution network, **the condition of the sewer network shall be investigated using a sampling approach**.
8. The Consultant shall **propose medium and long term investment measures based on the projected water and wastewater service requirements and the assessed capacities of the existing facilities**. Where new water sources and treatment facilities are to be considered, the Consultant shall develop and evaluate alternative solutions before selecting the most technically and financially feasible option. It is important that each project component is selected on the basis a rational prioritization, with reference to its financial and economic costs, measured against its benefits or effectiveness (economic, financial, social and equity).
9. Consultant shall **prepare cost estimates** of the proposed investment measures. The Consultant shall develop realistic unit costs that take into account the current country/regional market conditions and inflationary expectations.
10. The aim of the **financial analysis is to ensure that there will be sufficient funds to cover the expenditure requirements during the life of the facilities** and to ensure that the project benefits are greater than the project costs over the life of the investment taking into account the time value of money. The Consultant shall, therefore, carry out a comprehensive financial analysis of the project using an appropriate financial model that captures the expected investment and recurrent expenditure over the project life (until

2030). Revenue expectations (tariffs) should be estimated, taking into account the ability and willingness to pay of the target population.

11. The Consultants shall **assess the capacity of the councils** to provide water and sewerage services effectively within the existing legislative and policy environment. The Consultant shall then make appropriate recommendations for the future institutional arrangements necessary for the sustainability of the investments.
12. The Consultant shall establish a framework for addressing environmental and social constraints that may arise during the implementation and operation of the project. The framework shall conform to the provisions of the National Environmental Policy (1997) and the Environmental Management Act of 2001.

APPENDIX 1.2: COMMENTS TO THE DRAFT REPORT

Comments from the World Bank (6th May 2014)	Reply from Gauff (8th May 2014)	Final remarks/ acceptance of Consultant's response by the World Bank	Response from Gauff (13th May 2014)
Comments Pertaining to Greater Harare			
1 Yield of the Kunzwi Dam after taking into account upstream commitments is much lower than allowed in the report.	The yield issue is proving to be quite controversial. We suggest that a more detailed study should be commissioned to revise the yield estimates and water rights. This could be part of the feasibility study prior to the revision of the detailed designs for the Kunzvi scheme done in 1997.	Use the lower figure provided by Peter Morris taking into account upper catchment commitments. Reduce Kunzwi Scheme.	Agreed. Kunzwi will be developed limited to 150 ML/day (Yield taking into account upper catchment commitments and demand requirements until 2030) in two stages: 100ML/day in 2022 (construction in 2019 to 2021) and additional 50ML/day in 2028 (construction in 2026 and 2027 – WTP extension and part of pumping stations only).
2 Yield of Seke/Harava Dams is insufficient to support Chitungwiza which will need to continue to receive water from Harare Water.	The resource zoning will be revised. Chitungwiza will continue to receive water from both Prince Edwards and Morton Jaffray WTW	ok	No comment.
3 Urban sewer boundary. Parts of the report describe the concept of an urban boundary with water kiosks and on-site sanitation outside the boundary, but the concept is not well represented in most of the report and in the investment proposals. See point 4 below.	See response to comment 4 below. The report will be revised to explicitly describe the urban boundary and related investment proposals. A more detailed determination of the suitable areas for sewer reticulation should be carried out at feasibility study/detailed design stage	Ok	No comment.
4 Extent of sewer network. In light of affordability considerations, the proposed extent of the sewer network is optimistic. The affordable investment scenario needs to incorporate proposed for a reduced extent of the sewer network. In particular, the proposed full provision of a sewer network in Epworth is not realistic.	Agreed. We will review the sewerage boundaries proposed for all towns and recommend on a reduced extent. We are proposing extending the network from 2020 to 2030 to service 50% of the current informal settlement by 2030 rather than to provide blanket coverage, such that by 2030 there will still be 43% of the overall Epworth population without cover. Whether this is realistic or not is difficult	Delay sewer network for Epworth, phase in line with late development of south trunk sewer and extend network to only 50% at end of period	Epworth will be considered with improved water services (kiosks and partly yard taps) to ensure safe drinking water and on-site sanitation. Approx. 50% of the population will be connected to a

Greater Harare Water & Sanitation Investment Plan – Investment Plan Report
Interim comments from the World Bank on the Draft Investment Plan Report and reply from Gauff

Comments from the World Bank (6th May 2014)	Reply from Gauff (8th May 2014)	Final remarks/ acceptance of Consultant's response by the World Bank	Response from Gauff (13th May 2014)
	for us to judge.		sewer network in 2028 when the Harare South WWTP is constructed (construction period in 2026 and 2027).
5 Water demand management. A strategic approach to bulk metering, zoning and district metering, prioritised replacement of old GMS distribution mains; more extensive use of pressure reducing valves to manage pressures; census of customer service points (including GPS positioning) etc. needs to be more explicitly developed and emphasized in the description of the investment measures.	We have made a provision in the investment plan for more detailed investigations needed to devise an appropriate NRW reduction action plan. An outline of the required activities is presented in Chapter 7. These activities should be part of the feasibility study/final design.	Communicate the need and a strategic approach more clearly, including in the exec summary.	This will be presented in the respective chapters in more detail.
6 Kiosks, flow-limiters and on-site sanitation. An explicit strategy and more detailed investment proposals for water kiosks, flow-limiting devices, support for on-site sanitation need to be elaborated. In light of affordability considerations, these proposals may need to be much more extensive (including inside the urban sewer boundary, or outside a much reduced urban sewer boundary) than invisaged in the current draft investment plan (see separate comments on the financial section).	Agreed. We will develop a more detailed strategy covering the sewerage boundaries, water kiosks, flow limiting devices and onsite sanitation support.	Ok	No comment.
7 Water demand management must include physical checks of properties and water meters as the billing data base is deficient, particularly in Harare and Chitungwiza.	Agreed. See also response to comment 5 above	Ok	No comment.
8 Sequencing of investments: In the investment proposals, many Priority 3 investments are shown before the Priority 1 investments.	These are reticulation extensions in new development areas which may be done annually by private developers or the local authorities. Harare Water is currently carrying out these works in some parts of Harare South.	Please make this clearer in the report.	Agreed.
9 Spellings of names must be checked as there are multiple errors.	Noted. The final report will be corrected	ok	No comment.
Town Specific Comments			
10 In Harare the investment proposals must include the smaller water booster stations.	Noted.	ok	No comment.

Comments from the World Bank (6th May 2014)	Reply from Gauff (8th May 2014)	Final remarks/ acceptance of Consultant's response by the World Bank	Response from Gauff (13th May 2014)
11 In Harare, data on network pipe materials is incorrect and may affect replacement prioritisation and costs.	Noted. We'll check again with Harare Water who provided the data.	ok	No comment.
13 In Norton, early investments must include duplication of the pipeline from Morton Jaffray and pipelines to reinforce supply to the western areas.	Agreed. This is supported by modeling. We will review the timing of the investments in various pipelines to ensure these are correctly prioritised.	ok	No comment.
14 In Ruwa it must be emphasised that the catchment for Green Sykes Dam must be sterilised against development to prevent pollution of this source. The watershed protection area should be shown on the layouts.	Noted. The catchment of Green Sykes Dam will be marked on the map and text regarding protecting the catchment will also be added in the report.	ok	No comment.
15 In Ruwa, it will take several years before there is an alternative to the existing sewage pump stations and treatment ponds on Adelaide. There is a need to rehabilitate these to prevent environmental pollution until an alternative is available.	Understood. We will include investment measures for rehabilitation of the main pump station and interim rehabilitation of the ponds. We will report on likely pond effluent quality and measures that could be taken to improve this.	ok	No comment.
16 In Ruwa, much of the distribution network is young (10 years and less) and should not need replacement in near to medium term future.	We will review the age spread of network pipes in Ruwa and the proposed level of investment.	ok	No comment.
17 In Epworth, Ventersburg reservoir provides adequate static head for all except a small area along the northern boundary of Epworth. Pressure reducing valves will be needed for the lower lying areas. There is no need for pressure boosting (that is proposed). There is no high ground to locate more storage within Epworth and the solution will be to ensure adequate supply from Ventersburg.	Our modeling shows that even with pipe velocities near minimum there is insufficient pressure in Epworth without a booster station in the long term. We agree that no additional storage should be established in Epworth.	ok	No comment.
18 In Epworth, review proposal for full coverage for sewer network. The assumption of conversion of informal to fully serviced HD after 2020 is optimistic. Epworth serves the poorest segment of Harare's population and putting in water connections and sewer connections to each house is likely to make it unaffordable. I think it would be better to ensure safe water supply by installing yard taps with flow limiters or stand pipes/kiosks, and supporting a program to improve on-site sanitation.	This is much the same as for no 4. Is the suggestion that that there should be no further upgrading of informal to HD settlement? If so, this would be contrary to the stated objectives and intentions of the Local Board. Is 50% unrealistic? If so what is a realistic %? We will review this but our feeling of Epworth is that whilst it is poor and somewhat unplanned there are many much poorer and poorer planned areas in African cities which have successfully	See above.	No comment.

Comments from the World Bank (6th May 2014)	Reply from Gauff (8th May 2014)	Final remarks/ acceptance of Consultant's response by the World Bank	Response from Gauff (13th May 2014)
	implemented household sewer connections.		
Selected Detailed Comments			
Page 3-17. I do not see why the Nyatsime Farms cannot accommodate 105,420 people in HD stands. Land has been identified to accommodate35,889 stands which equates to 2.9 people per stand.	Correct, the Nyatsime Farms can accommodate way more than 105,420 people in HD stands. The figure of 105,240 relates to the initial phase of development on Nyatsime which is considered likely to be achieved by 2030. Hence the statement on pages 3-17 to 3-18 "If necessary, the balance (for HD) could be accommodated either by reallocation of some of the proposed Nyatsime LD and MD housing (within the initial phases of development to 2030) to HD, or else through continued expansion of HD housing to the south within Nyatsime."	ok	No comment.
Page 5-19. Chitungwiza modified conventional plant. Please check the stated capacity of 35 Ml/day, my information is that it is 18 Ml/day. Assuming that this is the case then there is capacity only in the medium term unless as is suggested in the report, areas that need pumping to discharge to the Zengeza Works are drained to the Harare South STW.	We have confirmed with Chitungwiza Municipality that the capacity of the modified conventional treatment works is 35 ML/day. The proposal is to decommission the pumps in St Mary's once the Harare South STW is commissioned.	ok	No comment.
Ruwa STW. Google image indicates that development has not taken place over the Adelaide Ponds although part of Sunway City is close to the ponds. Current reason for the ponds not being used is failure of the pumps.	Information from Ruwa Council was that Epworth have asked them to vacate the ponds to allow for expansion of Sunway city into this area. We suggest and will indicate in the report that the two councils should formally agree a need/ schedule for the decommissioning of the ponds, probably in parallel to the implementation of 'long term' investments.	Recommend use of ponds for Ruwa ponds as medium term measure, this delays south trunk sewer.	Agreed. We are proposing ponds as a short-term solution for Ruwa and delaying the construction of the Harare South Trunk Sewer until 2029 (construction in 2026 to 2028).
Is there a justification for a dedicated pump station to supply Norton? Morton Jaffray can already pump more than the	Wording will be checked as it is not intended to provide a dedicated pump	ok	No comment.

Comments from the World Bank (6th May 2014)	Reply from Gauff (8th May 2014)	Final remarks/ acceptance of Consultant's response by the World Bank	Response from Gauff (13th May 2014)
available yield and all that it needed is to increase the pipeline capacity.	station, just a dedicated pump within the existing station. Modelling showed a different head requirement for pumping to Norton.		
Marlborough Sewage Pumping Station. Please confirm that the New Marlborough SPS is at the treatment ponds. My understanding is that all sewage arriving at the ponds has to be pumped because the sewer is lower than the ponds and that the pumps are not working.	Marlborough SPS: the ponds are adjacent to the PS. Originally these were surface pumps but have been converted to a submersible system with 2 pumps in each sump The sewage has to be pumped to the ponds. All 4 pumps were not operational. New Marlborough SPS: the ponds are about 1.0 km from the PS. There are 2 submersible pumps and both were operational at the time of our visit. The sewage has to be pumped to the ponds.	ok	No comment.
The investment measures for Epworth must take into consideration that the population depends on unsafe sources such as shallow wells and surface water. It is also a very poor population and it will be difficult for the people to sustain the investment needed to provide fully reticulated water supply. Harare must commit to supply more water to Epworth and immediate measures are needed to provide kiosks.	We will provide more detail for a plan for water kiosks and flow limiting devices to be rolled out urgently in Epworth.	ok	No comment.
7.3.4 Epworth Sewerage. Report recommends rehabilitation of the existing network. This cannot be done until there is a connection to a treatment works, whether at Lyndhurst or Harare South. In the mean time, support must be provided to ensure safe onsite sanitation in Epworth.	Agreed. We will develop this activity.	ok	No comment.
It is incorrect that Nora scheme competes with Kunzvi for the same raw water source. The confluence of the Nora River with the Nyagui is downstream of Kunzwi Dam. In discussion of further expansion of the works take in to consideration that the yield of Nora Dam is 27 Ml/day average equates to 34 Ml/day peak day. Transfer system can move 21 Ml/day. Pumping from Nora to Ruwa will take less energy than pumping from Kunzwi. Nora Dam is closer than Kunzwi, is at a higher altitude, the highest point to which the water has to be lifted is lower. Thus the pumping head from Nora to Ruwa	We will review this. Confusion arose as the Nora Weir yields are included in the yield for Kunzvi (ZINWA Yield Report for Kunzvi Dam). We will therefore review both the figures for Nora and Kunzvi to ensure no water has been double accounted.	ok	No comment.

Comments from the World Bank (6th May 2014)	**Reply from Gauff (8th May 2014)**	**Final remarks/ acceptance of Consultant's response by the World Bank**	**Response from Gauff (13th May 2014)**
is less than Kunzwi to Donnybrook to Nora. Unless there is a good reason, Nora system should be developed to its full capacity.			
Table 7-52 Accompanying Measures. It is known that there is a large number of consumers that are not on the billing data base. These include co-operative housing areas along the southern boundary of Harare. A recent exercise by Harare Water in Budiriro revealed that only half of the occupied No comment.stands had meters and were on the data base. A subsequent exercise in Belvedere showed a similar pattern. Chitungwiza Town Engineer considers that there are large numbers of consumers who are not on the data base and who are not billed. The accompanying measures must include an exercise by meter readers equipped with GPS to log every meter read. Transfer of this data to recent satellite imagery will show consumers that are not registered.	We have made a provision for a database cleanup exercise which will include mapping of all customers.	ok	No comment.

Greater Harare Water & Sanitation Investment Plan – Investment Plan Report

Comments from ZINWA on the Draft Investment Plan Report and reply from Gauff

Comments from ZINWA (4th June 2014)	Reply from Gauff (4th June 2014)	Final remarks/ acceptance of Consultant's response by the World Bank
The issue of Water demand management must be relooked at. They have recommended bulk replacement of valves, meters etc.; I think some of the items can be reusable within the reticulation system.	The conclusions made on replacement of valves, service connections and meters are based on statistical results from pilot area investigations. More refined localized investigations will have to be conducted before determining which network elements will be replaced. The Investment Plan makes provisions for such investigations.	Agreed.
The PR issues regarding Water Demand Management must also come out Clearer and more emphatic since acceptance is crucial for it to be successful. Physical operation may improve but unless the users understand and accept WDM this can end up being a disaster, can encourage water hording and contamination etc.	Item F.3 (ii), in the investment plan, under the broad category of "Accompanying Measures" is the provision for customer awareness campaigns that will cover a broad range of issues, including WDM	Agreed.
The first stage can be integrated as Harare, Chitungwiza, Norton, Epworth and Ruwa in one basket but it's important to look at segment affairs so that there is buy-in. The satellite towns have their local administrative structures and I think long term development must be in separate council areas with encouragement for cross trading and promotion of basin transfers.	The issue of institutional arrangements has been addressed by the World Bank under the broader strategic plan development.	Agreed.
This will also bring competition among the Authorities	Ditto above	Agreed.
Operation structures must distinguish bulk supply points and the secondary distribution network.	This is a detailed operational issue that is outside the scope of this investment plan (not sure I understand the relevance of the comment actually!!).	Operational issue.

Comments from the World Bank (25th April 2014)	Reply from Gauff (30th April 2014)	Final remarks/ acceptance of Consultant's response by the World Bank
Main Comment – Financial Analysis and Investment Plan		
While a lot of good work that has been undertaken on this project, particularly the work to develop the investment plan (what investments are needed, where they are needed and what they are likely to cost), the report falls substantively short in two very important respects: • The report does not present a realistic and plausible financial scenario for a utility providing water and sanitation to both invest in service improvements and to sustain these improvements over time. Instead, the report presents an investment plan that the financial analysis then shows be unaffordable. • The report does not present an affordable investment plan. Both of these aspects (a realistic financial scenario for a financially viable utility to improve and maintain services, and an affordable investment plan) were key parts of the brief….. Therefore, paragraph 11-8 of the report, the main concluding paragraph of the financial analysis, and all of the financial analysis leading to this conclusion, cannot be accepted. We therefore request that you: (1) Redo and substantially improve the financial analysis (both the modelling and the reporting of the analysis) to develop a realistic and financially affordable and sustainable scenario for the improved and sustainable provision of water services to Greater Harare. This analysis should take into account the above points as well as the detailed comments below. (2) Present an alternative investment plan that fits within the investment resource envelope shown to be realistic by the financial model. (The full investment plan can also be kept as a scenario).	The model and the assumptions will be reviewed in light of your observations as explained in the detailed comments and responses below	Thank you.
2 Detailed comments		
Use of 0 for chapter (sub-section and page) numbering for Executive Summary is unusual (or is it just my own software?).	It's just a unique presentation style. We can change it if you want us to.	Not necessary
Par 0.4.1 Need to also state that actual functioning capacity is much less.	Noted.	
Par 0.4.3 Change sentence with "non-existent", suggest "for all practical purposes, supply is negligible"	Noted	
All Paragraphs in 0.11 need to be completely rewritten. The analysis and summary is not adequate. See comments on the financial analysis	The whole chapter 11 and the associated summary will be revised in light of your comments	

Comments from the World Bank (25th April 2014)	Reply from Gauff (30th April 2014)	Final remarks/ acceptance of Consultant's response by the World Bank
	and suggestions	
Is Figure 8-1 up to date? (There have been recent changes in structure.) Provide a date for the information "as at *** 2014."	Noted. As you are aware, we struggled to get data from the City of Harare and Harare Water, so the data we have may not be up-to-date	Understood
Par 8.3.1: It is not correct to say that Harare Water's finances are ring-fenced.	Noted. The correction will be made	
Figure 8-2: Has a separate customer management position been created? Is the post filled?	Data from Harare Water is scanty	Understood
A ratio of 10 staff per 1000 connections is high. Need to calculate as staff per 1000 water and sewer connections.	Noted.	
Par 8.3.1 Best practice is much lower than this (4 or even much less than this), though in developing countries should expect it to be below 8 and preferable below 6 for the scale of operations of Harare Water (a large city).	Noted	
Par 8.3.1 You have provided the full staff establishment (positions and grades) in Figure 8-2 and Table 8-4. Surely it is possible to make a comment on the appropriateness of this structure? – Some questions to ask and answer include: Are there any clear imbalances? Too many people at low grade? An 'intermediate/supervisory layer that is understaffed? Missing sections? Under-staffed/over-staffed sections? Too many managers? Location and reporting of the meter readers not optimal?	Noted. We'll provide more commentary on the assessment of the existing structures. The whole chapter will be restructured. Detailed tables and charts will go to the appendix so that only succinct information remains in the main report.	Noted
Figure 8-3 text boxes are not completed	Noted. This will be corrected	
Table 9-1. Page 9-4. Sewerage critical interventions – environmental. Need to make link to water restoration progress. No point in addressing overcapacity lines if this is due to major water leakages rather than managed consumptions.	Noted	
Par 10.1 1st bullet. Cannot assume World Bank finance will be available. Can assume some form of concessionary finance is available. (I think this will be necessary, though it is not clear where it will come from.)	Noted. This will be corrected	
Par 10.2. 2nd bullet. Evolution towards an independent utility is not detailed in Section 8 as indicated in this paragraph.	Noted. Chapter 8 will be revised to include a brief description of the proposed progression from the current arrangement to the autonomous metropolitan utility.	Noted. Please also attach a budget to the institutional strengthen and reform program.

Greater Harare Water & Sanitation Investment Plan – Investment Plan Report
Interim comments from the World Bank on the financial analysis and reply from Gauff

Comments from the World Bank (25th April 2014)	Reply from Gauff (30th April 2014)	Final remarks/ acceptance of Consultant's response by the World Bank
Par 10.3 Page 10-2 3rd par. Long-term project implementation years are incorrect.	Noted	
Figure 10-1 Spelling mistake – institutional reforms, consistency of capitals	Noted	
Par 11.2 last paragraph is not clear. Please clarify explanation.	The text will be revised. The point we are making is that the current cost of bulk water production determined by the model is compared with current sales price of bulk water to the satellite towns to determine whether the satellite local authorities are paying the cost covering price or not. Under the clustered utility scenario the tariff will reflect the appropriate cost of proving the bulk water to the satellite towns.	Okay
Table 11.3 There appear to be mistakes in the table for the unit costs (eg Ruwa power cost)	Noted. Will be corrected.	
Par 11.3 Page 11-5 Production losses estimate of 5% is probably too optimistic, at least in the near term.	We think that production losses of 5% is realistic, especially that the production facilities are currently being rehabilitated and that the raw water abstraction facilities are close to treatment facilities	Noted, okay.
Page 11-5. Why do you assume that Harare Water should subsidise the other towns?	We are not saying that Harare Water should subsidize the other towns. What we are saying is that Harare water is currently selling bulk water to the satellite towns at a tariff that is below cost (essentially subsidizing them). But the situation should change under a unitary utility company.	Okay, please make text clearer to reflect this.
Table 11-4. Are these full operating and maintenance costs for the bulk water and bulk sewer systems only? Do they include depreciation? Are finance costs excluded? Would help to include notes to table to state exactly what is included and excluded from these costs. Are they for the purposes of selling bulk water (and treatment services) to the other towns?	Yes, they are full operating and maintenance costs only and do not include depreciation and finance costs up to 2019. Thereafter, the costs include depreciation and finance costs. Noted. Notes will be included in the report to clarify this.	Noted, okay.
Sentence below table 11-4 does not make sense – actual costs have not yet been presented in the report.	Note. This comment is related to Table 11-4 only.	Okay
Page 11-5. Please justify the 60:40 split. I do not think it correct to split the financing costs in this way, as magnitude of investments in water and sanitation differ and also swing between periods.	Noted. This will be revised.	Okay

Greater Harare Water & Sanitation Investment Plan – Investment Plan Report

Interim comments from the World Bank on the financial analysis and reply from Gauff

Comments from the World Bank (25th April 2014)	**Reply from Gauff (30th April 2014)**	**Final remarks/ acceptance of Consultant's response by the World Bank**
Par 11-3 Page 11-6 last paragraph. Statement that cancellation of debt will lead to improved willingness to pay is not necessarily true. Evidence so far does not prove this to be true. Do not agree with last paragraph. Increasing collection efficiency will require a whole combination of initiatives that should be spelled out in the report.	The cancellation of debt was made on condition that the customers will commit to paying their bills post debt cancellation. The local authorities were advised to sensitize their customers on this before effecting the debt cancellation. We believe that with debt burden lifted and improved services brought about by the investment and restructuring of the service provider, the customers will be more willing to pay their bills.	In previous discussions, World bank specifically requested that a sensitivity analysis (or alternative scenario) be presented where NRW and collection efficiency targets are not achieved. Please can you show the financial impact of these assumed targets not being achieved.
Par 11-4 .We requested base year to be 2013 and this was agreed in the Inception Report. Data is available to June 2013 (FY 2012/13). It would be helpful to also include in the analysis prior years (a few years of financial data is available for Harare Water).	Noted. Since we couldn't get any data from Harare Water, we will use data from the World Bank and the tariff study.	Okay
Table 11-5. The presented data differs substantially from the analysis undertaken by the World Bank that was previously shared with you. What was your source? Does it include depreciation? Does it include provisions for bad debt? Has VAT been excluded from the numbers? What sits inside the very large 'other expenditure' category? How could the utility incur expenses that are $40 million in excess of its revenues? Are the revenue billings or cash? Specific comments on table: • The data I have shows Revenue for 2012 was $93 million not $64.5 million • The data I have shows total expenses of $84 million (not $105 million) – major difference appears to be the "other expenses" item of $19million – what is in this? • Chemicals, power, salaries & maintenance numbers appear to be in right ball park.	Noted. The input data has been revised to include data from the World Bank. The financial data we used was informally obtained from the Finance Manage at Harare Water. We could not verify whether it was final audited data or draft. So it is safer to use verified data from the World Bank.	Okay.
Page 11-11 1st par. Is this full cost including finance costs? If so, contradicts earlier statement.	See response to similar comment above.	Okay. Please clarify in text.
Table 11-10. It is not stated if these numbers are real (constant $) or nominal (increasing with inflation). If the values are nominal, they should be converted back to real – it is very hard to make any sense of nominal projections in the context of inflation.	All the costs including investment costs have been converted back to real.	Okay.
Par 11-6-1: The tariff scenario presented is unrealistic. Not only is this clearly unaffordable, it also shows a highly profitable situation towards the end of the period, which is unlikely. Comment on financial statements:	Note. This will be revised.	Okay

Greater Harare Water & Sanitation Investment Plan – Investment Plan Report
Interim comments from the World Bank on the financial analysis and reply from Gauff

Comments from the World Bank (25th April 2014)	Reply from Gauff (30th April 2014)	Final remarks/ acceptance of Consultant's response by the World Bank
• Provision for bad debts should be explicitly included and shown • A balance sheet should be included • Cash flow should also show investments made, and source of investments (grants/loans/own resources) There should be an additional table that includes important other data such as: • volume produced • volume sold • average water tariff • average wastewater tariff • annual investments (by main category of investment – bulk water, other water, bulk wastewater, other wastewater, institutional strengthening) • Outstanding debt • Key performance ratios should be shown in a table over time: o NRW o Collection efficiency o Gross margin o Staff productivity o Number of water connections o Water sold per connection o People per connection o Return on assets o Debt-equity ratio	Noted. This has been included Noted. We have now included a simplified balance sheet. Noted. This has been included Noted. Most of these parameters are presented in the detailed sheets in the model workbook. We'll present all the relevant tables in the Appendix. We don't have data on this Noted.	
It would be help to make the other key assumptions directly associated with this project more explicit by being included on table, or in an closely associated accompanying table. Some Important assumptions to foreground are interest rate used and inflation rate.	Noted	
Par 11-8. The brief was to develop an affordable investment plan to improve water and sanitation services in Greater Harare. The analysis shows that the proposed investment plan is not affordable. The World Bank communicated this danger from the very beginning of the project and asked you to be creative in looking for low cost and incremental solutions to improving the water and sanitation situation in Harare. The substantive brief of the financial analysis and investment plan has not been met.	We have revised our approach. We'll create model scenarios guided by the prioritization principles outlined in Chapter 9. The prioritization levels will be modeled separately as scenarios. The base scenario will include all identified investment measures. Scenario 1 will include investment measures under priority 1 while scenario 2 will include priority 1 & 2 investment measures.	Okay

Comments from the World Bank (25th April 2014)	Reply from Gauff (30th April 2014)	Final remarks/ acceptance of Consultant's response by the World Bank
Need to include the risks of: ■ Financial sustainability of the service provider / utility	Noted. Will be included	
3 Comments on the Harare Financial model		
1. It looks like the model is a nominal model (though this is not explicitly stated), using an annual inflation adjustment factor of 2% per annum for key cost items (staff, fuel etc). The financial presentation of the financial statements (income statement, cash flow and balance sheet) should be presented in real (constant 2013 dollars).	All cost items will be presented in real terms, including investment costs	Okay. But the modeling needs to be done in nominal first, and the presentation of the "final" financial statements needs to be in real (converted back to real at the end). Easiest way to do this is have a full nominal model, and add a final 'duplicate' financial statements made where all values converted back to real. The reasons for this is that debt is incurred as a nominal amount and the real value of the debt erodes over time due to inflation. (The Harare model is now modeled with zero inflation but but 2% annual increase in unit staff costs.)
2. There is a very large discrepancy between World Bank (ball park) estimate of replacement cost of assets of $1.8 billion compared to Gauff estimate of $5.7 billion. The WB figure is probably too low (more than $10 000 per water and sewer connection) We are of the view that the Gauff estimate (more than $32 000 per water and sewer connection) is too high. (Existing Assets sheet)	The valuation of existing assets is highly subjective. It's possible that our figure is too high and your figure is too low. We could agree to use a figure in between. What do you think?	Agreed. We can discuss and agree on what is appropriate. Please include Peter Morris in discussion.
3. The calculation of interest is incorrect, it does not take into account the repayment of principle. So interest in the later years is much too high. You need to model a loan balance and calculate interest on the loan balance. (Costs sheet, line 15)	Noted. This will be corrected	Revision in model look okay

Comments from the World Bank (25th April 2014)	Reply from Gauff (30th April 2014)	Final remarks/ acceptance of Consultant's response by the World Bank
4. The model assumes all debt is at 5%. In practice, the debt is likely to come from two sources, concessionary grant finance and 'normal' grant finance. The financial scenario should incorporate a portion of investments coming from concessionary finance (grants or low interest loans) and also some from own resources, particularly after the first five years. (Costs sheet line 15)	Noted. We have added a number of possible sources of finance, including own financing for periodic replacement of water meters and private financing for service extensions in new development areas (private developers could potentially be forced to finance service extensions in new housing estates). It is difficult, however, to determine with reasonable accuracy at this stage the proportions of the different financing sources	Agreed. Need to make an estimate of what is most likely or plausible. For discussion.
5. It is unrealistic to impose a depreciation charge of 30 million from 2013. This charge should be introduced gradually over a period of 5 years (or more). The resources raised to meet this cost should be available as "own resources" spending, and this should be subtracted from the grant/loan financing amount. (Costs sheet, lines 17 and 18)	Noted. In fact we have removed the depreciation charge on existing assets all together. The freed up resources will be used for periodic replacement of service meters.	Okay, this is probably realistic. Not shown in the Harare Model r1 provided.
6. It would be clearer to have a separate financing page which deals with the financing assumptions and shows investments, net debt, interest costs and depreciation calculations	Noted.	
7. Operating cost calculations. While I understand that costs have been developed from 'first principles', these costs need to be introduced over time from the existing base. So, for example, maintenance costs should be ramped up over five years from the existing $10 million per annum to the amount calculated as necessary ($25 million and growing). Fin Analysis sheet, line 12	Noted. The calculated operating costs will be harmonize with the current spend and ramped over time as advised.	Not shown in the Harare Model r1 provided.
8. I would prefer for the Income Statement to include a line for provisions for bad debt that matches the revenue not collected. This makes the cost of non-collection explicit.	Noted.	Need to prvide for the full amount not collected, not 25% as shown in the Harare Model r1 provided
9. The cash flow needs to show all of the investment and financing activities.	Noted.	Not shown in the Harare Model r1 provided.
10. The financial model does not have a balance sheet. This is an important view on the sustainability of the utility and a simplified balance sheet should be included.	Noted. A simplified balance sheet has been created.	The balance sheet is not correct. The outstanding debt does not correspond to that shown in the cost sheet. The balance sheet does not appear to reflect the affect of net cash flows correctly. The Balance sheet references external sheets whereas it should get all

Comments from the World Bank (25th April 2014)	Reply from Gauff (30th April 2014)	Final remarks/ acceptance of Consultant's response by the World Bank
		of its data from the model itself.
11. The calculated cost recovery tariff is a nominal tariff. When expressed in real terms (revenue sheet, line 41), it shows the real tariff moves from $0.59 to $1.02 by 2017 and then gradually increases to $1.20 in 2030. This is not that unreasonable.	Noted.	
12. The financial analysis shows large negative cash flows in the early years, but these are not 'real' deficits as in practice actual costs will be (or should be) phased in, so the early cash flows will look much better in practice. Also, there are large cash flow surpluses in the later years that suggest the tariff in this period could be reduced. In addition. The interest calculation is incorrect.	Noted. This will be addressed in the revised model	Not shown in the Harare Model r1 provided.
13. The analysis needs to be redone taking the above comments into account.	Agreed.	
14. A scenario also needs to be developed that shows both a realistic revenue profile and related affordable investment profile. The investment plan then needs to be adjusted to fit this affordable investment profile.	Noted.	
15. General presentation of the model can be improved to make assumptions and linkages more explicit so it is easier for a third party to follow.	Agreed. The model has been substantially revised.	Some improvements noted.
16. There is no annotating the model so it is no clear what the specific model scenario is that is show – the report presents 2 model runs.	Noted	Still no labeling of what scenario is being modeled in the Harare Model r1 provided
4 Comments on the Greater Harare Financial model		
In the two models provided (Harare and Greater Harare), you have assumed that Greater Harare has personnel costs that are 25% greater than for Harare only – this seems too high. Also the revenues (actual cash collected) for Greater Harare are only 4% higher on average compared to Harare only (this seems too low). So obviously, in terms of these assumptions, moving to a Greater Harare utility is a non-starter for the City of Harare as costs increase more than the revenues. This does not present a convincing case for a Greater Harare utility. Please can you re-examine your assumptions.	This will change with the revised assumptions	

APPENDIX 1.3: MINUTES OF STAKEHOLDER WORKSHOP

URGENT WATER SUPPLY AND SANITATION REHABILITATION PROJECT

GREATER HARARE WATER AND SANITATION STRATEGIC PLAN

JOINT STAKEHOLDER WORKSHOP TO DISCUSS THE GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

Minutes

Date & Time	**28th May 2014, 9:00h – 13:00h**
Venue	Harare, World Bank Offices
Meeting attended by	List appended (pdf)
Proceedings	• Introductory remarks by the World Bank and self-introduction of participants • Introductory remarks by the African Development Bank • Presentation by Gauff on the draft Investment Plan Report and discussions on matters arising • Policy note briefing presentation by the World Bank and discussions on matters arising
Notes & Key substantive issues	**The need for institutional reforms:** Given the poor performance of the service providers currently – particularly Harare Water – it was unanimously acknowledged that institutional reforms are necessary and should begin immediately alongside implementation of the proposed investment measures. **Muda Dam:** Chitungwiza municipality expressed concern over the exclusion of the Muda Dam scheme from the investments measures. They contend that the option of having a dedicated source and production facilities for Chitungwiza such as the Muda Dam scheme should not be discounted. The consultant's response was that the Muda Dam scheme can still be considered for the future beyond the current planning horizon. The construction of the Kunzvi scheme in two phases within the planning horizon of this study will provide sufficient water for Harare and the satellite towns. The Muda Dam scheme can only provide 50 ML/day, which is not sufficient to satisfy demand within the planning horizon. Construction of Kunzvi is more cost effective considering that we can satisfy all demand at one site without having to develop another site within the planning horizon.

Norton's own water production facility: Norton Town Council requested that the consultant considers the option of completing the water treatment plant, allowing the council to operate their own treatment facility and be independent of Harare Water. The consultant's response was that GIZ already did a cost comparison and concluded that the cost of water from an own source would be high than the cost of bulk water from Harare water. Besides, the low yield of the dam coupled with the heavy pollution of the catchment from which the new treatment facility would be abstracting water weakens the argument of adding more production facilities within the Upper Manyame catchment

Adelaide Ponds: the ponds can only be utilised in the very short term. The trunk main to the ponds had been closed by Epworth Local board until a cabinet committee on water and pollution intervened, ordering Epworth to open it and allow Ruwa to discharge sewage. Apparently, the Epworth Local Board has allocated the land around the ponds to the Mabvazuwa housing development. Hence the directive to allow Ruwa to continue using the ponds is only temporary. **Interim solution for sewage treatment** is to build ponds at Solomio farm and an irrigation scheme for treated effluent at Mara farm.

Concerns over joining the Greater Harare utility: Ruwa is concerned that joining the Greater Harare unitary utility will only raise tariffs for them. They are concerned that the cost of producing expensive water from a polluted catchment in Harare will be passed on to them as well since the unitary utility might want to apply a uniform tariff. They are more comfortable staying on their own, but they welcome the institutional reforms that could create a semi-autonomous utility wholly owned by the Ruwa local authority and servicing Ruwa only.

Poor performance of Harare Water: The Mayor of the City of Harare attributed the poor performance of Harare Water and the council in general (with regard to the declining cash collection efficiency) to the residents' negative attitude towards settling of bills for municipal services created by the government directive to cancel all outstanding bills in 2012. He said that people have no incentive to settle bills anymore. Those who were paying before the debt relief feel that they were punished for being good residents and have no incentive to pay their bills anymore. Those whose debt was cancelled think that if they hold out long enough, another benevolent debt cancellation will come from the political establishment.

BNR Optimisation: It was suggested that optimization of the BNR plants should be given high priority as more capacity can be realised. The Consultant explained that the rehabilitation measures at the BNR plants include elements of optimization – the details of which will become clearer at the feasibility or final design stage.

	Investments per capita differences: A concern was raised that the per capita investment costs in Epworth and Chitungwiza were much lower than those for Ruwa and Norton. The Consultant explained that the difference lay in the service levels as well as the dire starting situation, especially in Ewporth. Most of the population in Epworth and Chitungwiza are in either high density suburbs or informal settlements where water usage is by way of public water points or low use in house plumbing. The investments required for low service levels are lower. The investment plan is cognisant of the need to upgrade the service levels in these areas, but this is likely to take time given the poor water supply situation currently obtaining. Initial investments in Epworth and Chitungwiza will be directed towards stabilising the situation and getting more water to the people through a combination of increased bulk water and equitable water distribution techniques such as the use of flow limiters.

Harare, 28th May 2014

Gauff Ingenieure

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

WORKSHOP TO DISCUSS REPORT

28TH MAY 2014

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APPENDIX 3: DEMOGRAPHIC PROFILE AND MACROECONOMIC OUTLOOK

APPENDIX 3.1: DETAILED DEMOGRAPHIC PROFILE REPORT – HARARE

GREATER HARARE WATER AND SANITATION STRATEGIC PLAN

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 3.1: DETAILED DEMOGRAPHIC REPORT

HARARE

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1 INTRODUCTION

Harare is the capital city of Zimbabwe. With a 2012 population of 1,708,538 Harare is the largest city in Zimbabwe, accounting for some 38% of the overall urban population and 13% of the total population of the country.

Modern development of Harare goes back to its initial establishment as a military fort in late 1890. An initial Board of Management was appointed in 1891. In 1897 Harare achieved municipal status, and in 1935 was declared a city. From 1923 Harare has been the seat of government for Zimbabwe. As such it has seen the genesis of and become the centre for many of the services operated by government. In addition to hosting many national and local institutions, the city has also served as a focus for commercial and industrial activity. Over the last 30 years there has been a clear trend of increasing concentration of population, capital and economic activity in Harare, as has been the case for a number of other capital cities in the region, and this trend seems likely to continue.

Harare is contiguous with the surrounding urban areas of Chitungwiza, Epworth and Ruwa. Collectively, these form part of a single urban area and economic entity. Together with Norton, they are also linked in having a common water supply system. The three constituent areas of Harare, Chitungwiza and Epworth collectively comprise Harare Province. Other neighbouring areas include rural parts of Zvimba District (Mashonaland West Province) to the west; Mazowe District (Mashonaland Central Province) to the north; plus Goromonzi District to the east and Seke District to the south (both forming part of Mashonaland East Province, and which also includes Ruwa).

Harare is situated on the highveld of Zimbabwe, on the watershed between Manyame catchment to the south and west and Mazowe catchment to the north east. It is important to note that the city is located upstream of its main water supply dams, Lake Chivero and Lake Manyame, on the Manyame catchment, such that all wastewater and accompanying waterborne pollution from the city eventually drains into these supply dams.

The city comprises relatively flat terrain intersected by numerous open wetland areas. Known locally as vleis these wetlands areas serve as important catchment areas for Lake Chivero and Lake Manyame. In recent years this function has been increasingly compromised, primarily through ongoing conversion of these key areas to urban development and urban agriculture.

2 PAST, PRESENT AND FUTURE POPULATIONS

2.1 Historical Population Data

Harare urban has grown in terms of population from 364,390 in 1969, to 1,708,538 people in 2012, a more than four-fold increase over this 43 year period (Table 2-1, Figure 2-1). The figures from 1992 onwards are inclusive of Harare South (Ward 01), whilst the figure for 2012 also includes the populations from six adjacent wards (Zwimba District Wards 24 and 35; Mazowe District Ward 20, and Goromonzi District Wards 06, 07 and 25 which are expected to be incorporated into the City of Harare in the near future), amounting to a total of 109,708 people.

Corresponding annual rates of population growth for the respective census intervals are shown in Table 2-2. For the country as a whole there has been a dramatic decline in annual growth rates over the last 20 years, from over 3% for the period 1969 to 1992, to just over 1% for the last 20 years from 1992 to 2012. Likely causes of this marked decline include the impacts of HIV and the national economic collapse during the 2000s leading to high levels of out-migration.

Table 2-1: Population Data for Greater Harare from 1969 to 2012 (Source: ZIMSTAT)

Year	1969	1982	1992	2002	2012
Harare urban	**364,390**	**658,364**	**1,148,073**	**1,458,807**	**1,708,538**
Chitungwiza	14,970	172,000	274,912	323,260	356,840
Epworth			62,630	114,067	167,462
Norton		12,438	29,000	44,397	67,591
Ruwa			1,447	23,681	56,333
Total Greater Harare	**379,360**	**842,802**	**1,516,062**	**1,964,212**	**2,356,764**
ZIMBABWE	5,134,300	7,608,432	10,412,548	11,631,657	12,973,808
Total as % of Zimbabwe	7.4	11.1	14.6	16.9	18.2

* Note that the Harare population figures from 1992 onwards include Harare South (Ward 1), and the figure for 2012 also includes populations from six adjacent wards amounting to a total of 109,708 people.

Figure 2-1 below shows the population growth in Harare from 1969 to 2012. (Source: ZIMSTAT).

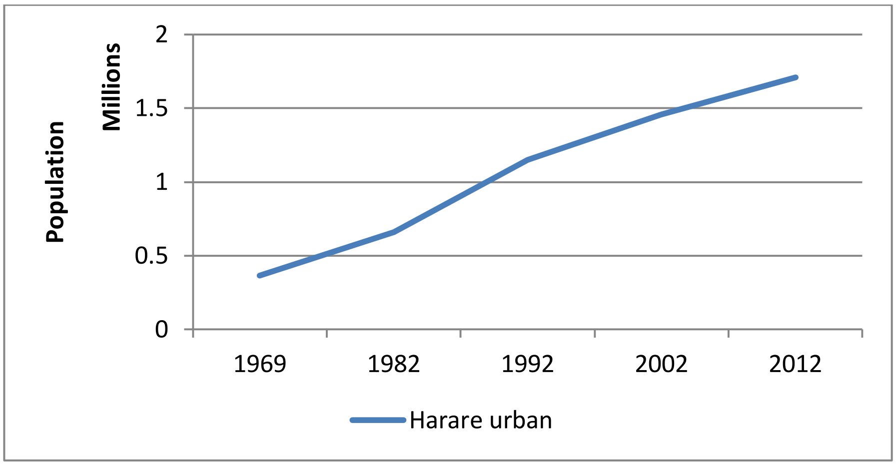

Figure 2-1: Harare Population Growth from 1969 to 2012

Table 2-2 below shows mean inter census annual population growth rates for Greater Harare from 1969 to 2012. (Source: ZIMSTAT).

Table 2-2: Inter Census Annual Growth Rates for Greater Harare

Period	1969-82	1982-92	1992-02	2002-12
Harare urban	**4.66%**	**5.72%**	**2.42%**	**1.59%**
Chitungwiza	20.66%	4.80%	1.63%	0.99%
Epworth			6.18%	3.91%
Norton		8.83%	4.35%	4.29%
Ruwa			32.25%	9.05%
Total Greater Harare	**6.33%**	**6.05%**	**2.62%**	**1.84%**
ZIMBABWE	3.07%	3.19%	1.11%	1.10%

Growth for Harare urban has shown a similar marked decline from above 4.5% per annum prior to 1992 to 2.42% for 1992-2002 and further to 1.59% for 2002-2012 (and which for 2012 includes the additional population from six adjacent wards not counted during 2002). Other potential factors contributing to the slower growth rate over the last census interval include implementation of the Murambatsvina programme which saw the violent destruction of informal housing units, and has acted as a strong deterrent to further illegal settlements; and persistent difficulties in providing reliable water and sanitation services.

2.2 Future Population Growth

Future population growth rates for Greater Harare were estimated through consideration of historical rates of growth (Table 2-2); comparison to regional data (Table 2-3); comparison to estimated growth rates for towns included under the associated Urgent Water Supply and Sanitation Rehabilitation Project (UWSSRP), (Table 2-4); and through discussions with the respective urban authorities.

Data on population growth was obtained from 87 urban centres (>25,000 people) in seven comparable Southern and East African countries for which data was available (Namibia, Botswana, Mozambique, Zambia, Malawi, Tanzania, Kenya), as recorded over their most recent census interval (variously 1997-2007 to 2002-2012). For all 87 towns the overall range of annual growth rates over the last decade was -0.03% to 6.97% with a mean value of 3.23% (Table 2-3). The data further suggests that growth is strongest in the largest cities (> 1 million inhabitants = 3.94%) and slightly lower in smaller centres (3.1% for centres smaller than 250,000 people).

Table 2-3 shows comparative annual growth rates for 87 Southern and East African urban areas (>25,000 people) over their respective most recent census intervals (from 1997-2007 to 2002-2012).

Table 2-3: Comparative Annual Growth Rates for 87 Southern and East African Cities

Population	Number	Range (%)	Median (%)	Mean (%)
> 1 Million	4	1.25 - 5.78	4.36	3.94
500,000 - 1Million	5	2.79 - 4.69	4.06	3.88
250,000-500,000	12	0.83 - 7.16	3.39	3.47
100,000-250,000	32	0.38 - 6.55	2.71	3.08
25,000-100,000	34	-0.03 - 6.97	3.14	3.11
Total	**87**	**-0.03 - 7.16**	**3.32**	**3.23**

Under the UWSSRP future population growth rates for the six project towns (Chegutu, Masvingo, Kwekwe, Mutare, Chitungwiza and Harare urban) were examined and debated at a combined workshop held in Harare on 09 July 2013. A key outcome of the workshop was to estimate future annual rates of population growth to 2020 and 2030 for each of the project centres, based on the specific conditions pertaining to each of the centres.

Table 2-4 shows the projected annual growth rates for the medium (2012-2020) and long term (2020-2030) for the six UWSSRP project towns. (Source: Workshop, Harare, 09 July 2013).

Table 2-4: Projected Annual Growth Rates for six Urban Centres Included in the UWSSRP

	Annual Growth Rate (%)		
Period	**2002-2012**	**2012-2020**	**2020-2030**
Chegutu	1.39	4	2
Masvingo	2.45	3	1.5-2
Kwekwe	0.71	3	4
Mutare	1.00	3	4
Chitungwiza	0.93	1.1	2
Harare	**0.23**	**4**	**4**

The resulting estimates varied between 1.1-4% for the period 2012-2020 and from 2-4% for the subsequent interval from 2020-2030. Future growth for Harare urban was estimated at 4% per annum throughout. Following a series of meetings with Harare Water and the City of Harare, and particularly with respect to the continuing adverse macroeconomic situation, the growth figure to 2020 was subsequently revised downwards.

Based on these deliberations, and particularly with respect to the continuing difficult macroeconomic outlook, the overall future rate of growth for Greater Harare for the period 2012-2020 was estimated at 2%, this being slightly higher than the figure of 1.84% as obtained for the previous census interval. Consistent with this overall figure, the growth rates of the individual urban centres for the period 2012-2020 have been maintained at the same levels as for 2002-2012, other than for Epworth and Harare urban (Table 2-5). For Epworth, due to restricted opportunities for expansion, the rate of growth is expected to decline from 3.91% to 2.50%. For Harare urban, it was assumed that the relatively restricted opportunities for growth in Chitungwiza and Epworth would be compensated for by marginally higher rates of growth here, such that the future growth was forecast to increase from the previous figure of 1.59% for 2002-2012 to that of 1.75% for 2012-2020.

Table 2-5: Projected Future Annual Growth Rates for Greater Harare

	Annual Growth Rate (%)			
Period	**2002-2012**	**2012-2020**	**2020-2025**	**2025-2030**
Harare urban	**1.59**	**1.75**	**4.00**	**5.00**
Chitungwiza	0.99	0.99	2.00	4.00
Epworth	3.91	2.50	2.00	2.00
Norton	4.29	4.29	4.00	5.00
Ruwa	9.05	9.05	4.00	5.00
Total Greater Harare	**1.84**	**2.00**	**3.59**	**4.68**

Population growth for Greater Harare is projected to escalate markedly after 2020, to 3.59% for the period 2020-2025 and increasing to 4.68% for the subsequent interval to 2030. Corresponding projections for the individual urban centres of Harare urban, Norton and Ruwa are 4% to 2025 and 5% to 2030. Estimates for Epworth are markedly lower (2% and 2%) again due to space constraints, and also for Chitungwiza (2% and 4%), on the basis that the targeted area of expansion on the Nyatsime farms is further away from the city centre than much of Harare urban, such that development in this area is likely to be slower until such time as the closer areas are beginning to reach capacity.

2.3 Harare Urban Future Population

For the purpose of estimating future populations for Harare Urban the above proposed annual growth rates of 1.75% to 2020, 4.0% to 2025 and 5.0% to 2030 were used. Resulting annual population estimates are shown in Table 2-6. These figures suggest population increases from 1,708,538 (2012) to 1,962,908 in 2020 and 3,047,987 in 2030. This implies total population increases of 254,370 people for the interval 2012-2020, of 1,085,079 people for the period 2020-2030, and overall from 2012-2030 of 1,339,449 people.

Table 2-6 shows the estimated annual and cumulative population increases for the period 2012-2030, based on projected annual growth rates of 4.29% for the mid-term (2012-2020) and thereafter increasing to 4% to 2025 and 5% to 2030.

Table 2-6: Projected Annual Populations for Harare 2012-2030

Year	Annual Growth Rate (%)	Estimated Population	Cumulative Population Increase
2012	1.75	1,708,538	
2013	1.75	1,738,437	29,899
2014	1.75	1,768,860	60,322
2015	1.75	1,799,815	91,277
2016	1.75	1,831,312	122,774
2017	1.75	1,863,360	154,822
2018	1.75	1,895,969	187,431
2019	1.75	1,929,148	220,610
2020	**1.75**	**1,962,908**	**254,370**
2021	4	2,041,425	332,887
2022	4	2,123,081	414,543
2023	4	2,208,005	499,467
2024	4	2,296,325	587,787
2025	**4**	**2,388,178**	**679,640**
2026	5	2,507,587	799,049
2027	5	2,632,966	924,428
2028	5	2,764,614	1,056,076
2029	5	2,902,845	1,194,307
2030	**5**	3,047,987	1,339,449

3 URBAN PLANNING

3.1 Overview

Harare is the capital city of Zimbabwe. Together with the contiguous settlements of Chitungwiza and Epworth it makes up Harare Province. As the capital, it is the largest city in the country, hosts many national and local institutions, and is the centre of commercial and industrial activity. With an area of 84,994 ha Harare accounts for 82% of the overall extent of Greater Harare and, with a 2012 census count of 1,708,538, included 72% of the overall population.

The city is divided into 46 wards (Figure 3-1). For the purpose of this project, it was decided to also include portions of six adjacent wards parts of which have been, or are anticipated as being, incorporated into the city in the near future, certainly within the lifespan of the project (i.e. before 2030). These wards comprise, to the west, Wards 35 (Whitecliff, Rainham, Spitzkop, Heaney and Rydale Ridge) and 24 (Mt. Hampden) of Zwimba District; to the north, Ward 20 (Mt. Pleasant Heights) of Mazowe District; and Wards 6 (Sally Mugabe Heights) and 7 (Echo and Rumani farms) of Goromonzi District; and to the east Ward 25 (Caledonia) of Goromonzi District. Other neighbouring areas are, to the east, Epworth, Ruwa and Wards 14, 15 and 23 of Goromonzi District; and to the south, Chitungwiza and Wards 1, 9 and 10 of Seke District. The surrounding areas generally comprise prime farming lands.

The Central Business District (CBD) is situated in Ward 6 (City Centre), although many of the houses and flats in the neighbouring areas have now been converted to commercial use. Indeed, there is a proposal to enlarge the CBD to include portions of Ward 7 (Avondale) to the north, Ward 8 (Highlands) to the east, Ward 2 (Eastlea) to the southeast, parts of Wards 4 (Mbare) and 10 (Sunningdale) to the south, and to the west Ward 5 (Belvedere), although this has yet to be adopted.

The primary industrial areas extend to the south and west of the CBD, particularly Graniteside within Ward 10 (Sunningdale), Workington and Southerton in Ward 11 (Mbare); Lochinvar and Aspindale Park in Ward 13 (Rugare); Willowvale in Ward 26 (Highfield) and Ardbennie in Ward 24 (Highfield), with additional minor portions in the southeastern part of Ward 5 (Belvedere), the northern part of Ward 4 (Mbare) and to the west and north of Ward 23 (Waterfalls). To the east there is a secondary industrial area, Masasa, which is mainly located within the southern part of Ward 9 (Greendale), with a minor extension into the northeastern corner of Ward 22 (Hatfield).

All wards include residential areas of various types: low density (LD), medium density (MD), high density (HD) or informal (INF) settlements.

There are ten wards that comprise entirely of LD housing, plus Mabelreign and Hatfield which are predominantly LD but also include smaller portions of MD housing (25% and 10%, respectively). Collectively these wards cover the major part of the northern and eastern sectors of the city, plus a substantial band across the south. This includes the City Centre (Ward 6) and, extending to the west, Belvedere (Ward 5), Mabelreign (Ward 16) and Marlborough (Ward 41); to the north, Avondale (Ward 7), Mt. Pleasant (Ward 17) and Borrowdale (Ward 18); to the east, Eastlea (Ward 2), Highlands (Ward 8) and Greendale (Ward 9); and, in a band across the south, Hatfield (Ward 22) and Waterfalls (Ward 23).

MD housing does not dominate in any wards, but rather occurs as a component in association with either LD housing (as for Mabelreign and Hatfield), or else HD housing, as is the case for Sunningdale (Ward 10), Kambuzuma (Ward 14), Highfield (Ward 25), Glen View (Ward 31) and Dzivarasekwa (Ward 40).

HD housing dominates the southwestern and western portions of the city, with relatively small occurrences to the north (Hatcliffe, Ward 42) and to the east (Mabvuku, Wards 19 and 21; Tafara, Wards 20 and 46). Immediately to the south of the City Centre is Mbare (Wards 3, 4, 11 and 12) and Sunningdale (Ward 10). Continuing to the southwest, within the sector bounded by the Simon Mazorodze Road (leading south to Masvingo), the High Glen Road (to the west) and the Bulawayo Road, are included the HD areas of Highfield (Wards 24, 25 and 26), Rugare (Ward 13), Kambuzuma (Ward 14) and Warren Park (Ward 15). Further out, to the west of High Glen Road, are the suburbs of Glen Norah (Wards 27, 28 and 29), Glen View (Wards 30, 31 and 32), Budiriro (Wards 33 and 43), Mufakose (Wards 34, 35 and 36), Kuwadzana (Wards 37, 38 and 44), and Dzivarasekwa (Wards 39, 40 and 45).

The single remaining ward, Ward 1 (Harare Rural or Harare South),covers a vast swathe across the southern portion of the city from the headwaters of Lake Chivero in the west to Epworth in the east, and from Chitungwiza in the south to the remainder Harare in the north. Previously this portion comprised commercial farm land and, at the time of the 2002 national census (population of 23,023 people), was excluded from the remainder of Harare. Over the subsequent decade large parts have been subdivided and settled informally, that is to say without provision of any services, such that by 2012 the population had risen to 113,599. This is an ongoing process and which, despite having now been incorporated into the City, is overseen by the Department of Physical Planning rather than the City of Harare. Ward 1 includes minor portions of LD housing, these comprising the residents of the remaining farms that have not yet been subdivided, and also HD residents (situated immediately to the south of Waterfalls).

In addition to the above 46 wards, parts of six of the adjacent wards have already been incorporated into the city or are planned to be incorporated in the coming years. Of these, the population of the four wards to the north have been classified as LD, these being primarily agricultural areas but that include Mt. Hampden (Zwimba Ward 24), Mt. Pleasant Heights (Mazowe Ward 20), Sally Mugabe Heights (Goromonzi Ward 6) and the adjacent farms of Rumani and Echo (Goromonzi Ward 7, incorporated but not yet subdivided). The remaining two wards are Caledonia (Goromonzi Ward 25) to the east and Whitecliff/ Rainham/ Spitzkop/ Heaney and Rydale Ridge (Zwimba Ward 35) to the west. Caledonia comprises entirely of informal settlement. Whitecliff is dominated by informal settlement (75%), but also includes portions of MD (20%) and LD (5%) housing.

A summary of the wards is shown in Table 3-1.

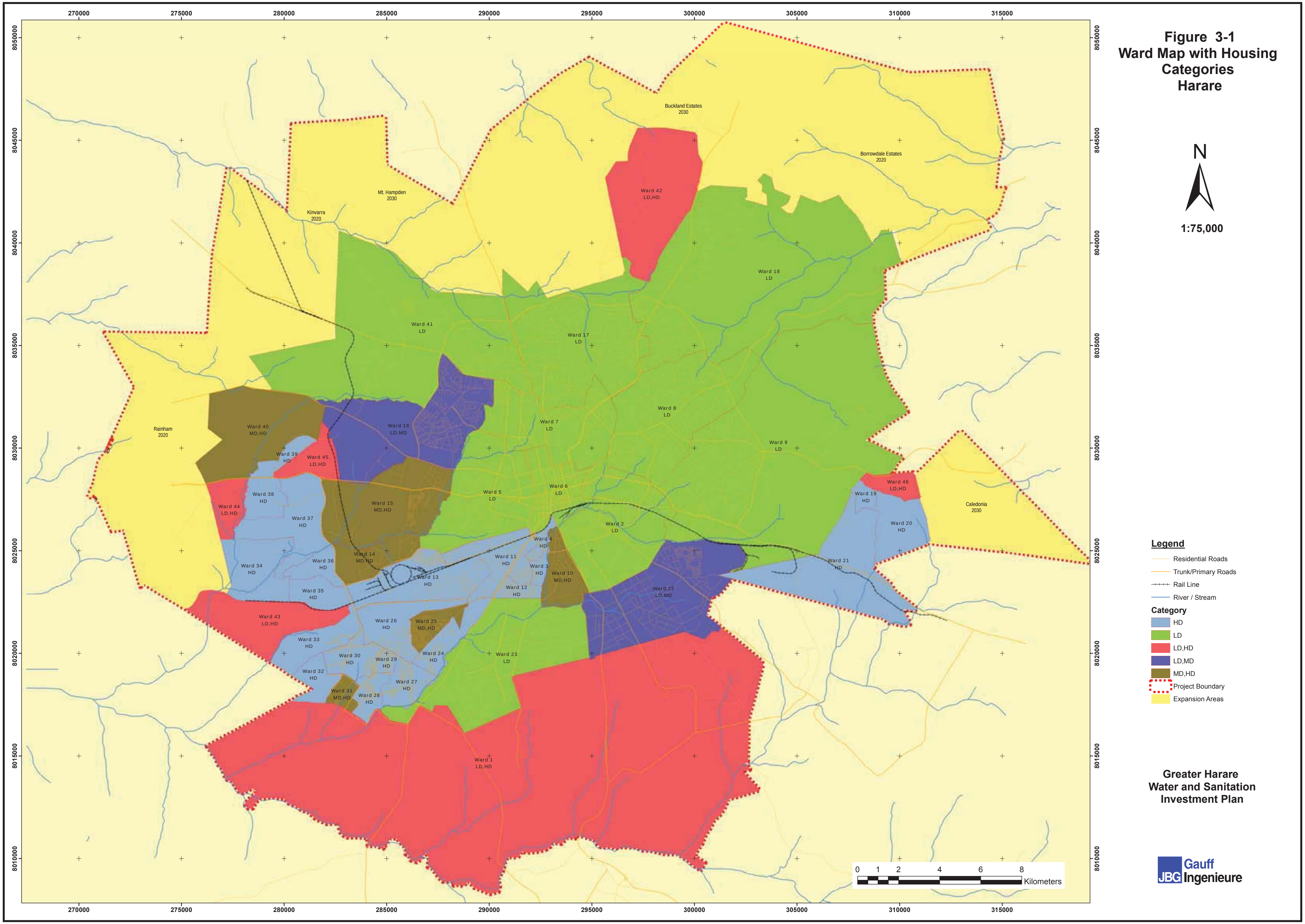

Figure 3-1
Ward Map with Housing Categories
Harare

Greater Harare Water and Sanitation Investment Plan

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Table 3-1: Summary of Wards

Ward No.	Name	Area (ha)	Population 2012	Land Use / Housing Category	Proportion of housing stands developed (%)
1	Harare South	19,440.23	113,599	LD (5%), HD (5%), INF (90%)	25
2	Eastlea	2,260.94	37,024	LD	85
3	Mbare	103.90	22,397	HD	100
4	Mbare	115.07	15,027	HD	100
5	Belvedere	2,012.05	21,981	LD	100
6	City Centre	813.86	21,257	LD	100
7	Avondale	1,761.95	29,372	LD	100
8	Highlands	2,731.80	20,785	LD	100
9	Greendale	8,776.36	48,026	LD	65
10	Sunningdale	547.68	22,042	MD (25%), HD (75%)	100
11	Mbare	772.39	20,835	HD	100
12	Mbare	171.50	22,324	HD	100
13	Rugare	1,201.89	23,123	HD	95
14	Kambuzuma	593.30	30,517	MD (10%), HD (90%)	100
15	Warren Park	1,934.17	66,182	MD (5%), HD (95%)	95
16	Mabelreign	2,767.76	46,598	LD (75%), MD (25%)	75
17	Mt Pleasant	3,327.02	26,412	LD	90
18	Borrowdale	7,749.12	32,789	LD	75
19	Mabvuku	121.50	21,138	HD	100
20	Tafara	681.06	24,145	HD	70
21	Mabvuku	2,107.06	23,036	HD	60
22	Hatfield	2,663.36	44,612	LD(90%), MD(10%)	90
23	Waterfalls	3,029.66	63,955	LD	100
24	Highfield	461.99	29,488	HD	90
25	Highfield	304.78	29,858	MD (20%), HD (80%)	100
26	Highfield	711.92	36,275	HD	100
27	Glen Norah	394.21	32,409	HD	100
28	Glen Norah	274.25	27,419	HD	100
29	Glen Norah	105.96	13,237	HD	100
30	Glen View	409.80	53,508	HD	95
31	Glen View	170.94	22,975	MD (15%), HD (85%)	95
32	Glen View	320.46	37,210	HD	95
33	Budiriro	587.02	60,116	HD	95
34	Mufakose	883.70	18,532	HD	100
35	Mufakose	369.26	23,937	HD	100
36	Mufakose	280.05	12,993	HD	100
37	Kuwadzana	1,035.82	70,754	HD	75
38	Kuwadzana	361.71	34,466	HD	100
39	Dzivarasekwa	213.02	24,507	HD	100
40	Dzivarasekwa	1,882.05	45,317	MD (10%), HD (90%)	50
41	Marlborough	5,887.05	55,881	LD	65
42	Hatcliffe	2,300.06	45,344	LD (5%), HD (95%)	70
43	Budiriro	1,259.64	61,120	HD	75
44	Kuwadzana	409.24	26,926	HD	75
45	Dzivarasekwa	421.05	28,900	HD	70
46	Tafara	266.55	10,482	HD	85
Subtotal		**84,994.15**	**1,598,830**		
ZWM 35	Whitecliff		42,382	LD (5%), MD (20%), HD (75%)	15
ZWM 24	Mt. Hampden		8,931	LD	25
MAZ 20	Mt. Pleasant Heights		13,308	LD	30
GOR 6	Sally Mugabe		12,174	LD	30
GOR 7	Rumani		5,901	LD	30
GOR 25	Caledonia		27,012	HD	25
Subtotal			**109,708**		
Total			**1,708,538**		

3.2 Master Plan

There are a number of significant challenges as regards predicting the future spatial pattern of growth for Harare. Firstly, Harare lacks a master plan, other than the outdated Harare Combination Master Plan which was developed some 25 years ago during the late 1980s and adopted in 1992. This was prepared against a background of a considerable housing deficit and in the face of expected rapid population increase.

Secondly, the planning environment is complicated by the presence of competing authorities, in particular the City of Harare and the Department of Physical Planning under the Ministry of Local Government, Public Works and National Housing. The Ministry of Local Government remains the primary authority over state land even within urban areas. This includes portions of land that have been retained by the state for future allocation, as well as former commercial farms that have been acquired under the land reform programme. Communication and cooperation between the City Council and the Department of Physical Planning is often inadequate. For example there are numerous cases whereby the Department of Physical Planning has developed and/or authorised residential plans with little or no consultation with the City of Harare, and despite the fact that the city is subsequently expected to provide services for such developments. Another result is that there is no single source from which one can obtain comprehensive and reliable data concerning future plans for development.

The situation is further complicated by the fact that access to and allocation of land has become strongly politicised, particularly in the run up to the recent national elections. This has led to widespread manipulation of ward boundaries and to the allocation of lands for political purposes, with little regard to basic issues of town planning.

The on-going land reform programme also continues to impact development patterns within the Harare area. The continued absence of security over agricultural land provides a strong stimulus for current owners of land within or adjacent to urban areas to seek to convert such land to urban development and to subdivide and sell the resulting stands as quickly as possible, thus minimizing the risk of loss due to possible future repossession or reallocation. Again this is happening with little or no consideration of wider urban planning issues.

Another significant issue is the emergence and continued growth of informal settlements within Harare, particularly within Ward 1 and in the peripheral settlements of Caledonia and Whitecliff. Such developments cannot be ignored, yet pose particular demands and challenges in terms of cost and associated complexities for the future provision of services.

The following analysis of future supply and demand of different types of housing, and resulting future ward populations is based on detailed discussions held with District Officers or technical staff in each of the 20 administrative “Districts” of the City of Harare, plus numerous meetings with staff of the Department of Town Planning, plus the District Administrator for Harare South. It should be noted, in this respect, that the District boundaries used by the City of Harare, in many places differ from the ward boundaries used by ZIMSTAT and as are followed for the purpose of this project.

3.3 Opportunities for Growth

The expected general pattern of development is for continued expansion of LD housing to the north and northeast (between the Lomagundi and Murewa roads), and for continued HD expansion to the west and south of the city. This will serve to confine future extension of the sewer network to the southern portions of the city, whilst the LD residents to the north can continue to rely on septic tanks.

For the purpose of converting numbers of stands to numbers of people the following conversions have been applied: for HD 10 people per stand and for MD and LD each seven people per stand.

Twelve areas were identified for future LD expansion, eight within the boundaries of the current 46 wards and four in the peripheral areas to the north (Table 3-2). Within the existing wards, collectively, there is opportunity to develop a further 14,500 LD stands and to accommodate a population of 101,500 people. Additional LD growth is expected to be absorbed in the adjacent areas of Zwimba Ward 24, Mazowe Ward 20 and Goromonzi Wards 6 and 7. Some LD development is expected in the medium term to 2020 in all potential areas other than Goromonzi Ward 7, and in all cases also extending to the longer term (2030).

Opportunities for MD expansion are relatively limited. A total of 1,800 stands (12,600 people) were identified for Wards 16, 22, 40 and 45. The major MD development, however, is expected to occur to the west within Zwimba Ward 35, where a further 2,000 stands (14,000 residents) are expected. As for LD housing, development of MD housing in each of these areas is expected to start in the medium term (to 2020) and to continue into the longer term (2030) period.

Fifteen of the existing wards appear to offer possibility for HD expansion, collectively amounting to a total of 14,510 stands or 145,100 residents. For all fifteen wards, development is expected to start in the medium term and, for ten of the wards to be completed by 2020, and for the remaining five to extend into the following period to 2030.

The bulk of the low income development is expected to comprise informal housing, and is anticipated to occur primarily within Ward 1 and the peripheral wards of Zwimba 35 to the west and Goromonzi 25 to the east (99,500 stands or 995,000 people). All growth in these areas in the medium term to 2020 is expected to comprise informal housing. However, during the subsequent interval to 2030, while it is assumed that informal growth will continue in these areas, it is further assumed that a substantial portion of the informal settlement in each of these areas will be provided with services and thus upgraded to formal HD housing.

Table 3-2: Opportunities for Residential Expansion

Map ID	Ward	Type	Stands	Population	Year
LA	2	LD	800	5,600	2020/30
LB	9	LD	3,500	24,500	2020/30
LC	16	LD	1,500	10,500	2020/30
LD	17	LD	400	2,800	2020/30
LE	18	LD	1,500	10,500	2020/30
LF	21	LD	1,000	7,000	2020/30
LG	41	LD	4,000	28,000	2020/30
LH	42	LD	1,800	12,600	2020/30
LI	ZWM 24	LD	4,120	28,840	2020/30
LJ	MAZ 20	LD	4,120	28,840	2020/30
LK	GOR 6	LD	4,120	28,840	2020/30

Map ID	Ward	Type	Stands	Population	Year
LL	GOR 7	LD	2,120	14,840	2030
	Subtotal	**LD**	**28,980**	**202,860**	**2030**
MA	16	MD	500	3,500	2020/30
MB	22	MD	600	4,200	2020/30
MC	40	MD	500	3,500	2020/30
MD	45	MD	200	1,400	2020/30
ME	ZWM 35	MD	2,000	14,000	2020/30
	Subtotal	**MD**	**3,800**	**26,600**	**2030**
HB	13	HD	100	1,000	2020
HC	15	HD	200	2,000	2020
HD	20	HD	1,000	10,000	2020/30
HE	21	HD	1,000	10,000	2020/30
HF	24	HD	360	3,600	2020
HG	30	HD	280	2,800	2020
HH	31	HD	120	1,200	2020
HI	32	HD	200	2,000	2020
HJ	33	HD	350	3,500	2020
HK	37	HD	2,500	25,000	2020/30
HL	40	HD	4,000	40,000	2020/30
HM	43	HD	2,200	22,000	2020/30
HN	44	HD	1,000	10,000	2020
HO	45	HD	1,000	10,000	2020
HP	46	HD	200	2,000	2020
	Subtotal	**HD**	**14,510**	**145,100**	**2030**
INA	1	HD/INFORMAL	65,000	650,000	2020/30
INB	ZWM 35	HD/INFORMAL	27,000	270,000	2020/30
INC	GOR 25	HD/INFORMAL	7,500	75,000	2020/30
	Subtotal	**INFORMAL**	**99,500**	**995,000**	2020/30
	TOTAL		**146,790**	**1,369,560**	**2030**

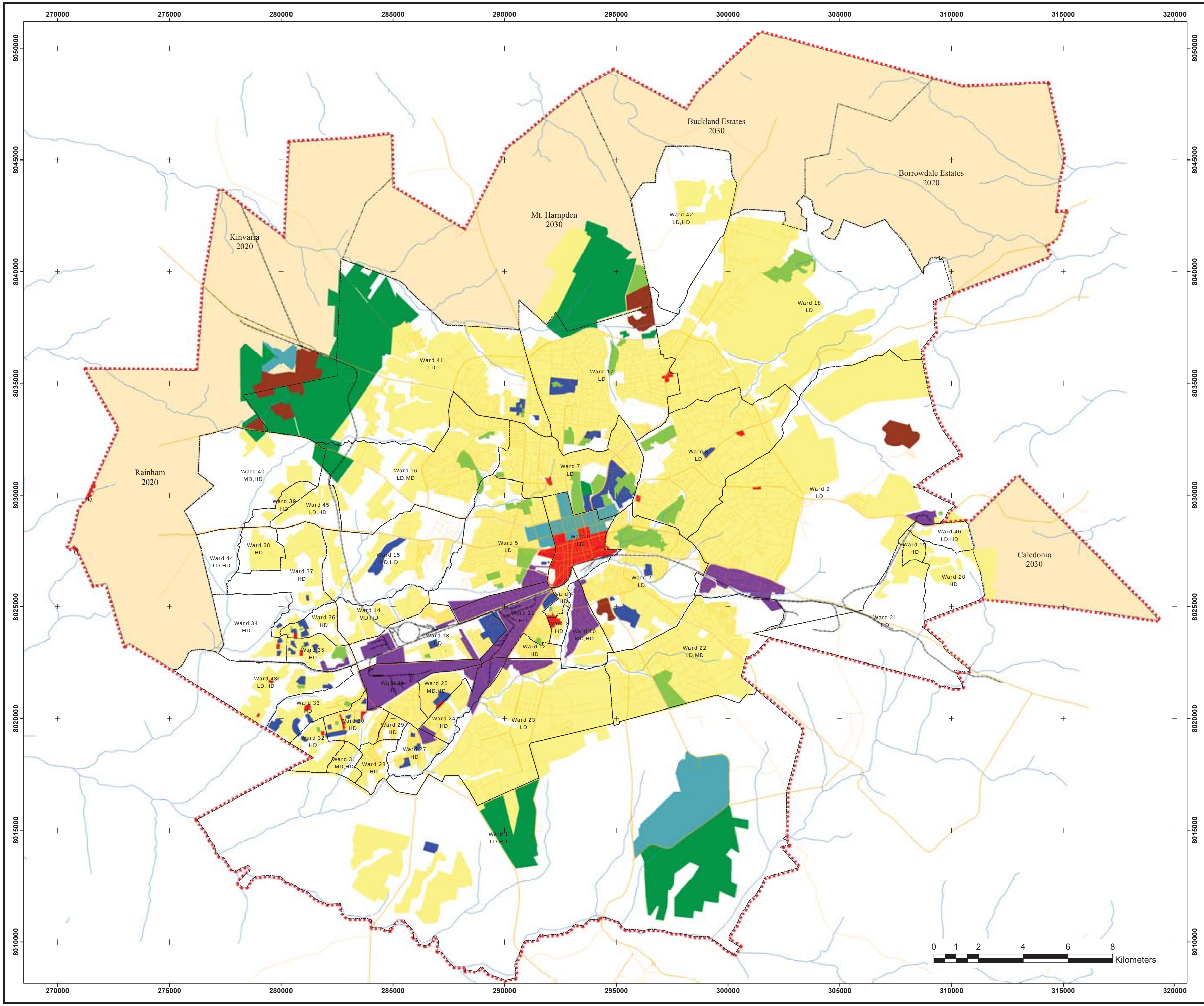

Figure 3-2
Future Town Development Map
Harare

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Legend

- Expansion Areas
- Ward No.

Landuse

- Agriculture
- Business
- CBD
- Industrial
- Institutional
- Mining/Quarrying
- Recreational
- Residential
- Residential Roads
- Trunk/Primary Roads
- Project Boundary
- Rail Line
- River / Stream

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3.4 Future Demand by Housing Types

The distribution of population in 2012 by housing types was 28.3% LD, 3.0% MD, 59.4% HD and 9.4% informal settlements (Table 3-3). Based on discussions with planning officials it is expected that the combined proportion of LD and MD residents will gradually decline over the planning period from a combined figure of 31.3% for 2012, to 29% for 2020 to 25% by 2030. During the same period the proportion of informal settlement is expected to grow from 9.4% for 2012 to 13.6% for 2020 and 19.6% for 2030. This implies a corresponding decrease in the proportion of HD population from 59.4% in 2012 to 57.4% in 2020 to 55.4% in 2030.

Using these figures, the future estimated populations by housing types for the years 2020 and 2030 are shown in Table 3-3. This suggests that the LD population will grow from 483,000 in 2012, by 29,000 people to 512,000 in 2020, and then by 173,000 people to reach 686,000 in 2030. The MD population is forecast to increase from 50,000 in 2012 to 57,000 in 2020 and to 76,000 in 2030.

The HD population was just over 1 million in 2012. This is forecast to grow by 113,000 to 1.13 million in 2020 and then by 674,000 to reach 1.69 million in 2030. Coupled with this, the informal population is expected to grow from 161,000 in 2012, by 106,000 to reach 267,000 in 2020, and by a further 330,000 to reach a total of 597,000 in 2030.

Table 3-3: Estimated Future Populations by Residential Types

Type	LD	MD	HD	INF	Total
Estimated Proportion (%)					
2012	28.3	3.0	59.4	9.4	100
2020	26.1	2.9	57.4	13.6	100
2030	22.5	2.5	55.4	19.6	100
Estimated Population					
2012	482,961	50,409	1,014,130	161,038	1,708,538
2020	512,319	56,924	1,126,709	266,956	1,962,908
2030	685,797	76,200	1,688,585	597,405	3,047,987
Estimated Population Growth					
2012-20	29,358	6,515	112,579	105,918	254,370
2020-30	173,478	19,276	561,876	330,449	1,085,079
2012-30	202,836	25,791	674,455	436,367	1,339,449
Estimated Growth of Residential Stands					
2012-20	4,194	931	11,258	10,592	26,975
2020-30	24,783	2,754	56,188	33,045	116,770
2012-30	28,977	3,685	67,446	43,637	143,745

Using the conversion factors of seven residents per each LD or MD stand and 10 for each HD or informal stand, the population growth figures imply an overall increase of 26,975 residential stands of all types to 2020, and a further increase of 116,770 to 2030 (Table 3-3). This implies the mean development of 3,372 stands per year to 2020 and thereafter of 11,678 stands per year to 2030. In terms of waste water management, given that the LD and informal stands will not be serviced with sewers, this implies lower mean annual demands for new sewer connections of 1,524 stands per annum to 2020 and then 5,894 to 2030.

3.5 Comparison to Expected Level of Growth

Respective figures for expected population growth by housing types (Table 3-3), as compared to potential opportunities for growth (Table 3-2), are summarised in Table 3-4.

For LD housing, the existing wards appear to offer a total growth opportunity of 14,500 stands or 101,500 people. This is more than adequate to cater for the anticipated demand of 29,358 extra LD residents to 2020, but substantially short of the projected demand of 173,478 new residents to 2030. Thus, by 2030 all LD growth within the existing wards is expected to be fully taken up, and a similar amount of growth will have taken place in the neighbouring areas to the north. However, growth in all prospective areas, other than Goromonzi Ward 7, is expected to start prior to 2020 and to continue into the subsequent interval to 2030.

The picture for MD expansion is similar to that of LD, in that the identified opportunities for expansion within the existing wards of 1,800 stands or 12,600 people are sufficient to cater for demand to 2020 (6,515 people) but not to 2030 (25,791 people). It appears possible to accommodate the projected shortfall within Zwimba Ward 35. Again, development in all five potential areas appears likely to span both time horizons to 2020 and to 2030. It is also feasible that there might be additional MD developments in the peripheral areas to the north, although this has not been provided for in this working model.

The possibilities for expansion of HD housing within the existing wards amount to a total of 14,510 stands or 145,100 residents. This compares to an estimated demand of 112,579 people to 2020 and of 674,455 to 2030. Thus, all HD expansion to 2020 is projected to be accommodated within the existing wards, with the balance of opportunities being taken up during the subsequent period to 2030. However during this time, the bulk of HD growth will occur in Ward 1 and the peripheral areas of Caledonia and Whitecliff, and will come about through upgrading of existing informal settlements to formal HD housing.

For informal settlements, the collective capacity of Ward 1 plus Caledonia plus Zwimba Ward 35 of 995,000 people or 99,500 stands appears more than adequate to cope with the expected demand through to 2030 of 436,367 people, even allowing for the anticipated ongoing conversion of informal to formal HD settlements.

Table 3-4: Estimated Population Growth Versus Identified Growth Opportunities

Type	LD	MD	HD	INF	Total
Estimated Population Growth					
2012-20	29,358	6,515	112,579	105,918	254,370
2020-30	173,478	19,276	561,876	330,449	1,085,079
2012-30	**202,836**	**25,791**	**674,455**	**436,367**	**1,339,449**
Potential for Expansion					

2012-30	**202,860**	**26,600**	**145,100**	**995,000**	**1,369,560**

3.6 Future Ward Populations

LD growth to 2020 is assumed to occur in the eleven identified wards at an even rate of 20% of identified opportunities, with the remaining balance of 80% being taken up during the subsequent interval to 2030, together with some growth in Goromonzi Ward 7. This scenario assumes equal growth for the peripheral wards of Zwimba Ward 24, Mazowe Ward 20 and Goromonzi Ward 6. In reality, although growth can be expected in each of these wards, the individual figures are likely to vary, but at present there is no way of predicting which areas will show stronger or weaker growth.

Similarly, MD growth to 2020 is assumed to occur in all five potential areas at an even rate of 25% of the identified opportunities, with the remainder being developed during the subsequent interval to 2030.

For HD housing, all growth in ten wards (Wards 13, 15, 24, 30, 31, 32, 33, 44, 45 and 46) is assumed to be fulfilled by 2020. The balance of the projected growth to 2030 is split amongst the other five wards (Wards 20, 21, 37, 40 and 43) in varying proportions (50-80%) according to perceived situations, but with the balance of the potential growth in these five wards being realized during the subsequent period to 2030. For the second period to 2030, it is assumed that by 2030 roughly half of the overall settlement in Wards 1 and Zwimba Ward 35 will have been converted from informal to formal HD settlement, and for Caledonia the rate of conversion will be slightly slower at about 33%.

The growth of informal settlements in Ward 1, Zwimba Ward 35 and Goromonzi Ward 25 is expected to continue to occur during both time horizons. To 2020, about 60% of the growth is expected within Ward 1, with the balance being split equally between Zwimba Ward 35 and Goromonzi Ward 25. During the subsequent interval to 2030, growth is according to the perceived opportunities within each of these wards.

The resulting predicted ward populations are shown in Table 3-5 and in Table 3-6 these are broken down by housing types.

Table 3-5: Estimated Future Ward Populations

WARD	NAME	TYPE	2012	2020	2030
1	Harare south	LD (5%), HD (5%), INF (90%)	113,599	177,517	754,322
2	Eastlea	LD	37,024	38,144	42,624
3	Mbare (Matapi)	HD	22,397	22,397	22,397
4	Mbare (Nyenyere)	HD	15,027	15,027	15,027
5	Belvedere	LD	21,981	21,981	21,981
6	City Centre	LD	21,257	21,257	21,257
7	Avondale	LD	29,372	29,372	29,372
8	Highlands	LD	20,785	20,785	20,785
9	Greendale	LD	48,026	52,926	72,526
10	Sunningdale	MD (25%) HD (75%)	22,042	22,042	22,042
11	Mbare	HD	20,835	20,835	20,835
12	Mbare	HD	22,324	22,324	22,324
13	Rugare	HD	23,123	24,123	24,123
14	Kambuzuma	MD (10%) HD (90%)	30,517	30,517	30,517
15	Warren Park	MD (5%) HD (95%)	66,182	68,182	68,182
16	Mabelreign	LD (75%) MD (25%)	46,598	49,573	60,598
17	Mt Pleasant	LD	26,412	26,972	29,212
18	Borrowdale	LD	32,789	34,889	43,289
19	Mabvuku	HD	21,138	21,138	21,138
20	Tafara	HD	24,145	29,145	34,145
21	Mabvuku	HD	23,036	29,436	40,036
22	Hatfield	LD (90%) MD (10%)	44,612	45,662	48,812
23	Waterfalls	LD	63,955	63,955	63,955
24	Highfield	HD	29,488	33,088	33,088
25	Highfield	MD (20%) HD (80%)	29,858	29,858	29,858
26	Highfield	HD	36,275	36,275	36,275
27	Glen Norah	HD	32,409	32,409	32,409
28	Glen Norah	HD	27,419	27,419	27,419
29	Glen Norah	HD	13,237	13,237	13,237
30	Glen View	HD	53,508	56,308	56,308
31	Glen View	MD (15%) HD (85%)	22,975	24,175	24,175
32	Glen View	HD	37,210	39,210	39,210
33	Budiriro	HD	60,116	63,616	63,616
34	Mufakose	HD	18,532	18,532	18,532
35	Mufakose	HD	23,937	23,937	23,937
36	Mufakose	HD	12,993	12,993	12,993
37	Kuwadzana	HD	70,754	90,754	95,754
38	Kuwadzana	HD	34,466	34,466	34,466
39	Dzivarasekwa	HD	24,507	24,507	24,507
40	Dzivarasekwa	MD (10%) HD (90%)	45,317	73,671	88,817

WARD	NAME	TYPE	2012	2020	2030
41	Marlborough	LD	55,881	61,481	83,881
42	Hatcliffe	LD (5%) HD (95%)	45,344	47,864	57,944
43	Budiriro	HD	61,120	78,120	83,120
44	Kuwadzana	HD	26,926	36,926	36,926
45	Dzivarasekwa	HD	28,900	39,250	40,300
46	Tafara	HD	10,482	12,482	12,482
ZWM 35	Whitecliff	LD (5%) MD (20%) INF (75%)	42,382	66,747	305,572
ZWM 24	Mt. Hampden	LD	8,931	11,731	37,765
MAZ 20	Mt. Pleasant Heights	LD	13,308	16,108	42,142
GOR 06	Sally Mugabe	LD	12,174	15,632	41,008
GOR 07	Echo / Rumani farms	LD	5,901	5,901	20,735
GOR25	Caledonia	INF	27,012	48,012	102,012
TOTAL	**Harare urban**		**1,708,538**	**1,962,908**	**3,047,987**

Table 3-6: Estimated Future Ward Populations by Residential Types

WARD	2012 LD	2012 MD	2012 HD	2012 INF	2012 TOTAL	2020 LD	2020 MD	2020 HD	2012 INF	2020 TOTAL	2030 LD	2030 MD	2030 HD	2030 INF+	2030 TOTAL
1	5,680		5,680	102,239	113,599	5,680		5,680	166,157	177,517	5,680	-	360,801	387,841	754,322
2	37,024	-	-	-	37,024	38,144	-	-	-	38,144	42,624	-	-	-	42,624
3	-	-	22,397	-	22,397	-	-	22,397	-	22,397	-	-	22,397	-	22,397
4	-	-	15,027	-	15,027	-	-	15,027	-	15,027	-	-	15,027	-	15,027
5	21,981	-	-	-	21,981	21,981	-	-	-	21,981	21,981	-	-	-	21,981
6	21,257	-	-	-	21,257	21,257	-	-	-	21,257	21,257	-	-	-	21,257
7	29,372	-	-	-	29,372	29,372	-	-	-	29,372	29,372	-	-	-	29,372
8	20,785	-	-	-	20,785	20,785	-	-	-	20,785	20,785	-	-	-	20,785
9	48,026	-	-	-	48,026	52,926	-	-	-	52,926	72,526	-	-	-	72,526
10	-	5,511	16,531	-	22,042	-	5,511	16,531	-	22,042	-	5,511	16,531	-	22,042
11	-	-	20,835	-	20,835	-	-	20,835	-	20,835	-	-	20,835	-	20,835
12	-	-	22,324	-	22,324	-	-	22,324	-	22,324	-	-	22,324	-	22,324
13	-	-	23,123	-	23,123	-	-	24,123	-	24,123	-	-	24,123	-	24,123
14	-	3,052	27,465	-	30,517	-	3,052	27,465	-	30,517	-	3,052	27,465	-	30,517
15	-	3,309	62,873	-	66,182	-	3,309	64,873	-	68,182	-	3,309	64,873	-	68,182
16	34,948	11,650	-	-	46,598	37,048	12,525	-	-	49,573	45,448	15,150	-	-	60,598
17	26,412	-	-	-	26,412	26,972	-	-	-	26,972	29,212	-	-	-	29,212
18	32,789	-	-	-	32,789	34,889	-	-	-	34,889	43,289	-	-	-	43,289
19	-	-	21,138	-	21,138	-	-	21,138	-	21,138	-	-	21,138	-	21,138
20	-	-	24,145	-	24,145	-	-	29,145	-	29,145	-	-	34,145	-	34,145
21	-	-	23,036	-	23,036	1,400	-	28,036	-	29,436	7,000	-	33,036	-	40,036
22	40,151	4,461	-	-	44,612	40,151	5,511	-	-	45,662	40,151	8,661	-	-	48,812
23	63,955	-	-	-	63,955	63,955	-	-	-	63,955	63,955	-	-	-	63,955
24	-	-	29,488	-	29,488	-	-	33,088	-	33,088	-	-	33,088	-	33,088
25	-	5,972	23,886	-	29,858	-	5,972	23,886	-	29,858	-	5,972	23,886	-	29,858
26	-	-	36,275	-	36,275	-	-	36,275	-	36,275	-	-	36,275	-	36,275
27	-	-	32,409	-	32,409	-	-	32,409	-	32,409	-	-	32,409	-	32,409
28	-	-	27,419	-	27,419	-	-	27,419	-	27,419	-	-	27,419	-	27,419
29	-	-	13,237	-	13,237	-	-	13,237	-	13,237	-	-	13,237	-	13,237
30	-	-	53,508	-	53,508	-	-	56,308	-	56,308	-	-	56,308	-	56,308
31	-	3,446	19,529	-	22,975	-	3,446	20,729	-	24,175	-	3,446	20,729	-	24,175
32	-	-	37,210	-	37,210	-	-	39,210	-	39,210	-	-	39,210	-	39,210

WARD	2012 LD	2012 MD	2012 HD	2012 INF	2012 TOTAL	2020 LD	2020 MD	2020 HD	2012 INF	2020 TOTAL	2030 LD	2030 MD	2030 HD	2030 INF+	2030 TOTAL
33	-	-	60,116	-	60,116	-	-	63,616	-	63,616	-	-	63,616	-	63,616
34	-	-	18,532	-	18,532	-	-	18,532	-	18,532	-	-	18,532	-	18,532
35	-	-	23,937	-	23,937	-	-	23,937	-	23,937	-	-	23,937	-	23,937
36	-	-	12,993	-	12,993	-	-	12,993	-	12,993	-	-	12,993	-	12,993
37	-	-	70,754	-	70,754	-	-	90,754	-	90,754	-	-	95,754	-	95,754
38	-	-	34,466	-	34,466	-	-	34,466	-	34,466	-	-	34,466	-	34,466
39	-	-	24,507	-	24,507	-	-	24,507	-	24,507	-	-	24,507	-	24,507
40	-	4,532	40,785	-	45,317	-	5,407	68,264	-	73,671	-	8,032	80,785	-	88,817
41	55,881	-	-	-	55,881	61,481	-	-	-	61,481	83,881	-	-	-	83,881
42	2,267	-	43,077	-	45,344	4,787	-	43,077	-	47,864	14,867	-	43,077	-	57,944
43	-	-	61,120	-	61,120	-	-	78,120	-	78,120	-	-	83,120	-	83,120
44	-	-	26,926	-	26,926	-	-	36,926	-	36,926	-	-	36,926	-	36,926
45	-	-	28,900	-	28,900	-	350	38,900	-	39,250	-	1,400	38,900	-	40,300
46	-	-	10,482	-	10,482	-	-	12,482	-	12,482	-	-	12,482	-	12,482
ZWM 35	2,119	8,476	-	31,787	42,382	2,119	11,841	-	52,787	66,747	2,119	21,667	140,988	140,798	305,572
ZWM 24	8,931	-	-	-	8,931	11,731	-	-	-	11,731	37,765	-	-	-	37,765
MAZ 20	13,308	-	-	-	13,308	16,108	-	-	-	16,108	42,142	-	-	-	42,142
GOR 06	12,174	-	-	-	12,174	15,632	-	-	-	15,632	41,008	-	-	-	41,008
GOR 07	5,901	-	-	-	5,901	5,901	-	-	-	5,901	20,735	-	-	-	20,735
GOR 25	-	-	-	27,012	27,012	-	-	-	48,012	48,012	-	-	33,246	68,766	102,012
TOTAL	**482,961**	**50,409**	**1,014,130**	**161,038**	**1,708,538**	**512,319**	**56,924**	**1,126,709**	**266,956**	**1,962,908**	**685,797**	**76,200**	**1,688,585**	**597,405**	**3,047,987**

APPENDIX 3.2: DETAILED DEMOGRAPHIC PROFILE REPORT – CHITUNGWIZA

GREATER HARARE WATER AND SANITATION STRATEGIC PLAN

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 3.2: DETAILED DEMOGRAPHIC REPORT

CHITUNGWIZA

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1 INTRODUCTION

Chitungwiza is a high density dormitory town located approximately 30 km to the south of Harare. The town developed from former peasant settlements. It was formed virtually from scratch on 01 January 1978 through amalgamation of the existing townships of St. Marys and Zengeza (formerly under the City of Harare), the Seke area (formerly under the African Development Fund of Internal Affairs) and the TILCOR industrial complex. Chitungwiza was granted town council status in 1981 and became a municipality in 1996.

Development of Seke started in 1952, St Marys was started in 1962 under the Ministry of Local Government and Housing, and was taken over by the City of Harare in 1971, and Zengeza was started in 1974. At the time of formation of Chitungwiza in January 1978 the estimated population was 117,000.

Chitungwiza includes an industrial portion known as the TILCOR Industrial Area. Some of the larger companies were Chibuku Breweries, Cone Textiles and Dairibord Zimbabwe. However, the city remains dominated by residential areas such that the economic base is unstable.

Chitungwiza is currently the third largest urban centre in Zimbabwe, behind Harare and Bulawayo. Together with Norton, Epworth and Ruwa it forms part of the overall Harare metropolitan area, the combined population of which in 2012 was about 2.3 million. This represents 52% of the total urban population in the country.

2 PAST, PRESENT AND FUTURE POPULATIONS

2.1 Historical Population Data

Chitungwiza has grown in terms of population from 14,970 people in 1969 to 356,840 people in 2012 (Table 2-1, Figure 2-1), which represents doubling by four times in this period of less than 50 years.

Corresponding annual rates of population growth for the respective census intervals are shown in Table 2-2. For the country as a whole there has been a dramatic decline in annual growth rates over the last 20 years, from over 3% for the period 1969 to 1992, to just over 1% for the last 20 years from 1992 to 2012. Likely causes of this marked decline include the impacts of HIV and the national economic collapse during the 2000s leading to high levels of out-migration.

Table 2-1: Population Data for Greater Harare from 1969 to 2012 (Source: ZIMSTAT)

Year	1969	1982	1992	2002	2012
Harare*	364,390	658,364	1,148,073	1,458,807	1,708,538
Chitungwiza	**14,970**	**172,000**	**274,912**	**323,260**	**356,840**
Epworth			62,630	114,067	167,462
Norton		12,438	29,000	44,397	67,591
Ruwa			1,447	23,681	56,333
Total Greater Harare	**379,360**	**842,802**	**1,516,062**	**1,964,212**	**2,356,764**
ZIMBABWE	5,134,300	7,608,432	10,412,548	11,631,657	12,973,808
Total as % of Zimbabwe	7.4	11.1	14.6	16.9	18.2

* Note that the Harare population figures from 1992 onwards include Harare South (Ward 1), and for 2012 also includes populations from six adjacent wards amounting to a total of 109,708 people.

The downturn in annual growth rate has been dramatic for Chitungwiza, from 4.80% for the 1982-92 census interval to 1.63% for 1992-02 and to 0.99% for 2002-12. For Chitungwiza, other potential factors contributing to the slower growth rate over the last census interval include implementation of the Murambatsvina programme which saw the violent destruction of informal housing units, and has acted as a strong deterrent to further illegal settlements; the availability of cheaper (although unserviced) stands in nearby areas, such as Harare South; and persistent difficulties in providing reliable water and sanitation services.

Figure 2-1 below shows the population growth in Chitungwiza 1969 to 2012. (Source: ZIMSTAT).

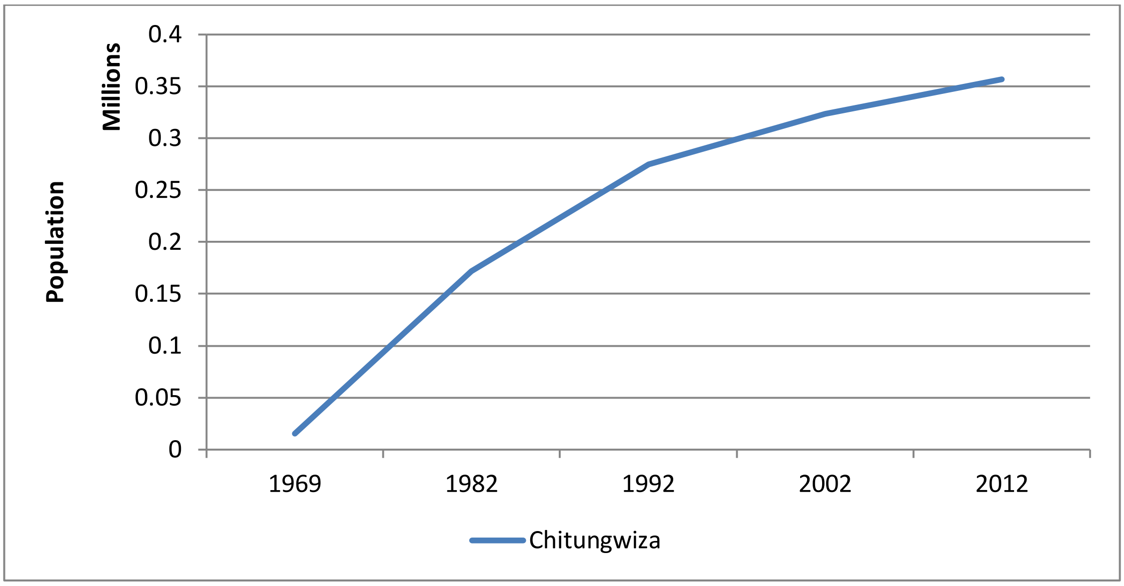

Figure 2-1: Chitungwiza Population Growth from 1969 to 2012

Table 2-2 below shows mean inter census annual population growth rates for Greater Harare from 1969 to 2012. (Source: ZIMSTAT).

Table 2-2: Inter Census Annual Growth Rates for Greater Harare

Period	1969-82	1982-92	1992-02	2002-12
Harare	4.66%	5.72%	2.42%	1.59%
Chitungwiza	**20.66%**	**4.80%**	**1.63%**	**0.99%**
Epworth			6.18%	3.91%
Norton		8.83%	4.35%	4.29%
Ruwa			32.25%	9.05%
Total Greater Harare	**6.33%**	**6.05%**	**2.62%**	**1.84%**
ZIMBABWE	3.07%	3.19%	1.11%	1.10%

2.2 Future Population Growth

Future population growth rates for Greater Harare were estimated through consideration of historical rates of growth (Table 2-2); comparison to regional data (Table 2-3); comparison to estimated growth rates for other towns included under the associated Urgent Water Supply and Sanitation Rehabilitation Project (UWSSRP), (Table 2-4); and through discussions with the respective urban authorities.

Data on population growth was obtained from 87 urban centres (>25,000 people) in seven comparable Southern and East African countries for which data was available (Namibia, Botswana, Mozambique, Zambia, Malawi, Tanzania, Kenya), as recorded over their most recent census interval (variously 1997-2007 to 2002-2012). For all 87 towns the overall range of annual growth rates over the last decade was -0.03% to 6.97% with a mean value of 3.23% (Table 2-3). The data further suggests that growth is strongest in the largest cities (> 1 million inhabitants = 3.94%) and slightly lower in smaller centres (3.1% for centres smaller than 250,000 people).

Table 2-3 shows comparative annual growth rates for 87 Southern and East African urban areas (>25,000 people) over their respective most recent census intervals (from 1997-2007 to 2002-2012).

Table 2-3: Comparative Annual Growth Rates for 87 Southern and East African Cities

Population	Number	Range (%)	Median (%)	Mean (%)
> 1 Million	4	1.25% - 5.78%	4.36%	3.94%
500,000 - 1Million	5	2.79% - 4.69%	4.06%	3.88%
250,000-500,000	12	0.83% - 7.16%	3.39%	3.47%
100,000-250,000	32	0.38% - 6.55%	2.71%	3.08%
25,000-100,000	34	-0.03% - 6.97%	3.14%	3.11%
Total	**87**	**-0.03 - 7.16%**	**3.32%**	**3.23%**

Under the UWSSRP future population growth rates for the six project towns (Chegutu, Masvingo, Kwekwe, Mutare, Chitungwiza and Harare urban) were examined and debated at a combined workshop held in Harare on 09 July 2013. A key outcome of the workshop was to estimate future annual rates of population growth to 2020 and 2030 for each of the project centres, based on the specific conditions pertaining to each of the centres.

Table 2-4 shows the projected annual growth rates for the medium (2012-2020) and long term (2020-2030) for the six UWSSRP project towns. (Source: Workshop, Harare, 09 July 2013).

Table 2-4: Projected Annual Growth Rates for six Urban Centres Included in the UWSSRP

	Annual Growth Rate (%)		
Period	**2002-2012**	**2012-2020**	**2020-2030**
Chegutu	1.39%	4%	2%
Masvingo	2.45%	3%	1.5-2%
Kwekwe	0.71%	3%	4%
Mutare	1.00%	3%	4%
Chitungwiza	**0.93%**	**1.1%**	**2%**
Harare	0.23%	4%	4%

The resulting estimates varied between 1.1-4% for the period 2012-2020 and from 2-4% for the subsequent interval from 2020-2030. For Chitungwiza, the following factors were identified as being important to future growth of the city:

- Incorporation of portions of surrounding communal lands resulting in 7,000 new stands,
- Incorporation of adjacent Nyatsime farms with estimated area for 45,000 stands,
- Cheaper land price and cheaper rented accommodation than for Harare,
- National economic recovery,

- Achievement of full capacity in manufacturing and other services,
- Development of an agro-based economy, and
- Good connectivity to other parts of the country.

On the other hand it was noted that growth is currently being constrained by the limited ability to provide services, particularly water and sanitation.

Based on these deliberations, and particularly with respect to the continuing difficult macroeconomic outlook, the overall future rate of growth for Greater Harare for the period 2012-2020 was estimated at 2%, this being slightly higher than the figure of 1.84% as obtained for the previous census interval. Consistent with this overall figure, the growth rates of the individual urban centres for the period 2012-2020 have been maintained at the same levels as for 2002-2012, other than for Epworth and Harare urban (Table 2-5). For Epworth, due to restricted opportunities for expansion, the rate of growth is expected to decline from 3.91% to 2.50%. For Harare urban, it was assumed that the relatively restricted opportunities for growth in Chitungwiza and Epworth would be compensated for by marginally higher rates of growth here, such that the future growth was forecast to increase from the previous figure of 1.59% for 2002-2012 to that of 1.75% for 2012-2020.

Table 2-5: Projected Future Annual Growth Rates to 2030 for Greater Harare

	Annual Growth Rate (%)			
Period	**2002-2012**	**2012-2020**	**2020-2025**	**2025-2030**
Harare	1.59	1.75	4.00	5.00
Chitungwiza	**0.99**	**0.99**	**2.00**	**4.00**
Epworth	3.91	2.50	2.00	2.00
Norton	4.29	4.29	4.00	5.00
Ruwa	9.05	9.05	4.00	5.00
Total Greater Harare	**1.84**	**2.00**	**3.59**	**4.68**

Population growth for Greater Harare is projected to escalate markedly after 2020, to 3.59% for the period 2020-2025 and increasing to 4.68% for the subsequent interval to 2030. Corresponding projections for the individual urban centres of Harare urban, Norton and Ruwa are 4% to 2025 and 5% to 2030. Estimates for Epworth are markedly lower (2% and 2%) again due to space constraints, and also for Chitungwiza (2% and 4%), on the basis that the targeted area of expansion on the Nyatsime farms is further away from the city centre than much of Harare urban, such that development in this area is likely to be slower until such time as the closer areas are beginning to reach capacity.

2.3 Chitungwiza Future Population

For the purpose of estimating future populations for Chitungwiza the above proposed annual growth rates of 0.99% to 2020, 2.0% to 2025 and 4.0% to 2030 were used. Resulting annual population estimates are shown in Table 2-6. These figures suggest population increases from 356,840 (2012) to 386,199 in 2020 and 518,774 in 2030. This implies total population increases of 29,359 people for the interval 2012-2020, of 132,575 people for the period 2020-2030, and overall from 2012-2030 of 161,934 people.

Table 2-6 shows the estimated annual and cumulative population increases for the period 2012-2030, based on projected annual growth rates of 0.99% for the mid-term (2012-2020) and thereafter increasing to 2% to 2025 and 4% to 2030.

Table 2-6: Projected Annual Populations for Chitungwiza 2012-2030

Year	Annual Growth Rate (%)	Estimated Population	Cumulative Population Increase
2012	0.99	356,840	
2013	0.99	360,384	3,544
2014	0.99	363,964	7,124
2015	0.99	367,578	10,738
2016	0.99	371,229	14,389
2017	0.99	374,916	18,076
2018	0.99	378,640	21,800
2019	0.99	382,401	25,561
2020	**0.99**	**386,199**	**29,359**
2021	2	393,923	37,083
2022	2	401,801	44,961
2023	2	409,837	52,997
2024	2	418,034	61,194
2025	**2**	**426,395**	**69,555**
2026	4	443,450	86,610
2027	4	461,188	104,348
2028	4	479,636	122,796
2029	4	498,821	141,981
2030	**4**	**518,774**	**161,934**

2.4 Comparison to Population Estimates by JICA

For the last several years JICA has been providing technical support to the Chitungwiza City Council, specifically to develop a master plan for future development of water supply, waste water treatment and solid waste treatment infrastructure. As part of this work JICA produced population estimates for Chitungwiza to 2020 and 2030, the respective projected future populations being 405,200 and 455,900 (Table 2-7). These estimates were based on using satellite imagery to count the number of stands and then multiplying up by the number of people per stand, as derived from a sample of 300 households.

The overall estimate to 2020 by JICA of 405,200 residents is similar to that produced under the current project of 386,199; the difference of 19,001 equates to 4.9% of the projected 2020 total of 386,199. By 2030 the difference between the two sets of figures is larger, amounting to 60,034 people. The main difference between the two sets of figures is in terms of growth rates. JICA proposes a higher growth rate from 2012-2020 than for this project (1.68% versus 0.99%), and then a lower growth rate than for the current project for the subsequent decade (1.19% versus 2.00% and then 4.00%).

Table 2-7: Comparison to Chitungwiza Population Estimates by JICA

Factor	JICA	GAUFF
Population 2012	354,000	356,840
Annual growth rate 2012-20 (%)	1.68%	1.10%
Population increase 2012-20	51,200	29,359
Population 2020	405,200	386,199
Annual growth rate 2020-30 (%)	1.19%	2.00% and 4.00%
Population increase 2020-30	50,700	132,575
Population 2030	455,900	518,774
Population increase 2012-30	101,900	161,934

3 URBAN PLANNING

3.1 Overview

Chitungwiza is sandwiched between the Manyame River and a south bank tributary, the Nyatsime River, which respectively define its northern and western boundaries. Downstream the Manyame River feeds into Lake Chivero. The eastern boundary approximates the alignment of the Harare-Seke road, whilst the southern boundary against Seke Communal Land is marked by the Duri River, a minor tributary of the Nyatsime River. Chitungwiza is bounded to the north by Harare South (Harare Ward 1) and to the west, south and north by Wards 10, 9, 8 and 1 of Seke District.

Chitungwiza covers just 5,106 ha, or 51 km^2. Yet with a 2012 population of 356,840 Chitungwiza accounted for 15.1% of the overall population of Greater Harare, and was the third largest urban settlement in Zimbabwe.

Chitungwiza includes 25 wards, the overall extent of which largely coincides with the existing municipal boundary (Figure 3-1). The principal exception is for Ward 6, which extends considerably further to the west of the municipal boundary to include the portion of Longlands Farm situated between the Nyatsime and Manyame Rivers. This portion forms part of the future planned Nyatsime expansion.

The three portions of Chitungwiza, St. Marys, Zengeza and Seke form a single contiguous block of high density residential settlement, broken up in places by minor drainages which take the form of vlei areas generally draining in a southwest direction into the Nyatsime River. Interspersed amongst this are minor portions of LD and MD housing. There are a number of shopping centres with associated commercial and home industries and, in Ward 14 space has been reserved for development of a town centre, but this has yet to come to fruition. There is also a heavy industrial portion, principally within Ward 12 but with provision to extend into the adjacent Ward 18 to the east.

St. Marys is situated to the north. It comprises Wards 1-5, which are dominated by HD housing and which is fully developed with no opportunity for further expansion. Wards 1 and 2 have limited areas of LD housing which are not yet fully developed.

Zengeza occupies the central portion of Chitungwiza. Zengeza is composed of five portions, known as Zengeza 1-5. In terms of wards the area is divided into nine wards (Wards 6-14). Wards 7, 8, 9 and 11 form a contiguous block to the east of St. Marys. This portion is already fully developed. Continuing further east, there are plans for additional minor HD development in Wards 10 (plus two sites of LD development) and Ward 14, and for Ward 13 there is minor opportunity for infill of existing LD housing. The remaining two wards (Ward 6 and Ward 12) are situated to the south. Ward 12 has some HD housing but the major portion comprises the Tilcor Industrial Area; it also includes the Zengeza wastewater treatment plant. Not all the demarcated industrial stands are being utilized such that there is capacity for additional infill. The remaining Ward 6, situated to the northwest, is the largest ward. It is here that there is greatest opportunity for future expansion, immediately to the west of the existing residential areas and continuing to the west onto Longlands Farm which forms part of the planned Nyatsime expansion area.

The remaining 11 wards (Ward 15-25) make up the Seke portion of Chitungwiza. Seke includes more than 15 housing estates which are named after the alphabet (Units A, B, C, D, E, F, G, H, J, K, L, M, N, O and P). All of these wards are dominated by HD housing, although there are small portions of MD housing in Ward 21 (to the north) and of LD housing in Wards 17 (to the southwest) and 25 (along the northern boundary). For Wards 15, 16, 17, 19, 20, 21 and 25 there is no further opportunity for HD expansion. The remaining four wards (Wards 18, 22, 23 and 24) are situated along the eastern and southern periphery of Chitungwiza. For all these wards there is an ongoing process of informal construction within the lowest lying areas in proximity to the Duri drainage. Many of the stands in these informal portions do not have water or sewer connections (they rely on shallow wells or boreholes), and some of them are too low lying to enable connection to the existing sewers. There is an ongoing process of regularizing these informal HD stands. Across the river to the southeast (adjacent to but outside of Ward 22) there is a plan for a new high density development with more than 2,000 stands, although this has not yet been approved. Ward 12 also has a plan for further development of HD housing in the southwestern portion and the northwestern Masango portion, adjacent to Ward 12, is reserved for future industrial expansion.

A summary of the wards is shown in Table 3-1. Apart from the informal settlements in Wards 18, 22, 23 and 24 along the Duri drainage, virtually all other stands are serviced with individual household water connections. The same situation applies regarding sewer connections for these four wards. For the other wards, all HD areas are served with sewer connections, whilst the minor portions of LD housing in Wards 1, 2, 13, 17 and 25 are served by septic tanks.

Table 3-1: Summary of Wards

Ward No.	Location	Area (ha)	Population 2012	Housing Category	Proportion of developed stands (%)	Proportion of sewered stands (%)
1	St Marys	112.45	8,262	HD (90%) LD (10%)	95	95
2	St Marys	111.56	11,169	HD (90%) LD (10%)	95	95
3	St Marys	109.72	10,057	HD	100	100
4	St Marys	251.34	27,560	HD	100	100
5	St Marys	56.25	10,620	HD	100	100
6	Zengeza 5	902.78	17,339	HD	40	100
7	Zengeza 1	28.18	7,988	HD	100	100
8	Zengeza 1	60.03	10,119	HD	100	100
9	Zengeza 2	86.89	8,229	HD	100	100
10	Zengeza 2	162.89	8,788	HD	50	100
11	Zengeza 3	81.73	9,392	HD	100	100
12	Zengeza 3	491.10	15,129	HD + IND	100	100
13	Zengeza 4	162.52	9,489	HD (95%) LD (5%)	95	95

14	Zengeza 4	183.23	15,484	HD	80	100
15	Seke D	231.00	13,781	HD	100	100
16	Seke J	181.46	14,730	HD	100	100
17	Seke K	139.55	15,242	HD (95%) LD (5%)	95	95
18	Seke L	477.84	19,717	HD + IND Informal	50	25
19	Seke F+C	155.87	16,712	HD	100	100
20	Seke E+H	64.69	11,308	HD	100	100
21	Seke A+B	197.65	18,666	HD (70%) MD (30%)	100	100
22	Seke O	128.90	15,187	HD + Informal	70	90
23	Seke N+P	230.90	28,073	HD + Informal	70	90
24	Seke M	158.06	20,697	HD + Informal	60	80
25	Seke G	339.54	13,102	HD (90%) LD (10%)	95	90
Total		**5,106.13**	**356,840**			

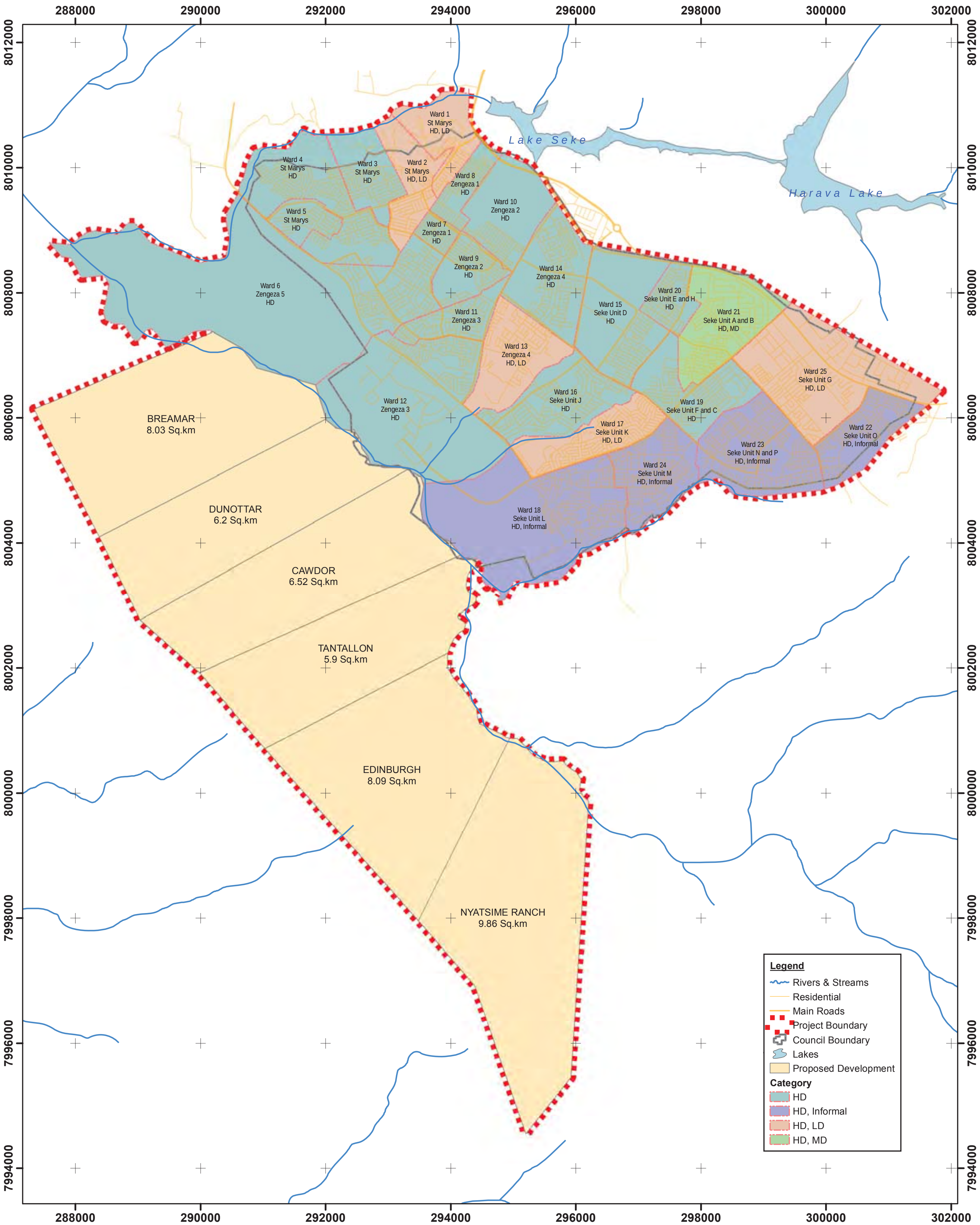

Figure 3-1
Ward Map with Housing Categories
Chitungwiza

Datum WGS 84
1:55,000

Greater Harare Water and Sanitation Investment Plan

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3.2 Master Plan

Over the last few years JICA has been providing technical support to the Chitungwiza City Council, in particular to develop an updated master plan for future development of water supply, waste water treatment and solid waste management infrastructure to 2020 and 2030. A final draft has recently been produced.

A key expectation of the master plan is to incorporate the six farms of Longlands, Braemar A, Dunnotar, Cawdor, Tantallon and Edinburgh into the municipal area of Chitungwiza. Collectively known as the Nyatsime Farms, these farms are situated to the south of the Nyatsime River, mainly between the Nyatsime River and the Charter Road (other than Edinburgh which continues to the west of the Charter Road). These form a single contiguous block of land, extending some 10 km to the south of Ward 6. The intention is that this area should be developed in phases, through to perhaps 2040, with the anticipation of providing 35,889 HD stands on 890 ha; 11,514 MD stands on 576 ha; 2,257 LD stands on 339 ha, and with 157 ha being reserved for industrial stands.

The master plan also anticipates incorporation of a neighbouring portion of Seke Communal Land, adjacent to Ward 22. It is possible that this will be an ongoing exercise, with continued expansion into Seke Communal Land to the east, although no concrete plans for this exist as yet.

3.3 Opportunities for Growth

Fourteen areas of possible residential expansion were identified within the extent of the current 25 wards of Chitungwiza (Table 3-2 and Figure 3-2), plus four in the surrounding areas: HD expansion in the adjacent portion of Seke Communal Land and on the Nyatsime farms mixed development of LD, MD and HD housing.

Expansion to 2020 is expected to be confined to the existing wards and Seke Communal Land, but thereafter to 2030 the bulk of the expansion is expected to occur on the Nyatsime Farms. Development to 2030 is expected to be concentrated in the northern sector of the Nyatsime Farms (Longlands and Braemar). A layout plan has already been prepared for this area, showing opportunity for 10,542 HD, 1,670 MD and 2,875 LD stands (note this figure of 2,875 LD stands is in excess of the approximate figure of 2,257 LD stands for the entire extent of the Nyatsime Farms). This translates to a potential to accommodate a total of 105,420 HD, 11,690 MD and 20,125 LD residents (overall total of 137,235), and which represents roughly one third of the anticipated overall total for the six Nyatsime Farms.

Collectively, to 2030, there is opportunity for development of an additional 21,037 stands to accommodate 192,235 additional people. For the purpose of converting numbers of stands to numbers of people the following conversions have been applied: for HD 10 people per stand and for MD and LD each seven people per stand. Broken down by housing types there is opportunity to accommodate a total of 26,495 LD residents, 15,610 MD dwellers; 147,970 HD people and 2,250 informal settlers (and considering only Phase I of the Nyatsime Farms development). For each area an indication of the anticipated timing of development (before or after 2020) is also provided.

Table 3-2: Opportunities for Resedential Expansion

Map ID	Ward	Name	Type	Stands	Population	Year
A	1	Infill of existing low density stands	LD	60	420	2020
B	2	Infill of existing low density stands	LD	60	420	2020
C	10	Layout approved for a private developer comprising a mix of HD and LD.	LD	300	2,100	2020
D	10	Layout on state land for LD housing, not yet approved	LD	120	840	2020
E	13	Infill of some existing LD stands that have not yet been developed	LD	40	280	2020
F	17	Infill of existing low density stands	LD	30	210	2020
G	25	Riverside LD layout plan in northern portion	LD	300	2,100	2020
H	Nyatsime	Phase 1	LD	2,875	20,125	2030
	Subtotal		**LD**	**3,785**	**26,495**	
I	6	Layout plan for 559 MD stands registered, but not yet approved.	MD	560	3,920	2020
J	Nyatsime	Phase 5 and 6	MD	1,670	11,690	2030
	Subtotal		**MD**	**2,230**	**15,610**	
K	10	Layout approved for a private developer comprising a mix of HD and LD.	HD	95	950	2020
L	14	Plan for HD development (Mhurushomana) already approved and under development	HD	140	1,400	2020
M	18	Plan for HD development in southwestern portion not yet approved.	HD	2,020	20,200	2020
N	Seke CL	Plan for HD development with more than 2000 stands, not yet approved	HD	2,000	20,000	2020
O	Nyatsime	Phase 2, 4 and 6	HD	10,542	105,420	2030
	Subtotal		**HD**	**14,797**	**147,970**	

Map ID	Ward	Name	Type	Stands	Population	Year
P	22	Infill of HD in low lying strip along Duri River	INF	75	750	2020
Q	23	Some HD infill along southern boundary Duri River	INF	75	750	2020
R	24	Some HD infill along southern boundary Duri River	INF	75	750	2020
	Subtotal		**INF**	**225**	**2,250**	
Total	**N = 18**		**HD/MD/LD**	**21,037**	**192,325**	**2030**

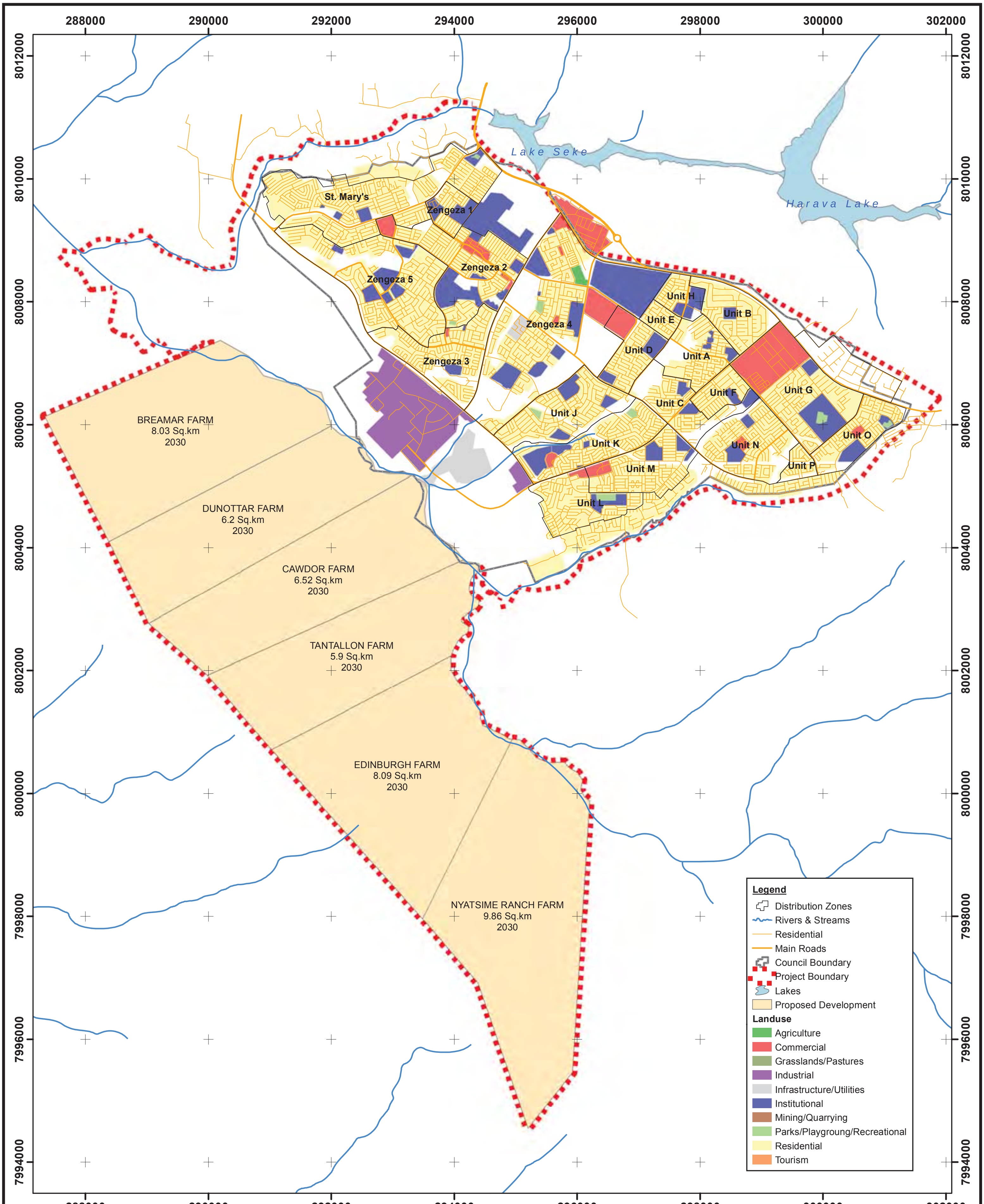

Figure 3-2
Future Town Development Map
Chitungwiza

Greater Harare Water and Sanitation Investment Plan

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3.4 Future Demand by Housing Types

The distribution of population in 2012 by housing types was 1.3% LD, 1.6% MD, 92.2% HD and 4.7% informal settlement (Table 3-3). For the purpose of calculating future demand for different types of housing, it was assumed that future proportions of housing types will generally be maintained at these values, except that future informal settlement will be restricted to the Duri River area, and will be completed by 2020. This gives rise to minor fluctuations in the proportions of HD and informal categories of housing.

Using these figures, the future estimated populations for the years 2020 and 2030 broken down by housing categories are shown in Table 3-3. This suggests that the LD population will grow from 4,489 in 2012 by 369 people, to give a 2020 population of 4,858, and then by 2,034 people to give a 2030 population of 6,523. MD growth will similarly be limited, growing from 5,600 in 2012 by 461 to 6,061 in 2020, and by 2,542 to 8,142 in 2030.

The bulk of the growth is expected to be in HD housing, which will expand from 330,017 in 2012 by 26,279 people to 356,296 in 2020, and by 155,108 people to 485,125 in 2030.

Growth in informal population is expected to be limited to 2,250 people during the interval from 2012 to 2020, resulting in a small rise in population from 16,734 in 2012 to 18,984 in 2020, and which will be maintained to 2030.

Table 3-3: Current (2012) and Estimated Future Populations by Residential Types

Type	LD	MD	HD	INF	Total
Estimated Proportion (%)					
2012	1.3	1.6	92.4	4.7	100
2020	1.3	1.6	92.2	4.9	100
2030	1.3	1.6	93.4	3.7	100
Estimated Population					
2012	4,489	5,600	330,017	16,734	356,840
2020	4,858	6,061	356,296	18,984	386,199
2030	6,523	8,142	485,125	18,984	518,774
Estimated Population Growth					
2012-20	369	461	26,279	2,250	29,359
2020-30	1,665	2,081	128,829	0	132,575
2012-30	2,034	2,542	155,108	2,250	161,934

3.5 Comparison to Expected Level of Growth

Respective figures for expected population growth by housing types (Table 3-3) as compared to potential opportunities for growth (Table 3-2) are summarised in Table 3-4.

The opportunities for LD and MD growth far outstrip the projected demand. Although much of the supply relates to development of the Nyatsime Farms, the existing wards have more than enough capacity to satisfy the projected demand, such that future LD and MD growth to 2030 is projected to be confined to the existing wards and allocated proportionally in relation to the identified opportunities. Informal growth is expected to be confined to the interval 2012-2020 and to be restricted to the three wards along the Duri River, where this is already taking place.

The major expected demand is for HD housing (155,108 people), and which is projected to marginally outstrip the potential supply by 2030 (147,970 but including only the initial portion of the Nyatsime Farms). If necessary any excess demand can be accommodated either by reallocation of some of the proposed LD and MD housing to HD, or else through continued expansion to the south within Nyatsime. HD growth to 2020 is expected to be relatively limited (26,729 people) and to be split between the existing wards and adjacent portion of Seke Communal Land.

Table 3-4: Estimated Population Growth Versus Identified Growth Opportunities

Type	LD	MD	HD	INF	Total
			Estimated Population Growth		
2012-20	369	461	26,279	2,250	29,359
2020-30	1,665	2,081	128,829	0	132,575
2012-30	**2,034**	**2,542**	**155,108**	**2,250**	**161,934**
			Potential for Expansion		
2012-30	**26,495**	**15,610**	**147,970**	**2,250**	**192,325**

3.6 Future Ward Populations

For the sake of future population projections it has firstly been assumed that development to 2020 is confined to the existing city boundary, plus the immediately neighbouring portion of Seke Communal Land. The remainder of these expansion opportunities are taken up during the subsequent interval to 2030, with the remaining bulk of the growth, in particular the HD growth, occurring on the northern portion of the Nyatsime Farms (Longlands and Braemar).

For the HD sector, growth to 2020 is expected to occur within Wards 10 (Zengeza 2, n = 950 people) and 14 (Zengeza 4, n = 1,400), with the remaining anticipated expansion being split between Ward 18 (Seke Unit L, n = 12,027) and Seke Communal Land (n = 11,902). For 2030, it is assumed that the remaining capacity in Ward 18 (n = 8,137) and Seke Communal Land (n = 8,098) will be taken up, with the excess growth being directed to the Nyatsime Farms (n = 112,558).

Minimal growth is projected for the MD and LD sectors, and the existing possibilities within Wards 1, 2, 6, 10, 13 and 17 appear to be more than sufficient to cater for the projected demand to 2030. Accordingly, for both time intervals, growth is allocated in proportion to the identified opportunities in these wards. No MD/LD growth is projected for the Nyatsime Farms up to 2030, although the draft layout plan does include some provision for this.

The resulting predicted ward populations are shown in Tables 3-5 and, in Table 3-6, these are broken down by housing types.

Table 3-5: Estimated Future Ward Populations to 2030

WARD	NAME	TYPE	2012	2020	2030
1	St Marys	HD (90%) LD (10%)	8,262	8,286	8,403
2	St Marys	HD (90%) LD (10%)	11,169	11,193	11,310
3	St Marys	HD	10,057	10,057	10,057
4	St Marys	HD	27,560	27,560	27,560
5	St Marys	HD	10,620	10,620	10,620
6	Zengeza 5	HD	17,339	17,800	19,881
7	Zengeza 1	HD	7,988	7,988	7,988
8	Zengeza 1	HD	10,119	10,119	10,119
9	Zengeza 2	HD	8,229	8,229	8,229
10	Zengeza 2	HD	8,788	9,909	10,678
11	Zengeza 3	HD	9,392	9,392	9,392
12	Zengeza 3	HD	15,129	15,129	15,129
13	Zengeza 4	HD (95%) LD (5%)	9,489	9,505	9,563
14	Zengeza 4	HD	15,484	16,884	16,884
15	Seke D	HD	13,781	13,781	13,781
16	Seke J	HD	14,730	14,730	14,730
17	Seke K	HD (95%) LD (5%)	15,242	15,254	15,309
18	Seke L	HD + Informal	19,717	31,744	39,917
19	Seke F+C	HD	16,712	16,712	16,712
20	Seke E+H	HD	11,308	11,308	11,308
21	Seke A+B	HD (70%) MD(30%)	18,666	18,666	18,666
22	Seke O	HD + Informal	15,187	15,937	15,937
23	Seke N+P	HD + Informal	28,073	28,823	28,823
24	Seke M	HD + Informal	20,697	21,447	21,447
25	Seke G	HD (90%) LD (10%)	13,102	13,224	13,773
	Seke CL	HD	-	11,902	20,000
	Nyatsime Farms	HD/MD/LD	-	-	112,558
TOTAL			**356,840**	**386,199**	**518,774**

Table 3-6: Estimated Future Ward Populations to 2030 by Residential Types

WARD	2012 LD	2012 MD	2012 HD	2012 INF	2012 TOTAL	2020 LD	2020 MD	2020 HD	2012 INF	2020 TOTAL	2030 LD	2030 MD	2030 HD	2030 INF	2030 TOTAL
1	826	-	7,436	-	8,262	850	-	7,436	-	8,286	967	-	7,436	-	8,403
2	1,117	-	10,052	-	11,169	1,141	-	10,052	-	11,193	1,258	-	10,052	-	11,310
3	-		10,057	-	10,057	-	-	10,057	-	10,057	-	-	10,057	-	10,057
4	-	-	27,560	-	27,560	-	-	27,560	-	27,560	-	-	27,560	-	27,560
5	-	-	10,620	-	10,620	-	-	10,620	-	10,620	-	-	10,620	-	10,620
6	-	-	17,339	-	17,339	-	461	17,339	-	17,800	-	2,542	17,339	-	19,881
7	-	-	7,988	-	7,988	-	-	7,988	-	7,988	-	-	7,988	-	7,988
8	-	-	10,119	-	10,119	-	-	10,119	-	10,119	-	-	10,119	-	10,119
9	-	-	8,229	-	8,229	-	-	8,229	-	8,229	-	-	8,229	-	8,229
10	-	-	8,788	-	8,788	171	-	9,738	-	9,909	940	-	9,738	-	10,678
11	-	-	9,392	-	9,392	-	-	9,392	-	9,392	-	-	9,392	-	9,392
12	-	-	15,129	-	15,129	-	-	15,129	-	15,129	-	-	15,129	-	15,129
13	474	-	9,015	-	9,489	490	-	9,015	-	9,505	548	-	9,015	-	9,563
14	-	-	15,484	-	15,484	-	-	16,884	-	16,884	-	-	16,884	-	16,884
15	-	-	13,781	-	13,781	-	-	13,781	-	13,781	-	-	13,781	-	13,781
16	-	-	14,730	-	14,730	-	-	14,730	-	14,730	-	-	14,730	-	14,730
17	762	-	14,480	-	15,242	774	-	14,480	-	15,254	829	-	14,480	-	15,309
18	-	-	15,774	3,943	19,717	-	-	27,801	3,943	31,744	-	-	35,974	3,943	39,917
19	-	-	16,712	-	16,712	-	-	16,712	-	16,712	-	-	16,712	-	16,712
20	-	-	11,308	-	11,308	-	-	11,308	-	11,308	-	-	11,308	-	11,308
21	-	5,600	13,066	-	18,666	-	5,600	13,066	-	18,666	-	5,600	13,066	-	18,666
22	-	-	12,150	3,037	15,187	-	-	12,150	3,787	15,937	-	-	12,150	3,787	15,937
23	-	-	22,458	5,615	28,073	-	-	22,458	6,365	28,823	-	-	22,458	6,365	28,823
24	-	-	16,558	4,139	20,697	-	-	16,558	4,889	21,447	-	-	16,558	4,889	21,447

WARD	2012 LD	2012 MD	2012 HD	2012 INF	2012 TOTAL	2020 LD	2020 MD	2020 HD	2012 INF	2020 TOTAL	2030 LD	2030 MD	2030 HD	2030 INF	2030 TOTAL
25	1,310	-	11,792		13,102	1,432	-	11,792	-	13,224	1,981	-	11,792	-	13,773
Seke CL	-	-	-	-	-	-	-	11,902	-	11,902	-	-	20,000	-	20,000
Nyatsime	-	-	-	-	-	-	-	-	-	-	-	-	112,558	-	112,558
TOTAL	**4,489**	**5,600**	**330,017**	**16,734**	**356,840**	**4,858**	**6,061**	**356,296**	**18,984**	**386,199**	**6,523**	**8,142**	**485,125**	**18,984**	**518,774**

APPENDIX 3.3: DETAILED DEMOGRAPHIC PROFILE REPORT – EPWORTH

GREATER HARARE WATER AND SANITATION STRATEGIC PLAN

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 3.3: DETAILED DEMOGRAPHIC REPORT

EPWORTH

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1 INTRODUCTION

Epworth is situated on the south eastern periphery of Harare urban, sandwiched between Harare South, Hatfield and Mabvuku and, to the east, Ruwa. With a population of 167,462 in 2012 Epworth was the fifth largest urban centre in Zimbabwe, after Harare, Bulawayo, Chitungwiza and Mutare.

The settlement of Epworth dates back to the late 1800s when the British South Africa Company granted some 1,102 hectares of land to the Methodist Wesleyan Mission in 1892. The Mission subsequently bought additional land in 1904 (Glenwood farm, 1,010 ha) and in 1908 (Adelaide farm 1,610 ha). The 500 or so families initially residing at Epworth Mission were allocated land (about 4,000 m^2 each) for residential and agricultural (gardening) use. In broad terms, Epworth had taken shape as a settlement by 1929 and its development before and after that was incremental, informal and non-commercial.

Large population influxes into Epworth occurred in the 1970s during the peak of the liberation war. This created a market for ‘urban land’ in Epworth and by 1980 a number of the original residents had sold portions of their land to the new arrivals.

That the settlement was on relatively under-utilized Church land where little to no farming was going on in many ways influenced the pace and nature of population influx. The area’s proximity to Harare and absence of proper development controls made Epworth attractive to informal settlement. The Methodist Church did not have the institutional mechanisms to regulate the growth and planning of the settlement on its farms (Epworth, Glenwood and Adelaide). The flow of residents followed diverse patterns but notably some resident followers of the Church accommodated relatives who subsequently occupied their own pieces of land. While it is conceivable that some local land administration practices existed it is fair to say these were informal and by extension their activities generally irregular. These activities included informal land sales, ‘pegging’ and possible dispute resolution. A key challenge was that the influx occurred on land not planned for residential purposes. As such, no adequate reticulated water and sanitation facilities existed to cope with the population influx.

The pace and pattern of Epworth’s growth increasingly overwhelmed the Church which was the default local authority for the area, and prompted the need for some form of administering and service-providing authority other than the Mission. In July 1983 the Mission donated a large portion of its land to central government. This was the first step towards the establishment of a formal local authority for the area. Subsequent to the donation, Government froze all developments in the area and initiated formal processes to guide the planned development of the area. This signalled the beginning of an ‘upgrading’ (re-planning and regularization) programme with an initial view to incorporate the area into the City of Harare following installation of relevant infrastructural services. Central government remained the authority for Epworth until the establishment of the Epworth Local Board in 1986. The mandate of the new board was to regularize existing settlements, provide services and to manage the planned development of the whole area. Despite success in regularizing some of the informal settlement, and the recent planned settlement of Glenwood Farm (Ward 3), additional informal activities have continued to the present.

Epworth residents can thus be classified into three distinct categories as follows:

- The early settlers or 'originals' mainly in Wards 1 and 4. These residents invariably had something to do with the Methodist Church either as followers, employees at the Church farms, or immediate relatives of the early settlers.
- Settlers who came into Epworth during the liberation struggle and the early independence years (1970s through to 1983). These are mainly in Wards 2, 3 and 5. This period saw significant influx coinciding with the handover of Epworth by the Methodist Church to the Government. The areas are generally referred to as 'extensions' as they generally abut the areas where the 'originals' were settled.
- 'Overspill' (Ward 6) made up of the most recent informal settlements i.e. yet to be regularized, and Ward 7, which holds the largest and last group of settlers. The area is also known as '*Gada*' meaning 'free riders' who are generally seen as the illegal and informal settlers.

The majority of the current residents are actively self-employed while a few are in wage employment. Most of Epworth's residents live below the poverty line in an overcrowded area where basic infrastructure is inadequate. There is a gap between basic service requirements and actual provision for services like water and sanitation. The reality is that Epworth remains an urban fringe choking from years of informality that render parts of the settlement difficult to upgrade.

2 PAST, PRESENT AND FUTURE POPULATIONS

2.1 Historical Population Data

Epworth has grown in terms of population from 62,630 in 1992, to 167,462 people in 2012 (Table 2-1, Figure 2-1). Corresponding annual rates of population growth for the respective census intervals are shown in Table 2-2. For the country as a whole there has been a dramatic decline in annual growth rates over the last 20 years, from over 3% for the period 1969 to 1992, to just over 1% for the last 20 years from 1992 to 2012. Likely causes of this marked decline include the impacts of HIV and the national economic collapse during the 2000s leading to high levels of out-migration.

Table 2-1: Population Data for Greater Harare from 1969 to 2012 (Source: ZIMSTAT)

Year	1969	1982	1992	2002	2012
Harare urban	364,390	658,364	1,148,073	1,458,807	1,708,538
Chitungwiza	14,970	172,000	274,912	323,260	356,840
Epworth			**62,630**	**114,067**	**167,462**
Norton		12,438	29,000	44,397	67,591
Ruwa			1,447	23,681	56,333
Total Greater Harare	**379,360**	**842,802**	**1,516,062**	**1,964,212**	**2,356,764**
ZIMBABWE	5,134,300	7,608,432	10,412,548	11,631,657	12,973,808
Total as % of Zimbabwe	7.4	11.1	14.6	16.9	18.2

* Note that the Harare population figures from 1992 onwards include Harare South (Ward 1), and for 2012 also includes populations from six adjacent wards amounting to a total of 109,708 people.

Figure 2-1 below shows the population growth in Epworth from 1992 to 2012. (Source: ZIMSTAT).

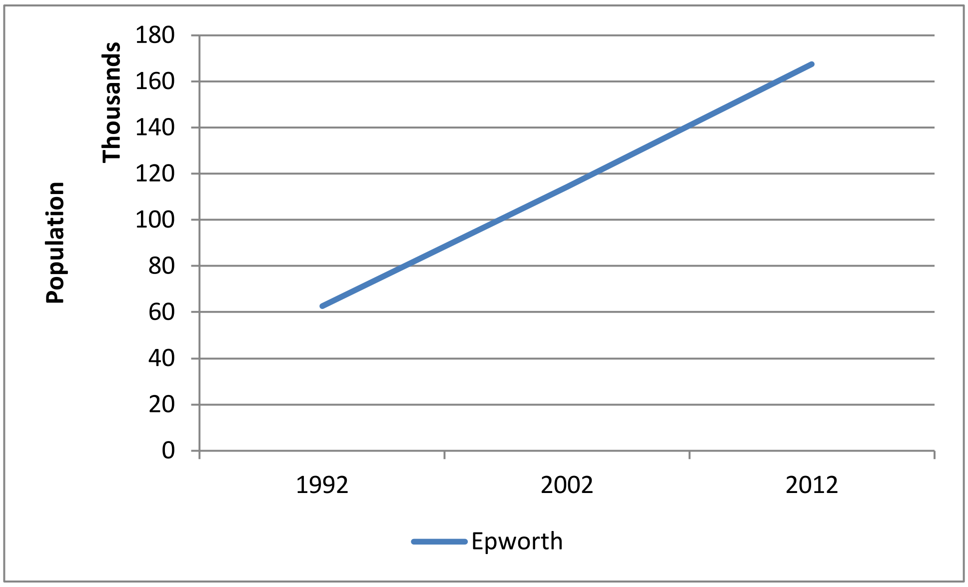

Figure 2-1: Epworth Population Growth from 1992 to 2012

Table 2-2 below shows mean inter census annual population growth rates for Greater Harare from 1969 to 2012. (Source: ZIMSTAT).

Table 2-2: Inter Census Annual Growth Rates for Greater Harare

Period	1969-82	1982-92	1992-02	2002-12
Harare urban	4.66%	5.72%	2.42%	1.59%
Chitungwiza	20.66%	4.80%	1.63%	0.99%
Epworth			**6.18%**	**3.91%**
Norton		8.83%	4.35%	4.29%
Ruwa			32.25%	9.05%
Total Greater Harare	**6.33%**	**6.05%**	**2.62%**	**1.84%**
ZIMBABWE	3.07%	3.19%	1.11%	1.10%

Growth in Epworth has slowed from a mean annual rate of 6.18% for the period 1992-2002 to 3.91% for the interval 2002-2012. This has resulted in the population nearly tripling in size from 62,630 in 1992 to 167,462 in 2012.

2.2 Future Population Growth

Future population growth rates for Greater Harare were estimated through consideration of historical rates of growth (Table 2-2); comparison to regional data (Table 2-3); comparison to estimated growth rates for towns included under the associated Urgent Water Supply and Sanitation Rehabilitation Project (UWSSRP), (Table 2-4); and through discussions with the respective urban authorities.

Data on population growth was obtained from 87 urban centres (>25,000 people) in seven comparable Southern and East African countries for which data was available (Namibia, Botswana, Mozambique, Zambia, Malawi, Tanzania, Kenya), as recorded over their most recent census interval (variously 1997-2007 to 2002-2012). For all 87 towns the overall range of annual growth rates over the last decade was -0.03% to 6.97% with a mean value of 3.23% (Table 2-3). The data further suggests that growth is strongest in the largest cities (> 1 million inhabitants = 3.94%) and slightly lower in smaller centres (3.1% for centres smaller than 250,000 people).

Table 2-3 shows comparative annual growth rates for 87 Southern and East African urban areas (>25,000 people) over their respective most recent census intervals (from 1997-2007 to 2002-2012).

Table 2-3: Comparative Annual Growth Rates for 87 Southern and East African Cities

Population	Number	Range (%)	Median (%)	Mean (%)
> 1 Million	4	1.25% - 5.78%	4.36%	3.94%
500,000 - 1Million	5	2.79% - 4.69%	4.06%	3.88%
250,000-500,000	12	0.83% - 7.16%	3.39%	3.47%
100,000-250,000	32	0.38% - 6.55%	2.71%	3.08%
25,000-100,000	34	-0.03% - 6.97%	3.14%	3.11%

Total	**87**	**-0.03% - 7.16%**	**3.32%**	**3.23%**

Under the UWSSRP future population growth rates for the six project towns (Chegutu, Masvingo, Kwekwe, Mutare, Chitungwiza and Harare urban) were examined and debated at a combined workshop held in Harare on 09 July 2013. A key outcome of the workshop was to estimate future annual rates of population growth to 2020 and 2030 for each of the project centres, based on the specific conditions pertaining to each of the centres.

Table 2-4 shows the projected annual growth rates for the medium (2012-2020) and long term (2020-2030) for the six UWSSRP project towns. (Source: Workshop, Harare, 09 July 2013).

Table 2-4: Projected Annual Growth Rates for six Urban Centres Included in the UWSSRP

	Annual Growth Rate (%)		
Period	**2002-2012**	**2012-2020**	**2020-2030**
Chegutu	1.39%	4%	2%
Masvingo	2.45%	3%	1.5-2%
Kwekwe	0.71%	3%	4%
Mutare	1.00%	3%	4%
Chitungwiza	0.93%	1.1%	2%
Harare	0.23%	4%	4%

The resulting estimates varied between 1.1-4% for the period 2012-2020 and from 2-4% for the subsequent interval from 2020-2030.

Based on these deliberations, and particularly with respect to the continuing difficult macroeconomic outlook, the overall future rate of growth for Greater Harare for the period 2012-2020 was estimated at 2%, this being slightly higher than the figure of 1.84% as obtained for the previous census interval. Consistent with this overall figure, the growth rates of the individual urban centres for the period 2012-2020 have been maintained at the same levels as for 2002-2012, other than for Epworth and Harare urban (Table 2-5). For Epworth, due to restricted opportunities for expansion, the rate of growth is expected to decline from 3.91% to 2.50%. For Harare urban, it was assumed that the relatively restricted opportunities for growth in Chitungwiza and Epworth would be compensated for by marginally higher rates of growth here, such that the future growth was forecast to increase from the previous figure of 1.59% for 2002-2012 to that of 1.75% for 2012-2020.

Table 2-5: Projected Future Annual Growth Rates for Greater Harare

	Annual Growth Rate (%)			
Period	**2002-2012**	**2012-2020**	**2020-2025**	**2025-2030**
Harare urban	1.59%	1.75%	4.00%	5.00%
Chitungwiza	0.99%	0.99%	2.00%	4.00%
Epworth	**3.91%**	**2.50%**	**2.00%**	**2.00%**
Norton	4.29%	4.29%	4.00%	5.00%
Ruwa	9.05%	9.05%	4.00%	5.00%
Total Greater Harare	**1.84%**	**2.00%**	**3.59%**	**4.68%**

Population growth for Greater Harare is projected to escalate markedly after 2020, to 3.59% for the period 2020-2025 and increasing to 4.68% for the subsequent interval to 2030. Corresponding projections for the individual urban centres of Harare urban, Norton and Ruwa are 4% to 2025 and 5% to 2030. Estimates for Epworth are markedly lower (2% and 2%) again due to space constraints, and also for Chitungwiza (2% and 4%), on the basis that the targeted area of expansion on the Nyatsime farms is further away from the city centre than much of Harare urban, such that development in this area is likely to be slower until such time as the closer areas are beginning to reach capacity.

2.3 Epworth Future Population

For the purpose of estimating future populations for Epworth the above proposed annual growth rates of 2.50% to 2020, and 2.0% to 2030 were used. Resulting annual population estimates are shown in Table 2-6. These figures suggest population increases from 167,462 (2012) to 204,036 in 2020 and 225,272 in 2030. This implies total population increases of 36,574 people for the interval 2012-2020, of 44,683 people for the period 2020-2030, and overall from 2012-2030 of 81,257 people.

Table 2-6 shows the estimated annual and cumulative population increases for the period 2012-2030, based on projected annual growth rates of 2.50% for the mid-term (2012-2020) and thereafter reducing to 2% to 2030.

Table 2-6: Projected Annual Populations for Epworth 2012-2030

Year	Annual Growth Rate (%)	Estimated Population	Cumulative Population Increase
2012	2.50	167,462	
2013	2.50	171,649	4,187
2014	2.50	175,940	8,478
2015	2.50	180,338	12,876
2016	2.50	184,847	17,385
2017	2.50	189,468	22,006
2018	2.50	194,205	26,743
2019	2.50	199,060	31,598
2020	**2.50**	**204,036**	**36,574**
2021	2	208,117	40,655
2022	2	212,279	44,817
2023	2	216,525	49,063
2024	2	220,855	53,393
2025	**2**	**225,272**	**57,810**
2026	2	229,778	62,316
2027	2	234,373	66,911
2028	2	239,061	71,599
2029	2	243,842	76,380
2030	**2**	**248,719**	**81,257**

3 URBAN PLANNING

3.1 Overview

Epworth comprises a small densely populated residential area situated on the outskirts of Harare to the southeast along the Chiremba Road. It is sandwiched between the airport (Harare Ward 1) and Hatfield (Harare Ward 22) to the west; the Ventersburg portion of Mabvuku to the north (Harare Ward 21); and Ruwa to the east. To the south, Epworth borders against farm land which forms part of Goromonzi District (Wards 23 and 24).

The eastern and southern boundary is marked by the Ruwa River, whilst the remainder of Epworth is bisected by two additional tributaries of the Ruwa River: the Jacha River that drains through the central portion of Epworth and, to the east, the Sambwa which is situated between the Jacha and Ruwa Rivers. The Jacha and Sambwa Rivers are both flanked by sizeable wetland areas. The Ruwa River, from the southwestern corner of Epworth, continues to the southeast for another 8 km until it feeds into the Manyame River at the headwaters of Prince Edward Dam. Parts of Epworth are characterized by low granite outcrops (including the famous balancing rocks previously featured on the national currency), but most of the terrain is relatively flat to gently sloping.

Epworth covers only 3,438 ha, or 34 km^2. Yet with a 2012 population of 167,462, Epworth accounted for 7.1% of the overall population of Greater Harare, and had grown to become the fifth largest urban settlement in Zimbabwe.

The town is divided into seven wards (Figure 3-1). It should be noted that there are substantial differences in the ward boundaries as used by ZIMSTAT and followed for this project, as compared to those currently in use by the Epworth Local Board.

Epworth is dominated by residential housing. There are a number of shopping centres with associated home industry activities but there is no defined CBD, nor any formal industrial areas. This relates to its particular history of development under control of the Methodist Church.

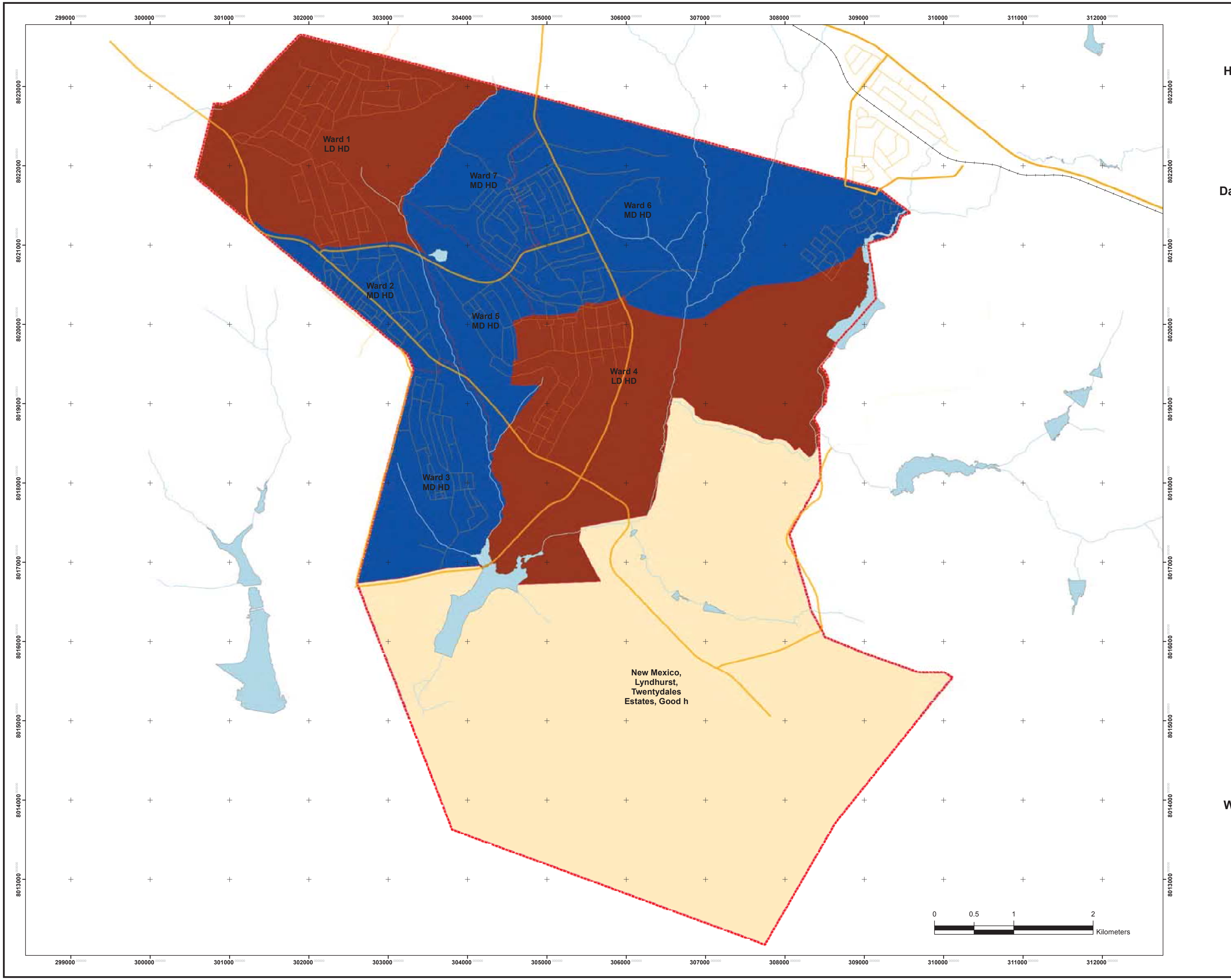

Figure 3-1
Ward Map With Housing Categories Epworth

Datum : WGS84 Zone 36S
Scale 1:21,500

Greater Harare Water and Sanitation Investment Plan

Gauff JBG Ingenieure

Unlike many other urban areas in Zimbabwe, all the Epworth wards include a mixture of residential types. Wards 1 and 4 have some LD housing, Wards 2, 3, 5, 6 and 7 some MD housing, Ward 3 also has some HD housing, whilst all wards contain varying proportions of informal settlements. The informal settlements in Wards 2, 3 and 5 are relatively limited (c. 10% of the population) and are restricted to the low lying areas along the Jacha drainage. Wards 1, 4, 6 and 7 have much more substantial informal settlements (up to 50% of the respective populations), and not necessarily associated with wetland areas. In particular, the extensive western portions of Wards 4 and 6 comprise mainly informal settlements. The recent HD development in Ward 3, on what was previously Glenwood Farm, currently comprises the only formal HD development in Epworth. A summary of the wards is shown in Table 3-1.

Table 3-1: Summary of Wards

Ward No.	Location	Area (ha)	Population 2012	Land Use / Housing Category	Proportion of housing stands developed (%)
1	North	628.97	31,537	LD, INF	95
2	West	182.95	14,941	MD, INF	100
3	Southwest	330.76	16,020	MD, HD, INF	80
4	Southeast	996.48	23,320	LD, INF	55
5	Centre	208.29	16,273	MD, INF	100
6	Northeast	876.57	25,819	MD, INF	70
7	North centre	213.67	39,552	MD, INF	100
Total		**3,437.68**	**167,462**		

3.2 Master Plan

Epworth does not have any master plan. One of the key planning concerns in Epworth is how to regularise and provide services to the existing informal settlements, many of which have been settled in a haphazard manner. This presents numerous challenges to the provision of services, and will necessarily be a demanding and slow process. Based on discussions with town authorities it is assumed that no progress will be made in this respect during the medium term to 2020. However, during the subsequent interval to 2030 it is anticipated that roughly half of the existing informal settlement in Epworth will be upgraded to formal high density housing (with individual household water and sewer connections).

Epworth has relatively limited opportunity for future expansion within the existing wards, and most of the surrounding areas, other than to the south, are already incorporated into either Harare or Ruwa, again limiting opportunities for future expansion. Thus, although some expansion is envisaged into the adjacent southern areas, the limited availability of land is expected to lead to slower rates of growth than has been the case in the past.

The below analysis of future supply and demand of different types of residential housing to 2030, suggests that the projected demand to 2020 can just be accommodated within the existing wards, but thereafter any additional growth will need to be accommodated in adjacent areas to the south.

3.3 Opportunities for Growth

Six areas of possible expansion were identified within the extent of the current seven wards of Epworth, two for LD housing, one for HD housing and three where there is likely to be expansion of informal settlements (Table 3-2, Figure 3-2). Collectively, these areas can accommodate a total of a further 3,900 stands. For the purpose of converting numbers of stands to numbers of people the following conversions have been applied: for HD and informal settlements 10 people per stand and for MD and LD each seven people per stand. Thus there is opportunity to accommodate a further 36,600 residents, comprising 5,600 LD residents, 4,000 HD and 27,000 informal settlers. For each area an indication of the anticipated timing of development (before or after 2020) is provided.

Table 3-2: Opportunities for Residential Expansion

Map ID	Ward	Type	Stands	Population	Year
A	4	LD	400	2,800	2020
B	6	LD	400	2,800	2020
	Subtotal	**LD**	**800**	**5,600**	
C	3	HD	400	4,000	2020
	Subtotal	**HD**	**400**	**4,000**	
D	1	INF	250	2,500	2020
E	4	INF	1,650	16,500	2020
F	6	INF	800	8,000	2020
	Subtotal	**INF**	**2,700**	**27,000**	

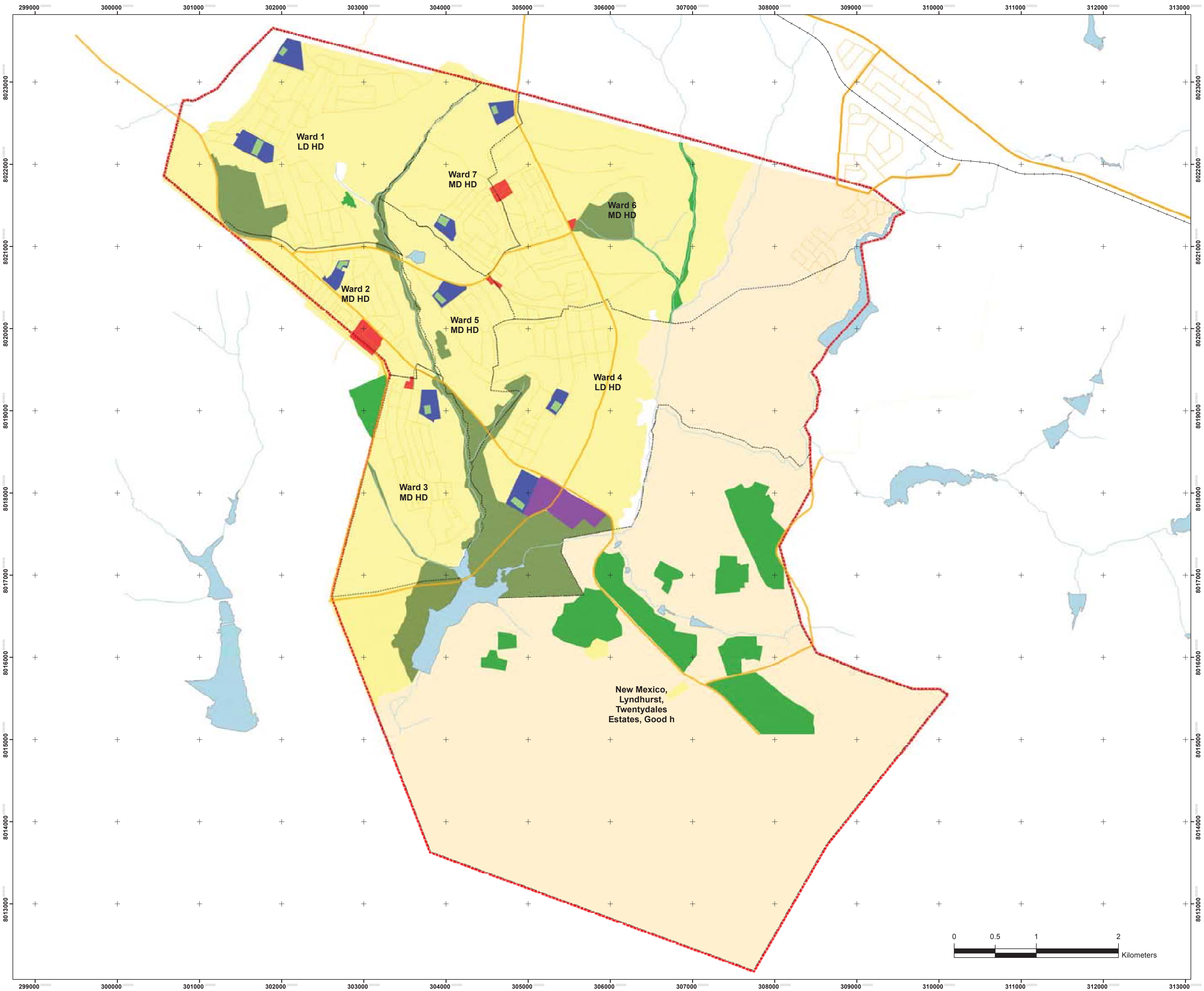

Figure 3-2
Future Town Developent Map
Epworth

N

Dutam : WGS 84 Zone 36S
Scale 1:21,500

Legend

- Expansion Areas
- Ward No.

Landuse

- Agriculture
- Commercial
- Grasslands/Pastures
- Industrial
- Institutional
- Mining/Quarrying
- Park/Playground And Other Recreational Spaces
- Proposed Development/Expansion Areas
- Residential
- Residential Roads
- Trunk/Primary Roads
- Project Boundary
- Rail Line
- Rivers/Stream
- Epw_Lakes

Greater Harare
Water and Sanitation
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3.4 Future Demand by Housing Types

The distribution of population in 2012 by housing types was 8.9% LD, 25.1% MD, 5.7% HD and 60.2% informal settlement (Table 3-3). The above analysis indicates that there is limited opportunity for LD growth, and no MD growth is anticipated. In fact the bulk of the future growth is expected to be informal settlement, but in the long term (2020-30) this will be tempered by conversion of some of the informal settlement to formal high density housing. The resulting anticipated changes in proportions of housing to 2020 and 2030 are shown in Table 3-3. The general trend is of a decrease in the combined proportion of LD and MD housing from 34.0% in 2012 to 30.6% in 2020 to 25.1% in 2030. The proportions of HD and informal housing (currently at 5.7% and 60.2%) are expected to expand marginally to 2020 (to 6.7% and 62.7%, respectively), but thereafter the anticipated conversion of informal settlements to HD housing is expected to lead to a marked drop in the proportion of informal settlements by 2030 (42.7%) and a corresponding increase in the proportion of HD housing (32.1%).

Using these figures, the future estimated populations for the years 2020 and 2030 broken down by housing categories are shown in Table 3-3. This suggests that the LD population will grow from 14,880 in 2012 by 5,600 people, to give a 2020 population of 20,480, and that there will be no further LD growth to 2030. Similarly, there will be no MD growth such that the 2012 MD population of 42,100 will be maintained to 2030.

The largest change is projected for HD housing, which will experience modest growth of 4,000 people from 9,612 in 2012 to 13,612 in 2020, but thereafter will increase by 66,284 people to 2030 to give a total 2030 population of 79,896.

The informal population is expected to grow from 100,870 in 2012 by 26,974 to give a 2020 population of 127,844, and then to reduce by 21,601 people to 2030 (through conversion to formal HD housing) to give a 2030 informal population of 106,243.

Table 3-3: Estimated Future Populations by Residential Types

Type	LD	MD	HD	INFORMAL	Total
Estimated Proportion (%)					
2012	8.9	25.1	5.7	60.2	100
2020	10.0	20.6	6.7	62.7	100
2030	8.2	16.9	32.1	42.7	100
Estimated Population					
2012	14,880	42,100	9,612	100,870	167462
2020	20,480	42,100	13,612	127,844	204036
2030	20,480	42,100	79,896	106,243	248719
Estimated Population Growth					
2012-20	5,600	0	4,000	26,974	36,574
2020-30	0	0	66,284	-21,601	44,683
2012-30	5,600	0	70,284	5,373	81,257

3.5 Comparison to Expected Level of Growth

Respective figures for expected population growth by housing types (Table 3-3) as compared to potential opportunities for growth (Table 3-2) are summarised in Table 3-4.

Essentially, all remaining opportunities within the existing wards will be taken up by 2020 for all housing categories. For the subsequent interval to 2030 all growth (44,683 people) will occur in the adjacent areas to the south, and it will all be informal in nature. However this will be accompanied by substantial conversion of existing informal settlements to HD settlements within Wards 1 to 7.

Table 3-4: Estimated Population Growth Versus Identified Growth Opportunities

Type	LD	MD	HD	INFORMAL	Total
		Estimated Population Growth			
2012-20	5,600	0	4,000	26,974	36,574
2020-30	0	0	66,284	-21,601	44,683
2012-30	**5,600**	**0**	**70,284**	**5,373**	**81,257**
		Potential for Expansion			
2012-30	**5,600**	**0**	**4,000**	**27,000**	**36,600**

3.6 Future Ward Populations

For the purpose of calculating future ward populations, for LD residents the potential growth of 400 stands in Ward 4 and 400 stands in Ward 6 were assumed to all be taken up by 2020, together with the uptake of the remaining 400 HD stands in Ward 3. Additional informal growth is projected for Wards 1, 4 and 6 to 2020, and to the south during the period 2020-30, and this will be accompanied by partial conversion of informal to formal HD housing within Wards 1-7, again during the period 2020-30. The resulting predicted ward populations are shown in Tables 3-5 and, in Table 3-6, these are broken down by housing types.

Table 3-5: Estimated Future Ward Populations

WARD	TYPE	2012	2020	2030
1	LD and INF	31,537	34,037	34,037
2	MD and INF	14,941	14,941	14,941
3	MD and HD and INF	16,020	20,020	20,020
4	LD and INF	23,320	42,594	42,594
5	MD and INF	16,273	16,273	16,273
6	LD and MD and INF	25,819	36,619	36,619
7	MD and INF	39,552	39,552	39,552
GOR 23/24	INF	-	-	44,683
TOTAL		**167,462**	**204,036**	**248,719**

Table 3-6: Estimated Future Ward Populations by Residential Types

WARD	2012 LD	2012 MD	2012 HD	2012 INF	2012 TOTAL	2020 LD	2020 MD	2020 HD	2012 INF	2020 TOTAL	2030 LD	2030 MD	2030 HD	2030 INF	2030 TOTAL
1	7,884	-	-	23,653	31,537	7,884	-	-	26,153	34,037	7,884	-	13,077	13,076	34,037
2	-	13,447	-	1,494	14,941	-	13,447	-	1,494	14,941	-	13,447	1,494	-	14,941
3	-	4,806	9,612	1,602	16,020	-	4,806	13,612	1,602	20,020	-	4,806	15,214	-	20,020
4	6,996	-	-	16,324	23,320	9,796	-	-	32,798	42,594	9,796		16,399	16,399	42,594
5	-	14,646	-	1,627	16,273	-	14,646	-	1,627	16,273	-	14,646	1,627	-	16,273
6	-	1,291	-	24,528	25,819	2,800	1,291	-	32,528	36,619	2,800	1,291	16,264	16,264	36,619
7	-	7,910	-	31,642	39,552	-	7,910	-	31,642	39,552	-	7,910	15,821	15,821	39,552
GOR 23/24	-	-	-	-	-	-	-	-	-	-	-	-	-	44,683	44,683
TOTAL	**14,880**	**42,100**	**9,612**	**100,870**	**167,462**	**20,480**	**42,100**	**13,612**	**127,844**	**204,036**	**20,480**	**42,100**	**79,896**	**106,243**	**248,719**

APPENDIX 3.4: DETAILED DEMOGRAPHIC PROFILE REPORT – NORTON

GREATER HARARE WATER AND SANITATION STRATEGIC PLAN

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 3.4: DETAILED DEMOGRAPHIC REPORT

NORTON

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Figure 3-2: Norton Future Town Development Map...... 3-13

1 INTRODUCTION

Norton is a small town situated some 45 km to the west of Harare along the main road to Bulawayo. With a population of 67,591 in 2012, it was the 12 largest centre in Zimbabwe, after Harare, Bulawayo, Chitungwiza, Mutare, Epworth, Gweru, Kwekwe, Kadoma, Masvingo, Chinhoyi and Marondera.

Norton started out as a railway siding, later (1914) developing into a small village surrounded by productive agricultural land. During the early years of the Federal Period (1953-1963) the government decided to develop an industrial area at Norton with provision for heavy industrial sites with rail access, to cater for the overflow of industry from Harare. The town was planned to accommodate 8,500 low density residents and 25,000 high density residents, to be constructed according to demand. The first company to set up in Norton was Harold Poole Ltd. (later Rio Tinto) which started production in 1952. Another of the early industries was Rhodesia Pulp and Paper Industry (later Hunyani Pulp and Paper Industry). Despite ample supply of water from Lake Chivero and electricity from Kariba, it never developed as expected and only a few factories were initially established. However, during the subsequent UDI era (1965-1980) there was a renewal of interest and considerable development took place; including the establishment of Central African Batteries, Cone Textiles and Dandy sweets.

Developments continued after independence in 1980, and in May 1994 Norton was upgraded from a Town Board to a Town Council. This coincided with the establishment of BHP, a foreign conglomerate with interest in platinum mining and which injected new life into the town in the form of demand for residential properties and jobs. Between 1995 and 1997 Norton was a beehive of activity but then towards the end of 1998 BHP suddenly closed. This dealt a major blow to the business climate in the town.

During the 2000s, in line with the nationwide economic downturn, Norton suffered a further collapse of industrial activity, and most industries remain closed today. Despite shrinking employment opportunities over the last decade, the town population has continued to grow relatively rapidly, primarily through providing a cheaper alternative for residential development to Harare.

Regardless of the current depressed situation, Norton retains the necessary ingredients for successful industrial development, in the form of ample land, serviced industrial stands, a good communications (road and rail) network, and centrality and proximity to a large urban market in Harare. Current constraints include inadequate water supply and treatment of waste water, erratic power supplies, and the continuing gloomy macroeconomic conditions.

2 PAST, PRESENT AND FUTURE POPULATIONS

2.1 Historical Population Data

Norton has grown in terms of population from 12,438 in 1982, to 67,591 people in 2012 (Table 2-1, Figure 2-1). Corresponding annual rates of population growth for the respective census intervals are shown in Table 2-2. For the country as a whole there has been a dramatic decline in annual growth rates over the last 20 years, from over 3% for the period 1969 to 1992, to just over 1% for the last 20 years from 1992 to 2012. Likely causes of this marked decline include the impacts of HIV and the national economic collapse during the 2000s leading to high levels of out-migration.

Table 2-1: Population Data for Greater Harare from 1969 to 2012 (Source: ZIMSTAT)

Year	1969	1982	1992	2002	2012
Harare urban*	364,390	658,364	1,148,073	1,458,807	1,708,538
Chitungwiza	14,970	172,000	274,912	323,260	356,840
Epworth			62,630	114,067	167,462
Norton		**12,438**	**29,000**	**44,397**	**67,591**
Ruwa			1,447	23,681	56,333
Total Greater Harare	**379,360**	**842,802**	**1,516,062**	**1,964,212**	**2,356,764**
ZIMBABWE	5,134,300	7,608,432	10,412,548	11,631,657	12,973,808
Total as % of Zimbabwe	7.4	11.1	14.6	16.9	18.2

* Note that the Harare population figures from 1992 onwards include Harare South (Ward 1), and for 2012 also includes populations from six adjacent wards amounting to a total of 109,708 people.

Figure 2-1 below shows the population growth in Norton from 1969 to 2012. (Source: ZIMSTAT).

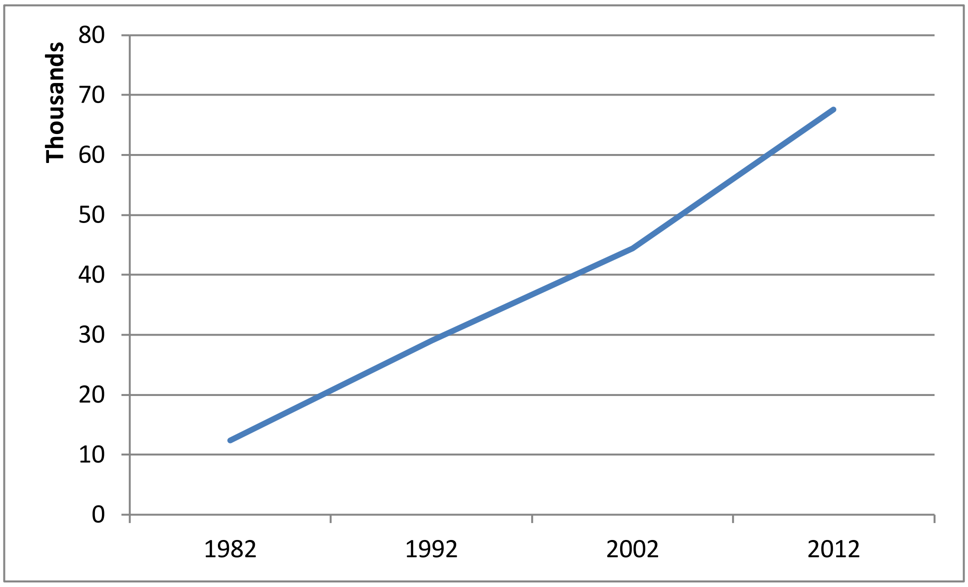

Figure 2-1: Norton Population Growth from 1982 to 2012

Table 2-2 below shows mean inter census annual population growth rates for Greater Harare from 1969 to 2012. (Source: ZIMSTAT).

Table 2-2: Inter Census Annual Growth Rates for Greater Harare

Period	1969-82	1982-92	1992-02	2002-12
Harare urban	4.66%	5.72%	2.42%	1.59%
Chitungwiza	20.66%	4.80%	1.63%	0.99%
Epworth			6.18%	3.91%
Norton		**8.83%**	**4.35%**	**4.29%**
Ruwa			32.25%	9.05%
Total Greater Harare	**6.33%**	**6.05%**	**2.62%**	**1.84%**
ZIMBABWE	3.07%	3.19%	1.11%	1.10%

Whilst growth in Norton has slowed from a mean annual rate of 8.83% for the period 1982-92, for the last twenty years the rate of growth has been maintained at above 4% per annum. This has resulted in the population more than doubling over the same period from 29,000 in 1992 to 67,591 in 2012.

2.2 Future Population Growth

Future population growth rates for Greater Harare were estimated through consideration of historical rates of growth (Table 2-2); comparison to regional data (Table 2-3); comparison to estimated growth rates for towns included under the associated Urgent Water Supply and Sanitation Rehabilitation Project (UWSSRP), (Table 2-4); and through discussions with the respective urban authorities.

Data on population growth was obtained from 87 urban centres (>25,000 people) in seven comparable Southern and East African countries for which data was available (Namibia, Botswana, Mozambique, Zambia, Malawi, Tanzania, Kenya), as recorded over their most recent census interval (variously 1997-2007 to 2002-2012). For all 87 towns the overall range of annual growth rates over the last decade was -0.03% to 6.97% with a mean value of 3.23% (Table 3-3). The data further suggests that growth is strongest in the largest cities (> 1 million inhabitants = 3.94%) and slightly lower in smaller centres (3.1% for centres smaller than 250,000 people).

Table 2-3 shows comparative annual growth rates for 87 Southern and East African urban areas (>25,000 people) over their respective most recent census intervals (from 1997-2007 to 2002-2012).

Table 2-3: Comparative Annual Growth Rates for 87 Southern and East African Cities

Population	Number	Range (%)	Median (%)	Mean (%)
> 1 Million	4	1.25 - 5.78	4.36	3.94
500,000 - 1Million	5	2.79 - 4.69	4.06	3.88
250,000-500,000	12	0.83 - 7.16	3.39	3.47
100,000-250,000	32	0.38 - 6.55	2.71	3.08
25,000-100,000	34	-0.03 - 6.97	3.14	3.11
Total	**87**	**-0.03 - 7.16**	**3.32**	**3.23**

Under the UWSSRP future population growth rates for the six project towns (Chegutu, Masvingo, Kwekwe, Mutare, Chitungwiza and Harare urban) were examined and debated at a combined workshop held in Harare on 09 July 2013. A key outcome of the workshop was to estimate future annual rates of population growth to 2020 and 2030 for each of the project centres, based on the specific conditions pertaining to each of the centres.

Table 2-4 shows the projected annual growth rates for the medium (2012-2020) and long term (2020-2030) for the six UWSSRP project towns. (Source: Workshop, Harare, 09 July 2013).

Table 2-4: Projected Annual Growth Rates for six Urban Centres Included in the UWSSRP

	Annual Growth Rate (%)		
Period	**2002-2012**	**2012-2020**	**2020-2030**
Chegutu	1.39	4	2
Masvingo	2.45	3	1.5-2
Kwekwe	0.71	3	4
Mutare	1.00	3	4
Chitungwiza	0.93	1.1	2
Harare	0.23	4	4

The resulting estimates varied between 1.1-4% for the period 2012-2020 and from 2-4% for the subsequent interval from 2020-2030.

Based on these deliberations, and particularly with respect to the continuing difficult macroeconomic outlook, the overall future rate of growth for Greater Harare for the period 2012-2020 was estimated at 2%, this being slightly higher than the figure of 1.84% as obtained for the previous census interval. Consistent with this overall figure, the growth rates of the individual urban centres for the period 2012-2020 were generally maintained at the same levels as for 2002-2012, other than for Epworth and Harare urban (Table 2-5). For Epworth, due to restricted opportunities for expansion, the rate of growth is expected to decline from 3.91% to 2.50%. For Harare urban, it was assumed that the relatively restricted opportunities for growth in Chitungwiza and Epworth would be compensated for by marginally higher rates of growth here, such that the future growth was forecast to increase from the previous figure of 1.59% for 2002-2012 to that of 1.75% for 2012-2020.

Table 2-5: Projected Future Annual Growth Rates for Greater Harare

	Annual Growth Rate (%)			
Period	**2002-2012**	**2012-2020**	**2020-2025**	**2025-2030**
Harare urban	1.59	1.75	4.00	5.00
Chitungwiza	0.99	0.99	2.00	4.00
Epworth	3.91	2.50	2.00	2.00
Norton	**4.29**	**4.29**	**4.00**	**5.00**
Ruwa	9.05	9.05	4.00	5.00
Total Greater Harare	**1.84**	**2.00**	**3.59**	**4.68**

Population growth for Greater Harare is projected to escalate markedly after 2020, to 3.59% for the period 2020-2025 and increasing to 4.68% for the subsequent interval to 2030. Corresponding projections for the individual urban centres of Harare urban, Norton and Ruwa are 4% to 2025 and 5% to 2030. Estimates for Epworth are markedly lower (2% and 2%) again due to space constraints, and also for Chitungwiza (2% and 4%), on the basis that the targeted area of expansion on the Nyatsime farms is further away from the city centre than much of Harare urban, such that development in this area is likely to be slower until such time as the closer areas are beginning to reach capacity.

2.3 Norton Future Population

For the purpose of estimating future populations for Norton the above proposed annual growth rates of 4.29% to 2020, 4.0% to 2025 and 5.0% to 2030 were used. Resulting annual population estimates are shown in Table 2-6. These figures suggest population increases from 67,591 (2012) to 94,606 in 2020 and 146,903 in 2030. This implies total population increases of 27,015 people for the interval 2012-2020, of 52,297 people for the period 2020-2030, and overall from 2012-2030 of 79,312 people.

Table 2-6 shows the estimated annual and cumulative population increases for the period 2012-2030, based on projected annual growth rates of 4.29% for the mid-term (2012-2020) and thereafter increasing to 4% to 2025 and 5% to 2030.

Table 2-6: Projected Annual Populations for Norton 2012-2030

Year	Annual Growth Rate (%)	Estimated Population	Cumulative Population Increase
2012	4.29	67,591	
2013	4.29	70,492	2,901
2014	4.29	73,518	5,927
2015	4.29	76,674	9,083
2016	4.29	79,966	12,375
2017	4.29	83,398	15,807
2018	4.29	86,978	19,387
2019	4.29	90,712	23,121

Year	Annual Growth Rate (%)	Estimated Population	Cumulative Population Increase
2020	**4.29**	**94,606**	**27,015**
2021	4	98,390	30,799
2022	4	102,325	34,734
2023	4	106,418	38,827
2024	4	110,675	43,084
2025	**4**	**115,102**	**47,511**
2026	5	120,857	53,266
2027	5	126,900	59,309
2028	5	133,245	65,654
2029	5	139,907	72,316
2030	**5**	**146,903**	**79,312**

3 URBAN PLANNING

3.1 Overview

Norton is a small town situated some 45 km to the west Harare, alongside the main road and railway lines to Gweru and Bulawayo. Unlike the other component entities Norton is not contiguous with the remainder of Greater Harare; it is included here as it forms part of the common water supply system receiving treated water from the Morton Jaffray WTW at Lake Chivero (some 7 km to the east of the Norton).

Norton covers an area of 6,005 ha or 60 km^2. With a 2012 population of 67,591 Norton accounted for just 2.9% of the overall population of Greater Harare.

The town is bounded to the north by Lake Manyame and to the south by the Gweru road, although small parts of Wards 2 and 4 extend just to the south of this road. The town is also split by the railway line, which divides Ward 4 to the south of the line from the remainder of the town to the north.

The town is surrounded by productive farming land, to the west, south and east forming part of Chegutu District (Wards 14 and 15), whilst the land to the north of Lake Manyame comprises part of Ward 25 of Zwimba District.

The town comprises of a CBD, industrial area and a mix of low and high density residential housing. There is little in the way of medium density housing and informal settlements are absent. Norton is divided into thirteen wards (Figure 3-1).

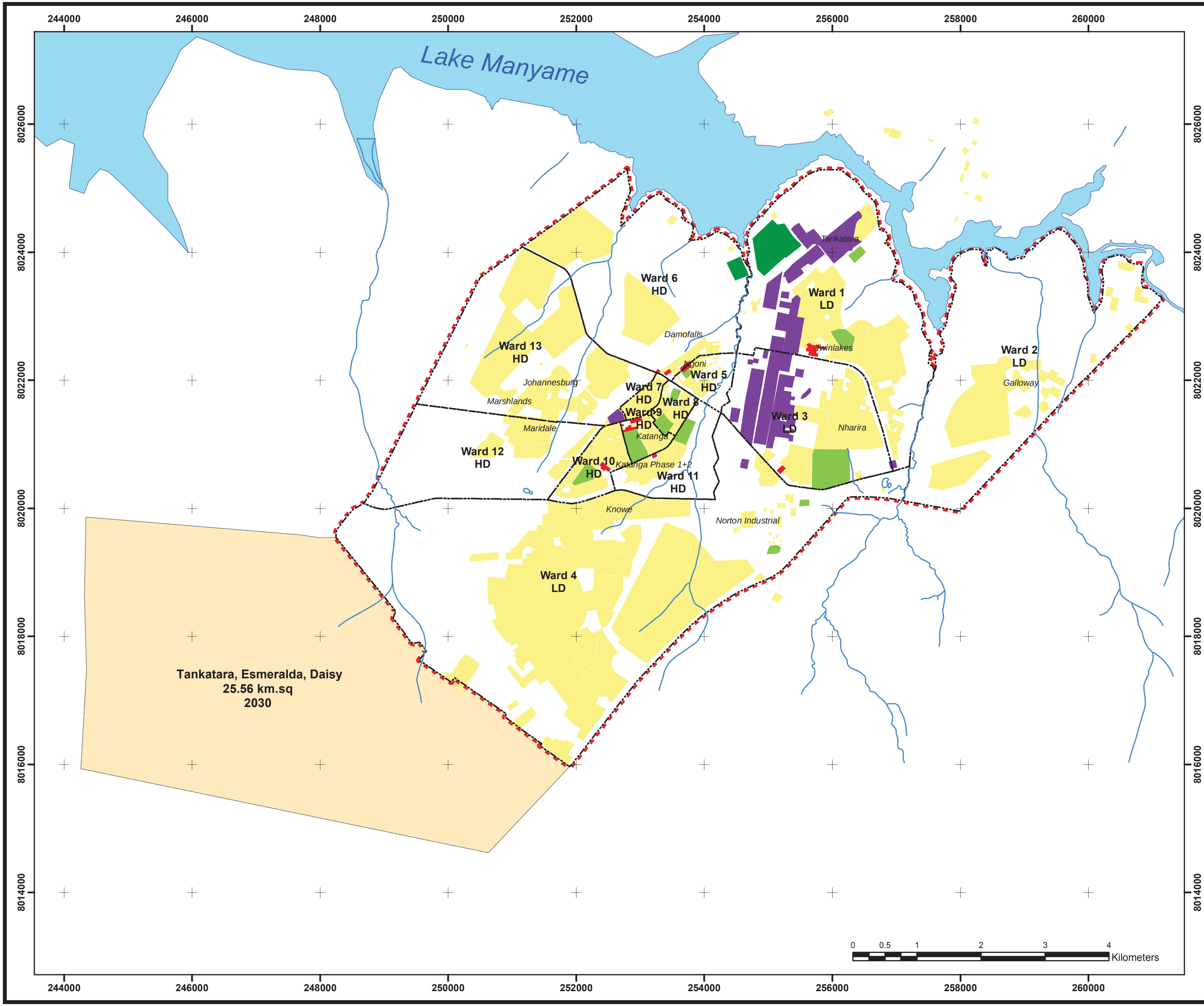

Figure 3-1
Ward Map with Housing Categories
Norton

N

Datum WGS 84
1:55,000

Legend

- Streams
- Council Boundary
- Wards
- Lake

Landuse

- Agriculture
- Business/Commercial
- Industrial
- Park
- Residential
- Expansion Areas

Greater Harare Water and Sanitation Investment Plan

Gauff Ingenieure

The CBD is situated with Ward 1, which comprises an irregular strip stretching between the Gweru road to the south and Lake Manyame to the north, and is bounded to the south by the primary access road off the Gweru road. Ward 1 also includes LD residential areas and a substantial portion of heavy industrial stands.

The industrial area occupies a strip of land that extends to either side of a branch railway line, from the northern portion of Ward 4 to the south, through Ward 3 to Ward 1 in the north. Many of the former industries are currently closed and within the designated area there is considerable scope for future infill.

LD residential areas are currently confined to Wards 1, 2, 3 (between the Gweru road and Lake Manyame to the north and east of the town) and Ward 4 (situated to the south and occupying the portion between the railway line and the Gweru road). Collectively, these four wards cover about two thirds of the overall area of Norton. Wards 1 and 3 are virtually fully developed; Ward 4 is roughly half developed, whilst development in Ward 2 (to the east) is just beginning.

Additional LD development is planned for Wards 6 and 13. Although previously zoned for HD housing, it has been decided to reallocate the northern portions of these wards that are closest to Lake Manyame to LD rather than HD housing, in an effort to reduce potential pollution of the lake by waste waters.

Wards 5 to 13 cover a contiguous portion of land situated to the west of the town between the railway line and Lake Manyame. These wards are all dominated by HD housing. Initial development of HD housing occurred in Wards 6 to 11. Most of this portion is fully developed (Wards 5, 7, 8, 9 and 10), although in Ward 11 there is place for limited expansion. Future expansion in Ward 6 is anticipated to comprise LD rather than HD housing. The HD developments in Wards 12 and 13, to the west, are more recent and ongoing.

A summary of the wards is shown in Table 3-1.

Table 3-1: Summary of Wards

Ward No.	Location	Area (ha)	Population 2012	Land Use / Housing Category	Proportion of housing stands developed (%)
1	Centre	763.50	8,107	CBD, Industry, LD	95
2	East	895.67	4,804	LD	10
3	Centre	414.88	7,874	Industry, LD	100
4	South	1,930.62	7,463	Industry, LD	45
5	Centre	57.30	8,954	HD	100
6	Centre	638.47	5,454	HD	45
7	Centre	24.79	7,324	HD	100
8	Centre	36.49	6,188	HD	100
9	Centre	38.13	7,947	HD	100
10	Centre	82.24	3,379	HD	100

11	Centre	144.19	10,052	HD	60
12	West	395.48	13,744	HD	70
13	West	583.95	2,905	HD	45
Total		**6,005.71**	**67,591**		

3.2 Master Plan

Norton has a master plan that was produced in the early 1990s. Although outdated, the town is still following the general vision articulated in the plan. The main difference is the rezoning of parts of Wards 6 and 13 to accommodate LD rather than HD housing. The existing wards appear to offer adequate opportunity for LD expansion, whilst the potential for future HD development is more constrained. The existing allocation for industry appears adequate to cater for demand through to 2030.

The most logical direction of expansion for HD housing would be to continue to the west of Wards 12 and 13 (i.e. to the north of the railway line). Apparently this is not possible and, instead, the town envisages expanding into the portion to the south of the railway line and to the west of Ward 4, within what is now Ward 14 of Chegutu District. Linked to this, the Town Council is already in the process of negotiating access to land for development of a site for disposal of solid waste within this portion of Chegutu.

The below analysis of future supply and demand of different types of residential housing to 2030, suggest that the projected demand for LD housing can be satisfied within the existing wards, and for HD housing to 2020, but thereafter most of the envisaged HD expansion from 2020-2030 will need to be accommodated elsewhere outside of the existing wards (i.e. within Chegutu District).

3.3 Opportunities for Growth

Eight areas of possible expansion were identified within the extent of the current 13 wards of Norton, five for LD housing and three for HD housing (Table 3-2, Figure 3-2). Collectively, there is opportunity for development of an additional 2,691 LD stands and 2,198 HD stands. For the purpose of converting numbers of stands to numbers of people the following conversions have been applied: for HD 10 people per stand and for MD and LD each seven people per stand. Thus there is opportunity to accommodate a further 18,837 LD and 21,980 HD residents. For each area an indication of the anticipated timing of development (before or after 2020) is also provided.

Table 3-2: Opportunities for Residential Expansion

Map ID	Ward	Type	Stands	Population	Year
A	1	LD	26	182	**2020**
B	2	LD	750	5,250	**2020/30**
C	4	LD	1,315	9,205	**2020/30**
D	6	LD	400	2,800	**2020/30**
E	13	LD	200	1,400	**2030**

	Subtotal	**LD**	**2,691**	**18,837**	
F	11	HD	400	4,000	**2020**
G	12	HD	750	7,500	**2020**
H	13	HD	1,048	10,480	**2020/30**
	Subtotal	**HD**	**2,198**	**21,980**	

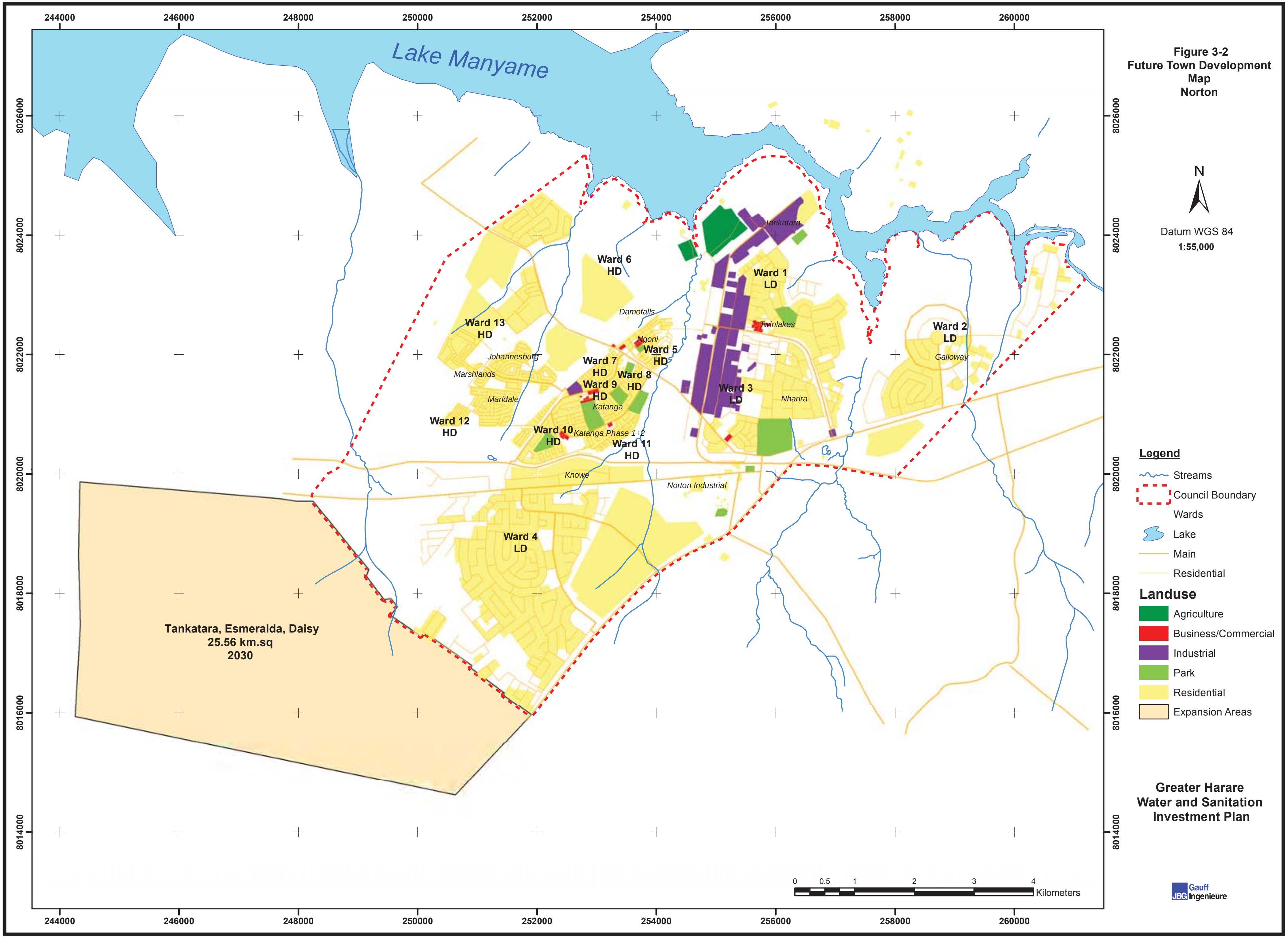

Figure 3-2
Future Town Development Map
Norton
N
Datum WGS 84
1:55,000
Lake Manyame
Tankatara, Esmeralda, Daisy
25.56 km.sq
2030
Ward 1 LD
Ward 2 LD
Ward 3 LD
Ward 4 LD
Ward 5 HD
Ward 6 HD
Ward 7 HD
Ward 8 HD
Ward 9 HD
Ward 10 HD
Ward 11 HD
Ward 12 HD
Ward 13 HD
Tankatara
Twinlakes
Damofalls
Ngoni
Johannesburg
Marshlands
Maridale
Katanga
Katanga Phase 1+2
Nharira
Galloway
Knowe
Norton Industrial
Legend
Streams
Council Boundary
Wards
Lake
Main
Residential
Landuse
Agriculture
Business/Commercial
Industrial
Park
Residential
Expansion Areas
0 0.5 1 2 3 4 Kilometers
Greater Harare Water and Sanitation Investment Plan
JBG Gauff Ingenieure

3.4 Future Demand by Housing Types

The distribution of population in 2012 by housing types was 23.8% LD and 76.2% HD – there were no MD housing or informal settlements. In the absence of any current plans to introduce any MD housing or informal growth, for the purpose of calculating future demand for different types of housing, it was assumed that future proportions of housing types will be maintained to 2030 at the same values of 23.8% LD and 76.2% HD.

Using these figures, the future estimated populations for LD and HD residents for the years 2020 and 2030 are shown in Table 3-3. This suggests that the LD population will grow from 16,112 in 2012 by 6,440 people, to give a 2020 population of 22,552, and by a further 12,467 people to give a 2030 population of 35,019. Similarly, HD residents are expected to grow from 51,479 in 2012, by 20,575 people to give a 2020 population of 72,054, and by an additional 39,830 people to give a 2030 population of 111,884.

Table 3-3: Estimated Future Populations by Residential Types

Type	LD	MD	HD	INFORMAL	Total
Estimated Proportion (%)					
2012	23.8	0	76.2	0	100
2020	23.8	0	76.2	0	100
2030	23.8	0	76.2	0	100
Estimated Population					
2012	16,112	0	51,479	0	67,591
2020	22,552	0	72,054	0	94,606
2030	35,019	0	111,884	0	146,903
Estimated Population Growth					
2012-20	6,440	0	20,575	0	27,015
2020-30	12,467	0	39,830	0	52,297
2012-30	18,907	0	60,405	0	79,312

3.5 Comparison to Expected Level of Growth

Respective figures for expected population growth by housing types (Table 3-3) as compared to potential opportunities for growth (Table 3-2) are summarised in Table 3-4.

For LD housing, the existing wards appear to offer a total growth opportunity of 18,837 people (or 2,691 stands), and this should be just sufficient to cater for the total expected growth to 2030, which is projected to amount to 18,907 people or 2,701 stands.

For HD housing, the expected growth of 20,575 people (2,056 stands) will virtually exhaust the estimated growth opportunities within Wards 11, 12 and 13, which amount to a total of 2,198 stands or 21,980 people. For the subsequent period from 2020 to 2030 it is therefore assumed that the anticipated HD growth of 39,830 people (3,983 stands) will need to be accommodated outside of the existing town boundary, presumably within what is now Ward 14 of Chegutu District.

These figures imply a need to service nearly 3,000 new stands by 2020 or a mean of 375 per annum, and from 2020-30 another 5,765 stands or about 576 per annum.

Table 3-4: Estimated Population Growth Versus Identified Growth Opportunities

Type	LD	MD	HD	INFORMAL	Total
			Estimated Population Growth		
2012-20	6,440	0	20,575	0	27,015
2020-30	12,467	0	39,830	0	52,297
2012-30	**18,907**	**0**	**60,405**	**0**	**79,312**
			Potential for Expansion		
2012-30	**18,837**	**0**	**21,980**	**0**	**40,817**

3.6 Future Ward Populations

For the purpose of calculating future ward populations, for LD residents the minor growth of 26 LD stands in Ward 1 was assumed to be taken up by 2020, and the remainder of the growth was split between Wards 2, 4 and 6, roughly in proportion to opportunities, to 2020 and to 2030.

For HD populations the 400 HD stands in Ward 11 and 750 HD stands in Ward 12 were assumed to be fully developed by 2020, with the balance of demand being accommodated in Ward 13. For the subsequent interval to 2030 it is assumed that all growth occurs in what is now Chegutu District. The resulting predicted ward populations are shown in Tables 3-5 and, in Table 3-6, these are broken down by housing types.

Table 3-5: Estimated Future Ward Populations

WARD	TYPE	2012	2020	2030
1	LD	4,630	4,812	4,812
2	LD	535	2,285	5,785
3	LD	3,169	3,169	3,169
4	LD	7,778	11,278	16,983
5	HD	2,522	2,522	2,522
6	HD	2,350	3,358	5,220
7	HD	4,256	4,256	4,256
8	HD	3,809	3,809	3,809
9	HD	3,735	3,735	3,735
10	HD	3,455	3,455	3,455
11	HD	5,438	9,438	9,438
12	HD	17,836	25,334	25,336
13	HD	8,078	17,155	18,558
Chegutu 14	HD	-	-	39,825
TOTAL		**67,591**	**94,606**	**146,903**

Table 3-6: Estimated Future Ward Populations by Residential Types

WARD	2012 LD	2012 MD	2012 HD	2012 INF	2012 TOTAL	2020 LD	2020 MD	2020 HD	2012 INF	2020 TOTAL	2030 LD	2030 MD	2030 HD	2030 INF	2030 TOTAL
1	4,630	-	-	-	4,630	4,812	-	-	-	4,812	4,812	-	-	-	4,812
2	535	-	-	-	535	2,285	-	-	-	2,285	5,785	-	-	-	5,785
3	3,169	-	-	-	3,169	3,169	-	-	-	3,169	3,169	-	-	-	3,169
4	7,778	-	-	-	7,778	11,278	-	-	-	11,278	16,983	-	-	-	16,983
5	-	-	2,522	-	2,522	-	-	2,522	-	2,522	-	-	2,522	-	2,522
6	-	-	2,350	-	2,350	1,008	-	2,350	-	3,358	2,870	-	2,350	-	5,220
7	-	-	4,256	-	4,256	-	-	4,256	-	4,256	-	-	4,256	-	4,256
8	-	-	3,809	-	3,809	-	-	3,809	-	3,809	-	-	3,809	-	3,809
9	-	-	3,735	-	3,735	-	-	3,735	-	3,735	-	-	3,735	-	3,735
10	-	-	3,455	-	3,455	-	-	3,455	-	3,455	-	-	3,455	-	3,455
11	-	-	5,438	-	5,438	-	-	9,438	-	9,438	-	-	9,438	-	9,438
12	-	-	17,836	-	17,836	-	-	25,334	-	25,334	-	-	25,336	-	25,336
13	-	-	8,078	-	8,078	-	-	17,155	-	17,155	1,400	-	17,158	-	18,558
Chegutu 14	-	-	-	-	-	-	-	-	-	-	-	-	39,825	-	39,825
TOTAL	**16,112**	**-**	**51,479**	**-**	**67,591**	**22,552**	**-**	**72,054**	**-**	**94,606**	**35,019**	**-**	**111,884**	**-**	**146,903**

APPENDIX 3.5: DETAILED DEMOGRAPHIC PROFILE REPORT – RUWA

GREATER HARARE WATER AND SANITATION STRATEGIC PLAN

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 3.5: DETAILED DEMOGRAPHIC REPORT

RUWA

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1 INTRODUCTION

Ruwa is a small town located immediately east of Harare along the Mutare road. With a population of 56,333 in 2012, Ruwa accounted for 2.4% of the overall population of Greater Harare, and was the 13th largest urban centre in Zimbabwe, behind Harare, Bulawayo, Chitungwiza, Mutare, Epworth, Gweru, Kwekwe, Kadoma, Masvingo, Chinhoyi, Marondera and Norton.

Ruwa was initially established as a Growth Point in 1986 with the intention of taking pressure off Harare for industrial expansion. Initially the government played a leading role in promoting investments in the growth point, primarily in the form of provision of utilities which were instrumental in luring private sector industrial developments. For example, the construction of a trunk sewer to serve both the industrial and the high density residential areas and the building of a pump station effectively reduced the cost of industrial investment. A number of early developments were associated with influential personalities such as the former First Lady, Mrs. Sally Mugabe, who was the patron of the Ruwa Rehabilitation Centre, and this political patronage also played an important role during the initial stages of the development of Ruwa.

The Ruwa Local Board was established in 1990. Against the background of austerity measures introduced under ESAP during the 1990s and its sequel the Zimbabwe Programme for Economic and Structural Transformation (ZIMPREST), the Local Board found itself unable to provide adequate infrastructure due to shortages of plant and equipment, financial resources and manpower. In response, the Board increasingly pursued a strategy of encouraging private developers to bridge the gap created by its own inability to provide infrastructure attractive for investment, in the form of private-public sector partnerships.

This policy coupled with the attraction of a relatively less congested and pollution free environment resulted in a good number of industries locating in Ruwa. At its peak Ruwa had about 100 industrial establishments, employing close to 10,000 people mainly in agro-based industries. The development of this industrial base was accompanied by massive demand for housing and associated services. The greatest beneficiaries of this have been private landowners who subdivided and later sold stands at a profit. While the local authority draws levies and rates on developed properties, such developments tend to put pressure on its resources as demand for water, sewer and solid waste disposal services increases.

Residential growth continued into the 2000s, particularly in the northern sector with the development of ZIMRE Park. However, consistent with the nationwide economic decline, and exacerbated by persistent water problems, many industries have either relocated to Harare or closed down.

2 PAST, PRESENT AND FUTURE POPULATIONS

2.1 Historical Population Data

Census data for Ruwa is only available from 1992 onwards. Ruwa has grown in terms of population from 1,447 in 1992, to 56,333 people in 2012 (Table 2-1, Figure 2-1). Corresponding annual rates of population growth for the respective census intervals are shown in Table 2-2. For the country as a whole there has been a dramatic decline in annual growth rates over the last 20 years, from over 3% for the period 1969 to 1992, to just over 1% for the last 20 years from 1992 to 2012. Likely causes of this marked decline include the impacts of HIV and the national economic collapse during the 2000s leading to high levels of out-migration.

Table 2-1: Population Data for Greater Harare from 1969 to 2012 (Source: ZIMSTAT)

Year	1969	1982	1992	2002	2012
Harare urban	364,390	658,364	1,148,073	1,458,807	1,708,538
Chitungwiza	14,970	172,000	274,912	323,260	356,840
Epworth			62,630	114,067	167,462
Norton		12,438	29,000	44,397	67,591
Ruwa			**1,447**	**23,681**	**56,333**
Total Greater Harare	**379,360**	**842,802**	**1,516,062**	**1,964,212**	**2,356,764**
ZIMBABWE	5,134,300	7,608,432	10,412,548	11,631,657	12,973,808
Total as % of Zimbabwe	7.4	11.1	14.6	16.9	18.2

* Note that the Harare population figures from 1992 onwards include Harare South (Ward 1), and for 2012 also includes populations from six adjacent wards amounting to a total of 109,708 people.

Figure 2-1 below shows the population growth in Ruwa from 1992 to 2012. (Source: ZIMSTAT).

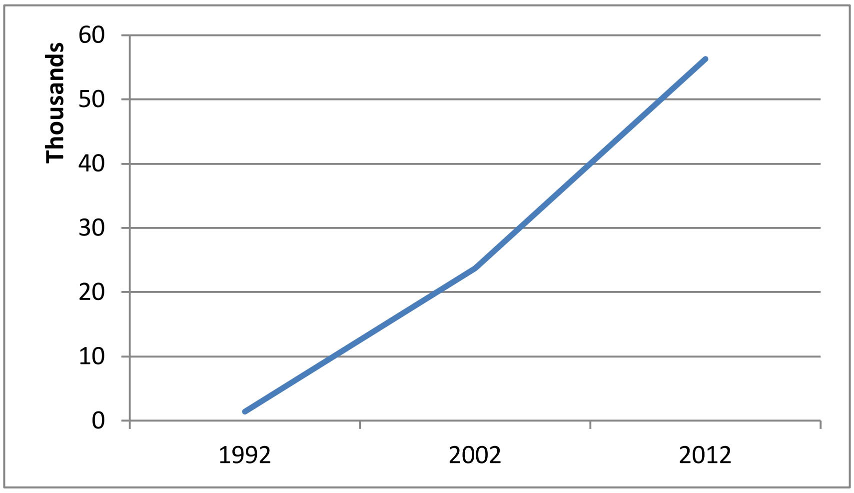

Figure 2-1: Ruwa Population Growth from 1992 to 2012

Table 2-2 below shows mean inter census annual population growth rates for Greater Harare from 1969 to 2012. (Source: ZIMSTAT).

Table 2-2: Inter Census Annual Growth Rates for Greater Harare

Period	1969-82	1982-92	1992-02	2002-12
Harare urban	4.66%	5.72%	2.42%	1.59%
Chitungwiza	20.66%	4.80%	1.63%	0.99%
Epworth			6.18%	3.91%
Norton		8.83%	4.35%	4.29%
Ruwa			**32.25%**	**9.05%**
Total Greater Harare	**6.33%**	**6.05%**	**2.62%**	**1.84%**
ZIMBABWE	3.07%	3.19%	1.11%	1.10%

Over the last 20 years Ruwa has shown by far the highest rates of growth within Greater Harare, registering 32.25% for the period 1992 to 2002 and 9.05% for the subsequent census interval from 2002-2012. This has resulted in the population more than doubling even during the last decade from 23,681 in 2002 to 56,333 in 2012.

2.2 Future Population Growth

Future population growth rates for Greater Harare were estimated through consideration of historical rates of growth (Table 2-2); comparison to regional data (Table 2-3); comparison to estimated growth rates for towns included under the associated Urgent Water Supply and Sanitation Rehabilitation Project (UWSSRP), (Table 2-4); and through discussions with the respective urban authorities.

Data on population growth was obtained from 87 urban centres (>25,000 people) in seven comparable Southern and East African countries for which data was available (Namibia, Botswana, Mozambique, Zambia, Malawi, Tanzania, Kenya), as recorded over their most recent census interval (variously 1997-2007 to 2002-2012). For all 87 towns the overall range of annual growth rates over the last decade was -0.03% to 6.97% with a mean value of 3.23% (Table 2-3). The data further suggests that growth is strongest in the largest cities (> 1 million inhabitants = 3.94%) and slightly lower in smaller centres (3.1% for centres smaller than 250,000 people).

Table 2-3 shows comparative annual growth rates for 87 Southern and East African urban areas (>25,000 people) over their respective most recent census intervals (from 1997-2007 to 2002-2012).

Table 2-3: Comparative Annual Growth Rates for 87 Southern and East African Cities

Population	Number	Range (%)	Median (%)	Mean (%)
> 1 Million	4	1.25% - 5.78%	4.36%	3.94%
500,000 - 1Million	5	2.79% - 4.69%	4.06%	3.88%
250,000-500,000	12	0.83% - 7.16%	3.39%	3.47%
100,000-250,000	32	0.38% - 6.55%	2.71%	3.08%

25,000-100,000	34	-0.03% - 6.97%	3.14%	3.11%
Total	**87**	**-0.03 - 7.16%**	**3.32%**	**3.23%**

Under the UWSSRP future population growth rates for the six project towns (Chegutu, Masvingo, Kwekwe, Mutare, Chitungwiza and Harare urban) were examined and debated at a combined workshop held in Harare on 09 July 2013. A key outcome of the workshop was to estimate future annual rates of population growth to 2020 and 2030 for each of the project centres, based on the specific conditions pertaining to each of the centres.

Table 2-4 shows the projected annual growth rates for the medium (2012-2020) and long term (2020-2030) for the six UWSSRP project towns. (Source: Workshop, Harare, 09 July 2013).

Table 2-4: Projected Annual Growth Rates for six Urban Centres Included in the UWSSRP

	Annual Growth Rate (%)		
Period	**2002-2012**	**2012-2020**	**2020-2030**
Chegutu	1.39%	4%	2%
Masvingo	2.45%	3%	1.5-2%
Kwekwe	0.71%	3%	4%
Mutare	1.00%	3%	4%
Chitungwiza	0.93%	1.1%	2%
Harare	0.23%	4%	4%

The resulting estimates varied between 1.1-4% for the period 2012-2020 and from 2-4% for the subsequent interval from 2020-2030.

Based on these deliberations, and particularly with respect to the continuing difficult macroeconomic outlook, the overall future rate of growth for Greater Harare for the period 2012-2020 was estimated at 2%, this being slightly higher than the figure of 1.84% as obtained for the previous census interval. Consistent with this overall figure, the growth rates of the individual urban centres for the period 2012-2020 have been maintained at the same levels as for 2002-2012, other than for Epworth and Harare urban (Table 2-5). For Epworth, due to restricted opportunities for expansion, the rate of growth is expected to decline from 3.91% to 2.50%. For Harare urban, it was assumed that the relatively restricted opportunities for growth in Chitungwiza and Epworth would be compensated for by marginally higher rates of growth here, such that the future growth was forecast to increase from the previous figure of 1.59% for 2002-2012 to that of 1.75% for 2012-2020.

Table 2-5: Projected Future Annual Growth Rates for Greater Harare

	Annual Growth Rate (%)			
Period	**2002-2012**	**2012-2020**	**2020-2025**	**2025-2030**
Harare urban	1.59%	1.75%	4.00%	5.00%
Chitungwiza	0.99%	0.99%	2.00%	4.00%
Epworth	3.91%	2.50%	2.00%	2.00%
Norton	4.29%	4.29%	4.00%	5.00%
Ruwa	**9.05%**	**9.05%**	**4.00%**	**5.00%**
Total Greater Harare	**1.84%**	**2.00%**	**3.59%**	**4.68%**

Population growth for Greater Harare is projected to escalate markedly after 2020, to 3.59% for the period 2020-2025 and increasing to 4.68% for the subsequent interval to 2030. Corresponding projections for the individual urban centres of Harare urban, Norton and Ruwa are 4% to 2025 and 5% to 2030. Estimates for Epworth are markedly lower (2% and 2%) again due to space constraints, and also for Chitungwiza (2% and 4%), on the basis that the targeted area of expansion on the Nyatsime farms is further away from the city centre than much of Harare urban, such that development in this area is likely to be slower until such time as the closer areas are beginning to reach capacity.

2.3 Ruwa Future Population

For the purpose of estimating future populations for Ruwa the above proposed annual growth rates of 9.05% to 2020, 4.0% to 2025 and 5.0% to 2030 were used. Resulting annual population estimates are shown in Table 2-6. These figures suggest population increases from 56,333 (2012) to 112,682 in 2020 and 174,971 in 2030. This implies total population increases of 56,349 people for the interval 2012-2020, of 62,289 people for the period 2020-2030, and overall from 2012-2030 of 118,638 people.

Table 2-6 shows the estimated annual and cumulative population increases for the period 2012-2030, based on projected annual growth rates of 4.29% for the mid-term (2012-2020) and thereafter increasing to 4% to 2025 and 5% to 2030.

Table 2-6: Projected Annual Populations for Ruwa 2012-2030

Year	Annual Growth Rate (%)	Estimated Population	Cumulative Population Increase
2012	9.05	56,333	
2013	9.05	61,433	5,100
2014	9.05	66,994	10,661
2015	9.05	73,059	16,726
2016	9.05	79,672	23,339
2017	9.05	86,885	30,552
2018	9.05	94,750	38,417
2019	9.05	103,328	46,995
2020	**9.05**	**112,682**	**56,349**
2021	4	117,189	60,856
2022	4	121,876	65,543
2023	4	126,752	70,419
2024	4	131,822	75,489
2025	**4**	**137,094**	**80,761**
2026	5	143,949	87,616
2027	5	151,147	94,814
2028	5	158,704	102,371
2029	5	166,639	110,306
2030	**5**	**174,971**	**118,638**

3 URBAN PLANNING

3.1 Overview

Ruwa is situated immediately to the east of Harare and is contiguous with both Harare (Tafara/Mabvuku - Wards 20 and 21) and Epworth (Wards 4 and 6). To the north, east and south Ruwa is surrounded by productive agricultural land included under Wards 24 and 25 of Goromonzi District.

Ruwa covers an area of 4,187 ha or 40 km^2. The town is split in half by the Harare-Mutare road and railway that in this portion run parallel and immediately adjacent to one another. The town is divided into nine wards (Figure 3-1). Wards 1 to 7 are situated to the south of the road/railway and Wards 8 and 9 to the north.

The most prominent natural feature is the Ruwa River which flows from east to west through Ward 9 to the north of the Marondera road, and then turns abruptly to the south where it forms the boundary between Ruwa and Epworth, subsequently continuing downstream to join the Manyame River immediately upstream of Prince Edward Dam.

Ruwa includes a mix of low (LD), medium (MD) and high density (HD) housing, and there is also a substantial industrial area. Land has been reserved for construction of a town centre, but this has yet to be realized. Currently, there is no informal settlement.

Low and medium density housing is confined to Wards 7, 8 and 9. These three wards cover roughly 85% of the overall extent of Ruwa. Ward 7 is dominated by LD housing, whilst Wards 8 and 9 comprise a mix of LD and MD housing, and Ward 9 also includes a substantial HD portion. The remaining Wards 1 to 6 comprise a contiguous portion of HD development extending as an irregular strip to the south of the Harare-Marondera road. The industrial area is located in the northeastern corner of Ward 7, immediately to the south of the Marondera road and railway. Part of the northeastern portion of Ward 9 has also been reserved for heavy industry, but has not yet been developed. A summary of the wards is shown in Table 3-1.

Wards 7, 8 and 9 appear to offer potential for expansion of LD and MD housing. Ward 7 has considerable space for expansion, and 660 LD stands have already been planned and surveyed. However, other parties are motivating for the remaining area to be reallocated for HD rather than LD housing. The outcome remains unclear although it seems likely that the 660 LD stands will go ahead. Opportunities within Ward 8 are relatively limited, such that the major LD expansion is likely to occur within Ward 9.

For HD housing the main opportunities for future growth appear to be within Wards 5, 7 and 9, plus limited growth in Wards 1 and 2. Wards 3, 4 and 6 are already fully developed.

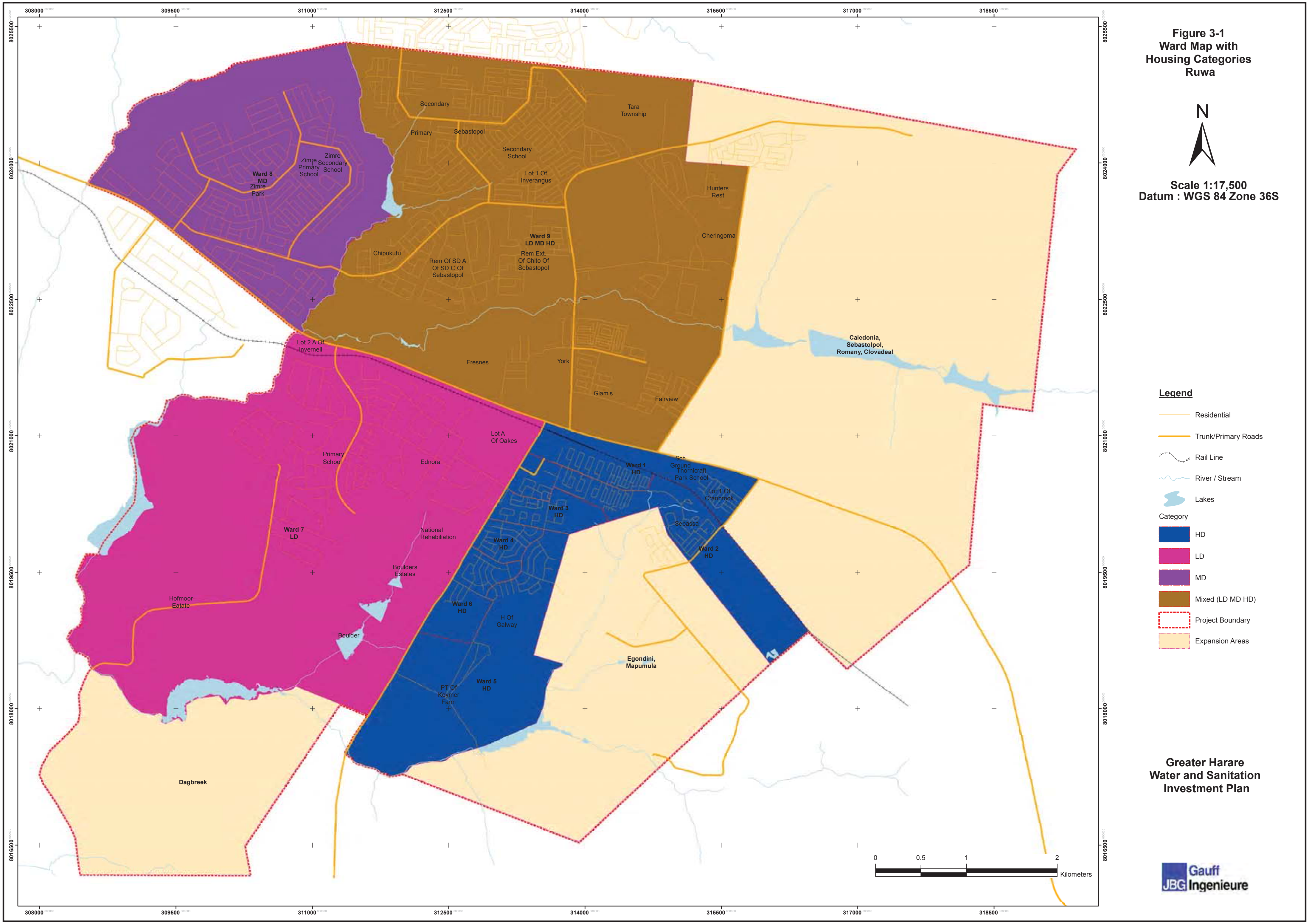

Figure 3-1
Ward Map with Housing Categories
Ruwa

Table 3-1: Summary of Wards

Ward No.	Location	Area (ha)	Population 2012	Land Use / Housing Category	Proportion of housing stands developed (%)
1	Southeast	98.67	6,518	HD	75%
2	Southeast	170.25	5,373	HD	75%
3	Southeast	40.77	3,731	HD	100%
4	Southeast	24.39	2,368	HD	100%
5	Southeast	293.60	2,329	HD	15%
6	Southeast	55.63	2,896	HD	100%
7	Southwest	1,392.37	4,493	LD	15%
8	Northwest	611.93	13,695	LD (60%), MD (40%)	90%
9	Northeast	1,499.41	14,930	LD (15%), MD (15%) HD (70%)	33%
Total		**4,187.02**	**56,333**		

3.2 Master Plan

Ruwa has a dated master plan (not seen during the course of this study) but which still encapsulates the vision for future development of the town. This plan envisages the incorporation of additional land and associated expansion to the northeast (Ward 9 Extension - Tarisa, Sebastopol, Romany, Clovadael B and Liddesdale Farms of Goromonzi Ward 25); to the southeast (Ward 5 Extension – Galway Estate) and to the south (Ward 7 Extension - Dagbreek, Mariandi and Mandalay Farms of Goromonzi Ward 24).

The below analysis of future supply and demand of different types of residential housing to 2030, suggest that the projected demand for MD housing can be satisfied within the existing wards, but for LD and HD housing some of the envisaged expansion will need to be accommodated within the adjacent areas, particularly for the interval from 2020-2030.

3.3 Opportunities for Growth

Nine areas of possible expansion were identified within the extent of the current 9 wards of Ruwa, three for LD housing (Wards 7, 8 and 9), one for MD (Ward 9) and five for HD (Wards 1, 2, 5, 7 and 9) (Table 3-2, Figure 3-2).

Collectively, there is opportunity for development of an additional 1,320 LD stands, 2,000 MD stands and 5,400 HD stands. For the purpose of converting numbers of stands to numbers of people the following conversions have been applied: for HD 10 people per stand and for MD and LD each seven people per stand. Thus there is opportunity to accommodate a further 9,240 LD, 14,000 MD and 54,000 HD residents. For each area an indication of the anticipated timing of development (before or after 2020) is also provided.

Table 3-2: Opportunities for Residential Expansion

Map ID	Ward	Type	Stands	Population	Year
A	7	LD	660	4,620	**2020**
B	8	LD	180	1,260	**2020**
C	9	LD	480	3,360	**2020**
	Subtotal	**LD**	**1,320**	**9,240**	
D	9	MD	2,000	14,000	**2020/30**
	Subtotal	**MD**	**2,000**	**14,000**	
E	1	HD	200	2,000	**2020**
F	2	HD	200	2,000	**2020**
G	5	HD	1,200	12,000	**2020/30**
H	7	HD	2,500	25,000	**2020/30**
I	9	HD	1,300	13,000	**2020/30**
	Subtotal	**HD**	**5,400**	**54,000**	

Additional expansion is expected to occur in the neighbouring areas to the northeast (Ward 9 Extension, LD and HD, situated to the north of the Marondera road and the east of Ward 9 on Tarisa, Sebastopol, Romany, Clovadael and Liddesdale Farms); to the east on Galway Estates (Ward 5 Extension, HD), and to the south on Dagbreek Farm (Ward 7 Extension, HD).

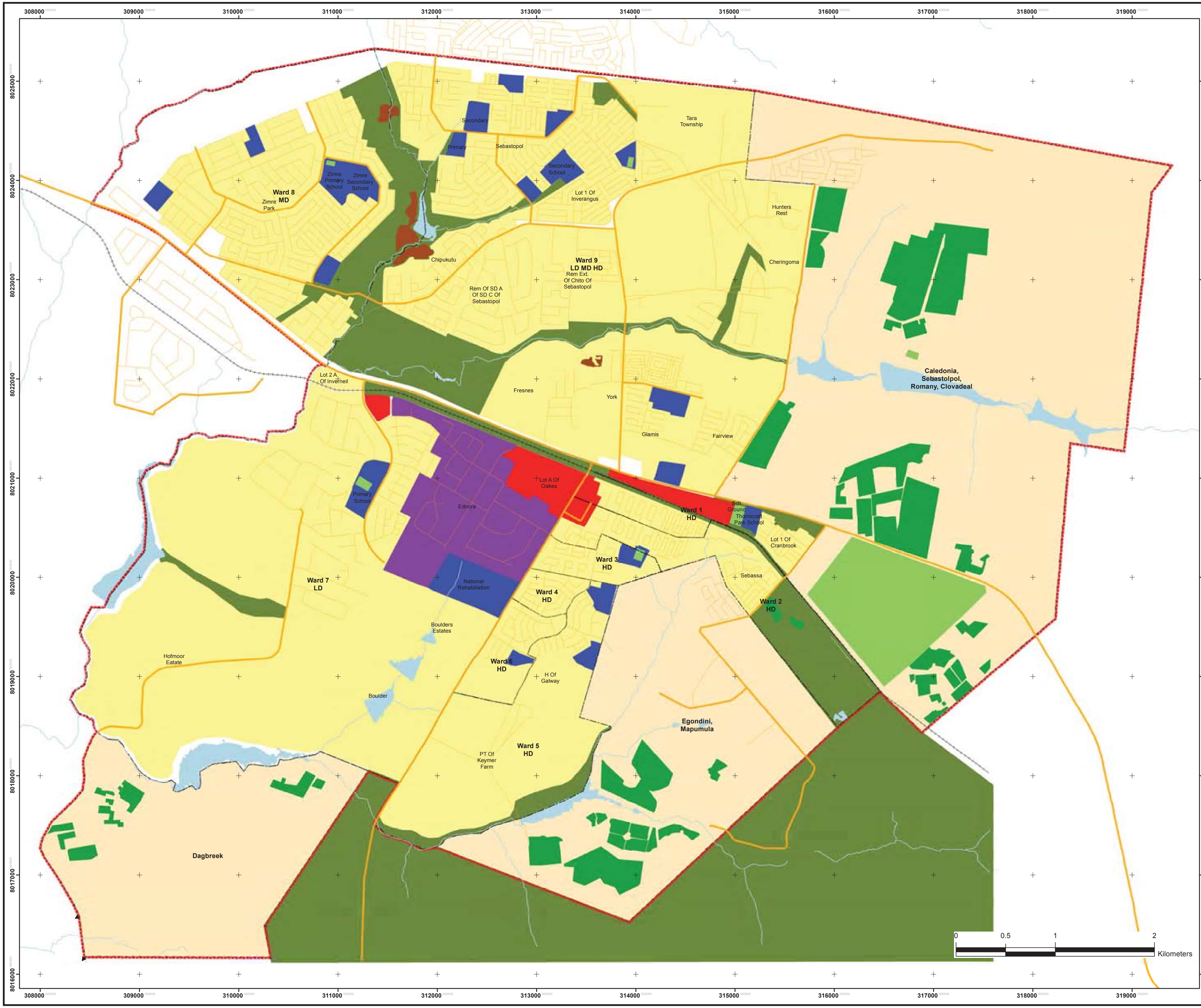

Figure 3-2
Future Town Development Map
Ruwa

N

Dutam : WGS 84 Zone 36S
Scale 1:17,500

Legend

- Expansion Areas
- Ward No.

Landuse

- Agriculture
- Commercial
- Grasslands/Pastures
- Industrial
- Institutional
- Mining/Quarrying
- Park/Playground And Other Recreational Spaces
- Proposed Development/Expansion Areas
- Residential
- Residential
- Trunk/Primary Roads
- Project Boundary
- Rail Line
- River / Stream
- Lakes

Greater Harare Water and Sanitation Investment Plan

Gauff JBG Ingenieure

3.4 Future Demand by Housing Types

The distribution of population in 2012 by housing types was 26.5% LD, 13.7% MD and 59.8% HD – there were no informal settlements. The combined proportion of LD and MD housing (40.2%) is considerably higher than that of the other urban entities of Greater Harare or of the other project towns covered under the UWSSRP (range is 2.9% for Chitungwiza to 34% for Epworth). Moreover, LD and MD account for only one third of the total identified opportunities for future expansion in Ruwa. As such the combined proportion of LD and MD housing is expected to gradually decrease from 40.2% in 2012, to 35% in 2020 and 30% in 2030. The balance is expected to be taken up by HD housing, which is projected to rise in proportion from 59.8% in 2012, to 65% in 2020, and to 70% in 2030. No development of informal settlement is envisaged.

Using these figures, the future estimated populations broken down by housing types for the years 2020 and 2030 are shown in Table 3-3. This suggests that the LD population will grow from 14,950 in 2012 by 10,967 people, to give a 2020 population of 25,917, and by a further 9,077 people to give a 2030 population of 34,994. Similarly, MD residents are expected to grow from 7,718 in 2012, by 5,804 people to give a 2020 population of 13,522, and by an additional 3,976 people to give a 2030 population of 17,498.

The major growth will be in terms of HD, in which case the HD population is expected to increase from 33,665 in 2012 to 73,243 in 2020 to 122,479 in 2030, the corresponding levels of growth being 39,578 from 2012-2020 and by 49,235 from 2020-2030.

Table 3-3: Estimated Future Populations by Residential Types

Type	LD	MD	HD	INF	Total
			Estimated Proportion (%)		
2012	26.5	13.7	59.8	0	100
2020	23.0	12.0	65.0	0	100
2030	20.0	10.0	70.0	0	100
			Estimated Population		
2012	14,950	7,718	33,665	0	56,333
2020	25,917	13,522	73,243	0	112,682
2030	34,994	17,498	122,479	0	174,970
			Estimated Population Growth		
2012-20	10,967	5,804	39,578	0	56,349
2020-30	9,077	3,976	49,235	0	62,288
2012-30	20,044	9,780	88,813	0	118,637

3.5 Comparison to Expected Level of Growth

Respective figures for expected population growth by housing types (Table 3-3) as compared to potential opportunities for growth (Table 3-2) are summarised in Table 3-4.

For LD housing, the existing wards appear to offer a total growth opportunity of 9,240 people as compared to an estimated demand to 2020 of 10,967 people and to 2030 of

20,044 people. The balance of the anticipated growth is expected to occur in Ward 9 Extension.

For MD the projected development in Ward 9 of 2,000 MD stands (14,000 people) should be more than sufficient to cater for the expected MD growth through to 2030 (9,780 people).

For HD housing, the expected growth of 39,578 people to 2020 could feasibly be accommodated within the existing wards, although some growth is forecast to also occur within Ward 9 extension during this period. For the subsequent interval from 2020 to 2030 it is expected that HD growth will occur in Wards 5, 7 and 9, and in the adjacent areas of Ward 5 Extension, Ward 7 Extension and Ward 9.

These figures imply a need to service about 6,350 new stands by 2020 or a mean of 795 per annum, and from 2020-30 another 6,800 stands or about 680 per annum.

Table 3-4: Estimated Population Growth Versus Identified Growth Opportunities

Type	LD	MD	HD	INF	Total
			Estimated Population Growth		
2012-20	10,967	5,804	39,578	0	56,349
2020-30	9,077	3,976	49,235	0	62,288
2012-30	**20,044**	**9,780**	**88,813**	**0**	**118,637**
			Potential for Expansion		
2012-30	**9,240**	**14,000**	**54,000**	**0**	**77,240**

3.6 Future Ward Populations

For LD housing, it is assumed that all existing opportunities within Wards 7 (660 stands, 4,620 people), 8 (180 stands, 1,260 people) and 9 (480 stands 3,360 people) are developed by 2020, with the balance of the expected population (1,727 people, 247 stands) being absorbed in Ward 9 extension. For the subsequent interval to 2030 it is assumed that all LD growth will occur in Ward 9 extension (9,077 people, 1,297 stands).

For MD housing the identified opportunities within Ward 9 (2,000 stands, 14,000 people) appears adequate to cater for envisaged growth to 2030 (9,780 people or 1,398 stands).

For HD populations to 2012 it is expected that development will occur in Wards 1 and 2 (200 stands, 2,000 people each), Ward 5 (800 stands, 8,000 people), Ward 7 (958 stands, 9,578 people), Ward 9 (1,000 stands, 10,000 people) and Ward 9 extension (800 stands, 8,000 people). For the subsequent interval to 2030 growth is predicted to occur in Ward 5 (400 stands, 4,000 people), Ward 7 (2,000 stands, 20,000 people), Ward 9 (300 stands, 3,000 people), Ward 5 Extension (600 stands, 6,000 people), Ward 9 extension (800 stands, 8,000 people) and with the balance of 8,235 people or 824 stands being constructed on Dagbreek (Ward 7 Extension).

The resulting predicted ward populations are shown in Tables 3-5 and, in Table 3-6, these are broken down by housing types.

Table 3-5: Estimated Future Ward Populations

WARD	TYPE	2012	2020	2030
1	HD	6,518	8,518	8,518
2	HD	5,373	7,373	7,373
3	HD	3,731	3,731	3,731
4	HD	2,368	2,368	2,368
5	HD	2,329	10,329	14,329
6	HD	2,896	2,896	2,896
7	LD	4,493	18,691	38,691
8	LDMD	13,695	14,955	14,955
9	LD/MD/HD	14,930	34,094	41,070
Ext 5	HD			6,000
Ext 7	HD			8,235
Ext 9	LD/HD		9,727	26,804
TOTAL		**56,333**	**112,682**	**174,970**

Table 3-6: Estimated Future Ward Populations by Residential Types

WARD	2012 LD	2012 MD	2012 HD	2012 INF	2012 TOTAL	2020 LD	2020 MD	2020 HD	2012 INF	2020 TOTAL	2030 LD	2030 MD	2030 HD	2030 INF	2030 TOTAL
1	-	-	6,518	-	6,518	-	-	8,518	-	8,518	-	-	8,518	-	8,518
2	-	-	5,373	-	5,373	-	-	7,373	-	7,373	-	-	7,373	-	7,373
3	-	-	3,731	-	3,731	-	-	3,731	-	3,731	-	-	3,731	-	3,731
4	-	-	2,368	-	2,368	-	-	2,368	-	2,368	-	-	2,368	-	2,368
5	-	-	2,329	-	2,329	-	-	10,329	-	10,329	-	-	14,329	-	14,329
6	-	-	2,896	-	2,896	-	-	2,896	-	2,896	-	-	2,896	-	2,896
7	4,493	-	-	-	4,493	9,113	-	9,578	-	18,691	9,113	-	29,578	-	38,691
8	8,217	5,478	-	-	13,695	9,477	5,478	-	-	14,955	9,477	5,478	-	-	14,955
9	2,240	2,240	10,450	-	14,930	5,600	8,044	20,450	-	34,094	5,600	12,020	23,450	-	41,070
Ext 5	-	-	-	-	-	-	-	-	-	-	-	-	6,000	-	6,000
Ext 7	-	-	-	-	-	-	-	-	-	-	-	-	8,235	-	8,235
Ext 9	-	-	-	-	-	1,727	-	8,000	-	9,727	10,804	-	16,000	-	26,804
TOTAL	**14,950**	**7,718**	**33,665**	**0**	**56,333**	**25,917**	**13,522**	**73,243**	-	**112,682**	**34,994**	**17,498**	**122,478**	-	**174,970**

APPENDIX 3.6: POPULATION PROJECTIONS VALIDATION REPORT

566 Campbell Avenue
Pomona
Borrowdale
Harare

Mr Stefan Dörner
HP Gauff Ingenieure GmbH & Co. KG-JBG
4 Loanda Lane, Chisipite
Harare

Dear Sir

Subject: COMMENTS ON THE METHODOLOGY USED TO DERIVE POPULATION ESTIMATES FOR GREATER HARARE

1. Introduction

I refer to your e-mail of 17 December 2013 in which you sought the opinion of an independent demographer on the projections for Greater Harare's population, which your team was preparing. You specifically asked me to provide an independent opinion on the proposed projections, and that the time of my involvement on the task should not be more than 5 working days. I have participated in a preparatory meeting which involved your team and the City of Harare on the 17th of December 2013, perused Mr Cunliffe's methodology, and attended a meeting on the 23rd of January 2014 with the project sponsor and your team.

2. Methods Used

Population Projections

A key problem encountered in trying to project urban populations is the unpredictability of changes in some of the population change factors, especially net migration. While births and deaths can potentially be estimated from historical trends, since they take some time to change significantly, net migration can be influenced by and can quickly respond to short-term changes such as economic swings. The most plausible approach would be to estimate growth rates of the population from historical data and make reasonable scenarios about these growth rates into the future. This is the method that was adopted by Mr Cunliffe, after a thorough interrogation of the socio-economic environment of Harare. Some of the input into the scenario building was obtained from the meeting of the 17th of December 2013 with the City of Harare. What then becomes critical is the determination of the baseline population, because with a wrong baseline population, regardless of the plausibility of the projected growth rates, the resultant projections may be way off the mark.

(i) Defining the Baseline Population

Defining the baseline population involved specific input from the City of Harare, which was obtained at the meeting of 17 December 2013. The City of Harare was disputing the baseline population of Greater Harare as provided in the 2012 population census. It felt that its catchment area for water delivery spans beyond the delineated census boundaries for Greater Harare. They were however advised that for whatever population projections were to be done, a scientific basis has to exist, and that this basis could only be the official 2012 population census. It was therefore agreed:

a. To use the 2012 census figures for the baseline population.
b. To increase the baseline population for Harare through inclusion of Ward 1 (Harare South) as well as additional peripheral areas where the city anticipated demand for services.
c. To use the historical growth rate of 2002-12 for the subsequent interval from 2012-20.
d. For the subsequent interval from 2020-2030, to increase the growth rates to between 4.2 and 4.8%.

With the concurrence of the City of Harare, the population in the following areas was added to the baseline population:

- Caledonia,
- Sally Mugabe, where Rumani, Echo, Acorn and "J" farms have already been incorporated into the City,
- Glenforest,
- Mt. Pleasant Heights and adjacent farms (Bannockburn Farm, Thornpark and Komani),
- Haydon and associated residential areas planned under Mt. Hampden Local Development Plan,
- To the west of the city, Rainham, Spitzkop, Whitecliff, Heaney and Rydale Ridge, and
- Ward 01 (Harare South or Harare rural).

Adding these populations to the baseline population of Greater Harare addressed the City of Harare's concerns about the under representation of the baseline population or of the population which they are already serving and are projecting to serve in future. This would also cater for what the City termed the "floating" populating that was not necessarily resident in the Greater Harare area but commuted into the city on a daily basis.

In any population projection it is important to work with figures that are agreed to and that are official. Mr Cunliffe updated the preliminary baseline population figures by using the final figures, which were released late during 2013. This resulted in a minor increase, by 34,103, to the population of Greater Harare. Adding the peripheral areas gave a baseline population of 2,356,764 for 2012.

With the addition of the outlying wards and the adjustment of the preliminary population figures, the baseline population should have been properly defined to include the current population being serviced by the City of Harare.

(ii) Growth Rates

The model used in the projections was to use a three-step growth model where the 2002-2012 growth rate was applied for the short-term i.e. 2012-2020 and assumed rates applied to the periods 2020-2025 and 2025-2030, respectively. The projections were adjusted for carrying capacities of certain localities like Epworth where the annual growth rate was reduced to a level that is consistent with the available opportunities for expansion of residential housing. The projections were also robust enough to allocate the population of Epworth in excess of its carrying capacity to Harare.

For the subsequent periods 2020-2025 and 2025-2030 growth rates were increased to 4% and 5%, respectively, for Harare, Norton and Ruwa. These growth rates are in line with the City of Harare's envisaged growth of industry and the ability of the City to attract people once what they termed an "economic turnaround" occurs. The City of Harare's position was that the anticipated turnaround of the economy would occur possibly before 2020. For other centres like Chitungwiza Mr. Cunliffe sought input of the respective Local Authority for the medium term population growth and then put a growth rate in line with other centres for the last five years of projections.

3. Conclusion

Estimates of projected populations are as good as the assumptions on population change factors. In my opinion the methodology and methods used in these projections are plausible. In addition the projected population of 2.7 million in 2020 and 4.3 million in 2030 seem acceptable and in line with what the City of Harare predicts and is planning for in terms of the city's socio-economic developments.

Faithfully Yours

Henry Chikova (Dr)

24/01/14.
Date

APPENDIX 4: EXISTING WATER SUPPLY AND SEWERAGE SITUATION

APPENDIX 4.1: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT - HARARE

GREATER HARARE WATER AND SANITATION STRATEGIC PLAN

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 4.1: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT

HARARE

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1 WATER SUPPLY

The water supply system of Harare consists of two water treatment works namely: Morton Jaffray Water Treatment Works located adjacent to the Harare - Bulawayo Highway about 40 km west of Harare and Prince Edward Water Treatment Works located approximately 22 km South of Harare.

Morton Jaffray Water Treatment Works was constructed in three stages with the first module constructed in 1953, with an initial rated capacity of 162,000 m^3/day followed by the second module in 1976 with a rated capacity of 227,000 m^3/day. The third module was constructed in 1994 with a rated capacity of 227,000 m^3/day. Therefore the total capacity of the Treatment Works is thus 616,000 m^3/day. However, due to operational challenges,it has been reported that, the present combined output under the current mode of operation is limited to only 429,408 m^3/day.

Prince Edward Water Treatment Works was constructedin 1972.The Water Treatment Works has a reported maximum peak production capacity of approximately 90,000 m^3/day. However, due to operational challenges,it has been reported that the works is currently doing 50,000 m^3/day.

The present water supply system of the City of Harare includes 16 treated water pumping stations. The pumping stations are described in the following paragraphs in detail. The capacity of the pumping stations ranges from 13,500 m^3/hour (Warren Control) to 19 m^3/h (Emerald Hill). Nine pumping stations pump directly into the distribution system and/or to reservoir sites. The remaining six pumping stations act as lift stations to supply water towers. The characteristic key data of the existing 16 pumping stations are summarized in Table 1.1 below.

Table 1-1: Pumping Stations

Ref.	Pumping Station	Function of PS	Capacity(1) (m3/d)	Head (m)	No. of Pumps (nos.)	Meter Device (BM/FM)(2)	Year of Constr. (year)
(a)	Alexandra Park	transmission	50,000	45		FM	1971
(b)	Avondale	transmission	325	55		not metered	1959
(c)	Bluff Hill	transmission	13,055	55		not metered	1960
(d)	Crow hill	transmission	9,160	37		not metered	1971-72
(e)	Emerald Hill	lift station	460	27		BM	?
(f)	Greendale	lift station	?	?		BM	1979-80
(g)	Hatfield	removed	-	-	-	-	-
(h)	Hogert Hill	transmission	3,260	30		not metered	1978-79

Ref.	Pumping Station	Function of PS	Capacity[1] (m3/d)	Head (m)	No. of Pumps (nos.)	Meter Device (BM/FM)[2]	Year of Constr. (year)
(j)	Kwadzana	transmission	4,750	90		FM	1995
(k)	Letombo	transmission	64,800	98		FM	NA
(l)	Mabvuku	lift station	1,700	22		BM	1955-56
(m)	Marimba Park	lift station	NA	NA		BM	NA
(n)	Orange Grove	transmission	15,650	35		not metered	1969-70
(o)	Pocket Hill	lift station	NA	NA		BM	NA
(p)	Warren Control	transmission	324,000	125		BM/FM	NA
(q)	Waterfalls	lift station	NA	NA		not metered	NA

(1) The pumping station capacity is calculated assuming 24h-pumping and taking into consideration the available operating pumps (stand-by pumps are not considered)

(2) BM = bulk meter; FM = flow meter

*NA – Not Available

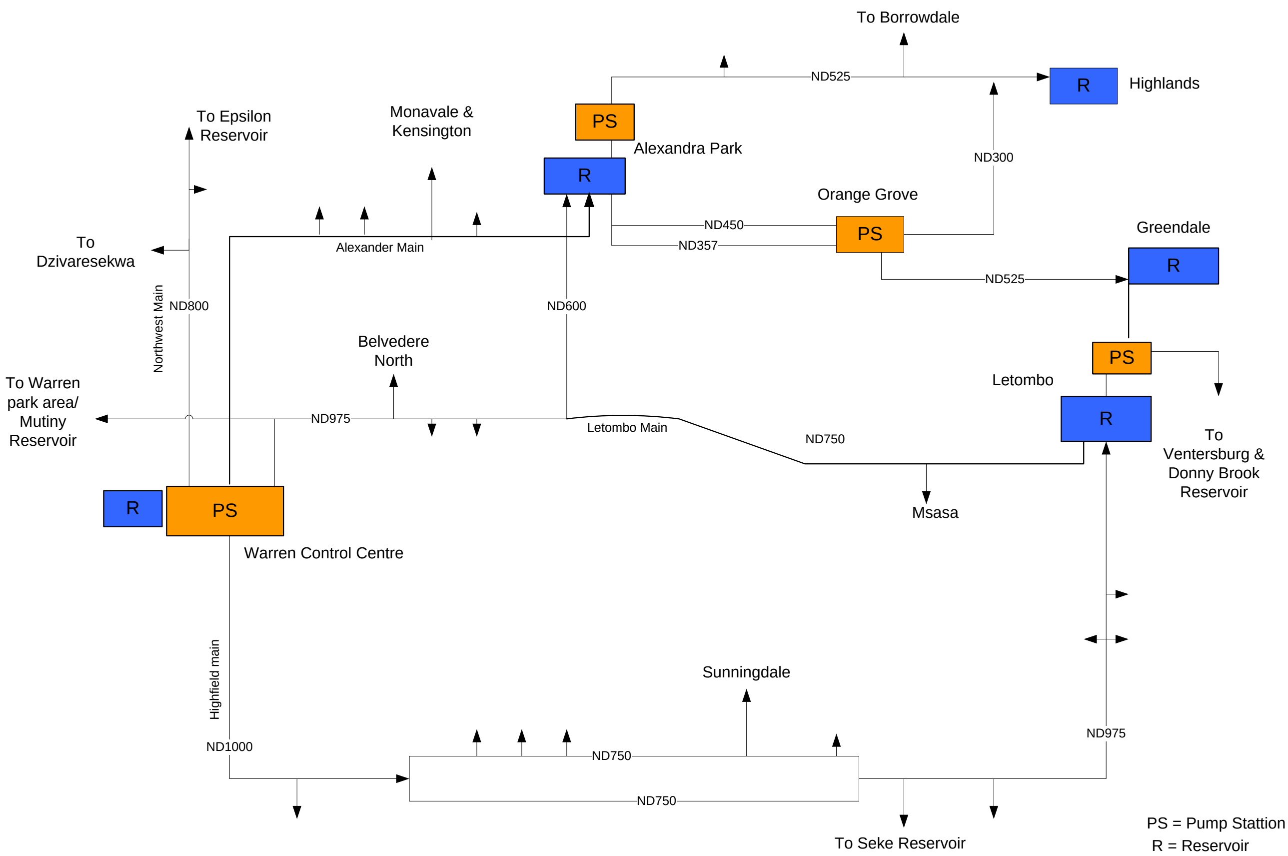


Figure 1-1: Principle layout of the water system of Harare

1.1 Water Sources

Harare is supplied with raw water from the following reservoirs; Harava Dam, Seke Dam, Lake Chivero and Lake Manyame. Morton Jaffray WTW is supplied by Lake Chivero and Lake Manyame whilst Prince Edward WTW is supplied by Harava and Seke Dams. All the raw water dams are located in the Upper Manyame Catchment area, along the Manyame River. The following wastewater treatment works located upstream of Lake Chivero and Lake Manyame; Zengeza Sewage treatment Works, Donnybrook Stabilisation Ponds, Crowborough Sewage Treatment Works and Firle Sewage Treatment Works discharge treated effluent into the same river system. Due to the dilapidation of the above sewage works, raw sewage is currently being discharged into the Manyame River System.

Capacity of Existing Sources

Harare is supplied with raw water from Harava Dam, Seke Dam, Lake Chivero and Lake Manyame. Morton Jaffray WTW is supplied by Lake Chivero and Lake Manyame whilst Prince Edward WTW is supplied by Harava and Seke Dams. All the raw water dams are located in the Upper Manyame Catchment area, along the Manyame River.

The total estimated 4% yield of the Chivero-Manyamewith allowance for upstream and downstream commitments is 159,376 Ml/year - approximately 436 Ml/day (Latest ZINWA assessment). Allowing for upstream commitments only, the 4% risk yield is 174,448 Ml/year (478 Ml/d). The 10% risk yield with upstream commitments only is estimated to be 231,117 Ml/year (478 Ml/d). The safe yield of the dams is clearly much lower than current average demand, let alone projected demand. This is risky for a large city such as Harare. There is need to develop water production facilities in other catchments.

The two upstream dams, Harava and Seke with a combined capacity of 12.5 million m3, which is a relatively small storage capacity provide water for treatment at Prince Edward WTW. They are normally only used for water supply purposes after the rain season when the dams contain sufficient water of a reasonable quality. It is important to note that the Prince Edward WTW was intended as a peak load facility to be operated during the hot season.

Morton Jaffray Water Treatment Works has three number intake works namely; the old intake tower (intake No.1) constructed in 1952 and draws water at five water levels; three being the City of Harare intakes and the other two an irrigation intake and the river outlet pipe respectively. Each of the COH intakes is connected to a common 1100 mm Ø water main which transports raw water to the distribution chamber at the head of the water treatment works.

Another intake tower was constructed in 1976 in order to resolve the issue of abstraction levels in the old intake tower. Raw water from the intake works enters the treatment works from the northeast via a 3 m × 3 m tunnel. It is directed initially to a mixing chamber before being fed into the treatment works.

The third supply is from Lake Manyame and is via a 3m x 3m rectangular 15.4 km long tunnel. The tunnel is approximately 45m into the ground at the works and raw water is pumped to a riser shaft.

1.1.1 Raw Water Intake

Raw water for Morton Jaffray Water Treatment Works is abstracted from three number intake works namely;

- The old intake tower (intake No. 1) constructed in 1952 and draws water at five water levels; three being the City of Harare intakes and the other two an irrigation intake and the river outlet pipe respectively. The COH intakes are connected to a common 1100 mm diameter water main which transports raw water to the distribution chamber at the head of the water treatment works.
- The new intake tower constructed in 1976 in order to resolve the issue of abstraction levels in the old intake tower. This discharges raw water into a mixing chamber via a 3 m × 3 m tunnel before it is fed into the treatment works.
- The Lake Manyame 3m x 3m rectangular 15.4 km long tunnel. The tunnel is approximately 45m into the ground at the works and raw water is pumped to a riser shaft.

The mechanical and electrical components of the above intake structures will need to be rehabilitated or replaced.

Therefore, the investment measures for the raw water abstraction and transmission facilities shall be as shown in the figures below;

Table 1-2: Investment Measures for at Lake Chivero Intake

Immediate	Medium Term (2020)	Long Term (2020)
	Rehabilitation and maintenance of all lifting gear,butterfly valves, actuators,desludging pumps and 3m x 3m Penstocks, Replacements of 1200 diameter 75mm mesh screens. Rehabilitation and maintenance of 100KVA Transformer,LV switchboard, intake building and replacement of small power and lighting.	Rehabilitation and maintenance of all lifting gear, butterfly valves, actuators,desludging pumps and 3m x 3m Penstocks, Replacements of 1200 diameter 75mm mesh screens. Rehabilitation and maintenance of 100KVA Transformer,LV switchboard, intake building and replacement of small power and lighting.

Table 1-3: Investment Measures for at Lake Manyame Intake

Immediate	Medium Term (2020)	Long Term (2020)
	Rehabilitation and maintenance of all lifting gear,butterfly valves including actuators, desludging pumps (turbine type 10 KW) and forebay pumps (turbine type 10 KW). The works will also include rehabilitation of penstocks, replacement of 1200 diameter 75mm mesh screens and replacement of 100KVA Transformer and LV switchboard. The rehabilitation of a small power and lighting,building and security fence, anddesludging pumps and hoist, DN 150 in shaft 5.	Rehabilitation and maintenance of all lifting gear,butterfly valves including actuators, desludging pumps (turbine type 10 KW) and forebay pumps (turbine type 10 KW). The works will also include rehabilitation of penstocks, replacement of 1200 diameter 75mm mesh screens and replacement of 100KVA Transformer and LV switchboard. The rehabilitation of a small power and lighting, building and security fence, and desludging pumps and hoist, DN 150 in shaft 5.

1.1.2 Raw Water Transmission Mains and Pump Stations

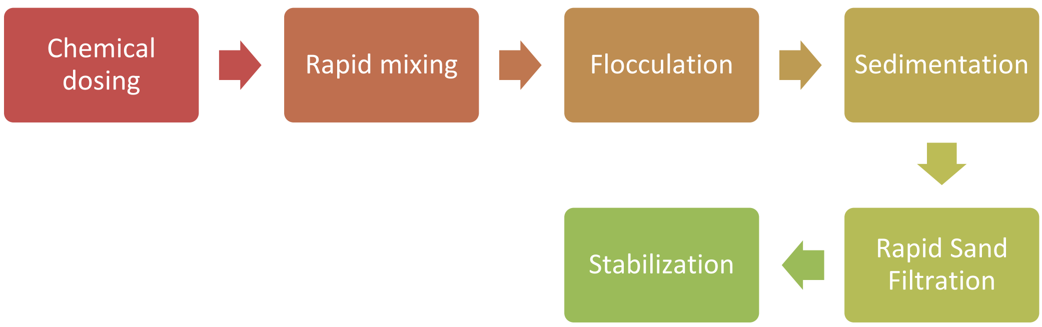
The following table gives an outline of the proposed investment measures for raw water transmission mains and pump stations.

Table 1-4: Investment Measures for Raw Water Transmission Mains and Pump Stations

Immediate	Medium Term (2020)	Long Term (2020)
	Replacement and maintenance of DN 600, DN 1300, DN 1400 and DN 1400 butterfly valves including actuators from Lake Chivero,DN 1800 butterfly valves including actuators from Lake Manyame,DN 1200 Needle valve,DN 900 butterfly valve gear-operated handle to Clr Nr 07 and valve actuator control switchboard; Replacement of valve chamber small power and lighting, shaft hoist, 7.5 t,raw water pumps, Q=5,400, H=60m, including control gear,DN 700 raw water pump suction and delivery gate and non-return valves including actuators and pressure gauges, Replacement/Maintenance/Rehabilitation of air valves, raw water pump 3.3 kV starter switchboard, 3,3 kV starter consoles, and 3.3 kV starter panels, raw water pump 380 LV switchboard, small power and lighting, overhead wire rope hoist, 3t, dewatering pumps and ventilation fan.	Replacement and maintenance of DN 600, DN 1300, DN 1400 and DN 1400 butterfly valves including actuators from Lake Chivero,DN 1800 butterfly valves including actuators from Lake Manyame, DN 1200 Needle valve, DN 900 butterfly valve gear-operated handle to Clr Nr 07 and valve actuator control switchboard; Replacement of valve chamber small power and lighting, shaft hoist, 7.5 t,raw water pumps, Q=5,400, H=60m, including control gear, DN 700 raw water pump suction and delivery gate and non-return valves including actuators and pressure gauges, Replacement/Maintenance/Rehabilitation of air valves, raw water pump 3.3 kV starter switchboard, 3,3 kV starter consoles, and 3.3 kV starter panels, raw water pump 380 LV switchboard, small power and lighting, overhead wire rope hoist, 3t, dewatering pumps and ventilation fan.

1.2 Water Treatment Works

Harare Municipality operates two water treatment facilities namely: Morton Affray Water Treatment Works located adjacent to the Harare and Prince Edward Water Treatment Works located approximately 22 km South of Harare. They are conventional surface water treatment plants consisting of the process units illustrated in the sketch overleaf:



1.2.1 Morton Jaffray WTW

Morton Jaffray Water Treatment Works (WTW) consists of three units namely; Unit 1 constructed in 1954 with a design capacity of 160,000 m^3/day and fed from Lake Chivero by gravity, Unit 2 constructed in 1976 with a design capacity of 227,000 m^3/day fed from both Lake Chivero and Lake Manyame by gravity, and Unit 3 constructed in 1994 with a design capacity of 227,000 m^3/day and fed from both Lake Chivero and Lake Manyame by gravity. The total design capacity is therefore 614,000m^3/day; however the estimated current total water production is reported to be around 500,000 m^3/day to 550,000 m^3/day.

A: Unit 1

Chemical Storage, Preparation and Dosing

Raw water is dosed with aluminium sulphate which is prepared in four concrete tanks equipped with a stirrer. These concrete tanks are badly corroded and refurbishment is greatly recommended preferably using an HDPE membrane liner. For pH adjustment, the water is dosed with lime slurry prepared from two circular steel tanks. The corresponding stirrers and dosing pumps need to be replaced. In order to reduce the organic matter content of the raw water, Powdered Activated Carbon (PAC) is also dosed and is prepared in two concrete tanks with stirrers which were recently been rehabilitated and new stirrers installed. However, dosing pumps and corresponding pipework does not exist. Sodium silicate is dosed as a flocculation aid after being prepared from two recently rehabilitated concrete tanks with new stirrers. Stirrers have not yet been commissioned. As part of the disinfection process, gaseous chlorine is dosed. The chlorination system for treated water disinfection was rehabilitated under the “UNICEF “project in 2009/2010. Two new chlorinators were installed.

Clarifiers

Clarifiers No. 1 and No. 2 are circular with separate upstream flocculation chambers equipped with flocculators for moderate mixing purposes and bottom scrapers for sludge removal. For both clarifiers, flocculators are not operational. The motors and stirrers would have to be replaced. The scraper bridge drives are not working, making sludge removal very difficult. This can only be achieved by emptying the tanks and removing sludge manually. Clarifier No. 3 is a circular clarifier of the Accelerator type with an integrated flocculator. This clarifier is completely out of operation as the electromechanical equipment (motor, stirrer, valves, and pipe-work) is worn out and would have to be replaced.

Powdered Activated Carbon: PAC *Lime Make-up*

Clarifiers No. 4, No. 5 and No. 6 are vertical flow clarifiers (overall depth: 12m) of the Patterson Candy type with 8 sludge pockets each. Clarifier No. 7 is a DegremontPulsator type clarifier, which receives its raw water by means of a separate gravity main from Lake Chivero. The vacuum system that creates the pulsations for sludge blanket formation is not working. A number of raw water diversion plates at the bottom of the rectangular clarifier are broken. Raw water inlet and clarified water outlet valves will need to be checked on their operational status including desludge valves.

Rapid Gravity Sand Filters

Unit 1 comprises a total of 26 No. rapid gravity sand filters: 12 PATTERSON filters (installed between 1952 and 1954) and 14 DEGREMONT filters (installed in 1966). Inlet and outlet baffle gates of the 12 "Patterson "type filters are completely corroded and need complete replacement. The float type filter outflow regulation system is completely worn out, and no longer operational. All valves (filtered water outlet, backwash water inlet, and air inlet) need to be replaced as many of these are heavily leaking. The new valves will need to be equipped with pneumatic actuators complete with corresponding air compressors. The two existing backwash air blowers are very old, but still operational.

Inlet plates of the 14 "Degremont" filters are heavily corroded. A number of the A.C. filter floor slabs are cracked and need repairing. The "Degremont" siphon type outflow control system is not working. All valves (filtered water outlet, backwash water inlet, and air inlet) will need to be replaced. The new valves will need to be equipped with pneumatic actuators complete with corresponding air compressors. Only one air blower is operational for filter backwashing. A second air blower will need to be installed including all corresponding pipework and fittings.

Circular Sedimentation Tanks

The existing air pipework is leaking and requires repair or replacement. Two very old backwash water pumps (installed in 1954) are serving both, the “Paterson” and “Degremont” filters. A number of valves and pump starters will need to be replaced as the electrical control board is now in a bad state.

For standby power Unit 1 has an old 120 kVA standby power generator.

B: Unit 2 and Unit 3

<u>Raw Water Pumping Station/ Raw Water Tower</u>

The underground raw water pumping station receives water by gravity flow from Lake Manyame via a rectangular tunnel, approximately 3m x 3m and 15.4 km long. The underground raw water pumping station is approximately 45m below the ground, and comprises a total of 5 WEIR pumps; 3 pumps installed in 1985 and 2 pumps installed in 1993. Raw water is pumped up a raw water tower approximately 40m above ground and then falls down by gravity into the 1800mm Ø main leading to the raw water mixing chamber where it is mixed with Lake Chivero raw water. Due to the 40m falling height it is expected that the water from Lake Manyame is supersaturated with dissolved oxygen, which later on is released in the Pulsator type clarifiers, thus reducing the floc formation process due to flotation effects.

<u>Chemical Storage, Preparation and Dosing</u>

In order to reduce the organic matter content of the raw water, Powdered Activated Carbon (PAC) is dosed into the raw water mixing chamber by one PAC dosing pump capable of dosing 25% of the total PAC demand leaving 75% being dosed manually by pouring the content of 25kg bags of PAC directly into the mixing chamber. For pH correction Sulphuric Acid (H_2SO_4, 98%) is dosed into the same mixing chamber above in order to reduce the raw water pH from a maximum range of 8.5 to 8.7 down to 6.8 to 7.0 which is the optimum pH range for subsequent coagulation with aluminium sulphate.Sulphuric acid is stored in a

60 ton storage capacity tank, which lasts on average 4 days only and is dosed by a single pump.

Aluminium Sulphate is dosed at the inlet point of the six distribution channels to the six Pulsator type clarifiers of Unit 2 and 3. Due to the required high aluminium dosing rates of 60 to 80 mg/l, a daily amount of approximately 40 tons of aluminium sulphate is required. There are three aluminium sulphate solution tanks approximately 600 m^3 in capacity each. Granular aluminium sulphate is being dosed. Two concrete tanks, originally foreseen for sodium silicate preparation are now used for alum solution preparation and from these preparation tanks alum is pumped to two alum dosing tanks, out of which alum is dosed by means of two centrifugal pumps (GRUNDFOS). In order to allow for some alum solution reserve volume, it is now common practice to store surplus prepared alum solution in the above 600 m^3 alum solution tanks.

Sodium Silicate is dosed as a flocculation aid by means of two separate dosing plants, one for Unit 2 and one for Unit 3.Each plant comprises two concrete preparation and dosing tanks, each tank is equipped with a stirrer.

Lime dosing for final pH-adjustment is through a lime dosing station, comprising 4 No. lime slurry hoppers and 4 No. lime dosing pumps.

As part of the disinfection process, gaseous chlorine is dosed.

Pulsator Type Sludge Blanket Clarifiers

Unit 2 comprises 3 Pulsator type Clarifiers commissioned in 1976 and Unit 3 again comprises 3 Pulsator type Clarifiers commissioned in 1994. All clarifiers are of the same type and size.

Pre-treated water is distributed by a distribution chamber with weirs discharging partially treated water to individual channels, where coagulation and some kind of pre-flocculation take place. Each clarifier inlet channel has a “Venturi” flume for flow measurement purposes. However, in one of the six channels this flume has been taken out, which leads to overloading of this individual channel and thus of the corresponding downstream clarifier. The “Pulsator” type clarification process is considered as not being the optimum clarification process for algae containing raw water as the formation of a sludge blanket over a large rectangular surface area is rather difficult under operational circumstances, where chemical dosing rates cannot be accurately monitored and where frequent power failures occur, leading to a complete breakdown of these sludge blankets. Compared to the vertical clarifiers (No.4, No.5 and No.6 of Unit 1), the solids and algae removal rate of Unit 2 and Unit 3 clarifiers is less than the removal rates observed for Unit 1 clarifiers.

Therefore, due to the difficult sludge blanket formation only a limited sludge abstraction via sludge concentrators located at one side of the clarifiers, a lot of sludge is accumulated at the bottom of the clarifiers. This leads to frequent emptying and cleaning of the clarifiers (roughly, every 3 to 4 months) and thus a significant loss of water.

The Pulsator system comprises the air pump, the corresponding motor, the starters and the vacuum release device. The vacuum systems are subject to frequent failures and thus have to be monitored very carefully and are being repaired rather frequently.

Pulsator Clarifiers

Rapid Gravity Sand Filters

Unit 2 comprises 18 Degremont V-type rapid gravity sand filters and Unit 3 comprises 18 rapid gravity sand filters of the same type. Filter regulation is of the syphon type outflow regulation. This system is longer operational. New pneumatically actuated solenoid valves were installed in 2009/2010 in all four mains per filter (i.e. in Φ400 mm filtered water outlet, Φ 600 mm backwash water outlet, Φ 500 mm backwash water inlet and Φ 300 mm air inlet) for both, Unit 2 and Unit 3 sand filters,. However, Unit 3, compressed airlines are inadequate to meet the pressure required to operate the valve actuators.

Filter backwash is by 5 No. backwash water pumps of which, 3 are dedicated to Unit 2 and 2 are dedicated to Unit 3.5 No. air blowers are also operational of which 2 are dedicated to Unit 2 and 2 are dedicated to Unit 3 with one stand-by air blower serving both Unit 2 and Unit 3.

Rapid Gravity Sand Filters

Stand-by Power Supply and Electrical Spare Parts

Unit 2 and Unit 3 have a stand-by diesel generator set (PETBOW, 160 kVA),

High Lift Pump Station

The treated water pump station comprisesof 14 pump-sets. Pump-sets 1-3 are fed from an ND 800 mm Ø suction pipe with a positive suction. Pump-sets 4-14 are fed from a concrete clear water duct with a capacity of 455 Ml/d with a positive suction.

Pump-sets 1 - 3 were commissioned in 1954 as treated water pumps for the old treatment works. Due to continual operating problems during the last 5 to 10 years the pumps (W. H. Allen, Sons & Co, Size 20"/18") are scheduled to be replaced by Worthington Pumps with the same characteristics during 1996. When operating with two pumps in parallel only a minor rise in flow is achieved and the usual duty is with one pump operating and two as standby. The maximum discharge is for one pump is approximately 25 m^3/min. The pumps discharge into a 750 mm Ø transmission main to Lochinvar Reservoir. A performance curve for the new 12 UZDL 25 Worthington pumps is available. The duty point for each pump-set is 19.0 m^3/min, against a 172 m head with a pump efficiency of 85%. The speed is 1450 rpm.

Pump-sets 4 - 6 were installed in 1960 for the transfer of treated water from the water treatment works to Warren Control Pumpstation through a 975 mm Ø pumping main. These pumps are now being replaced with new Worthington pumps with the same characteristics. The pumping station is connected to the old 1300 mm Ø pumping maindue to the replacement of the old and damaged pipes along the pipeline route to Warren Control. A performance curve for the new 12 LNC 29"A Pleuger Worthington pump is available. The duty point for two pumps in parallel is 75 m^3/min against a 154.3 m head with an efficiency of 85%. The speed is 1480 rpm.

Pump-sets 7 - 10 were commissioned in 1976 and the pump Model is 20" SDS METS. Each pump-set consists of two identical pumps connected in series with a duty point of 65 m^3/min against a head of 123.83 m. The speed is 1482 rpm. They discharge into a 1300 mm Ø transmission main to Warren Control Pump Station.

Pump-sets 11 - 14 were installed in 1994 and the pump Model is 16-LN-35E. Each pump set consists of two identical pumps connected in series with a duty point of 53 m^3/min against a of 90 m head. The speed is 1482 rpm and the efficiency 88%. They discharge into another 1300 mm Ø transmission main to Warren Control Pumpstation.

The three old pipes (750 mm, 975 mm and 1300 mm Ø) and the new 1300 mm Ø pipelinefrom the treated water pumpstation have flow recorders installed in separate chambers out of the main pumpstation.

Treated Water Pump Station

Backwash Water Treatment and Recycling Plant

A backwash water treatment plant was installed approximately 10 years ago to treat dirty backwash water and recycle treated dirty backwash water to the head of the works. At nominal plant design capacity and depending on filter backwashing frequencies, the plant could easily result in a water savings of around 12,000 to 15,000 m^3/d. However, due to lack of funding for the final completion of the works by ODIS Filtering Ltd., of Israel, the plant was never commissioned.

The plant comprises the following treatment processes:

- Polymer supported solid-liquid separation, (SOLIQUATOR),
- Pressure filtration of the liquid phase of the SOLIQUATOR with the filtered water to Unit 3,
- High rate settling for the solid phase of the SOLIQUATOR with the settled water returned to the SOLIQUATOR,
- Polymer supported belt press thickening of the settled solids of the high rate settlers with the supernatant returned to the SOLIQUATOR,
- Polymer supported filter press dewatering of the sludge from the belt press with the supernatant returned to the SOLIQUATOR.

The following is the treated water production amounts for the past three years from 2009 to 2011.

Table 1-5: Production amount of MJ-WTW

Production / Month (x 1000 m^3/d)	2009		2010		2011	
	Monthly	Daily	Monthly	Daily	Monthly	Daily
January	13,459	434	18,011	581	18,182	587
February	10,968	392	15,526	555	15,513	554
March	11913	384	17,173	554	18,576	599
April	11,452	369	15,923	514	17,792	574
May	11,228	362	18.151	586	17,985	580
June	17,667	489	15,147	505	17,981	599
July	11,981	384	16,822	543	18,804	607
August	15,930	514	18,207	587	17,794	574
September	17,887	596	17,535	585	17,683	589
October	16,944	547	17,816	575	17,559	566
November	15,976	533	17,248	575	17,573	586
December	16,362	528	17,581	567	18,029	582
Total	**168,677**	462	**205,140**	562	**213,471**	**5**85

As shown in the table above, the 2011 production amount almost reached 600,000 m^3/d and has been gradually increasing as compared with that in 2009 and 2010

In 2009, a survey for the improvement of the WTW was carried out, and financing of the water treatment chemicals was provided by UNICEF. In addition, the chlorine dosing facilities were being refurbished since 2012. Chemical consumption of MJ-WTP is shown in the table below and the dosing rates of coagulant and acid were quite large.

Table 1-6: Consumption of chemicals at MJ-WTP (2012)

Chemical / duration	Consumption (ton)		Dosing Rate (mg/l)
	Monthly	Daily	
Activated Carbon	270.0	9.00	15.4
Granular Alum	2,025.0	67.50	115.4
Liquid Aluminium Sulphate	3,900.0	130.00	222.2
Chlorine Gas	45.0	1.50	2.6
Powder Lime	162.0	5.40	9.20
Sodium silicate	35.0	1.17	2.0
Sulphuric acid	4.7	0.16	0.3
Base Sulphuric Acid	450.0	15.0	25.6

Chemical / duration	Consumption (ton)		Dosing Rate (mg/l)
Hypochlorite	30.0	1.00	1.7

The table below shows the condition assessment of Morton Jaffray WTW.

Table 1-7: Condition Assessment of Morton Jaffray WTW

Structure	Morton JaffrayWTW
Civil structures	In general the concrete structures are in a reasonable condition. There is evidence of corrosion of concrete in places, but no costly repairs are envisaged.
Buildings	The administration building and superstructures of the pump stations and chemical buildings are in a reasonable to good condition and can be repaired relatively inexpensively
Pipework	The below-ground pipe work could not be assessed, but from previous experience, no major repairs are envisaged. All the above-ground steel pipe work is completely corroded. The steel pipe work inside the pump stations appears to be in a reasonable condition and could probably be refurbished by sand-blasting and painting
Structural Steelwork	The structural steelwork on the clarifiers, submerged pipes together with all handrails can be sand blasted and repainted.
Rapid Gravity Sand Filters	All pipework and fittings covering flow control mechanism, backwash, filtered water and raw water are all corroded and in need of replacement. Filter media needs replacing including rehabilitation of the under-drainage system
Mechanical Equipment	All the pumps will have to be replaced i.e. chemical dosing pumps, backwash pumps including associated air supply system
Electrical Equipment	All the electrical panels will have to be replaced and probably most of the underground cables as well

1.2.2 Prince Edwards WTW

Intake water of PE-WTW is taken from Seke and Harava Dams with a combined volume of 12.5 million m^3. The design capacity of PE-WTW is circa 90,000 m^3/day. The amount of water currently being treated at PE-WTW is circa 55,000 m^3/d during the wet season and 40,000 m^3/d in the dry season respectively. The quantities of the raw water intake during the above periods are around 60,000 m^3/d and 45,000 m^3/d respectively. The above production amounts are normally reduced during drought periods. The other related water reduction (withdrawal) from the lakes consists of evaporation and percolation /leakage from the bottom and dam structure. Prince Edward WTW was constructed in 1950 and renovated in 1973.

Prince Edward Water Treatment Works (WTW) is a conventional surface water treatment works which consist of the following unit processes:

- Chemical Dosing (Coagulation, disinfection),
- Rapid Mixing,
- Flocculation,
- Sedimentation,
- Rapid Sand Filtration,

- Stabilization, and
- Disinfection.

Low Lift Pump Station

The low lift pump station consist of 4 pumps and abstracts raw water from Prince Edward Dam. The pumps have been in operation for the past 40 years. These pumps will be replaced under the UWSSRP Phase 1.

Low Lift Pump Station

Chemical Dosing

Aluminium Sulphate is dosed at the inlet point of the distribution channel to 28 No. clarifiers where rapid mixing and flocculation is achieved.The channel is 28.6m long by 2.4m wide and 2m deep and has asbestos deflectors that facilitate mixing and flocculation and ensures the homogeneity of the coagulant and promotes flocculation.

The coagulant is mixed in three alum make-up tanks and the solution gravitates to three number mixing tanks before being pumped to the dosing point.According to the plant operators, the average Aluminium Sulphate dosage rate is almost the same throughout the year, approximately 27.5 to 35mg/l.

In order to reduce the organic matter content of the raw water during dry periods and following the first rains, Powdered Activated Carbon (PAC) is dosed into the raw water by means of manually dosing one 25 kg bag for 2 hrs. For pH correction, lime is dosed after being prepared in two octagonal tanks with mixers. Dosing is done down-stream of the rapid sand filters.

Sodium Silicate is dosed as a flocculation aid between September and December at a rate of 0.5mg/l.

As part of the disinfection process, gaseous chlorine is dosed. In addition it is dosed to kill algae, due to algal bloom in the supplying dams.

Clarifiers

There are 28 No. vertical flow clarifiers all approximately 18m x 9m x 9m with a surface loading rate of 1.5m/hr. The clarifiers receive coagulated water from a central circular distribution chamber that is connected to the flocculation channel. Clear water collection troughs are made of asbestos cement and consequently are very difficult to clean and as such these must be replaced with steel troughs with V-notch weirs for optimum and even distribution of clarified water. Treated water is collected by several troughs installed at the top of the tanks and flows to rapid sand filters. The clarification treatment performance appears to be good. The manually operated desludging valves are all in good operational status. The abstracted clarifier sludge is transferred to sludge lagoons by means of two sludge pumps, installed in the old 1929 low lift pump station. Out of these two pumps only one is operational and is very old. Therefore, two properly designed sludge pumps will need to be installed including corresponding pipework and valves.

Rapid Sand Filters

There are sixteen Degremont Aquazur typerapid gravity sand filters constructed in banks of eight either side of the filter gallery and observation deck with the following dimensions 11.8m x 4.25m. The operators advised that under normal circumstances the filtration rate is around 5m/hr. The water depth on the sand filter surface is controlled by siphons, of which vacuum strength is regulated by floats so that the water level is constant. However, this control mechanism is no longer operational andwhen the filter resistance reaches 1.5 m, washing of the filter layer using pumped water and pressurized air takes place. The backwash sequence is; air only followed by air and water and then water only until the water is clear. The filter floors comprise partly cracked asbestos cement slabs with Degremont D20 type filter nozzles. Each filter is operated via three valves i.e. filtered water outlet, backwash water inlet and air inlet valves. The valves are fitted with pneumatic actuators which needs a complete overhaul.

High Lift Pump Station

Three pumps are installed in the high lift pump station. Some pumps were replaced recently under the EU project. All the other installations are approximately 40 years old. Presently only one pump is operational and it is reported that even the characteristics of the newly installed pump motors might not be adequate for the corresponding pump. However, new pumps will be installed under the UWSSRP Phase 1. The pump station has a drainage pump that is very old.

Table 1-8: Condition Assessment of Prince Edward WTW

Structure	Prince Edward WTW
Civil structures	In general the concrete structures are in a reasonable condition. There is evidence of corrosion of concrete in places, but no costly repairs are envisaged.
Buildings	The administration building and superstructures of the pump stations and chemical buildings are in a reasonable to good condition and can be repaired relatively inexpensively
Pipework	The below-ground pipe work could not be assessed, but from previous experience, no major repairs are envisaged. All the above-ground steel pipe work is completely corroded. The steel pipe work inside the pump stations appears to be in a reasonable condition and

Structure	Prince Edward WTW
	could probably be refurbished by sand-blasting and painting
Structural Steelwork	The structural steelwork on the clarifiers, submerged pipes together with all handrails can be sand blasted and repainted.
Rapid Gravity Sand Filters	All pipework and fittings covering flow control mechanism, backwash, filtered water and raw water are all corroded and in need of replacement. Filter media needs replacing including rehabilitation of the under-drainage system
Mechanical Equipment	All the pumps will have to be replaced i.e. chemical dosing pumps, backwash pumps including associated air supply system
Electrical Equipment	All the electrical panels will have to be replaced and probably most of the underground cables as well

1.3 Booster Pump Stations

The water distribution network of the City of Harare consists of 16 booster stations for the conveyance of treated water. Based on the designated duty pumps in these stations, the minimum pumping capacity ranges from 720 m^3/day to 362,880 m^3/day.

Out of the 16 booster stations, 6 are lift stations with 4 water towers at Donnybrook, Highlands, Greendale and Waterfalls with 2 being reservoirs near Kuwadzana and Dzivaresekwa.

There are also 2 private pump stations at Donnybrook for Lafarge Cement Factory and at Philadelphia for a military camp.

With the proposed Kunzwi WTP and Kunzwi Booster Station, a number of these booster stations will not be required in the long term planning to 2030.

A summary of these booster stations is provided in the table overleaf.

Table 1-9: Greater Harare Booster Pump Stations

Item Nr	Item Description	Function	Pumping/ Gravitation to	Q (m³)	H (m)	Capacity (m³/d)	Pumps D + SB	kW per Pump	Yea Built	Remedial Measures	
										Medium Term	Long Term
1	**Warren Control**	Transmission		2520	12	362880	6+8	930.84	1953	Reh	Reh/Rep
1.1		Transmission	Letombo			181440					
1.2		Transmission	Alexandra Park			181440					
2	**Alexandra Park**										
2.1	New Pump house	Transmission	Hatcliff	1035	95	24840	1 + 1	200	2006	Reh	NR
2.2	Old Pump house	Transmission	Highlands	1250	55	60000	2 +2	300	1970		
3	**Highlands**	Lift Station	Distribution	45	60	1080	1 + 1	22	2002	Reh	Reh/Rep
4	**Donnybrook**	Lift Station	Distribution	140	30	3360	1 + 1	18.3	1955		
4.1	New Pump house	Distribution	Distribution	-	-	-	1 + 1		NC		
4.2	Private Pump house	Private Tank	Cement Factory	-	-	-			Priva		
5	**Letombo**	Transmission		900	97	86400	4 +2	450	1979	Reh	NR
5.1		Transmission	Greendale			43200	2 + 1				
5.2		Transmission	Donnybrook			43200	2 + 1				

Item Nr	Item Description	Function	Pumping/ Gravitation to	Q (m^3)	H (m)	Capacity (m^3/d)	Pumps D + SB	kW per Pump	Yea Built	Remedial Measures	
										Medium Term	Long Term
5.3		Transmission	Sunway City	-	-	-	1 + 1	75	NC		
6	**Orange Groove**	Transmission		250	15	18000	3 + 2	90		Reh	NR
										Medium	
		Transmission	Highlands			6000	1 + 1				
		Transmission	Greendale			12000	2 + 1				
7	**Greendale**	Lift Station		110	22	2640	1 + 1	15	1979	Reh	Rep
8	**Crow Hill**	Transmission	Philadelphia	400	40	9600	1 + 1	110	1971	Reh	Rep
9	**Philadelphia**	Transmission	Hogerty Hill	150	35	3600	1 + 1	18.5	1978		
9.1		Private Tank	Domboshava	-	-	-	-	-	-	-	-
10	**Emerald Hill**	Lift Station		15	30	720	2 + 1	4	1980	Reh	Rep
		Transmission		-	-	-	1 + 1		2000		RI
11	**Avondale**	Transmission	Emerald Hill	590	70	42480	3 + 1	160	1959	Reh	NR
12	**Bluff Hill***	Transmission	Adylinn	272	55	13056	2 + 1	55	1960	NR	NR
13	**Kuwadzana****	Lift to Reservoir	Reservoir 02	200	90	4800	1 + 1	90	1995	In	NR

Item Nr	Item Description	Function	Pumping/ Gravitation to	Q (m³)	H (m)	Capacity (m³/d)	Pumps D + SB	kW per Pump	Yea Built	Remedial Measures	
										Medium Term	Long Term
14	**Marimba Park*** **	Lift Station		150	35	3600	1 + 1	18.5	1980	Reh	Rep
15	**Water Falls*** **	Lift Station		150	35	3600	1 + 1	18.5	1995	Reh	Rep
16	**Dzivaresekwa**** **	Lift to Reservoir		-	-	-			IC	In	NR

Notes

*	*Completely vandalised and not in use*
**	*Both pumps are missing*
***	*Pump capacity estimated*
****	*Building complete but no equipment installed. Part of pipework completed.*
NC	*Not Commissioned*
IC	*Incomplete*
Reh	*Rehabilitation*
Rep	*Replacement*
In	*Installations*
NR	*Not required*
RI	*Reinstate*

1.3.1 Warren Control Pump Station

Warren Booster Pump Station is the central transfer station for the supply of water from Morton Jaffray WTW. This booster station was constructed in 1953 and since been upgraded at intervals to date. The pump station is situated on the Bulawayo Road, approximately 7 km west of the City Centre. This pump station was upgraded match with the upgrades at the Morton Jaffray WTW. The minimum capacity of this pump station is circa 362,880 m^3/day.

Warren Pump Station fourteen pumps which are installed in two pump houses; pump house No 2 and 3. Six of the fourteen pumps are duty pumps while the remaining eight are standby pumps. Below are the details of the pumps found at Warren Pump Station:

- Make: Weir Split Casing
- Model: Uniglide, SDBE 450/600
- Type: Horizontal side suction and delivery
- Q = 2520 m3/h.
- H = 120 m
- Motor: 930.84 kW, 3.3 kV
- Suction valves: DN 600 gate valves with actuators;
- Delivery valves: DN 600 gate valves with actuators
- Non-return valves: poppet type

The table below shows the condition of the pumps, motors and starter motors.

Table 1-10: Condition Pumps at Warren Pump Station

No	Pump	Motor	Console
1	Not Operational	Not Operational	Not Operational
2	Operational	Operational	Operational
3	Not Operational	Not Operational	Operational
4	Not Operational	Not Operational	Operational
5	Not Operational	Not Operational	Operational
6	Operational	Operational	Operational
7	Operational	Operational	Operational
8	Not Operational	Not Operational	Operational
9	Not Operational	Not Operational	Not Operational
10	Not Operational	Not Operational	Operational
11	Operational	Operational	Operational
12	Operational	Not Operational	Operational
13	Operational	Operational	Operational
14	Operational	Operational	Operational

The table overleaf shows the investment measures required at the Warren Control Pumps Station.

Table 1-11: Proposed Investment Measures at Warren Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of the chlorination plant, ammonia plant, Booster pumps and motors including the replacement of pumps, 2 and 4 complete with motors and pump controls. Rehabilitation of suction, delivery and non-return valves, Installation of air valves, gantry cranes, and Switchboards. Reinstatement of small power and lighting, security lights, dewatering pumps and ventilation fans. Rehabilitation of the standby generator, replacement of butterfly valves, flow meters, level gauges andInstallation of SCADA system.	Consolidation of SCADA System and Rehabilitation of Pumps

1.3.2 Alexandra Park Pump Station

The Alexandra Park Pump Station was built between 1974 and 1975. There are two pump stations at Alexandra Park Pump Station. The pump station is situated inside the Botanical Gardens at the north-east of the Alexandra Park reservoir site. The old pump station house pumps which pump water to the reservoirs at Highlands. A new pump station was constructed at Alexandra Park in 2000 next to the existing old pump house. This pump house pumps water to the Hatfield reservoirs.Below are the details of the pumps found at Alexandra Park Pump Station.

<u>Pump Station 1</u>

There are 4 No pumps (3 Duty, 1 Standby) having the following particulars:

- Make: KSB ETA 250-50 DSKN (2 nr, year 1975 and 2002)/ Boshan KT 300/250/400 (1 nr, year 2000)
- Type: Horizontal Volute
- Q = 1,036 m3/h.
- H = 45 m/50 m
- Motor: 250 kW/300 kW, 380 V
- Suction gate valves: DN 400 gear operated;
- Delivery gate valves: DN 400 gear operated;
- Non-return valves: hinged gate type, DN 400

<u>Pump Station 2</u>

The pump station, No 02 has two pumps (1 Duty; 1 Standby). The particulars of these pumps are:

- Make: KSB ETA 250-50 DSKN (Year: 2000)
- Type: Horizontal Split Casing
- Q = 1,035 m3/h.
- H = 95 m
- Motor: 375 kW, 380 V

- Suction gate valves: DN 400 gear operated;
- Delivery gate valves: DN 400 gear operated;
- Non-return valves: hinged gate type

The table below shows the condition of the pumps, motors and starter motors.

Table 1-12: Condition Pumps at Warren Pump Station

No	Pump	Motor	Console
		Pump Station 1	
1	Not Operational	Operational	Not Operational
2	Non Operational	Operational	Operational
3	Operational	Operational	Operational
4	Operational	Operational	Operational
		Pump Station 2	
1	Operational	Operational	Operational
2	Operational	Operational	Operational

The table overleaf shows the investment measures required at the Alexandra Park Pump Station.

Table 1-13: Proposed Investment Measures at Alexandra Park Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Pump Station No 1	
	Rehabilitation of booster pumps and motors, Suction, delivery and non-return valves and Installation of air valves. Rehabilitation of Switchboards, reinstatement of small power and lighting, security lights, replacement of dewatering pump, rehabilitation of ventilation fan and installation of electric wire rope hoist. Replacement of level gauges and installation of SCADA system	Will need to be decommissioned
	Pump Station No 2	
	Rehabilitation of booster pumps and motors, Suction, delivery and non-return valves and Installation of air valves. Rehabilitation of Switchboards, reinstatement of small power and lighting, security lights, replacement of dewatering pump, rehabilitation of ventilation fan and installation of electric wire rope hoist. Replacement of level gauges and installation of SCADA system	Consolidation of SCADA System and Rehabilitation of Pumps

1.3.3 Highlands Lift Station

The Highlands Lift Station has two pumps (1 Duty and 1 Standby) which pump water to an elevated fibre glass tank with a 10 m^3 capacity. From this tank, water gravitates to supply the highlands area.

The pumps at the Highlands Lift Station are controlled through a hydrophone. The pump station is operational but requires attention in improving the cable installations and the pump house itself. For the long term measures, the construction of a new pump house is recommended.

The two pumps at the Highlands Lift Station are of different make and capacity. The replaced pumps should be of the same capacities and make for standardisation and parallel operation for peak delivery. Below are the details of the pumps found at Highlands Lift Station:

Pump No 01

- Make: Ebara
- Model: MD/A 200/22 (Year 2002)
- Type: Horizontal volute
- Q = 48/132 m3/h.
- H = 59.5/46 m
- Motor: 22 kW, 380 V

Pump No 02

- Make: KSB
- Model: ETA 50/250(Year 2002)
- Type: Horizontal volute
- Q = 110 m3/h.
- H = 22 m
- Motor: 22 kW, 380 V

Non-return valves: poppet type

The table below shows the condition of the pumps, motors and starter motors.

Table 1-14: Proposed Investment Measures at Highlands Lift Station

Immediate	Medium Term (2020)	Long Term (2030)
	Replacement of cables, pumps complete with motors, starters and installation of SCADA system.	Construction of a new pump house, replacement of the elevated tank with one of a larger capacity. Replacement of pumps, motors and starters for the required water demand and Installation of pump controls.

1.3.4 Donnybrook Pump Station

The Donnybrook Pump Station has 3 pump houses:

- the Mabvuku Pump house located in the water tower;
- the Cement Factory Pump house;
- a new pump house, which had not been commissioned at the time of our visit.

Mabvuku Pump house

The Mabvuku pump station was built between 1955 and 1956. This is a lift pump station for pumping water to the elevated concrete tank. The pump house is located inside the water tower

The water tower supplies by gravity to the high lying area surrounding the reservoir site. The lift station is has two centrifugal pumps (1Duty and 1Standby). The pumps are arranged for parallel operation if required.

The capacity of the original pumps was71 m^3/h with a head of 22.25 m. These pumps have been replaced with the ones described below.

The pumps' operation is designed to be automatic by means of a float-switch installed in the water tower. This system, however, is not operational.The flow meter installed on the inlet pipe of the lift station is also not operational. Only one pump was found to be operational as the second pump had been removed.

Below are the details of the pumps found at Mukuvisi Pump House:

- Make: SPP;
- Model: Unistream;
- Type: Horizontal volute;
- Q = 140 m3/h;
- H = 30 m;
- Motor: 18.5 kW, 380 V.

New Pump House

A new pump house has been constructed within the compound of the Donnybrook reservoir. The pipework, pumps and switchboards have been installed but it was commissioned at the time of the site visit. Consequently, the specifications of the equipment could not be confirmed.

Cement Factory Pump House

A pump house for the Lafarge Cement Factory, situated at the reservoir site, also draws water from the Donnybrook reservoir. The pump capacities could not be confirmed.

The table overleaf shows the proposed investment measures at the Donnybrook Pump Station.

Table 1-15: Proposed Investment Measures at Donnybrook Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Provision of new pumps and motors, rehabilitation of the fittings, provision of air valves and pressure gauges. Installation of pump controls, flow meter, improvement of illumination and provision of SCADA system	Replacement of pumps, motors and starters for the required water demand, valves and fittings. Provision of a standby generator

1.3.5 Letombo Pump Station

The Letombo Pump Station is located on Cavan Lane, off Mutare Road and it was built in 1979. The pump station pumps water to the eastern zone of Harare. The water from the Letombo reservoirs is pumped to Donnybrook, Ventersburg and Greendale reservoirs.

Initially, there were five pumps (3Duty; 2Standby) with a capacity of:

- Q = 900 m^3/h
- H = 98 m

These pumps were arranged to operate as follows:

- Pumping to Donnybrook and Ventersburg reservoirs: 3 No pumps (2Duty and 1 Standby);
- Pumping to Greendale reservoirs and distribution system: 2 No pumps (1Duty; 1Standby)

The pump house initially had a plinth which was built to accommodate an additional pump. This pump was installed in 1999 to allow two duty pumps for each of the above pumping mains.

The pumps are automatically operated by a float-switch installed at the reservoir sites and linked by radio signal. The Clayton valve at Ventersburg is not operational. As a result, the gate valve at the inlet pipe of the two interconnected reservoirs has to be closed and opened manually, on a daily basis. The Clayton valve, DN 600 needs to be replaced.

The outlet pipe of the pumping station is metered with the following flow meters:

- Flow meter AL8: records flows to Ventersburg and Donnybrook on DN 600 line
- Flow meter AL9: records the discharge to Greendale reservoirs and the reticulation system of Greendale on DN 500 line

Both these flow meters were found to be not operational.In 1999, a new pump house (Sunny City) was constructed and equipped but to date it has not been commissioned.The following are the pump parameters at the Sunway City Pump House.

- Make: Weir Envirotech (1999);
- Type: Horizontal Split Casing;
- Q & H: Not shown on the nameplate;
- Suction gate valves: DN 200;
- Delivery butterfly valves: DN 200;
- Motor: 75 kW, 380 V;

In addition, a new chlorination facility was constructed in 2012 by UNICEF. This facility has also not been commissioned to date.

Letombo Pump House

Below are the details of the pumps found at Letombo Pump House:

Pumps (2Duty; 1Standby): Pumping to Donnybrook (Pump Nos 01, 02 & 03)

- Make: Salweir (original pumps)
- Type: Split Casing
- Q = 900 m^3/h
- H = 98 m
- Motor: 350 kW, 3.3 kV

Pump Nos 01 and 02 were installed in 1979 and are worn out. Pump No 03 was replaced in 1999 with the following pump:

- Make: Boshan
- Model: OS 250/600
- Type: Split Casing
- Q = 1036 m^3/h
- H = 105 m
- Motor: 450 kW, 3.3 kV

Pumps (2Duty; 1Standby): Pumping to Green Dale (Pump Nos 04, 05 & 06)

- Make: Salweir (original pumps)
- Type: Split Casing
- Q = 900 m^3/h
- H = 98 m
- Motor: 350 kW, 3.3 kV

Pump Nos 04 and 05 were installed in 1979 and are worn out. Pump No 04 is operational but the motor is not operational. Pump No 06 was replaced in 1999 with the following pump:

- Make: Boshan
- Model: OS 250/600
- Type: Split Casing
- Q = 1036 m^3/h
- H = 105 m
- Motor: 450 kW, 3.3 kV

The table overleaf shows the condition of the pumps at Letombo Pump Station.

Table 1-16: Condition Pumps at Letombo Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Operational	Non Operational	Operational
3	Operational	Operational	Operational
4	Operational	Non Operational	Operational
5	Non Operational	Operational	Operational
6	Operational	Operational	Operational

The table below shows the proposed investment measures at the Letombo Pump Station.

Table 1-17: Proposed Investment Measures at Letombo Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Replace pumps complete with motors and starters, rehabilitate pumps and motors. Replacement of suction butterfly valves and delivery gate valves. Rehabilitation of motor feeder switchboard, replace the DC system and replace 1 transformer. Installation of overhead electric wire rope hoist and SCADA system and harmonise with the reservoir float switches	

1.3.6 Orange Grove Pump Station

Orange Grove pump station was constructed between 1969 and 1970 and it is situated on Ranelagh Drive off Orange Grove, south west of Highlands reservoir site.

Orange Grove gets it's ,main supply from Alexandra Park reservoirs by two gravity mains of DN 450 and DN 375.

The water is supplied to a sump from where it is pumped to Greendale and Highlands reservoirs. There are six pumps and two pumps operate in parallel for the supply to Greendale and Highlands with one pump for each pumping main being on standby.

These pumps are automatically operated by float-switches installed at Greendale and Highlands reservoirs and linked by radio signal. This system, however, is no longer operational.

Below are the details of the pumps found at Orange Grove Pump House:

- Make: Weir Envirotech
- Type: Horizontal Multistage
- Q = 250 m^3/h
- H = 150 m
- Motor: 90 kW, 380 kV

The table below shows the condition of the pumps at Letombo Pump Station.

Table 1-18: Condition Pumps at Orange Grove Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Non Operational	Operational	Removed
3	Operational	Operational	Operational
4	Operational	Operational	Operational
5	Operational	Operational	Operational
6	Removed	Removed	Removed

The table below shows the investment measures required at the Orange Grove Pump Station.

Table 1-19: Proposed Investment Measures at Orange Grove Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of pumps complete with motors and starter panels. Replacement of ZESA Incomer OCB, suction valves,delivery valves,NRV and rehabilitation of valve headstocks. Replacement of suction manifold and main delivery manifold gate valves. Reinstatement of the radio link, float switches in the reservoirs and float switches in the pump suction chamber Reinstatement of the lights and servicing of the gantry crane	The Orange Grove pump station pumps to Highlands and Greendale. In the long term, the latter will get supplies from the proposed Kunzwi resource zone and the pump station (Orange Grove) will not be required the

1.3.7 Green Dale Pump Station

The Green Dale water tower was constructed between 1979 and 1980 and it replaced the old water tower, which still exists. The lift pumps convey water to the elevated tank for supply by gravity to the high lying areas of Greendale surrounding the reservoir site. Green Dale receives water from Alexandra Park via Orange Grove.

The lift station is located in the base of the water tower and it is equipped with two pumps, which may be operated in parallel.

The original pumps were reportedly Salsa Weir, model VES 100-728. The existing pumps have the following specifications:

- Q = 110 m^3/h;
- H = 22 m

The table overleaf shows the condition of the pumps at Green Dale Pump Station.

Table 1-20: Condition Pumps at Green Dale Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Non Operational	Operational	Removed
3	Operational	Operational	Operational
4	Operational	Operational	Operational
5	Operational	Operational	Operational
6	Removed	Removed	Removed

The table below shows the investment measures required at the Green Dale Pump Station

Table 1-21: Proposed Investment Measures at Green Dale Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Reinstatement of the pump station by the replacement of pumps and motors, starters, flow meter, valves and pump control system.	The Orange Grove pump station pumps to Highlands and Greendale. In the long term, the latter will get supplies from the proposed Kunzwi resource zone and the pump station (Orange Grove) will not be required the

1.3.8 Crow Hill Pump Station

The Crow Hill Pump Station was constructed between 1971 and 1972 and it is located at the junction of Borrowdale Road and Crow Hill Roads.

The water supplied from Alexandra Park Pump Station 02 is pumped by the Crow Hill Pump Station to Philadelphia reservoirs to supply the Winchendon, Quinnington and Philadelphia areas from the reservoir. In a long term, it is proposed that Crow Hill will receive water by gravity from Highlands and then pump to Philadelphia reservoirs.

The pumping station is equipped with two horizontal centrifugal pumps. The pumps may be operated in parallel. There is an additional space available to install another pump if required.

The pumping station is automatically operated by a float-switch installed at Philadelphia reservoir. There is no flow meter to record the outflow. A dedicated transformer supplies the LV power for the pumps.

Below are the details of the pumps found at Crow Hill Pump Station:

<u>Pump No 01</u>

- Make: Boshan (2006)
- Model: RS 150 46 DA
- Q = 415 m^3/h
- H = 46 m
- Motor: 110 kW/380V

<u>Pump No 02</u>

- Make: Harland (1972)
- Q = 381.6 m^3/h
- H = 37.5 m
- Motor: (missing)

The table below shows the condition of the pumps at Crow Hill Pump Station.

Table 1-22: Condition Pumps at Crow Hill Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Non Operational	Removed	Removed

The table below shows the investment measures required at the Crow Hill Pump Station.

Table 1-23: Proposed Investment Measures at Crow Hill Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of pump complete with motor and starter panel. Rehabilitation of suction valves, delivery valves and NRVs Reinstatement of the radio link, float switches in the reservoirs and float switches in the pump suction chamber. Installation of electric wire rope hoist and reinstatement of the lights.	Replacement of pumps with lower capacities.

1.3.9 Kuwadzana

The Kuwadzana Pump Station was commissioned in 1995 and it is situated on in the south-east of Kuwadzana. The pump station receives water from a branch line of 600 mm Ø off the 750 mm Ø pipeline from Morton Jaffray WTP, which conveys water to the City.

The pumping main is a 300 mm Ø pipe to the Fontainebleau reservoir, north of Kuwadzana.

The pump station has three plinths for pumps. Only two pumps were installed but both of these pumps have been removed, leaving the motors only. The spare plinth has the pipework.

Two pumps for parallel operation were installed as one duty and one standby. The original pumps reportedly had the following specifications:

- Make: Vogel
- Model: LS 100-250
- Q = 198 m^3/h
- H = 90 m
- Motor: 90 kW/380 V

The pumps were operated automatically by a float switch installed in the reservoir and linked by radio connection.

Table 1-24: Condition Pumps at Kuwadzana Pump Station

No	Pump	Motor	Console
1	Removed	Not Operational	Operational
2	Removed	Not Operational	Operational

The table below shows the investment measures required at the Kuwadzana Pump Station.

Table 1-25: Proposed Investment Measures at Kuwadzana Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of pump complete with motor and starter panel. Rehabilitation of suction valves, delivery valves and NRVs Reinstatement of the radio link, float switches in the reservoirs and float switches in the pump suction chamber. Installation of electric wire rope hoist and reinstatement of the lights.	

1.3.10 Hogerty Hill Pump Station

The Hogerty Hill pump station was commissioned in 1979 and it is situated on the Philadelphia reservoir site, which lies north east of Harare. The pumps draw water from a sump and supply it to the Hogerty Hill reservoir through a pumping main of 200mm Ø transmission line.

The pump station has three plinths for pumps.Only two pumps have been installed. The pumps are operated automatically by a float switch installed in the reservoir and linked by radio connection. The particulars of the pumps (1Duty and 1Standby) are as follows:

- Make: AJAX
- Type: 3 MS
- Q = 136 m^3/h
- H = 30 m

Table 1-26: Condition Pumps at Hogerty Hill Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Operational	Operational	Operational

<u>Domboshava (Private) Pump House</u>

The Domboshava Pump House is similar to the above but it was not inspected at the time of the site visit, therefore, the particulars of the installations could not be confirmed.

The table overleaf shows the investment measures required at the Hogerty Hill Pump Station.

Table 1-27: Proposed Investment Measures at Hogerty Hill Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of pump complete with motor and starter panel. Rehabilitation of suction valves, delivery valves and flow meter Rehabilitation of manifolds and reinstatement of small power and lighting	Rehabilitation/replacement of electromechanical equipment

1.3.11 Emerald Hill Pump Station.

Emerald Hill has two pump stations. The old pump station was commissioned in 1980 and it is a lift station which supplies the Emerald Hill Water Tower for distribution to the neighbouring school and other high lying areas. The Emerald Hill reservoirs receive water from Avondale Pump Station.

In 2000, another pump house was built to supply high lying areas some 15 km away in Mount Pleasant Heights Area. This pump house has not been used in spite of having all the pumps and switchboards fully installed.

The lift station was equipped with three centrifugal pumps which are arranged for parallel operation with two pumps on duty and one pump on standby. However, there is now only one pump in operation and the other two have been removed.

The pumps are operated automatically by a float switch installed in the water tower and linked by radio signal.

The Lift Station

The particulars of the pumps (1 Duty and 1 Standby) installed in the old pump house are as follows:

- Make: SUNGUS,
- Model: VSC Size 11/2x2
- Q = 9.55 m^3/h
- H = 27.4 m

The current condition of the pumps, motors and starters is summarised in the table below:

Table 1-28: Condition Pumps at High Lift Pump Station

No	Pump	Motor	Console
1	Removed	Not Operational	Operational
2	Removed	Removed	Not Operational
3	Removed	Removed	Not Operational

The New Pump House

The particulars of the pumps (1Duty; 1Standby) installed in the new pump house could not be confirmed.

The current condition of the pumps, motors and starters is summarised in the table overleaf:

Table 1-29: Condition Pumps at New Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Operational	Operational	Operational

The table below shows the investment measures required at the Emerald Hill Pump Station.

Table 1-30: Proposed Investment Measures at Emerald Hill Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Replacement of pumps, starters, switchboard, and pump control system, valves, reinstatement of small power and lighting at the old pump station.	Replacement of pumps, starters, switchboard, and pump control system, valves, reinstatement of small power and lighting at the old pump station.

1.3.12 Avondale Pump Station

The Avondale pump station was commissioned in 1959 and it is situated at the junction of Lomagundi Road/West Road. The pump station receives water from Warren Control Station and it pumps it to Emerald Hill reservoirs. Three of the pumps are fed from a suction chamber but one pump is for emergency use and it gets water directly from the Warren pumping main.

There are four centrifugal pumps which are arranged for parallel operation. The pumps are operated automatically by a float switch installed in the Emerald Hill reservoir and liked by radio signal. The particulars of the new pumps (2 Duty; 1 Standby) are as follows:

- Make: Boshan;
- Type: Horizontal Split Casing;
- Q = 590 m^3/h;
- H = 70 m;

The current condition of the pumps, motors and starters is summarised in the table below:

Table 1-31: Condition Pumps at Avondale Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Operational	Operational	Operational
3	Non Operational	Non Operational	Non Operational
4	Operational	Operational	Operational

The table below shows the investment measures required at the Avondale Pump Station.

Table 1-32: Proposed Investment Measures at Avondale Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of pumps complete with motors and starters.	This pump station will not be required for long term as

Immediate	Medium Term (2020)	Long Term (2030)
	Replacement of flow meters, pump control system and valves. Rehabilitation of manifolds and reinstatement of small power and lighting	adequate water from the proposed Kunzwi project will be available.

1.3.13 Bluff Hill Pump Station

The Bluff Hill Pump Station was commissioned in 1960 and is situated on Lorraine Drive, near Faber Road. It was observed during the site visit that Bluff Hill pump station has completely been vandalised and all the equipment stolen. The pump station supplied water to Adylinn, Epsilon, and Bluff Hill reservoir sites.

The station was equipped with three centrifugal pumps which were arranged for parallel operation. These pumps reportedly had the following specifications.

- Make: Harland
- Model: SDC 5/6
- Q = 272 m^3/h
- H = 55 m
- Motor: 75 kW/380 V

There is now a direct 800 mm pumping main from Warren to the above reservoirs and therefore, there is no need for this pump station.

<u>Recommended Remedial Measures for Bluff Hill Pump Station</u>

As stated above, the Bluff Hill pump station is completely vandalised and it also served no purpose as direct pumping main of 800 mm is existing to supply water to Adylinn, Epsilon and Bluff Hill areas. Therefore, no remedial measures are required.

1.3.14 Marimba Park Pump Station

Marimba Park pump station is situated in the south west of the City centre and it is located inside the Marimba Park reservoir site. The pumps were commissioned in 1980.

The two horizontal centrifugal pumps supply water into the water tower situated nearby. From here, water gravitates to high lying areas.

The pumps are installed for parallel operation with normally one pump on duty and the other on standby. However, there is now only one pump and the second pump, motor and starter have been removed.

These pumps are operated automatically by a float switch installed in the water tower and linked by radio signal. The particulars of the pumps (1 Duty; 1 Standby) installed in the pump house are as follows:

- Make: Unknown
- Model: Unknown
- Q = 9.55 m^3/h
- H = 30 m

Table 1-33: Condition Pumps at Marimba Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Removed	Removed	Removed

The table below shows the investment measures required at the Avondale Pump Station.

Table 1-34: Proposed Investment Measures at Marimba Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of pumps complete with motors and starters. Replacement of flow meters, pump control system and valves.	Replacement of the most of the installations.

1.3.15 Waterfalls Pump Station

The Waterfalls pump station is situated in the south of the City centre. The pump station was reported to have been constructed in the 1970s but it has not been in use for over past 10 years. However, the pumps appear to be intact.

The two horizontal centrifugal pumps are supposed to supply water into the water tower situated nearby.

The pumps were installed for parallel operation with one pump on duty and the other on standby. Both the pumps, motors and starters appear to be in working order.These pumps were planned to be operated automatically by a float switch installed in the water tower and linked by radio signal.

The particulars of the pumps (1Duty and 1Standby) installed in the pump house are as follows:

- Make: Worthington
- Type: Horizontal split casing
- $Q = 120\ m^3/h$
- $H = 30\ m$

Table 1-35: Condition Pumps at Waterfalls Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Operational	Operational	Operational

The table below shows the investment measures required at the Waterfalls Pump Station.

Table 1-36: Proposed Investment Measures at Waterfalls Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of pumps complete with motors and starters. Replacement of flow meters, pump control system and valves.	Replacement of the installations.

1.3.16 Dzivaresekwa Pump Station

Dzivaresekwa Pump Station is situated towards the west of the City. The construction of the Dzivaresekwa pump station commenced in 2012 and to date, it is not complete.

Recommended Remedial Measures for Dzivaresekwa Pump Station

It is envisaged that Harare Water will complete this pump station and that it will serve for the medium term period.For the long term, it is envisaged that this pump station will not be required as Reservoir 02 will receive water from Mutiny.

1.4 Treated Water Transmission System

1.4.1 Water Supply Zones

The zoning criteria of the Greater Harare, as applied in the modelling process, used the existing water supply zones as well as the proposed zones. The zones are independent in the sense that each zone has a dedicated service reservoir. These reservoirs are supplied by transmissions mains. The bulk water transmission pipelines are normally of larger diameter and convey water to these service reservoirs, from where the water is supplied into the WSZ. Each bulk water transmission main supplying the reservoirs are equipped with bulk water meters at the inlet and outlet of the reservoirs. However, the bulk water meters are currently not operational. Consequently, the current water demand was calculate based on the 2012 population figures. This section briefly describes the proposed water zones

The demand in each zone was obtained by overlaying the wards layer with the proposed zones layer in ArcView 10.1. The demand in each supply zone was calculated in such a way that the ward that was completely in a particular zone was allocated 100% of its demand to that particular zone. For those wards which shared boundaries between different zones, their demand were subdivided according to the shared boundary in each zone.

The following table shows the water supply zones proposed zones, the dedicated storage reservoirs and the estimated water demand requirements in the supply zone. All zones will be equipped with bulk meters for monitoring the inflow from reservoirs into the zones. This is an important aspect of leak detection activities.

Table 1-37: Zones and Service Reservoirs

Water Supply Zone	Storage (m^3)	2013 (m^3/d)	2020 (m^3/d)	2030 (m^3/d)
Hatcliff	11,400	7,245	15,536	26,401
Kambanji	5680	11,110	8,063	7,348
Philadelphia	7580	5,532	4,056	3,782
Adylinn	1,140	11,281	13,634	21,776
Highlands	61,710	14,369	10,110	8,372
Arundel	7,580	5,989	4,227	3,460
Epsilon	4,090	15,042	10,684	10,939
Bluff Hill	5,680	24,014	16,822	16,401
Emerald Hill	25,750	6,367	4,404	4,098
Greendale	70,770	14,629	11,579	12,257

Water Supply Zone	Storage (m^3)	2013 (m^3/d)	2020 (m^3/d)	2030 (m^3/d)
Donnybrook	47,460	36,172	34,016	43,738
Alexandra Park	111,950	40,255	28,335	23,968
Ridge Road	3,580	6,617	4,284	3,234
Meyrick Park	2,280	6,367	4,404	4,098
Dzivaresekwa	16,480	17,232	21,784	37,002
Letombo	236,400	101,045	77,404	72,620
Kopje	7,960	33,102	25,914	24,982
Mutiny	11,400	5,973	4,440	4,106
Viking	27,260	17,115	13,751	13,460
Lochinvar	72,160	71,410	55,518	53,573
Ventersburg	22,800	34,478	47,666	50,467
Hatfield	13,610	13,700	13,734	49,663
Marimba Park	34,700	30,990	25,751	24,898
Waterfalls	5,680	24,283	21,355	56,128
Kwadzana	11,940	46,487	43,871	56,192
Shamva RD (Proposed)			2,828	7,452
Mt Pleasant Heights			7718	15,145

Hatcliff Water Supply Zone

This WSZ is supplied from the Hatcliff Reservoir with the capacity of 11,400 m^3. The Zone covers Hatcliff, Sally Mugabe, part of Sunningdale and Graniteside. The total peak season demand for year 2020 and 2030 in the zone is 15,536 m^3/day and 26,401 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Hatcliff Reservoirs will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 16,000 m^3 will be required to meet the 2030 peak demand.

Kambanji Supply Zone

This WSZ is supplied from the Kambanji Reservoir with the capacity of 5,680 m^3. The Zone covers Greystone Park Quinnington, Chiltern Hills, Glenwood, Kambanji, Glen Lorne, Grey Lichen and Carrick Creach. The total peak season demand for year 2020 and 2030 in the zone is 8,063 m^3/day and 7,348 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Kambanji Reservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 2,000 m^3 will be required to meet the 2030 peak demand.

Philadelphia Supply Zone

This WSZ is supplied from the Philadelphia Reservoir with the capacity of 7,580 m^3. The Zone covers Winchendon, Helensvale, Borrowdale Brook, Philadelphia and Eland Park. The total peak season demand for year 2020 and 2030 in the zone is 4,053 m^3/day and 3,782 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Philadelphia Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Adylinn Supply Zone

This WSZ is supplied from the Adylinn Reservoir with the capacity of 1,140 m^3. The Zone covers New Marlborough and Adylinn areas. The total peak season demand for year 2020 and 2030 in the zone is 13,634 m^3/day and 21,776 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Adylinn Reservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 22,000 m^3 will be required to meet the 2030 peak demand.

Highlands Supply Zone

This WSZ is supplied from the Highlands Reservoir with the capacity of 61,710 m^3. The Zone covers Borrowdale, Vainona, Pomona, Colray, Borrowdale West, Rietfontein, Colne Valley and Ballantyne Park areas. The total peak season demand for year 2020 and 2030 in the zone is 10,110 m^3/day and 8,372 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Highlands Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Arundel Supply Zone

This WSZ is supplied from the Arundel Reservoir with the capacity of 7,580 m^3. The Zone covers Mount Pleasant, Little Norfolk and Northwood areas. The total peak season demand for year 2020 and 2030 in the zone is 4,227 m^3/day and 3,460 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Arundel Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Epsilon Supply Zone

This WSZ is supplied from the Epsilon Reservoir with the capacity of 4,090 m^3. The Zone covers Marlborough, Avonlea, Emerald Hill and Ashrrittle areas. The total peak season demand for year 2020 and 2030 in the zone is 10,684 m^3/day and 10,939 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Epsilon Reservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 7,500 m^3 will be required to meet the 2030 peak demand.

Bluff Hill Supply Zone

This WSZ is supplied from the Bluff Hill Reservoir with the capacity of 5,680 m^3. The Zone covers New Bluff Hill, Bluff Hill Park, Ashdown Park and Sanganayi Park areas. The total peak season demand for year 2020 and 2030 in the zone is 16,822 m^3/day and 16,401 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Bluff Hill Reservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 12,000 m^3 will be required to meet the 2030 peak demand.

Emerald HillSupply Zone

This WSZ is supplied from the Emerald Hill Reservoir with the capacity of 25,750 m^3. The Zone covers Sherwood Park, Sentosa and Mayfield Park areas. The total peak season demand for year 2020 and 2030 in the zone is 4,404 m^3/day and 4,098 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Emerald Hill Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Greendale Supply Zone

This WSZ is supplied from the Greendale Reservoir with the capacity of 70,770 m^3. The Zone covers Lewisam, Chisipite, The Grange, Athlone, Mandara, Wormshill, Lichendale, Oval Park, Runnivale and Rhodesvale areas. The total peak season demand for year 2020 and 2030 in the zone is 11,579 m^3/day and 12,257 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Greendale Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Donnybrook Supply Zone

This WSZ is supplied from the Donnybrook Reservoir with the capacity of 47,460 m^3. The Zone covers Mabvuku, Tafara, Chikurubi, Manresa and Chiznanje areas. The total peak season demand for year 2020 and 2030 in the zone is 34,016 m^3/day and 43,738 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Donnybrook Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Alexandra Park Supply Zone

This WSZ is supplied from the Alexandra Park Reservoir with the capacity of 47,460 m^3. The Zone covers Alexandra Park, Avondale, Kensington, Milton Park, Belvedere Park, Strathaven and Avenue areas. The total peak season demand for year 2020 and 2030 in the zone is 28,335 m^3/day and 23,968 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Alexandra Park Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Ridge Road Supply Zone

This WSZ is supplied from the Ridge Road Reservoir with the capacity of 3,580 m^3. The Zone covers Avondale West areas. The total peak season demand for year 2020 and 2030 in the zone is 4,284 m^3/day and 3,234 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Ridge Road Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Meyrick Park Supply Zone

This WSZ is supplied from the Meyrick Park Reservoir with the capacity of 2,280 m^3. The Zone covers St Andrews, Haig Park, Cotswold Hills, Mablereigh, Sunridge, Ridgeway and Sunrise areas. The total peak season demand for year 2020 and 2030 in the zone is 4,404 m^3/day and 4,098 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Meyrick ParkReservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 2,000 m^3 will be required to meet the 2030 peak demand.

Dzivaresekwa Supply Zone

This WSZ is supplied from the DzivaresekwaReservoir with the capacity of 16,480 m^3. The Zone covers Dzivaresekwa area. The total peak season demand for year 2020 and 2030 in the zone is 21,784 m^3/day and 37,002 m^3/day respectively. Based on the long-term peak demand, the current combined storage for DzivaresekwaReservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 22,000 m^3 will be required to meet the 2030 peak demand.

Letombo Supply Zone

This WSZ is supplied from the Letombo Reservoir with the capacity of 236,400 m^3. The Zone covers Sunningdale, Graniteside, Highfield, Ardbennie, Mbare, Prospect, Logan Park, Sunningdale, St Martins, Cranborne Park, Queensdale, Arcadia, Graniteside, Braeside, Hillside, Beverly West, Masasa, Mukuvisi Park, Amby, Bingley, Beverly, Greengrove and Lorelei areas. The total peak season demand for year 2020 and 2030 in the zone is 77,404 m^3/day and 72,620 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Letombo Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Kopje Supply Zone

This WSZ is supplied from the Kopje Reservoir with the capacity of 7,960 m^3. The Zone covers the City Centre area. The total peak season demand for year 2020 and 2030 in the zone is 25,914 m^3/day and 24,982 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Kopje Reservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 18,000 m^3 will be required to meet the 2030 peak demand.

Mutiny Supply Zone

This WSZ is supplied from the Mutiny Reservoir with the capacity of 11,400 m^3. The Zone covers Warren Park and Warren Park D. The total peak season demand for year 2020 and 2030 in the zone is 4,440 m^3/day and 4,106 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Mutiny Reservoir will not be able to provide 24 hours emergency storage for the long-term scenario.

Viking Supply Zone

This WSZ is supplied from the Viking Reservoir with the capacity of 27,260 m^3. The Zone covers Workingston, Southerton, Ridgeview, Belvedere South and Lincoln Green areas. The total peak season demand for year 2020 and 2030 in the zone is 13,751 m^3/day and 13,460 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Viking Reservoir will not be able to provide 24 hours emergency storage for the long-term scenario.

Lochinvar Supply Zone

This WSZ is supplied from the LochinvarReservoir with the capacity of 72,160 m^3. The Zone covers Kambuzuma, Rugare, Marimba Park, Aspindale Park, Lochinvar and Willowvale areas. The total peak season demand for year 2020 and 2030 in the zone is 55,518 m^3/day and 53,573 m^3/day respectively. Based on the long-term peak demand, the current combined storage for LochinvarReservoir will not be able to provide 24 hours emergency storage for the long-term scenario.

Ventersburg Supply Zone

This WSZ is supplied from the VentersburgReservoir with the capacity of 22,800 m^3. The Zone covers Epworth, Chadcombe, Masasa Park, Mukuvisi and Park Meadowland areas. The total peak season demand for year 2020 and 2030 in the zone is 47,666 m^3/day and 50,467 m^3/day respectively. Based on the long-term peak demand, the current combined storage for VentersburgReservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 30,000 m^3 will be required to meet the 2030 peak demand.

Hatfield Supply Zone

This WSZ is supplied from the HatfieldReservoir with the capacity of 13,610 m^3. The Zone covers Hatfield area. The total peak season demand for year 2020 and 2030 in the zone is 13,734 m^3/day and 49,663 m^3/day respectively. Based on the long-term peak demand, the current combined storage for HatfieldReservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 37,000 m^3 will be required to meet the 2030 peak demand.

Marimba Park Supply Zone

This WSZ is supplied from the Marimba ParkReservoir with the capacity of 34,700 m^3. The Zone covers Hatfield area. The total peak season demand for year 2020 and 2030 in the zone is 25,751 m^3/day and 24,898 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Marimba Park Reservoir will be able to provide 24 hours emergency storage for the long-term scenario.

Waterfalls Supply Zone

This WSZ is supplied from the WaterfallsReservoir with the capacity of 5,680 m^3. The Zone covers Houghton Park, Park Town, Malvern, Midlands, Waterfalls, Induna and Brobee Park areas. The total peak season demand for year 2020 and 2030 in the zone is 21,355 m^3/day and 56,128 m^3/day respectively. Based on the long-term peak demand, the current combined storage for WaterfallsReservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 51,000 m^3 will be required to meet the 2030 peak demand.

Kuwadzana Supply Zone

This WSZ is supplied from the Kuwadzana Reservoir with the capacity of 11,940 m^3. The Zone covers Tynwald, Nkwisi Park, Westlea, Kwadzana, Kwadzana Phase 3, Kwadzana Phase 4 Extension, Crowborough and Crowborough North areas. The total peak season demand for year 2020 and 2030 in the zone is 43,871 m^3/day and 56,192 m^3/day respectively. Based on the long-term peak demand, the current combined storage for Kuwadzana Reservoir will not be able to provide 24 hours emergency storage for the long-term scenario. An additional capacity of 45,000 m^3 will be required to meet the 2030 peak demand.

Shamva Road Supply Zone

This is a proposed WSZ is supplied from the proposed Shamva RoadReservoir. The Zone will cover part of the Sally Mugabe area. The total peak season demand for year 2020 and 2030 in the zone is 2,828 m^3/day and 7,452 m^3/day respectively. To provide a 24 hours emergency storage for the long-term scenario, a new concrete reservoir with a capacity of 8,000 m^3 will be required to meet the 2030 peak demand.

Mt Pleasant Heights Supply Zone

This is a proposed WSZ which will be supplied from the Mt Pleasant Heights Reservoir. The Zone will cover the mount Hampden area. The total peak season demand for year 2020 and 2030 in the zone is 7,718 m^3/day and 15,145 m^3/day respectively. To provide a

24 hours emergency storage for the long-term scenario, a new concrete reservoir with a capacity of 8,000 m^3 will be required to meet the 2030 peak demand.

Figure 1-2 overleaf shows the WSZ in Harare and the bulk water transmission mains.

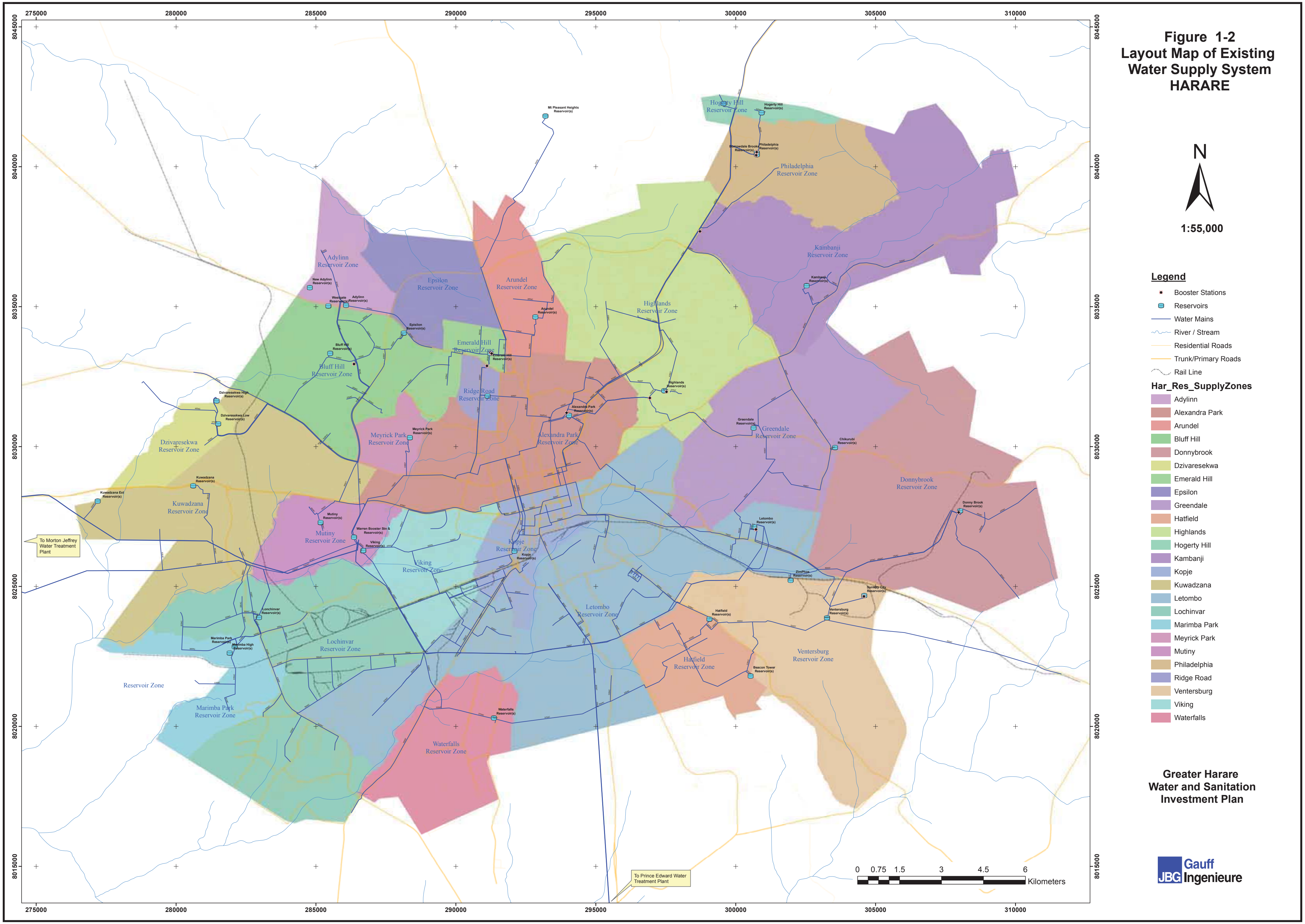


Figure 1-2
Layout Map of Existing Water Supply System HARARE
N
1:55,000
Legend
Booster Stations
Reservoirs
Water Mains
River / Stream
Residential Roads
Trunk/Primary Roads
Rail Line
Har_Res_SupplyZones
Adylinn
Alexandra Park
Arundel
Bluff Hill
Donnybrook
Dzivaresekwa
Emerald Hill
Epsilon
Greendale
Hatfield
Highlands
Hogerty Hill
Kambanji
Kopje
Kuwadzana
Letombo
Lochinvar
Marimba Park
Meyrick Park
Mutiny
Philadelphia
Ridge Road
Ventersburg
Viking
Waterfalls
Greater Harare Water and Sanitation Investment Plan
Gauff Ingenieure
JBG
Hogerty Hill Reservoir Zone
Philadelphia Reservoir Zone
Kambanji Reservoir Zone
Adylinn Reservoir Zone
Epsilon Reservoir Zone
Arundel Reservoir Zone
Highlands Reservoir Zone
Emerald Hill Reservoir Zone
Bluff Hill Reservoir Zone
Ridge Road Reservoir Zone
Dzivaresekwa Reservoir Zone
Meyrick Park Reservoir Zone
Alexandra Park Reservoir Zone
Greendale Reservoir Zone
Donnybrook Reservoir Zone
Kuwadzana Reservoir Zone
Mutiny Reservoir Zone
Kopje Reservoir Zone
Viking Reservoir Zone
Letombo Reservoir Zone
Lochinvar Reservoir Zone
Hatfield Reservoir Zone
Ventersburg Reservoir Zone
Reservoir Zone
Marimba Park Reservoir Zone
Waterfalls Reservoir Zone
To Morton Jeffrey Water Treatment Plant
To Prince Edward Water Treatment Plant
0 0.75 1.5 3 4.5 6 Kilometers
275000 280000 285000 290000 295000 300000 305000 310000
8045000 8040000 8035000 8030000 8025000 8020000 8015000

1.4.2 Proposed Resource Zones

Proposed water resource zones (WRZ) were formulated for the Greater Harare and were used in the model. The proposed water supply zones are:

- Morton Jaffray and Prince Edward – 685,000 m^3/d
- Kunzwi – 200,000 m^3/d

The WRZ would provide the water company with a strategic framework for managing water resources supply and demand management and investment. It describes an area within which the management of supply and demand is largely self-contained (apart from agreed bulk transfers of water). Within the WRZ, supply infrastructure and demand centres are generally integrated to the extent that customers in the WRZ should experience the same risk of supply failure. Consequently all customers share the same level of service. There will be limitations in achieving these requirements within a distribution network but significant numbers of customers should not experience different risks of supply failure within a single WRZ.

It is the water companies' responsibility to make sure that their WRZs meet this definition and clearly explain this within their water resources management plan. The proposed water resource for the Greater Harare included Norton, Chitungwiza and Epworth. Figure 1-3 overleaf shows the boundaries of the WRZ.

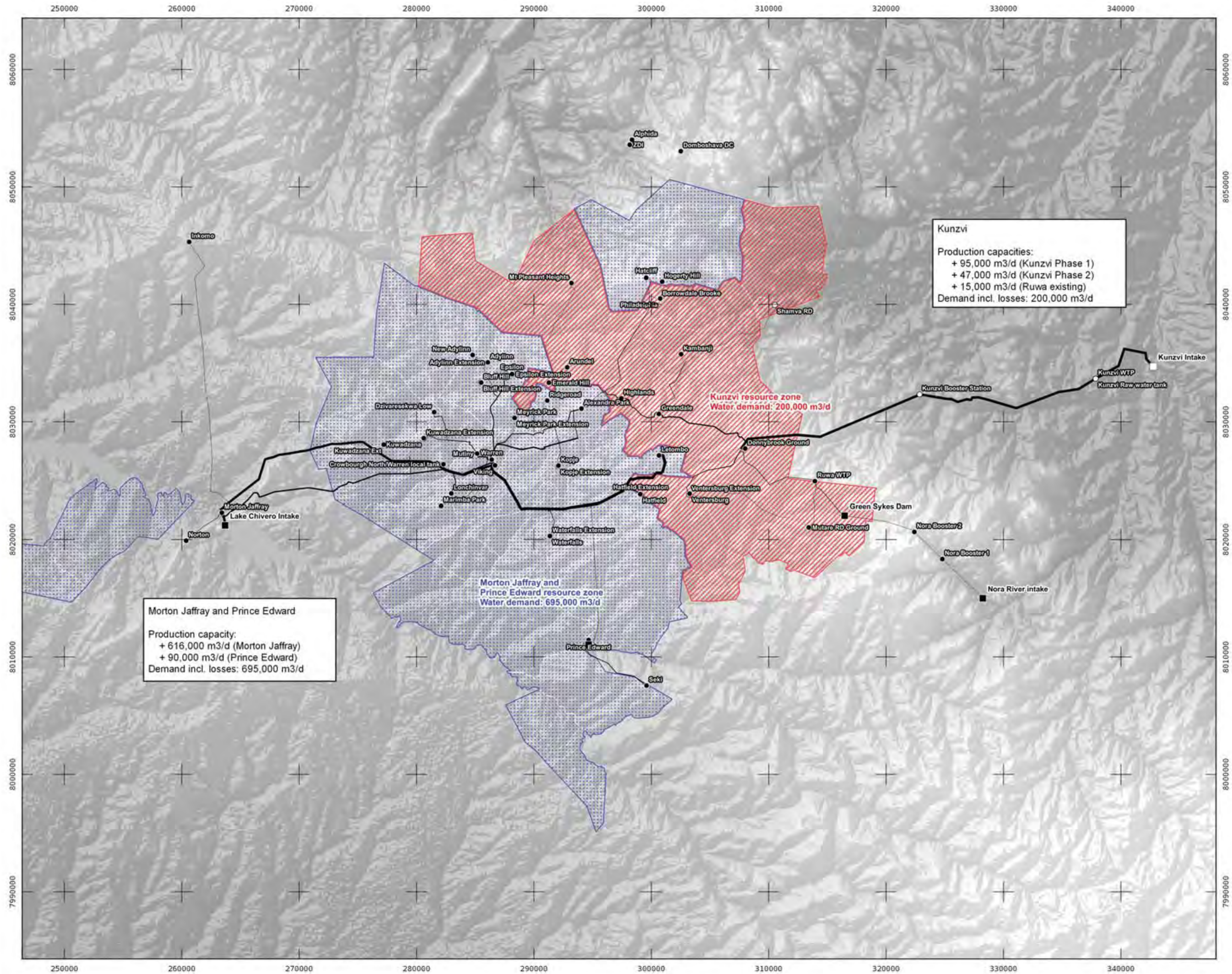
LAYOUT OF PROPOSED
WATER RESSOURCE ZONES

N

1:300,000

Datum: WGS84 Z36S

HARARE



Legend

Transmission line, width corresponds to pipe diameter

Tank sites/Distribution centers

- Proposed new
- Existing

Reservoirs

- Proposed new
- Existing

Water resource zone

- Kunzvi
- Morton Jaffray and Prince Edward

Urgent Water Supply
and Sanitation Rehabilitation
Project (USSRP)

JBG Gauff Ingenieure

1.4.3 Network Hydraulic Modelling

A hydraulic model was constructed in conformity with the proposed restructured network. A primary network grid was laid out for each proposed water resource zone and sized for the medium term (2020) and long term (2030) hydraulic loading.

Modelling Parameters

A hydraulic model requires several input parameters in order to simulate the actual conditions under which the network will be operating. These parameters are; the physical characteristics of the network and its boundary conditions (pipe roughness, elevations) and the hydraulic loading (Demand).

In order to build a realistic representation of the system, the age and material of the mains were considered with the friction factors altered to reflect the material of pipe and the age of pipe. Most mains in Chitungwiza are more than 30 years old. Therefore, it was deemed suitable to assume that the condition of these mains would be poor in places and hence; mains friction factors were increased to help reflect this.

The elevations for model junctions and reservoirs were interpolated/extrapolated off the contour dataset obtained from Google Earth. The dataset has contour lines with an elevation interval of five meters. This data is fairly adequate for the purpose of modelling the trunk mains. More accurate surveys for transmission mains and reservoirs will be conducted for the final design phase.

The hydraulic loading (water Demand) used for modelling the network has been calculated using population figures taken from the recently published report for the Census 2012 by the Zimbabwe National Statistics Agency (ZIMSTAT) as outlined in Chapter 3. A detailed analysis of demand calculations is outlined in Chapter 5.

Different specific consumption figures were applied to the consumer categories to obtain the total consumption. Since the network had to be sized for peak hour demand, the peak hour factors were applied to consumption figures.

The demand in each zone was obtained by overlaying the wards layer with the proposed zones layer in ArcView 10.1. The wards lie either completely within a zone or only partially. The extent by which a particular ward is contained in a zone was estimated in terms of percentage. The zone received this percentage of demand for that ward. The wards that fell wholly within a particular zone were allocated 100% to that zone. The various demands from the wards that intersect the zone were aggregated to get the total demand for the zone.

Modelling Scenarios

Two scenarios were used to depict the worst case operating conditions of the network, as presented in the table below.

Table 1-38: Network Modelling Scenarios

Scenario	Scenario Description	Peak factor
Scenario 1	Peak hour demand and lowest levels in reservoirs	1.5
Scenario 2	Lowest demand during the night time and highest water levels in reservoirs	0.5

The scenarios were simulated with the peak hour demand and lowest levels in reservoirs by multiplying the daily demand with the peak hour demand factor of 2.0 and lowest demand during the night time when the water levels in the reservoir is high. For any network analysis case study, it is important to model the 'worst-case' scenario so that all potential issues can be predicted with mitigation measures put in place at the earliest possible opportunity.

Results of the Modelling Simulations

In the restructured network for the year 2020 and 2030 scenarios, the pressures within the mains are fairly within acceptable limits stipulated in the design criteria. According to national and regional guidelines the minimum pressure should be at least 10 metres (1.0 bars) in the main supplying pipes. On average the normal operating pressure in the transmission mains is around 45mH2O.

The velocities experienced within the transmission mains are below the 3.0 m/s stipulated in the inception report. Velocities should normally be kept within certain limits to avoid deposition of sediments on the lower end, and to limit forces on bends and water hammer effects, on the upper end. The economic velocities increase with the diameter of the pipe. The table below shows the pipes that are required in the restructured network for the 2030 design horizon.

Table 1-39: Water Transmission Investment Measures

Resource Zone	Pipeline	Diameter	Length (m)
Morton Jaffray	Warren to Munity and Kuwadzana and Dzivaresekwa	DN 600	3,200
		DN 900	1,800
		DN 700	3,189
	Warren to Lochinvar and Marimba Park	DN 350	576
		DN 400	1,176
		DN 500	5,311
	Existing DN 1500 (Warren-Letombo) to Waterfalls	DN 600	2,715
	Existing DN 1500 (Warren-Letombo) to Hatfield	DN 600	1,481
	to Adylinn	DN 400	454
		DN 450	2,148
		DN 650	1,049
	Morton Jaffray to Norton (pumping)	DN 500	3,861
Kunzwi	DN 525 from Ventersburg to Ruwa WTP	DN 500	4,050
	Ruwa WTP to Ruwa, Mutare RD Ground Tanks	DN 400	4,000
	Kunzwi Intake to Donnybrook (pumping in stages)	DN 1400	39,432
	Donnybrook to Ventersburg	DN 600	7,086
	Donnybrook to Greendale	DN 900	9,413
	Greendale to Shamva Rd	DN 350	12,750

Resource Zone	Pipeline	Diameter	Length (m)
	Greendale to Highlands and Crow Hill	DN 350	6,303
		DN 500	5,353
		DN 700	1,658
Prince Edward	Prince Edward to Seki	DN 600	7,007

1.4.4 System description

The City of Harare and surrounding areas are supplied by transmission pipelines from Morton Jaffray and Prince Edward Water Treatment Works. Two 1300 mm pipelines, a 750 mm and a 975 mm pipeline pumps water from Morton Jaffray treated water pumping station to Warren Control ground reservoir. DN 750 mm main conveys water from Morton Jaffray to Lochinvar reservoir.

Prince Edward Treatment Works supplies treated water through a 975 mm Ø pipeline to the City of Harare.

The main supply point of the city's water distribution system is the Warren Control pumping station from where most of the city is supplied with treated water. From Warren Control, water is conveyed to 24 reservoirs by four transmission mains. These transmission mains feed directly into the distribution system of the City. The four transmission mains are:

- The 800 mm main, supplying the north-west of the City (North-West Main);
- The 750 mm main supplying the Alexandra Park reservoir site (Alexandra Main);
- The 975 mm main supplying the Letombo system reservoirs (Letombo Main);
- The 1000 mm main supplying the south of the City and feeding the Letombo reservoir (Highfield Main).

These four transmission mains constitute the backbone of the supply system of the city. They are supported by additional primary mains which form a looped system incorporating the main pumping stations and reservoirs of the water distribution system. The main components of this system are:

- Warren Control pumping station;
- Letombo reservoirs and pumping station;
- Alexandra Park reservoirs and pumping station;
- Orange Grove pumping station;
- Greendale reservoirs;
- Highlandsreservoirs and pumping station.

From Warren Control pumping station treated water gets pumped through the Letombo Mains and Highfield Mains to the Letombo reservoirs. The Letombo reservoir site/ pumping station operates as the main supply point of the eastern part of Harare. From there treated water gets transferred by pumping to the reservoirs at Greendale, Ventersburg and Donnybrook. These reservoirs command the eastern areas of Harare. Greendale reservoir gets fed by a second supply source, the Orange Grove pumping station. This pumping station is supplied by two gravity mains a 450 mm Ø and 375 mm Ø from Alexandra Park reservoirs.

From Warren Control pumping station the Alexandra Park reservoirs are fed by two transmission mains, the 750 mm Ø Alexandra Main and a 600 mm Ø pipe branching off the 975 mm Letombo Main. From Alexandra Park the Highlands reservoirs are fed by pumping through a 525 mm Ø main which gets supported by a 300 mm Ø pumping main from Orange Grove pumping station. The north-east of the city is supplied from the Highlands reservoirs.

The north-west of the city is supplied by the 800 mm Ø North-West Main from Warren Control. The reservoirs of Dzivaresekwa, Bluff Hill, Epsilon and Adylinn get supplied by this main.

The south-western areas of the city are supplied off the transmission mains from Morton-Jaffray to Warren Control by pumping. In addition the reservoirs at Lochinvar and Marimba are directly fed from this transmission main.

1.4.5 Condition Assessment

Letombo Main

The Letombo Main conveys water from Warren Control pumping station to Letombo reservoir. This transmission main was built in the early 1960's to feed Letombo reservoirs, the supply source of the eastern areas of the city. The transmission main consists of 9.5 km of 975 mm steel pipeline and 7 km of 750 mm Ø steel pipeline. The discharge into the transmission main is metered at Warren Control.

Through five metered branches this transmission main feeds directly into residential areas, namely: Harare city centre, Alexandra Park area and Hillside/Braeside. The 150 mm branch supplying Belvedere North and the 375 mm Msasa branch are not metered. Therefore, the quantities supplied from Warren Control to Letombo reservoir cannot be quantified. Due to high pressure levels in the pumping main most of the off-takes are equipped with PRV's to avoid excessive pressure head which unfortunately are not working at the moment and consequently distribution systems fed by these mains are constantly bursting.

Highfield Main

The Highfield Main conveys water from Warren Control pumping station to the Letombo reservoirs. The transmission main was built in the early 1980's to provide additional capacity to the Letombo reservoirs. The transmission main consists of 4.8 km bitumen-lined1000 mm Ø steel main and2No parallel750 mm Ø bitumen-linedsteel pipeline, each 6 km long and another 8.5 km 1000 mm Ø bitumen-linedsteel pipeline. At Warren Control the discharge into the transmission main is metered. During times when Prince Edward treatment plant is not operating, Chitungwiza Town gets supplied by the Highfield Main. This transmission main leaves Warren Control as 1000 mm Ø and splits to 2 No. parallel DN 750mm Øpipelines before merging again to one 1000 mm Ø pipeline at SPCA (junction of Seke road and Cranborne Avenue West).

The transmission main suppliestreated water to Letombo, Kopje, Waterfalls, Hatfield and Seke (supplying Chitungwiza) reservoirs and feeds directly into the distribution network in the south of Harare. The following high-density residential areas are supplied directly off the pumping main through ten metered branches: Lochinvar, Willowvale, Highfield, Ardbennie, Southerton, Mbare, Prospect, Hatfield, Chadcombe and Queensdale. The 150 mm Ø branch off the transmission main supplying Sunningdale is not metered.

In addition to the above Main, a parallel pipeline (1500 mm Ø steel, length 19.7km) was laid in 1995 delivering water via pumping from Warren Control to Letombo reservoir. This pipeline is cement-mortar lined with plastic wrapping externally and is in good operational condition.

Air valve chamber along DN 1500 pipeline

An off-take with faulty flow meter and PRV

Alexandra Main

The Alexandra Main conveys water from Warren Control pumping station to Alexandra Park reservoir. The main consists of a total length of 10.7 km of 750 mm Ø steel pipeline. Take offsfrom the 750 mm Ø pumping main feed the Mutiny, Meyrick Park, Kopje, Ridge Road, Emerald Hill and Arundel reservoirs. The transmission main was built in the early 1950's. At Warren Control the discharge into the transmission main is metered by a flow meter.

The transmission main pumps directly into the distribution network of Warren Park, Milton Park and Kensington. The supply into Monavale and Kensington is not metered. Due to high pressure levels in the pumping main the branches into the distribution areas are controlled by PRV's, except the supply areas of Monavale and Kensington.

Therefore, nearly 70% of the water pumped into the transmission main gets either supplied into the distribution system of connected areas or fed into service reservoirs before the water reaches the Alexandra Park reservoir site.

North-West Main

The North-West Main conveys water from Warren Control pumping station to Dzivaresekwa, Bluff Hill, Adylinn and Epsilon reservoirs. The 800 mm Ø steel transmission main was built in the late 1970. The transmission main's length is about 7.7 km in 800mm Ø, which reduces to 400 mm Ø for about 1 km before the transmission main reaches the Adylinn reservoir site. The discharge into the transmission main is metered at Warren Control. In addition to these areas the transmission main supplies the residential areas of Mablereigh, Ashdown Park and Bluff Hill directly off the pumping main.

Table 1-40: Condition Assessment of the Water Transmission System

Component	Evaluation	Remarks/rehabilitation measures
Letombo main, Highfield	The 150 mm branch supplying Belvedere North and the 375 mm Msasa branch are not metered. Therefore, the quantities supplied from Warren Control to Letombo reservoir cannot be quantified.	Supply and install water meters
General	Due to high pressure levels in the pumping mains most of the off-takes are equipped with PRV's to avoid excessive pressure head which unfortunately are not working at the moment and consequently distribution systems fed by these mains are constantly bursting.	Replace pressure reducing valves
General	Most of the transmission pipelines are too old; constructed in 1930s (Morton Jaffray – Warren Control), 1960's (Letombo), Highfield - 1980s, Alexandra – 1950s. Hence facing frequent bursts leading to high losses.	Replace old and damaged pipelines.
General	The older pipelines' bitumen lining and coating worn out.	Replace damaged pipes.
General	Some mains are not metered, while existing meters are not working.	Replace faulty water meters and install new ones on main pipelines.
General	Alexandra main: 70% of the water pumped into the transmission main gets either supplied into the distribution system of connected areas or fed into service reservoirs before the water reaches the Alexandra Park reservoir site.	Reduce and/or meter off-takes from the transmission mains.
General	Some lines have not been commissioned since construction – e.g. 400 mm dia. AC pipeline to Dzivaresekwa tank.	Newly constructed pipelines should be commissioned and handed over to Harare Water.
Letombo pumping main to Donnybrook	Transmission pipeline from Letombo pump station changes from DN 600 to 4No. Pipelines of different diameters (150mm AC, 225mm AC, 300mm AC and 450mm AC). All these smaller diameter pipelines are prone to frequent bursts reportedly due to lower class material. It was also reported that the pumps at Letombo booster station have since been upgraded to deliver higher flow but the pipelines were not changed.	Replace the smaller diameter pipelines that are prone to bursting with a larger diameter pipeline of higher pressure class.
Valve chambers	Some valve chambers are broken.	Reconstruct broken valve chambers.
	Some valve chambers have broken	Replace missing or broken

Component	Evaluation	Remarks/rehabilitation measures
	or missing covers.	covers.
	Several chambers have debris and water in them.	Clean valve chambers.
Air valves	Most of them are faulty	Replace faulty Air valves.
Washout valves	Several are stuck and gland packing damaged.	Clean and service washout valves. Replace faulty ones.
Water meters	Majority of water meters are either faulty or have been vandalized or missing.	Replace water meters. Construct lockable chambers.
Pressure reducing valves (PRVs)	In general, most PRVs are not in good operational condition.	Replace all pressure reducing valves

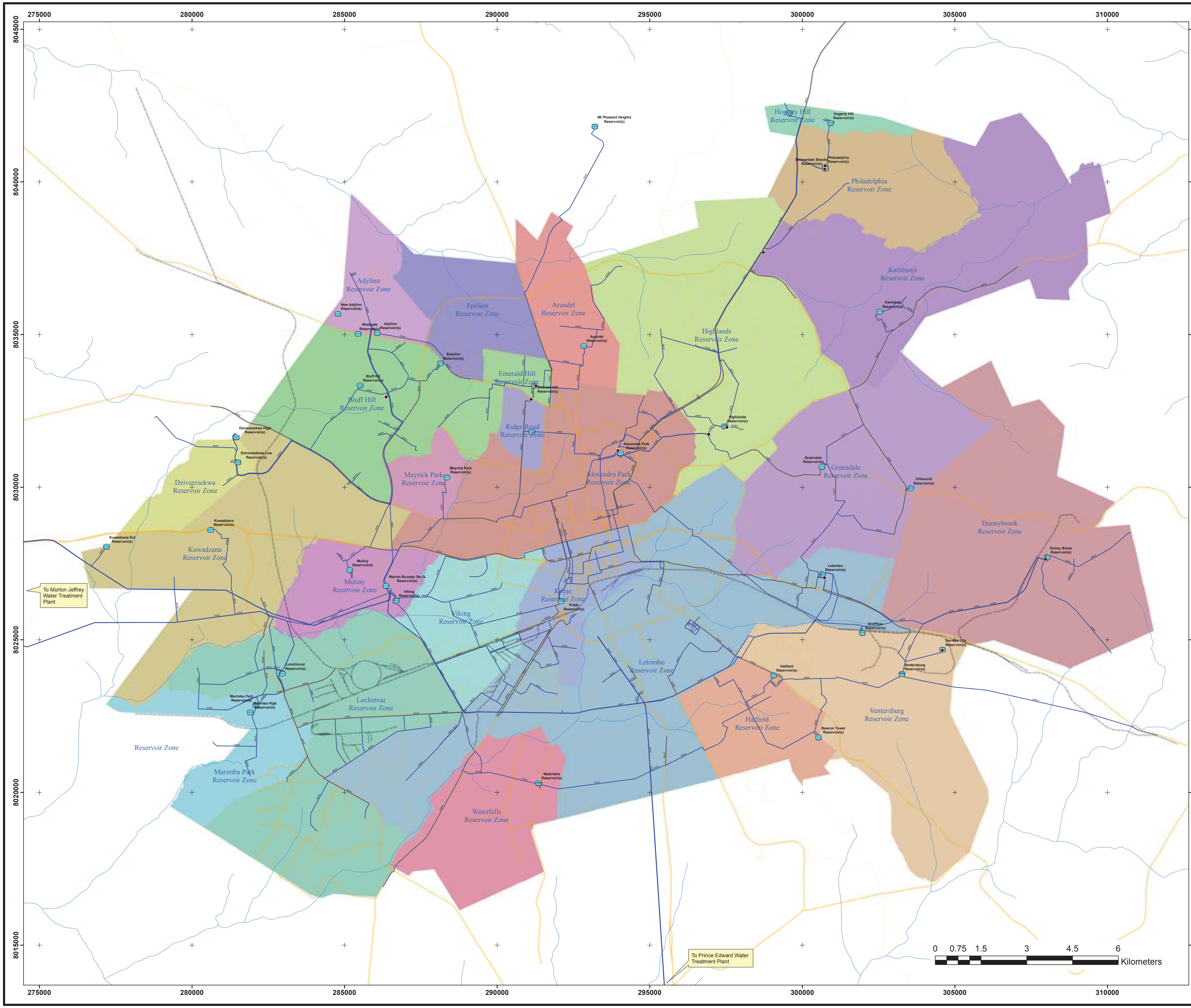


Figure 1-4
Layout Map of Existing Water Supply System HARARE

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Legend

- Booster Stations
- Reservoirs
- Water Mains
- River / Stream
- Residential Roads
- Trunk/Primary Roads
- Rail Line

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1.5 Storage Reservoirs

1.5.1 Capacity assessment; Condition assessment; proposed investment measures

The water supply system of the City of Harare (COH) has 27 treated water reservoir sites. These are covered in the table below:

Table 1-41: Treated Water Reservoir Sites in the System

Ref.	Reservoir Site	Volume (m3)	T.W.L (m)	Meter Device (BM/FM)(1)	Outflow(2) Ratio
(a)	Adylinn	1,140	1519.02	FM	0.76
(b)	Alexandra Park	111,950	1538.37	FM	3.10
(c)	Arundel	7,580	1532.82	not metered	*
(d)	Bluff Hill	5,680	1506.06	not metered	*
(e)	Donnybrook	36,180	1602.02	BM /FM	5.43
(f)	Dzivaresekwa	5,680	1481.50	BM	1.06
(g)	Emerald Hill	25,750	1552.39	BM	*
(h)	Epsilon	4,090	1518.86	FM	1.33
(i)	Greendale	70,770	1583.76	BM	6.20
(j)	Hatfield	13,630	1521.30	BM/ FM	6.80
(k)	Highlands	61,740	1568.55	BM	*
(l)	Hogerty Hill	1,140	1600.07	not metered	*
(m)	Kambanji	5,680	1538.75	FM	0.41
(n)	Kopje	7,960	1527.27	FM	*
(o)	Kuwadzana				
(p)	Letombo	236,400	1539.51	FM	8.50
(q)	Lochinvar	72,880	1475.58**	not metered	*
			1478.05	not metered	*
(r)	Marimba Park	34,400	1463.45	BM	*
(s)	Meyrick Park	2,280	1517.65	FM	*
(t)	Mutiny	11,400	1520.45	FM	2.31
(u)	Philadelphia	7,580	1574.40	not metered	*
(v)	Ridge Road	3,410	1531.31	not metered	*
(w)	Ventersburg	22,800	1559.50	FM	5.07
(x)	Viking	27,260	1516.73	FM	*
(y)	Waterfalls	5,680	1467.13	not metered	*

Ref.	Reservoir Site	Volume (m3)	T.W.L (m)	Meter Device (BM/FM)(1)	Outflow(2) Ratio
	Total Volume (m^3)	**783,060**			

(Source: Harare Water Study Stage 1)

(1) BM=Bulk Water Meter FM=Flow Meter

(2) Flow meter ratio is defined as the relationship between the Volume and the flow in or out of the reservoir.

* These reservoir sites are not metered, but some of them that are metered do not have enough meters on the inlets or on the outlet, hence the outflow ratios were not calculated.

** The reservoir site has 7 reservoirs of which 4 are inter-connected with a T.W.L of 1475.58 m and the remaining 3 have a T.W.L of 1478.05 m

The reservoirs are located between 1,460 m and 1,600 m amsl. The main reservoirs in terms of capacity are Letombo, Alexandra Park, Lochinvar, Greendale and Highlands which together have a storage capacity of approximately 553,740 m^3. This is about 70% of the total storage capacity of the water supply system.

1.5.2 Proposed investment measures

The table below shows the investment measures required for reservoirs in Harare.

Table 1-42: Investment Measures for Reservoirs in Harare

Reservoir Site	Unit	Additional Capacity	Comments
Adylinn	m^3	22,000	ADC
Epsilon	m^3	7,500	ADC
Bluff Hill	m^3	12,000	ADC
Meyrick Park	m^3	2,000	ADC
Kopje	m^3	18,000	ADC
Ventersberg	m^3	30,000	ADC
Hatfield	m^3	36,000	ADC
Waterfalls	m^3	50,000	ADC
Kuwadzana	m^3	45,000	ADC
Shamva Rd Tank	m^3	7,500	NR
Total		**230,000**	

*ADC – Additional Capacity

*NR – New Reservoir

1.6 Distribution Network

The function of the distribution pipework is to transfer potable water from storage facilities and pumping stations to the consumer. Distribution pipes can be grouped depending on function and diameter into three groups:

- Primary network;
- Secondary network and

- Tertiary network.

In general, primary network pipes transfer water from reservoirs and pumping stations into the supply network. Primary network pipes do not usually have connections to individual stands. From primary pipes water gets transferred through secondary distribution pipes to consumer groups. Tertiary pipes are connected to secondary pipes and distribute water to the consumer's premises.

Based on information collected from previous projects carried out by other consultants namely; BCHOD in conjunction with GKW and Hydro-Utilities, the Consultant has collected pipe length and identified pipe material of existing primary (350 to 600 mm) and secondary distribution network pipes (200 to 350) . The results are summarized in the table below.

Table 1-43: Existing Primary and Secondary Pipework

Diameter	Length of Pipes		
	AC	**Steel**	**Total**
[mm]	**[m]**	**[m]**	**[m]**
200	6,440	0	6,440
225	148,998	1,820	150,818
250	16,150	2,810	18,960
300	97,294	9,720	107,014
350	7,578	2,700	10,278
375	38,614	3,920	42,534
400	3,490	570	4,060
450	19,383	5,430	24,813
500	3,390	1,565	4,955
525	14,850	6,220	21,070
600	8,702	3,230	11,932
Total	**364,889**	**37,985**	**402,874**

At present about 90% of the primary and secondary pipework is of AC pipes. The remaining pipes are steel. Due to the lack of existing records, the age of pipelines cannot be determined. Due to high pressure levels in the pumping main the areas directly supplied by pumping are controlled by PRV's.

The distribution system of Harare is supplied by both pumped and gravity systems thereby resulting into the following categories;

- Zones supplied by pumping,
- Zones supplied by gravity, and
- Zones supplied by both gravity and pumped systems.

At present, due to unmetered gravity mains off reservoir sites and unmetered branches off pumping mains, a water balance calculation cannot be carried out to determine quantities of flow in the main grid of the distribution system. Therefore, the quantities of flow described herein should be seen as preliminary results evaluating the available data which was used as a basis for conclusions and recommendations on the proposed water supply scheme.

1.6.1 Gravity System

Areas supplied by gravity are concentrated in the west and the east of the city, whereas the areas supplied by pumping are concentrated in the city centre. Presently, 17 out of 24 reservoirs feed into the distribution system. The amount of water distributed is metered but most of the bulk meters are not working.

Table 1-44: Gravity Areas

Reservoir	Supply Area	Water Meter	Flow (m^3/d)
Adylinn	Adylinn, Marlborough		
Arundel/ Emerald Hill	Northwood, Mount Pleasant, Emerald Hill, Ridge Road, Avondale		
Donnybrook	Mabvuku, Tafara		
Dzivaresekwa	Dzivaresekwa		
Epsilon	Greencroft, Stanbury Park and north of Mablereigh		
Highlands			
Hogert Hill	Hatcliff		
Kambanji	Kambanji		
Lochinvar/ Marimba Park	Mufakose, Marimba Park, Glen View, Glen Norah, Budiriro; flow to Aspindale Park and Willowvale is not metered		
Meyrick Park	Meyrick Park		
Mutiny	Warren Park		
Ridge Road	Strathaven, Avondale West		
Ventersburg	Epworth		
Viking	Rugare, Westwood, Belvedere South, Ridge View, Workington, Southerton		
Waterfalls	Park Town west, Hoppley Farm, Grobbie Park, Waterfalls Induna		
		Total:	

1.6.2 Pumped Areas

The city of Harare is supplied mainly by pumping. Off-takes on transmission mains feed directly into the distribution system. These off-takes are equipped with 33 pressure reducing valves (PRVs) in order to reduce excessive pressure levels in the distribution network.

1.6.3 Pumped/ Gravity Areas

The remaining areas are supplied by pumped and gravity systems. Large areas with high water demands, such as the City Centre, Hatfield and Greendale receive water from both systems. The reservoirs feeding into these areas are Alexandra Park, Greendale, Kopje, Ventersburg and Hatfield. The pumping station feeding into the same areas is Warren Control through the transmission mains Letombo Main and Highfield Main and Letombo pumping station.

1.6.4 District Metering System

The City of Harare used to have a comprehensive metering system in operation. Bulk water meters and flow meters were installed to measure weekly flows at outlets/inlets of reservoirs and pumping stations as well as flows in main supply pipes transferring water into individual supply areas of the city. There were 145 meters installed in the water supply system. Out of 145 meters, 11 bulk meters used to be read by the Chitungwiza Council. The remaining 134 meters were under the control of the water workshop of the COH. The bulk and flow meters used to be read on Tuesdays every week by employees of the COH water workshop.

1.6.5 Metered Supply Zones

The bulk meter readings taken on site were recorded on pre-printed bulk meter sheets. The pre-printed bulk meter sheets consisted of nine pages. The first six pages listed weekly readings of installed water meters. These pages were sent to the Water and Sewerage Department of the COH for analysing and comparison. The remaining three pages summarized water meter readings of big consumers and townships. These sheets were sent to the City Treasury for comparison with water meter readings sent in by the Housing Department. The following large consumers are read by the water workshop of the COH:

- Belvedere Training College,
- Chikurubi Prison,
- Harare Airport,
- Portland Cement, and
- Veterinary Research.

The water workshop used to read meters which indicated weekly flows into 17 different suburbs of the City outlined below:

- Dzivaresekwa;
- Epworth;
- Glen Norah;
- Glen View;
- Hatcliff Park;
- Highfield;
- Kambuzuma;
- Kuwadzana;

- Mabvuku;
- Marimba;
- Mbare;
- Mufakose;
- Rugare;
- Ruwa;
- Tafara;
- Warren Park; and
- Westwood;

The distribution network systems of the above areas are independent of each other. The subdivision of the complex urban distribution network of the COH was established either through closed zone valves, pipe-gaps or unclosed loops.

The Housing Department of the COH is reading water meters in the following suburbs of the city: Budiriro, Dzivaresekwa, Glen Norah, Glen View, Hatcliff, Highfield, Kambuzuma, Kuwadzana, Mabvuku, Mbare, Mufakose, Tafara and Warren Park. The City Treasury receives meter readings from the District offices for billing purposes. The inflow to the highlighted areas is controlled with bulk water meters read by the COH water workshop. Assuming that the individual water meters at the consumers' premises (read by Housing Department) and the bulk water meters (read by the Water Workshop of the COH) installed at the feeding point into the area are in working condition and measure flows properly, then the comparison of water consumed by consumers per supply area with water supplied into the area gives an indication of Unaccounted-for-Water (UfW) in the area.

Uncounted for Water is reported to be around 62% and brief calculations conducted by GKW, BCHOD and Hydro-Utilities in 1995 indicated values ranging from 10 to 66 %.This information is not verified therefore must be treated with caution. Unknown interconnections to adjacent supply areas, not registered consumers, incorrect water meter readings, etc. influence the reliability of the data. Therefore, further investigations will have to be carried out to ensure the correctness of the data. The data originating from individual water meters and bulk water meters will be difficult to work with since most of these meters are no longer operational.

1.6.6 Independent Non-Monitored Areas

- Budiriro,
- Ashdown Park,
- Mabelreign,
- Meyrick Park,
- Bluff Hill,
- Mabelreign,
- Ardbennie, and
- Kambanji

1.6.7 Areas outsidethe City Boundaries

Harare provides treated water to consumers outside the city boundaries. These areas include neighbouring municipalities and government facilities and are as outlined below;

- Chitungwiza
- Epworth
- Ruwa
- Norton
- Domboshava
- Inkomo Barracks
- Chikurubi Complex (within the City boundaries)
- Cranborne Barracks (within the City boundaries)

All the above areas are supplied from Morton Jaffray WTW or Prince Edward WTW via the Harare distribution system through transmission branches and are further discussed below:

Chitungwiza

Chitungwiza is situated approximately 20 km to the south of Harare and was formed in 1978 by the amalgamation of three townships outside the city boundaries, Seke, St Marys and Zengeza. The estimated population of Chitungwiza is 354,472 (2012 National Statistics).

Water supply in Chitungwiza is controlled by the Chitungwiza Municipality, who purchase bulk water from the COH. The area is supplied either from Prince Edward WTW (when it operates) along a 375 mmØ, or from a 750 mmØ branch off the 975 mmØ main from Warren Control. The 750 mmØ main reduces to a 525 mmØ from the treatment works to Chitungwiza. The various parts of Chitungwiza are supplied by pumping, via PRV's, or from the Seke Reservoir, which acts as a floating reservoir for the area.

Epworth

Epworth is situated to the south-east of the city immediately adjacent to the city boundary. The area is under the control of the Ministry of Local Government, Rural and Urban Development. The population of Epworth is 354,472 (2012 National Statics).

Epworth is supplied by a 600mm Ø that comes off the 525mm Ø feeding the Hatfield Reservoir from Ventersburg Reservoir.

Ruwa

The COH provides a bulk supply to Ruwa Local Board through ZINWA. Supplies to consumers in the area are controlled by the Ruwa Local Board through a 300 mm ØAC gravity pipeline from Ventersberg Reservoir constructed at the end of 1993. The Ruwa water supply system consists of two separate supply lines based on two delivery pipelines from COH namely:

A 100 mm ØAC pipeline conveying water to a 250 m^3 ground reservoir, before being pumped into a 50 m^3 elevated tank, and

A 300mm ØAC pipeline conveying water to an 80 m^3 pump station sump. The water is then transferred to a 1000 m^3 ground reservoir and then pumped to a 100 m^3 steel modular elevated tank.

Zimre Park in Ruwa is also supplied with water from a 525mmØ steel pipeline from Donnybrook reservoir.

Norton

Norton is located approximately 40km to the west of Harare, to the south of Lake Manyame. Water supplies in Norton are provided by the Norton Town Board. The COH provides a bulk supply to ZINWA who in turn sell the water to the Town Board.

Norton obtains treated water through a pumped system and gravity system from Morton Jaffray Treatment Work. The system consists of:

- Two 300 mm Ø AC pumping mains connected to the 1000 mm Ø and 750 mm Ø transmission mains from Morton Jaffray to Warren Control.
- Two 5000 m3 service reservoirs.
- A 600mm Ø gravity main connected to Norton's reticulation system.

Domboshava

Domboshava is situated to the north of Harare and acts as a dormitory town. The Zimbabwe Defence Industries (ZDI) is situated near the town and is supplied with water by ZINWA, who receive bulk supply from the COH.

The area is supplied from the Philadelphia Reservoir, through a 200 mm Ø AC rising main 14,550 m long into a 500 m^3 brick reservoir where it then gravitates through a 150 mm Ø AC pipeline, 1,900 m long to a 1000 m^3 ground reservoir.

Inkomo Barracks

Inkomo Barracks is situated to the north-west of Harare and is controlled by the Ministry of Public Construction and National Housing (MPCNH). A bulk supply is provided by the COH to ZINWA, who then supply water to Inkomo Barracks.

Inkomo Barracks is supplied with water via a 400 mm Ø and 350 mm Ø AC pumping main connected to the 1300 mm Ø transmission main from Morton Jaffray Treatment Works to Warren Control. A pumpstation is situated approximately 4 km away from Inkomo, with a 200 m^3 reservoir, to pump the water through 350 mm Ø AC pumping main into the 2 x 2000 m^3 ground reservoirs.

Chikurubi Complex

The Chikurubi Complex is located within the city boundary at the north-east perimeter. The COH provide a bulk supply to ZINWA, who in turn service Chikurubi Prison Complex, Police Support Unit and CMED.

There are two connections from the COH mains, each connection is 200 mm in Ø and the pipelines deliver water into 2 x 1000 m^3 and 1 x 2000 m^3 ground reservoirs.

The reservoirs supply the first site and water is pumped to the storage facilities of two other sites. Of these two sites one consist of 2 x 500 m^3 ground reservoirs and an elevated 500 m^3 water tower. The other site consists of a 500 m^3ground reservoir and a 500 m^3water tower.

Cranborne Barracks

Cranborne Barracks is situated within the city boundaries adjacent to Airport Road in the south-east of the city. The COH provides a bulk supply to ZINWA, who in turn supply the Ministries of Public Construction and National Housing, Education, Lands and Water and Defence. There are various 15 mm, 25 mm and 50 mm Ø connections from City of Harare distribution pipes. The connections are metered and read by the City Treasury.

Table 1-45: Existing Network Pipes

Pipe Size &Material	Length (m)	Avg. Age
ND 375 AC		>50
ND 300 AC		>50
ND 250 AC		>50
ND 225 AC		>50
ND 200 AC		>50
ND 150 AC		>50
ND 163 PVC		<30
ND 100 AC		>50
ND 110 PVC		<30
ND 75 AC		>50
ND 63 PVC		<30
ND 50 AC		>50
Total		

1.7 Pilot Zone Investigations

The pilot area water and sewer network investigations constitute part of task D in the ToR, which states that "…the water distribution network condition assessment will be done using sampling methods aimed at establishing parameter relationships that can be used to extrapolate network rehabilitation investment requirements." Hence, the purpose of the pilot area investigations was to assess the condition of the water distribution and sewerage networks and recommend rehabilitation investment measures for the entire system using statistical methods.

1.7.1 Methodology and Approach

The pilot area was selected in liaison with the council following the selection criteria specified in the ToR. It was chosen to be conveniently small, but characteristically representative of the entire network so that extrapolations to the entire network could be done with reasonable levels of confidence. The activities carried out in the pilot area and the sequence of operations is shown in the figure below.

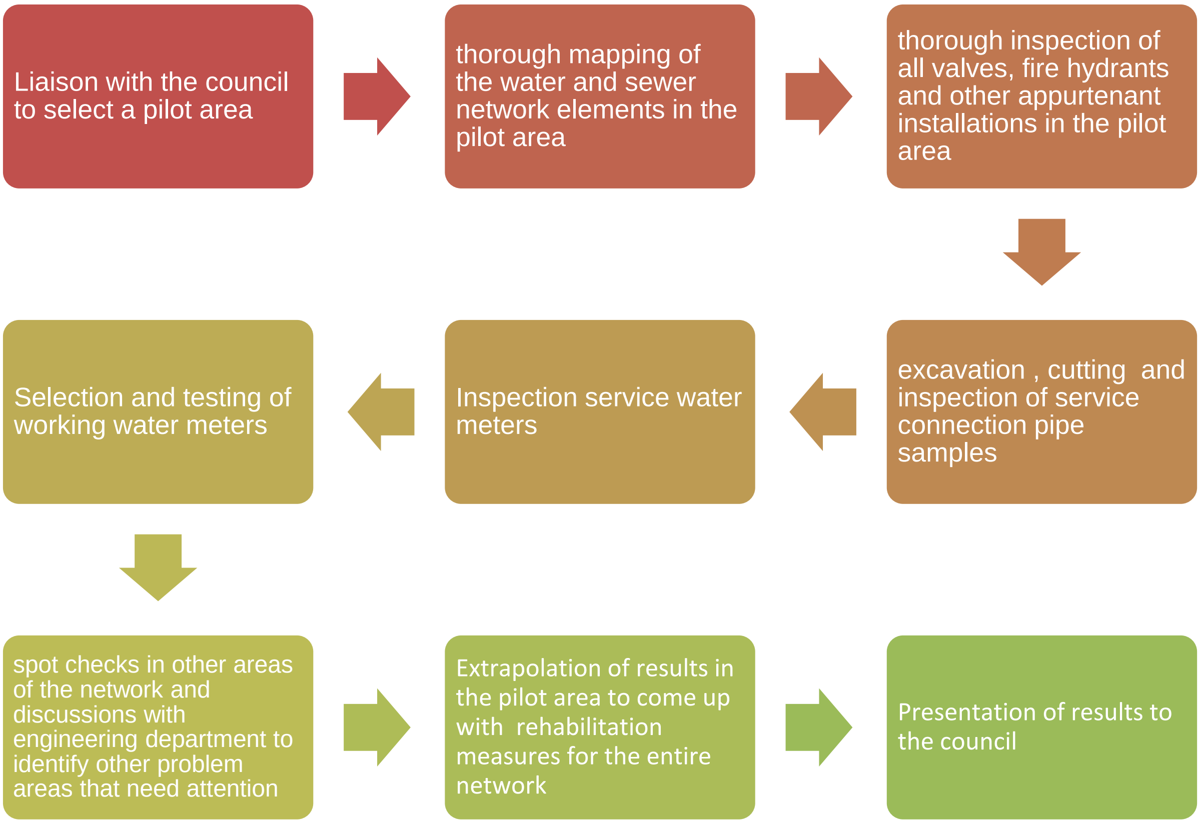

Figure 1-5: Sequence of Activities in the Pilot Area

The inspections and assessments in the pilot area provided relationships among age, material and condition of the network elements, which were used to extrapolate network rehabilitation investment requirements for the entire network. In addition to investigations in the pilot area, spot checks in other parts of the network were conducted to validate the findings in the pilot area and the subsequent extrapolations.

1.7.2 Location and Characteristic of the Pilot Area

Two pilot areas namely; Highfield representing the high density housing category and Cranborne representing the medium density housing category, were chosen for the investigation.

Highfield High Density Suburb

Highfield was chosen because it is one of the oldest high density suburbs and is densely populated. It was assumed that investigations in the area would fairly represent the condition of the distribution networks and service connections in all high density suburbs. Based on household flow meter testing conducted in the study area, all domestic meters are not working and will need to be replaced. Most flow meters do not register flows, with some completely vandalised.

Highfield is supplied from the Highfield main which is a 4.8 km bitumen lined1000 mm Ø steel main. The water distribution mains within the pilot zone are 75 mm Ø AC.The water network is made up of the elements shown in the figure below:

Network Pipes	Valves, fire hydrants and other fittings	Service connections
• 390m of ND 75 mm ø AC pipes • 0 m of 100 mm ø AC pipes • 0of 63 mm ø PVC	• 4No CI fire hydrants • 12 no. 100 mm ø CI gate valves	• 136 No 15 mm ø service connections • 136 Kent water meters, representing 100% service coverage and metering

Figure 1-6: Network Elements in the Pilot Area (Highfield)

The sewer network is made up of 390 m of ND 150 and 553.13m of ND 225 AC pipes laid parallel to the water pipes. Manholes are at approximately 20 m intervals. Figure 1-6 shows the location and characteristics of the pilot area.

<u>Cranborne Medium Density Suburb</u>

Cranborne was chosen because it is one of the oldest medium density suburbs and isfairly representative of most medium density suburbs.Therefore, it was assumed that investigations in the area would fairly represent the condition of the distribution networks and service connections in all medium density suburbs. Based on household flow meter testing conducted in the study area, all domestic meters are not working and will need to be replaced. Most flow meters do not register flows, with some completely vandalised.

Cranborne is supplied from the Letombo main which consists of 9.5 km of 975 mm Ø steel pipeline and 7 km of 750 mm Ø steel pipeline. The water distribution mains within the pilot zone are 75 mm Ø AC.

Figure 1-7
Layout Map of the Pilot Area (Water)
HARARE

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Legend

Water Lines
Pilot Zone (Boundary)

Pilot Zone (MD)
Pilot Zone (MD)

Streams / Rivers
Streams / Rivers

Landuse
Agriculture
Business
CBD
Industrial
Institutional
Mining/Quarrying
Recreational
Residential

Road Network
Residential Roads
Trunk/Primary Roads

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1.7.3 Findings and Recommendations – Water Distribution Network

All the network elements in the pilot areas are over 30 years old. There have not been any major rehabilitation or replacement undertakings since the city was developed. In the oldest parts of the city, water pipes and appurtenant structures date as far back as 1940.

Water pipes

The AC pipes in the study areas appear to be in good condition despite the age – not very surprising considering that AC pipes have a lifespan of 50-70 years. Even though AC pipes undergo gradual degradation in the form of corrosion (i.e., internal calcium leaching due to conveyed water (lower Langelier index = more leaching) and/or external leaching due to groundwater), the council has not reported enough pipe failures to suggest that the pipes need replacement. The exposed pipes from the replaced pipes did indicate that the pipes were in fair condition except for those cracked pipes from presumably too high pressures as shown below.

Asbestos Cement (AC) pipe

Valves and fire hydrants

There were no hydrants in the pilot area. Isolation valves were found randomly installed on the distribution mains. Generally, all the valves are in a bad shape; they are rusty and leaking.

Valve chambers are generally in a very poor condition, damaged and filled with stones as shown in the photos below. Furthermore, there are no covers and those that do have, they have been vandalised.

Therefore, the conclusion based on the above is that, all network appurtenant fittings and structures must be replaced as most network leakages occur there.

Fire hydrant chamber with marker post | Valve chamber (vandalized)

Leakages after the meter

Significant amount of water is lost after the meter resulting in unnecessary water use/ wastage. If metered, these wastages lead to increased water bills, which may not be paid by the consumers. If unmetered, these wastages result in high NRW levels, as flat rate billing considers only a limited average amount of water usage. Wastage can be reduced and water conservation measures be implemented through rehabilitation of household installations and household education and awareness programs. Even though Household investments are normally not part of project funding, a provision in the investment plan for public awareness campaigns aimed at sensitizing consumers on the motivation and financial benefits associated with investing in internal plumbing repairs is made. It is further recommended that council should make it a policy to fix leaking taps and pass on the costs to the consumers as a way to minimise water losses.

Vandalised water meter Testing of flow meter

House connections

- Service connections are taken off the 75 mmØtertiary mains using cast iron saddles. Each saddle serves 4 ND 20 service connections.

As can be seen from the photos below, the service connections are heavily corroded and incrusted. This was expected, given that these connections have been in service for over 30 years. Most of the leakages in the network occur on these lines.

It is therefore recommend that, all house connections be replaced including the saddles. It is further recommend that, the replacement of service lines should be of HDPE. HDPE house connections have proved to be durable and reliable. HDPE pipes have a smooth internal surface that does not corrode or tuberculate and maintains its flow capability over time. HDPE service connection pipes have a cost benefit associated with their longevity. The polyethylene pipe industry conservatively estimates the service life for HDPE pipes to be 50-100 years. This relates to savings in replacement costs for a long period.

Encrusted pipes

Testing of consumer water meter

Operation and Maintenance Procedures

The municipal workshop does not have an operations manual. Operations and maintenance procedures are non-existent.

Field visits to various infrastructures in Chitungwiza, plant and evaluation of equipment revealed that there is a major problem relating to the operation and maintenance of equipment and plant. The council currently operates on a reactive basis. There is no scheduled maintenance programme for infrastructure, works or equipment. Examination of the expenditure records reveals that there is no expenditure line, let alone a budget line for routine maintenance, confirming the observation above.

The daily operation plan involves resolving customer complaints, attending to reported leakages, sewer overflows, and other reactive repairs at the water treatment works and wastewater treatment works.

Furthermore, the engineering department does not have adequate tools and transport to carry out repairs effectively. As a result, reaction time to repair requests is quite long. The available transport is stretched among other technical needs of the department such as road street repairs and solid waste management operations.

The consultant also observed that there is no system for record keeping at the Engineering Department – manual or computerised. Further compounding problems are the lack of Operation & Maintenance Manuals for existing Works and equipment. Under the UWSSRP Phase 1 which is under implementation, the Contractor is required to provide O&M Manuals for all new Works and equipment. This will hopefully, be the start of a systematic record keeping culture at the department. As part of the investment measures, regarding operation and maintenance, the Consultant proposes the implementation of a computerised record keeping system that will be linked to a broader Computerised Maintenance Management Programme (CMMP).

2 SEWERAGE

2.1 Reticulation System

2.1.1 Description of catchment areas

Harare is divided into five catchment areas according to the drainage patterns of the city. The existing catchment areas are; Firle or Mukuvisi Catchment Area, Crowborough Catchment Area, Marlborough Catchment Area, Budiriro Catchment Area and Hatcliff Catchment Area.

Firle or Mukuvisi Catchment Area

Firle or Mukuvisi Catchment Area is a large drainage area which encompasses the low density suburbs of Chisipite, Lewisham, Highland, Newlands, Oval Park, Runnivale, Borrowdale West, Pomona, Vainona, Groombridge, Little Norfolk, Mount Pleasant, North Wood, Gunhill, Worms Hill, Greendale, Dawn Hill, Oval Park, Rhodesville, Masasa, Mukuvisi Park, Beverly, Mukuvisi, Mukuvisi Park, Gleenglove, Beverly West, Amby, Bingley, Athlone, Cranborne Park, Queensdale, Arcadia, Braeside, Chadcombe, Masasa Park, Park Meadows, Hatfield, Graniteside, St Martins, Sunningdale, New Prospect Park, City Centre, the Avenues, Mbare, part of Southerton, Ardbennie, Prospect, Park Town, Malvern, Midlands, Waterfalls, Induna, Grobbie Park, Mbare West, Glen View, Glen Norah, Highfield and Willowvale.The projected average dry weather flow (ADWF) for the catchment area is estimated to be 82,204 m^3/day for the 2020 design horizon, and is projected to increase to 85,425m^3/day by 2030.

Crowborough Catchment Area

Sunrise, Sunridge, Avondale West, Sherwood Park, Sentosa, Mayfield Park, Gotsword Hills, Meyrick Park, Strathaven, St Andrews Park, Mablereigh, Monavale, Avondale, Kensington, Alexandra Park, Belvedere North, Milton Park, Lincoln Green, Belvedere South, Ridge View, Workingston, Rugare, Lochinvar, Kambuzuma, New Marimba, Marimba, Mufakose, Crowborough, Crowborough North, Kwadzana, Kwadzana Phase 3, Kwadzana Phase 4 Ext, Glaudina, Dzivaresekwa, Dzivaresekwa Ext, Tynwald North and Sanganayi Park, Bluff Hill, Bluff Park, New Bluff Hill Park, Tynwald, Tynwald South, Nkwisi Park, Westlea, Ashdown Park, Warren Park and Warren Park D and part of the Town Centre. The projected average dry weather flow (ADWF) for the catchment area is estimated to be 73,645 m^3/day for the 2020 design horizon, and is projected to increase to 75,625 m^3/day by 2030.

Budiriro Catchment Area

Budiriro Catchment Area comprise of the high density areas of Budiriro 1, 2, 3, 4 and 5. The projected average dry weather flow (ADWF) for the catchment area is estimated to be 15,177 m^3/day for the 2020 design horizon, and is projected to increase to 15,684 m^3/day by 2030.

Marlborough Catchment Area

Marlborough Catchment Area consists of the low density of Marlborough, New Marlborough, Adylinn, Emerald Hill, Ashrrittle and Avonlea. The projected average dry weather flow (ADWF) for the catchment area is estimated to be 4,325 m^3/day for the 2020 design horizon, and is projected to increase to 4,724 m^3/day by 2030.

Hatcliff Catchment Area

Hatcliff Catchment Area encompasses low density areas of Philadelphia, Borrowdale Brook, and Hogertt Hill part of Carrick Creach. The catchment also consists of the High density area of Hatcliff. The projected average dry weather flow (ADWF) for the catchment area is estimated to be 4,391 m^3/day for the 2020 design horizon, and is projected to increase to 6,396 m^3/day by 2030.

2.1.2 System description

The sewer shades within the City Harare are as described in the previous section. The following paragraphs give a brief description of the sewerage network system in each catchment area.

Firle or Mukuvisi Catchment Area

The collector mains carrying influent flows from this catchment area ranges from 150 mm Ø to 1400 mm Ø mains. The table below gives detailed sewerage system description in the contributing suburbs within the Firle Catchment Area.

Table 2-1: Systems Description in each Suburb in Firle Catchment Area

Suburbs covered	System Description
Chisipite and Lewisham	Wastewater from these areas is pumped via a 200 mm Ø AC to a Transition Chamber in Highlands. The influent gravitates from the Transition Chamber via the 375 mm Ø RC main into a 450 mm Ø RC pipe which subsequently discharges into the 750 mm Ø RC main. The 750 mm Ø main discharges into a 900 mm Ø AC main which also discharges into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
Highland, part of Newlands, Oval Park and Runnivale	Wastewater from these areas discharge into a 450 mm Ø RC pipe which subsequently discharges into the 750 mm Ø RC main. The 750 mm Ø main discharges into a 900 mm Ø AC main which also discharges into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
Borrowdale West, Pomona, Vainona, Groombridge, Little Norfolk, Mount Pleasant and North Wood	Wastewater from these areas is pumped via a 300 mm Ø AC to a Transition Chamber in Gunhill. The influent gravitates from the Transition Chamber via the 450 mm Ø RC main. The 450 mm Ø RC main discharges into the 675 mm Ø RC main.The 675 mm Ø main discharge into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
Gunhill and part of Newlands	The influent from these areas gravitates from the Transition Chamber via the 450 mm Ø RC main. The 450 mm Ø RC main discharges into the 675 mm Ø RC

Suburbs covered	System Description
	main.The 675 mm Ø main discharge into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
Worms Hill, Greendale, Dawn Hill, Oval Park and Rhodesville	Wastewater from these areas discharge a 315 mm Ø PVC main which subsequently discharge into the 450 mm Ø RC main. The 450 mm Ø RC main discharges into the 675 mm Ø RC main.The 675 mm Ø main discharge into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
Masasa, Mukuvisi Park, Beverly, Mukuvisi, Mukuvisi Park, Gleenglove, Beverly West, Amby, Bingley and Athlone	Wastewater from these areas discharge a 375 mm Ø RC main which subsequently discharge into the 525 mm Ø RC main and then into a 600 mm Ø RC main. The 600 mm Ø RC main discharges into the 750 mm Ø RC main.The 750 mm Ø main discharge into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
Cranborne Park, Queensdale, Arcadia and Braeside	Wastewater from these area discharge a 675 mm Ø RC main.The 675 mm Ø main discharge into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
Chadcombe, Masasa Park, Park Meadows and Hatfield	Wastewater from these areas discharge a 375 mm Ø RC main which subsequently discharge into the 525 mm Ø RC main. The 525 mm Ø main discharge into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
Graniteside, St Martins, Sunningdale and New Prospect Park	Wastewater from these areas discharge into two directions. Graniteside drains directly into the 1400 mm Ø collector main discharges into the Firle WWTW 1400 mm while Sunningdale, St Martins and New Prospects area drains into the 675 mm Ø main, which also discharges into one of the 1400 mm Ø twin collector main. The 1400 mm Ø collector main discharges into the Firle WWTW.
City Centre and the Avenues	Wastewater from these areas discharge into two mains. The 525 mm Ø RC main collecting wastewater from the town centre and the 750 mm Ø RC main collecting the wastewater from the avenues. The 525 mm Ø RC main discharges into a 750 mm Ø RC main which in turn discharges into the 1400 mm Ø RC collector main to Firle WWTW. The 750 mm also discharges into another twin 1400 mm Ø RC collector main to the Firle WWTW.

Suburbs covered	System Description
Mbare	Wastewater from this area discharges into the 1400 mm Ø RC collector main to the Firle WWTW.
Part of Southerton	Wastewater from these areas is discharges a 375 mm Ø RC main which subsequently discharge into the 600 mm Ø RC main. The 600 mm Ø main discharge into one of the 1400 mm Ø twin collector main which in turn discharges into the Firle WWTW.
Ardbennie	Wastewater from this areadischarges into two mains directions, the North Eastern part discharges into a 375 mm Ø RC main which in turn discharge into the 1400 mm Ø RC collector main. The other parts other parts of the suburb discharges into the 1400 mm Ø RC collector main to the Firle WWTW.
Prospect and Park Town	Wastewater from theseareas discharge into a 300 mm Ø RC main which in turn discharge into the 1400 mm Ø RC collector main to the Firle WWTW.
Malvern, Midlands, Waterfalls, Induna, Grobbie Park and Mbare West	Wastewater from theseareas discharge into the 1400 mm Ø RC collector main to the Firle WWTW
Glen View	Wastewater from this area discharges into a 300 mm Ø AC main which in turn discharge into a 375 mm Ø AC main. The 375 mm Ø AC main in turn discharges into the 450 mm Ø AC collector main. The influent from the 450 mm Ø AC main discharges into the 675 mm Ø AC collector main to the Firle WWTW.
Glen Norah	Wastewater from this area discharges into two mains directions, the North part discharges into a 300 mm Ø AC. The Southern part discharges into 450 mm Ø RC main. Both mains discharge into the 1400 mm Ø RC collector main to the Firle WWTW.
Highfield	Wastewater from this area discharges into two 375 mm Ø RC mains. Both mains merge downstream a 375 mm Ø RC before joining the 1400 mm Ø RC collector main to the Firle WWTW.
Willowvale	Wastewater from this area discharges into a 450 mm Ø RC main which in turn discharge into a 525 mm Ø RC main. The 525 mm Ø RC main in turn discharges into the 675 mm Ø RC collector main which discharges into the Firle WWTW.

Crowborough Catchment Area

The collector mains carrying influent flows from this catchment area ranges from 150 mm Ø to 1400 mm Ø mains. The table below gives detailed sewerage system description in the contributing suburbs within the Crowborough Catchment Area.

Table 2-2: Systems Description in each Suburb in Crowborough Catchment Area

Suburbs covered	System Description
Sunrise, Sunridge, Avondale West, Sherwood Park, Sentosa, Mayfield Park, Gotsword Hills, Meyrick Park, Strathaven, St Andrews Park, Mablereigh and Monavale	Wastewater from these areasdischarge into two mains; a 315 mm Ø PVC and 525 mm Ø RC mains. The mains join downstream into a 900 mm Ø RC main also discharges into the Crowborough WWTW.
Avondale, Kensington and Alexandra Park	Wastewater from these areas discharges into two mains 315 mm Ø PVC mains. The mains join downstream into a 450 mm Ø RC main also discharges into one of the 900 mm Ø twin collector main. The 900 mm Ø collector main discharges into the Crowborough WWTW.
Belvedere North, Milton Park and Lincoln Green	Wastewater from these areas discharge into a 450 mm Ø RC main. The 450 mm Ø RC main discharge into a 900 mm Ø RC twin main which discharge into the Crowborough WWTW.
Belvedere South, Ridge View and Workingston	Wastewater from these areas discharge into a 315 mm Ø PVC main which in turn discharge into a 450 mm Ø RC main. The 450 mm Ø RC main discharge into a 900 mm Ø RC twin main which discharge into the Crowborough WWTW.
Rugare	Wastewater from thisarea discharge into a 450 mm Ø RC main. The 450 mm Ø RC main discharge into a 900 mm Ø RC twin main which discharge into the Crowborough WWTW.
Lochinvar and Kambuzuma	Wastewater from these areas discharge into a 300 mm Ø PVC main. The 300 mm Ø PVC main discharge into a 900 mm Ø RC twin main which discharge into the Crowborough WWTW.
New Marimba and Marimba	Wastewater from these areas discharge into a 300 mm Ø AC main. The 300 mm Ø AC main discharge into a 900 mm Ø RC twin main which discharge into the Crowborough WWTW.
Mufakose	Wastewater from this area discharges into a 315 mm Ø PVC and 600 mm Ø RC mains. The 315 mm Ø PVC main discharges directly into Crowborough WWTW. The 600 mm Ø RC discharges into the 900 mm Ø RC

Suburbs covered	System Description
	which in turn discharges into the Crowborough WWTW.
Crowborough and Crowborough North	Wastewater from these areas discharge into a 300 mm Ø AC main. The 300 mm Ø AC main discharges into a 900 mm Ø RC twin main which discharge into the Crowborough WWTW.
Kwadzana, Kwadzana Phase 3, Kwadzana Phase 4 Ext, Glaudina, Dzivaresekwa, Dzivaresekwa Ext, Tynwald North and Sanganayi Park, Bluff Hill, Bluff Park and New Bluff Hill Park	Wastewater from these areas discharge into a 600 mm Ø AC main which in turn discharges into the Crowborough WWTW.
Tynwald, Tynwald South, Nkwisi Park, Westlea, Ashdown Park and Warren Park D	Wastewater from these areas discharge into a 450 mm Ø RC main. The 450 mm Ø RC main discharges into a 900 mm Ø RC twin main which discharge into the Crowborough WWTW.
Warren Park	Wastewater from these areas discharge into a 900 mm Ø RC twin main which discharge into the Crowborough WWTW.

Budiriro Catchment Area

The collector mains carrying influent flows from this catchment area ranges from 300 mm Ø to 675 mm Ø mains. The table below gives detailed sewerage system description in the contributing suburbs within the Budiriro Catchment Area.

Table 2-3: Systems Description in each Suburb in Budiriro Catchment Area

Suburbs covered	System Description
Budiriro 1, 2 and 3	Wastewater from these areas discharge into two mains 375 mm Ø RC main which in turn discharges into a 450 mm Ø RC main. The 450 mm Ø RC main discharges into a 675 mm Ø collector main. The 675 mm Ø collector main discharges into the Firle WWTW
Budiriro 4 and 5	Wastewater from these areas discharges into a 450 mm Ø RC to Budiriro Pump Station. From here, the influent is pumped to Firle WWTW via a 675 mm Ø RC collector main.

Marlborough Catchment Area

The collector mains carrying influent flows from this catchment area ranges from 300 mm Ø to 450 mm Ø mains. The table below gives detailed sewerage system description in the contributing suburbs within the Marlborough Catchment Area.

Table 2-4: Systems Description in each Suburb in Marlborough Catchment Area

Suburbs covered	System Description
Avonlea, Ashrrittle and Emerald Hill	Wastewater from these areas discharge into the Marlborough Pump Station where it is pumped via 375 mm Ø RC main into the Firle wastewater pipe network. In case of power outages, wastewater from these areas gravitates to the Marlborough WWTW.
Adylinn and Marlborough	Wastewater from these areas discharge into a 450 mm Ø RC main which discharge into the Marlborough WWTW
New Marlborough	Wastewater from these areas discharge into a 300 mm Ø AC main which discharge into the Marlborough WWTW

Hatcliff Catchment Area

The collector mains carrying influent flows from this catchment area ranges from 250 mm Ø to 450 mm Ø mains. The table below gives detailed sewerage system description in the contributing suburbs within the Hatcliff Catchment Area.

Table 2-5: Systems Description in each Suburb in Hatcliff Catchment Area

Suburbs covered	System Description
Hogert Hill, Borrowdale Brook, Philadelphia and part of Carrick Creagh	Wastewater from these areas is pumped through a series of Booster Pump Stations into a Transition Chamber in Hatcliff. From here, the wastewater gravitates via a 300 mm Ø AC main and then into a 450 mm Ø AC main to the Hatcliff WWTW.
Hatcliff	Wastewater from this discharges into a 300 mm Ø AC main and then into a 450 mm Ø AC main to the Hatcliff WWTW.

2.1.3 Condition assessment

The condition of the critical sewer mains conveying waste water from different suburbs in Harare were accessed with the help of Harare Water Staff. The following are the critical sections inspected during the site visit:

- the 1400 mm Ø RC twin mains collecting most of the influent in the Firle or Mukuvisi Catchment;
- the 600 mm Ø AC main collecting most of the influent on the eastern part of the Crowborough Catchment;
- the 900 mm Ø RC twin mains collecting most of the influent on the western part of the Crowborough Catchment.

<u>The 1400 mm Ø RC Twin Mains</u>

The 1400 mm Ø RC twin mains colleting waste water in the Mukuvisi Catchment. Assessment of these mains was carried by visual inspection via manholes. The main seem to be in good condition. However, the benching indicated some corrosion. The mains will require rehabilitation in a long term (2030). The figure below shows the condition of the manholes on the 1400 mm Ø RC twin mains.


Condition of manholes on the 1400 mm Ø RC mains

<u>The 600 mm Ø AC Main</u>

The 600 mm Ø AC main collects waste water from the eastern section of the Crowborough Catchment Area such as Kwadzana, Glaudina, Dzivaresekwa, Tynwald North Sanganayi Park and Bluff Hill. Assessment of this main was carried out by visual inspection of the manholes and on specific sections of the pipe. The pipe is currently surging and has collapsed at the downstream end. The entire section of main is required to be replaced and upgraded. The figure below shows the condition of the manholes and collapsed sections on the 600 mm Ø ACmain.

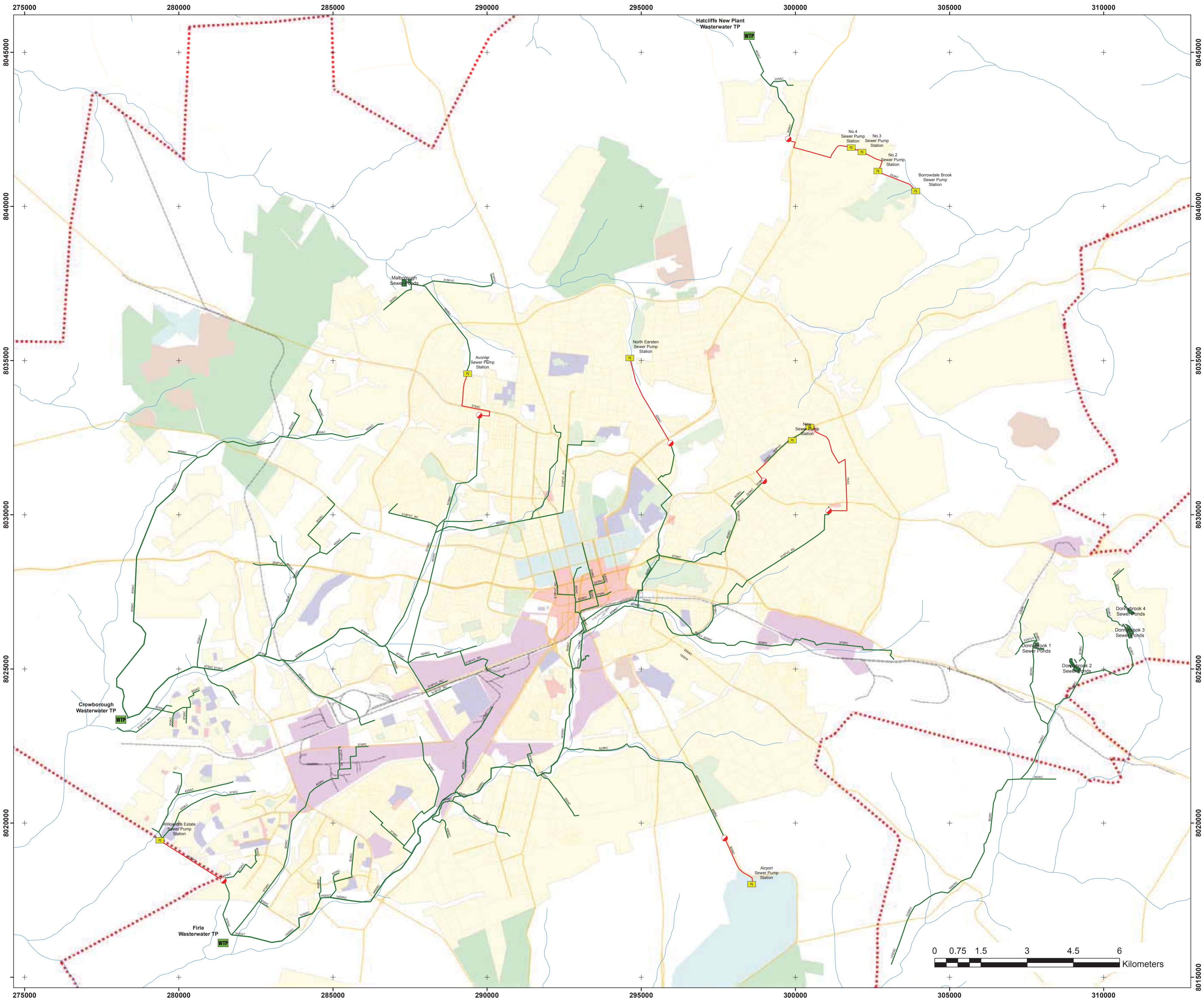

Collapsed section of the 600 mm Ø AC and state of Manholes on the main

<u>The 900 mm RC Twin Mains</u>

The 900 mm Ø RC twin mains collects the influent from the western part of Crowborough Catchment. Assessment of these mains was carried out by visual inspection of the manholes and the pipe bridge upstream of the Crowborough WWTW. The steel pipes on the pipe bridge are severely corroded and damaged, and all the influent from one of the 900 mm Ø is surcharging into the stream. Consequently, about 5,000 m of the 900 mm Ø does not convey any waste water and is in effect, abandoned. Part of the influent from the other 900 mm Ø RC main discharges into the river, the rest discharges into the Crowborough WWTW. The steel pipes pipe bridge and the 5,000 m length of the 900 mm Ø RC downstream of the pipe bridge that is currently abandoned due to the influent surcharging into the stream needs to be replace and upgraded. The figure below shows the condition of the manholes and damaged pipes on Pipe Bridge.

Condition of manhole and surcharging pipe on Pipe Bridge

Figure 2-1
Layout Map of Existing Sewerage System HARARE



N

1:55,000

Legend

- Transition Chambers
- Har_SewerPumpStations
- Har_SewerTreatmentPlants
- Har_SewerPonds
- Gravity Main
- Pumping Main
- River Crossing
- River / Stream
- Residential Roads
- Trunk/Primary Roads
- Rail Line
- Project Boundary
- Agriculture
- Business
- CBD
- Industrial
- Institutional
- Mining/Quarrying
- Recreational
- Residential

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2.1.4 Transmission Sewers Mains

A hydraulic model was constructed in conformity with the proposed restructured network. A primary network grid was laid out for each proposed zone and sized for the medium term (2020) and long term (2030) hydraulic loading.

Modelling Parameters

A hydraulic model requires several input parameters in order to simulate the actual conditions under which the network will be operating. These parameters are; the physical characteristics of the network and its boundary conditions (pipe roughness, manhole inverts) and the sewer loading.

In order to build a realistic representation of the system, the age and material of the mains were considered with the friction factors altered to reflect the material of pipe and the age of pipe. Most of the mains in Harare are in excess of 30 years old, therefore, it was deemed suitable to assume that the condition of these mains would be poor in places and hence; mains friction factors were increased to help reflect this.

The invert levels of the manholes on the collector mains were interpolated/extrapolated off the contour dataset obtained from Google Earth. The dataset has contour lines with an elevation interval of five meters. This data is fairly adequate for the purpose of higher level modelling of collector mains. More accurate surveys for collector mains, pump stations and ponds will be conducted for the final design.

The hydraulic loading (Sewer Flow) used for modelling the network has been calculated using population figures taken from the recently published report for the Census 2012 by the Zimbabwe National Statistics Agency (ZIMSTAT) as outlined in Chapter 3. A detailed analysis of the sewer loading calculations is outlined in Chapter 5.

The sewer flow loading in each catchment area was obtained by overlaying the wards layer with the catchment areas layer in ArcView 10.1. The wards lie either completely within a zone or only partially. The extent by which a particular ward is contained in a zone was estimated in terms of percentage. The catchment area received this percentage of demand for that ward. The wards that fell wholly within a particular catchment area were allocated 100% to that zone. The various flow loads from the wards that intersect the zone were aggregated to get the total demand for the catchment.

Modelling Scenarios

The restructured network was simulated using the daily peak demand of 2.0. The peak hour factor was added to the model and the impact towards the performance of the collectors mains analysed. For any network analysis case study, it is important to model the ‘worst-case’ scenario so that all potential issues can be predicted with mitigation measures put in place at the earliest possible opportunity. The calculated peak hour flow in each catchment area is tabulated in the table overleaf.

Table 2-6: Peak Hour Sewer Flow for Proposed Catchment Areas- Harare

Scenario	Catchment Area	Unit	Average Daily Demand		Peak Factor	Peak Hour Demand	
			2020 Demand	**2030 Demand**	**Factor**	**2020 Demand**	**2030 Demand**
Scenario	Firle or Mukuvisi	m³/day	82,204	85,425	2.0	164,408	170,850
	Crowborough	m³/day	73,645	75,625	2.0	147,289	151,251
	Marlborough	m³/day	4,325	4,724	2.0	8,649	9,449
	Budiriro	m³/day	15,177	15,684	2.0	30,353	31,368
	Hatcliff	m³/day	4,391	6,396	2.0	8,782	12,791

Results of the Modelling Simulations

In the restructured network for the year 2030 scenarios, the observed velocities within the collector mains were fairly within acceptable limits stipulated in the design criteria except for the mains highlighted in redin the figure below.

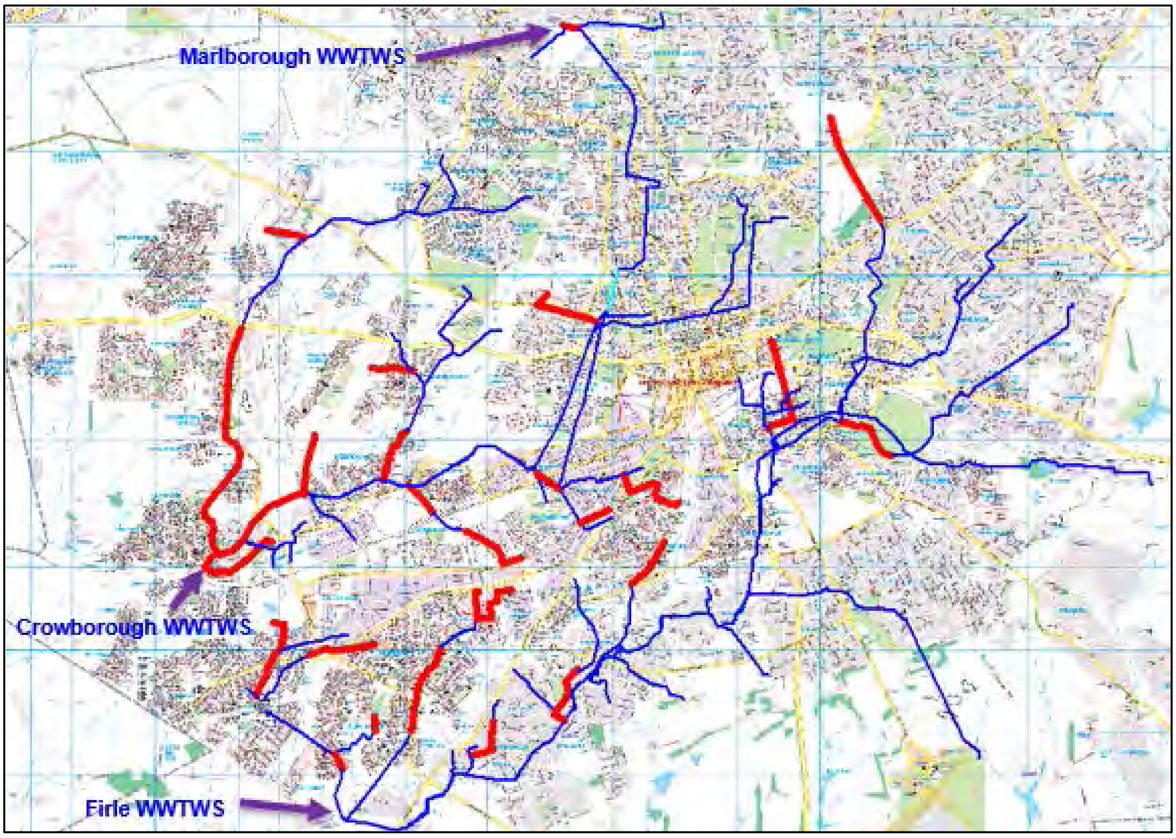

Figure 2-2: Surged Sewer Mains Highlighted in Red

These mains surcharged during the simulation. The maximum flow ratio and maximum depth of over 1.0 experienced in these sections of mains, indicates that pipes are running at full bore and as such, the hydraulic grade line was above the diameter of the pipe. This indicates that, these sections of mains do not have enough hydraulic capacity to handle the demand for the 2030 scenario and needs to be upsized.

A further simulation was performed in an attempt to find the optimal upgrades required to provide adequate levels of service. It is hoped that these changes to the network would help to reduce the surcharge experienced during the simulation.Table below shows the sections of mains that surcharged during the simulation and the recommended upgrades.

Table 2-7: Sewer Trunk Upgrade Measures

Section	Pipe (mm)	Length (m)	Upgrade Pipe (mm)	Material
Avenues	225	2826	450	PVC
Kuwadzana Phase 3	250	1104	450	PVC
Borrowdale West	300	3072	450	PVC
Budiriro	300	990	450	PVC
Crowborough North	300	1612	525	RC
Glen North	300	1925	450	PVC
Glenview	300	429	450	RC
Kambuzuma	300	2071	525	RC
Lochinvar	300	1877	525	RC
Marlborough	315	414	450	PVC
Mufakose	315	1598	450	PVC
St Andrews Park	315	2071	450	PVC
Willowvale	315	784	450	PVC
Budiriro	375	1756	450	PVC
Highfield	375	1807	525	RC
Mbare	375	1400	525	RC
Willowvale	375	1662	450	PVC
Braeside/Hillside	450	1821	525	RC
Budiriro	450	1632	600	RC
Dzivaresekwa	450	1007	600	RC
Warren Park D	450	1541	525	RC
Willowvale	450	1389	525	RC
Budiriro	525	984	600	RC
Budiriro	525	1419	600	RC
Willowvale	525	1490	675	RC
Dzivaresekwa	600	1659	825	RC
Dzivaresekwa	600	6755	900	RC
Braeside/Hillside	675	1951	750	RC
Willowvale	675	945	750	RC
Willowvale	675	1728	825	RC
Willowvale	675	301	875	RC
Crowborough North	900	2905	1050	RC
Outfall - Crowborough	900	197	1200	RC

To maintain self-cleaning velocities in the sewers a minimum velocity of 0.5 m/s is recommended and to prevent scour a maximum velocity range of 5-12 m/s is recommended, depending on the material. To follow the conservative approach a maximum velocity of 5 m/s is chosen for all materials, even if studies have shown that erosion effects observed at velocities greater than 4 m/s are only minimal.

The maximum velocities experienced within the collector mains are below the 2 m/s stipulated in the inception report and above the 0.75m/s recommended for self-cleansing velocity. Pipes at the selected gradient should be capable of conveying the ultimate flows and give minimum velocities at peak daily flow.

2.2 Sewage Pump Stations

The waste water distribution network of the City of Harare consists of 8 booster stations for the conveyance of waste water. The following sections give a summary of the pump stations and the proposed investment measures required for the medium and long term.

2.2.1 Avonlea Sewerage Pump Station

The Avonlea pump station was built in 1950 and is located in the North East of the City centre. Sewerage from Emerald Hill and Avonlea Suburbs flow by gravity into two sumps from where it is pumped to Crowborough WWTP.

The pump station consists of a dry well with three vertical centrifugal sewerage pumps, one with a larger capacity and the other two with 50% of the capacity. All the three pumps have the same head.

The influent two sumps, each of 29.4 m^3 capacity from where it enters the pump suction pipe. The sump has a manually-operated winch retrieval hoist for the removal of solids from the waste water. There is one screen, a penstock gate and a ladder.

The following are the details of the pumps at Avonlea Pump station.

Larger Capacity Pump (1 No)

- Make: APE
- Type: Vertical Sewer
- Q = 736 m^3/h.
- H = 38 m
- Motor: 90 kW, 380 V

Lower Capacity Pumps (2 No)

- Make: APE
- Type: Vertical Sewer
- Q = 368 m3/h.
- H = 38 m
- Motor: 45 kW, 380 V

The table below shows the condition of the pumps, motors and starter consoles.

Table 2-8: Condition Pumps at Avonlea Sewer Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Operational	Operational	Operational
3	Operational	Operational	Operational

From above table, it can be concluded that all the three pumps including motors and starter consoles are operational. However, because the pump station was not operational for three years, and considering when they were first installed (60 years ago), major rehabilitation/replacement are needed to reinstate the pump station to the design capacity.

The table below shows the proposed investment measures at the Avonlea Sewer Pump Station.

Table 2-9: Proposed Investment Measures at Letombo Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Replacement of pumps complete with motors and starters. Rehabilitation of sumps by desludging, repairs of cracks, painting of the safety railings, replacement of the screens, replacement of the penstock gate, replacement of the ladder and rehabilitation of the manual hoist. Rehabilitation of suction, delivery and non-return valves, rehabilitation of suction and delivery valves and replacement of NRVs. Installation of air valves, pressure gauges, installation of electric wire rope hoist and switchboards. Reinstatement of small power and lighting and security lights. Replacement of dewatering pump, installation of standby generator, flow meter, installation of level gauges and SCADA system.	For long term remedial measures, most of equipment which is not replaced at the medium term intervention will need to be replaced. The SCADA system shall be consolidated and further improved.

2.2.2 New Marlborough Sewerage Pump Station

The Marlborough Sewerage Pump Station was reportedly to have been built in 2002. It is located to the North of the City Centre. Sewerage from the surrounding areas flows by gravity into one sump of 3.5m x 3.5m (approx.) from where it is pumped by submersible pumps to the three Marlborough Ponds, situated at a distance of about 1.0 km from the pump station.

There are two submersible pumps (1Duty, 1Standby) but the pump specifications could not be confirmed.

The table below shows the condition of the pumps, motors and starter consoles.

Table 2-10: Condition Pumps at New Marlborough Sewer Pump Station

No	Pump	Motor	Console
1	Operational	Operational	Operational
2	Operational	Operational	Operational

The table overleaf shows the proposed investment measures at the New Marlborough Sewer Pump Station.

Table 2-11: Proposed Investment Measures at New Marlborough Sewer Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Construction of a new pump house, relocation of LV Switchboard and starter panels to inside the new pump house and replacement of pumps complete with motors and starters. Rehabilitation of sumps by desludging, repairs of cracks, painting of the safety railings, replacement of the screens, replacement of the penstock gate, replacement of the ladder and rehabilitation of the manual hoist. Rehabilitation of suction, delivery and non-return valves, rehabilitation of suction and delivery valves and replacement of NRVs. Installation of air valves, pressure gauges, installation of electric wire rope hoist and switchboards. Reinstatement of small power and lighting and security lights. Replacement of dewatering pump, installation of standby generator, flow meter, installation of level gauges and SCADA system.	For long term remedial measures, most of equipment which is not replaced at the medium term intervention will need to be replaced. The SCADA system shall be consolidated and further improved.

2.2.3 North East/Mount Pleasant Sewerage Pump Station

The North East/Mount Pleasant Pump Station was built in 1975 and is located in the North East of the City Centre. Sewerage from the Mount Pleasant areas flows by gravity into two sumps from where it is pumped for about 2.5 km to Gunhill transition chamber. The influent flows by gravity from this chamber to Firle WWTP.

The pump station consists of a dry well with three vertical centrifugal sewerage pumps. Below are the details of the centrifugal sewerage pumps at the North East/Mount Pleasant Pump Station.

Pump Details (2Duty and 1Standby)

- Make: TWRBA SAN
- Model: Cap 250/400
- Type: Vertical Sewer

- Q = 298 m3/h.
- H = 45 m
- Motor: 75 kW, 380 V
- Suction gate valves: DN 225
- Delivery gate valves: DN 150 with spindles
- Non-return valves: DN 150
- Main incomer valve: DN 300
- Main delivery valve: DN 300

The table below shows the condition of the pumps, motors and starter consoles.

Table 2-12: Condition Pumps at North East/Mount Pleasant Pump Station

No	Pump	Motor	Console
1	Non Operational	Non Operational	Non Operational
2	Operational	Operational	Operational
3	Non Operational	Non Operational	Non Operational

The table below shows the proposed investment measures at the New Marlborough Sewer Pump Station.

Table 2-13: Proposed Investment Measures at North East/Mount Pleasant Pump Station

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of sumps by desludging, repairs of cracks, painting of the safety railings, replacement of the screens, replacement of the penstock gate, replacement of the ladder and rehabilitation of the manual hoist. Rehabilitation of suction, delivery and non-return valves, rehabilitation of suction and delivery valves and replacement of NRVs. Installation of air valves, pressure gauges, installation of electric wire rope hoist and switchboards. Reinstatement of small power and lighting and security lights. Replacement of dewatering pump, installation of standby generator, flow meter, installation of level gauges and SCADA system.	For long term remedial measures, most of equipment which is not replaced at the medium term intervention will need to be replaced. The SCADA system shall be consolidated and further improved.

2.2.4 Borrowdale Brook Sewerage Pump Stations

The Borrowdale Brook Sewer Pumps Stations, as described here, are four pump stations pumping in series at different locations. The pumps, pumps the influent from Borrowdale Brook, Philadelphia and Hogert to a transition chamber in Hatcliff. These pump stations were built in the 1970s and have not worked since 2005.The pumps operate with 1 duty and 1 standby.

At the time of the field investigations, PS 01 was completely flooded and could not be accessed. However, Harare Water representative reportedthat all the four pump stations have the same type of immersible pumps (pumps which normally are not submersible but could work in case they get submersed).

The following are the details of the pumps at the Borrowdale Brook Sewerage Pump Stations.

- Type: Vertical Sewer Immersible
- Q = 200 m3/h.
- H = 50 m
- Motor: 35 kW, 380 V
- Suction gate valves: DN 150
- Delivery gate valves: DN 150
- Non-return valves: DN 150
- Main incomer valve: DN 225
- Main delivery valve: DN 225

The table below shows the condition of the pumps, motors and starter consoles.

Table 2-14: Condition Pumps at Borrowdale Brooks Pump Stations

No	Pump	Motor	Console
		Pump Station 1	
1	Non Operational	Non Operational	Non Operational
2	Non Operational	Non Operational	Non Operational
		Pump Station 2	
1	Non Operational	Non Operational	Non Operational
2	Removed	Removed	Non Operational
		Pump Station 3	
1	Non Operational	Non Operational	Non Operational
2	Non Operational	Non Operational	Non Operational
		Pump Station 4	
	Non Operational	Non Operational	Non Operational
	Non Operational	Non Operational	Non Operational

From above, it can be concluded that the pumps, motors and starters are not operational. However, due to good security of the pump houses, very few items have been vandalised.

From the physical examination, it can be concludedthat about 50% of the equipment can be rehabilitated.

The four pump stations are reportedly being rehabilitated and upgraded under the Chinese Exim bank Project.

However, after the field inspection, the following works are recommended in case the same sizes of pumps are used. If the capacity is to be increased, then pumps with larger capacity and also the pipe works may have to be completely replaced. The table below shows the proposed investment measures at the Borrowdale Brook Sewer Pumps Stations.

Table 2-15: Proposed Investment Measures at Borrowdale Brooks Pump Stations

Immediate	Medium Term (2020)	Long Term (2030)
	Rehabilitation of sumps by desludging, repairs of cracks, painting of the safety railings, replacement of the screens, replacement of the penstock gate, replacement of the ladder and rehabilitation of the manual hoist. Rehabilitation of suction, delivery and non-return valves, rehabilitation of suction and delivery valves and replacement of NRVs. Installation of air valves, pressure gauges, installation of electric wire rope hoist and switchboards. Reinstatement of small power and lighting and security lights. Replacement of dewatering pump, installation of standby generator, flow meter, installation of level gauges and SCADA system. Replacement of ladders and chain blocks.	For long term remedial measures, most of equipment which is not replaced at the medium term intervention will need to be replaced. The SCADA system shall be consolidated and further improved.

2.2.5 Donnybrook Sewerage Pump Stations

The Donnybrook Sewerage Pump Stations consist of four separate small pumping stations in Donnybrook, situated in the North East of the City Centre.

These pump stations pump the waste water to a number of ponds (primary, secondary and tertiary) for eventual delivery to the Vendersburg Farm.

There are two primary ponds, two secondary and one tertiary.

These pump stations have intake works for the removal of grit before pumping to the ponds. The influent flows by gravity from the following areas:

- PS 01: from Old Tafara and parts of Old Mabvuku;
- PS02: from New Mabvuku;
- PS03: from New Tafara
- PS04: from Old Tafara

All the four pump houses have been completely vandalised and there is no equipment in these pump houses. In fact, even the building of Pump House No 01 has been removed by vandals.

Harare Water is contemplating of abandoning these small pump houses andbuild one large pump station. However, if the existing scheme is to be rehabilitated, the security in the area must be improved.

Pump Details

There were three Pump Stations, PS 01, PS 03 and PS 04 are supposed to operate with 2Duty and 1Standby while PS 02 has two pumps (1Duty and 1 Standby).

As the pumps and the starters have been vandalised, the only known details are:

Type: Horizontal surface pumps;

- Estimated capacity: 100 to 150 m3/h;
- Suction valves: DN 150
- Delivery valves: DN 100

According to Harare Water, these pump stations will not be needed in future as a new facility is being proposed. However, the table below shows the proposed investment measures at the Donnybrook Pumps Stations in case the same existing scheme needs to be reinstated.

Table 2-16: Proposed Investment Measures at Donnybrook Pump Stations

Immediate	Medium Term (2020)	Long Term (2030)
	Desludging and repairs of cracks at the inlet works. Replacement/installation of the screens, gate valves, jetting systems, pumps and motors. Rehabilitation of suction, delivery and non-return valves, rehabilitation of suction and delivery valves and replacement of NRVs. Installation of air valves, pressure gauges, switchboards. Reinstatement of small power and lighting and security lights. Replacement of dewatering pump, installation of standby generator, flow meter, installation of level gauges and SCADA system. Replacement of ladders and chain blocks.	For long term remedial measures, most of equipment which is not replaced at the medium term intervention will need to be replaced. The SCADA system shall be consolidated and further improved.

2.2.6 Budiriro Sewerage Pump Station

The Budiriro pump station is located in the south of the City centre. This pump station serves the Budiriro catchment area from where the influent gravitates to the pump house. The influent is pumped from here to Firle WWTP.

This pump house was last used in 2006 but it is now undergoing rehabilitation and improvements. The original pumping had three submersible pumps. This has now been modified by the construction of a new pump house with a dry well accommodating horizontal surface pumps.

The following shows the details of the newly installed pumps.

- Make: Boshan

- Type: Horizontal Split Casing
- Q = 500 m^3/h.
- H = 60 m
- Motor: 132 kW, 380 V
- Suction gate valves: DN 300 with spindles
- Delivery gate valves: DN 300 with spindles
- Non-return valves: DN 300
- Gate valve on main delivery pipe: DN 450

From the hydraulic assessment of the Budiriro catchment areas, it estimated that the catchment would produce the influent loading of circa 660 m^3/h in the 2030 design horizon. Based on this, the new pumps would not be adequate for the 2030 design horizon. It is recommended that the old design pump of 750 m^3/h be reverted to in the long term.

The table below shows the proposed investment measures at the Donnybrook Sewer Pump Stations.

Table 2-17: Proposed Investment Measures at Donnybrook Pump Stations

Immediate	Medium Term (2020)	Long Term (2030)
	Desludging and repairs of cracks at the inlet works. Replacement/installation of the screens, gate valves, jetting systems, pumps and motors. Rehabilitation of suction, delivery and non-return valves, rehabilitation of suction and delivery valves and replacement of NRVs. Installation of air valves, pressure gauges, switchboards. Reinstatement of small power and lighting and security lights. Replacement of dewatering pump, installation of standby generator, flow meter, installation of level gauges and SCADA system. Replacement of ladders and chain blocks.	For long term remedial measures, most of equipment which is not replaced at the medium term intervention will need to be replaced. The SCADA system shall be consolidated and further improved.

2.2.7 New Chisipite Sewerage Pump Station

A new pump station was constructed in 2007 and the pipework was completed in 2013. However, no pumps were installed at the time of the field visit. The pump station was completely flooded.

The pumps are reportedly to have the following parameters:

- Q = 240 m^3/h
- H = 60 m

2.2.8 Old Chisipite Sewerage Pump Station

The Old Chisipite Sewerage pump station is located in the north west of the City Centre. The pump station was reportedly built in the 1970s.

It is a small pump station with an estimated output of about 0.5 ML/D. It collects the influent from the Chisipite area and pumps it to Firle WWTP.

The station is equipped with old mono-pumps which are belt-driven. The suction valves are DN 100 and the delivery valves are DN 80.

This pump station is planned to be decommissioned and abandoned in the near future since the new plant will soon be in operation.

2.3 Firle WWTW

2.3.1 Description of Fire WWTW

Firle sewage treatment works comprises a total of 5 individual wastewater treatment streams with a nominal overall design treatment capacity of 144,000m^3/day. The estimated average dry weather flow is reported to vary between 130,000 m^3/day and 150,000 m^3/day, whereas the wet weather flow is estimated to rise up to approximately 250,000 m^3/day.

Unit 1 and Unit 2

Units 1 and 2 were commissioned around 1970, and have a nominal design treatment capacity of 18,000 m^3/d each. The two units comprise the following;

- A common intake works comprising two parallel screen channels equipped with two sets of manually raked coarse and medium screens and corresponding Venturi Flumes,
- Six parallel baffled type vertical flow grit chambers with corresponding air-lift type grit removal system including compressor and air-lift pipework,
- Each unit has 6 No. circular sedimentation tanks, of the Dortmund tank design, without any sludge scraping device,
- Each unit has 4 No. trickling filters 38m in diameter and 4m high, filled with granite rocks,
- Each unit has 4 No. circular humus tanks (Final Sedimentations Tanks).

Unit 3

Unit 3 is a modified activated sludge process biological reactor commonly known as a BNR with a 5 stage configuration for biological nutrient removal of nitrogen and phosphorous, and was commissioned in 1982 and has a nominal design treatment capacity of 18,000 m^3/d. Unit 3 comprises;

- A 5 stage biological reactor that includes denitrification and phosphorous removal and treatment of carbonaceous load,
- Three number humus tanks.

Unit 4

Unit 4 is also a modified activated sludge process biological reactor with a 3-stage configuration for the biological nutrient removal of nitrogen and phosphorous, instead of the 5-stage concept as unit 3.

Unit 5

Unit 5 is a modified activated sludge process biological reactor commissioned in 1996 and has a nominal design treatment capacity of 72,000 m^3/day. Unit 5 comprises the following;

- Four parallel lines with a nominal design treatment capacity of 18,000 m3/d per line.

Pond System

Firle Sewage Treatment Works in addition to the above units has 3 No. ponds in series serving all units for additional effluent treatment in order to meet the corresponding standards for land and/or crop irrigation. However, under normal circumstances treated effluent from units 3, 4 and 5 is directly discharged into Mukuvisi River.

Effluent Pump Stations

Firle Sewage Treatment Works has two separate effluent pump stations:

- Existing Effluent Pump Station (EEPS) with a total of six pumps, all of which are not working,
- New Effluent Pump Station with a total of four pumps, two of which are operational.

Treated effluent from Unit 1 & 2 is discharge on adjacent farms owned by the City of Harare for further purification.

2.3.2 Capacity Assessment of Firle Sewage Treatment Works

Based on the water demand and wastewater flow calculations, Firle Catchment is generating less than 144,000 m^3/d. Hence, Firle Sewage Works has enough capacity to treat current flows, medium term flows and long term flows as shown in the table below;

Table 2-18: Waste Water Loading at Firle WWTW

Works	Current Flows (Ml/d)	2020 Flows (Ml/d)	2030 Flow (Ml/d)
Firle Sewage Works	**81.43**	**82.20**	**85.43**

Unit 1 and Unit 2

Units 1 and 2 have a nominal design treatment capacity of 18,000 m^3/d each. Flow measurement and distribution at the works to the various units is not functional hence, Unit 1 and 2 have been assessed based on the nominal design flow;

Primary Sedimentation Tanks

Each unit has 6 number tanks. However, due to lack of information on these tanks in terms of as built drawings, these have been assumed to be as observed on site;

- 12 Number;
- 12m in diameter;
- Inlet Depth 2m below maximum sewage level;
- Outlet depth 0.4m below maximum sewage level.

Best Practise design Specification for Circular Tanks is as outlined below;

Minimum Retention Time@ peak flow:	1.5 hrs.
Upflow Velocity @ peak flow:	2.00 m/hr.

For a flow of 36 Ml/day (36,000 m^3/day) the surface area and volume required for the above to be met will be as outlined in the table below;

Total sedimentation surface area required:	750 m^2
Maximum capacity:	24,000 m^3

Based on the assumed dimensions as paced on site, the existing tanks' surface area and volume and retention time is as outlined in the tables below;

Total sedimentation surface area:	1,356.48 m^2
Maximum capacity:	15,192.58 m^3

Retention Time@ peak flow:	10.1 hrs.
Upflow Velocity @ peak flow:	1.11 m/hr.

Therefore, based on the above brief assessment, the Primary Sedimentation Tanks are not hydraulically overloaded.

Biological Trickling Filters

The two units have the following biological trickling filters with outlined dimensions;

- 4 Number each;
- 38m in diameter;
- 4 m deep, and;
- 1m internal radius.

Best Practise Design Specification for Mineral Media Trickling Filters is as outlined below;

Minimum filter depth:	2m
BOD loading rate:	0.12 kgBOD/m^3.d
Ammoniacal Nitrogen loading rate:	0.02kgNH_3-N/m^3.d
Minimum hydraulic loading rate:	0.75m^3/m^3.d
Maximum wetting rate:	6m^3/m^2.d
Maximum influent BOD concentration:	150 mg/l
Maximum influent NH3-N concentration:	25mg/l

For the above filters, the total surface area and total filter volume are as outlined in the table below;

Total filter surface area:	9,062.04m^2
Total filter volume:	36,248.16 m^3

Based on the above dimensions the combined filter performance is as outlined in the table below;

Calculated BOD loading rate (incl return liquors@50% of consent):	0.601kgBOD/m^3.d
Calculated Ammoniacal Nitrogen loading rate (incl return liquors@100% of consent):	0.103kgNH_3-N/m^3.d

Therefore, based on the above brief assessment, the biological trickling filters are hydraulically overloaded and are failing to remove BOD5 and Ammoniacal Nitrogen. It must be noted that, the raw sewage is very strong and BOD5 does exceed the recommended value above.

<u>Final Sedimentation Tanks</u>

Each unit has 4 number tanks. However, due to lack of information on these tanks in terms of as built drawings, these have been assumed to be as observed on site;

- 8 Number;
- 23 m in diameter;
- Inlet Depth 3.2m below maximum sewage level;
- Outlet depth 0.4m below maximum sewage level.

Best Practise design Specification for Circular Tanks is as outlined below;

Minimum Retention Time@ peak flow:	2 hrs
Upflow Velocity @ peak flow:	1.00 m/hr

For a flow of 36 Ml/day (36,000 m^3/day) the surface area and volume required for the above to be met will be as outlined in the table below;

Total sedimentation surface area required:	1,500 m^2
Maximum capacity:	3,000 m^3

Based on the assumed dimensions as paced on site, the existing tanks' surface area and volume and retention time is as outlined in the tables below;

Total sedimentation surface area:	904.32 m^2
Maximum capacity:	1205.76 m^3

Retention Time@ peak flow:	1.9 hrs.
Upflow Velocity @ peak flow:	0.69 m/hr.

Based on the above brief assessment, the Final Sedimentation Tanks are hydraulically overloaded.

Unit 3

This Unit is commonly known as the Bardenpho which comprises of a 5 stage configuration for biological nutrient removal of nitrogen and phosphorous. This is basically a Johannesburg (JHB) process, with the following four stages; pre-anoxic, anaerobic, anoxic, and aerobic zones. An additional anoxic zone at the end of the aerobic zone makes the 5 stage treatment stream. The various stages do achieve the following;

- Pre-anoxic zone for denitrification before entering the anaerobic zone. This receives RAS only from the clarifiers, Anaerobic zone for the removal of phosphorus. This receives electron rich influent for the formation of volatile fats acids. Availability of VFAs is crucial to the efficiency of phosphorous release and subsequent uptake of same in the aerobic zone;
- Anoxic zone receives nitrate by internal recycle from the aerobic zone;
- Aerobic zone completes the utilisation of biodegradable organic matter while ammonium nitrogen is converted to nitrates by the nitrification organisms
- The post anoxic zone reduces the oxygen concentration of the mixed liquor and therefore contributes to additional denitrification in the anoxic zone, reducing the nitrate concentration of the recycle and enhances phosphorous release in the anaerobic zone.

Based on the design flow of 18,000m^3/day the various process units have been assessed as outlined below;

Primary Sedimentation Tanks

Unit 3 has 4 number tanks. However, due to lack of information on these tanks in terms of as built drawings, these have been assumed to be as observed on site;

- 4 Number;
- 12m in diameter;
- Inlet Depth 2m below maximum sewage level;
- Outlet depth 0.4m below maximum sewage level.

Best Practise design Specification for Circular Tanks is as outlined overleaf;

Minimum Retention Time@ peak flow:	1.5 hrs.
Upflow Velocity @ peak flow:	2.00 m/hr.

For a flow of 18 Ml/day (18,000 m^3/day) the surface area and volume required for the above to be met will be as outlined in the table below;

Total sedimentation surface area required:	450 m^2
Maximum capacity:	14,400m^3

Based on the assumed dimensions as paced on site, the existing tanks' surface area and volume and retention time is as outlined in the tables below;

Total sedimentation surface area:	452.16 m^2

Maximum capacity:	1,688 m^3

Retention Time@ peak flow:	3.8 hrs
Upflow Velocity @ peak flow:	1 m/hr

Based on the above brief assessment, the Primary Sedimentation Tanks are not hydraulically overloaded.

Activated Sludge Plant

Unit 3 has one basin with a 5 stage treatment process comprising; pre-anoxic, anaerobic, anoxic, and aerobic zones and has the following paced dimensions;

- Length of aerator 80 m;
- Width of 28.5 m; and
- Depth 4.7m.

Best Practise Design Specification for an activated sludge plant is as outlined below;

F/M ratio:	0.07 d^{-1}
Minimum retention time at peak flow:	3hrs
Minimum number of lanes/basins:	2
Design Mixed Liquor suspended solids (MLSS):	2000 to 3000mg/l
Minimum Dissolved Oxygen (D.O):	2mg/l
Minimum Influent Temperature:	7^oC
Minimum Surplus Activated Sludge (SAS):	0.75kgDS/kgBOD applied
Anoxic Selector:	30mins at DWF+ return liquors
$SSVI_{3.5}$:	125ml/g

The F/M ratio can be 0.07d^{-1} or 0.1d^{-1} and based on the MLSS of 3kg/m^3, 2.5kg/m^3 and 2kg/m^3 the required volumes at full flow to treatment of 36,599m3/d assuming 50% return liquors will be as outlined in the table below:

F/M Ratio of 0.07d^{-1}

MLSS kg/m3	3	2.5	2
Volume required with PSTs	48,214	57,857	72,321

F/M Ratio of 0.1d^{-1}

MLSS kg/m3	3	2.5	2
Volume required with PSTs	33,750	40,500	50,625

Existing Tank details based on paced dimensions on site are as outlined below for the above criteria;

F/M Ratio of $0.07d^{-1}$

MLSS kg/m3	3	2.5	2
No of tanks	1	1	1
Tank Length	80	80	80
Tank Width	28.5	28.5	28.5
Tank depth TWL	4.7	4.7	4.7
Total Tank depth	5.95	5.95	5.95
Tank Surface area	1910	1910	1910
Tank Volume	10,716	10,716	10,716

F/M Ratio of $0.1d^{-1}$

MLSS kg/m3	3	2.5	2
No of tanks	1	1	1
Tank Length	80	80	80
Tank Width	28.5	28.5	28.5
Tank depth TWL	4.7	4.7	4.7
Total Tank depth	5.95	5.95	5.95
Tank Surface area	1910	1910	1910
Tank Volume	10,716	10,716	10,716

The existing tank is a combined tank with baffle walls separating the anaerobic section from the other sections. Consequently it was very difficult without proper drawings to double check the volumes for the various zones.

However, based on the above, the tank volume provided does not meet the above best practise criteria, however, volume provided does meet the minimum retention time at peak flow.

Fundamentally Sludge Age or Solids retention time is the basic principle that under-pins the design of activated sludge plants and for the removal of Nitrogen and Phosphorous this parameter must be greater than 15 days. Aeration, F/M ratio which is dependent on the rate of MLSS recirculation and RAS rate are also very fundamental to the success of this technology. Therefore, a check of the Aeration Capacity provided based on Best Practice was conducted and the following came out of the assessment;

Actual oxygen requirement (AOR)		
Actual oxygen requirement (AOR)	1.6kgO_2/kg BOD + (4.5 - 0.5x2.8)kgO_2/kgNH_3-N	

AOR	21431.3 kgO_2/d	
Peaking Factor	**2**	Best practice
AOR	42862.5 kgO_2/d	1785.94 kgO_2/h
Standard oxygen requirement (SOR)		
SOR	$$\frac{AOR*C_{std} * D_c}{\alpha * (q)^{T-20} * [(t * W * \beta * D_c * C_{std}) - C_L]}$$	
d	Water Depth (m)	**4.7** m
C_{std}	Standard surface saturation dissolved oxygen concentration (9.07mg/l)	9.07 mg/l
D_c	Depth Correction Factor (= 1 + d * 0.0328)	1.15
T	Temperature	20^oC
α	Ratio of transfer coefficient (K_{La}) of the wastewater to that of tap water	**0.85** Best practice
q	Temperature correction coefficient for K_{La}	1.024
t	Temperature correction coefficient for solubility (= 51.6 / (31.6 + T))	1.00
W	Site Atmospheric Pressure Correction Coefficient	1.00
β	Ratio of oxygen saturation of the wastewater to that of tap water	**0.95** Best practice
C_L	Residual dissolved oxygen concentration	2.0 mg/l
SOR	Ratio of Standard to Actual oxygen transfer rate	**2768.43** kgO_2/h

The Standard Oxygen required for the existing tanks is much higher than the Actual Oxygen required. Based on the above brief assessment, a check of the power that is required for maximum optimum operation was carried out and compared with specifications of installed aerators as gleaned on site since even the operation and maintenance documents of the existing plant could not be found.

Surface Aerators must meet the following specifications although confirmation will be required from suppliers;

Standard Oxygen Aerator Efficiency (SAE)	1.8 kgO2/kWh	
Power Required	1538 kW	
Motor/Gearbox/Invertor Efficiency	84%	

Therefore, actual power required will be;

Power Required	1538 kW
Actual Power Required	1832 kW
Aerator per Tank	229 kW

Existing Mixers and Aerator power is as outlined in the table below;

Mixers	----- kW
Aerators	-------kW
Total Power	------ kW

Final Sedimentation Tanks

Unit 3 has 3 number tanks. However, due to lack of information on these tanks in terms of as built drawings, these have been assumed to be as observed on site;

- 3 Number;
- 20m in diameter;
- Inlet Depth 2m below maximum sewage level;
- Outlet depth 0.4m below maximum sewage level.

Best Practise design Specification for Final ASP Circular Tanks is as outlined below;

Upflow Velocity @ peak flow:	0.9m/hr
Underflow Velocity @ peak flow:	0.5 m/hr

Based on the assumed dimensions as paced on site, the existing tanks' surface area and volume is as outlined in the table below;

Total sedimentation surface area required:	942 m^2

Maximum capacity:	879.2 m^3

For a flow of 18 Ml/day (18,000 m^3/day) the surface area and volume required for the above to be met will be as outlined below based on the Mass Flux Theory using the following parameters;

Design Settleability (SSVI):	125.0 ml/g
Operating MLSS Xo:	3 g/m^3
Maximum underflow rate Vo/e^2;	0.57
N:	0.42
Vo:	4.23
Maximum Overflow rate $Vo.e^{-nXo}$;	1.19 m/h
Theoretical Settlement Area required:	1278.16 m^2
Maximum Sludge Holding Capacity:	5.11 kg/m^2.h

Limiting Flux Load:	$307(SSVI_{3.5})^{-0.77}(Q_u/A)^{0.68}{}_{crit}$	4.31 kg/m^2.h
		4.27
Safety Factor		20%

Theoretical Settlement Area required:	1533.79 m^3

Therefore, based on the above brief assessment, the Final Sedimentation Tanks are hydraulically overloaded although this is not very significant.

<u>Unit 4 and Unit 5</u>

These Units are also of Bardenpho but have less stages as compared to Unit 3. The basic principles under-pinning their design and operation is still the same as evidenced by their configurations. This similarity in layout includes also the number of FSTs. Therefore, the above assessment for Unit 3 was considered applicable and sufficient for these units at this stage.

Therefore, the investment measures for Firle Sewage Treatment Works shall be as shown in the figures below;

2.3.3 Proposed Investment Measures for Firle WWTW

Table 2-19: Proposed Investment Measures

Immediate	Medium Term (2020)	Long Term (2030)
	Intake WorksUnit 1 to 4	
	Replacement and maintenance of main Intake sluice gate Screens, mechanical screen,Air lift pumps, detritors and elevators and flow meters. Replacement and maintenance of Compressors for Air Pumps, LV Switchboard, and Small	Replacement and maintenance of main Intake sluice gate Screens, mechanical screen,Air lift pumps, detritors and elevators and flow meters. Replacement and maintenance of Compressors for Air Pumps, LV Switchboard, and Small Power and Lighting.

Immediate	Medium Term (2020)	Long Term (2030)
	Power and Lighting.	
	Intake Works Unit 5	
	Replacement and maintenance of main Intake sluice gate Screens, mechanical screen,Air lift pumps, detritors and elevators and flow meters. Replacement and maintenance of Compressors for Air Pumps, LV Switchboard, and Small Power and Lighting.	Replacement and maintenance of main Intake sluice gate Screens, mechanical screen,Air lift pumps, detritors and elevators and flow meters. Replacement and maintenance of Compressors for Air Pumps, LV Switchboard, and Small Power and Lighting.
	Extension of Intake Works	
		Extension of the Intake Works.
	PSTs and Trickling FiltersUnit 1 to 4	
	Maintenance and rehabilitation of Division Box,Primary Sedimentation Tanks, andTrickling Filters.	Maintenance and rehabilitation of Division Box, Primary Sedimentation Tanks, and Trickling Filters.
	Raw Sludge PumpsUnit 1 to 4	
	Maintenance and rehabilitation of Raw Sludge Pumps, including pump controls, suction gate valves, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance/of Raw Water Pump Switchboard, Small Power and Lighting,overhead wire rope hoist, Dewatering Pumps,Humus Pumps and Fittings. Replacement and maintenance of Irrigation Pumps and Fittings.	Maintenance and rehabilitation of Raw Sludge Pumps, including pump controls, suction gate valves, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance/of Raw Water Pump Switchboard, Small Power and Lighting,overhead wire rope hoist, Dewatering Pumps,Humus Pumps and Fittings. Replacement and maintenance of Irrigation Pumps and Fittings.
	BNR PlantUnit 3 to 4	
	Maintenance and rehabilitation of Raw Sludge Pumpsincluding pump controls, suction gate valves, delivery gate valves, non-return valves, pressure gauges and air valves. Maintenance and rehabilitation of BNR Unit, RAS Pumps including delivery gate valves, non-return valves, pressure gauges and air valves. Maintenance and rehabilitation of WAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenanceof RAS and WAS Pump LV Switchboard, Small Power and	Maintenance and rehabilitation of Raw Sludge Pumpsincluding pump controls, suction gate valves, delivery gate valves, non-return valves, pressure gauges and air valves. Maintenance and rehabilitation of BNR Unit, RAS Pumps including delivery gate valves, non-return valves, pressure gauges and air valves. Maintenance and rehabilitation of WAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenanceof RAS and WAS Pump LV Switchboard, Small Power and Lighting and overhead wire rope hoist.

Immediate	Medium Term (2020)	Long Term (2030)
	Lighting and overhead wire rope hoist.	
	ClarifiersUnit 3 to 4	
	Maintenance/Rehabilitation of Clarifiers.	Maintenance/Rehabilitation of Clarifiers.
	Unit 5 PSTs	
	Maintenance and rehabilitation of Division Box of Primary Sedimentation Tanks.	Maintenance and rehabilitation of Division Box of Primary Sedimentation Tanks.
	Unit 5 Raw Sludge Pumps	
	Maintenance and rehabilitation of Raw Sludge Pumps including pump controls suction gate valves, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance of Raw Sludge Pump LV Switchboard, Small Power and Lighting. Replacement and maintenance of overhead wire rope hoist and Dewatering Pumps.	Maintenance and rehabilitation of Raw Sludge Pumps including pump controls suction gate valves, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance of Raw Sludge Pump LV Switchboard, Small Power and Lighting. Replacement and maintenance of overhead wire rope hoist and Dewatering Pumps.
	Unit 5 BNR Plant	
	Maintenance and rehabilitation of BNR Unit,RAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Maintenance and rehabilitation of WAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance of RAS and WAS Pump LV Switchboard, Small Power and Lighting. Replacement and maintenanceof overhead wire rope hoist.	Maintenance and rehabilitation of BNR Unit,RAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Maintenance and rehabilitation of WAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance of RAS and WAS Pump LV Switchboard, Small Power and Lighting. Replacement and maintenanceof overhead wire rope hoist.
	Unit 5 Clarifiers	
	Maintenance/Rehabilitation of Clarifiers.	Maintenance/Rehabilitation of Clarifiers.
	Pump Station A	
	Replacement and maintenance of High Lift Pumps, Q=2000m^3/h, H=65m, including pump controls, suction gate valves, DN 400, delivery gate valves with actuators, DN 400, non-return valves, DN 400, pressure gauges, air valves, Replacement/Maintenance of overhead wire rope hoist, HL pump 3.3 kV Starter feeder switchboard, including 3.3 kV starter console, and	Replacement and maintenance of High Lift Pumps, Q=2000m^3/h, H=65m, including pump controls, suction gate valves, DN 400, delivery gate valves with actuators, DN 400, non-return valves, DN 400, pressure gauges, air valves, Replacement/Maintenance of overhead wire rope hoist, HL pump 3.3 kV Starter feeder switchboard, including 3.3 kV starter console, and

Immediate	Medium Term (2020)	Long Term (2030)
	3.3 kV remote starter panels, Maintenance and rehabilitation HL Effluent pump 380V LV switchboard. Replacement and rehabilitation of Small Power and Lighting, dewatering pumps, andventilation fans.	3.3 kV remote starter panels, Maintenance and rehabilitation HL Effluent pump 380V LV switchboard. Replacement and rehabilitation of Small Power and Lighting, dewatering pumps, andventilation fans.
	Pump Station B	
	Replacement and Maintenance of High Lift Pumps, Q=2000m^3/h, H=65m, including pump controls, suction gate valves, DN 700, delivery gate valves with actuators, DN 700, non-return valves, DN 700, pressure gauges and air valves. Replacement and Maintenance of overhead wire rope hoist. Maintenance and rehabilitation of HL pump 3.3 kV Starter feeder switchboard, including 3.3 kV starter console, and 3.3 kV remote starter panels HL Effluent pump 380V LV switchboard. Replacement and maintenance of Small Power and Lighting, dewatering pumps, and ventilation fans.	Replacement and Maintenance of High Lift Pumps, Q=2000m^3/h, H=65m, including pump controls, suction gate valves, DN 700, delivery gate valves with actuators, DN 700, non-return valves, DN 700, pressure gauges and air valves. Replacement and Maintenance of overhead wire rope hoist. Maintenance and rehabilitation of HL pump 3.3 kV Starter feeder switchboard, including 3.3 kV starter console, and 3.3 kV remote starter panels HL Effluent pump 380V LV switchboard. Replacement and maintenance of Small Power and Lighting, dewatering pumps, and ventilation fans.
	Effluent Pump Transmission Valves	
	Replacement and maintenance of Gate Valve, DN 900,NRV, DN 900, and Gate Valve, DN 700.	Replacement and maintenance of Gate Valve, DN 900,NRV, DN 900, and Gate Valve, DN 700.
	Digesters Unit 1 and 4	
	Rehabilitation and maintenance of Primary andSecondary Digesters.	Rehabilitation and maintenance of Primary Secondary Digesters
	Digesters Unit 5	
	Rehabilitation and maintenance of Primary Secondary Digesters.	Rehabilitation and maintenance of Primary Secondary Digesters
	Digester Sludge Control Pumps	
	Maintenance and replacement of Mixing Pumps, Q= 72 m3/h, H= 13 m, including, pump controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Maintenance and rehabilitation of Injection Pumps, Q= 108, H= 39 m, including, pump controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Replacement and rehabilitation of	Maintenance and replacement of Mixing Pumps, Q= 72 m3/h, H= 13 m, including, pump controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Maintenance and rehabilitation of Injection Pumps, Q= 108, H= 39 m, including, pump controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Replacement and rehabilitation of Mixing and Injection Pumps 380 V LV Switchboard,Small Power and lighting,

Immediate	Medium Term (2020)	Long Term (2030)
	Mixing and Injection Pumps 380 V LV Switchboard,Small Power and Lighting, overhead wire rope hoist,dewatering pumps.	overhead wire rope hoist,dewatering pumps.
	Heat Exchanger A	
	Maintenance and rehabilitation of Boilers, Heat Effluent Pumps, kW= 11, including, pumps controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Recirculation Pumps, kW= 2.2, including, pumps controls, suction gate valves, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Replacement and maintenanceof Heat Effluent and Circulation Pumps 380 V LV Switchboard, Small Power and Lighting, overhead wire rope hoist, and dewatering pumps.	Maintenance and rehabilitation of Boilers, Heat Effluent Pumps, kW= 11, including, pumps controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Recirculation Pumps, kW= 2.2, including, pumps controls, suction gate valves, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Replacement and maintenanceof Heat Effluent and Circulation Pumps 380 V LV Switchboard, Small Power and lighting, overhead wire rope hoist, and dewatering pumps.
	Heat Exchanger B	
	Maintenance and Rehabilitation of Boilers,Heat Effluent Pumps, Q= 43.2 m3/h, H= 14 m, kW= 11, including, pumps controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Recirculation Pumps, Q= 54 m^3/h, H= 15 m, kW= 15, including, pumps controls, suction gate valves, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Gas Booster Pumps, kW= 15, including, pumps controls, suction gate valves, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Replacement and maintenanceof Heat Effluent , Circulation and Gas Booster Pumps 380 V LV Switchboard, Replacement and maintenance of Small Power and Lighting, overhead wire rope hoist and dewatering pumps.	Maintenance and Rehabilitation of Boilers,Heat Effluent Pumps, Q= 43.2 m3/h, H= 14 m, kW= 11, including, pumps controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Recirculation Pumps, Q= 54 m3/h, H= 15 m, kW= 15, including, pumps controls, suction gate valves, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Gas Booster Pumps, kW= 15, including, pumps controls, suction gate valves, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Replacement and maintenanceof Heat Effluent , Circulation and Gas Booster Pumps 380 V LV Switchboard, Replacement and maintenance of Small Power and Lighting, overhead wire rope hoist and dewatering pumps.
	Gasholders	
	Rehabilitation/Maintenance of Gas Holders, and Burners.	Rehabilitation/Maintenance of Gas Holders, and Burners.

Immediate	Medium Term (2020)	Long Term (2030)
	Transformers	
	Replacement and rehabilitation of Transformers: 5 MVA, 33/3.3 kV,Transformers: 4 MVA, 33/11 kV, Transformers: 0.5 MVA, 3.3/0.4 kV, Transformers: 0.75 MVA, 11/3.3 kV, Transformers: 0.2 MVA, 11/0.4 kV, and Auto Reclosers.	Replacement and rehabilitation of Transformers: 5 MVA, 33/3.3 kV,Transformers: 4 MVA, 33/11 kV, Transformers: 0.5 MVA, 3.3/0.4 kV, Transformers: 0.75 MVA, 11/3.3 kV, Transformers: 0.2 MVA, 11/0.4 kV, and Auto Reclosers.
	Security Lights and Fence	
	Rehabilitation and replacement of security lights, and security fence.	Rehabilitation and replacement of security lights, and security fence.
	Standby Generator	
	Rehabilitation and replacementof existing generator, 275 kVA.	Rehabilitation and replacementof existing generator, 275 kVA.
	Buildings and Roads	
	Rehabilitation and maintenance of Office Buildings, WWTP Buildings Staff Houses and Compound Roads.	Rehabilitation and maintenance of Office Buildings, WWTP Buildings Staff Houses and Compound Roads.

2.4 Crowborough WWTW

2.4.1 Description of Crowborough WWTW

Crowborough sewage treatment works comprises a total of 3 individual wastewater treatment streams with a nominal overall design treatment capacity of 54,000 m^3/day. The estimated average dry weather flow has been reported to periodically rise to, 100,000 m^3/day.

<u>Unit 1 and Unit 2</u>

Units 1 and 2 were commissioned in 1959 and 1972 respectively, and have a nominal design treatment capacity of 18,000 m^3/day each. The two units comprise the following;

- A common intake works comprising two parallel screen channels equipped with two sets of manually raked coarse and medium screens and corresponding Venturi Flumes;
- Six parallel baffled type vertical flow grit chambers with corresponding air-lift type grit removal system including compressor and air-lift pipework;
- Each unit has 6 No. circular sedimentation tanks, of the Dortmund tank design, without any sludge scraping device;
- Each unit has 4 No. trickling filters 38m in diameter and 4m high, filled with granite rocks;
- Each unit has 4 No. circular humus tanks (Final Sedimentations Tanks).

<u>Unit 3</u>

Unit 3 is a modified activated sludge process biological reactor commonly known as a BNR with a 5 stage configuration for biological nutrient removal of nitrogen and phosphorous, and was commissioned in 1982 and has a nominal design treatment capacity of 18,000 m^3/d. Unit 3 comprises;

- A 5 stage biological reactor that includes denitrification and phosphorous removal and treatment of carbonaceous load,
- Three number humus tanks.

<u>Pond System</u>

Crowborough Sewage Treatment Works in addition to the above units has 3 No. ponds in series serving unit 1 and 2 for additional effluent treatment in order to meet the corresponding standards for land and/or crop irrigation. However, under normal circumstances treated effluent from units 3 is directly discharged into Marimba River.

<u>Effluent Pump Stations</u>

Crowborough Sewage Treatment Works has one effluent pump station:

- With a total of six pumps, all of which are not working,

Treated effluent from Unit 1 & 2 is discharge on adjacent farms owned by the City of Harare for further purification.

2.4.2 Capacity Assessment of Crowborough Sewage Treatment Works

Unit 1 and Unit 2

Units 1 and 2 have a nominal design treatment capacity of 18,000 m^3/d each. Flow measurement and distribution at the works to the various units is not functional however, from water demand and sewage flow calculations an additional 18,000 m^3/d module is required hence, the existing process units have not been assessed to ascertain their hydraulic and process capacities. Comparing the number of process units and configurations with those at Firle Sewage Treatment Works, the assessment above for Firle Sewage Treatment Works is considered sufficient for Crowborough Sewage treatment Works for the design flow of 54.000 m^3/d.

Table 2-20: Waste Water Loading at Crowborough WWTW

Works	Current Flows (Ml/d)	2020 Flows (Ml/d)	2030 Flow (Ml/d)
Crowborough Works	**70.83**	**73.64**	**75.63**

Therefore, the investment measures for Crowborough Sewage Treatment Works are highlighted in the following section.

2.4.3 Proposed Investment Measures for Crowborough WWTW

The following tables show a summary of the investment measures required at Crowborough WWTW.

Table 2-21: Proposed Investment Measures for Crowborough WWTW

Immediate	Medium Term (2020)	Long Term (2030)
	Intake Works Unit 3	
	Replacement and maintenance of Main Intake Coarse Screens, Intake Sluice Gates, Grit Tanks, mechanical screen, Air lift pumps, Detritors, Elevators, Flowmeters and Compressors for Air Pumps. Enlargement of Intake Works to 110 ML/D. Replacement and maintenance of LV Switchboard and Small Power and Lighting.	Replacement and maintenance of Main Intake Coarse Screens, Intake Sluice Gates, Grit Tanks, mechanical screen, Air lift pumps, Detritors, Elevators, Flow meters and Compressors for Air Pumps. Enlargement of Intake Works to 110 ML/D. Replacement and maintenance of LV Switchboard and Small Power and Lighting
	Intake Works 1 and 2	
	Replacement and maintenance of Intake Sluice Gates, Main Intake Coarse Screens, Main Intake Fine Screens, Air lift pumps, flowmeters,LV Switchboard, and Small Power and Lighting.	Replacement and maintenance of Intake Sluice Gates, Main Intake Coarse Screens, Main Intake Fine Screens, Air lift pumps, flow meters,LV Switchboard, and Small Power and Lighting.
	Splitter Box	
	Replacement and maintenance of Intake Sluice Gates and DN 900 inflow Concrete Pipes.	Replacement and maintenance of Intake Sluice Gates and DN 900 inflow Concrete Pipes.

Immediate	Medium Term (2020)	Long Term (2030)
	Unit 1 to Unit 2 PSTs, Trickling Filters and Humus Tanks	
	Maintenance and rehabilitation of Primary Sedimentation Tanks, Trickling Filters and Humus Tanks.	Maintenance and rehabilitation of Primary Sedimentation Tanks, Trickling Filters and Humus Tanks.
	Unit 1 Raw Sludge Pumps	
	Maintenance and rehabilitation of Raw Sludge Pumps, Q= 95 m3, H= 20 m, including pump controls, delivery gate valves, DN 250, non-return valves, DN 250, pressure gauges and air valves, Replacement and maintenance of Raw Water Pump 380 V LV Switchboard, Small Power and Lighting and overhead wire rope hoist, 3t.	Maintenance and rehabilitation of Raw Sludge Pumps, Q= 95 m3, H= 20 m, including pump controls, delivery gate valves, DN 250, non-return valves, DN 250, pressure gauges and air valves, Replacement and maintenance of Raw Water Pump 380 V LV Switchboard, Small Power and Lighting and overhead wire rope hoist, 3t.
	Effluent Pump Station to Crowborough Farm	
	Replacement and maintenance of Effluent Pumps, Q=1500m3/h, H=60m, including pump controls, suction gate valves, DN 250, delivery gate valves with actuators, DN 250, non-return valves, DN 250, pressure gauges, air valves, Replacement and maintenance of overhead wire rope hoist, HL Effluent pump 380V LV switchboard, Small Power and Lighting, and dewatering pumps.	Replacement and maintenance of Effluent Pumps, Q=1500m3/h, H=60m, including pump controls, suction gate valves, DN 250, delivery gate valves with actuators, DN 250, non-return valves, DN 250, pressure gauges, air valves, Replacement and maintenance of overhead wire rope hoist, HL Effluent pump 380V LV switchboard, Small Power and Lighting, and dewatering pumps.
	Raw Sludge Surface Pumps to Ingwe Farm	
	Maintenance and rehabilitation of Raw Sludge Pumps, Q= 1500 m3, H= 60 m, including pump controls, suction gate valves, DN 500, delivery gate valves, DN 450, non-return valves, DN 450, pressure gauges and air valves,3.3 kV Switchboard,Raw Water Pump 380 V LV Switchboard, Small Power and Lighting, overhead wire rope hoist and dewatering pumps.	Maintenance/Rehabilitation of Raw Sludge Pumps, Q= 1500 m3, H= 60 m, including pump controls, suction gate valves, DN 500, delivery gate valves, DN 450, non-return valves, DN 450, pressure gauges and air valves,3.3 kV Switchboard,Raw Water Pump 380 V LV Switchboard, Small Power and Lighting, overhead wire rope hoist and dewatering pumps.
	Raw Sludge Surface Pumps to Mufakose	
	Maintenance and rehabilitation of Raw Sludge Pumps, Q= 1000 m3, H= 30 m, including pump controls, suction gate valves, DN 250, delivery gate valves, DN 250, non-return valves, DN 250, pressure gauges and air valves,Raw Water Pump 380 V LV	Maintenance and rehabilitation of Raw Sludge Pumps, Q= 1000 m3, H= 30 m, including pump controls, suction gate valves, DN 250, delivery gate valves, DN 250, non-return valves, DN 250, pressure gauges and air valves,Raw Water Pump 380 V LV

Immediate	Medium Term (2020)	Long Term (2030)
	Switchboard, Small Power and Lighting, overhead wire rope hoist and dewatering pumps.	Switchboard, Small Power and Lighting, overhead wire rope hoist and dewatering pumps.
	Effluent Pump Transmission Pipe and Valves	
	Replacement and maintenance of, DN 450 Gate Valves, DN 450 NRV and DN 600 Steel Pipe.	Replacement and maintenance of, DN 450 Gate Valves, DN 450 NRV and DN 600 Steel Pipe.
	Unit 3 PSTs and Humus Tanks	
	Maintenance and rehabilitation of Primary Sedimentation Tanks, and Humus Tanks.	Maintenance and rehabilitation of Primary Sedimentation Tanks, and Humus Tanks.
	Unit 3 Raw Sludge Surface Pumps	
	Maintenance and rehabilitation of Raw Sludge Pumps, Q= 150 m3, H= 20 m, including pump controls, suction gate valves, DN 250, delivery gate valves, DN 250, non-return valves, DN 250, pressure gauges and air valves. Replacement and maintenance of Raw Water Pump 380 V LV Switchboard,Small Power and Lighting, overhead wire rope hoist and dewatering pumps.	Maintenance and rehabilitation of Raw Sludge Pumps, Q= 150 m3, H= 20 m, including pump controls, suction gate valves, DN 250, delivery gate valves, DN 250, non-return valves, DN 250, pressure gauges and air valves. Replacement and maintenance of Raw Water Pump 380 V LV Switchboard,Small Power and Lighting, overhead wire rope hoist and dewatering pumps.
	Unit 3 BNR Plant	
	Maintenance and rehabilitation of BNR Unit, RAS Pumps, kW= 11, including, delivery gate valves, DN 250, non-return valves, DN 250, pressure gauges and air valves, WAS Pumps, kW= 5.5, including, delivery gate valves, DN 200, non-return valves, DN 200, pressure gauges and air valves. Replacement and maintenance RAS and WAS Pump 380 V LV Switchboard,BNR LV Switchboard, Small Power and Lighting and overhead wire rope hoist.	Maintenance and rehabilitation of BNR Unit, RAS Pumps, kW= 11, including, delivery gate valves, DN 250, non-return valves, DN 250, pressure gauges and air valves, WAS Pumps, kW= 5.5, including, delivery gate valves, DN 200, non-return valves, DN 200, pressure gauges and air valves. Replacement and maintenance RAS and WAS Pump 380 V LV Switchboard,BNR LV Switchboard, Small Power and Lighting and overhead wire rope hoist.
	Digesters	
	Rehabilitation and maintenance of Primary andSecondary Digesters	Rehabilitation and maintenance of Primary andSecondary Digesters
	Digester Sludge Control Pumps	
	Maintenance and replacement of Mixing Pumps, Q= 72 m3/h, H= 13 m, including, pump controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150,	Maintenance and replacement of Mixing Pumps, Q= 72 m3/h, H= 13 m, including, pump controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150,

Immediate	Medium Term (2020)	Long Term (2030)
	pressure gauges and air valves,Pumps, Q= 108, H= 39 m, including, pump controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Replacement and maintenance of Mixing and Injection Pumps 380 V LV Switchboard,Small Power and Lighting, overhead wire rope hoist, anddewatering pumps.	pressure gauges and air valves,Pumps, Q= 108, H= 39 m, including, pump controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Replacement and maintenance of Mixing and Injection Pumps 380 V LV Switchboard,Small Power and Lighting, overhead wire rope hoist, anddewatering pumps.
Heat Exchanger		
	Maintenance and rehabilitation of Boilers,Heat Effluent Pumps, kW= 11, including, pumps controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Pumps, kW= 2.2, including, pumps controls, suction gate valves, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Replacement and maintenance of Heat Effluent and Circulation Pumps 380 V LV Switchboard, Small Power and Lighting,overhead wire rope hoist, dewatering pumps.	Maintenance and rehabilitation of Boilers,Heat Effluent Pumps, kW= 11, including, pumps controls, suction gate valves, DN 150, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves, Pumps, kW= 2.2, including, pumps controls, suction gate valves, delivery gate valves, DN 150, non-return valves, DN 150, pressure gauges and air valves. Replacement and maintenance of Heat Effluent and Circulation Pumps 380 V LV Switchboard, Small Power and Lighting,overhead wire rope hoist, dewatering pumps.
Gas Holders		
	Rehabilitation and maintenance of Gas Holders, and Burner.	Rehabilitation and maintenance of Gas Holders, and Burner.
Transformers		
	Replacement and maintenance of Transformers: 2 MVA, 33/3.3 kV, Transformers: 500 kVA, 11/0.4 kV, 33kV Switchboard (4nr VCBs), 33kV Switchboard (4nr VCBs), Transformers: 0.2 MVA, 11/0.4 kV, and Switchgear Components.	Replacement and maintenance of Transformers: 2 MVA, 33/3.3 kV, Transformers: 500 kVA, 11/0.4 kV, 33kV Switchboard (4nr VCBs), 33kV Switchboard (4nr VCBs), Transformers: 0.2 MVA, 11/0.4 kV, and Switchgear Components.
Security Lights and Fence		
	Rehabilitation and replacement security lights and security fence.	Rehabilitation and replacement security lights and security fence.
Security Lights and Fence		
	Rehabilitation and replacement of existing 275 kVA Generator.	Rehabilitation and replacement of existing 275 kVA Generator.
Standby Generators		
	Rehabilitation and replacement of	Rehabilitation and replacement of

Immediate	Medium Term (2020)	Long Term (2030)
	existing 275 kVA Generator.	existing 275 kVA Generator.
	Building and Roads	
	Rehabilitation and maintenance of Office Buildings, WWTP Buildings, Staff Houses andRoads.	Rehabilitation and maintenance of Office Buildings, WWTP Buildings, Staff Houses andRoads.

Table 2-22: Proposed Investment Measures for New BNR Module

Immediate	Medium Term (2020)	Long Term (2030)
	Intake Works Unit 3	
Construction of a new inlet works complete with a grit removal system, Construction of new Primary Sedimentation Tanks. Construction of a new 18,000m3/d BNR Unit, Construction of Final Settlement Tanks		Maintenance and rehabilitation of BNR Unit,RAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves, WAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance of RAS and WAS Pump LV Switchboard, BNR LV Switchboard, Small Power and Lighting and overhead hoist. Maintenance and Rehabilitation of Primary Sedimentation Tanks and Humus Tanks.

2.5 HatcliffWWTW

2.5.1 Description of Hatcliff WWTW

Hatcliff sewage treatment works comprises one wastewater treatment stream with a nominal overall design treatment capacity of 5,000m^3/day. The estimated average dry weather flow has been reported to periodically rise to, 2,500 m^3/day.

The treatment train comprises the following;

- Preliminary Treatment, and
- Biological treatment using a BNR.

The works are very small since they serve a limited catchment area and as such their impact in treating sewage based on the demand and wastewater flow calculations is not very significant.

Table 2-23: Waste Water Loading at Hatcliff WWTW

Works	Current Flows (Ml/d)	2020 Flows (Ml/d)	2030 Flow (Ml/d)
Hatcliff Sewerage Works	**3.07**	**4.39**	**6.40**

Subsequently, these have not been assessed in detail but, the following investment measures are required in order to meet the medium term and long term wastewater treatment from the small catchment area;

2.5.2 Proposed Investment Measures

The following figure shows some of the investment measures that are required in the short and long term.

Table 2-24: Proposed Investment Measures for Hatcliff WWTW

Immediate	Medium Term (2020)	Long Term (2030)
	Maintenance and rehabilitation of BNR Unit, RAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves,WAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance RAS and WAS Pump LV Switchboard, BNR LV Switchboard, Replacement and maintenance of Small Power, Lighting and overhead hoist.	Maintenance and rehabilitation of BNR Unit, RAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves,WAS Pumps, including, delivery gate valves, non-return valves, pressure gauges and air valves. Replacement and maintenance RAS and WAS Pump LV Switchboard, BNR LV Switchboard, Replacement and maintenance of Small Power, Lighting and overhead hoist.

2.6 Marlborough WWTW

2.6.1 Description of Marlborough WWTW

Marlborough sewage treatment works comprises one wastewater treatment stream with a nominal overall design treatment capacity of 2,000m^3/day. The estimated average dry weather flow is not known.

The treatment train comprises the following;

- 3 primary stabilisation ponds; and
- 2 secondary stabilisation ponds.

The works are very small since they serve a limited catchment area and as such their impact in treating sewage based on the demand and wastewater flow calculations is not very significant.

Table 2-25: Waste Water Loading at Marlborough WWTW

Works	:urrent Flows (Ml/d)	2020 Flows (Ml/d)	2030 Flow (Ml/d)
Marlborough Sewerage Works	**4.70**	**4.32**	**4.72**

Subsequently, these have not been assessed in depth but the following investment measures are required in order to meet the medium term and long term wastewater treatment from the small catchment area;

Immediate	meidum term (2020)	Long term (2030)
	• Rehabilitation of ponds, • Construction of 2,000 m^3/d stabilisation ponds.	• Rehabilitation of ponds.

3 PROPOSED HARARE SOUTH SEWERAGE MEASURES

3.1 Background

Harare is served by a number of sewage treatment plants of varying sizes. This discussion relates to the sewage collection and treatment for the eastern, south eastern and southern suburbs of Harare as shown in the map and tables below. These areas all fall within the Manyame river catchment.

Currently these areas have varied sewage provision and include large unsewered areas into which the city is expanding. Collected sewage is, with the exception of Chitungwiza, treated in many, dispersed small stabilization ponds which are generally functioning poorly. The current situation in this catchment is that the majority of sewage is therefore discharged into the Manyame and its tributaries untreated.

The prince Edward Water Treatment works extracts water from the centre of this increasingly polluted catchment.

3.2 Existing Plans

The following scope of works is covered under the UWSSRP regarding the water supply components for Harare Municipality.

Current plans date back to the 2003 Harare Sewage Master Plan prepared by Safege. This master plan recognized that the major expansions of Harare would be in the southern suburbs, termed in that report the Southern Industrial Area or SIA. That Master Plan expected population growth within the SIA to increase sewage production from zero in 2003 to 85MLD in 2015. The management of this sewage and sewage from eastern suburbs was proposed as follows:

- Ventersberg, Tafara, Donny Brook, Ruwa and Epworth would all be drained to a new sewage treatment works at Lyndhurst Farm. The plan called for the construction of collector and trunk sewers leading a Biological Nutrient Removal (BNR) plant on Lyndhurst Farm. Considerable progress was made on the sewer construction but none on the treatment works before the project was suspended due to lack of funds.
- The Southern Harare Suburbs, collectively termed the SIA were divided into six sub catchments. The 2003 plan calls for part of the effluent from the SIA area to be pumped to Lyndhurst Farm WWTW whilst 3 new BNR works and two additional sewage pumping stations would serve the balance of the SIA.
- Not included in the 2003 Harare Master Plan is Chitungwiza. Current plans are for the construction of a new Sewage Treatment Plant at the confluence of the Nyatsime and Manyame rivers and the North West corner of Chitungwiza.

3.3 Proposed Combined Plan

This project is recommending a proposal to combine all of these areas into a single sewage catchment with all of the effluent to be collected into a major new Harare South Trunk Sewer (HSTS) and treated at a new Harare South Wastewater Treatment Works (HSWWTW). The proposal would include the following sub projects:

- Completion of the Donny Brook to Lyndhurst Farm trunk sewer and connection of Ventersberg, Donny Brook and Mabvuku /Tafara to this line. This was partly constructed in 2003 but not completed. This sub project is required regardless of whether a combined sewage plan is implemented and will allow for the decommissioning of three sets of waste stabilization ponds in Donny Brook.
- Connection of the Epworth area to the Donny Brook to Lyndhurst Farm trunk sewer which passes through Epworth. This sub project is required regardless of whether a combined sewage plan is implemented and will allow the Epworth sewer system constructed 20 years ago finally to be commissioned.
- Construction of two trunk sewers to link the collection system in Ruwa to the Donny Brook to Lyndhurst sewer. This construction will allow the decommissioning of three sewage pumping stations in Ruwa which currently regularly discharge raw sewage into the Ruwa River. This sub project is required regardless of whether a combined sewage plan is implemented.
- An extension from the end of the existing Donny Brook to Lyndhurst Farm Sewer approximately 28 km to a proposed new Sewage Treatment Plant close to the confluence between the Manyame and Mukuvisi Rivers.
- An extension in the trunk sewer proposed to link Chitungwiza to its new WWTW by approximately 1 km such that it ties into the trunk sewer from Lyndhurst Farm to the new WWTW.
- Construction of a single WWTW at the end of the new Trunk Sewer. The construction of this works would obviate the need for construction of the five new WWTWs currently proposed at Lyndhurst Farm, SIA Zones 2, 3 and 4 and Chitungwiza.

Ideally these works would be put in place immediately but the HSTS and its associated treatment works represent a very major capital investment at a time when the city has many competing demands for resources. Therefore it is planned that interim measures will be put in place in the short to medium term to keep the existing system functioning and return it to its designed functionality whilst the HSTS scheme will be implemented as a long term investment measure.

Interim measures proposed are as follows:

1. Short term minor works to rehabilitate the existing Donny Brook 1 to 4 waste stabilisation ponds
2. Construction of temporary pond system in Ruwa to treat Ruwa Wastewater in the Medium Term
3. Delay any measures to provide waterborne sanitation in Epworth until the long term when the HSTS will be in place.
4. Develop a 125Ha irrigation area for the disposal of wastewater from the Donny Brook Ponds
5. Only the lowest portion of the Harare South Trunk Sewer will be developed in the Medium Term, from Chitungwiza to the outfall.

6. Initially the new Single Treatment works will be sized for just flows from Chitungwiza and areas downstream and so wil require a small pump station and DN500 force main to the location of the new ponds and irrigation system.

3.4 New Harare South Trunk Sewer

As seen from the list above the proposed trunk sewer between Lyndhurst Farm and the new works is a very major component of the proposal. The route for this sewer is shown in the Figure 3-1 overleaf. Along its route the trunk sewer collects flows from the various SIA Zones and from Chitungwiza.

In the initial phase of the project, only the lower portion of the sewer will be constructed from the location where Chitungwiza's sewage flows in to the discharge point. This section will be constructed with pipes sized to the expected flows from these areas only.

In the long term the line will be extended all the way to Donny Brook through the construction of line north towards Lyndhurst farm, the commissioning of the Lyndhurst Farm to Donny Brook sewer and finally connection of Ruwa and Epworth to the HSTS. At this stage a new large diameter line will be laid parallel to the line constructed as a short term measure in the lower reaches.

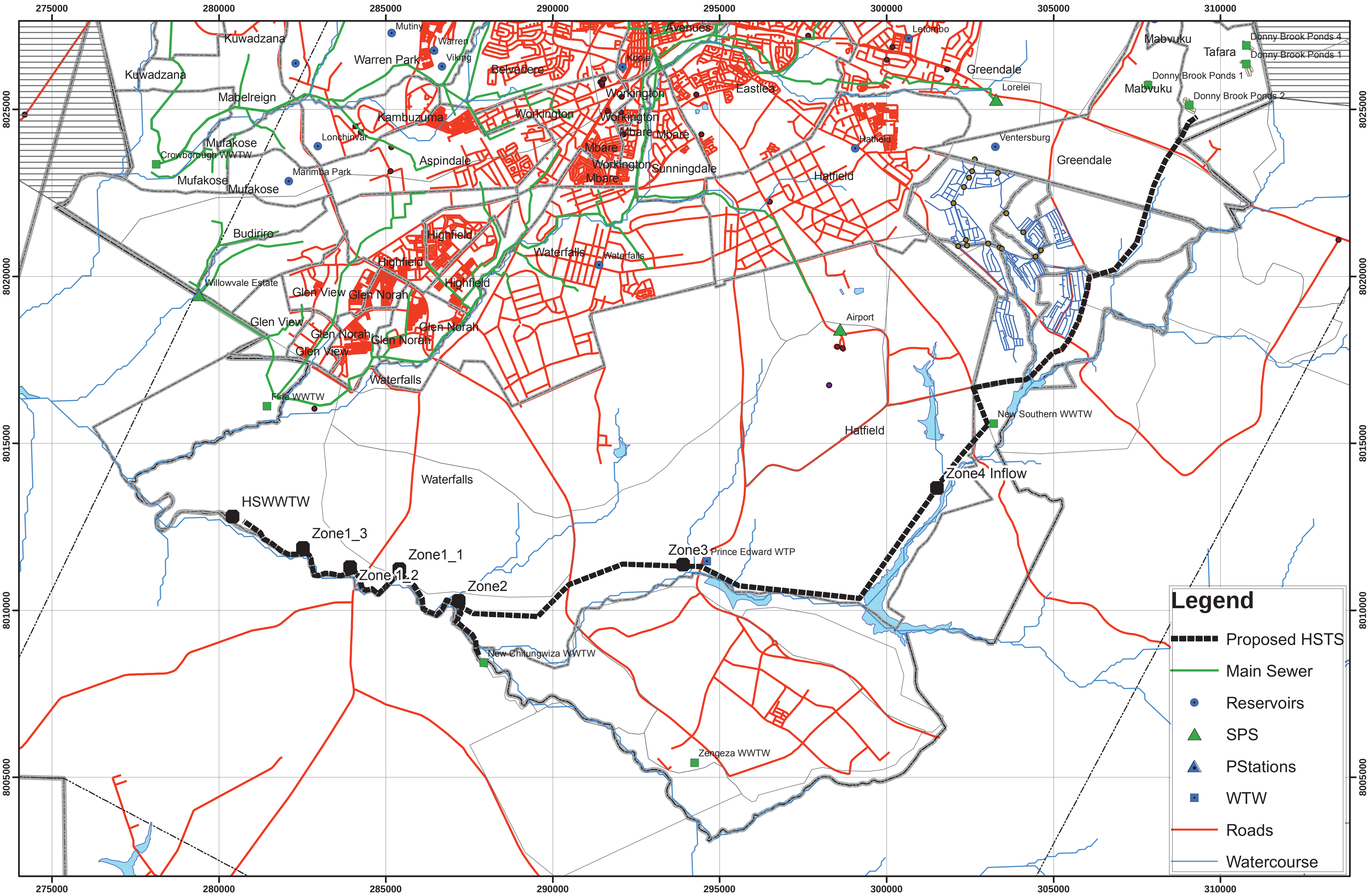

Figure 3-1 **Greater Harare Water and Sanitation Investment Plan**

Using flow figures from the current master planning exercise the following overview of the likely flows and sizing options for the trunk sewer are obtained:

Table 3-1: Proposed Trunk Sewer Flows and Sizing

				Flows (Average WWF)		Pipe Diameter			
Reach	From	To	Length	2020	2030	2020 Flow	2030 Flow	Phased [2] Install	2nd Phase Timing[2]
			km	ML/d	ML/d	(m)	(m)	(m)	
Ext	Donnybrook	Lyndhurst Farm	Exist	35	45	Existing Line – Modelling Shows Adequate Size for 2030 Flows			
1	Lyndhurst Farm	Zone 4	2.44	35	45	1.05	1.2	0.9	2020+
2	Zone 4	Zone 3	9.45	36	55	1.05	1.2	0.9	2020+
3	Zone 3	Zone 2[1]	7.36	36	59	1.05	1.2	0.9	2020+
4	Zone 2	Zone 1_1	2.57	47	98	1.35	1.65	1.35	2020+
5	Zone 1_1	Zone 1_2	1.89	47	101	1.35	1.8	1.5	2020+
6	Zone 1_2	Zone 1_3	2.25	47	104	1.35	1.95	1.5	2020+
7	Zone 1_3	New WWTW	2.25	47	107	1.35	1.95	1.5	2020+

1. Chitungwiza inflows at this Location

2. Phased installation is the pipe diameter capable of carrying 50% of the ultimate flow. This assumes that the smaller diameter pipe will be constructed initially and an equal diameter pipe laid parallel at a later date.

3. This is the date by which the second phase pipe will be required assuming the growth rates used in the current master plan are met.

The table above shows that this is a considerable investment with significant lengths of large diameter sewers. It also points to a number of possible implementation strategies as follows:

- Provided the current master plan population and sewerage coverage growth rates are considered reasonable the system should be installed now for 2030 flows.
- However there is considered to be a significant risk that sewage flows will develop slower than expected so an interim solution may be to install a trunk sewer to 50% of the 2030 capacity. It should be noted that this will not represent a 50% cost saving but the saving would be significant and even with growth as predicted this solution will see the line past the 2020 horizon before overloading.
- Ssome other design flow may be selected higher than the 50% but below the predicted high 2030 flow. The peak flows used here are 2.5 x average DWF. As most of the areas to be sewered are new networks constructed from uPVC these may have considerably lower infiltration rates that existing and the 2.5 factor may be

uneconomically high. This however leaves a risk of an under-capacity line running parallel to an important watercourse

- Investment timing concerns may take precedence over technical requirements requiring different phasing of the works. In the final proposal this is the case and only the lower reaches of the line (Reaches 4 to 7) will be constructed in the short term and the balance as a long term investment.

The selected approach is to install the line from Reach 4 to 7 to the 2020 capacity of those zones only with Ventersburg, Donny Brook, Epworth, Ruwa and other upper areas only connecting to the line in the long term.

In the long term the upper reaches will be completed and the lower reaches provided with a new parallel line for increased capacity.

Table 3-2: Selected Approach for Sewer Sizing

Reach	From	To	Length (km)	Installed Diameter (mm)	
				2020	2030
Ext	Donnybrook	Lyndhurst Farm	Extist		1200
1	Lyndhurst Farm	Zone 4	2.44		1200
2	Zone 4	Zone 3	9.45		1200
3	Zone 3	Zone 21	7.36		1500
4	Zone 2	Zone 1_1	2.57	750	1650
5	Zone 1_1	Zone 1_2	1.89	825	1800
6	Zone 1_2	Zone 1_3	2.25	825	1800
7	Zone 1_3	New WWTW	2.25	825	1800

Table 3-3: Advantages and Disadvantages of the Single WWTW Option

Advantages	Disadvantages
• Economies of scale offer lower overall capital cost. • The trunk sewer will removal all sewage pumping stations and thereby ensure that no effluent is discharged untreated into the Manyame River. The project will go a significant distance towards ensuring the long term protection of the portion of the Manyame catchment within the urban	• Larger initial outlay required to bring the system into operation as the whole trunk main must be completed. This is a potentially serious handicap for the project as it is essential to find the money for the trunk sewer before any sewerage expansion within the catchment. • However this advantage of dispersed

boundary.

- No sewage, treated or untreated will be discharged into the Manyame River above the Prince Edward Water Treatment Works. This will ease operations at the WTW and in the long run may result in operational cost savings from improved raw water.
- A single, large, centralized treatment works will allow for more specialized operational staff including more process specialists, chemists etc. than would be available at multiple dispersed works.
- The reduction in dispersed mechanical plants and pumping stations will result in a lower maintenance burden than the alternatives.
- This option has a significantly lower staffing requirement than the alternatives. One WWTW must be staffed as opposed to five WWTW and seven SPS required under the 2003 Master Plan.
- >1,000m buffer available from the nearest proposed housing.
- By piping the effluent to the proposed HSWWTW location shown in the map an opportunity is created to do away with the energy intensive BNR process which is explored in another discussion paper.

facilities is partially offset because development has commenced in all SIA Zones already and so all four urgently require WWTW or an outfall sewer, so initial capital cost outlays will be large for either option.

3.5 Treating the Expanded Sewage Production

3.5.1 Overview of Proposal

The future population growth in Harare is predicted to take place predominantly in the Southern suburbs of the city. This area referred to as the Southern Industrial Areas (SIA) in the 2003 Harare Sewage Master Plan prepared by Safege and as Ward 1 Harare South Rural in the current study is expected to expand from almost no population to over 700,000 residents in 2030. The average dry weather flow (ADWF) from this area is predicted to grow to of 371MLD by 2020, rising to 87MLD by 2030.

The increase in Harare's water supply to provide for this increased sewage production is expected to come from reductions in non revenue water and the commissioning of a new water source at Kunzwi, capable of supplying 250MLD to the city of Harare. The Kunzwi development is critical to this sewage treatment plan as for the first time the city will have a water supply from outside of the Manyame catchment. Therefore it will be possible to dispose of certain quantities of wastewater outside of the Manyame catchment without negatively affecting the catchment's water balance.

The current proposal is therefore:

- To collect sewage at the termination of the HSTS and to locate preliminary treatment and primary treatment at that location, close to the confluence of the Manyame and the Mukuvisi rivers.
- The settled effluent will then be pumped through a distance of 5-6km in a southerly direction to the watershed between the Manyame and the Mupfure catchments.
- At this location there is extensive farmland that could be acquired for a stabilisation pond based sewage treatment plant.
- As nutrient removal is a key requirement of the Environmental Management Agency and pond systems cannot achieve the rates of nutrient removal required, the pond system effluent must be disposed of through irrigation.

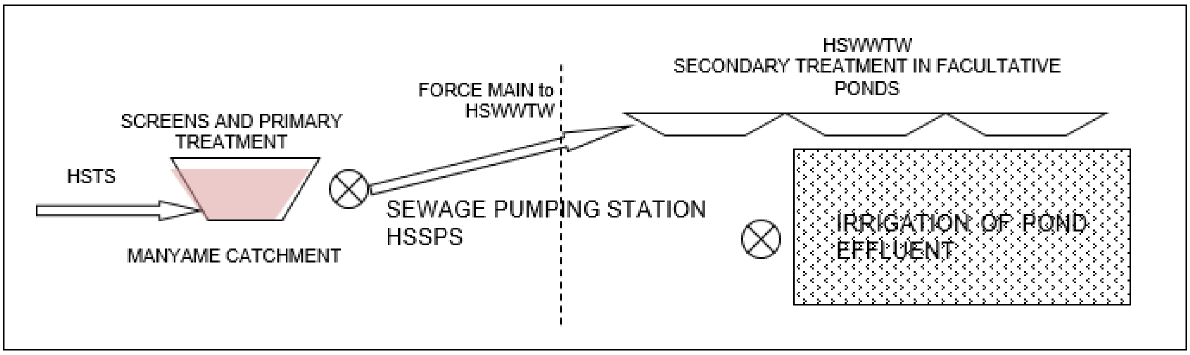

Figure 3-2: Schematic Layout of Proposed Treatment

In this case treatment by waste stabilisation pond stream with effluent disposal by irrigation has been selected because it has the lowest energy usage and the simplest and most robust operation and maintenance regime of all treatment processes whilst meeting EMA requirements for nutrient removal.

A preliminary process design has been prepared based on the design methods recommended in 'Domestic Wastewater Treatment in Developing Countries', Duncan Mara

[1] Figures are for average DWF, net of the factor of 1.25 for average wet weather flow used in the sewage production figures submitted separately under the GHWSSP project.

2003. Design is based on the coldest month of the year (July) and therefore dry weather flows are used.

3.5.2 Alternative Systems with Similar Outcomes

The following alternatives would offer similar treatment quality to the pond system described above and should only be ruled out at detailed feasibility stage.

Trickling Filter Secondary Treatment

The system would comprise:

- Preliminary Treatment and Anaerobic Ponds at the termination of the HSTS.
- Sewage pump station and 6km force main to the HSWWTW
- Trickling filters in place of the facultative ponds
- Irrigation area of similar extent as required for facultative ponds.

Table 3-4: Advantages and Disadvantages of Trickling Filter Alternative

Advantages	Disadvantages
• Smaller land footprint (+-140Ha per 29ML stream) • Filter construction programming is more scalable to actual rates of growth in sewage production. • Maintenance failure leading to total loss of secondary treatment in filters would still leave considerable pond area to guarantee secondary treatment	• Mechanical plants of this nature require more intensive maintenance. • Holding pond would be needed for plant effluent.

EMA Standards Compliance

The proposal and alternatives here all meet EMA standards for sewage quality and nutrient removal.

3.6 Lifecycle Cost Considerations

A detailed comparison was made of the lifecycle costs of the following options for the collection and treatment of sewage from Harare South:

- **Option 1** - BNR treatment through distributed BNR plants in the Manyame Catchment. This is the base option based on the 2003 Harare Sewage Master Plan.
- **Option 2** - Harare South Trunk Sewer (HSTS) plus centralised BNR treatment at one Harare South Wastewater Treatment Works (HSWWTW) at the discharge point of the HSTS.
- **Option 3** – HSTS with Harare South Sewage Pump Station (HSSPS) at the discharge point of the HSTS feeding an HSWWTW based on pond treatment with effluent irrigation in the Mupfure catchment where more land is available.

As the purpose of this exercise is simply to compare options, any costs which are common to all options are excluded from the analysis. These include;

- General overheads of the water utility
- Sewer network expansions in various areas that will contribute to the systems
- Trunk sewer portions serving Mabvuku/ Tafara, Donnybrook, Epworth and Ruwa and linking to Lyndhurst Farm.

3.6.1 Method of Cash flow Preparation

Costs

For each of the above options a cash flow has been prepared on the following basis:

- Initial Construction costs are financed through 20 year loans at an assumed 5% interest rate.
- Routine maintenance costs are assumed to be cash financed and are allowed for as follows:
    - Civil works and pipework - 1% of capital cost per annum
    - Mechanical and electrical works - 10% of capital cost per annum
- Operational Costs
    - Staff Costs. A staffing breakdown has been prepared for each type of process and facility.
    - Electricity costs. Electricity consumption is estimated for each facility and has been priced at current weighted average rates of around US$0.09 per kw.hr[2].
- Opportunity Costs. Where plant effluent is disposed of outside the Manyame catchment there is an opportunity cost involved because the effluent is no longer available for recycling through the Morton Jaffray WTW. This cost is considered to apply 50% of the time as it is only applicable at times when the output of Morton Jaffray is limited by available water resource in the Manyame catchment.

Revenue

Billing revenues are assumed to be constant for all options and are therefore excluded from the analysis.

There is potential for significant revenue from the sewage irrigation option but whilst the costs associated with the irrigation are certain, obtaining revenue requires other activities (e.g sale of water, farming, forestry management etc.) which are not certain.

The assumption made therefore is that the irrigation system will be owned and managed by the Harare Water utility and will generate sufficient revenue only to cover its operational

[2] The rate used was calculated from the detailed energy calculations made by Peter Morris for the Chitungwiza BNR as total energy consumed in kw.hr/ total energy cost in US$.

expenses of general labour, land management equipment, replanting etc. Revenues are not expected to cover costs of energy or irrigation equipment maintenance and replacement. This is considered a safe assumption as from experience (estimates made for Lusaka International Airport) a fee can be charged to a private operator to cut and bale grass which will cover these expenses. Commercial timber revenues would be much larger.

Construction Capital Costs

Distributed BNR Plants

For Option 1, utilising distributed BNR plants, these are assumed to be installed as treatment streams of 10ML each.

Harare South Trunk Sewer

The estimates of the Harare South Trunk Sewer assume phased installation as discussed above.

It should be noted that the portion of the Harare South Trunk sewer above the previously proposed Lyndhurst Farm WWTW (Harare Sewage Master Plan 2003) is common to all of the options and is therefore excluded from this simplified comparison.

Centralised BNR Plant

For Option 2, the centralised BNR plant is estimated to be installed in three streams of 30MLD nominal capacity each3. The timing for installation of the streams is as indicated in the previous discussion paper.

Harare South Sewage Pump Station

For Options 3 and 4 The HSSPS has been costed assuming that it is installed in two phases each of 50% of the required 2030 capacity. Cost estimates for each Phase are included in Attachment [3].

Pond and Irrigation Systems

For Options 3 and 4, the pond or pond/ irrigation plant is estimated to be installed in three streams of 30MLD nominal capacity each. The timing for installation of the streams is as indicated in the previous discussion paper and is the same as proposed for the centralised BNR.

Investment Costs and Timings

The table overleaf shows the proposed magnitude and timing of the main investment costs in each option under consideration.

3 Figures are for average DWF, net of the factor of 1.25 for average wet weather flow used in the sewage production figures submitted separately under the GHWSSP project.

Table 3-5: Major Investments 2016 - 2020 by Options (US$ Millions)

Year		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Option 1 - Capital Costs																
BNR Plants	Zone1				15.6											15.6
	Zone2			15.6						15.6					15.6	
	Lyndhurst	31.2	15.6			15.6					15.6				15.6	
	Chitungwiza	15.6							15.6							
SPS and Force Mains	Zone1-1				0.6				0.6							
	Zone1_2			0.6					0.6							
	Zone 3-4	2.6							2.6							
	Zone4	1.4							1.4							
Option 2 - Capital Costs																
Trunk Sewers	Zone Ext	5														
	HSTS1	3														
	HSTS2	12														
	HSTS3	9														
	HSTS4	4				4										
	HSTS5	4				4										
	HSTS6	5					5									
	HSTS7	5					5									
BNR Plants	HSWWTW	46.8		46.8							46.8					
Option 3 - Capital Costs																
Trunk Sewers	Zone Ext	5														
	HSTS1	3														
	HSTS2	12														
	HSTS3	9														
	HSTS4	4				4										
	HSTS5	4				4										
	HSTS6	5					5									
	HSTS7	5					5									

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Sewage Pump Stations	9				9										
Land purchase	4														
Pond and Irrigation	22		22							22					

Table 3-6: Amortised Cash Flow2016-2020 by Options (US$ Millions)

Year		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
<u>Option 1</u>	**Total**															
Amortised Capital Cost	301	5.1	6.4	7.7	8.9	10.0	9.5	9.1	10.7	11.7	12.7	12.1	11.5	10.9	13.5	14.4
Maintenance Cost	101	1.0	1.3	1.6	1.9	2.2	2.2	2.2	2.7	3.0	3.3	3.3	3.3	3.3	3.9	4.1
Staffing Costs	124	1.2	1.6	2.1	2.5	2.9	2.9	2.9	3.2	3.6	4.0	4.0	4.0	4.0	4.7	5.0
Energy Costs	130	1.4	1.6	1.9	2.2	2.4	2.7	3.0	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.4
Total	656	8.7	10.	13.3	15.6	17.5	17.3	17.1	19.9	21.9	23.8	23.5	23.2	22.9	27.1	28.9
Present Worth Costs	195	*8.7*	*9.9*	*11.0*	*11.7*	*12.0*	*10.8*	*9.7*	*10.2*	*10.2*	*10.1*	*9.1*	*8.1*	*7.3*	*7.8*	*7.6*
<u>Option 2</u>																
Amortised Capital Cost	304	9.3	8.8	13.1	12.4	12.6	12.9	12.3	11.6	11.1	15.2	14.4	13.7	13.0	12.4	11.8
Maintenance Cost	87	1.3	1.3	2.2	2.2	2.3	2.4	2.4	2.4	2.4	3.2	3.2	3.2	3.2	3.2	3.2
Staffing Costs	81	1.1	1.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	3.1	3.1	3.1	3.1	3.1	3.1
Energy Costs	125	1.3	1.5	1.6	1.8	1.9	2.2	2.4	2.7	2.9	3.2	3.4	3.7	3.9	4.2	4.4
Total	598	13.	12.	19.0	18.5	18.9	19.5	19.1	18.7	18.4	24.7	24.2	23.7	23.2	22.8	22.5
Present Worth Costs	197	*13.*	*11.*	*15.7*	*13.9*	*12.9*	*12.1*	*10.8*	*9.6*	*8.6*	*10.5*	*9.3*	*8.3*	*7.4*	*6.6*	*5.9*
<u>Option 3</u>																
Amortised Capital Cost	231	8.2	7.8	9.6	9.1	10.4	10.8	10.3	9.7	9.3	11.0	10.5	10.0	9.5	9.0	8.5
Maintenance Cost	63	1.1	1.1	1.5	1.5	1.8	1.9	1.9	1.9	1.9	2.3	2.3	2.3	2.3	2.3	2.3

Year		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Staffing Costs	24	0.5	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.9	0.9	0.9	0.9	0.9
Energy Costs	72	0.8	0.8	0.9	1.0	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.2	2.4	2.5
Total	390	10.	10.	12.7	12.3	14.0	14.6	14.2	13.8	13.5	16.0	15.6	15.2	14.9	14.6	14.2
Present Worth Costs	136	*10.*	*9.3*	*10.5*	*9.3*	*9.5*	*9.1*	*8.0*	*7.1*	*6.3*	*6.8*	*6.0*	*5.3*	*4.7*	*4.2*	*3.8*

The cash flow on the previous page is summarised below. For the calculation of Present Worth Costs a discount rate of 10% has been used in line with previous submissions under the project.

Table 3-7: Cash Flow Summary 2016 to 2030

	OPTION		
Figures US$ Million	**1**	**2**	**3**
Amortised Capital Cost	154	185	144
Maintenance Cost	39	38	29
Staffing Costs	48	35	11
Energy Costs	50	41	23
Total	**292**	**299**	**206**
Present Worth Costs	***144***	***156***	***110***

Overall Cost

- Option 3 (Ponds with irrigation) is clearly favoured from the analysis with lowest capital cost, operational costs, overall cost and discounted cost.
- Of the two options using BNR treatment, Option 1 (distributed BNR plants) is marginally favoured by the analysis. However the difference is probably within the accuracy of the model and declines with increasing modelling period with the totals becoming equal at around 17 years and the discounted totals at 25-30 years, approximately the lifetime of the facilities.

Operation and Maintenance Cost

- Option 3 has the lowest O&M cost of the options meeting EMA requirements.
- Of the two options using BNR treatment, Option 2 (Single BNR) is approximately 20% cheaper to run than Option 1.

Sensitivity Analysis

The cash flows contain numerous assumptions which are subject to varying levels of certainty. To check the sensitivity of the result to changes in these assumptions a 'Monte Carlo' simulation was carried out.

The following assumptions were varied randomly over 2000 calculations:

Table 3-8: Base Prices and Selection of Bounds

Variable	Description of Base Price and Selection of Bounds
Construction Cost BNR Plants	Base price used is 2003 construction costs escalated at 3% per annum. Lower bound is 2% per annum escalation, upper is 3.5% per annum.
Construction Cost Pond Systems	Pond Capex based on estimates appended as no similar recent examples exist. Bounds favour cost overrun
Energy Price	US$0.09 per kw.hr is the current price. Falls in price in real terms are unlikely and recent trends have been above

	inflationary increases. Lower bound is $0.08/ kW.hr upper is $0.12/ kW.hr
Energy Consumption Pond System Options	Base values are calculated for the layouts assumed. Variations in energy of pumping may result from main sizing optimisation, changes in final location of ponds or variations in irrigation pumping pressures depending on system design
Energy Consumption BNR Systems	The base value is based on calculations for Chitungwiza. Although this is a relatively new plant literature indicates constantly improving energy efficiencies and allowance has been made for this in the lower bound.
Energy Consumption Small SPS	Base values are calculated for the layouts assumed. Variations may result from actual pipe lengths, sump depths, discharge points etc.
Staffing Ponds	Pond staffing estimates are based on experience but have been increased to reflect generally high staffing levels seen at existing facilities. Bounds therefore favour a reduction in staff costs
Staffing BNR	Base values are from Crowborough existing staffing levels factored for size of works. These are considered to be high compared to the needs of the facilities so bounds favour a significant reduction in these prices.

Table 3-9: Base Values and Bounds for Variables in Monte Carlo Simulation

		Factor Bounds	
Variable	**Base Value**	**Lower**	**Upper**
Construction Cost BNR Plants	$1.57Million / ML Nominal Capacity	0.75	1.1
Construction Cost Pond Systems	Pond / Irrigation $22.4/ML Nominal Capacity Pond Only $27.3/ML Nominal Capacity	0.9	1.25
Energy Price	US$0.09 per kw.hr	0.9	1.3
Energy Consumption Pond System Options	Pond / Irrigation 451 kW.hr/ML (high pressure irrigation assumed) Pond Only 196kW.hr/ML	0.9	1.1
Energy Consumption BNR Systems	1423kW.hr/ML	0.7	1
Energy Consumption Small SPS	Varies between 22 and 248kw.hr/ML depending on the station	0.9	1.1
Staffing Ponds	$400,000 per ann. 1st Stream $200,000 per ann. subsequent streams	0.8	1
Staffing BNR	$1,050,000 per ann. 1st Stream (30MLD) $1,000,000 per ann. subsequent stream (30MLD) $400,000 per ann. 1st Stream (10MLD) $360,000 per ann. subsequent Stream (10MLD)	0.6	1

Table 3-10: Summary of Results from Monte Carlo Simulation (Analysis 2016 to 2030)

US$M	Sum of Cash Flow Costs			Present Worth of Cash Flow Costs		
Option	**Opt. 1**	**Opt. 2**	**Opt. 3**	**Opt. 1**	**Opt. 2**	**Opt. 3**
Mean	266	273	222	131	143	119
Median	266	274	222	131	143	119
Max	319	327	256	158	171	137

US$M	Sum of Cash Flow Costs			Present Worth of Cash Flow Costs		
Min	212	219	185	105	115	99

The sensitivity analysis shows that between Options 1, 2 and 3:

- Option 3 (ponds with irrigation in Mupfure Catchment) has lowest overall and discounted cost in 80% of simulations.
- Options 1 and 2 show similar discounted cost in all simulations as they use many of the same input assumptions. Generally Option 1 (distributed BNR) is favoured between the two in the models due to the additional capital cost of the HSTS in Option 2.

3.7 Concluding Discussion on Proposed Options

The final conclusions made from the arguments presented in the previous discussion and from the results of the costs cash flow comparison contained here are as follows:

- The least cost alternative in terms of capital cost and operational cost for sewering the Harare South catchments is Option 3. This involves the construction of a trunk sewer around the south of the city and then pumping the sewage into the Mupfure catchment for treatment in ponds followed by disposal through land irrigation.
- If the Mukuvisi water supply is not to be brought into operation or if it is considered of greater importance to keep all water within the Manyame catchment then a BNR solution is required. For this Option 2 is recommended. This involves the construction of a trunk sewer around the south of the city with a single new BNR plant at its terminus.
- Whilst the models slightly favour Option 1 with numerous small BNR plants distributed within the catchment the final conclusion takes into account the following factors also:
    - In Option 2 Sewage is piped by gravity to below the Prince Edward WTW securing this source from pollution.
    - Option 1 has numerous points of failure at sewage pump stations and distributed BNR plants. Environmental costs, not considered here, are likely to be higher especially in an environment of deficient operational finance.
    - Utilities are better able to manage capital expenditure on sewage treatment than operational expenditure. Option 2 has significantly lower operational costs.
    - BNR plants require significant expertise to run well. This is more likely to be achieved at a large centralised plant than at numerous, dispersed facilities. This again will result in lower environmental costs.
- If the City of Harare's investment plans are unable to sustain the capital cost expenditure required for either of the above recommended options then the only viable alternative, which should be considered as the 'Do Minimum' option, will be a partial implementation of Option 1 under which the following would be done:

- o Construct the lower reaches of the HSTS, below Chitungwiza in the the short term and a reduced firts phase WWTW for just these flows (Approx 12MLD).
- o Rehabilitate the Donny Brook Ponds and their associated irrigation disposal system to treat wastewater from Venetersberg, Mabvuku / Tafara and Donny Brook.
- o Provide Ruwa with new ponds and an irrigation disposal system to treat that towns sewage until connection to the HSTS is possibly in the future. Ruwa's existing ponds are too small, lack irrigation disposal and are on land controlled by Epworth and earmarked for redevelopment.
- o Keep Epworth entirely on on site sanitation (pit latrines etc.) for the forseeable future, until a connection to the HSTS is possible. Epworth has no ponds or access to other treatment facilities at this stage.
- o Delay the expansion of waterborne sanitation in the areas of ward 1 which will have no trunk sewer for 10 to 15 years, until the trunk sewer is extended past them.
- o Construct the main Harare South Wastewater Treatment Plant only as a long term measure (2030).

Having reviewed the financial modelling for the city for the 2015 to 2030 horizon the final option of phased implementation has been recommended. This reduces the short term financial burden on the city of implementing the whole HSTS but has the drawback of leaving many satellite treatment operations in place in Donny Brook and Ruwa with the associated environmental risks to the Manyame catchment.

4 ON-GOING WORKS

4.1 Zim-Fund Financing

In December 2011, the Ministry of Finance through the Zim-Fund engaged the services of an Implementing Entity to, among other services, design and supervise implementation of immediate measures works in Harare and other five project towns. These works under the Urban Water Supply and Sanitation Rehabilitation Project (UWSSRP) are designed to reinstate existing water production and wastewater treatment plants.

4.1.1 On-going UWSSRP Water Projects

The following scope of works is covered under the UWSSRP regarding the water supply components for Harare Municipality.

Table 4-1: Works of UWSSRP on Water Supply System

Location	Scope of Works	Objectives of intervention
Morton Jaffray Water Treatment Works	Unit 1: o Installation of proper flow meters in following mains; raw water main from Lake Chivero to raw water inlet chamber, raw water main from Lake Chivero to Clarifier No. 7, o Installation of Aluminium Sulphate solution transfer pumps, o Installation of Aluminium Sulphate solution dosing pumps, o Replacement of existing lime slurry preparation and dosing facilities, o Rehabilitation of the Chlorine Dosing System, o Replacement of pump sets No. 1 to 3, including all related motors, starters, pipework, valves and fittings and electrical control boards, o Installation of an electric powered chlorine cylinder lifting system.	
Morton Jaffray Water Treatment Works	Units 2 & 3: o Installation of proper flow meters in following mains; raw water 2200mm Ømain from Lake Manyame to raw water mixing chamber, raw water 1390mm Ømain from Lake Manyame to raw water mixing chamber, o Installation of Aluminium Sulphate solution transfer pumps, o Rehabilitation of the lime slurry preparation and dosing facilities, o Installation of sodium silicate dosing pumps, o Replacement of sand to 16 rapid gravity sand filters,	

	o Refurbishment to filter under-drainage system, o Replacement of broken nozzles, o Replacement of all gallery pipework and valves, o Installation of an additional air compressor for the operation of pneumatically actuated valves, o Refurbishment of the Pulsator system of 3No. Clarifiers, including air pump, motor, starters and vacuum release devices, o Replacement of lateral pipes to 1No. Clarifier, o Replacement of baffles to 3No. Clarifiers, o Replacement of pump sets No. 4 to 6, including all related motors, starters, pipework, valves and fittings and electrical control boards, o Replacement of pump sets No. 7 to 10, including all related motors, starters, pipework, valves and fittings and electrical control boards, o Supplying spare parts for pump sets No. 11 to 14. • Rehabilitation of Unit 2 & 3 Buildings covering: o Rehabilitation of raw water intake building, o Rehabilitation of administration block, o Rehabilitation of Laboratory building.	
Prince Edward Water Treatment Works	• Rehabilitation of the raw water pump-station, including: o Remedial works to concrete staircase treads, o Bitumen sealing to top of pumpstation roof, o Replacing all lights, o Supplying and installing 2 No. low lift raw water pumps complete with motors, valves, starters and MCC in the low lift pump station, o Changing pump No.4 suction, discharge pipe work and base plinth to accommodate a similar pump with capacity as pumps No.1, 2, and 3, o Painting work to walls. • Rehabilitation of Flash Mixing and Flocculation Tank, including: o Installation of 6 No. missing baffle plates at the dosing point. • Rehabilitation of Clarifiers, including: o Replacement of desludge valves. • Rehabilitation of Rapid Gravity Sand Filters, comprising: o Refurbishment of the underdrainage system,	

	o Replacement of broken nozzles, o Replacement of all gallery pipework and valves, o Replacement of 22 No. lights, o Provision of handrailing, o Replacement of filter sand, o Bitumen sealing to top of filter building roof, o Replacing all lights in pipe gallery. • Rehabilitation of Highlift Clear Water Pumpstation: o Supply and install 2 Nr. high lift clear water pump sets complete with motors, valves, starters and MCC in the High Lift Pump Station, o Replacing all lights highlift clear water pumpstation, • Rehabilitation of Chemical Building o Replacing all lights in highlift clear water pumpstation, o Bitumen sealing to top of chemical building roof, o Rehabilitation of alum dosing tanks, o Rehabilitation of lime dosing tanks, o Rehabilitation of chlorine dosing facilities, o Replacing all lights, o Painting work to walls and steel works. • General Site Works o Painting work to fence and external steel works, o Replacement of 55No. perimeter lights, o Replacement of 38 No. flood lights.	

4.1.2 On-going UWSSRP Sanitation Projects

The following scope of works is covered under the UWSSRP regarding the wastewater components for Harare Municipality.

Table 4-2: Works of UWSSRP on Wastewater System

Location	Scope of Works	Objectives of intervention
Firle Sewage Treatment Works	• Rehabilitation of Biological Trickling Filters, including: o Remedial works to spalling concrete and exposed rusting reinforcement, o Digging media to a depth of 1m to remove sludge, o Replacement of ladders to biological filters and distribution chamber,	

	o Replacement of pivots, bearings and distribution arms to biological filters, • Rehabilitation of Pond System (Firle 1&2), including: o Estimating, cleaning, removal, handling, transporting and disposal of wet sludge, o Repair of inlet, outlet structures, including installation of aluminium gates, valves and other metal fittings to distribution and collection chambers. o Inspecting and repairing pond embankments. • Rehabilitation of Effluent Pumping Station, including: o Installation of new effluent pumps, including all motors, pipework, valves, starters and electrical installations, o Installation of new effluent recirculation pumps, including all motors, pipework, valves, starters and electrical installations, o Upgrading of power supply to effluent pumping station. • Rehabilitation of Effluent Pumping Main, including: o Replacement of approximately 2000m of 675mm Ø AC pumping main, including valves, fittings and thrust blocks.	
Crowborough Sewage Treatment Works	• Rehabilitation of Biological Trickling Filters, including: o Remedial works to spalling concrete and exposed rusting reinforcement, o Digging media to a depth of 1m to remove sludge, o Replacement of ladders to biological filters and distribution chamber, o Replacement of pivots, bearings and distribution arms to biological filters, • Rehabilitation of Pond System, including: o Estimating, cleaning, removal, handling, transporting and disposal of wet sludge, o Repair of inlet, outlet structures, including installation of aluminium gates, valves and other metal fittings to distribution and collection chambers, o Inspecting and repairing pond embankments.	
Donnybrook Stabilisation Ponds	• Rehabilitation of Pond System, including: o Estimating, cleaning, removal, handling,	

	transporting and disposal of wet sludge, o Repair of inlet, outlet structures, including installation of aluminium gates, valves and other metal fittings to distribution and collection chambers, o Inspecting and repairing pond embankments.	
Little Marimba Trunk Sewer	• Rehabilitation of damaged sections along the trunk sewer, including: o Relaying of damaged sections and support system.	
Supply of Goods	• Supply of Laboratory Equipment; • Supply of Shop Tools and Equipment; and • Supply of Mandatory Spare Parts.	

APPENDIX 4.2: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT - CHITUNGWIZA

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 5.2: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT

CHITUNGWIZA

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1 WATER SUPPLY

The Municipality of Chitungwiza receives bulk water from the City of Harare's water treatment facilities which are mainly; Morton Jaffray Water Treatment Works and Prince Edward Water Treatment Works. The transmission system is designed in such a way that water can be drawn from both Prince Edward WTW and Morton Jaffray WTW.

Overall, the city provides services to a population of 356,840 (2012 National Statistics). At present, the system has 55,669 connections, which are equipped with water meters most of which are not functional. The schematic layout of the system is presented in the following figure.

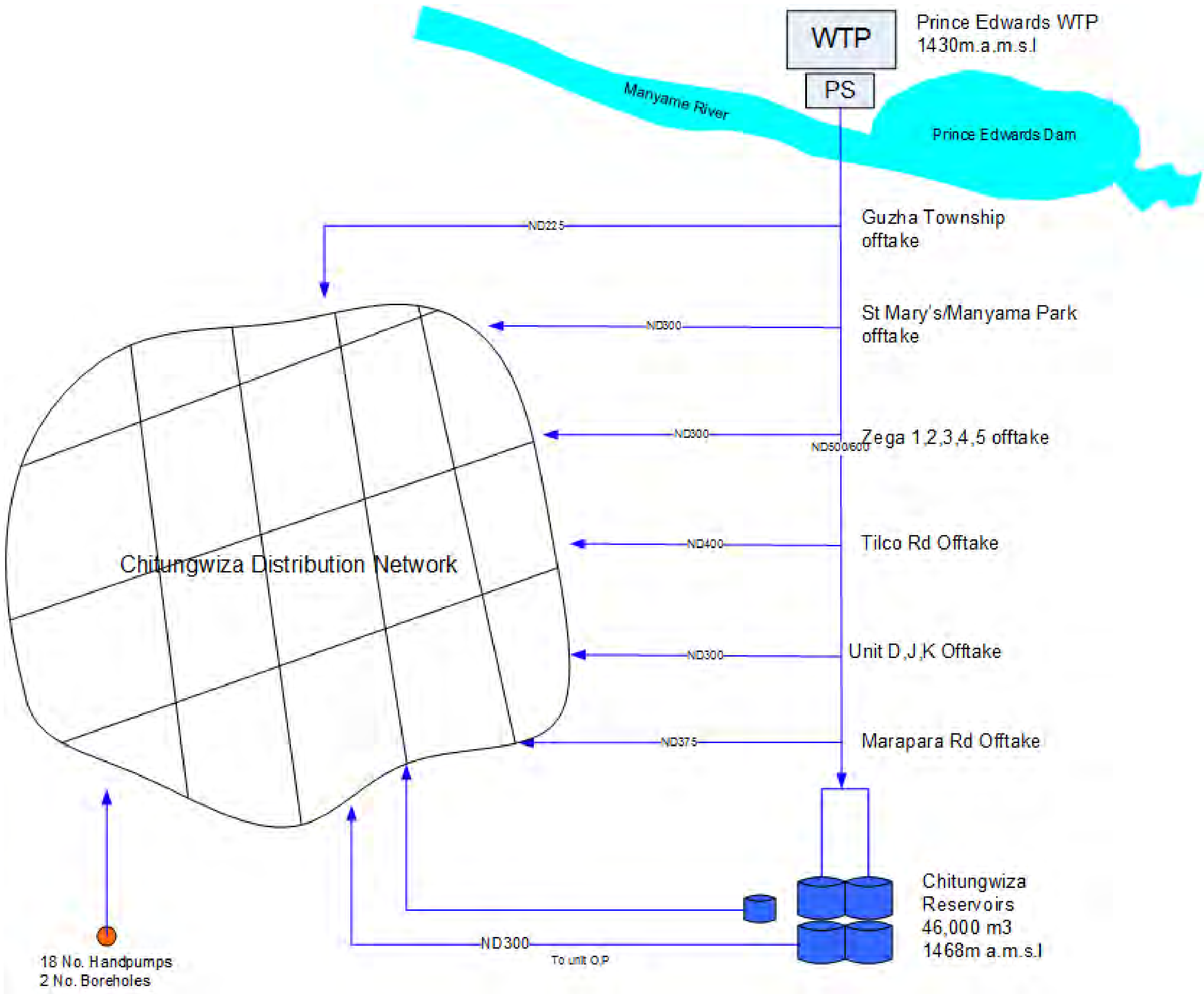
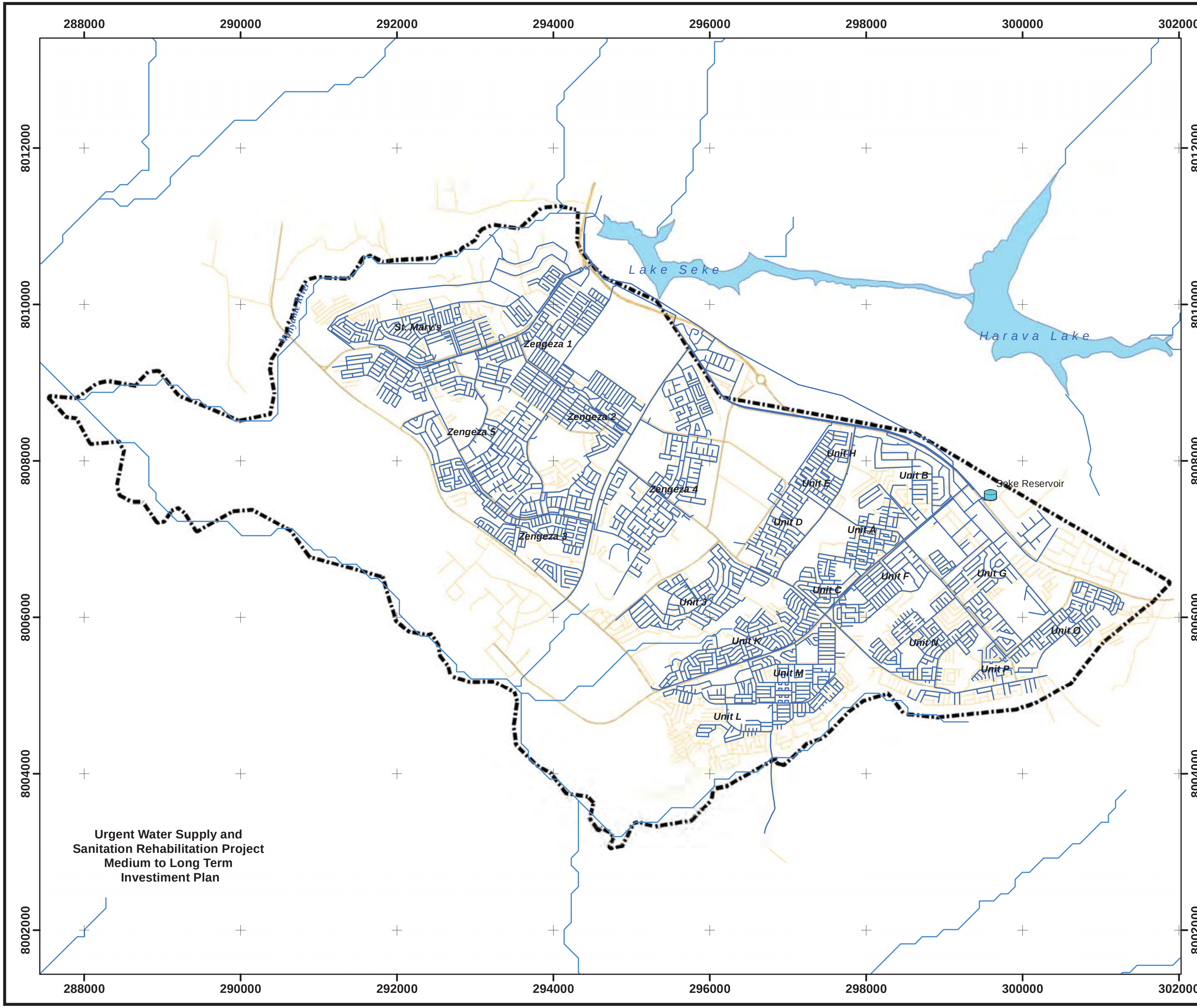


Figure 1-1: Principle layout of the water system of Chitungwiza

Figure 1-2
Layout Map of Existing Water Supply Infrastructure



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Legend

Reservoirs

Reservoirs

Rivers

Rivers

Roads

Residential

Secondary

Trunk

Dams & Lakes

Dams & Lakes

Project Boundary

Project Boundary

Urgent Water Supply and Sanitation Rehabilitation Project Medium to Long Term Investiment Plan

Gauff JBG Ingenieure

1.1 Water Source

Prince Edward Water Treatment Works (WTW) is located approximately 22 km South of Harare adjacent to Prince Edward Dam also known as Seke Dam. The Water Treatment Works has a reported maximum peak production of 90,000 m3/day. The current average daily water production is reported to vary between 50,000 to 55,000 m3/day.

During the rainy season when Prince Edward WTW is operating at full capacity, most of the supply to Chitungwiza is from Prince Edward WTW. Prince Edward WTW is supplied with raw water from the upstream Harava 1, Harava 2 and Seke Dams all along the Manyame River. During the dry season when Prince Edward WTW is not operating at full capacity due to insufficient water in the upstream dams, Chitungwiza is supplied from the Morton Jaffray WTW system.

1.2 Transmission System

The transmission main from Prince Edward WTW starts off as a ND 600 steel main followed by a ND 225 branch after the bridge feeding an area called Mayambara which is under Harava Rural District Council. The ND 600 main continues before splitting into a 450 mm diameter main and a ND 525 main before the Police Station. The ND 450 main feeds the reservoirs located on the northern part of Makoni Shopping Centre. The ND 525 main also feeds the reservoirs and the reticulation network. The reservoirs can hydraulically be described as floating reservoirs.

The ND 600mm diameter main has three off-takes feeding the following areas;

- ND 225 off-take for Area 1 - Mayambara;
- ND 300 off-take for Area 2 - St Mary`s & Manyame Park;
- ND 300 off-take for Area 3 - Zengeza 1, 2, 3 & 5;
- Area 4- ND 375 - off take for area 4-Tilcor, Zengeza 2, 3 & 4.
- The ND 525 main has 3 number off-takes feeding the following areas;
- ND 300 off-take for Area 5- Unit H,D,J, with interconnection to Unit K;
- ND 375 off-take for Area 6- Unit A, C, F, M, L & K.

1.2.1 Hydraulic Modeling

A hydraulic model was constructed in conformity with the existing transmission and primary network. The model was constructed to simulate the flow on the bulk mains from the PE WTW to the distribution network up to Makoni Reservoirs. This was used to check the capacity of the mains for the medium term (2020) and long term (2030) hydraulic loading.

Modelling Parameters

A hydraulic model requires several input parameters in order to simulate the actual conditions under which the network will be operating. These parameters are; the physical characteristics of the network and its boundary conditions (pipe roughness, elevations) and the hydraulic loading (Demand).

In order to build a realistic representation of the system, the age and material of the mains were considered with the friction factors altered to reflect the material of pipe and the age of pipe. Most mains in Chitungwiza are more than 30 years old. Therefore, it was deemed suitable to assume that the condition of these mains would be poor in places and hence; mains friction factors were increased to help reflect this.

The elevations for model junctions and reservoirs were interpolated/extrapolated off the contour dataset obtained from Google Earth. The dataset had contour lines with an elevation interval of five meters. This data is fairly adequate for the purpose of modelling the trunk mains. More accurate surveys for transmission mains and reservoirs will be conducted for the final design phase.

The hydraulic loading (water Demand) used for modelling the network has been calculated using population figures taken from the recently published report for the Census 2012 by the Zimbabwe National Statistics Agency (ZIMSTAT) as outlined in Chapter 3. A detailed analysis of demand calculations is outlined in Chapter 6.

Different specific consumption figures were applied to the consumer categories to obtain the total consumption. Since the network had to be sized for peak hour demand, the peak hour factors were applied to consumption figures.

The demand in each zone was obtained by overlaying the wards layer with the proposed zones layer in ArcView 10.1. The wards lie either completely within a zone or only partially. The extent by which a particular ward is contained in a zone was estimated in terms of percentage. The zone received this percentage of demand for that ward. The wards that fell wholly within a particular zone were allocated 100% to that zone. The various demands from the wards that intersect the zone were aggregated to get the total demand for the zone.

Modelling Scenarios

Two scenarios were used to depict the worst case operating conditions of the network, as presented in the table below.

Table 1-1: Network Modelling Scenarios

Scenario	Scenario Description	Peak factor
Scenario 1	Peak hour demand and lowest levels in reservoirs	2.0
Scenario 2	Lowest demand during the night time and highest water levels in reservoirs	0.5

Scenario 1 - Peak hour demand and lowest levels in reservoirs

Scenario 1 simulated the peak hour demand and lowest levels in reservoirs. The peak hour demand factor of 2.0 was applied to the model and impact towards the performance of the mains analysed. For any network analysis case study, it is important to model the 'worst-case' scenario so that all potential issues can be predicted with mitigation measures put in place at the earliest possible opportunity. The calculated peak hour flow in each ward is tabulated below.

Table 1-2: Peak Hour Demand in each Ward-Chitungwiza

Ward	Area	2020 Demand		2030 Demand	
		Average Demand (l/s)	Peak Demand (l/s)	Average Demand (l/s)	Peak Demand (l/s)
1	St Marys	17.87	35.74	16.32	32.64
2	St Marys	23.76	47.52	21.56	43.12
3	St Marys	18.14	36.27	17.00	34.01
4	St Marys	48.75	97.49	45.70	91.40
5	St Marys	19.31	38.62	18.10	36.21
6	Zengeza 5	30.80	61.60	31.84	63.68
7	Zengeza 1	14.10	28.20	13.22	26.44
8	Zengeza 1	17.79	35.58	16.68	33.35
9	Zengeza 2	15.10	30.20	14.16	28.31
10	Zengeza 2	18.61	37.22	20.41	40.82
11	Zengeza 3	16.80	33.60	15.75	31.50
12	Zengeza 3	76.72	153.43	71.92	143.84
13	Zengeza 4	20.48	40.97	18.98	37.95
14	Zengeza 4	37.95	75.90	35.58	71.15
15	Seke Unit D	35.83	71.66	33.59	67.18
16	Seke Unit J	26.28	52.55	24.63	49.27
17	Seke Unit K	32.38	64.76	29.71	59.43
18	Seke Unit L	57.04	114.07	64.01	128.01
19	Seke Unit F+C	29.56	59.13	27.72	55.43
20	Seke Unit E+H	20.03	40.05	18.77	37.55
21	Seke Unit A+B	44.85	89.70	39.14	78.28
22	Seke Unit O	28.55	57.11	26.77	53.54
23	Seke Unit N+P	51.85	103.69	48.61	97.21
24	Seke Unit M	38.07	76.13	35.69	71.38
25	Seke Unit G	33.39	66.79	32.10	64.21
SP 1	Seke CL	24.37	48.73	33.28	66.55
SP 2	Nyatsime Farm	6.51	13.02	153.75	307.50

Scenario 2 - Lowest demand during the night time and highest water levels in reservoirs

Scenario 2 simulated the lowest demand during the night time and highest water levels in reservoirs. The peak hour demand factor of 0.5 was applied to the model and impact towards the performance of the mains analysed. For any network analysis case study, it is important to model the 'worst-case' scenario so that all potential issues can be predicted with mitigation measures put in place at the earliest possible opportunity. The calculated night flow (lowest demand) in each ward is tabulated below.

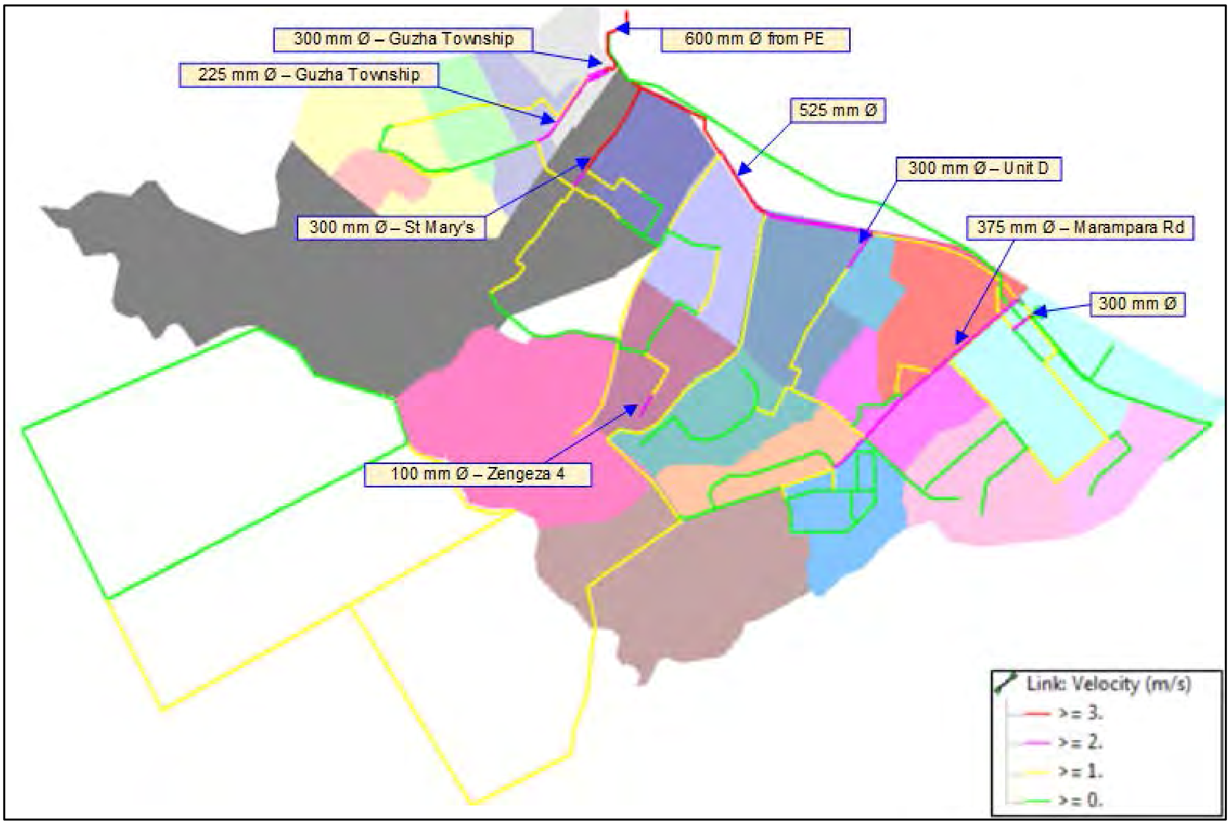
Table 1-3: Lowest Demand in each Ward-Chitungwiza

Ward	Area	2020 Demand		2030 Demand	
		Average Demand (l/s)	Lowest Demand (l/s)	Average Demand (l/s)	Lowest Demand (l/s)
1	St Marys	17.87	8.16	16.32	8.16
2	St Marys	23.76	10.78	21.56	10.78
3	St Marys	18.14	8.50	17.00	8.50
4	St Marys	48.75	22.85	45.70	22.85
5	St Marys	19.31	9.05	18.10	9.05
6	Zengeza 5	30.80	15.92	31.84	15.92
7	Zengeza 1	14.10	6.61	13.22	6.61
8	Zengeza 1	17.79	8.34	16.68	8.34
9	Zengeza 2	15.10	7.08	14.16	7.08
10	Zengeza 2	18.61	10.21	20.41	10.21
11	Zengeza 3	16.80	7.88	15.75	7.88
12	Zengeza 3	76.72	35.96	71.92	35.96
13	Zengeza 4	20.48	9.49	18.98	9.49
14	Zengeza 4	37.95	17.79	35.58	17.79
15	Seke Unit D	35.83	16.80	33.59	16.80
16	Seke Unit J	26.28	12.32	24.63	12.32
17	Seke Unit K	32.38	14.86	29.71	14.86
18	Seke Unit L	57.04	32.01	64.01	32.01
19	Seke Unit F+C	29.56	13.86	27.72	13.86
20	Seke Unit E+H	20.03	9.39	18.77	9.39
21	Seke Unit A+B	44.85	19.57	39.14	19.57
22	Seke Unit O	28.55	13.39	26.77	13.39
23	Seke Unit N+P	51.85	24.31	48.61	24.31
24	Seke Unit M	38.07	17.85	35.69	17.85
25	Seke Unit G	33.39	16.05	32.10	16.05
SP 1	Seke CL	24.37	16.64	33.28	16.64
SP 2	Nyatsime Farm	6.51	76.88	153.75	76.88

Results of the Modelling Simulations

In the restructured network for the year 2020 and 2030 design horizons, the model was run using a peak hour demand factor of 2.0, and impact towards the performance of the mains analysed. The pressures observed within the network were substandard and far below the acceptable limits stipulated in the design criteria. According to national and regional guidelines the minimum pressure should be at least 10 metres (1.0 bars) in the main supplying pipes. The minimum operating pressure in the transmission mains was around below Zero.

The velocities experienced within most mains were less than the stipulated velocity limit in the inception report except for the major supplying mains i.e. the ND 600 bulk main supplying water to Chitungwiza, the ND 525 main supplying the Makoni Reservoirs, the ND 300 feeding Guzha Township, ND 225 feeding Guzha Township and the ND 300 supplying St Mary's/Manyame Park. Higher velocities were also observed in the ND 375 off-take on Marapara Road, ND 100 supplying Zengeza 4 and the ND 300 supplying Unit D, J and K. The thematic map below shows the velocities experienced in the network after applying the peak hour factor.



The table overleaf shows the velocities and headloss per unit distance (m/km) experienced in the major mains supplying water to Chitungwiza after applying a peak hour factor.

Table 1-4: Velocities and Headloss per Unit Distance at Peak Hour Demand

Section of Main	Velocity (m/s)	Headloss (m/km)	Length (m)
ND 600 from PE WTWS	6.51	97.00	2,553
ND 525 to Makoni RES	3.70	37.34	925
ND 300 to Guzha Township	3.85	83.76	230
ND 225 to Guzha Township	2.14	37.90	1,236
ND 300 to St Mary's/Manyama	3.85	83.76	230
ND 375 offtake on Marapara Road	2.83	33.89	2,994
ND 300 to Unit D,J and K	2.98	50.17	520

ND 100 to Zengeza 4	2.42	145.11	315
ND 300 from Pumped main from Makoni Reservoir	3.37	64	90

It is clear from the above results that sections of the mains indicated do not have the required hydraulic capacity to handle the extra demand required for the 2030 design horizon. The results of the model are presented in appendix 8.2.

A further simulation was performed in an attempt to find the optimal upgrades required to provide adequate levels of service. It was hoped that, these changes to the network would help to reduce the levels of headloss per unit distance experienced along the lengths of the existing mains whilst also providing sufficient hydraulic head within the network.

By increasing the diameter of the mains at these particular sections of the network, the extreme level of headloss per unit distance experienced along their lengths would be reduced significantly thus reducing the risk of future mains failures.

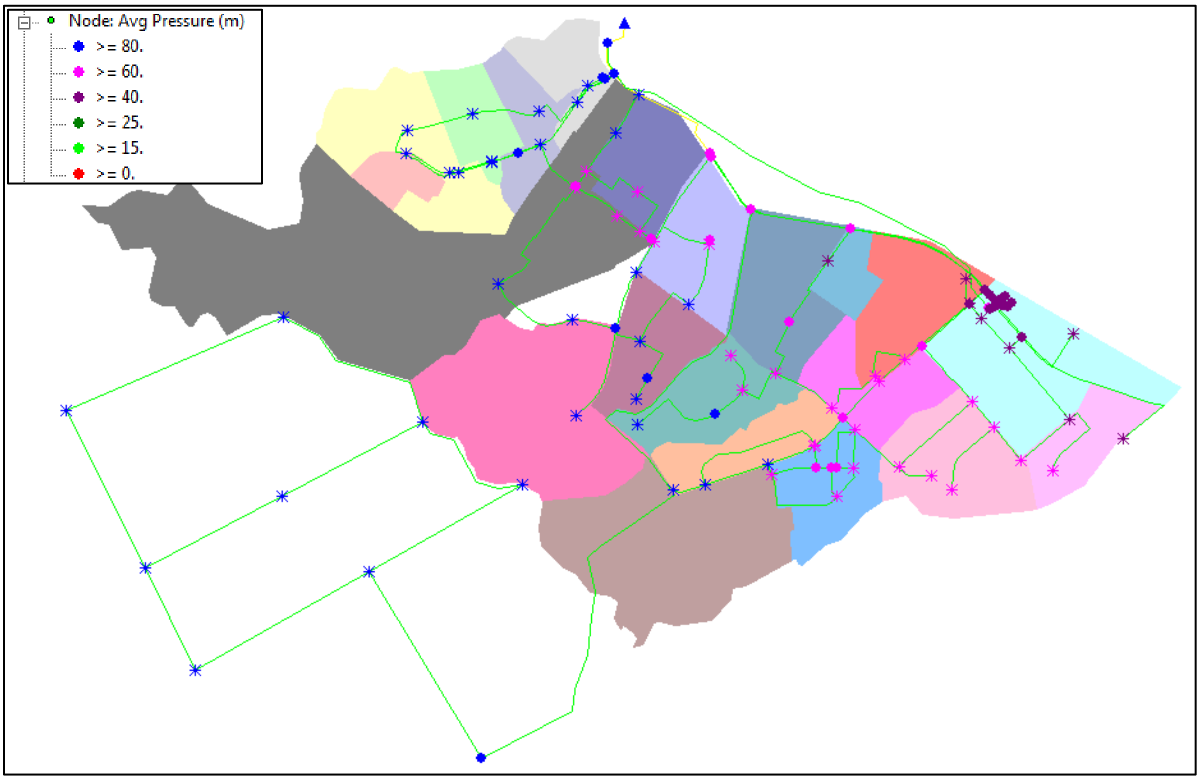
Table 1-5: Water Transmission Upgrade Measures

	Pipe Diameter (mm)	Section of Main	Upgrade Parameters	Length (m)
ND 600 from PE WTWS	700 DI	2.86	6.57	2,553
ND 525 to Makoni RES	600	2.96	8.33	925
ND 300 to Guzha Township	450 DI	1.47	3.19	230
ND 225 to Guzha Township	315 PVC	1.22	3.72	1,236
ND 300 to St Mary's/Manyama	450 DI	1.69	4.11	1465
ND 375 offtake on Marapara Road	500 DI	1.08	11.37	2,994
ND 300 to Unit D,J and K	400 DI	1.41	3.37	2888
ND 100 to Zengeza 4	150 PVC	1.07	6.69	315
ND 300 from Pumped main from Makoni Reservoir	400 DI	2.42	9.37	90

From Table 1-6, it can be recommended that, instead of upgrading the ND 600 Steel bulk main supplying Chitungwiza from PE, a new ND 700 DI main be installed parallel to the existing ND 600 from PE. This will be used together with the existing ND 600 main to supply the existing water network and the proposed developments on Nyatsime farm and Seke CL area.

A further scenario was analysed using the night flow factor of 0.5, and impact towards the performance of the mains analysed. The observed pressures are way above the acceptable limits stipulated in the design criteria. According to national and regional guidelines, the minimum pressure should be at least 10 metres (1.0 bars) in the main supplying pipes, whilst the maximum pressure should not exceed 60m. The model predicted that pressures of more than 60m will be experienced in the 2030 design horizon.

It is recommended that, pressure management measures be implemented by the installation of pressure reducing valves. This will subsequently reduce excessive pressures and UFW caused by pipe bursts due to excessive pressures. A detailed pressure management exercise is recommended which would establish the number of pressure reducing valves required to minimise the observed excessive pressure. The thematic map below shows the excessive pressures observed in most places in Chitungwiza after applying the night flow factor of 0.5.



A further simulation was run using the peak hourly factor which would replicate the water demand in the proposed developmental areas. The model was used to help predict the pipe sizes that would be required in these areas in the 2020 and 2030 design horizons. The water transmission investment measures are presented in the table overleaf. It should be noted that, the transmission mains proposed satisfy the 2030 service requirements but will be implemented under the project in the medium term.

Table 1-6: Water Transmission Investment Measures

Item	Unit	Medium-term project
Water Pipes		
ND 200 PVC (OD 225)	m	7,157
ND 250 PVC (OD 280)	m	4,742
ND 315 PVCI	m	11,380
ND 450 DI	m	12,633

1.3 Storage Reservoirs

The reservoirs for Chitungwiza are located on the north eastern outskirts of the town north of Makoni Shopping Centre at the end of the network. The reservoir site has four ground reservoirs of equal capacity and an elevated tank. They have a total storage capacity of approximately 46, 000 m^3. A small booster pump station houses the pump sets used to transfer water to the elevated tank.

From a visual inspection, the tanks are in a good state with no cracks, scaling concrete or rusting rebar. They are in good working order but, largely redundant since they never fill up because of their location in the network and the limited water supply from Harare.

Considering the long term demand of around 85,000 m3, it is clear that the existing storage capacity will not be sufficient. Hence we recommend the following investment measures:

- Construction of a new 22,000 m^3 /d concrete reservoir at Makoni Reservoir Site;
- Construction of a new 15,000 m^3/d concrete reservoir at highest point on Nyatsime Farm Development.

1.4 Distribution Zones

There are currently no defined water supply zones in Chitungwiza. Water is supplied via interconnected pipes which are fed directly by the ND 600 from the PE WTW. The excess water which is stored in the Makoni Reservoir is fed back into the system.

Due to the topography of the ground in the City of Chitungwiza, it was not possible to formulate new supply zones. Subsequently, the existing layout of the water network was adopted.

1.5 Distribution Network

The distribution network comprises of a combination of AC pipes in very old sections of the city, Polyethylene and PVC pipes in newer sections of the city (15 years old).

The Municipality of Chitungwiza advised that, some sections in the distribution network continuously suffer from pipe bursts. This is attributed to inadequate design especially poor specification of the pipes with respect to pressure ratings and also probably poor workmanship. The areas most vulnerable are; Unit N (ND 150 AC Class 12, and ND 125 AC Class 12 and Unit K (ND 100 AC Class 12, and ND 75 AC Class 12). Some pipes have surpassed their life span especially, in the old suburbs (Zengeza 1, 2, 3, 4 and St Marys).

No issues have been raised in the recently installed networks. The recently installed networks include the following areas:

- ND 90 Polyethylene pipes in Zengeza;
- ND 110 PVC pipes in St Mary's (Manyame Park);
- ND 90 PVC pipes in New Developments and infill areas;
- ND 75 PVC pipes in New Developments and infill areas.

It is worth noting that, there are control valves and bulk flow meters on all the branches, but most of them are not working. The branches come off the 525 mm Ø rising main to the storage reservoir resulting in low lying areas getting water ahead of the high level areas, hence the need to address the issue of control valves.

The oldest section of the distribution network was constructed in 1978 and the network has been expanding based on the growth of the city. The layout of the network is structured in eight independent supply zones, with the last supply zone to Unit O formed as a loop so that water can be supplied from both the service reservoirs and also from Unit N.

The water supply to Chitungwiza is erratic and varies in terms of continuity of supply but has an approximate supply rate of 500 m^3/hour. To manage supplies to the various suburbs, the municipality has a rationing criterion in which certain areas/zones get water on a particular day in a week. The table overleaf shows a summary of the water supply schedules for Chitungwiza.

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Table 1-7: Water service on daily basis

Supply Zones	Supply day
Area 1- Old St Mary's and Manyame Park	Monday
Area 2- Zengeza 1	Tuesday
Area 3- Industrial Area	continuous
Area 4- Unit H	Thursday
Area 5 – Unit A	Saturday

1.5.1 Pilot Zone Investigations

The pilot area water and sewer network investigations constitute part of task D in the ToR, which states that "…the water distribution network condition assessment will be done using sampling methods aimed at establishing parameter relationships that can be used to extrapolate network rehabilitation investment requirements." Hence, the purpose of the pilot area investigations was to assess the condition of the water distribution and sewerage networks and recommend rehabilitation investment measures for the entire system using statistical methods.

Methodology and Approach

The pilot area was selected in liaison with the council following the selection criteria specified in the ToR. It was chosen to be conveniently small, but characteristically representative of the entire network so that extrapolations to the entire network could be done with reasonable levels of confidence. The activities carried out in the pilot area and the sequence of operations is shown in the figure below.

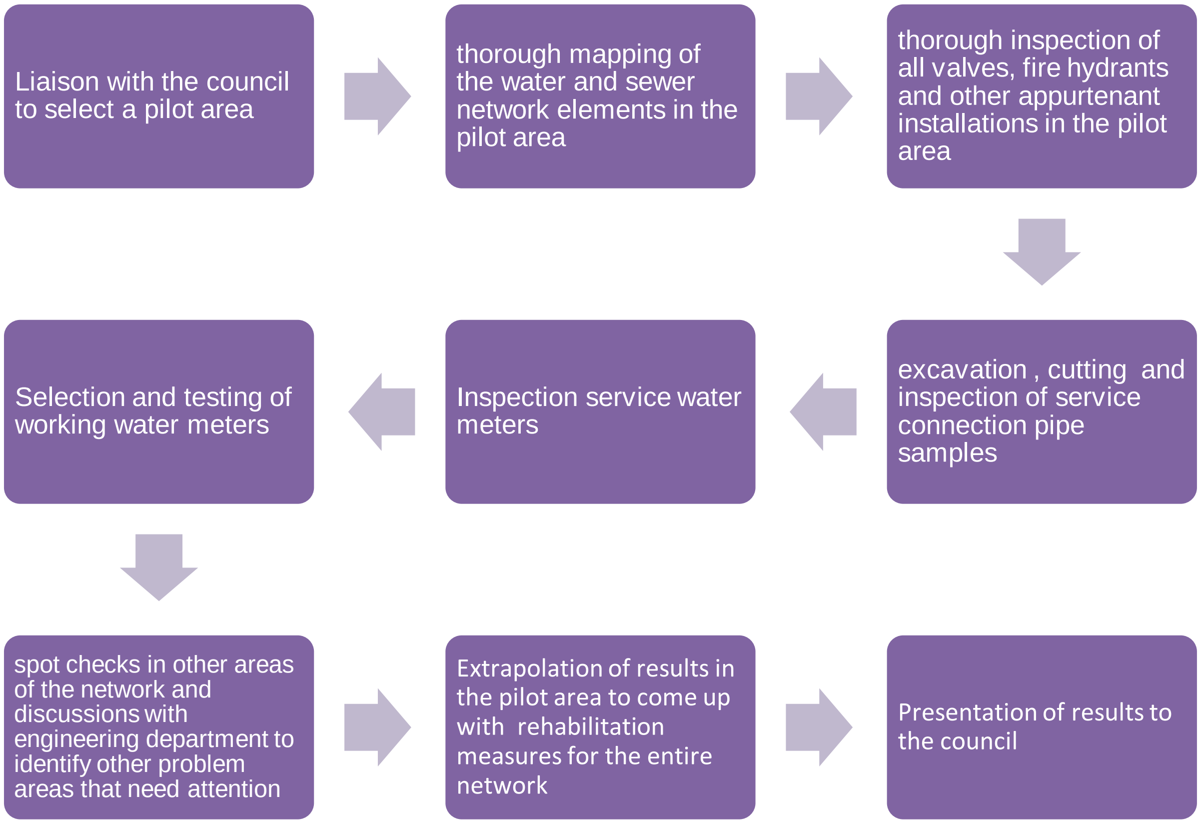


Figure 1-3: Sequence of Activities in the Pilot Area

The inspections and assessments in the pilot area provided relationships among age, material and condition of the network elements, which were used to extrapolate network rehabilitation investment requirements for the entire network. In addition to investigations in the pilot area, spot checks in other parts of the network were conducted to validate the findings in the pilot area and the subsequent extrapolations.

Location and Characteristic of the Pilot Area

The pilot area chosen for the investigation was St Marys. The area was chosen because it is the oldest suburb and is densely populated. It was assumed that, investigations in the area would fairly represent the condition of the distribution networks and service connections in Chitungwiza. Based on household flow meter testing conducted in the study area, all domestic meters are not working and will need to be replaced. Most flow meters do not register flows, with some completely vandalised.

St Marys is supplied by a ND 225 main. The water distribution mains within the pilot zone are ND 75 AC. The water network is made up of the elements shown in the figure overleaf:

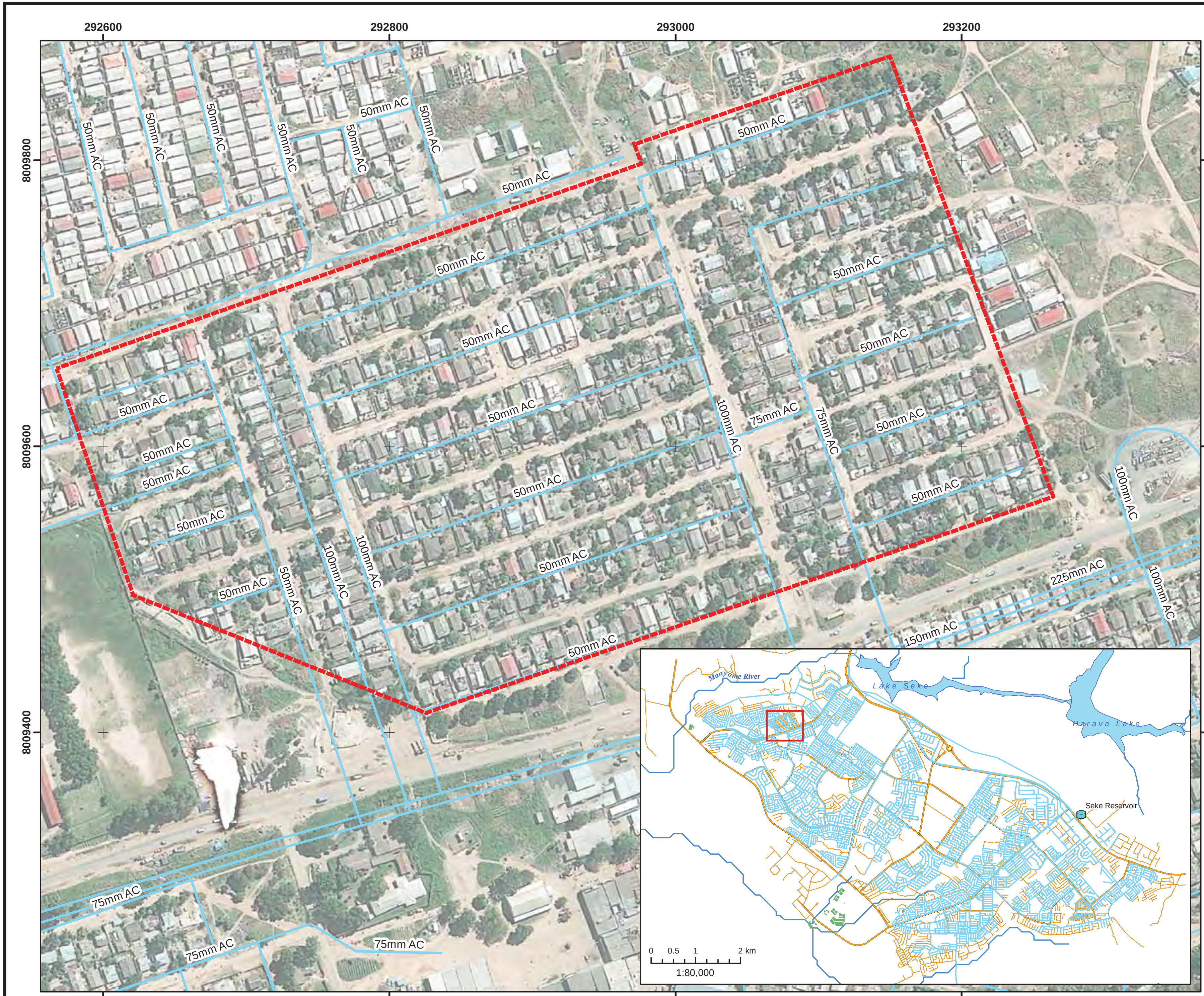
Network Pipes	Service connections
• 3,797m of ND 50 AC pipes • 64 m of ND 75 AC pipes • 1060m of ND 100 AC pipes	• 504 No ND 15 service connections • 504 Kent water meters, representing 100% service coverage and metering

Figure 1-4: Network Elements in the Pilot Area

The sewer network is made up of 2,251 m of ND 150 Vitrified Clay (VC), 363 m of ND 225 AC and 730 m of ND 300 AC pipes laid parallel to the water pipes.

The map in figure…. overleaf shows the location and characteristics of the pilot area.

Figure 1-5
Map of the Pilot Area
(Water)



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1:2,500

Datum WGS 84

Urgent Water Supply and Sanitation Rehabilitation Project Medium to Long Term Investiment Plan

Legend

- Transition Chambers
- WTP Wastewater TW
- PS Sewer Pump Stations
- Chitu_WaterPipes
- Rivers
- Study Zone Boundary
- Dams & Lakes

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Findings and Recommendations – Water Distribution Network

All the network elements are over 30 years old. There have not been any major rehabilitation or replacement undertakings since the town was developed. In the oldest parts of town, water pipes and appurtenant structures date as far back as 1978.

Water pipes

St Marys is supplied by a ND 225 main. The water distribution mains within the pilot zone are ND 75 mm mains.

The AC pipes appear to be in good condition despite the age – not very surprising considering that AC pipes have a lifespan of 50-70 years. Even though AC pipes undergo gradual degradation in the form of corrosion (i.e., internal calcium leaching due to conveyed water (lower Langelier index = more leaching) and/or external leaching due to groundwater), the council has not reported enough pipe failures to suggest that the pipes need replacement. The exposed pipes from the replaced pipes did indicate that the pipes were in fair condition except for those blocked as a result of siltation.

Valves and fire hydrants

There were no hydrants in the pilot area. Isolation valves were found randomly installed on the distribution mains. Generally, all the valves are in a bad shape; they are rusty and leaky.

Valve chambers are generally in a very poor condition, damaged and filled with stones as shown in the photos below. Furthermore, there are no covers and those that do have, they have been vandalised.

Therefore, the conclusion based on the above is that, all network appurtenant fittings and structures must be replaced as most network leakages occur there.

Vandalised valve chamber

Significant amount of water is lost after the meter resulting in unnecessary water use/ wastage. If metered, these wastages lead to increased water bills, which may not be paid by the consumers. If unmetered, these wastages result in high NRW levels, as flat rate billing considers only a limited average amount of water usage. Wastage can be reduced and water conservation measures be implemented through rehabilitation of household installations and household education and awareness programs. Even though Household investments are normally not part of project funding, a provision in the investment plan for public awareness campaigns aimed at sensitizing consumers on the motivation and financial benefits associated with investing in internal plumbing repairs is made. It is further recommended that council should make it a policy to fix leaking taps and pass on the costs to the consumers as a way to minimise water losses.

Vandalised water meter *House connection* Flow meter testing

Service connections are taken off the 75 mm tertiary mains using cast iron saddles. Each saddle serves 4 ND 20 service connections.

As can be seen from the photos below, the service connections are heavily corroded and incrusted. This was expected, given that these connections have been in service for over 30 years. Most of the leakages in the network occur on these lines.

It is therefore recommend that, all house connections be replaced including the saddles. It is further recommend that, the replacement of service lines should be of HDPE. HDPE house connections have proved to be durable and reliable. HDPE pipes have a smooth internal surface that does not corrode or tuberculate and maintains its flow capability over time. HDPE service connection pipes have a cost benefit associated with their longevity. The polyethylene pipe industry conservatively estimates the service life for HDPE pipes to be 50-100 years. This relates to savings in replacement costs for a long period.

Water testing meter

Encrusted pipes

1.5.2 Proposed Investment measures

Network Rehabilitation Measures

In order to bring the physical water losses down to around 20% by 2030, the network will be systematically rehabilitated (replacing pipes and valves in bad condition). The ToR stipulates that the network rehabilitation measures for the entire network shall be determined using statistical methods[1]. Pipe and valve condition assessments were conducted in a pilot area that could be deemed as representative of the entire network. The details of the pilot area investigations have been presented in Chapter 5. The findings of the investigation are summarised below:

- The AC distribution pipes are reported to be in good condition despite their age;
- All of the gate valves are in poor condition. Network leakages occur at these fittings;
- The majority of service connections are corroded and incrusted. This is where most of the network leakages occur;
- The majority of water meters are non-functional and few functional ones are not measuring water usage accurately;
- Significant amount of water is wasted after the meter resulting in unnecessary water use/ wastage.

In light of the above findings, the following measures are recommended:

- Since the AC pipes are still in good condition, they should be left in service except for the broken pipes identified by council;
- All network appurtenant structures such as valves and fire hydrants should be replaced;

[1] Detailed network investigations will be conducted at feasibility or final design stage.

- All service connections and water meters should be replaced;
- All bulk water meters should be replaced;
- Under normal circumstances, line after the service meter and the plumbing system in a property is the responsibility of the property owner or water user. But, if the property is not metered, there is no incentive for the water user to keep their plumbing system in good condition and reduce water wastage. In a water supply scheme where most water users are not metered (or meters are not working) as is the case in Chitungwiza, there are huge water losses at the properties and this is usually part of the NRW since the customers are billed on normal usage estimates. Hence, we recommend that council should, firstly, meter all customers and then implement a water conservation programme that has elements of rehabilitating household plumbing installations and household education and awareness programmes. The finances for such a programme are part of the investment plan.

Given the recommendations outlined above, the investment measures needed to rehabilitate the network and reduce physical losses are presented in the table below. The network rehabilitation measures proposed will be implemented under the medium term project.

Table 8-8: Network Rehabilitation Measures

Item	Unit	Medium-term project
Replacement/Installation of section valves		
ND 50 Gate	no.	409
ND 75 Gate	no.	1,190
ND 100 Gate	no.	544
ND 150 Gate	no.	88
ND 200 Gate	no.	4
ND 250 Gate	No.	2
ND 300 Gate	no.	1
ND 400 Butterfly	no.	1
Replacement of service connection and water meters		
Service connections (20 m long)	no.	56,000
Water meters	no.	56,000

Extension of Water Supply Services to new Areas

The water reticulation network will be extended to cover the new development areas. As outlined in Chapter 3, most of the additional population in the medium and long term will settle on Nyatsime Farms. There will also be some infill growth in the following areas; Seke CL. The water network requirements in the new development areas have been calculated on the basis of population and the per capita infrastructure requirements. The per capita infrastructure requirements were calculated using the existing network quantities and the population from the 2012 census. The parameters below were used to calculate the infrastructure requirements in extension areas

- House hold size (assuming one connection per household): 6 people
- Tertiary pipe network lengths per capita – ND 75: 1.2 m/ca.

- Tertiary pipe network lengths per capita – ND 100: 0.8 m/ca.

The table below shows the investment measures needed to extend the water network to the new development areas.

Table 1-9: Water Network Extension Measures

Item	Unit	Medium term project	2030
Additional Population			
Water reticulated	no.	29,359	132,575
Sewer reticulated	no.	28,990	130,910
Tertiary Water Network Requirements			
ND 100	m	23,487	106,060
ND 75	m	29,359	132,575
Water Service Connection			
Domestic (15 mm)	no.	4,893	22,096
Non-domestic (20 mm) (20%) of domestic	no.	979	4,419

2 SEWERAGE

2.1 Sewer Reticulation System

The wastewater infrastructure in Chitungwiza consists of both on-site and off-site sanitation systems. Building and housing guidelines, by-laws and standards stipulate that Low density properties depending on soil conditions, are not connected to the sewerage system. They are provided with on-site septic tanks and soak-away pits. High and medium density properties, on the other hand, are all connected to the sewerage system. The sewerage system in Chitungwiza consists of laterals, collector mains, pump stations and trunk mains that collectively convey wastewater to Zengeza Sewage Treatment Works.

Figure ….overleaf shows the schematic layout of the sewerage system in Chitungwiza.

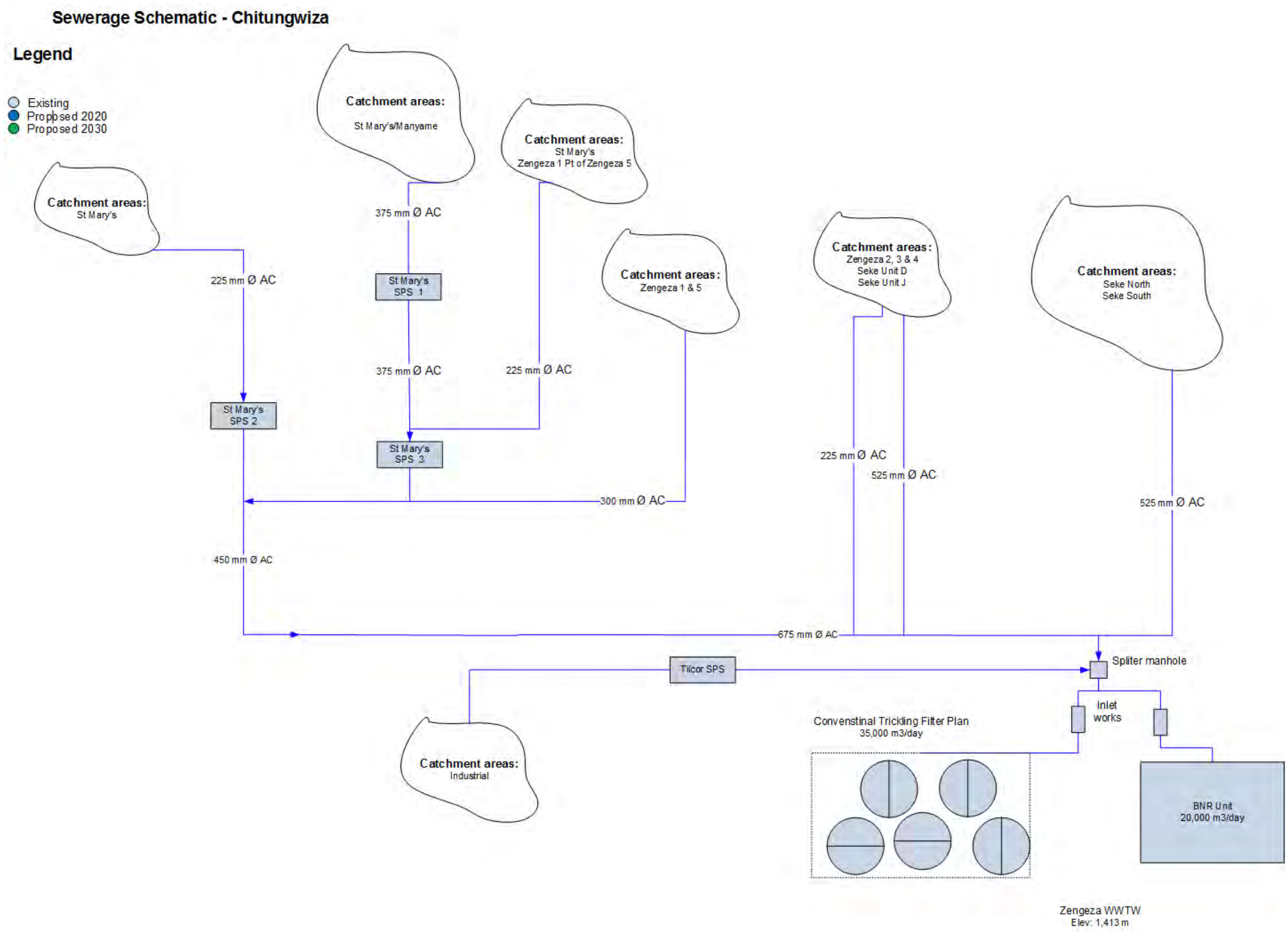
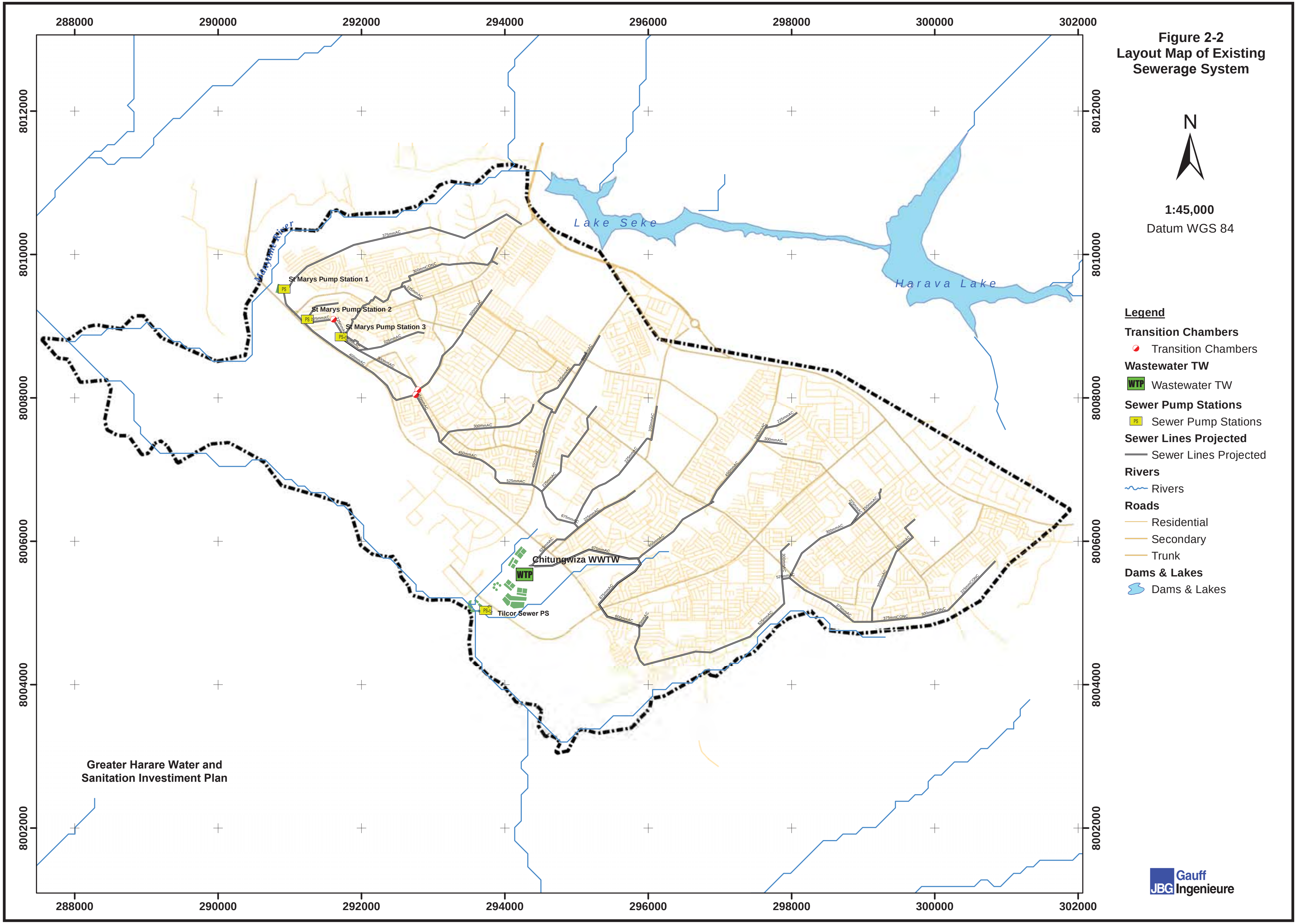


Figure 2-1: Schematic Layout of the Sewerage System of Chitungwiza

Figure 2-2
Layout Map of Existing Sewerage System



Greater Harare Water and Sanitation Investiment Plan

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2.1.1 Existing Catchment Areas and Sewer Network

Chitungwiza has currently seven catchment areas according to the drainage patterns of the city. The existing catchment areas are; Old St Mary's, St Mary's/Manyame Park, Zengeza 1 & 5, Zengeza 2, 3 & 4, Seke North & South and Industrial Catchment Areas. The following table summarises the characteristics of the catchment areas.

Table 2-1: Catchment Areas

Catchment Areas	Suburbs covered	General characteristics
Old St Mary's	Old St Mary's	Wastewater from this catchment area discharges into a ND 225 AC pipe which subsequently drains into Pump Station No. 2. Pump Station No 2 pumps waste water flow to Pump Station No. 3 where it is pumped to Zengeza Wastewater Treatment Works.
St Mary's Manyame Park	St Mary's/Manyame Park.	Wastewater from this catchment area discharges into a ND 375 AC pipe which subsequently drains into Pump Station No. 1. Pump Station No 1 pumps via a ND 400 AC pipe to Zengeza Wastewater Treatment Works.
New St Mary's	St Mary's, parts of Zengeza 1 and 5	Wastewater from this catchment area discharges into a ND 225 AC pipe which subsequently drains into Pump Station No. 3. Pump Station No 3 pumps via a ND 300 AC to Zengeza Wastewater Treatment Works.
Zengeza 1 & 5	Zengeza 2, part of Zengeza 1 & 5	Wastewater from this catchment area discharges into a ND 300 AC pipe which subsequently drains into the ND 450 AC to Zengeza Wastewater Treatment Works.
Zengeza	Zengeza 2, 3 and 4, Seke Unit D and J	Wastewater from this catchment area discharges into ND 225 and ND 450 AC pipes which subsequently drain into ND 675 AC collector main to Zengeza Wastewater Treatment Works.
Seke North and South	Seke North and South	Wastewater from this catchment area discharges into a ND 525 AC pipe which subsequently drains to Zengeza Wastewater Treatment Work.
Industrial	Industrial	Wastewater from this catchment area discharges into the Tilcor Pump Station which subsequently pumps wastewater flow to Zengeza Wastewater Treatment Works.

The sewer network comprises collector mains ranging in size from ND 100 to ND 525 and trunk/outfall sewers up to ND 825. Most of the drawings showing the layout plans and longitudinal profiles of the existing collector, sub-trunk and trunk sewers could not be located. Due to lack of sufficient information, it was not possible to establish the exact length of the existing network and number of man-holes.

2.1.2 Pilot Zone Investigations

The detailed sewer network investigations were carried in the same pilot area as for the water distribution network. The same methodology and approach was followed.

Findings and Recommendations – Sewerage Network

The sewer collection system in the pilot area comprises of ND 150 Vitrified Clay (VC) and AC material.

The sewer pipes are generally in good condition though; there is silt/solids accumulation due to insufficient sewage flow. The structural integrity of all inspected manholes is considered to be good. However, there seems to be insufficient flow in the sewers to flush away the solids (silt and human waste) as observed in the photos below.

Given the findings elaborated above, it is recommend that measures should be put in place for routine cleaning of sewer pipes and ensuring that there is sufficient flow in the sewers by improving water supply services. Phase 1 of the UWSSRP has provided sufficient sewer cleaning equipment that the councils will be using to address the problem of sewer blockages.

Investment should also be directed towards replacing those sewers that were reported by the council to have collapsed, including reconstructing the manholes that are damaged.

Sewer manholes blocked due to siltation in pipes

2.1.3 Proposed Catchment Areas

The sewerage system in Chitungwiza was optimised for the 2020 and 2030 design horizon. The optimization of the system looked at the effective way of conveying the sewage without pumping, which will effectively reduce the pumping costs. The outcome of this optimization process was the formulation of three main sewer catchment areas and the introduction of a new sewerage treatment plant which will serve part of Chitungwiza and the proposed developments on Nyatsime Farms earmarked to be developed in the 2020 and 2030 design horizons.

Catchment 1 comprising of St Mary's and part of Zengeza, Catchment 2 comprising Zengeza and Seke, Industrial Catchment comprising the industrial area and Nyatsime catchment comprising of the proposed Nyastime Development. The following table summarises the characteristics of the proposed catchment areas.

Table 2-2: Catchment Areas

Catchment Areas	Suburbs covered	General characteristics
Catchment 1	St Mary's and part of Zengeza.	This area is a proposed catchment which will serve St Mary's and parts of Zengeza in the 2020 and 2030 design horizon. The assumption in formatting this catchment is that, the existing pumping regime will be done away with. All the wastewater for this catchment will discharge into a proposed ND 450 pipe which will run along the Manyame River. The ND 450 pipe will discharge into a ND 500 main, which will discharge into the proposed Waste Water Treatment Works downstream of the confluence of Manyame River and Nyatsime River.
Catchment 2	Zengeza and Seke Areas	Wastewater from this catchment area discharges into two main outfall sewers; Zengeza area discharges into the ND 525 AC sewer main which discharges into the ND 675 AC sewer main, which subsequently discharges into Zengeza Waste Water Treatment Works. The second direction of flow comes from Seke area. This area discharges into a ND 675 AC outfall sewer, which in turn discharges into an ND 825 AC outfall sewer before discharging into Zengeza Waste Water Treatment Works.
Industrial Catchment	Industrial Area	Waste water from this catchment discharge into the Tilcor Pump Station, which subsequently pumps to Zengeza Waste Water Treatment Works
Nyatsime Catchment	Proposed Nyatsime Development.	This catchment is proposed to discharge into a ND 500 DI main, which will discharge into the proposed Waste Water Treatment Works downstream of the Nyatsime River.

The proposed sewer catchment areas were established according to the drainage patterns of Chitungwiza. Except for the Industrial catchment area, the proposed Nyatsime Farm Catchment, Catchments 1 and 2 were assumed to collect sewage flow by gravity. The Industrial catchment was assumed to continue to use pumps, to transport sewage to the existing waste water treatment works.

Sewage collected from each sewer catchment area was obtained by overlaying the wards layer with the proposed catchment areas layer in ArcView 10.1. Some of the wards lie completely within a catchment area or only partially. The extent by which a particular ward is contained in a catchment area was estimated in terms of percentage. The catchment area received this percentage of demand for that ward. The wards that fell wholly within a particular catchment area were allocated 100% to that catchment area. The various sewer flows from different wards that intersect the catchment area were aggregated to get the total demand for the catchment area. Figure 8-6 overleaf shows the proposed catchment areas.

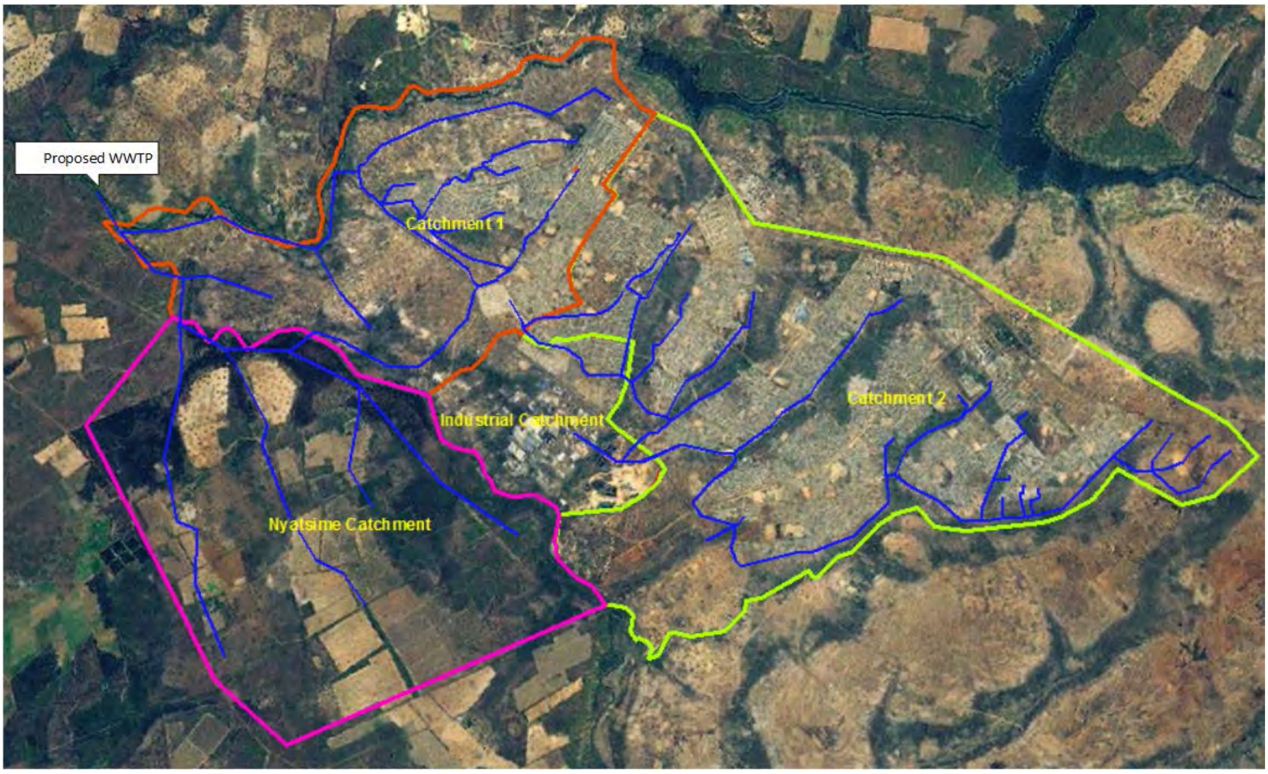

Figure 8-3: Proposed Sewer Catchment Areas

2.1.4 Hydraulic Modeling

A hydraulic model was constructed in conformity with the proposed restructured network. A primary network grid was laid out for each proposed zone and sized for the medium term (2020) and long term (2030) hydraulic loading.

Modelling Parameters

A hydraulic model requires several input parameters in order to simulate the actual conditions under which the network will be operating. These parameters are; the physical characteristics of the network and its boundary conditions (pipe roughness, manhole inverts) and the sewer loading.

In order to build a realistic representation of the system, the age and material of the mains were considered with the friction factors altered to reflect the material of pipe and the age of pipe. Most of the mains in Chitungwiza are in excess of 30 years old, therefore, it was deemed suitable to assume that the condition of these mains would be poor in places and hence; mains friction factors were increased to help reflect this.

The invert levels of the manholes on the collector mains were interpolated/extrapolated off the contour dataset obtained from Google Earth. The dataset has contour lines with an elevation interval of five meters. This data is fairly adequate for the purpose of higher level modelling of collector mains. More accurate surveys for collector mains, pump stations and ponds will be conducted for the final design.

The hydraulic loading (Sewer Flow) used for modelling the network has been calculated using population figures taken from the recently published report for the Census 2012 by the Zimbabwe National Statistics Agency (ZIMSTAT) as outlined in Chapter 3 of the main report. A detailed analysis of the sewer loading calculations is outlined in Chapter 5 of the main report.

The sewer flow loading in each zone was obtained by overlaying the wards layer with the proposed zones layer in ArcView 10.1. The wards lie either completely within a zone or only partially. The extent by which a particular ward is contained in a zone was estimated in terms of percentage. The zone received this percentage of demand for that ward. The wards that fell wholly within a particular zone were allocated 100% to that zone. The various flow loads from the wards that intersect the zone were aggregated to get the total demand for the zone.

The restructured network was simulated using the maximum peak season demand. The peak season demand factors were added to the model and impact towards the performance of the collectors mains analysed. For any network analysis case study, it is important to model the ‘worst-case’ scenario so that all potential issues can be predicted with mitigation measures put in place at the earliest possible opportunity. The calculated peak season flow in each catchment area is tabulated in the table below.

Table 2-3: Peak Season Sewer Flow for Proposed Catchment Areas-Chitungwiza

Description	Unit	Design Parameter			
		Factor	2020 Demand	Factor	2030 Demand
Catchment 1	m^3/day	1.25	10,316.84	1.25	10,316.84
Catchment 2	m^3/day	1.25	28,342.35	1.25	29,632.61
Industrial Catchment	m^3/day	1.25	3,729	1.25	3,729
Nyatsime Catchment	m^3/day	1.25	338	1.25	8,826

Results of the Modelling Simulations

In the restructured network for the year 2020 and 2030 scenarios, the observed velocities within the collector mains were fairly within acceptable limits stipulated in the design criteria except for ND 150 AC main collecting sewer flow from Seke South and the ND 225 concrete main collecting sewer flow from Seke North (See Appendix 8.3).

These mains surcharged during the simulation. The maximum flow ratio and maximum depth of over 1.0 experienced in these sections of mains, indicates that pipes are running at full bore and as such, the hydraulic grade line was above the diameter of the pipe. This indicates that, these sections of mains do not have enough hydraulic capacity to handle the demand for the 2030 scenario and needs to be upsized.

A further simulation was performed in an attempt to find the optimal upgrades required to provide adequate levels of service. It is hoped that these changes to the network would help to reduce the surcharge experienced during the simulation. Table below shows the sections of mains that surcharged during the simulation and the recommended upgrades.

Table 2-4: Sewer Trunk Upgrade Measures

Section	Pipe (mm)	Length	Max/Flow Ratio	Upgrade Pipe (mm)
Main from Seke South	ND 150 AC	1,188	1.00	250 PVC
Main from Seke North	ND 225 conc.	954	1.00	315 PVC

Velocities in sewer mains should normally be kept within certain limits to avoid deposition of sediments on the lower end.

To maintain self-cleaning velocities in the sewers a minimum velocity of 0.5 m/s is recommended and to prevent scour a maximum velocity range of 5-12 m/s is recommended, depending on the material. To follow the conservative approach a maximum velocity of 5 m/s is chosen for all materials, even if studies have shown that erosion effects observed at velocities greater than 4 m/s are only minimal.

The maximum velocities experienced within the collector mains are below the 2 m/s stipulated in the inception report and above the 0.75m/s recommended for self-cleansing velocity. Pipes at the selected gradient should be capable of conveying the ultimate flows and give minimum velocities at peak daily flow.

A further simulation was run which replicated the waste water flow in the proposed development areas. The model was used to help predict the sewer pipe sizes that will be required in these areas in the 2020 and 2030 design horizons. The sewer transmission investment measures are presented in the table below. It should be noted that the investment measures satisfy the 2030 service requirements but will be implemented under the project in the medium term.

Table 2-5: Sewer Transmission Investment Measures

Item	Unit	Medium term project
Sewer Pipes		
ND 150 PVC	M	8,965
ND 200 PVC (OD 225)	M	8,246
ND 250 PVC (OD 280)	M	6,139
ND 315 PVC	M	3,169
ND 450 PVC	M	4,040
ND 500 RC	M	616

2.1.5 Extension of Sewerage Network to New Development Areas

The sewer network will be extended to cover the new development areas. As outlined in Chapter 3, most of the additional population in the medium and long term will settle in Longlands, Braemar A, Dunnotar, Cawdor, Tantallon and Edinburgh which are loosely referred to as Nyatsime Farms. There will also be some infill growth in the existing areas. The sewer network requirements in the new development areas have been calculated on the basis of population and the per capita infrastructure requirements. The per capita infrastructure requirements were calculated using the existing network quantities and the population from the recent census. The parameters below were used to calculate the infrastructure requirements in extension areas

- House hold size (assuming one connection per household): 6 people
- Tertiary sewer collector lengths per capita: 1.2 m/ca.

The table below shows the investment measures needed to extend the sewer network to the new development areas.

Table 8-6: Tertiary Sewer Extension Investment Measures

Item	Unit	Medium term project	2030
Additional Population			
Water reticulated	no.	29,359	132,575
Sewer reticulated (MD & HD)	no.	28,990	130,910
Tertiary Sewer collectors			
ND 150	M	34,788	157,092
ND 100	M	14,495	65,455
Sewer Service Connections	no.	5,798	26,182

2.2 Sewage Pump Stations

The Tilcor Industrial Area Pump Station is situated on the south of the Zengeza WWTW. This pump station is not operational and it is in a dilapidated state. There were two surface pumps installed in a dry well but due to ground water seepage, the well gets flooded and the building has been undermined by the water. The building doors and windows have warped and are no longer functional. The horizontal pumps have been removed and the starter panel has been tempered with and parts are missing.

The medium term and long term investment measures required are also outlined in the same table;

Medium Term Project	Long Term (2030)
• Replacement of submersible pumps including control gear	• Replacement of submersible pumps including control gear.

2.3 Zengeza WWTW

Zengeza WWTW consist of two treatment facilities constructed in phases – the Modified Conventional Treatment Works and the Biological Nutrient Removal Works

2.3.1 Modified Conventional Treatment Works – Old Works

The modified conventional treatment works consist of the following process units;

Intake Works

The inlet works consist of two parallel screen channels, which were supposed to be isolated by penstocks which are completely corroded. According to the original design, the two screen channels would comprise a coarse screen (with approximately 60mm spacing between bars) and a medium screen (with approximately 30mm spacing between bars), manually raked. However, only the medium screens are in place at present, but are highly corroded and damaged.

Grit removal is supposed to take place in two parallel baffled grit chambers. The baffles (A.C. plates) are no longer in place and the weir penstocks are completely corroded and missing in some areas. The two grit removal chambers are nearly full with sand.

Rusting Air-lift pipework with ND 150, discharges grit into a shallow grit separation box, with missing aluminium sluice gates.

Anaerobic Ponds

The pond system consists of 4 parallel sets of ponds, i.e. 3 ponds in series each. All ponds are concrete lined with a sloped floor and a sloped collection trough to allow for gravity flow of the settled sludge towards the scour valves (one per pond) for desludging.

Two ponds are interconnected by sluice gates in order to be able to take-out of operation one of the two ponds for maintenance (cleaning) purposes. A third pond can be by-passed by making use of a separation chamber, which was supposed to be equipped with sluice gates.

All the ponds are filled up with sand, sludge and weeds.

All gates submerged steel plates (at the outlet of the ponds) and valves are corroded and some are missing.

The ponds are surrounded by ND 150 A.C. pipes, which supply recycled effluent from the outlet of the biological trickling filters by means of the effluent pumping station back to the ponds for scum breaking purposes. The recycled effluent is distributed on top of the ponds by making use of numerous jet pipes (ND 50). However, these jet pipes are heavily corroded and not operational.

Biological Trickling Filters

The works comprises a total number of 5 trickling filters, approximately 38 m, in diameter and 4.0 m deep. The filters are filled with granite rocks of average grain size of around 50 to 80mm from local quarries. The trickling filters were constructed between 1975 and 1980.

They have, however, undergone major repair works to inlet columns and distributor arms, between 1997 and 1999.

The ND 450 incoming pipes to the five trickling filters are partly broken and valves would be required to isolate individual trickling filters for maintenance purposes.

The concrete structures of the trickling filters do show cracks and leakages and thus have to be sealed.

Effluent Pumping

There are 2 no. Effluent Pump Stations. The old Pump Station was constructed in 1975 and comprises a total of 4 pumps. The new Pump Station was constructed in 1995 and comprises a total of 5 pumps, out of which 3 are treated effluent pumps to Imbwa farm and 2 are recirculation pumps to anaerobic ponds for scum breaking purposes.

Table 2-7: Condition Assessment of Conventional Works

Structure	Condition assessment notes
Civil structures	The civil structures including pavements are in a poor state.
Buildings	The administration building and superstructures of the pump stations are in a reasonable, to good condition and can be repaired relatively inexpensively
Pipework	All the pipework and related appurtenances are still intact and in good condition.
Mechanical Equipment	All pumps are in a poor condition.
Electrical Equipment	Most of the electric motors are in need of repairs or replacement

2.3.2 BNR WWTW

The BNR Plant was constructed with some financial support from Japan in 2000. It has a nominal plant capacity of 20,000 m^3/d. It consists of the following process units;

- New Inlet Works complete with a grit system discharging grit to the existing Old Works grit removal system.
- Primary sedimentation tanks,
- Equalisation basin,
- BNR Tank comprising; an anaerobic basin, anoxic basin, and an aerobic basin,
- Final Sedimentation Tanks,
- Maturation Ponds,
- Sludge Thickeners,
- Sludge Digesters.

The plant was operated from the day of commissioning up to 2004. The condition assessment of the works is summarised in the following table.

Table 2-8: Condition Assessment of BNR Plant

Structure	Condition assessment notes

Civil structures	The civil structures including pavements are still in good condition.
Buildings	The administration building and superstructures of the pump stations are in a reasonable to good condition and can be repaired relatively inexpensively
Pipework	All the pipework and related appurtenances are still intact and in good condition.
Mechanical Equipment	All the mixers are in good condition.
Electrical Equipment	Most of the electric motors are in need of repair or replacement

The estimated wastewater flows from the Chitungwiza catchment areas over the medium to long term horizon are as outlined below;

- Peak season sewage flow for 2012- 34,210 m^3/day,
- Peak season sewage flow for 2020- 42,015 m^3/day, and
- Peak season sewage flow for 2030- 53,725 m^3/day.

The above implies that present sewage treatment facilities are hydraulically adequate to service existing areas that will not be affected by proposed development. However, in Chitungwiza, development over the medium and long term horizon will be concentrated in Longlands, Braemar A, Dunnotar, Cawdor, Tantallon and Edinburgh. The above areas have been assumed to drain into a new wastewater treatment works that will be part of the Greater Harare Medium to Long Term Investment Plan which is proposing the creation of an integrated sewage collection and treatment system covering; Mabvuku and Tafara, Ruwa, Ventersburg, Epworth, Harare South, Chitungwiza catchment area 1 and Nyastime Farms.

2.3.3 Proposed Investment Measures

Therefore, the investment measures for wastewater treatment required in Chitungwiza for the 2030 horizon will be as detailed in the Greater Harare Medium to Long Term Investment Plan. Below is an outline of the various investment measures required in Chitungwiza.

Medium Term project	Long Term (2030)
• Rehabilitation of the Biological Nutrient Removal treatment works, • Rehabilitation of the modified conventional wastewater treatment works • Replacement of effluent pumps and control gear, • Replacement of mixers, aerators and pumps for the BNR	• Replacement of effluent pumps and control gear, • Replacement of mixers, aerators and pumps for the BNR

Figure 2-4: Investment Measures at Wastewater Treatment Facilities

3 ON-GOING WORKS

In December 2011, the Ministry of Finance through the Zim-Fund engaged the services of an Implementing Entity to, among other services, design and supervise implementation of immediate measures works in Chitungwiza and five other project towns. The work covered the design of identified immediate measures with respect to existing water production and wastewater treatment plants and is being carried out at the moment. The following scope of works is covered under the UWSSRP regarding the water supply components in Chitungwiza.

Table 3-1: Works of UWSSRP on Sewer System

Scope of Works	Location	Objectives of intervention
	Sewage Works	
Rehabilitation of Inlet Works	Zengeza WWTW	Increase flows to wastewater treatment plants and improve effluent qualities
Rehabilitation of Anaerobic Ponds	Zengeza WWTW	Improve sewage treatment and reduce incidence of disease
Rehabilitation of Biological Filters	Zengeza WWTW	Improve sewage treatment and reduce incidence of disease
Rehabilitation of Effluent Pump Stations	Zengeza WWTW	Improve effluent pumping to farms and reduce spillage into Nyatsime river
	Supply of Goods	
Supply of Laboratory Equipment	Municipality	Reduce incidence of disease
Supply of vehicles, vacuum tankers, jetting machines and rodding equipment	Municipality	Reduce and prevent sewage overflows of sewer network (this is a public hazard that increases the risk of cholera), improve flow in sewage network
Supply of Mandatory Spare Parts	Municipality	Improved management efficiency, revenue collection

APPENDIX 4.3: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT - EPWORTH

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 4.3: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT

EPWORTH

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1 WATER SUPPLY

1.1 Water Sources

1.1.1 Description of water sources

Epworth has only one source of water which is the City of Harare via the Ventersberg Tanks. For the supply route from Morton Jaffray WTW to Ventersberg refer to the City of Harare Report.

1.1.2 Raw Water Pump Stations and Intakes

None

1.1.3 Raw Water Transmission Mains

None

1.2 Water Treatment Works

None

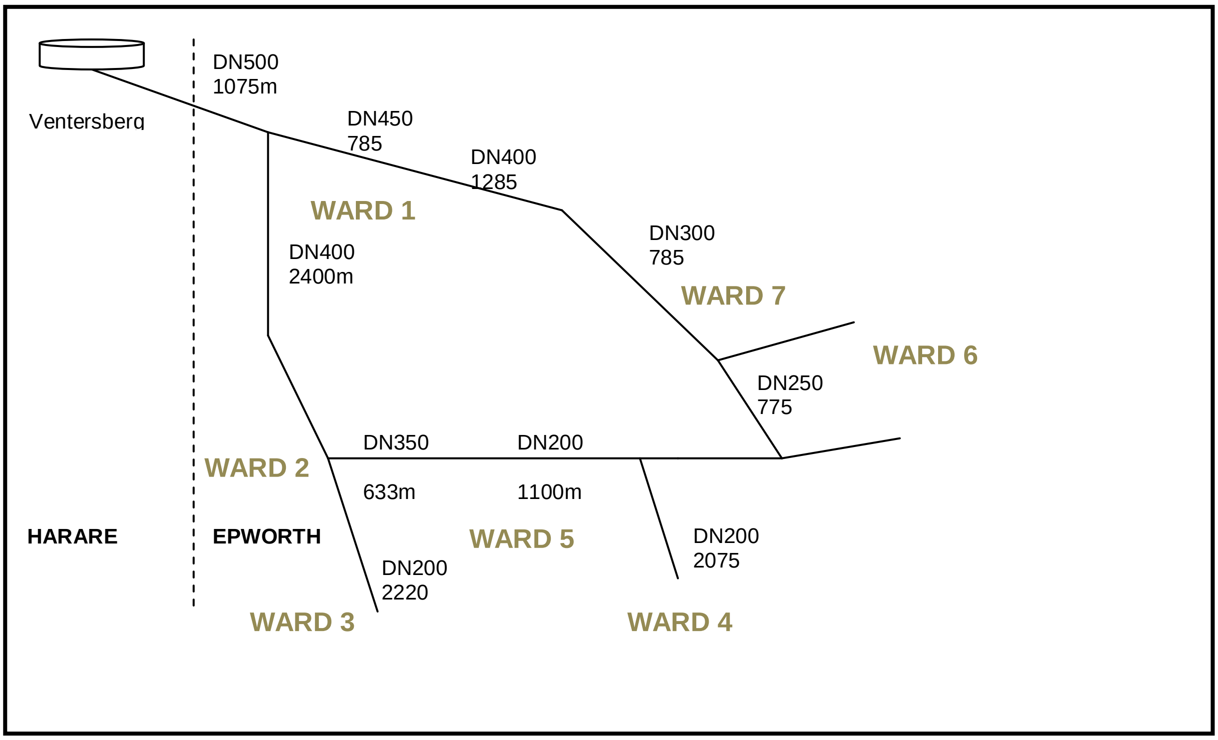
1.3 Booster Pump Stations

There are no booster pumping stations in Epworth.

1.4 Transmission System

Figure 1-1 below shows the transmission system for Epworth, in schematic form:

Figure 1-1 Epworth Transmission and Storage Schematic - Existing



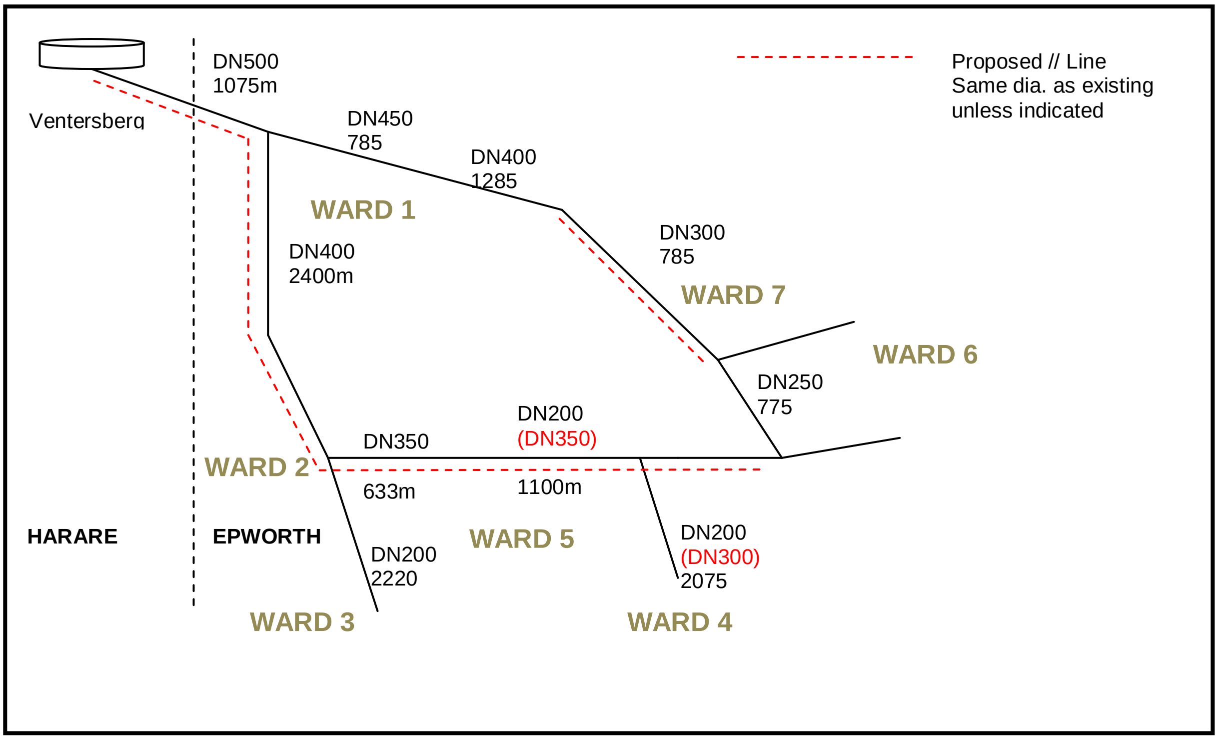
1.4.1 Existing Transmission System Description

Only one source of treated water is available to Epworth from the City of Harare's Ventersberg Tanks, directly into the supply network via a 1075m long DN500 supply line.

1.4.2 Investment Measures

Figure 1-2 below shows the proposed future transmission/ distribution system for Epworth, in schematic form:

Figure 1-2 Epworth Transmission and Distribution Schematic - Proposed



Short Term Investment Measures

Epworth has seen a total absence of water for many years and even with water available has a very limited distribution network. The initial focus in Epworth will therefore be on achieving 24 hours supply in the areas with existing networks and rolling out a programme of water kiosks to provide full coverage with safe drinking water. The existing network will be quite adequate for this and large increases in demand are not expected to develop initially. Therefore no work is programmed to increase pipe sizes in the transmission and distribution system in the short term.

Long Term Investment Measures

As Epworth's water supply situation normalizes it will be necessary to reinforce the primary and secondary distribution system as tabulated below as a large and growing population increasingly demands stand connections, without flow limiters to the water networks.

As seen from Figure 1-2 above the principal Employed has been to provide for parallel mains to those already in place. It is assumed that the mains already in place will have multiple connections to the network. The new mains will be laid with limited, metered interconnections to the existing to allow for improved pressure and demand management.

Table 1-1 Long Term Primary and Secondary Distribution Investments

Note Refers	Description of Pipeline	Investment Required	Reason for Investment
Transmission/ Primary/ Secondary Distribution			
a	Ventersberg to Ward 1 'Overspill' Area	975m of DN500 Ductile Iron parallel to existing DN500	Increased general flow requirements
b	From Ward 1 tee to Ward 7 to tee off to ward 2	2500m of DN400 (// to existing DN400)	Increased general flow requirements
c	Through Ward 2 to Ward 5	2500m of DN200 (// to existing DN400)	Increased general flow requirements
d	Tee at south of ward 1 to tee off to ward 3 and 4	2200m of DN350 (// to existing DN350 and DN200)	Increased general flow requirements
e	Line from ward 6, south into ward 4	4200m of DN300 (// to existing DN200)	Increased general flow requirements
f	Through part of Ward 7	785m of DN300 (// to existing DN300)	Localised bottleneck in supply capacity after end of DN400

1.5 Storage Reservoirs

1.5.1 Existing Reservoirs

Epworth has no existing storage reservoirs.

1.5.2 Proposed Investment Measures

Epworth Council would like to construct an elevated tank at the Overspill area on the basis that this will allow them to better manage demand. However, discussion with the modellers for the Harare network indicates that this would be a very inefficient location for storage compared to the nearby and much larger Ventersberg tanks. Therefore within this investment plan no reservoirs are includes for within the Epworth Area.

1.6 Distribution Network

1.6.1 Distribution zones and DMAs

The following Zones are logically identified from the network layout. Currently poor valves etc. mean that many of the zones are heavily interconnected and do not constitute demand management areas. Also in many cases there is very limited supply network in the Zone indicated:

Table 1-2 Demand Management Areas

DMA	Source of Supply	Comment
Existing Town Areas		
Ward 1	DN500 from Ventersberg.	All other DMZs are supplied through ward 1
Ward 2	DN 400 from Ward 1	Onward supply to wards 3 and 5 through ward 2
Ward 3	DN200 from Ward 2	
Ward 5	Existing DN350 on boundary of Wards 1 and 2 Future Supply may include supply through ward 2	In future ward 5 could be subdivided into northern and southern halves with separate supply each
Ward 4	DN200 from ward 6	Only a small area is currently developed. Major expansion expected in this ward
Ward 6	DN200 southern part of ring from ward 5 DN300 northern part of ring from Ward 7	Only a small area is currently developed. Major expansion in to Rockview is expected
Wards 7	DN400 from Ward 1	Only a small area of the ward has water network.

1.6.2 NRW assessment

<u>Bulk and Block Metering</u>

Bulk and block metering is absent and new metering will be needed throughout as soon as water is restored.

<u>Distribution Networks</u>

The Ruwa distribution networks were reportedly in relatively good condition when water was last regularly supplied. The condition cannot be assessed now as water has been entirely absent for many years. Incidents of vandalism have been noted, especially at locations where public water points used to be provided.

<u>Consumer Metering</u>

The Council Reports that almost all consumers either have never had a meter or have a faulty meter.

1.6.3 Proposed Investment measures

Short Term Investment Measures – Non Revenue Water

Currently there is near zero non revenue water in Epworth as no water is supplied. As soon as supplies are restored however the proportion of non revenue water is likely to be high. The majority of the effort at non revenue water reduction will take place in the short term investment timeframe. Investment measures proposed are:

- A programme of valve replacement to allow proper demand zoning and management. This covers all valves within the system.
- A programme of installation and or replacement of bulk and bock meters to allow proper accounting for water. This covers all meters within the system
- A programme for the replacement of all consumer meters within the system, domestic and commercial.
- A programme of technical assistance to assist in identification of losses and developing programmes for NRW reduction. This will include detailed network mapping, customer database cleanup and customer awareness programmes.
- Following from improved metering and modelling it will be possible to identify areas of the tertiary distribution system where losses are high and target a programme of pipe and house connection replacement at these areas. At this stage the Council has not identified any specific area as highly problematic.
- Level control valves for reservoirs will be replaced as necessary to prevent losses through overflows.

As major expansions to the primary and secondary distribution network will not take place in the short term but expansions of supply to new house connections and many kiosks will take place, it is recommended that all connections in the short term be fitted with flow limiters to assist the Local Board in maintaining 24 hour supply and reasonable network pressures.

Short Term Investment Measures – Reticulation Expansion

Short term expansion of the tertiary water supply network will be concentrated in the Rock View area of Epworth where expansion is already underway. This is earmarked as a medium density development and is key to the Local Board's revenue raising strategy. Once again it is recommended to install flow limiters to ensure 24 hour supply.

Long Term Investment Measures – Non Revenue Water

The long term measures in NRW reduction will largely involve a continuation of the activities in the short term. Specific investments allowed for are:

- Replacement of all bulk and block meters. Experience indicates these have a life not exceeding 8-10 years and those installed in 2015-2017 will therefore need replacement before 2030.
- Replacement of all consumer meters. Experience indicates these have a life not exceeding 8-10 years and those installed in 2015-2017 will therefore need replacement before 2030.

Long Term Investment Measures – Reticulation Expansion

Long term expansion of the tertiary water supply network will be in areas earmarked for growth of Epworth beyond its current boundaries and areas of settlement that are yet to be formalised. The bulk of the long term expansion into areas with no current supply networkwill occur in:

- Ward 6
- Ward 4
- Ward 3

1.7 Emergency Water Supplies

With the considerable water shortages that Epworth has been experiencing the Local Board has an ongoing programme to supply water through strategically located boreholes as follows:

- 6 No Boreholes with handpumps were installed in a joint programme with a church

Water Point with Hand Borehole Pump

A once off testing of all boreholes was carried out and all were found to have high iron content but met requirements for potable water.

Short Term Investment Measures

Initially a major programme of construction of water kiosks throughout the coverage area of Epworth is required to ensure that the whole population has access to clean water. This is essential as restoration of sewerage will take many years and contamination of shallow wells will remain a problem.

Discussions with the Local Board indicate that the rollout of Kiosks should follow some restoration of supplies to existing serviced areas. otherwise there may be strong resistance to the kiosks from residents who fear that the network will not be restored once kiosks are in place.

Long Term Investment Measures

Many areas will likely need to maintain their kiosks into the long term.

2 SEWERAGE

2.1 Sewage Sub Catchments

A small area of Epworth, within Wards 1, 2, 5 and 7 currently has a sewerage network. Ponds were constructed to collect and treat the sewage from these areas but were quickly overbuilt and were never commissioned. Therefore the sewerage network was never commissioned either.

2.2 Sewer Reticulation System

The sewerage system covering most areas that have water supply has never been commissioned. As soon as water supply is restored there are many properties that do have water connections and demand for a sewage system will grow.

Discussions with the local board indicate that sewer pipes are likely to be in good condition whilst manholes will require sand removal and in about 50% of cases, reconstruction of the cover slab.

Short Term Investment Measures

In the short term, the inability to treat any sewage generated in Epworth means that the area must remian on on site sanitation systems.

Long Term Investment Measures

In the long term improvement to the sewer network in Epworth will commence with the activation of the sewer network that was previously installed but never commissioned. This will involve limited replacements, extensive grit removal and refurbishment of nearly all manholes on this system.

Long term expansion of waterborne sanitation in Epworth will depend on the water supply network first being reinforced such that there is sufficient supply for all households with waterborne sanitation. Only once this occurs can the sewer network be expanded.

2.3 Transmission Sewers

Epworth requires a single main sewer to link it to the Donny Brook to Lyndhurst Farm sewer. Node numbering refers to Figure 7-10:

<u>Short Term Investment Measures</u>

In the short term Epworth will have no outfall sewer and no treatment facilities and therefore no works will be done on sewerage. This will be delayed until the Long Term when the Harare South Trunk Sewer is in place.

<u>Long Term Investment Measures</u>

Table 2-1 Long Term Transmission Sewer Investments

ID	Model Nodes	Investment Required	Reason for Investment
New Mains			
1	J23 to J291	New 1450m of DN250 uPVC	
2	J291 to J292	1260m of DN350 uPVC	
3	J292 t J299	1020m of DN450 uPVC	

2.4 Sewage Pump Stations

Epworth has no sewage pumping and none is proposed.

2.5 Sewage Treatment

Epworth has an existing pond set which was never commissioned and is now overbuilt and used as a sports field and so cannot now be commissioned.

It is not proposed to install any treatment in Epworth but rather it shall be linked to the existing but not yet commissioned sewer line from Donny Brook to Lyndhurst farm.

Epworth Sewage Ponds

2.6 Sewerage Boundary

The concept of a sewerage boundary has been proposed. This forms a boundary outside which the town will not provide waterborne sanitation (potable water will generally be supplied). In the case of Epworth the following Sewerage Boundaries are proposed:

Short Term

The boundary shall contain only those areas where sewer lines have been laid in the past but which were not commissioned. Lined within this boundary will be commissioned but the network will not be extended outside of it.

Long Term

The sewage boundary in the long term shall be the outer boundary formed by Wards 1 to 7 with their current definition. Sewerage will not be provided outside of these boundaries.

Furthermore, within these boundaries sewerage will not be provided to any area that requires pumping in order to reach the outfall pipe.

2.7 On- Site Sanitation Support

Many areas of Epworth will remain without waterborne sanitation, even in the long term. Sewage system investments will take many years to implement and some area will remain outside of the sanitation boundary for the town even in the long term. In these areas support must be given for the proper use of on site sewage disposal and treatment systems. Support will include:

- In areas of high water table where pit latrines and pour flush latrines are not practical, communities will need support to deploy and manage urine separation composting toilets. This type of toilet offers a good solution in these areas but as they require a more significant structure than pits or pour flush toilets they are often unaffordable. In addition users must be trained in their proper use and communities must find a source of ash which has to be added to the composting solids and is not readily available in Harare where people do not cook on wood stoves.
- In other areas pour flush toilets are clearly the preference of the householders and are seen to be installed where ever sufficient water is available. These offer a cheap alternative to a full waterborne solution with significant benefits over pit latrines. Pour flush systems should only be encouraged in areas where water supply is piped in. Support to communities wishing to use this type of toilet may include:
    - Improvements to water supply such that the householders have sufficient water to operate pour flush systems
    - Training of builders in good practices for construction of pour flush toilets and soakaways.
    - Provision of subsidised components such as cover slabs and squat pans to improve the affordability of pour flush systems
- Only where water supplies are very scarce will pit latrines be favoured by house holders. In future, reliance on pit latrines should therefore be limited to areas where no formal water supply system is in place. Support to communities on pit latrines may include:
    - Training of builders in good practices for construction of pit latrines.
    - Provision of subsidised components such as cover slabs, squat pans and ventilation pipes to improve the affordability of quality pit latrine systems
    - Training of householders in methods of maintaining the toilets and preventing the breeding of insects in the toilets.

APPENDIX 4.4: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT - NORTON

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 4.4: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT

NORTON

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1 WATER SUPPLY

1.1 Water Sources

1.1.1 Description of water sources

Norton currently obtains all of its water from Morton Jaffray WTW. A DN300 steel treated water supply line 4.3km long feeds the town's reservoirs on a hill to the east of the town from the WTW.

1.1.2 Supply Capacity

The existing supply has a capacity of between 8 and 10MLD, depending on the pumping pressure at the Morton Jaffray WTW. Modelling for Harare indicates that pressures at Morton Jaffray will be about 12.5bar at the discharge manifold once the refurbishment is complete. On this basis the existing line can supply around 8MLD to Norton. Current supplies are also around this figure.

1.1.3 Raw Water Pump Stations and Intakes and Transmission Mains

The town currently has no raw water supply of its own although a project has been underway for some time to develop one. This is discussed in Section 4.

1.1.4 Raw Water Investment Measures

As discussed in Section 4 there are no investments recommended in raw water supplies.

1.2 Norton WTW

The town currently has no water treatment works of its own although a project has been underway for some time to develop one. This is discussed in Section 4.

1.2.1 WTW Investment Measures

As discussed in Section 4 there are no investments recommended in the water treatment works.

1.3 Booster Pump Stations

1.3.1 Existing System

The current system in Norton is entirely gravity fed. This makes for easy operation but supply pressures have been declining with increased demands and as more demand areas have been added to the system.

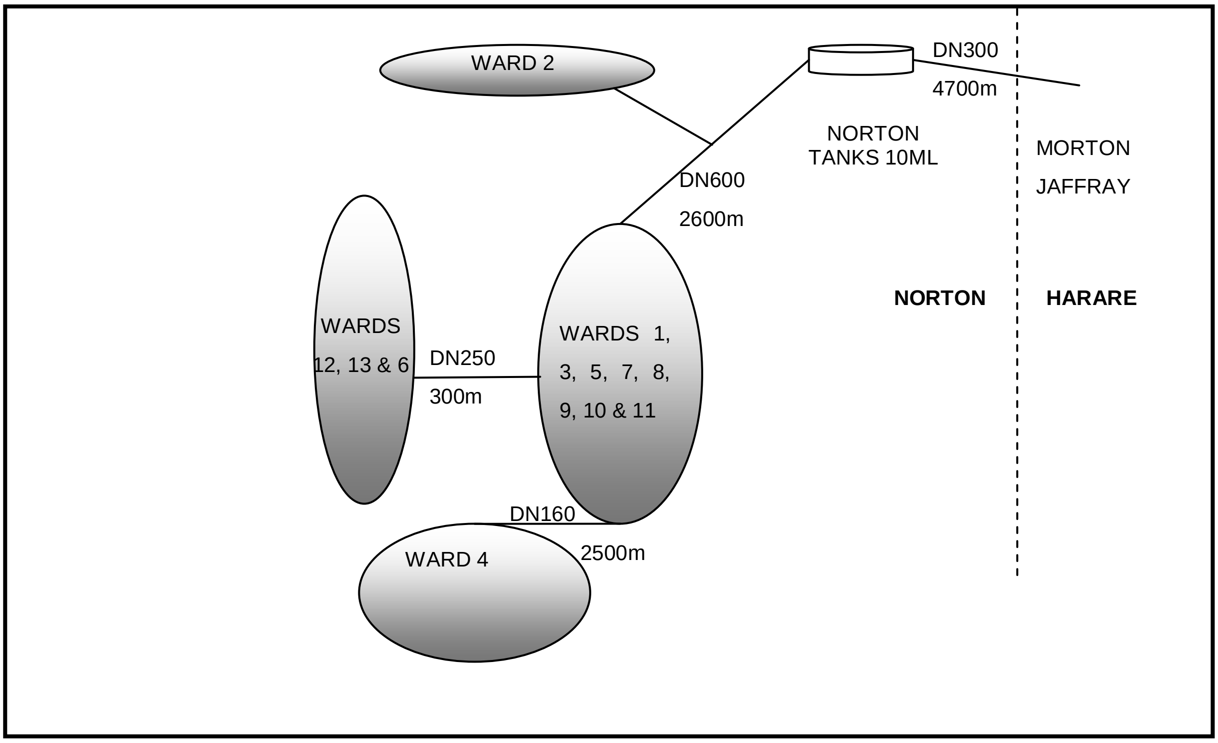
1.3.2 Proposed Investment Measures

Modelling of the Norton supply system has shown it is possible to keep the current set up of gravity only supply. Therefore no booster pump stations are recommended.

1.4 Transmission System

Figure 1-1 below shows the transmission system for Norton, in schematic form:

Figure 1-1 Norton Transmission and Storage Schematic - Existing



1.4.1 Existing Transmission System Description

The sole treated water supply to the whole of Norton is a single DN600 AC pipeline from the Norton Tanks to a distribution centre at the Council Engineering Offices in Ward 3. A major concern with this line once it enters the town boundary it has no servitude and has been overbuilt in areas.

A tee off approximately half way along the line feeds Ward 2 which is a newly developed low density suburb.

At ward 3 the DN600 splits into the various parts of the distribution system for Wards 1 and 3 and with onward transmission to Wards5, 6, 7, 8, 9,10 and 11. These wards together make up the whole of the original town of Norton for which the water supply system was designed.

New expansion areas in Wards 12,13 and 6 have been attached to the distribution system for the old town and receive almost no water. Modelling confirms that the network simply does not have capacity to supply these areas.

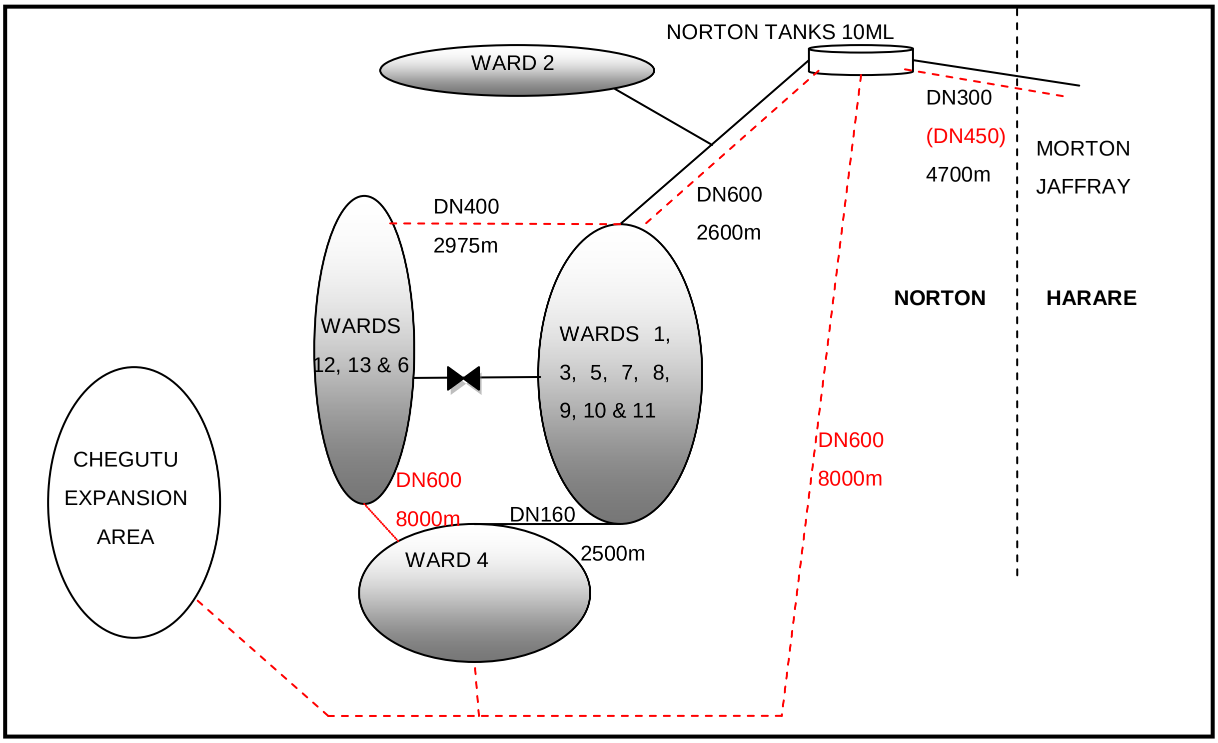
Similarly Ward 4 is supplied through the distribution system of ward 3 and then via a 2.5km DN160 main which is entirely too small to supply the area.

Thus under the existing condition areas of the old town which used to have adequate supply now suffer from low pressures and short supply hours but do receive water, New development areas receive little or no water at very low pressures. As a result many people, especially in the new development areas now rely on shallow wells for their water supplies.

1.4.2 Investment Measures

Figure 1-2 below shows the proposed future transmission system for Ruwa, in schematic form:

Figure 1-2 Norton Transmission and Storage Schematic - Proposed



Short Term Investment Measures

In the short term the minimal intervention necessary is to supply sufficient water to the town for its populations minimal requirements and to reverse the trend of chronic low pressure in the network. The 8MLD that can be supplied by the existing line cannot sustain Norton so this supply must be expanded. At the same time regardless of available supplies pressures will be very low unless certain minimum interventions are carried out. The following short term measures are therefore proposed. Junction numbers in the table refer to Figure 7-12.

Table 1-1 Short Term Primary and Secondary Distribution Investments

Note Refers	Description of Pipeline	Investment Required	Reason for Investment
Transmission/ Primary and Secondary Distribution			
a	Morton Jaffray to Norton Tanks.	3800m DN500 DI	Increase supply capacity to Norton to meet the town's long term needs
b	Termination of DN600 in Ward 3 to Ward 6	2975m of DN400 DI	Provide sufficient supply to Wards 6, 12 and 13 and improve pressures throughout.
c	Line J-98_3 to 98_5	2995m of DN200	New secondary pipe network for Ward

Note Refers	Description of Pipeline	Investment Required	Reason for Investment
		uPVC	6 where development has commenced
d	Main connection between ward 6 and ward 13	1365m of DN300 uPVC	Improve supplies to Wards 12 and 13 and allow these to be disconnected from current connection to ward 10. This will improve pressures in all areas.
e	Connect existing DN225 in Ward 12 to Ward 4. Pipeline J98_1 to J99_4	453m of DN150	Improve pressures in ward 4 temporarily. Ward 4 will still require flow limiters until the long term investment measures are in place but will receive improved flow. In the ultimate configuration this line would be valved off.
f	Norton Tanks to Ward 4	8000m of DN600 DI	New line to provide proper rate of supply to ward 4 and to provide the supply to allow for expansion of the network into the Chegutu expansion area. This line is considered essential to improve supplies to western Norton

<u>Long Term Investment Measures</u>

The focus of the long term investment measures will be to supply adequate water to meet normal demands are reasonable network pressures in all areas of Norton and to supply the increasing demand of the areas of new development in Wards 2, 4 12, 13 and the Chegutu expansion area:

Table 1-2 Long Term Primary and Secondary Distribution Investments

Note Refers	Description of Pipeline	Investment Required	Reason for Investment
Primary Distribution			
a	Norton Tanks to Norton Town Center (Ward 3)	5150m of DN600 DI	The new line feeds Wards 13 and 6 releasing the old line to its design duty of feeding wards 1, 2, 3, 4, 5, 7, 8, 9, 10 and 11. Once this line is in place demand management flow limiters may be removed in all Wards.

Note Refers	Description of Pipeline	Investment Required	Reason for Investment
Secondary Distribution			
c	Extension of existing DN200 on boundary of wards 12 and 13	1665m of DN200 uPVC	Allows the completion of the expansion of these wards
d	New Link between J98_2 in ward 13 and J98_1 in Ward 12	1390m of DN200	Allows for higher flow rates and pressures to ward 12 as it expands to full potential size.
e	New supply line into Ward 4 from the new DN600 in (b) above. J99_3 to J99_2	850m of DN350DI	With the installation of the DN600 there will be sufficient supply for ward 4 but the existing pipework in ward 4 is insufficient to distribute it.
f	New line through ward 4 J99_2 to J99_4	2600m of DN250uPVC	All secondary pipework in Ward 4 is currently undersized.
g	New supply line to the Chegutu expansion area from Ward 4. J99_2 to J99_4	3925m of DN450DI	New development area requires main water supply
h	New secondary supply line in Chegutu extension. J97_4 to J97_3	5760m of DN315	Secondary distribution to new expansion area
i	Extension of the above line, J97_3 to J97_2	2285m of DN250	Secondary distribution to new expansion area

1.5 Storage Reservoirs

1.5.1 Existing Reservoirs

Existing storage reservoirs are located and supplied as shown in Figure 1-1 above. The following reservoirs exist in the town:

Table 1-3 Reservoir Storage - Norton

ID	Location	Capacity
1	Norton Tanks	2 x 5000m^3

Norton Tanks

GIZ Installed Flow Meter into Norton Tanks

1.5.2 Proposed Investment Measures

Short Term Investment Measures

In the short term the existing 10ML of reservoir capacity will have to suffice as demand management methods are still in place. The storage time will drop well below the recommended 24 hours during this period.

Long Term Investment Measures

In the long term it will be necessary to build reservoir volume to get back to the required 24hours of storage. This will require the construction of an additional 26ML of storage at the same reservoir site.

Table 1-4 Proposed Reservoir Storage - Norton

ID	Location	Capacity
1	Norton Tanks	2 x 13,000m^3

1.6 Distribution Network

1.6.1 Distribution zones and DMAs

The following Zones are logically identified from the network layout. Currently poor valves etc. mean that many of the zones are heavily interconnected and do not constitute demand management areas.

Table 1-5: Demand Management Areas

DMA	Source of Supply	Comment
Existing Town Areas		
Ward 1	Off-takes from existing DN600	
Ward 2	Off take half way along existing DN600	-
Ward 3	Off-takes from existing DN600	
Ward 4	Via 2500m long DN160 from Ward 3	Supply line is totally insufficient for demand
Ward 5	DN375 form Ward 3	Low pressures in ward
Ward 6	Supplied out of Ward 5 network	Investments plant to provide separate supply for Ward 6
Ward 7	DN225 from Ward 8	Low pressures in ward
Ward 8	DN300 from Ward 7	Low pressures in ward
Ward 9	DN225 from ward 8	Low pressures in ward
Ward 10	DN225 from Ward 9	Low pressures in ward
Ward 11	DN225 from Ward 9	Low pressures in ward
Ward 12	DN250 from Ward 10	Line and pressures are absolutely insufficient to supply Ward 12 in this way. Ward 12 effectively receives no supply
Ward 13	DN225 from Ward 12	Ward 13 effectively receives no supply
New Supply Areas		
Chegutu Expansion	DN450 from Ward 4	This area has not commenced formal development. Network expansion into the area will be a long term goal.

1.6.2 NRW assessment

Bulk and Block Metering

Bulk and block metering is absent for most of the town.

Distribution Networks

The distribution network has certain parts which are known to be problematic and which will require significant rehabilitation. These tend to be the older areas of the town. The Council staff identified:

- DN300AC line in Wards 8 and 9 suffers regular burst despite low pressures.
- Western part of Ward 5 has GI pipes and very low supply pressures despite bing low lying.

Consumer Metering

The Council Reports that over 50% of consumer meters are faulty or inoperable.

1.6.3 Proposed Investment measures

Short Term Investment Measures – Non Revenue Water

The majority of the effort at non revenue water reduction will take place in the short term investment timeframe. Investment measures proposed are:

- A programme of valve replacement to allow proper demand zoning and management. This covers all valves within the system.
- A programme of installation and or replacement of bulk and bock meters to allow proper accounting for water. This covers all meters within the system
- A programme for the replacement of all consumer meters within the system, domestic and commercial.
- A programme of technical assistance to assist in identification of losses and developing programmes for NRW reduction. This will include detailed network mapping, customer database cleanup and customer awareness programmes.
- Following from improved metering and modelling it will be possible to identify areas of the tertiary distribution system where losses are high and target a programme of pipe and house connection replacement at these areas. At this stage the Council has not identified any specific area as highly problematic.
- Level control valves for reservoirs will be replaced as necessary to prevent losses through overflows.

The use of flow limiters may be required in areas such as Ward 4 where there will remain insufficient supply in the short term.

Short Term Investment Measures – Reticulation Expansion

Short term expansion of the tertiary water supply network will be concentrated in the areas of Norton where developers are installing the networks. This investment will generally not require monetary outlay from the Council as the developers foot the bill. Where expansions occur before reinforcement of the primary distribution system there may be limited water to supply these areas and flow limiting devices may have to be fitted to house connections until more water is available. These areas include:

- Ward 2
- Ward 6
- Ward 12

- Ward 13
- Ward 4
- The Chegutu Expansion Area

Long Term Investment Measures – Non Revenue Water

The long term measures in NRW reduction will largely involve a continuation of the activities in the short term. Specific investments allowed for are:

- Replacement of all bulk and block meters. Experience indicates these have a life not exceeding 8-10 years and those installed in 2015-2017 will therefore need replacement before 2030.
- Replacement of all consumer meters. Experience indicates these have a life not exceeding 8-10 years and those installed in 2015-2017 will therefore need replacement before 2030.

Long Term Investment Measures – Reticulation Expansion

Long term expansion of the tertiary water supply network will be in areas earmarked for growth of Ruwa beyond its current boundaries. This investment will generally not require monetary outlay from the Council as the developers foot the bill. Control of development permits should be exercised to ensure that the Council is not committed to supplying water into these areas before it has adequately provisioned existing areas. The long term expansion areas include:

- Ward 6
- Ward 12
- Ward 13
- The Chegutu Expansion Area

1.7 Emergency Water Supplies

With the considerable water shortages that Ruwa has been experiencing the Council has an ongoing programme to supply water through strategically located water points and boreholes as follows:

- 21 boreholes with hand pumps

Council borehole with Handpump

Well maintained private shallow well. Note the proximity of the shallow well (foreground) to the pit latrine (background)

The Council arranges for the department of health to test the boreholes.

Short Term Investment Measures

Maintenance of the existing emergency facilities.

Long Term Investment Measures

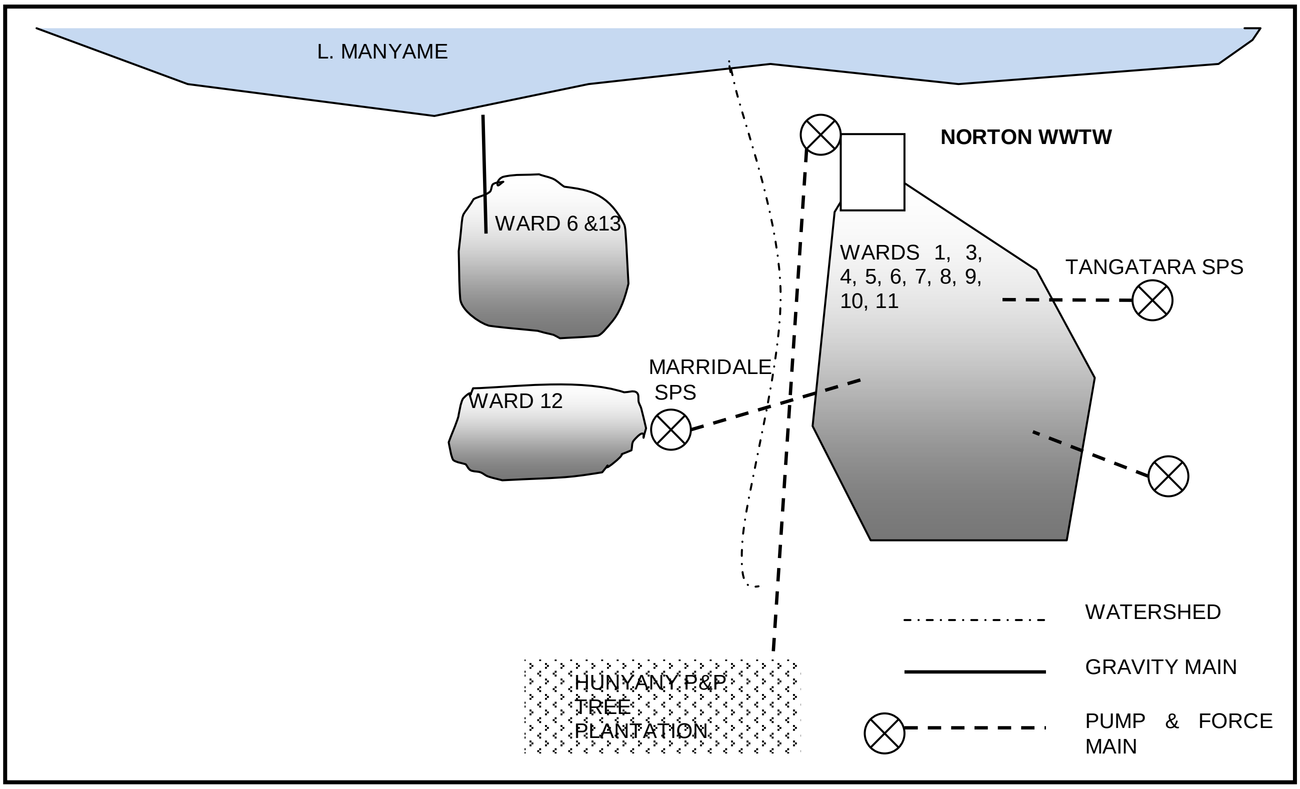
Normalisation of supplies should allow for the decommissioning of the emergency facilities.

2 SEWERAGE

2.1 Sewage Sub Catchments

Originally there was just one main sewerage catchment in Norton with two small sub-catchments supplied by small sewage pump stations. All wastewater was conveyed to the Town's wastewater treatment works on a single location near lake Manyame. Recent expansion in the town to the west has led to development outside of this sewage catchment and consideration must now be given to strategically planning the future sewerage catchments of the town.

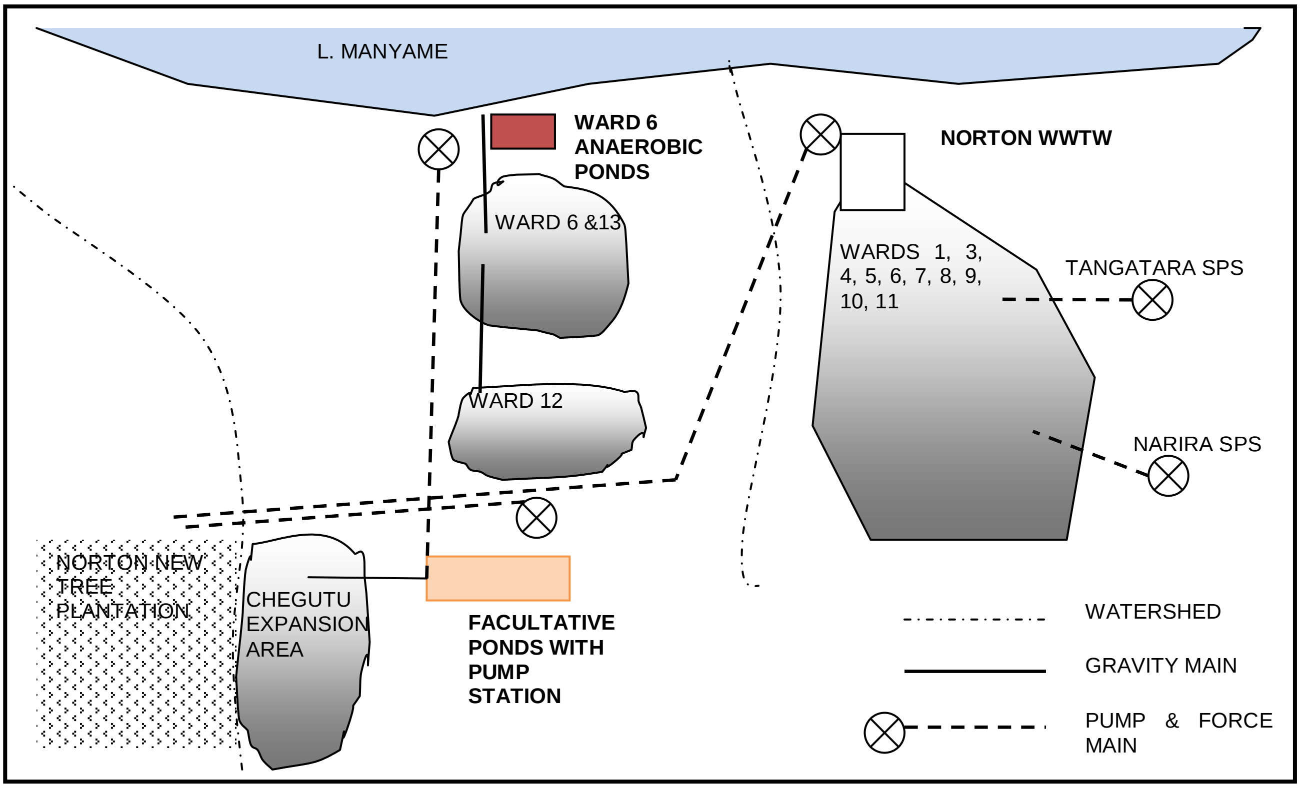
Figure 2-1 Norton Existing Sewerage Catchments Schematic



The schematic above shows the intended function of the Norton sewerage system. The main current concerns are that the Maridale SPS is not equipped with pumps and that Ward 6 and 13 have a sewerage system which is blanked off and has neither ponds nor pump station to discharge to.

A system is required which collects from all areas that are currently sewered and that the Council intends to provide with sewerage services in future. The proposed system of sewerage catchments for Norton is shown in the figure below.

Figure 2-2 Norton Proposed Sewerage Catchments Schematic



In the revised system those wards which originally fed into the Norton WWTW will continue to do so. Newly developing areas in Ward 12, 13 and 6 will drain by gravity to a WWTW in Ward 6 using anaerobic primary treatment only. Land is available in Ward 6 for this.

As there is a shortage of space in Ward 6 which prevents the location of facultative ponds there, these will be placed at a location where they can serve the Chegutu expansion by gravity.

The effluent from all of the existing WWTW and the facultative ponds will be pumped to a new irrigation area, located outside of the Manyame Catchment, on land west of the Chegutu district expansion area. This report has not recommended the refurbishment of the existing force main and irrigation system for the existing WWTW because these facilities are not controlled by the Norton Council. However a detailed feasibility study may revisit this decision and consider this refurbishment if proper control of the system by Norton can be guaranteed.

The system is more complex than in other towns but has the following advantages over other systems considered:

- No sewage will be able to drain into Lake Manyame without at least receiving primary treatment, even if sewage pump stations fail.
- BNR Treatment and its associated high energy costs and maintenance burden is avoided.
- Screened and settled sewage is pumped which is lower maintenance than raw sewage pumping

- Norton will own the irrigation area and not be reliant on other parties to manage it.

2.2 Sewer Reticulation System

Norton's sewer system varies in age but is generally considered to be in reasonable condition with no areas reported as causing significant maintenance problems. However general rehabilitation works will be expected on the system including targeted line replacements and manhole rehabilitation and cover programmes.

2.3 Transmission Sewers

The current sewage transmission system meets current hydraulic requirements and according to the Council is reliable and does not present an undue maintenance burden. The system has been modelled assuming normalized water supplies to meet demands and in areas of existing development is adequate.

In Figure 2-2 above the proposed sewerage catchment development is presented. If this is followed then all existing sewers have the capacity needed for the long term duty.

For Norton, it is not planned that any expansion to the existing sewerage reticulation system will be carried out in the short term (See Section 2.6 Sewerage Boundary). Therefore there are no proposed short term measures to expand the main sewage transmission.

<u>Long Term Investment Measures</u>

In the long term Norton's water shortages should be resolved an it is intended to remove flow limiting devices as significantly increased supply volumes become available with the construction of the two new DN600 supply lines into Norton as described above. At this stage it will be necessary to greatly expand the sewerage systems in Wards 6, 12 and in the new Chegutu Expansion area. The following lines are proposed. Manhole numbers given refer to Figure 7-13:

Table 2-1 Long Term Transmission Sewer Investments

ID	Model Nodes	Investment Required	Reason for Investment
Existing Mains Upgrades/Augmentation			
1	MH03 to MH04	390m of DN450 Steel on Existing Pipe Bridge	Original pipe was replaced with new AC. The new line is starting to show signs of similar failure (longitudinal cracking). It will need to be replaced and steel is preferred.
New Mains			
1	MH49-MH50-MH51	1650m of DN230	Western expansion of sewerage boundary in ward 6
2	MH51-MH52-MH48 (new Ward 6 WWTW)	1440m of DN315	Western expansion of sewerage boundary in ward 6

ID	Model Nodes	Investment Required	Reason for Investment
3	MH053-MH54-MH55-MH47	2420m of DN200	Western expansion of sewerage boundary in ward 6
4	MH24-MH45-MH46-MH47	2700m of DN315	Western expansion of sewerage boundary in ward 6
5	MH47-MH48 (new Ward 6 WWTW)	525m of DN350	Western expansion of sewerage boundary in ward 6, 12 and 13
6	MH59-MH61-MH60	1810m of DN200	Chegutu District Expansion Area
7	MH56-MH45-MH57-MH58	2709m of DN200	Chegutu District Expansion Area
8	MH58-MH60	1200 of DN315	Chegutu District Expansion Area
9	MH60-MH62 (new facultative ponds)	1200 of DN315	Chegutu District Expansion Area outfall line to treatment works

2.4 Sewage Pump Stations

2.4.1 Existing Sewage Pump Station Condition

There are three sewage pump stations in Norton as follows:

Tangatara SPS

Tangatara SPS handles flows from a few houses in the Twin Lakes Area of Norton. Peak flows are <10l/s. The station pumps into a 785m long AC force main 150mm diameter.

The SPS is not enclosed in a fenced area and its pump is considered by the Council to be unreliable as it is a temporary unit which is also used for many other duties. The 1AC force main suffers regular bursts and should be replaced.

There are no standby power facilities and the station overflows at times of power failure.

Details of the pumping equipment in the station was not available.

Tangatara Sewage Pumping Station

Sewage Overflow from Burst Force Main

Narira SPS

Narira SPS handles flows from a few houses in the Narira Area of Norton. Peak flows are <10l/s. The station pumps into a 500m long AC force main 150mm diameter.

The SPS is enclosed in a fenced area and its pump and force main are reliable.

There are no standby power facilities and the station overflows at times of power failure. Large informal ponds have been dug to capture these overflows.

Details of the pumping equipment in the station was not available.

Narira Sewage Pumping Station

Maridale SPS

The Maridale SPS was built by a private developer to handles flows from the development in Ward 12. Modelled flows are 35l/second. It is however intended that this station will be abandoned in the long term and will therefore only continue to operate in the short term.

Currently that station does not function because it has no pumps installed. No problems are reported with the Force Main which discharges to a manhole in Ward 9 from where sewage gravitates to the Norton WWTW.

The SPS is not enclosed in a fenced area and there are no standby power facilities.

As there is almost no water supplied to this area overflows of sewage are minimal but as soon as water returns these will be serious.

Maridale Sewage Pumping Station

2.4.2 Proposed Investment Measures

<u>Short Term Investment Measures</u>

The short term investment measures are as follows:

Tangatara SPS

- Enclose the site with a fence
- Clean up the damage from spills
- Replace 785m of DN150 AC force main with DN150 HDPE with 'electrofusion' joints
- Replace the existing pump with one duty/ one standby pump suited to the actual duty of the station and permanently installed. All electrical equipment should be replaced at the same time.
- Provide a standby generator

Table 2-2 Pump Station Data – Tangatara SPS New Pumps

Characteristic	Unit	Value
Pumps to		MH037a
No. of Pumps	No.	2 (Duty/ Standby)
Pumps Make and Model		Sewage Submersible Flygt or similar
Coupling		Submersible
Station Elevation	m	1360
Discharge Elevation	m	1367
Nominal Static Head	m	7
Rising Main Length	m	785
Rising Main Nominal Diameter	mm	160
Rising main material		HDPE PN10

Narira SPS

- Provide a standby generator

Table 2-3 Pump Station Data – Maridale SPS New Pumps

Characteristic	Unit	Value
Pumps to		MH032
No. of Pumps	No.	2 (Duty/ Standby)
Pumps Make and Model		Sewage Submersible Flygt or similar
Coupling		Submersible
Station Elevation	m	1373
Discharge Elevation	m	1375
Nominal Static Head	m	2
Rising Main Length	m	970
Rising Main Nominal Diameter	mm	225
Rising main material		AC

<u>Long Term Investment Measures</u>

In the long term there will be no Sewage Pump Stations in Ruwa.

2.5 Sewage Treatment

2.5.1 Existing Sewage Treatment Facilities

Norton has two sewage treatment plants at the same location known as the ‘Old Works’ and the ‘New Works’.

<u>Norton Old Works</u>

The Norton Old Works consists of a traditional treatment process with the following components:

- Intake works with coarse and fine bar screens, grit screening and flow measuring and flow diversion facilities.
- 2 No. Primary sewage clarifiers with bridge mounted scrapers
- 2No. Biological trickling filters
- 2No. Humus tanks
- Holding ponds for treated wastewater awaiting pumping to disposal
- Disposal to a forest plantation owned by Hunyani Pulp and Paper but currently leased out.
- Drying beds for clarifier sludge.

In addition to the above, non treatment components include:

- A pump station with the following functions;
  - Pumping of clarified wastewater to the filters
  - Recirculation to the filters
  - Pumping of sludge to the drying beds
- High lift pump station at the ponds serving the new and old works
- 7.8km AC main to the forest plantation serving the new and old works

<u>Norton New Works</u>

The Norton New Works consists of a traditional treatment process with the following components:

- Intake works with coarse and fine bar screens, grit screening and flow measuring and flow diversion facilities.
- 4 No. Primary sewage clarifiers of the 'Dortmund' upflow type, without scrapers. 2 of the four are generally finished but not yet commissioned
- 3No. Biological trickling filters. Only one is commissioned and two are partly constructed.
- 6No. Humus tanks of the dortmund type. Three are commissioned and three are generally finished but not commissioned.
- Sludge drying beds
- A partly completed digester. Construction quality on this is poor and the potential to complete it dubious.
- Disposal system is the same as for the old works.

In addition to the above, non treatment components include:

- A pump station with the following functions;
  - Pumping of primary clarified wastewater to the trickling filter distribution box

- o Pumping of sludge to the drying beds

2.5.2 Existing Works Capacity

Calculations of the capacity of the new and old works have been carried out as part of the GIZ exercise which looked at, but eventually did not proceed with, rehabilitation of the works. The following capacities were provided based on actual sewage characteristics at the plant inflow:

<u>Old Works</u>

Limiting component is the Biological Trickling Filters with 3.2MLD capacity. Clarifier capacity is 6.6MLD. Works nominal capacity is 3.2MLD.

<u>New Works</u>

Limiting component is the Primary Clarifiers with 2.2MLD capacity in the two existing clarifies which can be economically raised to 4.4MD by commissioning the other two units. Filter capacity of the one complete unit is 4.7MLD. Therefore completion of the other two units is not required. The large filter capacity of this plant arises from design at a time when Norton had significant industry producing high COD wastewater.

<u>Combined Works Capacity</u>

The combined nominal capacity of the works is around 7.2MLD.

<u>Holding Ponds</u>

The existing holding ponds have an allowable loading rate of around 300kg BOD per day, equivalent to a flow of 2.4MLD from treated sewage from the works. Thus with any flow above this the pond will be overloaded and will remain anaerobic throughout.

2.5.3 Investment Measures

<u>Short Term Investment Measures</u>

In the short term it is proposed that the Norton Old and New Sewage Treatment works be fully rehabilitated as these will remain integral to sewage treatment in Norton in the future. The rehabilitation measures shall include:

Old Works

- Intake
  - o Replace flow measurement devices
  - o Provide grit drying slabs and skip from screenings
- 2 No. Primary sewage clarifiers
  - o Mechanical rehabilitation and
  - o replacement of corroded steelwork
- 2No. Biological trickling filters
  - o Remove, clean and replace media
  - o Reconstruct collapsed wall

  - Renew distributor arms
- 4No. Humus tanks
  - Mechanical rehabilitation and
  - replacement of corroded steelwork
- Holding ponds for treated wastewater awaiting pumping to disposal
  - Clear vegetation from embankments
  - Clear vegetation from pond and dredge sediment
  - Fill low areas of embankment where overflow occurs
- Drying beds for clarifier sludge.
  - Clean the drying beds
  - Replace sections of collapsed wall
  - Replace sludge carts

In addition to the above, non treatment components include:

- Pumps to the filters:
  - Replace 1 duty and 1 standby pump
  - Service all electrical equipment
- New pumps as described below

Norton New Works

The Norton New Works consists of a traditional treatment process with the following components:

- Intake works
  - Replace flow measurement devices
  - Provide grit drying slabs and skip from screenings
- 4 No. Primary sewage clarifiers of the 'Dortmund' upflow type, without scrapers. 2 of the four are generally finished but not yet commissioned
  - Complete commissioning of 2 clarifiers
- 3No. Biological trickling filters. Only one is commissioned and two are partly constructed.
  - No works
- 6No. Humus tanks. Three are commissioned and three are generally finished but not commissioned.
  - No Works
- Sludge drying beds
  - Replace sludge carts

- Digester
    - o Construct a sludge digester for the sludge produced by the new and old works
- New treated effluent pump station and force main
    - o Install new treated effluent pumps and force main discharging at the proposed new irrigation site with characteristics as follows:

Table 2-4 Pump Station Data – New Norton WWTW Effluent Pump Station

Characteristic	Unit	Value
Pumps to		Irrigation Disposal Site at MH066
No. of Pumps	No.	3 (2 Duty/ 1 Standby)
Duty Flow (Station)	m3/hr	325
Station Elevation	m	1352
Discharge Elevation	m	1392
Nominal Static Head	m	40
Rising Main Length	m	11,200
Rising Main Nominal Diameter	mm	315
Rising main material		HDPE PN10

Wastewater Disposal Area

It is proposed to provide Norton with a new wastewater disposal area. This should be outside of the Manyame catchment where there is land available and a promising area has been located at the location of MH 66 on the mapping. This area is within the Chegutu expansion area but outside of the Town’s proposed Sewerage Boundary.

At this location it is proposed that Norton shall establish 170Ha of forest plantation onto which its wastewater can be irrigated. The entire 170Ha shall be established as a short term measure as the effluent from the existing WWTW can be disposed of on 170Ha without the need for any storage pond to allow for lower application rates during the rainy season.

In the long term the proposed new pond system in Norton will also discharge to this irrigation area but no additional land will be required as the ponds will provide significant rainy season storage.

<u>Long Term Investment Measures</u>

Norton WWTW

Long term investment measures will involve the periodic maintenance of all mechanical equipment at the works.

Ward 6 WWTW

As a long term measure it is proposed to construct an anaerobic pond at ward 6 for the purpose of primary treatment of wastewater arising from Wards 12, 13 and 6. Peak and average inflow to this works are predicted at 9.5 and 3.8MLD respectively. The works to be constructed will consist:

- Inlet works with coarse and fine screens and grit screening as well as screening disposal
- Anaerobic pond with 2 streams in parallel of 3 days retention time. Each pond should therefore have volume around 6,000m3.
- Pump station and force main with characteristics described below:

Table 2-5 Pump Station Data – Ward 6 Anaerobic Pond Pump Station

Characteristic	Unit	Value
Pumps to		Facultative Ponds
No. of Pumps	No.	3 (2 Duty/ 1 Standby)
Duty Flow (Station)	m^3/hr	400
Station Elevation	m	1350
Discharge Elevation	m	1368
Nominal Static Head	m	18
Rising Main Length	m	6600
Rising Main Nominal Diameter	mm	315
Rising main material		HDPE PN10

Facultative Ponds Near Chegutu Expansion Area

As a long term measure it is proposed to construct an facultative ponds at a location where the Chegutu Expansion area can gravitate to the ponds. This location is between the Chegutu Expansion and Ward 12. The ponds shall provide treatment for wastewater from the Chegutu Expansion area and secondary treatment for the wastewater from the Ward 6 Anaerobic Ponds. The works to be constructed will consist:

- Inlet works with coarse and fine screens and grit screening as well as screening disposal
- Anaerobic pond with 2 streams in parallel of 3 days retention time. Each pond should therefore have volume around 5,000m3 as anaerobic treatment is only required for wastewater from the Chegutu Expansion Area.
- Facultative pond for all wastewater (approximately 9MLD). The pond will require retention time of 20 days and approximate volume 180,000m3. Typical dimensions would be 600 x 300m which could be subdivided into two parallel streams.
- Pump station and force main with characteristics described below:

Table 2-6 Pump Station Data – Facultative Pond Pump Station

Characteristic	Unit	Value
Pumps to		Facultative Ponds
No. of Pumps	No.	3 (2 Duty/ 1 Standby)
Duty Flow (Station)	m3/hr	435 (designed for average WWF)
Station Elevation	m	1368
Discharge Elevation	m	1392
Nominal Static Head	m	24
Rising Main Length	m	6300
Rising Main Nominal Diameter	mm	315
Rising main material		HDPE PN10

2.6 Sewerage Boundary

The concept of a sewerage boundary has been proposed. This forms a boundary outside which the town will not provide waterborne sanitation (potable water will generally be supplied). In the case of Ruwa the following Sewerage Boundaries are proposed:

Short Term

In the short term the sewage boundary shall be the extent of the existing sewered catchments in all wards except Wards 13 and 6. To bring the small area of these two already developed to within the boundary would require significant investments in new WWTW which cannot be justified.

Long Term

In the long term the construction of the new Anaerobic ponds in Ward 6 and the Facultative ponds between the Chegutu Expansion Area and Ward 12 will allow for a significant increase in the area within the Sewage Boundary. This will therefore be increased to encompass all areas that are able to gravitate to the existing works, the new Ward 6 Anaerobic Ponds or the Facultative Ponds. Approximately 50% of the proposed Chegutu Expansion Area will fall outside of this sewerage boundary.

2.7 On- Site Sanitation Support

Many areas of Norton will remain without waterborne sanitation, even in the long term. Sewage system investments will take many years to implement and some area will remain outside of the sanitation boundary for the town even in the long term. In these areas support must be given for the proper use of on site sewage disposal and treatment systems. Support will include:

- In areas of high water table where pit latrines and pour flush latrines are not practical, communities will need support to deploy and manage urine separation composting toilets. This type of toilet offers a good solution in these areas but as they require a more significant structure than pits or pour flush toilets they are often unaffordable. In addition users must be trained in their proper use and communities must find a source of ash which has to be added to the composting solids and is not readily available in Harare where people do not cook on wood stoves.

- In other areas pour flush toilets are clearly the preference of the householders and are seen to be installed where ever sufficient water is available. These offer a cheap alternative to a full waterborne solution with significant benefits over pit latrines. Pour flush systems should only be encouraged in areas where water supply is piped in. Support to communities wishing to use this type of toilet may include:
    - Improvements to water supply such that the householders have sufficient water to operate pour flush systems
    - Training of builders in good practices for construction of pour flush toilets and soakaways.
    - Provision of subsidised components such as cover slabs and squat pans to improve the affordability of pour flush systems
- Only where water supplies are very scarce will pit latrines be favoured by house holders. In future, reliance on pit latrines should therefore be limited to areas where no formal water supply system is in place. Support to communities on pit latrines may include:
    - Training of builders in good practices for construction of pit latrines.
    - Provision of subsidised components such as cover slabs, squat pans and ventilation pipes to improve the affordability of quality pit latrine systems
    - Training of householders in methods of maintaining the toilets and preventing the breeding of insects in the toilets.

3 ON-GOING WORKS

3.1 Norton Water supply Project

When supply difficulties first arouse with the Morton Jaffray Supply Norton commenced a project to bring Raw Water from Lake Chivero to their own water treatment works, from where it was to be pumped to the tanks. The project included the following components:

1. An intake on Lake Chivero based on the re-use of an existing intake tower. This tower has been identified as problematic because it has a fixed depth intake which cannot be moved to access the layers of best water and it is located within a bay that wind tends to fill will weed from other areas of the lake.
2. A raw water pump station and pipeline 3km long
3. A 20MLD FC Reactor type water treatment plant.
4. A treated water pump station and pipeline 1500m to the Norton tanks

Money for the project was provided intermittently and at the time it was suspended the main works were the partial completion of the FC reactor WTW. None of the pump stations or pipework had been completed.

A review of the project was carried out by GIZ with a view to a decision on whether it would be prudent to fund the completion of the works. GIZ concluded that the costs would be very high and that the raw water source quality was very low and therefore a risk to success and decided not to finance completion. The current review concurs with the GIZ findings and therefore we have recommended an increase in supplies to Norton from Morton Jaffray WTW as a more efficient investment than the completion of Norton's independent water supply.

Partially Complete FC Reactor

3.2 GIZ Financing

GIZ are funding some Non Revenue Water activities in Norton including a current programme of valve replacement and bulk and block metering.

APPENDIX 4.5: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT - RUWA

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

APPENDIX 5.4: WATER AND SEWERAGE INFRASTRUCTURE ASSESSMENT REPORT

RUWA

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1 WATER SUPPLY

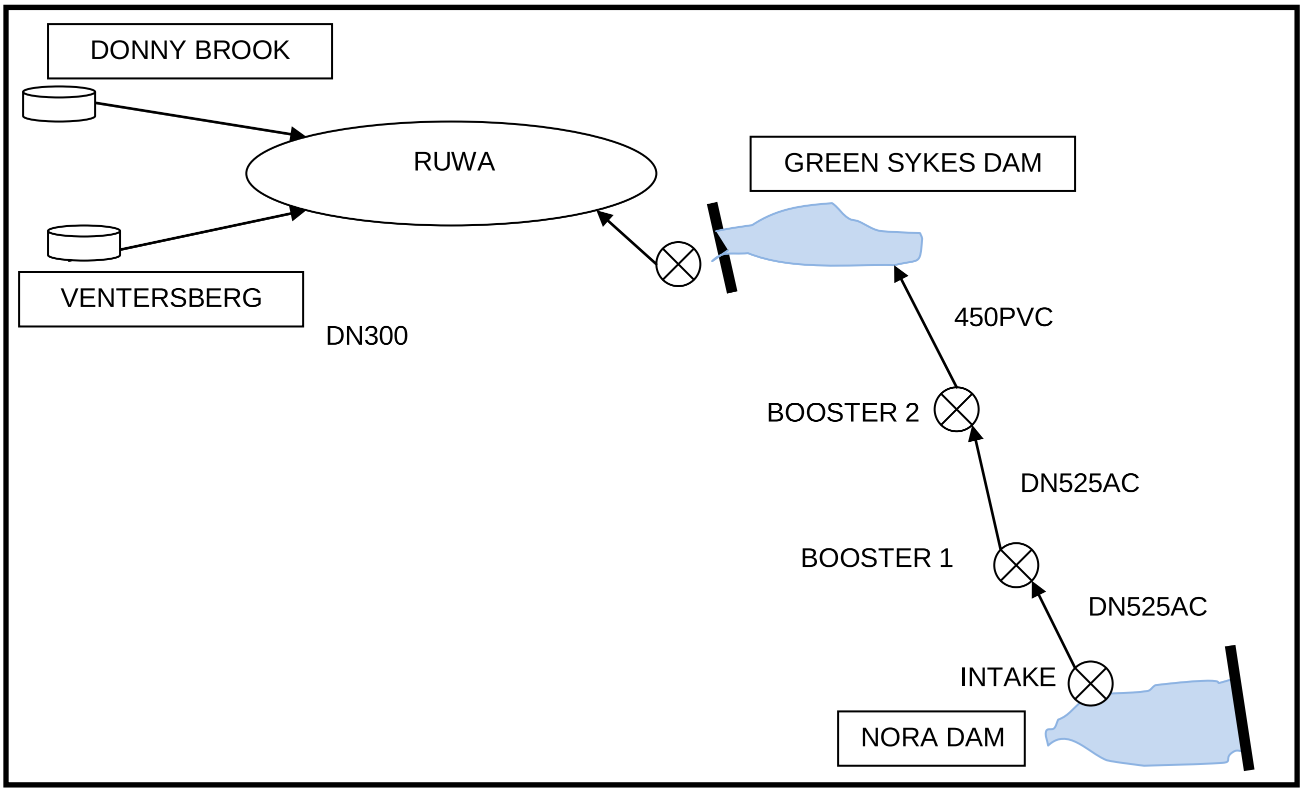
1.1 Water Sources

1.1.1 Description of water sources

Ruwa currently obtains water from the following sources:

- Nora Dam via DN450 uPVC/ DN515AC supply line which feeds into Green Sykes dam on the outskirts of the town. This has been constructed as part of a 25 year Build Operate Transfer (BOT) scheme.
- City of Harare (treated water supply) via:
    - DN525 supply line from Donny Brook tanks to the ZIMRE estate and onwards into the supply network for Ruwa
    - DN350 supply line from the Ventersberg tanks which feeds the Mutare Road Ground Tanks via a booster station on the western outskirts of Ruwa.
- Green Sykes dam on the outskirts of the town which is connected to the WTW via DN515 AC supply line.

Figure 1-1 Ruwa Water Supplies



1.1.2 Yield assessment

The supplies from City of Harare have become increasingly unreliable and are now virtually non- existent. Thus over the past ten years Ruwa has focused on its project to bring the town's water needs from Nora dam, some 15.5km southeast of the town. This project has been largely completed in 2014.

The ZINWA yield assessment for the 'Nora Pick up Weir' gives a 4% yield of around 10,000 ML per annum or 27MLD. Ruwa have installed a raw water system capable of transferring 21ML per day (24 hour pumping).

1.1.3 Raw Water Pump Stations and Intakes

<u>Intakes</u>

There are two raw water intakes for the town, at Nora Dam and at Green Sykes Dam as shown in the figure above. The characteristics of the stations are given in the tables below;

Table 1-1 Pump Station Data – Green Sykes Raw Water PS

Characteristic	Unit	Value
No. of Pumps	No.	3No. Pump locations 2No. Duty pumps 2No. Installed pumps at time of inspection
Pumps Make and Model		KSB ETA125/250 Full Size Impellers
Motors Make and Model		37kW
Coupling		Belt drive
Station Elevation	m	1550
Discharge Elevation	m	1582
Nominal Static Head	m	32
Rising Main Length	m	3850
Rising Main Nominal Diameter	mm	525
Rising main material		Asbestos Cement

Green Sykes Raw Water Pump Station

Green Sykes Raw Water Pump and pipework

Table 1-2 Pump Station Data – Nora Intake PS

Characteristic	Unit	Value
Pumps to		Raw Water Booster No. 1
No. of Pumps	No.	3No
Pumps Make and Model		KSB Omega 200-760A Rated 437m3/hr each
Motors Make and Model		250kW 4P
Coupling		Direct
Station Elevation	m	1390
Discharge Elevation	m	1463
Nominal Static Head	m	73
Rising Main Length	m	3500
Rising Main Nominal Diameter	mm	525
Rising main material		Asbestos Cement

Table 1-3 Pump Station Data – Nora Raw Water Booster No. 1

Characteristic	Unit	Value
Pumps to		Raw Water Booster No. 2
No. of Pumps	No.	3No
Pumps Make and Model		KSB Omega 200-760A Rated 437m^3/hr each
Motors Make and Model		250kW 4P
Coupling		Direct
Station Elevation	m	1463
Discharge Elevation	m	1562
Nominal Static Head	m	99
Rising Main Length	m	600
Rising Main Nominal Diameter	mm	525
Rising main material		Asbestos Cement

Table 1-4 Pump Station Data – Nora Raw Water Booster No. 2

Characteristic	Unit	Value
Pumps to		Green Sykes Dam
No. of Pumps	No.	3No
Pumps Make and Model		KSB Omega 150-650A
Motors Make and Model		185kW 4P
Coupling		Direct

Station Elevation	m	1562
Discharge Elevation	m	1605 high point on line at 1900m from pump station 1560 elevation of discharge point
Nominal Static Head	m	-2
Rising Main Length	m	9700
Rising Main Nominal Diameter	mm	450
Rising main material		uPVC

1.1.4 Raw Water Transmission Mains

Raw water transmission mains are as indicated in Figure 1-1 and in the tables above. The project for the Raw Water Supply was completed only in 2014 and so these lines are only just commissioned and in good condition. The capacity of the lines is adequate for the ultimate capacity of the raw water source.

1.1.5 Raw Water Investment Measures

The raw water system is recently completed and adequately sized and no investment measures are proposed beyond the periodic maintenance of mechanical plant which will not be required until the implementation of long term investment measures.

1.2 Ruwa WTW

1.2.1 Works Description

The Ruwa WTW is of the ‘FC Reactor’ type. This is a proprietary design of ‘Hydro Project Zimbabwe’ of Bulawayo.

The FC reactor contains two functional units within a single vessel constructed of either steel of concrete. The base of unit functions as an upward flow clari-floculator and above this there is a filter which achieves filtration through a floating bed media composed of hardened kaylite pellets. Filtration is upwards and backwash is downwards, achieved by opening a valve at the base of the unit.. The system operates entirely under gravity and requires no circulation or backwash pumps.

The FC reactor plant is used in many locations throughout Zimbabwe and the Ruwa Engineering staff are very happy with the performance of the units installed.

There are two FC reactor units on the site:

1. The original 2.5MLD unit fabricated steel steel unit
2. A more recent 5MLD reinforced concrete unit

Works was commenced on a 4000m3 clear water reservoir at the site of the WTW but this has not been completed. The FC reactor units therefore drain directly into supply.

1.2.2 WTW Condition

The works is generally in good condition although the following issues were identified:

1. Corrosion of the 2.5ML steel FC reactor vessel.

2. Chemical dosing arrangement is not functional and requires overhaul. Filter beds are losing hardened kaylite media which finds its way into supply and clogs supply meters.
3. Sludge drying bed construction is incomplete
4. Treated water reservoir is incomplete.

Ruwa WTW: FC Reactor Units 2.5MLD (left) and 5MLD (right)

Ruwa WTW: Broken Down Chemical Dosing

1.2.3 WTW Investment Measures

<u>Short Term Investment Measures</u>

1. Expand the capacity of the Works to 20MLD with the construction of a new 12.5MLD FC Reactor unit.
2. Strip down and apply internal and external corrosion protection to the steel 2.5MLD FC reactor unit.
3. General servicing/ rehabilitation of both FC reactor units is required, including:
    a. Attend to seals which are allowing filter media to escape into supply
    b. Install strainers on discharge pipework to catch any filter media that does escape the reactor.
    c. Service all valves
    d. Improve safety and handrailing on walkways and ladders
4. Replace the existing chemical mixing and dosing facilities. As this is the only, very small power requirement of the plant, it is recommended that the current system be replaced with a solar powered dosing system. With a solar power source it will be possible to increase the automation of the chemical dosing system.
5. Complete the 4000m3 circular clear water reservoir and all connecting pipework. The works currently operate at low flow rate, discharging directly into supply. The 4000m3 clear water reservoir should be constructed to balance outflows and allow the plant to optimize production.

6. Complete the construction of the sludge drying beds. The works are currently operating at low rate but when 20MLD of treatment capacity is on site the drying beds will be essential.

Long Term Investment Measures

No further expansion of the works is expected in the long term as at that time the 'Kunzvi' project will be on line. Kunzvi will deliver its treated water to Donny Brook reservoirs which already have a high capacity link to Ruwa. However the works will be maintained at 20MLD capacity even after commissioning of Kunzvi.

Long term investment measures will be limited to repair and rehabilitation of mechanical plant, corrosion protection and servicing of the FC reactor units and the dosing equipment.

1.3 Booster Pump Stations

1.3.1 Existing System

The system currently contains one booster pump station, split into two parts, located at the Mutare Road reservoir site.

Table 1-5 Pump Station Data – Mutare Road Booster PS – Old Pump Room

Characteristic	Unit	Value
Pumps to		180m3 Elevated Tanks
No. of Pumps	No.	3
Pumps Make and Model		Cochrane Stork Cen 80-250 Impeller Dia 245mm
Motors Make and Model		7.5kW 380V
Coupling		Direct drive
Station Elevation	m	1560
Discharge Elevation	m	1573
Nominal Static Head	m	13m
Rising Main Length	m	20m
Rising Main Nominal Diameter	mm	300
Rising main material		Steel

Table 1-6 Pump Station Data – Mutare Road Booster PS – New Pump Room

Characteristic	Unit	Value
Pumps to		1,000m3 New Damofalls Tanks(but with offtakes to supply)
No. of Pumps	No.	3
Pumps Make and Model		not available
Motors Make and Model		50kW
Coupling		Direct drive
Station Elevation	m	1560
Discharge Elevation	m	1575
Nominal Static Head	m	15
Rising Main Length	m	1350
Rising Main Nominal Diameter	mm	300
Rising main material		Steel

Mutare Road P/Stn: Existing Pumps to Elevated Tanks

Mutare Road P/Stn: Works underway to new pumps to Damofalls

1.3.2 Proposed Investment Measures

Modelling of the Ruwa system first investigated the possibility of supplying all areas of the town using gravity supplies and reasonably sized elevated tanks. Unfortunately the rather flat terrain in Ruwa is not conducive to such a system with the design resulting in oversized pipes with very low velocities and uneconomically high elevated tanks.

Therefore as water volumes normalize it will be necessary to introduce booster pumping into the network to maintain network pressures. The following investments in booster pumping will be required:

Short Term Investment Measures

The additional water supply availability in Ruwa inn the short term will require the construction or reconfiguration of the booster stations as follows:

Table 1-7 Long Booster Station Investment Measures

Pump Station Location	Supplies to	Type of Pumping	Capacity
Ruwa WTW	Mutare Road Ground Reservoir	Water Transfer. Constant Speed Pumping	230l/s @25m head
	Wards 9, Damofalls, New Expansions North and East of Ruwa	Booster pumping. Variable speed pumping preferred	400l/s @25m head
Mutare Road Reservoirs	Wards 1 to 7 and new expansion areas southeast, south and southwest of Ruwa	Booster pumping. Variable speed pumping preferred	455l/s @20m head

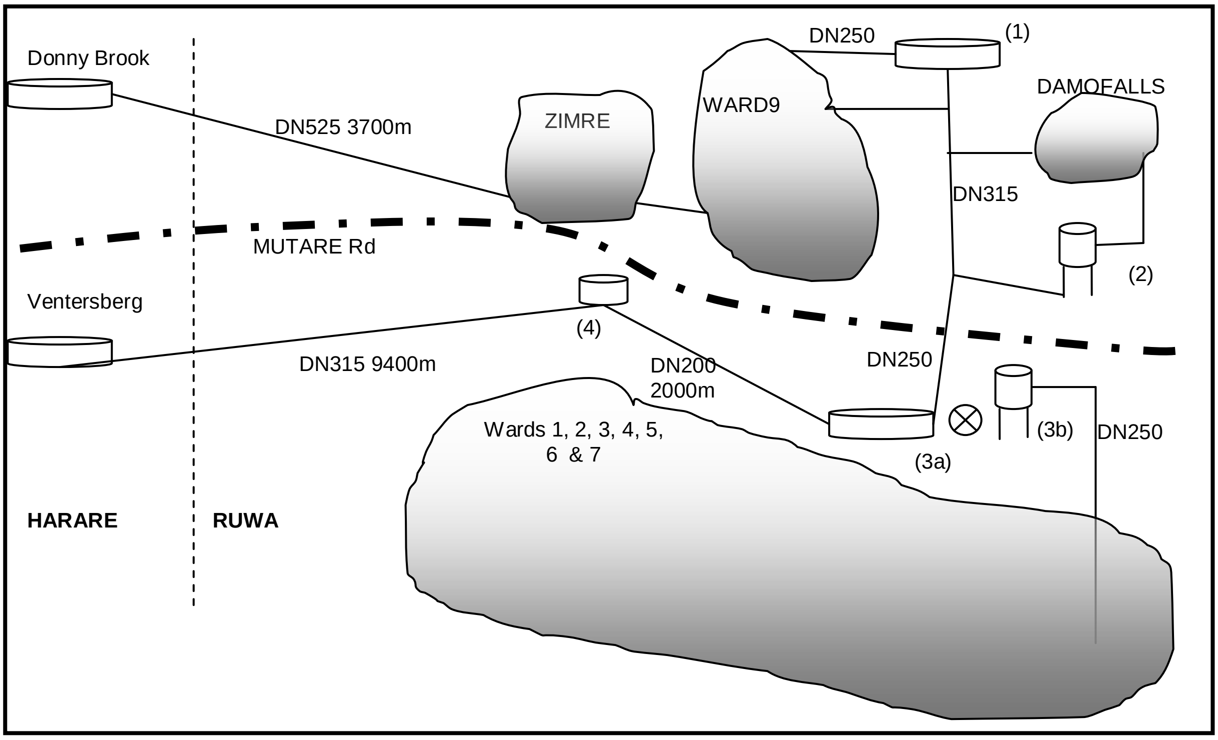
Long Term Investment Measures

Long term investment measures require only the periodic maintenance of the pumping equipment.

1.4 Transmission System

Figure 1-2 below shows the transmission system for Ruwa, in schematic form:

Figure 1-2 Ruwa Transmission and Storage Schematic - Existing



1.4.1 Existing Transmission System Description

Three sources of treated water are available to Ruwa when all things are functioning normally. These are the two City of Harare reservoirs at Ventersberg and Donny Brook and the Ruwa WTW.

The City of Harare Supplies are as follows:

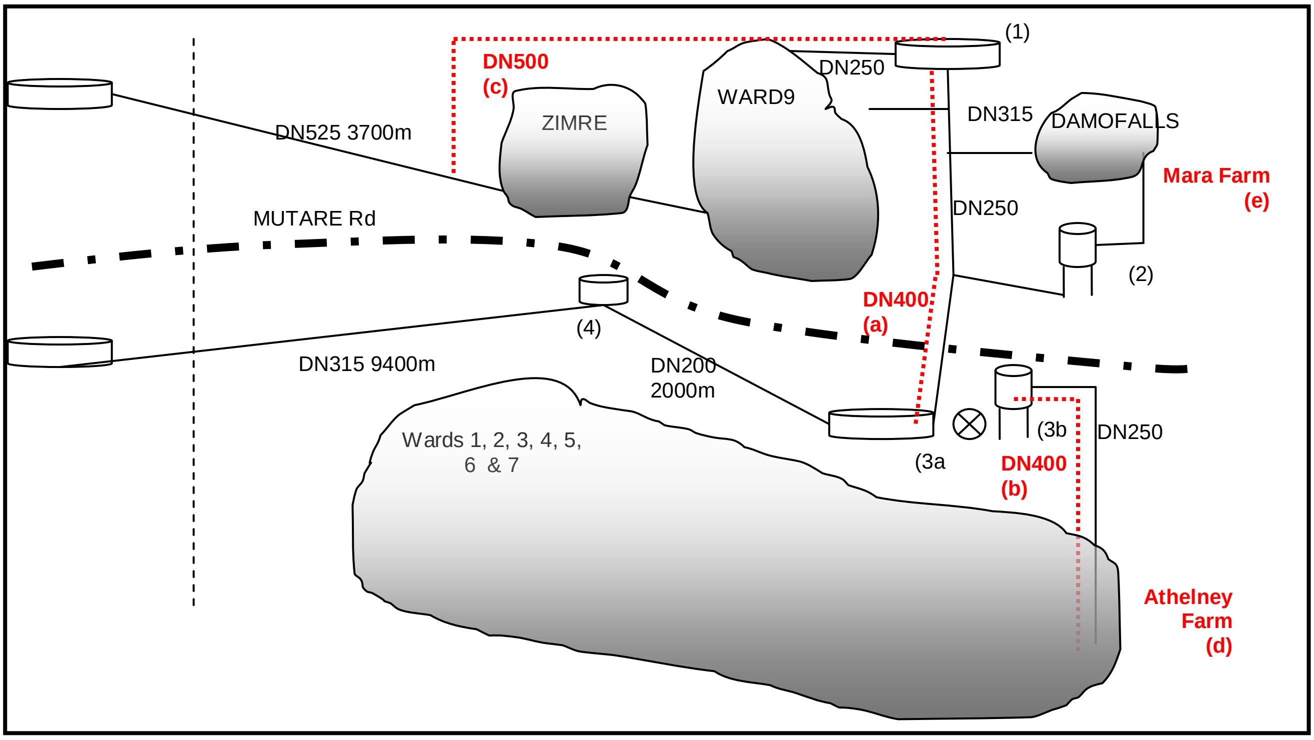
- The original supply to Ruwa was a DN315 line from Ventersberg through a booster at Sunway City and then Via a DN200 Line to Ruwa's Mutare Road Tanks.
- Later a DN525 was added to supply the ZIMRE area without any intervening storage.
- Currently no supply is received from Ventersberg and little from Donny Brook.
- There are no reported problems with the pipelines themselves.

The supply from Ruwa WTW Operates as Follows:

- At the water treatment works there are a number of connections directly into the supply network of the northern part of Ward 9.
- A DN315 AC line runs south with offtakes to Ward 9 and Damofalls before reducing to DN250 and terminating at the Mutare Road Ground Tanks
- From Mutare Road Ground Tanks a single DN250 goes into supply in the southern area of the town with multiple off-takes.

1.4.2 Investment Measures

Figure 1-3 Ruwa Transmission and Storage Schematic - Proposed



Short Term Investment Measures

The Ruwa Transmission system is to be reinforced in the short term to the extent necessary to properly distribute the water that will become available from the expanded WTW. This requires additional capacity on a north south axis through the town allowing higher feed rate from the Ruwa WTW to Mutare Tanks and from Mutare Tanks to the expansion areas in the south of Ruwa in Wards 5 and 7.

Table 1-8 Short Term Primary and Secondary Distribution Investments

Note Refers	Description of Pipeline	Investment Required	Reason for Investment
Transmission/ Primary Distribution			
a	Ruwa WTW to Mutare Rd Tanks.	4650m DN400 Ductile Iron	Increase supply availability in Southern areas of Ruwa
b	Mutare Road Tanks to Southern Ruwa	3260m DN400 Ductile Iron 775m DN315 uPVC	Augment supply the southern expansion areas of Ruwa currently supplied through the distribution network for existing areas.

Long Term Investment Measures

As Ruwa's water supply situation normalizes it will be necessary to reinforce the primary and secondary distribution system as tabulated below:

Table 1-9 Long Term Primary and Secondary Distribution Investments

Note Refers	Description of Pipeline	Investment Required	Reason for Investment
Transmission/ Primary Distribution			
a	ZIMRE to WTW Tanks	4250m of DN500 Ductile Iron	Allow the existing DN525AC to be used as a main treated water supply line to rather than just as supply to ZIMRE. This will meet Ruwa's expanding treated water requirements in the long term
Secondary Distribution			
b	New line to supply east of ward 5 and the new expansion area (2030) of Athelney Farm.	3720m of DN200 PVC	Expansion of water supply into new residential areas
c	New line to supply the 2030 expansion area of Mara Farm east of Ruwa WTW and Damofalls.	7900 of DN200 PVC	Expansion of water supply into new residential areas

1.5 Storage Reservoirs

1.5.1 Existing Reservoirs

Existing storage reservoirs are located and supplied as shown in Figure 1-2 above. The following reservoirs exist in the town:

Table 1-10 Reservoir Storage - Ruwa

ID	Location	Capacity
1	Ruwa WTW	4000m^3 under construction
2	New Damofalls	1000m^3 elevated on 10m stand
3a	Mutare Road Ground	2000m3 Ground with - 3 x 50kW Pumps to (3b). - 3 x 50kW Pumps to (2) Not connected
3b	Mutare Road Elev.	180m^3 steel – condition suspect
4	Sunway City	+-200m^3

The above table covers the storage within the town only. Of great importance to Ruwa but belonging to Harare are the Donny Brook tanks which have a large diameter supply line to Ruwa and to a lesser extent the Ventersberg tanks which have a long DN300 supply line to Ruwa but which should also feed the growing Sunway City development. Little or no water is currently received through these lines.

New 'Damofalls' Tank in Ward 9

Mutare Road Elevated and Ground Tanks

1.5.2 Proposed Investment Measures

Short Term Investment Measures

The completion of the clear water reservoir at Ruwa WTW is the only proposed short term investment in storage.

Long Term Investment Measures

As Ruwa's water supply situation normalizes the available storage as proportion of daily supply will likely drop significantly below the recommended 24hour minimum. Therefore as a long term measure it will be necessary to augment storage within Ruwa.

The layout of the town is such that the existing WTW is at approximately the highest point but also it is the closest high point in the town which can be easily connected to the Donny Brook Tanks which will supply treated water above and beyond the 17.5MLD that the Ruwa WTW will ultimately be capable of. It is therefore makes sense to construct the town's main storage at this location.

It is proposed therefore, as a long term investment measure, to construct 40,000m3 (100 x 80 x 5m deep) of storage at the location of the Ruwa WTW. The Council should ensure land for this is secured now.

1.6 Distribution Network

1.6.1 Distribution zones and DMAs

The following Zones are logically identified from the network layout. Currently poor valves etc. mean that many of the zones are heavily interconnected and do not constitute demand management areas.

Table 1-11 Demand Management Areas

DMA	Source of Supply	Comment
Existing Town Areas		
ZIMRE Area	Via DN525 from Harare Donny Brook Tanks.	Interconnected to ward 9 via DN250. This should be normally closed
Ward 9	Ruwa WTW via numerous offtakes from DN315 line running from Ruwa WTW to Mutare Road Tanks	Ward 9 should be subdivided into three DMAs covering; - the northern and southern parts of the ward west of the supply line and, - the Damofalls area east of the supply line.
Ward 1	Mutare Road Tanks offtake from Existing DN250 running south from the tanks	
Ward 2	Mutare Road Tanks offtake from Existing DN250 running south from the tanks	
Ward 3	Mutare Road Tanks offtake from Existing DN250 running south from the tanks	
Wards 4 and 6	Mutare Road Tanks offtake from Existing DN250 running south from the tanks	
Ward 5	Mutare Road Tanks offtake from Proposed DN400/315 running south from the tanks Item (b) in Table 1-8	This area is currently expanding
Ward 7 - North	Mutare Road Tanks with offtake from existing DN250 running south from the tanks	This is the existing developed area of Ward 7
Ward 7 - South	Ward 5	Mutare Road Tanks offtake from Proposed DN400/315 running south from the tanks Item (b) in Table 1-8
Expansion Areas (Current and Future)		
Tarisa Farm	Ruwa WTW via existing Dn250 line running east to west along the boundary between Tarisa Farm and Ward 9	This is a currently expanding area and will continue to expand eastwards up to 2030

Mara Farm	Ruwa WTW via new secondary network, Item (e) in Table 1-9	Expansion into Mara Farm area has commenced but only at small scale.
Athelney Farm	Mutare Road Tanks via new secondary network, Item (d) in Table 1-9	Expansion into Athelney Farm area has not commenced.

Ruwa has a complex arrangement of multiple supply sources and multiple reservoirs, some of which boost into supply. To work efficiently this system will require good control and automation of reservoir levels and booster pumping pressures.

Variable speed pumping is recommended on all booster pump stations and should be controlled by network pressures with lower pressures set for off peak hours when system frictional losses are lower.

A system will be required to monitor the status of all reservoirs and to control the feed pumps from the Ruwa WTW to the tanks

1.6.2 NRW assessment

Bulk and Block Metering

Bulk and block metering is absent for most of the town.

Distribution Networks

The Ruwa distribution networks are relatively new as Ruwa is a new settlement. As such major issues with dilapidated pipes and house connections are not generally reported. However there has been a significant water supply deficit for many years which makes it almost impossible to assess the level of leakage in the tertiary distribution system.

Consumer Metering

The Council Reports that over 50% of consumer meters are faulty or inoperable.

1.6.3 Proposed Investment measures

Short Term Investment Measures – Non Revenue Water

The majority of the effort at non revenue water reduction will take place in the short term investment timeframe. Investment measures proposed are:

- A programme of valve replacement to allow proper demand zoning and management. This covers all valves within the system.
- A programme of installation and or replacement of bulk and bock meters to allow proper accounting for water. This covers all meters within the system
- A programme for the replacement of all consumer meters within the system, domestic and commercial.

- A programme of technical assistance to assist in identification of losses and developing programmes for NRW reduction. This will include detailed network mapping, customer database cleanup and customer awareness programmes.
- Following from improved metering and modelling it will be possible to identify areas of the tertiary distribution system where losses are high and target a programme of pipe and house connection replacement at these areas. At this stage the Council has not identified any specific area as highly problematic.
- Level control valves for reservoirs will be replaced as necessary to prevent losses through overflows.

With the planned expansion of the Ruwa WTW to 20MLD and the deferral of many network expansion measures into the long term interventions plan, it is not anticipated that flow limiters will be needed as a demand management measure.

<u>Short Term Investment Measures – Reticulation Expansion</u>

Short term expansion of the tertiary water supply network will be concentrated in the areas of Ruwa where developers are installing the networks. This investment will generally not require monetary outlay from the Council as the developers foot the bill. Where expansions occur before reinforcement of the primary distribution system there may be limited water to supply these areas and flow limiting devices may have to be fitted to house connections until more water is available. These areas include:

- North-western area of Ward 9
- Sunway City
- Southern portion of Ward 7
- Ward 5
- Tarisa Farm

<u>Long Term Investment Measures – Non Revenue Water</u>

The long term measures in NRW reduction will largely involve a continuation of the activities in the short term. Specific investments allowed for are:

- Replacement of all bulk and block meters. Experience indicates these have a life not exceeding 8-10 years and those installed in 2015-2017 will therefore need replacement before 2030.
- Replacement of all consumer meters. Experience indicates these have a life not exceeding 8-10 years and those installed in 2015-2017 will therefore need replacement before 2030.

<u>Long Term Investment Measures – Reticulation Expansion</u>

Long term expansion of the tertiary water supply network will be in areas earmarked for growth of Ruwa beyond its current boundaries. This investment will generally not require monetary outlay from the Council as the developers foot the bill. Control of development permits should be exercised to ensure that the Council is not committed to supplying water into these areas before it has adequately provisioned existing areas. The long term expansion areas include:

- Mara Farm
- Athelney
- Tarisa Farm

1.7 Emergency Water Supplies

With the considerable water shortages that Ruwa has been experiencing the Council has an ongoing programme to supply water through strategically located water points and boreholes as follows:

- 5 electrically powered boreholes with typical yields <1 lps.
- 5 boreholes with hand pumps

Water Point with Electric Borehole Pump

The Council tests the boreholes at the time when the WTW is to be closed due to lack of water testing is carried out at the Tobacco Research Board Lab. At the last round of testing:

- 10 boreholes were tested, none failed
- 7 shallow wells were tested, 5 failed.

<u>Short Term Investment Measures</u>

Maintenance of the existing emergency facilities.

<u>Long Term Investment Measures</u>

Normalisation of supplies should allow for the decommissioning of the emergency facilities.

2 SEWERAGE

2.1 Sewage Sub Catchments

Ruwa has a single sewage catchment served by the Adleigh Ponds. This is divided into three sub-catchments, each served by a single sewage pump station.

Runyaro SPS Sub-catchment

This is a small area of Wards 1 and 2 which drains to the Runyaro SPS. This SPS has a short lift into a sewer line in the Ruwa Main SPS sub-catchment at Jun-93.

Chiremba SPS Sub-catchment

This covers wards 4 and 6 and areas of Ward 5 which drain to the Chiremba SPS. This SPS has a short lift into a sewer line in the Ruwa Main SPS sub catchment at Jun-102.

Ruwa Main SPS Sub-catchment

This covers the whole of Ruwa, including flows from the two above sub catchments with the balance of flow arriving all the way by gravity to the Ruwa Main SPS.

Wards 5&7 Sub Catchment

The new developments in Wards 5 and 7, south of the Chiremba SPS cannot feed any of the existing sub catchments by gravity. It would appear that the developer intends to install a sewage pump station at the southernmost extent of this area (Jun-31 in mapping) and pump up to a manhole within the Ruwa Main SPS sub-catchment. This pump station has not yet been installed.

2.2 Sewer Reticulation System

Ruwa is a relatively new town and as such there are no significant problems reported with the sewer network. However, in the last decade water supplies have been short and flows therefore low and it is expected that a return to normal supply levels may show up areas where the existing system has deteriorated.

2.3 Transmission Sewers

The main sewer network for Ruwa has been modelled using the expected flows at the 2030 time horizon to identify sewer lines which may need to be augmented or upgraded to accommodate the expansion of the town. It should be noted that all of the current network appears adequate for normal flows with the current population. The modelling has identified the following investments required within Ruwa. Node numbering refers to Figure 7-16:

Short Term Investment Measures

Table 2-1 Short Term Transmission Sewer Investments

ID	Model Nodes	Investment Required	Reason for Investment
Existing Mains Upgrades/ Augmentation			
1	J116 to J73	Replace 175m of DN300 with DN450 RC	Allow for flows arising from northerly expansion of Ruwa into Tarisa Farm
2	J73-J65-J59	Replace 650m of DN300 with DN525 RC	Allow for flows arising from northerly expansion of Ruwa into Tarisa Farm

ID	Model Nodes	Investment Required	Reason for Investment
3	J59-J57	Replace 215m of DN525 215 with DN675 RC	Crossing of Mutare Road will accommodate Ruwa's northerly and easterly expansions
New Mains			
A	J58-J228	3165m of DN750 RC	New sewer line from the location of the existing Ruwa Main SPS to the lowest point in Ruwa. This line will also provide gravity sewer of the expansion areas of Ward 7 and Sunway City.
B	J87 (Relnyaro SPS) to J29	1228m of DN315 uPVC	Links the existing SPS to the gravity sewage system
C	J106 (existing Chilemba SPS) to J33	50m of DN250 uPVC	Links the existing SPS to the gravity sewage system
D	J31 to J32	435m of DN250 uPVC	Link the low points east and west of Ward 5.
	J32 to J228	3210m of DN400 uPVC	Link the lowest point in ward 4 to the lowest point in ward 7. This line completes the new gravity network required in Ruwa to allow for the decommissioning of all SPS.

<u>Long Term Investment Measures</u>

The short term measures described above will remove Ruwa's reliance on sewage pumping and add capacity in certain critical sections which will become overloaded because of existing development. Long term measures are required to accommodate increased flows from new development areas.

Table 2-2 Short Term Transmission Sewer Investments

ID	Model Nodes	Investment Required	Reason for Investment
Existing Mains Upgrades/ Augmentation			
1	J84 - J86 - J83	1640 of DN225 uPVC laid parallel to existing DN225	Additional flows arising from expansion into Mara Farm
2	J57-J58	1780m of DN525 RC laid parallel to existing DN525	Additional flows arising from expansion into Mara Farm
3			
New Mains			
A	J304 -J302-J84	2250m of DN200 uPVC	Expansion into Mara Farm
B	J306-J305—J84	2250 of DN200 uPVC	Expansion into Mara Farm
C	J302-J301-J300-J44	3075m of DN200 uPVC	Expansion into Athalney Farm area
D	J228 to J229	4550m of DN825	Main outfall from Ruwa to the exitsing but as yet not commissioned main sewer line between Donny Brook and Lyndhurst Farm.

2.4 Sewage Pump Stations

2.4.1 Existing Sewage Pump Station Condition

There are three sewage pump stations in Ruwa as follows:

Runyaro SPS

Runyaro SPS (Jun-87 in modelling). Peak modelled inflows were 18l/s and pumping head is not clear but <15m for the short lift to Jun-93 in the Ruwa Main SPS sub catchment.

The SPS has is enclosed within a fenced area and has an inlet works with coarse and fine bar screen and grit screening upstream of the pumps.

pumping equipment consists of one submersible pump in a wet well.

The station is prone to overflows as a result of power failures but is mechanically reliable. Spills are into the Ruwa stream and thence into the Manyame No standby power is available at the station.


Relnyaro SPS: Intake works and sewage spills


Relnyaro SPS: Wet well and superstructure

<u>Chilemba SPS</u>

Chiremba SPS (Jun-106 in modelling). Peak modelled inflows were 6l/s and pumping head is not clear but are estimated around 40m for the lift to Jun-103 in the Ruwa Main SPS sub catchment.

The SPS is enclosed within a fenced area and has an inlet works with coarse and fine bar screen and grit screening upstream of the pumps.

Pumping equipment normally consists of two submersible pumps but has been replaced by a single end suction pump after failure of the submersibles.

The station is prone to overflows as a result of power failures but is mechanically reliable. Spills are into the Ruwa stream and thence into the Manyame. The station has a relatively new standby generator.


Chilemba SPS: Intake works


Chilemba SPS: Temporary Pumping Arrangement

<u>Ruwa Main SPS</u>

All sewage from Ruwa ends up at the main sewage pumps station. From here it should be pumped around 1250m to the Adleigh ponds located between Ruwa and Epworth.

The SPS is enclosed within a walled area and has an inlet works with coarse and fine bar screen and grit screening upstream of the pumps. There are three inlet works consisting of coarse and fine screens and grit screening. Two feed into old wet wells and are not used whilst the one feeding the current pump station is in good condition and is in use.

The pumping equipment in that station is as follows:

Table 2-3 Pump Station Data – Ruwa Main SPS

Characteristic	Unit	Value
Pumps to		Adleigh Ponds
No. of Pumps	No.	3
Pumps Make and Model		Gorman Rupp T8A3-B /FM Std Impeller
Motors Make and Model		55kW
Coupling		Belt drive
Station Elevation	m	1500
Discharge Elevation	m	1515
Nominal Static Head	m	15
Rising Main Length	m	1250
Rising Main Nominal Diameter	mm	250
Rising main material		AC

Ruwa Main SPS: Gorman Rupp Sewage Pumps

Ruwa Main SPS: Inlet works left and center to old wet wells and right to new station

The station is currently inoperable with one pump failed, two motors failed and one panel failed. With no pumps running, all of Ruwa's sewage discharges untreated into the Manyame catchment.

Ruwa Stream Downstream of Ruwa Main SPS

2.4.2 Proposed Investment Measures

<u>Short Term Investment Measures</u>

The pollution to the Ruwa and Manyame streams from Ruwa's discharge of untreated sewage is considerable and occurs just a few km upstream of the Prince Edwards Water Treatment Works supplying Chitungwiza. The current system of sewage pump stations has proved unreliable, prone to breakdowns and at risk from loss of power. Consultation with Ruwa Council confirms that they would like to replace the current system with a gravity only system.

Ruwa's Wards 5 and most of Ward 7, where the bulk of the short term development of the town will take place are both at lower elevation to the current Ruwa Main SPS and would require at least one, if not two new sewage pump stations to be serviced.

The existing Adelaide ponds are in an area which forms part of Epworth and which has been zoned by Epworth for development. Ruwa has no direct access to the ponds and discharge no effluent to them.

It is proposed therefore to link Ruwa by gravity to the existing line that has been constructed but never commissioned from Donny Brook to Lyndhurst Farm. However investment programming means that this connection will not be available until long term measures are implemented. As soon as the investment measures given in Table 2-1 items A to E are completed all of Ruwa will be served by gravity systems and all existing sewage pump stations can be decommissioned. The decommissioning would however retain the bar screening and grit screening facilities at these pump stations.

In the short term the system will discharge to new ponds at the southern extreme of Ruwa and the connection to the Donny Brook to Lydhurst farm line will only take place in the longt term

<u>Long Term Investment Measures</u>

In the long term there will be no Sewage Pump Stations in Ruwa.

2.5 Sewage Treatment

2.5.1 Sewage Treatment Facilities

Ruwa currently uses the Adelaide stabilization ponds which are in an area which forms part of Epworth and which has been zoned by Epworth for development. Ruwa has no direct access to the ponds and discharge no effluent to them.

2.5.2 Investment Measures

Short Term Investment Measures

With the proposal to re-route all of Ruwa's sewage by gravity to the existing Donny Brook to Lyndhurst farm sewer line these ponds will be decommissioned. Decommissioning will include for removal of all sludge and reclamation of the pond area to a condition suitable for redevelopment.

However the outfall to the new sewer will not be available in the short trem so the town will need an interim sewage treatment arrangement. It is therefore proposed to construct new Ponds for the predicted 18MLD wastewater generated by the town in the 2020 horizon at the southern extreme of Ruwa. These ponds will require a 250Ha irrigation disposal system to dispose of wastewater.

Long Term Investment Measures

In the long term the 18MLD ponds will be decommissioned and Ruwa will be linked to the Harare South Trunk Sewer, releasing the land used for treatment and irrigation for redevelopment.

2.6 Sewerage Boundary

The concept of a sewerage boundary has been proposed. This forms a boundary outside which the town will not provide waterborne sanitation (potable water will generally be supplied). In the case of Ruwa the following Sewerage Boundaries are proposed:

Short and Long Term

The boundary shall contain all areas of the current wards forming Ruwa plus:

- Tarisa Farm. The limit of the sewer boundary on Tarisa Farm shall be the watershed of the Manyame catchment which cuts through the Farm. Areas to the north of this watershed shall be outside of the boundary.
- Mara Farm. The limit of the sewer boundary on Mara Farm shall be the watershed of the Manyame catchment which cuts through the Farm. Areas to the north of this watershed shall be outside of the boundary.
- Athelney Farm.

2.7 On- Site Sanitation Support

Many areas of Epworth will remain without waterborne sanitation, even in the long term. Sewage system investments will take many years to implement and some area will remain outside of the sanitation boundary for the town even in the long term. In these areas support must be given for the proper use of on site sewage disposal and treatment systems. Support will include:

- In areas of high water table where pit latrines and pour flush latrines are not practical, communities will need support to deploy and manage urine separation composting toilets. This type of toilet offers a good solution in these areas but as they require a more significant structure than pits or pour flush toilets they are often unaffordable. In addition users must be trained in their proper use and communities must find a source of ash which has to be added to the composting solids and is not readily available in Harare where people do not cook on wood stoves.
- In other areas pour flush toilets are clearly the preference of the householders and are seen to be installed where ever sufficient water is available. These offer a cheap alternative to a full waterborne solution with significant benefits over pit latrines. Pour flush systems should only be encouraged in areas where water supply is piped in. Support to communities wishing to use this type of toilet may include:
    - Improvements to water supply such that the householders have sufficient water to operate pour flush systems
    - Training of builders in good practices for construction of pour flush toilets and soakaways.
    - Provision of subsidised components such as cover slabs and squat pans to improve the affordability of pour flush systems
- Only where water supplies are very scarce will pit latrines be favoured by house holders. In future, reliance on pit latrines should therefore be limited to areas where no formal water supply system is in place. Support to communities on pit latrines may include:
    - Training of builders in good practices for construction of pit latrines.
    - Provision of subsidised components such as cover slabs, squat pans and ventilation pipes to improve the affordability of quality pit latrine systems
    - Training of householders in methods of maintaining the toilets and preventing the breeding of insects in the toilets.

APPENDIX 5: WATER DEMAND AND WASTEWATER FLOW PROJECTIONS

GREATER HARARE

Appendix 5-1A: Proportion of Population in Housing Categories

Present

S/N	City/Town	Area	% in consumer category				Population in consumer category				
			LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
		[ha]	[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	*Harare	84,922	28%	3%	59%	9%	482,961	50,409	1,014,130	161,038	1,708,538
2	Chitungwiza	5,106	1%	2%	92%	5%	4,489	5,600	330,017	16,734	356,840
3	Epworth	3,509	9%	25%	6%	60%	14,880	42,100	9,612	100,870	167,462
4	Norton	6,005	24%	0%	76%	0%	16,112	-	51,479	-	67,591
5	Ruwa	4,007	12%	28%	60%	0%	6,733	15,935	33,665	-	56,333
	Grand-total	**103,549**					**525,175**	**114,044**	**1,438,903**	**278,642**	**2,356,764**

2020

S/N	City/Town	% in consumer category				Population in consumer category				
		LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
		[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	*Harare	26%	3%	57%	14%	512,319	56,924	1,126,709	266,956	1,962,908
2	Chitungwiza	1%	2%	92%	5%	4,858	6,061	356,296	18,984	386,199
3	Epworth	10%	21%	7%	63%	20,480	42,100	13,612	127,844	204,036
4	Norton	24%	0%	76%	0%	22,552	-	72,054	-	94,606
5	Ruwa	12%	28%	60%	0%	13,468	31,874	67,339	-	112,682
	Grand-total					**573,677**	**136,959**	**1,636,010**	**413,784**	**2,760,430**

2030

S/N	City/Town	% in consumer category				Population in consumer category				
		LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
		[%]	[%]	[%]		[No]	[No]	[No]		[No]
1	*Harare	22%	3%	55%	20%	685,797	76,200	1,688,585	597,405	3,047,987
2	Chitungwiza	1%	2%	94%	4%	6,523	8,142	485,125	18,984	518,774
3	Epworth	8%	17%	32%	43%	20,480	42,100	79,896	106,243	248,719
4	Norton	24%	0%	76%	0%	35,019	-	111,884	-	146,903
5	Ruwa	12%	28%	60%	0%	20,913	49,494	104,564	-	174,971
	Grand-total					**768,732**	**175,936**	**2,470,054**	**722,632**	**4,137,355**

Category	2012		2020		2030	
	Pop	Prop (%)	Pop	Prop (%)	Pop	Prop (%)
LD	525,175	22%	573,677	21%	768,732	19%
MD	114,044	5%	136,959	5%	175,936	4%
HD (a)	1,438,903	61%	1,636,010	59%	2,470,054	60%
HD (b)	278,642	12%	413,784	15%	722,632	17%
Total	2,356,764	100%	2,760,431	100%	4,137,354	100%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

GREATER HARARE
Appendix 5-1B: Water Demand forecast

Present

S/N	City/Town	Area [ha]	Service Coverage [%]	Domestic LD [m³/day]	Domestic MD [m³/day]	Domestic HD (a) [m³/day]	Domestic HD (b) [m³/day]	Domestic sub-Total [m³/day]	Non-domestic Inst. [m³/day]	Non-domestic Com. [m³/day]	Non-domestic Ind. [m³/day]	Non-domestic Sub-total [m³/day]	Total [m³/day]	Ave. Dem (incl. NRW) [m³/day]	Peak Season Demand [m³/day]
1	*Harare	84,922		109,699	8,253	83,897	82	201,930	30,290	9,130	28,446	67,866	269,796	465,166	581,457
2	Chitungwiza	5,106		1,347	1,120	26,671	507	29,645	4,447	1,681	1,811	7,938	37,583	54,469	68,086
3	Epworth	3,509		1,457	5,867	409	974	8,706	1,306	47	-	1,353	10,059	14,371	17,963
4	Norton	6,005		4,834	-	4,376	-	9,209	1,381	110	2,320	3,811	13,020	20,031	25,039
5	Ruwa	4,007		2,020	3,187	2,702	-	7,909	1,186	340	1,079	2,605	10,514	16,175	20,219
	Grand-total			**119,356**	**18,426**	**118,054**	**1,562**	**257,399**	**38,610**	**11,308**	**33,656**	**83,574**	**340,973**	**570,212**	**712,765**

2020

S/N	City/Town	Service Coverage [%]	Domestic LD [m³/day]	Domestic MD [m³/day]	Domestic HD (a) [m³/day]	Domestic HD (b) [m³/day]	Domestic sub-total [m³/day]	Non-domestic Inst. [m³/day]	Non-domestic Com. [m³/day]	Non-domestic Ind. [m³/day]	Non-domestic sub-total [m³/day]	Total [m³/day]	Ave. Dem (incl. NRW) [m³/day]	Peak Season Demand [m³/day]
1	*Harare		112,808	9,817	89,048	7,355	219,028	32,854	11,087	34,542	78,483	297,511	396,681	495,851.83
2	Chitungwiza		1,215	1,061	28,504	759	31,538	4,731	2,018	2,587	9,336	40,874	54,499	68,123.40
3	Epworth		5,120	7,368	1,089	5,114	18,690	2,804	128	-	2,932	21,622	28,829	36,036.67
4	Norton		5,638	-	5,764	-	11,402	1,710	175	3,712	5,598	17,000	22,666	28,333.11
5	Ruwa		3,099	4,736	5,858	-	13,693	2,054	587	3,965	6,606	20,299	27,066	33,832.36
	Grand-total		**127,880**	**22,982**	**130,263**	**13,228**	**294,352**	**44,153**	**13,996**	**44,806**	**102,954**	**397,306**	**529,742**	**662,177**

2030

S/N	City/Town	Service Coverage [%]	Domestic LD [m³/day]	Domestic MD [m³/day]	Domestic HD (a) [m³/day]	Domestic HD (b) [m³/day]	Domestic sub-total [m³/day]	Non-domestic Inst. [m³/day]	Non-domestic Com. [m³/day]	Non-domestic Ind. [m³/day]	Non-domestic sub-total [m³/day]	Total [m³/day]	Ave. Dem (incl. NRW) [m³/day]	Peak Season Demand [m³/day]
1	*Harare		127,044	11,300	134,742	23,896	296,982	44,547.36	13,043	40,638	98,228	395,210	494,013	617,516.26
2	Chitungwiza		1,305	1,221	38,810	759	42,095	6,314.29	2,581	3,787	12,682	54,777	68,471	85,589.28
3	Epworth		4,096	6,315	6,392	4,250	21,052	3,157.86	139	-	3,296	24,349	30,436	38,044.95
4	Norton		7,004	-	8,951	-	15,955	2,393.18	219	4,640	7,252	23,207	29,008	36,260.47
5	Ruwa		4,036	4,679	9,888	-	18,603	2,790.43	856	5,751	9,397	28,000	35,000	43,750.28
	Grand-total		**143,484**	**23,516**	**198,782**	**28,905**	**394,687**	**59,203**	**16,837**	**54,815**	**130,856**	**525,543**	**656,929**	**821,161**

Peak Season Factor (1.25

Present

Specific Consumption	
LD	300
MD	200
HD (a)	85
HD (b)	40

Institutional Consumption	of domestic
Harare	15%
Satellite Towns	15%

Physical Leakage in 2012		
Harare	42%	40%
Chitungwiza	31%	
Epworth	30%	
Norton	35%	
Ruwa	35%	

2020

Specific Consumption	
LD	250
MD	175
HD (a)	80
HD (b)	40

Institutional Consumption	of domestic
Harare	15%
Satellite Towns	15%

Physical Leakage in 2020 25.0%

2030

Specific Consumption	
LD	200
MD	150
HD (a)	80
HD (b)	40

Institutional Consumption	of domestic
Harare	15%
Satellite Towns	15%

Physical Leakage in 2030 20.0%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

GREATER HARARE

Appendix 5-1C: Wastewater Flow Estimates

S/N	City/Town	Category	Present – Wastewater flow LD [m³/day]	MD [m³/day]	HD [m³/day]	Inst [m³/day]	Com. [m³/day]	Ind [m³/day]	Total [m³/day]
1	*Harare		38,014	6,624	89,131	22,842	6,262	19,481	182,354
2	Chitungwiza		842	980	28,338	4,447	1,681	1,584	37,872
3	Epworth		-	-	-	-	-	-	-
4	Norton		413	-	2,309	425	81	577	3,805
5	Ruwa		1,178	2,789	2,871	1,166	334	883	9,221
Total			**40,447**	**10,393**	**122,648**	**28,880**	**8,358**	**22,525**	**233,251**

S/N	City/Town	Category	2020 – Wastewater flow LD [m³/day]	MD [m³/day]	HD [m³/day]	Inst [m³/day]	Com. [m³/day]	Ind. [m³/day]	Total [m³/day]
1	*Harare		34,660	6,313	94,493	23,108	9,040	23,656	191,270
2	Chitungwiza		759	928	30,285	4,731	2,018	2,263	40,985
3	Epworth		-	-	-	-	-	-	-
4	Norton		509	-	6,125	987	130	993	8,743
5	Ruwa		1,937	4,144	6,224	2,054	587	3,469	18,416
Total			**37,865**	**11,385**	**137,126**	**30,880**	**11,776**	**30,382**	**259,413**

S/N	City/Town	Category	2030 – Wastewater flow LD [m³/day]	MD [m³/day]	HD [m³/day]	Inst [m³/day]	Com. [m³/day]	Ind. [m³/day]	Total [m³/day]
1	*Harare		34,435	6,407	130,965	30,470	12,361	27,830	242,468
2	Chitungwiza		815	1,069	41,236	6,314	2,581	3,313	55,328
3	Epworth		730	3,850	2,031	1,256	68	-	7,934
4	Norton		815	-	9,510	1,538	162	1,241	13,266
5	Ruwa		2,523	4,094	10,506	2,790	856	5,032	25,801
Total			**39,317**	**15,420**	**194,247**	**42,369**	**16,027**	**37,417**	**344,798**

Harare

Appendix 5-2A: Proportion of Population in Housing Categories

Present

Ward No.	Ward Name / Category	Area [ha]	% LD [%]	% MD [%]	% HD (a) [%]	% HD (b) [%]	Pop. LD [No]	Pop. MD [No]	Pop. HD (a) [No]	Pop. HD (b) [No]	Total [No]
1	Harare South (Rural)	19,385	5%	0%	5%	90%	5,680		5,680	102,239	113,599
2	Cranborne Park, Queensdale, Braeside, Arcadia, Hillside, Eastlea	2,261	100%	0%	0%	0%	37,024				37,024
3	Mbare	104	0%	0%	100%	0%			22,397		22,397
4	Rufaro, Remembrance Drive	115	0%	0%	100%	0%			15,027		15,027
5	Ridgeview, Lincoln Green, Belvedere North & South, Milton Park, Nonavale	2,012	100%	0%	0%	0%	21,981				21,981
6	CBD, Avenues	814	100%	0%	0%	0%	21,257				21,257
7	Kensington, Avondale, Alexander Park, Gunhill, Strathaven, Avondale West	1,762	100%	0%	0%	0%	29,372				29,372
8	Newlands, Highlands, Lewisam, Chisipite, Rietfontein, Colney Valley, Rolf Valley, The Grange	2,732	100%	0%	0%	0%	20,785				20,785
9	Greendale, Msasa , Bingley, Athlone, Mandara, Chikurubi, Wormshill, Greengrove, Lichendale	8,777	100%	0%	0%	0%	48,026				48,026
10	Sunningdale, Graniteside	548	0%	25%	75%	0%		5,511	16,531		22,042
11	Workington, Southerton, Mbare	772	0%	0%	100%	0%			20,835		20,835
12	Mbare	172	0%	0%	100%	0%			22,324		22,324
13	Aspindale, Lochinvar, Southerton	1,202	0%	0%	100%	0%			23,123		23,123
14	Kambuzuma	593	0%	10%	90%	0%		3,052	27,465		30,517
15	Warren Park, Warren Park D, Westlea	1,934	0%	5%	95%	0%		3,309	62,873		66,182
16	Tynwald, Nkwisi Park, Sanganayi Park, Ashdown Park, ST Andrews' Park, Haig Park, Sherwood Pa	2,768	75%	25%	0%	0%	34,948	11,650			46,598
17	Little Norfolk, Mount Pleasant, Groombridge, Borodale West, Northwood, Vainona	3,327	100%	0%	0%	0%	26,412				26,412
18	Borrodale, Colray, Greystone Park, Helensvale, Quinnington, Chiltern Hills, Borrodale Brook, Philad	7,750	100%	0%	0%	0%	32,789				32,789
19	Mabvuku	122	0%	0%	100%	0%			21,138		21,138
20	Tafara	681	0%	0%	100%	0%			24,145		24,145
21	Mabvuku	2,096	0%	0%	100%	0%			23,036		23,036
22	Logan Park, Hatfield, Park Meadowland, Chadcombe, Msasa Park	2,655	90%	10%	0%	0%	40,151	4,461			44,612
23	Grobie Park, Induna, Waterfalls, Midlands, Malvern, Park Town, Prospect, Ardbennie, Houghton Pa	3,030	100%	0%	0%	0%	63,955				63,955
24	Highfield, Paradise, Ardbennie	462	0%	0%	100%	0%			29,488		29,488
25	Highfield	305	0%	20%	80%	0%		5,972	23,886		29,858
26	Willowvale, Highfield	712	0%	0%	100%	0%			36,275		36,275
27	Glen Norah C	394	0%	0%	100%	0%			32,409		32,409
28	Glen View 7, Glen Norah	274	0%	0%	100%	0%			27,419		27,419
29	Glen Norah	106	0%	0%	100%	0%			13,237		13,237
30	Glen View	410	0%	0%	100%	0%			53,508		53,508
31	Glen View No. 1, 3 & 9	171	0%	15%	85%	0%		3,446	19,529		22,975
32	Glenview No. 6	320	0%	0%	100%	0%			37,210		37,210
33	Budiriro 1, 2 & 3	587	0%	0%	100%	0%			60,116		60,116
34	Mufakose	884	0%	0%	100%	0%			18,532		18,532
35	Marimba	369	0%	0%	100%	0%			23,937		23,937
36	New Marimba Park, Mufakose	280	0%	0%	100%	0%			12,993		12,993
37	Mufakose, Crowborough, Crowborough North, Kuwadzana	1,036	0%	0%	100%	0%			70,754		70,754
38	Kuwadzana	362	0%	0%	100%	0%			34,466		34,466
39	Dzivaresekwa	213	0%	0%	100%	0%			24,507		24,507
40	Glaudina, Dzivaresekwa Extension, Dzivaresekwa	1,882	0%	10%	90%	0%		4,532	40,785		45,317
41	Tynwald North, New Bluff Hill, New Bluff Hill Park, Bluff Hill, Adylinn, Marlborough, New Marlborou	5,887	100%	0%	0%	0%	55,881				55,881
42	Hatcliffe	2,300	5%	0%	95%	0%	2,267		43,077		45,344
43	Budiriro 5	1,260	0%	0%	100%	0%			61,120		61,120
44	Kuwadzana Phase 4 Extension	409	0%	0%	100%	0%			26,926		26,926
45	Kuwadzana Phase 3, Tynwald South	421	0%	0%	100%	0%			28,900		28,900
46	Tafara	267	0%	0%	100%	0%			10,482		10,482
SP 1	Harare Extension - Zwimba 35		5%	20%	0%	75%	2,119	8,476		31,787	42,382
SP 2	Harare Extension - Zwimba 24		100%	0%	0%	0%	8,931				8,931
SP 3	Harare Extension - Mazowe 20		100%	0%	0%	0%	13,308				13,308
SP 4	Harare Extension - Goromonzi 6		100%	0%	0%	0%	12,174				12,174
SP 5	Harare Extension - Goromonzi 7		100%	0%	0%	0%	5,901				5,901
SP 6	Harare Extension - Goromonzi 25		0%	0%	0%	100%				27,012	27,012
	Grand-total	**84,922**					**482,961**	**50,409**	**1,014,130**	**161,038**	**1,708,538**

2020

Ward No.	% LD [%]	% MD [%]	% HD (a) [%]	% HD (b) [%]	Pop. LD [No]	Pop. MD [No]	Pop. HD (a) [No]	Pop. HD (b) [No]	Total [No]
1	3%	0%	3%	94%	5,680		5,680	166,157	177,517
2	100%	0%	0%	0%	38,144				38,144
3	0%	0%	100%	0%			22,397		22,397
4	0%	0%	100%	0%			15,027		15,027
5	100%	0%	0%	0%	21,981				21,981
6	100%	0%	0%	0%	21,257				21,257
7	100%	0%	0%	0%	29,372				29,372
8	100%	0%	0%	0%	20,785				20,785
9	100%	0%	0%	0%	52,926				52,926
10	0%	25%	75%	0%		5,511	16,531		22,042
11	0%	0%	100%	0%			20,835		20,835
12	0%	0%	100%	0%			22,324		22,324
13	0%	0%	100%	0%			24,123		24,123
14	0%	10%	90%	0%		3,052	27,465		30,517
15	0%	5%	95%	0%		3,309	64,873		68,182
16	75%	25%	0%	0%	37,048	12,525			49,573
17	100%	0%	0%	0%	26,972				26,972
18	100%	0%	0%	0%	34,889				34,889
19	0%	0%	100%	0%			21,138		21,138
20	0%	0%	100%	0%			29,145		29,145
21	5%	0%	95%	0%	1,400		28,036		29,436
22	88%	12%	0%	0%	40,151	5,511			45,662
23	100%	0%	0%	0%	63,955				63,955
24	0%	0%	100%	0%			33,088		33,088
25	0%	20%	80%	0%		5,972	23,886		29,858
26	0%	0%	100%	0%			36,275		36,275
27	0%	0%	100%	0%			32,409		32,409
28	0%	0%	100%	0%			27,419		27,419
29	0%	0%	100%	0%			13,237		13,237
30	0%	0%	100%	0%			56,308		56,308
31	0%	14%	86%	0%		3,446	20,729		24,175
32	0%	0%	100%	0%			39,210		39,210
33	0%	0%	100%	0%			63,616		63,616
34	0%	0%	100%	0%			18,532		18,532
35	0%	0%	100%	0%			23,937		23,937
36	0%	0%	100%	0%			12,993		12,993
37	0%	0%	100%	0%			90,754		90,754
38	0%	0%	100%	0%			34,466		34,466
39	0%	0%	100%	0%			24,507		24,507
40	0%	7%	93%	0%		5,407	68,264		73,671
41	100%	0%	0%	0%	61,481				61,481
42	10%	0%	90%	0%	4,787		43,077		47,864
43	0%	0%	100%	0%			78,120		78,120
44	0%	0%	100%	0%			36,926		36,926
45	0%	1%	99%	0%		350	38,900		39,250
46	0%	0%	100%	0%			12,482		12,482
SP 1	3%	18%	0%	79%	2,119	11,841		52,787	66,747
SP 2	100%	0%	0%	0%	11,731				11,731
SP 3	100%	0%	0%	0%	16,108				16,108
SP 4	100%	0%	0%	0%	15,632				15,632
SP 5	100%	0%	0%	0%	5,901				5,901
SP 6	0%	0%	0%	100%				48,012	48,012
Grand-total					**512,319**	**56,924**	**1,126,709**	**266,956**	**1,962,908**

2030

Ward No.	% LD [%]	% MD [%]	% HD (a) [%]	% HD (b)	Pop. LD [No]	Pop. MD [No]	Pop. HD (a) [No]	Pop. HD (b)	Total [No]
1	1%	0%	48%	51%	5,680		360,801	387,841	754,322
2	100%	0%	0%	0%	42,624				42,624
3	0%	0%	100%	0%			22,397		22,397
4	0%	0%	100%	0%			15,027		15,027
5	100%	0%	0%	0%	21,981				21,981
6	100%	0%	0%	0%	21,257				21,257
7	100%	0%	0%	0%	29,372				29,372
8	100%	0%	0%	0%	20,785				20,785
9	100%	0%	0%	0%	72,526				72,526
10	0%	25%	75%	0%		5,511	16,531		22,042
11	0%	0%	100%	0%			20,835		20,835
12	0%	0%	100%	0%			22,324		22,324
13	0%	0%	100%	0%			24,123		24,123
14	0%	10%	90%	0%		3,052	27,465		30,517
15	0%	5%	95%	0%		3,309	64,873		68,182
16	75%	25%	0%	0%	45,448	15,150			60,598
17	100%	0%	0%	0%	29,212				29,212
18	100%	0%	0%	0%	43,289				43,289
19	0%	0%	100%	0%			21,138		21,138
20	0%	0%	100%	0%			34,145		34,145
21	17%	0%	83%	0%	7,000		33,036		40,036
22	82%	18%	0%	0%	40,151	8,661			48,812
23	100%	0%	0%	0%	63,955				63,955
24	0%	0%	100%	0%			33,088		33,088
25	0%	20%	80%	0%		5,972	23,886		29,858
26	0%	0%	100%	0%			36,275		36,275
27	0%	0%	100%	0%			32,409		32,409
28	0%	0%	100%	0%			27,419		27,419
29	0%	0%	100%	0%			13,237		13,237
30	0%	0%	100%	0%			56,308		56,308
31	0%	14%	86%	0%		3,446	20,729		24,175
32	0%	0%	100%	0%			39,210		39,210
33	0%	0%	100%	0%			63,616		63,616
34	0%	0%	100%	0%			18,532		18,532
35	0%	0%	100%	0%			23,937		23,937
36	0%	0%	100%	0%			12,993		12,993
37	0%	0%	100%	0%			95,754		95,754
38	0%	0%	100%	0%			34,466		34,466
39	0%	0%	100%	0%			24,507		24,507
40	0%	9%	91%	0%		8,032	80,785		88,817
41	100%	0%	0%	0%	83,881				83,881
42	26%	0%	74%	0%	14,867		43,077		57,944
43	0%	0%	100%	0%			83,120		83,120
44	0%	0%	100%	0%			36,926		36,926
45	0%	3%	97%	0%		1,400	38,900		40,300
46	0%	0%	100%	0%			12,482		12,482
SP 1	1%	7%	46%	46%	2,119	21,667	140,988	140,798	305,572
SP 2	100%	0%	0%	0%	37,765				37,765
SP 3	100%	0%	0%	0%	42,142				42,142
SP 4	100%	0%	0%	0%	41,008				41,008
SP 5	100%	0%	0%	0%	20,735				20,735
SP 6	0%	0%	33%	67%			33,246	68,766	102,012
Grand-total					**685,797**	**76,200**	**1,688,585**	**597,405**	**3,047,987**

Category	2012 Population	2012 Prop (%)	2020 Population	2020 Prop (%)	2030 Population	2030 Prop (%)
LD	482,961	28%	512,319	26%	685,797	22%
MD	50,409	3%	56,924	3%	76,200	3%
HD	1,014,130	59%	1,126,709	57%	1,688,585	55%
Inf.	161,038	9%	266,956	14%	597,405	20%
Total	1,708,538	100%	1,962,908	100%	3,047,987	100%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

Harare

Appendix 5-2B: Water Demand forecast

Present

Ward No	Ward Name	Category	Area [ha]	Service Coverage [%]	Domestic LD [m3/day]	Domestic MD [m3/day]	Domestic HD (a) [m3/day]	Domestic HD (b)	Domestic sub-Total	Non-domestic Inst. [m3/day]	Non-domestic Com. [m3/day]	Non-domestic Ind. [m3/day]	Non-domestic Sub-total [m3/day]	Total [m3/day]	Ave. Dem (incl. NRW)	Peak Season Demand
1	Harare South (Rural)		19,385	2%	34.08	-	9.66	81.79	126	19	2,415.00	-	2,434	2,559	4,413	5,515.85
2	Cranborne Park, Queensdale, Braeside, Arcadia, Hillside, Eastlea		2,261	80%	8,886	-	-	-	8,886	1,333	96	-	1,429	10,314	17,784	22,229.42
3	Mbare		104	100%	-	-	1,904	-	1,904	286	11	-	297	2,201	3,794	4,743.04
4	Rufaro, Remembrance Drive		115	100%	-	-	1,277	-	1,277	192	45	-	237	1,514	2,611	3,263.49
5	Ridgeview, Lincoln Green, Belvedere North & South, Milton Park, Nonavale		2,012	90%	5,935	-	-	-	5,935	890	16	1,341	2,248	8,182	14,108	17,634.50
6	CBD, Avenues		814	100%	6,377	-	-	-	6,377	957	5,068	955	6,979	13,357	23,029	28,785.63
7	Kensington, Avondale, Alexander Park, Gunhill, Strathaven, Avondale West		1,762	100%	8,812	-	-	-	8,812	1,322	101	-	1,423	10,234	17,646	22,057.01
8	Newlands, Highlands, Lewisam, Chisipite, Rietfontein, Colney Valley, Rolf Valley, The Grange		2,732	80%	4,988	-	-	-	4,988	748	109	-	857	5,845	10,078	12,597.63
9	Greendale, Msasa , Bingley, Athlone, Mandara, Chikurubi, Wormshill, Greengrove, Lichendale		8,777	75%	10,806	-	-	-	10,806	1,621	151	7,560	9,332	20,138	34,720	43,400.24
10	Sunningdale, Graniteside		548	100%	-	1,102	1,405	-	2,507	376	-	3,224	3,600	6,107	10,530	13,162.53
11	Workington, Southerton, Mbare		772	100%	-	-	1,771	-	1,771	266	4	7,334	7,603	9,374	16,162	20,202.89
12	Mbare		172	100%	-	-	1,898	-	1,898	285	-	-	285	2,182	3,762	4,702.95
13	Aspindale, Lochinvar, Southerton		1,202	100%	-	-	1,965	-	1,965	295	36	2,328	2,659	4,625	7,974	9,967.02
14	Kambuzuma		593	100%	-	610	2,335	-	2,945	442	58	-	499	3,444	5,939	7,423.20
15	Warren Park, Warren Park D, Westlea		1,934	100%	-	662	5,344	-	6,006	901	22	-	923	6,929	11,946	14,932.47
16	Tynwald, Nkwisi Park, Sanganayi Park, Ashdown Park, ST Andrews' Park, Haig Park, Sherwood Park		2,768	100%	10,484	2,330	-	-	12,814	1,922	34	-	1,956	14,770	25,466	31,832.60
17	Little Norfolk, Mount Pleasant, Groombridge, Borodale West, Northwood, Vainona		3,327	75%	5,943	-	-	-	5,943	891	113	-	1,004	6,947	11,978	14,971.96
18	Borrodale, Colray, Greystone Park, Helensvale, Quinnington, Chiltern Hills, Borrodale Brook, Philadelphia		7,750	75%	7,378	-	-	-	7,378	1,107	72	-	1,179	8,556	14,752	18,439.82
19	Mabvuku		122	100%	-	-	1,797	-	1,797	270	11	-	280	2,077	3,581	4,476.49
20	Tafara		681	100%	-	-	2,052	-	2,052	308	44	-	352	2,404	4,145	5,181.19
21	Mabvuku		2,096	100%	-	-	1,958	-	1,958	294	4	144	442	2,400	4,138	5,172.34
22	Logan Park, Hatfield, Park Meadowland, Chadcombe, Msasa Park		2,655	85%	10,239	758	-	-	10,997	1,650	46	-	1,696	12,693	21,884	27,355.01
23	Grobie Park, Induna, Waterfalls, Midlands, Malvern, Park Town, Prospect, Ardbennie, Houghton Park		3,030	75%	14,390	-	-	-	14,390	2,158	98	-	2,256	16,646	28,700	35,874.85
24	Highfield, Paradise, Ardbennie		462	100%	-	-	2,506	-	2,506	376	19	-	395	2,901	5,002	6,252.65
25	Highfield		305	100%	-	1,194	2,030	-	3,225	484	16	-	500	3,725	6,422	8,027.73
26	Willowvale, Highfield		712	100%	-	-	3,083	-	3,083	463	123	5,561	6,146	9,230	15,913	19,891.74
27	Glen Norah C		394	100%	-	-	2,755	-	2,755	413	14	-	427	3,182	5,486	6,857.37
28	Glen View 7, Glen Norah		274	100%	-	-	2,331	-	2,331	350	13	-	363	2,694	4,644	5,805.20
29	Glen Norah		106	100%	-	-	1,125	-	1,125	169	-	-	169	1,294	2,231	2,788.61
30	Glen View		410	100%	-	-	4,548	-	4,548	682	51	-	733	5,281	9,106	11,382.08
31	Glen View No. 1, 3 & 9		171	100%	-	689	1,660	-	2,349	352	-	-	352	2,702	4,658	5,822.28
32	Glenview No. 6		320	100%	-	-	3,163	-	3,163	474	11	-	486	3,649	6,291	7,863.68
33	Budiriro 1, 2 & 3		587	100%	-	-	5,110	-	5,110	766	20	-	786	5,896	10,165	12,706.64
34	Mufakose		884	100%	-	-	1,575	-	1,575	236	27	-	263	1,839	3,170	3,962.33
35	Marimba		369	100%	-	-	2,035	-	2,035	305	-	-	305	2,340	4,034	5,042.76
36	New Marimba Park, Mufakose		280	100%	-	-	1,104	-	1,104	166	-	-	166	1,270	2,190	2,737.21
37	Mufakose, Crowborough, Crowborough North, Kuwadzana		1,036	100%	-	-	6,014	-	6,014	902	23	-	925	6,939	11,964	14,955.60
38	Kuwadzana		362	100%	-	-	2,930	-	2,930	439	20	-	459	3,389	5,843	7,303.66
39	Dzivaresekwa		213	100%	-	-	2,083	-	2,083	312	-	-	312	2,396	4,130	5,162.84
40	Glaudina, Dzivaresekwa Extension, Dzivaresekwa		1,882	100%	-	906	3,467	-	4,373	656	6	-	662	5,035	8,681	10,851.38
41	Tynwald North, New Bluff Hill, New Bluff Hill Park, Bluff Hill, Adylinn, Marlborough, New Marlborough, Avon		5,887	90%	15,088	-	-	-	15,088	2,263	97	-	2,360	17,448	30,083	37,604.11
42	Hatcliffe		2,300	50%	340	-	1,831	-	2,171	326	10	-	335	2,506	4,321	5,401.17
43	Budiriro 5		1,260	100%	-	-	5,195	-	5,195	779	86	-	865	6,060	10,449	13,060.94
44	Kuwadzana Phase 4 Extension		409	100%	-	-	2,289	-	2,289	343	31	-	374	2,663	4,591	5,739.35
45	Kuwadzana Phase 3, Tynwald South		421	100%	-	-	2,457	-	2,457	368	-	-	368	2,825	4,871	6,088.31
46	Tafara		267	100%	-	-	891	-	891	134	9	-	143	1,034	1,782	2,227.63
SP 1	Harare Extension - Zwimba 35			0%	-	-	-	-	-	-	-	-	-	0	-	-
SP 2	Harare Extension - Zwimba 24			0%	-	-	-	-	-	-	-	-	-	0	-	-
SP 3	Harare Extension - Mazowe 20			0%	-	-	-	-	-	-	-	-	-	0	-	-
SP 4	Harare Extension - Goromonzi 6			0%	-	-	-	-	-	-	-	-	-	0	-	-
SP 5	Harare Extension - Goromonzi 7			0%	-	-	-	-	-	-	-	-	-	0	-	-
SP 6	Harare Extension - Goromonzi 25			0%	-	-	-	-	-	-	-	-	-	0	-	-
	Grand-total		**84,922**		**109,699**	**8,253**	**83,897**	**82**	**201,930**	**30,290**	**9,130**	**28,446**	**67,866**	**269,796**	**465,166**	**581,457**

2020

Ward No	Service Coverage [%]	Domestic LD [m3/day]	Domestic MD [m3/day]	Domestic HD (a) [m3/day]	Domestic HD (b) [m3/day]	Domestic sub-total [m3/day]	Non-domestic Inst. [m3/day]	Non-domestic Com. [m3/day]	Non-domestic Ind. [m3/day]	Non-domestic sub-total [m3/day]	Total [m3/day]	Ave. Dem (incl. NRW) [m3/day]	Peak Season Demand [m3/day]
1	50%	710	-	227	3,323	4,260	639	2,933	-	3,572	7,832	10,443	13,053.15
2	90%	8,582	-	-	-	8,582	1,287	116	-	1,404	9,986	13,315	16,643.54
3	100%	-	-	1,792	-	1,792	269	14	-	283	2,074	2,766	3,457.41
4	100%	-	-	1,202	-	1,202	180	55	-	235	1,438	1,917	2,395.96
5	90%	4,946	-	-	-	4,946	742	20	1,628	2,390	7,336	9,781	12,226.23
6	100%	5,314	-	-	-	5,314	797	6,154	1,160	8,111	13,425	17,900	22,374.78
7	100%	7,343	-	-	-	7,343	1,101	123	-	1,224	8,567	11,423	14,278.71
8	85%	4,417	-	-	-	4,417	663	132	-	794	5,211	6,948	8,685.42
9	80%	10,585	-	-	-	10,585	1,588	183	9,180	10,951	21,536	28,715	35,893.87
10	100%	-	964	1,322	-	2,287	343	-	3,915	4,258	6,545	8,726	10,907.95
11	100%	-	-	1,667	-	1,667	250	5	8,905	9,160	10,827	14,436	18,044.45
12	100%	-	-	1,786	-	1,786	268	-	-	268	2,054	2,738	3,423.01
13	100%	-	-	1,930	-	1,930	289	44	2,827	3,161	5,090	6,787	8,484.00
14	100%	-	534	2,197	-	2,731	410	70	-	480	3,211	4,281	5,351.77
15	100%	-	579	5,190	-	5,769	865	26	-	892	6,661	8,881	11,101.12
16	100%	9,262	2,192	-	-	11,454	1,718	41	-	1,759	13,213	17,617	22,021.59
17	80%	5,394	-	-	-	5,394	809	137	-	946	6,341	8,454	10,567.73
18	80%	6,978	-	-	-	6,978	1,047	87	-	1,134	8,112	10,816	13,519.68
19	100%	-	-	1,691	-	1,691	254	13	-	267	1,958	2,610	3,263.12
20	100%	-	-	2,332	-	2,332	350	53	-	403	2,735	3,646	4,557.74
21	100%	350	-	2,243	-	2,593	389	5	175	569	3,162	4,216	5,269.61
22	85%	8,532	820	-	-	9,352	1,403	56	-	1,459	10,811	14,414	18,018.12
23	80%	12,791	-	-	-	12,791	1,919	118	-	2,037	14,828	19,771	24,713.56
24	100%	-	-	2,647	-	2,647	397	23	-	420	3,067	4,089	5,111.49
25	100%	-	1,045	1,911	-	2,956	443	20	-	463	3,419	4,559	5,698.92
26	100%	-	-	2,902	-	2,902	435	150	6,752	7,337	10,239	13,652	17,065.27
27	100%	-	-	2,593	-	2,593	389	17	-	406	2,998	3,998	4,997.39
28	100%	-	-	2,194	-	2,194	329	16	-	345	2,539	3,385	4,231.38
29	100%	-	-	1,059	-	1,059	159	-	-	159	1,218	1,624	2,029.67
30	100%	-	-	4,505	-	4,505	676	62	-	737	5,242	6,989	8,736.86
31	100%	-	603	1,658	-	2,261	339	-	-	339	2,601	3,467	4,334.29
32	100%	-	-	3,137	-	3,137	471	14	-	484	3,621	4,828	6,035.41
33	100%	-	-	5,089	-	5,089	763	24	-	787	5,876	7,835	9,794.00
34	100%	-	-	1,483	-	1,483	222	33	-	255	1,738	2,317	2,896.25
35	100%	-	-	1,915	-	1,915	287	-	-	287	2,202	2,936	3,670.34
36	100%	-	-	1,039	-	1,039	156	-	-	156	1,195	1,594	1,992.26
37	100%	-	-	7,260	-	7,260	1,089	28	-	1,117	8,378	11,170	13,962.56
38	100%	-	-	2,757	-	2,757	414	24	-	438	3,195	4,260	5,324.95
39	100%	-	-	1,961	-	1,961	294	-	-	294	2,255	3,006	3,757.74
40	100%	-	946	5,461	-	6,407	961	7	-	968	7,376	9,834	12,292.78
41	90%	13,833	-	-	-	13,833	2,075	118	-	2,193	16,026	21,368	26,710.51
42	75%	898	-	2,585	-	3,482	522	12	-	534	4,016	5,355	6,693.80
43	100%	-	-	6,250	-	6,250	937	104	-	1,042	7,291	9,722	12,152.03
44	100%	-	-	2,954	-	2,954	443	38	-	481	3,435	4,580	5,724.81
45	100%	-	61	3,112	-	3,173	476	-	-	476	3,649	4,866	6,082.06
46	100%	-	-	999	-	999	150	11	-	161	1,159	1,546	1,932.13
SP 1	100%	530	2,072	-	2,111	4,713	707	-	-	707	5,420	7,227	9,034.03
SP 2	100%	2,933	-	-	-	2,933	440	-	-	440	3,373	4,497	5,621.10
SP 3	100%	4,027	-	-	-	4,027	604	-	-	604	4,631	6,175	7,718.42
SP 4	100%	3,908	-	-	-	3,908	586	-	-	586	4,494	5,992	7,490.33
SP 5	100%	1,475	-	-	-	1,475	221	-	-	221	1,697	2,262	2,827.56
SP 6	100%	-	-	-	1,920	1,920	288	-	-	288	2,209	2,945	3,680.92
Grand-total		**112,808**	**9,817**	**89,048**	**7,355**	**219,028**	**32,854**	**11,087**	**34,542**	**78,483**	**297,511**	**396,681**	**495,852**

2030

Ward No	Service Coverage [%]	Domestic LD [m3/day]	Domestic MD [m3/day]	Domestic HD (a) [m3/day]	Domestic HD (b) [m3/day]	Domestic sub-total [m3/day]	Non-domestic Inst. [m3/day]	Non-domestic Com. [m3/day]	Non-domestic Ind. [m3/day]	Non-domestic sub-total [m3/day]	Total [m3/day]	Ave. Dem (incl. NRW) [m3/day]	Peak Season Demand [m3/day]
1	100%	1,136	-	28,864	15,514	45,514	6,827.06	3,450	-	10,277	55,791	69,738	87,173.09
2	90%	7,672	-	-	-	7,672	1,150.85	137	-	1,288	8,960	11,200	14,000.10
3	100%	-	-	1,792	-	1,792	268.76	16	-	285	2,077	2,596	3,245.16
4	100%	-	-	1,202	-	1,202	180.32	65	-	245	1,447	1,809	2,261.41
5	90%	3,957	-	-	-	3,957	593.49	23	1,916	2,532	6,489	8,111	10,139.18
6	100%	4,251	-	-	-	4,251	637.71	7,240	1,364	9,242	13,493	16,867	21,083.13
7	100%	5,874	-	-	-	5,874	881.16	144	-	1,026	6,900	8,625	10,781.26
8	90%	3,741	-	-	-	3,741	561.20	155	-	716	4,458	5,572	6,965.15
9	90%	13,055	-	-	-	13,055	1,958.20	216	10,800	12,974	26,029	32,536	40,669.65
10	100%	-	827	1,322	-	2,149	322.37	-	4,606	4,928	7,077	8,846	11,058.10
11	100%	-	-	1,667	-	1,667	250.02	5	10,477	10,732	12,399	15,499	19,373.43
12	100%	-	-	1,786	-	1,786	267.89	-	-	268	2,054	2,567	3,209.08
13	100%	-	-	1,930	-	1,930	289.48	52	3,326	3,667	5,597	6,996	8,745.41
14	100%	-	458	2,197	-	2,655	398.25	82	-	481	3,136	3,920	4,899.50
15	100%	-	496	5,190	-	5,686	852.93	31	-	884	6,570	8,213	10,265.94
16	100%	9,090	2,273	-	-	11,362	1,704.32	48	-	1,753	13,115	16,393	20,491.64
17	80%	4,674	-	-	-	4,674	701.09	161	-	862	5,536	6,920	8,650.43
18	80%	6,926	-	-	-	6,926	1,038.94	103	-	1,142	8,068	10,085	12,606.13
19	100%	-	-	1,691	-	1,691	253.66	16	-	269	1,960	2,450	3,062.81
20	100%	-	-	2,732	-	2,732	409.74	63	-	472	3,204	4,005	5,006.33
21	100%	1,400	-	2,643	-	4,043	606.43	6	206	818	4,861	6,076	7,595.35
22	90%	7,227	1,169	-	-	8,396	1,259.46	66	-	1,326	9,722	12,153	15,190.70
23	90%	11,512	-	-	-	11,512	1,726.79	139	-	1,866	13,378	16,723	20,903.25
24	100%	-	-	2,647	-	2,647	397.06	27	-	424	3,071	3,839	4,798.31
25	100%	-	896	1,911	-	2,807	421.00	23	-	445	3,251	4,064	5,079.97
26	100%	-	-	2,902	-	2,902	435.30	176	7,944	8,555	11,457	14,321	17,901.78
27	100%	-	-	2,593	-	2,593	388.91	20	-	409	3,001	3,752	4,689.69
28	100%	-	-	2,194	-	2,194	329.03	19	-	348	2,542	3,177	3,971.41
29	100%	-	-	1,059	-	1,059	158.84	-	-	159	1,218	1,522	1,902.82
30	100%	-	-	4,505	-	4,505	675.70	73	-	748	5,253	6,566	8,207.84
31	100%	-	517	1,658	-	2,175	326.28	-	-	326	2,502	3,127	3,908.60
32	100%	-	-	3,137	-	3,137	470.52	16	-	487	3,624	4,530	5,662.04
33	100%	-	-	5,089	-	5,089	763.39	28	-	791	5,881	7,351	9,188.42
34	100%	-	-	1,483	-	1,483	222.38	39	-	261	1,744	2,179	2,724.28
35	100%	-	-	1,915	-	1,915	287.24	-	-	287	2,202	2,753	3,440.94
36	100%	-	-	1,039	-	1,039	155.92	-	-	156	1,195	1,494	1,867.74
37	100%	-	-	7,660	-	7,660	1,149.05	33	-	1,182	8,843	11,053	13,816.41
38	100%	-	-	2,757	-	2,757	413.59	28	-	442	3,199	3,999	4,998.79
39	100%	-	-	1,961	-	1,961	294.08	-	-	294	2,255	2,818	3,522.88
40	100%	-	1,205	6,463	-	7,668	1,150.14	8	-	1,159	8,826	11,033	13,790.99
41	90%	15,099	-	-	-	15,099	2,264.79	139	-	2,404	17,502	21,878	27,347.36
42	90%	2,676	-	3,102	-	5,778	866.64	14	-	880	6,658	8,323	10,403.27
43	100%	-	-	6,650	-	6,650	997.44	123	-	1,120	7,770	9,712	12,140.01
44	100%	-	-	2,954	-	2,954	443.11	44	-	487	3,442	4,302	5,377.40
45	100%	-	210	3,112	-	3,322	498.30	-	-	498	3,820	4,775	5,969.22
46	100%	-	-	999	-	999	149.78	13	-	163	1,161	1,452	1,814.39
SP 1	100%	424	3,250	11,279	5,632	20,585	3,087.72	-	-	3,088	23,673	29,591	36,988.33
SP 2	100%	7,553	-	-	-	7,553	1,132.95	-	-	1,133	8,686	10,857	13,571.80
SP 3	100%	8,428	-	-	-	8,428	1,264.26	-	-	1,264	9,693	12,116	15,144.78
SP 4	100%	8,202	-	-	-	8,202	1,230.24	-	-	1,230	9,432	11,790	14,737.25
SP 5	100%	4,147	-	-	-	4,147	622.05	-	-	622	4,769	5,961	7,451.64
SP 6	100%	-	-	2,660	2,751	5,410	811.55	-	-	812	6,222	7,777	9,721.67
Grand-total		**127,044**	**11,300**	**134,742**	**23,896**	**296,982**	**44,547**	**13,043**	**40,638**	**98,228**	**395,210**	**494,013**	**617,516**

Peak Season Factor (psf) 1.25

Specific Consumption (Present)	
LD	300
MD	200
HD (a)	85
HD (b)	40

Institutional Consumption 15% of domestic

Physical Leakage in 2012 42.0%

Specific Consumption (2020)	
LD	250
MD	175
HD (a)	80
HD (b)	40

Institutional Consumption 15% of domestic

Physical Leakage in 2020 25.0%

Specific Consumption (2030)	
LD	200
MD	150
HD (a)	80
HD (b)	40

Institutional Consumption 15% of domestic

Physical Leakage in 2030 20.0%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

Harare

Appendix 5-2C: Wastewater Flow Estimates

Ward no.	Ward Name	Category	Present								2020								2030							
			Cov.	Wastewater flow							Cov.	Wastewater flow							Cov.	Wastewater flow						
				LD	MD	HD	Inst	Com.	Ind	Total		LD	MD	HD	Inst	Com.	Ind.	Total		LD	MD	HD	Inst	Com.	Ind.	Total
				$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$		$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$		$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$	$[m^3/day]$
1	Harare South (Rural)		1%	0	-	0	0	24	-	25	50%	222	-	121	320	1,466	-	2,128	100%	710	-	30,668	6,827	3,450	-	41,655
2	Cranborne Park, Queensdale, Braeside, Arcadia, Hillside, Eastlea		100%	5,554	-	-	1,333	96	-	6,982	100%	5,364	-	-	1,287	116	-	6,768	100%	4,795	-	-	1,151	137	-	6,083
3	Mbare		100%	-	-	2,023	286	11	-	2,320	100%	-	-	1,904	269	14	-	2,186	100%	-	-	1,904	269	16	-	2,189
4	Rufaro, Remembrance Drive		100%	-	-	1,357	192	45	-	1,594	100%	-	-	1,277	180	55	-	1,513	100%	-	-	1,277	180	65	-	1,522
5	Ridgeview, Lincoln Green, Belvedere North & South, Milton Park, Nonavale		90%	3,338	-	-	801	15	1,056	5,210	90%	2,782	-	-	668	18	1,282	4,750	90%	2,226	-	-	534	21	1,509	4,289
6	CBD, Avenues		100%	3,986	-	-	957	5,068	836	10,846	100%	3,321	-	-	797	6,154	1,015	11,287	100%	2,657	-	-	638	7,240	1,194	11,728
7	Kensington, Avondale, Alexander Park, Gunhill, Strathaven, Avondale West		100%	5,507	-	-	1,322	101	-	6,930	100%	4,589	-	-	1,101	123	-	5,814	100%	3,672	-	-	881	144	-	4,697
8	Newlands, Highlands, Lewisam, Chisipite, Rietfontein, Colney Valley, Rolf Valley, The Grange		10%	312	-	-	75	11	-	397	10%	276	-	-	66	13	-	355	10%	234	-	-	56	16	-	305
9	Greendale, Msasa , Bingley, Athlone, Mandara, Chikurubi, Wormshill, Greengrove, Lichendale		20%	1,351	-	-	324	30	1,323	3,028	20%	1,323	-	-	318	37	1,607	3,284	20%	1,632	-	-	392	43	1,890	3,957
10	Sunningdale, Graniteside		100%	-	964	1,493	376	-	2,821	5,654	100%	-	844	1,405	343	-	3,425	6,018	100%	-	723	1,405	322	-	4,030	6,481
11	Workington, Southerton, Mbare		100%	-	-	1,882	266	4	6,417	8,568	100%	-	-	1,771	250	5	7,792	9,818	100%	-	-	1,771	250	5	9,167	11,194
12	Mbare		100%	-	-	2,016	285	-	-	2,301	100%	-	-	1,898	268	-	-	2,165	100%	-	-	1,898	268	-	-	2,165
13	Aspindale, Lochinvar, Southerton		100%	-	-	2,088	295	36	2,037	4,457	100%	-	-	2,050	289	44	2,474	4,858	100%	-	-	2,050	289	52	2,910	5,302
14	Kambuzuma		100%	-	534	2,480	442	58	-	3,514	100%	-	467	2,335	410	70	-	3,282	100%	-	401	2,335	398	82	-	3,216
15	Warren Park, Warren Park D, Westlea		100%	-	579	5,678	901	22	-	7,180	100%	-	507	5,514	865	26	-	6,913	100%	-	434	5,514	853	31	-	6,833
16	Tynwald, Nkwisi Park, Sanganayi Park, Ashdown Park, ST Andrews' Park, Haig Park, Sherwood Park	MD	100%	6,553	2,039	-	1,922	34	-	10,547	100%	5,789	1,918	-	1,718	41	-	9,466	100%	5,681	1,988	-	1,704	48	-	9,422
17	Little Norfolk, Mount Pleasant, Groombridge, Borodale West, Northwood, Vainona		70%	2,600	-	-	624	79	-	3,303	70%	2,360	-	-	566	96	-	3,022	70%	2,045	-	-	491	113	-	2,648
18	Borrodale, Colray, Greystone Park, Helensvale, Quinnington, Chiltern Hills, Borrodale Brook, Philadelphia		10%	461	-	-	111	7	-	579	10%	436	-	-	105	9	-	550	10%	433	-	-	104	10	-	547
19	Mabvuku		100%	-	-	1,909	270	11	-	2,189	100%	-	-	1,797	254	13	-	2,064	100%	-	-	1,797	254	16	-	2,066
20	Tafara		100%	-	-	2,181	308	44	-	2,532	100%	-	-	2,477	350	53	-	2,880	100%	-	-	2,902	410	63	-	3,375
21	Mabvuku		100%	-	-	2,080	294	4	126	2,504	100%	219	-	2,383	389	5	153	3,149	100%	875	-	2,808	606	6	180	4,476
22	Logan Park, Hatfield, Park Meadowland, Chadcombe, Msasa Park		10%	640	66	-	165	5	-	876	10%	533	72	-	140	6	-	751	10%	452	102	-	126	7	-	687
23	Grobie Park, Induna, Waterfalls, Midlands, Malvern, Park Town, Prospect, Ardbennie, Houghton Park		10%	899	-	-	216	10	-	1,125	10%	799	-	-	192	12	-	1,003	10%	719	-	-	173	14	-	906
24	Highfield, Paradise, Ardbennie		100%	-	-	2,663	376	19	-	3,058	100%	-	-	2,812	397	23	-	3,232	100%	-	-	2,812	397	27	-	3,236
25	Highfield		100%	-	1,045	2,157	484	16	-	3,702	100%	-	914	2,030	443	20	-	3,408	100%	-	784	2,030	421	23	-	3,259
26	Willowvale, Highfield		100%	-	-	3,276	463	123	4,866	8,727	100%	-	-	3,083	435	150	5,908	9,577	100%	-	-	3,083	435	176	6,951	10,646
27	Glen Norah C		100%	-	-	2,927	413	14	-	3,354	100%	-	-	2,755	389	17	-	3,160	100%	-	-	2,755	389	20	-	3,163
28	Glen View 7, Glen Norah		100%	-	-	2,476	350	13	-	2,839	100%	-	-	2,331	329	16	-	2,676	100%	-	-	2,331	329	19	-	2,679
29	Glen Norah		100%	-	-	1,195	169	-	-	1,364	100%	-	-	1,125	159	-	-	1,284	100%	-	-	1,125	159	-	-	1,284
30	Glen View		100%	-	-	4,832	682	51	-	5,566	100%	-	-	4,786	676	62	-	5,524	100%	-	-	4,786	676	73	-	5,535
31	Glen View No. 1, 3 & 9		100%	-	603	1,764	352	-	-	2,719	100%	-	528	1,762	339	-	-	2,629	100%	-	452	1,762	326	-	-	2,541
32	Glenview No. 6		100%	-	-	3,361	474	11	-	3,846	100%	-	-	3,333	471	14	-	3,817	100%	-	-	3,333	471	16	-	3,820
33	Budiriro 1, 2 & 3		100%	-	-	5,429	766	20	-	6,215	100%	-	-	5,407	763	24	-	6,194	100%	-	-	5,407	763	28	-	6,199
34	Mufakose		100%	-	-	1,674	236	27	-	1,937	100%	-	-	1,575	222	33	-	1,830	100%	-	-	1,575	222	39	-	1,836
35	Marimba		100%	-	-	2,162	305	-	-	2,467	100%	-	-	2,035	287	-	-	2,322	100%	-	-	2,035	287	-	-	2,322
36	New Marimba Park, Mufakose		100%	-	-	1,173	166	-	-	1,339	100%	-	-	1,104	156	-	-	1,260	100%	-	-	1,104	156	-	-	1,260
37	Mufakose, Crowborough, Crowborough North, Kuwadzana		100%	-	-	6,390	902	23	-	7,315	100%	-	-	7,714	1,089	28	-	8,831	100%	-	-	8,139	1,149	33	-	9,321
38	Kuwadzana		100%	-	-	3,113	439	20	-	3,572	100%	-	-	2,930	414	24	-	3,367	100%	-	-	2,930	414	28	-	3,372
39	Dzivaresekwa		100%	-	-	2,213	312	-	-	2,526	100%	-	-	2,083	294	-	-	2,377	100%	-	-	2,083	294	-	-	2,377
40	Glaudina, Dzivaresekwa Extension, Dzivaresekwa		100%	-	793	3,683	656	6	-	5,138	100%	-	828	5,802	961	7	-	7,599	100%	-	1,054	6,867	1,150	8	-	9,080
41	Tynwald North, New Bluff Hill, New Bluff Hill Park, Bluff Hill, Adylinn, Marlborough, New Marlborough, Avonlea, Emerald Hill, Ash		70%	6,601	-	-	1,584	68	-	8,253	70%	6,052	-	-	1,452	83	-	7,587	70%	6,606	-	-	1,585	97	-	8,288
42	Hatcliffe		100%	213	-	1,945	326	10	-	2,493	100%	561	-	2,746	522	12	-	3,841	100%	1,673	-	3,295	867	14	-	5,848
43	Budiriro 5		100%	-	-	5,520	779	86	-	6,385	100%	-	-	6,640	937	104	-	7,682	100%	-	-	7,065	997	123	-	8,185
44	Kuwadzana Phase 4 Extension		100%	-	-	2,432	343	31	-	2,806	100%	-	-	3,139	443	38	-	3,620	100%	-	-	3,139	443	44	-	3,626
45	Kuwadzana Phase 3, Tynwald South		100%	-	-	2,610	368	-	-	2,979	100%	-	54	3,307	476	-	-	3,836	100%	-	184	3,307	498	-	-	3,989
46	Tafara		100%	-	-	947	134	9	-	1,089	100%	-	-	1,061	150	11	-	1,222	100%	-	-	1,061	150	13	-	1,224
SP 1	Harare Extension - Zwimba 35		0%	-	-	-	-	-	-	-	10%	33	181	-	71	-	-	285	10%	26	284	1,198	309	-	-	1,818
SP 2	Harare Extension - Zwimba 24		0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-
SP 3	Harare Extension - Mazowe 20		0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-
SP 4	Harare Extension - Goromonzi 6		0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-
SP 5	Harare Extension - Goromonzi 7		0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-
SP 6	Harare Extension - Goromonzi 25		0%	-	-	-	-	-	-	-	30%	-	-	-	86	-	-	86	50%	-	-	1,413	406	-	-	1,819
Total				**38,014**	**6,624**	**89,131**	**22,842**	**6,262**	**19,481**	**182,354**		**34,660**	**6,313**	**94,493**	**23,108**	**9,040**	**23,656**	**191,270**		**34,435**	**6,407**	**130,965**	**30,470**	**12,361**	**27,830**	**242,468**

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Appendix 5-3A: Proportion of Population in Housing Categories

Ward No.	Ward Name	Category	Area	Present								
				% in consumer category				Population in consumer category				
				LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
			[ha]	[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	St Marys	Mixed (HD/LD)	112	10%	0%	90%	0%	826		7,436		8,262
2	St Marys	Mixed (HD/LD)	112	10%	0%	90%	0%	1,117		10,052		11,169
3	St Marys	HD	110	0%	0%	100%	0%			10,057		10,057
4	St Marys	HD	251	0%	0%	100%	0%			27,560		27,560
5	St Marys	HD	56	0%	0%	100%	0%			10,620		10,620
6	Zengeza 5	HD	903	0%	0%	100%	0%			17,339		17,339
7	Zengeza 1	HD	28	0%	0%	100%	0%			7,988		7,988
8	Zengeza 1	HD	60	0%	0%	100%	0%			10,119		10,119
9	Zengeza 2	HD	87	0%	0%	100%	0%			8,229		8,229
10	Zengeza 2	HD	163	0%	0%	100%	0%			8,788		8,788
11	Zengeza 3	HD	82	0%	0%	100%	0%			9,392		9,392
12	Zengeza 3	HD	491	0%	0%	100%	0%			15,129		15,129
13	Zengeza 4	Mixed (HD/LD)	163	5%	0%	95%	0%	474		9,015		9,489
14	Zengeza 4	HD	183	0%	0%	100%	0%			15,484		15,484
15	Seke Unit D	HD	231	0%	0%	100%	0%			13,781		13,781
16	Seke Unit J	HD	181	0%	0%	100%	0%			14,730		14,730
17	Seke Unit K	Mixed (HD/LD)	140	5%	0%	95%	0%	762		14,480		15,242
18	Seke Unit L	Mixed (HD/Inf.)	478	0%	0%	80%	20%			15,774	3,943	19,717
19	Seke Unit F+C	HD	156	0%	0%	100%	0%			16,712		16,712
20	Seke Unit E+H	HD	65	0%	0%	100%	0%			11,308		11,308
21	Seke Unit A+B	Mixed (HD/MD)	198	0%	30%	70%	0%		5,600	13,066		18,666
22	Seke Unit O	Mixed (HD/Inf.)	129	0%	0%	80%	20%			12,150	3,037	15,187
23	Seke Unit N+P	Mixed (HD/Inf.)	231	0%	0%	80%	20%			22,458	5,615	28,073
24	Seke Unit M	Mixed (HD/Inf.)	158	0%	0%	80%	20%			16,558	4,139	20,697
25	Seke Unit G	Mixed (HD/LD)	340	10%	0%	90%	0%	1,310		11,792		13,102
SP 1	Seke CL	HD										
SP 2	Nyatsime Farm	HD										
	Grand-total		**5,106**					**4,489**	**5,600**	**330,017**	**16,734**	**356,840**

Ward No.	Ward Name	2020								
		% in consumer category				Population in consumer category				
		LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
		[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	St Marys	10%	0%	90%	0%	850		7,436		8,286
2	St Marys	10%	0%	90%	0%	1,141		10,052		11,193
3	St Marys	0%	0%	100%	0%			10,057		10,057
4	St Marys	0%	0%	100%	0%			27,560		27,560
5	St Marys	0%	0%	100%	0%			10,620		10,620
6	Zengeza 5	0%	3%	97%	0%		461	17,339		17,800
7	Zengeza 1	0%	0%	100%	0%			7,988		7,988
8	Zengeza 1	0%	0%	100%	0%			10,119		10,119
9	Zengeza 2	0%	0%	100%	0%			8,229		8,229
10	Zengeza 2	2%	0%	98%	0%	171		9,738		9,909
11	Zengeza 3	0%	0%	100%	0%			9,392		9,392
12	Zengeza 3	0%	0%	100%	0%			15,129		15,129
13	Zengeza 4	5%	0%	95%	0%	490		9,015		9,505
14	Zengeza 4	0%	0%	100%	0%			16,884		16,884
15	Seke Unit D	0%	0%	100%	0%			13,781		13,781
16	Seke Unit J	0%	0%	100%	0%			14,730		14,730
17	Seke Unit K	5%	0%	95%	0%	774		14,480		15,254
18	Seke Unit L	0%	0%	88%	12%			27,801	3,943	31,744
19	Seke Unit F+C	0%	0%	100%	0%			16,712		16,712
20	Seke Unit E+H	0%	0%	100%	0%			11,308		11,308
21	Seke Unit A+B	0%	30%	70%	0%		5,600	13,066		18,666
22	Seke Unit O	0%	0%	76%	24%			12,150	3,787	15,937
23	Seke Unit N+P	0%	0%	78%	22%			22,458	6,365	28,823
24	Seke Unit M	0%	0%	77%	23%			16,558	4,889	21,447
25	Seke Unit G	11%	0%	89%	0%	1,432		11,792		13,224
SP 1	Seke CL	0%	0%	100%	0%			11,902		11,902
SP 2	Nyatsime Farm									0
	Grand-total					**4,858**	**6,061**	**356,296**	**18,984**	**386,199**

Ward No.	Ward Name	2030								
		% in consumer category				Population in consumer category				
		LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
		[%]	[%]	[%]		[No]	[No]	[No]		[No]
1	St Marys	12%	0%	88%	0%	967		7,436		8,403
2	St Marys	11%	0%	89%	0%	1,258		10,052		11,310
3	St Marys	0%	0%	100%	0%			10,057		10,057
4	St Marys	0%	0%	100%	0%			27,560		27,560
5	St Marys	0%	0%	100%	0%			10,620		10,620
6	Zengeza 5	0%	13%	87%	0%		2,542	17,339		19,881
7	Zengeza 1	0%	0%	100%	0%			7,988		7,988
8	Zengeza 1	0%	0%	100%	0%			10,119		10,119
9	Zengeza 2	0%	0%	100%	0%			8,229		8,229
10	Zengeza 2	9%	0%	91%	0%	940		9,738		10,678
11	Zengeza 3	0%	0%	100%	0%			9,392		9,392
12	Zengeza 3	0%	0%	100%	0%			15,129		15,129
13	Zengeza 4	6%	0%	94%	0%	548		9,015		9,563
14	Zengeza 4	0%	0%	100%	0%			16,884		16,884
15	Seke Unit D	0%	0%	100%	0%			13,781		13,781
16	Seke Unit J	0%	0%	100%	0%			14,730		14,730
17	Seke Unit K	5%	0%	95%	0%	829		14,480		15,309
18	Seke Unit L	0%	0%	90%	10%			35,974	3,943	39,917
19	Seke Unit F+C	0%	0%	100%	0%			16,712		16,712
20	Seke Unit E+H	0%	0%	100%	0%			11,308		11,308
21	Seke Unit A+B	0%	30%	70%	0%		5,600	13,066		18,666
22	Seke Unit O	0%	0%	76%	24%			12,150	3,787	15,937
23	Seke Unit N+P	0%	0%	78%	22%			22,458	6,365	28,823
24	Seke Unit M	0%	0%	77%	23%			16,558	4,889	21,447
25	Seke Unit G	14%	0%	86%	0%	1,981		11,792		13,773
SP 1	Seke CL	0%	0%	100%	0%			20,000		20,000
SP 2	Nyatsime Farm	0%	0%	100%	0%			112,558		112,556
	Grand-total					**6,523**	**8,142**	**485,125**	**18,984**	**518,772**

Category	2012		2020		2030	
	Population	Prop (%)	Population	Prop (%)	Population	Prop (%)
LD	4,489	1%	4,858	1%	6,523	1%
MD	5,600	2%	6,061	2%	8,142	2%
HD (a)	330,017	92%	356,296	92%	485,125	94%
HD (b)	16,734	5%	18,984	5%	18,984	4%
Total	356,840	100%	386,199	100%	518,774	100%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

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Appendix 5-3B: Water Demand forecast

Present

Ward No	Ward Name	Category	Area [ha]	Service Coverage [%]	Consumption – Domestic LD [m³/day]	Domestic MD [m³/day]	Domestic HD (a) [m³/day]	Domestic HD (b) [m³/day]	Domestic sub-Total [m³/day]	Non-domestic Inst. [m³/day]	Non-domestic Com. [m³/day]	Non-domestic Ind. [m³/day]	Non-domestic Sub-total [m³/day]	Total [m³/day]	Ave. Dem (incl. NRW) [m³/day]	Peak Season Demand [m³/day]
1	St Marys	HD, LD	112	100%	248	-	632	-	880	132	-	-	132	1,012	1,466	1,833.04
2	St Marys	HD, LD	112	100%	335	-	854	-	1,190	178	-	-	178	1,368	1,983	2,478.17
3	St Marys	HD	110	100%	-	-	855	-	855	128	19	-	148	1,002	1,453	1,816.09
4	St Marys	HD	251	100%	-	-	2,343	-	2,343	351	-		351	2,694	3,904	4,880.42
5	St Marys	HD	56	100%	-	-	903	-	903	135	14		149	1,052	1,525	1,905.93
6	Zengeza 5	HD	903	100%	-	-	1,474	-	1,474	221	-		221	1,695	2,456	3,070.45
7	Zengeza 1	HD	28	100%	-	-	679	-	679	102	-		102	781	1,132	1,414.54
8	Zengeza 1	HD	60	100%	-	-	860	-	860	129	-		129	989	1,434	1,791.91
9	Zengeza 2	HD	87	100%	-	-	699	-	699	105	30		135	835	1,209	1,511.87
10	Zengeza 2	HD	163	100%	-	-	747	-	747	112	50		162	909	1,318	1,647.14
11	Zengeza 3	HD	82	100%	-	-	798	-	798	120	8		128	926	1,342	1,677.76
12	Zengeza 3	HD	491	100%	-	-	1,286	-	1,286	193	-	1,811	2,004	3,290	4,768	5,959.45
13	Zengeza 4	HD, LD	163	100%	142	-	766	-	908	136	59		195	1,104	1,600	1,999.87
14	Zengeza 4	HD	183	100%	-	-	1,316	-	1,316	197	415		613	1,929	2,796	3,494.59
15	Seke Unit D	HD	231	100%	-	-	1,171	-	1,171	176	617		793	1,964	2,846	3,557.95
16	Seke Unit J	HD	181	100%	-	-	1,252	-	1,252	188	11		199	1,451	2,103	2,628.21
17	Seke Unit K	HD, LD	140	100%	229	-	1,231	-	1,459	219	32		251	1,710	2,478	3,097.79
18	Seke Unit L	HD, Informal	478	40%	-	-	536	63	599	90	71		161	761	1,102	1,377.86
19	Seke Unit F+C	HD	156	100%	-	-	1,421	-	1,421	213	-		213	1,634	2,368	2,959.42
20	Seke Unit E+H	HD	65	100%	-	-	961	-	961	144	-		144	1,105	1,602	2,002.46
21	Seke Unit A+B	HD, MD	198	100%	-	1,120	1,111	-	2,231	335	-		335	2,565	3,718	4,647.10
22	Seke Unit O	HD, Informal	129	90%	-	-	929	109	1,039	156	8		164	1,202	1,743	2,178.42
23	Seke Unit N+P	HD, Informal	231	90%	-	-	1,718	202	1,920	288	36		325	2,245	3,253	4,066.48
24	Seke Unit M	HD, Informal	158	80%	-	-	1,126	132	1,258	189	-		189	1,447	2,097	2,621.65
25	Seke Unit G	HD	340	100%	393	-	1,002	-	1,395	209	309		519	1,914	2,774	3,467.20
SP 1	Seke CL			0%	-	-	-	-	-	-	-		-	0	-	-
SP 2	Nyatsime Farm			0%	-	-	-	-	-	-			-	0	-	-
	Grand-total				**1,347**	**1,120**	**26,671**	**507**	**29,645**	**4,447**	**1,681**	**1,811**	**7,938**	**37,583**	**54,469**	**68,086**

2020

Ward No	Ward Name	Service Coverage [%]	Domestic LD [m³/day]	Domestic MD [m³/day]	Domestic HD (a) [m³/day]	Domestic HD (b) [m³/day]	Domestic sub-total [m³/day]	Non-domestic Inst. [m³/day]	Non-domestic Com. [m³/day]	Non-domestic Ind. [m³/day]	Non-domestic sub-total [m³/day]	Total [m³/day]	Ave. Dem (incl. NRW) [m³/day]	Peak Season Demand [m³/day]
1	St Marys	100%	213	-	595	-	807	121	-		121	928	1,238	1,547.48
2	St Marys	100%	285	-	804	-	1,089	163	-		163	1,253	1,670	2,088.04
3	St Marys	100%	-	-	805	-	805	121	19		140	945	1,260	1,574.43
4	St Marys	100%	-	-	2,205	-	2,205	331	-		331	2,536	3,381	4,225.87
5	St Marys	100%	-	-	850	-	850	127	14		141	991	1,321	1,651.68
6	Zengeza 5	100%	-	81	1,387	-	1,468	220	-		220	1,688	2,251	2,813.27
7	Zengeza 1	100%	-	-	639	-	639	96	-		96	735	980	1,224.83
8	Zengeza 1	100%	-	-	810	-	810	121	-		121	931	1,241	1,551.58
9	Zengeza 2	100%	-	-	658	-	658	99	30		129	787	1,050	1,312.06
10	Zengeza 2	100%	43	-	779	-	822	123	50		173	995	1,327	1,658.75
11	Zengeza 3	100%	-	-	751	-	751	113	8		121	872	1,163	1,453.53
12	Zengeza 3	100%	-	-	1,210	-	1,210	182	-	2,587	2,768	3,979	5,305	6,631.10
13	Zengeza 4	100%	123	-	721	-	844	127	59		186	1,029	1,373	1,715.73
14	Zengeza 4	100%	-	-	1,351	-	1,351	203	415		618	1,969	2,625	3,281.30
15	Seke Unit D	100%	-	-	1,102	-	1,102	165	617		782	1,885	2,513	3,141.25
16	Seke Unit J	100%	-	-	1,178	-	1,178	177	11		188	1,366	1,821	2,276.79
17	Seke Unit K	100%	194	-	1,158	-	1,352	203	32		234	1,586	2,115	2,643.92
18	Seke Unit L	100%	-	-	2,224	158	2,382	357	71		429	2,810	3,747	4,683.89
19	Seke Unit F+C	100%	-	-	1,337	-	1,337	201	-		201	1,538	2,050	2,562.51
20	Seke Unit E+H	100%	-	-	905	-	905	136	-		136	1,040	1,387	1,733.89
21	Seke Unit A+B	100%	-	980	1,045	-	2,025	304	-		304	2,329	3,105	3,881.79
22	Seke Unit O	100%	-	-	972	151	1,123	169	8		176	1,300	1,733	2,166.44
23	Seke Unit N+P	100%	-	-	1,797	255	2,051	308	36		344	2,395	3,194	3,992.36
24	Seke Unit M	100%	-	-	1,325	196	1,520	228	-		228	1,748	2,331	2,913.72
25	Seke Unit G	100%	358	-	943	-	1,301	195	309		504	1,806	2,408	3,009.73
SP 1	Seke CL	100%	-	-	952	-	952	143	-		143	1,095	1,460	1,824.97
SP 2	Nyatsime Farm	100%	-	-	-	-	-	-	338		338	338	450	562.50
	Grand-total		**1,215**	**1,061**	**28,504**	**759**	**31,538**	**4,731**	**2,018**	**2,587**	**9,336**	**40,874**	**54,499**	**68,123**

2030

Ward No	Ward Name	Service Coverage [%]	Domestic LD [m³/day]	Domestic MD [m³/day]	Domestic HD (a) [m³/day]	Domestic HD (b) [m³/day]	Domestic sub-total [m³/day]	Non-domestic Inst. [m³/day]	Non-domestic Com. [m³/day]	Non-domestic Ind. [m³/day]	Non-domestic sub-total [m³/day]	Total [m³/day]	Ave. Dem (incl. NRW) [m³/day]	Peak Season Demand [m³/day]
1	St Marys	100%	193	-	595	-	788	118.24	-		118	907	1,133	1,416.44
2	St Marys	100%	252	-	804	-	1,056	158.36	-		158	1,214	1,518	1,897.07
3	St Marys	100%	-	-	805	-	805	120.68	19		140	945	1,181	1,476.03
4	St Marys	100%	-	-	2,205	-	2,205	330.72	-		331	2,536	3,169	3,961.75
5	St Marys	100%	-	-	850	-	850	127.44	14		141	991	1,239	1,548.45
6	Zengeza 5	100%	-	381	1,387	-	1,768	265.26	-		265	2,034	2,542	3,177.63
7	Zengeza 1	100%	-	-	639	-	639	95.86	-		96	735	919	1,148.28
8	Zengeza 1	100%	-	-	810	-	810	121.43	-		121	931	1,164	1,454.61
9	Zengeza 2	100%	-	-	658	-	658	98.75	30		129	787	984	1,230.05
10	Zengeza 2	100%	188	-	779	-	967	145.06	50		195	1,162	1,453	1,816.08
11	Zengeza 3	100%	-	-	751	-	751	112.70	8		121	872	1,090	1,362.68
12	Zengeza 3	100%	-	-	1,210	-	1,210	181.55	-	2,587	2,768	3,979	4,973	6,216.66
13	Zengeza 4	100%	110	-	721	-	831	124.62	59		184	1,015	1,268	1,585.32
14	Zengeza 4	100%	-	-	1,351	-	1,351	202.61	415		618	1,969	2,461	3,076.22
15	Seke Unit D	100%	-	-	1,102	-	1,102	165.37	617		782	1,885	2,356	2,944.92
16	Seke Unit J	100%	-	-	1,178	-	1,178	176.76	11		188	1,366	1,708	2,134.49
17	Seke Unit K	100%	166	-	1,158	-	1,324	198.63	32		230	1,554	1,943	2,428.91
18	Seke Unit L	100%	-	-	2,878	158	3,036	455.35	71		527	3,562	4,453	5,566.01
19	Seke Unit F+C	100%	-	-	1,337	-	1,337	200.54	-		201	1,538	1,922	2,402.35
20	Seke Unit E+H	100%	-	-	905	-	905	135.70	-		136	1,040	1,300	1,625.53
21	Seke Unit A+B	100%	-	840	1,045	-	1,885	282.79	-		283	2,168	2,710	3,387.61
22	Seke Unit O	100%	-	-	972	151	1,123	168.52	8		176	1,300	1,625	2,031.03
23	Seke Unit N+P	100%	-	-	1,797	255	2,051	307.69	36		344	2,395	2,994	3,742.84
24	Seke Unit M	100%	-	-	1,325	196	1,520	228.03	-		228	1,748	2,185	2,731.61
25	Seke Unit G	100%	396	-	943	-	1,340	200.93	309		510	1,850	2,312	2,890.26
SP 1	Seke CL	100%	-	-	1,600	-	1,600	240.00	-	-	240	1,840	2,300	2,875.00
SP 2	Nyatsime Farm	100%	-	-	9,005	-	9,005	1,350.70	900	1,200	3,451	12,455	15,569	19,461.46
	Grand-total		**1,305**	**1,221**	**38,810**	**759**	**42,095**	**6,314**	**2,581**	**3,787**	**12,682**	**54,777**	**68,471**	**85,589**

Peak Season Factor (psf) 1.25

Specific Consumption	Present	2020	2030
LD	300	250	200
MD	200	175	150
HD (a)	85	80	80
HD (b)	40	40	40

Institutional Consumption 15% of domestic

Institutional Consumption 15% of domestic

Institutional Consumption 15% of domestic

Physical Leakage in 2012 31.0%

Physical Leakage in 2020 25.0%

Physical Leakage in 2030 20.0%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

CHITUNGWIZA
Appendix 5-3C: Wastewater Flow Estimates

Ward no.	Ward Name	Category	Present							2020							2030						
			Wastewater flow							Wastewater flow							Wastewater flow						
			LD	MD	HD	Inst	Com.	Ind	Total	LD	MD	HD	Inst	Com.	Ind.	Total	LD	MD	HD	Inst	Com.	Ind.	Total
			[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]	[m^3/day]
1	St Marys	HD, LD	155	-	672	132	-	-	958	133	-	632	121	-	-	886	121	-	632	118	-	-	871
2	St Marys	HD, LD	209	-	908	178	-	-	1,296	178	-	854	163	-	-	1,196	157	-	854	158	-	-	1,170
3	St Marys	HD	-	-	908	128	19	-	1,056	-	-	855	121	19	-	995	-	-	855	121	19	-	995
4	St Marys	HD	-	-	2,489	351	-	-	2,840	-	-	2,343	331	-	-	2,673	-	-	2,343	331	-	-	2,673
5	St Marys	HD	-	-	959	135	14	-	1,108	-	-	903	127	14	-	1,044	-	-	903	127	14	-	1,044
6	Zengeza 5	HD	-	-	1,566	221	-	-	1,787	-	71	1,474	220	-	-	1,765	-	334	1,474	265	-	-	2,073
7	Zengeza 1	HD	-	-	721	102	-	-	823	-	-	679	96	-	-	775	-	-	679	96	-	-	775
8	Zengeza 1	HD	-	-	914	129	-	-	1,043	-	-	860	121	-	-	982	-	-	860	121	-	-	982
9	Zengeza 2	HD	-	-	743	105	30	-	878	-	-	699	99	30	-	828	-	-	699	99	30	-	828
10	Zengeza 2	HD	-	-	794	112	50	-	956	27	-	828	123	50	-	1,028	118	-	828	145	50	-	1,140
11	Zengeza 3	HD	-	-	848	120	8	-	976	-	-	798	113	8	-	919	-	-	798	113	8	-	919
12	Zengeza 3	HD	-	-	1,366	193	-	1,584	3,144	-	-	1,286	182	-	2,263	3,731	-	-	1,286	182	-	2,263	3,731
13	Zengeza 4	HD, LD	89	-	814	136	59	-	1,098	77	-	766	127	59	-	1,029	69	-	766	125	59	-	1,019
14	Zengeza 4	HD	-	-	1,398	197	415	-	2,011	-	-	1,435	203	415	-	2,053	-	-	1,435	203	415	-	2,053
15	Seke Unit D	HD	-	-	1,245	176	617	-	2,037	-	-	1,171	165	617	-	1,954	-	-	1,171	165	617	-	1,954
16	Seke Unit J	HD	-	-	1,330	188	11	-	1,529	-	-	1,252	177	11	-	1,440	-	-	1,252	177	11	-	1,440
17	Seke Unit K	HD, LD	143	-	1,308	219	32	-	1,701	121	-	1,231	203	32	-	1,586	104	-	1,231	199	32	-	1,565
18	Seke Unit L	HD, Informal	-	-	570	90	71	-	731	-	-	2,363	357	71	-	2,792	-	-	3,058	455	71	-	3,584
19	Seke Unit F+C	HD	-	-	1,509	213	-	-	1,722	-	-	1,421	201	-	-	1,621	-	-	1,421	201	-	-	1,621
20	Seke Unit E+H	HD	-	-	1,021	144	-	-	1,165	-	-	961	136	-	-	1,097	-	-	961	136	-	-	1,097
21	Seke Unit A+B	HD, MD	-	980	1,180	335	-	-	2,495	-	858	1,111	304	-	-	2,272	-	735	1,111	283	-	-	2,128
22	Seke Unit O	HD, Informal	-	-	988	156	8	-	1,151	-	-	1,033	169	8	-	1,209	-	-	1,033	169	8	-	1,209
23	Seke Unit N+P	HD, Informal	-	-	1,825	288	36	-	2,150	-	-	1,909	308	36	-	2,253	-	-	1,909	308	36	-	2,253
24	Seke Unit M	HD, Informal	-	-	1,196	189	-	-	1,385	-	-	1,407	228	-	-	1,635	-	-	1,407	228	-	-	1,635
25	Seke Unit G	HD	246	-	1,065	209	309	-	1,829	224	-	1,002	195	309	-	1,731	248	-	1,002	201	309	-	1,760
SP 1	Seke CL		-	-	-	-	-	-	-	-	-	1,012	143	-	-	1,154	-	-	1,700	240	-	-	1,940
SP 2	Nyatsime Farm		-	-	-	-	-	-	-	-	-	-	-	338	-	338	-	-	9,567	1,351	900	1,050	12,868
Total			**842**	**980**	**28,338**	**4,447**	**1,681**	**1,584**	**37,872**	**759**	**928**	**30,285**	**4,731**	**2,018**	**2,263**	**40,985**	**815**	**1,069**	**41,236**	**6,314**	**2,581**	**3,313**	**55,328**

Epworth

Appendix 5-4A: Proportion of Population in Housing Categories

Present

Ward No.	Ward Name	Category	Area	% LD	% MD	% HD (a)	% HD (b)	Pop. LD	Pop. MD	Pop. HD (a)	Pop. HD (b)	Total
			[ha]	[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	Muguta	LD/Inf	80	25%	0%	0%	75%	7,884			23,653	31,537
2	Makomo	MD/Inf	117	0%	90%	0%	10%		13,447		1,494	14,941
3	Dombo la Mwari	MD/(HD/Inf	288	0%	30%	60%	10%		4,806	9,612	1,602	16,020
4	Chizungu	LD/Inf	156	30%	0%	0%	70%	6,996			16,324	23,320
5	Maseko	MD/Inf	215	0%	90%	0%	10%		14,646		1,627	16,273
6	Overspill	MD/Inf	485	0%	5%	0%	95%		1,291		24,528	25,819
7	Ward 7	MD/Inf	281	0%	20%	0%	80%		7,910		31,642	39,552
SP-1	Ext W3/W4											0
	Grand-total		**1,622**					**14,880**	**42,100**	**9,612**	**100,870**	**167,462**

2020

Ward No.	Ward Name	% LD	% MD	% HD (a)	% HD (b)	Pop. LD	Pop. MD	Pop. HD (a)	Pop. HD (b)	Total
		[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	Muguta	23%	0%	0%	77%	7,884			26,153	34,037
2	Makomo	0%	90%	0%	10%		13,447		1,494	14,941
3	Dombo la Mwari	0%	24%	68%	8%		4,806	13,612	1,602	20,020
4	Chizungu	23%	0%	0%	77%	9,796			32,798	42,594
5	Maseko	0%	90%	0%	10%		14,646		1,627	16,273
6	Overspill	8%	4%	0%	89%	2,800	1,291		32,528	36,619
7	Ward 7	0%	20%	0%	80%		7,910		31,642	39,552
SP-1	Ext W3/W4									
	Grand-total					**20,480**	**42,100**	**13,612**	**127,844**	**204,036**

2030

Ward No.	Ward Name	% LD	% MD	% HD (a)	% HD (b)	Pop. LD	Pop. MD	Pop. HD (a)	Pop. HD (b)	Total
		[%]	[%]	[%]		[No]	[No]	[No]		[No]
1	Muguta	23%	0%	38%	38%	7,884		13,077	13,076	34,037
2	Makomo	0%	90%	10%	0%		13,447	1,494		14,941
3	Dombo la Mwari	0%	24%	76%	0%		4,806	15,214		20,020
4	Chizungu	23%	0%	39%	39%	9,796		16,399	16,399	42,594
5	Maseko	0%	90%	10%	0%		14,646	1,627		16,273
6	Overspill	8%	4%	44%	44%	2,800	1,291	16,264	16,264	36,619
7	Ward 7	0%	20%	40%	40%		7,910	15,821	15,821	39,552
SP-1	Ext W3/W4	0%	0%	0%	100%				44,683	44,683
	Grand-total					**20,480**	**42,100**	**79,896**	**106,243**	**248,719**

Category	2012 Population	2012 Prop (%)	2020 Population	2020 Prop (%)	2030 Population	2030 Prop (%)
LD	14,880	9%	20,480	10%	20,480	8%
MD	42,100	25%	42,100	21%	42,100	17%
HD (a)	9,612	6%	13,612	7%	79,896	32%
HD (b)	100,870	60%	127,844	63%	106,243	43%
Total	167,462	100%	204,036	100%	248,719	100%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

Epworth

Appendix 5-4B: Water Demand forecast

Present (Physical Leakage in 2012)

Ward No	Ward Name	Category	Area [ha]	Service Coverage [%]	Domestic LD [m3/day]	Domestic MD [m3/day]	Domestic HD (a) [m3/day]	Domestic HD (b)	Domestic sub-Total	Non-domestic Inst. [m3/day]	Non-domestic Com. [m3/day]	Non-domestic Ind. [m3/day]	Non-domestic Sub-total [m3/day]	Total [m3/day]	Ave. Dem (incl. NRW)	Peak Season Demand
1	Muguta	LD/Inf	802	35%	827.82	-	-	331.14	1,159	174	25		199	1,358	2,089	2,611.55
2	Makomo	MD/Inf	275	90%	-	2,420	-	53.78	2,474	371	-		371	2,845	4,378	5,471.89
3	Dombo la Mwari	MD/(HD/Inf	877	50%	-	481	409	32.04	921	138	11		149	1,071	1,647	2,058.79
4	Chizungu	LD/Inf	30	30%	629.64	-	-	195.89	826	124	-		124	949	1,461	1,825.69
5	Maseko	MD/Inf	20	90%	-	2,636	-	58.57	2,695	404	11		415	3,110	4,784	5,980.54
6	Overspill	MD/Inf	36	5%	-	13	-	49.06	62	9	-		9	71	110	137.04
7	Ward 7	MD/Inf	501	20%	-	316	-	253.14	570	85	-		85	655	1,008	1,259.55
Ext W3/W4					-	-	-	-	-	-	-		-	0	-	-
	Grand-total				**1,457**	**5,867**	**409**	**974**	**8,706**	**1,306**	**47**	**-**	**1,353**	**10,059**	**15,476**	**19,345**

Present (Physical Leakage in 2020)

Ward	Service Coverage [%]	Domestic LD [m3/day]	Domestic MD [m3/day]	Domestic HD (a) [m3/day]	Domestic HD (b) [m3/day]	Domestic sub-total [m3/day]	Non-domestic Inst. [m3/day]	Non-domestic Com. [m3/day]	Non-domestic Ind. [m3/day]	Non-domestic sub-total [m3/day]	Total [m3/day]	Ave. Dem (incl. NRW) [m3/day]	Peak Season Demand [m3/day]
1 Muguta	100%	1,971	-	-	1,046	3,017	453	38		490	3,507	4,676	5,845.31
2 Makomo	100%	-	2,353	-	60	2,413	362	8		369	2,782	3,710	4,637.39
3 Dombo la Mwari	100%	-	841	1,089	64	1,994	299	17		316	2,310	3,080	3,849.51
4 Chizungu	100%	2,449	-	-	1,312	3,761	564	10		574	4,335	5,780	7,225.18
5 Maseko	100%	-	2,563	-	65	2,628	394	32		426	3,054	4,072	5,089.75
6 Overspill	100%	700	226	-	1,301	2,227	334	14		348	2,575	3,433	4,291.00
7 Ward 7	100%	-	1,384	-	1,266	2,650	397	12		409	3,059	4,079	5,098.53
Ext W3/W4	100%	-	-	-	-	-	-	-		-	0	-	-
Grand-total		**5,120**	**7,368**	**1,089**	**5,114**	**18,690**	**2,804**	**128**	**-**	**2,932**	**21,622**	**28,829**	**36,037**

2030

Ward	Service Coverage [%]	Domestic LD [m3/day]	Domestic MD [m3/day]	Domestic HD (a) [m3/day]	Domestic HD (b) [m3/day]	Domestic sub-total [m3/day]	Non-domestic Inst. [m3/day]	Non-domestic Com. [m3/day]	Non-domestic Ind. [m3/day]	Non-domestic sub-total [m3/day]	Total [m3/day]	Ave. Dem (incl. NRW) [m3/day]	Peak Season Demand [m3/day]
1 Muguta	100%	1,577	-	1,046	523	3,146	471.90	41		512	3,658	4,573	5,716.25
2 Makomo	100%	-	2,017	120	-	2,137	320.49	8		329	2,465	3,081	3,851.81
3 Dombo la Mwari	100%	-	721	1,217	-	1,938	290.70	18		309	2,247	2,808	3,510.22
4 Chizungu	100%	1,959	-	1,312	656	3,927	589.06	11		600	4,527	5,659	7,073.43
5 Maseko	100%	-	2,197	130	-	2,327	349.06	34		383	2,710	3,388	4,234.59
6 Overspill	100%	560	194	1,301	651	2,705	405.80	15		420	3,126	3,907	4,883.92
7 Ward 7	100%	-	1,187	1,266	633	3,085	462.75	13		475	3,560	4,451	5,563.14
Ext W3/W4	100%	-	-	-	1,787	1,787	268.10	-		268	2,055	2,569	3,211.59
Grand-total		**4,096**	**6,315**	**6,392**	**4,250**	**21,052**	**3,158**	**139**	**-**	**3,296**	**24,349**	**30,436**	**38,045**

Peak Season Factor (psf)		1.25

Specific Consumption	Present (2012)	Present (2020)	2030
LD	300	250	200
MD	200	175	150
HD (a)	85	80	80
HD (b)	40	40	40

Institutional Consumption 15% of domestic (Present 2012)
Institutional Consumption 15% of domestic (Present 2020)
Institutional Consumption 15% of domestic (2030)

Physical Leakage in 2012: 35.0%
Physical Leakage in 2020: 25.0%
Physical Leakage in 2030: 20.0%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

Epworth
Appendix 5-4C: Wastewater Flow Estimates

Ward no.	Ward Name	Category	Present Cov.	Present Wastewater flow LD [m³/day]	MD [m³/day]	HD [m³/day]	Inst [m³/day]	Com. [m³/day]	Ind [m³/day]	Total [m³/day]
1	Muguta	LD/Inf	0%	-	-	-	-	-	-	-
2	Makomo	MD/Inf	0%	-	-	-	-	-	-	-
3	Dombo la Mwari	MD/(HD/Inf	0%	-	-	-	-	-	-	-
4	Chizungu	LD/Inf	0%	-	-	-	-	-	-	-
5	Maseko	MD/Inf	0%	-	-	-	-	-	-	-
6	Overspill	MD/Inf	0%	-	-	-	-	-	-	-
7	Ward 7	MD/Inf	0%	-	-	-	-	-	-	-
Ext W3/W4			0%	-	-	-	-	-	-	-
Total				**-**	**-**	**-**	**-**	**-**	**-**	**-**

Ward no.	Ward Name	2020 Cov.	2020 Wastewater flow LD [m³/day]	MD [m³/day]	HD [m³/day]	Inst [m³/day]	Com. [m³/day]	Ind. [m³/day]	Total [m³/day]
1	Muguta	0%	-	-	-	-	-	-	-
2	Makomo	0%	-	-	-	-	-	-	-
3	Dombo la Mwari	0%	-	-	-	-	-	-	-
4	Chizungu	0%	-	-	-	-	-	-	-
5	Maseko	0%	-	-	-	-	-	-	-
6	Overspill	0%	-	-	-	-	-	-	-
7	Ward 7	0%	-	-	-	-	-	-	-
Ext W3/W4		0%	-	-	-	-	-	-	-
Total			**-**	**-**	**-**	**-**	**-**	**-**	**-**

Ward no.	Ward Name	2030 Cov.	2030 Wastewater flow LD [m³/day]	MD [m³/day]	HD [m³/day]	Inst [m³/day]	Com. [m³/day]	Ind. [m³/day]	Total [m³/day]
1	Muguta	35%	345	-	389	165	14	-	913
2	Makomo	90%	-	1,588	114	288	7	-	1,998
3	Dombo la Mwari	50%	-	315	647	145	9	-	1,116
4	Chizungu	30%	367	-	418	177	3	-	965
5	Maseko	90%	-	1,730	124	314	31	-	2,199
6	Overspill	5%	18	8	69	20	1	-	116
7	Ward 7	20%	-	208	269	93	3	-	572
Ext W3/W4		20%	-	-	-	54	-	-	54
Total			**730**	**3,850**	**2,031**	**1,256**	**68**	**-**	**7,934**

NORTON

Appendix 5-5A: Proportion of Population in Housing Categories

Present

Ward No.	Ward Name	Category	Area	% in consumer category				Population in consumer category				Total
				LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
			[ha]	[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	Twinlakes	LD	764	100%	0%	0%	0%	4,630				4,630
2	Galloway	LD	896	100%	0%	0%	0%	535				535
3	Nharira	LD	415	100%	0%	0%	0%	3,169				3,169
4	Knowe	LD	1,931	100%	0%	0%	0%	7,778				7,778
5	Ngoni	HD	57	0%	0%	100%	0%			2,522		2,522
6	Damofalls	HD	638	0%	0%	100%	0%			2,350		2,350
7	Katanga	HD	25	0%	0%	100%	0%			4,256		4,256
8	Katanga	HD	36	0%	0%	100%	0%			3,809		3,809
9	Katanga	HD	38	0%	0%	100%	0%			3,735		3,735
10	Katanga Phase 1 & 2	HD	82	0%	0%	100%	0%			3,455		3,455
11	Katanga Phase 1 & 2	HD	144	0%	0%	100%	0%			5,438		5,438
12	Maridale	HD	395	0%	0%	100%	0%			17,836		17,836
13	Johannesburg, Marshlands	HD	584	0%	0%	100%	0%			8,078		8,078
SP-1	Chegutu14		-									0
SP-2	0		-									0
	Grand-total		**6,005**					**16,112**	**-**	**51,479**	**-**	**67,591**

2020

Ward No.	Ward Name	% in consumer category				Population in consumer category				Total
		LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
		[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	Twinlakes	100%	0%	0%	0%	4,812				4,812
2	Galloway	100%	0%	0%	0%	2,285				2,285
3	Nharira	100%	0%	0%	0%	3,169				3,169
4	Knowe	100%	0%	0%	0%	11,278				11,278
5	Ngoni	0%	0%	100%	0%			2,522		2,522
6	Damofalls	30%	0%	70%	0%	1,008		2,350		3,358
7	Katanga	0%	0%	100%	0%			4,256		4,256
8	Katanga	0%	0%	100%	0%			3,809		3,809
9	Katanga	0%	0%	100%	0%			3,735		3,735
10	Katanga Phase 1 & 2	0%	0%	100%	0%			3,455		3,455
11	Katanga Phase 1 & 2	0%	0%	100%	0%			9,438		9,438
12	Maridale	0%	0%	100%	0%			25,334		25,334
13	Johannesburg, Marshlands	0%	0%	100%	0%			17,155		17,155
SP-1	Chegutu14									0
SP-2	0									0
	Grand-total					**22,552**	**-**	**72,054**	**-**	**94,606**

2030

Ward No.	Ward Name	% in consumer category				Population in consumer category				Total
		LD	MD	HD (a)	HD (b)	LD	MD	HD (a)	HD (b)	Total
		[%]	[%]	[%]		[No]	[No]	[No]		[No]
1	Twinlakes	100%	0%	0%	0%	4,812				4,812
2	Galloway	100%	0%	0%	0%	5,785				5,785
3	Nharira	100%	0%	0%	0%	3,169				3,169
4	Knowe	100%	0%	0%	0%	16,983				16,983
5	Ngoni	0%	0%	100%	0%			2,522		2,522
6	Damofalls	55%	0%	45%	0%	2,870		2,350		5,220
7	Katanga	0%	0%	100%	0%			4,256		4,256
8	Katanga	0%	0%	100%	0%			3,809		3,809
9	Katanga	0%	0%	100%	0%			3,735		3,735
10	Katanga Phase 1 & 2	0%	0%	100%	0%			3,455		3,455
11	Katanga Phase 1 & 2	0%	0%	100%	0%			9,438		9,438
12	Maridale	0%	0%	100%	0%			25,336		25,336
13	Johannesburg, Marshlands	8%	0%	92%	0%	1,400		17,158		18,558
SP-1	Chegutu14	0%	0%	100%	0%			39,825		39,825
SP-2	0									0
	Grand-total					**35,019**	**-**	**111,884**	**-**	**146,903**

Category	2012		2020		2030	
	Population	Prop (%)	Population	Prop (%)	Population	Prop (%)
LD	16,112	24%	22,552	24%	35,019	24%
MD	-	0%	-	0%	-	0%
HD (a)	51,479	76%	72,054	76%	111,884	76%
HD (b)	-	0%	-	0%	-	0%
Total	67,591	100%	94,606	100%	146,903	100%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

NORTON

Appendix 5-5B: Water Demand forecast

Present

Ward No	Ward Name	Category	Area	Service Coverage	Domestic LD	Domestic MD	Domestic HD (a)	Domestic HD (b)	Domestic sub-Total	Non-domestic Inst.	Non-domestic Com.	Non-domestic Ind.	Non-domestic Sub-total	Total	Ave. Dem (incl. NRW)	Peak Season Demand
			[ha]	[%]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]
1	Twinlakes		764	100%	1,389.00	-	-	-	1,389	208	30.00	1,040.00	1,278	2,667	4,104	5,129.52
2	Galloway		896	100%	160.50	-	-	-	161	24	-	-	24	185	284	354.95
3	Nharira		415	100%	950.70	-	-	-	951	143	9.00	1,210.00	1,362	2,312	3,557	4,446.74
4	Knowe		1,931	100%	2,333.40	-	-	-	2,333	350	-	20.00	370	2,703	4,159	5,198.87
5	Ngoni		57	100%	-	-	214	-	214	32	15.00	-	47	262	402	502.93
6	Damofalls		638	100%	-	-	200	-	200	30	9.00	-	39	239	367	459.06
7	Katanga		25	100%	-	-	362	-	362	54	-	-	54	416	640	800.05
8	Katanga		36	100%	-	-	324	-	324	49	-	-	49	372	573	716.02
9	Katanga		38	100%	-	-	317	-	317	48	26.25	-	74	391	602	752.59
10	Katanga Phase 1 & 2		82	100%	-	-	294	-	294	44	12.75	-	57	350	539	673.99
11	Katanga Phase 1 & 2		144	100%	-	-	462	-	462	69	7.50	-	77	539	829	1,036.66
12	Maridale		395	100%	-	-	1,516	-	1,516	227	-	-	227	1,743	2,682	3,352.83
13	Johannesburg, Marshlands		584	100%	-	-	687	-	687	103	-	50.00	153	840	1,292	1,614.66
SP-1	Chegutu14		-	100%	-	-	-	-	-	-	-	-	-	0	-	-
SP-2			-	100%	-	-	-	-	-	-	-	-	-	0	-	-
	Grand-total				**4,834**	**-**	**4,376**	**-**	**9,209**	**1,381**	**110**	**2,320**	**3,811**	**13,020**	**20,031**	**25,039**

2020

Ward No	Ward Name	Service Coverage	Domestic LD	Domestic MD	Domestic HD (a)	Domestic HD (b)	Domestic sub-total	Non-domestic Inst.	Non-domestic Com.	Non-domestic Ind.	Non-domestic sub-total	Total	Ave. Dem (incl. NRW)	Peak Season Demand
		[%]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]
1	Twinlakes	100%	1,203	-	-	-	1,203	180	48	1,664	1,892	3,095	4,127	5,159.08
2	Galloway	100%	571	-	-	-	571	86	-	-	86	657	876	1,094.90
3	Nharira	100%	792	-	-	-	792	119	14	1,936	2,069	2,861	3,815	4,769.15
4	Knowe	100%	2,820	-	-	-	2,820	423	-	32	455	3,274	4,366	5,457.38
5	Ngoni	100%	-	-	202	-	202	30	24	-	54	256	341	426.71
6	Damofalls	100%	252	-	188	-	440	66	14	-	80	520	694	867.33
7	Katanga	100%	-	-	340	-	340	51	-	-	51	392	522	652.59
8	Katanga	100%	-	-	305	-	305	46	-	-	46	350	467	584.05
9	Katanga	100%	-	-	299	-	299	45	42	-	87	386	514	642.70
10	Katanga Phase 1 & 2	100%	-	-	276	-	276	41	20	-	62	338	451	563.77
11	Katanga Phase 1 & 2	100%	-	-	755	-	755	113	12	-	125	880	1,174	1,467.16
12	Maridale	100%	-	-	2,027	-	2,027	304	-	-	304	2,331	3,108	3,884.55
13	Johannesburg, Marshlands	100%	-	-	1,372	-	1,372	206	-	80	286	1,658	2,211	2,763.77
SP-1	Chegutu14	100%	-	-	-	-	-	-	-	-	-	0	-	-
SP-2		100%	-	-	-	-	-	-	-	-	-	0	-	-
	Grand-total		**5,638**	**-**	**5,764**	**-**	**11,402**	**1,710**	**175**	**3,712**	**5,598**	**17,000**	**22,666**	**28,333**

2030

Ward No	Ward Name	Service Coverage	Domestic LD	Domestic MD	Domestic HD (a)	Domestic HD (b)	Domestic sub-total	Non-domestic Inst.	Non-domestic Com.	Non-domestic Ind.	Non-domestic sub-total	Total	Ave. Dem (incl. NRW)	Peak Season Demand
		[%]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]
1	Twinlakes	100%	962	-	-	-	962	144.36	60	2,080	2,284	3,247	4,058	5,073.06
2	Galloway	100%	1,157	-	-	-	1,157	173.55	-	-	174	1,331	1,663	2,078.98
3	Nharira	100%	634	-	-	-	634	95.07	18	2,420	2,533	3,167	3,959	4,948.23
4	Knowe	100%	3,397	-	-	-	3,397	509.49	-	40	549	3,946	4,933	6,165.77
5	Ngoni	100%	-	-	202	-	202	30.26	30	-	60	262	328	409.41
6	Damofalls	100%	574	-	188	-	762	114.30	18	-	132	894	1,118	1,397.34
7	Katanga	100%	-	-	340	-	340	51.07	-	-	51	392	489	611.80
8	Katanga	100%	-	-	305	-	305	45.71	-	-	46	350	438	547.54
9	Katanga	100%	-	-	299	-	299	44.82	53	-	97	396	495	618.94
10	Katanga Phase 1 & 2	100%	-	-	276	-	276	41.46	26	-	67	343	429	536.50
11	Katanga Phase 1 & 2	100%	-	-	755	-	755	113.26	15	-	128	883	1,104	1,380.15
12	Maridale	100%	-	-	2,027	-	2,027	304.03	-	-	304	2,331	2,914	3,642.05
13	Johannesburg, Marshlands	100%	280	-	1,373	-	1,653	247.90	-	100	348	2,001	2,501	3,125.84
SP-1	Chegutu14	100%	-	-	3,186	-	3,186	477.90	-	-	478	3,664	4,580	5,724.84
SP-2		100%	-	-	-	-	-	-	-	-	-	0	-	-
	Grand-total		**7,004**	**-**	**8,951**	**-**	**15,955**	**2,393**	**219**	**4,640**	**7,252**	**23,207**	**29,008**	**36,260**

Peak Season Factor (psf)		1.25

Specific Consumption	Present	2020	2030
LD	300	250	200
MD	200	175	150
HD (a)	85	80	80
HD (b)	40	40	40

Institutional Consumption 15% of domestic (Present, 2020, 2030)

Physical Leakage in 2012 35.0%

Physical Leakage in 2020 25.0%

Physical Leakage in 2030 20.0%

LD = Low Density

MD = Medium Density

HD (a) = High Density with in-house plumbing

HD (b) = High Density unplanned without in-house plumbing

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Appendix 5-5C: Wastewater Flow Estimates

Ward no.	Ward Name	Category	Present								2020								2030							
			Cov.	Wastewater flow							Cov.	Wastewater flow							Cov.	Wastewater flow						
				LD [m^3/day]	MD [m^3/day]	HD [m^3/day]	Inst [m^3/day]	Com. [m^3/day]	Ind [m^3/day]	Total [m^3/day]		LD [m^3/day]	MD [m^3/day]	HD [m^3/day]	Inst [m^3/day]	Com. [m^3/day]	Ind. [m^3/day]	Total [m^3/day]		LD [m^3/day]	MD [m^3/day]	HD [m^3/day]	Inst [m^3/day]	Com. [m^3/day]	Ind. [m^3/day]	Total [m^3/day]
1	Twinlakes		25%	217	-	-	52	8	228	504	25%	188	-	-	45	12	364	609	25%	150	-	-	36	15	455	656
2	Galloway		0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-
3	Nharira		33%	196	-	-	47	3	349	595	33%	163	-	-	39	5	559	766	33%	131	-	-	31	6	699	867
4	Knowe		0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-
5	Ngoni		100%	-	-	228	32	15	-	275	100%	-	-	214	30	24	-	269	100%	-	-	214	30	30	-	275
6	Damofalls		100%	-	-	212	30	9	-	251	100%	158	-	200	66	14	-	438	100%	359	-	200	114	18	-	691
7	Katanga		100%	-	-	384	54	-	-	439	100%	-	-	362	51	-	-	413	100%	-	-	362	51	-	-	413
8	Katanga		100%	-	-	344	49	-	-	393	100%	-	-	324	46	-	-	369	100%	-	-	324	46	-	-	369
9	Katanga		100%	-	-	337	48	26	-	411	100%	-	-	317	45	42	-	404	100%	-	-	317	45	53	-	415
10	Katanga Phase 1 & 2		100%	-	-	312	44	13	-	369	100%	-	-	294	41	20	-	356	100%	-	-	294	41	26	-	361
11	Katanga Phase 1 & 2		100%	-	-	491	69	8	-	568	100%	-	-	802	113	12	-	927	100%	-	-	802	113	15	-	930
12	Maridale		0%	-	-	-	-	-	-	-	100%	-	-	2,153	304	-	-	2,457	100%	-	-	2,154	304	-	-	2,458
13	Johannesburg, Marshlands		0%	-	-	-	-	-	-	-	100%	-	-	1,458	206	-	70	1,734	100%	175	-	1,458	248	-	88	1,969
SP-1				-	-	-	-	-	-	-		-	-	-	-	-	-	-	100%	-	-	3,385	478	-	-	3,863
SP-2				-	-	-	-	-	-	-		-	-	-	-	-	-	-		-	-	-	-	-	-	-
Total				**413**	**-**	**2,309**	**425**	**81**	**577**	**3,805**		**509**	**-**	**6,125**	**987**	**130**	**993**	**8,743**		**815**	**-**	**9,510**	**1,538**	**162**	**1,241**	**13,266**

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Appendix 5-6A: Proportion of Population in Housing Categories

Ward No.	Ward Name	Category	Area	Present: % in consumer category LD	MD	HD (a)	HD (b)	Present: Population in consumer category LD	MD	HD (a)	HD (b)	Total
			[ha]	[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	Runyararo	HD	110			100%				6,518		6,518
2	Runyararo, Sebassa	HD	156			100%				5,373		5,373
3	Mash Holdings	HD	53			100%				3,731		3,731
4	Eight Five Six	HD	22			100%				2,368		2,368
5	Kaymer Farm	HD	269			100%				2,329		2,329
6	H of Galway	HD	54			100%				2,896		2,896
7	Hofmoor Estate, Boulders, New Inverneil, Ednora	LD	1,338	100%				4,493				4,493
8	Zimre Park	MD	532		100%				13,695			13,695
9	Everangus, Sebastopol, Tara Township	LD/MD/HD	1,473	15%	15%	70%		2,240	2,240	10,450		14,930
Ext W3	Athelney Farm		-									0
Ext W5/W7	Mara Farms		-									0
Ext W9	Tarisa farm		-									0
	Grand-total		**4,007**					**6,733**	**15,935**	**33,665**	**-**	**56,333**

Ward No.	Ward Name	2020: % in consumer category LD	MD	HD (a)	HD (b)	2020: Population in consumer category LD	MD	HD (a)	HD (b)	Total
		[%]	[%]	[%]	[%]	[No]	[No]	[No]	[No]	[No]
1	Runyararo	0%	0%	100%	0%			8,518		8,518
2	Runyararo, Sebassa	0%	0%	100%	0%			7,373		7,373
3	Mash Holdings	0%	0%	100%	0%			3,731		3,731
4	Eight Five Six	0%	0%	100%	0%			2,368		2,368
5	Kaymer Farm	0%	0%	100%	0%			14,929		14,929
6	H of Galway	0%	0%	100%	0%			2,896		2,896
7	Hofmoor Estate, Boulders, New Inverneil, Ednora	100%	0%	0%	0%	6,796				6,796
8	Zimre Park	0%	100%	0%	0%		14,955			14,955
9	Everangus, Sebastopol, Tara Township	14%	29%	57%	0%	5,600	12,110	23,450		41,160
Ext W3	Athelney Farm									0
Ext W5/W7	Mara Farms									
Ext W9	Tarisa farm	0%	0%	100%	0%			9,956		9,956
	Grand-total					**12,396**	**27,065**	**73,221**	**-**	**112,682**

Ward No.	Ward Name	2030: % in consumer category LD	MD	HD (a)	HD (b)	2030: Population in consumer category LD	MD	HD (a)	HD (b)	Total
		[%]	[%]	[%]		[No]	[No]	[No]		[No]
1	Runyararo	0%	0%	100%	0%			8,518		8,518
2	Runyararo, Sebassa	0%	0%	100%	0%			7,373		7,373
3	Mash Holdings	0%	0%	100%	0%			3,731		3,731
4	Eight Five Six	0%	0%	100%	0%			2,368		2,368
5	Kaymer Farm	0%	0%	100%	0%			32,329		32,329
6	H of Galway	0%	0%	100%	0%			2,896		2,896
7	Hofmoor Estate, Boulders, New Inverneil, Ednora	54%	0%	46%	0%	14,580		12,500		27,080
8	Zimre Park	0%	100%	0%	0%		14,955			14,955
9	Everangus, Sebastopol, Tara Township	12%	36%	52%	0%	5,600	16,240	23,450		45,290
Ext W3	Athelney Farm	0%	0%	100%	0%			4,000		4,000
Ext W5/W7	Mara Farms	0%	0%	100%	0%			10,000		10,000
Ext W9	Tarisa farm	0%	0%	100%	0%			16,430		16,430
	Grand-total					**20,180**	**31,195**	**123,595**	**-**	**174,970**

Category	2012 Population	2012 Prop (%)	2020 Population	2020 Prop (%)	2030 Population	2030 Prop (%)
LD	6,733	12%	12,396	11%	20,180	12%
MD	15,935	28%	27,065	24%	31,195	18%
HD	33,665	60%	73,221	65%	123,595	71%
Total	56,333	100%	112,682	100%	174,970	100%

LD = Low Density
MD = Medium Density
HD (a) = High Density with in-house plumbing
HD (b) = High Density unplanned without in-house plumbing

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Appendix 5-6B: Water Demand forecast

Present

Ward No.	Ward Name	Category	Area [ha]	Service Coverage [%]	Domestic LD [m^3/day]	Domestic MD [m^3/day]	Domestic HD (a) [m^3/day]	Domestic HD (b) [m^3/day]	Domestic sub-Total [m^3/day]	Non-domestic Inst. [m^3/day]	Non-domestic Com. [m^3/day]	Non-domestic Ind. [m^3/day]	Non-domestic Sub-total [m^3/day]	Total [m^3/day]	Ave. Dem (incl. NRW) [m^3/day]	Peak Season Demand [m^3/day]
1	Runyararo	HD	110	100%	-	-	554.03	-	554	83	46.80	129.00	259	813	1,251	1,563.34
2	Runyararo, Sebassa	HD	156	65%	-	-	296.86	-	297	45	15.75	-	60	357	549	686.80
3	Mash Holdings	HD	53	100%	-	-	317.14	-	317	48	7.50	-	55	372	573	715.78
4	Eight Five Six	HD	22	100%	-	-	201.28	-	201	30	-	-	30	231	356	445.14
5	Kaymer Farm	HD	269	100%	-	-	197.97	-	198	30	9.00	-	39	237	364	455.11
6	H of Galway	HD	54	100%	-	-	246.16	-	246	37	3.75	-	41	287	441	551.60
7	Hofmoor Estate, Boulders, New Inverneil, Ednora	LD	1,338	100%	1,348	-	-	-	1,348	202	57.90	700.00	960	2,308	3,551	4,438.43
8	Zimre Park	MD	532	100%	-	2,739	-	-	2,739	411	98.25	-	509	3,248	4,997	6,246.35
9	Everangus, Sebastopol, Tara Township	LD/MD/HD	1,473	100%	672	448	888.25	-	2,008	301	101.25	250.00	652	2,661	4,093	5,116.80
Ext W3	Athelney Farm		-	0%	-	-	-	-	-	-	-	-	-	0	-	-
Ext W5/W7	Mara Farms		-	0%	-	-	-	-	-	-	-	-	-	0	-	-
Ext W9	Tarisa farm		-	0%	-	-	-	-	-	-	-	-	-	0	-	-
	Grand-total		**4,007**		**2,020**	**3,187**	**2,702**	**-**	**7,909**	**1,186**	**340**	**1,079**	**2,605**	**10,514**	**16,175**	**20,219**

2020

Ward No.	Ward Name	Service Coverage [%]	Consumption Domestic LD [m^3/day]	Domestic MD [m^3/day]	Domestic HD (a) [m^3/day]	Domestic HD (b) [m^3/day]	Domestic sub-total [m^3/day]	Non-domestic Inst. [m^3/day]	Non-domestic Com. [m^3/day]	Non-domestic Ind. [m^3/day]	Non-domestic sub-total [m^3/day]	Total [m^3/day]	Ave. Dem (incl. NRW) [m^3/day]	Peak Season Demand [m^3/day]
1	Runyararo	100%	-	-	681	-	681	102	94	215	411	1,092	1,456	1,820.43
2	Runyararo, Sebassa	100%	-	-	590	-	590	88	32	-	120	710	946	1,183.03
3	Mash Holdings	100%	-	-	298	-	298	45	11	-	55	354	472	589.59
4	Eight Five Six	100%	-	-	189	-	189	28	-	-	28	218	290	363.09
5	Kaymer Farm	100%	-	-	1,194	-	1,194	179	23	-	202	1,396	1,861	2,326.61
6	H of Galway	100%	-	-	232	-	232	35	5	-	40	272	362	452.80
7	Hofmoor Estate, Boulders, New Inverneil, Ednora	100%	1,699	-	-	-	1,699	255	145	1,750	2,150	3,849	5,131	6,414.33
8	Zimre Park	100%	-	2,617	-	-	2,617	393	138	-	530	3,147	4,196	5,245.41
9	Everangus, Sebastopol, Tara Township	100%	1,400	2,119	1,876	-	5,395	809	142	2,000	2,951	8,346	11,128	13,910.48
Ext W3	Athelney Farm	0%	-	-	-	-	-	-	-	-	-	0	-	-
Ext W5/W7	Mara Farms	0%	-	-	-	-	-	-	-	-	-	0	-	-
Ext W9	Tarisa farm	100%	-	-	796	-	796	119	-	-	119	916	1,221	1,526.59
	Grand-total		**3,099**	**4,736**	**5,858**	**-**	**13,693**	**2,054**	**587**	**3,965**	**6,606**	**20,299**	**27,066**	**33,832**

2030

Ward No.	Ward Name	Service Coverage [%]	Consumption Domestic LD [m^3/day]	Domestic MD [m^3/day]	Domestic HD (a) [m^3/day]	Domestic HD (b) [m^3/day]	Domestic sub-total [m^3/day]	Non-domestic Inst. [m^3/day]	Non-domestic Com. [m^3/day]	Non-domestic Ind. [m^3/day]	Non-domestic sub-total [m^3/day]	Total [m^3/day]	Ave. Dem (incl. NRW) [m^3/day]	Peak Season Demand [m^3/day]
1	Runyararo	100%	-	-	681	-	681	102.22	125	301	528	1,209	1,512	1,889.78
2	Runyararo, Sebassa	100%	-	-	590	-	590	88.48	42	-	130	720	900	1,125.49
3	Mash Holdings	100%	-	-	298	-	298	44.77	15	-	60	358	448	559.77
4	Eight Five Six	100%	-	-	189	-	189	28.42	-	-	28	218	272	340.40
5	Kaymer Farm	100%	-	-	2,586	-	2,586	387.95	36	-	424	3,010	3,763	4,703.54
6	H of Galway	100%	-	-	232	-	232	34.75	8	-	42	274	342	428.02
7	Hofmoor Estate, Boulders, New Inverneil, Ednora	100%	2,916	-	1,000	-	3,916	587.40	232	2,450	3,269	7,185	8,981	11,226.56
8	Zimre Park	100%	-	2,243	-	-	2,243	336.49	197	-	533	2,776	3,470	4,337.87
9	Everangus, Sebastopol, Tara Township	100%	1,120	2,436	1,876	-	5,432	814.80	203	3,000	4,017	9,449	11,812	14,764.53
Ext W3	Athelney Farm	100%	-	-	320	-	320	48.00	-	-	48	368	460	575.00
Ext W5/W7	Mara Farms	100%	-	-	800	-	800	120.00	-	-	120	920	1,150	1,437.50
Ext W9	Tarisa farm	100%	-	-	1,314	-	1,314	197.16	-	-	197	1,512	1,889	2,361.81
	Grand-total		**4,036**	**4,679**	**9,888**	**-**	**18,603**	**2,790**	**856**	**5,751**	**9,397**	**28,000**	**35,000**	**43,750**

Peak Season Factor (psf)	1.25

Specific Consumption	Present	2020	2030
LD	300	250	200
MD	200	175	150
HD (a)	85	80	80
HD (b)	40	40	40

Institutional Consumption 15% of domestic (Present, 2020, 2030)

Physical Leakage in 2012 35.0%

Physical Leakage in 2020 25.0%

Physical Leakage in 2030 20.0%

LD = Low Density

MD = Medium Density

HD (a) = High Density with in-house plumbing

HD (b) = High Density unplanned without in-house plumbing

RUWA
Appendix 5-6C: Wastewater Flow Estimates

Ward no.	Ward Name	Category	Present								2020								2030							
			Cov.	Wastewater flow							Cov.	Wastewater flow							Cov.	Wastewater flow						
				LD	MD	HD	Inst	Com.	Ind	Total		LD	MD	HD	Inst	Com.	Ind.	Total		LD	MD	HD	Inst	Com.	Ind.	Total
			%	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]		[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]		[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]	[m³/day]
1	Runyararo		100%	-	-	589	83	47	113	831	100%	-	-	724	102	94	188	1,108	100%	-	-	724	102	125	263	1,214
2	Runyararo, Sebassa		100%	-	-	315	45	16	-	376	100%	-	-	627	88	32	-	747	100%	-	-	627	88	42	-	757
3	Mash Holdings		100%	-	-	337	48	8	-	392	100%	-	-	317	45	11	-	372	100%	-	-	317	45	15	-	377
4	Eight Five Six		100%	-	-	214	30	-	-	244	100%	-	-	201	28	-	-	230	100%	-	-	201	28	-	-	230
5	Kaymer Farm		100%	-	-	210	30	9	-	249	100%	-	-	1,269	179	23	-	1,471	100%	-	-	2,748	388	36	-	3,172
6	H of Galway		100%	-	-	262	37	4	-	302	100%	-	-	246	35	5	-	286	100%	-	-	246	35	8	-	288
7	Hofmoor Estate, Boulders, New Inverneil, Ednora		90%	758	-	-	182	52	551	1,544	100%	1,062	-	-	255	145	1,531	2,993	100%	1,823	-	1,063	587	232	2,144	5,848
8	Zimre Park		100%	-	2,397	-	411	98	-	2,906	100%	-	2,290	-	393	138	-	2,820	100%	-	1,963	-	336	197	-	2,496
9	Everangus, Sebastopol, Tara Township		100%	420	392	944	301	101	219	2,377	100%	875	1,854	1,993	809	142	1,750	7,424	100%	700	2,132	1,993	815	203	2,625	8,467
Ext W3	Athelney Farm			-	-	-	-	-	-	-		-	-	-	-	-	-	-	100%	-	-	340	48	-	-	388
Ext W5/W7	Mara Farms			-	-	-	-	-	-	-		-	-	-	-	-	-	-	100%	-	-	850	120	-	-	970
Ext W9	Tarisa farm			-	-	-	-	-	-	-	100%	-	-	846	119	-	-	966	100%	-	-	1,397	197	-	-	1,594
Total				**1,178**	**2,789**	**2,871**	**1,166**	**334**	**883**	**9,221**		**1,937**	**4,144**	**6,224**	**2,054**	**587**	**3,469**	**18,416**		**2,523**	**4,094**	**10,506**	**2,790**	**856**	**5,032**	**25,801**

APPENDIX 8: INSTITUTIONAL CAPACITY ASSESSMENT

Appendix 8: Institutional Capacity Assessment

Table A8.1: Proposed Reduction of Current Harare Water Department Establishment Numbers (2338 to 1924)

Job Title	Department	Activity	Number	Grade
Director, Harare Water and Sewerage Services	Water and Sewerage company	Overall Management	1	
Finance and Administration Manager	Finance	In charge of financial services	1	
Distribution and Customer services Manager	Distribution and Commercial Operations	In charge of distribution and commercial operations	1	
Planning and Technical Services Manager	Technical Operations	In charge of technical operations	1	
Production Manager	Water Operations	In charge of production of water	1	
Waste Water Manager	Waste water operations	In charge of WWTP and WW reticulation	1	
Maintenance Manager	Maintenance Services	In charge of workshops		
Quality Assurance Manager	Quality control services	In charge of QC labs for both water and sewerage and trade effluents	1	
Internal Auditor	Audit		1	8
Internal Audit Clerk	Audit		1	3
Chief Information Systems Officer	Information	ICT services	1	10
Systems support Officer	Information	ICT services	1	9
Technician	Information	ICT services	1	8
Chief Human Capital	Human Resource	Human Resources Services	1	10
Human Capital Officers	Human Resource	Human Resources Services	1	9
Senior Human Capital Clerks	Human Resource	Human Resources Services	2	4
Human Capital Clerks	Human Resource	Human Resources Services	2	3
Payroll Officer	Human Resource	Human Resources Services	1	9
Senior Payroll Clerk	Human Resource	Human Resources Services	2	4
Payroll Clerks	Human Resource	Human Resources Services	1	3
Financial Accountant	Finance & Admin	Finance	1	9

Job Title	Department	Activity	Number	Grade
Management Accountant	Finance & Admin	Finance services	1	9
Procurement and Stores Officer	Finance & Admin	Finance services	1	9
Senior Administration Officer	Finance & Admin	Administration services	1	10
Accounting Officers	Finance & Admin	Finance	4	6
Accounts Clerks	Finance & Admin	Finance	4	4
Registry Supervisor	Finance & Admin	Administration	1	5
Transport Supervisor	Finance & Admin	Administration	1	5
Senior Administration Clerk	Finance & Admin	Administration	2	4
Administrative Clerk	Finance & Admin	Administration	1	3
Secretary and administrative assistant to Director HW	Administration	Support	1	6
Secretary to Finance Director	Administration	Support	1	5
Switch Board Operator	Finance & Admin	Support	1	3
Typists	Finance & Admin	Support	2	3
Drivers	Finance & Admin	Support	2	3
Commissionaire	Finance & Admin	Support	1	2
Waiter	Finance & Admin	Support	4	2
Messenger / Cleaner	Finance & Admin	Support	6	1
Production Engineer	Production	In charge water Treatment Works	1	10
Sr/Principal Engineer	Production		1	9
Chief Civil Engineering Technician	Production		2	7
Civil Engineering technician	Production		2	5
Secretary to Production director	Administration	support	1	3
Senior Superintendent	Production	Morton Jaffray	1	9
Shift Supervisors	Production	Morton Jaffray	5	7
Superintendent	Production	Morton Jaffray	1	7
Water Works Attendant	Production	Morton Jaffray	28	6
Assistant Water Works Attendant	Production	Morton Jaffray	13	4
Senior Operators	Production	Morton Jaffray	90	4
Senior Clerical officer	Production	Morton Jaffray	1	4
Heavy vehicle Driver	Production	Morton Jaffray	6	4

Job Title	Department	Activity	Number	Grade
Cooks Supervisor	Production	Morton Jaffray	1	4
Operators	Production	Morton Jaffray	54	3
Cooks	Production	Morton Jaffray	6	2
Senior Superintended	Production	Prince Edward WW	1	9
Water works attendant	Production	Prince Edward WW	11	6
Assistant WW attendant	Production	Prince Edward WW	3	4
Water bailiff	Production	Prince Edward WW	1	4
Senior clerical officer	Production	Prince Edward WW	1	4
Light Vehicle Driver	Production	Prince Edward WW	2	4
Senior Operator	Production	Prince Edward WW	26	4
Operator	Production	Prince Edward WW	20	3
Cooks	Production	Prince Edward WW	3	2
General Labourer	Production	Prince Edward WW	2	1
Distribution Engineer	Distribution & Commercial	Distribution	1	10
Works Superintended	Distribution	Water Workshop (T)	1	9
Foreman	Distribution	Water Workshop (T)	2	7
Skilled Worker 1 (Plumber)	Distribution	Water Workshop (T)	7	6
Skilled Worker 1 (Fitter and Turner)	Distribution	Water Workshop (T)	1	6
Skilled Worker 2 Meter Assembly	Distribution	Water Workshop (T)	1	5
Pump Station Attendant	Distribution	Water Workshop (T)	4	5
Skilled Worker 2: Bitumen Painter	Distribution	Water Workshop (T)	1	5
Skilled Worker 3: (Plumber)	Distribution	Water Workshop (T)	7	4
Skilled Worker 3: (Bricklayer)	Distribution	Water Workshop (T)	2	4
Senior Clerical Officer	Distribution	Water Workshop (T)	1	4
Heavy Vehicle Driver	Distribution	Water Workshop (T)	2	4
Senior Operator	Distribution	Water Workshop (T)	33	4
Operator	Distribution	Water Workshop	73	3

Job Title	Department	Activity	Number	Grade
		(T)		
Works Superintended	Distribution	Maintenance W W	1	9
Foreman (Plumber)	Distribution	Maintenance WW	3	7
Foreman (Boilermaker)	Distribution	Maintenance WW	1	7
Skilled Worker 1: (Plumber)	Distribution	Maintenance WW	9	6
Skilled Worker 1: (Boilermaker)	Distribution	Maintenance WW	1	6
Skilled Worker 2: (Water met. Ass)	Distribution	Maintenance WW	1	5
Skilled worker 2: (Welder)	Distribution	Maintenance WW	2	5
Skilled Worker 3 (Plumber)	Distribution	Maintenance WW	9	4
Skilled Worker 3 (Bricklayer)	Distribution	Maintenance WW	2	4
Store man	Distribution	Maintenance WW	1	4
Senior Clerical Officer	Distribution	Maintenance WW	1	4
Heavy vehicle driver	Distribution	Maintenance WW	4	4
Senior Operator	Distribution	Maintenance WW	30	4
Operator	Distribution	Maintenance WW	100	3
Senior Superintended	Distribution	Warren Control	1	9
Superintended	Distribution	Warren Control	2	7
Water Works attendant	Distribution	Warren Control	13	6
Asst. Water Works attendant	Distribution	Warren Control	6	4
Light Vehicle Driver	Distribution	Warren Control	4	4
Senior Clerical Officer	Distribution	Warren Control	1	4
Senior Operator	Distribution	Warren Control	13	4
Operator	Distribution	Warren Control	10	3
Cooks	Distribution	Warren Control	2	2
General Labour	Distribution	Warren Control	2	1
Works Superintended	Distribution	Hartfield/Waterfalls	1	9
Foreman	Distribution	Hartfield/Waterfalls	1	7
Skilled Worker 1: (Plumber)	Distribution	Hartfield/Waterfalls	1	6
Heavy Vehicle driver	Distribution	Hartfield/Waterfalls	1	4
Skilled Worker 3: (Plumber)	Distribution	Hartfield/Waterfalls	2	4
Senior Operator	Distribution	Hartfield/Waterfalls	8	4
Clerical Officer	Distribution	Hartfield/Waterfalls	1	3
Operator	Distribution	Hartfield/Waterfalls	28	3
Snr/Principal Engineer	Distribution		1	9
Chief Civil Eng. Technician	Distribution		1	7
Chief Technical Officer	Distribution		1	6
Civil Eng. Technician	Distribution		1	5
Customer Services Officer	Distribution		1	5
Senior Operator	Distribution		8	4
Technician Assistant	Distribution		4	4
Clerical Officer	Distribution		1	3
Commercial Services Officer	Distribution and	Commercial	1	10

Job Title	Department	Activity	Number	Grade
	Commercial			
Chief Billing Officer	Commercial	Billing	1	7
Billing Officer	Commercial	Billing	8	5
Billing Clerk	Commercial	Billing	10	4
Customer Relations Supervisor	Commercial	Customer Relations	1	7
Clerical Officers	Commercial	Customer Relations	8	3
Data Capture Supervisor	Commercial	Data Capture	1	7
Data Capture Clerks	Commercial	Data capture	5	3
Chief Meter Reader	Commercial	Meter Reading	1	6
Ass. Chief Meter Reader	Commercial	Meter Reading	2	5
Heavy Vehicle Driver	Commercial	Meter Reading	2	4
SW Plumber	Commercial	Meter Reading	3	4
Meter Reader Supervisor	Commercial	Meter Reading	4	4
Meter Reader	Commercial	Meter reading	60	3
Clerical Officer	Commercial	Meter Reading	2	3
Area Customer Services Officer	Commercial	Billing Districts	2	7
Billing Supervisor (Districts)	Commercial	Billing Districts	11	6
Billing Officer	Commercial	Billing Districts	22	5
Billing Clerks	Commercial	Billing Districts	29	4
Meter Readers Supervisor	Commercial	Billing Districts	14	4
Meter Readers	Commercial	Billing Districts	129	3
Late Payment Officer	Commercial	Late payment	1	7
Late Payment Supervisor	Commercial	Late payment	2	6
Senior Clerical Officers	Commercial	Late payment	5	4
Snr/Principal Engineer	Waste Water		1	9
Chief Civil Eng Technician	Waste Water		2	7
Senior Civil Eng Technician	Waste Water		2	6
Civil Eng Technician	Waste Water		2	5
Maintenance Engineer	Waste Water		1	10
Sewerage works superintended	Waste Water	Suburban sewerage works (SSW)	1	9
Foreman: Sewerage	Waste Water	SSW	2	7
Skilled worker 1: (Plumber)	Waste Water	SSW	8	6
Skilled worker 1: (Fitter and Turner)	Waste Water	SSW	1	6
Pump station attendant	Waste Water	SSW	5	5
Skilled worker 2: (Bitumen Painter)	Waste Water	SSW	1	5
Skilled worker 3: (Plumber)	Waste Water	SSW	9	4
Skilled Worker 3: (Bricklayer)	Waste water	SSW	2	4
Heavy Duty Vehicle Driver	Waste Water	SSW	2	4
Senior clerical Officer	Waste water	SSW	1	4

Job Title	Department	Activity	Number	Grade
Senior Operator	Waste water	SSW	36	3
Operator	Wastewater	SSW	80	3
Works Superintended	Waste water	Sewerage Workshop	1	9
Foreman (Plumber)	Wastewater	Sewerage Workshop	2	7
Foreman (Boiler maker)	Waste water	Sewerage Workshop	1	7
Foreman (Bricklayer)	Waste water	Sewerage Workshop	1	7
Skilled worker 1: (Plumber)	Waste water	Sewerage Workshop	5	6
Skilled worker 1 (Boilermaker)	Waste water	Sewerage Workshop	1	6
Skilled worker 1: (Bricklayer)	Waste water	Sewerage Workshop	1	6
Skilled Worker 3: (Plumber)	Waste water	Sewerage Workshop	10	4
Heavy Duty Operator	Waste water	Sewerage Workshop	4	4
Senior clerical officer	Waste water	Sewerage Workshop	1	4
Heavy Vehicle driver	Waste water	Sewerage Workshop	3	4
Senior Operator	Waste water	Sewerage Workshop	24	4
Operator	Waste water	Sewerage Workshop	65	3
Plant Engineer	Waste water	In charge Sewage Treatment works	1	10
Senior Superintended	Waste water	Crowborough	1	9
Works Attendant	Waste water	Crowborough	5	6
Asst. Works Attendant	Waste water	Crowborough	5	5
Senior Operator	Waste water	Crowborough	52	4
Light Vehicle Driver	Waste water	Crowborough	2	4
Operator	Waste water	Crowborough	22	3
General Labourer	Waste water	Crowborough	12	1
Works Attendant	Waste water	Firle	10	6
Asst. Works Attendant	Waste water	Firle	10	5
Senior Operator	Waste water	Firle	105	4
Light Vehicle Driver	Waste water	Firle	4	4
Operator	Waste water	Firle	45	3
General Labourer	Waste water	Firle	25	1
Senior Superintended	Waste water	Farm	1	9
Works Attendant	Waste water	Farm	10	6
Asst. Works Attendant	Waste water	Farm	10	5
Senior Operator	Waste water	Farm	110	4

Job Title	Department	Activity	Number	Grade
Light Vehicle Driver	Waste water	Farm	4	4
Operator	Waste water	Farm	50	3
General Labourer	Waste water	Farm	30	1
Snr/Principal Chemist	Quality Assurance	Chemistry Lab	1	9
Chief Chem Lab Technician	Quality Assurance	Chemistry Lab	1	7
Senior Lab technicians	Quality Assurance	Chemistry Lab	2	6
Lab Technicians	Quality Assurance	Chemistry Lab	5	5
Technician Assistants	Quality Assurance	Chemistry Lab	4	4
Handy men	Quality Assurance	Chemistry Lab	4	1
Microbiologist	Quality Assurance	Microbiology lab	1	9
Chief Microbio Lab Technician	Quality Assurance	Microbiology lab	1	7
Senior Lab technicians	Quality Assurance	Microbiology lab	2	6
Lab Technicians	Quality Assurance	Microbiology lab	4	5
Technician Assistants	Quality Assurance	Microbiology lab	4	4
Handy men	Quality Assurance	Microbiology lab	4	1
Planning Engineer	Planning and Technical Services (P&TS)	Planning	1	10
Snr/Principal Engineer (Civil)	P&TS	Planning	1	9
Snr/Principal Engineer (Mech)	P&TS	Planning	1	9
Snr/Principal Engineer (Elect)	P&TS	Planning	1	9
Chief Technician Engineer (Civil)	P&TS	Planning	1	7
Chief Technician Engineer (Mech)	P&TS	Planning	1	7
Chief Technician Engineer (Elect)	P&TS	Planning	1	7
Senior Technician Engineer (Civil)	P&TS	Planning	2	6
Senior Technician Engineer (Mech)	P&TS	Planning	2	6
Senior Technician Engineer (Elect)	P&TS	Planning	2	6
Technician Draughtsman (Civil)	P&TS	Planning	4	4
Technician Draughtsman (Mech)	P&TS	Planning	1	4
Technician Draughtsman (Elect)	P&TS	Planning	1	4
Technical Services Engineer	P&TS	Technical Services	1	10
Snr/Principal Engineer (TS)	P&TS	Technical Services	1	9
Technician (TS)	P&TS	Technical Services	1	4

Job Title	Department	Activity	Number	Grade
Total			**1924**	

Table A8.2: New Proposal for Greater Harare City Autonomous Water and Sewerage Company. (Company independent of Town Council (after 2018)) but forming nucleus for GHWSC

Job Title	Department	Activity	Proposed Number	Grade
Managing Director for Water and Sewerage Services	Water and Sewerage company	Overall Management	1	12
Finance and Administration Director	Finance	In charge of financial services	1	11
Distribution and Customer services Director	Distribution and Commercial Operations	In charge of distribution and commercial operations	1	11
Planning and Technical Operations Director	Technical Operations	In charge of technical operations	1	11
Production Director	Water Operations	In charge of production of water	1	11
Waste Water Director	Waste water operations	In charge of WWTP and WW reticulation	1	11
Maintenance Director	Maintenance Services	In charge of workshops		11
Quality Assurance Director	Quality control services	In charge of QC labs for both water and sewerage and trade effluents	1	11
Chief Legal Operations Officer	Legal Services	In charge of legal services	1	11
Legal Operations officer	Legal services		1	8
Legal Services Clerk	Legal Services		1	3
Chief Internal Auditor	Audit	Audit services	1	10
Internal Auditor	Audit		1	8
Internal Audit Clerk	Audit		1	3
Chief Information Systems Officer	Information	ICT services	1	10
Systems support Officer	Information	ICT services	1	9
Technician	Information	ICT services	1	8
Chief Human Capital	Human Resource	Human Resources Services	1	10
Human Capital Officers	Human Resource	Human Resources Services	1	9
Senior Human Capital Clerks	Human Resource	Human Resources Services	2	4
Human Capital Clerks	Human Resource	Human Resources Services	2	3
Payroll Officer	Human Resource	Human Resources Services	1	9
Senior Payroll Clerk	Human Resource	Human Resources Services	2	4

Job Title	Department	Activity	Proposed Number	Grade
Payroll Clerks	Human Resource	Human Resources Services	1	3
Water Works superintendent	Water	In charge water supply	1	9
Sewage works superintendent	Sewerage	Sewerage services	1	9
Water and Sewer Reticulation Superintended	Water and Sewage		1	9
Environment Officer	Garbage collection		1	9
Financial Accountant	Finance & Admin	Finance	1	9
Management Accountant	Finance & Admin	Finance services	1	9
Procurement and Stores Officer	Finance & Admin	Finance services	1	9
Senior Administration Officer	Finance & Admin	Administration services	1	10
Accounting Officers	Finance & Admin	Finance	4	6
Accounts Clerks	Finance & Admin	Finance	4	4
Registry Supervisor	Finance & Admin	Administration	1	5
Transport Supervisor	Finance & Admin	Administration	1	5
Senior Administration Clerk	Finance & Admin	Administration	2	4
Administrative Clerk	Finance & Admin	Administration	1	3
Secretary and administrative assistant to MD	Administration	Support	1	6
Billing Officer	Finance	Billing	1	6
Revenue collection officer	Finance	Revenue	1	6
Secretary to Finance Director	Administration	Support	1	5
Switch Board Operator	Finance & Admin	Support	1	3
Typists	Finance & Admin	Support	2	3
Drivers	Finance & Admin	Support	2	3
Commissionaire	Finance & Admin	Support	1	2
Waiter	Finance & Admin	Support	4	2
Messenger / Cleaner	Finance & Admin	Support	6	1
Production Engineer	Production	In charge water Treatment Works	1	10
Sr/Principal Engineer	Production		1	9

Job Title	Department	Activity	Proposed Number	Grade
Chief Civil Engineering Technician	Production		2	7
Civil Engineering technician	Production		2	5
Secretary to Production director	Administration	support	1	3
Senior Superintendent	Production	Morton Jaffray	1	9
Shift Supervisors	Production	Morton Jaffray	5	7
Superintendent	Production	Morton Jaffray	1	7
Water Works Attendant	Production	Morton Jaffray	28	6
Assistant Water Works Attendant	Production	Morton Jaffray	13	4
Senior Operators	Production	Morton Jaffray	90	4
Senior Clerical officer	Production	Morton Jaffray	1	4
Heavy vehicle Driver	Production	Morton Jaffray	6	4
Cooks Supervisor	Production	Morton Jaffray	1	4
Operators	Production	Morton Jaffray	54	3
Cooks	Production	Morton Jaffray	6	2
Senior Superintended	Production	Prince Edward WW	1	9
Water works attendant	Production	Prince Edward WW	11	6
Assistant WW attendant	Production	Prince Edward WW	3	4
Water bailiff	Production	Prince Edward WW	1	4
Senior clerical officer	Production	Prince Edward WW	1	4
Light Vehicle Driver	Production	Prince Edward WW	2	4
Senior Operator	Production	Prince Edward WW	26	4
Operator	Production	Prince Edward WW	20	3
Cooks	Production	Prince Edward WW	3	2
General Labourer	Production	Prince Edward WW	2	1
Distribution Engineer	Distribution & Commercial	Distribution	1	10
Works Superintended	Distribution	Water Workshop (T)	1	9
Foreman	Distribution	Water Workshop (T)	2	7
Skilled Worker 1 (Plumber)	Distribution	Water Workshop (T)	7	6
Skilled Worker 1 (Fitter and Turner)	Distribution	Water Workshop (T)	1	6
Skilled Worker 2 Meter Assembly	Distribution	Water Workshop (T)	1	5
Pump Station Attendant	Distribution	Water Workshop	4	5

Job Title	Department	Activity	Proposed Number	Grade
		(T)		
Skilled Worker 2: Bitumen Painter	Distribution	Water Workshop (T)	1	5
Skilled Worker 3: (Plumber)	Distribution	Water Workshop (T)	7	4
Skilled Worker 3: (Bricklayer)	Distribution	Water Workshop (T)	2	4
Senior Clerical Officer	Distribution	Water Workshop (T)	1	4
Heavy Vehicle Driver	Distribution	Water Workshop (T)	2	4
Senior Operator	Distribution	Water Workshop (T)	33	4
Operator	Distribution	Water Workshop (T)	73	3
Works Superintended	Distribution	Maintenance W W	1	9
Foreman (Plumber)	Distribution	Maintenance WW	3	7
Foreman (Boilermaker)	Distribution	Maintenance WW	1	7
Skilled Worker 1: (Plumber)	Distribution	Maintenance WW	9	6
Skilled Worker 1: (Boilermaker)	Distribution	Maintenance WW	1	6
Skilled Worker 2: (Water met. Ass)	Distribution	Maintenance WW	1	5
Skilled worker 2: (Welder)	Distribution	Maintenance WW	2	5
Skilled Worker 3 (Plumber)	Distribution	Maintenance WW	9	4
Skilled Worker 3 (Bricklayer)	Distribution	Maintenance WW	2	4
Store man	Distribution	Maintenance WW	1	4
Senior Clerical Officer	Distribution	Maintenance WW	1	4
Heavy vehicle driver	Distribution	Maintenance WW	4	4
Senior Operator	Distribution	Maintenance WW	30	4
Operator	Distribution	Maintenance WW	100	3
Senior Superintended	Distribution	Warren Control	1	9
Superintended	Distribution	Warren Control	2	7
Water Works attendant	Distribution	Warren Control	13	6
Asst. Water Works attendant	Distribution	Warren Control	6	4
Light Vehicle Driver	Distribution	Warren Control	4	4
Senior Clerical Officer	Distribution	Warren Control	1	4
Senior Operator	Distribution	Warren Control	13	4
Operator	Distribution	Warren Control	10	3
Cooks	Distribution	Warren Control	2	2
General Labour	Distribution	Warren Control	2	1
Works Superintended	Distribution	Hartfield/Waterfalls	1	9
Foreman	Distribution	Hartfield/Waterfalls	1	7
Skilled Worker 1: (Plumber)	Distribution	Hartfield/Waterfalls	1	6
Heavy Vehicle driver	Distribution	Hartfield/Waterfalls	1	4
Skilled Worker 3: (Plumber)	Distribution	Hartfield/Waterfalls	2	4
Senior Operator	Distribution	Hartfield/Waterfalls	8	4

Job Title	Department	Activity	Proposed Number	Grade
Clerical Officer	Distribution	Hartfield/Waterfalls	1	3
Operator	Distribution	Hartfield/Waterfalls	28	3
Snr/Principal Engineer	Distribution		1	9
Chief Civil Eng. Technician	Distribution		1	7
Chief Technical Officer	Distribution		1	6
Civil Eng. Technician	Distribution		1	5
Customer Services Officer	Distribution		1	5
Senior Operator	Distribution		8	4
Technician Assistant	Distribution		4	4
Clerical Officer	Distribution		1	3
Commercial Services Officer	Distribution and Commercial	Commercial	1	10
Chief Billing Officer	Commercial	Billing	1	7
Billing Officer	Commercial	Billing	8	5
Billing Clerk	Commercial	Billing	10	4
Customer Relations Supervisor	Commercial	Customer Relations	1	7
Clerical Officers	Commercial	Customer Relations	8	3
Data Capture Supervisor	Commercial	Data Capture	1	7
Data Capture Clerks	Commercial	Data capture	5	3
Chief Meter Reader	Commercial	Meter Reading	1	6
Ass. Chief Meter Reader	Commercial	Meter Reading	2	5
Heavy Vehicle Driver	Commercial	Meter Reading	2	4
SW Plumber	Commercial	Meter Reading	3	4
Meter Reader Supervisor	Commercial	Meter Reading	4	4
Meter Reader	Commercial	Meter reading	60	3
Clerical Officer	Commercial	Meter Reading	2	3
Area Customer Services Officer	Commercial	Billing Districts	2	7
Billing Supervisor (Districts)	Commercial	Billing Districts	11	6
Billing Officer	Commercial	Billing Districts	22	5
Billing Clerks	Commercial	Billing Districts	29	4
Meter Readers Supervisor	Commercial	Billing Districts	14	4
Meter Readers	Commercial	Billing Districts	129	3
Late Payment Officer	Commercial	Late payment	1	7
Late Payment Supervisor	Commercial	Late payment	2	6
Senior Clerical Officers	Commercial	Late payment	5	4
Snr/Principal Engineer	Waste Water		1	9
Chief Civil Eng Technician	Waste Water		2	7
Senior Civil Eng Technician	Waste Water		2	6
Civil Eng Technician	Waste Water		2	5
Maintenance Engineer	Waste Water		1	10
Sewerage works superintended	Waste Water	Suburban	1	9

Job Title	Department	Activity	Proposed Number	Grade
		sewerage works (SSW)		
Foreman: Sewerage	Waste Water	SSW	2	7
Skilled worker 1: (Plumber)	Waste Water	SSW	8	6
Skilled worker 1: (Fitter and Turner)	Waste Water	SSW	1	6
Pump station attendant	Waste Water	SSW	5	5
Skilled worker 2: (Bitumen Painter)	Waste Water	SSW	1	5
Skilled worker 3: (Plumber)	Waste Water	SSW	9	4
Skilled Worker 3: (Bricklayer)	Waste water	SSW	2	4
Heavy Duty Vehicle Driver	Waste Water	SSW	2	4
Senior clerical Officer	Waste water	SSW	1	4
Senior Operator	Waste water	SSW	36	3
Operator	Wastewater	SSW	80	3
Works Superintended	Waste water	Sewerage Workshop	1	9
Foreman (Plumber)	Wastewater	Sewerage Workshop	2	7
Foreman (Boiler maker)	Waste water	Sewerage Workshop	1	7
Foreman (Bricklayer)	Waste water	Sewerage Workshop	1	7
Skilled worker 1: (Plumber)	Waste water	Sewerage Workshop	5	6
Skilled worker 1 (Boilermaker)	Waste water	Sewerage Workshop	1	6
Skilled worker 1: (Bricklayer)	Waste water	Sewerage Workshop	1	6
Skilled Worker 3: (Plumber)	Waste water	Sewerage Workshop	10	4
Heavy Duty Operator	Waste water	Sewerage Workshop	4	4
Senior clerical officer	Waste water	Sewerage Workshop	1	4
Heavy Vehicle driver	Waste water	Sewerage Workshop	3	4
Senior Operator	Waste water	Sewerage Workshop	24	4
Operator	Waste water	Sewerage Workshop	65	3
Plant Engineer	Waste water	In charge Sewage Treatment works	1	10
Senior Superintended	Waste water	Crowborough	1	9
Works Attendant	Waste water	Crowborough	5	6
Asst. Works Attendant	Waste water	Crowborough	5	5
Senior Operator	Waste water	Crowborough	52	4
Light Vehicle Driver	Waste water	Crowborough	2	4
Operator	Waste water	Crowborough	22	3

Job Title	Department	Activity	Proposed Number	Grade
General Labourer	Waste water	Crowborough	12	1
Works Attendant	Waste water	Firle	10	6
Asst. Works Attendant	Waste water	Firle	10	5
Senior Operator	Waste water	Firle	105	4
Light Vehicle Driver	Waste water	Firle	4	4
Operator	Waste water	Firle	45	3
General Labourer	Waste water	Firle	25	1
Senior Superintended	Waste water	Farm	1	9
Works Attendant	Waste water	Farm	10	6
Asst. Works Attendant	Waste water	Farm	10	5
Senior Operator	Waste water	Farm	110	4
Light Vehicle Driver	Waste water	Farm	4	4
Operator	Waste water	Farm	50	3
General Labourer	Waste water	Farm	30	1
Snr/Principal Chemist	Quality Assurance	Chemistry Lab	1	9
Chief Chem Lab Technician	Quality Assurance	Chemistry Lab	1	7
Senior Lab technicians	Quality Assurance	Chemistry Lab	2	6
Lab Technicians	Quality Assurance	Chemistry Lab	5	5
Technician Assistants	Quality Assurance	Chemistry Lab	4	4
Handy men	Quality Assurance	Chemistry Lab	4	1
Microbiologist	Quality Assurance	Microbiology lab	1	9
Chief Microbio Lab Technician	Quality Assurance	Microbiology lab	1	7
Senior Lab technicians	Quality Assurance	Microbiology lab	2	6
Lab Technicians	Quality Assurance	Microbiology lab	4	5
Technician Assistants	Quality Assurance	Microbiology lab	4	4
Handy men	Quality Assurance	Microbiology lab	4	1
Planning Engineer	Planning and Technical Services (P&TS)	Planning	1	10
Snr/Principal Engineer (Civil)	P&TS	Planning	1	9
Snr/Principal Engineer (Mech)	P&TS	Planning	1	9
Snr/Principal Engineer (Elect)	P&TS	Planning	1	9
Chief Technician Engineer (Civil)	P&TS	Planning	1	7
Chief Technician Engineer (Mech)	P&TS	Planning	1	7

Job Title	Department	Activity	Proposed Number	Grade
Chief Technician Engineer (Elect)	P&TS	Planning	1	7
Senior Technician Engineer (Civil)	P&TS	Planning	2	6
Senior Technician Engineer (Mech)	P&TS	Planning	2	6
Senior Technician Engineer (Elect)	P&TS	Planning	2	6
Technician Draughtsman (Civil)	P&TS	Planning	4	4
Technician Draughtsman (Mech)	P&TS	Planning	1	4
Technician Draughtsman (Elect)	P&TS	Planning	1	4
Technical Services Engineer	P&TS	Technical Services	1	10
Snr/Principal Engineer (TS)	P&TS	Technical Services	1	9
Technician (TS)	P&TS	Technical Services	1	4
Total			**1933**	

Table A8.3: New Proposals for Epworth Town Council Semi-autonomous Water and Sewerage Company. (Company under Greater Harare Water after 2018

Job Title	Department	Activity	Proposed Number	Grade
Branch Manager for Water and Sewerage Services	Water and Sewerage semi-autonomous body	Overall Management	1	10
Financial Operations Supervisor (Accountant)	Finance	In charge of financial services	1	9
Commercial Operations Officer	Commercial Operations	In charge of commercial operations	1	9
Technical Operations Officer	Technical Operations	In charge of technical operations	1	9
Water Operations Supervisor	Water	In charge water supply	1	7
Sewage Operations Supervisor	Sewerage	Sewerage services	1	7
Secretary and administrative assistant	Administration	Support	1	6
Billing Officer	Commercial		1	6
Revenue collection officer	Commercial		1	6
Payroll clerk and Time Keeper	Administration		1	5
Assistant Accountant	Finance		1	5
Meter reading supervisor / Pipe fitter	Commercial		1	5
Customer Relations Officer	Commercial		1	5
Cashier	Finance		1	5
Meter readers / Pipe fitters	Commercial	Meter reading / Pipe Fitting	6	4

Plumbers	Sewerage	3	4
Drivers	Administration	3	3
Stores Clerk	Administration	1	3
Assistant Plumbers / Attendants	Sewerage	2	2
General Hands	Sewerage	5	1
Total		**33**	

Table A8.4: New Proposal for Norton Town Council Semi-Autonomous Water and Sewerage Company. (Company under Greater Harare Water 2018)

Job Title	Department	Activity	Proposed Number	Grade
Branch Manager Water and Sewerage Services	Water and Sewerage semi-autonomous body	Overall Management	1	10
Financial Operations Supervisor (Accountant)	Finance	In charge of financial services	1	9
Commercial Operations Officer	Commercial Operations	In charge of commercial operations	1	9
Technical Operations Officer	Technical Operations	In charge of technical operations	1	9
Water Purification superintendent	Water	In charge water supply	1	8
Sewage works superintendent	Sewerage	Sewerage services	1	8
Credit Controller	Finance	Revenue collection	1	8
Stores Controller / Buyer	Finance	Support	1	8
Systems Administrator	Finance	Billing	1	8
Secretary and administrative assistant	Administration	Support	1	6
Billing Officer	Finance	Billing	1	6
Revenue collection officer	Finance	Revenue	1	6
Accountant	Finance	Revenue collection	2	6
Computer Operator	Finance	Billing	1	6
Payroll clerk	Administration	Payroll	1	5
Plumbing Foreman / Pipe fitter	Water	supervisor	1	5
Sewerage Supervisor	Sewage	supervisor	1	5
Meter reading supervisor / Pipe fitter	Commercial	supervisor	1	5
Customer Relations Officer	Commercial	Support	1	5
Cashier	Finance	Support	1	5
Meter readers / Pipe fitters	Commercial		13	4

Plumbers / Pipe fitters	Water		2	4
Water Linesmen	Water		8	4
Sewer Linesmen	Sewage		14	4
Receptionist / Typist	Administration	Support	1	3
Drivers	Administration		3	3
Stores Clerk	Administration		1	3
Water Operators	Water		1	3
Sewer Operators	Sewage		17	3
Guards	Administration	Support	69	3
Assistant Plumbers / Attendants	Sewerage		2	2
General Hands	Sewerage		5	1
Total			**157**	

Table A8.5: New Proposal for Ruwa Town Council Semi-Autonomous Water and Sewerage Company. (Company under Greater Harare Water 2018)

Job Title	Department	Activity	Proposed Number	Grade
Branch Manager Water and Sewerage Services	Water and Sewerage semi-autonomous body	Overall Management	1	10
Financial Operations Supervisor (Accountant)	Finance	In charge of financial services	1	9
Commercial Operations Officer	Commercial Operations	In charge of commercial operations	1	9
Technical Operations Officer	Technical Operations	In charge of technical operations	1	9
Water Works superintendent	Water	In charge water supply	1	8
Sewage works superintendent	Sewerage	Sewerage services	1	8
Water and Sewer Reticulation Superintended	Water and Sewage		1	8
Environment Officer	Garbage collection		1	8
Credit Controller	Finance	Revenue collection	1	8
Systems Administrator	Finance	Billing	1	8
Secretary and administrative assistant	Administration	Support	1	6
Billing Officer	Finance	Billing	1	6
Revenue collection officer	Finance	Revenue	1	6
Secretaries	Technical and Financial	Support	2	5
Stores Controller	Finance		1	5

Payroll clerk	Administration	Payroll	1	5
Senior Plumber Sewage	Sewage		1	5
Plumbing Foreman / Pipe fitter	Water	supervisor	1	5
Senior Water Works Operator	Water		1	5
Senior Sewage Works Operator	Sewage	supervisor	1	5
Meter reading supervisor / Pipe fitter	Commercial	supervisor	1	5
Customer Relations Officer	Commercial	Support	1	5
Cashier	Finance	Support	2	5
Meter readers / Pipe fitters	Commercial		11	4
Water Supervisor	Water		1	4
Sewer Cleaning Supervisor	Sewage		1	4
Drivers	Administration		3	3
Water Works Operators	Water		10	3
Sewer Works Operators	Sewage		11	3
Water Linesmen	Water		2	2
Sewer Linesmen	Sewage		2	2
Assistant Plumbers / Attendants	Sewerage		2	2
General Hands	Support		14	1
Total			**82**	

Table A8.6: New Proposal for Chitungwiza Town Council Semi-Autonomous Water and Sewerage Company. (Company under Greater Harare Water 2018)

Job Title	Department	Activity	Proposed Number	Grade
Branch Manager Water and Sewerage Services	Water and Sewerage semi-autonomous body	Overall Management	1	12
Financial Operations Supervisor (Accountant)	Finance	In charge of financial services	1	11
Commercial Operations Manager	Commercial Operations	In charge of commercial operations	1	11
Technical Operations Manager	Technical Operations	In charge of technical operations	1	11
Water Works Engineer	Water	In charge water supply	1	10
Sewage works Engineer	Sewerage	Sewerage services	1	10
Systems Administrator	ICT	Commercial	1	9
Professional Head	Commercial	Commercial	2	8
Water and Sewer Reticulation Superintended	Water and Sewage		2	7

Job Title	**Department**	**Activity**	**Proposed Number**	**Grade**
Accountant	Finance	Revenue collection	3	7
Secretary and administrative assistant	Administration	Support	1	6
Billing Officer	Finance	Billing	2	6
Revenue collection officer	Finance	Revenue	2	6
Customer Relations Officer	Commercial	Support	1	5
Secretaries	Technical and Financial	Support	2	5
Plumbing Foreman / Pipe fitter	Water	supervisor	3	5
Meter reading supervisor / Pipe fitter / clerk	Commercial	supervisor	37	5
Meter readers / Pipe fitters/Fitter	Commercial		33	4
Water Supervisor/Foreman	Water		3	4
Sewer Cleaning Supervisor/Plumber	Sewage		37	4
Drivers	Administration		3	3
Water Works Operators	Water		7	3
Sewer Works Operators	Sewage		9	3
Assistant Plumbers / Attendants	Sewerage		20	2
Guards	Support		4	2
General Hands	Support		30	1
Total			**208**	

Total Numbers for Greater Harare Water and Sewerage Company:

• Harare Head Office and Harare Branch	1,933
• Epworth Branch	33
• Norton Branch	157
• Ruwa Branch	82
• Chitungwiza Branch	208
TOTAL	**2,413**

APPENDIX 9: COST ESTIMATES

APPENDIX 9: DETAILED INVESTMENT COST ESTIMATES

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Medium Term Projects: FS/FD (2015–2016), Construction (2017–2018)
Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
A. WATER DEMAND MANAGEMENT/NRW REDUCTION PROGRAMME					**109,054,350**			**-**	**-**	**-**	**-**	**23,904,070**	**23,904,070**	**23,904,070**	**23,904,070**	**15,271,195**	**263,875**	**1,847,125**	**12,327,125**	**12,327,125**	**12,327,125**	**12,327,125**	**5,608,898**	**4,025,649**	**5,608,898**
A.1	**Rehabilitation/replacement of treated water transmission network**				**12,313,800**			-	-	-	-	**2,462,760**	**2,462,760**	**2,462,760**	**2,462,760**	**2,462,760**	-	-	-	-	-	-	-	-	-
i	Replacement of pipes																								
	ND 150 (OD 160) PVC	m	13,000	45	585,000							117,000	117,000	117,000	117,000	117,000					-	-			
	ND 200 (OD 225) PVC	m	2,700	75	202,500							40,500	40,500	40,500	40,500	40,500					-	-			
	ND 225 (OD 280) PVC	m	4,300	90	387,000							77,400	77,400	77,400	77,400	77,400					-	-			
	ND 250 (OD 280) PVC	m	740	90	66,600							13,320	13,320	13,320	13,320	13,320					-	-			
	ND 300 (OD 315) PVC	m	13,320	120	1,598,400							319,680	319,680	319,680	319,680	319,680					-	-			
	ND 375 (ND 400) PVC	m	1,590	200	318,000							63,600	63,600	63,600	63,600	63,600					-	-			
	ND 400 DI	m	530	200	106,000							21,200	21,200	21,200	21,200	21,200					-	-			
	ND 450 DI	m	7,160	250	1,790,000							358,000	358,000	358,000	358,000	358,000					-	-			
	ND 525 (ND 500) DI	m	2,210	300	663,000							132,600	132,600	132,600	132,600	132,600					-	-			
	ND 600 DI	m	2,000	450	900,000							180,000	180,000	180,000	180,000	180,000					-	-			
	ND 750 DI	m	6,000	700	4,200,000							840,000	840,000	840,000	840,000	840,000					-	-			
																					-	-			
ii	Replacement of gate/butterfly valves																				-	-			
	ND 400	nos	3	4,000	12,000							2,400	2,400	2,400	2,400	2,400					-	-			
	ND 450	nos	10	5,700	57,000							11,400	11,400	11,400	11,400	11,400					-	-			
	ND 500	nos	2	7,000	14,000							2,800	2,800	2,800	2,800	2,800					-	-			
	ND 600	nos	2	11,000	22,000							4,400	4,400	4,400	4,400	4,400					-	-			
	ND 750	nos	4	16,000	64,000							12,800	12,800	12,800	12,800	12,800					-	-			
	ND 800	nos	1	20,300	20,300							4,060	4,060	4,060	4,060	4,060					-	-			
	ND 1000	nos	5	27,700	138,500							27,700	27,700	27,700	27,700	27,700					-	-			
																					-	-			
iii	Replacement of bulk water meters:																				-	-			
	ND 375	nos	10	10,000	100,000							20,000	20,000	20,000	20,000	20,000					-	-			
	ND 400	nos	2	12,000	24,000							4,800	4,800	4,800	4,800	4,800					-	-			
	ND 450	nos	9	15,000	135,000							27,000	27,000	27,000	27,000	27,000					-	-			
	ND 525 (ND 500)	nos	5	17,000	85,000							17,000	17,000	17,000	17,000	17,000					-	-			
	ND 600	nos	7	18,000	126,000							25,200	25,200	25,200	25,200	25,200					-	-			
	ND 700	nos	1	22,000	22,000							4,400	4,400	4,400	4,400	4,400					-	-			
	ND 750	nos	3	27,000	81,000							16,200	16,200	16,200	16,200	16,200					-	-			
	ND 800	nos	1	40,000	40,000							8,000	8,000	8,000	8,000	8,000					-	-			
	ND 975	nos	2	45,000	90,000							18,000	18,000	18,000	18,000	18,000					-	-			
	ND 1000	nos	1	84,000	84,000							16,800	16,800	16,800	16,800	16,800					-	-			
	ND 1300	nos	2	100,500	201,000							40,200	40,200	40,200	40,200	40,200					-	-			
	ND 1500	nos	1	116,000	116,000							23,200	23,200	23,200	23,200	23,200					-	-			
iv	Replacement of air valves	nos	45	1,100	49,500							9,900	9,900	9,900	9,900	9,900					-	-			
v	Reconstruction of broken chambers and covers	nos	80	200	16,000							3,200	3,200	3,200	3,200	3,200					-	-			
A.2	**Rehabilitation/replacement of water distribution network**				**92,240,550**			-	-	-	-	**20,541,310**	**20,541,310**	**20,541,310**	**20,541,310**	**11,908,435**	**263,875**	**1,847,125**	**12,327,125**	**12,327,125**	**12,327,125**	**12,327,125**	**5,608,898**	**4,025,649**	**5,608,898**
i	Replacement of pipes																								
	ND 75 (OD 80) PVC	m	8,250	22	181,500							36,300	36,300	36,300	36,300	36,300									
	ND 100 (OD 110) PVC	m	28,380	30	851,400							170,280	170,280	170,280	170,280	170,280					-	-			
	ND 150 (OD 160) PVC	m	26,620	45	1,197,900							239,580	239,580	239,580	239,580	239,580					-	-			
	ND 200 (OD 225) PVC	m	1,000	75	75,000							15,000	15,000	15,000	15,000	15,000					-	-			
	ND 225 (OD 280) PVC	m	1,100	90	99,000							19,800	19,800	19,800	19,800	19,800					-	-			
	ND 300 (OD 280) PVC	m	15,070	120	1,808,400							361,680	361,680	361,680	361,680	361,680					-	-			
	ND 400 DI	m	3,000	200	600,000							120,000	120,000	120,000	120,000	120,000					-	-			
																					-	-			
ii	Replacement of air valves	nos	76	800	60,800							12,160	12,160	12,160	12,160	12,160					-	-			
iii	Replacement of fire hydrants	nos	152	200	30,400							6,080	6,080	6,080	6,080	6,080					-	-			
																					-	-			
iv	Replacement of gate/butterfly valves																				-	-			
	ND 80	nos	10	200	2,000							400	400	400	400	400					-	-			
	ND 100	nos	45	250	11,250							2,250	2,250	2,250	2,250	2,250					-	-			
	ND 150	nos	30	450	13,500							2,700	2,700	2,700	2,700	2,700					-	-			
	ND 200	nos	10	800	8,000							1,600	1,600	1,600	1,600	1,600					-	-			
	ND 250	nos	5	1,500	7,500							1,500	1,500	1,500	1,500	1,500					-	-			
	ND 300	nos	12	2,000	24,000							4,800	4,800	4,800	4,800	4,800					-	-			
	ND 350	nos	5	3,200	16,000							3,200	3,200	3,200	3,200	3,200					-	-			
	ND 375 (ND 400)	nos	5	4,000	20,000							4,000	4,000	4,000	4,000	4,000					-	-			
v	Replacement of pressure reducing valves:																				-	-			
	ND 50	nos	20	1,700	34,000							6,800	6,800	6,800	6,800	6,800					-	-			
	ND 80	nos	20	2,200	44,000							8,800	8,800	8,800	8,800	8,800					-	-			
	ND 100	nos	15	4,000	60,000							12,000	12,000	12,000	12,000	12,000					-	-			
	ND 150	nos	25	5,000	125,000							25,000	25,000	25,000	25,000	25,000					-	-			
	ND 200	nos	15	5,500	82,500							16,500	16,500	16,500	16,500	16,500					-	-			
	ND 250	nos	5	6,500	32,500							6,500	6,500	6,500	6,500	6,500					-	-			
	ND 300	nos	8	8,000	64,000							12,800	12,800	12,800	12,800	12,800					-	-			
vi	Replacement of bulk water meters:																				-	-			
	ND 50	nos	1	500	500							100	100	100	100	100					-	-			
	ND 75	nos	3	800	2,400							480	480	480	480	480					-	-			
	ND 100	nos	18	1,000	18,000							3,600	3,600	3,600	3,600	3,600					-	-			
	ND 150	nos	38	2,000	76,000							15,200	15,200	15,200	15,200	15,200					-	-			
	ND 200	nos	16	3,000	48,000							9,600	9,600	9,600	9,600	9,600					-	-			
	ND 225 (ND 250)	nos	2	4,000	8,000							1,600	1,600	1,600	1,600	1,600					-	-			
	ND 300	nos	8	7,000	56,000							11,200	11,200	11,200	11,200	11,200					-	-			
	ND 325 (ND 300)	nos	1	7,000	7,000							1,400	1,400	1,400	1,400	1,400					-	-			
vii	Replacement of non-return valves	nos	100	1,000	100,000							20,000	20,000	20,000	20,000	20,000					-	-			
viii	Clean and service sluice valves	Sum	1	2,000	2,000							400	400	400	400	400					-	-			
ix	Reconstruction of broken chambers and covers	Sum	1	14,000	14,000																-	-			
																					-	-			
x	Replacement of service connections																				-	-			
a	Domestic (ND 15) (OD 20)	nos.	209,600	150	31,440,000							6,288,000	6,288,000	6,288,000	6,288,000	6,288,000					-	-			
b	Non-Domestic (ND 25)	nos.	52,400	250	13,100,000							2,620,000	2,620,000	2,620,000	2,620,000	2,620,000					-	-			
												-									-	-			
xi	Replacement of service water meters																								
a	Domestic (ND 15)	nos.	209,600	150	31,440,000				-	-	-	7,860,000	7,860,000	7,860,000	7,860,000	1,458,256	208,322	1,458,256	9,318,256	9,318,256	9,318,256	9,318,256	4,428,078	3,178,144	4,428,078
b	Non-Domestic (ND 25)	nos.	52,400	200	10,480,000				-	-	-	2,620,000	2,620,000	2,620,000	2,620,000	388,868	55,553	388,868	3,008,868	3,008,868	3,008,868	3,008,868	1,180,821	847,505	1,180,821
												-													
A.3	**NRW Reduction programme**				**4,500,000**				-	-	-	**900,000**	**900,000**	**900,000**	**900,000**	**900,000**	-	-	-	-	-	-	-	-	-

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Medium Term Projects: FS/FD (2015–2016), Construction (2017–2018)
Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
i	Network Mapping, Network investigations and repair/replacement programme	Sum	1	3,000,000	3,000,000							600,000	600,000	600,000	600,000	600,000									
ii	Customer database cleanup and awareness campaigns	Sum	1	1,500,000	1,500,000							300,000	300,000	300,000	300,000	300,000									
B. WATER SUPPLY SERVICE IMPROVEMENTS					**22,612,854**			**47,848,302**	-	-	-	**10,506,427**	**10,506,427**	-	-	-	-	-	-	-	**23,924,151**	**23,924,151**	-	-	-
B.1	**Rehabilitation of MORTON JAFRAY WTW including source works**				**10,964,937**			**30,873,426**	-	-	-	**5,482,469**	**5,482,469**	-	-	-	-	-	-	-	**15,436,713**	**15,436,713**	-	-	-
i	Rehabilitation of Lake Chivero Intake																								
a	Rehabilitation/Replacement of Periscope Lifting Mechanism	nos	4	15,000	60,000	4	30,000	120,000				30,000	30,000								60,000	60,000			
b	Rehabilitation/Replacement of Butterfly Valves and Actuators , DN 1200	nos		31,200	-	4	102,625	410,500				-	-								205,250	205,250			
c	Replacement of Desludging Pumps, DN 50 with lifting mechanism	nos		12,000	-		12,000	-				-	-								-	-			
d	Rehabilitation/Replacement of Penstock Gates, 3mx3m	nos	2	8,000	16,000	2	30,000	60,000				8,000	8,000								30,000	30,000			
e	Replacement of Screens and liftin mechanism, 75 mm mesh, 1200 mm dia	nos		12,000	-	4	12,000	48,000				-	-								24,000	24,000			
f	Replacement/Rehabilitation of Transformer, 100 kVA	nos		16,000	-		9,600	-				-	-								-	-			
g	Replacement/Rehabilitation of LV Switchboard	nos		12,000	-	1	7,200	7,200				-	-								3,600	3,600			
h	Replacement of Small Power and Lighting	sum		12,000	-	1	7,200	7,200				-	-								3,600	3,600			
i	Rehabilitation/Rehabilitation of Intake Building	sum	1	10,000	10,000	1	6,000	6,000				5,000	5,000								3,000	3,000			
												-	-								-	-			
ii	Rehabilitation of Lake Manyame Intake											-	-								-	-			
a	Rehabilitation/Replacement of Periscope Lifting Mechanism	nos	4	4,500	18,000	4	10,000	40,000				9,000	9,000								20,000	20,000			
b	Rehabilitation/Replacement of Butterfly Valves and Actuators , DN 1200	nos	4	15,000	60,000	4	102,625	410,500				30,000	30,000								205,250	205,250			
c	Replacement of Desludging Pump, Turbine Type, 10 kW	nos	1	23,000	23,000	1	23,000	23,000				11,500	11,500								11,500	11,500			
d	Replacement of Forebay Pumps, Turbine Type, 10 kW	nos	2	23,000	46,000	2	23,000	46,000				23,000	23,000								23,000	23,000			
e	Rehabilitation/Replacement of Penstock Gates	nos	4	2,500	10,000	4	4,500	18,000				5,000	5,000								9,000	9,000			
f	Replacement/Rehabilitation of Screens and lifting mechanism, 75 mm mesh, 1200 mm dia	nos	4	12,000	48,000	4	3,000	12,000				24,000	24,000								6,000	6,000			
g	Replacement/Service/Replacement of Transformer, 100 kVA	nos	1	16,000	16,000	1	8,000	8,000				8,000	8,000								4,000	4,000			
h	Replacement of LV Switchboard	nos	1	6,000	6,000	1	1,800	1,800				3,000	3,000								900	900			
i	Replacement of Small Power and Lighting	sum	1	3,500	3,500	1	6,000	6,000				1,750	1,750								3,000	3,000			
j	Repairs/Repairs of Building and Security Fence	sum	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
k	Replacement of Desludging Pumps and Hoist, DN 150 in Shaft 5	nos	2	7,500	15,000	2	7,500	15,000				7,500	7,500								7,500	7,500			
												-	-												
iii	Raw water transmission and pumping											-	-												
a	Replacement/Rehabilitation of Inflow from Lake Chivero Butterfly Valve with Actuator, DN 600	nos		33,808	-	1	10,000	10,000				-	-								5,000	5,000			
b	Replacement/Rehabilitation of Inflow from Lake Chivero Butterfly Valve with Actuator, DN 1300	nos		106,010	-	1	15,000	15,000				-	-								7,500	7,500			
c	Replacement/Rehabilitation of Inflow from Lake Chivero Butterfly Valve with Actuator, DN 1400	nos		110,610	-	1	20,000	20,000				-	-								10,000	10,000			
d	Replacement/Rehabilitation of Raw Water Pumping Butterfly Valve with Actuator, DN 1400	nos		110,610	-	1	20,000	20,000				-	-								10,000	10,000			
e	Replacement/Rehabilitation of Inflow from Lake Manyame Butterfly Valve with Actuator, DN 1800	nos		144,159	-	1	20,000	20,000				-	-								10,000	10,000			
f	Replacement/Rehabilitation of Needle Valve, DN 1200	nos		150,822	-	2	150,822	301,644				-	-								150,822	150,822			
g	Replacement/Replacement of Inflow Valve Actuator Control Switchboard	nos		8,000	-	1	1,600	1,600				-	-								800	800			
h	Replacement/Rehabilitationof Inflow Valve Chamber Small Power and Lighting	sum		3,500	-	1	3,500	3,500				-	-								1,750	1,750			
iii	Replacement/Rehabilitation of Riser Shaft Hoist, 7.5 t	nos		20,000	-	1	20,000	20,000				-	-								10,000	10,000			
j	Replacement of Butterfly Valve with Gear-Operated Handle to Clr Nr 07, DN 900	nos		65,001	-	1	20,000	20,000				-	-								10,000	10,000			
												-	-												
k	Replacement of Raw Water Pumps, Q = 5,400, H = 60 m	nos.	5	200,000	1,000,000	5	200,000	1,000,000				500,000	500,000								500,000	500,000			
l	Replacement of RW Water Pump Controls	sum	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
m	Replacement/Rehabilitation of Raw Water Pump Suction Gate Valves with Actuators, DN 700	nos.	5	12,000	60,000	5	12,000	60,000				30,000	30,000								30,000	30,000			
n	/Replacement of Raw Water Pump Delivery Gate Valves with Actuators, DN 700	nos.	5	12,000	60,000	5	12,000	60,000				30,000	30,000								30,000	30,000			
o	Replacement of Non-Return Valves, DN 700	nos.	5	20,000	100,000	5	20,000	100,000				50,000	50,000								50,000	50,000			
p	Replacement of Pressure Gauges	nos.	10	2,000	20,000	10	2,000	20,000				10,000	10,000								10,000	10,000			
q	Installation/Replacement of Air Valves	nos	5	3,572	17,861	5	3,572	17,861				8,930	8,930								8,930	8,930			
r	Replacement/Rehabilitation of Raw Water Pump 3.3 kV Starter Switchboard	nos.	1	437,500	437,500	1	437,500	437,500				218,750	218,750								218,750	218,750			
s	Replacement/Rehabilitation of Raw Water Pump 3.3 kV Starter Consoles	nos.	5	30,000	150,000	5	30,000	150,000				75,000	75,000								75,000	75,000			
t	Replacement/Rehabilitation of Raw Water Pump 3.3 kV Remote Starter Panels	nos.	5	15,000	75,000	5	15,000	75,000				37,500	37,500								37,500	37,500			
u	Replacement/Rehabilitation of Raw Water Pump 380 V LV Switchboard	nos.	1	16,000	16,000	1	16,000	16,000				8,000	8,000								8,000	8,000			
v	Replacement/Replacement of Small Power and Lighting	sum	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
w	Maintenance/Replacement overhead Wire Rope Hoist, 3 t	nos.	2	6,000	12,000	2	6,000	12,000				6,000	6,000								6,000	6,000			
x	Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
y	Replacement of Ventilation Fan	nos.	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
												-	-												
iv	Chemical Preparation and Dosing Unit 1*											-	-												
a	Replacement/Replacement of Alum Mixers	nos		3,000	-	4	3,000	12,000				-	-								6,000	6,000			
b	Replacement of Alum Dosing Pumps, Q = 1383 l/h; H = 3 bar	nos		6,000	-	5	6,000	30,000				-	-								15,000	15,000			
c	Replacement/Maintenance/Replacement of Lime Preparation Tanks, 2600 mm dia.	nos		6,000	-	3	6,000	18,000				-	-								9,000	9,000			
d	Replacement of Lime Mixers*	nos		3,000	-	3	3,000	9,000				-	-								4,500	4,500			
e	Replacement of Lime Dosing Pumps*	nos		6,000	-	3	6,000	18,000				-	-								9,000	9,000			
f	Replacement of PAC Mixers	nos		3,000	-	2	3,000	6,000				-	-								3,000	3,000			
g	Replacement of PAC Dosing Pumps	nos		6,000	-	2	6,000	12,000				-	-								6,000	6,000			
h	Replacement of Silica Mixers	nos		3,000	-	6	3,000	18,000				-	-								9,000	9,000			
iv	Replacement of Silica Dosing Pumps	nos		6,000	-	2	6,000	12,000				-	-								6,000	6,000			
j	Replacement of Chlorinator Unit (Post-chlorination), 20 kg/h*	sum		20,000	-	1	20,000	20,000				-	-								10,000	10,000			
k	Installation of new Chlorinator Unit (Pre-Chlorination), 20 kg/h	sum		4,500	-	1	4,500	4,500				-	-								2,250	2,250			
l	Installation/Rehabilitation of a new Sulphuric Acid Dosing Unit	sum		24,000	-	1	24,000	24,000				-	-								12,000	12,000			
m	Replacement of Small Power and Lighting	sum		4,500	-	1	4,500	4,500				-	-								2,250	2,250			
n	Replacement/Rehabilitation of Chemical LV Switchboards and MCCs	sum		5,280	-	3	5,280	15,840				-	-								7,920	7,920			
												-	-												
v	Chemical Preparation and Dosing Unit 2 and Unit 3*											-	-												
a	Rehabilitation/Replacement of Alum Mixers	nos		3,000	-	3	3,000	9,000				-	-								4,500	4,500			
b	Rehabilitation/Replacement of Silica Mixer	nos		3,000	-	1	3,000	3,000				-	-								1,500	1,500			
c	Replacement of Alum Dosing Pumps, Q = 4383 l/h; H = 3 bar	nos		6,000	-	7	6,000	42,000				-	-								21,000	21,000			
d	Replacement of Alum Transfer Pumps	nos		6,000	-	5	6,000	30,000				-	-								15,000	15,000			
e	Replacement of Lime Mixers and Screw Conveyors	nos		4,000	-	3	4,000	12,000				-	-								6,000	6,000			
f	Replacement of Lime Dosing Pumps	nos		6,000	-	4	6,000	24,000				-	-								12,000	12,000			
g	Replacement of PAC Mixers	nos		3,000	-	2	3,000	6,000				-	-								3,000	3,000			
h	Replacement of PAC Dosing Pumps	nos		6,000	-	2	6,000	12,000				-	-								6,000	6,000			
i	Replacement of Silica Mixers	nos		3,000	-	1	3,000	3,000				-	-								1,500	1,500			
j	Replacement of Silica Dosing Pumps	nos		6,000	-	2	6,000	12,000				-	-								6,000	6,000			
k	Replacement of Granular Silica and Alum Mixers	nos		4,000	-	4	4,000	16,000				-	-								8,000	8,000			
l	Replacement of Silica and Alum Transfer Pumps	nos		6,000	-	6	6,000	36,000				-	-								18,000	18,000			
m	Replacement of Chlorinator Unit (Post-chlorination), 20 kg/h*	sum		30,000	-		30,000	-				-	-								-	-			
n	Installation of new Chlorinator Unit (Pre-Chlorination), 20 kg/h	sum		13,500	-	1	13,500	13,500				-	-								6,750	6,750			
o	Replacement/Rehabilitation the Sulphuric Acid Dosing Unit	sum		24,000	-	1	24,000	24,000				-	-								12,000	12,000			
p	Replacement of Small Power and Lighting	sum		6,000	-	1	6,000	6,000				-	-								3,000	3,000			
q	Replacement/Maintenance/Replacement of Chemical LV Switchboards and MCCs	sum		30,000	-	1	30,000	30,000				-	-								15,000	15,000			
												-	-												
vi	Rehabilitation of Unit 1 Clarifiers											-	-												
a	Rehabilitation of Circular Clarifiers (nr 01 and nr 02)*	nos		40,000	-		40,000	-				-	-								-	-			
b	Rehabilitation of Accelerator Type of Circular Clarifier (nr 03)*	nos		40,000	-		40,000	-				-	-								-	-			
c	Rehabilitation of Vertical Flow Patterson Candy Clarifiers (nr 04, nr 05 & nr 06)	nos	3	22,809	68,427	3	22,809	68,427				34,214	34,214								34,214	34,214			
d	Rehabilitation/Modification of Degremont Pulsator Type Clarifier (nr 07)	nr	1	135,941	135,941	1	756,667	756,667				67,970	67,970								378,333	378,333			
e	Replacement/Maintenence/Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-												

Greater Harare Water and Sanitation Investment Plan

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Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Medium Term Projects — FS/FD (2015–2016), Construction (2017–2018)
Long Term Projects — FS/FD (2024–2025), Construction (2026–2027)

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount																	
vii	Rehabilitation and Modification of Unit 2 and 3 Clarifiers											-	-												
a	Rehabilitation/Modification of Unit 2 Degremont Type of Clarifier (nr 08)*	no		12,394	-	1	2,270,000	2,270,000				-	-								1,135,000	1,135,000			
b	Rehabilitation/Modification of Unit 2 Degremont Type of Clarifiers (nr 09 & nr 10)	sum	2	12,394	24,789	1	2,270,000	2,270,000				12,394	12,394								1,135,000	1,135,000			
c	Rehabilitation/Modification of Unit 3 Degremont Type of Clarifiers (nr 11, nr 12 & nr 13)	sum	3	12,394	37,183	1	2,270,000	2,270,000				18,591	18,591								1,135,000	1,135,000			
d	Replacement of Small Power and Lighting	sum	1	3,000	3,000	1	10,000	10,000				1,500	1,500								5,000	5,000			
							-	-				-	-												
viii	Rehabilitation of Unit 1 Filters						-	-				-	-												
a	Maintenance/Rehabilitation of the Patterson Candy Rapd Gravity Filters (7.6mx5.9mx2.7m dept) - 12 nr*	nos		70,384	-	12	70,384	844,608				-	-								422,304	422,304			
b	Rehabilitation of Degremont Filters (10.4mx4.9mx1.45m dept)	nos		88,886	-	14	88,886	1,244,408				-	-								622,204	622,204			
c	Replacement/Maintenance/Replacement of Backwash Pumps, Q = 450 m3/h; H =14 m	nos		53,000	-	2	53,000	106,000				-	-								53,000	53,000			
d	Replacement of BW Water Pump Controls	sum		10,000	-	1	10,000	10,000				-	-								5,000	5,000			
e	Replacement of Foot Valves, DN 300	nos.		2,500	-	2	2,500	5,000				-	-								2,500	2,500			
f	Replacement of Delivery Gate Valves, DN 300	nos.		5,502	-	2	5,502	11,004				-	-								5,502	5,502			
g	Replacement of Non-Return Valves, DN 300	nos.		20,000	-	2	20,000	40,000				-	-								20,000	20,000			
h	Replacement of Pressure Gauges	nos.	4	13,799	55,196	4	13,799	55,196				27,598	27,598								27,598	27,598			
i	Installation/Replacement of Air Valves	nos	2	3,000	6,000	2	3,000	6,000				3,000	3,000								3,000	3,000			
j	Installation/Replacement of Overhead Electric Wire Rope Hoist, 5 t	nos.	2	20,000	40,000	2	20,000	40,000				20,000	20,000								20,000	20,000			
k	Replacement of Air Scour Blowers, Q = 2,800 m3/h; Diff Press = 0.4 bar	nos		25,000	-	2	25,000	50,000				-	-								25,000	25,000			
l	Replacement of Delivery Gate Valves, DN 150	nos	2	1,309	2,618	2	1,309	2,618				1,309	1,309								1,309	1,309			
m	Replacement of Safety Valves	nos	2	8,000	16,000	2	8,000	16,000				8,000	8,000								8,000	8,000			
n	Replacement of Pressure Gauges	nos.	4	2,000	8,000	4	2,000	8,000				4,000	4,000								4,000	4,000			
o	Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
p	Replacement of Backwash Switchboard	nos	1	16,000	16,000	1	16,000	16,000				8,000	8,000								8,000	8,000			
												-	-												
ix	Rehabilitation of Unit 2 and Unit 3 Filters											-	-												
a	Rehabilitation of Degremont Filters (17.5mx8.7mx2.5m dept)	nos	36	140,180	5,046,492	36	140,180	5,046,492				2,523,246	2,523,246								2,523,246	2,523,246			
b	Replacement of Backwash Pumps and fittings, Q = 1080 m3/h; H =14 m	nos		85,000	-	5	85,000	425,000				-	-								212,500	212,500			
c	Rehabilitation of BW Water Pump Controls	sum		6,000	-	1	6,000	6,000				-	-								3,000	3,000			
d	Replacement of Suction Butterfly Valves, DN 300	nos.		3,631	-	5	3,631	18,157				-	-								9,078	9,078			
e	Replacement of Delivery Gate Valves, DN 300	nos.		5,502	-	2	5,502	11,004				-	-								5,502	5,502			
f	Replacement of Non-Return Valves, DN 300	nos.		20,000	-	2	20,000	40,000				-	-								20,000	20,000			
g	Replacement of Pressure Gauges	nos.		2,000	-	4	2,000	8,000				-	-								4,000	4,000			
h	Installation/Replacement of Air Valves	nos		1,737	-	2	1,737	3,473				-	-								1,737	1,737			
ix	Installation/Rehabilitation of Overhead Electric Wire Rope Hoist, 5 t	nos.	2	9,000	18,000	2	9,000	18,000				9,000	9,000								9,000	9,000			
j	Replacement/Replacement of Air Scour Blowers and fittings, Q = 3,050 m3/h; Diff Press = 0.4 bar	nos		30,000	-	5	30,000	150,000				-	-								75,000	75,000			
k	Replacement of Delivery Gate Valves, DN 200	nos		2,226	-	2	2,226	4,452				-	-								2,226	2,226			
l	Replacement of Safety Valves	nos		4,500	-	2	4,500	9,000				-	-								4,500	4,500			
m	Replacement of Non-Return Valves, DN 200	nos.		20,000	-	2	20,000	40,000				-	-								20,000	20,000			
n	Rehabilitate /Replacement of Air Compressors for Valve Actuators	nos		20,000	-	3	20,000	60,000				-	-								30,000	30,000			
o	Replacement/Replacement of Small Power and Lighting	sum		6,000	-	1	6,000	6,000				-	-								3,000	3,000			
p	Replacement/Rehabilitation of Filter Switchboards and MCCs	nos		12,000	-	1	12,000	12,000				-	-								6,000	6,000			
												-	-												
x	Rehabilitation/Replacement and Maintenance of HL Pumps: Unit 1 (Pump Nrs 1 - 3)											-	-												
a	Replacement of HL Water Pumps, Q = 1125, H = 172 m*	nos.		160,000	-	3	160,000	480,000				-	-								240,000	240,000			
b	Installation/Replacement of HL Water Pump Controls	sum		20,000	-	1	20,000	20,000				-	-								10,000	10,000			
c	Rehabilitation of HL Water Pumps Gate Valves with Actuators, DN 600*	nos.		30,734	-	3	30,734	92,203				-	-								46,101	46,101			
d	Rehabilitation of HL Water Pump Delivery Gate Valves with Actuators, DN 450*	nos.		15,367	-	3	15,367	46,101				-	-								23,051	23,051			
e	Rehabilitation of Non-Return Valves, DN 450*	nos.		17,388	-	3	17,388	52,164				-	-								26,082	26,082			
f	Replacement of Pressure Gauges	nos.		2,000	-	6	2,000	12,000				-	-								6,000	6,000			
g	Installation/Replacement of Air Valves	nos		2,000	-	2	2,000	4,000				-	-								2,000	2,000			
h	Rehabilitation of HL Pump 3.3 kV Starter Switchboard*	nos.		157,500	-	1	157,500	157,500				-	-								78,750	78,750			
i	Rehabilitation of HL Pump 3.3 kV Starter Console*	nos.		63,000	-	1	63,000	63,000				-	-								31,500	31,500			
j	Replacement of HL Pump 3.3 kV Remote Starter Panels*	nos.		12,000	-	3	12,000	36,000				-	-								18,000	18,000			
k	Replacement of HL Water Pump 380 V LV Switchboard*	nos.		21,000	-	1	21,000	21,000				-	-								10,500	10,500			
l	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
m	Replacement/Rehabilitation overhead Wire Rope Hoist, 10 t	nos.	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
n	Maintenance/Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
o	Maintenance/Replacement of Ventilation Fans	nos.	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
												-	-												
xi	Rehabilitation/Replacement and Maintenance of HL Pumps: Unit 2 (Pump Nrs 4 - 6)			-								-	-												
a	Replacement of HL Water Pumps, Q = 2630, H = 145 m*	nos.		180,000	-	3	180,000	540,000				-	-								270,000	270,000			
b	Installation/Replacement of HL Water Pump Controls	sum		20,000	-	1	20,000	20,000				-	-								10,000	10,000			
c	Rehabilitation of HL Water Pumps Suction Gate Valves with Actuators, DN 600*	nos.		30,734	-	3	30,734	92,203				-	-								46,101	46,101			
d	Rehabilitation of HL Water Pump Delivery Gate Valves with Actuators, DN 450*	nos.		15,367	-	3	15,367	46,101				-	-								23,051	23,051			
e	Rehabilitation of Non-Return Valves, DN 600*	nos.		17,388	-	3	17,388	52,164				-	-								26,082	26,082			
f	Rehabilitation of Pressure Gauges	nos.		2,000	-	6	2,000	12,000				-	-								6,000	6,000			
g	Installation/Replacement of Air Valves	nos		2,000	-	2	2,000	4,000				-	-								2,000	2,000			
h	Replacement of HL Pump 3.3 kV Starter Switchboard*	nos.		450,000	-	1	450,000	450,000				-	-								225,000	225,000			
i	Replacement of HL Pump 3.3 kV Starter Console*	nos.		36,000	-	1	36,000	36,000				-	-								18,000	18,000			
j	Replacement of HL Pump 3.3 kV Remote Starter Panels*	nos.		12,000	-	3	12,000	36,000				-	-								18,000	18,000			
k	Replacement of HL Water Pump 380 V LV Switchboard	nos.		14,400	-	1	14,400	14,400				-	-								7,200	7,200			
l	Replacement of Small Power and Lighting	sum	1	8,800	8,800	1	8,800	8,800				4,400	4,400								4,400	4,400			
m	Replacement/Rehabilitation overhead Wire Rope Hoist, 12.5 t	nos.	1	9,000	9,000	1	9,000	9,000				4,500	4,500								4,500	4,500			
n	Replacement/Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
o	Replacement of Ventilation Fans	nos.	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
												-	-												
xii	Rehabilitation/Replacement and Maintenance of HL Pumps: Unit 3 (Pump Nrs 7 - 10: 2 Stage)											-	-												
a	Replacement of HL Water Pumps, Q = 3161, H = 67 m/Q = 3161, H = 124 m*	nos.		200,000	-	8	200,000	1,600,000				-	-								800,000	800,000			
b	Installation/Rehabilitation of HL Water Pump Controls	sum		20,000	-	1	20,000	20,000				-	-								10,000	10,000			
c	Rehabilitation of HL Water Pumps Suction Butterfly Valves, DN 600*	nos.		17,639	-	4	17,639	70,555				-	-								35,278	35,278			
d	Rehabilitation of HL Water Pump Delivery Gate Valves with Actuators, DN 600*	nos.		30,734	-	4	30,734	122,937				-	-								61,469	61,469			
e	Rehabilitation of Non-Return Valves, DN 600*	nos.		22,841	-	4	22,841	91,365				-	-								45,683	45,683			
f	Replacement of Pressure Gauges	nos.		2,000	-	16	2,000	32,000				-	-								16,000	16,000			
g	Rehabilitation of Air Valves	nos		2,000	-	2	2,000	4,000				-	-								2,000	2,000			
h	Rehabilitation of HL Pump 3.3 kV Starter Switchboard*	nos.		210,000	-	1	210,000	210,000				-	-								105,000	105,000			
i	Replacement of HL Pump 3.3 kV Starter Console*	nos.		21,000	-	8	21,000	168,000				-	-								84,000	84,000			
j	Rehabilitation of HL Pump 3.3 kV Remote Starter Panels*	nos.		12,000	-	4	12,000	48,000				-	-								24,000	24,000			
k	Rehabilitation of HL Water Pump 380 V LV Switchboard	nos.		9,600	-	1	9,600	9,600				-	-								4,800	4,800			
l	Replacement of Small Power and Lighting	sum	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
m	Replacement overhead Wire Rope Hoist, 12.5 t	nos.	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
n	Replacement of Dewatering Pumps	nos.	3	4,500	13,500	3	4,500	13,500				6,750	6,750								6,750	6,750			
o	Replacement of Ventilation Fans	nos.	6	3,000	18,000	6	3,000	18,000				9,000	9,000								9,000	9,000			
												-	-												
xiii	Rehabilitation/Replacement of High Lift (HL) Pumps: Unit 4 (Pump Nrs 11 - 14: 2 Stage)	Sum										-	-												
a	Replacement of HL Water Pumps, Q = 3161, H = 67 m/Q = 3161, H = 124 m*	nos.		200,000	-	8	200,000	1,600,000				-	-								800,000	800,000			
b	Installation/Rehabilitation of HL Water Pump Controls	sum		20,000	-	1	20,000	20,000				-	-								10,000	10,000			
c	Rehabilitation of HL Water Pumps Suction Butterfly Valves, DN 600*	nos.		1,800	-	4	1,800	7,200				-	-								3,600	3,600			
d	Rehabilitation of HL Water Pump Delivery Gate Valves with Actuators, DN 600*	nos.		-	-	4	-	-				-	-								-	-			
e	Rehabilitation of Non-Return Valves, DN 600*	nos.		-	-	4	-	-				-	-								-	-			
f	Replacement of Pressure Gauges	nos.		2,000	-	16	2,000	32,000				-	-								16,000	16,000			
g	Replacement of Air Valves	nos		2,000	-	2	2,000	4,000				-	-								2,000	2,000			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan (pink)
Covered under Zim-Fund Phase 1 (yellow)

Medium Term Projects: FS/FD (2015–2016), Construction (2017–2018)

Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
h	Rehabilitation of HL Pump 3.3 kV Starter Switchboard*	nos.		144,000	-	1	144,000	144,000				-	-								72,000	72,000			
i	Replacement of HL Pump 3.3 kV Starter Console*	nos.		-	-	8	-	-				-	-								-	-			
j	Rehabilitation of HL Pump 3.3 kV Remote Starter Panels*	nos.		-	-	4	-	-				-	-								-	-			
k	Rehabilitation of HL Water Pump 380 V LV Switchboard	nos.		96,000	-	1	96,000	96,000				-	-								48,000	48,000			
l	Replacement of Small Power and Lighting	sum	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
m	Replacement/Rehabilitation overhead Wire Rope Hoist, 12.5 t	nos.	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
n	Replacement of Dewatering Pumps	nos.	3	4,500	13,500	3	4,500	13,500				6,750	6,750								6,750	6,750			
o	Replacement of Ventilation Fans	nos.	6	3,000	18,000	6	3,000	18,000				9,000	9,000								9,000	9,000			
												-	-												
xiv	Clear water valves, flowmeters and level gauges											-	-												
a	Replacement of Gate Valve, DN 1000 on Old DN 1300 Transmission Line	nos		150,822	-	1	150,822	150,822				-	-								75,411	75,411			
b	Replacement of Gate Valve, DN 1000 on New DN 1300 Transmission Line	nos		150,822	-	1	150,822	150,822				-	-								75,411	75,411			
c	Replacement of Gate Valve, DN 1000 on DN 975 Distribution Line	nos		150,822	-	1	150,822	150,822				-	-								75,411	75,411			
d	Replacement of Gate Valve, DN 750 on DN 750 Distribution Line	nos		76,000	-	1	76,000	76,000				-	-								38,000	38,000			
e	Replacement of Gate Valve, DN 1000 on DN 1300 Interconnection Line	nos		150,822	-	1	150,822	150,822				-	-								75,411	75,411			
f	Replacement of Flowmeter on Raw Water Pipe from L. Chivero to Mix Ch., DN 1400 (Unit 1)	nos		51,237	-	1	51,237	51,237				-	-								25,618	25,618			
g	Replacement of Flowmeter on Raw Water Pipe from L. Chivero to Clr Nr 07, DN 900 (Unit 1)	nos		21,919	-	1	21,919	21,919				-	-								10,959	10,959			
h	Replacement of Flowmeter on Backwash Pipe to Patterson Candy Filters, DN 200 (Unit 1)	nos		3,000	-	1	3,000	3,000				-	-								1,500	1,500			
i	Replacement of Flowmeter on Backwash Pipe to Degremont Filters, DN 300 (Unit 1)	nos		7,000	-	1	7,000	7,000				-	-								3,500	3,500			
j	Replacement of Flowmeter on Raw Water Main Pipe from L. Manyame, DN 2200 (Units 2&3)	nos		116,820	-	1	116,820	116,820				-	-								58,410	58,410			
k	Replacement of Flowmeter on Raw Water Main Pipe from L. Chivero, DN 1300 (Units 2&3)	nos		34,878	-	1	34,878	34,878				-	-								17,439	17,439			
l	Replacement of Flowmeter on Backwash Pipe to Unit 2 Filters, DN 400 ((Units 2&3)	nos		8,650	-	1	8,650	8,650				-	-								4,325	4,325			
m	Replacement of Flowmeter on Backwash Pipe to Unit 3 Filters, DN 400 ((Units 2&3)	nos		8,650	-	1	8,650	8,650				-	-								4,325	4,325			
n	Replacement of Flowmeter on Clear Water Transmission Lines, DN 1300 (Units 2&3)	nos		34,878	-	1	34,878	34,878				-	-								17,439	17,439			
o	Replacement of Flowmeter on Clear Water Distribution Line, DN 750 (Units 2&3)	nos		17,015	-	1	17,015	17,015				-	-								8,508	8,508			
p	Replacement of Flowmeter on Clear Water Distribution Line, DN 700 (Units 2&3)	nos		17,015	-	1	17,015	17,015				-	-								8,508	8,508			
q	Replacement of Level Gauges on Clear Water Tanks	sum		40,000	-	1	40,000	40,000				-	-								20,000	20,000			
												-	-												
xv	Rehabilitation of the Washwater Recovery Plant											-	-												
a	Rehabilitation of Secondary Clarifier	nos	1	40,000	40,000	1	40,000	40,000				20,000	20,000								20,000	20,000			
b	Replacement of Turbine Pumps, Q = 1,800 m3/h, H = 18 m	nos.	5	48,000	240,000	5	48,000	240,000				120,000	120,000								120,000	120,000			
c	Replacement of Raw Water Pump Delivery Gate Valves, DN 500	nos.	5	11,465	57,325	5	11,465	57,325				28,662	28,662								28,662	28,662			
d	Replacement of Non-Return Valves, DN 500	nos.	5	19,061	95,306	5	19,061	95,306				47,653	47,653								47,653	47,653			
e	Replacement of Pressure Gauges	nos.	5	2,000	10,000	5	2,000	10,000				5,000	5,000								5,000	5,000			
f	Replacementn of Raw Water Pump 380 V LV Switchboard	nos.	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
g	Replacement of Small Power and Lighting	sum	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
h	Replacement overhead Wire Rope Hoist, 7.5 t	nos.	2	10,000	20,000	2	10,000	20,000				10,000	10,000								10,000	10,000			
i	Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
j	Replacement of Alum Dosing System	sum	1	15,000	15,000	1	15,000	15,000				7,500	7,500								7,500	7,500			
k	Replacement of the Farm Irrigation System	sum	1	60,000	60,000	1	60,000	60,000				30,000	30,000								30,000	30,000			
												-	-												
xvi	Replacement/Rehabilitation of Transformers											-	-												
a	Replacement of Transformer for the RW Pump Station: 4 MVA, 33/3.3 kV	nos.		120,000	-		120,000	-				-	-								-	-			
b	Rehabilitation/Replacement of Transformer for the RW Pump Station: 150 kVA, 3.3/.40 kV	nos.		18,000	-		18,000	-				-	-								-	-			
c	Rehabilitation of Transformer for HL Pump Station 01: 1 MVA, 33/3.3 kV	nos.	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
d	Replacement of Transformer for the HL Pump Station 01: 100 kVA, 3.3/.40 kV	nos.	2	15,000	30,000	2	15,000	30,000				15,000	15,000								15,000	15,000			
e	Replacement of Transformer for the HL Pump Station 01: 200 kVA, 3.3/.40 kV	nos.	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
f	Replacement of Transformer for the HL Pump Stations 02 & 03: 6.3 MVA, 33/3.3 kV	nos.	4	180,000	720,000	4	180,000	720,000				360,000	360,000								360,000	360,000			
g	Replacement of Transformer for the HL Pump Station 02: 1600 kVA, 3.3/.40 kV	nos.	2	60,000	120,000	2	60,000	120,000				60,000	60,000								60,000	60,000			
h	Replacement of Transformer for the Waste Water Stations: 2 MVA, 33/3.3 kV	nos.	1	100,000	100,000	1	100,000	100,000				50,000	50,000								50,000	50,000			
												-	-												
xvii	Miscellaneous											-	-												
a	Security lights and fence	Sum	1	80,000	80,000	1	80,000	80,000				40,000	40,000								40,000	40,000			
b	Standby generators	Sum	1	63,000	63,000	1	63,000	63,000				31,500	31,500								31,500	31,500			
c	Rehabilitation of buildings and roads	Sum	1	500,000	500,000	1	500,000	500,000				250,000	250,000								250,000	250,000			
d	Replacement of boats	Sum	1	21,000	21,000	1	21,000	21,000				10,500	10,500								10,500	10,500			
e	Replacement of vehicles, tractors and plant	Sum	1	600,000	600,000	1	600,000	600,000				300,000	300,000								300,000	300,000			
f	Laboratory equipment	Sum	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
g	SCADA and Radio communication systems	Sum	1	125,000	125,000	1	125,000	125,000				62,500	62,500								62,500	62,500			
												-													
B.2	**Rehabilitation of PE WTW including source works**				**3,012,058**			**6,779,552**	**-**	**-**	**-**	**1,506,029**	**1,506,029**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3,389,776**	**3,389,776**	**-**	**-**	**-**
i	Rehabilitation of Dam Intake			-	-		-	-																	
a	Replacement of Intake Gate Valves, DN 1000	nos	4	30,000	120,000	4	30,000	120,000				60,000	60,000								60,000	60,000			
b	Rehabilitation/Maintennce Replacement of Butterfly Valves and Actuators , DN 1200	nos	4	15,000	60,000	4	15,000	60,000				30,000	30,000								30,000	30,000			
c	Replacement/Maintenance/Replacement of Desludging Pumps, DN 50 with lifting mechanism	nos	2	3,500	7,000	2	3,500	7,000				3,500	3,500								3,500	3,500			
d	Replacement of Screens and liftin mechanism, 75 mm mesh, 1200 mm dia	nos	4	2,000	8,000	4	2,000	8,000				4,000	4,000								4,000	4,000			
e	Replacement/Maintenance/Rehabilitation of Transformer, 100 kVA	nos	1	15,000	15,000	1	15,000	15,000				7,500	7,500								7,500	7,500			
f	Replacement/Maintenence of LV Switchboard	nos	1	3,600	3,600	1	3,600	3,600				1,800	1,800								1,800	1,800			
g	Replacement/Maintenance/Replacement of Small Power and Lighting	sum	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
												-	-								-	-			
ii	Raw Water Pumps, Fittings and MV Switchboards and MCCs											-	-								-	-			
a	Replacement of Raw Water Pumps, Q = 2700, H = 24 m*	nos.		150,000	-	4	150,000	600,000				-	-								300,000	300,000			
b	Replacement of RW Water Pump Controls	sum	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
c	Replacement of Raw Water Pump Suction Butterfly Valves with Actuators, DN 500*	nos.		21,975	-	4	21,975	87,898				-	-								43,949	43,949			
d	Replacement of Raw Water Pump Delivery Butterfly Valves with Actuators, DN 500*	nos.		21,975	-	4	21,975	87,898				-	-								43,949	43,949			
e	Replacement of Non-Return Valves, DN 500	nos.	4	20,000	80,000	4	20,000	80,000				40,000	40,000								40,000	40,000			
f	Replacement of Pressure Gauges	nos.	8	2,000	16,000	8	2,000	16,000				8,000	8,000								8,000	8,000			
g	Installation of Air Valves	nos	4	3,000	12,000	4	3,000	12,000				6,000	6,000								6,000	6,000			
h	Replacement/Rehabilitation of Raw Water Pump 3.3 kV Starter Feeder Switchboard	nos.	1	210,000	210,000	1	210,000	210,000				105,000	105,000								105,000	105,000			
ii	Replacement/Rehabilitation of Raw Water Pump 3.3 kV Starter Consoles	nos.	4	21,000	84,000	4	21,000	84,000				42,000	42,000								42,000	42,000			
j	Replacement of Raw Water Pump 3.3 kV Remote Starter Panels	nos.	4	20,000	80,000	4	20,000	80,000				40,000	40,000								40,000	40,000			
k	Replacement of Raw Water Pump 380 V LV Switchboard	nos.	1	16,000	16,000	1	16,000	16,000				8,000	8,000								8,000	8,000			
l	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
m	Maintenance overhead Wire Rope Hoist, 7.5 t	nos.	2	20,000	40,000	2	20,000	40,000				20,000	20,000								20,000	20,000			
n	Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
o	Replacement of Ventilation Fan	nos.	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
												-	-												
iii	Chemical preparation and dosing plant											-	-												
a	Replacement of Alum Mixers	nos	3	3,000	9,000	3	3,000	9,000				4,500	4,500								4,500	4,500			
b	Replacement of Alum Dosing Pumps, 0 - 45 l/min	nos	3	6,000	18,000	2	6,000	12,000				9,000	9,000								6,000	6,000			
c	Replacement of Air Agitation System for Alum	sum	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
d	Replacement of Lime Mixers, 0 - 45 l/min	nos	3	3,000	9,000	2	3,000	6,000				4,500	4,500								3,000	3,000			
e	Replacement of Lime Dosing Pumps	nos	3	6,000	18,000	3	6,000	18,000				9,000	9,000								9,000	9,000			
f	Replacement of PAC Plant	sum	1	25,000	25,000	1	25,000	25,000				12,500	12,500								12,500	12,500			
g	Replacement of Silica Mixers	nos	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
h	Replacement of Silica Dosing Pumps	nos	3	6,000	18,000	2	6,000	12,000				9,000	9,000								6,000	6,000			
i	Replacement of Chlorinator Unit (Post-chlorination), 20 kg/h	sum	1	30,000	30,000	1	30,000	30,000				15,000	15,000								15,000	15,000			
j	Replacement of Chlorination Unit (Pre-Chlorination)	sum	1	30,000	30,000	1	30,000	30,000				15,000	15,000								15,000	15,000			
k	Replacement of Small Power and Lighting	sum	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
l	Replacement of Chemical LV Switchboards and MCC	nos	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan (pink)
Covered under Zim-Fund Phase 1 (yellow)

Medium Term Projects: FS/FD 2015–2016; Construction 2017–2018
Long Term Projects: FS/FD 2024–2025; Construction 2026–2027

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
												-	-												
iv	Vertical flow clarifiers (LxWxD: 18m x 9m x 9m)											-	-												
a	Replacement of Decanting Troughs/Maintenance/Rehabilitation of Vertical Flow Clarifiers*	nos		22,050	-	28	22,050	617,400				-	-								308,700	308,700			
b	Extension of the Under-Sized Clarifier	nos		291,600	-	1	291,600	291,600				-	-								145,800	145,800			
c	Replacement/Maintenance/Replacement of Small Power and Lighting	sum	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
												-	-												
v	Rapid Gravity Sand Filters											-	-												
a	Rehabilitation of Degremont Filters*	nos		34,146	-	16	34,146	546,336				-	-								273,168	273,168			
b	Replacement of Backwash Pumps, Q = 425 m3/h; H =15 m (3 nr)*	nos		54,000	-	3	54,000	162,000				-	-								81,000	81,000			
c	Replacement/Rehabilitation of BW Water Pump Controls	sum	1	10,000	10,000	1	10,000	10,000				5,000	5,000								5,000	5,000			
d	Replacement/Rehabilitation of Suction Gate Valves, DN 250*	nos.		1,500	-	3	1,500	4,500				-	-								2,250	2,250			
e	Replacement/Rehabilitation of Delivery Gate Valves, DN 200*	nos.		2,000	-	3	2,000	6,000				-	-								3,000	3,000			
f	Replacement/Rehabilitation of Non-Return Valves, DN 200*	nos.		20,000	-	3	20,000	60,000				-	-								30,000	30,000			
g	Replacement/Replacement of Pressure Gauges	nos.	6	2,000	12,000	6	2,000	12,000				6,000	6,000								6,000	6,000			
h	Installation/Replacement of Air Valves	nos	3	3,000	9,000	3	3,000	9,000				4,500	4,500								4,500	4,500			
i	Installation/Rehabilitation of Overhead Electric Wire Rope Hoist, 3 t	nos.	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
j	Replacement/Rehabilitation of Air Scour Blowers and fittings, Q = 3,179 m3/h; Diff Press = 1.0 bar	nos	2	4,000	8,000	2	4,000	8,000				4,000	4,000								4,000	4,000			
k	Replacement/Rehabilitation of Delivery Gate Valves, DN 200	nos	2	1,500	3,000	2	1,500	3,000				1,500	1,500								1,500	1,500			
l	Replacement/Replacement of Safety Valves	nos	2	2,500	5,000	2	2,500	5,000				2,500	2,500								2,500	2,500			
m	Replacement/Replacement of Small Power and Lighting	sum	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
n	Replacement/Replacement of the BW Switchboard	nos	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
												-	-												
vi	Rehabilitation/Replacement High Lift Pumps (Pump Nrs 1 - 3)*											-	-												
a	Replacement (1 nr)/Maintenance/Replacement of HL Water Pumps, Q = 1125, H = 172 m*	nos.		160,000	-	4	160,000	640,000				-	-								320,000	320,000			
b	Installation/Maintenance/Rehabilitation of HL Water Pump Controls	sum	4	12,000	48,000	4	12,000	48,000				24,000	24,000								24,000	24,000			
c	Maintenance/Replacement of HL Water Pumps Suction Gate Valves with Actuators, DN 600*	nos.		15,000	-	4	15,000	60,000				-	-								30,000	30,000			
d	Maintenance/Replacement of HL Water Pump Delivery Gate Valves with Actuators, DN 500*	nos.		12,000	-	4	12,000	48,000				-	-								24,000	24,000			
e	Maintenance/Replacement of Non-Return Valves, DN 500*	nos.		45,000	-	4	45,000	180,000				-	-								90,000	90,000			
f	Maintenance/Replacement of Pressure Gauges	nos.	4	2,000	8,000	4	2,000	8,000				4,000	4,000								4,000	4,000			
g	Installation/Maintenance/Replacement of Air Valves	nos	4	3,000	12,000	4	3,000	12,000				6,000	6,000								6,000	6,000			
h	Maintenance/Rehabilitation of HL Pump 3.3 kV Starter Feeder Switchboard*	nos.			-	1	210,000	210,000				-	-								105,000	105,000			
i	Maintenance/Replacement of HL Pump 3.3 kV Starter Console*	nos.		21,000	-	4	21,000	84,000				-	-								42,000	42,000			
j	Maintenance/Replacement of HL Pump 3.3 kV Remote Starter Panels*	nos.		12,000	-	4	12,000	48,000				-	-								24,000	24,000			
k	Maintenance/Rehabilitation of HL Water Pump 380 V LV Switchboard*	nos.		9,600	-	1	9,600	9,600				-	-								4,800	4,800			
l	Replacement/Maintenance/Replacement of Small Power and Lighting	sum	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
m	Maintenance/Replacement/Rehabilitation overhead Wire Rope Hoist, 10 t	nos.	1	9,000	9,000	1	9,000	9,000				4,500	4,500								4,500	4,500			
n	Replacement/Maintenance/Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
o	Replacement/Maintenance/Replacement of Ventilation Fans	nos.	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
												-	-								-	-			
vii	Clear water valves, flowmeters and level gauges											-	-								-	-			
a	Replacement/Rehabilitation of Valves	Sum	1	225,000	225,000	1	225,000	225,000				112,500	112,500								112,500	112,500			
b	Replacement/Rehabilitation of Flowmeters	Sum	1	85,000	85,000	1	85,000	85,000				42,500	42,500								42,500	42,500			
c	Replacement/Rehabilitation of Level Gauges	Sum	1	60,000	60,000	1	60,000	60,000				30,000	30,000								30,000	30,000			
												-	-								-	-			
viii	Sludge pump house											-	-								-	-			
a	Replacement of Sludge Pumps, Q = 350 m3/h, H = 40 m	nos.	3	55,000	165,000	3	55,000	165,000				82,500	82,500								82,500	82,500			
b	Replacement/Rehabilitation of Sludge Pump Suction Gate Valves, DN 300	nos.	3	5,502	16,506	5	5,502	27,510				8,253	8,253								13,755	13,755			
c	Replacement of Sludge Water Pump Delivery Gate Valves, DN 250	nos.	3	4,064	12,193	5	4,064	20,321				6,096	6,096								10,161	10,161			
d	Replacement of Non-Return Valves, DN 250	nos.	3	11,065	33,195	5	11,065	55,325				16,597	16,597								27,662	27,662			
e	Replacement of Pressure Gauges	nos.	6	2,000	12,000	5	2,000	10,000				6,000	6,000								5,000	5,000			
f	Replacement of Sludge Pump 380 V Incomer Switchboard	nos.	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
g	Replacement of Sludge Pump 380 V LV Switchboard and MCC	nos.	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
h	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
i	Replacement overhead Wire Rope Hoist, 3 t	nos.	1	10,000	10,000	1	10,000	10,000				5,000	5,000								5,000	5,000			
j	Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
k	Replacement of Screen, DN 400	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
l	Replacement of the Main Valve , DN 250	nos.	1	4,064	4,064	1	4,064	4,064				2,032	2,032								2,032	2,032			
												-	-								-	-	-		
x	Miscellaneous											-	-								-	-			
a	Rehabilitation/Replacement of transformers	Sum	1	375,000	375,000	1	375,000	375,000				187,500	187,500								187,500	187,500			
b	Rehabilitation/Replacement of security lights and fence	Sum	1	30,000	30,000	1	30,000	30,000				15,000	15,000								15,000	15,000			
c	Replacement/Replacement of Existing Generator, 87 kVA	Sum	1	25,000	25,000	1	25,000	25,000				12,500	12,500								12,500	12,500			
d	Maintenance/Rehabilitation of Office and Workshop Buildings Incl. Electrical and Mechanical Works	Sum	1	45,000	45,000	1	45,000	45,000				22,500	22,500								22,500	22,500			
e	Repaving/Rehabilitation of Compound Roads	Sum	1	120,000	120,000	1	120,000	120,000				60,000	60,000								60,000	60,000			
f	Supply and Delivery/Replacement of Boat	Sum	1	21,000	21,000	1	21,000	21,000				10,500	10,500								10,500	10,500			
g	Supply and Delivery/Replacement of operational Vehicles	Sum	1	225,000	225,000	1	225,000	225,000				112,500	112,500								112,500	112,500			
h	Supply and Delivery/Replacement of Tractors and Plant	Sum	1	175,000	175,000	1	175,000	175,000				87,500	87,500								87,500	87,500			
i	Supply and Delivery/Replacement of Laboratory Equipment	Sum	1	40,000	40,000	1	40,000	40,000				20,000	20,000								20,000	20,000			
j	Supply and Delivery/Replacement of SCADA and Radio Communication Systems	Sum	1	125,000	125,000	1	125,000	125,000				62,500	62,500								62,500	62,500			
B.3	**Rehabilitation of Warren Control station**				**2,343,456**			**8,658,409**	**-**	**-**	**-**	**1,171,728**	**1,171,728**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**4,329,205**	**4,329,205**	**-**	**-**	**-**
i	Chemical preparation and dosing plant											-	-										-		
a	Rehabilitation/Replacement of Chlorination Unit , 20 kg/h	sum	1	30,000	30,000	1	30,000	30,000				15,000	15,000								15,000	15,000			
b	Rehabilitation/Replacement of Ammonia Unit , 5 kg/h	sum	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
c	Replacement of Small Power and Lighting	sum	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
d	Replacement of Lifting Hoist and Adapters, 3 t	nos	3	3,500	10,500	3	3,500	10,500				5,250	5,250								5,250	5,250			
e	Replacement of Chemical LV Switchboards and MCC	nos	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
f	Replacement of Chlorination Chamber	nos	1	6,500	6,500	1	6,500	6,500				3,250	3,250								3,250	3,250			
												-	-								-	-			
ii	Replacement/Rehabilitation of High Lift Booster Pumps (Pump Nrs 1 - 14)											-	-								-	-			
a	Replacement of HL Water Pumps, Q = 2520, H = 120 m*	nos.				14	180,000	2,520,000				-	-								1,260,000	1,260,000			
b	Replacement of HL Water Pump Controls	sum				1	20,000	20,000				-	-								10,000	10,000			
c	Replacement of HL Water Pumps Suction Gate Valves, DN 600	nos.				14	26,725	374,156				-	-								187,078	187,078			
d	Replacement of HL Water Pump Delivery Gate Valves with Actuators, DN 600	nos.				14	51,224	717,133				-	-								358,566	358,566			
e	Replacement of HL Water Pump NRVs, DN 600	nos.				14	38,069	532,963				-	-								266,482	266,482			
f	Replacement of Pressure Gauges	nos.				28	2,000	56,000				-	-								28,000	28,000			
g	Installation/Replacement of Air Valves, DN 100	nos				14	2,000	28,000				-	-								14,000	14,000			
h	Rehabilitation/Replacement of HL Pump 3.3 kV Starter Feeder Switchboard	nos.				1	1,147,701	1,147,701				-	-								573,850	573,850			
i	Replacement of HL Pump 3.3 kV Starter Console	nos.				14	35,000	490,000				-	-								245,000	245,000			
j	Installation of HL Pump 3.3 kV Remote Starter Panels	nos.				14	20,000	280,000				-	-								140,000	140,000			
k	Replacement of HL Water Pump 380 V LV Switchboard	nos.				1	56,000	56,000				-	-								28,000	28,000			
l	Replacement of Small Power and Lighting	sum				1	20,000	20,000				-	-								10,000	10,000			
m	Replacement overhead Wire Rope Hoist, 12.5 t	nos.				2	20,000	40,000				-	-								20,000	20,000			
n	Replacement of Dewatering Pumps	nos.				2	4,500	9,000				-	-								4,500	4,500			
o	Replacement of Ventilation Fans	nos.				8	3,000	24,000				-	-								12,000	12,000			
												-	-								-	-			
iii	Clear water valves, flowmeters and level gauges											-	-								-	-			
a	Replacement of Butterfly Valve, DN 1500	nos										-	-								-	-			
b	Replacement of Butterfly Valve with Actuators, DN 1500	nos										-	-								-	-			
c	Replacement of Butterfly Valve, DN 1400	nos										-	-								-	-			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Medium Term Projects: FS/FD (2015–2016), Construction (2017–2018)
Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Item		Unit	Medium Term (upto 2020) Qty	Rate [USD]	Amount	Long Term (upto 2030) Qty	Rate [USD]	Amount	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
d	Replacement of Butterfly Valve with Actuator, DN 800	nos										-	-								-	-			
e	Replacement of Butterfly Valve with Actuator, DN 1000	nos										-	-								-	-			
f	Replacement of Butterfly Valve, DN 1000	nos										-	-								-	-			
g	Replacement of Flowmeters, DN1500	nos	2	57,384	114,769	2	57,384	114,769				57,384	57,384								57,384	57,384			
h	Replacement of Flowmeters, DN1400	nos	2	51,237	102,473	2	51,237	102,473				51,237	51,237								51,237	51,237			
iii	Replacement of Flowmeters, DN800 (to Emerald Hill)	nos	1	19,797	19,797	1	19,797	19,797				9,899	9,899								9,899	9,899			
j	Replacement of Flowmeters, DN 975 (to Alexandra Park)	nos	1	19,797	19,797	1	19,797	19,797				9,899	9,899								9,899	9,899			
k	Replacement of Flowmeters, DN 750 (to Alexandra Park)	nos	1	17,015	17,015	1	17,015	17,015				8,508	8,508								8,508	8,508			
l	Replacement of Level Gauges on Clear Water Reservoir	nos	2	10,000	20,000	2	10,000	20,000				10,000	10,000								10,000	10,000			
m	Replacement of Mechanical Level Gauge on Clear Water Reservoir	nos	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
												-	-								-	-			
iv	Replacement/Rehabilitation of Power Transformers											-	-								-	-			
a	Rehabilitation/Replacement of Transformers : 10 MVA, 33/3.3 kV	nos.	3	250,000	750,000	3	250,000	750,000				375,000	375,000								375,000	375,000			
b	Rehabilitation/Replacement of Transformers : 300 kVA, 3.3/0.40 kV	nos.	3	25,000	75,000	3	25,000	75,000				37,500	37,500								37,500	37,500			
c	Replacement of Transformer Secondary Cables, XLPE/SWA, 25 mm2	m	9,000	60	540,000	9,000	60	540,000				270,000	270,000								270,000	270,000			
												-	-								-	-			
v	Miscellaneous											-	-								-	-			
a	Security lights and fence	sum	1	15,000	15,000	1	15,000	15,000				7,500	7,500								7,500	7,500			
b	Standby generators	sum	1	40,000	40,000	1	40,000	40,000				20,000	20,000								20,000	20,000			
c	Buildings	sum	1	105	105	1	105	105				53	53								53	53			
d	Vehicles, plant and equipment	sum	1	400,000	400,000	1	400,000	400,000				200,000	200,000								200,000	200,000			
e	SCADA and radio communication systems	sum	1	145,000	145,000	1	145,000	145,000				72,500	72,500								72,500	72,500			
B.4	**Rehabilitation of ALEXANDER PARK Booster Station**				**2,692,403**			**1,536,915**	-	-	-	**546,202**	**546,202**	-	-	-	-	-	-	-	**768,457**	**768,457**	-	-	-
i	Replacement/Rehabilitation/Replacement of Booster Pumps (Pump House No. 01)																								
a	Replacement/Replacement of Booster Pumps, Q = 1250, H = 55 m	nos.	3	80,000	240,000	3	80,000	240,000				120,000	120,000								120,000	120,000			
b	Rehabilitation/Replacement of Booster Pumps, Q = 1250, H = 55 m	nos.	1	48,000	48,000	1	80,000	80,000				24,000	24,000								40,000	40,000			
c	Replacement/Replacement of Booster Pump Controls	sum	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
d	Rehabilitation/Replacement of Booster Pump Suction Gate Valves, DN 400	nos.	4	10,356	41,425	4	17,261	69,042				20,713	20,713								34,521	34,521			
e	Rehabilitation/Replacement of Booster Pump Delivery Gate Valves, DN 400	nos.	4	10,356	41,425	4	17,261	69,042				20,713	20,713								34,521	34,521			
f	Rehabilitation/Replacement of Booster Water Pump NRVs, DN 400	nos.	4	12,443	49,770	4	20,738	82,950				24,885	24,885								41,475	41,475			
g	Replacement/Replacement of Pressure Gauges	nos.	8	2,000	16,000	8	2,000	16,000				8,000	8,000								8,000	8,000			
h	Installation/Replacement of Air Valves, DN 100	nos	4	3,000	12,000	4	3,000	12,000				6,000	6,000								6,000	6,000			
i	Rehabilitation/Replacement of Feeder Switchboard	nos.	1	21,000	21,000	1	35,000	35,000				10,500	10,500								17,500	17,500			
j	Rehabilitation/Replacement of Booster Pump Starter Console	nos.	4	3,600	14,400	4	6,000	24,000				7,200	7,200								12,000	12,000			
k	Rehabilitation/Replacement of 380 V LV Switchboard	nos.	1	2,400	2,400	1	8,000	8,000				1,200	1,200								4,000	4,000			
l	Rehabilitation/Replacement of Small Power and Lighting	sum	2	7,200	14,400	2	12,000	24,000				7,200	7,200								12,000	12,000			
m	Installation/Replacement overhead Wire Rope Hoist, 5 t	nos.	2	4,800	9,600	2	8,000	16,000				4,800	4,800								8,000	8,000			
n	Replacement/Replacement of Dewatering Pumps	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
o	Rehabilitation/Replacement of Ventilation Fans	nos.	8	1,800	14,400	8	3,000	24,000				7,200	7,200								12,000	12,000			
												-	-								-	-			
ii	Rehabilitation/Replacement of Booster Pumps (Pump House No. 02)											-	-								-	-			
a	Rehabilitation/Replacement of Booster Pumps, Q = 1035, H = 95 m	nos.	2	84,000	168,000	2	140,000	280,000				84,000	84,000								140,000	140,000			
b	Replacement/Replacement of Booster Pump Controls	sum	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
c	Rehabilitation/Replacement of Booster Pump Suction Butterfly Valves, DN 400	nos.	2	6,835	13,670	2	11,392	22,784				6,835	6,835								11,392	11,392			
d	Rehabilitation/Replacement of Booster Pump Delivery Gate Valves, DN 400	nos.	2	10,356	20,713	2	17,261	34,521				10,356	10,356								17,261	17,261			
f	Rehabilitation/Replacement of Booster Water Pump NRVs, DN 400	nos.	2	10,800	21,600	2	18,000	36,000				10,800	10,800								18,000	18,000			
g	Replacement/Replacement of Pressure Gauges	nos.	4	2,000	8,000	4	2,000	8,000				4,000	4,000								4,000	4,000			
h	Installation/Replacement of Air Valves, DN 100	nos	2	3,000	6,000	2	3,000	6,000				3,000	3,000								3,000	3,000			
i	Rehabilitation/Replacement of 380 V LV Switchboard	nos.	1	2,400	2,400	1	8,000	8,000				1,200	1,200								4,000	4,000			
j	Rehabilitation/Replacement of Small Power and Lighting	sum	1	7,200	7,200	1	12,000	12,000				3,600	3,600								6,000	6,000			
k	Installation/Replacement overhead Wire Rope Hoist, 3 t	nos.	1	4,800	4,800	1	8,000	8,000				2,400	2,400								4,000	4,000			
l	Rehabilitation/Replacement of Gravity Drainage System	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
m	Install/Replacement of Ventilation Fan	nos.	1	1,800	1,800	1	3,000	3,000				900	900								1,500	1,500			
												-	-								-	-			
iii	Rehabilitation/Replacement of Valves											-	-								-	-			
a	Rehabilitation/Replacement of Butterfly Valve, DN 525 (outflow from Pump House 01)	nos	1	11,465	11,465	1	19,108	19,108				5,732	5,732								9,554	9,554			
b	Rehabilitation/Replacement of NRV, DN 525 (outflow from Pump House 01)	nos	1	19,061	19,061	1	31,769	31,769				9,531	9,531								15,884	15,884			
c	Rehabilitation/Replacementof Gate Valve, DN 525 (main inflow)	nos	3	17,371	52,114	1	28,952	28,952				26,057	26,057								14,476	14,476			
	Installation/Replacement of Level Gauges on Clear Water Reservoir	nos	1	10,000	10,000	1	10,000	10,000				5,000	5,000								5,000	5,000			
iv	Installation/Replacement of Flowmeters											-	-								-	-			
a	Installation /Replacement of Inflow Flowmeter, DN 600 (from Warren)	nos	1	13,669	13,669	1	13,669	13,669				6,835	6,835								6,835	6,835			
b	Installation /Replacement of Inflow Flowmeter, DN 750 (from Warren)	nos	1	17,262	17,262	1	17,262	17,262				8,631	8,631								8,631	8,631			
c	Installation/Replacement of Outflow Flowmeters, DN 450 (to Hatcliff)	nos	1	10,000	10,000	4	10,000	40,000				5,000	5,000								20,000	20,000			
d	Installation/Replacement of Outflow Flowmeters, DN 525 (to Crow Hill)	nos	1	11,329	11,329	4	11,329	45,315				5,664	5,664								22,658	22,658			
												-	-								-	-			
v	Miscellaneous											-	-								-	-			
a	Rehabilitation/Replacement of Transformer : 500 kVA, 11/0.40 kV (Pump House 02)	nos.	1	18,000	18,000	1	30,000	30,000				9,000	9,000								15,000	15,000			
b	Rehabilitation/Maintenance/Replacement of Transformers : 750 kVA, 11/0.40 kV (Pump House 01)	nos.	2	21,000	42,000	2	35,000	70,000				21,000	21,000								35,000	35,000			
c	Installation/Replacement of security fence and lights	sum	1	18,000	18,000	1	18,000	18,000				9,000	9,000								9,000	9,000			
d	Installatio/Replacement of Generator, 60 kVA (for dewatering pumps and security lights)	nos	1	25,000	25,000	1	25,000	25,000				12,500	12,500								12,500	12,500			
e	Maintenance/Rehabilitation of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	8,500	8,500	1	12,500	12,500				4,250	4,250								6,250	6,250			
d	Supply and Delivery/Replacement of SCADA and Radio Communication Systems	sum	1	24,000	24,000	1	24,000	24,000				12,000	12,000								12,000	12,000			
B.5	**Rehabilitation of Letombo Booster Station**				**1,600,000**				-	-	-	**800,000**	**800,000**	-	-	-	-	-	-	-	-	-	-	-	-
	Replacement of booster pumps, clear water valves, flowmeters, and other miscellaneous items	Sum	1	1,600,000	1,600,000							800,000	800,000												
B.6	**Rehabilitation of storage Reservoirs including lift stations**				**2,000,000**				-	-	-	**1,000,000**	**1,000,000**	-	-	-	-	-	-	-	-	-	-	-	-
		Sum	1	2,000,000	2,000,000							1,000,000	1,000,000												
C. EXTENSION OF WATER SUPPLY SERVICES					**55,761,426**			**401,777,404**	**7,774,489**	**7,774,489**	**7,774,489**	**8,444,489**	**8,444,489**	**49,621,335**	**49,621,335**	**57,680,032**	**15,833,187**	**15,833,187**	**15,833,187**	**15,833,187**	**55,134,854**	**55,134,854**	**55,134,854**	**15,833,187**	**15,833,187**
C.1	**Proposed Kunzvi Water Supply Scheme**				**-**			**151,445,535**	-	-	-	-	-	**41,846,845**	**41,846,845**	**41,846,845**	-	-	-	-	**8,635,000**	**8,635,000**	**8,635,000**	-	-
i	Kunzvi Dam																								
a	Construction of Dam	sum				-	40,000,000	-																	
ii	Water Production, Treatment and Transmission Facilities																								
a	Raw water intake and pump station	Sum				1	7,000,000	7,000,000						2,333,333.33	2,333,333.33	2,333,333.33									
b	Raw water transmission main (ND 1200)	m				8,050	890	7,164,500						2,388,166.67	2,388,166.67	2,388,166.67									
c	Water Treatment Plant (150 ML/day)	ML/day				150	450,000	67,500,000						15,075,000	15,075,000	15,075,000					7,425,000	7,425,000	7,425,000		
d	First treated water pump station	Sum				1	5,000,000	5,000,000						1,116,667	1,116,667	1,116,667					550,000	550,000	550,000		
e	Treated water transmission main (ND 1200)	m				39,432	890	35,094,480						11,698,160	11,698,160	11,698,160									
f	Second treated water pump station	Sum				1	6,000,000	6,000,000						1,340,000	1,340,000	1,340,000					660,000	660,000	660,000		
g	Miscellaneous (access roads, surge relief structures, special pipe surports, power supply etc)	Sum				1	3,500,000	3,500,000						1,166,666.67	1,166,666.67	1,166,666.67									
							-	-																	
iii	Transmission Pipelines downstream of Donny Brook Reservoirs						-	-																	
a	ND 900 from Donny Brook to Greendale pipeline	m				9,413	620	5,836,060						1,945,353.33	1,945,353.33	1,945,353.33									
b	ND 350 from Greendale to Highlands and Crowhill	m				6,303	190	1,197,570						399,190.00	399,190.00	399,190.00									
c	ND 350 from Greendale to Shamva Rd	m				12,750	190	2,422,500						807,500.00	807,500.00	807,500.00									
d	ND 600 from Donnybrook to Vernterberg	m				7,100	350	2,485,000						828,333.33	828,333.33	828,333.33									

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Medium Term Projects: FS/FD (2015–2016), Construction (2017–2018)
Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
e	Warren to Munity and Kuwadzana and Dzivaresekwa							-																	
	ND 300	m				3,116	160	498,609						166,203.12	166,203.12	166,203.12									
	ND 600	m				4,927	350	1,724,354						574,784.70	574,784.70	574,784.70									
	ND 700	m				1,553	440	683,399						227,799.81	227,799.81	227,799.81									
f	Warren to Lonchinvar and Marimba Park							-																	
	ND 350	m				576	190	109,496						36,498.57	36,498.57	36,498.57									
	ND 400	m				1,176	210	246,981						82,327.03	82,327.03	82,327.03									
	ND 500	m				5,311	250	1,327,773						442,591.04	442,591.04	442,591.04									
g	to Adylinn (See map)																								
	ND 400	m				454	210	95,379						31,792.89	31,792.89	31,792.89									
	ND 450	m				2,148	240	515,551						171,850.35	171,850.35	171,850.35									
	ND 650	m				1,049	440	461,574						153,858.02	153,858.02	153,858.02									
h	ND 600 Off Warren-Letombo line to Waterfalls (off-take)	m				2,715	350	950,134						316,711.23	316,711.23	316,711.23									
i	ND 600 Off Warren-Letombo line to Hatfield (off-take)	m				1,481	350	518,425						172,808.36	172,808.36	172,808.36									
j	ND 525 from Ventersburg to Ruwa WTP	m				4,050	275	1,113,750						371,250.00	371,250.00	371,250.00									
C.2	**Construction of new storage reservoirs**				-			**92,000,000**	-	-	-	-	-	-	-	-	-	-	-	-	**30,666,667**	**30,666,667**	**30,666,667**	-	-
i	Additional capacity at Adylinn	m^3				22,000	400	8,800,000													2,933,333	2,933,333	2,933,333		
ii	Additional capacity at Epsilon	m^3				7,500	400	3,000,000													1,000,000	1,000,000	1,000,000		
iii	Additional capacity at Bluff Hill	m^3				12,000	400	4,800,000													1,600,000	1,600,000	1,600,000		
iv	Additional capacity at Meyrick Park	m^3				2,000	400	800,000													266,667	266,667	266,667		
v	Additional capacity at Kopje	m^3				18,000	400	7,200,000													2,400,000	2,400,000	2,400,000		
vi	Additional capacity at Ventersberg	m^3				30,000	400	12,000,000													4,000,000	4,000,000	4,000,000		
vii	Additional capacity at Hatfield	m^3				36,000	400	14,400,000													4,800,000	4,800,000	4,800,000		
vii	Additional capacity at Waterfalls	m^3				50,000	400	20,000,000													6,666,667	6,666,667	6,666,667		
viii	Additional capacity at Kuwadzana	m^3				45,000	400	18,000,000													6,000,000	6,000,000	6,000,000		
iv	New Shamva Rd Tank	m^3				7,500	400	3,000,000				-	-								1,000,000	1,000,000	1,000,000		
C.3	**Extension of distribution system in expansion areas**				**54,421,426**			**158,331,869**	**7,774,489**	**7,774,489**	**7,774,489**	**7,774,489**	**7,774,489**	**7,774,489**	**7,774,489**	**15,833,187**	**15,833,187**	**15,833,187**	**15,833,187**	**15,833,187**	**15,833,187**	**15,833,187**	**15,833,187**	**15,833,187**	**15,833,187**
i	Pipes																								
	ND 75 PVC	m	408,312	22	8,982,859	1,187,929	22	26,134,428	1,283,266	1,283,266	1,283,266	1,283,266	1,283,266	1,283,266	1,283,266	2,613,443	2,613,443	2,613,443	2,613,443	2,613,443	2,613,443	2,613,443	2,613,443	2,613,443	2,613,443
	ND 110 PVC	m	326,649	30	9,799,482	950,343	30	28,510,285	1,399,926	1,399,926	1,399,926	1,399,926	1,399,926	1,399,926	1,399,926	2,851,029	2,851,029	2,851,029	2,851,029	2,851,029	2,851,029	2,851,029	2,851,029	2,851,029	2,851,029
	ND 160 PVC	m	146,992	45	6,614,651	427,654	45	19,244,443	944,950	944,950	944,950	944,950	944,950	944,950	944,950	1,924,444	1,924,444	1,924,444	1,924,444	1,924,444	1,924,444	1,924,444	1,924,444	1,924,444	1,924,444
ii	Section valves																								
	ND 75 Gate	nos.	4,083	200	816,624	11,879	200	2,375,857	116,661	116,661	116,661	116,661	116,661	116,661	116,661	237,586	237,586	237,586	237,586	237,586	237,586	237,586	237,586	237,586	237,586
	ND 100 Gate	nos.	3,266	250	816,624	9,503	250	2,375,857	116,661	116,661	116,661	116,661	116,661	116,661	116,661	237,586	237,586	237,586	237,586	237,586	237,586	237,586	237,586	237,586	237,586
	ND 150 Gate	nos.	1,470	450	661,465	4,277	450	1,924,444	94,495	94,495	94,495	94,495	94,495	94,495	94,495	192,444	192,444	192,444	192,444	192,444	192,444	192,444	192,444	192,444	192,444
iii	Fire hydrants																								
	ND 80	nos.	947	200	189,457	2,756	200	551,199	27,065	27,065	27,065	27,065	27,065	27,065	27,065	55,120	55,120	55,120	55,120	55,120	55,120	55,120	55,120	55,120	55,120
iv	Service connections																								
	ND 15	nos.	68,052	150	10,207,794	197,988	150	29,698,214	1,458,256	1,458,256	1,458,256	1,458,256	1,458,256	1,458,256	1,458,256	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821
	ND 25	nos.	13,610	250	3,402,598	39,598	250	9,899,405	486,085	486,085	486,085	486,085	486,085	486,085	486,085	989,940	989,940	989,940	989,940	989,940	989,940	989,940	989,940	989,940	989,940
v	Service water meters																								
	Domestic (ND 15)	nos.	68,052	150	10,207,794	197,988	150	29,698,214	1,458,256	1,458,256	1,458,256	1,458,256	1,458,256	1,458,256	1,458,256	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821	2,969,821
	Non-Domestic (ND 25)	nos.	13,610	200	2,722,078	39,598	200	7,919,524	388,868	388,868	388,868	388,868	388,868	388,868	388,868	791,952	791,952	791,952	791,952	791,952	791,952	791,952	791,952	791,952	791,952
C.4	**Other new bulk water management facilities**				**1,340,000**			-	-	-	-	**670,000**	**670,000**	-	-	-	-	-	-	-	-	-	-	-	-
i	Automatic Control System for pumps and reservoirs	Station	50	25,000	1,250,000							625,000	625,000										-		
ii	Water quality monitoring equipment	Sum	3	30,000	90,000							45,000	45,000										-		
	D. SEWERAGE SERVICE IMPROVEMENTS				**46,102,489**			**23,032,306**	**-**	**-**	**-**	**13,517,894**	**13,517,894**	**6,355,567**	**6,355,567**	**6,355,567**	**-**	**-**	**-**	**-**	**11,516,153**	**11,516,153**	**-**	**-**	**-**
D.1	**Rehabilitation of Firle WWTW**				**5,879,230**			**11,483,621**	-	-	-	**2,939,615**	**2,939,615**	-	-	-	-	-	-	-	**5,741,811**	**5,741,811**	-	-	-
i	Rehabilitation of Inlet Works: Unit 1 to Unit 4																								
a	Replacement of the Main Intake Sluice Gate, 1.8m x 2.0m*	nos			-	1	4,000	4,000				-	-								2,000	2,000			
b	Replacement of the Main Intake Screens, 1.8m x 3.0m (approx)*	nos			-	3	4,500	13,500				-	-								6,750	6,750			
c	Replacement of Intake Sluice Gates, 1.5m x 1.5m*	nos			-	13	2,000	26,000				-	-								13,000	13,000			
d	Installation of mechanical screen	nos			-	1	25,000	25,000				-	-								12,500	12,500			
e	Replacement of Intake Screens*	nos			-	4	3,500	14,000				-	-								7,000	7,000			
f	Replacement of Air Lift Pumps*	nos			-	6	4,500	27,000				-	-								13,500	13,500			
g	Replacement of Detritors*	nos			-	2	9,000	18,000				-	-								9,000	9,000			
h	Replacement of Elevators*	nos			-	2	6,500	13,000				-	-								6,500	6,500			
i	Replacement of Flowmeters*	nos			-	2	12,000	24,000				-	-								12,000	12,000			
j	Replacement of Compressors for Air Pumps*	nos			-	2	15,000	30,000				-	-								15,000	15,000			
k	Replacement of LV Switchboard	nos	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
l	Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-								-	-			
ii	Rehabilitation of Inlet Works: Unit 5											-	-								-	-			
a	Replacement of Intake Sluice Gates, 1.5m x 1.5m*	sum		4,500	-	1	4,500	4,500				-	-								2,250	2,250			
b	Replacement of Detritors*	nos		9,000	-	4	9,000	36,000				-	-								18,000	18,000			
c	Replacement of Elevators*	nos		6,500	-	2	6,500	13,000				-	-								6,500	6,500			
d	Replacement of Flowmeters*	nos		12,000	-	2	12,000	24,000				-	-								12,000	12,000			
e	Replacement of LV Switchboard	nos	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
f	Replacement of Air Lift Pumps*	nos		4,500	-	6	4,500	27,000				-	-								13,500	13,500			
g	Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
h	Installation of mechanical screen	nos		25,000	-	1	25,000	25,000				-	-								12,500	12,500			
												-	-								-	-			
iii	Extension of inlet works	Sum				1	1,440,000	1,440,000				-	-								720,000	720,000			
												-	-								-	-			
iv	PSTs and Trickling Filters (Units 1 to 4)											-	-								-	-			
a	Rehabilitation of the Division Box*	sum				1	30,000	30,000				-	-								15,000	15,000			
b	Rehabilitation of the Primary Sedimentation Tanks*	nos				16	17,628	282,054				-	-								141,027	141,027			
c	Rehabilitation of the Trickling Filters*	nos				8	107,553	860,426				-	-								430,213	430,213			
												-	-								-	-			
v	Raw sludge pumps (Units 1 to 4)											-	-								-	-			
a	Replacement of Raw Sludge Pumps, Q = 95 m3, H = 20 m	nos.	2	10,800	21,600	2	10,800	21,600				10,800	10,800								10,800	10,800			
b	Replacement of RW Water Pump Controls	sum	1	4,800	4,800	1	4,800	4,800				2,400	2,400								2,400	2,400			
c	Rehabilitation of Raw SludgePump Suction Gate Valves, DN 150*	nos.	2	785	1,571	2	785	1,571				785	785								785	785			
d	Replacement of Raw Sludge Pump Delivery Gate Valves, DN 100*	nos.	2	459	919	2	459	919				459	459								459	459			
e	Replacement of Non-Return Valves, DN 100	nos.	2	20,000	40,000	2	20,000	40,000				20,000	20,000								20,000	20,000			
f	Replacement of Pressure Gauges	nos.	4	2,000	8,000	4	2,000	8,000				4,000	4,000								4,000	4,000			
g	Installation of Air Valves	nos	2	3,000	6,000	2	3,000	6,000				3,000	3,000								3,000	3,000			
h	Replacement/Maintenance/Rehabilitation of Raw Water Pump 380 V LV Switchboard	nos.	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Medium Term Projects
FS/FD — Construction

Long Term Projects
FS/FD — Construction

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)		
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount
i	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000
j	Repalcement/Maintenance/Rehabilitation overhead Wire Rope Hoist, 5 t	nos.	1	5,000	5,000	1	5,000	5,000
k	Replacement of Dewatering Pumps	nos.	1	4,500	4,500	1	4,500	4,500
l	Replacement of Humas Pumps and Fittings, Q = 1620 m3/h, H = 40 m	nos	1	65,000	65,000	1	65,000	65,000
m	Replacement of Irrigation Pumps and Fittings, Q = 40 m3/h, H = 10 m	nos	1	9,000	9,000	1	9,000	9,000
vi	BNR Reactor (Units 3 & 4)							
a	Rehabilitation of BNR Unit*	sum	4	107,000	428,000	4	107,000	428,000
b	Replacement of RAS Pump, kW = 11	nos	4	25,000	100,000	4	25,000	100,000
c	Replacement/Rehabilitation of RAS Pump Delivery Valves, DN 250	nos.	4	4,064	16,257	4	4,064	16,257
d	Replacement/Rehabilitation of RAS Pump Non-Return Valves, DN 250	nos.	4	4,064	16,257	4	4,064	16,257
e	Replacement of Ras Pump Pressure Gauges	nos.	4	2,000	8,000	4	2,000	8,000
f	Installation/Rehabilitation of RAS Pump Air Valves	nos	4	3,000	12,000	4	3,000	12,000
g	Replacement of WAS Pump, kW = 5.5	nos	2	18,000	36,000	2	18,000	36,000
h	Replacement/Rehabilitation of WAS Pump Delivery Valves, DN 150	nos.	2	1,309	2,618	2	1,309	2,618
i	Replacement/Rehabilitation of WAS Pump Non-Return Valves, DN 150	nos.	2	1,309	2,618	2	1,309	2,618
j	Replacement of Was Pump Pressure Gauges	nos.	2	2,000	4,000	2	2,000	4,000
k	Installation/Maintenance/Rehabilitation of WAS Pump Air Valves	nos	2	1,500	3,000	2	1,500	3,000
l	Replacement/Maintenance/Rehabilitation of RAS & Was Pump 380 V LV Switchboard	nos.	1	16,000	16,000	1	16,000	16,000
m	Replacement of Small Power and Lighting	sum	1	2,500	2,500	1	2,500	2,500
n	Maintenance/Maintenance/Rehabilitation overhead Wire Rope Hoist, 3.0 t	nos.	2	3,500	7,000	2	3,500	7,000
					-			-
vii	Rehabilitation/Maintenance/Rehabilitation of Clarifiers	nos	5	27,600	138,000	5	16,560	82,800
viii	PSTs (Unit 5)							
a	Maintenance/Rehabilitation of the Division Box*	sum				1	30,000	30,000
b	Maintenance/Rehabilitation of the Primary Sedimentation Tanks*	nos				16	17,628	282,054
ix	Raw Sludge Pumps (Unit 5)							
a	Replacement of Raw Sludge Pumps, Q = 95 m3/h, H = 20 m	nos.	4	18,000	72,000	4	10,800	43,200
b	Maintenance/Replacement of Raw Sludge Water Pump Controls	sum	1	10,000	10,000	1	6,000	6,000
c	Replacement/Rehabilitation of Raw SludgePump Suction Gate Valves, DN 150*	nos.		1,309	-	2	785	1,571
d	Replacement/Rehabilitation of Raw Sludge Pump Delivery Gate Valves, DN 100*	nos.		766	-	2	459	919
e	Replacement of Non-Return Valves, DN 100	nos.	2	2,982	5,964	2	20,000	40,000
f	Replacement of Pressure Gauges	nos.	4	2,000	8,000	4	2,000	8,000
g	Installation/Rehabilitation of Air Valves	nos	2	3,000	6,000	2	3,000	6,000
h	Replacement/Rehabilitation of Raw Sludge Pump 380 V LV Switchboard	nos.	1	16,000	16,000	1	9,600	9,600
i	Replacement of Small Power and Lighting	sum	1	3,500	3,500	1	3,500	3,500
j	Repalcement/Rehabilitation overhead Wire Rope Hoist, 5 t	nos.	1	5,000	5,000	1	3,000	3,000
k	Replacement of Dewatering Pump	nos.	1	4,500	4,500	1	4,500	4,500
x	BNR Reactor (Unit 5)							
a	Rehabilitation of BNR Unit*	sum			-	4	135,000	540,000
b	Replacement of RAS Pump, kW = 37	nos	8	35,000	280,000	8	35,000	280,000
c	Rehabilitation of RAS Pump Delivery Valves, DN 400	nos.	8	17,261	138,085	8	10,356	82,851
d	Replacement/Rehabilitation of RAS Pump Non-Return Valves, DN 400	nos.	8	20,738	165,900	8	12,443	99,540
e	Replacement of Ras Pump Pressure Gauges	nos.	8	2,000	16,000	8	2,000	16,000
f	Installation/Rehabilitation of RAS Pump Air Valves	nos	8	3,000	24,000	8	3,000	24,000
g	Replacement of WAS Pump, kW = 13.5	nos	4	18,000	72,000	4	18,000	72,000
h	Replacement/Rehabilitation of WAS Pump Delivery Valves, DN 150	nos.	4	1,309	5,236	4	785	3,142
i	Replacement/Rehabilitation of WAS Pump Non-Return Valves, DN 150	nos.	4	2,982	11,928	4	1,789	7,157
j	Replacement of Was Pump Pressure Gauges	nos.	4	2,000	8,000	4	2,000	8,000
k	Installation/Rehabilitation of WAS Pump Air Valves	nos	4	1,500	6,000	4	1,500	6,000
l	Replacement/Rehabilitation of RAS & Was Pump 380 V LV Switchboard	nos.	4	16,000	64,000	4	9,600	38,400
m	Replacement of Small Power and Lighting	sum	1	2,500	2,500	1	2,500	2,500
n	Rehabilitation overhead Wire Rope Hoist, 3.0 t	nos.	4	3,500	14,000	4	2,100	8,400
					-			-
xi	Rehabilitation/Maintenance/Rehabilitation of Clarifiers	nos	12	27,600	331,200	12	16,560	198,720
xi	Effluent Pump Station A							
	Replacement of Effluent Pumps, Q = 2000, H = 65 m*	nos.			-	6	160,000	960,000
	Installation of Effluent Pumps Controls	sum		15,000	-	1	9,000	9,000
	Rehabilitation of Effluent Pumps Suction Gate Valves, DN 400*	nos.			-	6	10,356	62,138
	Rehabilitation of Effluent Pumps Delivery Gate Valves with Actuators, DN 400*	nos.			-	6	10,356	62,138
	Rehabilitation of Effluent Pumps Non-Return Valves, DN 400*	nos.			-	6	12,443	74,655
	Rehabilitation of Effluent PumpsPressure Gauges*	nos.			-	12	2,000	24,000
	Installation of Effluent Pumps Air Valves*	nos			-	6	600	3,600
	Rehabilitation of Effluent Pump 3.3 kV Starter Feeder Switchboard*	nos.			-	1	126,000	126,000
	Rehabilitation of Effluent Pump 3.3 kV Starter Console*	nos.			-	6	10,500	63,000
	Rehabilitation of Effluent Pump 3.3 kV Remote Starter Panels*	nos.			-	6	12,000	72,000
	Rehabilitation of HL Effluent Pump 380 V LV Switchboard*	nos.			-	1	9,600	9,600
	Replacement of Small Power and Lighting	sum		6,000	-	1	8,000	8,000
	Rehabilitation overhead Wire Rope Hoist, 10 t	nos.		8,000	-	1	4,800	4,800
	eplacement of Dewatering Pumps	nos.		4,500	-	2	4,500	9,000
	Rehabilitation of Ventilation Fans	nos.		3,000	-	1	1,800	1,800
xii	Effluent Pump Station B							
	Replacement of Effluent Pumps, Q = 2000, H = 65 m*	nos.	3	160,000	480,000	4	160,000	640,000
	Installation/Rehabilitation Effluent Pumps Controls	sum	1	10,000	10,000	1	6,000	6,000
	Rehabilitation of Effluent Pumps Suction Gate Valves, DN 700*	nos.	3	69,663	208,989	4	76,549	306,196
	Replacement/Rehabilitation of Effluent Pumps Delivery Gate Valves with Actuators, DN 700*	nos.	3	69,663	208,989	4	76,549	306,196
	Replacement/Rehabilitation of Effluent Pumps Non-Return Valves, DN 700*	nos.	3	38,069	114,206	4	22,841	91,365
	Replacement/Rehabilitation of Effluent PumpsPressure Gauges*	nos.	6	2,000	12,000	8	1,200	9,600
	Installation/Replacement of Effluent Pumps Air Valves	nos	3	2,000	6,000	4	1,200	4,800
	Repalcement/Rehabilitation of Effluent Pump 3.3 kV Starter Feeder Switchboard*	nos.			-	1	144,000	144,000
	Replacement/Rehabilitation of Effluent Pump 3.3 kV Starter Console*	nos.	3	35,000	105,000	4	21,000	84,000
	Replacement/Rehabilitation of Effluent Pump 3.3 kV Remote Starter Panels*	nos.	3	20,000	60,000	4	12,000	48,000
	Replacement/Rehabilitation of HL Effluent Pump 380 V LV Switchboard*	nos.			-	1	9,600	9,600
	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	8,000	8,000
	Replacement/Rehabilitation overhead Wire Rope Hoist, 10 t	nos.	1	8,000	8,000	1	4,800	4,800
	Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000
	Replacement of Ventilation Fans	nos.	1	3,000	3,000	1	3,000	3,000
	Replacement of Gate Valve, DN 900	nos.	1	104,064	104,064	1	104,064	104,064

Item	Description	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
i	Replacement of Small Power and Lighting				3,000	3,000								3,000	3,000			
j	Repalcement/Maintenance/Rehabilitation overhead Wire Rope Hoist, 5 t				2,500	2,500								2,500	2,500			
k	Replacement of Dewatering Pumps				2,250	2,250								2,250	2,250			
l	Replacement of Humas Pumps and Fittings, Q = 1620 m3/h, H = 40 m				32,500	32,500								32,500	32,500			
m	Replacement of Irrigation Pumps and Fittings, Q = 40 m3/h, H = 10 m				4,500	4,500								4,500	4,500			
					-	-								-	-			
vi	BNR Reactor (Units 3 & 4)				-	-								-	-			
a	Rehabilitation of BNR Unit*				214,000	214,000								214,000	214,000			
b	Replacement of RAS Pump, kW = 11				50,000	50,000								50,000	50,000			
c	Replacement/Rehabilitation of RAS Pump Delivery Valves, DN 250				8,128	8,128								8,128	8,128			
d	Replacement/Rehabilitation of RAS Pump Non-Return Valves, DN 250				8,128	8,128								8,128	8,128			
e	Replacement of Ras Pump Pressure Gauges				4,000	4,000								4,000	4,000			
f	Installation/Rehabilitation of RAS Pump Air Valves				6,000	6,000								6,000	6,000			
g	Replacement of WAS Pump, kW = 5.5				18,000	18,000								18,000	18,000			
h	Replacement/Rehabilitation of WAS Pump Delivery Valves, DN 150				1,309	1,309								1,309	1,309			
i	Replacement/Rehabilitation of WAS Pump Non-Return Valves, DN 150				1,309	1,309								1,309	1,309			
j	Replacement of Was Pump Pressure Gauges				2,000	2,000								2,000	2,000			
k	Installation/Maintenance/Rehabilitation of WAS Pump Air Valves				1,500	1,500								1,500	1,500			
l	Replacement/Maintenance/Rehabilitation of RAS & Was Pump 380 V LV Switchboard				8,000	8,000								8,000	8,000			
m	Replacement of Small Power and Lighting				1,250	1,250								1,250	1,250			
n	Maintenance/Maintenance/Rehabilitation overhead Wire Rope Hoist, 3.0 t				3,500	3,500								3,500	3,500			
					-	-								-	-			
vii	Rehabilitation/Maintenance/Rehabilitation of Clarifiers				69,000	69,000								41,400	41,400			
					-	-								-	-			
viii	PSTs (Unit 5)				-	-								-	-			
a	Maintenance/Rehabilitation of the Division Box*				-	-								15,000	15,000			
b	Maintenance/Rehabilitation of the Primary Sedimentation Tanks*				-	-								141,027	141,027			
					-	-								-	-			
ix	Raw Sludge Pumps (Unit 5)				-	-								-	-			
a	Replacement of Raw Sludge Pumps, Q = 95 m3/h, H = 20 m				36,000	36,000								21,600	21,600			
b	Maintenance/Replacement of Raw Sludge Water Pump Controls				5,000	5,000								3,000	3,000			
c	Replacement/Rehabilitation of Raw SludgePump Suction Gate Valves, DN 150*				-	-								785	785			
d	Replacement/Rehabilitation of Raw Sludge Pump Delivery Gate Valves, DN 100*				-	-								459	459			
e	Replacement of Non-Return Valves, DN 100				2,982	2,982								20,000	20,000			
f	Replacement of Pressure Gauges				4,000	4,000								4,000	4,000			
g	Installation/Rehabilitation of Air Valves				3,000	3,000								3,000	3,000			
h	Replacement/Rehabilitation of Raw Sludge Pump 380 V LV Switchboard				8,000	8,000								4,800	4,800			
i	Replacement of Small Power and Lighting				1,750	1,750								1,750	1,750			
j	Repalcement/Rehabilitation overhead Wire Rope Hoist, 5 t				2,500	2,500								1,500	1,500			
k	Replacement of Dewatering Pump				2,250	2,250								2,250	2,250			
					-	-								-	-			
x	BNR Reactor (Unit 5)				-	-								-	-			
a	Rehabilitation of BNR Unit*				-	-								270,000	270,000			
b	Replacement of RAS Pump, kW = 37				140,000	140,000								140,000	140,000			
c	Rehabilitation of RAS Pump Delivery Valves, DN 400				69,042	69,042								41,425	41,425			
d	Replacement/Rehabilitation of RAS Pump Non-Return Valves, DN 400				82,950	82,950								49,770	49,770			
e	Replacement of Ras Pump Pressure Gauges				8,000	8,000								8,000	8,000			
f	Installation/Rehabilitation of RAS Pump Air Valves				12,000	12,000								12,000	12,000			
g	Replacement of WAS Pump, kW = 13.5				36,000	36,000								36,000	36,000			
h	Replacement/Rehabilitation of WAS Pump Delivery Valves, DN 150				2,618	2,618								1,571	1,571			
i	Replacement/Rehabilitation of WAS Pump Non-Return Valves, DN 150				5,964	5,964								3,578	3,578			
j	Replacement of Was Pump Pressure Gauges				4,000	4,000								4,000	4,000			
k	Installation/Rehabilitation of WAS Pump Air Valves				3,000	3,000								3,000	3,000			
l	Replacement/Rehabilitation of RAS & Was Pump 380 V LV Switchboard				32,000	32,000								19,200	19,200			
m	Replacement of Small Power and Lighting				1,250	1,250								1,250	1,250			
n	Rehabilitation overhead Wire Rope Hoist, 3.0 t				7,000	7,000								4,200	4,200			
					-	-								-	-			
xi	Rehabilitation/Maintenance/Rehabilitation of Clarifiers				165,600	165,600								99,360	99,360			
					-	-								-	-			
xi	Effluent Pump Station A				-	-								-	-			
	Replacement of Effluent Pumps, Q = 2000, H = 65 m*				-	-								480,000	480,000			
	Installation of Effluent Pumps Controls				-	-								4,500	4,500			
	Rehabilitation of Effluent Pumps Suction Gate Valves, DN 400*				-	-								31,069	31,069			
	Rehabilitation of Effluent Pumps Delivery Gate Valves with Actuators, DN 400*				-	-								31,069	31,069			
	Rehabilitation of Effluent Pumps Non-Return Valves, DN 400*				-	-								37,328	37,328			
	Rehabilitation of Effluent PumpsPressure Gauges*				-	-								12,000	12,000			
	Installation of Effluent Pumps Air Valves*				-	-								1,800	1,800			
	Rehabilitation of Effluent Pump 3.3 kV Starter Feeder Switchboard*				-	-								63,000	63,000			
	Rehabilitation of Effluent Pump 3.3 kV Starter Console*				-	-								31,500	31,500			
	Rehabilitation of Effluent Pump 3.3 kV Remote Starter Panels*				-	-								36,000	36,000			
	Rehabilitation of HL Effluent Pump 380 V LV Switchboard*				-	-								4,800	4,800			
	Replacement of Small Power and Lighting				-	-								4,000	4,000			
	Rehabilitation overhead Wire Rope Hoist, 10 t				-	-								2,400	2,400			
	eplacement of Dewatering Pumps				-	-								4,500	4,500			
	Rehabilitation of Ventilation Fans				-	-								900	900			
					-	-								-				
xii	Effluent Pump Station B				-	-								-				
	Replacement of Effluent Pumps, Q = 2000, H = 65 m*				240,000	240,000								320,000	320,000			
	Installation/Rehabilitation Effluent Pumps Controls				5,000	5,000								3,000	3,000			
	Rehabilitation of Effluent Pumps Suction Gate Valves, DN 700*				104,495	104,495								153,098	153,098			
	Replacement/Rehabilitation of Effluent Pumps Delivery Gate Valves with Actuators, DN 700*				104,495	104,495								153,098	153,098			
	Replacement/Rehabilitation of Effluent Pumps Non-Return Valves, DN 700*				57,103	57,103								45,683	45,683			
	Replacement/Rehabilitation of Effluent PumpsPressure Gauges*				6,000	6,000								4,800	4,800			
	Installation/Replacement of Effluent Pumps Air Valves				3,000	3,000								2,400	2,400			
	Repalcement/Rehabilitation of Effluent Pump 3.3 kV Starter Feeder Switchboard*				-	-								72,000	72,000			
	Replacement/Rehabilitation of Effluent Pump 3.3 kV Starter Console*				52,500	52,500								42,000	42,000			
	Replacement/Rehabilitation of Effluent Pump 3.3 kV Remote Starter Panels*				30,000	30,000								24,000	24,000			
	Replacement/Rehabilitation of HL Effluent Pump 380 V LV Switchboard*				-	-								4,800	4,800			
	Replacement of Small Power and Lighting				3,000	3,000								4,000	4,000			
	Replacement/Rehabilitation overhead Wire Rope Hoist, 10 t				4,000	4,000								2,400	2,400			
	Replacement of Dewatering Pumps				4,500	4,500								4,500	4,500			
	Replacement of Ventilation Fans				1,500	1,500								1,500	1,500			
	Replacement of Gate Valve, DN 900				52,032	52,032								52,032	52,032			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Medium Term Projects: FS/FD (2014–2016) → Construction (2017–2018)
Long Term Projects: FS/FD (2024–2025) → Construction (2026–2027)

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
	Replacement of NRV, DN 900	nos.	1	38,069	38,069	1	38,069	38,069				19,034	19,034								19,034	19,034			
	Replacement of Gate Valve, DN 700	nos.	1	69,663	69,663	1	69,663	69,663				34,832	34,832								34,832	34,832			
					-			-				-	-								-	-			
xiii	Digesters: Unit 1 to Unit 4 and Unit 5				-			-				-	-								-	-			
	Rehabilitation/Maintenance/Rehabilitation of Primary Digesters	nos.	19	50,774	964,697	19	30,464	578,818				482,348	482,348								289,409	289,409			
	Rehabilitation/Maintenance/Rehabilitation of Secondary Digesters	nos.	5	29,500	147,500	5	17,700	88,500				73,750	73,750								44,250	44,250			
								-				-	-								-	-			
xiv	Digester Sludge Control Pumps											-	-								-	-			
a	Replacement of Mixing Pumps, Q = 72, H = 13 m*	nos.				5	16,000	80,000				-	-								40,000	40,000			
b	Installation/Rehabilitation Mixing Pumps Controls	sum	1	4,000	4,000	1	2,400	2,400				2,000	2,000								1,200	1,200			
c	Rehabilitation of Mixing Pumps Suction Gate Valves, DN 150*	nos.			-	5	785	3,927				-	-								1,964	1,964			
d	Rehabilitation of Mixing Pumps Delivery Gate Valves, DN 150*	nos.			-	5	785	3,927				-	-								1,964	1,964			
e	Rehabilitation of Mixing Pumps Non-Return Valves, DN 150*	nos.			-	5	1,789	8,946				-	-								4,473	4,473			
f	Replacement of Mixing PumpsPressure Gauges*	nos.			-	10	1,200	12,000				-	-								6,000	6,000			
g	Rehabilitation of Mixing Pumps Air Valves*	nos			-	5	1,200	6,000				-	-								3,000	3,000			
h	Replacement of Injection Pumps, Q = 108, H = 39 m*	nos.			-	3	25,000	75,000				-	-								37,500	37,500			
i	Installation/Rehabilitation Injection Pumps Controls	sum	1	4,000	4,000	1	2,400	2,400				2,000	2,000								1,200	1,200			
j	Rehabilitation of Injection Pumps Suction Gate Valves, DN 150*	nos.			-	3	785	2,356				-	-								1,178	1,178			
k	Rehabilitation of Injection Pumps Delivery Gate Valves, DN 150	nos.			-	3	785	2,356				-	-								1,178	1,178			
l	Rehabilitation of Injection Pumps Non-Return Valves, DN 150	nos.			-	3	1,789	5,368				-	-								2,684	2,684			
m	Rehabilitation of Injection Pumps Pressure Gauges	nos.			-	6	1,200	7,200				-	-								3,600	3,600			
n	Rehabilitation of Injection Pumps Air Valves	nos			-	3	1,200	3,600				-	-								1,800	1,800			
o	Rehabilitation of Mixing and Injection Pumps 380 V LV Switchboard*	nos.			-	1	9,600	9,600				-	-								4,800	4,800			
p	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
q	Replacement/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	8,000	8,000	1	4,800	4,800				4,000	4,000								2,400	2,400			
r	Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
												-	-								-	-			
xv	Heat Exchanger A											-	-								-	-			
a	Replacement of Boilers*	nos			-	2	100,000	200,000				-	-								100,000	100,000			
b	Replacement of Heat Effluent Pumps, kW = 11*	nos.			-	2	12,000	24,000				-	-								12,000	12,000			
c	Installation/Rehabilitation Heat Effluent Pumps Controls	sum	1	4,000	4,000	1	2,400	2,400				2,000	2,000								1,200	1,200			
d	Rehabilitation of Heat Effluent Pumps Suction Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
e	Rehabilitation of Heat Effluent Pumps Delivery Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
f	Rehabilitation of Heat Effluent Pumps Non-Return Valves, DN 150*	nos.			-	2	2,982	5,964				-	-								2,982	2,982			
g	Replacement of Heat Effluent Pumps Pressure Gauges*	nos.			-	4	1,200	4,800				-	-								2,400	2,400			
h	Rehabilitation of Heat Effluent Pumps Air Valves*	nos			-	2	1,200	2,400				-	-								1,200	1,200			
i	Replacement of Recirculation Pumps, kW = 2.2*	nos.			-	2	9,000	18,000				-	-								9,000	9,000			
j	Installation/Rehabilitation Recirculation Pumps Controls	sum	1	4,000	4,000	1	2,400	2,400				2,000	2,000								1,200	1,200			
k	Rehabilitation of Recirculation Pumps Suction Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
l	Rehabilitation of Recirculation Pumps Delivery Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
m	Rehabilitation of Recirculation Pumps Non-Return Valves, DN 150*	nos.			-	2	2,982	5,964				-	-								2,982	2,982			
n	Rehabilitation of Recirculation Pumps Pressure Gauges	nos.			-	4	1,200	4,800				-	-								2,400	2,400			
o	Rehabilitation of Recirculation Pumps Air Valves	nos			-	2	1,200	2,400				-	-								1,200	1,200			
p	Rehabilitation of Heat Effluent and Circulation Pumps 380 V LV Switchboard*	nos.			-	1	9,600	9,600				-	-								4,800	4,800			
q	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
r	Replacement/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	8,000	8,000	1	4,800	4,800				4,000	4,000								2,400	2,400			
s	Replacement of Dewatering Pumps	nos.	2	4,500	9,000	1	4,500	4,500				4,500	4,500								2,250	2,250			
								-				-	-								-	-			
xvi	Heat Exchanger B											-	-								-	-			
a	Maintenance/Replacement of Boilers*	nos			-	4	80,000	320,000				-	-								160,000	160,000			
b	Replacement of Heat Effluent Pumps, Q = 43.2 m3/h; H =14 m; kW = 11*	nos.			-	5	16,000	80,000				-	-								40,000	40,000			
c	Installation/Rehabilitation Heat Effluent Pumps Controls	sum	1	6,000	6,000	1	2,400	2,400				3,000	3,000								1,200	1,200			
d	ehabilitation of Heat Effluent Pumps Suction Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
e	Rehabilitation of Heat Effluent Pumps Delivery Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
f	Rehabilitation of Heat Effluent Pumps Non-Return Valves, DN 150*	nos.			-	2	1,789	3,578				-	-								1,789	1,789			
g	Replacement of Heat Effluent Pumps Pressure Gauges*	nos.			-	4	1,200	4,800				-	-								2,400	2,400			
h	Rehabilitation of Heat Effluent Pumps Air Valves*	nos			-	2	1,200	2,400				-	-								1,200	1,200			
i	Replacement of Recirculation Pumps, Q = 54 m3/h; H = 15 m; kW = 15*	nos.			-	2	23,000	46,000				-	-								23,000	23,000			
j	Installation/Rehabilitation Recirculation Pumps Controls	sum	1	4,000	4,000	1	2,400	2,400				2,000	2,000								1,200	1,200			
k	Rehabilitation of Recirculation Pumps Suction Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
l	Rehabilitation of Recirculation Pumps Delivery Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
m	Rehabilitation of Recirculation Pumps Non-Return Valves, DN 150*	nos.			-	2	1,789	3,578				-	-								1,789	1,789			
n	Rehabilitation of Recirculation Pumps Pressure Gauges	nos.			-	4	1,200	4,800				-	-								2,400	2,400			
o	Rehabilitation of Recirculation Pumps Air Valves	nos			-	2	1,200	2,400				-	-								1,200	1,200			
p	Replacement of Gas Booster Pumps, kW = 2.2*	nos.			-	2	9,000	18,000				-	-								9,000	9,000			
q	Installation/Rehabilitation of Gas Booster Pumps Controls	sum	1	4,000	4,000	1	2,400	2,400				2,000	2,000								1,200	1,200			
r	Rehabilitation of Gas Booster Pumps Suction Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
s	Rehabilitation of Gas Booster Pumps Delivery Gate Valves, DN 150*	nos.			-	2	785	1,571				-	-								785	785			
t	Rehabilitation of Gas Booster Pumps Non-Return Valves, DN 150*	nos.			-	2	1,789	3,578				-	-								1,789	1,789			
u	Rehabilitation of Gas Booster Pumps Pumps Pressure Gauges	nos.			-	4	1,200	4,800				-	-								2,400	2,400			
v	Rehabilitation of Gas Booster Pumps Air Valves	nos			-	2	1,200	2,400				-	-								1,200	1,200			
w	Rehabilitation of Heat Effluent , Circulation and Gas Booster Pumps 380 V LV Switchboard*	nos.			-	1	9,600	9,600				-	-								4,800	4,800			
x	Replacement/Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
y	Replacement/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	8,000	8,000	1	4,800	4,800				4,000	4,000								2,400	2,400			
z	Replacement of Dewatering Pumps	nos.	2	4,500	9,000	1	4,500	4,500				4,500	4,500								2,250	2,250			
ab	Maintenance/Rehabilitation of Gas Holders*	nos				2	43,297	86,595				-	-								43,297	43,297			
ac	Maintenance/Replacement of Burner	nos				1	15,000	15,000				-	-								7,500	7,500			
												-	-								-	-			
xvii	Power Transformers and Switchgear											-	-								-	-			
a	Replacement of Transformers, 5 MVA, 33/3.3 kV	nos.										-	-								-	-			
b	Replacement of Transformer, 4 MVA, 33/11 kV	nos.										-	-								-	-			
c	Replacement of Transformer, 0.5 MVA, 3.3/0.40 kV	nos.										-	-								-	-			
d	Replacement of Transformer, 0.75 MVA, 11/3.3 kV	nos.										-	-								-	-			
e	Replacement of Transformer, 0.2 MVA, 11/0.40 kV	nos.										-	-								-	-			
f	Replacement of Auto Reclosers	nos.										-	-								-	-			
												-	-								-	-			
xviii	Miscellaneous											-	-								-	-			
a	Security lights and fence	Sum	1	20,000	20,000	1	35,000	35,000				10,000	10,000								17,500	17,500			
b	Standby generators	Sum	1	54,600	54,600	1	54,600	54,600				27,300	27,300								27,300	27,300			
c	Buildings and roads	Sum	1	300,000	300,000			-				150,000	150,000								-	-			
d	Vehicles, plant and equipment	Sum	1	450,000	450,000	1	450,000	450,000				225,000	225,000								225,000	225,000			
e	SCADA and radio communication systems	Sum	1	125,000	125,000			-				62,500	62,500								-	-			
												-	-												

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Medium Term Projects — FS/FD (2015–2016), Construction (2017–2018)
Long Term Projects — FS/FD (2024–2025), Construction (2026–2027)

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020) Qty	Rate [USD]	Amount	Long Term (upto 2030) Qty	Rate [USD]	Amount	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
												-	-												
D.2	**Rehabilitation of Crowborough WWTW**				**5,108,014**			**7,519,615**	-	-	-	**2,554,007**	**2,554,007**	-	-	-	-	-	-	-	**3,759,808**	**3,759,808**	-	-	-
i	Rehabilitation of Inlet Works											-	-								-	-			
	Replacement of the Main Intake Coarse Screens, 1.2m x 2.0m (approx)*	nos	3	4,000	12,000	3	4,000	12,000				6,000	6,000								6,000	6,000			
	Replacement of the Main Intake Fine Screens, 1.2m x 2.0m (approx)*	nos	3	5,000	15,000	3	5,000	15,000				7,500	7,500								7,500	7,500			
	Replacement of Intake Sluice Gates, 1.2m x 2.0m*	nos	7	2,500	17,500	7	2,500	17,500				8,750	8,750								8,750	8,750			
	Rehabilitationof Grit Tanks	sum	1	10,000	10,000	1	10,000	10,000				5,000	5,000								5,000	5,000			
	Installation of mechanical screen	nos			-	1	25,000	25,000				-	-								12,500	12,500			
	Replacement of Air Lift Pumps*	nos	6	6,000	36,000	6	6,000	36,000				18,000	18,000								18,000	18,000			
	Installation/Replacement of Elevators*	nos	1	6,500	6,500	1	6,500	6,500				3,250	3,250								3,250	3,250			
	Replacement of Flowmeter*	nos	1	3,600	3,600	1	12,000	12,000				1,800	1,800								6,000	6,000			
	Replacement of Compressors for Air Pumps*	nos	2	4,500	9,000	2	15,000	30,000				4,500	4,500								15,000	15,000			
	Enlargement of Intake Works to 110 ML/D	sum	1	80,000	80,000			-				40,000	40,000								-	-			
	Replacement of LV Switchboard	nos	1	3,600	3,600	1	3,600	3,600				1,800	1,800								1,800	1,800			
	Replacement of Small Power and Lighting	sum	1	1,350	1,350	1	3,500	3,500				675	675								1,750	1,750			
												-	-								-	-			
ii	Rehabilitation of Intake Works: Mufakose											-	-								-	-			
a	Replacement of Intake Sluice Gates, 1.2m x 1.5m (approx)	sum	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
b	Replacement of the Main Intake Coarse Screens, 1.2m x 2.0m (approx)*	nos	2	4,000	8,000	2	4,000	8,000				4,000	4,000								4,000	4,000			
c	Replacement of the Main Intake Fine Screens, 1.2m x 2.0m (approx)*	nos	2	5,000	10,000	2	5,000	10,000				5,000	5,000								5,000	5,000			
d	Replacement of Flowmeter	nos	1	12,000	12,000	2	12,000	24,000				6,000	6,000								12,000	12,000			
e	Replacement of LV Switchboard	nos	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
f	Replacement of Air Lift Pumps	nos	6	4,500	27,000	6	4,500	27,000				13,500	13,500								13,500	13,500			
g	Replacement of Small Power and Lighting	sum	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
h	Enlargement and Improvement of Intake Works	nos	1	30,000	30,000							15,000	15,000								-	-			
i	Replacement of Intake Sluice Gates, 1.2m x 1.5m (approx)	sum	3	4,500	13,500	3	4,500	13,500				6,750	6,750								6,750	6,750			
j	Replacement of Inflow DN 900 Concrete Pipes	m	120	250	30,000							15,000	15,000								-	-			
												-	-								-	-			
iii	Maintenance/Rehabilitation of PSTs, Trickling Filters and Humas Tanks (Unit 1 & 2)											-	-								-	-			
a	Rehabilitation of the Primary Sedimentation Tanks*	nos				12	17,628	211,541				-	-								105,770	105,770			
b	Rehabilitation of the Trickling Filters*	nos				8	107,553	860,426				-	-								430,213	430,213			
c	Rehabilitation of the Humas Tanks*	nos				8	13,904	111,232				-	-								55,616	55,616			
												-	-								-	-			
iv	Replacement/Maintenance/Replacement of Raw Sludge Submersible Pumps Unit 1																				-	-			
a	Replacement of Raw Sludge Pumps, Q = 95 m3, H = 20 m*	nos.				3	30,000	90,000				-	-								45,000	45,000			
b	Installation/Replacement of RW Sludge Pump Controls	sum	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
c	Rehabilitation/Replacement of Raw Sludge Pump Delivery Gate Valves, DN 250*	nos.			-	3	4,064	12,193				-	-								6,096	6,096			
d	Rehabilitation/Replacement of Non-Return Valves, DN 250*	nos.			-	3	11,065	33,195				-	-								16,597	16,597			
e	Rehabilitation/Replacement of Pressure Gauges*	nos.			-	3	2,000	6,000				-	-								3,000	3,000			
f	Installation/Rehabilitation of Air Valves	**nos**	3	3,000	9,000	2	3,000	6,000				4,500	4,500								3,000	3,000			
g	Replacement of Raw Sludge Pump 380 V LV Switchboard	nos.	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
h	Replacement of Small Power and Lighting	sum	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
i	Repalcement/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
												-	-								-	-			
v	Replacement/Maintenance/Replacement of Effluent Pumps to Crowborough Farm											-	-								-	-			
a	Replacement of Effluent Pumps, Q = 1500 m3, H = 60 m*	nos.		120,000	-	3	54,000	162,000				-	-								81,000	81,000			
b	Installation/Replacement of Effluent Pumps Controls	sum	1	10,000	10,000	1	10,000	10,000				5,000	5,000								5,000	5,000			
c	Replacement of Effluent Pumps Suction Gate Valves, DN 250*	nos.		4,064	-	3	4,064	12,193				-	-								6,096	6,096			
d	Replacement of Effluent Pumps Delivery Gate Valves, DN 250*	nos.		4,064	-	3	4,064	12,193				-	-								6,096	6,096			
e	Replacement of Non-Return Valves, DN 250*	nos.		11,065	-	3	11,065	33,195				-	-								16,597	16,597			
f	Replacement of Pressure Gauges	nos.	3	2,000	6,000	3	2,000	6,000				3,000	3,000								3,000	3,000			
g	Installation/Replacement of Air Valves	nos	3	3,000	9,000	3	3,000	9,000				4,500	4,500								4,500	4,500			
h	Rehabilitation/Replacement of Effluent Pumps 380 V LV Switchboard	nos.	1	12,000	12,000	1	7,200	7,200				6,000	6,000								3,600	3,600			
i	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
j	Repalcement/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	5,000	5,000	1	3,000	3,000				2,500	2,500								1,500	1,500			
k	Replacement of Dewatering Pump	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-								-	-			
vi	Replacement/Maintenance/Replacement of Raw Sludge Surface Pumps to Ingwe Farm											-	-								-	-			
a	Rehabilitation/Replacement of Raw Sludge Pumps, Q = 1500 m3, H = 60 m*	nos.				2	54,000	108,000				-	-								54,000	54,000			
b	Installation/Rehabilitation/ Replacement of RW Sludge Pump Controls	sum	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
c	Rehabilitation/Replacement of Raw SludgePump Suction Gate Valves, DN 500*	nos.			-	2	28,952	57,904				-	-								28,952	28,952			
d	Rehabilitation/Replacement of Raw Sludge Pump Delivery Gate Valves, DN 450*	nos.			-	2	22,271	44,542				-	-								22,271	22,271			
e	Rehabilitation/Replacement of Non-Return Valves, DN 450*	nos.			-	2	28,980	57,960				-	-								28,980	28,980			
f	Rehabilitation/Replacement of Pressure Gauges	nos.	3	2,000	6,000	2	2,000	4,000				3,000	3,000								2,000	2,000			
g	Installation/Maintenance/Rehabilitation of Air Valves	nos	2	3,000	6,000	2	3,000	6,000				3,000	3,000								3,000	3,000			
h	Replacement of 3.3 kV Switchboard	nos.	1	262,500	262,500	1	262,500	262,500				131,250	131,250								131,250	131,250			
i	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
j	Repalcement/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	5,000	5,000	1	3,000	3,000				2,500	2,500								1,500	1,500			
k	Replacement of Dewatering Pump	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-								-	-			
vii	Replacement/Maintenance/Replacement of Raw Sludge Surface Pumps Mufakose											-	-								-	-			
a	Rehabilitation/Replacement of Raw Sludge Pumps, Q = 1000 m3, H = 30 m*	nos.			-	3	54,000	162,000				-	-								81,000	81,000			
b	Installation/Rehabilitation/ Replacement of RW Sludge Pump Controls	sum	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
c	Rehabilitation/Replacement of Raw SludgePump Suction Gate Valves, DN 250*	nos.			-	3	4,000	12,000				-	-								6,000	6,000			
d	Rehabilitation/Replacement of Raw Sludge Pump Delivery Gate Valves, DN 250*	nos.			-	3	4,000	12,000				-	-								6,000	6,000			
e	Rehabilitation/Replacement of Non-Return Valves, DN 250*	nos.			-	3	11,065	33,195				-	-								16,597	16,597			
f	Rehabilitation/Replacement of Pressure Gauges	nos.	3	2,000	6,000	3	2,000	6,000				3,000	3,000								3,000	3,000			
g	Installation/Maintenance/Rehabilitation of Air Valves	nos	2	3,000	6,000	2	3,000	6,000				3,000	3,000								3,000	3,000			
h	Rehabilitation/Replacement of Raw Sludge Pump 380 V LV Switchboard	nos.	1	8,000	8,000	1	4,800	4,800				4,000	4,000								2,400	2,400			
i	Replacement/Maintenance/Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
j	Repalcement/Maintenance/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	5,000	5,000	1	3,000	3,000				2,500	2,500								1,500	1,500			
k	Replacement/Maintenance/Replacement of Dewatering Pump	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-								-	-			
viii	Rehabilitation/Maintenance/Replacement of Effluent Pump Transmission Pipe and Valves											-	-								-	-			
a	ReplacementMaintenance/Replacement of Gate Valve, DN 450	nos.	5	22,271	111,356	5	22,271	111,356				55,678	55,678								55,678	55,678			
b	ReplacementMaintenance/Replacement of NRV, DN 450	nos.	1	28,980	28,980	1	28,980	28,980				14,490	14,490								14,490	14,490			
c	ReplacementMaintenance/Replacement of Steel Pipe, DN 600	nos.	6,000	250	1,500,000							750,000	750,000								-	-			
												-	-								-	-			
ix	Maintenance/Rehabilitation of PSTs and Clarifiers (Unit 3)											-	-								-	-			
a	Maintenance/Rehabilitation of the Primary Sedimentation Tanks*	nos				6	17,628	105,770				-	-								52,885	52,885			
b	Maintenance/Rehabilitation of the Clarifiers*	nos				3	27,600	82,800				-	-								41,400	41,400			
												-	-								-	-			
x	Replacement/Maintenance/Replacement of Raw Sludge Surface Pumps Unit 3											-	-								-	-			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Medium Term Projects: FS/FD (2014–2016), Construction (2017–2018)
Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020) Qty	Medium Term (upto 2020) Rate [USD]	Medium Term (upto 2020) Amount	Long Term (upto 2030) Qty	Long Term (upto 2030) Rate [USD]	Long Term (upto 2030) Amount	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
a	Rehabilitation/Replacement of Raw Sludge Pumps, Q = 150 m3, H = 20 m	nos.				3	30,000	90,000				-	-								45,000	45,000			
b	Installation/Rehabilitation/ Replacement of RW Sludge Pump Controls	sum	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
c	Rehabilitation/Replacement of Raw SludgePump Suction Gate Valves, DN 250*	nos.			-	3	22,440	67,320				-	-								33,660	33,660			
d	Rehabilitation/Replacement of Raw Sludge Pump Delivery Gate Valves, DN 250*	nos.			-	3	22,440	67,320				-	-								33,660	33,660			
e	Rehabilitation/Replacement of Non-Return Valves, DN 250*	nos.			-	3	-	-				-	-								-	-			
f	Rehabilitation/Replacement of Pressure Gauges	nos.	3	2,000	6,000	3	2,000	6,000				3,000	3,000								3,000	3,000			
g	Installation/Maintenance/Rehabilitation of Air Valves	nos	2	3,000	6,000	2	3,000	6,000				3,000	3,000								3,000	3,000			
h	Rehabilitation/Replacement of Raw Sludge Pump 380 V LV Switchboard	nos.	1	8,000	8,000	1	4,800	4,800				4,000	4,000								2,400	2,400			
i	Replacement/Maintenance/Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
j	Repalcement/Maintenance/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	5,000	5,000	1	3,000	3,000				2,500	2,500								1,500	1,500			
k	Replacement/Maintenance/Replacement of Dewatering Pump	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-								-				
xi	Maintenance/Rehabilitation of BNR Unit 3											-	-								-				
a	Maintenance/Rehabilitation of BNR Unit*	sum			-	3	183,000	549,000				-	-								274,500	274,500			
b	Replacement of RAS Pump, kW = 11	nos	3	25,000	75,000	3	25,000	75,000				37,500	37,500								37,500	37,500			
c	Replacement/Rehabilitation of RAS Pump Delivery Valves, DN 250	nos.	3	4,064	12,193	3	2,439	7,316				6,096	6,096								3,658	3,658			
d	Replacement/Rehabilitation of RAS Pump Non-Return Valves, DN 250	nos.	3	4,064	12,193	3	2,439	7,316				6,096	6,096								3,658	3,658			
e	Replacement of Ras Pump Pressure Gauges	nos.	3	2,000	6,000	3	2,000	6,000				3,000	3,000								3,000	3,000			
f	Installation/Maintenance/Rehabilitation of RAS Pump Air Valves	nos	3	3,000	9,000	3	3,000	9,000				4,500	4,500								4,500	4,500			
g	Replacement of WAS Pump, kW = 5.5	nos	3	18,000	54,000	3	18,000	54,000				27,000	27,000								27,000	27,000			
h	Replacement/Rehabilitation of WAS Pump Delivery Valves, DN 200	nos.	3	2,226	6,678	3	1,336	4,007				3,339	3,339								2,003	2,003			
i	Replacement/Rehabilitation of WAS Pump Non-Return Valves, DN 200	nos.	3	2,226	6,678	3	1,336	4,007				3,339	3,339								2,003	2,003			
j	Replacement/Replacement of Was Pump Pressure Gauges	nos.	3	2,000	6,000	3	2,000	6,000				3,000	3,000								3,000	3,000			
k	Installation/Rehabilitation of WAS Pump Air Valves	nos	3	1,500	4,500	3	1,500	4,500				2,250	2,250								2,250	2,250			
l	Replacement/Rehabilitation of RAS & Was Pump 380 V LV Switchboard	nos.	1	16,000	16,000	1	9,600	9,600				8,000	8,000								4,800	4,800			
m	Rehabilitation of BNR LV Switchboard	nos			-	1	30,000	30,000				-	-								15,000	15,000			
n	Replacement of Small Power and Lighting	sum	1	2,500	2,500	1	2,500	2,500				1,250	1,250								1,250	1,250			
o	Rehabilitation overhead Wire Rope Hoist, 3.0 t	nos.	2	3,500	7,000	2	2,100	4,200				3,500	3,500								2,100	2,100			
												-	-								-	-			
xii	Rehabilitation/Replacement and Maintenance of Digesters											-	-								-	-			
a	Rehabilitation of Primary Digesters	nos.	7	61,246	428,719	7	61,246	428,719				214,359	214,359								214,359	214,359			
b	Rehabilitation of Secondary Digesters	nos.	2	29,500	59,000	2	29,500	59,000				29,500	29,500								29,500	29,500			
												-	-								-	-			
xiii	Rehabilitation/Replacement and Maintenance of Digester Sludge Control Pumps											-	-								-	-			
a	Replacement/Maintenance/Replacement of Mixing Pumps, Q = 72, H = 13 m*	nos.		20,000	-	4	16,000	64,000				-	-								32,000	32,000			
b	Installation/Maintenance/Rehabilitation Mixing Pumps Controls	sum	1	2,400	2,400	1	2,400	2,400				1,200	1,200								1,200	1,200			
c	Maintenance/Rehabilitation of Mixing Pumps Suction Gate Valves, DN 150*	nos.		1,309	-	4	785	3,142				-	-								1,571	1,571			
d	Replacement/Maintenance/Rehabilitation of Mixing Pumps Delivery Gate Valves, DN 150*	nos.		1,309	-	4	785	3,142				-	-								1,571	1,571			
e	Replacement/Maintenance/Rehabilitation of Mixing Pumps Non-Return Valves, DN 150*	nos.		2,982	-	4	1,789	7,157				-	-								3,578	3,578			
f	Replacement/Maintenance/Replacement of Mixing PumpsPressure Gauges*	nos.		2,000	-	8	1,200	9,600				-	-								4,800	4,800			
g	Replacement/Maintenance/Rehabilitation of Mixing Pumps Air Valves*	nos		1,200	-	4	1,200	4,800				-	-								2,400	2,400			
h	Replacement/Maintenance/Replacement of Injection Pumps, Q = 108, H = 39 m*	nos.		25,000	-	4	25,000	100,000				-	-								50,000	50,000			
i	Installation/Maintenance/Rehabilitation Injection Pumps Controls	sum	1	2,400	2,400	1	2,400	2,400				1,200	1,200								1,200	1,200			
j	Replacement/Maintenance/Rehabilitation of Injection Pumps Suction Gate Valves, DN 150*	nos.		1,309	-	4	785	3,142				-	-								1,571	1,571			
k	Replacement/Maintenance/Rehabilitation of Injection Pumps Delivery Gate Valves, DN 150	nos.	4	1,309	5,236	4	785	3,142				2,618	2,618								1,571	1,571			
l	Replacement/Maintenance/Rehabilitation of Injection Pumps Non-Return Valves, DN 150	nos.	4	2,982	11,928	4	1,789	7,157				5,964	5,964								3,578	3,578			
m	Replacement/Maintenance/Rehabilitation of Injection Pumps Pressure Gauges	nos.	8	1,200	9,600	8	1,200	9,600				4,800	4,800								4,800	4,800			
n	Replacement/Maintenance/Rehabilitation of Injection Pumps Air Valves	nos	4	1,200	4,800	4	1,200	4,800				2,400	2,400								2,400	2,400			
o	ReplacementMaintenance/Rehabilitation of Mixing and Injection Pumps 380 V LV Switchboard*	nos.		9,600	-	1	9,600	9,600				-	-								4,800	4,800			
p	Replacement/Maintenance/Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
q	Replacement/Maintenance/Replacement overhead Wire Rope Hoist, 3 t	nos.	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
r	Replacement/Maintenance/Replacement of Dewatering Pumps	nos.	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
												-	-								-	-			
xiv	Rehabilitation/Replacement and Maintenance of Heat Exchanger											-	-								-	-			
a	Replacement of Boilers*	nos	3	30,000	90,000	3	100,000	300,000				45,000	45,000								150,000	150,000			
b	Replacement of Heat Effluent Pumps, kW = 11	nos.	3	3,600	10,800	3	12,000	36,000				5,400	5,400								18,000	18,000			
c	Installation/Rehabilitation Heat Effluent Pumps Controls	sum	1	2,400	2,400	1	2,400	2,400				1,200	1,200								1,200	1,200			
d	Rehabilitation of Heat Effluent Pumps Suction Gate Valves, DN 150	nos.	3	236	707	3	785	2,356				353	353								1,178	1,178			
e	Rehabilitation of Heat Effluent Pumps Delivery Gate Valves, DN 150	nos.	3	236	707	3	785	2,356				353	353								1,178	1,178			
f	Rehabilitation of Heat Effluent Pumps Non-Return Valves, DN 150	nos.	3	895	2,684	3	2,982	8,946				1,342	1,342								4,473	4,473			
g	Replacement of Heat Effluent Pumps Pressure Gauges	nos.	6	360	2,160	6	1,200	7,200				1,080	1,080								3,600	3,600			
h	Rehabilitation of Heat Effluent Pumps Air Valves	nos	2	600	1,200	2	1,200	2,400				600	600								1,200	1,200			
i	Replacement of Recirculation Pumps, kW = 2.2	nos.	2	2,700	5,400	2	9,000	18,000				2,700	2,700								9,000	9,000			
j	Installation/Rehabilitation Recirculation Pumps Controls	sum	1	2,400	2,400	1	2,400	2,400				1,200	1,200								1,200	1,200			
k	Rehabilitation of Recirculation Pumps Suction Gate Valves, DN 150	nos.	2	236	471	2	785	1,571				236	236								785	785			
l	Rehabilitation of Recirculation Pumps Delivery Gate Valves, DN 150	nos.	2	236	471	2	785	1,571				236	236								785	785			
m	Rehabilitation of Recirculation Pumps Non-Return Valves, DN 150	nos.	2	895	1,789	2	2,982	5,964				895	895								2,982	2,982			
n	Rehabilitation of Recirculation Pumps Pressure Gauges	nos.	4	360	1,440	4	1,200	4,800				720	720								2,400	2,400			
o	Rehabilitation of Recirculation Pumps Air Valves	nos	2	600	1,200	2	1,200	2,400				600	600								1,200	1,200			
p	Rehabilitation of Heat Effluent and Circulation Pumps 380 V LV Switchboard	nos.	1	2,880	2,880	1	9,600	9,600				1,440	1,440								4,800	4,800			
q	Replacement of Small Power and Lighting	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
r	Replacement/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	6,000	6,000	1	3,600	3,600				3,000	3,000								1,800	1,800			
s	Replacement of Dewatering Pumps	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-								-	-			
xv	Maintenance/Rehabilitation of Gas Holders											-	-								-	-			
a	Replacement/Rehabilitation of Gas Holders	nos	2	53,297	106,595	2	53,297	106,595				53,297	53,297								53,297	53,297			
b	Replacement of Burner	nos	1	15,000	15,000	1	15,000	15,000				7,500	7,500								7,500	7,500			
												-	-								-	-			
xvi	Rehabilitation/Relacement of Power Transformers and Switchgear											-	-								-	-			
a	Replace/Rehabilitation of Transformers, 2 MVA, 33/3.3 kV	nos.	3	80,000	240,000	4	150,000	600,000				120,000	120,000								300,000	300,000			
b	Replace/Rehabilitation of Transformer, 500 kVA, 11/0.40 kV	nos.	4	30,000	120,000	3	120,000	360,000				60,000	60,000								180,000	180,000			
c	Replace/Rehabilitation 33 kV Switchboard (4 nr VCBs)	nos.	1	50,000	50,000	1	30,000	30,000				25,000	25,000								15,000	15,000			
d	Replace/Rehabilitation 11 kV Switchboard (4 nr VCBs)	nos.	1	80,000	80,000	1	38,000	38,000				40,000	40,000								19,000	19,000			
e	Rehabilitation/Replacement of Transformer, 0.2 MVA, 11/0.40 kV	nos.	1	60,000	60,000	1	20,000	20,000				30,000	30,000								10,000	10,000			
f	Replacement/Maintenance/Rehabilitation of Swiychgear Components	sum	1	90,000	90,000	1	54,000	54,000				45,000	45,000								27,000	27,000			
												-	-								-	-			
xvii	Miscellaneous											-	-								-	-			
a	Security lights and fence	sum	1	68,000	68,000	1	50,000	50,000				34,000	34,000								25,000	25,000			
b	Rehabilitation/Replacement of Standby Generators	sum	1	60,000	60,000	1	60,000	60,000				30,000	30,000								30,000	30,000			
c	Rehabilitation of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	90,000	90,000	1	177,000	177,000				45,000	45,000								88,500	88,500			
d	Rehabilitation of Roads	sum	1	200,000	200,000	1	200,000	200,000				100,000	100,000								100,000	100,000			
e	Supply and Delivery/Replacement of Vehicles	sum	1	225,000	225,000	1	225,000	225,000				112,500	112,500								112,500	112,500			
f	Supply and Delivery/Replacement of Tractors and Plant	sum	1	174,000	174,000	1	174,000	174,000				87,000	87,000								87,000	87,000			

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Medium Term Projects: FS/FD (2014–2016), Construction (2017–2018)
Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount																	
g	Supply and Delivery/Replacement of Laboratory Equipment	sum	1	40,000	40,000	1	40,000	40,000				20,000	20,000								20,000	20,000			
h	Supply and Delivery/Replacement of SCADA and Radio Communication Systems	sum	1	125,000	125,000	1	125,000	125,000				62,500	62,500								62,500	62,500			
																					-	-			
D.3	**Rehabilitation of Hatcliff WWTW**				**604,092**			**771,112**	-	-	-	**302,046**	**302,046**	-	-	-	-	-	-	-	**385,556**	**385,556**	-	-	-
i	Rehabilitation/Maintenance/Rehabilitation of Intake Works																								
a	Modification and Extension/Rehabilitation of Intake Civil Works	sum	1	20,000	20,000	1	6,000	6,000				10,000	10,000								3,000	3,000			
b	Replacement of the Main Intake Coarse Screens	nos	2	4,000	8,000	3	4,000	12,000				4,000	4,000								6,000	6,000			
c	Replacement of the Main Intake Fine Screens	nos	2	5,000	10,000	3	5,000	15,000				5,000	5,000								7,500	7,500			
d	Replacement of Intake Sluice Gates	nos	8	10,000	80,000	7	2,500	17,500				40,000	40,000								8,750	8,750			
e	Construction of Grit Tanks/Rehabilitationof Grit Tanks	sum	1	15,000	15,000	1	9,000	9,000				7,500	7,500								4,500	4,500			
f	Installation of mechanical screen	nos			-	1	25,000	25,000				-	-								12,500	12,500			
g	Installation/Replacement of Air Lift Pumps	nos	3	9,000	27,000	6	6,000	36,000				13,500	13,500								18,000	18,000			
h	Installation/Replacement of Compressors for Air Pumps	nos	2	16,000	32,000	2	16,000	32,000				16,000	16,000								16,000	16,000			
i	Installation/Replacement of Elevator	nos	1	6,500	6,500	1	6,500	6,500				3,250	3,250								3,250	3,250			
j	Replacement of Flowmeter	nos	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
k	Replacement of LV Switchboard	nos	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
l	Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-								-	-			
ii	Rehabilitation of BNR Unit*											-	-								-	-			
a	Rehabilitation of BNR Unit	sum	1	29,700	29,700	1	99,000	99,000				14,850	14,850								49,500	49,500			
b	Replacement of RAS Pump	nos	2	5,400	10,800	3	18,000	54,000				5,400	5,400								27,000	27,000			
c	Replacement of RAS Pump Delivery Valves, DN 200	nos.	2	668	1,336	3	2,226	6,678				668	668								3,339	3,339			
d	Replacement of RAS Pump Non-Return Valves, DN 200	nos.	2	668	1,336	3	2,226	6,678				668	668								3,339	3,339			
e	Replacement of Ras Pump Pressure Gauges	nos.	2	600	1,200	3	2,000	6,000				600	600								3,000	3,000			
f	Rehabilitation of RAS Pump Air Valves	nos	2	900	1,800	3	3,000	9,000				900	900								4,500	4,500			
g	Replacement of Axial Pumps	nos	2	4,800	9,600	3	16,000	48,000				4,800	4,800								24,000	24,000			
h	Rehabilitation of Axial Pump Delivery Valves, DN 200	nos.	2	668	1,336	3	2,226	6,678				668	668								3,339	3,339			
i	Replacement of Axial Pump Non-Return Valves, DN 200	nos.	2	668	1,336	3	2,226	6,678				668	668								3,339	3,339			
j	Replacement of Axial Pump Pressure Gauges	nos.	2	600	1,200	3	2,000	6,000				600	600								3,000	3,000			
k	Rehabilitation of Axial Pump Air Valves	nos	2	900	1,800	3	3,000	9,000				900	900								4,500	4,500			
l	Rehabilitation of RAS & Axial Pump 380 V LV Switchboard	nos.	1	4,800	4,800	1	16,000	16,000				2,400	2,400								8,000	8,000			
m	Replacement of Small Power and Lighting	sum	1	1,350	1,350	1	4,500	4,500				675	675								2,250	2,250			
												-	-								-	-			
iii	Maintenance/Rehabilitation of Clarifiers Unit											-	-								-	-			
	Rehabilitation of Clarifiers*	nos				1	40,900	40,900				-	-								20,450	20,450			
												-	-								-	-			
iv	Miscellaneous											-	-								-	-			
a	Replacement of Transformer, 500 kVA, 11/0.40 kV	nos.	1	30,000	30,000	1	18,000	18,000				15,000	15,000								9,000	9,000			
b	Replacement of Security Lights	sum	1	7,500	7,500	1	7,500	7,500				3,750	3,750								3,750	3,750			
c	Replacement of Security Fence	m	500	75	37,500	300	75	22,500				18,750	18,750								11,250	11,250			
d	Installation/Replacement of Generator, 300 kVA	nos	1	50,000	50,000	1	50,000	50,000				25,000	25,000								25,000	25,000			
e	Rehabilitation of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	18,000	18,000	1	24,000	24,000				9,000	9,000								12,000	12,000			
f	Rehabilitation of Road/Compound	m^2	900	15	13,500							6,750	6,750								-	-			
g	Supply and Delivery/Replacement of Vehicles	sum	1	35,000	35,000	1	35,000	35,000				17,500	17,500								17,500	17,500			
h	Supply and Delivery/Replacement of Tractors and Plant	Sum	1	87,000	87,000	1	94,000	94,000				43,500	43,500								47,000	47,000			
i	Supply and Delivery/Replacement of Laboratory Equipment	sum	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
j	Supply and Delivery/Replacement of SCADA and Radio Communication Systems	sum	1	35,000	35,000	1	17,500	17,500				17,500	17,500								8,750	8,750			
D.4	**Rehabilitation of AVONLEA Sewage Pump Stations**				**460,058**			**363,130**	-	-	-	**230,029**	**230,029**	-	-	-	-	-	-	-	**181,565**	**181,565**	-	-	-
i	Rehabilitation of Pump Sump											-	-								-	-			
a	Rehabilitation of Pump Sump, 29.4x2 m3	nos	2	4,500	9,000	2	4,500	9,000				4,500	4,500								4,500	4,500			
b	Replacement of Winch Retriving System for Solids	nos	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
c	Replacement of Screen	nos	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
d	Replacement of Penstock Gate	nos	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
e	Replacement of ladder	nos	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
												-	-								-	-			
ii	Replacement/Maintenance/Replacement of Sewage Pump, No. 2											-	-								-	-			
a	Replacement of Vertical Turbine Sewage Pumps, Q = 736 m3/h, H = 38 m	nos	1	100,000	100,000	1	100,000	100,000				50,000	50,000								50,000	50,000			
b	Replacement of SewagePumps Controls	sum	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
c	Replacement of Sewage Pumps Main Delivery Gate Valves, DN 300	nos.	1	5,502	5,502	1	5,502	5,502				2,751	2,751								2,751	2,751			
d	Replacement of Non-Return Valves, DN 300	nos.	1	13,799	13,799	1	13,799	13,799				6,900	6,900								6,900	6,900			
e	Replacement of Pressure Gauges	nos.	1	2,000	2,000	1	2,000	2,000				1,000	1,000								1,000	1,000			
f	Installation/Replacement of Air Valves	nos	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
g	Replacement of Sewage Pumps 380 V LV Switchboard	nos.	1	12,000	12,000	1	7,200	7,200				6,000	6,000								3,600	3,600			
h	Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
i	Repalcement/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	5,000	5,000	1	3,000	3,000				2,500	2,500								1,500	1,500			
j	Replacement of Dewatering Pump	nos.	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
												-	-												
iii	Replacement/Maintenance/Replacement of Sewage Pump, No. 3 and No 4											-	-												
a	Replacement/Maintenance/Replacement of Vertical Turbine Sewer Pumps, Q = 368 m3/h, H = 38 m	nos	2	54,000	108,000	1	54,000	54,000				54,000	54,000								27,000	27,000			
b	Replacement/Rehabilitation/ Replacement of Sewer Pumps Controls	sum	1	9,000	9,000	1	9,000	9,000				4,500	4,500								4,500	4,500			
c	Replacement/Rehabilitation/Replacement of Sewer Pumps Main Delivery Gate Valves, DN 250	nos.	2	4,064	8,128	1	4,064	4,064				4,064	4,064								2,032	2,032			
d	Replacement/Rehabilitation/Replacement of Non-Return Valves, DN 250	nos.	2	4,064	8,128	1	4,064	4,064				4,064	4,064								2,032	2,032			
e	Replacement/Rehabilitation/Replacement of Pressure Gauges	nos.	2	2,000	4,000	1	2,000	2,000				2,000	2,000								1,000	1,000			
f	Installation/Maintenance/Replacement of Air Valves	nos	2	3,000	6,000	1	3,000	3,000				3,000	3,000								1,500	1,500			
												-	-								-	-			
iv	Miscellaneous											-	-								-	-			
a	Rehabilitation/Replacement/Rehabilitation of Transformer, 750 kVA, 11/0.40 kV	nos.	1	38,000	38,000	1	38,000	38,000				19,000	19,000								19,000	19,000			
b	Installation/Maintenance/Replacement of Generator, 100 kVA (for 1 smaller pump and dewatering pump)	nos	1	25,000	25,000	1	25,000	25,000				12,500	12,500								12,500	12,500			
c	Rehabilitation/Maintenance of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	9,500	9,500	1	9,500	9,500				4,750	4,750								4,750	4,750			
d	Rehabilitation/Rehabilitation of Road/Compound	sum	1	3,000	3,000							1,500	1,500								-	-			
e	Supply and Delivery/Maintenance/Replacement of Vehicles	sum	1	35,000	35,000	1	35,000	35,000				17,500	17,500								17,500	17,500			
f	Supply and Delivery/Maintenance/Replacement of Lawn Mover	nos	1	7,000	7,000	1	7,000	7,000				3,500	3,500								3,500	3,500			
g	Supply and Delivery/Maintenance/Replacement of SCADA and Radio Communication Systems	sum	1	20,000	20,000							10,000	10,000								-	-			
												-	-												
D.5	**Rehabilitation of BUDIRIRO Sewage Pump Station**				**485,000**			**1,019,762**	-	-	-	**242,500**	**242,500**	-	-	-	-	-	-	-	**509,881**	**509,881**	-	-	-
i	Rehabilitation of Intake Works																								
a	Replacement of the Main Intake Coarse Screens	nos	2	4,000	8,000	3	4,000	12,000				4,000	4,000								6,000	6,000			
b	Replacement of the Main Intake Fine Screens	nos	2	5,000	10,000	3	5,000	15,000				5,000	5,000								7,500	7,500			
c	Replacement of Intake Sluice Gates	nos	8	10,000	80,000	7	2,500	17,500				40,000	40,000								8,750	8,750			
d	Construction of Grit Tanks/Rehabilitationof Grit Tanks	sum	1	15,000	15,000	1	9,000	9,000				7,500	7,500								4,500	4,500			
e	Installation of mechanical screen	nos			-	1	25,000	25,000				-	-								12,500	12,500			
f	Installation/Replacement of Air Lift Pumps	nos	3	9,000	27,000	6	6,000	36,000				13,500	13,500								18,000	18,000			
g	Installation/Replacement of Compressors for Air Pumps	nos	2	16,000	32,000	2	16,000	32,000				16,000	16,000								16,000	16,000			
h	Installation/Replacement of Elevator	nos	1	6,500	6,500	1	6,500	6,500				3,250	3,250								3,250	3,250			
i	Replacement/Replacement of Flowmeter	nos	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Medium Term Projects
FS/FD — Construction

Long Term Projects
FS/FD — Construction

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)				2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount		[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
j	Replacement/Replacement of LV Switchboard	nos	1	4,000	4,000	1	4,000	4,000					2,000	2,000								2,000	2,000			
k	Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500					2,250	2,250								2,250	2,250			
													-	-								-	-			
ii	Rehabilitation of Pump Sump												-	-								-	-			
a	Rehabilitation of Pump Sump*	nos				1	10,000	10,000					-	-								5,000	5,000			
b	Replacement of Penstock Gates and Gate Valves *	sum				1	12,000	12,000					-	-								6,000	6,000			
c	Replacement of ladder*	nos				1	2,000	2,000					-	-								1,000	1,000			
													-	-								-	-			
iii	Replacement of Sewage Surface Pumps												-	-								-	-			
a	Replacement/Replacement of Horizontal Spli Casing Sewage Pumps, Q = 750 m3/h, H = 60 m*	nos			-	3	110,000	330,000					-	-								165,000	165,000			
b	Replacement/ Replacement of Sewage Pumps Controls*	sum			-	1	10,000	10,000					-	-								5,000	5,000			
c	Replacement of Sewage Pumps Main Suction Gate Valve, DN 300*	nos.			-	1	5,502	5,502					-	-								2,751	2,751			
d	Replacement of Sewage Pumps Suction Gate Valves, DN 300*	nos.			-	3	5,502	16,506					-	-								8,253	8,253			
e	Replacement of Sewage Pumps Main Delivery Gate Valves, DN 450*	nos.			-	3	22,271	66,814					-	-								33,407	33,407			
f	Replacement of Non-Return Valves, DN 300*	nos.			-	3	28,980	86,940					-	-								43,470	43,470			
g	Rehabilitation/Replacement of Pressure Gauges	nos.	6	3,000	18,000	6	3,000	18,000					9,000	9,000								9,000	9,000			
h	Installation/Replacement of Air Valves	nos	3	4,500	13,500	3	4,500	13,500					6,750	6,750								6,750	6,750			
iii	Replacement of Sewage Pumps 380 V LV Switchboard*	nos.			-	1	12,000	12,000					-	-								6,000	6,000			
j	Replacement of Small Power and Lighting*	sum			-	1	4,500	4,500					-	-								2,250	2,250			
k	Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	8,000	8,000	1	6,000	6,000					4,000	4,000								3,000	3,000			
l	Replacement of Dewatering Pump*	nos.				2	4,500	9,000					-	-								4,500	4,500			
																						-	-			
iv	Miscellaneous																					-	-			
a	Replacement of Transformer, 500 kVA, 11/0.40 kV	nos.	1	30,000	30,000	1	30,000	30,000					15,000	15,000								15,000	15,000			
b	Rehabilitation/Replacement of Security Lights and Fence	sum	1	4,500	4,500	1	4,500	4,500					2,250	2,250								2,250	2,250			
c	Installation/Replacement of Generator, 135 kVA (for 1 pump, dewatering pump and security lights)	nos	1	27,000	27,000	1	27,000	27,000					13,500	13,500								13,500	13,500			
d	Rehabilitation of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	18,000	18,000	1	24,000	24,000					9,000	9,000								12,000	12,000			
e	Rehabilitation/Rehabilitation of Road/Compound	m^2	600	15	9,000								4,500	4,500								-	-			
f	Supply and Delivery/Replacement of Vehicles	sum	1	35,000	35,000	1	35,000	35,000					17,500	17,500								17,500	17,500			
g	Supply and Delivery/Replacement of Tractors and Plant	sum	1	94,000	94,000	1	94,000	94,000					47,000	47,000								47,000	47,000			
h	Supply and Delivery/Replacement of Laboratory Equipment	sum	1	4,000	4,000	1	4,000	4,000					2,000	2,000								2,000	2,000			
i	Supply and Delivery/Replacement of SCADA and Radio Communication Systems	sum	1	25,000	25,000	1	25,000	25,000					12,500	12,500								12,500	12,500			
																						-	-			
D.6	**Rehabilitation of MT PLEASANT NE Sewage Pump Station**				**571,797**			**559,797**		-	-	-	**285,899**	**285,899**	-	-	-	-	-	-	-	**279,899**	**279,899**	-	-	-
i	Rehabilitation of Pump Sump																									
a	Rehabilitation/Maintenance/Rehabilitation of Pump Sump	nos	2	5,000	10,000	2	5,000	10,000					5,000	5,000								5,000	5,000			
b	Replacement/Maintenance/Replacement of Winch Retriving System for Solids	nos	1	6,000	6,000	1	6,000	6,000					3,000	3,000								3,000	3,000			
c	Replacement/Maintenance/Replacement of Screen	nos	2	4,000	8,000	1	4,000	4,000					4,000	4,000								2,000	2,000			
d	Replacement/Maintenance/Replacement of Penstock Gate	nos	1	3,500	3,500	1	3,500	3,500					1,750	1,750								1,750	1,750			
e	Replacement/Maintenance/Replacement of ladder	nos	1	3,500	3,500	1	3,500	3,500					1,750	1,750								1,750	1,750			
f	Replacement/Maintenance/Replacement of Gate Valve, DN 300	nos	1	5,502	5,502	1	5,502	5,502					2,751	2,751								2,751	2,751			
													-	-								-	-			
ii	Replacement/Maintenance/Replacement of Sewage Surface Pumps												-	-								-	-			
a	Replacement/Maintenance/Replacement of Vertical Turbine Sewage Pumps, Q = 298 m3/h, H = 45 m	nos	3	54,000	162,000	3	54,000	162,000					81,000	81,000								81,000	81,000			
b	Replacement/Rehabilitation/ Replacement of SewagePumps Controls	sum	1	3,000	3,000	1	3,000	3,000					1,500	1,500								1,500	1,500			
c	Replacement/Rehabilitation/Replacement of Sewage Pumps Main Suction Gate Valve, DN 300	nos.	1	5,502	5,502	1	5,502	5,502					2,751	2,751								2,751	2,751			
d	Replacement/Rehabilitation/Replacement of Sewage Pumps Suction Gate Valves, DN 225	nos.	3	4,064	12,193	3	4,064	12,193					6,096	6,096								6,096	6,096			
e	Replacement/Rehabilitation/Replacement of Sewage Pumps Main Delivery Gate Valves, DN 150	nos.	3	17,261	51,782	3	17,261	51,782					25,891	25,891								25,891	25,891			
f	Replacement/Rehabilitation/Replacement of Non-Return Valves, DN 150	nos.	3	1,309	3,927	3	1,309	3,927					1,964	1,964								1,964	1,964			
g	Replacement/Rehabilitation/Replacement of Pressure Gauges	nos.	6	2,982	17,892	6	2,982	17,892					8,946	8,946								8,946	8,946			
h	Installation/Maintenance/Replacement of Air Valves	nos	3	3,000	9,000	3	3,000	9,000					4,500	4,500								4,500	4,500			
i	Replacement/Maintenance/Replacement of Sewage Pumps 380 V LV Switchboard	nos.	1	12,000	12,000	1	7,200	7,200					6,000	6,000								3,600	3,600			
j	Replacement/Maintenance/Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500					2,250	2,250								2,250	2,250			
k	Repalcement/Maintenance/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	8,000	8,000	1	4,800	4,800					4,000	4,000								2,400	2,400			
l	Replacement/Maintenance/Replacement of Dewatering Pump	nos.	2	4,500	9,000	2	4,500	9,000					4,500	4,500								4,500	4,500			
													-	-								-	-			
iii	Miscellaneous												-	-								-	-			
a	Replacement of Transformer, 750 kVA, 11/0.40 kV	nos.	1	38,000	38,000	1	38,000	38,000					19,000	19,000								19,000	19,000			
b	Rehabilitation/Replacement of Security Lights and Fence	sum	1	4,500	4,500	1	4,500	4,500					2,250	2,250								2,250	2,250			
c	Installation/Replacement of Generator, 100 kVA (for 1 pump, dewatering pump and security lights)	nos	1	25,000	25,000	1	25,000	25,000					12,500	12,500								12,500	12,500			
d	Rehabilitation of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	24,000	24,000	1	24,000	24,000					12,000	12,000								12,000	12,000			
e	Rehabilitation of Road/Compound	m^2	1	3,000	3,000	1	3,000	3,000					1,500	1,500								1,500	1,500			
f	Supply and Delivery/Replacement of Vehicles	sum	1	35,000	35,000	1	35,000	35,000					17,500	17,500								17,500	17,500			
g	Supply and Delivery/Replacement of Tractors and Plant	sum	1	87,000	87,000	1	87,000	87,000					43,500	43,500								43,500	43,500			
h	Supply and Delivery/Replacement of SCADA and Radio Communication Systems	sum	1	20,000	20,000	1	20,000	20,000					10,000	10,000								10,000	10,000			
D.7	**Rehabilitation of NEW MARLBOROUGH Sewage Pump Station**				**255,434**			**265,134**		-	-	-	**127,717**	**127,717**	-	-	-	-	-	-	-	**132,567**	**132,567**	-	-	-
i	Rehabilitation of Pump Sump																									
a	Rehabilitation/Maintenance/Rehabilitation of Pump Sump	nos	2	4,500	9,000	3	4,500	13,500					4,500	4,500								6,750	6,750			
b	Replacement/Maintenance/Replacement of Screen	nos	1	4,000	4,000	3	4,000	12,000					2,000	2,000								6,000	6,000			
													-	-								-	-			
ii	Replacement/Maintenance/Replacement of Sewage Submersible Pumps												-	-								-	-			
a	Replacement of Submersible Sewage Pumps	nos	2	25,000	50,000	2	23,000	46,000					25,000	25,000								23,000	23,000			
b	Replacement of Sewage Pumps Controls	sum	1	6,000	6,000	1	6,000	6,000					3,000	3,000								3,000	3,000			
c	Replacement of Sewage Pumps Main Delivery Gate Valves, DN 250	nos.	2	5,502	11,004	2	5,502	11,004					5,502	5,502								5,502	5,502			
d	Replacement of Non-Return Valves, DN 250	nos.	2	11,065	22,130	2	11,065	22,130					11,065	11,065								11,065	11,065			
e	Replacement of Pressure Gauges	nos.	2	2,000	4,000	2	2,000	4,000					2,000	2,000								2,000	2,000			
f	Installation/Replacement of Air Valves	nos	2	3,000	6,000	2	3,000	6,000					3,000	3,000								3,000	3,000			
g	Maintenance/Replacement of Sewage Pumps 380 V LV Switchboard	nos.	2	8,000	16,000	2	8,000	16,000					8,000	8,000								8,000	8,000			
h	Replacement of Small Power and Lighting	sum	2	900	1,800	2	3,000	6,000					900	900								3,000	3,000			
ii	Replacement overhead Wire Rope Hoist, 3 t	nos.	1	5,000	5,000	1	5,000	5,000					2,500	2,500								2,500	2,500			
j	Replacement of Dewatering Pump	nos.	-	4,500	-	-	4,500	-					-	-								-	-			
													-	-								-	-			
iii	Miscellaneous												-	-								-	-			
a	Supply and Install/Replacement of Transformer, 200 kVA, 11/0.40 kV	sum	1	20,000	20,000	1	20,000	20,000					10,000	10,000								10,000	10,000			
b	Rehabilitation/Replacement of Security Lights and Fence	sum	1	4,500	4,500	1	4,500	4,500					2,250	2,250								2,250	2,250			
c	Installation/Replacement of Generator, 80 kVA (for 1 pump and security lights)	sum	1	16,000	16,000	1	16,000	16,000					8,000	8,000								8,000	8,000			
d	Rehabilitation of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	15,000	15,000	1	15,000	15,000					7,500	7,500								7,500	7,500			
e	Rehabilitation of Road/Compound	sum	1	3,000	3,000								1,500	1,500								-	-			
f	Supply and Delivery/Replacement of Vehicles	sum	1	35,000	35,000	1	35,000	35,000					17,500	17,500								17,500	17,500			
g	Supply and Delivery/Maintenance/Replacement of Lawn Mover	sum	1	7,000	7,000	1	7,000	7,000					3,500	3,500								3,500	3,500			
h	Supply and Delivery/Replacement of SCADA and Radio Communication Systems	sum	1	20,000	20,000	1	20,000	20,000					10,000	10,000								10,000	10,000			
													-	-												
D.8	**Rehabilitation of BORROWDALE BROOK Sewage Pump Station**				**636,859**			**723,965**	-	-	-	-	**318,430**	**318,430**	-	-	-	-	-	-	-	**361,983**	**361,983**	-	-	-
i	Rehabilitation of Pump Sump - Pump Station, No. 01*												-	-								-	-			
a	Rehabilitation/Rehabilitation of Pump Sump	nos				2	4,500	9,000					-	-								4,500	4,500			
b	Rehabilitation/Rehabilitation of Screen	nos				2	4,000	8,000					-	-								4,000	4,000			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Medium Term Projects: FS/FD (2015–2016), Construction (2017–2018)
Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
c	Rehabilitation/Replacement of Gate Valves, DN 225	nos				2	3,500	7,000				-	-								3,500	3,500			
d	Rehabilitation/Replacement of ladder	nos				2	3,500	7,000				-	-								3,500	3,500			
												-	-								-	-			
ii	Rehabilitation of Pump Sump - Pump Stations Nos. 02 - 04*											-	-								-	-			
a	Rehabilitation/Rehabilitation of Pump Sump, 10.9 m3	nos				3	4,500	13,500				-	-								6,750	6,750			
b	Rehabilitation/Replacement of Screen	nos				3	4,000	12,000				-	-								6,000	6,000			
c	Rehabilitation/Replacement of Gate Valves, DN 225	nos				6	3,500	21,000				-	-								10,500	10,500			
d	Rehabilitation/Replacement of ladder	nos				3	3,500	10,500				-	-								5,250	5,250			
												-	-								-	-			
iii	Replacement/Maintenance/Replacement of Sewage Pump Station, No. 01											-	-								-	-			
a	Replacement of Vertical Immersible Pump, Q = 160 m3/h, H = m 50 (estimated)	nos	1	35,000	35,000	1	25,000	25,000				17,500	17,500								12,500	12,500			
b	Replacement of Sewage Pumps Controls	sum	1	1,800	1,800	1	3,000	3,000				900	900								1,500	1,500			
c	Rehabilitation/Replacement of Sewage Pumps Suction Gate Valves, DN 200	nos.	1	1,336	1,336	1	2,226	2,226				668	668								1,113	1,113			
d	Rehabilitation/Replacement of Sewage Pumps Suction Gate Valves, DN 200	nos.	1	1,336	1,336	1	2,226	2,226				668	668								1,113	1,113			
e	Replacement of Non-Return Valves, DN 200	nos.	1	2,888	2,888	1	4,813	4,813				1,444	1,444								2,407	2,407			
f	Replacement of Pressure Gauges	nos.	2	1,200	2,400	2	2,000	4,000				1,200	1,200								2,000	2,000			
g	Replacement of Air Valves	nos	1	1,800	1,800	1	3,000	3,000				900	900								1,500	1,500			
h	Replacement of Sewage Pumps 380 V LV Switchboard	nos.	1	7,200	7,200	1	12,000	12,000				3,600	3,600								6,000	6,000			
iii	Replacement of Small Power and Lighting	sum	1	2,700	2,700	1	4,500	4,500				1,350	1,350								2,250	2,250			
j	Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	3,000	3,000	1	5,000	5,000				1,500	1,500								2,500	2,500			
k	Replacement of Dewatering Pump	nos.	1	2,700	2,700	1	4,500	4,500				1,350	1,350								2,250	2,250			
												-	-								-	-			
iv	Replacement/Maintenance/Replacement of Sewage Pump Station, No. 02 - 04											-	-								-	-			
a	Maintenance/Replacement of Vertical Immersible Pump, Q = 160 m3/h, H = 50 m (estimated)	nos	3	25,000	75,000	3	25,000	75,000				37,500	37,500								37,500	37,500			
b	Maintenance/ Replacement of Sewage Pumps Controls	sum	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
c	Replacement/Rehabilitation/Replacement of Sewage Pumps Suction Gate Valves, DN 150	nos.	3	1,309	3,927	3	1,309	3,927				1,964	1,964								1,964	1,964			
d	Replacement/Rehabilitation/Replacement of Sewage Pumps Suction Gate Valves, DN 150	nos.	3	1,309	3,927	3	1,309	3,927				1,964	1,964								1,964	1,964			
e	Maintenance/Replacement of Non-Return Valves, DN 150	nos.	3	2,982	8,946	3	2,982	8,946				4,473	4,473								4,473	4,473			
f	Maintenance Replacement of Pressure Gauges	nos.	6	2,000	12,000	6	2,000	12,000				6,000	6,000								6,000	6,000			
g	Maintenance/Replacement of Air Valves	nos	3	3,000	9,000	3	3,000	9,000				4,500	4,500								4,500	4,500			
h	Maintenance/Replacement of Sewage Pumps 380 V LV Switchboard	nos.	3	8,000	24,000	3	8,000	24,000				12,000	12,000								12,000	12,000			
iv	Maintenance/Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
j	Maintenance/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	3	5,000	15,000	3	5,000	15,000				7,500	7,500								7,500	7,500			
k	Maintenance/Replacement of Dewatering Pump	nos.	3	4,500	13,500	3	4,500	13,500				6,750	6,750								6,750	6,750			
												-	-								-	-			
v	Miscellaneous											-	-								-	-			
a	Rehabilitation/Replacement of Transformer, 200 kVA, 11/0.40 kV	nos.	1	12,000	12,000	1	20,000	20,000				6,000	6,000								10,000	10,000			
b	Installation/Replacement of Generator, 60 kVA (for 1 sewage pump and dewatering pump)	nos.	4	75,600	302,400	4	75,600	302,400				151,200	151,200								151,200	151,200			
c	Rehabilitation/Maintenance of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	20,000	20,000	1	28,000	28,000				10,000	10,000								14,000	14,000			
d	Rehabilitation/Rehabilitation of Road/Compound	sum	1	3,000	3,000	1	3,000	3,000				1,500	1,500								1,500	1,500			
e	Supply and Delivery/Maintenance/Replacement of Vehicles	sum	1	35,000	35,000	1	35,000	35,000				17,500	17,500								17,500	17,500			
f	Supply and Delivery/Maintenance/Replacement of Lawn Mover	nos	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
g	Supply and Delivery/Maintenance/Replacement of SCADA and Radio Communication Systems	sum	1	25,000	25,000			-				12,500	12,500								-	-			
D.9	**Rehabilitation of CHISIPITE Sewage Pump Station**				**324,170**			**326,170**	-	-	-	**162,085**	**162,085**	-	-	-	-	-	-	-	**163,085**	**163,085**	-	-	-
i	Rehabilitation of Pump Sump - Old Pump Station																				-	-			
a	Rehabilitation/Rehabilitation of Pump Sump	nos	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
b	Replacement/Replacement of Screen	nos	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
c	Replacement/Maintenance/Replacement of Valve, DN 225	nos	2	3,500	7,000	2	3,500	7,000				3,500	3,500								3,500	3,500			
d	Replacement/Replacement of ladder	nos	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
												-	-								-	-			
ii	Rehabilitation of Pump Sump - New Pump Station											-	-								-	-			
a	Rehabilitation/Rehabilitation of Pump Sump	nos	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
b	Installation/Replacement of Screen	nos	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
c	Installation/Replacement of Valves, DN 250	nos	2	3,500	7,000	2	3,500	7,000				3,500	3,500								3,500	3,500			
d	Installation/Replacement of ladder	nos	1	3,500	3,500	1	3,500	3,500				1,750	1,750								1,750	1,750			
												-	-								-	-			
iii	Replacement/Maintenance/Replacement of Old Sewage Pump Station											-	-								-	-			
a	Replacement/Replacement of Horizontal Sewage Pumps, Q = 133 m3/h, H = 60 m	nos	2	18,000	36,000	2	18,000	36,000				18,000	18,000								18,000	18,000			
b	Replacement/Replacement of SewagePumps Controls	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
c	Replacement/Replacement of Sewage Pumps Suction Gate Valve, DN 80	nos.	2	766	1,532	2	766	1,532				766	766								766	766			
d	Replacement/Replacement of Sewage Pumps Delivery Gate Valve, DN 80	nos.	2	766	1,532	2	766	1,532				766	766								766	766			
e	Replacement/Replacement of Non-Return Valves, DN 80	nos.	2	1,500	3,000	2	1,500	3,000				1,500	1,500								1,500	1,500			
f	Replacement/Replacement of Pressure Gauges	nos.	4	1,500	6,000	4	1,500	6,000				3,000	3,000								3,000	3,000			
g	Installation/Replacement of Air Valves	nos	2	3,000	6,000	2	3,000	6,000				3,000	3,000								3,000	3,000			
h	Replacement/Replacement of Sewage Pumps 380 V LV Switchboard	nos.	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
iii	Rehabilitation/Replacement of Small Power and Lighting	sum	1	2,000	2,000	1	2,000	2,000				1,000	1,000								1,000	1,000			
j	Replacement/Maintenance/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
k	Replacement/Maintenance/Replacement of Dewatering Pump	nos.	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
												-	-								-	-			
iv	Replacement/Maintenance/Replacement of New Sewage Pump Station.											-	-								-	-			
a	Installation/Replacement of Immersible Sewer Pumps, Q = 241 m3/h, H = 60 m	nos	2	24,000	48,000	2	24,000	48,000				24,000	24,000								24,000	24,000			
b	Replacement/Replacement of SewagePumps Controls	sum	1	6,000	6,000	1	6,000	6,000				3,000	3,000								3,000	3,000			
c	Replacement/Replacement of Sewage Pumps Suction Gate Valve, DN 250	nos.	2	4,064	8,128	2	4,064	8,128				4,064	4,064								4,064	4,064			
d	Replacement/Replacement of Sewage Pumps Delivery Gate Valve, DN 250	nos.	2	4,064	8,128	2	4,064	8,128				4,064	4,064								4,064	4,064			
e	Replacement/Replacement of Non-Return Valves, DN 250	nos.	2	11,065	22,130	2	11,065	22,130				11,065	11,065								11,065	11,065			
f	Replacement/Replacement of Pressure Gauges	nos.	4	1,500	6,000	4	1,500	6,000				3,000	3,000								3,000	3,000			
g	Installation/Replacement of Air Valves	nos	2	3,000	6,000	2	3,000	6,000				3,000	3,000								3,000	3,000			
h	Replacement/Replacement of Sewage Pumps 380 V LV Switchboard	nos.	1	8,000	8,000	1	8,000	8,000				4,000	4,000								4,000	4,000			
i	Rehabilitation/Replacement of Small Power and Lighting	sum	1	4,500	4,500	1	4,500	4,500				2,250	2,250								2,250	2,250			
j	Replacement/Maintenance/Rehabilitation overhead Wire Rope Hoist, 3 t	nos.	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
k	Replacement/Maintenance/Replacement of Dewatering Pump	nos.	1	4,000	4,000	1	4,000	4,000				2,000	2,000								2,000	2,000			
												-	-								-	-			
v	Miscellaneous											-	-								-	-			
	Rehabilitation/Replacement/Rehabilitation of Transformer, 200 kVA, 11/0.40 kV	nos.	1	12,000	12,000	1	20,000	20,000				6,000	6,000								10,000	10,000			
	Rehabilitation/Maintenance/Replacement of Security Lights and Fence	sum	1	10,000	10,000	1	10,000	10,000				5,000	5,000								5,000	5,000			
	Installation/Replacement of Generator, 60 kVA (for 1 pump, dewatering pump and Security lights)	nos	1	28,220	28,220	1	28,220	28,220				14,110	14,110								14,110	14,110			
	Rehabilitation/Maintenance of Office and Workshop Buildings Incl. Electrical and Mechanical Works	sum	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
	Rehabilitation/Rehabilitation of Road/Compound	sum	1	6,000	6,000							3,000	3,000								-	-			
	Supply and Installatio/Maintenance of SCADA System and PCs	sum	1	10,000	10,000	1	10,000	10,000				5,000	5,000								5,000	5,000			
	Supply and Installation/Maintenance/Replacement of Radio Communication System	sum	1	5,000	5,000	1	5,000	5,000				2,500	2,500								2,500	2,500			
D.10	**Replacement/Upgrading of existing sewer network**				**31,777,835**			-	-	-	-	**6,355,567**	**6,355,567**	**6,355,567**	**6,355,567**	**6,355,567**	-	-	-	-	-	-	-	-	-
i	Sewer reticulation pipes in some areas (Mbare, CBD, Kuwadzana, Rugare, Westlea etc)																								
	ND 150 PVC	m	35,484	75	2,661,271							532,254	532,254	532,254	532,254	532,254					-	-			
	ND 250 PVC	m	3,255	90	292,966							58,593	58,593	58,593	58,593	58,593					-	-			
	ND 315 PVC	m	3,026	120	363,136							72,627	72,627	72,627	72,627	72,627					-	-			

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Medium Term Projects: FS/FD (2014–2016), Construction (2017–2018)

Long Term Projects: FS/FD (2024–2025), Construction (2026–2027)

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020) Qty	Rate [USD]	Amount	Long Term (upto 2030) Qty	Rate [USD]	Amount	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
												-	-								-	-			
ii	Replacement (complete with pipe bridge) of leaking pipe sections on stream/river crossings											-	-								-	-			
	ND 250 ST	m	75	120	9,000							1,800	1,800	1,800	1,800	1,800					-	-			
	ND 300 ST	m	670	198	132,660							26,532	26,532	26,532	26,532	26,532					-	-			
	ND 375 ST	m	75	230	17,250							3,450	3,450	3,450	3,450	3,450					-	-			
	ND 450 ST	m	300	246	73,800							14,760	14,760	14,760	14,760	14,760					-	-			
	ND 525 ST	m	200	396	79,200							15,840	15,840	15,840	15,840	15,840					-	-			
	ND 600 ST	m	880	450	396,000							79,200	79,200	79,200	79,200	79,200					-	-			
	ND 675 ST	m	250	650	162,500							32,500	32,500	32,500	32,500	32,500					-	-			
	ND 750 ST	m	270	712	192,240							38,448	38,448	38,448	38,448	38,448					-	-			
	ND 875 ST	m	150	826	123,900							24,780	24,780	24,780	24,780	24,780					-	-			
	ND 1400 ST	m	2,390	1,000	2,390,000							478,000	478,000	478,000	478,000	478,000					-	-			
												-	-												
iii	Trunk sewer upgrades											-	-												
	ND 450 PVC	m	18,630	150	2,794,566							558,913	558,913	558,913	558,913	558,913									
	ND 525 RC	m	13,517	380	5,136,547							1,027,309	1,027,309	1,027,309	1,027,309	1,027,309									
	ND 600 RC	m	6,359	440	2,798,101							559,620	559,620	559,620	559,620	559,620									
	ND 675 RC	m	2,484	530	1,316,769							263,354	263,354	263,354	263,354	263,354									
	ND 750 RC	m	2,896	650	1,882,179							376,436	376,436	376,436	376,436	376,436									
	ND 825 RC	m	3,688	700	2,581,376							516,275	516,275	516,275	516,275	516,275									
	ND 900 RC	m	6,755	760	5,134,142							1,026,828	1,026,828	1,026,828	1,026,828	1,026,828									
	ND 1050 RC	m	2,905	1,030	2,991,923							598,385	598,385	598,385	598,385	598,385									
	ND 1200 RC	m	197	1,260	248,308							49,662	49,662	49,662	49,662	49,662									
																					-	-			
E. EXTENSION OF SEWERAGE SERVICES					**119,158,599**			**278,103,622**	**7,208,614**	**7,208,614**	**7,208,614**	**41,557,764**	**41,557,764**	**7,208,614**	**7,208,614**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**	**52,629,240**	**52,629,240**	**50,816,740**	**17,432,629**	**17,432,629**
E.1	**Rehabilitatioin and Decommissioning of Sewage Treatment Works**				**1,227,500**			**3,625,000**	**-**	**-**	**-**	**613,750**	**613,750**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,812,500**	**1,812,500**	**-**	**-**	**-**
i	Donny Brook 1											-	-												
a	Short Term Pond Refurbishment and desludging	Sum	1	75,000	75,000	-	75,000	-				37,500	37,500								-	-			
	Dewatering and drying out	Sum			-	1	50,000	50,000				-	-								25,000	25,000			
	Sludge excavation and removal	m^3			-	6,000	50	300,000				-	-								150,000	150,000			
	Dozing of walls and lanscaping level	m^3			-	28,600	10	286,000				-	-								143,000	143,000			
	Demolition of unused structures	nos			-	2	5,000	10,000				-	-								5,000	5,000			
												-	-								-	-			
ii	Donny Brook 2											-	-								-	-			
a	Short Term Pond Refurbishment and desludging	Sum	1	75,000	75,000	-	75,000	-				37,500	37,500								-	-			
	Dewatering and drying out	Sum			-	1	50,000	50,000				-	-								25,000	25,000			
	Sludge excavation and removal	m^3			-	13,600	50	680,000				-	-								340,000	340,000			
	Dozing of walls and lanscaping level	m^3			-	45,300	10	453,000				-	-								226,500	226,500			
	Demolition of unused structures	nos			-	2	5,000	10,000				-	-								5,000	5,000			
												-	-								-	-			
iii	Donny Brook 3											-	-								-	-			
a	Short Term Pond Refurbishment and desludging	Sum	1	75,000	75,000	-	75,000	-				37,500	37,500								-	-			
	Dewatering and drying out	Sum			-	1	50,000	50,000				-	-								25,000	25,000			
	Sludge excavation and removal	m^3			-	15,000	50	750,000				-	-								375,000	375,000			
	Dozing of walls and lanscaping level	m^3			-	38,000	10	380,000				-	-								190,000	190,000			
	Demolition of unused structures	nos			-	2	5,000	10,000				-	-								5,000	5,000			
												-	-								-	-			
iv	Donny Brook 4											-	-								-	-			
a	Short Term Pond Refurbishment and desludging	Sum	1	75,000	75,000	-	75,000	-				37,500	37,500								-	-			
	Dewatering and drying out	Sum			-	1	50,000	50,000				-	-								25,000	25,000			
	Sludge excavation and removal	m^3			-	6,200	50	310,000				-	-								155,000	155,000			
	Dozing of walls and lanscaping level	m^3			-	22,600	10	226,000				-	-								113,000	113,000			
	Demolition of unused structures	nos			-	2	5,000	10,000				-	-								5,000	5,000			
	Donny Brook Area Irrigation System (9 MLD Capacity)																								
	Irrigation Set Up	Ha	125	4,770	596,250		4,770	-				298,125	298,125								-	-			
	Irrigation Pumps and Equipment	Ha	125	2,650	331,250		2,650	-				165,625	165,625								-	-			
												-	-								-	-			
E.2	**Rehabilitation/ Commissioning of Existing Lyndhurst Farm Sewer**				**-**			**1,153,944**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**384,648**	**384,648**	**384,648**	**-**	**-**
i	New / replacement Pipework											-	-												
	ND 450 PVC	m				300	190	57,000				-	-								19,000	19,000	19,000		
	ND 525 Concrete	m					300	-				-	-								-	-	-		
	ND 600 Concrete	m				210	342	71,820				-	-								23,940	23,940	23,940		
	ND 675 Concrete	m					422	-				-	-								-	-	-		
	ND 750 Concrete	m				90	509	45,810				-	-								15,270	15,270	15,270		
	ND 825 Concrete	m					536	-				-	-								-	-	-		
	ND 900 Concrete	m				390	753	293,514				-	-								97,838	97,838	97,838		
	ND 1050 Concrete	m				340	825	280,500				-	-								93,500	93,500	93,500		
	ND 1200 Concrete	m				190	900	171,000				-	-								57,000	57,000	57,000		
	ND 1350 Concrete	m					968	-				-	-								-	-	-		
	ND 1500 Concrete	m					1,325	-				-	-								-	-	-		
	Construction of replacement manholes	nos.				15	5,300	79,500				-	-								26,500	26,500	26,500		
	Rehabilitation of manhole cover and frame	nos.				30	350	10,500				-	-								3,500	3,500	3,500		
	New manhole covers only	nos.				106	150	15,900				-	-								5,300	5,300	5,300		
												-	-								-	-	-		
ii	Complete Pipelaying over Pipe Bridges											-	-								-	-	-		
	ND 450 ST	m			-	200	246	49,200				-	-								16,400	16,400	16,400		
	ND 525 ST	m			-	200	396	79,200				-	-								26,400	26,400	26,400		
												-	-												
E.3	**Trunk Sewer Extensions in Southern Suburbs (Ward 1)**				**-**			**3,520,907**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,173,636**	**1,173,636**	**1,173,636**	**-**	**-**
i	New / replacement Pipework																								
	ND 400 PVC	m			-	2,300	165	379,500				-	-								126,500	126,500	126,500		
	ND 450 PVC	m			-	2,550	190	484,500				-	-								161,500	161,500	161,500		
	ND 525 Concrete	m			-	1,000	300	300,000				-	-								100,000	100,000	100,000		
	ND 600 Concrete	m			-		342	-				-	-								-	-	-		
	ND 675 Concrete	m			-		422	-				-	-								-	-	-		
	ND 750 Concrete	m			-	860	509	437,740				-	-								145,913	145,913	145,913		
	ND 825 Concrete	m			-	2,450	536	1,313,200				-	-								437,733	437,733	437,733		
	ND 900 Concrete	m			-		753	-				-	-								-	-	-		
	ND 1050 Concrete	m			-		825	-				-	-								-	-	-		
	ND 1200 Concrete	m			-		900	-				-	-								-	-	-		
	ND 1350 Concrete	m			-		968	-				-	-								-	-	-		
	ND 1500 Concrete	m			-		1,325	-				-	-								-	-	-		
	Construction of New Manhole	nos.			-	114	5,300	605,967				-	-								201,989	201,989	201,989		

Greater Harare Water and Sanitation Investment Plan

Covered under Chinese Exim Bank loan
Covered under Zim-Fund Phase 1

Appendix 9-1: Detailed Investment Cost Estimates - HARARE

Item		Unit	Medium Term (upto 2020) Qty	Medium Term (upto 2020) Rate [USD]	Medium Term (upto 2020) Amount	Long Term (upto 2030) Qty	Long Term (upto 2030) Rate [USD]	Long Term (upto 2030) Amount
E.4	**Harare South Trunk Sewer**				-			**31,403,383**
i	New Pipework							
	ND 450 PVC	m			-		190	-
	ND 525 Concrete	m			-		300	-
	ND 600 Concrete	m			-		342	-
	ND 675 Concrete	m			-		422	-
	ND 750 Concrete	m	2,570		-		509	-
	ND 825 Concrete	m	640		-		536	-
	ND 900 Concrete	m			-	19,250	753	14,487,550
	ND 1050 Concrete	m			-		825	-
	ND 1200 Concrete	m			-		900	-
	ND 1350 Concrete	m			-		968	-
	ND 1500 Concrete	m			-	9,000	1,325	11,925,000
	Construction of new manholes	nos.	54		-	471	10,600	4,990,833
E.5	**Harare South Sewage Pump Station and Force Main**				**2,100,000**			**11,167,000**
i	Sewage Pumping Station Construction	kW	250		-	1,500	482	723,450
ii	Sewage Pumping Equipment	kW	250		-	1,500	896	1,343,550
iii	GRP Force Main DN500	m	7,000	300	2,100,000	-	300	-
iii	GRP Force Main DN1100	m	-	1,300	-	7,000	1,300	9,100,000
E.6	**Harare South Wastewater Treatment Works**				**7,770,800**			**52,907,100**
i	Wastewater Stabiliation Pond System							
	Construction of Wastewater Stabilisation Ponds System	MLD	12	561,000	6,732,000	83	561,000	46,563,000
ii	Wastewater Slow Rate (irrigation) disposal system							
	Irrigation Set Up	Ha	140	4,770	667,800	805	4,770	3,839,850
	Irrigation Pumps and Equipment	Ha	140	2,650	371,000	945	2,650	2,504,250
E.7	**Expansion of Crowborough WWTW**				**57,600,000**			-
	Construction of additional 18 ML/day BNR modules	ML/day	36	1,600,000	57,600,000			
E.8	**Extension of sewer reticulation system in new development areas**				**50,460,299**			**174,326,288**
i	pipes							
	ND 100 PVC	m	118,063	27	3,187,712	407,876	27	11,012,657
	ND 160 PVC	m	283,352	36	10,200,678	978,903	36	35,240,504
ii	Construction of manholes	nos.	8,028	2,500	20,070,779	27,736	2,500	69,338,954
iii	Sewer service connections							
i	ND 100	nos.	47,225	360	17,001,130	163,150	360	58,734,173
F. ACCOMPANYING MEASURES					**61,408,972**			**75,076,163**
F.1	**Technical operations management**				**1,200,000**			
i	Establishment of meter control, testing and repair workshop	Sum	15	50,000	750,000			
ii	Procurement of tools and equipment for operations and maintenance	Sum			-			
iii	Provision of vehicles for operation and maintenance teams	Sum	1	150,000	150,000			
iv	Provision of vacuum tanker for septic tank emptying	no.s	10	30,000	300,000			
F.2	**Information Communication Technology Infrastructure**				**-**			
ii	Supply of server	nos						
iii	Supply and install Local Area Networking	Sum						
iv	Supply and install Wide Area Networking	Satelite						
v	Supply and install generator power back-up	nos						
vi	Supply personal computers complete with software, UPS, etc.	nos						
vii	Supply laptop computers	nos						
viii	Supply heavy duty printer (dot-matrix)	nos						
ix	Supply laser printers	nos						
x	Supply and if appropraiate install auxiliary equipment	Sum						
F.3	**Commercial operations management**				**800,000**			
i	Review/Improvement of billing and commercial operations (consultancy)	Sum	1	500,000	500,000			
ii	Socio-economic surveys and customer awareness campaigns	Sum	1	300,000	300,000			
F.4	**Management, commercial and technical information systems**				**140,000**			
i	Procurement and installation of billing and customer services software	Sum	1	20,000	20,000			
ii	Procurement and installation of management information software	Sum	1	15,000	15,000			
iii	Procurement of commercial operations software (various)	Sum	1	50,000	50,000			
iv	Procurement and installation of accounting and payroll software	Sum	1	15,000	15,000			
iiv	Procurement and installation of GIS based Network Information Systems software	Sum	1	10,000	10,000			
iiiv	Procurement and installation of other software (asset management, hyrauli modelling etc)	Sum	1	30,000	30,000			
F.5	**Professional services - Institutional Support**				**24,000,000**			-
i	Advice, guidance and support in the development of institutional frameworks towards an autonomous utility	Sum	1	18,000,000	18,000,000			-
ii	Assessment of capacity, competency and development of a comprehesive training program	Sum	1	4,000,000	4,000,000			
iii	Specific training courses (various)	Sum	1	2,000,000	2,000,000			
F.6	**Professional services - Feasibility, Design and Supervision**				**35,268,972**			**75,076,163**
iv	Engineering Services	Sum			35,268,972			75,076,163

Medium Term Projects: FS/FD 2015–2016; Construction 2017–2018
Long Term Projects: FS/FD 2024–2025; Construction 2026–2027

Item		2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
E.4	**Harare South Trunk Sewer**	-	-	-	-	-	-	-	-	-	-	-	-	**10,467,794**	**10,467,794**	**10,467,794**	-	-
i	New Pipework																	
	ND 450 PVC				-	-								-	-	-		
	ND 525 Concrete				-	-								-	-	-		
	ND 600 Concrete				-	-								-	-	-		
	ND 675 Concrete				-	-								-	-	-		
	ND 750 Concrete				-	-								-	-	-		
	ND 825 Concrete				-	-								-	-	-		
	ND 900 Concrete				-	-								4,829,183	4,829,183	4,829,183		
	ND 1050 Concrete				-	-								-	-	-		
	ND 1200 Concrete				-	-								-	-	-		
	ND 1350 Concrete				-	-								-	-	-		
	ND 1500 Concrete				-	-								3,975,000	3,975,000	3,975,000		
	Construction of new manholes				-	-								1,663,611	1,663,611	1,663,611		
E.5	**Harare South Sewage Pump Station and Force Main**	-	-	-	**1,050,000**	**1,050,000**	-	-	-	-	-	-	-	**3,722,333**	**3,722,333**	**3,722,333**	-	-
i	Sewage Pumping Station Construction				-	-								241,150	241,150	241,150		
ii	Sewage Pumping Equipment				-	-								447,850	447,850	447,850		
iii	GRP Force Main DN500				1,050,000	1,050,000								-	-	-		
iii	GRP Force Main DN1100				-	-								3,033,333	3,033,333	3,033,333		
E.6	**Harare South Wastewater Treatment Works**	-	-	-	**3,885,400**	**3,885,400**	-	-	-	-	-	-	-	**17,635,700**	**17,635,700**	**17,635,700**	-	-
i	Wastewater Stabiliation Pond System																	
	Construction of Wastewater Stabilisation Ponds System				3,366,000	3,366,000								15,521,000	15,521,000	15,521,000		
					-	-								-	-	-		
ii	Wastewater Slow Rate (irrigation) disposal system				-	-								-	-	-		
	Irrigation Set Up				333,900	333,900								1,279,950	1,279,950	1,279,950		
	Irrigation Pumps and Equipment				185,500	185,500								834,750	834,750	834,750		
														-	-	-		
E.7	**Expansion of Crowborough WWTW**	-	-	-	**28,800,000**	**28,800,000**	-	-	-	-	-	-	-	-	-	-	-	-
	Construction of additional 18 ML/day BNR modules				28,800,000	28,800,000								-	-	-		
E.8	**Extension of sewer reticulation system in new development areas**	**7,208,614**	**7,208,614**	**7,208,614**	**7,208,614**	**7,208,614**	**7,208,614**	**7,208,614**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**	**17,432,629**
i	pipes																	
	ND 100 PVC	455,387	455,387	455,387	455,387	455,387	455,387	455,387	1,101,266	1,101,266	1,101,266	1,101,266	1,101,266	1,101,266	1,101,266	1,101,266	1,101,266	1,101,266
	ND 160 PVC	1,457,240	1,457,240	1,457,240	1,457,240	1,457,240	1,457,240	1,457,240	3,524,050	3,524,050	3,524,050	3,524,050	3,524,050	3,524,050	3,524,050	3,524,050	3,524,050	3,524,050
ii	Construction of manholes	2,867,254	2,867,254	2,867,254	2,867,254	2,867,254	2,867,254	2,867,254	6,933,895	6,933,895	6,933,895	6,933,895	6,933,895	6,933,895	6,933,895	6,933,895	6,933,895	6,933,895
iii	Sewer service connections																	
i	ND 100	2,428,733	2,428,733	2,428,733	2,428,733	2,428,733	2,428,733	2,428,733	5,873,417	5,873,417	5,873,417	5,873,417	5,873,417	5,873,417	5,873,417	5,873,417	5,873,417	5,873,417
F. ACCOMPANYING MEASURES		**1,498,310**	**5,498,310**	**5,498,310**	**15,933,064**	**13,793,064**	**12,708,959**	**12,708,959**	**9,673,942**	**3,352,969**	**3,511,294**	**4,559,294**	**4,559,294**	**15,553,152**	**15,553,152**	**11,156,049**	**3,729,146**	**3,887,471**
F.1	**Technical operations management**	-	-	-	**1,200,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Establishment of meter control, testing and repair workshop				750,000													
ii	Procurement of tools and equipment for operations and maintenance				-													
iii	Provision of vehicles for operation and maintenance teams				150,000													
iv	Provision of vacuum tanker for septic tank emptying				300,000													
F.2	**Information Communication Technology Infrastructure**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ii	Supply of server																	
iii	Supply and install Local Area Networking																	
iv	Supply and install Wide Area Networking																	
v	Supply and install generator power back-up																	
vi	Supply personal computers complete with software, UPS, etc.																	
vii	Supply laptop computers																	
viii	Supply heavy duty printer (dot-matrix)																	
ix	Supply laser printers																	
x	Supply and if appropraiate install auxiliary equipment																	
F.3	**Commercial operations management**	-	-	-	**800,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Review/Improvement of billing and commercial operations (consultancy)				500,000													
ii	Socio-economic surveys and customer awareness campaigns				300,000													
F.4	**Management, commercial and technical information systems**	-	-	-	**140,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Procurement and installation of billing and customer services software				20,000													
ii	Procurement and installation of management information software				15,000													
iii	Procurement of commercial operations software (various)				50,000													
iv	Procurement and installation of accounting and payroll software				15,000													
iiv	Procurement and installation of GIS based Network Information Systems software				10,000													
iiiv	Procurement and installation of other software (asset management, hyrauli modelling etc)				30,000													
F.5	**Professional services - Institutional Support**	-	**4,000,000**	**4,000,000**	**4,000,000**	**4,000,000**	**4,000,000**	**4,000,000**	-	-	-	-	-	-	-	-	-	-
i	Advice, guidance and support in the development of institutional frameworks towards an autonomous utility		3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000										
ii	Assessment of capacity, competency and development of a comprehesive training program		666,667	666,667	666,667	666,667	666,667	666,667										
iii	Specific training courses (various)		333,333	333,333	333,333	333,333	333,333	333,333										
F.6	**Professional services - Feasibility, Design and Supervision**	**1,498,310**	**1,498,310**	**1,498,310**	**9,793,064**	**9,793,064**	**8,708,959**	**8,708,959**	**9,673,942**	**3,352,969**	**3,511,294**	**4,559,294**	**4,559,294**	**15,553,152**	**15,553,152**	**11,156,049**	**3,729,146**	**3,887,471**
iv	Engineering Services	1,498,310	1,498,310	1,498,310	9,793,064	9,793,064	8,708,959	8,708,959	9,673,942	3,352,969	3,511,294	4,559,294	4,559,294	15,553,152	15,553,152	11,156,049	3,729,146	3,887,471
	Contingency	**5,244,086**	**5,244,086**	**5,244,086**	**34,275,726**	**34,275,726**	**30,481,355**	**30,481,355**	**33,858,798**	**11,735,392**	**12,289,529**	**15,957,529**	**15,957,529**	**54,436,033**	**54,436,033**	**39,046,172**	**13,052,013**	**13,606,150**
	Total	**21,725,500**	**25,725,500**	**25,725,500**	**148,139,435**	**145,999,435**	**130,279,899**	**130,279,899**	**140,272,163**	**48,618,051**	**50,913,764**	**66,109,764**	**66,109,764**	**225,520,707**	**225,520,707**	**161,762,714**	**54,072,623**	**56,368,335**
	Cum. Total	**21,725,500**	**47,451,000**	**73,176,501**	**221,315,935**	**367,315,370**	**497,595,269**	**627,875,169**	**768,147,331**	**816,765,383**	**867,679,146**	**933,788,910**	**999,898,673**	**1,225,419,380**	**1,450,940,087**	**1,612,702,801**	**1,666,775,424**	**1,723,143,760**

Engineering Services 10% of physical works (A+B+C+D+E)
Contractors' P&G and Physical contingencies 35% of physical works (A+B+C+D+E)
Inflation 0%

Medium term Projects — FS/FD — Construction (2015–2018); Long term Projects — FS/FD — Construction (2024–2027)

Appendix 9-2: Detailed Investment Cost Estimates - CHITUNGWIZA

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount																	
A. WATER DEMAND MANAGEMENT/NRW REDUCTION PROGRAMME					10,969,195			75,000	-	-	-	5,484,598	5,484,598	-	-	132,815	132,815	132,815	9,092,815	132,815	170,315	170,315	552,635	552,635	552,635
A.1	Rehabilitation/replacement of water distribution network				14,175				-	-	-	7,088	7,088	-	-	-	-	-	-	-	-	-	-	-	-
i	ND 75 PVC	m		22	-							-	-								-	-			
ii	ND 110 PVC	m		30	-							-	-								-	-			
iii	ND 160 PVC	m	315	45	14,175							7,088	7,088								-	-			
A.2	Replacement/Installation of section valves				506,420				-	-	-	253,210	253,210	-	-	-	-	-	-	-	-	-	-	-	-
i	ND 50 Gate	nos.	409	180	73,620							36,810	36,810								-	-			
ii	ND 75 Gate	nos.	1,190	200	238,000							119,000	119,000								-	-			
iii	ND 100 Gate	nos.	544	250	136,000							68,000	68,000								-	-			
iv	ND 150 Gate	nos.	88	450	39,600							19,800	19,800								-	-			
v	ND 200 Gate	nos.	4	800	3,200							1,600	1,600								-	-			
vi	ND 250 Gate	nos.	2	1,500	3,000							1,500	1,500								-	-			
vii	ND 300 Butterfly	nos.	1	2,000	2,000							1,000	1,000								-	-			
viii	ND 400 Butterfly	nos.	1	4,000	4,000							2,000	2,000								-	-			
ix	ND 500 Butterfly	nos.	1	7,000	7,000							3,500	3,500								-	-			
A.3	Installation of bulk meters				75,000			75,000	-	-	-	37,500	37,500	-	-	-	-	-	-	-	37,500	37,500	-	-	-
i	ND 150 Woltman type	nos.	4	2,000	8,000	4	2,000	8,000				4,000	4,000								4,000	4,000			
ii	ND 200 Woltman type	nos.	3	3,000	9,000	3	3,000	9,000				4,500	4,500								4,500	4,500			
iii	ND 250 Woltman type	nos.	2	4,000	8,000	2	4,000	8,000				4,000	4,000								4,000	4,000			
iv	ND 300 Woltman type	nos.	3	7,000	21,000	3	7,000	21,000				10,500	10,500								10,500	10,500			
v	ND 400 Electromagnetic	nos.	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
vi	ND 500 Electromagnetic	nos.	1	17,000	17,000	1	17,000	17,000				8,500	8,500								8,500	8,500			
A.4	Rehabilitating/Installation of pressure reducing valves				-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
i	ND 150	nos.			-							-	-								-	-			
ii	ND 200	nos.			-							-	-								-	-			
iii	ND 250	nos.			-							-	-								-	-			
												-	-												
A.5	Replacement of service connections				313,600				-	-	-	156,800	156,800	-	-	-	-	-	-	-	-	-	-	-	-
i	Domestic (ND 15) (OD 20)	nos.	44,800	5	224,000							112,000	112,000								-	-			
ii	Non-Domestic (ND 25)	nos.	11,200	8	89,600							44,800	44,800								-	-			
												-													
A.6	Replacement of service water meters				8,960,000				-	-	-	4,480,000	4,480,000	-	-	132,815	132,815	132,815	9,092,815	132,815	132,815	132,815	552,635	552,635	552,635
i	Domestic (ND 15)	nos.	44,800	150	6,720,000				-	-	-	3,360,000	3,360,000	-	-	104,854	104,854	104,854	6,824,854	104,854	104,854	104,854	436,291	436,291	436,291
ii	Non-Domestic (ND 25)	nos.	11,200	200	2,240,000				-	-	-	1,120,000	1,120,000	-	-	27,961	27,961	27,961	2,267,961	27,961	27,961	27,961	116,344	116,344	116,344
A.7	NRW Reduction programme				1,100,000				-	-	-	550,000	550,000	-	-	-	-	-	-	-	-	-	-	-	-
i	Network Mapping, Network investigations and repair/replacement programme	Sum	1	800,000	800,000							400,000	400,000								-	-			
ii	Customer database cleanup and awareness campaigns	Sum	1	300,000	300,000							150,000	150,000								-	-			
B. WATER SUPPLY SERVICE IMPROVEMENTS					4,245,610			50,000	-	-	-	2,122,805	2,122,805	-	-	-	-	-	-	-	-	-	-	-	-
B.1	Rehabilitation of Source Works				-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
												-											-		
B.2	Rehabilitation of existing water treatment facilities				-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
												-													
												-											-		
B.3	Rehabilitation of Pump Stations (Booster Pump Station @ Reservoirs)				50,000			50,000	-	-	-	25,000	25,000	-	-	-	-	-	-	-	-	-	-	-	-
		Sum	1	50,000	50,000	1	50,000	50,000				25,000	25,000												
												-											-		
B.4	Replacement/rehabilitation of existing transmission and primary distribution mains				4,125,610			-	-	-	-	2,062,805	2,062,805	-	-	-	-	-	-	-	-	-	-	-	-
i	Pipes																								
	ND 200 PVC (OD 225)	m		75	-							-	-								-	-			
	ND 250 PVC (OD 280)	m		90	-							-	-								-	-			
	ND 315 PVC	m	1,236	120	148,320							74,160	74,160								-	-			
	ND 350 DI	m		150	-							-	-								-	-			
	ND 400 DI	m	2,978	200	595,600							297,800	297,800								-	-			
	ND 450 DI	m	1,695	250	423,750							211,875	211,875								-	-			
	ND 500 DI	m	2,995	300	898,500							449,250	449,250								-	-			
	ND 600 DI	m	925	450	416,250							208,125	208,125								-	-			
	ND 700 DI	m	2,553	640	1,633,920							816,960	816,960								-	-			
												-	-												
i	Valves											-	-												
	ND 200 Gate	nos.		800	-							-	-								-	-			
	ND 250 Gate	nos.	6.18	1,500	9,270							4,635	4,635								-	-			
	ND 300 Butterfly	nos.		2,000	-							-	-								-	-			
	ND 400 Butterfly	nos.		4,000	-							-	-								-	-			
	ND 500 Butterfly	nos.		7,000	-							-	-								-	-			
B.5	Rehabilitation of storage tanks				70,000				-	-	-	35,000	35,000	-	-	-	-	-	-	-	-	-	-	-	-
i	Chitungwiza Reservoirs	Sum	1	70,000	70,000							35,000	35,000								-	-			
												-													
C. EXTENSION OF WATER SUPPLY SERVICES					8,893,052			17,015,215	348,477	348,477	348,477	7,975,333	7,975,333	348,477	348,477	1,101,521	1,101,521	1,101,521	1,101,521	1,101,521	4,101,521	4,101,521	1,101,521	1,101,521	1,101,521
C.1	Extension of water abstraction and treatment facilities				-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
												-	-												
												-	-												
												-	-												
C.2	Construction of new Pump Stations				-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
												-											-		
C.3	Installtion of new transmission and primary mains				6,348,711			-	-	-	-	3,174,356	3,174,356	-	-	-	-	-	-	-	-	-	-	-	-
i	Pipes																								
	ND 200 PVC (OD 225)	m	7,157	75	536,775							268,388	268,388								-	-			
	ND 250 PVC (OD 280)	m	4,742	90	426,780							213,390	213,390								-	-			
	ND 315 PVC	m	11,380	120	1,365,600							682,800	682,800								-	-			
	ND 350 DI	m		150	-							-	-								-	-			
	ND 400 DI	m		200	-							-	-								-	-			
	ND 450 DI	m	12,633	250	3,158,250							1,579,125	1,579,125								-	-			
	ND 500 DI	m		300	-							-	-								-	-			
	ND 600 DI	m		450	-							-	-								-	-			
												-	-												
i	Section Valves											-	-												
	ND 200 Gate	nos.	71.57	800	57,256							28,628	28,628								-	-			

Appendix 9-2: Detailed Investment Cost Estimates - CHITUNGWIZA

Medium term Projects — FS/FD (2015–2016), Construction (2017–2018)
Long term Projects — FS/FD (2024–2025), Construction (2026–2027)

Item		Unit	Medium Term (upto 2020) Qty	Medium Term Rate [USD]	Medium Term Amount	Long Term (upto 2030) Qty	Long Term Rate [USD]	Long Term Amount	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
	ND 250 Gate	nos.	47.42	1,500	71,130							35,565	35,565								-	-			
	ND 300 Butterfly	nos.	113.80	2,000	227,600							113,800	113,800								-	-			
	ND 400 Butterfly	nos.	126.33	4,000	505,320							252,660	252,660								-	-			
	ND 500 Butterfly	nos.		7,000	-							-	-								-	-			
C.4	**Construction of new storage tanks**							**6,000,000**	**-**	**-**	**-**	**4,400,000**	**4,400,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3,000,000**	**3,000,000**	**-**	**-**	**-**
	New 15,000 m3 storage tank (6 Farms)	m^3		400	-	15,000	400	6,000,000				-	-								3,000,000	3,000,000			
	New 22,000 m3 storage tank (Makoni Storage Area additional Storage)	m3	22,000	400	8,800,000		400	-				4,400,000	4,400,000								-	-			
												-	-												
												-													
C.5	**Extension of distribution system in expansion areas**				**1,477,345**			**6,671,174**	**211,049**	**211,049**	**211,049**	**211,049**	**211,049**	**211,049**	**211,049**	**667,117**	**667,117**	**667,117**	**667,117**	**667,117**	**667,117**	**667,117**	**667,117**	**667,117**	**667,117**
i	Pipes																								
	ND 75 PVC	m	29,359	22	645,898	132,575	22	2,916,650	92,271	92,271	92,271	92,271	92,271	92,271	92,271	291,665	291,665	291,665	291,665	291,665	291,665	291,665	291,665	291,665	291,665
	ND 110 PVC	m	23,487	30	704,616	106,060	30	3,181,800	100,659	100,659	100,659	100,659	100,659	100,659	100,659	318,180	318,180	318,180	318,180	318,180	318,180	318,180	318,180	318,180	318,180
	ND 160 PVC	m		45	-		45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ii	Section valves																								
	ND 75 Gate	nos.	294	200	58,718	1,326	200	265,150	8,388	8,388	8,388	8,388	8,388	8,388	8,388	26,515	26,515	26,515	26,515	26,515	26,515	26,515	26,515	26,515	26,515
	ND 100 Gate	nos.	235	250	58,718	1,061	250	265,150	8,388	8,388	8,388	8,388	8,388	8,388	8,388	26,515	26,515	26,515	26,515	26,515	26,515	26,515	26,515	26,515	26,515
	ND 150 Gate	nos.	-	450	-	-	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
iii	Installation of fire hydrants in expansion areas																								
	ND 80	nos.	47	200	9,395	212	200	42,424	1,342	1,342	1,342	1,342	1,342	1,342	1,342	4,242	4,242	4,242	4,242	4,242	4,242	4,242	4,242	4,242	4,242
C.6	**Installation of service connections in expansion areas**				**32,295**			**145,833**	**4,614**	**4,614**	**4,614**	**4,614**	**4,614**	**4,614**	**4,614**	**14,583**	**14,583**	**14,583**	**14,583**	**14,583**	**14,583**	**14,583**	**14,583**	**14,583**	**14,583**
i	ND 15	nos.	4,893	5	24,466	22,096	5	110,479	3,495	3,495	3,495	3,495	3,495	3,495	3,495	11,048	11,048	11,048	11,048	11,048	11,048	11,048	11,048	11,048	11,048
ii	ND 25	nos.	979	8	7,829	4,419	8	35,353	1,118	1,118	1,118	1,118	1,118	1,118	1,118	3,535	3,535	3,535	3,535	3,535	3,535	3,535	3,535	3,535	3,535
C.7	**Installation of service water meters in expansion areas**				**929,702**			**4,198,208**	**132,815**	**132,815**	**132,815**	**132,815**	**132,815**	**132,815**	**132,815**	**419,821**	**419,821**	**419,821**	**419,821**	**419,821**	**419,821**	**419,821**	**419,821**	**419,821**	**419,821**
i	Domestic (ND 15)	nos.	4,893	150	733,975	22,096	150	3,314,375	104,854	104,854	104,854	104,854	104,854	104,854	104,854	331,438	331,438	331,438	331,438	331,438	331,438	331,438	331,438	331,438	331,438
ii	Non-Domestic (ND 25)	nos.	979	200	195,727	4,419	200	883,833	27,961	27,961	27,961	27,961	27,961	27,961	27,961	88,383	88,383	88,383	88,383	88,383	88,383	88,383	88,383	88,383	88,383
C.8	**Other new bulk water management facilities**				**105,000**			**-**	**-**	**-**	**-**	**52,500**	**52,500**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i	Automatic Control System for pumps and reservoirs	Station	3	25,000	75,000							37,500	37,500												
ii	Water quality monitoring equipment	Sum	1	30,000	30,000							15,000	15,000												
D. SEWERAGE SERVICE IMPROVEMENTS					**7,226,727**				**-**	**-**	**-**	**3,613,363**	**3,613,363**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2,696,250**	**2,696,250**	**-**	**-**	**-**
D.1	**Rehabilitation of wastewater treatment facilities**				**6,906,555**			**5,392,500**	**-**	**-**	**-**	**3,453,277**	**3,453,277**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2,696,250**	**2,696,250**	**-**	**-**	**-**
D.1.1	**Rehabilitation of Zengeza WWTW- Modified Conventional Works**				**2,055,500**			**870,000**				**1,027,750**	**1,027,750**								**435,000**	**435,000**	**-**		
i	Refurbishment of Inlet Structure											-									-	-			
	Replacement of coarse screens	nos.	2	4,000	8,000							4,000	4,000								-	-			
	Replacement of the drainage trough	nos.	1	2,500	2,500							1,250	1,250								-	-			
	Replacement of the partial flume	nos.	1	10,000	10,000							5,000	5,000								-	-			
	Replacement of the flow measurement system	nos.	1	10,000	10,000		10,000	-				5,000	5,000								-	-			
	Refurbishment of grit removal system	Sum	2	50,000	100,000							50,000	50,000								-	-			
	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	5,000	5,000							2,500	2,500								-	-			
	Refurbishment of the above ground shed structure	Sum	1	2,500	2,500							1,250	1,250								-	-			
												-	-								-	-			
ii	Refurbishment of Anaerobic Ponds											-	-								-	-			
	Removal and disposal of all vegetation	Sum	1	50,000	50,000							25,000	25,000								-	-			
	Dealing with existing flows	nos.	1	75,000	75,000							37,500	37,500								-	-			
	Removal of sludge (Wet)	Sum	1	350,000	350,000							175,000	175,000								-	-			
	Restoration of conveyance works i.e pipes and steel fittings	Sum	1	10,000	10,000							5,000	5,000								-	-			
												-	-								-	-			
iii	Refurbishment of Flow Distribution Chamber											-	-								-	-			
	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	5,000	5,000							2,500	2,500								-	-			
	Rehabilitation of distribution weirs	Sum	1	2,500	2,500							1,250	1,250								-	-			
												-	-								-	-			
iv	Refurbishment of Biological Filters											-	-								-	-			
	Replacement of filter media	Sum	1	75,000	75,000							37,500	37,500								-	-			
	Replacement of filter arms and central columns	nos.	5	60,000	300,000							150,000	150,000								-	-			
	Refurbishment of the underdrainage and airflow system	Sum	1	30,000	30,000							15,000	15,000								-	-			
												-	-								-	-			
v	Refurbishment of Humus Tanks/Secondary Sedimentation Tanks											-	-								-	-			
	Replacement of weirs	Sum	1	5,000	5,000							2,500	2,500								-	-			
	Replacement of steel pipes attached to concrete bridges	Sum	1	20,000	20,000							10,000	10,000								-	-			
	Replacement of inlet and outlet pipes and fittings	Sum	1	75,000	75,000							37,500	37,500								-	-			
	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	25,000	25,000							12,500	12,500								-	-			
												-	-								-	-			
vi	Refurbishment of the effluent recirculation pump station											-	-								-	-			
	Replacement of pumps	nos.	2	25,000	50,000	2	25,000	50,000				25,000	25,000								25,000	25,000			
	Replacement of control gear	nos.	2	50,000	100,000	2	50,000	100,000				50,000	50,000								50,000	50,000			
	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	5,000	5,000							2,500	2,500								-	-			
												-	-								-	-			
vii	Refurbishment of the effluent pump stations											-	-								-	-			
	Replacement of pumps	nos.	6	45,000	270,000	6	45,000	270,000				135,000	135,000								135,000	135,000			
	Replacement of control gear	nos.	6	75,000	450,000	6	75,000	450,000				225,000	225,000								225,000	225,000			
	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	20,000	20,000							10,000	10,000								-	-			
												-	-												
D.1.2	**Rehabilitation of Zengeza WWTW- BNR System**				**4,851,055**			**4,522,500**				**2,425,527**	**2,425,527**								**2,261,250**	**2,261,250**	**-**		
i	Refurbishment of Inlet Structure											-	-												
	Replacement of screens	nos.	4	4,000	16,000			-				8,000	8,000								-	-			
	Replacement of hand penstock gates	nos.	2	2,500	5,000			-				2,500	2,500								-	-			
	Replacement of intake control valve	nos.	1	5,000	5,000			-				2,500	2,500								-	-			
	Replacement of the flow measurement system	nos.	1	10,000	10,000	1	10,000	10,000				5,000	5,000								5,000	5,000			
	Refurbishment of grit removal system	Sum	1	50,000	50,000	1	50,000	50,000				25,000	25,000								25,000	25,000			
	Replacement of water tower supply pumps	Sum	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
	Refurbishment of the above ground shed structure	Sum	1	2,500	2,500			-				1,250	1,250								-	-			
	Replace baffles in the grit tanks	Sum	1	2,500	2,500							1,250	1,250								-	-			
	Replace weir overflow gates	Sum	1	2,500	2,500							1,250	1,250								-	-			
	Replace compressor	No.	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
	Replace air receiver	Sum	1	10,000	10,000							5,000	5,000								-	-			
	Empty and clean grit chambers	Sum	1	25,000	25,000							12,500	12,500								-	-			
												-	-								-	-			
ii	Refurbishment of Primary Sedimentation Tanks											-	-								-	-			

Appendix 9-2: Detailed Investment Cost Estimates - CHITUNGWIZA

Medium term Projects: 2015–2016 FS/FD, 2017–2018 Construction. Long term Projects: 2024–2025 FS/FD, 2026–2027 Construction.

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
a	Replacement of weirs	Sum	2	5,000	10,000			-				5,000	5,000								-	-			
b	Rehabilitate sludge collectors	nos.	2	15,000	30,000			-				15,000	15,000								-	-			
c	Replacement of inlet and outlet pipes and fittings	Sum	2	45,000	90,000			-				45,000	45,000								-	-			
d	Rehabilitation of pitted concrete walls and damaged sections	Sum	2	15,000	30,000			-				15,000	15,000								-	-			
e	Replace sludge pump	No.	1	20,000	20,000	1	20,000	20,000				10,000	10,000								10,000	10,000			
												-	-								-	-			
iii	Equalisation/Balancing Basin											-	-								-	-			
a	Replace/rehabilitate mixers	No.	4	15,000	60,000	4	15,000	60,000				30,000	30,000								30,000	30,000			
b	Replace flow meters	No.	3	7,500	22,500	3	7,500	22,500				11,250	11,250								11,250	11,250			
												-	-								-	-			
iv	Biological Nutrient Removal Plant Unit											-	-								-	-			
a	Replacement of mixers, motors and gear box	nos.	12	30,000	360,000	12	30,000	360,000				180,000	180,000								180,000	180,000			
b	Replacement of aerators, motors and gear box	nos.	10	115,000	1,150,000	10	115,000	1,150,000				575,000	575,000								575,000	575,000			
c	Replacement of all hand-railing and related steel work	Sum	1	10,000	10,000			-				5,000	5,000								-	-			
												-	-								-	-			
v	Rehabilitation of Secondary Sedimentation Tanks											-	-								-	-			
a	Replacement of weirs	Sum	1	5,000	5,000							2,500	2,500								-	-			
b	Replacement of steel bridges	nos.	2	50,000	100,000							50,000	50,000								-	-			
c	Replacement of inlet and outlet pipes and fittings	Sum	1	45,000	45,000							22,500	22,500								-	-			
d	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	15,000	15,000							7,500	7,500								-	-			
e	Replacement of all hand-railing and related steel work	Sum	1	5,000	5,000							2,500	2,500								-	-			
f	Repair sludge collector bridge drives	Sum	1	50,000	50,000	1	50,000	50,000				25,000	25,000								25,000	25,000			
												-	-								-	-			
vi	Rehabilitation of Return Activated Sludge Pump Station											-	-								-	-			
a	Replacement of pumps	nos.	6	45,000	270,000	6	45,000	270,000				135,000	135,000								135,000	135,000			
b	Replacement of control gear	nos.	6	75,000	450,000	6	75,000	450,000				225,000	225,000								225,000	225,000			
c	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	10,000	10,000							5,000	5,000								-	-			
												-	-								-	-			
vii	Rehabilitation of Waste Activated Sludge Pump Station											-	-								-	-			
a	Replacement of pumps	nos.	4	45,000	180,000	4	45,000	180,000				90,000	90,000								90,000	90,000			
b	Replacement of control gear	nos.	4	75,000	300,000	4	75,000	300,000				150,000	150,000								150,000	150,000			
c	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	10,000	10,000							5,000	5,000								-	-			
												-	-								-	-			
viii	Rehabilitation of Infiltration Pit											-	-								-	-			
a	Replacement of pumps	nos.	1	45,000	45,000	1	45,000	45,000				22,500	22,500								22,500	22,500			
b	Replacement of control gear	nos.	1	75,000	75,000	1	75,000	75,000				37,500	37,500								37,500	37,500			
c	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	10,000	10,000							5,000	5,000								-	-			
												-	-								-	-			
ix	Rehabilitation of Mixed Liquor Recycle Pump Station											-	-								-	-			
a	Replacement of pumps	nos.	6	25,000	150,000	6	25,000	150,000				75,000	75,000								75,000	75,000			
b	Replacement of control gear	nos.	6	75,000	450,000	6	75,000	450,000				225,000	225,000								225,000	225,000			
b	Replacement of compressors	nos.	2	25,000	50,000	2	25,000	50,000				25,000	25,000								25,000	25,000			
c	Replacement of control gear	nos.	2	50,000	100,000	2	50,000	100,000				50,000	50,000								50,000	50,000			
d	Rehabilitation of pitted concrete walls and damaged sections	Sum	1	10,000	10,000							5,000	5,000								-	-			
												-	-								-	-			
x	Refurbishment of Sludge Digesters											-	-								-	-			
a	Replacement of choked pipes	Sum	1	20,000	20,000							10,000	10,000								-	-			
b	Replacement of thickener drives	No.	2	20,000	40,000	2	20,000	40,000				20,000	20,000								20,000	20,000			
c	Replacement of thickener pumps	No.	6	25,000	150,000	6	25,000	150,000				75,000	75,000								75,000	75,000			
d	Replacement of mixing pumps	No.	3	25,000	75,000	3	25,000	75,000				37,500	37,500								37,500	37,500			
e	Repalcement of bilge pumps	No.	2	25,000	50,000	2	25,000	50,000				25,000	25,000								25,000	25,000			
f	Replacement of withdrawal pumps	No.	3	25,000	75,000	3	25,000	75,000				37,500	37,500								37,500	37,500			
a	Replacement of sludge storage shed roof	Sum	1	10,000	10,000			-				5,000	5,000								-	-			
b	Replacement of pumps and motors	Sum	1	75,000	75,000	1	75,000	75,000				37,500	37,500								37,500	37,500			
												-	-								-	-			
xi	Refurbishment of control building											-	-								-	-			
a	Replacement of electrical switchboard	Sum	1	55	55	1	150,000	150,000				27	27								75,000	75,000			
b	Replacement of mimic panel	Sum	1	75,000	75,000	1	75,000	75,000				37,500	37,500								37,500	37,500			
c	Service the main switchboard	Sum										-	-								-	-			
												-	-										-		
D.2	Rehabilitation of sewage pump stations				**150,000**			**150,000**	**-**	**-**	**-**	**75,000**	**75,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	Tilcor Sewage Pump Station	Sum	1	150,000	150,000	1	150,000	150,000				75,000	75,000												
												-	-												
D.3	**Rehabilitation/replacement of existing sewer network**				**170,172**			**-**	**-**	**-**	**-**	**85,086**	**85,086**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i	Pipes											-	-												
	ND 200 PVC	m		44	-							-	-								-	-			
	ND 250 PVC	m	1,188	57	67,716							33,858	33,858								-	-			
	ND 315 PVC	m	954	80	76,320							38,160	38,160								-	-			
ii	Manholes											-	-												
	rehabilitation of manholes	nos.	24	1,000	23,760							11,880	11,880								-	-			
	replacement of missing manhole covers	nos.	24	100	2,376							1,188	1,188								-	-			
												-	-												
E. EXTENSION OF SEWERAGE SERVICES					**8,138,656**			**27,975,467**	**885,023**	**885,023**	**885,023**	**1,856,770**	**1,856,770**	**885,023**	**885,023**	**2,797,547**	**2,797,547**	**2,797,547**	**2,797,547**	**2,797,547**	**2,797,547**	**2,797,547**	**2,797,547**	**2,797,547**	**2,797,547**
E.1	**Extension of sewage treatment facilities**				**-**				**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	none																								
E.2	**Extension of sewage pumping stations**				**-**				**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	none											-													
												-													
E.3	**Construction of new sewer trunk mains**				**1,943,493**				**-**	**-**	**-**	**971,747**	**971,747**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i	pipes																								
	ND 200 PVC (OD 225)	m	8,246	44	362,824							181,412	181,412								-	-			
	ND 250 PVC (OD 280)	m	6,139	57	349,923							174,962	174,962								-	-			
	ND 315 PVC	m	3,169	80	253,520							126,760	126,760								-	-			
	ND 400 PVC	m	4,040	111	448,440							224,220	224,220								-	-			
	ND 450 PVC	m	616	146	89,936							44,968	44,968								-	-			
												-	-												
ii	Construction of manholes	nos.	176	2,500	438,850							219,425	219,425								-	-			
E.4	**Extension of sewer reticulation system in new development areas**				**4,107,883**			**18,549,947**	**586,840**	**586,840**	**586,840**	**586,840**	**586,840**	**586,840**	**586,840**	**1,854,995**	**1,854,995**	**1,854,995**	**1,854,995**	**1,854,995**	**1,854,995**	**1,854,995**	**1,854,995**	**1,854,995**	**1,854,995**
i	pipes																								
	ND 100 PVC	m	14,495	27	391,365	65,455	27	1,767,285	55,909	55,909	55,909	55,909	55,909	55,909	55,909	176,729	176,729	176,729	176,729	176,729	176,729	176,729	176,729	176,729	176,729

Medium term Projects → Construction (2017–2018); FS/FD (2015–2016)

Long term Projects → Construction (2026–2027); FS/FD (2024–2025)

Appendix 9-2: Detailed Investment Cost Estimates - CHITUNGWIZA

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)		
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount
	ND 160 PVC	m	34,788	36	1,252,368	157,092	36	5,655,312
ii	Construction of manholes	nos.	986	2,500	2,464,150	4,451	2,500	11,127,350
E.5	**Installation of sewer service connections in new development areas**				**2,087,280**			**9,425,520**
i	ND 100	nos.	5,798	360	2,087,280	26,182	360	9,425,520
F. ACCOMPANYING MEASURES					**6,337,124**			**4,511,568**
F.1	**Technical operations management**				**430,000**			
i	Establishment of meter control, testing and repair workshop	Sum	1	50,000	50,000			
ii	Procurement of tools and equipment for operations and maintenance	Sum	1	200,000	200,000			
iii	Provision of vehicles for operation and maintenance teams	Sum	1	150,000	150,000			
iv	Provision of vacuum tanker for septic tank emptying	no.s	1	30,000	30,000			
F.2	**Information Communication Technology Infrastructure**				**258,800**			
ii	Supply of server	nos	1	5,500	5,500			
iii	Supply and install Local Area Networking	Sum	4	5,000	20,000			
iv	Supply and install Wide Area Networking	Satel	4	5,000	20,000			
v	Supply and install generator power back-up	nos	5	3,000	15,000			
vi	Supply personal computers complete with software, UPS, etc.	nos	35	2,000	70,000			
vii	Supply laptop computers	nos	4	2,500	10,000			
viii	Supply heavy duty printer (dot-matrix)	nos	3	4,500	13,500			
ix	Supply laser printers	nos	12	400	4,800			
x	Supply and if appropraiate install auxiliary equipment	Sum	1	100,000	100,000			
F.3	**Commercial operations management**				**350,000**			
i	Review/Improvement of billing and commercial operations (consultancy)	Sum	1	200,000	200,000			
ii	Socio-economic surveys and customer awareness campaigns	Sum	1	150,000	150,000			
F.4	**Management, commercial and technical information systems**				**83,000**			
i	Procurement and installation of billing and customer services software	Sum	1	20,000	20,000			
ii	Procurement and installation of management information software	Sum	1	15,000	15,000			
iii	Procurement of commercial operations software (various)	Sum	1	10,000	10,000			
iv	Procurement and installation of accounting and payroll software	Sum	1	8,000	8,000			
iiv	Procurement and installation of GIS based Network Information Systems software	Sum	1	10,000	10,000			
iiiv	Procurement and installation of other software (asset management, hyrauli modelling etc)	Sum	1	20,000	20,000			
F.5	**Professional services - Institutional Support**				**1,268,000**			**-**
i	Advice, guidance and support in the development of institutional frameworks towards an autonomous utility	Mont	42	20,000	840,000			-
ii	Assessment of capacity, competency and development of a comprehesive training program	Mont	18	20,000	360,000			
iii	Specific training courses (various)	nos	136	500	68,000			
F.6	**Professional services - Feasibility, Design and Supervision**				**3,947,324**			**4,511,568**
iv	Engineering Services	Sum			3,947,324			4,511,568

Item		2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
	ND 160 PVC	178,910	178,910	178,910	178,910	178,910	178,910	178,910	565,531	565,531	565,531	565,531	565,531	565,531	565,531	565,531	565,531	565,531
ii	Construction of manholes	352,021	352,021	352,021	352,021	352,021	352,021	352,021	1,112,735	1,112,735	1,112,735	1,112,735	1,112,735	1,112,735	1,112,735	1,112,735	1,112,735	1,112,735
E.5	**Installation of sewer service connections in new development areas**	**298,183**	**298,183**	**298,183**	**298,183**	**298,183**	**298,183**	**298,183**	**942,552**	**942,552**	**942,552**	**942,552**	**942,552**	**942,552**	**942,552**	**942,552**	**942,552**	**942,552**
i	ND 100	298,183	298,183	298,183	298,183	298,183	298,183	298,183	942,552	942,552	942,552	942,552	942,552	942,552	942,552	942,552	942,552	942,552
F. ACCOMPANYING MEASURES		**123,350**	**1,650,150**	**123,350**	**2,968,287**	**2,105,287**	**123,350**	**123,350**	**403,188**	**403,188**	**403,188**	**1,299,188**	**403,188**	**976,563**	**976,563**	**445,170**	**445,170**	**445,170**
F.1	**Technical operations management**	-	-	-	**430,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Establishment of meter control, testing and repair workshop				50,000									-	-			
ii	Procurement of tools and equipment for operations and maintenance				200,000									-	-			
iii	Provision of vehicles for operation and maintenance teams				150,000									-	-			
iv	Provision of vacuum tanker for septic tank emptying				30,000									-	-			
F.2	**Information Communication Technology Infrastructure**	-	**258,800**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ii	Supply of server		5,500											-	-			
iii	Supply and install Local Area Networking		20,000											-	-			
iv	Supply and install Wide Area Networking		20,000											-	-			
v	Supply and install generator power back-up		15,000											-	-			
vi	Supply personal computers complete with software, UPS, etc.		70,000											-	-			
vii	Supply laptop computers		10,000											-	-			
viii	Supply heavy duty printer (dot-matrix)		13,500											-	-			
ix	Supply laser printers		4,800											-	-			
x	Supply and if appropraiate install auxiliary equipment		100,000											-	-			
F.3	**Commercial operations management**	-	-	-	**350,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Review/Improvement of billing and commercial operations (consultancy)				200,000									-	-			
ii	Socio-economic surveys and customer awareness campaigns				150,000									-	-			
F.4	**Management, commercial and technical information systems**	-	-	-	**83,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Procurement and installation of billing and customer services software				20,000									-	-			
ii	Procurement and installation of management information software				15,000									-	-			
iii	Procurement of commercial operations software (various)				10,000									-	-			
iv	Procurement and installation of accounting and payroll software				8,000									-	-			
iiv	Procurement and installation of GIS based Network Information Systems software				10,000									-	-			
iiiv	Procurement and installation of other software (asset management, hyrauli modelling etc)				20,000									-	-			
F.5	**Professional services - Institutional Support**	-	**1,268,000**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Advice, guidance and support in the development of institutional frameworks towards an autonomous utility		840,000											-	-			
ii	Assessment of capacity, competency and development of a comprehesive training program		360,000											-	-			
iii	Specific training courses (various)		68,000											-	-			
F.6	**Professional services - Feasibility, Design and Supervision**	**123,350**	**123,350**	**123,350**	**2,105,287**	**2,105,287**	**123,350**	**123,350**	**403,188**	**403,188**	**403,188**	**1,299,188**	**403,188**	**976,563**	**976,563**	**445,170**	**445,170**	**445,170**
iv	Engineering Services	123,350	123,350	123,350	2,105,287	2,105,287	123,350	123,350	403,188	403,188	403,188	1,299,188	403,188	976,563	976,563	445,170	445,170	445,170
	Contractor's P&G and Physical contingencies	**431,725**	**431,725**	**431,725**	**7,368,504**	**7,368,504**	**431,725**	**431,725**	**1,411,159**	**1,411,159**	**1,411,159**	**4,547,159**	**1,411,159**	**3,417,971**	**3,417,971**	**1,558,096**	**1,558,096**	**1,558,096**
	Total	**1,788,576**	**3,315,376**	**1,788,576**	**31,389,659**	**30,526,659**	**1,788,576**	**1,788,576**	**5,846,230**	**5,846,230**	**5,846,230**	**18,838,230**	**5,846,230**	**14,160,167**	**14,160,167**	**6,454,970**	**6,454,970**	**6,454,970**
	Cum. Total	**1,788,576**	**5,103,952**	**6,892,528**	**38,282,187**	**68,808,846**	**70,597,422**	**72,385,998**	**78,232,228**	**84,078,458**	**89,924,688**	**108,762,918**	**114,609,148**	**128,769,315**	**142,929,483**	**149,384,453**	**155,839,423**	**162,294,393**

Engineering Services 10% of physical works (A+B+C+D+E)
Contractor's P&G and Physical contingencies 35% of physical works (A+B+C+D+E)
Inflation 0%

Greater Harare Water and Sanitation Investment Plan

Appendix 9-3: Detailed Investment Cost Estimates - EPWORTH

Medium Term Projects

Long Term Projects

FS/FD | Construction (2017–2018) | FS/FD | Construction (2026–2027)

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount																	
A. WATER DEMAND MANAGEMENT/NRW REDUCTION PROGRAMME					6,133,200			4,094,441	-	-	-	3,066,600	3,066,600	-	-	43,429	43,429	43,429	2,593,429	43,429	283,679	283,679	253,314	253,314	253,314
A.1	Rehabilitation/replacement of water transmission & distribution network				930,000			-	-	-	-	465,000	465,000	-	-	-	-	-	-	-	-	-	-	-	-
i	ND 110 PVC or less	m	11,100	30	333,000							166,500	166,500								-	-			
ii	ND 160 PVC	m	2,800	45	126,000							63,000	63,000								-	-			
iii	ND 200 PVC	m	2,000	75	150,000							75,000	75,000								-	-			
iv	ND 250 PVC	m	300	90	27,000							13,500	13,500								-	-			
v	ND 315 PVC	m	200	120	24,000							12,000	12,000								-	-			
vi	ND 350 DI	m	200	150	30,000							15,000	15,000								-	-			
vii	ND 400 DI	m	800	200	160,000							80,000	80,000								-	-			
viii	ND 450 DI	m	200	250	50,000							25,000	25,000								-	-			
ix	ND 500 DI	m	100	300	30,000							15,000	15,000								-	-			
x	ND 600 DI	m	-	450	-							-	-								-	-			
xi	ND 750 DI	m	-	640	-							-	-								-	-			
A.2	Replacement/Installation of zone valves				98,700			-	-	-	-	49,350	49,350	-	-	-	-	-	-	-	-	-	-	-	-
i	ND 75 Gate	nos.	86	200	17,200							8,600	8,600								-	-			
ii	ND 100 Gate	nos.	36	250	9,000							4,500	4,500								-	-			
iii	ND 150 Gate	nos.	18	450	8,100							4,050	4,050								-	-			
iv	ND 200 Gate	nos.	6	800	4,800							2,400	2,400								-	-			
v	ND 250 Gate	nos.	3	1,500	4,500							2,250	2,250								-	-			
vi	ND 300 Gate	nos.	2	2,000	4,000							2,000	2,000								-	-			
vii	ND 350 Butterfly	nos.	2	3,100	6,200							3,100	3,100								-	-			
viii	ND 400 Butterfly	nos.	8	4,000	32,000							16,000	16,000								-	-			
ix	ND 450 Butterfly	nos.	1	5,900	5,900							2,950	2,950								-	-			
x	ND 500 Butterfly	nos.	1	7,000	7,000							3,500	3,500								-	-			
xi	ND 600 Butterfly	nos.		9,200	-							-	-								-	-			
xii	ND 750 Butterfly	nos.		11,000	-							-	-								-	-			
xiii	ND 800 Butterfly	nos.		13,300	-							-	-								-	-			
xiv	ND 1000 Butterfly	nos.		15,900	-							-	-								-	-			
A.3	Installation of bulk meters				141,500			141,500	-	-	-	70,750	70,750	-	-	-	-	-	-	-	70,750	70,750	-	-	-
i	ND 100 Woltman type	nos.	35	1,300	45,500	35	1,300	45,500				22,750	22,750								22,750	22,750			
ii	ND 150 Woltman type	nos.	20	2,000	40,000	20	2,000	40,000				20,000	20,000								20,000	20,000			
iii	ND 200 Woltman type	nos.	4	3,000	12,000	4	3,000	12,000				6,000	6,000								6,000	6,000			
iv	ND 250 Woltman type	nos.	2	4,000	8,000	2	4,000	8,000				4,000	4,000								4,000	4,000			
v	ND 300 Woltman type	nos.	1	7,000	7,000	1	7,000	7,000				3,500	3,500								3,500	3,500			
vi	ND 400 Electromagnetic	nos.	1	12,000	12,000	1	12,000	12,000				6,000	6,000								6,000	6,000			
vii	ND 500 Electromagnetic	nos.	1	17,000	17,000	1	17,000	17,000				8,500	8,500								8,500	8,500			
viii	ND 600 Electromagnetic	nos.		20,000	-		20,000	-				-	-								-	-			
ix	ND 700 Electromagnetic	nos.		22,000	-		22,000	-				-	-								-	-			
x	ND 800 Electromagnetic	nos.		26,000	-		26,000	-				-	-								-	-			
xi	ND 900 Electromagnetic	nos.		31,000	-		31,000	-				-	-								-	-			
xii	ND 1000 Electromagnetic	nos.		35,000	-		35,000	-				-	-								-	-			
																							-		
A.4	Installation/Replacement of pressure reducing valves				14,000			14,000	-	-	-	7,000	7,000	-	-	-	-	-	-	-	7,000	7,000	-	-	-
i	ND 50	nos.	-	1,600	-		1,600	-				-	-								-	-			
ii	ND 80	nos.	-	1,800	-		1,800	-				-	-								-	-			
iii	ND 100	nos.	-	2,300	-		2,300	-				-	-								-	-			
iv	ND 150	nos.	-	3,600	-		3,600	-				-	-								-	-			
v	ND 200	nos.	-	6,200	-		6,200	-				-	-								-	-			
vi	ND 250	nos.	-	8,800	-		8,800	-				-	-								-	-			
vii	ND 300	nos.	1	14,000	14,000	1	14,000	14,000				7,000	7,000								7,000	7,000			
A.5	Replacement of service connections				2,309,000			325,000	-	-	-	1,154,500	1,154,500	-	-	-	-	-	-	-	162,500	162,500	-	-	-
i	Domestic (ND 15) (OD 20)	nos.	11,300	150	1,695,000		150	-				847,500	847,500								-	-			
ii	Non-Domestic (ND 25)	nos.	2,300	250	575,000		250	-				287,500	287,500								-	-			
iii	Installation of flow limiter (done with service connection replacement)	nos.	13,000	3	39,000		250	-				19,500	19,500								-	-			
iv	Removal of flow Limiters	nos.		25	-	13,000	25	325,000				-	-								162,500	162,500			
												-													
A.6	Replacement of service water meters				2,550,000			3,613,941	-	-	-	1,275,000	1,275,000	-	-	43,429	43,429	43,429	2,593,429	43,429	43,429	43,429	253,314	253,314	253,314
i	Domestic (ND 15)	nos.	13,000	150	1,950,000	18,600	150	2,789,972	-	-	-	975,000	975,000	-	-	34,286	34,286	34,286	1,984,286	34,286	34,286	34,286	199,991	199,991	199,991
ii	Non-Domestic (ND 25)	nos.	3,000	200	600,000	4,120	200	823,969	-	-	-	300,000	300,000	-	-	9,143	9,143	9,143	609,143	9,143	9,143	9,143	53,323	53,323	53,323
												-													
A.7	NRW Reduction programme				90,000			-	-	-	-	45,000	45,000	-	-	-	-	-	-	-	-	-	-	-	-
i	Network Mapping, Network investigations and repair/replacement programme	Sum	1	15,000	15,000							7,500	7,500								-	-			
ii	Customer database cleanup and awareness campaigns	Sum	1	75,000	75,000							37,500	37,500								-	-			
B. WATER SUPPLY SERVICE IMPROVEMENTS					1,583,300			-	-	-	-	791,650	791,650	-	-	-	-	-	-	-	-	-	-	-	-
B.1	Water Kiosk Programme				1,583,300			-	-	-	-	791,650	791,650	-	-	-	-	-	-	-	-	-	-	-	-
																					-	-			
i	Construction of Water Kiosks Including Valves etc.	Sum	21	28,800	604,800		50	-				302,400	302,400								-	-			
ii	Pipework Connections to Kiosks											-	-								-	-			
a	DN50 HDPE Pipework	m	21,000	26	546,000		25,500	-				273,000	273,000								-	-			
b	DN160 PVC Mains into Areas to be Kios Supplied	m	9,500	45	427,500		25,500	-				213,750	213,750								-	-			
iii	Metering of Kiosks																								
a	Non-Domestic (ND 25)	nos.	20	250	5,000		250	-				2,500	2,500								-	-			
												-	-								-	-			
C. EXTENSION OF WATER SUPPLY SERVICES					1,298,688			12,148,900	185,527	185,527	185,527	185,527	185,527	185,527	185,527	945,610	945,610	945,610	945,610	945,610	2,292,010	2,292,010	1,000,610	945,610	945,610
C.1	Primary and Secondary Distribution System Expansion				-			2,637,800	-	-	-	-	-	-	-	-	-	-	-	-	1,318,900	1,318,900	-	-	-
												-	-								-	-			
i	Ventersberg - Epworth Booster Pump Station											-	-								-	-			
a	Water booster pump sets Transfer to Mutare Road 580m3/hr @70m	No.		78,000	-	6	78,000	468,000				-	-								234,000	234,000			
c	Booster Pump Suction and Discharge Ppipework	No.		6,000	-	12	6,000	72,000				-	-								36,000	36,000			
g	Booster Pump Station Building	m2		1,200	-	160	1,200	192,000				-	-								96,000	96,000			
h	Booster Pump Station Ancilliaries	Sum		10,000	-	1	10,000	10,000				-	-								5,000	5,000			
												-	-								-	-			
ii	Secondary Network - (a) Supply Line from Ventersberg							-				-	-								-	-			
a	ND 500 DI	m		300	-	975	300	292,500				-	-								146,250	146,250			
b	ND 500 Butterfly	nos.		7,000	-	2	7,000	14,000				-	-								7,000	7,000			
c	ND 500 Electromagnetic	nos.		17,000	-	1	17,000	17,000				-	-								8,500	8,500			
iii	Secondary Network - (b) Line From Tee to Ward 7 to Tee to Ward 2											-	-								-	-			
a	ND 400 DI	m		200	-	2,500	200	500,000				-	-								250,000	250,000			

Greater Harare Water and Sanitation Investment Plan

Appendix 9-3: Detailed Investment Cost Estimates - EPWORTH

Medium Term Projects

Long Term Projects

FS/FD Construction FS/FD Construction

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount																	
b	ND 400 Butterfly	nos.		4,000	-	2	4,000	8,000				-	-								4,000	4,000			
c	ND 400 Electromagnetic	nos.		12,000	-	1	12,000	12,000				-	-								6,000	6,000			
iv	Secondary Network - (c) Line Through Ward 2 to Ward 5											-	-								-	-			
a	ND 200 PVC	m		75	-	2,500	75	187,500				-	-								93,750	93,750			
b	ND 200 Gate	nos.		800	-	2	800	1,600				-	-								800	800			
c	ND 200 Woltman type	nos.		3,000	-	1	3,000	3,000				-	-								1,500	1,500			
iv	Secondary Network - (d) From Tee South Ward 1 to Tee to Ward 3 and 4											-	-								-	-			
a	ND 350 DI	m		150	-	2,200	150	330,000				-	-								165,000	165,000			
b	ND 350 Butterfly	nos.		3,100	-	2	3,100	6,200				-	-								3,100	3,100			
c	ND 300 Woltman type	nos.		7,000	-	1	7,000	7,000				-	-								3,500	3,500			
v	Secondary Network - (e) Supply Line South into Ward 4											-	-								-	-			
a	ND 315 PVC	m		120	-	4,200	120	504,000				-	-								252,000	252,000			
b	ND 300 Gate	nos.		2,000	-	3	2,000	6,000				-	-								3,000	3,000			
c	ND 300 Woltman type	nos.		7,000	-	1	7,000	7,000				-	-								3,500	3,500			
												-	-								-	-			
C.2	**Extension of distribution system in expansion areas**				**1,298,688**			**9,456,100**	**185,527**	**185,527**	**185,527**	**185,527**	**185,527**	**185,527**	**185,527**	**945,610**	**945,610**	**945,610**	**945,610**	**945,610**	**945,610**	**945,610**	**945,610**	**945,610**	**945,610**
i	Pipes																								
a	ND 75 PVC	m	9,600	22	211,200	53,000	22	1,166,000	30,171	30,171	30,171	30,171	30,171	30,171	30,171	116,600	116,600	116,600	116,600	116,600	116,600	116,600	116,600	116,600	116,600
b	ND 110 PVC	m	7,680	30	230,400	67,000	30	2,010,000	32,914	32,914	32,914	32,914	32,914	32,914	32,914	201,000	201,000	201,000	201,000	201,000	201,000	201,000	201,000	201,000	201,000
c	ND 160 PVC	m	3,840	45	172,800	33,500	45	1,507,500	24,686	24,686	24,686	24,686	24,686	24,686	24,686	150,750	150,750	150,750	150,750	150,750	150,750	150,750	150,750	150,750	150,750
ii	Section valves																								
a	ND 75 Gate	nos.	96	200	19,200	530	200	106,000	2,743	2,743	2,743	2,743	2,743	2,743	2,743	10,600	10,600	10,600	10,600	10,600	10,600	10,600	10,600	10,600	10,600
b	ND 100 Gate	nos.	77	250	19,200	670	250	167,500	2,743	2,743	2,743	2,743	2,743	2,743	2,743	16,750	16,750	16,750	16,750	16,750	16,750	16,750	16,750	16,750	16,750
c	ND 150 Gate	nos.	38	450	17,280	335	450	150,750	2,469	2,469	2,469	2,469	2,469	2,469	2,469	15,075	15,075	15,075	15,075	15,075	15,075	15,075	15,075	15,075	15,075
iii	Fire hydrants																								
a	ND 80	nos.	23	200	4,608	201	200	40,200	658	658	658	658	658	658	658	4,020	4,020	4,020	4,020	4,020	4,020	4,020	4,020	4,020	4,020
iv	Service connections																								
a	ND 15	nos.	1,600	150	240,000	11,047	150	1,657,050	34,286	34,286	34,286	34,286	34,286	34,286	34,286	165,705	165,705	165,705	165,705	165,705	165,705	165,705	165,705	165,705	165,705
b	ND 25	nos.	320	250	80,000	2,209	250	552,250	11,429	11,429	11,429	11,429	11,429	11,429	11,429	55,225	55,225	55,225	55,225	55,225	55,225	55,225	55,225	55,225	55,225
v	Service water meters																								
a	Domestic (ND 15)	nos.	1,600	150	240,000	11,047	150	1,657,050	34,286	34,286	34,286	34,286	34,286	34,286	34,286	165,705	165,705	165,705	165,705	165,705	165,705	165,705	165,705	165,705	165,705
b	Non-Domestic (ND 25)	nos.	320	200	64,000	2,209	200	441,800	9,143	9,143	9,143	9,143	9,143	9,143	9,143	44,180	44,180	44,180	44,180	44,180	44,180	44,180	44,180	44,180	44,180
C.3	**Other new bulk water management facilities**				**-**			**55,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**27,500**	**27,500**	**55,000**	**-**	**-**
i	Automatic Control System for pumps and reservoirs	Station		25,000	-	1	25,000	25,000				-	-								12,500	12,500	25,000		
ii	Water quality monitoring equipment	Sum		30,000	-	1	30,000	30,000				-	-								15,000	15,000	30,000		
D. SEWERAGE SERVICE IMPROVEMENTS					**-**			**728,430**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**364,215**	**364,215**	**-**	**-**	**-**
D.1	**Rehabilitation/replacement of existing sewer network**				**-**			**728,430**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**364,215**	**364,215**	**-**	**-**	**-**
i	Sewer reticulation pipes Replacement																								
a	ND 150 PVC	m			-	2,720	36	98,325				-	-								49,163	49,163			
b	ND 200 PVC (OD 225)	m			-	340	44	15,011				-	-								7,506	7,506			
c	ND 250 PVC (OD 280)	m			-	100	57	5,698				-	-								2,849	2,849			
d	ND 315 PVC	m			-	100	80	7,996				-	-								3,998	3,998			
e	ND 400 PVC	m			-	-	111	-				-	-								-	-			
f	ND 450 PVC	m			-	-	146	-				-	-								-	-			
g	Construction of manholes	nos.			-	65	2,500	163,000				-	-								81,500	81,500			
h	Rehabilitation of Manhole cover and frame	nos.			-	249	350	87,080				-	-								43,540	43,540			
i	New Manhole Covers only	nos.			-	-	150	-				-	-								-	-			
ii	Sewer reticulation pipes Grit Removal																								
a	ND 150 PVC	m			-	10,880	25	272,000				-	-								136,000	136,000			
b	ND 200 PVC (OD 225)	m			-	1,360	25	34,000				-	-								17,000	17,000			
c	ND 250 PVC (OD 280)	m			-	100	35	3,500				-	-								1,750	1,750			
d	ND 315 PVC	m			-	100	45	4,500				-	-								2,250	2,250			
g	Clearing of silted Manhole	nos.			-	249	150	37,320				-	-								18,660	18,660			
																					-	-			
E. EXTENSION OF SEWERAGE SERVICES					**-**			**15,527,794**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,381,352**	**1,381,352**	**1,381,352**	**1,381,352**	**1,381,352**	**2,238,489**	**2,238,489**	**1,381,352**	**1,381,352**	**1,381,352**
E.1	**Epworth Outfall to Lyndhyrst Farm Line**				**-**			**633,361**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**316,681**	**316,681**	**-**	**-**	**-**
a	ND 150 PVC	m		36	-		36	-				-	-								-	-			
b	ND 200 PVC (OD 225)	m		44	-		44	-				-	-								-	-			
c	ND 250 PVC (OD 280)	m		57	-	1,430	57	81,483				-	-								40,742	40,742			
d	ND 315 PVC	m		80	-	-	80	-				-	-								-	-			
e	ND 400 PVC	m		111	-	1,260	111	139,380				-	-								69,690	69,690			
f	ND 450 PVC	m		146	-	2,020	146	294,748				-	-								147,374	147,374			
g	ND 525 Concrete	m		375	-		375	-				-	-								-	-			
h	ND 600 Concrete	m		342	-		342	-				-	-								-	-			
i	ND 675 Concrete	m		524	-		524	-				-	-								-	-			
j	ND 750 Concrete	m		643	-		643	-				-	-								-	-			
k	Construction of manholes	nos.		2,500	-	47	2,500	117,750				-	-								58,875	58,875			
												-	-								-	-			
E.2	**Epworth Wards 3 and 4 Expansion**				**-**			**1,080,913**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**540,456**	**540,456**	**-**	**-**	**-**
a	ND 150 PVC	m		36	-		36	-				-	-								-	-			
b	ND 200 PVC (OD 225)	m		44	-	4,250	44	187,643				-	-								93,822	93,822			
c	ND 250 PVC (OD 280)	m		57	-	9,600	57	547,019				-	-								273,510	273,510			
d	ND 315 PVC	m		80	-		80	-				-	-								-	-			
e	ND 400 PVC	m		111	-		111	-				-	-								-	-			
f	ND 450 PVC	m		146	-		146	-				-	-								-	-			
g	ND 525 Concrete	m		375	-		375	-				-	-								-	-			
h	ND 600 Concrete	m		342			342	-				-	-								-	-			
i	ND 675 Concrete	m		524	-		524	-				-	-								-	-			
j	ND 750 Concrete	m		643			643					-	-								-	-			
k	Construction of manholes	nos.	-	2,500	-	139	2,500	346,250				-	-								173,125	173,125			

Greater Harare Water and Sanitation Investment Plan

Medium Term Projects — FS/FD (2015–2016), Construction (2017–2018)

Long Term Projects — FS/FD (2024–2025), Construction (2026–2027)

Appendix 9-3: Detailed Investment Cost Estimates - EPWORTH

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)		
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount
E.3	**Extension of sewer reticulation system in new development areas**				**-**			**13,813,520**
i	pipes							
a	ND 100 PVC	m		27	-	80,000	27	2,160,000
b	ND 160 PVC	m		36	-	33,500	36	1,206,000
ii	Construction of manholes	nos.		2,500	-	2,270	2,500	5,675,000
iii	Sewer service connections							
i	ND 100	nos.		360	-	13,257	360	4,772,520
F. ACCOMPANYING MEASURES					**4,216,119**			**3,249,957**
F.1	**Technical operations management**				**230,000**			
i	Establishment of meter control, testing and repair workshop	Sum	1	50,000	50,000			
ii	Procurement of tools and equipment for operations and maintenance	Sum			-			
iii	Provision of vehicles for operation and maintenance teams	Sum	1	150,000	150,000			
iv	Provision of vacuum tanker for septic tank emptying	no.s	1	30,000	30,000			
F.2	**Information Communication Technology Infrastructure**				**176,600**			
ii	Supply of server	nos	1	5,500	5,500			
iii	Supply and install Local Area Networking	Sum	2	5,000	10,000			
iv	Supply and install Wide Area Networking	Satelite	2	5,000	10,000			
v	Supply and install generator power back-up	nos	2	3,000	6,000			
vi	Supply personal computers complete with software, UPS, etc.	nos	10	2,000	20,000			
vii	Supply laptop computers	nos	4	2,500	10,000			
viii	Supply heavy duty printer (dot-matrix)	nos	3	4,500	13,500			
ix	Supply laser printers	nos	4	400	1,600			
x	Supply and if appropraiate install auxiliary equipment	Sum	1	100,000	100,000			
F.3	**Commercial operations management**				**1,500,000**			
i	Review/Improvement of billing and commercial operations (consultancy)	Sum	1	1,000,000	1,000,000			
ii	Socio-economic surveys and customer awareness campaigns	Sum	1	500,000	500,000			
F.4	**Management, commercial and technical information systems**				**140,000**			
i	Procurement and installation of billing and customer services software	Sum	1	20,000	20,000			
ii	Procurement and installation of management information software	Sum	1	15,000	15,000			
iii	Procurement of commercial operations software (various)	Sum	1	50,000	50,000			
iv	Procurement and installation of accounting and payroll software	Sum	1	15,000	15,000			
iiv	Procurement and installation of GIS based Network Information Systems software	Sum	1	10,000	10,000			
iiiv	Procurement and installation of other software (asset management, hyrauli modelling etc)	Sum	1	30,000	30,000			
F.5	**Professional services - Institutional Support**				**1,268,000**			**-**
i	Advice, guidance and support in the development of institutional frameworks towards an autonomous utility	Month	42	20,000	840,000			-
ii	Assessment of capacity, competency and development of a comprehesive training program	Month	18	20,000	360,000			
iii	Specific training courses (various)	nos	136	500	68,000			
F.6	**Professional services - Feasibility, Design and Supervision**				**901,519**			**3,249,957**
iv	Engineering Services	Sum			901,519			3,249,957

Item	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]
E.3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,381,352**	**1,381,352**
i									
a	-	-	-	-	-	-	-	216,000	216,000
b	-	-	-	-	-	-	-	120,600	120,600
ii	-	-	-	-	-	-	-	567,500	567,500
iii									
i	-	-	-	-	-	-	-	477,252	477,252
F. ACCOMPANYING MEASURES	**18,553**	**498,553**	**138,553**	**2,690,978**	**832,378**	**18,553**	**18,553**	**237,039**	**237,039**
F.1	**-**	**-**	**-**	**230,000**	**-**	**-**	**-**	**-**	**-**
i				50,000					
ii				-					
iii				150,000					
iv				30,000					
F.2	**-**	**-**	**-**	**176,600**	**-**	**-**	**-**	**-**	**-**
ii				5,500					
iii				10,000					
iv				10,000					
v				6,000					
vi				20,000					
vii				10,000					
viii				13,500					
ix				1,600					
x				100,000					
F.3	**-**	**-**	**-**	**1,500,000**	**-**	**-**	**-**	**-**	**-**
i				1,000,000					
ii				500,000					
F.4	**-**	**-**	**-**	**140,000**	**-**	**-**	**-**	**-**	**-**
i				20,000					
ii				15,000					
iii				50,000					
iv				15,000					
iiv				10,000					
iiiv				30,000					
F.5	**-**	**480,000**	**120,000**	**240,000**	**428,000**	**-**	**-**	**-**	**-**
i		240,000	120,000	240,000	240,000				
ii		240,000			120,000				
iii					68,000				
F.6	**18,553**	**18,553**	**18,553**	**404,378**	**404,378**	**18,553**	**18,553**	**237,039**	**237,039**
iv	18,553	18,553	18,553	404,378	404,378	18,553	18,553	237,039	237,039
Contingency	**64,934**	**64,934**	**64,934**	**1,415,322**	**1,415,322**	**64,934**	**64,934**	**829,637**	**829,637**
Total	**269,014**	**749,014**	**389,014**	**8,150,076**	**6,291,476**	**269,014**	**269,014**	**3,437,066**	**3,437,066**
Cum. Total	**269,014**	**1,018,028**	**1,407,042**	**9,557,118**	**15,848,595**	**16,117,609**	**16,386,623**	**19,823,689**	**23,260,755**

Item	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
E.3	**1,381,352**	**1,381,352**	**1,381,352**	**1,381,352**	**1,381,352**	**1,381,352**	**1,381,352**	**1,381,352**
i								
a	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000
b	120,600	120,600	120,600	120,600	120,600	120,600	120,600	120,600
ii	567,500	567,500	567,500	567,500	567,500	567,500	567,500	567,500
iii								
i	477,252	477,252	477,252	477,252	477,252	477,252	477,252	477,252
F. ACCOMPANYING MEASURES	**237,039**	**492,039**	**237,039**	**517,839**	**517,839**	**263,528**	**258,028**	**258,028**
F.1	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F.2	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F.3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F.4	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F.5	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F.6	**237,039**	**492,039**	**237,039**	**517,839**	**517,839**	**263,528**	**258,028**	**258,028**
iv	237,039	492,039	237,039	517,839	517,839	263,528	258,028	258,028
Contingency	**829,637**	**1,722,137**	**829,637**	**1,812,437**	**1,812,437**	**922,346**	**903,096**	**903,096**
Total	**3,437,066**	**7,134,566**	**3,437,066**	**7,508,670**	**7,508,670**	**3,821,150**	**3,741,400**	**3,741,400**
Cum. Total	**26,697,822**	**33,832,388**	**37,269,454**	**44,778,124**	**52,286,793**	**56,107,943**	**59,849,343**	**63,590,742**

Engineering Services 10% of physical works (A+B+C+D+E)
Contractor's P&G and Physical contingencies 35% of physical works (A+B+C+D+E)
Inflation 0%

Greater Harare Water and Sanitation Investment Plan

Medium Term Projects — FS/FD — Construction

Long Term Projects — FS/FD — Construction

Appendix 9-4: Detailed Investment Cost Estimates - NORTON

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
A. WATER DEMAND MANAGEMENT/NRW REDUCTION PROGRAMME					4,544,350			3,980,829	-	-	-	2,272,175	2,272,175	-	-	122,211	122,211	122,211	1,867,211	122,211	380,661	380,661	287,818	287,818	287,818
A.1	Rehabilitation/replacement of water transmission & distribution network				462,500			-	-	-	-	231,250	231,250	-	-	-	-	-	-	-	-	-	-	-	-
ii	ND 110 PVC or less	m	5,800	30	174,000							87,000	87,000								-	-			
iii	ND 160 PVC	m	1,100	45	49,500							24,750	24,750								-	-			
a	ND 200 PVC	m	200	75	15,000							7,500	7,500								-	-			
b	ND 250 PVC	m	500	90	45,000							22,500	22,500								-	-			
c	ND 315 PVC	m	200	120	24,000							12,000	12,000								-	-			
d	ND 350 DI	m	-	150	-							-	-								-	-			
e	ND 400 DI	m	100	200	20,000							10,000	10,000								-	-			
f	ND 450 DI	m	-	250	-							-	-								-	-			
g	ND 500 DI	m	-	300	-							-	-								-	-			
h	ND 600 DI	m	300	450	135,000							67,500	67,500								-	-			
i	ND 750 DI	m	-	640	-							-	-								-	-			
A.2	Replacement/Installation of zone valves				232,950			-	-	-	-	116,475	116,475	-	-	-	-	-	-	-	-	-	-	-	-
i	ND 75 Gate	nos.	100	200	20,000							10,000	10,000								-	-			
ii	ND 100 Gate	nos.	72	250	18,000							9,000	9,000								-	-			
iii	ND 150 Gate	nos.	23	450	10,350							5,175	5,175								-	-			
iv	ND 200 Gate	nos.	50	800	40,000							20,000	20,000								-	-			
v	ND 250 Gate	nos.	14	1,500	21,000							10,500	10,500								-	-			
vi	ND 300 Gate	nos.	-	2,000	-							-	-								-	-			
vii	ND 350 Butterfly	nos.	2	3,100	6,200							3,100	3,100								-	-			
viii	ND 400 Butterfly	nos.	-	4,000	-							-	-								-	-			
ix	ND 450 Butterfly	nos.	-	5,900	-							-	-								-	-			
x	ND 500 Butterfly	nos.	1	7,000	7,000							3,500	3,500								-	-			
xi	ND 600 Butterfly	nos.	12	9,200	110,400							55,200	55,200								-	-			
xii	ND 750 Butterfly	nos.	-	11,000	-							-	-								-	-			
xiii	ND 800 Butterfly	nos.	-	13,300	-							-	-								-	-			
xiv	ND 1000 Butterfly	nos.	-	15,900	-							-	-								-	-			
A.3	Installation of bulk meters				159,400			159,400	-	-	-	79,700	79,700	-	-	-	-	-	-	-	79,700	79,700	-	-	-
i	ND 100 Woltman type	nos.	18	1,300	23,400	18	1,300	23,400				11,700	11,700								11,700	11,700			
ii	ND 150 Woltman type	nos.	15	2,000	30,000	15	2,000	30,000				15,000	15,000								15,000	15,000			
iii	ND 200 Woltman type	nos.	8	3,000	24,000	8	3,000	24,000				12,000	12,000								12,000	12,000			
iv	ND 250 Woltman type	nos.	-	4,000	-	-	4,000	-				-	-								-	-			
v	ND 300 Woltman type	nos.	6	7,000	42,000	6	7,000	42,000				21,000	21,000								21,000	21,000			
vi	ND 400 Electromagnetic	nos.		12,000	-		12,000	-				-	-								-	-			
vii	ND 500 Electromagnetic	nos.	-	17,000	-	-	17,000	-				-	-								-	-			
viii	ND 600 Electromagnetic	nos.	2	20,000	40,000	2	20,000	40,000				20,000	20,000								20,000	20,000			
																							-		
A.4	Installation/Replacement of pressure reducing valves				70,000			70,000	-	-	-	35,000	35,000	-	-	-	-	-	-	-	35,000	35,000	-	-	-
i	ND 50	nos.	-	1,600	-		1,600	-				-	-								-	-			
ii	ND 80	nos.	-	1,800	-		1,800	-				-	-								-	-			
iii	ND 100	nos.	-	2,300	-		2,300	-				-	-								-	-			
iv	ND 150	nos.	-	3,600	-		3,600	-				-	-								-	-			
v	ND 200	nos.	-	6,200	-		6,200	-				-	-								-	-			
vi	ND 250	nos.	-	8,800	-		8,800	-				-	-								-	-			
vii	ND 300	nos.	5	14,000	70,000	5	14,000	70,000				35,000	35,000								35,000	35,000			
A.5	Replacement of service connections				1,784,500			287,500	-	-	-	892,250	892,250	-	-	-	-	-	-	-	143,750	143,750	-	-	-
i	Domestic (ND 15) (OD 20)	nos.	11,500	150	1,725,000							862,500	862,500								-	-			
ii	Non-Domestic (ND 25)	nos.	100	250	25,000							12,500	12,500								-	-			
iii	Installation of flow limiter (done with service connection replacement)	nos.	11,500	3	34,500		3	-				17,250	17,250								-	-			
iv	Removal of flow Limiters	nos.		25	-	11,500	25	287,500				-	-								143,750	143,750			
												-													
A.6	Replacement of service water meters				1,745,000			3,463,929	-	-	-	872,500	872,500	-	-	122,211	122,211	122,211	1,867,211	122,211	122,211	122,211	287,818	287,818	287,818
i	Domestic (ND 15)	nos.	11,500	150	1,725,000	20,547	150	3,082,049	-	-	-	862,500	862,500	-	-	96,482	96,482	96,482	1,821,482	96,482	96,482	96,482	227,225	227,225	227,225
ii	Non-Domestic (ND 25)	nos.	100	200	20,000	1,909	200	381,880	-	-	-	10,000	10,000	-	-	25,729	25,729	25,729	45,729	25,729	25,729	25,729	60,593	60,593	60,593
A.7	NRW Reduction programme				90,000			-	-	-	-	45,000	45,000	-	-	-	-	-	-	-	-	-	-	-	-
i	Network Mapping, Network investigations and repair/replacement programme	Sum	1	15,000	15,000							7,500	7,500								-	-			
ii	Customer database cleanup and awareness campaigns	Sum	1	75,000	75,000							37,500	37,500								-	-			
B. WATER SUPPLY SERVICE IMPROVEMENTS					76,800			28,000	-	-	-	38,400	38,400	-	-	-	-	-	-	-	14,000	14,000	-	-	-
B.1	Rehabilitation of Existing Water Tanks				76,800			28,000	-	-	-	38,400	38,400	-	-	-	-	-	-	-	14,000	14,000	-	-	-
																					-	-			
a	ND 300 Gate	nos.	6	2,000	12,000							6,000	6,000								-	-			
a	ND 600 Butterfly	nos.	4	9,200	36,800							18,400	18,400								-	-			
c	Level Control Valve 300	nos.	2	14,000	28,000	2	14,000	28,000				14,000	14,000								14,000	14,000			
												-	-								-	-			
C. EXTENSION OF WATER SUPPLY SERVICES					10,594,667			18,494,508	400,842	400,842	400,842	4,295,229	4,295,229	400,842	400,842	539,130	539,130	539,130	539,130	539,130	7,090,735	7,090,735	539,130	539,130	539,130
C.1	Expansion of Primary and Secondary Distribution				7,103,625			2,686,210	-	-	-	3,551,813	3,551,813	-	-	-	-	-	-	-	1,343,105	1,343,105	-	-	-
i	Primary Network - Morton Jafray to Hilside Tanks											-	-								-	-			
a	ND 500 DI	m	3,851	300	1,155,300	-	300	-				577,650	577,650								-	-			
b	ND 500 Electromagnetic	nos.	2	17,000	34,000	2	17,000	34,000				17,000	17,000								17,000	17,000			
c	ND 500 Butterfly	nos.	3	7,000	21,000	-	7,000	-				10,500	10,500								-	-			
ii	Primary Network - (a) & (b) Main feeds from Norton Tanks											-	-								-	-			
a	ND 600 DI	m	13,150	450	5,917,500	-	450	-				2,958,750	2,958,750								-	-			
b	ND 600 Electromagnetic	nos.	4	20,000	80,000	4	20,000	80,000				40,000	40,000								40,000	40,000			
c	ND 600 Butterfly	nos.	4	9,200	36,800	-	9,200	-				18,400	18,400								-	-			
												-	-								-	-			
iii	Secondary Network - (1) Supply to Ward 6																								
a	ND 400 DI	m	2,995	200	599,000		200					299,500	299,500								-	-			
b	ND 400 Butterfly	nos.	3	4,000	12,000		4,000					6,000	6,000								-	-			
c	ND 400 Electromagnetic	nos.	2	12,000	24,000		12,000	-				12,000	12,000								-	-			
iv	Secondary Network - (2) Secondary Network in Ward 6											-	-								-	-			
a	ND 200 PVC	m	2,994	75	224,550		75	-				112,275	112,275								-	-			
b	ND 200 Gate Valve	nos.	2	800	1,600		800	-				800	800								-	-			
c	ND 200 Woltman type Water meter	nos.	1	3,000	3,000		3,000	-				1,500	1,500								-	-			
v	Secondary Network - (3) Ward 6 to Ward 13																								
a	ND 315 PVC	m	1,365	120	163,800		120					81,900	81,900								-	-			
b	ND 300 Gate	nos.	2	2,000	4,000		2,000					2,000	2,000								-	-			
c	ND 300 Woltman type	nos.	2	7,000	14,000	6	7,000	42,000				7,000	7,000								21,000	21,000			
vi	Secondary Network - (4) Ward 12/13 boundary line											-	-								-	-			
a	ND 200 PVC	m		75	-	1,662	75	124,650				-	-								62,325	62,325			
b	ND 200 Gate Valve	nos.		800	-	2	800	1,600				-	-								800	800			
c	ND 200 Woltman type Water meter	nos.		3,000	-	1	3,000	3,000				-	-								1,500	1,500			
vii	Secondary Network - (6) Improved Link Ward 13 to 12																								
a	ND 200 PVC	m		75	-	1,390	75	104,250				-	-								52,125	52,125			
b	ND 200 Gate Valve	nos.		800	-	2	800	1,600				-	-								800	800			
c	ND 200 Woltman type Water meter	nos.		3,000	-	1	3,000	3,000				-	-								1,500	1,500			
viii	Secondary Network - (7), (8) &(9) Interim and Final Supply Connection to Ward 4																								
a	ND 160 PVC	m	455	45	20,475		45	-				10,238	10,238								-	-			
b	ND 250 PVC	m	-	90	-	2,599	90	233,910				-	-								116,955	116,955			
c	ND 350 DI	m	-	150	-	852	150	127,800				-	-								63,900	63,900			

Greater Harare Water and Sanitation Investment Plan

Appendix 9-4: Detailed Investment Cost Estimates - NORTON

Medium Term Projects — FS/FD (2015–2016), Construction (2017–2018)

Long Term Projects — FS/FD (2024–2025), Construction (2026–2027)

Item		Unit	Medium Term (upto 2020) Qty	Medium Term Rate [USD]	Medium Term Amount	Long Term (upto 2030) Qty	Long Term Rate [USD]	Long Term Amount	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
d	ND 150 Gate	nos.	2	450	900		450	-				450	450								-	-			
e	ND 250 Gate	nos.	-	1,500	-	1	1,500	1,500				-	-								750	750			
f	ND 350 Butterfly	nos.	-	3,100	-	1	3,100	3,100				-	-								1,550	1,550			
g	ND 150 Woltman type	nos.	1	2,000	2,000	-	2,000	-				1,000	1,000								-	-			
h	ND 250 Woltman type	nos.	-	4,000	-	1	4,000	4,000				-	-								2,000	2,000			
i	ND 300 Woltman type	nos.	-	7,000	-	1	7,000	7,000				-	-								3,500	3,500			
ix	Secondary Network - (10), (11) New Supply Line Ward 4 to Chegutu Extension and within Extension																								
a	ND 250 PVC	m		90	-	2,285	90	205,650				-	-								102,825	102,825			
b	ND 315 PVC	m		120	-	5,760	120	691,200				-	-								345,600	345,600			
c	ND 450 DI	m		250	-	3,925	250	981,250				-	-								490,625	490,625			
d	ND 250 Gate	nos.		1,500	-	2	1,500	3,000				-	-								1,500	1,500			
e	ND 300 Gate	nos.		2,000	-	4	2,000	8,000				-	-								4,000	4,000			
f	ND 450 Butterfly	nos.		5,900	-	3	5,900	17,700				-	-								8,850	8,850			
g	ND 250 Woltman type	nos.		4,000	-	1	4,000	4,000				-	-								2,000	2,000			
h	ND 300 Woltman type	nos.		7,000	-	2	7,000	14,000				-	-								7,000	7,000			
i	ND 400 Electromagnetic	nos.		12,000	-	2	12,000	24,000				-	-								12,000	12,000			
												-	-								-	-			
C.2	**Construction of new storage reservoirs**				**-**			**10,400,000**	**-**	**-**	**-**	**-**	**-**								**5,200,000**	**5,200,000**	**-**	**-**	**-**
i	Expansion of Norton Hillside Storage	m^3		400	-	26,000	400	10,400,000				-	-								5,200,000	5,200,000			
C.3	**Extension of distribution system in expansion areas**				**2,805,892**			**5,391,298**	**400,842**	**400,842**	**400,842**	**400,842**	**400,842**	**400,842**	**400,842**	**539,130**	**539,130**	**539,130**	**539,130**	**539,130**	**539,130**	**539,130**	**539,130**	**539,130**	**539,130**
i	Pipes																								
a	ND 75 PVC	m	27,000	22	594,000	52,000	22	1,144,000	84,857	84,857	84,857	84,857	84,857	84,857	84,857	114,400	114,400	114,400	114,400	114,400	114,400	114,400	114,400	114,400	114,400
b	ND 110 PVC	m	22,000	30	660,000	42,000	30	1,260,000	94,286	94,286	94,286	94,286	94,286	94,286	94,286	126,000	126,000	126,000	126,000	126,000	126,000	126,000	126,000	126,000	126,000
c	ND 160 PVC	m	11,000	45	495,000	21,000	45	945,000	70,714	70,714	70,714	70,714	70,714	70,714	70,714	94,500	94,500	94,500	94,500	94,500	94,500	94,500	94,500	94,500	94,500
ii	Section valves																								
a	ND 75 Gate	nos.	270	200	54,000	520	200	104,000	7,714	7,714	7,714	7,714	7,714	7,714	7,714	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400	10,400
b	ND 100 Gate	nos.	220	250	55,000	420	250	105,000	7,857	7,857	7,857	7,857	7,857	7,857	7,857	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500
c	ND 150 Gate	nos.	110	450	49,500	210	450	94,500	7,071	7,071	7,071	7,071	7,071	7,071	7,071	9,450	9,450	9,450	9,450	9,450	9,450	9,450	9,450	9,450	9,450
iii	Fire hydrants																								
a	ND 80	nos.	66	200	13,200	126	200	25,200	1,886	1,886	1,886	1,886	1,886	1,886	1,886	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520
iv	Service connections																								
a	ND 15	nos.	4,503	5	22,513	8,716	5	43,581	3,216	3,216	3,216	3,216	3,216	3,216	3,216	4,358	4,358	4,358	4,358	4,358	4,358	4,358	4,358	4,358	4,358
b	ND 25	nos.	901	8	7,204	1,743	8	13,946	1,029	1,029	1,029	1,029	1,029	1,029	1,029	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395
v	Service water meters																								
a	Domestic (ND 15)	nos.	4,503	150	675,375	8,716	150	1,307,425	96,482	96,482	96,482	96,482	96,482	96,482	96,482	130,743	130,743	130,743	130,743	130,743	130,743	130,743	130,743	130,743	130,743
b	Non-Domestic (ND 25)	nos.	901	200	180,100	1,743	200	348,647	25,729	25,729	25,729	25,729	25,729	25,729	25,729	34,865	34,865	34,865	34,865	34,865	34,865	34,865	34,865	34,865	34,865
C.4	**Other new bulk water management facilities**				**80,000**			**-**	**-**	**-**	**-**	**40,000**	**40,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i	Automatic Control System for pumps and reservoirs	Station	2	25,000	50,000							25,000	25,000								-	-	-		
ii	Water quality monitoring equipment	Sum	1	30,000	30,000							15,000	15,000								-	-	-		
D. SEWERAGE SERVICE IMPROVEMENTS					**7,855,077**			**758,400**	**-**	**-**	**-**	**3,927,539**	**3,927,539**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**379,200**	**379,200**	**-**	**-**	**-**
D.1	**Rehabilitation of Norton WWTW**				**3,402,667**			**-**	**-**	**-**	**-**	**1,701,333**	**1,701,333**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i	Rehabilitation of old Works	ML	3.6	293,333	1,056,000							528,000	528,000								-	-			
ii	Rehabilitation and Expansion of New Works	ML	4	586,667	2,346,667		4,000	-				1,173,333	1,173,333								-	-			
D.2	**New Pumps and Force Main to New SR Irrigation System**				**2,683,768**			**156,000**	**-**	**-**	**-**	**1,341,884**	**1,341,884**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**78,000**	**78,000**	**-**	**-**	**-**
i	Sewage Pumps 322m3/hr @80m Head	No.	2	78,000	156,000	2	78,000	156,000				78,000	78,000								78,000	78,000			
ii	ND 315 Class 9 HDPE	m	11,200	226	2,525,768							1,262,884	1,262,884								-	-			
iii	ND 300 Gate	nos.	1	2,000	2,000							1,000	1,000								-	-			
												-	-								-	-			
D.3	**Establishment of New Slow Rate Irrigation Disposal System**				**1,261,400**			**450,500**	**-**	**-**	**-**	**630,700**	**630,700**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**225,250**	**225,250**	**-**	**-**	**-**
ii	Wastewater Slow Rate (irrigation) disposal system											-	-								-	-			
a	Irrigation Set Up	Ha	170	4,770	810,900		4,770	-				405,450	405,450								-	-			
b	Irrigation Pumps and Equipment	Ha	170	2,650	450,500	170	2,650	450,500				225,250	225,250								225,250	225,250			
																					-	-			
D.4	**Rehabilitate Existing Sewage Pump Stations**				**182,243**			**31,000**	**-**	**-**	**-**	**91,121**	**91,121**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**15,500**	**15,500**	**-**	**-**	**-**
i	Tangatara SPS												-								-	-			
a	ND 150 Class 9 HDPE	m	785	77	60,793							30,396	30,396								-	-			
b	ND 150 Gate	nos.	1	450	450							225	225								-	-			
c	Sewage Pumps 36m3/hr @20m Head	nos.	2	8,000	16,000	2	8,000	16,000				8,000	8,000								8,000	8,000			
d	Standby Generator	No.	1	15,000	15,000	1	15,000	15,000				7,500	7,500								7,500	7,500			
ii	Maridale SPS												-								-	-			
a	Sewage Pumps 136m3/hr @11m Head	No.	2	45,000	90,000		45,000	-				45,000	45,000								-	-			
b	Standby Generator	No.	1	30,000	30,000	1	30,000	30,000				15,000	15,000								15,000	15,000			
iii	Narira SPS																								
a	Standby Generator	No.	1	15,000	15,000	1	15,000	15,000				7,500	7,500								7,500	7,500			
												-	-								-	-			
D.5	**Rehabilitation/replacement of existing sewer network**				**302,500**			**98,400**	**-**	**-**	**-**	**151,250**	**151,250**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**49,200**	**49,200**	**-**	**-**	**-**
i	Sewer reticulation pipes in some areas																								
a	ND 150 PVC	m	400	75	30,000		75	-				15,000	15,000								-	-			
b	ND 200 PVC (OD 225)	m	-	75	-		75	-				-	-								-	-			
c	ND 250 PVC (OD 280)	m	400	90	36,000		90	-				18,000	18,000								-	-			
d	ND 315 PVC	m	500	120	60,000		120	-				30,000	30,000								-	-			
e	ND 400 PVC	m	-	165	-		165	-				-	-								-	-			
f	ND 450 PVC	m	100	190	19,000		190	-				9,500	9,500								-	-			
g	ND 450 ST on Pipe Bridge	m	-	246	-	400	246	98,400				-	-								49,200	49,200			
g	Construction of manholes	nos.	23	2,500	57,500		2,500	-				28,750	28,750								-	-			
h	Rehabilitation of Manhole cover and frame	nos.	200	350	70,000		350	-				35,000	35,000								-	-			
i	New Manhole Covers only	nos.	200	150	30,000		150	-				15,000	15,000								-	-			
																					-	-			
E. EXTENSION OF SEWERAGE SERVICES					**4,923,700**			**16,330,973**	**703,386**	**703,386**	**703,386**	**703,386**	**703,386**	**703,386**	**703,386**	**947,830**	**947,830**	**947,830**	**947,830**	**947,830**	**4,374,167**	**4,374,167**	**947,830**	**947,830**	**947,830**
E.1	**New Norton WWTW (anaerobic/ Facultative Ponds)**				**-**			**4,433,308**	-	-	-	-	-	-	-	-	-	-	-	-	2,216,654	2,216,654	-	-	-
i	Anaerobic Ponds at Ward 6	sum				1	530,000	530,000				-	-								265,000	265,000			
ii	Facultative Ponds at Chegutu Extension	sum				1	2,502,660	2,502,660				-	-								1,251,330	1,251,330			
iii	Sewage Pump Station from Ward 6 to facultative Ponds											-	-								-	-			
a	Sewage Pumps 394m3/hr @47m	No.				2	55,000	110,000				-	-								55,000	55,000			
c	Booster Pump Suction and Discharge Ppipework	No.				4	6,000	24,000				-	-								12,000	12,000			
d	Booster Pump Station Building	m2				60	1,200	72,000				-	-								36,000	36,000			
e	Booster Pump Station Ancilliaries	Sum				1	10,000	10,000				-	-								5,000	5,000			
iv	Force Main from Ward 6 to facultative Ponds																								
a	ND 315 Class 9 HDPE	m				6,586	77	510,040				-	-								255,020	255,020			
b	ND 300 Gate	nos.				1	2,000	2,000				-	-								1,000	1,000			
iv	Sewage Pump Station from facultative Ponds to SR Irrigation Disposal Site											-	-								-	-			
a	Sewage Pumps 718m3/hr @40m	No.				3	78,000	234,000				-	-								117,000	117,000			
c	Booster Pump Suction and Discharge Ppipework	No.				2	6,000	12,000				-	-								6,000	6,000			
d	Booster Pump Station Building Refurbishment	m2				60	1,200	72,000				-	-								36,000	36,000			
e	Booster Pump Station Building	Sum				1	10,000	10,000				-	-								5,000	5,000			
iv	Force Main from facultative Ponds to SR Irrigation Disposal Site																								
a	ND 315 Class 9 HDPE	m				4,424	77	342,608				-	-								171,304	171,304			
b	ND 300 Gate	nos.				1	2,000	2,000				-	-								1,000	1,000			
E.2	**New Secondary Sewerage Wards 12 and 13**				**-**			**1,407,850**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**703,925**	**703,925**	**-**	**-**	**-**
a	ND 150 PVC	m		75	-		75	-				-	-								-	-			
b	ND 200 PVC (OD 225)	m		75	-	2,419	75	181,425				-	-								90,713	90,713			
c	ND 250 PVC (OD 280)	m		90	-	2,643	90	237,870				-	-								118,935	118,935			
d	ND 315 PVC	m		120	-	4,139	120	496,680				-	-								248,340	248,340			

Medium Term Projects — FS/FD: 2015–2016; Construction: 2017–2018

Long Term Projects — FS/FD: 2024–2025; Construction: 2026–2027

Appendix 9-4: Detailed Investment Cost Estimates - NORTON

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)		
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount
e	ND 400 PVC	m		165	-	525	165	86,625
f	Construction of manholes	nos.	-	2,500	-	162	2,500	405,250
E.3	**New Secondary Sewerage Chegutu Expansion Area**				**-**			**1,011,515**
a	ND 150 PVC	m		75	-		75	-
b	ND 200 PVC (OD 225)	m		75	-	1,807	75	135,525
c	ND 250 PVC (OD 280)	m		90	-	2,709	90	243,810
d	ND 315 PVC	m		120	-	1,192	120	143,040
e	ND 400 PVC	m		165	-	1,216	165	200,640
f	Construction of manholes	nos.	-	2,500	-	115	2,500	288,500
E.4	**Extension of sewer reticulation system in new development areas**				**4,923,700**			**9,478,300**
i	pipes							
a	ND 100 PVC	m	24,700	36	889,200	47,800	36	1,720,800
b	ND 160 PVC	m	10,300	75	772,500	19,900	75	1,492,500
ii	Construction of manholes	nos.	700	2,500	1,750,000	1,354	2,500	3,385,000
iii	Sewer service connections							
i	ND 100	nos.	4,200	360	1,512,000	8,000	360	2,880,000
F. ACCOMPANYING MEASURES					**5,107,059**			**3,959,271**
F.1	**Technical operations management**				**430,000**			
i	Establishment of meter control, testing and repair workshop	Sum	1	50,000	50,000			
ii	Procurement of tools and equipment for operations and maintenance	Sum	1	200,000	200,000			
iii	Provision of vehicles for operation and maintenance teams	Sum	1	150,000	150,000			
iv	Provision of vacuum tanker for septic tank emptying	no.s	1	30,000	30,000			
F.2	**Information Communication Technology Infrastructure**				**176,600**			
ii	Supply of server	nos	1	5,500	5,500			
iii	Supply and install Local Area Networking	Sum	2	5,000	10,000			
iv	Supply and install Wide Area Networking	Satelite	2	5,000	10,000			
v	Supply and install generator power back-up	nos	2	3,000	6,000			
vi	Supply personal computers complete with software, UPS, etc.	nos	10	2,000	20,000			
vii	Supply laptop computers	nos	4	2,500	10,000			
viii	Supply heavy duty printer (dot-matrix)	nos	3	4,500	13,500			
ix	Supply laser printers	nos	4	400	1,600			
x	Supply and if appropraiate install auxiliary equipment	Sum	1	100,000	100,000			
F.3	**Commercial operations management**				**350,000**			
i	Review/Improvement of billing and commercial operations (consultancy)	Sum	1	200,000	200,000			
ii	Socio-economic surveys and customer awareness campaigns	Sum	1	150,000	150,000			
F.4	**Management, commercial and technical information systems**				**83,000**			
i	Procurement and installation of billing and customer services software	Sum	1	20,000	20,000			
ii	Procurement and installation of management information software	Sum	1	15,000	15,000			
iii	Procurement of commercial operations software (various)	Sum	1	10,000	10,000			
iv	Procurement and installation of accounting and payroll software	Sum	1	8,000	8,000			
iiv	Procurement and installation of GIS based Network Information Systems software	Sum	1	10,000	10,000			
iiiv	Procurement and installation of other software (asset management, hyrauli modelling etc)	Sum	1	20,000	20,000			
F.5	**Professional services - Institutional Support**				**1,268,000**			**-**
i	Advice, guidance and support in the development of institutional frameworks towards an autonomous utility	Month	42	20,000	840,000			-
ii	Assessment of capacity, competency and development of a comprehesive training program	Month	18	20,000	360,000			
iii	Specific training courses (various)	nos	136	500	68,000			
F.6	**Professional services - Feasibility, Design and Supervision**				**2,799,459**			**3,959,271**
iv	Engineering Services	Sum			2,799,459			3,959,271

Item	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
e ND 400 PVC				-	-								43,313	43,313			
f Construction of manholes				-	-								202,625	202,625			
				-	-								-	-			
E.3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**505,758**	**505,758**	**-**	**-**	**-**
a ND 150 PVC				-	-								-	-			
b ND 200 PVC (OD 225)				-	-								67,763	67,763			
c ND 250 PVC (OD 280)				-	-								121,905	121,905			
d ND 315 PVC				-	-								71,520	71,520			
e ND 400 PVC				-	-								100,320	100,320			
f Construction of manholes				-	-								144,250	144,250			
E.4	**703,386**	**703,386**	**703,386**	**703,386**	**703,386**	**703,386**	**703,386**	**947,830**	**947,830**	**947,830**	**947,830**	**947,830**	**947,830**	**947,830**	**947,830**	**947,830**	**947,830**
a ND 100 PVC	127,029	127,029	127,029	127,029	127,029	127,029	127,029	172,080	172,080	172,080	172,080	172,080	172,080	172,080	172,080	172,080	172,080
b ND 160 PVC	110,357	110,357	110,357	110,357	110,357	110,357	110,357	149,250	149,250	149,250	149,250	149,250	149,250	149,250	149,250	149,250	149,250
ii Construction of manholes	250,000	250,000	250,000	250,000	250,000	250,000	250,000	338,500	338,500	338,500	338,500	338,500	338,500	338,500	338,500	338,500	338,500
i ND 100	216,000	216,000	216,000	216,000	216,000	216,000	216,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000
F. ACCOMPANYING MEASURES	**110,423**	**590,423**	**230,423**	**2,649,273**	**1,551,673**	**110,423**	**110,423**	**160,917**	**160,917**	**160,917**	**335,417**	**160,917**	**1,223,876**	**1,223,876**	**177,478**	**177,478**	**177,478**
F.1	**-**	**-**	**-**	**430,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i				50,000													
ii				200,000													
iii				150,000													
iv				30,000													
F.2	**-**	**-**	**-**	**176,600**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
ii				5,500													
iii				10,000													
iv				10,000													
v				6,000													
vi				20,000													
vii				10,000													
viii				13,500													
ix				1,600													
x				100,000													
F.3	**-**	**-**	**-**	**350,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i				200,000													
ii				150,000													
F.4	**-**	**-**	**-**	**83,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i				20,000													
ii				15,000													
iii				10,000													
iv				8,000													
iiv				10,000													
iiiv				20,000													
F.5	**-**	**480,000**	**120,000**	**486,000**	**428,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i		240,000	120,000	240,000	240,000												
ii		240,000		240,000	120,000												
iii				6,000	68,000												
F.6	**110,423**	**110,423**	**110,423**	**1,123,673**	**1,123,673**	**110,423**	**110,423**	**160,917**	**160,917**	**160,917**	**335,417**	**160,917**	**1,223,876**	**1,223,876**	**177,478**	**177,478**	**177,478**
iv Engineering Services	110,423	110,423	110,423	1,123,673	1,123,673	110,423	110,423	160,917	160,917	160,917	335,417	160,917	1,223,876	1,223,876	177,478	177,478	177,478
Contingency	**386,480**	**386,480**	**386,480**	**3,932,855**	**3,932,855**	**386,480**	**386,480**	**563,210**	**563,210**	**563,210**	**1,173,960**	**563,210**	**4,283,567**	**4,283,567**	**621,172**	**621,172**	**621,172**
Total	**1,601,130**	**2,081,130**	**1,721,130**	**17,818,856**	**16,721,256**	**1,601,130**	**1,601,130**	**2,333,297**	**2,333,297**	**2,333,297**	**4,863,547**	**2,333,297**	**17,746,205**	**17,746,205**	**2,573,428**	**2,573,428**	**2,573,428**
Cum. Total	**1,601,130**	**3,682,259**	**5,403,389**	**23,222,245**	**39,943,502**	**41,544,632**	**43,145,761**	**45,479,059**	**47,812,356**	**50,145,653**	**55,009,200**	**57,342,498**	**75,088,703**	**92,834,908**	**95,408,336**	**97,981,763**	**100,555,191**

Engineering Services 10% of physical works (A+B+C+D+E)
Contractor's P&G anc 35% of physical works (A+B+C+D+E)
Inflation 0%

Medium Term Projects

Long Term Projects

FS/FD | Construction | FS/FD | Construction

Appendix 9-5: Detailed Investment Cost Estimates - RUWA

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
A. WATER DEMAND MANAGEMENT/NRW REDUCTION PROGRAMME					3,333,200			5,213,857	-	-	-	1,666,600	1,666,600	-	-	254,912	254,912	254,912	2,154,912	254,912	341,412	341,412	452,157	452,157	452,157
A.1	**Rehabilitation/replacement of water transmission & distribution network**				**757,000**			-	-	-	-	378,500	378,500	-	-	-	-	-	-	-	-	-	-	-	-
i	ND 110 PVC or less	m	9,000	30	270,000							135,000	135,000								-	-			
ii	ND 160 PVC	m	1,600	45	72,000							36,000	36,000								-	-			
iii	ND 200 PVC	m	600	75	45,000							22,500	22,500								-	-			
iv	ND 250 PVC	m	1,600	90	144,000							72,000	72,000								-	-			
v	ND 315 PVC	m	300	120	36,000							18,000	18,000								-	-			
vi	ND 350 DI	m	500	150	75,000							37,500	37,500								-	-			
vii	ND 400 DI	m	-	200	-							-	-								-	-			
viii	ND 450 DI	m	100	250	25,000							12,500	12,500								-	-			
ix	ND 500 DI	m	-	300	-							-	-								-	-			
x	ND 600 DI	m	200	450	90,000							45,000	45,000								-	-			
xi	ND 750 DI	m	-	640	-							-	-								-	-			
A.2	**Replacement/Installation of zone valves**				**88,200**			-	-	-	-	44,100	44,100	-	-	-	-	-	-	-	-	-	-	-	-
i	ND 75 Gate	nos.	70	200	14,000							7,000	7,000								-	-			
ii	ND 100 Gate	nos.	20	250	5,000							2,500	2,500								-	-			
iii	ND 150 Gate	nos.	10	450	4,500							2,250	2,250								-	-			
iv	ND 200 Gate	nos.	20	800	16,000							8,000	8,000								-	-			
v	ND 250 Gate	nos.	5	1,500	7,500							3,750	3,750								-	-			
vi	ND 300 Gate	nos.	10	2,000	20,000							10,000	10,000								-	-			
vii	ND 350 Butterfly	nos.	2	3,100	6,200							3,100	3,100								-	-			
viii	ND 400 Butterfly	nos.	2	4,000	8,000							4,000	4,000								-	-			
ix	ND 450 Butterfly	nos.	-	5,900	-							-	-								-	-			
x	ND 500 Butterfly	nos.	1	7,000	7,000							3,500	3,500								-	-			
A.3	**Installation of bulk meters**				**103,000**			**103,000**	-	-	-	51,500	51,500	-	-	-	-	-	-	-	51,500	51,500	-	-	-
i	ND 100 Woltman type	nos.	-	1,300	-	-	1,300	-				-	-								-	-			
ii	ND 150 Woltman type	nos.	-	2,000	-	-	2,000	-				-	-								-	-			
iii	ND 200 Woltman type	nos.	8	3,000	24,000	8	3,000	24,000				12,000	12,000								12,000	12,000			
iv	ND 250 Woltman type	nos.	12	4,000	48,000	12	4,000	48,000				24,000	24,000								24,000	24,000			
v	ND 300 Woltman type	nos.	2	7,000	14,000	2	7,000	14,000				7,000	7,000								7,000	7,000			
vi	ND 400 Electromagnetic	nos.		12,000	-		12,000	-				-	-								-	-			
vii	ND 500 Electromagnetic	nos.	1	17,000	17,000	1	17,000	17,000				8,500	8,500								8,500	8,500			
																							-		
A.4	**Installation/Replacement of pressure reducing valves**				**70,000**			**70,000**	-	-	-	35,000	35,000	-	-	-	-	-	-	-	35,000	35,000	-	-	-
i	ND 300	nos.	5	14,000	70,000	5	14,000	70,000				35,000	35,000								35,000	35,000			
A.5	**Replacement of service connections**				**325,000**			-	-	-	-	162,500	162,500	-	-	-	-	-	-	-	-	-	-	-	-
i	Domestic (ND 15) (OD 20)	nos.	2,000	150	300,000							150,000	150,000								-	-			
ii	Non-Domestic (ND 25)	nos.	100	250	25,000							12,500	12,500								-	-			
												-													
A.6	**Replacement of service water meters**				**1,900,000**			**5,040,857**	-	-	-	950,000	950,000	-	-	254,912	254,912	254,912	2,154,912	254,912	254,912	254,912	452,157	452,157	452,157
i	Domestic (ND 15)	nos.	12,000	150	1,800,000	28,531	150	4,279,624	-	-	-	900,000	900,000	-	-	201,246	201,246	201,246	2,001,246	201,246	201,246	201,246	356,966	356,966	356,966
ii	Non-Domestic (ND 25)	nos.	500	200	100,000	3,806	200	761,233	-	-	-	50,000	50,000	-	-	53,666	53,666	53,666	153,666	53,666	53,666	53,666	95,191	95,191	95,191
												-													
A.7	**NRW Reduction programme**				**90,000**			-	-	-	-	45,000	45,000	-	-	-	-	-	-	-	-	-	-	-	-
i	Network Mapping, Network investigations and repair/replacement programme	Sum	1	15,000	15,000							7,500	7,500								-	-			
ii	Customer database cleanup and awareness campaigns	Sum	1	75,000	75,000							37,500	37,500								-	-			
B. WATER SUPPLY SERVICE IMPROVEMENTS					2,432,250			506,850	-	-	-	1,216,125	1,216,125	-	-	-	-	-	-	-	253,425	253,425	-	-	-
B.1	**Rehabilitation of Existing WTW**				**2,432,250**			**506,850**	-	-	-	1,216,125	1,216,125	-	-	-	-	-	-	-	253,425	253,425	-	-	-
																					-	-			
i	Corrosion protection to existng 2.5MLD FC Reactor WT Vessel	m2	412	50	20,600	412	50	20,600				10,300	10,300								10,300	10,300			
ii	Rehabilitation of FC Reactor Units											-	-								-	-			
a	5MLD Unit	MLD	5	25,500	127,500	5	25,500	127,500				63,750	63,750								63,750	63,750			
b	2.5MLD Unit (Steel)	MLD	3	25,500	63,750	3	25,500	63,750				31,875	31,875								31,875	31,875			
c	10MLD Unit (2018 Install)	MLD	-	25,500	-	10	25,500	255,000				-	-								127,500	127,500			
iii	Rehabilitation / Extension of Chemical Dosing Facilities											-	-								-	-			
a	Provision of 3kW Solar Array with Controller and Batteries for dosing	kW	3	5,000	15,000	3	3,000	9,000				7,500	7,500								4,500	4,500			
b	Replacement of dosing equipment	nos	1	10,000	10,000	1	6,000	6,000				5,000	5,000								3,000	3,000			
iv	Complete drying beds	m2	400	250	100,000							50,000	50,000								-	-			
v	Completeion of WTW treated water reservoir 4000m3											-	-								-	-			
a	Concrete Reservoir 4000m3	m3	4,000	500	2,000,000							1,000,000	1,000,000								-	-			
b	Supply Pipework DN750	m	110	640	70,400							35,200	35,200								-	-			
c	Level Control Valve DN750	nos.	1	25,000	25,000	1	25,000	25,000				12,500	12,500								12,500	12,500			
												-	-								-	-			
C. EXTENSION OF WATER SUPPLY SERVICES					12,154,785			26,769,420	1,140,326	1,140,326	1,140,326	3,226,576	3,226,576	1,140,326	1,140,326	881,142	881,142	881,142	881,142	881,142	9,860,142	9,860,142	881,142	881,142	881,142
C.1	**Proposed WTW Expansion**				**1,062,500**			-	-	-	-	531,250	531,250	-	-	-	-	-	-	-	-	-	-	-	-
																					-	-			
i	Water Production, Treatment and Transmission Facilities																				-	-			
a	12.5ML Expansion of FC Reactor WTW	ML	12.5	85,000	1,062,500							531,250	531,250								-	-			
C.2	**Primary and Secondary Distribution System Expansion**				**2,630,000**			**1,958,000**	-	-	-	1,315,000	1,315,000	-	-	-	-	-	-	-	979,000	979,000	-	-	-
												-	-								-	-			
i	Ruwa WTW Booster Pump Station											-	-								-	-			
a	Water booster pump sets Transfer to Mutare Road 415m3/hr @25m	nos.	3	55,000	165,000	3	55,000	165,000				82,500	82,500								82,500	82,500			
c	Booster Pump Suction and Discharge Ppipework	nos.	6	6,000	36,000	-		-				18,000	18,000								-	-			
d	Water booster pump sets into supply 480m3/hr @25m	nos.	4	55,000	220,000	4	55,000	220,000				110,000	110,000								110,000	110,000			
f	Booster Pump Suction and Discharge Ppipework	nos.	8	6,000	48,000	-		-				24,000	24,000								-	-			
g	Booster Pump Station Building	m2	120	1,200	144,000	-		-				72,000	72,000								-	-			
h	Booster Pump Station Ancilliaries	Sum	1	10,000	10,000	-		-				5,000	5,000								-	-			
												-	-								-	-			
iii	Mutare Road Water Booster Pump Station											-	-								-	-			
a	Water booster pump sets Transfer to Mutare Road 545m3/hr @20m	nos.	3	55,000	165,000	3	55,000	165,000				82,500	82,500								82,500	82,500			
c	Booster Pump Suction and Discharge Ppipework	nos.	6	6,000	36,000	-		-				18,000	18,000								-	-			
d	Booster Pump Station Building Refurbishment	m2	90	600	54,000	-		-				27,000	27,000								-	-			
e	Booster Pump Station Ancilliaries	Sum	1	10,000	10,000	-		-				5,000	5,000								-	-			
												-	-								-	-			
iii	Primary Network - (a) Ruwa WTW to Mutare Road Tanks											-	-								-	-			
a	ND 400 DI	m	4,650	200	930,000			-				465,000	465,000								-	-			
b	ND 400 Electromagnetic Meter	nos.	2	12,000	24,000	2	12,000	24,000				12,000	12,000								12,000	12,000			
c	ND 400 Butterfly Valve	nos.	3	4,000	12,000			-				6,000	6,000								-	-			
												-	-								-	-			
iv	Primary Network - (b) Mutare Road Tanks to Southern Ruwa											-	-								-	-			

Greater Harare Water and Sanitatation Investment Plan

Medium Term Projects

FS/FD Construction

Long Term Projects

FS/FD Construction

Appendix 9-5: Detailed Investment Cost Estimates - RUWA

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)				2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount		[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
a	ND 315 PVC	m	775	120	93,000			-	-				46,500	46,500								-	-			
b	ND 400 DI	m	3,260	200	652,000			-	-				326,000	326,000								-	-			
c	ND 300 Woltman type	nos.	1	7,000	7,000	1	7,000	7,000	-				3,500	3,500								3,500	3,500			
d	ND 400 Electromagnetic Meter	nos.	1	12,000	12,000	1	12,000	12,000	-				6,000	6,000								6,000	6,000			
e	ND 300 Gate	nos.	2	2,000	4,000			-	-				2,000	2,000								-	-			
f	ND 400 Butterfly Valve	nos.	2	4,000	8,000			-	-				4,000	4,000								-	-			
									-				-	-								-	-			
v	Primary Network - (c) ZIMRE to Ruwa WTW								-				-	-								-	-			
a	ND 500 DI	m		300	-	4,250	300	1,275,000	-				-	-								637,500	637,500			
b	ND 500 Electromagnetic	nos.		17,000	-	2	17,000	34,000	-				-	-								17,000	17,000			
c	ND 500 Butterfly	nos.		7,000	-	4	7,000	28,000	-				-	-								14,000	14,000			
d	ND 300 PRV	nos.		14,000	-	1	14,000	14,000	-				-	-								7,000	7,000			
									-				-	-								-	-			
vi	Secondary Network - (d) Athelney Farm								-				-	-								-	-			
a	ND 200 PVC	m		75	-	3,720		-	-				-	-								-	-			
b	ND 200 Gate Valve	nos.		800	-	4		-	-				-	-								-	-			
c	ND 200 Woltman type Water meter	nos.		3,000	-	2	3,000	6,000	-				-	-								3,000	3,000			
									-				-	-								-	-			
vii	Secondary Network - (e) Mara Farm								-				-	-								-	-			
a	ND 250 PVC	m		90	-	7,900			-				-	-								-	-			
b	ND 250 Gate Valve	nos.		1,500	-	5			-				-	-								-	-			
c	ND 250 Woltman type water meter	nos.		4,000	-	2	4,000	8,000	-				-	-								4,000	4,000			
									-				-	-								-	-			
C.3	**Construction of new storage reservoirs**				**200,000**			**16,000,000**	-	**-**	**-**	**-**	**100,000**	**100,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8,000,000**	**8,000,000**	**-**	**-**	**-**
i	Replacement of Mutare Road Elevated	m^3	200	1,000	200,000				-				100,000	100,000								-	-			
ii	Ruwa WTW Clear Water Tanks Expansion	m^3		400	-	40,000	400	16,000,000	-				-	-								8,000,000	8,000,000			
									-				-	-								-	-			
C.4	**Extension of distribution system in expansion areas**				**7,982,285**			**8,811,420**	-	**1,140,326**	**1,140,326**	**1,140,326**	**1,140,326**	**1,140,326**	**1,140,326**	**1,140,326**	**881,142**	**881,142**	**881,142**	**881,142**	**881,142**	**881,142**	**881,142**	**881,142**	**881,142**	**881,142**
i	Pipes								-																	
a	ND 75 PVC	m	45,000	22	990,000	49,000	22	1,078,000	-	141,429	141,429	141,429	141,429	141,429	141,429	141,429	107,800	107,800	107,800	107,800	107,800	107,800	107,800	107,800	107,800	107,800
b	ND 110 PVC	m	56,000	30	1,680,000	62,000	30	1,860,000	-	240,000	240,000	240,000	240,000	240,000	240,000	240,000	186,000	186,000	186,000	186,000	186,000	186,000	186,000	186,000	186,000	186,000
c	ND 160 PVC	m	28,000	45	1,260,000	31,000	45	1,395,000	-	180,000	180,000	180,000	180,000	180,000	180,000	180,000	139,500	139,500	139,500	139,500	139,500	139,500	139,500	139,500	139,500	139,500
									-																	
ii	Section valves								-																	
a	ND 75 Gate	nos.	450	200	90,000	490	200	98,000	-	12,857	12,857	12,857	12,857	12,857	12,857	12,857	9,800	9,800	9,800	9,800	9,800	9,800	9,800	9,800	9,800	9,800
b	ND 100 Gate	nos.	560	250	140,000	620	250	155,000	-	20,000	20,000	20,000	20,000	20,000	20,000	20,000	15,500	15,500	15,500	15,500	15,500	15,500	15,500	15,500	15,500	15,500
c	ND 150 Gate	nos.	280	450	126,000	310	450	139,500	-	18,000	18,000	18,000	18,000	18,000	18,000	18,000	13,950	13,950	13,950	13,950	13,950	13,950	13,950	13,950	13,950	13,950
									-																	
iii	Fire hydrants								-																	
a	ND 80	nos.	168	200	33,600	186	200	37,200	-	4,800	4,800	4,800	4,800	4,800	4,800	4,800	3,720	3,720	3,720	3,720	3,720	3,720	3,720	3,720	3,720	3,720
									-																	
iv	Service connections								-																	
a	ND 15	nos.	9,392	150	1,408,725	10,381	150	1,557,200	-	201,246	201,246	201,246	201,246	201,246	201,246	201,246	155,720	155,720	155,720	155,720	155,720	155,720	155,720	155,720	155,720	155,720
b	ND 25	nos.	1,878	250	469,575	2,076	250	519,067	-	67,082	67,082	67,082	67,082	67,082	67,082	67,082	51,907	51,907	51,907	51,907	51,907	51,907	51,907	51,907	51,907	51,907
									-																	
v	Service water meters								-																	
a	Domestic (ND 15)	nos.	9,392	150	1,408,725	10,381	150	1,557,200	-	201,246	201,246	201,246	201,246	201,246	201,246	201,246	155,720	155,720	155,720	155,720	155,720	155,720	155,720	155,720	155,720	155,720
b	Non-Domestic (ND 25)	nos.	1,878	200	375,660	2,076	200	415,253	-	53,666	53,666	53,666	53,666	53,666	53,666	53,666	41,525	41,525	41,525	41,525	41,525	41,525	41,525	41,525	41,525	41,525
									-																	
C.5	**Other new bulk water management facilities**				**280,000**			**-**	-	**-**	**-**	**-**	**140,000**	**140,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i	Automatic Control System for pumps and reservoirs	Station	10	25,000	250,000				-				125,000	125,000								-	-	-		
ii	Water quality monitoring equipment	Sum	1	30,000	30,000				-				15,000	15,000								-	-	-		
									-																	
D. SEWERAGE SERVICE IMPROVEMENTS					**2,282,913**			**1,660,376**	-	**-**	**-**	**-**	**1,141,457**	**1,141,457**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**830,188**	**830,188**	**-**	**-**	**-**
									-																	
D.1	**Decommissioning of Sewage Treatment Works**				**1,130,250**			**-**	-	**-**	**-**	**-**	**565,125**	**565,125**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i	RUWA Adelaide Stabilisation Pond								-																	
a	Dewatering and drying out	Sum	1	50,000	50,000		4,000	-	-				25,000	25,000								-	-			
b	Sludge excavation and removal	m3	15,741	50	787,050		4,500	-	-				393,525	393,525								-	-			
c	Dozing of walls and lanscaping level	m3	28,320	10	283,200		2,000	-	-				141,600	141,600								-	-			
d	Demolition of unused structures	nos	2	5,000	10,000		25,000	-	-				5,000	5,000								-	-			
									-				-	-												
D.2	**Decommissioning of Sewage Pump Stations (Retain Screening Facilities)**				**218,800**			**-**	-	**-**	**-**	**-**	**109,400**	**109,400**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i	Renyaro SPS								-																	
a	Grade and Gravel Access Road	m	50	80	4,000		4,000	-	-				2,000	2,000								-	-			
b	New Site Fencing (Clearvu)	m	142	150	21,300		4,500	-	-				10,650	10,650								-	-			
c	New Gate	No.	1	4,500	4,500		2,000	-	-				2,250	2,250								-	-			
d	Demolition of unused structures	nos	2	5,000	10,000		25,000	-	-				5,000	5,000								-	-			
e	Landscaping and grassing or gravelling	nos	1,050	15	15,750		3,500	-	-				7,875	7,875								-	-			
f	Removal of contaminated material to spoil	nos	210	50	10,500		4,500	-	-				5,250	5,250								-	-			
g	Construction of skip hardstanding for rakings	m2	24	150	3,600		9,000	-	-				1,800	1,800								-	-			
									-				-	-								-	-			
ii	Chilemba SPS								-																	
a	Grade and Gravel Access Road	m	85	80	6,800		4,000	-	-				3,400	3,400								-	-			
b	New Site Fencing (Clearvu)	m	184	150	27,600		4,500	-	-				13,800	13,800								-	-			
c	New Gate	No.	1	4,500	4,500		2,000	-	-				2,250	2,250								-	-			
d	Demolition of unused structures	nos	2	5,000	10,000		25,000	-	-				5,000	5,000								-	-			
e	Landscaping and grassing or gravelling	nos	2,091	15	31,365		3,500	-	-				15,683	15,683								-	-			
f	Removal of contaminated material to spoil	nos	418	50	20,910		4,500	-	-				10,455	10,455								-	-			
g	Construction of skip hardstanding for rakings	m2	24	150	3,600		9,000	-	-				1,800	1,800								-	-			
									-																	
iii	Ruwa Terminal SPS								-																	
a	Grade and Gravel Access Road	m	-	80	-		4,000	-	-				-	-								-	-			
b	Repairs and painting to site walling	m	240	75	18,000		4,500	-	-				9,000	9,000								-	-			
c	New Gate	No.	1	4,500	4,500		2,000	-	-				2,250	2,250								-	-			
d	Demolition of unused structures	nos	-	5,000	-		25,000	-	-				-	-								-	-			
e	Landscaping and grassing or gravelling	nos	875	15	13,125		3,500	-	-				6,563	6,563								-	-			
f	Removal of contaminated material to spoil	nos	175	50	8,750		4,500	-	-				4,375	4,375								-	-			
g	Construction of skip hardstanding for rakings	m2	-	150	-		9,000	-	-				-	-								-	-			
									-				-	-												
D.3	**Rehabilitation/replacement of existing sewer network**				**933,863**			**1,660,376**	-	**-**	**-**	**-**	**466,932**	**466,932**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**830,188**	**830,188**	**-**	**-**	**-**
i	Sewer reticulation pipes in some areas								-																	
a	ND 150 PVC	m	5,328	75	399,637	10,657	75	799,275	-				199,819	199,819								399,637	399,637			
b	ND 200 PVC (OD 225)	m	256	75	19,200	512	75	38,401	-				9,600	9,600								19,200	19,200			
c	ND 250 PVC (OD 280)	m	1,820	90	163,786	3,640	90	327,572	-				81,893	81,893								163,786	163,786			

Greater Harare Water and Sanitatation Investment Plan

Medium Term Projects — FS/FD — Construction

Long Term Projects — FS/FD — Construction

Appendix 9-5: Detailed Investment Cost Estimates - RUWA

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)				2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount		[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]	[USD]
d	ND 315 PVC	m	205	120	24,547	409	120	49,094	-				12,273	12,273								24,547	24,547			
e	ND 400 PVC	m	290	165	47,878	580	165	95,757	-				23,939	23,939								47,878	47,878			
f	ND 450 PVC	m	76	190	14,454	152	190	28,908	-				7,227	7,227								14,454	14,454			
g	Construction of manholes	nos.	23	2,500	57,010	46	2,500	114,020	-				28,505	28,505								57,010	57,010			
h	Rehabilitation of Manhole cover and frame	nos.	319	350	111,650	319	350	111,650	-				55,825	55,825								55,825	55,825			
i	New Manhole Covers only	nos.	638	150	95,700	638	150	95,700	-				47,850	47,850								47,850	47,850			
									-													-	-			
E. EXTENSION OF SEWERAGE SERVICES					24,957,743			16,107,641	- 0	1,501,743	1,501,743	1,501,743	8,724,513	8,724,513	1,501,743	1,501,743	1,130,420	1,130,420	1,130,420	1,130,420	1,130,420	3,532,140	3,532,140	1,130,420	1,130,420	1,130,420
E.1	**Ruwa Northern Expansion**				**2,510,623**			**712,000**	-	-	-	-	**1,255,311**	**1,255,311**	-	-	-	-	-	-	-	**356,000**	**356,000**	-	-	-
a	ND 150 PVC	m		36	-	-	36	-	-				-	-								-	-			
b	ND 200 PVC (OD 225)	m		44	-	-	44	-	-				-	-								-	-			
c	ND 250 PVC (OD 280)	m		57	-	-	57	-	-				-	-								-	-			
d	ND 315 PVC	m	175	80	13,993	-	80	-	-				6,996	6,996								-	-			
e	ND 400 PVC	m		111	-	-	111	-	-				-	-								-	-			
f	ND 450 PVC	m		146	-	-	146	-	-				-	-								-	-			
g	ND 525 Concrete	m	650.00	375	243,750	1,780	375	667,500	-				121,875	121,875								333,750	333,750			
h	ND 600 Concrete	m		342	-		342	-	-				-	-								-	-			
i	ND 675 Concrete	m	215.00	524	112,660		524	-	-				56,330	56,330								-	-			
j	ND 750 Concrete	m	3,165	643	2,035,095		643	-	-				1,017,548	1,017,548								-	-			
k	Construction of manholes	nos.	42	2,500	105,125	18	2,500	44,500	-				52,563	52,563								22,250	22,250			
													-	-								-	-			
E.2	**Ruwa Southern and Ward 4 Expansion**				**627,529**			**212,640**	-	-	-	-	**313,765**	**313,765**	-	-	-	-	-	-	-	**106,320**	**106,320**	-	-	-
a	ND 150 PVC	m		36	-		36	-	-				-	-								-	-			
b	ND 200 PVC (OD 225)	m		44	-	3,075	44	135,765	-				-	-								67,883	67,883			
c	ND 250 PVC (OD 280)	m	50	57	2,849		57	-	-				1,425	1,425								-	-			
d	ND 315 PVC	m	1,230	80	98,348		80	-	-				49,174	49,174								-	-			
e	ND 400 PVC	m	3,645	111	403,207		111	-	-				201,604	201,604								-	-			
f	Construction of manholes	nos.	49	2,500	123,125	31	2,500	76,875	-				61,563	61,563								38,438	38,438			
E.3	**Ruwa Eastern Expansion**				**-**			**445,630**	-	-	-	-	**-**	**-**	-	-	-	-	-	-	-	**222,815**	**222,815**	-	-	-
a	ND 150 PVC	m		36	-		36	-	-				-	-								-	-			
b	ND 200 PVC (OD 225)	m		44	-	4,500	44	198,681	-				-	-								99,341	99,341			
c	ND 250 PVC (OD 280)	m		57	-	1,640	57	93,449	-				-	-								46,725	46,725			
d	Construction of manholes	nos.	-	2,500	-	61	2,500	153,500	-				-	-								76,750	76,750			
E.4	**New Ruwa WWTW Ponds and Lift Pump Station**				**11,307,387**			**165,000**	-	-	-	-	**5,653,693**	**5,653,693**	-	-	-	-	-	-	-	**82,500**	**82,500**	-	-	-
i	Pump station from south of Ruwa to head of ponds												-	-								-	-			
a	Sewage Pumps 600m3/hr @15	No.	3	49,000	147,000	3	55,000	165,000	-				73,500	73,500								82,500	82,500			
c	Booster Pump Suction and Discharge Ppipework	No.	3	8,000	24,000	-	6,000	-	-				12,000	12,000								-	-			
d	Booster Pump Station Building	m2	60	1,200	72,000	-	1,200	-	-				36,000	36,000								-	-			
e	Booster Pump Station Ancilliaries	Sum	1	10,000	10,000	-	10,000	-	-				5,000	5,000								-	-			
									-				-	-								-	-			
ii	Force Main 1000m ND500 GRP	m	1,200	276	330,720		260	-	-				165,360	165,360								-	-			
									-				-	-								-	-			
	Civil Works in Pond Construction 9MLD Stream	Stream	2	3,144,667	6,289,333	-	6,289,333	-	-				3,144,667	3,144,667								-	-			
	Pond System Pipework	Stream	2	530,000	1,060,000	-	1,060,000	-	-				530,000	530,000								-	-			
	Inlet Works	Stream	2	88,333	176,667	-	176,667	-	-				88,333	88,333								-	-			
	Ancilliary Buildings	Stream	2	671,333	1,342,667	-	1,342,667	-	-				671,333	671,333								-	-			
									-				-	-								-	-			
iv	Wastewater Slow Rate (irrigation) disposal system								-				-	-								-	-			
	Irrigation Set Up	Ha	250	4,770	1,192,500	-	4,770	-	-				596,250	596,250								-	-			
	Irrigation Pumps and Equipment	Ha	250	2,650	662,500	-	2,650	-	-				331,250	331,250								-	-			
									-				-	-								-	-			
E.5	**Ruwa Outfall to Lyndhurst Farm / HSTS**				**-**			**3,268,169**	-	-	-	-	**-**	**-**	-	-	-	-	-	-	-	**1,634,084**	**1,634,084**	-	-	-
a	ND 825 Concrete	m		693	-	4,550	693	3,154,419	-				-	-								1,577,209	1,577,209			
b	Construction of manholes	nos.		2,500	-	46	2,500	113,750	-				-	-								56,875	56,875			
									-																	
E.6	**Extension of sewer reticulation system in new development areas**				**10,512,204**			**11,304,202**	-	**1,501,743**	**1,501,743**	**1,501,743**	**1,501,743**	**1,501,743**	**1,501,743**	**1,501,743**	**1,130,420**	**1,130,420**	**1,130,420**	**1,130,420**	**1,130,420**	**1,130,420**	**1,130,420**	**1,130,420**	**1,130,420**	**1,130,420**
i	pipes								-																	
a	ND 100 PVC	m	60,823	27	1,642,226	65,405	27	1,765,930	-	234,604	234,604	234,604	234,604	234,604	234,604	234,604	176,593	176,593	176,593	176,593	176,593	176,593	176,593	176,593	176,593	176,593
b	ND 160 PVC	m	25,343	36	912,348	27,252	36	981,072	-	130,335	130,335	130,335	130,335	130,335	130,335	130,335	98,107	98,107	98,107	98,107	98,107	98,107	98,107	98,107	98,107	98,107
ii	Construction of manholes	nos.	1,723	2,500	4,308,310	1,853	2,500	4,632,840	-	615,473	615,473	615,473	615,473	615,473	615,473	615,473	463,284	463,284	463,284	463,284	463,284	463,284	463,284	463,284	463,284	463,284
									-																	
iii	Sewer service connections								-																	
i	ND 100	nos.	10,137	360	3,649,320	10,901	360	3,924,360	-	521,331	521,331	521,331	521,331	521,331	521,331	521,331	392,436	392,436	392,436	392,436	392,436	392,436	392,436	392,436	392,436	392,436
									-																	
F. ACCOMPANYING MEASURES					6,823,689			5,025,814	-	264,207	744,207	384,207	2,877,127	2,025,527	264,207	264,207	226,647	226,647	226,647	416,647	226,647	1,481,731	1,481,731	246,372	246,372	246,372
									-																	
F.1	**Technical operations management**				**430,000**				-	-	-	-	**430,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Establishment of meter control, testing and repair workshop	Sum	1	50,000	50,000				-				50,000													
ii	Procurement of tools and equipment for operations and maintenance	Sum	1	200,000	200,000				-				200,000													
iii	Provision of vehicles for operation and maintenance teams	Sum	1	150,000	150,000				-				150,000													
iv	Provision of vacuum tanker for septic tank emptying	no.s	1	30,000	30,000				-				30,000													
									-																	
F.2	**Information Communication Technology Infrastructure**				**176,600**				-	-	-	-	**176,600**	-	-	-	-	-	-	-	-	-	-	-	-	-
ii	Supply of server	nos	1	5,500	5,500				-				5,500													
iii	Supply and install Local Area Networking	Sum	2	5,000	10,000				-				10,000													
iv	Supply and install Wide Area Networking	Satelite	2	5,000	10,000				-				10,000													
v	Supply and install generator power back-up	nos	2	3,000	6,000				-				6,000													
vi	Supply personal computers complete with software, UPS, etc.	nos	10	2,000	20,000				-				20,000													
vii	Supply laptop computers	nos	4	2,500	10,000				-				10,000													
viii	Supply heavy duty printer (dot-matrix)	nos	3	4,500	13,500				-				13,500													
ix	Supply laser printers	nos	4	400	1,600				-				1,600													
x	Supply and if appropraiate install auxiliary equipment	Sum	1	100,000	100,000				-				100,000													
									-																	
F.3	**Commercial operations management**				**350,000**				-	-	-	-	**350,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Review/Improvement of billing and commercial operations (consultancy)	Sum	1	200,000	200,000				-				200,000													
ii	Socio-economic surveys and customer awareness campaigns	Sum	1	150,000	150,000				-				150,000													
									-																	
F.4	**Management, commercial and technical information systems**				**83,000**				-	-	-	-	**83,000**	-	-	-	-	-	-	-	-	-	-	-	-	-
i	Procurement and installation of billing and customer services software	Sum	1	20,000	20,000				-				20,000													
ii	Procurement and installation of management information software	Sum	1	15,000	15,000				-				15,000													
iii	Procurement of commercial operations software (various)	Sum	1	10,000	10,000				-				10,000													
iv	Procurement and installation of accounting and payroll software	Sum	1	8,000	8,000				-				8,000													
iiv	Procurement and installation of GIS based Network Information Systems software	Sum	1	10,000	10,000				-				10,000													

Greater Harare Water and Sanitatation Investment Plan

Appendix 9-5: Detailed Investment Cost Estimates - RUWA

Medium Term Projects

FS/FD Construction

Long Term Projects

FS/FD Construction

Item		Unit	Medium Term (upto 2020)			Long Term (upto 2030)			
			Qty	Rate [USD]	Amount	Qty	Rate [USD]	Amount	
iiiv	Procurement and installation of other software (asset management, hyrauli modelling etc)	Sum	1	20,000	20,000				-
									-
F.5	**Professional services - Institutional Support**				**1,268,000**			**-**	-
i	Advice, guidance and support in the development of institutional frameworks towards an autonomous utility	Month	42	20,000	840,000			-	-
ii	Assessment of capacity, competency and development of a comprehesive training program	Month	18	20,000	360,000				-
iii	Specific training courses (various)	nos	136	500	68,000				-
									-
F.6	**Professional services - Feasibility, Design and Supervision**				**4,516,089**			**5,025,814**	-
iv	Engineering Services	Sum			4,516,089			5,025,814	-

Item	2014 [USD]	2015 [USD]	2016 [USD]	2017 [USD]	2018 [USD]	2019 [USD]	2020 [USD]	2021 [USD]	2022 [USD]	2023 [USD]	2024 [USD]	2025 [USD]	2026 [USD]	2027 [USD]	2028 [USD]	2029 [USD]	2030 [USD]
iiiv				20,000													
F.5	**-**	**480,000**	**120,000**	**240,000**	**428,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
i		240,000	120,000	240,000	240,000												
ii		240,000			120,000												
iii					68,000												
F.6	**264,207**	**264,207**	**264,207**	**1,597,527**	**1,597,527**	**264,207**	**264,207**	**226,647**	**226,647**	**226,647**	**416,647**	**226,647**	**1,481,731**	**1,481,731**	**246,372**	**246,372**	**246,372**
iv	264,207	264,207	264,207	1,597,527	1,597,527	264,207	264,207	226,647	226,647	226,647	416,647	226,647	1,481,731	1,481,731	246,372	246,372	246,372
Contingency	**924,724**	**924,724**	**924,724**	**5,591,345**	**5,591,345**	**924,724**	**924,724**	**793,266**	**793,266**	**793,266**	**1,458,266**	**793,266**	**5,186,057**	**5,186,057**	**862,302**	**862,302**	**862,302**
Total	**3,831,001**	**4,311,001**	**3,951,001**	**24,443,743**	**23,592,143**	**3,831,001**	**3,831,001**	**3,286,388**	**3,286,388**	**3,286,388**	**6,041,388**	**3,286,388**	**21,485,095**	**21,485,095**	**3,572,393**	**3,572,393**	**3,572,393**
Cum. Total	**3,831,001**	**8,142,003**	**12,093,004**	**36,536,747**	**60,128,889**	**63,959,891**	**67,790,892**	**71,077,280**	**74,363,667**	**77,650,055**	**83,691,443**	**86,977,831**	**108,462,926**	**129,948,021**	**133,520,415**	**137,092,808**	**140,665,201**

Engineering Services 10% of physical works (A+B+C+D+E)
Contractor's P&G and Physical contingencies 35% of physical works (A+B+C+D+E)
Inflation 0%

APPENDIX 11: FINANCIAL ANALYSIS

APPENDIX 11: DETAILED FINANCIAL ANALYSIS TABLES

GREATER HARARE WATER AND SANITATION INVESTMENT PLAN

INVESTMENT PLAN REPORT

APPENDIX 11

Contents

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1.1 INTRODUCTION 1
1.2 DETAILED STAFF NUMBER AND EMPLOYMENT COSTS 2
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Financial Analysis Tables (Costs, Revenue, Financial Statements)

GREATER HARARE (4 Pages)
HARARE (4 Pages)
CHITUNGWIZA (4 Pages)
EPWORTH (4 Pages)
NORTON (4 Pages)
RUWA (4 Pages)

1 DETAILED NOTES TO THE FINANCIAL MODEL

1.1 Introduction

Appendix 11 at hand contains the relevant detailed tables of the financial analysis comprising of:

- Personnel cost forecasts detailing the number of staff by individual salary scale, the commensurate salary scale, proportions used to calculate estimates for allowances, pension, bonus etc. to arrive at an annual employment cost figure taken up in the detailed cost tables;
- Costs of various nature are calculated and presented in this detailed cost table divided into the following categories of costs identified:
    - Capital costs: investment disbursements, repayment of loan, balance on loan, interest calculations on loan (reducing balance) and depreciation;
    - Variable operating costs: Bulk water costs (if appropriate, i.e. bought in by the entity), abstraction, power and abstraction costs (if appropriate, i.e. if entity produces water);
    - Fixed operating costs: Personnel, transport and other administration costs (based on personnel);
    - Maintenance costs for both existing and investment assets.
    - Estimated bulk and retail cost covering water/sewerage tariffs are calculated below the main cost table providing a guideline for input and use in the financial model.
    - Unit cost calculations for chemicals and power are provided below the unit cost calculations for tariffs.
- Revenue calculations based on volumes of water sold either in bulk (before NRW) and retail (after NRW), tariff and collection efficiency are presented in this table forming the main source of income and cash collection used in the financial model.
- Financial Analysis encompasses three inter-linked tables: Income Statement, Cash Flow and Balance Sheet that draw relevant input data from various source tables of the financial model as described above and also below.

In addition the financial model includes tables, which are however not presented in this annex as they are already presented in other parts of this report. These tables are:

- Existing assets table listing all facilities already in existence capturing the year of construction, the construction cost (using base year cost estimates), breakdown into three category elements (civil works, pipework and mechanical and electrical) assumed economic life of each facility, straight line depreciation, maintenance and the depreciated residual cost (DRC). In the case of the combined investments for Greater Harare this spreadsheet collects the data from the individual satellite towns and sums them up for further use in other tables;
- Investment Assets table represents a transfer table obtained from the main investment plan used to break down the anticipated disbursements into the different financing sources as presented in the main text (Chapter 11). Apart from this, the

calculation sheet also estimates the depreciated residual costs. As with the existing assets spreadsheet, the investment assets sheet in the case of Greater Harare is used to collect the individual information from the satellite towns and used to sum these up before they are used elsewhere in the model;

- Pumping details include information on the pumping volumes (Q), head (h) and time (hr) required to establish a wieghte4d average for Q and h used as an input in the calculation of unit power cost calculations in the main cost tables;
- Dashboard output both in form of various tabulations: performance data (billing and collection efficiencies and staffing ratios), Income and Cash Flow statement outputs including typical Profitability measures (gross and profit margins), Costs and Volumes that are selectively expressed in graphical form used in the main text (Chapter 11)
- (Other) Result tables combining the main performance and profitability measures as well as a separate spreadsheet attempting to highlight the effect of the existing loan (Exim Bank).

The latter part of the financial model is accessible and available from the soft copy of the model.

For ease of understanding the data and following the calculations the relevant tables have been formatted as tables using the available table tool and where appropriate annotated with explanatory notes referenced in square brackets as presented in the following sections. To improve on data visibility and distinguish between data input, milestones and calculated figures, different fonts have been applied as per the following legend:

Sample		Interpretation
230,021	=	data input
235,024	=	milestone/key data
230,021	=	calculated figures

Figures in italics indicate input fields while figures in normal font (i.e. not italic) are calculated. Headings as well as sub-total and totals are indicated in bold.

1.2 Detailed Staff Number and Employment Costs

The datasheet labelled “HR” contains all relevant information required to establish annual employment costs over the entire project period considering changes in staff numbers, remuneration (if required) and allocation of costs to take cognisance of currently applied recharges for costs including staff deployed over more than one department at the current council setup.

The top part of the table deals with the staffing numbers broken down into twelve grades. This is a simplified form based on staffing categories in other cities and large towns in Zimbabwe (e.g. Mutare). For purposes of the investment plan a 12-grade breakdown of staff was deemed adequate, although detailed organisation development studies to guide the transformation of the entity into an autonomous utility will need to be more detailed.

The salary scales are based on the same 12-grade breakdown of staff. In the absence of information from Harare Water, the salary scales were based on remuneration levels obtained from Chegutu and compared with other cities and large towns in Zimbabwe. In consideration of higher costs of living in and directly around the capital, the salary scales were adjusted upward by 10 %. Although the model has provisions for an annual increase of salaries, this was set to nil in view of the financial forecasts were being made in real terms. After establishing the monthly salary for a particular year, provisions are made in the model to add:

- Allowances (including overtime);
- Pensions (i.e. contribution to pension funds by the employer);
- Bonuses (e.g. end of year bonus and other gratuities).

It was noted that the number of staff in the establishment differs to the actual staff numbers employed (in-post) as characterised and confirmed by the number of vacancies reported. Thus, if the payroll forecast is based on the establishment, the calculations will be an over-statement. Furthermore, it was also noted that some staff deployed for water and sewerage activities are also active in other departments of the council at present. In terms of the council's accounting, such sharing of resources is differentiated and reflected as recharges in their accounting. To include these findings into the calculations of the financial model a line labelled "Apportionment to WSS only" was introduced. Below this item the model offers an option to include and consider the cost of casual staff.

The total annual employment cost calculated for each year of the project horizon is carried forward to the main cost sheet and then onto other analysis tables of the financial model relating to fixed costs.

In line with the anticipated organisational transformation from the current set-up to a more autonomous department by 2015 (similar to that found for Harare Water) and ultimately an independent utility by 2018 the input of staff numbers is intended for 2013 (base year – current) and two milestone years; 2015 and 2018 as marked and highlighted appropriately in the model and sheets presented under this appendix.

1.3 Detailed (Main) Cost Calculations

The detailed cost calculation table, also referred to the main cost tables, includes all types of costs identified and quantified for purposes of the financial analysis forecasts. They do not necessarily follow the order of the financial analysis, but provides a comprehensive and detailed table used as a source of calculated and summarised figures required for the financial analysis. To support the figures with explanations on assumptions and calculation methods the following table provides the notes referenced in the main cost table.

Table 1-1: Referenced Explanation Notes for Cost Tables

Ref	Notes
[1]	Water demand as detailed in Chapter 5 was projected for 2013, 2020 and 2030 representing three milestones. The periods between these were interpolated on a linear basis to fit the demand of the milestones provided to obtain year-on-year demand. The resulting figures were input into the financial model. In the case for Harare and Greater Harare models the average demand included for Ruwa is reduced by the capacity of Ruwa's production which does and will not need to be produced by Harare.
[2]	The peak seasonal factor and peak demand are calculated as a function of average demand and used to ascertain the production surplus/ (deficit) only.
[3)	Production losses attributable to backwash, flushing and other cleaning operations are assumed to increase the abstraction of raw water.
[4]	The water produced is the volume of water after production losses equal to either the

Ref	Notes
	demand or the production capacity, whichever lower.
[5]	The proportion of bulk water available may be less than 100 % in the event that bulk water supply is practically throttled or cannot be produced to fully cover the demand for bulk water.
[6]	In the event that bulk water is required either because the entity does not possess its own treatment works or the entity is unable to produce adequate water to cover average demand, this would be bought (from Harare). Thus, Ruwa expects to satisfy the demand of water through a combination of own water produced and bulk water from Harare, while the other satellite towns solely rely on bulk water supplies from Harare. The model prioritises own production and covers the balance of the demand with bulk water if and as available. The "if" switch is required for the event that demand cannot be covered and bulk water is not available, e.g. Harare's current situation.
[7]	The volume of water available is the addition of water produced plus water bought in bulk (if any).
[8]	Details on funding of investments are provided in a separate table (Invest assets) that distinguishes between the following types of funding: • Grant – no repayment of principal or interest payments expected; • Concessionary loan for which the principal is expected to be paid but no interest, i.e. nil-interest loan; • Loan for which both principal and interest payments are expected depending on repayment periods and interest rate respectively.
[9]	The depreciation of existing assets is based on the estimated replacement value and assumed and agreed economic life of assets related to civil works, pipework and mechanical and electrical. However, in view of the financial performance reported by Harare Water for recent years it is not realistic to bring these calculated costs to account since they cannot be afforded. Thus, the calculated depreciation for existing assets was set to nil. Nonetheless, the model allows for a percentage of the calculated depreciation costs to be brought on board if required at a later stage to ascertain the financial impact thereof. This adjustment is possible under the column headed "Notes value".
[10]	For new capital investments, the depreciation was similarly calculated on the basis of their estimated cost and anticipated economic life. As with existing assets, the full annual value of depreciation of these assets is high and realistically not a priority and was therefore revised downward to a level representing expected levels of re-investment by the entity.
[11]	The assumed unit cost of water is brought forward from the bulk tariff calculations below the main cost table. In the case of Harare, the bulk rate applied Is that currently applied by the entity rather than the actual calculated bulk rate worked out.
[12]	From the management accounts reviewed it was not clear if any abstraction costs were/are paid. To gradually introduce this cost a percentage of the ideal costs is entered in this line.
[13]	The assumed unit power cost for power is brought forward from the calculations below the retail tariff calculations under the "Costs" tab, based on: • Average weighted volumes pumped (Q) and head (h); • Unit cost of power (per KWh); • Pump efficiency.
[14]	Unit chemical costs are brought forward from the main cost tables, which bear in mind: • Dosing and unit price (per kg) for aluminium sulphate; • Ditto for lime; and • Ditto for chlorine (conversion from gas to weight units if necessary) The model considers two water sources and associated qualities (surface and borehole), though only one is applied for this project.

Ref	Notes
[15]	Separately calculated employment costs are based on: • Number of staff; • Remuneration (salaries scales); • % allowances (to cater for e.g. overtime); • % pension; and • % bonuses (and other gratuities); • Allocation to WSS only to cater for vacancies and resale accounting; • Casual wages (if any).
[16]	Transport costs are derived from: • Number of units (distinguished between vehicles, motorcycles and heavy vehicles/machinery); • Average distance travelled (km/yr); • Average fuel consumption (l/100 km); and • Average fuel cost, which may be subject to inflation if desired – not in this case as costs treated in real terms.
[17]	Other administration costs calculated on the basis of a portion of employment costs are deemed to cover: • Office stationery; • Office utilities (communication, power, water); • Security (if outsourced); • Insurance (for office, vehicles and other e.g. public liability); • Professional services (including external audit);
[18]	Maintenance costs calculated separately on the basis of asset values (both existing and investment) are adjusted to gradually adopt realistic levels from currently too low levels, as affordability and financial performance of the entity improves.

Below the main cost tables are a series of other related detailed calculations for bulk tariff estimation, retail tariff estimation, power and chemical unit cost calculations, though not presented in this annex, described in further detail in the following sub-sections.

1.3.1 Bulk Tariff Calculations

The sale and hence responsibility of water losses are assumed to take place shortly after the water treatment works, or along main transmission lines which are deemed to have negligible water losses before the bulk meter. Therefore, the elements considered in the calculation of (theoretical) bulk water costs are:

- Abstraction costs (payable to ZINWA);
- Power costs used for pumping both raw and clean water at least up to the bulk meter or storage tank(s), whichever further;
- Chemical costs for both treatment (aluminium sulphate flocculants and lime for pH correction) and disinfection (chlorine);
- Treatment losses incurred during water treatment;
- Proportion of financial costs (including depreciation and capital charges) assumed at 25 % to cater for approximate financial costs relating to production of water only (i.e. excluding distribution network apart from trunk mains).

- Proportion of fixed costs (employment, transport and administration costs) set at an assumed level of 25 % to cover for costs related to water production and transmission main only.
- Proportion of maintenance costs for both existing and investment assets assumed to be 30 % of total recognised maintenance costs deemed to represent the portion for water treatment and mainline transmission (up to and including the bulk meter(.

The unit cost calculated for bulk water relates to the volumes produced as opposed to the volumes sold at the consumer meter. The resulting bulk water cost calculations are presented in the following table.

Table 1-2: Bulk Water Cost Calculations

Average Unit Bulk Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021
Assumed unit abstraction cost			USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Assumed unit power cost			USD/m^3	0.070139	0.070139	0.070139	0.070139	0.070139	0.070139	0.070139	0.08125	0.08125
Assumed unit chemical cost			USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		25%	USD/m^3	-	0.0003	0.0006	0.0008	0.0055	0.0096	0.0131	0.0179	0.0221
Proportion of fixed costs		25%	USD/m^3	0.0428	0.0464	0.0349	0.0397	0.0401	0.0457	0.0471	0.0477	0.0465
Proportion of Maintenance costs		30%	USD/m^3	0.0044	0.0049	0.0059	0.0060	0.0088	0.0120	0.0156	0.0222	0.0287
Sub-total unit cost for water	Average	0.25	USD/m^3	**0.23**	**0.23**	**0.22**	**0.23**	**0.24**	**0.25**	**0.26**	**0.28**	**0.29**

Average Unit Bulk Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	UNIT	2022	2023	2024	2025	2026	2027	2028	2029	2030
Annual chemical cost			USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Transport			USD/m^3	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125
Average consumption per 100 km			USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		25%	USD/m^3	0.0227	0.0235	0.0230	0.0221	0.0273	0.0320	0.0338	0.0321	0.0306
Proportion of fixed costs		25%	USD/m^3	0.0454	0.0444	0.0434	0.0424	0.0415	0.0406	0.0398	0.0390	0.0382
Proportion of Maintenance costs		30%	USD/m^3	0.0285	0.0283	0.0283	0.0284	0.0237	0.0250	0.0253	0.0253	0.0250
Sub-total unit cost for water	Average	29%	USD/m^3	**0.29**	**0.29**	**0.29**	**0.29**	**0.29**	**0.29**	**0.29**	**0.29**	**0.29**

From the above table the average calculated cost of producing bulk water over the project period is USD 0.27. However, based on the current levels charged by Harare Water, a constant USD 0.40 was applied throughout the project's evaluation period.

1.3.2 Retail Tariff Calculations

The principle of calculating the retail unit cost and hence cost covering tariff is based on the same principles as that used for bulk water. The main difference is a) that it also includes bulk water costs as detailed in the previous section and b) the unit cost considers the volume of water after water losses (NRW). It furthermore, also makes an attempt to consider financial losses (debtors) based on assumed collection efficiencies. Similar to bulk water costs, the calculations re provided and presented below, but the actual tariff applied is based on the current actual average tariff. Thus the following retail cost calculations are used as a guideline and should be a target for the utility to achieve. It is the basis of adopting a reducing tariff made possible as water and financial losses are gradually reduced in response to reforms and investments.

Table 1-3: Retail Cost Covering Tariff Calculations

Average Unit Retail Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021
Assumed unit cost for bulk water				USD/m³	-	-	-	-	-	-	-	-	-
Assumed unit abstraction cost				USD/m³	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Assumed unit power cost				USD/m³	0.0701	0.0701	0.0701	0.0701	0.0701	0.0701	0.0701	0.0812	0.0812
Assumed unit chemical cost				USD/m³	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		60%		USD/m³	-	0.0016	0.0033	0.0041	0.0268	0.0443	0.0574	0.0757	0.0936
Proportion of fixed costs		60%		USD/m³	0.2770	0.2776	0.1895	0.2029	0.1947	0.2122	0.2071	0.2022	0.1973
Proportion of Maintenance costs		60%		USD/m³	0.0235	0.0243	0.0266	0.0255	0.0356	0.0465	0.0572	0.0786	0.1015
Sub-total unit cost for water	Average	0.48		USD/m³	0.48	0.49	0.40	0.41	0.44	0.49	0.50	0.55	0.59
Adjustment for collection losses				USD/m³	0.28	0.24	0.16	0.12	0.09	0.07	0.05	0.03	0.03
Total average cost covering water tariff				USD/m³	0.77	0.73	0.56	0.54	0.53	0.56	0.55	0.58	0.61
Total average cost covering W&S tariff				USD/m³	1.09	1.03	0.77	0.74	0.73	0.79	0.79	0.83	0.89
Calculated sewerage charges				%	0.32	0.30	0.21	0.20	0.20	0.23	0.24	0.25	0.28
Calculated proportion of sewerage of Water					42%	41%	38%	37%	38%	41%	44%	43%	46%
Water tariff used in Fin Model	0%				*1.45*	*1.35*	*1.20*	*1.15*	*1.15*	*1.15*	*1.15*	*1.15*	*1.10*

Average Unit Retail Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2022	2023	2024	2025	2026	2027	2028	2029	2030
Number of vehicles				USD/m³	-	-	-	-	-	-	-	-	-
Number of Motor cycles				USD/m³	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Annual average distance by truck				USD/m³	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812
Annual vehicle operating cost				USD/m³	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		60%		USD/m³	0.0964	0.0999	0.0966	0.0913	0.1114	0.1291	0.1345	0.1261	0.1187
Proportion of fixed costs		60%		USD/m³	0.1927	0.1885	0.1817	0.1754	0.1694	0.1637	0.1583	0.1531	0.1482
Proportion of Maintenance costs		60%		USD/m³	0.1007	0.1001	0.0989	0.0978	0.0808	0.0839	0.0841	0.0828	0.0809
Sub-total unit cost for water	Average	#VALUE!		USD/m³	0.58	0.58	0.57	0.56	0.55	0.57	0.57	0.56	0.54
Adjustment for collection losses				USD/m³	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total average cost covering water tariff				USD/m³	0.61	0.61	0.60	0.59	0.58	0.60	0.60	0.58	0.57
Total average cost covering W&S tariff				USD/m³	0.88	0.88	0.86	0.84	0.84	0.86	0.86	0.84	0.81
Calculated sewerage charges				%	0.27	0.27	0.26	0.25	0.26	0.26	0.26	0.26	0.24
Calculated proportion of sewerage of Water					44%	44%	43%	42%	45%	43%	43%	45%	42%
Water tariff used in Fin Model	0%				*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*

The tariff actually applied and carried forward to the revenue calculation sheet of the financial model is high. This includes all fixed charges including sewerage, which at present is not charged on the basis of the volume of water consumed and billed. As mentioned in the foregoing, the average combined tariff (for water and sewerage) assumes to drop over time as efficiencies improve as expected.

1.3.3 Unit Chemical and Power Cost calculations

As outlined in the explanatory notes in the foregoing, the unit chemical and power costs re build from first principles as shown in the following set of tables.

Table 1-4: Unit Chemical Cost Calculations

Chemicals	UNIT	Surface	Borehole
Chlorine	USD/kg	*4*	*4*
Dosing rate	g/m³	*5*	*5*
Costs/m3	USD/m³	0.02	0.02
Alum	USD/kg	*0.4*	
Dosing rate	g/m³	*70*	
Costs/m3	USD/m³	0.028	
Lime	USD/kg	*0.65*	
Dosing rate	g/m³	*6*	
Costs/m3	USD/m³	0.0039	
Total Unit Chemical Cost	**USD/m³**	**0.0519**	**0.0200**

The unit cost of chemicals is calculated for two scenarios, (a) for surface water intakes and (b) borehole abstraction and the relevant cost is applied to the unit of water produced in the table above.

Table 1-5: Unit Power Cost Calculations

Power	UNIT		Mit-Term	Long-Term
Volume	m^3/h	*For details on Q & h refer to pumping tab*	3,513	4,633
Pumping head	H		101	117
Pump efficiency	%		0.72	0.72
KWh	KW/h	*Both the midium and long term unit cost calculations are linked to base year costs 2013*	492.7958	752.8625
Power consumption	KW/m^3		0.140278	0.1625
Cost/ KWh	USD/KWh		*0.5*	*0.5*
Cost per m3	**USD/m^3**		**0.0701**	**0.0813**

1.4 Detailed Revenue Calculations

Revenues from the sale of water and sewerage are the sole receivables recognised and incorporated in the model and. They are derived from the calculated estimates of volumes sold and the average combined tariff applied. The tariff, as mentioned in the foregoing, is a single charge expressed in USD/m^3 including all variable and fixed tariff elements, i.e. an overall (simplified) average tariff. A distinction is however made between the revenue from retail sales and bulk sales as the unit tariff rates are quite different.

The top part of the revenue table deals with water volumes for both bulk sales and retail sales, whereby the former is considered without NRW and the latter (retail) tariff is applied after NRW forecasts.

Although the revenue table is straight forward, relevant sections of the data is referenced with explanation notes on assumptions and calculation methods as provided for in the following table.

Table 1-6: Referenced Explanation Notes for Revenue Tables

Ref	Notes
[1]	It is not anticipated that Harare will be able to fully cover water demand until investments are made and efficiencies related to water losses (NRW) have improved significantly. To reflect this condition and hence shortfall in potential revenue from bulk water, a proportion is applied to the bulk supply that translates to revenue for Harare. With time and the ability to produce more water/loose less to NRW, the proportion of bulk water to the satellite towns and hence revenue to Harare for supplying this increased bulk water will increase.
[2]	NRW is aligned to currently reported levels and deemed to improve with reforms and future investments, whereby milestone targets are set for 2020 and 2030. The periods between these milestones are interpolated in a linear fashion.
[3]	Volumes of water sold in bulk and excluding bulk is based on estimated volumes of bulk water sold before NRW. Retail water sold on the other hand is considered as volumes after NRW. The tariffs for bulk and retail are different, in part to reflect the difference between inclusion and exclusion of NRW.
[4]	While detailed bulk tariff calculations are provided below the main cost table, the current existing bulk tariff is applied throughout.
[5]	The combined tariff includes water, sewerage and any fixed charge component applied as an overall unit tariff.
[6]	The collection efficiency in the base year appears to be an outlier compared to previous years. Future collection efficiencies are based on significantly improved and agreed milestones.
[7]	A proportion of old debt (3-years old) is assumed to be collected through assumed efforts including debt collectors and litigation.

To provide a baseline for comparison of different entities, i.e. Harare, Chitungwiza, Epworth, Norton Ruwa and Harare Water the key efficiencies modelled for Harare are applied to all other mentioned entities. The key revenue inputs are NRW, tariff and collection efficiency.

1.5 Financial Analysis Calculations

The main output of the financial model is the annual income statement, cash flow and balance sheet that draws on input data from the assets tables, the main cost and revenue tables, following the methodology outlined in the main text of Chapter 11.

The explanatory notes referenced in the various tables of the financial analysis are provided in the following table to support the data in terms of assumptions and calculation methodology.

Table 1-7: Referenced Explanation Notes for Financial Analysis Tables

Ref	Notes
[1]	Provision to write-off bad debt was set at 100 % throughout the evaluation period.
[2]	Depreciation for both existing and new assets is reflected here, as calculated in existing and Investment assets tables and allocated as per the main cost table.
[3]	Debtors are calculated as the difference between billing and cash collections for the respective year.
[4]	Partial debt recovery is calculated in the revenue table based on a small proportion of 3-year old debt recovered as cash collections.
[5]	With past history of deficit cash flow funded in part from creditors the entity has become uncreditworthy and future cash flow is based on a strictly cash on delivery basis, i.e. costs = expenditure.
[6]	The value of fixed assets is returned as the depreciated residual value of existing and investment assets calculated in the respective existing assets and investment assets tables.
[7]	Accumulated cash reserves/(deficit)
[8]	Debtors as defined under note [3].
[9]	Assume two months' worth of fixed costs (except personnel), variable and maintenance.
[10]	Balance of total assets and (less) long term liabilities.
[11]	The balance on loans is represented as long term liabilities.
[12]	

The output, in particular from the income statement and the cash flows are brought forward to the dashboard and other results tabulations and charts as presented in the main text of Chapter 11.

GREATER HARARE Detailed Cost Calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
VOLUMES																						
Average water demand			[1]	000 m^3	*162,790*	*162,790*	*203,907*	*201,797*	*199,686*	*197,576*	*195,466*	*193,356*	197,998	202,640	207,283	211,925	216,567	221,210	225,852	230,494	235,137	*239,779*
Peak water demand	Seasonal factor	*1.25*	[2]	000 m^3	203,488	203,488	254,884	252,246	249,608	246,970	244,333	241,695	247,498	253,301	259,103	264,906	270,709	276,512	282,315	288,118	293,921	299,724
Production Capacity				000 m^3	*162,790*	*162,790*	*246,010*	*246,010*	*246,010*	*246,010*	*246,010*	*246,010*	*246,010*	*282,510*	*282,510*	*282,510*	*282,510*	*282,510*	*282,510*	*282,510*	*300,760*	*300,760*
Treatment surplus/(deficit)			[2]		(40,698)	(40,698)	(8,874)	(6,236)	(3,598)	(960)	1,677	4,315	(1,488)	29,209	23,407	17,604	11,801	5,998	195	(5,608)	6,839	1,036
Raw Water			[3]	000 m^3	170,930	170,930	214,102	211,886	209,671	207,455	205,239	203,024	207,898	212,772	217,647	222,521	227,396	232,270	237,145	242,019	246,894	251,768
Assumed Production losses			[3]	%	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*
Water Produced			[4]	000 m^3	162,790	162,790	203,907	201,797	199,686	197,576	195,466	193,356	197,998	202,640	207,283	211,925	216,567	221,210	225,852	230,494	235,137	239,779
Proportion of bulk water available			[5]	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Water bought in bulk	Bulk available? (y/n)	*n*	[6]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water available			[7]	000 m^3	162,790	162,790	203,907	201,797	199,686	197,576	195,466	193,356	197,998	202,640	207,283	211,925	216,567	221,210	225,852	230,494	235,137	239,779
COST STREAMS																						
CAPITAL COSTS																						
Disbursements on capital investments			[8]																			
Disbursements from GHWSSIP grant				000 USD	-	720	2,944	2,000	100,520	89,517	46,679	46,679	44,679	-	-	-	-	102,714	102,714	52,737	-	-
Disbursements from GH WSSIP concessionary loan				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from GHWSSIP loan				000 USD	-	720	2,944	2,000	100,520	89,517	46,679	46,679	44,679	-	-	-	-	102,714	102,714	52,737	-	-
Disbursements from own resources				000 USD	-	-	-	-	-	15,196	15,196	15,196	3,481	1,185	3,481	40,651	18,677	18,677	18,677	10,374	8,079	10,374
Disbursements from external/private invest.				000 USD	-	29,215	29,215	29,215	29,215	29,215	29,215	29,215	62,336	62,336	62,336	62,336	62,336	62,336	62,336	62,336	62,336	62,336
Disbursements from CMEC				000 USD	-	129,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from ZimFund grant				000 USD	-	14,200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements for investments				000 USD	-	174,455	35,102	33,215	230,255	223,445	137,769	137,769	155,175	63,521	65,817	102,987	81,013	286,441	286,441	178,185	70,415	72,711
Repayments of principal	repay period																					
Repayment of GHWSSIP loan principal	*0 yr grace, repay*	*25 years*		000 USD	-	*29*	*147*	*227*	*4,247*	*7,828*	*9,695*	*11,562*	*13,350*	*13,350*	*13,350*	*13,350*	*13,350*	*17,458*	*21,567*	*23,676*	*23,676*	*23,676*
Repayment of CMEC principal	*3 yr grace, repay in*	*5 years*		000 USD					*25,920*	*25,920*	*25,920*	*25,920*	*25,920*							-	-	-
Total repayment of principal				000 USD	-	29	147	227	30,167	33,748	35,615	37,482	39,270	13,350	13,350	13,350	13,350	17,458	21,567	23,676	23,676	23,676
Balance on loans																						
Balance of concessionary loan principal	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance of GHWSSIP loan principal	year end			000 USD	-	691	3,488	5,262	101,534	183,223	220,207	255,324	286,653	273,304	259,954	246,605	233,255	318,511	399,659	428,719	405,043	381,367
Balance of CMEC loan	year end			000 USD	-	129,600	129,600	129,600	103,680	77,760	51,840	25,920	-	-	-	-	-	-	-	-	-	-
Total balance on loans	year end			000 USD	-	130,291	133,088	134,862	205,214	260,983	272,047	281,244	286,653	273,304	259,954	246,605	233,255	318,511	399,659	428,719	405,043	381,367
Interest on Loans																						
Interest on existing loans				000 USD																		
Interest on GHWSSIP loan	Interest rate	*5.0% p.a.*		000 USD	-	36	182	274	5,289	9,553	11,495	13,344	15,000	14,333	13,665	12,998	12,330	16,798	21,061	22,620	21,436	20,252
Interest on CMEC loan	Interest rate	*3.5% p.a.*		000 USD	-	4,536	4,536	4,536	4,536	3,629	2,722	1,814	907	-	-	-	-	-	-	-	-	-
Total interest on loans				000 USD	-	4,572	4,718	4,810	9,825	13,181	14,217	15,159	15,907	14,333	13,665	12,998	12,330	16,798	21,061	22,620	21,436	20,252
Depreciation																						
Depreciation on existing assets	Alloc of calc depr.	0%	[9]	000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed proportion of calc depreciation			[10]	%		5%	5%	5%	5%	5%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Depreciation on Capital Investment			[10]	000 USD		177	212	245	648	1,029	2,472	2,888	3,273	3,391	3,526	3,984	3,968	4,490	5,117	5,356	5,468	5,622
Sub-Total Capital Costs				000 USD	-	618,872	346,321	346,473	951,572	########	921,769	946,196	997,283	732,405	709,097	755,863	683,864	########	########	########	########	########
OPERATION - Variable																						
Bulk water	N/A																					
Assumed unit cost for bulk water	N/A		[11]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Annual bulk water cost	N/A			000 USD																		
Abstraction																						
Assumed unit abstraction cost	inflation	*0% p.a.*		USD/m^3	*0.06*	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Adjust (actual/desired level) on existing	gradual		[12]	%	*0%*	*0%*	*5%*	*5%*	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*	*100%*	*100%*	*100%*	*100%*
Annual abstraction cost				000 USD	-	-	642	636	1,258	2,489	3,694	4,873	6,237	7,660	9,141	10,681	12,279	13,936	14,229	14,521	14,814	15,106
Power																						
Assumed unit power cost	Inflation	*0% p.a.*	[13]	USD/m^3	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Annual power cost				000 USD	11,418	11,418	14,302	14,154	14,006	13,858	13,710	15,710	16,087	16,465	16,842	17,219	17,596	17,973	18,350	18,728	19,105	19,482
Chemical																						
Assumed unit chemical cost	Inflation p.a.	*0% p.a.*	[14]	USD/m^3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Annual chemical cost				000 USD	8,449	8,449	10,583	10,473	10,364	10,254	10,145	10,035	10,276	10,517	10,758	10,999	11,240	11,481	11,722	11,963	12,204	12,445
Sub-Total Variable Costs				000 USD	**19,867**	**19,867**	**25,527**	**25,263**	**25,628**	**26,601**	**27,549**	**30,618**	**32,600**	**34,641**	**36,741**	**38,899**	**41,115**	**43,390**	**44,301**	**45,211**	**46,122**	**47,033**
OPERATION - Fixed																						
Personnel			[15]	000 USD	26,395	26,392	30,876	32,692	34,508	36,981	36,981	36,981	36,981	36,981	36,981	36,981	36,981	36,981	36,981	36,981	36,981	36,981
Transport			[16]																			
Number of vehicles				No.	*25*	20	20	20	20	*35*	35	35	35	35	35	35	35	35	35	35	35	35
Number of Motor cycles				No	*50*	40	40	40	40	*60*	60	60	60	60	60	60	60	60	60	60	60	60
Number of Trucks				No	*5*	4	4	4	4	*7*	7	7	7	7	7	7	7	7	7	7	7	7
Assumed unit fuel cost	0% p.a.			USD/litre	*1.25*	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Annual vehicle operating cost				000 USD	141	113	113	113	113	191	191	191	191	191	191	191	191	191	191	191	191	191
Other administration costs	% of personnel	*15%*	[17]	000 USD	3,959	3,959	4,631	4,904	5,176	5,547	5,547	5,547	5,547	5,547	5,547	5,547	5,547	5,547	5,547	5,547	5,547	5,547
Sub-Total Fixed Costs				000 USD	**30,495**	**30,463**	**35,620**	**37,708**	**39,797**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**	**42,719**
MAINTENANCE																						
Adjust (actual/desired level) on maintenan	gradual		[18]	%	*10%*	*10%*	*15%*	*20%*	*25%*	*30%*	*35%*	*40%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*
Existing assets				000 USD	2,779	2,779	4,141	5,521	6,902	8,282	9,522	10,818	13,523	13,517	13,516	13,516	13,514	9,354	9,354	8,721	8,706	8,504
GHWSSIP Investments				000 USD	-	40	122	226	1,102	2,299	3,411	4,732	7,037	7,438	7,863	8,672	9,254	10,793	12,331	13,122	13,594	14,090
Other investments				000 USD	-	216	324	431	539	647	755	863	1,079	1,079	1,079	1,079	1,079	1,079	1,079	1,079	1,079	1,079
Sub-Total Maintenance				000 USD	**2,779**	**3,035**	**4,587**	**6,179**	**8,543**	**11,228**	**13,688**	**16,413**	**21,638**	**22,033**	**22,457**	**23,266**	**23,846**	**21,226**	**22,764**	**22,921**	**23,379**	**23,673**

Average Unit Bulk Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit abstraction cost				USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

GREATER HARARE Detailed Cost Calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit power cost				USD/m^3	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125
Assumed unit chemical cost				USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		25%		USD/m^3	-	0.0003	0.0005	0.0006	0.0074	0.0134	0.0179	0.0210	0.0231	0.0219	0.0207	0.0200	0.0188	0.0241	0.0290	0.0303	0.0286	0.0270
Proportion of fixed costs		25%		USD/m^3	0.0468	0.0468	0.0437	0.0467	0.0498	0.0541	0.0546	0.0552	0.0539	0.0527	0.0515	0.0504	0.0493	0.0483	0.0473	0.0463	0.0454	0.0445
Proportion of Maintenance costs		30%		USD/m^3	0.0051	0.0056	0.0067	0.0092	0.0128	0.0170	0.0210	0.0255	0.0328	0.0326	0.0325	0.0329	0.0330	0.0288	0.0302	0.0298	0.0298	0.0296
Sub-total unit cost for water	Average	0.28		USD/m^3	**0.23**	**0.23**	**0.23**	**0.24**	**0.25**	**0.27**	**0.28**	**0.29**	**0.30**	**0.30**	**0.30**	**0.30**	**0.29**	**0.29**	**0.30**	**0.30**	**0.30**	**0.29**

Average Unit Retail Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit cost for bulk water				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed unit abstraction cost				USD/m^3	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Assumed unit power cost				USD/m^3	0.0701	0.0701	0.0701	0.0701	0.0701	0.0701	0.0701	0.0813	0.0813	0.0813	0.0813	0.0813	0.0813	0.0813	0.0813	0.0813	0.0813	0.0813
Assumed unit chemical cost				USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		60%		USD/m^3	-	0.0016	0.0022	0.0028	0.0301	0.0511	0.0645	0.0720	0.0780	0.0729	0.0682	0.0650	0.0602	0.0760	0.0903	0.0934	0.0869	0.0809
Proportion of fixed costs		60%		USD/m^3	0.2498	0.2312	0.2010	0.2012	0.2017	0.2064	0.1974	0.1894	0.1823	0.1757	0.1694	0.1634	0.1578	0.1525	0.1474	0.1426	0.1380	0.1336
Proportion of Maintenance costs		60%		USD/m^3	0.0228	0.0230	0.0259	0.0330	0.0433	0.0542	0.0633	0.0728	0.0924	0.0906	0.0890	0.0890	0.0881	0.0758	0.0785	0.0765	0.0755	0.0740
Sub-total unit cost for water	Average	0.49		USD/m^3	0.45	0.44	0.41	0.42	0.46	0.49	0.51	0.53	0.55	0.53	0.52	0.51	0.50	0.50	0.51	0.51	0.49	0.48
Adjustment for collection losses				USD/m^3	0.25	0.22	0.16	0.13	0.09	0.07	0.05	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.02	0.02
Total average cost covering water tariff				USD/m^3	0.70	0.66	0.58	0.54	0.55	0.57	0.56	0.55	0.57	0.56	0.55	0.54	0.52	0.52	0.53	0.53	0.52	0.51
Total average cost covering W&S tariff				USD/m^3	0.99	0.91	0.79	0.75	0.77	0.81	0.80	0.79	0.82	0.80	0.77	0.76	0.74	0.74	0.76	0.75	0.73	0.71
Calculated sewerage charges				%	0.29	0.25	0.21	0.21	0.22	0.24	0.24	0.24	0.25	0.24	0.22	0.22	0.22	0.22	0.23	0.22	0.21	0.20
Calculated proportion of sewerage of Water					41%	38%	36%	39%	40%	42%	43%	44%	44%	43%	40%	41%	42%	42%	43%	42%	40%	39%
Water tariff used in Fin Model	0%				***1.45***	***1.35***	***1.20***	***1.15***	***1.15***	***1.15***	***1.15***	***1.15***	***1.10***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***

Unit Costs

Chemicals	UNIT	Borehole
Chlorine	USD/kg	*4*
Dosing rate	g/m^3	*5*
Costs/m3	USD/m^3	0.02
Alum	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Lime	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Total Unit Chemical Cost	**USD/m^3**	**0.0200**

The unit cost of chemicals is calculated for two scenarios, (a) for surface water intakes and (b) borehole abstraction and the relevant cost is applied to the unit of water produced

Power	UNIT	Long-Term
Volume	m^3/h	*4,633*
Pumping head	H	*117*
Pump efficiency	%	0.72
KWh	KW/h	752.8625
Power consumption	KW/m^3	0.1625
Cost/ KWh	USD/KWh	*0.5*
Cost per m3	**USD/m^3**	**0.0813**

For details on Q & h refer to

Both the midium and long term unit cost

Explanation notes for referenced items above:

[1] Water demand projected for 2013, 2020 and 2030 representing three milestones. The periods between these were interpolated on a linear basis.
[2] The peak seasonal factor and peak demand are calculated as a function of average demand and used to ascertain the production surplus/(deficit).
[3] Production losses attributable to backwash, flushing and other cleaning operations are assumed to increase the abstraction of raw water.
[4] The water produced is the volume of water after production losses equal to either the demand or the production capacity, whichever smaller.
[5] The proportion of bulk water available may be less than 100 % in the event that bulk water supply is practically throttled or cannot be produced.
[6] If the entity does not produce (adequate) water and bulk water is available (even if only limited), the assumed volumes of water bought are calculated considering demand, own production and proportional available.
[7] The volume of water available is the addition of water produced plus water bought in bulk (if any).
[8] Details on funding of investments are provided in a separate table (see Investment Assets Tab)..
[9] Depreciation is based on replacement value and economic life. In view of recent financial performance it is not realistic to bring these calculated costs to account, thus, the depreciation for existing assets was set to nil through entry
[10] As with existing assets, the full annual value of depreciation of new assets is high and realistically not a priority and therefore revised downward.
[11] Bulk water costs are calculated separately; considering abstraction, power, chemicals, financial, fixed and maintenance costs and compared with current levels.
[12] Abstraction costs are gradually adjusted from current payment levels to required levels.
[13] Unit power costs for pumping are calculated on the basis of current and anticipated Q & h values and pumping times as detailed in a separate table (see Pumping tab).
[14] Unit chemical costs are calculated for surface water and borehole abstraction and applied accordingly; they include treatment chemicals (aluminium sulphate, lime) and disinfection (chlorine) as detailed in a separate table below the
[15] Personnel costs are based on separately calculated (see HR tab) number of staff, assumed scales, allowances, contribution to pension, etc. and a % allocation to water and sanitation to take into account recharges for other
[16] The calculation of transport costs is based on the number of units, average annual distance travelled/hours worked, fuel consumption per km/hr. and fuel price.
[17] Other administration costs including insurance, external professional fees (e.g. audit), office stationery, office utilities, etc. are estimated as a proportion of employment costs.
[18] Desired and ideal maintenance costs are calculated for both existing and future assets, but are high and from past experience not realistic to apply the full cost. Therefore, an adjustment of the desired to the realistic level is carried

GREATER HARARE Detailed revenue calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WATER VOLUMES																						
Water Produced	From cost table			000 m^3	162,790	162,790	203,907	201,797	199,686	197,576	195,466	193,356	197,998	202,640	207,283	211,925	216,567	221,210	225,852	230,494	235,137	239,779
Water bought in bulk	From cost table			000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Demand for bulk water				000 m^3	38,015	37,411	38,814	40,217	41,620	43,023	40,776	42,180	43,269	44,359	45,449	46,538	47,628	48,718	49,808	50,897	51,987	53,077
Assumed proportion of bulk water supplied			[1]	%																		
Water sold in bulk	Sum of satellites		[1]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Water available				000 m^3	162,790	162,790	203,907	201,797	199,686	197,576	195,466	193,356	197,998	202,640	207,283	211,925	216,567	221,210	225,852	230,494	235,137	239,779
Non-Revenue Water (NRW)			[2]	%	*55%*	51%	48%	44%	41%	37%	34%	*30%*	29%	28%	27%	26%	25%	24%	23%	22%	21%	*20%*
NRW reduction			[2]	%		3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Total volumes billed incl. [sold] bulk				000 m^3	73,256	79,069	106,323	112,430	118,386	124,191	129,845	135,349	140,579	145,901	151,316	156,825	162,426	168,119	173,906	179,786	185,758	191,823
Total Volumes Billed [Sold] excl. bulk			[3]	000 m^3	73,256	79,069	106,323	112,430	118,386	124,191	129,845	135,349	140,579	145,901	151,316	156,825	162,426	168,119	173,906	179,786	185,758	191,823
REVENUE STREAMS																						
Assumed tariff for Bulk Supply (if any)	Keep current levels		[4]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Combined average retail tariff (simplified)	Water + Sewer incl fixed		[5]	USD/m^3	1.45	1.35	1.20	1.15	1.15	1.15	1.15	1.15	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Calculated Bulk Sales				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calculated Combined Retail Sales				000 USD	106,220	106,744	127,587	129,294	136,143	142,819	149,322	155,651	154,637	131,311	136,185	141,142	146,183	151,307	156,516	161,807	167,182	172,641
Total Billing for Water & Sewerage				000 USD	106,220	106,744	127,587	129,294	136,143	142,819	149,322	155,651	154,637	131,311	136,185	141,142	146,183	151,307	156,516	161,807	167,182	172,641
Collection Efficiency			[6]	%	*45%*	*50%*	*60%*	*70%*	*80%*	*85%*	*90%*	*95%*	*95%*	*95%*	*95%*	*95%*	*95%*	*95%*	*95%*	*95%*	*95%*	*95%*
Collections from Water & Sewerage				000 USD	47,799	53,372	76,552	90,506	108,915	121,396	134,390	147,869	146,905	124,745	129,376	134,085	138,874	143,742	148,690	153,717	158,823	164,009
Other revenue (recovery of old debt)	% of 3 year debt	*5.0%*	[7]	000 USD		2,315	2,555	2,921	2,669	2,552	1,939	1,361	1,071	747	389	387	328	340	353	365	378	391
Total revenue collection				000 USD	47,799	55,687	79,107	93,427	111,583	123,948	136,329	149,230	147,976	125,492	129,765	134,472	139,202	144,083	149,043	154,082	159,201	164,400

Explanation notes for referenced items above:

[1] It is not anticipated that Harare will be able to fully cover water demand until investments are made and efficiencies have improved. To reflect this condition, a proportion of bulk supply reflected as revenue for
[2] NRW is aligned to curredntly reported levels and deemed to improve with reforms and future investments, whereby milestone targets are set for 2020 and 2030.
[3] Volumes of water sold bulk and excl bulk is based on bulk sold before NRW and retail after NRW at different tariffs
[4] While detailed bulk tariff calculations are provided below the main cost table, the current existing bulk tariff is applied throughout.
[5] The combined tariff includes water, sewerage and any fixed charge component applied as an overall unit tariff.
[6] The collection efficiency in the base year appears to be anoutlier compared to previous years. Future collection efficiencies are based o agreed milestones.
[7] A proportion of old debt (3-years old) is assumed to be collected.

GREATER HARARE
INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income Streams																				
Bulk sales		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Water & Sewerage		000 USD	106,220	106,744	127,587	129,294	136,143	142,819	149,322	155,651	154,637	131,311	136,185	141,142	146,183	151,307	156,516	161,807	167,182	172,641
Sub-Total		000 USD	106,220	106,744	127,587	129,294	136,143	142,819	149,322	155,651	154,637	131,311	136,185	141,142	146,183	151,307	156,516	161,807	167,182	172,641
Cost Streams [=Expenditure]																				
Operation - Fixed Costs		000 USD	30,495	30,463	35,620	37,708	39,797	42,719	42,719	42,719	42,719	42,719	42,719	42,719	42,719	42,719	42,719	42,719	42,719	42,719
Operation - Variable		000 USD	19,867	19,867	25,527	25,263	25,628	26,601	27,549	30,618	32,600	34,641	36,741	38,899	41,115	43,390	44,301	45,211	46,122	47,033
Maintenance		000 USD	2,779	3,035	4,587	6,179	8,543	11,228	13,688	16,413	21,638	22,033	22,457	23,266	23,846	21,226	22,764	22,921	23,379	23,673
Capital Charges		000 USD	-	4,572	4,718	4,810	9,825	13,181	14,217	15,159	15,907	14,333	13,665	12,998	12,330	16,798	21,061	22,620	21,436	20,252
Sub-Total		000 USD	53,140	57,936	70,451	73,960	83,792	93,729	98,172	104,908	112,865	113,726	115,582	117,882	120,011	124,133	130,845	133,472	133,656	133,677
Surplus/(Deficit)		000 USD	**53,080**	**48,808**	**57,137**	**55,334**	**52,351**	**49,090**	**51,150**	**50,743**	**41,772**	**17,585**	**20,603**	**23,261**	**26,172**	**27,174**	**25,670**	**28,336**	**33,526**	**38,964**

ADJUSTED INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income																				
Total Income		000 USD	106,220	106,744	127,587	129,294	136,143	142,819	149,322	155,651	154,637	131,311	136,185	141,142	146,183	151,307	156,516	161,807	167,182	172,641
Expenditure																				
Total Expenses		000 USD	53,140	57,936	70,451	73,960	83,792	93,729	98,172	104,908	112,865	113,726	115,582	117,882	120,011	124,133	130,845	133,472	133,656	133,677
Provision for debt write-off	[1]	000 USD	29,211	53,372	51,035	38,788	27,229	21,423	14,932	7,783	7,732	6,566	6,809	7,057	7,309	7,565	7,826	8,090	8,359	8,632
Depreciation	[2]	000 USD	-	177	212	245	648	1,029	2,473	2,888	3,273	3,391	3,526	3,984	3,968	4,490	5,117	5,356	5,468	5,622
Total Expenses incl. Depreciation		000 USD	82,351	111,485	121,698	112,994	111,669	116,181	115,577	115,579	123,870	123,683	125,917	128,923	131,288	136,189	143,788	146,918	147,483	147,931
Adjusted Surplus/(Deficit)		000 USD	**23,870**	**(4,742)**	**5,890**	**16,300**	**24,474**	**26,638**	**33,745**	**40,073**	**30,767**	**7,628**	**10,268**	**12,219**	**14,895**	**15,119**	**12,727**	**14,889**	**19,700**	**24,710**

CASH FLOW STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cash Flow from Operating Activities																				
Profit/(loss) from income statement		000 USD	23,870	(4,742)	5,890	16,300	24,474	26,638	33,745	40,073	30,767	7,628	10,268	12,219	14,895	15,119	12,727	14,889	19,700	24,710
Adjust for non-cash items		000 USD																		
Depreciation	[2]	000 USD	0	177	212	(245)	648	1,029	2,473	2,888	3,273	3,391	3,526	3,984	3,968	4,490	5,117	5,356	5,468	5,622
Provision for debt write-off		000 USD	29,211	53,372	51,035	38,788	27,229	21,423	14,932	7,783	7,732	6,566	6,809	7,057	7,309	7,565	7,826	8,090	8,359	8,632
Net adjusted income for the year		000 USD	53,080	48,808	57,137	54,843	52,351	49,090	51,150	50,743	41,772	17,585	20,603	23,261	26,172	27,174	25,670	28,336	33,526	38,964
Adjust for Change in Working Capital																				
(Increase)/Decrease in debtors	[3]	000 USD	(58,421)	(53,372)	(51,035)	(38,788)	(27,229)	(21,423)	(14,932)	(7,783)	(7,732)	(6,566)	(6,809)	(7,057)	(7,309)	(7,565)	(7,826)	(8,090)	(8,359)	(8,632)
Partial debt recovery	[4]	000 USD	0	2,315	2,555	2,921	2,669	2,552	1,939	1,361	1,071	747	389	387	328	340	353	365	378	391
Increase/(Decrease) in creditors	[5]	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net change in working capital		000 USD	(58,421)	(51,057)	(48,480)	(35,867)	(24,560)	(18,871)	(12,993)	(6,421)	(6,661)	(5,819)	(6,420)	(6,671)	(6,981)	(7,225)	(7,473)	(7,725)	(7,981)	(8,241)
Cash Flow from Investment Activities																				
Repayment of principal		000 USD	0	(29)	(147)	(227)	(30,167)	(33,748)	(35,615)	(37,482)	(39,270)	(13,350)	(13,350)	(13,350)	(13,350)	(17,458)	(21,567)	(23,676)	(23,676)	(23,676)
Net change generaged by/(used in investment activit		000 USD	0	(29)	(147)	(227)	(30,167)	(33,748)	(35,615)	(37,482)	(39,270)	(13,350)	(13,350)	(13,350)	(13,350)	(17,458)	(21,567)	(23,676)	(23,676)	(23,676)
Cash Flow																				
Net increase/(decrease) in cash & equiv.		000 USD	(5,341)	(2,278)	8,510	18,749	(2,376)	(3,529)	2,542	6,840	(4,158)	(1,583)	833	3,241	5,842	2,491	(3,369)	(3,065)	1,870	7,047
Cash & cash equiv. at beginning of year		000 USD	0	(5,341)	(7,619)	891	19,641	17,264	13,735	16,277	23,117	18,958	17,375	18,208	21,449	27,291	29,782	26,413	23,347	25,217
Cash & cash equivalents at end of year		**000 USD**	**(5,341)**	**(7,619)**	**891**	**19,641**	**17,264**	**13,735**	**16,277**	**23,117**	**18,958**	**17,375**	**18,208**	**21,449**	**27,291**	**29,782**	**26,413**	**23,347**	**25,217**	**32,264**

BALANCE SHEET (Simplified)

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets																				
Fixed Assets	[6]																			
Existing Plant & equipment			891,515	855,793	820,071	784,749	749,427	714,104	678,782	644,127	609,632	575,136	540,654	506,176	471,698	437,227	411,076	384,925	360,042	335,225
Future Plant & equipment				29,988	63,725	94,908	315,074	520,823	636,743	748,511	873,830	906,316	939,750	1,005,772	1,049,976	1,294,394	1,532,539	1,660,039	1,678,653	1,698,019
Total Fixed Assets			891,515	885,781	883,796	879,656	1,064,500	1,234,927	1,315,526	1,392,638	1,483,462	1,481,452	1,480,403	1,511,947	1,521,674	1,731,621	1,943,615	2,044,964	2,038,695	2,033,244
Current Assets & Liabilities																				
Short term assets (cash)	[7]		(5,341)	(7,619)	891	19,641	17,264	13,735	16,277	23,117	18,958	17,375	18,208	21,449	27,291	29,782	26,413	23,347	25,217	32,264
Debtors	[8]		26,555	26,686	31,897	32,323	34,036	35,705	37,331	38,913	38,659	32,828	34,046	35,286	36,546	37,827	39,129	40,452	41,796	43,160
Creditors	[9]		(4,458)	(4,495)	(5,810)	(6,076)	(6,576)	(7,261)	(7,829)	(8,795)	(9,996)	(10,402)	(10,823)	(11,317)	(11,783)	(11,726)	(12,134)	(12,312)	(12,540)	(12,741)
Net Current Assets			16,757	14,571	26,978	45,888	44,724	42,179	45,778	53,235	47,621	39,801	41,432	45,417	52,053	55,883	53,408	51,487	54,473	62,684
Total Assets			**908,272**	**900,352**	**910,774**	**925,544**	**1,109,224**	**1,277,106**	**1,361,304**	**1,445,873**	**1,531,083**	**1,521,253**	**1,521,835**	**1,557,365**	**1,573,727**	**1,787,505**	**1,997,023**	**2,096,451**	**2,093,167**	**2,095,928**
Equity & Liabilites																				
Equity	[10]		908,272	770,061	777,686	790,682	904,010	1,016,123	1,089,257	1,164,629	1,244,430	1,247,949	1,261,881	1,310,760	1,340,472	1,468,993	1,597,364	1,667,732	1,688,124	1,714,561
Long Term liabilities	[11]		0	130,291	133,088	134,862	205,214	260,983	272,047	281,244	286,653	273,304	259,954	246,605	233,255	318,511	399,659	428,719	405,043	381,367
Total Equity & Liabilities			**908,272**	**900,352**	**910,774**	**925,544**	**1,109,224**	**1,277,106**	**1,361,304**	**1,445,873**	**1,531,083**	**1,521,253**	**1,521,835**	**1,557,365**	**1,573,727**	**1,787,505**	**1,997,023**	**2,096,451**	**2,093,167**	**2,095,928**

notes for referenced items above:

[1] Provisions to write off bad debt was set at 50 % in the base year and 100 % thereafter to gradually introduce the concept which does not appear to be ccarried out currently.
[2] Depreciation for both existing and new assets is reflected here, as calculated in existing and Investment assets tabs and allocated as per the main cost table under the Cost tab.
[3] Debtors are calculated as the difference between billing and cash collections for the respective year.
[4] Partial debt recovery is calculated in the revenue table based on a small proportion of 3-year old debt recovered as cash collections.
[5] With past history of deficit cash flow funded in part from creditors the entity has become uncreditworthy and future cash flow is based on a strictly cash on delivery basis, i.e. costs = expenditure.
[6] The value of fixed assets is returned as the depreciated residual value of existing and investment assets calculated in the respective existing assets and investment assets tabs.
[7] Accumulated cash reserves/(deficit)
[8] Debtors as defined under note [3]
[9] Asume two months worth of fixed costs (except personnel), variable and maintenance.
[10] Balance of total assets and (less) long term liabilities.
[11] The balance on loans is represented as long term liabilities.

HARARE Detailed Cost Calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
VOLUMES																						
Average water demand			[1]	000 m^3	*162,060*	*160,053*	*201,169*	*199,059*	*196,949*	*194,839*	*189,078*	*186,968*	191,610	196,252	200,895	205,537	210,179	214,822	219,464	224,106	228,749	*233,391*
Peak water demand	Seasonal factor	*1.25*	[2]	000 m^3	202,575	200,066	251,462	248,824	246,186	243,548	236,348	233,710	239,513	245,316	251,118	256,921	262,724	268,527	274,330	280,133	285,936	291,739
Production Capacity				000 m^3	*162,790*	*162,790*	*246,010*	*246,010*	*246,010*	*246,010*	*246,010*	*246,010*	*246,010*	*282,510*	*282,510*	*282,510*	*282,510*	*282,510*	*282,510*	*282,510*	*300,760*	*300,760*
Treatment surplus/(deficit)			[2]		(39,785)	(37,276)	(5,452)	(2,814)	(176)	2,462	9,662	12,300	6,497	37,194	31,392	25,589	19,786	13,983	8,180	2,377	14,824	9,021
Raw Water			[3]	000 m^3	170,163	168,055	211,228	209,012	206,796	204,581	198,532	196,316	201,191	206,065	210,940	215,814	220,688	225,563	230,437	235,312	240,186	245,061
Assumed Production losses			[3]	**%**	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*
Water Produced			[4]	000 m^3	162,060	160,053	201,169	199,059	196,949	194,839	189,078	186,968	191,610	196,252	200,895	205,537	210,179	214,822	219,464	224,106	228,749	233,391
Proportion of bulk water available			[5]	%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%	100%	100%	100%	100%	100%	100%	100%
Water bought in bulk	Bulk available? (y/n)	*n*	[6]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water available			[7]	000 m^3	162,061	160,053	201,170	199,060	196,950	194,839	189,079	186,969	191,611	196,253	200,896	205,538	210,180	214,823	219,465	224,107	228,750	233,392
COST STREAMS																						
CAPITAL COSTS																						
Disbursements on capital investments			[8]																			
Disbursements from GHWSSIP grant				000 USD	-	-	2,000	2,000	63,207	54,539	46,679	46,679	44,679	-	-	-	-	79,706	79,706	52,697	-	-
Disbursements from GH WSSIP concessionary loan				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from GHWSSIP loan				000 USD	-	-	2,000	2,000	63,207	54,539	46,679	46,679	44,679	-	-	-	-	79,706	79,706	52,697	-	-
Disbursements from own resources				000 USD	-	-	-	-	-	15,196	15,196	15,196	2,678	383	2,678	17,874	17,874	17,874	17,874	8,133	5,837	8,133
Disbursements from external/private invest.				000 USD	-	21,726	21,726	21,726	21,726	21,726	21,726	21,726	48,235	48,235	48,235	48,235	48,235	48,235	48,235	48,235	48,235	48,235
Disbursements from CMEC				000 USD	-	129,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from ZimFund grant				000 USD	-	14,200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements for investments				000 USD	-	165,526	25,726	25,726	148,140	146,000	130,280	130,280	140,272	48,618	50,914	66,110	66,110	225,521	225,521	161,762	54,073	56,368
Repayments of principal	repay period																					
Repayment of GHWSSIP loan principal	*0 yr grace, repay*	*20 years*		000 USD	-	-	*100*	*200*	*3,360*	*6,087*	*8,421*	*10,755*	*12,989*	*12,989*	*12,989*	*12,989*	*12,989*	*16,974*	*20,960*	*23,595*	*23,595*	*23,595*
Repayment of CMEC principal	*3 yr grace, repay in*	*5 years*		000 USD					*25,920*	*25,920*	*25,920*	*25,920*	*25,920*							-	-	-
Total repayment of principal				000 USD	-	-	100	200	29,280	32,007	34,341	36,675	38,909	12,989	12,989	12,989	12,989	16,974	20,960	23,595	23,595	23,595
Balance on loans																						
Balance of concessionary loan principal	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance of GHWSSIP loan principal	year end			000 USD	-	-	1,900	3,700	63,547	111,998	150,256	186,180	217,870	204,881	191,891	178,902	165,913	228,644	287,390	316,492	292,898	269,303
Balance of CMEC loan	year end			000 USD	-	129,600	129,600	129,600	103,680	77,760	51,840	25,920	-	-	-	-	-	-	-	-	-	-
Total balance on loans	year end			000 USD	-	129,600	131,500	133,300	167,227	189,758	202,096	212,100	217,870	204,881	191,891	178,902	165,913	228,644	287,390	316,492	292,898	269,303
Interest on Loans																						
Interest on existing loans				000 USD																		
Interest on GHWSSIP loan	Interest rate	*5.0% p.a.*		000 USD	-	-	100	195	3,345	5,904	7,934	9,847	11,543	10,893	10,244	9,595	8,945	12,281	15,417	17,004	15,825	14,645
Interest on CMEC loan	Interest rate	*3.5% p.a.*		000 USD	-	4,536	4,536	4,536	4,536	3,629	2,722	1,814	907	-	-	-	-	-	-	-	-	-
Total interest on loans				000 USD	-	4,536	4,636	4,731	7,881	9,533	10,655	11,661	12,450	10,893	10,244	9,595	8,945	12,281	15,417	17,004	15,825	14,645
Depreciation																						
Depreciation on existing assets	Alloc of calc depr.	0%	[9]	000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed proportion of calc depreciation	Gradual increase		[10]	%		*5%*	*10%*	*10%*	*10%*	*10%*	*10%*	*15%*	*20%*	*25%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*
Depreciation on Capital Investment			[10]	000 USD		169	388	438	998	1,541	1,939	3,507	5,372	6,933	8,641	9,355	9,608	11,147	12,694	13,280	13,525	13,899
Sub-Total Capital Costs				000 USD	-	599,492	324,311	328,351	706,053	756,137	756,684	784,939	824,373	561,696	540,718	544,547	517,523	977,988	########	########	786,305	741,721
OPERATION - Variable																						
Bulk water	N/A																					
Assumed unit cost for bulk water	N/A		[11]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Annual bulk water cost	N/A			000 USD																		
Abstraction																						
Assumed unit abstraction cost	inflation	*0% p.a.*		USD/m^3	*0.06*	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Adjust (actual/desired level) on existing	gradual		[12]	%	*0%*	*0%*	*5%*	*5%*	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*	*100%*	*100%*	*100%*	*100%*
Annual abstraction cost				000 USD	-	-	634	627	1,241	2,455	3,574	4,712	6,036	7,418	8,859	10,359	11,917	13,534	13,826	14,119	14,411	14,704
Power																						
Assumed unit power cost	Inflation	*0% p.a.*	[13]	USD/m^3	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Annual power cost				000 USD	11,367	11,226	14,110	13,962	13,814	13,666	13,262	15,191	15,568	15,946	16,323	16,700	17,077	17,454	17,831	18,209	18,586	18,963
Chemical																						
Assumed unit chemical cost	Inflation p.a.	*0% p.a.*	[14]	USD/m^3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Annual chemical cost				000 USD	8,411	8,307	10,441	10,331	10,222	10,112	9,813	9,704	9,945	10,186	10,426	10,667	10,908	11,149	11,390	11,631	11,872	12,113
Sub-Total Variable Costs				000 USD	**19,778**	**19,533**	**25,184**	**24,920**	**25,276**	**26,233**	**26,648**	**29,606**	**31,549**	**33,549**	**35,609**	**37,726**	**39,903**	**42,137**	**43,048**	**43,958**	**44,869**	**45,780**
OPERATION - Fixed																						
Personnel			[15]	000 USD	23,001	24,639	23,309	26,223	26,223	29,542	29,542	29,542	29,542	29,542	29,542	29,542	29,542	29,542	29,542	29,542	29,542	29,542
Transport			[16]																			
Number of vehicles				No.	*25*	20	20	20	20	*35*	35	35	35	35	35	35	35	35	35	35	35	35
Number of Motor cycles				No	*50*	40	40	40	40	*60*	60	60	60	60	60	60	60	60	60	60	60	60
Number of Trucks				No	*5*	4	4	4	4	*7*	7	7	7	7	7	7	7	7	7	7	7	7
Assumed unit fuel cost	0% p.a.			USD/litre	*1.25*	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Annual vehicle operating cost				000 USD	141	113	113	113	113	191	191	191	191	191	191	191	191	191	191	191	191	191
Other administration costs	% of personnel	*20%*	[17]	000 USD	4,600	4,928	4,662	5,245	5,245	5,908	5,908	5,908	5,908	5,908	5,908	5,908	5,908	5,908	5,908	5,908	5,908	5,908
Sub-Total Fixed Costs				000 USD	**27,741**	**29,680**	**28,083**	**31,580**	**31,580**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**	**35,641**
MAINTENANCE																						
Adjust (actual/desired level) on maintenanc	Gradual increase		[18]	%	*10%*	*10%*	*15%*	*20%*	*25%*	*30%*	*35%*	*40%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*
Existing assets				000 USD	2,356	2,356	3,533	4,711	5,889	7,067	8,105	9,199	11,498	11,492	11,492	11,492	11,492	7,332	7,332	7,332	7,332	7,132
GHWSSIP Investments				000 USD	-	29	88	159	792	1,663	2,631	3,796	5,756	6,046	6,359	6,830	7,301	8,580	9,859	10,522	10,869	11,238
Other investments				000 USD	-	216	324	431	539	647	755	863	1,079	1,079	1,079	1,079	1,079	1,079	1,079	1,079	1,079	1,079
Sub-Total Maintenance				000 USD	**2,356**	**2,601**	**3,945**	**5,301**	**7,221**	**9,377**	**11,491**	**13,858**	**18,333**	**18,616**	**18,930**	**19,400**	**19,871**	**16,991**	**18,270**	**18,933**	**19,279**	**19,449**

Average Unit Bulk Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit abstraction cost				USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Assumed unit power cost				USD/m^3	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125
Assumed unit chemical cost				USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		40%		USD/m^3	-	0.0004	0.0010	0.0013	0.0088	0.0153	0.0209	0.0286	0.0353	0.0363	0.0376	0.0369	0.0353	0.0436	0.0512	0.0541	0.0513	0.0489
Proportion of fixed costs		40%		USD/m^3	0.0685	0.0742	0.0558	0.0635	0.0641	0.0732	0.0754	0.0763	0.0744	0.0726	0.0710	0.0694	0.0678	0.0664	0.0650	0.0636	0.0623	0.0611
Proportion of Maintenance costs		40%		USD/m^3	0.0058	0.0065	0.0078	0.0107	0.0147	0.0193	0.0243	0.0296	0.0383	0.0379	0.0377	0.0378	0.0378	0.0316	0.0333	0.0338	0.0337	0.0333
Sub-total unit cost for water	Average	0.31		USD/m^3	**0.26**	**0.26**	**0.25**	**0.26**	**0.27**	**0.29**	**0.30**	**0.33**	**0.34**	**0.34**	**0.34**	**0.34**	**0.33**	**0.33**	**0.34**	**0.34**	**0.34**	**0.34**

Average Unit Retail Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit cost for bulk water				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed unit abstraction cost				USD/m^3	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Assumed unit power cost				USD/m^3	0.0701	0.0701	0.0701	0.0701	0.0701	0.0701	0.0701	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812	0.0812
Assumed unit chemical cost				USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		60%		USD/m^3	-	0.0016	0.0033	0.0041	0.0268	0.0443	0.0574	0.0757	0.0936	0.0964	0.0999	0.0966	0.0913	0.1114	0.1291	0.1345	0.1261	0.1187
Proportion of fixed costs		60%		USD/m^3	0.2770	0.2776	0.1895	0.2029	0.1947	0.2122	0.2071	0.2022	0.1973	0.1927	0.1885	0.1817	0.1754	0.1694	0.1637	0.1583	0.1531	0.1482
Proportion of Maintenance costs		60%		USD/m^3	0.0235	0.0243	0.0266	0.0341	0.0445	0.0558	0.0668	0.0786	0.1015	0.1007	0.1001	0.0989	0.0978	0.0808	0.0839	0.0841	0.0828	0.0809
Sub-total unit cost for water	Average	0.53		USD/m^3	0.48	0.49	0.40	0.42	0.45	0.49	0.51	0.55	0.59	0.58	0.58	0.57	0.56	0.55	0.57	0.57	0.56	0.54
Adjustment for collection losses				USD/m^3	0.28	0.24	0.16	0.13	0.09	0.07	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total average cost covering water tariff				USD/m^3	0.77	0.73	0.56	0.55	0.54	0.57	0.56	0.58	0.61	0.61	0.61	0.60	0.59	0.58	0.60	0.60	0.58	0.57
Total average cost covering W&S tariff				USD/m^3	1.09	1.03	0.77	0.76	0.75	0.81	0.81	0.83	0.89	0.88	0.88	0.86	0.84	0.84	0.86	0.86	0.84	0.81
Calculated sewerage charges				%	0.32	0.30	0.21	0.21	0.21	0.24	0.25	0.25	0.28	0.27	0.27	0.26	0.25	0.26	0.26	0.26	0.26	0.24
Calculated proportion of sewerage of Water					42%	41%	38%	38%	39%	42%	45%	43%	46%	44%	44%	43%	42%	45%	43%	43%	45%	42%
Water tariff used in Fin Model	0%				*1.45*	*1.35*	*1.20*	*1.15*	*1.15*	*1.15*	*1.15*	*1.15*	*1.10*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*

Unit Costs

Chemicals	UNIT	Borehole
Chlorine	USD/kg	*4*
Dosing rate	g/m^3	*5*
Costs/m3	USD/m^3	0.02
Alum	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Lime	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Total Unit Chemical Cost	**USD/m^3**	**0.0200**

The unit cost of chemicals is calculated for two scenarios, (a) for surface water intakes and (b) borehole abstraction and the relevant cost is applied to the unit of water produced

Power	UNIT	Long-Term
Volume	m^3/h	*4,633*
Pumping head	H	*117*
Pump efficiency	%	0.72
KWh	KW/h	752.8625
Power consumption	KW/m^3	0.1625
Cost/ KWh	USD/KWh	*0.5*
Cost per m3	**USD/m^3**	**0.0813**

For details on Q & h refer to

Both the midium and long term unit cost

Explanation notes for referenced items above:

[1] *Water demand projected for 2013, 2020 and 2030 representing three milestones. The periods between these were interpolated on a linear basis.*
[2] *The peak seasonal factor and peak demand are calculated as a function of average demand and used to ascertain the production surplus/(deficit).*
[3] *Production losses attributable to backwash, flushing and other cleaning operations are assumed to increase the abstraction of raw water.*
[4] *The water produced is the volume of water after production losses equal to either the demand or the production capacity, whichever smaller.*
[5] *The proportion of bulk water available may be less than 100 % in the event that bulk water supply is practically throttled or cannot be produced.*
[6] *If the entity does not produce (adequate) water and bulk water is available (even if only limited), the assumed volumes of water bought are calculated considering demand, own production and proportional available.*
[7] *The volume of water available is the addition of water produced plus water bought in bulk (if any).*
[8] *Details on funding of investments are provided in a separate table (see Investment Assets Tab)..*
[9] *Depreciation is based on replacement value and economic life. In view of recent financial performance it is not realistic to bring these calculated costs to account, thus, the depreciation for existing assets was set to nil through entry*
[10] *As with existing assets, the full annual value of depreciation of new assets is high and realistically not a priority and therefore revised downward.*
[11] *Bulk water costs are calculated separately; considering abstraction, power, chemicals, financial, fixed and maintenance costs and compared with current levels.*
[12] *Abstraction costs are gradually adjusted from current payment levels to required levels.*
[13] *Unit power costs for pumping are calculated on the basis of current and anticipated Q & h values and pumping times as detailed in a separate table (see Pumping tab).*
[14] *Unit chemical costs are calculated for surface water and borehole abstraction and applied accordingly; they include treatment chemicals (aluminium sulphate, lime) and disinfection (chlorine) as detailed in a separate table below the*
[15] *Personnel costs are based on separately calculated (see HR tab) number of staff, assumed scales, allowances, contribution to pension, etc. and a % allocation to water and sanitation to take into account recharges for other*
[16] *The calculation of transport costs is based on the number of units, average annual distance travelled/hours worked, fuel consumption per km/hr. and fuel price.*
[17] *Other administration costs including insurance, external professional fees (e.g. audit), office stationery, office utilities, etc. are estimated as a proportion of employment costs.*
[18] *Desired and ideal maintenance costs are calculated for both existing and future assets, but are high and from past experience not realistic to apply the full cost. Therefore, an adjustment of the desired to the realistic level is carried*

HARARE Detailed revenue calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WATER VOLUMES																						
Water Produced	From cost table			000 m^3	162,060	160,053	201,169	199,059	196,949	194,839	189,078	186,968	191,610	196,252	200,895	205,537	210,179	214,822	219,464	224,106	228,749	233,391
Water bought in bulk	From cost table			000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Demand for bulk water sales				000 m^3	38,015	37,411	38,814	40,217	41,620	43,023	40,776	42,180	43,269	44,359	45,449	46,538	47,628	48,718	49,808	50,897	51,987	53,077
Assumed proportion of bulk water supplied			[1]	%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%	100%	100%	100%	100%	100%	100%	100%
Water sold in bulk	Sum of satellites		[1]	000 m^3	19,008	20,576	23,288	26,141	29,134	32,267	32,621	35,853	38,942	42,141	45,449	46,538	47,628	48,718	49,808	50,897	51,987	53,077
Total Water available				000 m^3	143,052	139,477	177,881	172,918	167,815	162,571	156,457	151,115	152,668	154,111	155,446	158,999	162,551	166,104	169,656	173,209	176,762	180,314
Non-Revenue Water (NRW)			[2]	%	*58%*	54%	50%	46%	42%	38%	34%	*30%*	29%	28%	27%	26%	25%	24%	23%	22%	21%	20%
NRW reduction			[2]	%		4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Total volumes billed incl. [sold] bulk				000 m^3	79,090	84,735	112,229	119,517	126,467	133,062	135,883	141,633	147,336	153,101	158,924	164,197	169,542	174,957	180,443	186,000	191,629	197,328
Total Volumes Billed [Sold] excl. bulk			[3]	000 m^3	60,082	64,159	88,940	93,376	97,333	100,794	103,262	105,781	108,394	110,960	113,476	117,659	121,913	126,239	130,635	135,103	139,642	144,251
Number of Accounts	Based on metering program			000 No.	*262*	*274*	*275*	*287*	*299*	*311*	*322*	*334*	*346*	*357*	*369*	*381*	*392*	*404*	*416*	*428*	*439*	*451*
REVENUE STREAMS																						
Assumed tariff for Bulk Supply (if any)	Keep current levels		[4]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Combined average retail tariff (simplified)	Water + Sewer incl fixed		[5]	USD/m^3	1.45	1.35	1.20	1.15	1.15	1.15	1.15	1.15	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Calculated Bulk Sales				000 USD	7,603	8,230	9,315	10,456	11,654	12,907	13,048	14,341	15,577	16,856	18,179	18,615	19,051	19,487	19,923	20,359	20,795	21,231
Calculated Combined Retail Sales				000 USD	87,119	86,615	106,729	107,382	111,932	115,913	118,751	121,648	119,234	99,864	102,128	105,893	109,722	113,615	117,572	121,593	125,678	129,826
Total Billing for Water & Sewerage				000 USD	94,722	94,845	116,044	117,839	123,586	128,820	131,799	135,989	134,810	116,721	120,308	124,508	128,773	133,102	137,495	141,952	146,472	151,057
Collection Efficiency			[6]	%	*41%*	*50%*	*60%*	*70%*	*80%*	*85%*	*90%*	*95%*	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Collections from Water & Sewerage				000 USD	38,890	47,423	69,626	82,487	98,869	109,497	118,619	129,189	128,070	110,885	114,292	118,283	122,335	126,447	130,620	134,854	139,149	143,504
Other revenue (recovery of old debt)	% of 3 year debt	*5.0%*	[7]	000 USD		2,315	2,555	2,792	2,371	2,321	1,768	1,236	966	659	340	337	292	301	311	322	333	344
Total revenue collection				000 USD	38,890	49,738	72,181	85,279	101,240	111,818	120,387	130,425	129,036	111,544	114,632	118,620	122,626	126,748	130,931	135,176	139,482	143,848

Explanation notes for referenced items above:

[1] *It is not anticipated that Harare will be able to fully cover water demand until investments are made and efficiencies have improved. To reflect this condition, a proportion of bulk supply reflected as revenue for*
[2] *NRW is aligned to curredntly reported levels and deemed to improve with reforms and future investments, whereby milestone targets are set for 2020 and 2030.*
[3] *Volumes of water sold bulk and excl bulk is based on bulk sold before NRW and retail after NRW at different tariffs*
[4] *While detailed bulk tariff calculations are provided below the main cost table, the current existing bulk tariff is applied throughout.*
[5] *The combined tariff includes water, sewerage and any fixed charge component applied as an overall unit tariff.*
[6] *The collection efficiency in the base year appears to be an outlier compared to previous years. Future collection efficiencies are based on agreed milestones.*
[7] *A proportion of old debt (3-years old) is assumed to be collected.*

47,423

HARARE

INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income Streams																				
Bulk sales		000 USD	7,603	8,230	9,315	10,456	11,654	12,907	13,048	14,341	15,577	16,856	18,179	18,615	19,051	19,487	19,923	20,359	20,795	21,231
Combined Water & Sewerage		000 USD	87,119	86,615	106,729	107,382	111,932	115,913	118,751	121,648	119,234	99,864	102,128	105,893	109,722	113,615	117,572	121,593	125,678	129,826
Sub-Total		000 USD	94,722	94,845	116,044	117,839	123,586	128,820	131,799	135,989	134,810	116,721	120,308	124,508	128,773	133,102	137,495	141,952	146,472	151,057
Cost Streams [=Expenditure]																				
Operation - Fixed Costs		000 USD	27,741	29,680	28,083	31,580	31,580	35,641	35,641	35,641	35,641	35,641	35,641	35,641	35,641	35,641	35,641	35,641	35,641	35,641
Operation - Variable		000 USD	19,778	19,533	25,184	24,920	25,276	26,233	26,648	29,606	31,549	33,549	35,609	37,726	39,903	42,137	43,048	43,958	44,869	45,780
Maintenance		000 USD	2,356	2,601	3,945	5,301	7,221	9,377	11,491	13,858	18,333	18,616	18,930	19,400	19,871	16,991	18,270	18,933	19,279	19,449
Capital Charges (INTEREST ONLY)		000 USD	-	4,536	4,636	4,731	7,881	9,533	10,655	11,661	12,450	10,893	10,244	9,595	8,945	12,281	15,417	17,004	15,825	14,645
Sub-Total		000 USD	49,875	56,349	61,848	66,532	71,958	80,784	84,436	90,766	97,973	98,700	100,423	102,362	104,359	107,050	112,376	115,537	115,614	115,515
Surplus/(Deficit)		000 USD	**44,847**	**38,496**	**54,196**	**51,307**	**51,628**	**48,036**	**47,364**	**45,223**	**36,838**	**18,021**	**19,884**	**22,146**	**24,414**	**26,052**	**25,119**	**26,415**	**30,858**	**35,542**

ADJUSTED INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income																				
Total Income		000 USD	94,722	94,845	116,044	117,839	123,586	128,820	131,799	135,989	134,810	116,721	120,308	124,508	128,773	133,102	137,495	141,952	146,472	151,057
Expenditure																				
Total Expenses		000 USD	49,875	56,349	61,848	66,532	71,958	80,784	84,436	90,766	97,973	98,700	100,423	102,362	104,359	107,050	112,376	115,537	115,614	115,515
Provision for debt write-off	[1]	000 USD	27,916	47,423	46,418	35,352	24,717	19,323	13,180	6,799	6,741	5,836	6,015	6,225	6,439	6,655	6,875	7,098	7,324	7,553
Depreciation	[2]	000 USD	-	169	388	438	998	1,541	1,939	3,507	5,372	6,933	8,641	9,355	9,609	11,148	12,694	13,281	13,525	13,899
Total Expenses incl. Depreciation		000 USD	77,791	103,941	108,654	102,321	97,673	101,648	99,555	101,073	110,085	111,469	115,079	117,943	120,407	124,853	131,945	135,915	136,463	136,967
Adjusted Surplus/(Deficit)		000 USD	**16,931**	**(9,095)**	**7,390**	**15,517**	**25,913**	**27,172**	**32,244**	**34,916**	**24,726**	**5,252**	**5,228**	**6,566**	**8,367**	**8,250**	**5,550**	**6,037**	**10,009**	**14,090**

CASH FLOW STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cash Flow from Operating Activities																				
Profit/(loss) from income statement		000 USD	16,931	(9,095)	7,390	15,517	25,913	27,172	32,244	34,916	24,726	5,252	5,228	6,566	8,367	8,250	5,550	6,037	10,009	14,090
Adjust for non-cash items		000 USD																		
Depreciation	[2]	000 USD	0	169	388	438	998	1,541	1,939	3,507	5,372	6,933	8,641	9,355	9,609	11,148	12,694	13,281	13,525	13,899
Provision for debt write-off			27,916	47,423	46,418	35,352	24,717	19,323	13,180	6,799	6,741	5,836	6,015	6,225	6,439	6,655	6,875	7,098	7,324	7,553
Net adjusted income for the year		000 USD	44,847	38,496	54,196	51,307	51,628	48,036	47,364	45,223	36,838	18,021	19,884	22,146	24,414	26,052	25,119	26,415	30,858	35,542
Adjust for Change in Working Capital																				
(Increase)/Decrease in debtors	[3]	000 USD	(55,832)	(47,423)	(46,418)	(35,352)	(24,717)	(19,323)	(13,180)	(6,799)	(6,741)	(5,836)	(6,015)	(6,225)	(6,439)	(6,655)	(6,875)	(7,098)	(7,324)	(7,553)
Partial debt recovery	[4]	000 USD	0	2,315	2,555	2,792	2,371	2,321	1,768	1,236	966	659	340	337	292	301	311	322	333	344
Increase/(Decrease) in creditors	[5]	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net change in working capital		000 USD	(55,832)	(45,108)	(43,863)	(32,560)	(22,346)	(17,002)	(11,412)	(5,564)	(5,774)	(5,177)	(5,675)	(5,888)	(6,147)	(6,354)	(6,563)	(6,776)	(6,991)	(7,209)
Cash Flow from Investment Activities																				
Repayment of principal		000 USD	0	0	(100)	(200)	(29,280)	(32,007)	(34,341)	(36,675)	(38,909)	(12,989)	(12,989)	(12,989)	(12,989)	(16,974)	(20,960)	(23,595)	(23,595)	(23,595)
Net change generaged by/(used in investment activit		000 USD	0	0	(100)	(200)	(29,280)	(32,007)	(34,341)	(36,675)	(38,909)	(12,989)	(12,989)	(12,989)	(12,989)	(16,974)	(20,960)	(23,595)	(23,595)	(23,595)
Cash Flow																				
Net increase/(decrease) in cash & equiv.		000 USD	(10,985)	(6,611)	10,233	18,547	2	(973)	1,610	2,984	(7,846)	(145)	1,220	3,269	5,278	2,724	(2,404)	(3,955)	273	4,739
Cash & cash equiv. at beginning of year		000 USD	0	(10,985)	(17,596)	(7,363)	11,183	11,185	10,212	11,822	14,806	6,961	6,815	8,035	11,304	16,582	19,305	16,901	12,946	13,219
Cash & cash equivalents at end of year		**000 USD**	**(10,985)**	**(17,596)**	**(7,363)**	**11,183**	**11,185**	**10,212**	**11,822**	**14,806**	**6,961**	**6,815**	**8,035**	**11,304**	**16,582**	**19,305**	**16,901**	**12,946**	**13,219**	**17,957**

BALANCE SHEET (Simplified)

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets																				
Fixed Assets	[6]																			
Existing Plant & equipment			772,845	742,110	711,374	680,638	649,902	619,166	588,431	558,362	528,453	498,543	468,647	438,751	408,855	378,959	357,381	335,804	314,227	292,650
Future Plant & equipment				21,225	45,949	70,173	211,212	344,680	458,441	568,216	684,506	708,269	733,257	771,060	808,018	999,257	1,185,341	1,305,711	1,317,576	1,330,491
Total Fixed Assets			772,845	763,334	757,323	750,811	861,114	963,846	1,046,872	1,126,578	1,212,959	1,206,813	1,201,904	1,209,811	1,216,873	1,378,216	1,542,722	1,641,515	1,631,803	1,623,141
Current Assets & Liabilities																				
Short term assets (cash)	[7]		(10,985)	(17,596)	(7,363)	11,183	11,185	10,212	11,822	14,806	6,961	6,815	8,035	11,304	16,582	19,305	16,901	12,946	13,219	17,957
Debtors	[8]		23,680	23,711	29,011	29,460	30,897	32,205	32,950	33,997	33,703	29,180	30,077	31,127	32,193	33,276	34,374	35,488	36,618	37,764
Creditors	[9]		(4,479)	(4,529)	(5,651)	(5,930)	(6,309)	(6,952)	(7,373)	(8,261)	(9,330)	(9,711)	(10,106)	(10,538)	(10,979)	(10,871)	(11,236)	(11,498)	(11,708)	(11,888)
Net Current Assets			8,216	1,586	15,997	34,713	35,773	35,466	37,399	40,543	31,333	26,285	28,006	31,893	37,796	41,710	40,039	36,935	38,129	43,834
Total Assets			**781,062**	**764,921**	**773,320**	**785,524**	**896,887**	**999,312**	**1,084,271**	**1,167,121**	**1,244,292**	**1,233,097**	**1,229,910**	**1,241,705**	**1,254,670**	**1,419,926**	**1,582,761**	**1,678,450**	**1,669,932**	**1,666,974**
Equity & Liabilites																				
Equity	[10]		781,062	635,321	641,820	652,224	729,660	809,554	882,175	955,021	1,026,422	1,028,217	1,038,019	1,062,802	1,088,757	1,191,282	1,295,370	1,361,958	1,377,034	1,397,671
Long Term liabilities	[11]		0	129,600	131,500	133,300	167,227	189,758	202,096	212,100	217,870	204,881	191,891	178,902	165,913	228,644	287,390	316,492	292,898	269,303
Total Equity & Liabilities			**781,062**	**764,921**	**773,320**	**785,524**	**896,887**	**999,312**	**1,084,271**	**1,167,121**	**1,244,292**	**1,233,097**	**1,229,910**	**1,241,705**	**1,254,670**	**1,419,926**	**1,582,761**	**1,678,450**	**1,669,932**	**1,666,974**

notes for referenced items above:

[1]	Provisions to write off bad debt was set at 50 % in the base year and 100 % thereafter to gradually introduce the concept which does not appear to be ccarried out currently.
[2]	Depreciation for both existing and new assets is reflected here, as calculated in existing and Investment assets tabs and allocated as per the main cost table under the Cost tab.
[3]	Debtors are calculated as the difference between billing and cash collections for the respective year.
[4]	Partial debt recovery is calculated in the revenue table based on a small proportion of 3-year old debt recovered as cash collections.
[5]	With past history of deficit cash flow funded in part from creditors the entity has become uncreditworthy and future cash flow is based on a strictly cash on delivery basis, i.e. costs = expenditure.
[6]	The value of fixed assets is returned as the depreciated residual value of existing and investment assets calculated in the respective existing assets and investment assets tabs.
[7]	Accumulated cash reserves/(deficit)
[8]	Debtors as defined under note [3]
[9]	Asume two months worth of fixed costs (except personnel), variable and maintenance.
[10]	Balance of total assets and (less) long term liabilities.
[11]	The balance on loans is represented as long term liabilities.

CHITUNGWIZA Detailed Cost Calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
VOLUMES																						
Average water demand			[1]	000 m^3	19,881	19,883	19,884	19,886	19,887	19,889	19,890	19,892	20,402	20,912	21,422	21,932	22,442	22,952	23,462	23,972	24,482	24,992
Peak water demand	Seasonal factor	1.25	[2]	000 m^3	24,851	24,853	24,855	24,857	24,859	24,861	24,863	24,865	25,503	26,140	26,778	27,415	28,053	28,690	29,328	29,965	30,603	31,240
Production Capacity				000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Treatment surplus/(deficit)			[2]		(24,851)	(24,853)	(24,855)	(24,857)	(24,859)	(24,861)	(24,863)	(24,865)	(25,503)	(26,140)	(26,778)	(27,415)	(28,053)	(28,690)	(29,328)	(29,965)	(30,603)	(31,240)
Raw Water			[3]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed Production losses			[3]	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Water Produced			[4]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proportion of bulk water available			[5]	%	25%	30%	35%	40%	45%	50%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Water bought in bulk	Bulk available? (y/n)	Y	[6]	000 m^3	4,970	5,965	6,959	7,954	8,949	9,944	15,912	19,892	20,402	20,912	21,422	21,932	22,442	22,952	23,462	23,972	24,482	24,992
Water available			[7]	000 m^3	4,971	5,965	6,960	7,955	8,950	9,945	15,913	19,893	20,403	20,913	21,423	21,933	22,443	22,953	23,463	23,973	24,483	24,993
COST STREAMS																						
CAPITAL COSTS																						
Disbursements on capital investments			[8]																			
Disbursements from GHWSSIP grant				000 USD	-	-	764	-	14,801	14,369	-	-	-	-	-	-	-	4,157	4,157	-	-	-
Disbursements from GH WSSIP concessionary loan				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from GHWSSIP loan				000 USD	-	-	764	-	14,801	14,369	-	-	-	-	-	-	-	4,157	4,157	-	-	-
Disbursements from own resources				000 USD	-	-	-	-	-	-	-	-	193	193	193	13,185	193	193	193	801	801	801
Disbursements from external/private invest.				000 USD	-	1,789	1,789	1,789	1,789	1,789	1,789	1,789	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654	5,654
Disbursements from CMEC				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from ZimFund grant				000 USD	-	1,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements for investments				000 USD	-	3,289	3,316	1,789	31,390	30,527	1,789	1,789	5,846	5,846	5,846	18,838	5,846	14,160	14,160	6,455	6,455	6,455
Repayments of principal	repay period																					
Repayment of GHWSSIP loan principal	*0 yr grace, repay*	*20 years*		000 USD	-	-	*38*	*38*	*778*	*1,497*	*1,497*	*1,497*	*1,497*	*1,497*	*1,497*	*1,497*	*1,497*	*1,705*	*1,912*	*1,912*	*1,912*	*1,912*
Repayment of CMEC principal	*3 yr grace, repay in*	*5 years*		000 USD					-	-	-	-	-							-	-	-
Total repayment of principal				000 USD	-	-	38	38	778	1,497	1,497	1,497	1,497	1,497	1,497	1,497	1,497	1,705	1,912	1,912	1,912	1,912
Balance on loans																						
Balance of concessionary loan principal	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance of GHWSSIP loan principal	year end			000 USD	-	-	725	687	14,709	27,582	26,085	24,589	23,092	21,595	20,099	18,602	17,105	19,558	21,802	19,890	17,978	16,065
Balance of CMEC loan	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total balance on loans	year end			000 USD	-	-	725	687	14,709	27,582	26,085	24,589	23,092	21,595	20,099	18,602	17,105	19,558	21,802	19,890	17,978	16,065
Interest on Loans																						
Interest on existing loans				000 USD																		
Interest on GHWSSIP loan	Interest rate	*5.0% p.a.*		000 USD	-	-	38	36	774	1,454	1,379	1,304	1,229	1,155	1,080	1,005	930	1,063	1,186	1,090	995	899
Interest on CMEC loan	Interest rate	*3.5% p.a.*		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total interest on loans				000 USD	-	-	38	36	774	1,454	1,379	1,304	1,229	1,155	1,080	1,005	930	1,063	1,186	1,090	995	899
Depreciation																						
Depreciation on existing assets	Alloc of calc depr.	0%	[9]	000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed proportion of calc depreciation	Gradual increase		[10]	%		*5%*	*10%*	*10%*	*10%*	*10%*	*10%*	*15%*	*20%*	*25%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*
Depreciation on Capital Investment			[10]	000 USD		3	14	18	130	236	240	366	517	677	841	1,214	1,064	1,002	1,110	1,164	1,201	1,237
Sub-Total Capital Costs				000 USD	-	6,581	8,249	5,118	95,433	122,354	61,739	58,722	63,845	60,863	57,883	81,098	51,821	73,974	79,232	59,859	55,880	51,901
OPERATION - Variable																						
Bulk water	N/A																					
Assumed unit cost for bulk water	N/A		[11]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Annual bulk water cost	N/A			000 USD	1,988	2,386	2,784	3,182	3,580	3,978	6,365	7,957	8,161	8,365	8,569	8,773	8,977	9,181	9,385	9,589	9,793	9,997
Abstraction																						
Assumed unit abstraction cost	inflation	*0% p.a.*		USD/m^3	*0.06*	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Adjust (actual/desired level) on existing	gradual		[12]	%	*0%*	*0%*	*5%*	*5%*	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*	*100%*	*100%*	*100%*	*100%*
Annual abstraction cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power																						
Assumed unit power cost	Inflation	*0% p.a.*	[13]	USD/m^3	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Annual power cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemical																						
Assumed unit chemical cost	Inflation p.a.	*0% p.a.*	[14]	USD/m^3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Annual chemical cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Variable Costs				000 USD	**1,988**	**2,386**	**2,784**	**3,182**	**3,580**	**3,978**	**6,365**	**7,957**	**8,161**	**8,365**	**8,569**	**8,773**	**8,977**	**9,181**	**9,385**	**9,589**	**9,793**	**9,997**
OPERATION - Fixed																						
Personnel			[15]	000 USD	1,390	1,390	2,079	2,339	2,339	2,923	2,923	2,923	2,923	2,923	2,923	2,923	2,923	2,923	2,923	2,923	2,923	2,923
Transport			[16]																			
Number of vehicles				No.	*2*	2	2	2	5	*5*	5	5	5	5	5	5	5	5	5	5	5	5
Number of Motor cycles				No	*2*	2	2	2	10	*10*	10	10	10	10	10	10	10	10	10	10	10	10
Number of Trucks				No					1	*1*	1	1	1	1	1	1	1	1	1	1	1	1
Assumed unit fuel cost	0% p.a.			USD/litre	*1.25*	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Annual vehicle operating cost				000 USD	9	9	9	9	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Other administration costs	% of personnel	*20%*	[17]	000 USD	278	278	416	468	468	585	585	585	585	585	585	585	585	585	585	585	585	585
Sub-Total Fixed Costs				000 USD	**1,677**	**1,677**	**2,504**	**2,816**	**2,835**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**	**3,536**
MAINTENANCE																						
Adjust (actual/desired level) on maintenanc	Gradual increase		[18]	%	*10%*	*10%*	*15%*	*20%*	*25%*	*30%*	*35%*	*40%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*
Existing assets				000 USD	303	303	427	570	712	854	997	1,139	1,424	1,424	1,424	1,424	1,424	1,424	1,424	825	825	825
GHWSSIP Investments				000 USD	-	3	9	17	122	265	319	375	512	555	599	777	820	904	989	1,038	1,088	1,138
Other investments				000 USD	-	2	3	5	6	7	8	9	11	11	11	11	11	11	11	11	11	11
Sub-Total Maintenance				000 USD	**303**	**308**	**440**	**591**	**839**	**1,127**	**1,324**	**1,523**	**1,947**	**1,991**	**2,034**	**2,212**	**2,255**	**2,340**	**2,424**	**1,875**	**1,924**	**1,974**

Average Unit Bulk Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit abstraction cost				USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Assumed unit power cost				USD/m^3	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125
Assumed unit chemical cost				USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		25%		USD/m^3	-	0.0003	0.0038	0.0032	0.0436	0.0685	0.0385	0.0300	0.0301	0.0304	0.0307	0.0342	0.0296	0.0296	0.0318	0.0301	0.0284	0.0267
Proportion of fixed costs		25%		USD/m^3	0.2008	0.1528	0.1799	0.1639	0.1366	0.1434	0.0842	0.0635	0.0610	0.0587	0.0565	0.0545	0.0525	0.0507	0.0489	0.0473	0.0457	0.0442
Proportion of Maintenance costs		30%		USD/m^3	0.0435	0.0336	0.0379	0.0413	0.0485	0.0548	0.0378	0.0328	0.0403	0.0397	0.0390	0.0409	0.0402	0.0402	0.0403	0.0301	0.0298	0.0296
Sub-total unit cost for water	Average	0.35		USD/m^3	**0.43**	**0.37**	**0.40**	**0.39**	**0.41**	**0.45**	**0.34**	**0.32**	**0.32**	**0.32**	**0.32**	**0.32**	**0.32**	**0.31**	**0.31**	**0.30**	**0.30**	**0.29**

Average Unit Retail Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit cost for bulk water				USD/m^3	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
Assumed unit abstraction cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed unit power cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed unit chemical cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proportion of Financial costs		60%		USD/m^3	-	0.0008	0.0090	0.0076	0.1045	0.1645	0.0925	0.0720	0.0723	0.0730	0.0737	0.0820	0.0711	0.0710	0.0763	0.0723	0.0681	0.0641
Proportion of fixed costs		60%		USD/m^3	0.4819	0.3667	0.4318	0.3934	0.3277	0.3441	0.2020	0.1524	0.1465	0.1409	0.1357	0.1307	0.1260	0.1216	0.1174	0.1135	0.1097	0.1061
Proportion of Maintenance costs		60%		USD/m^3	0.0870	0.0673	0.0758	0.0826	0.0970	0.1096	0.0756	0.0656	0.0807	0.0793	0.0780	0.0818	0.0804	0.0805	0.0805	0.0602	0.0597	0.0592
Sub-total unit cost for water	Average	0.76		USD/m^3	0.97	0.83	0.92	0.88	0.93	1.02	0.77	0.69	0.70	0.69	0.69	0.69	0.68	0.67	0.67	0.65	0.64	0.63
Adjustment for collection losses				USD/m^3	0.24	0.21	0.23	0.22	0.19	0.15	0.08	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total average cost covering water tariff				USD/m^3	1.21	1.04	1.15	1.10	1.12	1.17	0.85	0.72	0.73	0.73	0.72	0.73	0.71	0.71	0.71	0.68	0.67	0.66
Total average cost covering W&S tariff				USD/m^3	1.69	1.41	1.58	1.51	1.54	1.64	1.12	0.93	0.94	0.93	0.92	0.94	0.91	0.90	0.90	0.85	0.84	0.82
Calculated sewerage charges				%	0.48	0.37	0.43	0.41	0.42	0.47	0.27	0.21	0.21	0.20	0.20	0.21	0.20	0.19	0.19	0.17	0.17	0.16
Calculated proportion of sewerage of Water					40%	36%	37%	37%	38%	40%	32%	29%	29%	27%	28%	29%	28%	27%	27%	25%	25%	24%
Water tariff used in Fin Model	0%				***1.45***	***1.35***	***1.20***	***1.15***	***1.15***	***1.15***	***1.15***	***1.15***	***1.10***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***

Unit Costs

Chemicals	UNIT	Borehole
Chlorine	USD/kg	*4*
Dosing rate	g/m^3	*5*
Costs/m3	USD/m^3	0.02
Alum	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Lime	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Total Unit Chemical Cost	**USD/m^3**	**0.0200**

The unit cost of chemicals is calculated for two scenarios, (a) for surface water intakes and (b) borehole abstraction and the relevant cost is applied to the unit of water produced

Power	UNIT	Long-Term
Volume	m^3/h	*4,633*
Pumping head	H	*117*
Pump efficiency	%	0.72
KWh	KW/h	752.8625
Power consumption	KW/m^3	0.1625
Cost/ KWh	USD/KWh	*0.5*
Cost per m3	**USD/m^3**	**0.0813**

For details on Q & h refer to

Both the midium and long term unit cost

Explanation notes for referenced items above:

[1] *Water demand projected for 2013, 2020 and 2030 representing three milestones. The periods between these were interpolated on a linear basis.*
[2] *The peak seasonal factor and peak demand are calculated as a function of average demand and used to ascertain the production surplus/(deficit).*
[3] *Production losses attributable to backwash, flushing and other cleaning operations are assumed to increase the abstraction of raw water.*
[4] *The water produced is the volume of water after production losses equal to either the demand or the production capacity, whichever smaller.*
[5] *The proportion of bulk water available may be less than 100 % in the event that bulk water supply is practically throttled or cannot be produced.*
[6] *If the entity does not produce (adequate) water and bulk water is available (even if only limited), the assumed volumes of water bought are calculated considering demand, own production and proportional available.*
[7] *The volume of water available is the addition of water produced plus water bought in bulk (if any).*
[8] *Details on funding of investments are provided in a separate table (see Investment Assets Tab)..*
[9] *Depreciation is based on replacement value and economic life. In view of recent financial performance it is not realistic to bring these calculated costs to account, thus, the depreciation for existing assets was set to nil through entry*
[10] *As with existing assets, the full annual value of depreciation of new assets is high and realistically not a priority and therefore revised downward.*
[11] *Bulk water costs are calculated separately; considering abstraction, power, chemicals, financial, fixed and maintenance costs and compared with current levels.*
[12] *Abstraction costs are gradually adjusted from current payment levels to required levels.*
[13] *Unit power costs for pumping are calculated on the basis of current and anticipated Q & h values and pumping times as detailed in a separate table (see Pumping tab).*
[14] *Unit chemical costs are calculated for surface water and borehole abstraction and applied accordingly; they include treatment chemicals (aluminium sulphate, lime) and disinfection (chlorine) as detailed in a separate table below the*
[15] *Personnel costs are based on separately calculated (see HR tab) number of staff, assumed scales, allowances, contribution to pension, etc. and a % allocation to water and sanitation to take into account recharges for other*
[16] *The calculation of transport costs is based on the number of units, average annual distance travelled/hours worked, fuel consumption per km/hr. and fuel price.*
[17] *Other administration costs including insurance, external professional fees (e.g. audit), office stationery, office utilities, etc. are estimated as a proportion of employment costs.*
[18] *Desired and ideal maintenance costs are calculated for both existing and future assets, but are high and from past experience not realistic to apply the full cost. Therefore, an adjustment of the desired to the realistic level is carried*

CHITUNGWIZA Detailed revenue calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WATER VOLUMES																						
Water Produced	From cost table			000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water bought in bulk	From cost table			000 m^3	4,970	5,965	6,959	7,954	8,949	9,944	15,912	19,892	20,402	20,912	21,422	21,932	22,442	22,952	23,462	23,972	24,482	24,992
Demand for bulk water sales				000 m^3																		
Assumed proportion of bulk water supplied			[1]	%	25%	30%	35%	40%	45%	50%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Water sold in bulk	Sum of satellites		[1]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Water available				000 m^3	4,970	5,965	6,959	7,954	8,949	9,944	15,912	19,892	20,402	20,912	21,422	21,932	22,442	22,952	23,462	23,972	24,482	24,992
Non-Revenue Water (NRW)			[2]	%	*58%*	54%	50%	46%	42%	38%	34%	*30%*	29%	28%	27%	26%	25%	24%	23%	22%	21%	*20%*
NRW reduction			[2]	%		4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Total volumes billed incl. [sold] bulk				000 m^3	2,088	2,744	3,480	4,295	5,191	6,166	10,502	13,924	14,485	15,057	15,638	16,230	16,832	17,444	18,066	18,698	19,341	19,994
Total Volumes Billed [Sold] excl. bulk			[3]	000 m^3	2,088	2,744	3,480	4,295	5,191	6,166	10,502	13,924	14,485	15,057	15,638	16,230	16,832	17,444	18,066	18,698	19,341	19,994
Number of Accounts	Based on metering program			000 No.	*358*	*373*	*379*	*394*	*409*	*424*	*439*	*455*	*473*	*491*	*509*	*527*	*545*	*563*	*581*	*599*	*617*	*635*
REVENUE STREAMS																						
Assumed tariff for Bulk Supply (if any)	Keep current levels		[4]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Combined average retail tariff (simplified)	Water + Sewer incl fixed		[5]	USD/m^3	1.45	1.35	1.20	1.15	1.15	1.15	1.15	1.15	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Calculated Bulk Sales				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calculated Combined Retail Sales				000 USD	3,027	3,704	4,176	4,940	5,969	7,090	12,077	16,013	15,934	13,551	14,074	14,607	15,148	15,699	16,259	16,828	17,407	17,994
Total Billing for Water & Sewerage				000 USD	3,027	3,704	4,176	4,940	5,969	7,090	12,077	16,013	15,934	13,551	14,074	14,607	15,148	15,699	16,259	16,828	17,407	17,994
Collection Efficiency			[6]	%	*75%*	*75%*	*75%*	*75%*	*80%*	*85%*	*90%*	*95%*	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Collections from Water & Sewerage				000 USD	2,270	2,778	3,132	3,705	4,775	6,027	10,870	15,212	15,137	12,873	13,371	13,876	14,391	14,914	15,446	15,987	16,536	17,095
Other revenue (recovery of old debt)	% of 3 year debt	*5.0%*	[7]	000 USD		2,315	2,555	38	46	52	62	60	53	60	40	40	34	35	37	38	39	41
Total revenue collection				000 USD	2,270	5,093	5,687	3,743	4,822	6,079	10,931	15,272	15,190	12,934	13,411	13,916	14,425	14,949	15,483	16,025	16,576	17,135

Explanation notes for referenced items above:

[1] *It is not anticipated that Harare will be able to fully cover water demand until investments are made and efficiencies have improved. To reflect this condition, a proportion of bulk supply reflected as revenue for*
[2] *NRW is aligned to curredntly reported levels and deemed to improve with reforms and future investments, whereby milestone targets are set for 2020 and 2030.*
[3] *Volumes of water sold bulk and excl bulk is based on bulk sold before NRW and retail after NRW at different tariffs*
[4] *While detailed bulk tariff calculations are provided below the main cost table, the current existing bulk tariff is applied throughout.*
[5] *The combined tariff includes water, sewerage and any fixed charge component applied as an overall unit tariff.*
[6] *The collection efficiency in the base year appears to be anoutlier compared to previous years. Future collection efficiencies are based o agreed milestones.*
[7] *A proportion of old debt (3-years old) is assumed to be collected.*

CHITUNGWIZA

INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income Streams																				
Bulk sales		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Water & Sewerage		000 USD	3,027	3,704	4,176	4,940	5,969	7,090	12,077	16,013	15,934	13,551	14,074	14,607	15,148	15,699	16,259	16,828	17,407	17,994
Sub-Total		000 USD	3,027	3,704	4,176	4,940	5,969	7,090	12,077	16,013	15,934	13,551	14,074	14,607	15,148	15,699	16,259	16,828	17,407	17,994
Cost Streams [=Expenditure]																				
Operation - Fixed Costs		000 USD	1,677	1,677	2,504	2,816	2,835	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536	3,536
Operation - Variable		000 USD	1,988	2,386	2,784	3,182	3,580	3,978	6,365	7,957	8,161	8,365	8,569	8,773	8,977	9,181	9,385	9,589	9,793	9,997
Maintenance		000 USD	303	308	440	591	839	1,127	1,324	1,523	1,947	1,991	2,034	2,212	2,255	2,340	2,424	1,875	1,924	1,974
Capital Charges (INTEREST ONLY)		000 USD	-	-	38	36	774	1,454	1,379	1,304	1,229	1,155	1,080	1,005	930	1,063	1,186	1,090	995	899
Sub-Total		000 USD	3,968	4,370	5,766	6,625	8,029	10,094	12,603	14,320	14,873	15,046	15,218	15,525	15,698	16,119	16,530	16,089	16,247	16,405
Surplus/(Deficit)		000 USD	**(941)**	**(666)**	**(1,590)**	**(1,686)**	**(2,059)**	**(3,004)**	**(526)**	**1,693**	**1,061**	**(1,495)**	**(1,144)**	**(918)**	**(549)**	**(420)**	**(271)**	**739**	**1,159**	**1,589**

ADJUSTED INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income																				
Total Income		000 USD	3,027	3,704	4,176	4,940	5,969	7,090	12,077	16,013	15,934	13,551	14,074	14,607	15,148	15,699	16,259	16,828	17,407	17,994
Expenditure																				
Total Expenses		000 USD	3,968	4,370	5,766	6,625	8,029	10,094	12,603	14,320	14,873	15,046	15,218	15,525	15,698	16,119	16,530	16,089	16,247	16,405
Provision for debt write-off	[1]	000 USD	378	926	1,044	1,235	1,194	1,064	1,208	801	797	678	704	730	757	785	813	841	870	900
Depreciation	[2]	000 USD	-	4	14	18	130	236	240	366	517	677	841	1,214	1,065	1,003	1,111	1,164	1,201	1,238
Total Expenses incl. Depreciation		000 USD	4,346	5,300	6,824	7,878	9,353	11,394	14,051	15,487	16,187	16,401	16,763	17,470	17,520	17,907	18,454	18,094	18,318	18,543
Adjusted Surplus/(Deficit)		000 USD	**(1,319)**	**(1,596)**	**(2,648)**	**(2,939)**	**(3,383)**	**(4,304)**	**(1,974)**	**526**	**(253)**	**(2,850)**	**(2,689)**	**(2,863)**	**(2,371)**	**(2,208)**	**(2,195)**	**(1,266)**	**(912)**	**(548)**

CASH FLOW STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cash Flow from Operating Activities																				
Profit/(loss) from income statement		000 USD	(1,319)	(1,596)	(2,648)	(2,939)	(3,383)	(4,304)	(1,974)	526	(253)	(2,850)	(2,689)	(2,863)	(2,371)	(2,208)	(2,195)	(1,266)	(912)	(548)
Adjust for non-cash items		000 USD																		
Depreciation	[2]	000 USD	0	4	14	18	130	236	240	366	517	677	841	1,214	1,065	1,003	1,111	1,164	1,201	1,238
Provision for debt write-off			378	926	1,044	1,235	1,194	1,064	1,208	801	797	678	704	730	757	785	813	841	870	900
Net adjusted income for the year		000 USD	(941)	(666)	(1,590)	(1,686)	(2,059)	(3,004)	(526)	1,693	1,061	(1,495)	(1,144)	(918)	(549)	(420)	(271)	739	1,159	1,589
Adjust for Change in Working Capital																				
(Increase)/Decrease in debtors	[3]	000 USD	(757)	(926)	(1,044)	(1,235)	(1,194)	(1,064)	(1,208)	(801)	(797)	(678)	(704)	(730)	(757)	(785)	(813)	(841)	(870)	(900)
Partial debt recovery	[4]	000 USD	0	2,315	2,555	38	46	52	62	60	53	60	40	40	34	35	37	38	39	41
Increase/(Decrease) in creditors	[5]	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net change in working capital		000 USD	(757)	1,389	1,511	(1,197)	(1,148)	(1,011)	(1,146)	(741)	(744)	(617)	(664)	(691)	(724)	(750)	(776)	(804)	(831)	(859)
Cash Flow from Investment Activities																				
Repayment of principal		000 USD	0	0	(38)	(38)	(778)	(1,497)	(1,497)	(1,497)	(1,497)	(1,497)	(1,497)	(1,497)	(1,497)	(1,705)	(1,912)	(1,912)	(1,912)	(1,912)
Net change generaged by/(used in investment activit		000 USD	0	0	(38)	(38)	(778)	(1,497)	(1,497)	(1,497)	(1,497)	(1,497)	(1,497)	(1,497)	(1,497)	(1,705)	(1,912)	(1,912)	(1,912)	(1,912)
Cash Flow																				
Net increase/(decrease) in cash & equiv.		000 USD	(1,697)	723	(117)	(2,921)	(3,985)	(5,512)	(3,168)	(544)	(1,179)	(3,609)	(3,304)	(3,106)	(2,770)	(2,874)	(2,960)	(1,977)	(1,584)	(1,182)
Cash & cash equiv. at beginning of year		000 USD	0	(1,697)	(975)	(1,092)	(4,013)	(7,998)	(13,509)	(16,678)	(17,222)	(18,402)	(22,010)	(25,315)	(28,420)	(31,190)	(34,064)	(37,024)	(39,000)	(40,584)
Cash & cash equivalents at end of year		**000 USD**	**(1,697)**	**(975)**	**(1,092)**	**(4,013)**	**(7,998)**	**(13,509)**	**(16,678)**	**(17,222)**	**(18,402)**	**(22,010)**	**(25,315)**	**(28,420)**	**(31,190)**	**(34,064)**	**(37,024)**	**(39,000)**	**(40,584)**	**(41,767)**

BALANCE SHEET (Simplified)

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets																				
Fixed Assets	[6]																			
Existing Plant & equipment			76,813	73,185	69,557	66,329	63,101	59,873	56,645	53,417	50,189	46,961	43,733	40,505	37,277	34,049	30,821	27,593	25,563	23,533
Future Plant & equipment				1,749	4,954	6,593	36,712	64,905	64,322	63,698	66,991	70,160	73,234	88,055	90,384	101,232	111,721	114,328	116,811	119,171
Total Fixed Assets			76,813	74,934	74,512	72,922	99,813	124,779	120,967	117,116	117,181	117,121	116,967	128,560	127,661	135,282	142,543	141,921	142,374	142,705
Current Assets & Liabilities																				
Short term assets (cash)	[7]		(1,697)	(975)	(1,092)	(4,013)	(7,998)	(13,509)	(16,678)	(17,222)	(18,402)	(22,010)	(25,315)	(28,420)	(31,190)	(34,064)	(37,024)	(39,000)	(40,584)	(41,767)
Debtors	[8]		757	926	1,044	1,235	1,492	1,773	3,019	4,003	3,983	3,388	3,519	3,652	3,787	3,925	4,065	4,207	4,352	4,499
Creditors	[9]		(430)	(497)	(608)	(708)	(819)	(953)	(1,384)	(1,682)	(1,787)	(1,828)	(1,869)	(1,933)	(1,974)	(2,022)	(2,070)	(2,013)	(2,055)	(2,097)
Net Current Assets			(1,370)	(545)	(656)	(3,486)	(7,325)	(12,690)	(15,042)	(14,901)	(16,205)	(20,451)	(23,665)	(26,701)	(29,377)	(32,161)	(35,029)	(36,806)	(38,288)	(39,365)
Total Assets			**75,443**	**74,389**	**73,856**	**69,436**	**92,489**	**112,089**	**105,925**	**102,215**	**100,976**	**96,671**	**93,302**	**101,859**	**98,284**	**103,120**	**107,514**	**105,115**	**104,087**	**103,339**
Equity & Liabilites																				
Equity	[10]		75,443	74,389	73,131	68,749	77,779	84,507	79,840	77,626	77,884	75,075	73,203	83,257	81,179	83,563	85,711	85,225	86,109	87,274
Long Term liabilities	[11]		0	0	725	687	14,709	27,582	26,085	24,589	23,092	21,595	20,099	18,602	17,105	19,558	21,802	19,890	17,978	16,065
Total Equity & Liabilities			**75,443**	**74,389**	**73,856**	**69,436**	**92,489**	**112,089**	**105,925**	**102,215**	**100,976**	**96,671**	**93,302**	**101,859**	**98,284**	**103,120**	**107,514**	**105,115**	**104,087**	**103,339**

notes for referenced items above:

[1]	Provisions to write off bad debt was set at 50 % in the base year and 100 % thereafter to gradually introduce the concept which does not appear to be ccarried out currently.
[2]	Depreciation for both existing and new assets is reflected here, as calculated in existing and Investment assets tabs and allocated as per the main cost table under the Cost tab.
[3]	Debtors are calculated as the difference between billing and cash collections for the respective year.
[4]	Partial debt recovery is calculated in the revenue table based on a small proportion of 3-year old debt recovered as cash collections.
[5]	With past history of deficit cash flow funded in part from creditors the entity has become uncreditworthy and future cash flow is based on a strictly cash on delivery basis, i.e. costs = expenditure.
[6]	The value of fixed assets is returned as the depreciated residual value of existing and investment assets calculated in the respective existing assets and investment assets tabs.
[7]	Accumulated cash reserves/(deficit)
[8]	Debtors as defined under note [3]
[9]	Asume two months worth of fixed costs (except personnel), variable and maintenance.
[10]	Balance of total assets and (less) long term liabilities.
[11]	The balance on loans is represented as long term liabilities.

EPWORTH Detailed Cost Calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
VOLUMES																						
Average water demand			[1]	000 m^3	*5,649*	*6,345*	*7,041*	*7,738*	*8,434*	*9,130*	*9,826*	*10,523*	10,581	10,640	10,699	10,757	10,816	10,874	10,933	10,992	11,050	*11,109*
Peak water demand	Seasonal factor	1.25	[2]	000 m^3	7,061	7,931	8,802	9,672	10,542	11,413	12,283	13,153	13,227	13,300	13,373	13,447	13,520	13,593	13,666	13,740	13,813	13,886
Production Capacity				000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Treatment surplus/(deficit)			[2]		(7,061)	(7,931)	(8,802)	(9,672)	(10,542)	(11,413)	(12,283)	(13,153)	(13,227)	(13,300)	(13,373)	(13,447)	(13,520)	(13,593)	(13,666)	(13,740)	(13,813)	(13,886)
Raw Water			[3]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed Production losses			[3]	%	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*
Water Produced			[4]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proportion of bulk water available			[5]	%	25%	30%	35%	40%	45%	50%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Water bought in bulk	Bulk available? (y/n)	Y	[6]	000 m^3	1,412	1,904	2,464	3,095	3,795	4,565	7,861	10,523	10,581	10,640	10,699	10,757	10,816	10,874	10,933	10,992	11,050	11,109
Water available			[7]	000 m^3	1,412	1,904	2,465	3,095	3,796	4,566	7,862	10,524	10,582	10,641	10,700	10,758	10,817	10,875	10,934	10,993	11,051	11,110
COST STREAMS																						
CAPITAL COSTS																						
Disbursements on capital investments			[8]																			
Disbursements from GHWSSIP grant				000 USD	-	240	60	-	3,941	3,011	-	-	-	-	-	-	-	2,036	2,036	40	-	-
Disbursements from GH WSSIP concessionary loan				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from GHWSSIP loan				000 USD	-	240	60	-	3,941	3,011	-	-	-	-	-	-	-	2,036	2,036	40	-	-
Disbursements from own resources				000 USD	-	-	-	-	-	-	-	-	63	63	63	3,760	63	63	63	367	367	367
Disbursements from external/private invest.				000 USD	-	269	269	269	269	269	269	269	3,374	3,374	3,374	3,374	3,374	3,374	3,374	3,374	3,374	3,374
Disbursements from CMEC				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from ZimFund grant				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements for investments				000 USD	-	749	389	269	8,150	6,291	269	269	3,437	3,437	3,437	7,135	3,437	7,509	7,509	3,821	3,741	3,741
Repayments of principal	repay period																					
Repayment of GHWSSIP loan principal	*0 yr grace, repay*	*20 years*		000 USD	-	*12*	*15*	*15*	*212*	*363*	*363*	*363*	*363*	*363*	*363*	*363*	*363*	*464*	*566*	*568*	*568*	*568*
Repayment of CMEC principal	*3 yr grace, repay in*	*5 years*		000 USD					-	-	-	-	-							-	-	-
Total repayment of principal				000 USD	-	12	15	15	212	363	363	363	363	363	363	363	363	464	566	568	568	568
Balance on loans																						
Balance of concessionary loan principal	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance of GHWSSIP loan principal	year end			000 USD	-	228	273	258	3,986	6,635	6,272	5,910	5,547	5,185	4,822	4,459	4,097	5,669	7,138	6,610	6,042	5,474
Balance of CMEC loan	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total balance on loans	year end			000 USD	-	228	273	258	3,986	6,635	6,272	5,910	5,547	5,185	4,822	4,459	4,097	5,669	7,138	6,610	6,042	5,474
Interest on Loans																						
Interest on existing loans				000 USD																		
Interest on GHWSSIP loan	Interest rate	*5.0% p.a.*		000 USD	-	12	14	14	210	350	332	314	295	277	259	241	223	307	385	359	331	302
Interest on CMEC loan	Interest rate	*3.5% p.a.*		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total interest on loans				000 USD	-	12	14	14	210	350	332	314	295	277	259	241	223	307	385	359	331	302
Depreciation																						
Depreciation on existing assets	Alloc of calc depr.	0%	[9]	000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed proportion of calc depreciation	Gradual increase		[10]	%		*5%*	*10%*	*10%*	*10%*	*10%*	*10%*	*15%*	*20%*	*25%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*	*30%*
Depreciation on Capital Investment			[10]	000 USD		0	2	3	31	54	55	84	127	176	233	350	302	296	341	372	393	414
Sub-Total Capital Costs				000 USD	-	2,003	1,385	1,114	25,148	27,331	14,526	13,794	19,412	18,700	17,995	24,745	16,541	28,194	31,539	23,089	21,757	20,585
OPERATION - Variable																						
Bulk water	N/A																					
Assumed unit cost for bulk water	N/A		[11]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Annual bulk water cost	N/A			000 USD	565	761	986	1,238	1,518	1,826	3,144	4,209	4,233	4,256	4,279	4,303	4,326	4,350	4,373	4,397	4,420	4,444
Abstraction																						
Assumed unit abstraction cost	inflation	*0% p.a.*		USD/m^3	*0.06*	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Adjust (actual/desired level) on existing	gradual		[12]	%	*0%*	*0%*	*5%*	*5%*	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*	*100%*	*100%*	*100%*	*100%*
Annual abstraction cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power																						
Assumed unit power cost	Inflation	*0% p.a.*	[13]	USD/m^3	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Annual power cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemical																						
Assumed unit chemical cost	Inflation p.a.	*0% p.a.*	[14]	USD/m^3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Annual chemical cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Variable Costs				000 USD	**565**	**761**	**986**	**1,238**	**1,518**	**1,826**	**3,144**	**4,209**	**4,233**	**4,256**	**4,279**	**4,303**	**4,326**	**4,350**	**4,373**	**4,397**	**4,420**	**4,444**
OPERATION - Fixed																						
Personnel			[15]	000 USD	291	291	524	590	590	623	623	623	623	623	623	623	623	623	623	623	623	623
Transport			[16]																			
Number of vehicles				No.					4	*4*	4	4	4	4	4	4	4	4	4	4	4	4
Number of Motor cycles				No	*1*	1	1	1	6	*6*	6	6	6	6	6	6	6	6	6	6	6	6
Number of Trucks				No					1	*1*	1	1	1	1	1	1	1	1	1	1	1	1
Assumed unit fuel cost	0% p.a.			USD/litre	*1.25*	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Annual vehicle operating cost				000 USD	1	1	1	1	22	22	22	22	22	22	22	22	22	22	22	22	22	22
Other administration costs	% of personnel	*20%*	[17]	000 USD	58	58	105	118	118	125	125	125	125	125	125	125	125	125	125	125	125	125
Sub-Total Fixed Costs				000 USD	**349**	**349**	**630**	**708**	**729**	**769**	**769**	**769**	**769**	**769**	**769**	**769**	**769**	**769**	**769**	**769**	**769**	**769**
MAINTENANCE																						
Adjust (actual/desired level) on maintenanc	Gradual increase		[18]	%	*10%*	*10%*	*15%*	*20%*	*25%*	*30%*	*35%*	*40%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*	*50%*
Existing assets				000 USD	17	17	26	35	44	52	61	70	87	87	87	87	87	87	87	87	87	87
GHWSSIP Investments				000 USD	-	0	1	3	25	53	63	74	118	143	168	232	257	306	355	384	412	441
Other investments				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Maintenance				000 USD	**17**	**18**	**27**	**37**	**68**	**105**	**125**	**144**	**205**	**230**	**256**	**319**	**344**	**393**	**442**	**471**	**500**	**528**

Average Unit Bulk Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit abstraction cost				USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Assumed unit power cost				USD/m^3	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125
Assumed unit chemical cost				USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		25%		USD/m^3	-	0.0037	0.0034	0.0025	0.0278	0.0360	0.0187	0.0135	0.0141	0.0148	0.0158	0.0186	0.0162	0.0182	0.0216	0.0213	0.0207	0.0201
Proportion of fixed costs		25%		USD/m^3	0.1547	0.1036	0.1315	0.1082	0.0841	0.0685	0.0372	0.0261	0.0256	0.0251	0.0246	0.0241	0.0237	0.0233	0.0228	0.0224	0.0220	0.0216
Proportion of Maintenance costs		30%		USD/m^3	0.0093	0.0064	0.0069	0.0069	0.0094	0.0113	0.0072	0.0059	0.0082	0.0090	0.0098	0.0120	0.0127	0.0143	0.0158	0.0165	0.0172	0.0178
Sub-total unit cost for water	Average	0.27		USD/m^3	**0.35**	**0.30**	**0.32**	**0.30**	**0.30**	**0.30**	**0.25**	**0.24**	**0.24**	**0.24**	**0.24**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**

Average Unit Retail Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit cost for bulk water				USD/m^3	0.3999	0.3999	0.3999	0.3999	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
Assumed unit abstraction cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed unit power cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed unit chemical cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proportion of Financial costs		60%		USD/m^3	-	0.0088	0.0081	0.0060	0.0668	0.0864	0.0449	0.0324	0.0337	0.0355	0.0378	0.0445	0.0388	0.0438	0.0518	0.0511	0.0497	0.0483
Proportion of fixed costs		60%		USD/m^3	0.3712	0.2487	0.3155	0.2597	0.2018	0.1645	0.0893	0.0626	0.0614	0.0602	0.0591	0.0580	0.0569	0.0558	0.0548	0.0538	0.0528	0.0519
Proportion of Maintenance costs		60%		USD/m^3	0.0186	0.0127	0.0138	0.0138	0.0189	0.0226	0.0145	0.0117	0.0164	0.0180	0.0196	0.0241	0.0255	0.0286	0.0315	0.0330	0.0344	0.0357
Sub-total unit cost for water	Average	0.59		USD/m^3	0.79	0.67	0.74	0.68	0.69	0.67	0.55	0.51	0.51	0.51	0.52	0.53	0.52	0.53	0.54	0.54	0.54	0.54
Adjustment for collection losses				USD/m^3	0.32	0.37	0.37	0.27	0.21	0.13	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total average cost covering water tariff				USD/m^3	1.11	1.04	1.11	0.95	0.89	0.81	0.60	0.53	0.54	0.54	0.54	0.55	0.55	0.55	0.56	0.56	0.56	0.56
Total average cost covering W&S tariff				USD/m^3	1.47	1.32	1.44	1.21	1.14	1.03	0.71	0.61	0.62	0.62	0.62	0.64	0.63	0.64	0.66	0.66	0.66	0.66
Calculated sewerage charges				%	0.36	0.28	0.33	0.26	0.25	0.22	0.11	0.08	0.08	0.08	0.08	0.09	0.08	0.09	0.10	0.10	0.10	0.10
Calculated proportion of sewerage of Water					32%	27%	30%	27%	28%	27%	18%	15%	15%	15%	15%	16%	15%	16%	18%	18%	18%	18%
Water tariff used in Fin Model	0%				***1.45***	***1.35***	***1.20***	***1.15***	***1.15***	***1.15***	***1.15***	***1.15***	***1.10***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***

Unit Costs

Chemicals	UNIT	Borehole
Chlorine	USD/kg	4
Dosing rate	g/m^3	5
Costs/m3	USD/m^3	0.02
Alum	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Lime	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Total Unit Chemical Cost	**USD/m^3**	**0.0200**

The unit cost of chemicals is calculated for two scenarios, (a) for surface water intakes and (b) borehole abstraction and the relevant cost is applied to the unit of water produced

Power	UNIT	Long-Term
Volume	m^3/h	4,633
Pumping head	H	117
Pump efficiency	%	0.72
KWh	KW/h	752.8625
Power consumption	KW/m^3	0.1625
Cost/ KWh	USD/KWh	0.5
Cost per m3	**USD/m^3**	**0.0813**

For details on Q & h refer to

Both the midium and long term unit cost

Explanation notes for referenced items above:

[1] *Water demand projected for 2013, 2020 and 2030 representing three milestones. The periods between these were interpolated on a linear basis.*
[2] *The peak seasonal factor and peak demand are calculated as a function of average demand and used to ascertain the production surplus/(deficit).*
[3] *Production losses attributable to backwash, flushing and other cleaning operations are assumed to increase the abstraction of raw water.*
[4] *The water produced is the volume of water after production losses equal to either the demand or the production capacity, whichever smaller.*
[5] *The proportion of bulk water available may be less than 100 % in the event that bulk water supply is practically throttled or cannot be produced.*
[6] *If the entity does not produce (adequate) water and bulk water is available (even if only limited), the assumed volumes of water bought are calculated considering demand, own production and proportional available.*
[7] *The volume of water available is the addition of water produced plus water bought in bulk (if any).*
[8] *Details on funding of investments are provided in a separate table (see Investment Assets Tab)..*
[9] *Depreciation is based on replacement value and economic life. In view of recent financial performance it is not realistic to bring these calculated costs to account, thus, the depreciation for existing assets was set to nil through entry*
[10] *As with existing assets, the full annual value of depreciation of new assets is high and realistically not a priority and therefore revised downward.*
[11] *Bulk water costs are calculated separately; considering abstraction, power, chemicals, financial, fixed and maintenance costs and compared with current levels.*
[12] *Abstraction costs are gradually adjusted from current payment levels to required levels.*
[13] *Unit power costs for pumping are calculated on the basis of current and anticipated Q & h values and pumping times as detailed in a separate table (see Pumping tab).*
[14] *Unit chemical costs are calculated for surface water and borehole abstraction and applied accordingly; they include treatment chemicals (aluminium sulphate, lime) and disinfection (chlorine) as detailed in a separate table below the*
[15] *Personnel costs are based on separately calculated (see HR tab) number of staff, assumed scales, allowances, contribution to pension, etc. and a % allocation to water and sanitation to take into account recharges for other*
[16] *The calculation of transport costs is based on the number of units, average annual distance travelled/hours worked, fuel consumption per km/hr. and fuel price.*
[17] *Other administration costs including insurance, external professional fees (e.g. audit), office stationery, office utilities, etc. are estimated as a proportion of employment costs.*
[18] *Desired and ideal maintenance costs are calculated for both existing and future assets, but are high and from past experience not realistic to apply the full cost. Therefore, an adjustment of the desired to the realistic level is carried*

EPWORTH Detailed revenue calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WATER VOLUMES																						
Water Produced	From cost table			000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water bought in bulk	From cost table			000 m^3	1,412	1,904	2,464	3,095	3,795	4,565	7,861	10,523	10,581	10,640	10,699	10,757	10,816	10,874	10,933	10,992	11,050	11,109
Demand for bulk water sales				000 m^3																		
Assumed proportion of bulk water supplied			[1]	%	25%	30%	35%	40%	45%	50%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Water sold in bulk	Sum of satellites		[1]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Water available				000 m^3	1,412	1,904	2,464	3,095	3,795	4,565	7,861	10,523	10,581	10,640	10,699	10,757	10,816	10,874	10,933	10,992	11,050	11,109
Non-Revenue Water (NRW)			[2]	%	*60%*	56%	51%	47%	43%	39%	34%	*30%*	29%	28%	27%	26%	25%	24%	23%	22%	21%	*20%*
NRW reduction			[2]	%		4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Total volumes billed incl. [sold] bulk				000 m^3	565	843	1,197	1,636	2,169	2,804	5,166	7,366	7,513	7,661	7,810	7,960	8,112	8,265	8,418	8,574	8,730	8,887
Total Volumes Billed [Sold] excl. bulk			[3]	000 m^3	565	843	1,197	1,636	2,169	2,804	5,166	7,366	7,513	7,661	7,810	7,960	8,112	8,265	8,418	8,574	8,730	8,887
Number of Accounts	Based on metering program			000 No.	*358*	*373*	*379*	*394*	*409*	*424*	*439*	*455*	*473*	*491*	*509*	*527*	*545*	*563*	*581*	*599*	*617*	*635*
REVENUE STREAMS																						
Assumed tariff for Bulk Supply (if any)	Keep current levels		[4]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Combined average retail tariff (simplified)	Water + Sewer incl fixed		[5]	USD/m^3	1.45	1.35	1.20	1.15	1.15	1.15	1.15	1.15	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Calculated Bulk Sales				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calculated Combined Retail Sales				000 USD	819	1,138	1,436	1,881	2,494	3,225	5,941	8,471	8,264	6,895	7,029	7,164	7,301	7,438	7,577	7,716	7,857	7,998
Total Billing for Water & Sewerage				000 USD	819	1,138	1,436	1,881	2,494	3,225	5,941	8,471	8,264	6,895	7,029	7,164	7,301	7,438	7,577	7,716	7,857	7,998
Collection Efficiency			[6]	%	*60%*	*45%*	*50%*	*60%*	*70%*	*80%*	*90%*	*95%*	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Collections from Water & Sewerage				000 USD	491	512	718	1,129	1,746	2,580	5,347	8,047	7,851	6,550	6,678	6,806	6,936	7,066	7,198	7,330	7,464	7,599
Other revenue (recovery of old debt)	% of 3 year debt	*5.0%*	[7]	000 USD		2,315	2,555	16	31	36	38	37	32	30	21	21	17	18	18	18	19	19
Total revenue collection				000 USD	491	2,827	3,273	1,145	1,777	2,616	5,384	8,085	7,883	6,580	6,699	6,827	6,953	7,084	7,216	7,349	7,483	7,617

Explanation notes for referenced items above:

[1]	*It is not anticipated that Harare will be able to fully cover water demand until investments are made and efficiencies have improved. To reflect this condition, a proportion of bulk supply reflected as revenue*
[2]	*NRW is aligned to currednlty reported levels and deemed to improve with reforms and future investments, whereby milestone targets are set for 2020 and 2030.*
[3]	*Volumes of water sold bulk and excl bulk is based on bulk sold before NRW and retail after NRW at different tariffs*
[4]	*While detailed bulk tariff calculations are provided below the main cost table, the current existing bulk tariff is applied throughout.*
[5]	*The combined tariff includes water, sewerage and any fixed charge component applied as an overall unit tariff.*
[6]	*The collection efficiency in the base year appears to be anoutlier compared to previous years. Future collection efficiencies are based o agreed milestones.*
[7]	*A proportion of old debt (3-years old) is assumed to be collected.*

EPWORTH

INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income Streams																				
Bulk sales		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Water & Sewerage		000 USD	819	1,138	1,436	1,881	2,494	3,225	5,941	8,471	8,264	6,895	7,029	7,164	7,301	7,438	7,577	7,716	7,857	7,998
Sub-Total		000 USD	819	1,138	1,436	1,881	2,494	3,225	5,941	8,471	8,264	6,895	7,029	7,164	7,301	7,438	7,577	7,716	7,857	7,998
Cost Streams [=Expenditure]																				
Operation - Fixed Costs		000 USD	349	349	630	708	729	769	769	769	769	769	769	769	769	769	769	769	769	769
Operation - Variable		000 USD	565	761	986	1,238	1,518	1,826	3,144	4,209	4,233	4,256	4,279	4,303	4,326	4,350	4,373	4,397	4,420	4,444
Maintenance		000 USD	17	18	27	37	68	105	125	144	205	230	256	319	344	393	442	471	500	528
Capital Charges (INTEREST ONLY)		000 USD	-	12	14	14	210	350	332	314	295	277	259	241	223	307	385	359	331	302
Sub-Total		000 USD	932	1,141	1,657	1,997	2,526	3,050	4,370	5,436	5,502	5,533	5,563	5,632	5,663	5,819	5,970	5,996	6,019	6,043
Surplus/(Deficit)		000 USD	**(113)**	**(3)**	**(221)**	**(116)**	**(32)**	**175**	**1,571**	**3,035**	**2,762**	**1,362**	**1,466**	**1,532**	**1,638**	**1,619**	**1,607**	**1,720**	**1,837**	**1,956**
ADJUSTED INCOME STATEMENT																				
Income																				
Total Income		000 USD	819	1,138	1,436	1,881	2,494	3,225	5,941	8,471	8,264	6,895	7,029	7,164	7,301	7,438	7,577	7,716	7,857	7,998
Expenditure																				
Total Expenses		000 USD	932	1,141	1,657	1,997	2,526	3,050	4,370	5,436	5,502	5,533	5,563	5,632	5,663	5,819	5,970	5,996	6,019	6,043
Provision for debt write-off	[1]	000 USD	164	626	718	753	748	645	594	424	413	345	351	358	365	372	379	386	393	400
Depreciation	[2]	000 USD	-	0	2	3	32	54	55	84	127	177	233	350	302	297	342	372	393	414
Total Expenses incl. Depreciation		000 USD	1,096	1,767	2,377	2,753	3,305	3,750	5,019	5,943	6,043	6,054	6,148	6,340	6,330	6,487	6,690	6,754	6,805	6,857
Adjusted Surplus/(Deficit)		000 USD	**(277)**	**(629)**	**(941)**	**(871)**	**(811)**	**(525)**	**922**	**2,528**	**2,222**	**841**	**881**	**824**	**971**	**951**	**886**	**963**	**1,052**	**1,142**

CASH FLOW STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cash Flow from Operating Activities																				
Profit/(loss) from income statement		000 USD	(277)	(629)	(941)	(871)	(811)	(525)	922	2,528	2,222	841	881	824	971	951	886	963	1,052	1,142
Adjust for non-cash items		000 USD																		
Depreciation	[2]	000 USD	0	0	2	3	32	54	55	84	127	177	233	350	302	297	342	372	393	414
Provision for debt write-off			164	626	718	753	748	645	594	424	413	345	351	358	365	372	379	386	393	400
Net adjusted income for the year		000 USD	(113)	(3)	(221)	(116)	(32)	175	1,571	3,035	2,762	1,362	1,466	1,532	1,638	1,619	1,607	1,720	1,837	1,956
Adjust for Change in Working Capital																				
(Increase)/Decrease in debtors	[3]	000 USD	(328)	(626)	(718)	(753)	(748)	(645)	(594)	(424)	(413)	(345)	(351)	(358)	(365)	(372)	(379)	(386)	(393)	(400)
Partial debt recovery	[4]	000 USD	0	2,315	2,555	16	31	36	38	37	32	30	21	21	17	18	18	18	19	19
Increase/(Decrease) in creditors	[5]	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net change in working capital		000 USD	(328)	1,689	1,837	(736)	(717)	(609)	(556)	(386)	(381)	(315)	(330)	(338)	(348)	(354)	(361)	(368)	(374)	(381)
Cash Flow from Investment Activities																				
Repayment of principal		000 USD	0	(12)	(15)	(15)	(212)	(363)	(363)	(363)	(363)	(363)	(363)	(363)	(363)	(464)	(566)	(568)	(568)	(568)
Net change generaged by/(used in investment activiti		000 USD	0	(12)	(15)	(15)	(212)	(363)	(363)	(363)	(363)	(363)	(363)	(363)	(363)	(464)	(566)	(568)	(568)	(568)
Cash Flow																				
Net increase/(decrease) in cash & equiv.		000 USD	(440)	1,674	1,601	(867)	(961)	(797)	652	2,286	2,018	684	773	832	928	801	680	784	895	1,007
Cash & cash equiv. at beginning of year		000 USD	0	(440)	1,234	2,835	1,968	1,007	210	862	3,149	5,167	5,851	6,624	7,457	8,384	9,185	9,865	10,649	11,544
Cash & cash equivalents at end of year		**000 USD**	**(440)**	**1,234**	**2,835**	**1,968**	**1,007**	**210**	**862**	**3,149**	**5,167**	**5,851**	**6,624**	**7,457**	**8,384**	**9,185**	**9,865**	**10,649**	**11,544**	**12,551**

BALANCE SHEET (Simplified)

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets																				
Fixed Assets	[6]																			
Existing Plant & equipment			6,333	6,145	5,957	5,769	5,581	5,394	5,206	5,018	4,830	4,642	4,454	4,266	4,079	3,891	3,703	3,515	3,327	3,139
Future Plant & equipment				740	1,112	1,355	9,190	14,940	14,659	14,370	17,173	19,904	22,565	28,534	30,965	37,485	43,857	46,440	48,872	51,235
Total Fixed Assets			6,333	6,885	7,069	7,124	14,772	20,334	19,865	19,388	22,003	24,546	27,020	32,801	35,043	41,376	47,560	49,955	52,200	54,374
Current Assets & Liabilities																				
Short term assets (cash)	[7]		(440)	1,234	2,835	1,968	1,007	210	862	3,149	5,167	5,851	6,624	7,457	8,384	9,185	9,865	10,649	11,544	12,551
Debtors	[8]		205	285	359	470	624	806	1,485	2,118	2,066	1,724	1,757	1,791	1,825	1,860	1,894	1,929	1,964	2,000
Creditors	[9]		(107)	(140)	(186)	(232)	(288)	(346)	(569)	(750)	(764)	(772)	(780)	(795)	(803)	(815)	(827)	(836)	(844)	(853)
Net Current Assets			(342)	1,379	3,008	2,206	1,343	670	1,778	4,517	6,469	6,803	7,601	8,453	9,407	10,230	10,932	11,743	12,664	13,698
Total Assets			**5,990**	**8,264**	**10,077**	**9,330**	**16,115**	**21,004**	**21,644**	**23,905**	**28,472**	**31,350**	**34,621**	**41,254**	**44,450**	**51,606**	**58,492**	**61,697**	**64,864**	**68,072**
Equity & Liabilites																				
Equity	[10]		5,990	8,036	9,804	9,072	12,128	14,369	15,371	17,995	22,925	26,165	29,799	36,794	40,353	45,937	51,353	55,087	58,822	62,598
Long Term liabilities	[11]		0	228	273	258	3,986	6,635	6,272	5,910	5,547	5,185	4,822	4,459	4,097	5,669	7,138	6,610	6,042	5,474
Total Equity & Liabilities			**5,990**	**8,264**	**10,077**	**9,330**	**16,115**	**21,004**	**21,644**	**23,905**	**28,472**	**31,350**	**34,621**	**41,254**	**44,450**	**51,606**	**58,492**	**61,697**	**64,864**	**68,072**

notes for referenced items above:

[1]	Provisions to write off bad debt was set at 50 % in the base year and 100 % thereafter to gradually introduce the concept which does not appear to be ccarried out currently.
[2]	Depreciation for both existing and new assets is reflected here, as calculated in existing and Investment assets tabs and allocated as per the main cost table under the Cost tab.
[3]	Debtors are calculated as the difference between billing and cash collections for the respective year.
[4]	Partial debt recovery is calculated in the revenue table based on a small proportion of 3-year old debt recovered as cash collections.
[5]	With past history of deficit cash flow funded in part from creditors the entity has become uncreditworthy and future cash flow is based on a strictly cash on delivery basis, i.e. costs = expenditure.
[6]	The value of fixed assets is returned as the depreciated residual value of existing and investment assets calculated in the respective existing assets and investment assets tabs.
[7]	Accumulated cash reserves/(deficit)
[8]	Debtors as defined under note [3]
[9]	Asume two months worth of fixed costs (except personnel), variable and maintenance.
[10]	Balance of total assets and (less) long term liabilities.
[11]	The balance on loans is represented as long term liabilities.

NORTON Detailed Cost Calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
VOLUMES																						
Average water demand			[1]	000 m^3	7,311	7,449	7,586	7,724	7,861	7,998	8,136	8,273	8,505	8,736	8,968	9,199	9,431	9,662	9,894	10,125	10,357	10,588
Peak water demand	Seasonal factor	1.25	[2]	000 m^3	9,139	9,311	9,483	9,655	9,826	9,998	10,170	10,342	10,631	10,920	11,210	11,499	11,788	12,078	12,367	12,656	12,946	13,235
Production Capacity				000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Treatment surplus/(deficit)			[2]		(9,139)	(9,311)	(9,483)	(9,655)	(9,826)	(9,998)	(10,170)	(10,342)	(10,631)	(10,920)	(11,210)	(11,499)	(11,788)	(12,078)	(12,367)	(12,656)	(12,946)	(13,235)
Raw Water			[3]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed Production losses			[3]	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Water Produced			[4]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proportion of bulk water available			[5]	%	25%	30%	35%	40%	45%	50%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Water bought in bulk	Bulk available? (y/n)	Y	[6]	000 m^3	1,828	2,235	2,655	3,089	3,537	3,999	6,509	8,273	8,505	8,736	8,968	9,199	9,431	9,662	9,894	10,125	10,357	10,588
Water available			[7]	000 m^3	1,828	2,235	2,656	3,090	3,538	4,000	6,509	8,274	8,506	8,737	8,969	9,200	9,432	9,663	9,895	10,126	10,358	10,589
COST STREAMS																						
CAPITAL COSTS																						
Disbursements on capital investments			[8]																			
Disbursements from GHWSSIP grant				000 USD	-	240	60	-	8,266	7,717	-	-	-	-	-	-	-	7,717	7,717	-	-	-
Disbursements from GH WSSIP concessionary loan				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from GHWSSIP loan				000 USD	-	240	60	-	8,266	7,717	-	-	-	-	-	-	-	7,717	7,717	-	-	-
Disbursements from own resources				000 USD	-	-	-	-	-	-	-	-	177	177	177	2,707	177	177	177	417	417	417
Disbursements from external/private invest.				000 USD	-	1,601	1,601	1,601	1,601	1,601	1,601	1,601	2,156	2,156	2,156	2,156	2,156	2,156	2,156	2,156	2,156	2,156
Disbursements from CMEC				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disbursements from ZimFund grant				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Disbursements for investments				000 USD	-	2,081	1,721	1,601	18,133	17,035	1,601	1,601	2,333	2,333	2,333	4,864	2,333	17,766	17,766	2,573	2,573	2,573
Repayments of principal	repay period																					
Repayment of GHWSSIP loan principal	0 yr grace, repay	20 years		000 USD	-	12	15	15	428	814	814	814	814	814	814	814	814	1,200	1,586	1,586	1,586	1,586
Repayment of CMEC principal	3 yr grace, repay in	5 years		000 USD					-	-	-	-	-							-	-	-
Total repayment of principal				000 USD	-	12	15	15	428	814	814	814	814	814	814	814	814	1,200	1,586	1,586	1,586	1,586
Balance on loans																						
Balance of concessionary loan principal	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Balance of GHWSSIP loan principal	year end			000 USD	-	228	273	258	8,096	14,999	14,184	13,370	12,556	11,742	10,928	10,114	9,300	15,816	21,947	20,361	18,775	17,189
Balance of CMEC loan	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total balance on loans	year end			000 USD	-	228	273	258	8,096	14,999	14,184	13,370	12,556	11,742	10,928	10,114	9,300	15,816	21,947	20,361	18,775	17,189
Interest on Loans																						
Interest on existing loans				000 USD																		
Interest on GHWSSIP loan	Interest rate	5.0% p.a.		000 USD	-	12	14	14	426	791	750	709	669	628	587	546	506	851	1,177	1,097	1,018	939
Interest on CMEC loan	Interest rate	3.5% p.a.		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total interest on loans				000 USD	-	12	14	14	426	791	750	709	669	628	587	546	506	851	1,177	1,097	1,018	939
Depreciation																						
Depreciation on existing assets	Alloc of calc depr.	0%	[9]	000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed proportion of calc depreciation	Gradual increase		[10]	%		5%	10%	10%	10%	10%	10%	15%	20%	25%	30%	30%	30%	30%	30%	30%	30%	30%
Depreciation on Capital Investment			[10]	000 USD		2	7	11	56	94	98	152	215	281	352	432	384	431	517	538	552	566
Sub-Total Capital Costs				000 USD	-	4,668	4,054	3,786	54,223	67,371	34,797	33,141	32,959	31,316	29,677	33,108	26,290	71,698	85,468	51,773	48,457	45,141
OPERATION - Variable																						
Bulk water	N/A																					
Assumed unit cost for bulk water	N/A		[11]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Annual bulk water cost	N/A			000 USD	731	894	1,062	1,236	1,415	1,600	2,603	3,309	3,402	3,494	3,587	3,680	3,772	3,865	3,957	4,050	4,143	4,235
Abstraction																						
Assumed unit abstraction cost	inflation	0% p.a.		USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Adjust (actual/desired level) on existing	gradual		[12]	%	0%	0%	5%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	100%	100%	100%	100%
Annual abstraction cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power																						
Assumed unit power cost	Inflation	0% p.a.	[13]	USD/m^3	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Annual power cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemical																						
Assumed unit chemical cost	Inflation p.a.	0% p.a.	[14]	USD/m^3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Annual chemical cost				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Variable Costs				000 USD	**731**	**894**	**1,062**	**1,236**	**1,415**	**1,600**	**2,603**	**3,309**	**3,402**	**3,494**	**3,587**	**3,680**	**3,772**	**3,865**	**3,957**	**4,050**	**4,143**	**4,235**
OPERATION - Fixed																						
Personnel			[15]	000 USD	1,169	1,169	1,641	1,846	1,846	2,107	2,107	2,107	2,107	2,107	2,107	2,107	2,107	2,107	2,107	2,107	2,107	2,107
Transport			[16]																			
Number of vehicles				No.					4	4	4	4	4	4	4	4	4	4	4	4	4	4
Number of Motor cycles				No	1	1	1	1	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Number of Trucks				No					1	1	1	1	1	1	1	1	1	1	1	1	1	1
Assumed unit fuel cost	0% p.a.			USD/litre	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Annual vehicle operating cost				000 USD	1	1	1	1	22	22	22	22	22	22	22	22	22	22	22	22	22	22
Other administration costs	% of personnel	20%	[17]	000 USD	234	234	328	369	369	421	421	421	421	421	421	421	421	421	421	421	421	421
Sub-Total Fixed Costs				000 USD	**1,404**	**1,404**	**1,970**	**2,216**	**2,237**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**	**2,550**
MAINTENANCE																						
Adjust (actual/desired level) on maintenanc	Gradual increase		[18]	%	10%	10%	15%	20%	25%	30%	35%	40%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Existing assets				000 USD	39	39	58	77	97	116	135	155	194	194	194	194	194	194	194	160	160	158
GHWSSIP Investments				000 USD	-	2	7	14	70	146	178	213	284	302	320	364	381	438	495	515	535	555
Other investments				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total Maintenance				000 USD	**39**	**41**	**65**	**92**	**167**	**262**	**314**	**368**	**478**	**496**	**513**	**557**	**575**	**632**	**688**	**675**	**695**	**713**

Average Unit Bulk Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit abstraction cost				USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Assumed unit power cost				USD/m^3	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.0701389	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125	0.08125
Assumed unit chemical cost				USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		25%		USD/m^3	-	0.0034	0.0041	0.0037	0.0588	0.0892	0.0493	0.0372	0.0366	0.0361	0.0359	0.0359	0.0315	0.0436	0.0556	0.0518	0.0480	0.0444
Proportion of fixed costs		25%		USD/m^3	0.4571	0.3413	0.3710	0.3321	0.2726	0.2571	0.1484	0.1101	0.1056	0.1013	0.0974	0.0936	0.0901	0.0868	0.0837	0.0807	0.0779	0.0753
Proportion of Maintenance costs		30%		USD/m^3	0.0151	0.0120	0.0147	0.0165	0.0244	0.0317	0.0219	0.0191	0.0237	0.0236	0.0235	0.0246	0.0244	0.0258	0.0271	0.0256	0.0255	0.0253
Sub-total unit cost for water	Average	0.43		USD/m^3	**0.65**	**0.54**	**0.57**	**0.53**	**0.54**	**0.56**	**0.40**	**0.36**	**0.36**	**0.35**	**0.35**	**0.35**	**0.34**	**0.35**	**0.36**	**0.35**	**0.34**	**0.34**

Average Unit Retail Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit cost for bulk water				USD/m^3	0.3999	0.3999	0.3999	0.3999	0.3999	0.3999	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
Assumed unit abstraction cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed unit power cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Assumed unit chemical cost				USD/m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proportion of Financial costs		60%		USD/m^3	-	0.0081	0.0098	0.0088	0.1411	0.2141	0.1184	0.0892	0.0878	0.0867	0.0861	0.0862	0.0755	0.1047	0.1334	0.1242	0.1151	0.1066
Proportion of fixed costs		60%		USD/m^3	1.0970	0.8192	0.8904	0.7971	0.6543	0.6170	0.3561	0.2642	0.2534	0.2432	0.2337	0.2247	0.2163	0.2083	0.2008	0.1937	0.1870	0.1806
Proportion of Maintenance costs		60%		USD/m^3	0.0303	0.0240	0.0294	0.0329	0.0489	0.0634	0.0438	0.0381	0.0475	0.0473	0.0470	0.0491	0.0488	0.0516	0.0542	0.0513	0.0510	0.0505
Sub-total unit cost for water	Average	0.96		USD/m^3	1.53	1.25	1.33	1.24	1.24	1.29	0.92	0.79	0.79	0.78	0.77	0.76	0.74	0.76	0.79	0.77	0.75	0.74
Adjustment for collection losses				USD/m^3	0.50	0.38	0.40	0.31	0.25	0.19	0.09	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Total average cost covering water tariff				USD/m^3	2.03	1.63	1.73	1.55	1.49	1.49	1.01	0.83	0.83	0.82	0.81	0.80	0.78	0.80	0.83	0.81	0.79	0.77
Total average cost covering W&S tariff				USD/m^3	3.03	2.36	2.53	2.25	2.17	2.17	1.39	1.11	1.10	1.08	1.06	1.05	1.02	1.06	1.10	1.07	1.04	1.01
Calculated sewerage charges				%	1.00	0.73	0.80	0.70	0.68	0.68	0.38	0.28	0.27	0.26	0.25	0.25	0.24	0.26	0.27	0.26	0.25	0.24
Calculated proportion of sewerage of Water					49%	45%	46%	45%	46%	46%	38%	34%	33%	32%	31%	31%	31%	33%	33%	32%	32%	31%
Water tariff used in Fin Model	0%				***1.45***	***1.35***	***1.20***	***1.15***	***1.15***	***1.15***	***1.15***	***1.15***	***1.10***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***

Unit Costs

Chemicals	UNIT	Borehole
Chlorine	USD/kg	*4*
Dosing rate	g/m^3	*5*
Costs/m3	USD/m^3	0.02
Alum	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Lime	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Total Unit Chemical Cost	**USD/m^3**	**0.0200**

The unit cost of chemicals is calculated for two scenarios, (a) for surface water intakes and (b) borehole abstraction and the relevant cost is applied to the unit of water produced

Power	UNIT	Long-Term
Volume	m^3/h	*4,633*
Pumping head	H	*117*
Pump efficiency	%	0.72
KWh	KW/h	752.8625
Power consumption	KW/m^3	0.1625
Cost/ KWh	USD/KWh	*0.5*
Cost per m3	**USD/m^3**	**0.0813**

For details on Q & h refer to

Both the midium and long term unit cost

Explanation notes for referenced items above:

[1] *Water demand projected for 2013, 2020 and 2030 representing three milestones. The periods between these were interpolated on a linear basis.*
[2] *The peak seasonal factor and peak demand are calculated as a function of average demand and used to ascertain the production surplus/(deficit).*
[3] *Production losses attributable to backwash, flushing and other cleaning operations are assumed to increase the abstraction of raw water.*
[4] *The water produced is the volume of water after production losses equal to either the demand or the production capacity, whichever smaller.*
[5] *The proportion of bulk water available may be less than 100 % in the event that bulk water supply is practically throttled or cannot be produced.*
[6] *If the entity does not produce (adequate) water and bulk water is available (even if only limited), the assumed volumes of water bought are calculated considering demand, own production and proportional available.*
[7] *The volume of water available is the addition of water produced plus water bought in bulk (if any).*
[8] *Details on funding of investments are provided in a separate table (see Investment Assets Tab)..*
[9] *Depreciation is based on replacement value and economic life. In view of recent financial performance it is not realistic to bring these calculated costs to account, thus, the depreciation for existing assets was set to nil through entry*
[10] *As with existing assets, the full annual value of depreciation of new assets is high and realistically not a priority and therefore revised downward.*
[11] *Bulk water costs are calculated separately; considering abstraction, power, chemicals, financial, fixed and maintenance costs and compared with current levels.*
[12] *Abstraction costs are gradually adjusted from current payment levels to required levels.*
[13] *Unit power costs for pumping are calculated on the basis of current and anticipated Q & h values and pumping times as detailed in a separate table (see Pumping tab).*
[14] *Unit chemical costs are calculated for surface water and borehole abstraction and applied accordingly; they include treatment chemicals (aluminium sulphate, lime) and disinfection (chlorine) as detailed in a separate table below the*
[15] *Personnel costs are based on separately calculated (see HR tab) number of staff, assumed scales, allowances, contribution to pension, etc. and a % allocation to water and sanitation to take into account recharges for other*
[16] *The calculation of transport costs is based on the number of units, average annual distance travelled/hours worked, fuel consumption per km/hr. and fuel price.*
[17] *Other administration costs including insurance, external professional fees (e.g. audit), office stationery, office utilities, etc. are estimated as a proportion of employment costs.*
[18] *Desired and ideal maintenance costs are calculated for both existing and future assets, but are high and from past experience not realistic to apply the full cost. Therefore, an adjustment of the desired to the realistic level is carried*

NORTON Detailed revenue calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WATER VOLUMES																						
Water Produced	From cost table			000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water bought in bulk	From cost table			000 m^3	1,828	2,235	2,655	3,089	3,537	3,999	6,509	8,273	8,505	8,736	8,968	9,199	9,431	9,662	9,894	10,125	10,357	10,588
Demand for bulk water sales				000 m^3																		
Assumed proportion of bulk water supplied			[1]	%	25%	30%	35%	40%	45%	50%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Water sold in bulk	Sum of satellites		[1]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Water available				000 m^3	1,828	2,235	2,655	3,089	3,537	3,999	6,509	8,273	8,505	8,736	8,968	9,199	9,431	9,662	9,894	10,125	10,357	10,588
Non-Revenue Water (NRW)			[2]	%	*58%*	54%	50%	46%	42%	38%	34%	*30%*	29%	28%	27%	26%	25%	24%	23%	22%	21%	*20%*
NRW reduction			[2]	%		4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Total volumes billed incl. [sold] bulk				000 m^3	768	1,028	1,328	1,668	2,052	2,480	4,296	5,791	6,038	6,290	6,546	6,807	7,073	7,343	7,618	7,898	8,182	8,470
Total Volumes Billed [Sold] excl. bulk			[3]	000 m^3	768	1,028	1,328	1,668	2,052	2,480	4,296	5,791	6,038	6,290	6,546	6,807	7,073	7,343	7,618	7,898	8,182	8,470
Number of Accounts	Based on metering program			000 No.	*358*	*373*	*379*	*394*	*409*	*424*	*439*	*455*	*473*	*491*	*509*	*527*	*545*	*563*	*581*	*599*	*617*	*635*
REVENUE STREAMS																						
Assumed tariff for Bulk Supply (if any)	Keep current levels		[4]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Combined average retail tariff (simplified)	Water + Sewer incl fixed		[5]	USD/m^3	1.45	1.35	1.20	1.15	1.15	1.15	1.15	1.15	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Calculated Bulk Sales				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calculated Combined Retail Sales				000 USD	1,113	1,388	1,593	1,919	2,359	2,851	4,940	6,660	6,642	5,661	5,892	6,127	6,366	6,609	6,856	7,108	7,364	7,623
Total Billing for Water & Sewerage				000 USD	1,113	1,388	1,593	1,919	2,359	2,851	4,940	6,660	6,642	5,661	5,892	6,127	6,366	6,609	6,856	7,108	7,364	7,623
Collection Efficiency			[6]	%	*67%*	*70%*	*70%*	*75%*	*80%*	*85%*	*90%*	*95%*	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Collections from Water & Sewerage				000 USD	746	971	1,115	1,439	1,888	2,424	4,446	6,327	6,310	5,378	5,597	5,820	6,047	6,278	6,513	6,752	6,995	7,242
Other revenue (recovery of old debt)	% of 3 year debt	*5.0%*	[7]	000 USD		2,315	2,555	18	21	24	24	24	21	25	17	17	14	15	15	16	17	17
Total revenue collection				000 USD	746	3,286	3,670	1,457	1,908	2,448	4,470	6,351	6,331	5,403	5,614	5,837	6,062	6,293	6,529	6,768	7,012	7,259

Explanation notes for referenced items above:

[1]	*It is not anticipated that Harare will be able to fully cover water demand until investments are made and efficiencies have improved. To reflect this condition, a proportion of bulk supply reflected as revenue for*
[2]	*NRW is aligned to currednlty reported levels and deemed to improve with reforms and future investments, whereby milestone targets are set for 2020 and 2030.*
[3]	*Volumes of water sold bulk and excl bulk is based on bulk sold before NRW and retail after NRW at different tariffs*
[4]	*While detailed bulk tariff calculations are provided below the main cost table, the current existing bulk tariff is applied throughout.*
[5]	*The combined tariff includes water, sewerage and any fixed charge component applied as an overall unit tariff.*
[6]	*The collection efficiency in the base year appears to be anoutlier compared to previous years. Future collection efficiencies are based o agreed milestones.*
[7]	*A proportion of old debt (3-years old) is assumed to be collected.*

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NORTON

INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income Streams																				
Bulk sales		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Water & Sewerage		000 USD	1,113	1,388	1,593	1,919	2,359	2,851	4,940	6,660	6,642	5,661	5,892	6,127	6,366	6,609	6,856	7,108	7,364	7,623
Sub-Total		000 USD	1,113	1,388	1,593	1,919	2,359	2,851	4,940	6,660	6,642	5,661	5,892	6,127	6,366	6,609	6,856	7,108	7,364	7,623
Cost Streams [=Expenditure]																				
Operation - Fixed Costs		000 USD	1,404	1,404	1,970	2,216	2,237	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550
Operation - Variable		000 USD	731	894	1,062	1,236	1,415	1,600	2,603	3,309	3,402	3,494	3,587	3,680	3,772	3,865	3,957	4,050	4,143	4,235
Maintenance		000 USD	39	41	65	92	167	262	314	368	478	496	513	557	575	632	688	675	695	713
Capital Charges (INTEREST ONLY)		000 USD	-	12	14	14	426	791	750	709	669	628	587	546	506	851	1,177	1,097	1,018	939
Sub-Total		000 USD	2,173	2,350	3,112	3,557	4,246	5,202	6,217	6,936	7,098	7,168	7,237	7,333	7,403	7,897	8,372	8,372	8,406	8,437
Surplus/(Deficit)		000 USD	**(1,060)**	**(963)**	**(1,519)**	**(1,639)**	**(1,886)**	**(2,351)**	**(1,277)**	**(277)**	**(456)**	**(1,507)**	**(1,345)**	**(1,206)**	**(1,037)**	**(1,288)**	**(1,516)**	**(1,264)**	**(1,042)**	**(814)**

ADJUSTED INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income																				
Total Income		000 USD	1,113	1,388	1,593	1,919	2,359	2,851	4,940	6,660	6,642	5,661	5,892	6,127	6,366	6,609	6,856	7,108	7,364	7,623
Expenditure																				
Total Expenses		000 USD	2,173	2,350	3,112	3,557	4,246	5,202	6,217	6,936	7,098	7,168	7,237	7,333	7,403	7,897	8,372	8,372	8,406	8,437
Provision for debt write-off	[1]	000 USD	184	416	478	480	472	428	494	333	332	283	295	306	318	330	343	355	368	381
Depreciation	[2]	000 USD	-	2	7	11	57	94	98	152	215	281	352	432	384	431	517	538	552	566
Total Expenses incl. Depreciation		000 USD	2,357	2,769	3,597	4,048	4,774	5,724	6,809	7,421	7,646	7,732	7,884	8,072	8,105	8,659	9,232	9,265	9,326	9,385
Adjusted Surplus/(Deficit)		000 USD	**(1,244)**	**(1,381)**	**(2,004)**	**(2,129)**	**(2,415)**	**(2,872)**	**(1,869)**	**(761)**	**(1,003)**	**(2,071)**	**(1,992)**	**(1,945)**	**(1,740)**	**(2,050)**	**(2,376)**	**(2,158)**	**(1,962)**	**(1,761)**

CASH FLOW STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cash Flow from Operating Activities																				
Profit/(loss) from income statement		000 USD	(1,244)	(1,381)	(2,004)	(2,129)	(2,415)	(2,872)	(1,869)	(761)	(1,003)	(2,071)	(1,992)	(1,945)	(1,740)	(2,050)	(2,376)	(2,158)	(1,962)	(1,761)
Adjust for non-cash items		000 USD																		
Depreciation	[2]	000 USD	0	2	7	11	57	94	98	152	215	281	352	432	384	431	517	538	552	566
Provision for debt write-off			184	416	478	480	472	428	494	333	332	283	295	306	318	330	343	355	368	381
Net adjusted income for the year		000 USD	(1,060)	(963)	(1,519)	(1,639)	(1,886)	(2,351)	(1,277)	(277)	(456)	(1,507)	(1,345)	(1,206)	(1,037)	(1,288)	(1,516)	(1,264)	(1,042)	(814)
Adjust for Change in Working Capital																				
(Increase)/Decrease in debtors	[3]	000 USD	(367)	(416)	(478)	(480)	(472)	(428)	(494)	(333)	(332)	(283)	(295)	(306)	(318)	(330)	(343)	(355)	(368)	(381)
Partial debt recovery	[4]	000 USD	0	2,315	2,555	18	21	24	24	24	21	25	17	17	14	15	15	16	17	17
Increase/(Decrease) in creditors	[5]	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net change in working capital		000 USD	(367)	1,899	2,077	(461)	(451)	(404)	(470)	(309)	(311)	(258)	(278)	(290)	(304)	(316)	(327)	(339)	(352)	(364)
Cash Flow from Investment Activities																				
Repayment of principal		000 USD	0	(12)	(15)	(15)	(428)	(814)	(814)	(814)	(814)	(814)	(814)	(814)	(814)	(1,200)	(1,586)	(1,586)	(1,586)	(1,586)
Net change generaged by/(used in investment activit		000 USD	0	(12)	(15)	(15)	(428)	(814)	(814)	(814)	(814)	(814)	(814)	(814)	(814)	(1,200)	(1,586)	(1,586)	(1,586)	(1,586)
Cash Flow																				
Net increase/(decrease) in cash & equiv.		000 USD	(1,428)	924	544	(2,115)	(2,766)	(3,569)	(2,561)	(1,400)	(1,581)	(2,579)	(2,438)	(2,310)	(2,155)	(2,804)	(3,429)	(3,190)	(2,980)	(2,764)
Cash & cash equiv. at beginning of year		000 USD	0	(1,428)	(504)	40	(2,075)	(4,841)	(8,409)	(10,970)	(12,371)	(13,951)	(16,530)	(18,968)	(21,278)	(23,433)	(26,237)	(29,666)	(32,856)	(35,835)
Cash & cash equivalents at end of year		**000 USD**	**(1,428)**	**(504)**	**40**	**(2,075)**	**(4,841)**	**(8,409)**	**(10,970)**	**(12,371)**	**(13,951)**	**(16,530)**	**(18,968)**	**(21,278)**	**(23,433)**	**(26,237)**	**(29,666)**	**(32,856)**	**(35,835)**	**(38,599)**

BALANCE SHEET (Simplified)

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets																				
Fixed Assets	[6]																			
Existing Plant & equipment			10,974	10,546	10,118	9,690	9,262	8,834	8,406	7,977	7,549	7,121	6,693	6,265	5,837	5,408	4,980	4,552	4,191	3,830
Future Plant & equipment				2,045	3,694	5,187	22,756	38,851	39,477	40,066	41,323	42,532	43,692	47,116	48,169	64,497	80,541	81,322	82,057	82,744
Total Fixed Assets			10,974	12,591	13,812	14,877	32,018	47,685	47,882	48,043	48,873	49,653	50,385	53,381	54,005	69,906	85,521	85,874	86,247	86,573
Current Assets & Liabilities																				
Short term assets (cash)	[7]		(1,428)	(504)	40	(2,075)	(4,841)	(8,409)	(10,970)	(12,371)	(13,951)	(16,530)	(18,968)	(21,278)	(23,433)	(26,237)	(29,666)	(32,856)	(35,835)	(38,599)
Debtors	[8]		278	347	398	480	590	713	1,235	1,665	1,661	1,415	1,473	1,532	1,591	1,652	1,714	1,777	1,841	1,906
Creditors	[9]		(167)	(195)	(243)	(283)	(329)	(384)	(560)	(687)	(721)	(739)	(757)	(780)	(798)	(823)	(848)	(861)	(880)	(899)
Net Current Assets			(1,317)	(352)	196	(1,878)	(4,580)	(8,081)	(10,296)	(11,392)	(13,011)	(15,854)	(18,252)	(20,527)	(22,640)	(25,408)	(28,800)	(31,940)	(34,875)	(37,592)
Total Assets			**9,658**	**12,240**	**14,008**	**12,999**	**27,438**	**39,604**	**37,587**	**36,651**	**35,861**	**33,799**	**32,133**	**32,854**	**31,365**	**44,498**	**56,721**	**53,934**	**51,373**	**48,981**
Equity & Liabilites																				
Equity	[10]		9,658	12,012	13,735	12,741	19,342	24,606	23,402	23,281	23,305	22,057	21,205	22,740	22,065	28,682	34,774	33,573	32,598	31,792
Long Term liabilities	[11]		0	228	273	258	8,096	14,999	14,184	13,370	12,556	11,742	10,928	10,114	9,300	15,816	21,947	20,361	18,775	17,189
Total Equity & Liabilities			**9,658**	**12,240**	**14,008**	**12,999**	**27,438**	**39,604**	**37,587**	**36,651**	**35,861**	**33,799**	**32,133**	**32,854**	**31,365**	**44,498**	**56,721**	**53,934**	**51,373**	**48,981**

notes for referenced items above:

[1]	Provisions to write off bad debt was set at 50 % in the base year and 100 % thereafter to gradually introduce the concept which does not appear to be ccarried out currently.
[2]	Depreciation for both existing and new assets is reflected here, as calculated in existing and Investment assets tabs and allocated as per the main cost table under the Cost tab.
[3]	Debtors are calculated as the difference between billing and cash collections for the respective year.
[4]	Partial debt recovery is calculated in the revenue table based on a small proportion of 3-year old debt recovered as cash collections.
[5]	With past history of deficit cash flow funded in part from creditors the entity has become uncreditworthy and future cash flow is based on a strictly cash on delivery basis, i.e. costs = expenditure.
[6]	The value of fixed assets is returned as the depreciated residual value of existing and investment assets calculated in the respective existing assets and investment assets tabs.
[7]	Accumulated cash reserves/(deficit)
[8]	Debtors as defined under note [3]
[9]	Asume two months worth of fixed costs (except personnel), variable and maintenance.
[10]	Balance of total assets and (less) long term liabilities.
[11]	The balance on loans is represented as long term liabilities.

RUWA Detailed Cost Calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
VOLUMES																							
Average water demand			[1]	000 m^3	5,904	6,472	7,040	7,608	8,175	8,743	9,311	9,879	10,169	10,458	10,748	11,037	11,327	11,617	11,906	12,196	12,485	12,775	
Peak water demand	Seasonal factor	1.25	[2]	000 m^3	7,380	8,090	8,800	9,510	10,219	10,929	11,639	12,349	12,711	13,073	13,435	13,797	14,159	14,521	14,883	15,245	15,607	15,969	
Production Capacity				000 m^3	730	2,738	2,738	2,738	2,738	2,738	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	
Treatment surplus/(deficit)			[2]		(6,650)	(5,352)	(6,062)	(6,772)	(7,482)	(8,192)	(5,251)	(5,961)	(6,323)	(6,685)	(7,047)	(7,409)	(7,771)	(8,133)	(8,495)	(8,857)	(9,219)	(9,581)	
Raw Water			[3]	000 m^3	767	2,874	2,874	2,874	2,874	2,874	6,707	6,707	6,707	6,707	6,707	6,707	6,707	6,707	6,707	6,707	6,707	6,707	
Assumed Production losses			[3]	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
Water Produced			[4]	000 m^3	730	2,738	2,738	2,738	2,738	2,738	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	
Proportion of bulk water available			[5]	%	25%	30%	35%	40%	45%	50%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Water bought in bulk	Bulk available? (y/n)	Y	[6]	000 m^3	1,294	1,120	1,506	1,948	2,447	3,003	2,339	3,491	3,781	4,070	4,360	4,649	4,939	5,229	5,518	5,808	6,097	6,387	
Water available			[7]	000 m^3	2,024	3,858	4,244	4,686	5,185	5,741	8,727	9,880	10,170	10,459	10,749	11,038	11,328	11,618	11,907	12,197	12,486	12,776	
COST STREAMS																							
CAPITAL COSTS																							
Disbursements on capital investments			[8]																				
Disbursements from GHWSSIP grant				000 USD	-	240	60	-	10,307	9,881	-	-	-	-	-	-	-	9,100	9,100	-	-	-	
Disbursements from GH WSSIP concessionary loan				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Disbursements from GHWSSIP loan				000 USD	-	240	60	-	10,307	9,881	-	-	-	-	-	-	-	9,100	9,100	-	-	-	
Disbursements from own resources				000 USD	-	-	-	-	-	-	-	-	370	370	370	3,125	370	370	370	656	656	656	
Disbursements from external/private invest.				000 USD	-	3,831	3,831	3,831	3,831	3,831	3,831	3,831	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	2,917	
Disbursements from CMEC				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Disbursements from ZimFund grant				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Disbursements for investments				000 USD	-	4,311	3,951	3,831	24,444	23,592	3,831	3,831	3,286	3,286	3,286	6,041	3,286	21,485	21,485	3,572	3,572	3,572	
Repayments of principal	repay period																						
Repayment of GHWSSIP loan principal	0 yr grace, repay	20 years		000 USD	-	12	15	15	530	1,024	1,024	1,024	1,024	1,024	1,024	1,024	1,024	1,479	1,934	1,934	1,934	1,934	
Repayment of CMEC principal	3 yr grace, repay in	5 years		000 USD					-	-	-	-	-							-	-	-	
Total repayment of principal				000 USD	-	12	15	15	530	1,024	1,024	1,024	1,024	1,024	1,024	1,024	1,024	1,479	1,934	1,934	1,934	1,934	
Balance on loans																							
Balance of concessionary loan principal	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Balance of GHWSSIP loan principal	year end			000 USD	-	228	273	258	10,034	18,890	17,866	16,842	15,817	14,793	13,769	12,744	11,720	19,340	26,505	24,571	22,637	20,702	
Balance of CMEC loan	year end			000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total balance on loans	year end			000 USD	-	228	273	258	10,034	18,890	17,866	16,842	15,817	14,793	13,769	12,744	11,720	19,340	26,505	24,571	22,637	20,702	
Interest on Loans																							
Interest on existing loans				000 USD																			
Interest on GHWSSIP loan	Interest rate	5.0% p.a.		000 USD	-	12	14	14	528	996	945	893	842	791	740	688	637	1,041	1,422	1,325	1,229	1,132	
Interest on CMEC loan	Interest rate	3.5% p.a.		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total interest on loans				000 USD	-	12	14	14	528	996	945	893	842	791	740	688	637	1,041	1,422	1,325	1,229	1,132	
Depreciation																							
Depreciation on existing assets	Alloc of calc depr.	0%	[9]	000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Assumed proportion of calc depreciation	Gradual increase		[10]	%		5%	10%	10%	10%	10%	10%	15%	20%	25%	30%	30%	30%	30%	30%	30%	30%	30%	
Depreciation on Capital Investment			[10]	000 USD		4	16	25	84	135	143	227	322	418	521	611	555	601	698	724	742	760	
Sub-Total Capital Costs				000 USD	-	9,130	8,523	8,260	71,157	89,140	47,475	45,408	42,262	40,208	38,159	41,608	33,891	87,293	103,392	63,530	59,486	55,442	
OPERATION - Variable																							
Bulk water	N/A																						
Assumed unit cost for bulk water	N/A		[11]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
Annual bulk water cost	N/A			000 USD	517	448	602	779	979	1,201	935	1,396	1,512	1,628	1,744	1,860	1,976	2,091	2,207	2,323	2,439	2,555	
Abstraction																							
Assumed unit abstraction cost	inflation	0% p.a.		USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
Adjust (actual/desired level) on existing	gradual		[12]	%	0%	0%	5%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	100%	100%	100%	100%	
Annual abstraction cost				000 USD	-	-	9	9	17	34	121	161	201	241	282	322	362	402	402	402	402	402	
Power																							
Assumed unit power cost	Inflation	0% p.a.	[13]	USD/m^3	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	
Annual power cost				000 USD	90	336	336	336	336	336	785	772	772	772	772	772	772	772	772	772	772	772	
Chemical																							
Assumed unit chemical cost	Inflation p.a.	0% p.a.	[14]	USD/m^3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Annual chemical cost				000 USD	38	142	142	142	142	142	332	332	332	332	332	332	332	332	332	332	332	332	
Sub-Total Variable Costs				000 USD	**645**	**927**	**1,090**	**1,266**	**1,475**	**1,714**	**2,173**	**2,661**	**2,817**	**2,973**	**3,129**	**3,285**	**3,441**	**3,597**	**3,713**	**3,829**	**3,945**	**4,061**	
OPERATION - Fixed																							
Personnel			[15]	000 USD	710	710	1,000	1,125	1,125	1,465	1,465	1,465	1,465	1,465	1,465	1,465	1,465	1,465	1,465	1,465	1,465	1,465	
Transport			[16]																				
Number of vehicles				No.					4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Number of Motor cycles				No	3	3	3	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Number of Trucks				No					1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Assumed unit fuel cost	0% p.a.			USD/litre	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	
Annual vehicle operating cost				000 USD	2	2	2	2	22	22	22	22	22	22	22	22	22	22	22	22	22	22	
Other administration costs	% of personnel	20%	[17]	000 USD	142	142	200	225	225	293	293	293	293	293	293	293	293	293	293	293	293	293	
Sub-Total Fixed Costs				000 USD	**854**	**854**	**1,202**	**1,351**	**1,371**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	**1,780**	
MAINTENANCE																							
Adjust (actual/desired level) on maintenan	Gradual increase		[18]	%	10%	10%	10%	15%	20%	25%	30%	35%	40%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Existing assets				000 USD	64	64	64	96	128	160	192	224	256	320	319	319	317	317	317	316	301	301	
GHWSSIP Investments				000 USD	-	6	11	25	74	143	188	239	293	391	416	470	495	565	634	662	690	718	
Other investments				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sub-Total Maintenance				000 USD	**64**	**70**	**75**	**121**	**202**	**303**	**380**	**463**	**549**	**711**	**735**	**789**	**812**	**882**	**951**	**978**	**992**	**1,020**	

Average Unit Bulk Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit abstraction cost				USD/m^3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Assumed unit power cost				USD/m^3	0.1229167	0.1229167	0.1229167	0.1229167	0.1229167	0.1229167	0.1229167	0.1208333	0.1208333	0.1208333	0.1208333	0.1208333	0.1208333	0.1208333	0.1208333	0.1208333	0.1208333	0.1208333
Assumed unit chemical cost				USD/m^3	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Proportion of Financial costs		25%		USD/m^3	-	0.0023	0.0036	0.0038	0.0509	0.0794	0.0472	0.0405	0.0403	0.0401	0.0402	0.0398	0.0351	0.0465	0.0578	0.0539	0.0499	0.0463
Proportion of fixed costs		25%		USD/m^3	0.2511	0.1202	0.1416	0.1335	0.1140	0.1251	0.0773	0.0644	0.0617	0.0591	0.0567	0.0545	0.0524	0.0504	0.0486	0.0468	0.0451	0.0436
Proportion of Maintenance costs		30%		USD/m^3	0.0226	0.0118	0.0106	0.0144	0.0202	0.0255	0.0198	0.0201	0.0228	0.0283	0.0281	0.0290	0.0287	0.0300	0.0311	0.0309	0.0302	0.0299
Sub-total unit cost for water	Average	0.38		USD/m^3	**0.51**	**0.37**	**0.39**	**0.39**	**0.42**	**0.46**	**0.38**	**0.36**	**0.36**	**0.36**	**0.36**	**0.36**	**0.35**	**0.36**	**0.37**	**0.36**	**0.36**	**0.35**

Average Unit Retail Cost Calculation	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assumed unit cost for bulk water				USD/m^3	0.2557	0.1162	0.1419	0.1663	0.1888	0.2092	0.1072	0.1413	0.1487	0.1557	0.1622	0.1685	0.1744	0.1800	0.1854	0.1905	0.1953	0.2000
Assumed unit abstraction cost				USD/m^3	0.0216	0.0426	0.0387	0.0351	0.0317	0.0286	0.0439	0.0388	0.0377	0.0366	0.0357	0.0347	0.0338	0.0330	0.0322	0.0314	0.0307	0.0300
Assumed unit power cost				USD/m^3	0.0443	0.0872	0.0793	0.0718	0.0649	0.0586	0.0900	0.0781	0.0759	0.0738	0.0718	0.0699	0.0681	0.0664	0.0648	0.0633	0.0618	0.0604
Assumed unit chemical cost				USD/m^3	0.0187	0.0368	0.0335	0.0303	0.0274	0.0247	0.0380	0.0336	0.0326	0.0317	0.0308	0.0300	0.0293	0.0285	0.0278	0.0272	0.0266	0.0260
Proportion of Financial costs		60%		USD/m^3	-	0.0054	0.0087	0.0091	0.1221	0.1906	0.1133	0.0972	0.0967	0.0963	0.0964	0.0954	0.0842	0.1116	0.1387	0.1293	0.1199	0.1110
Proportion of fixed costs		60%		USD/m^3	0.6026	0.2886	0.3398	0.3205	0.2736	0.3002	0.1855	0.1545	0.1480	0.1419	0.1362	0.1308	0.1257	0.1210	0.1165	0.1123	0.1083	0.1045
Proportion of Maintenance costs		60%		USD/m^3	0.0452	0.0235	0.0213	0.0287	0.0404	0.0510	0.0396	0.0401	0.0456	0.0567	0.0562	0.0580	0.0574	0.0599	0.0622	0.0617	0.0603	0.0599
Sub-total unit cost for water	Average	0.65		USD/m^3	0.99	0.60	0.66	0.66	0.75	0.86	0.62	0.58	0.59	0.59	0.59	0.59	0.57	0.60	0.63	0.62	0.60	0.59
Adjustment for collection losses				USD/m^3	0.58	0.30	0.27	0.20	0.15	0.13	0.06	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total average cost covering water tariff				USD/m^3	1.57	0.90	0.93	0.86	0.90	0.99	0.68	0.61	0.61	0.62	0.62	0.62	0.60	0.63	0.66	0.65	0.63	0.62
Total average cost covering W&S tariff				USD/m^3	2.26	1.22	1.27	1.17	1.25	1.41	0.93	0.82	0.82	0.83	0.82	0.82	0.79	0.84	0.88	0.86	0.83	0.81
Calculated sewerage charges				%	0.69	0.32	0.34	0.31	0.35	0.42	0.25	0.21	0.21	0.21	0.20	0.20	0.19	0.21	0.22	0.21	0.20	0.19
Calculated proportion of sewerage of Water					44%	36%	37%	36%	39%	42%	37%	34%	34%	34%	32%	32%	32%	33%	33%	32%	32%	31%
Water tariff used in Fin Model	0%				***1.45***	***1.35***	***1.20***	***1.15***	***1.15***	***1.15***	***1.15***	***1.15***	***1.10***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***	***0.90***

Unit Costs

Chemicals	UNIT	Borehole
Chlorine	USD/kg	*4*
Dosing rate	g/m^3	*5*
Costs/m3	USD/m^3	0.02
Alum	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Lime	USD/kg	
Dosing rate	g/m^3	
Costs/m3	USD/m^3	
Total Unit Chemical Cost	**USD/m^3**	**0.0200**

The unit cost of chemicals is calculated for two scenarios, (a) for surface water intakes and (b) borehole abstraction and the relevant cost is applied to the unit of water produced

Power	UNIT	Long-Term
Volume	m^3/h	648
Pumping head	H	174
Pump efficiency	%	0.72
KWh	KW/h	156.6
Power consumption	KW/m^3	0.2416667
Cost/ KWh	USD/KWh	*0.5*
Cost per m3	**USD/m^3**	**0.1208**

For details on Q & h refer to

Both the midium and long term unit cost

Explanation notes for referenced items above:

[1] *Water demand projected for 2013, 2020 and 2030 representing three milestones. The periods between these were interpolated on a linear basis.*
[2] *The peak seasonal factor and peak demand are calculated as a function of average demand and used to ascertain the production surplus/(deficit).*
[3] *Production losses attributable to backwash, flushing and other cleaning operations are assumed to increase the abstraction of raw water.*
[4] *The water produced is the volume of water after production losses equal to either the demand or the production capacity, whichever smaller.*
[5] *The proportion of bulk water available may be less than 100 % in the event that bulk water supply is practically throttled or cannot be produced.*
[6] *If the entity does not produce (adequate) water and bulk water is available (even if only limited), the assumed volumes of water bought are calculated considering demand, own production and proportional available.*
[7] *The volume of water available is the addition of water produced plus water bought in bulk (if any).*
[8] *Details on funding of investments are provided in a separate table (see Investment Assets Tab)..*
[9] *Depreciation is based on replacement value and economic life. In view of recent financial performance it is not realistic to bring these calculated costs to account, thus, the depreciation for existing assets was set to nil through*
[10] *As with existing assets, the full annual value of depreciation of new assets is high and realistically not a priority and therefore revised downward.*
[11] *Bulk water costs are calculated separately; considering abstraction, power, chemicals, financial, fixed and maintenance costs and compared with current levels.*
[12] *Abstraction costs are gradually adjusted from current payment levels to required levels.*
[13] *Unit power costs for pumping are calculated on the basis of current and anticipated Q & h values and pumping times as detailed in a separate table (see Pumping tab).*
[14] *Unit chemical costs are calculated for surface water and borehole abstraction and applied accordingly; they include treatment chemicals (aluminium sulphate, lime) and disinfection (chlorine) as detailed in a separate table below*
[15] *Personnel costs are based on separately calculated (see HR tab) number of staff, assumed scales, allowances, contribution to pension, etc. and a % allocation to water and sanitation to take into account recharges for other*
[16] *The calculation of transport costs is based on the number of units, average annual distance travelled/hours worked, fuel consumption per km/hr. and fuel price.*
[17] *Other administration costs including insurance, external professional fees (e.g. audit), office stationery, office utilities, etc. are estimated as a proportion of employment costs.*
[18] *Desired and ideal maintenance costs are calculated for both existing and future assets, but are high and from past experience not realistic to apply the full cost. Therefore, an adjustment of the desired to the realistic level is*

RUWA Detailed revenue calculations

ITEM	ASSUMPTION/ NOTE	NOTE VALUE	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WATER VOLUMES																						
Water Produced	From cost table			000 m^3	730	2,738	2,738	2,738	2,738	2,738	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388	6,388
Water bought in bulk	From cost table			000 m^3	1,294	1,120	1,506	1,948	2,447	3,003	2,339	3,491	3,781	4,070	4,360	4,649	4,939	5,229	5,518	5,808	6,097	6,387
Demand for bulk water sales				000 m^3																		
Assumed proportion of bulk water supplied			[1]	%	25%	30%	35%	40%	45%	50%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Water sold in bulk	Sum of satellites		[1]	000 m^3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Water available				000 m^3	2,024	3,858	4,243	4,686	5,185	5,740	8,727	9,879	10,169	10,458	10,748	11,037	11,327	11,617	11,906	12,196	12,485	12,775
Non-Revenue Water (NRW)			[2]	%	*58%*	54%	50%	46%	42%	38%	34%	*30%*	29%	28%	27%	26%	25%	24%	23%	22%	21%	*20%*
NRW reduction			[2]	%		4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Total volumes billed incl. [sold] bulk				000 m^3	850	1,775	2,122	2,530	3,007	3,559	5,760	6,915	7,220	7,530	7,846	8,168	8,495	8,829	9,168	9,513	9,863	10,220
Total Volumes Billed [Sold] excl. bulk			[3]	000 m^3	850	1,775	2,122	2,530	3,007	3,559	5,760	6,915	7,220	7,530	7,846	8,168	8,495	8,829	9,168	9,513	9,863	10,220
Number of Accounts	Based on metering program			000 No.	*358*	*373*	*379*	*394*	*409*	*424*	*439*	*455*	*473*	*491*	*509*	*527*	*545*	*563*	*581*	*599*	*617*	*635*
REVENUE STREAMS																						
Assumed tariff for Bulk Supply (if any)	Keep current levels		[4]	USD/m^3	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Combined average retail tariff (simplified)	Water + Sewer incl fixed		[5]	USD/m^3	1.45	1.35	1.20	1.15	1.15	1.15	1.15	1.15	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Calculated Bulk Sales				000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calculated Combined Retail Sales				000 USD	1,232	2,396	2,546	2,910	3,458	4,093	6,623	7,953	7,942	6,777	7,061	7,351	7,646	7,946	8,251	8,561	8,877	9,198
Total Billing for Water & Sewerage				000 USD	1,232	2,396	2,546	2,910	3,458	4,093	6,623	7,953	7,942	6,777	7,061	7,351	7,646	7,946	8,251	8,561	8,877	9,198
Collection Efficiency			[6]	%	*41%*	*50%*	*60%*	*70%*	*80%*	*85%*	*90%*	*95%*	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Collections from Water & Sewerage				000 USD	506	1,198	1,528	2,037	2,766	3,479	5,961	7,555	7,545	6,438	6,708	6,983	7,263	7,548	7,838	8,133	8,433	8,738
Other revenue (recovery of old debt)	% of 3 year debt	*5.0%*	[7]	000 USD		2,315	2,555	36	60	51	44	35	31	33	20	20	17	18	18	19	20	21
Total revenue collection				000 USD	506	3,513	4,083	2,073	2,826	3,530	6,005	7,590	7,575	6,471	6,728	7,003	7,280	7,566	7,857	8,152	8,453	8,759

Explanation notes for referenced items above:

[1] *It is not anticipated that Harare will be able to fully cover water demand until investments are made and efficiencies have improved. To reflect this condition, a proportion of bulk supply reflected as revenue for*
[2] *NRW is aligned to currednly reported levels and deemed to improve with reforms and future investments, whereby milestone targets are set for 2020 and 2030.*
[3] *Volumes of water sold bulk and excl bulk is based on bulk sold before NRW and retail after NRW at different tariffs*
[4] *While detailed bulk tariff calculations are provided below the main cost table, the current existing bulk tariff is applied throughout.*
[5] *The combined tariff includes water, sewerage and any fixed charge component applied as an overall unit tariff.*
[6] *The collection efficiency in the base year appears to be anoutlier compared to previous years. Future collection efficiencies are based o agreed milestones.*
[7] *A proportion of old debt (3-years old) is assumed to be collected.*

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RUWA

INCOME STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Income Streams																				
Bulk sales		000 USD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined Water & Sewerage		000 USD	1,232	2,396	2,546	2,910	3,458	4,093	6,623	7,953	7,942	6,777	7,061	7,351	7,646	7,946	8,251	8,561	8,877	9,198
Sub-Total		000 USD	1,232	2,396	2,546	2,910	3,458	4,093	6,623	7,953	7,942	6,777	7,061	7,351	7,646	7,946	8,251	8,561	8,877	9,198
Cost Streams [=Expenditure]																				
Operation - Fixed Costs		000 USD	854	854	1,202	1,351	1,371	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780
Operation - Variable		000 USD	645	927	1,090	1,266	1,475	1,714	2,173	2,661	2,817	2,973	3,129	3,285	3,441	3,597	3,713	3,829	3,945	4,061
Maintenance		000 USD	64	70	75	121	202	303	380	463	549	711	735	789	812	882	951	978	992	1,020
Capital Charges (INTEREST ONLY)		000 USD	-	12	14	14	528	996	945	893	842	791	740	688	637	1,041	1,422	1,325	1,229	1,132
Sub-Total		000 USD	1,563	1,862	2,381	2,753	3,577	4,793	5,278	5,797	5,988	6,256	6,385	6,543	6,671	7,301	7,867	7,913	7,945	7,992
Surplus/(Deficit)		000 USD	**(330)**	**534**	**165**	**157**	**(119)**	**(700)**	**1,346**	**2,155**	**1,953**	**521**	**677**	**808**	**974**	**645**	**384**	**648**	**932**	**1,206**
ADJUSTED INCOME STATEMENT																				
Income																				
Total Income		000 USD	1,232	2,396	2,546	2,910	3,458	4,093	6,623	7,953	7,942	6,777	7,061	7,351	7,646	7,946	8,251	8,561	8,877	9,198
Expenditure																				
Total Expenses		000 USD	1,563	1,862	2,381	2,753	3,577	4,793	5,278	5,797	5,988	6,256	6,385	6,543	6,671	7,301	7,867	7,913	7,945	7,992
Provision for debt write-off	[1]	000 USD	363	1,198	1,018	873	692	614	662	398	397	339	353	368	382	397	413	428	444	460
Depreciation	[2]	000 USD	-	4	17	25	84	135	143	227	322	418	521	611	556	602	698	724	742	760
Total Expenses incl. Depreciation		000 USD	1,926	3,064	3,416	3,650	4,352	5,542	6,083	6,422	6,708	7,013	7,259	7,522	7,609	8,299	8,977	9,066	9,131	9,212
Adjusted Surplus/(Deficit)		000 USD	**(693)**	**(668)**	**(870)**	**(741)**	**(894)**	**(1,449)**	**540**	**1,530**	**1,234**	**(236)**	**(197)**	**(171)**	**36**	**(354)**	**(726)**	**(504)**	**(254)**	**(14)**

CASH FLOW STATEMENT

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cash Flow from Operating Activities																				
Profit/(loss) from income statement		000 USD	(693)	(668)	(870)	(741)	(894)	(1,449)	540	1,530	1,234	(236)	(197)	(171)	36	(354)	(726)	(504)	(254)	(14)
Adjust for non-cash items		000 USD																		
Depreciation	[2]	000 USD	0	4	17	25	84	135	143	227	322	418	521	611	556	602	698	724	742	760
Provision for debt write-off			363	1,198	1,018	873	692	614	662	398	397	339	353	368	382	397	413	428	444	460
Net adjusted income for the year		000 USD	(330)	534	165	157	(119)	(700)	1,346	2,155	1,953	521	677	808	974	645	384	648	932	1,206
Adjust for Change in Working Capital																				
(Increase)/Decrease in debtors	[3]	000 USD	(726)	(1,198)	(1,018)	(873)	(692)	(614)	(662)	(398)	(397)	(339)	(353)	(368)	(382)	(397)	(413)	(428)	(444)	(460)
Partial debt recovery	[4]	000 USD	0	2,315	2,555	36	60	51	44	35	31	33	20	20	17	18	18	19	20	21
Increase/(Decrease) in creditors	[5]	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net change in working capital		000 USD	(726)	1,117	1,537	(837)	(632)	(563)	(619)	(363)	(366)	(306)	(333)	(348)	(365)	(380)	(394)	(409)	(424)	(439)
Cash Flow from Investment Activities																				
Repayment of principal		000 USD	0	(12)	(15)	(15)	(530)	(1,024)	(1,024)	(1,024)	(1,024)	(1,024)	(1,024)	(1,024)	(1,024)	(1,479)	(1,934)	(1,934)	(1,934)	(1,934)
Net change generaged by/(used in investment activit		000 USD	0	(12)	(15)	(15)	(530)	(1,024)	(1,024)	(1,024)	(1,024)	(1,024)	(1,024)	(1,024)	(1,024)	(1,479)	(1,934)	(1,934)	(1,934)	(1,934)
Cash Flow																				
Net increase/(decrease) in cash & equiv.		000 USD	(1,057)	1,639	1,687	(695)	(1,281)	(2,287)	(297)	768	563	(809)	(681)	(564)	(415)	(1,214)	(1,944)	(1,695)	(1,427)	(1,168)
Cash & cash equiv. at beginning of year		000 USD	0	(1,057)	582	2,269	1,575	294	(1,993)	(2,290)	(1,522)	(960)	(1,769)	(2,449)	(3,014)	(3,429)	(4,642)	(6,587)	(8,282)	(9,708)
Cash & cash equivalents at end of year		**000 USD**	**(1,057)**	**582**	**2,269**	**1,575**	**294**	**(1,993)**	**(2,290)**	**(1,522)**	**(960)**	**(1,769)**	**(2,449)**	**(3,014)**	**(3,429)**	**(4,642)**	**(6,587)**	**(8,282)**	**(9,708)**	**(10,876)**

BALANCE SHEET (Simplified)

ITEM	REF	UNIT	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets																				
Fixed Assets	[6]																			
Existing Plant & equipment			24,549	23,807	23,064	22,322	21,580	20,837	20,095	19,353	18,610	17,868	17,126	16,388	15,650	14,920	14,190	13,460	12,733	12,073
Future Plant & equipment				4,229	8,015	11,600	35,205	57,446	59,844	62,160	63,837	65,450	67,001	71,006	72,441	91,922	111,081	112,240	113,339	114,380
Total Fixed Assets			24,549	28,035	31,080	33,922	56,785	78,284	79,939	81,513	82,447	83,319	84,127	87,394	88,091	106,842	125,271	125,700	126,073	126,453
Current Assets & Liabilities																				
Short term assets (cash)	[7]		(1,057)	582	2,269	1,575	294	(1,993)	(2,290)	(1,522)	(960)	(1,769)	(2,449)	(3,014)	(3,429)	(4,642)	(6,587)	(8,282)	(9,708)	(10,876)
Debtors	[8]		308	599	636	727	865	1,023	1,656	1,988	1,985	1,694	1,765	1,838	1,911	1,986	2,063	2,140	2,219	2,300
Creditors	[9]		(142)	(190)	(228)	(269)	(321)	(389)	(478)	(573)	(613)	(667)	(697)	(732)	(761)	(799)	(830)	(854)	(875)	(899)
Net Current Assets			(891)	991	2,678	2,033	838	(1,358)	(1,112)	(107)	412	(741)	(1,381)	(1,907)	(2,279)	(3,455)	(5,354)	(6,995)	(8,364)	(9,476)
Total Assets			**23,658**	**29,027**	**33,758**	**35,955**	**57,623**	**76,925**	**78,827**	**81,406**	**82,859**	**82,578**	**82,746**	**85,487**	**85,813**	**103,387**	**119,918**	**118,705**	**117,709**	**116,977**
Equity & Liabilites																				
Equity	[10]		23,658	28,799	33,485	35,697	47,589	58,035	60,961	64,564	67,042	67,785	68,978	72,743	74,093	84,047	93,412	94,134	95,072	96,275
Long Term liabilities	[11]		0	228	273	258	10,034	18,890	17,866	16,842	15,817	14,793	13,769	12,744	11,720	19,340	26,505	24,571	22,637	20,702
Total Equity & Liabilities			**23,658**	**29,027**	**33,758**	**35,955**	**57,623**	**76,925**	**78,827**	**81,406**	**82,859**	**82,578**	**82,746**	**85,487**	**85,813**	**103,387**	**119,918**	**118,705**	**117,709**	**116,977**

notes for referenced items above:

[1] Provisions to write off bad debt was set at 50 % in the base year and 100 % thereafter to gradually introduce the concept which does not appear to be ccarried out currently.
[2] Depreciation for both existing and new assets is reflected here, as calculated in existing and Investment assets tabs and allocated as per the main cost table under the Cost tab.
[3] Debtors are calculated as the difference between billing and cash collections for the respective year.
[4] Partial debt recovery is calculated in the revenue table based on a small proportion of 3-year old debt recovered as cash collections.
[5] With past history of deficit cash flow funded in part from creditors the entity has become uncreditworthy and future cash flow is based on a strictly cash on delivery basis, i.e. costs = expenditure.
[6] The value of fixed assets is returned as the depreciated residual value of existing and investment assets calculated in the respective existing assets and investment assets tabs.
[7] Accumulated cash reserves/(deficit)
[8] Debtors as defined under note [3]
[9] Asume two months worth of fixed costs (except personnel), variable and maintenance.
[10] Balance of total assets and (less) long term liabilities.
[11] The balance on loans is represented as long term liabilities.